ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Volume II

REPORT

ASTON LTD

Great Connell
Strategic Housing Development
Newbridge
County Kildare

O'Callaghan Moran & Associates
ENVIRONMENTAL MANAGEMENT FOR BUSINESS

April 2022

O'Callaghan Moran & Associates
Unit 15,
Melbourne Business Park,
Model Farm Road,
Cork.

021-4345366
info@ocallaghanmoran.com
www.ocallaghanmoran.com

FiguUnit 15
Melbourne Business Park
Model Farm Road
Cork T12 WR89

T: 021 434 5366
E: admin@ocallaghanmoran.com
www.ocallaghanmoran.com

O'Callaghan Moran & Associates
ENVIRONMENTAL MANAGEMENT FOR BUSINESS

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

STRATEGIC HOUSING DEVELOPMENT

GREAT CONNELL

NEWBRIDGE

COUNTY KILDARE

Prepared For: -

Aston Ltd

Prepared By: -

O'Callaghan Moran & Associates
Unit 15 Melbourne Business Park
Model Farm Road
Cork.

April 2022

Project	Environmental Impact Assessment Report Great Connell SHD			
Client	Aston Ltd			
Report No	Date	Status	Prepared By	Reviewed By
211550101	22/03/2021	Draft Initial Client Review		J O'Callaghan MSc
	29/03/2022	Draft Rev A		
	11/04/2022	Final		

TABLE OF CONTENTS

PAGE

1 INTRODUCTION 1-1

1.1 Development Overview 1-1
1.2 Need for Environmental Impact Assessment (EIA) 1-1
1.3 Purpose of an EIAR 1-2
1.4 EIA Scoping 1-3
1.5 EIAR Methodology 1-3
1.6 Anticipation, Preventing, Avoiding and Mitigating Significant Effects 1-4
1.7 Cumulation of Effects 1-5
1.8 Assessment of Effects 1-5
1.9 Residual Impacts 1-7
1.10 Consultation 1-7
1.10.3 Other Consultees 1-8
1.11 Project Team: Competent Experts 1-8
1.12 Difficulties in Compiling the Required Information 1-10

2 EXISTING SITE DESCRIPTION 2-1

2.1 Site Location 2-1
2.2 Site Description 2-1
2.3 Land Zoning 2-1
2.4 Surrounding Land Use 2-4
2.5 Environmental Setting 2-4
2.5.1 Hydrology 2-4
2.5.2 Geology & Hydrogeology 2-5
2.5.3 Biodiversity 2-5
2.6 Services 2-5
2.6.1 Water Supply 2-5
2.6.2 Surface Water Drainage 2-5
2.6.3 Foul Water Drainage 2-5
2.6.4 Electricity 2-5
2.7 Road Network 2-6

3 PROJECT CHARACTERISTICS 3-1

3.1 Residential Development 3-1
3.2 Open Space/Amenity 3-3
3.3 Building Energy Performance 3-3
3.4 Landscape Strategy 3-5
3.5 Universal Access 3-6
3.6 Site Lighting 3-6
3.7 Connectivity 3-6
3.8 Newbridge South Outer Orbital Relief Road (NSOORR) 3-6

3.8 NEWBRIDGE SOUTH OUTER ORBITAL RELIEF ROAD (NSOORR) 3-6
3.9 SERVICES 3-7
3.9.1 Water Supply 3-7
3.9.2 Foul Water 3-7
3.9.3 Surface Water Drainage 3-10
3.9.4.4 Power Supply 3-12
3.10 FLOOD COMPENSATORY MEASURES 3-12
3.11 CONSTRUCTION STAGE 3-12
3.11.1 Development Phases 3-12
3.11.2 Construction Compound 3-15
3.11.3 Site Preparatory Works 3-16
3.11.4 Working Hours 3-16
3.11.5 Plant & Equipment 3-16
3.11.6 Excavation Works 3-16
3.11.7 Concrete Works 3-16
3.11.8 Surface Water Management 3-16
3.11. Materials – Source and Transportation 3-17
3.11.10 Oils and Chemical Storage 3-17
3.11.11 Traffic Management 3-17
3.11.2 Resource and Waste Management Plan 3-17
3.11.13 Construction Environmental Management Plan 3-17
3.11.14 Health and Safety 3-17
3.11.15 Site Security 3-18
3.12 CUMULATION 3-18
3.12.1 Scoping 3-18
3.12.2 Cumulative Projects 3-18

4 ALTERNATIVES 4-1

4.1 INTRODUCTION 4-1
4.2 METHODOLOGY 4-1
4.3 LOCATION 4-2
4.4 ALTERNATIVE SITE LAYOUT 4-3
4.5 ALTERNATIVE SERVICES DESIGN 4-8
4.6 ALTERNATIVE MITIGATION MEASURES 4-8

5 CLIMATE 5-1

5.1 INTRODUCTION 5-1
5.2 RELEVANT LEGISLATION AND GUIDANCE 5-1
5.3 METHODOLOGY 5-2
5.3.1 Assessment of Operational Impact: Dwellings 5-3
5.3.2 Assessment of Operational Impact: Traffic 5-5
5.4 EVALUATION CRITERIA – CLIMATE CHANGE AND POLICY CONTEXT 5-6
5.4.1 Global Climate Change Response 5-6
5.4.2 National Policy and Long-Term Vision 5-8
5.4.3 Kildare - Regional Commitments 5-9
5.5 DEVELOPMENT DESCRIPTION 5-9
5.6 RECEIVING ENVIRONMENT 5-9

5.6.1 Greenhouse Gas Emissions *5-9*
5.6.2 Climate Vulnerability *5-11*
5.7 IMPACTS 5-11
5.7.1 Construction Stage *5-11*
5.7.2 Operational Stage-Traffic-Do Something *5-12*
5.7.3 Operational Stage: Dwellings *5-13*
5.8 BASELINE SCENARIO 5-15
5.9 PREVENTION & MITIGATION MEASURES 5-15
5.9.1 Design Stage *5-15*
5.9.2 Construction Stage *5-15*
5.9.3 Operational Stage *5-15*
5.10 MONITORING 5-16
5.11 CUMULATIVE IMPACTS 5-16
5.12 RESIDUAL IMPACTS 5-16
5.13 REFERENCES 5-17

6 LAND & GEOLOGY 6-1

6.1 INTRODUCTION 6-1
6.2 RELEVANT LEGISLATION & GUIDANCE 6-1
6.3 METHODOLOGY 6-1
6.4 DEVELOPMENT DESCRIPTION 6-1
6.5 RECEIVING ENVIRONMENT 6-2
6.5.1 Land Use *6-2*
6.5.3 Soil Quality *6-2*
6.6 IMPACTS 6-6
6.6.1 Land Take *6-6*
6.6.2 Construction Stage *6-7*
6.6.3 Operational Stage *6-7*
6.7 BASELINE SCENARIO 6-7
6.8 PREVENTION AND MITIGATION MEASURES 6-7
6.8.1 Design *6-7*
6.8.2 Construction Stage *6-8*
6.8.3 Operational Stage *6-8*
6.9 MONITORING 6-8
6.10 CUMULATIVE IMPACTS 6-9
6.11 RESIDUAL IMPACTS 6-9
6.12 REFERENCES 6-10

7 WATER 7-1

7.1 INTRODUCTION 7-1
7.2 RELEVANT LEGISLATION & GUIDANCE 7-1
7.3 METHODOLOGY 7-2
7.3.1 Consultation *7-2*
7.4 DEVELOPMENT DESCRIPTION 7-2
7.5 RECEIVING ENVIRONMENT 7-3
7.5.1 Hydrology *7-3*
7.5.2 Hydrogeology *7-5*

7.5.3 Groundwater Quality *7-5*
7.5.4 Flood Risk *7-8*
7.6 IMPACTS 7-9
7.6.1 Construction Stage *7-9*
7.6.2 Operational Stage *7-10*
7.7 BASELINE SCENARIO 7-10
7.8 PREVENTION & MITIGATION MEASURES 7-10
7.8.1 Design Stage *7-10*
Flood Risk *7-10*
7.8.2 Construction Stage *7-13*
7.8.3 Operational Stage *7-15*
7.9 MONITORING 7-15
7.10 CUMULATIVE IMPACTS 7-16
7.11 RESIDUAL IMPACTS 7-16
7.11.1 Flood Risk *7-16*
7.11.2 Surface Water *7-16*
7.11.3 Groundwater *7-16*
7.11.4 Summary of Residual Effects *7-17*
7.12 REFERENCES 7-17

8 BIODIVERSITY 8-1

8.1 INTRODUCTION 8-1
8.2 RELEVANT LEGISLATION & GUIDANCE 8-2
8.2.1 Legislation *8-2*
8.2.2 Guidance *8-3*
8.3 METHODOLOGY 8-4
8.3.1 Desktop Study *8-4*
8.3.2 Site Surveys *8-5*
8.3.3 Assessment of Impacts *8-6*
8.3.4 Consultation *8-8*
8.4 DEVELOPMENT DESCRIPTION 8-8
8.5 RECEIVING ENVIRONMENT 8-8
8.5.1 General Landscape *8-8*
8.5.2 Designated Sites/Conservation Areas *8-8*
8.5.3 Habitats *8-13*
8.5.4 Flora *8-19*
8.5.5 Invasive Species *8-21*
8.5.6 Bats *8-22*
8.5.7 Otter *8-30*
8.5.8 Other Mammals *8-31*
8.5.9 Amphibians *8-33*
8.5.10 Reptiles *8-33*
8.5.11 Birds *8-33*
8.5.12 Other Species *8-35*
8.6 CONSTRUCTION STAGE IMPACTS 8-35
8.6.1 Habitats *8-36*
8.6.2 Invasive Species *8-37*

8.6.3 Mammals *8-37*
8.6.4 Amphibians *8-39*
8.6.5 Reptiles *8-39*
8.6.6 Birds *8-39*
8.6.8 Water Quality and Aquatic Ecology *8-40*
8.7 Operational Phase 8-41
8.7.1 Habitats *8-41*
8.7.2 Invasive species *8-41*
8.7.3 Mammals *8-42*
8.7.4 Amphibians *8-43*
8.7.5 Reptiles *8-43*
8.7.6 Birds *8-43*
8.8 Baseline Scenario 8-44
8.9 Prevention & Mitigation 8-44
8.9.1 Design Stage *8-44*
8.9.2 Construction Stage *8-45*
8.9.3 Operational Stage *8-49*
8.10 Monitoring 8-50
8.11 Cumulative Effects 8-50
8.12 Residual Impacts 8-54
8.12.1 Habitats *8-54*
8.12.2 Non -Native Invasive Species *8-54*
8.12.3 Bats *8-55*
8.12.4 Otter *8-55*
8.12.4 Other Mammals *8-55*
8.12.5 Amphibians and Reptiles *8-55*
8.12.6 Birds *8-55*
8.12.7 Other Species *8-56*
8.12.8 Summary of Residual Effects *8-56*
8.13 References 8-57

9 AIR 9-1

9.1 Introduction 9-1
9.2 Relevant Legislation and Guidance 9-1
9.3 Methodology 9-2
9.3.1 Air Quality Information Sources *9-3*
9.3.2 Assessment of Construction Impact *9-3*
9.3.3 Assessment of Operational Impact *9-7*
9.3.6 Method for the Conversion of NO_x to NO_2 ..... *9-10*
9.3.7 Evaluation Criteria *9-11*
9.4 Development Description 9-14
9.5 Receiving Environment 9-14
9.5.1 Local Meteorological Conditions *9-14*
9.5.2 Baseline Air Quality *9-17*
9.5.3 Sensitive Receptors *9-24*
9.6 Impacts 9-27
9.6.1 Construction Stage *9-27*

9.6.2 Operational Stage: Do Something *9-30*
9.7 BASELINE SCENARIO 9-35
9.8 PREVENTION & MITIGATION MEASURES 9-35
9.8.1 Construction Stage *9-35*
9.8.2 Operational Stage *9-35*
9.9 MONITORING 9-35
9.10 CUMULATIVE IMPACTS 9-36
9.11 RESIDUAL IMPACTS 9-36
9.11.1 Construction Stage *9-36*
9.11.2 Operational Stage *9-36*
9.11.3 Summary of Residual Impacts *9-36*
9.12 REFERENCES 9-37

10 POPULATION & HUMAN HEALTH 10-1

10.1 INTRODUCTION 10-1
10.2 METHODOLOGY 10-2
10.2.1 Consultation *10-2*
10.3 DEVELOPMENT DESCRIPTION 10-2
10.4 RECEIVING ENVIRONMENT: POPULATION 10-3
10.4.1 Surrounding Land Use *10-3*
10.4.2 Demographics *10-4*
10.4.3 Economy *10-5*
10.4.4 Employment *10-6*
10.4.5 Connectivity *10-6*
10.4.6 Social Infrastructure *10-6*
10.5 RECEIVING ENVIRONMENT: HUMAN HEALTH 10-7
10.5.1 Major Accidents/Natural Disasters *10-7*
10.5.2 Air Quality *10-8*
10.5.3 Noise & Vibration *10-8*
10.6 IMPACTS 10-8
10.6.1 Construction Stage *10-8*
10.6.2 Operational Stage *10-8*
10.7 BASELINE SCENARIO 10-9
10.8 PREVENTION & MITIGATION MEASURES 10-9
10.8.1 Design Stage *10-9*
10.8.2 Construction Stage. *10-10*
10.9 MONITORING 10-10
10.10 CUMULATIVE IMPACTS 10-10
10.11 RESIDUAL IMPACTS 10-11
10.11.1 Summary of Residual Impacts *10-11*

11 POPULATION & HUMAN HEALTH – NOISE & VIBRATION 11-1

11.1 INTRODUCTION 11-1
11.2 RELEVANT LEGISLATION AND GUIDANCE 11-1
11.3 METHODOLOGY 11-2
11.3.1 Construction Phase Noise Guidance *11-3*
11.4 PROPOSED DEVELOPMENT 11-11

11.5 RECEIVING ENVIRONMENT 11-11
11.6 IMPACTS CONSTRUCTION STAGE 11-22
11.7 IMPACTS OPERATIONAL STAGE 11-27
11.8 BASELINE SCENARIO 11-34
11.9 PREVENTION & MITIGATION MEASURES 11-35
11.9.1 Design Stage 11-35
11.9.2 Construction Stage 11-35
11.10 MONITORING 11-37
11.11 CUMULATIVE IMPACTS 11-37
11.12 RESIDUAL IMPACT 11-38
11.12.14 Summary of Residual Impacts 11-39

12 LANDSCAPE & VISUAL IMPACT 12-1

12.1 INTRODUCTION 12-1
12.2 RELEVANT LEGISLATION & GUIDANCE 12-1
12.3 METHODOLOGY 12-2
12.4 DEVELOPMENT DESCRIPTION 12-3
12.4.1 Landscape Proposals 12-3
12.5 RECEIVING ENVIRONMENT 12-5
12.5.1 Landscape Context & Site Description 12-5
12.5.2 Planning Policy Context 12-5
12.5.3 Views & Prospects 12-8
12.5.4 Protected Structures or Recorded Monuments 12-8
12.5.5 Designated Areas 12-10
12.5.6 Green Infrastructure 12-14
12.5.7.4 Existing Trees, Woodlands and Hedgerows 12-21
12.6 IMPACTS 12-24
12.6.1 Impacts on Existing Trees & Hedgerows 12-24
12.6.2 Impacts on Landscape Character 12-24
12.6.3 Impact on Views 12-25
12.7 BASELINE SCENARIO 12-36
12.8 PREVENTION & MITIGATION 12-36
12.8.1 Design Stage 12-36
12.8.2 Construction Phase: 12-36
12.9 MONITORING 12-37
12.10 CUMULATIVE IMPACTS 12-38
12.11 RESIDUAL IMPACTS 12-38
12.12 REFERENCES 12-39

13 ARCHAEOLOGY, ARCHITECTURE & CULTURAL HERITAGE 13-1

13.1 INTRODUCTION 13-1
13.2 RELEVANT LEGISLATION AND GUIDELINES 13-1
13.3 METHODOLOGY 13-1
13.3.1 Paper Survey 13-2
13.3.2 Field Inspection 13-2
13.3.3 Geophysical Survey 13-2
13.3.4 Archaeological Testing 13-2

13.4 PROPOSED DEVELOPMENT 13-2
13.5 RECEIVING ENVIRONMENT 13-3
13.5.1 Defined Study Area 13-3
13.5.2 Historical Background 13-3
13.5.3 Archaeological Heritage 13-10
13.5.4 Artefactual Discoveries 13-15
13.5. 5 Results of Previous Archaeological Investigations 13-15
13.5.6 Summary Results of Geophysical Survey 13-16
13.5.7 Summary of Site Specific Programme of Archaeological Testing 13-18
13.6 ARCHITECTURAL HERITAGE 13-19
13.6.1 Record of Protected Structures (Kildare County Development Plan 2017-2023 & Newbridge Local Area Plan 2013-2019) 13-20
13.6.2 National Inventory of Architectural Heritage (NIAH) 13-20
13.7 IMPACTS 13-20
13.7.1 Construction Phase 13-20
13.7.2 Post-Construction/Operational Phase 13-22
13.8 BASELINE SCENARIO 13-22
13.9 PREVENTION AND MITIGATION MEASURES 13-22
13.9.1 Construction Stage 13-22
13.9.2 Post-Construction/Operational Phase 13-23
13.10 MONITORING 13-23
13.11 CUMULATIVE IMPACT 13-23
13.12 RESIDUAL IMPACT 13-23
13.11.1 Archaeological Monuments 13-23
13.11.2 Archaeological Heritage 13-24
13.11.3 Cultural Heritage 13-24
13.11.4 Summary of Residual Impacts 13-24
13.13 REFERENCES 13-25

14 MATERIAL ASSETS: SITE SERVICES 14-1

14.1 INTRODUCTION 14-1
14.2 RELEVANT LEGISLATION & GUIDANCE 14-1
14.3 METHODOLOGY 14-2
14.3.1 Consultation 14-2
14.4 PROPOSED DEVELOPMENT 14-2
14.5 RECEIVING ENVIRONMENT 14-2
14.5.1 Water Supply 14-2
14.5.2 Surface Water Drainage 14-3
14.5.3 Foul Water Drainage 14-3
14.5.5 Waste Management 14-4
14.6 IMPACTS 14-4
14.6.1 Water Supply 14-4
14.6.2 Foul Water 14-4
14.6.3 Surface Water Drainage 14-4
14.6.4 Energy 14-5
14.6.5 Waste Management 14-5
14.6.6 Natural Resource Consumption 14-5

14.7 BASELINE SCENARIO 14-5
14.8 PREVENTION & MITIGATION MEASURES 14-5
14.8.1 Design Stage 14-5
14.8.2 Construction Stage 14-8
14.8.3 Operational Stage 14-8
14.9 MONITORING 14-9
14.10 CUMULATIVE EFFECTS 14-9
14.11 RESIDUAL IMPACTS 14-10

15 MATERIAL ASSETS - TRAFFIC & TRANSPORT 15-1

15.1 INTRODUCTION 15-1
15.2 RELEVANT LEGISLATION & GUIDANCE 15-1
15.3 METHODOLOGY 15-2
15.3.1 Consultation 15-2
15.4 PROPOSED DEVELOPMENT 15-3
15.5 RECEIVING ENVIRONMENT 15-4
15.5.1 Location 15-4
15.5.2 Local Road Network 15-4
15.5.4 Public Transport 15-7
15.5.4 Public Transport 15-1
15.5.5 Pedestrian & Cycle Networks 15-1
15.6 IMPACTS: CONSTRUCTION STAGE 15-1
15.7 IMPACTS OPERATIONAL STAGE 15-1
15.7.1 Vehicle Trip Generation 15-1
15.7.2 Trip Assignment & Distribution 15-2
15.7.3 Traffic Forecasting 15-2
15.8 BASELINE SCENARIO 15-10
15.9 PREVENTION & MITIGATION MEASURES 15-10
15.9.1 Design 15-10
15.9.2 Construction Stage 15-11
15.9.3 Operational Stage 15-11
15.10 CUMULATIVE EFFFECTS 15-12
15.11 RESIDUAL IMPACTS 15-12
15.10.1 Construction Stage 15-12
15.10.2 Operational Stage 15-12

16 INTERACTION OF THE FOREGOING 16-1

16.1 INTRODUCTION 16-1
16.2 POPULATION & HEALTH/AIR/TRAFFIC 16-1
16.3 WATER & BIODIVERSITY 16-1
16.4 CLIMATE & WATER 16-1
16.5 CLIMATE/TRAFFIC/MATERIAL ASSETS 16-1
16.6 LAND & GEOLOGY/BIODIVERSITY 16-2

LIST OF DRAWINGS

Drawing No. PA-002 Proposed Master Site Layout Plan

Drawing No. PA-008: Site Layout Showing Phasing Plan

Drawing No 192229-PUNCH-XX-XX-DR-C-0113 C01 Proposed Overall Foul Water Layout

Drawing 192229-PUNCH-XX-XX-DR-C-0114 Proposed Overall Watermain Layout

Drawing 192229-PUNCH-XX-XX-DR-C-0160. Proposed Overall Surface Water Layout

Drawing 192229-PUNCH-XX-XX-DR-C-0813, Flood Model-Q100 - Post Development With Compensation

LIST OF APPENDICES

APPENDIX 1 PUNCH PLANNING ENGINEERING REPORT

APPENDIX 2 RESIDUAL WASTE & RESOURCE MANAGEMENT PLAN

APPENDIX 3 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

APPENDIX 4 SITE INVESTIGATION REPORT

APPENDIX 5 JBA FLOOD RISK ASSESSMENT

APPENDIX 6 APPROPRIATE ASSESSMENT SCREENING REPORT

APPENDIX 7 NATURA IMPACT ASSESSMENT REPORT

APPENDIX 8 ECOLOGICAL IMPACT ASSESSMENT GUIDANCE & PHOTOGRAPHS

APPENDIX 9 KPMG SOCIAL INFRASTRUCTURE AUDIT

APPENDIX 10 NOISE SURVEY

APPENDIX 11 LANDSCAPE DEVELOPMENT REPORT

APPENDIX 12 ARCHAEOLOGICAL SURVEY

APPENDIX 13 METEC ESB INFRASTRUCTURE REPORT

APPENDIX 14 PUNCH TRAFFIC & TRANSPORT ASSESSMENT

1 INTRODUCTION

This Environmental Impact Assessment Report (EIAR) examines the potential impacts and significant effects on the environment of a proposed residential development on a 27.64 hectare(ha) site at Great Connell, Newbridge, County Kildare.

1.1 Development Overview

The development involves the demolition of two private residences, two former agricultural buildings and a shed; the phased construction of 569 residential units comprising a mix of 2, 3 and 4 bedroom houses, 1, 2 and 3 bedroom apartments with associated car parking (1,008) and bicycle (734) spaces; the construction of a neighbourhood centre and a crèche and the provision of a series of parks and open communal spaces.

Access will be off the Great Connell Road and the development will include the delivery of a 350m section of the Newbridge Southern Relief Road. There will be a foul water connection to the Upper Liffey Valley Sewerage Scheme and surface water flow attenuation will be provided for rainwater run-off before it discharges to the River Liffey.

1.2 Need for Environmental Impact Assessment (EIA)

The need for EIA derives from European Union (EU) Directive 85/337/EEC, as amended by Directives 97/11/EC 2003/35/EC, 2009/31/EC, 2011/92/EU and 2014/52/EU) on the assessment of the effects of certain public and private projects on the environment (EIA Directive).

The EIA Directive was initially transposed into Irish law by the European Communities (Environmental Impact Assessment) Regulations, 1989 (S.I. No. 349 of 1989), with subsequent amendments under the Planning and Development Regulations 2001 (SI No. 600 of 2001), as amended. The most recent amendment of the Directive was transposed by the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. 296 of 2018).

The primary objective of the EIA Directive is to ensure that projects that are likely to have 'significant effects' on the environment are subject to an assessment of their likely impacts.

The Environmental Protections Agency's *Revised Guidelines on the Information to be contained in Environmental Impact Statements Draft August 2017* define a staged process to determine if a proposed project is subject to EIA.

An initial determination is required to establish if the project comprises development, works or an activity, as defined in the relevant legislation. If it does, the next step is to determine whether the project falls into any of the activities listed in Annexes I and II of the EIA Directive, as transposed by Parts 1 and 2 of Schedule 5 of the Planning and Development Regulations 2001, as amended.

If it is not listed in the Annexes there is no statutory requirement for EIA, however regard must be had to the Directive's 'wide scope and broad purpose' and it may be necessary to go beyond the general project description and consider the component parts and/or any processes.

If any such parts or processes are significant and, in their own right, fall within a class of development covered by the Directive the proposed project as a whole may fall within the requirements of the Directive.

If a project is listed in Annexes I and II of the Directive, but is of a type where the need for EIA is based on a threshold, then it must be assessed against the thresholds specified in Part 2 of Schedule 5 of the Planning and Development Regulations. If the project exceeds the threshold EIA is mandatory.

The proposed project is 'development', is not listed in Annex I, but does fall into Class 10(b) (i) of Annex II '*Construction of more than 500 dwelling units'* and therefore EIA is required.

1.3 Purpose of an EIAR

An EIAR is defined in the EIA Regulations[1] as '*a report of the effects, if any, which proposed development, if carried out, would have on the environment and shall include the information specified in Annex IV of the Environmental Impact Assessment Directiv*e.'

An EIAR is prepared by the developer and is submitted to a Competent Authority as part of a consent process. The Competent Authority uses the information provided to assess the environmental effects of the project and, in the context of other considerations, to help determine if consent should be granted. The information in the EIAR is also used by other parties to evaluate the acceptability of the project and its effects and to inform their submissions to the Competent Authority.

Article 5 of the EIA Directive requires that the information to be provided in the EIAR should at least include:

(a) a description of the project comprising information on the site, design, size and other relevant features of the project;

(b) a description of the likely significant effects of the project on the environment;

(c) a description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;

(d) a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment;

(e) a non-technical summary of the information referred to in points (a) to (d); and (f) any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected.

To ensure completeness and quality of the EIAR it must be prepared by competent experts.

[1] http://www.irishstatutebook.ie/eli/2018/si/296/made/en/print

1.4 EIA Scoping

The objective of scoping is to identify the information to be contained in an EIAR and the methodology to be applied in compiling and assessing that information. The purpose is to tailor the EIAR to the proposed development's likely significant effects on the following:

(a) population and human health;

(b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC;

(c) land, soil, water, air and climate;

(d) material assets, cultural heritage and the landscape;

(e) the interaction between the factors referred to in points (a) to (d).

The effects must include the expected impacts associated with the vulnerability of the project to risks of major accidents[2] and/or relevant disasters.

O'Callaghan Moran & Associates (OCM) completed a scoping exercise based on an EIA Briefing Note prepared by Declan Brassil & Company Planning Consultants, consultations with the applicant and the EIA project team members and feedback on the pre-application meetings held with Kildare County Council and An Bord Pleanála.

1.5 EIAR Methodology

This EIAR presents an evaluation of the likely significant environmental impacts and applicable mitigation and monitoring measures associated with the construction and operation of the proposed development. It is the document which the applicant is required to submit to the Bord to inform the Bord's EIA of the proposed development.

This EIAR addresses all of the issues listed in Schedule 6 of the Planning and Development Regulations 2001 (SI No. 600 of 2001) (as amended) (the PDRs), having regard to the requirements of Article 5(1) and Annex IV of Directive 2011/92/EU as amended by Directive 2014/52/EU (the EIA Directive).

The information contained in the EIAR complies with the requirements the PDRs having regard to the requirements of Article 5 (1)(a) to (e), Article 3(1)(a) to (e) and Annex IV of Directive 2014/52/EU on the effects of certain public and private projects on the environment. The overall approach took into consideration the guidance and advise in the following:

- Environmental Protection Agency's *Draft Advise Notes for Preparing Environmental Impact Statements (2015).*
- European Commission's *Environmental Impact Assessment of Projects - Guidance on Screening (2017).*

[2]

- European Commission's *Environmental Impact Assessment of Projects - Guidance on Scoping Report (2017).*

- European Commission's *Environmental Impact Assessment of Projects - Guidance on the preparation of the Environmental Impact Assessment Report (2017).*

- Environmental Protection Agency's *Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017).*

- Government of Ireland *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (2018).*

Additional legislation and guidance pertinent to the particular environmental factor under consideration is referenced in the relevant Chapters of this EIAR.

The assessment of the effects on climate and water included the implications for climate change. The assessment of impacts on biodiversity included an evaluation of the significance of effects on Natura 2000 Sites.

The effects on population and human health took into consideration the likely effects of traffic, noise and vibration, lighting, emissions to air, major accidents and/or natural disasters and the existing local amenities and social infrastructure.

The interactions between impacts on different environmental factors are addressed, as is the potential for the cumulation of many minor or significant effects, including effects of other projects, to create larger, more significant effects.

To avoid repetition a detailed description of the Project Characteristics is provided in Chapter 3 and in the subsequent Chapters only those aspects of the development that are relevant to the environmental factor being assessed are described[3]. Similarly where, as a result of interaction(s) between two or more factors, there is a need for mitigation measures already described in detail in other Chapters these are cross referenced and not repeated.

The EIAR follows a grouped format structure, where each relevant topic is dealt with in a separate chapter that describes the baseline conditions (receiving environment), the direct and indirect significant impacts associated with the proposed activity, and the measures to avoid, prevent, reduce or, if possible, offset any identified significant adverse impacts, and assesses the effects and the residual impacts.

1.6 Anticipation, Preventing, Avoiding and Mitigating Significant Effects

The anticipation of impacts is the most effective means of avoiding adverse effects when applied at the beginning of the design stage of a project. This involves forming preliminary opinions, usually in the absence of complete data, on the approximate significance, magnitude, character, duration and type of the likely effects.

[3] • Environmental Protection Agency's Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017).

1.7 Cumulation of Effects

The assessment of the impacts of the proposed development took into consideration the existing land use patterns, demographics and local infrastructure and environmental setting, approved developments either already underway in the vicinity of the development, and developmenta that have recently received permission but have not started and thoses that are relevant and are at an advanced planning stage.

1.8 Assessment of Effects

Effects were assessed in terms of the likely natural or physical changes to the environment resulting either directly, or indirectly from the proposed development taking into consideration a 'baseline'[4] scenario, cumulative effects and accidents. Effects are, where possible, described in terms of, quality, significance, extent & context, probability, duration and type.

Quality.

- Positive: A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).

- Neutral: No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.

- Negative: A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).

Significance.

- Imperceptible: An effect capable of measurement but without significant consequences.

- Not Significant: An effect that causes noticeable changes in the character of the environment, but without significant consequences.

- Slight: An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.

- Moderate: An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends

- Significant: An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment

- Very Significant: An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.

[4] The was previously termed the 'do nothing' scenario

- Profound: An effect which obliterates sensitive characteristics.

Extent & Context.

- Extent: Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.

- Context: Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?).

Probability:

- Likely Effects: The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.

- Unlikely Effects: The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.

Duration:

- Momentary seconds-minutes.

- Brief <1day.

- Temporary <1 year.

- Short-term 1-7 years.

- Medium Term 7-15 years.

- Long Term 15-60 year.

- Permanent >60 years.

- Reversible effects that can be undone, for example through remediation or restoration.

- Frequency: how often the effect will occur (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly).

Type.

- Indirect: Impacts on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.

- Cumulative: The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.

- Do Nothing: The environment as it would be in the future should the subject project not be carried out.

- Worst Case: The effects arising from a project in the case where mitigation measures substantially fail.

- Indeterminable: When the full consequences of a change in the environment cannot be described.

- Irreversible: When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.

- Residual: The degree of environmental change that will occur after the proposed mitigation measures have taken effect.

- Synergistic: Where the resultant effect is of greater significance than the sum of its constituents, (e.g. combination of air pollutants to produce smog).

The significance of an effect was determined by a combination of objective (scientific) and subjective (social) concerns and the potential for the development to either have significant effect on an aspect of the environment that has been formally or systematically designated as being of importance, or to significantly alter the existing character of some aspects of the environment.

Prevention and mitigation measures and monitoring were only considered for those effects that were deemed likely to be significant.

1.9 Residual Impacts

Residual impacts are the final or intended effects that occur after the proposed mitigation measures have been implemented. It is not always either possible, or practical to mitigate all adverse effects. The effects that remain after all assessment and mitigation are referred to as 'Residual Effects'. These are the remaining environmental 'costs' of a proposed development that could not be reasonably avoided and are a key consideration in deciding whether a development should be permitted or not.

1.10 Consultation

1.10.1 Planning Authority

In accordance with Section 5(2) of the Planning and Development (Housing) and Residential Tenancies Act 2016, formal pre-planning consultation was carried out in a meeting with Kildare County Council on 12 July 2021. The principal issues addressed were:

1. Traffic impacts arising from the proposed development.

2. Surface water attenuation.

3. The need for high-quality landscaping and design.

4. Part V proposals.

5. Storage provision with the proposed units.

In addition, informal consultation took place with other Council Departments in respect to the detailed design of the proposed development.

1.10.2 An Bord Pleanála

Formal pre-planning consultation took place with An Bord Pleanála (the Bord) on 22nd October 2021. The Bord's Pre-Application Consultation Opinion issued on 4th November 2021 identified the following matters for further consideration and justification.

1. Traffic and Transport:

The application should address the requirement in the Local Area Plan for the delivery of the Newbridge South Orbital Relief Road.

The Traffic and Transport Assessment should assess potential scenarios with and without the bridge, capacity of the surrounding junctions and the impact of the proposed development on the surrounding road network.

The development scheme should comply with the requirements of the Kildare County Council Transport Section in respect of upgrade works and the Design Manual for Urban Roads and Streets standards.

2. Flood Risk Assessment

The Site-Specific Flood Risk Assessment should consider current permitted and under construction development, comply with National Guidance and provide full details of compensatory storage areas, alterations to all watercourses and drainage ditches, ground level changes, water level changes and a detailed assessment of the impact of flooding on any third-party lands.

3. Open Space

The design of open spaces throughout the site and at the River Liffey should have cognisance of the criteria set out in the Urban Design Manual that accompanies the 'Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas' (May 2009). The open spaces should incorporate high-quality design to ensure that they are useable and functional for all sectors of the community.

1.10.3 Other Consultees

Punch Consulting Engineers consulted with Inland Fisheries and Waterways Ireland in relation to the proposed design of the surface water drainage system. Punch Consulting Engineers engaged with Irish Water in relation to the design of the proposed foul water drainage system and the connections to the Irish Water foul sewer and mains water supply.

1.11 Project Team: Competent Experts

The EIAR was completed by a project team co-ordinated by O'Callaghan Moran & Associates (OCM) who also prepared a number of Chapters. The site layout was developed by O'Flynn Architects taking into consideration the outcome of the public consolations and inputs from the Project Team members over successive iterations. Declan Brassil & Company (DBCL) Planning Consultants provided oversight

of all aspects of the project to ensure that the requirements of the Planning and Development Act 2000, as amended were met.

The consultancy firms who prepared and or contributed to the Chapters are in Table 1.1, with details of the qualifications and experience of the individual competent experts provided in the relevant Chapters.

Table 1.1 Competent Experts

Chapter	Title	Prepared By	Contributor
1	Introduction	OCM	
2	Site Description	OCM	DBCL
3	Development Description	OCM	O'Flynn Architects/ Punch Consulting Engineers/ Applicant
4	Alternatives	OCM	O'Flynn Architects; Punch Consulting Engineers; The Big Space Landscape Architects. JBA Consultants
5	Climate	Katestone	Punch Consulting Engineers
6	Land & Geology	OCM	Byrne Looby
7	Water	OCM/ JBA Consulting	JBA Consulting: Punch Consulting Engineers : Byrne Looby: Dixon Brosnan
8	Biodiversity	Dixon Brosnan	Arborist Associated Ltd The Big Space Landscape Architects; Sabre Electrical Services
9	Air	Katestone	Punch Consulting Engineers
10	Population & Human Health	OCM	KPMG; 3D Design Bureau; TBS Landscape /Sabre Electrical Services
11	Population & Human Health: Noise & Vibration	dBA	Punch Consulting Engineers
12	Landscape & Visual Impact	TBS Landscape Architects	O'Flynn Architects, 3 D Design; Arborit Associates
13	Archaeology, Architecture & Cultural Heritage	Byrne Mullins & Associates.	
14	Material Assets: Infrastructure	OCM	Punch Consulting Engineers; Metec Consulting
15	Materials Assets: Traffic & Transport	Punch Consulting Engineers	
16	Interactions	OCM	

The field surveys and site specific assessments completed by the Project Team were;

- Archaeological Testing comprising geophysical and LIDAR surveys and trench excavations by Byrne Mullins & Associates Archaeological & Historical Heritage Consultants.
- Ecological Assessments by Dixon Brosnan Ecological Consultants, which included habitats, mammal, bat and bird, surveys, the completion of an Appropriate Assessment Screening and the preparation of a Natura Impact Statement.
- Tree and Hedgerow Assessment by Arborist Associated Ltd.
- Site Specific Flood Risk Assessment by JBA Consulting.
- Noise & Vibration Assessment by Damian Brosnan Acoustics.
- Traffic and Transport Assessment by Punch Consulting Engineers.
- Air Quality and Climate Assessments by Katestone.
- Ground Investigation by Byrne Looby Consulting Engineers, which included an assessment of groundwater levels and quality.
- Sunlight/Daylight/Shadow Assessment by 3D Design Bureau
- Electrical Infrastructure Design by Metec Engineering Consulting Engineers.
- Landscape Design Plan prepared by The Big Space Landscape Architects.
- Photomontages prepared by 3 D Design Bureau.
- Social Infrastructure Audit completed by KPMG.
- Engineering Services Report prepared by Punch Consulting Engineers, encompassing the design of foul water and surface water drainage systems, with the latter including sustainable urban drainage systems.
- Mobility Management Plan prepared by Punch Consulting Engineers
- Building Life Cycle Report prepared by O'Flynn Architects

1.12 Difficulties in Compiling the Required Information

No difficulties were encountered in compiling the required information. The Traffic & Transport Assessment included classified turning count surveys of relevant junctions on 10th of November 2021.

The surveys were undertaken at a time when schools were fully open and the government was not advising work from home during the Covid-19 pandemic. While it may be that more people were working at home at the time of the surveys compared to period to pre-Covid, it is expected this change in behaviour will become the norm in future years and it is therefore deemed the traffic survey results are appropriate for future analysis.

2 EXISTING SITE DESCRIPTION

This Chapter provides an overview of the existing site and is not intended to provide the full baseline information on the receiving environment on which the assessment of impacts is based. This level of detail is provided in the following Chapters.

2.1 Site Location

The site is to the east of Newbridge Town Centre (Figure 2.1). It is accessed from the Great Connell Road, which forms the eastern boundary.

2.2 Site Description

The site covers 27.64 hectares (ha) and the layout is shown on Drawing No PA-0012. Most of the site is in agricultural use, currently tillage. An open but overgrown drainage ditch runs along the northern border and in central area of the site. There are hedgerows along the northern, southern and eastern boundaries and an area of woodland in the southwest, on the eastern bank of the River Liffey.

There is a former agricultural yard (8,920m^2) towards the centre of the site containing two single storey sheds (1,440m^2 and 595m^2), and a three-sided shed (54 m^2) and a car park to the east. There is a former residential dwelling (Valencia Lodge) to the east of the agricultural yard. This is a single storey house (136 m^2) with a single storey garage (17.8 m^2) and garden. There is a second former residence (Great Connell) in the north-east corner of the site. This is a two-storey dwelling (332 m^2) with a detached single storey garage and boiler room (48 m^2). Both dwellings are owned by the applicant.

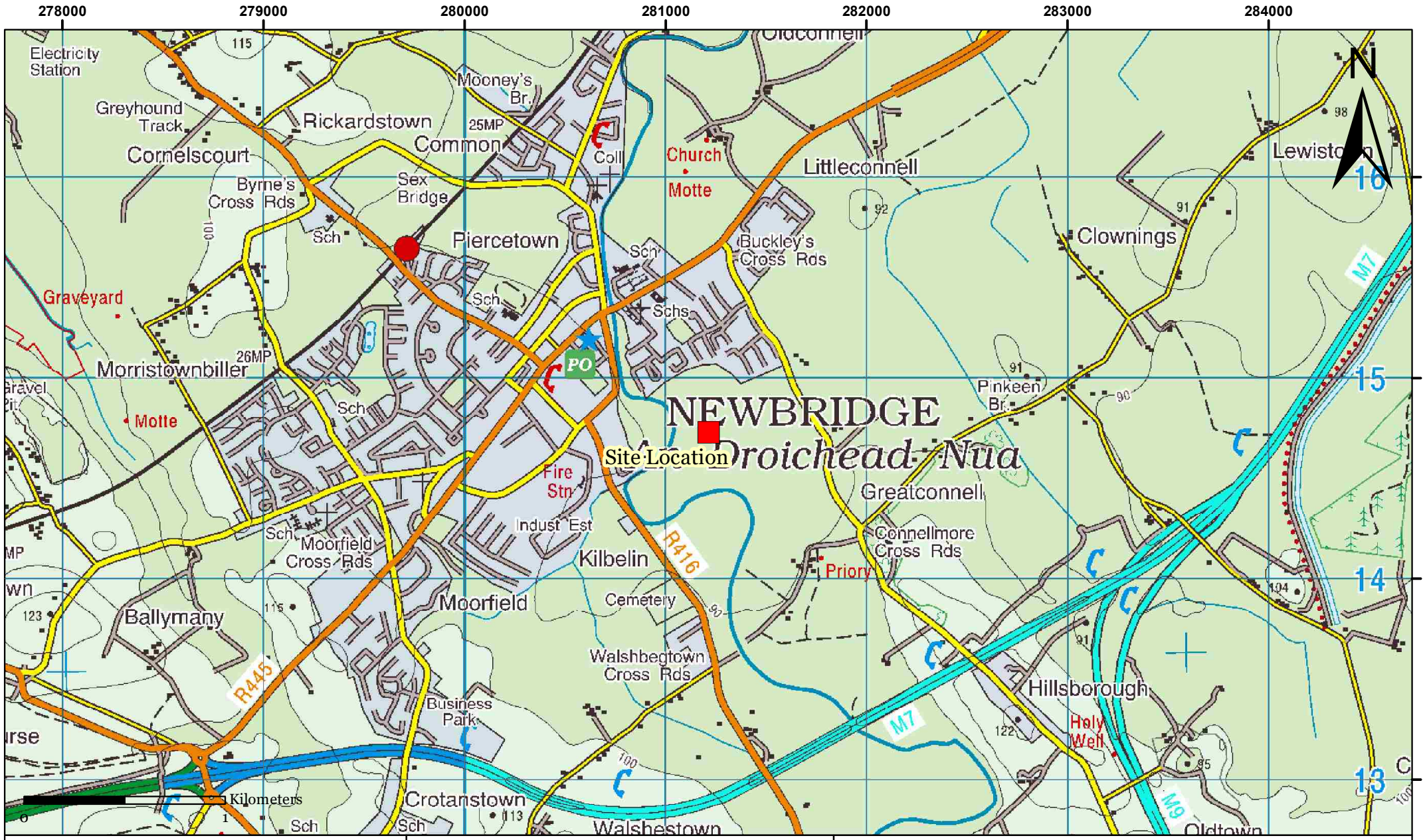
2.3 Land Zoning

The site is zoned for residential development and open space in the Newbridge Local Area Plan 2013-2019, as extended to December 2021 (LAP) (Figure 2.2). The main portion is zoned C – New Residential, which allows new residential development and associated ancillary services. Permission may also be granted for home based economic activity within this zone subject to the preservation of residential amenity and traffic considerations."

It is a specific zoning objective (C14) for the lands in the north-east corner of the site to provide a small, high quality designed neighbourhood centre to serve the local population.

The area adjacent to the river is zoned F – Open Space & Amenity and the objectives are to protect recreation open space and amenity areas, maintain and improve amenity lands, preserve private open space and provide recreational facilities."

The site is subject to LAP Policy SRO 5, which is the construction of the Newbridge Southern Outer Orbital Relief Road (NSOORR) from the R445 at Littleconnell, through the development site and on to the R416 Athgarvan Road, including a new crossing over the River Liffey.



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com
Environmental Management for Business

This drawing is the property of O'Callaghan Moran & Associates and shall not be used, produced or disclosed to anyone without the prior written permission at O'Callaghan Moran & Associates and shall be returned upon request.

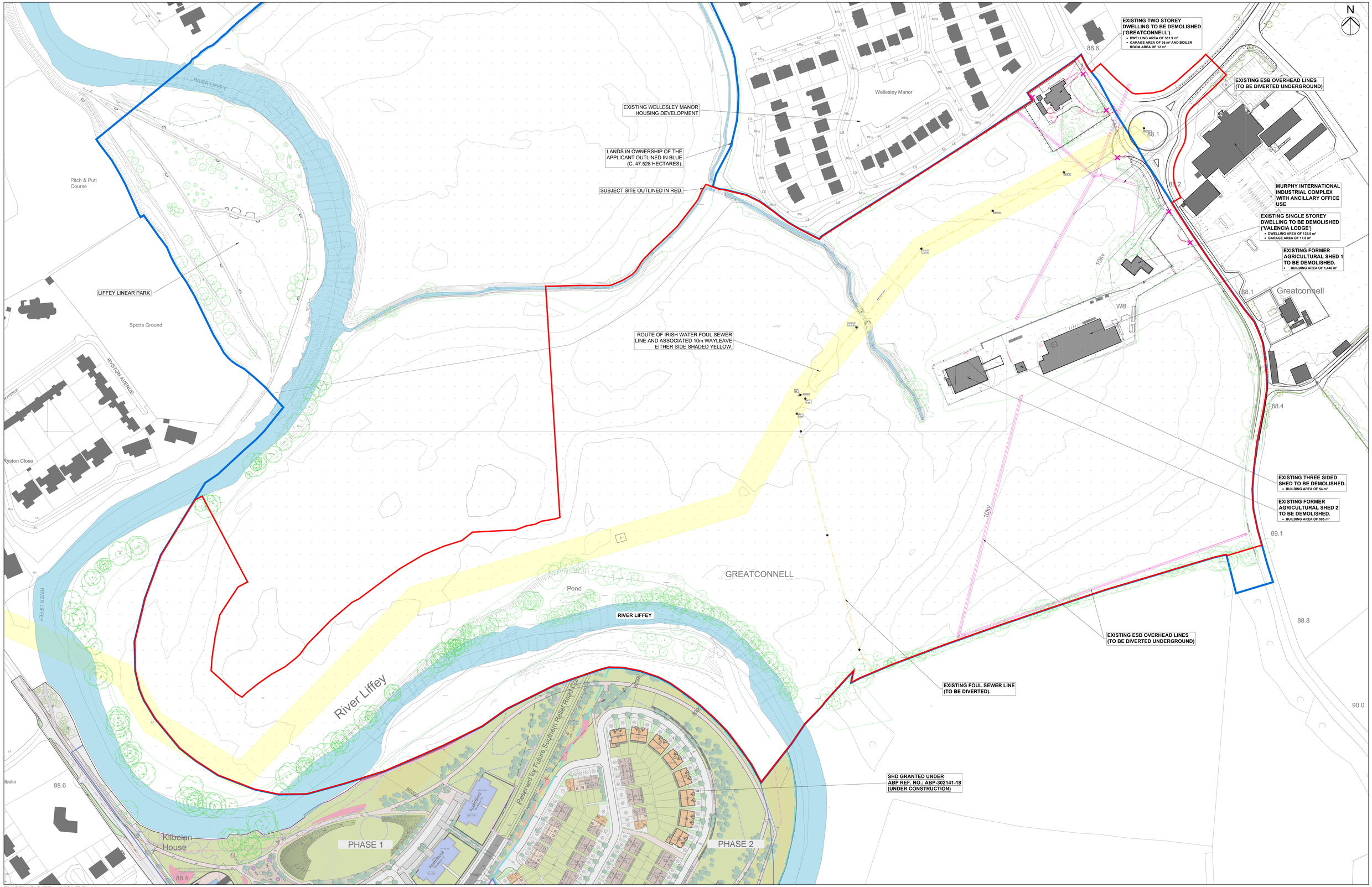
CLIENT
Aston Ltd

TITLE
Site Location

Details:
Site Location

Figure 2.1

A0



EXISTING SITE LAYOUT PLAN @ 1:1,000

NOTES:

DO NOT SCALE. USE ONLY FIGURED DIMENSIONS WHICH SHOULD BE CHECKED ON SITE BEFORE WORK COMMENCES.

ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH THE LATEST BUILDING REGULATIONS.

REFER TO STRUCTURAL ENGINEER'S DRAWINGS AND SPECIFICATION FOR ALL STRUCTURAL WORK.

THIS DRAWING IS COPYRIGHT.

NO.:	REVISIONS:	DATE:
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		
K		
L		
M		
N		
O		

LEGEND:

OFA
O'FLYNN ARCHITECTS, LYNCH'S COURT, NEWBRIDGE, CO. KILDARE.
TEL.: 045 433400
EMAIL: info@ofly nnarchitects.ie
WEB: www.ofly nnarchitect.ie
RIAI Practice Member 2021

PROJECT:	PROPOSED GREAT CONNELL SHD AT NEWBRIDGE, CO. KILDARE.
TITLE:	EXISTING SITE LAYOUT.
CLIENT:	ASTON LTD.
STAGE:	PLANNING
PROJECT NO.:	19070
DRG. NO.:	PA-012
SCALE:	1:1,000
DATE:	MARCH 2022
DRAWN:	POF
CHECKED:	POF

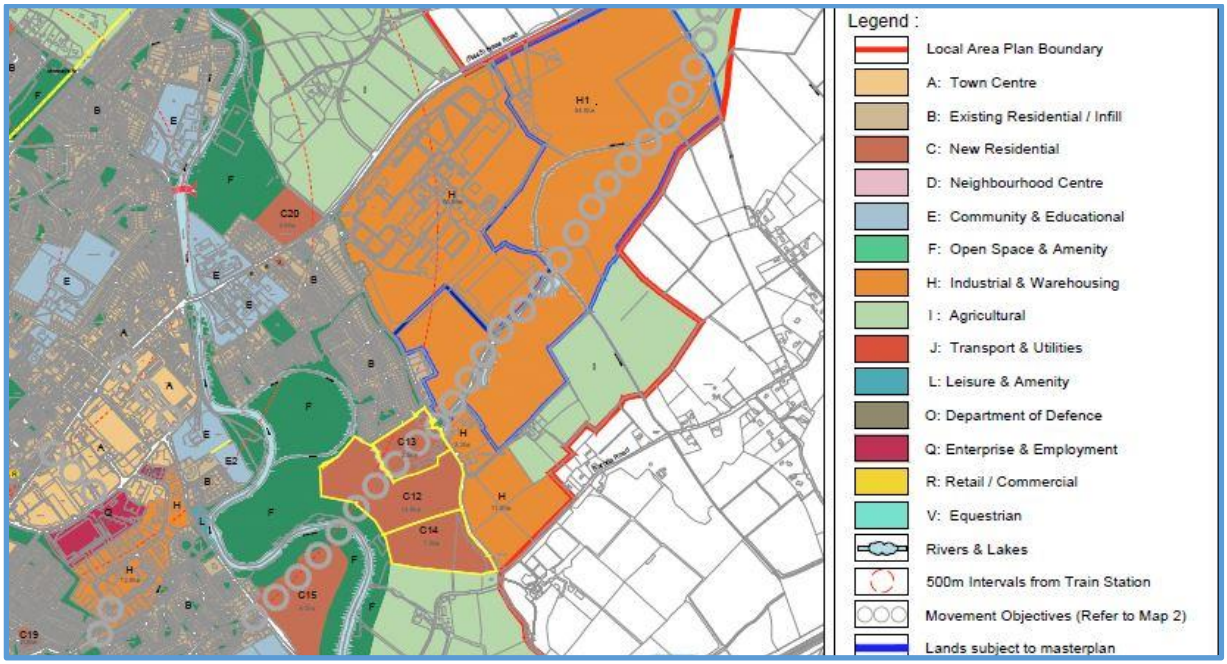


Figure 2.2 Extract from the Newbridge Local Area Plan

2.4 Surrounding Land Use

The surrounding land use is shown on Figure 2.1. The proposed development site is on the eastern outskirts of Newbridge, ca 1km from the Town Centre and main retail area. To the south and south-east are agricultural lands, primarily used for tillage. To the east, across the Great Connell Road, are the Murphy Ireland Ltd offices and compound. To the north-west of Murphy Ireland is the Great Connell Business Park, which is zoned for industrial use but is currently undeveloped.

To the north, the site bounds the Wellesley Manor, which is characterised by two-storey detached and semi-detached houses arranged around public open spaces. It has closest residential dwellings, with the houses in the south of the estate being approximately 10 meters (m) from the north-eastern development site boundary.

The Dr Pepper beverage manufacturing plant (formerly Lidl distribution centre) is ca 500m to the north-east. The Pfizer manufacturing complex, which is Europe's largest manufacturers of solid dose pharmaceuticals is ca 800m to the north. The Baroda Stud Farm is ca 500m to the south-east. To the south-west, across the River Liffey, a 343 unit residential development (Ardstone) is currently under construction (ABP-302141-18).

2.5 Environmental Setting

2.5.1 Hydrology

The site is in the catchment of the River Liffey, whose main channel runs through the site close to the south-western boundary. The open drainage ditches inside the site boundary follow the original alignment of an historic meander on the Liffey. There is an overland flow path for flood water from the River Liffey that follows the meander across the site

.

2.5.2 Geology & Hydrogeology

The subsoils in the western half of the site are Alluvium, with the eastern half underlain Gravels derived from Limestone. The subsoils are between 16.5m and 18m thick and overly limestone bedrock. The sands and gravels are classified as a locally important aquifer. The underlying bedrock is a regionally important karstified (Rkd) aquifer. The water table ranges from 1m to 2.9m below ground level.

2.5.3 Biodiversity

The site is dominated by large fields of arable crops, with two former residences and three former agricultural buildings at the centre of the site towards the eastern boundary. The northern, southern and eastern boundaries include hedgerows with small areas of scrub and treelines. There is an area of mixed broadleaved woodland in the south-west corner of the site and this is the most valuable habitat within the site and will be retained intact.

There is an 80m riparian zone either side of the River Liffey. There are localised stands of the invasive species Himalayan Balsam in the south for the site, on both banks of the river. The closest Natura 2000 Site is Pollardstown Fen Special Protection Area, which is 2.6km to the west.

2.6 Services

2.6.1 Water Supply

There is an Irish Water 300mm watermain running along the Great Connell Road to the east of the site. This supplies the Wellesley Manor residential estate via a 100mm uPVC network and also supplies Great Connell Business Park and the Murphy International.

2.6.2 Surface Water Drainage

A 1000mm concrete surface water sewer flows adjacent to the northeast boundary of the site, from the Great Connell Road in a southwest direction along Wellesley Manor and discharges to a small stream that flows into the Liffey. The drainage system system serving the Wellesley Manor residential estate connects to the 1000mm concrete surface water drain.

2.6.3 Foul Water Drainage

The Kilcullen/Athgarvan 450mm concrete foul sewer traverses north across the site. Foul drainage from Wellesley Manor development is collected in a network of 150mmm to 300mm foul sewers and discharges into this 450mm foul sewer at the northern boundary of the proposed development site. The newly constructed 600mm pumped rising main/900mm gravity Newbridge Eastern Interceptor Sewer, which is part of the Upper Liffey Valley Sewerage Scheme traverses the site west-east.

2.6.4 Electricity

There is an overhead 10 kV Medium Voltage electricity line traversing the site which drops to underground for a section of its run.

2.7 Road Network

The road network in the vicinity of the site is shown on Figure 2.3, which is an extract from the Punch Consulting Engineers (PUNCH) Traffic and Transport Assessment.

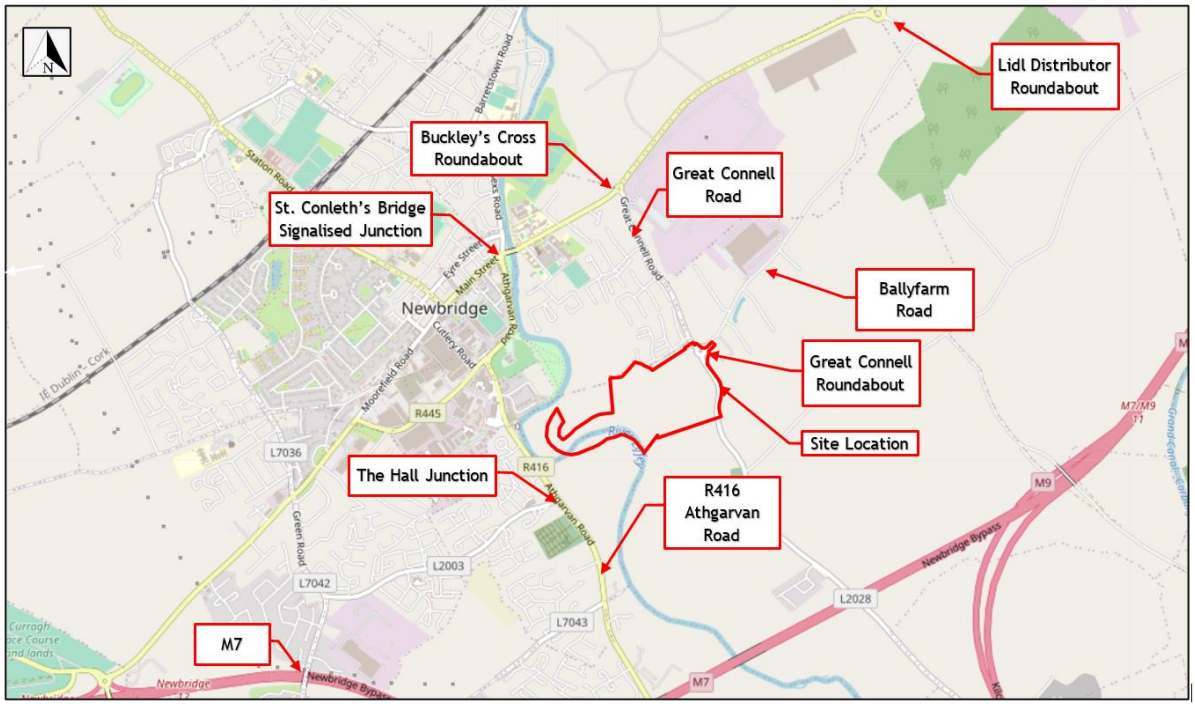


Figure 2.3 Local Road Network

The site is accessed of the Great Connell Road Roundabout. Great Connell Road is a Local Primary Road linking the R445 at Buckley's Cross with the L2032. It is a single lane two-way carriageway with a footpath on the western side of the road between the R445 junction and the Great Connell Roundabout. The roundabout provides access to the residential development on the western side of the Great Connell Road, the Murphy International offices and compounds and the Dr. Pepper beverage manufacturing plant. The Ballyfarm Road provides access from the Great Connell Roundabout to the Lidl Distributor Roundabout.

Traffic surveys established that the morning peak hour traffic flow at the junctions surrounding the proposed development site is between 8:00 and 09:00, with the evening peak hour flow between 17:00 and 18:00.

3 PROJECT CHARACTERISTICS

This Chapter describes the characteristics of the project including the nature and scale of the residential development; building design considerations to improve energy efficiency and minimise greenhouse gas emissions; services including water supply, sanitary wastewater and storm water management; landscape strategy; site lighting; connectivity and the construction stage works. It also identifies the permitted and proposed developments that have been taken into consideration for the assessment of cumulative effects.

The Chapter was prepared by OCM in consultation with Declan Brassil & Company Ltd who prepared the Planning Report and Statement of Consistency and it is based on the Design Statement completed by O'Flynn Architects, the Landscape Plan prepared by The Big Space (TBS), the Engineering Report prepared by PUNCH, and the Building Life Cycle Report prepared by O'Flynn Architects.

3.1 Residential Development

The proposed development layout is shown on Drawing No. PA-002. To facilitate this it is necessary to demolish the existing structures on the site which comprise; 'Great Connell' a two-storey dwelling of 331.9 sqm with detached single storey garage and outhouses of 48 sqm; 'Valencia Lodge' a single storey dwelling of 135.6 sqm with a single storey garage of 17.8 sqm; two no. single storey sheds of 1,440 sqm and 595 sqm, and a three-sided shed of 54 sqm.

The proposed residential development comprises the construction of 569 no. new residential dwellings (325 no. houses and 244 no. apartments). There are 15 no. house types proposed, which in total provide 64 no. two-bed houses; 173 no. three-bed houses; and 88 no. four-bed houses (ranging in height from 2 to 3 storeys).

The 244 no. proposed apartments include 164 no. own-door units and 80 no. shared access apartments and comprise the following;

- Apartment Block A (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
- Apartment Block B (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
- Apartment Block C (Part 3 and 4 Storeys): 4 no. one-bed apartments; 19 no. two-bed apartments and 4 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 87 sqm.
- 13 no. apartments above the proposed Neighbourhood Centre comprising; 4 no. own-door two-bed apartments; 3 no. shared-access one-bed apartments; and 6 no. shared-access two-bed apartments. These proposed units have private balconies or terraces, and access to the communal roof terrace of 176 sqm.
- 160 no. own-door apartments in 2- and 3- storey buildings comprising; 16 no. one-bed apartments; 78 no. two-bed apartments, 66 no. three-bed duplex apartments. These units will have private amenity areas in the form of terraces, balconies and/or rear gardens.

A0

LEGEND:

3 STOREY 4 BED HOUSE (8 PERSON):	
2 STOREY 4 BED HOUSE (7 PERSON):	
2 STOREY 3 BED HOUSE (6 PERSON):	
2 STOREY 3 BED HOUSE (5 PERSON):	
2 STOREY 2 BED HOUSE (4 PERSON):	
1 BED OWN DOOR APARTMENT UNIT (2 PERSON) IN 2 STOREY BLOCK—1 UNIT ON EACH FLOOR:	
3/4 STOREY 1/2/3 BED APARTMENT BLOCK:	
3 STOREY 2 BED (4 PERSON) & 3 BED (5 PERSON) DUPLEX BLOCK—2 BED ON GROUND FLOOR & 3 BED ON 1ST & 2ND FLOOR:	
2 STOREY 2 BED (4 PERSON) BLOCK—1 UNIT ON EACH FLOOR—ADJOINING 3 STOREY DUPLEX BLOCK:	
3 STOREY 2 BED (4 PERSON) & 3 BED (5 PERSON) DUPLEX BLOCK ADJOINING TERRACED HOUSING:	
PRIVATE AMENITY SPACE:	
PUBLIC OPEN SPACE:	
CHILDCARE FACILITY:	
NEIGHBOURHOOD CENTRE:	
LINK STREET / ARTERIAL LINK (NSOORR):	
LOCAL / LINK STREET:	
LOCAL STREET:	
CYCLE WAY:	
FOOTPATH:	
LOCAL STREET WITH HOMEZONE / SHARED SURFACE (PAVED FINISH):	
PAVED ON-STREET / SHARED CAR PARKING SPACES:	

SCHEDULE OF ACCOMMODATION:

HOUSE TYPE	TOTAL	(AND %)
2 BED HOUSE (2 STOREY MID TERRACE)	64	(11.2%)
TOTAL NO. OF 2 BED HOUSES	**64**	**(11.2%)**
3 BED HOUSE (2 STOREY MID TERRACE)	41	(7.2%)
3 BED HOUSE (2 STOREY END TERRACE)	64	(11.2%)
3 BED HOUSE (2 STOREY SEMI-DETACHED)	68	(12.0%)
TOTAL NO. OF 3 BED HOUSES	**173**	**(30.4%)**
4 BED HOUSE (2 STOREY END TERRACE)	32	(5.6%)
4 BED HOUSE (2 STOREY SEMI-DETACHED)	48	(8.5%)
4 BED HOUSE (3 STOREY END TERRACE)	08	(1.4%)
TOTAL NO. OF 4 BED HOUSES	**88**	**(15.5%)**
TOTAL NO. OF HOUSES	**325**	**(57.1%)**

OWN DOOR APARTMENTS	TOTAL	(AND %)
1 BED OWN DOOR APARTMENT	16	(2.8%)
2 BED OWN DOOR APARTMENT UNDER 3 BED DUPLEX	66	(11.6%)
2 BED OWN DOOR APARTMENT	16	(2.8%)
3 BED OWN DOOR DUPLEX APARTMENT (2 STOREY)	66	(11.6%)
TOTAL NO. OF OWN DOOR APARTMENTS	**164**	**(28.8%)**

STANDARD APARTMENTS (SHARED ACCESS)	TOTAL	(AND %)
1 BED APARTMENT	17	(3.0%)
2 BED APARTMENT	53	(9.3%)
3 BED APARTMENT	10	(1.8%)
TOTAL NO. OF STANDARD APARTMENTS	**80**	**(14.1%)**
TOTAL NO. OF APARTMENTS	**244**	**(42.9%)**

COMBINED UNIT MIX (APARTMENTS & HOUSES)	TOTAL	(AND %)
1 BED UNIT	33	(5.8%)
2 BED UNIT	199	(35.0%)
3 BED UNIT	249	(43.7%)
4 BED UNIT	88	(15.5%)
TOTAL NO. UNITS	**569**	**(100%)**

SITE STATISTICS:

APPLICATION SITE AREA (RED OUTLINE)	**27.635 HA**
ZONED LAND EXTENT (INCL. NSOORR ROUTE & IRISH WATER WAYLEAVE BUT EXCL. GREAT CONNELL ROAD)	**17.346 HA**
ZONED NET DEVELOPMENT AREA (EXCL. NSOORR ROUTE & IRISH WATER WAYLEAVE & GREAT CONNELL ROAD)	**15.978 HA**
NET DENSITY (569 / 15.978)	**35.6 UNITS / HA**
PUBLIC OPEN SPACE WITHIN ZONED LAND EXTENT (OPEN SPACE AREAS INDICATED ON LAYOUT)	**3.05 HA (17.6% OF ZONED LAND EXTENT) (19.1% OF ZONED NET DEVELOPMENT AREA)**

MASTER SITE LAYOUT PLAN @ 1:1,000

NOTES:

DO NOT SCALE, USE ONLY FIGURED DIMENSIONS WHICH SHOULD BE CHECKED ON SITE BEFORE WORK COMMENCES.

ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH THE LATEST BUILDING REGULATIONS.

REFER TO STRUCTURAL ENGINEER'S DRAWINGS AND SPECIFICATION FOR ALL STRUCTURAL WORK.

THIS DRAWING IS COPYRIGHT.

NO.:	REVISIONS:	DATE:	NO.:	REVISIONS:	DATE:
A			H		
B			I		
C			J		
D			K		
E			L		
F			M		
G			N		
			O		

LEGEND:

OFA
O'FLYNN ARCHITECTS,
LOWER EYRE STREET,
NEWBRIDGE,
CO. KILDARE.
TEL.: 045 433400
EMAIL: info@oflynnarchitects.ie
WEB: www.oflynnarchitect.ie
RIAI Practice Member 2021

PROJECT:	PROPOSED GREAT CONNELL SHD AT NEWBRIDGE, CO. KILDARE.		
TITLE:	PROPOSED MASTER SITE LAYOUT PLAN.		
CLIENT:	ASTON LTD.	STAGE:	PLANNING
PROJECT NO.:	19070	DRG. NO.:	PA-002
SCALE:	1:1,000	DRAWN:	POF
DATE:	FEBRUARY 2022	CHECKED:	POF

The proposed Neighbourhood Centre has a total commercial floor area of 2,141 sqm and accommodates 11 no. commercial units with a variety of uses comprising:

- Convenience shop of 909 sqm (unit 1)
- 3 no. doctor/dentist/physio units of 120 sqm, 120 sqm and 90 sqm (units 6, 7, and 8, respectively)
- café of 125 sqm (unit 4)
- restaurant of 213 sqm (unit 9)
- 5 no. shop/convenience services units of 112 sqm, 49 sqm, 171 sqm, 100sqm and 100 sqm (units 2, 3, 5, 10 and 11, respectively). It is envisaged that these units will be occupied by uses such as butchers, green grocers, hairdressers, pharmacies, or a local post office.

Within the Neighbourhood Centre it is proposed to provide a childcare facility (886 sqm) with capacity for in the order of 154 no. children.

A total of 1,008 no. car parking spaces are proposed to serve the proposed development. 650 no. car parking spaces are proposed to serve the 325 no. houses, 312 no. car parking spaces are proposed to serve the 244 no. apartments, and 46 no. car parking spaces are proposed to serve the neighbourhood centre, including the childcare facility.

A total of 732 no. bicycle parking spaces are proposed to serve the development comprising 536 no. long-stay residential spaces, 134 no. residential visitor spaces, and 62 no. bike spaces to serve the neighbourhood centre including the childcare facility.

3.2 Open Space/Amenity

A total of 18 no. landscaped public open spaces will be provided including, Central Parks, Linear Park and a Local Square/Civic Square. Together these open spaces have a net area of 2.595 ha and exclude the areas of the proposed swales and any area less than 10 metres wide. In addition, the scheme includes an 8.31 ha Ecological River Park in the riparian area of the River Liffey.

3.3 Building Energy Performance

The requirements for the conservation of fuel and energy for dwellings and the energy performance of dwellings are laid out in Part L of the Second Schedule to the Building Regulations 1997 (S.I. No. 497 of 1997), as amended by the Building Regulations (Part L Amendment) Regulations 2011 (S.I. 259 of 2011), the Building Regulations (Amendment) Regulations 2017 (S.I. 4 of 2017), the European Union (Energy Performance of Buildings) (No. 2) Regulations 2019 (S.I. No. 292 of 2019) and in the European Union (Energy Performance of Buildings) Regulations 2019 (S.I. No.183 of 2019).

Objective L1 of the Building Regulations stipulates that:

- A building shall be designed and constructed so as to ensure that the energy performance of the building is such as to limit the amount of energy required for the operation of the building and the amount of carbon dioxide (CO2) emissions associated with this energy use insofar as is reasonably practicable.

Regulation 8 of the European Union (Energy Performance of Buildings) Regulations 2019, requires:

For new dwellings, the nearly zero energy performance requirements of this regulation shall be met by:

(a) providing that the energy performance of the building is such as to limit the calculated primary energy consumption and related carbon dioxide (CO_2) to that of a nearly zero energy building within the meaning of the Directive insofar as is reasonably practicable, when both energy consumption and CO_2 emissions are calculated using the Dwelling Energy Assessment Procedure (DEAP) published by Sustainable Energy Authority of Ireland;

(b) providing that the nearly zero or very low amount of energy required is covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby;

(c) limiting the heat loss and, where appropriate, availing of heat gain through the fabric of the building;

(d) providing and commissioning energy efficient space and water heating systems with efficient heat sources and effective controls;

(e) providing that all oil and gas fired boilers shall meet a minimum seasonal efficiency of 90 %;

(f) providing to the dwelling owner sufficient information about the building, the fixed building services, controls and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and energy than is reasonable.

In relation to the design of the apartments the following will be taken into consideration:

- *A Building Energy Rating (BER) certificate will be provided for each dwelling in the proposed development which will provide detail of the energy performance of the dwellings. A BER is calculated through energy use for space and hot water heating, ventilation, and lighting and occupancy. It is proposed to target an A2 rating for the apartment.*

- *The Fabric Energy Efficiency of all units will be in line with the requirements of Technical Guidance Documents Part L, 'Conservation of Fuel and Energy Buildings other than Dwellings'. All buildings will be Near Zero Energy Building Standard compliant. Thermal bridging at junctions between construction elements and at other locations will be minimised.*

- *If gas fired heating is selected, condensing boilers will be provided as they have a higher operating efficiency, typically over 90%, than standard boilers and have the benefit of lower fuel consumption resulting from the higher operating efficiencies.*

- *For the apartments centralised mechanical ventilation will be provided to all dwellings to ensure that the air quality within the dwellings will be adequate. The inclusion of Heat Recovery Ventilation into the centralised ventilation system will be considered and assessed in order to minimise the energy usage within the dwelling.*

- *Photovoltaic Solar Panels will be considered in order to meet the renewable energy contribution required by Part L of the Building Regulations. These panels convert sunlight into electricity which can be used within the dwelling. They panels are typically placed on the south facing side of the building to maximise the solar exposure.*

- *The use of Air Source Heat Pumps will be assessed to determine their technical and commercial feasibility. These systems extract heat energy from the outside air and, using a refrigerant cycle, raise the temperature of the heat energy using a refrigerant vapour compression cycle.*

- *The use of Exhaust Air Source Heat Pumps will be assessed to determine their technical and commercial feasibility. These systems extract heat energy within the dwelling from the air exhausted from wet areas and kitchen and, using a refrigerant cycle, raise the temperature of the heat energy using a refrigerant vapour compression cycle.*

- *Combined Heat and Power, (CHP) may be considered in the event a number of apartments remain in a single ownership. This technology generates electricity and captures the waste heat from the generation unit that can be used within the development.*

- *Ducting and on street infrastructure will be provided from a local landlord distribution board to parking spaces identified. This will facilitate the installation of a number of E-car charging points to cater for the demands of the residences.*

The above guidance on energy performance was considered at the design stage and the Design Team decided that the appropriate energy options for the development included:

- Mechanical Ventilation Heat Recovery;

- Photovoltaic (PV) Solar Panels;

- Air Source Heat Pumps;

- Exhaust Air Heat Pumps, and

- Provision of electric vehicle charging points.

More details on the energy performance is in the Building Life Cycle Report included with this application under separate cover.

3.4 Landscape Strategy

The design approach was to retain the existing trees and hedgerows wherever possible and supplement them with native tree, wildflower and herbaceous planting that will benefit pollinators and reinforce biodiversity.

Several centrally located public spaces enclosed by residential blocks and streets were designed for flexible use, based on level changes, landscaping and contemporary paving materials and furniture.

The Linear Park along the western boundary provides walking and cycle links into and through the development and provides for new tree planting and a wildflower meadow to enhance biodiversity.

The Civic Square is adjacent to the Neighbourhood Centre and forms main space and focus at the entrance to the development. It provides a flexible use as a meeting space with a seating area and opportunities for weekend markets/special local events.

The Ecological Park in the riparian zone of the Liffey provides a multi-functional recreational area that incorporates flood compensation storage; a pedestrian/cycle route connecting the development with the existing/proposed public space network along the river, a kick about area and opportunities for passive recreational uses.

3.5 Universal Access

O'Flynn Architects has prepared a Universal Access Statement for the development that demonstrates how as a whole it complies with the guidelines and principles of universal design. A copy of the report is included in the application under separate cover. A high percentage of the units have been designed to comply with the guidelines for universal design, and while others may not comply fully with all aspects of the guidance, they do comply with the majority.

3.6 Site Lighting

Sabre Electrical Services Ltd prepared a Site Lighting Report and a copy is included in the application under separate cover. The lighting scheme is designed to provide a safe environment for pedestrians, cyclists and moving vehicles, deter antisocial behaviour and limit the impact of artificial lighting on animal species..

The proposed lighting scheme consists of light emitting diode (LED) public lighting pole mounted fittings. The selected luminaires are the Veelite Metro Streetlights 27w LED (51 x Street Optic S, 28 x Forward Throw Optic) mounted on 6m columns with a 5 degree tilt. Each light fitting will be controlled by an individual Photoelectric Control Unit (PECU) and will be on a dusk-dawn profile.

3.7 Connectivity

Access will be off the Great Connell Road. The internal roads are designed in accordance with Department of the Environment, Community and Local Government's Urban Design Manual (May 2009) (DMURS) and facilitate connectivity to the adjoining lands to the north and south and to Newbridge Town Centre.

3.8 Newbridge South Outer Orbital Relief Road (NSOORR)

The proposed development includes the provision of 350m of the NSOORR that will connect to a new signalised junction on Great Connell Road. The alignment of this road follows the wayleave for the Newbridge Eastern Interceptor Sewer.

The proposed NSOORR splits the development site into two distinct sections and will eventually tie in with the section of the NSOORR bineg constructed as part of the Ardstone residential development to the south west. This will require the construction of a bridge over the Liffey, but this not part of the proposed development. The construction of the bridge will be the subject of a separate planning application to Kildare County Council Aston Ltd is progressing this (PP-4559).

3.9 Services

This section presents an overview of the proposed services. A detailed description of the water supply, surface water and foul water drainage systems is in the Engineering Planning Report prepared by PUNCH. The Report is in Appendix 1 and should be consulted in relation to the detailed design calculations.

3.9.1 Water Supply

The development will connect to the mains water supply via a 200mm diameter connection from the existing watermain on the Great Connell Road, as shown on Drawing 192229-PUNCH-XX-XX-DR-C-0114 The watermain layout design is in accordance with "Irish Water Code of Practice for Water Infrastructure" and it will be constructed in accordance with Irish Water Code of Practice and the Local Authority's requirements.

PUNCH estimate the average daily demand will be 254,868 litres when the development is complete. To reduce the demand water conservation measures will be incorporated into the building design e.g. dual flush toilets.

A Pre-Connection Enquiry Form was sent to Irish Water in relation to the proposed development and Irish Water issued a Confirmation of Feasibility. The PUNCH proposed watermain connection proposals were then submitted to Irish Water for Design Vetting and Irish Water issued a Statement of Design Acceptance.

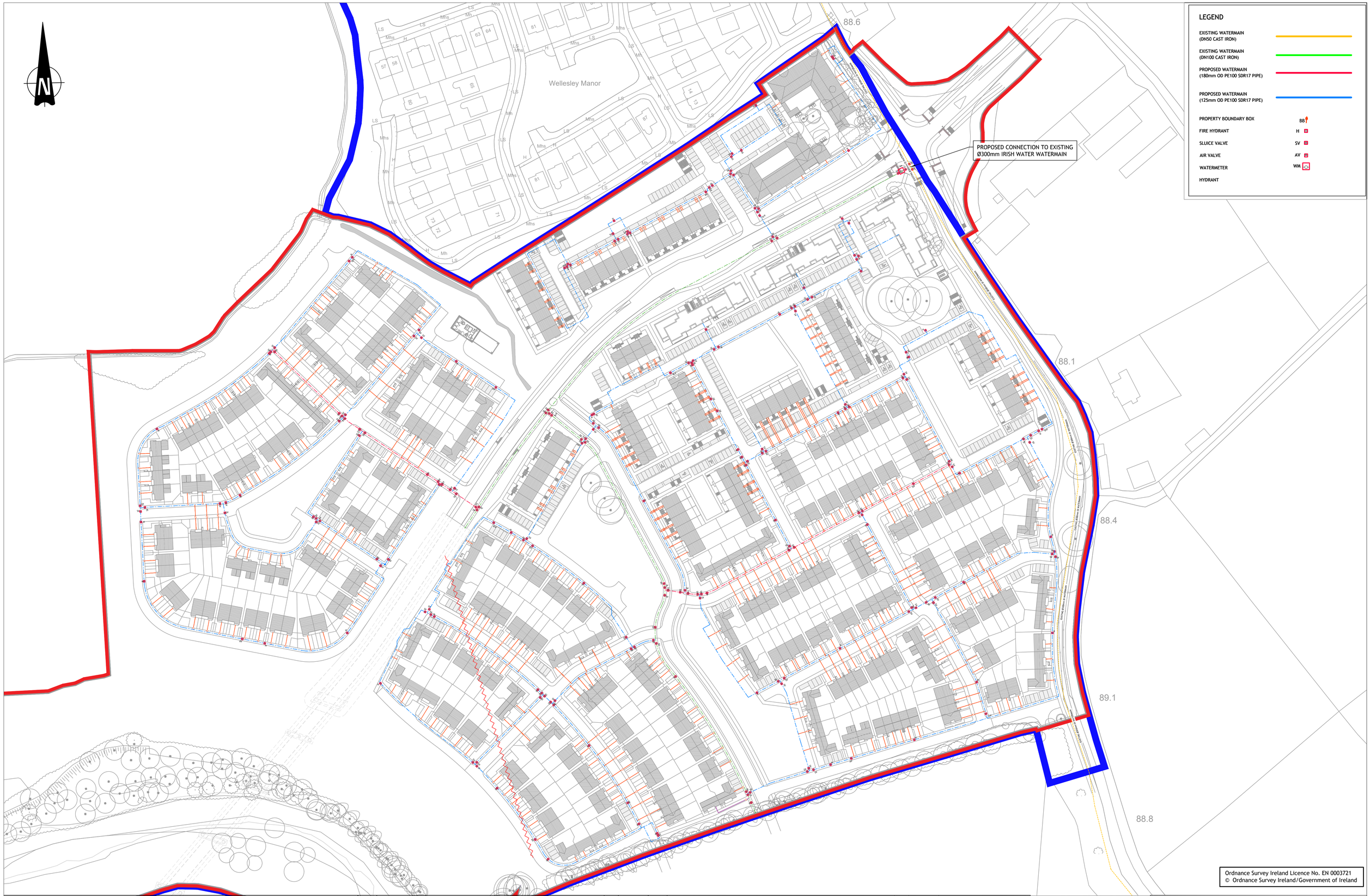
3.9.2 Foul Water

The network was designed using Causeway Flow software in accordance with Irish Water's Code of Practice for Wastewater Infrastructure and the Department of the Environment's Recommendations for Site Development Works for Housing Areas. The foul water loading was calculated in accordance with the Code of Practice for Wastewater Infrastructure, with a 10% allowance for infiltration.

The existing 450mm foul sewer that runs across the site from south to north will be diverted to connect to the Upper Liffey Valley Sewerage Scheme (ULVS) existing 900 mm diameter sewer. Due to the site topography it was not feasible to provide a gravity connection to the ULVS sewer.

All foul water from the proposed development will be collected and gravity flow to a pumping station in the north of the site, as shown on Drawing 192229-PUNCH-XX-XX-DR-C-0113, from where it will be pumped to the ULVS sewer The pumping station will deliver a peak flow to the ULVS sewer of 19.5l/s. It will include a 254m^3 capacity emergency storage tank that will retain the foul water in the event of a breakdown.

PUNCH estimate the average daily discharge to the Irish Water foul sewer will be 280,355 litres when the development is complete. A Pre-Connection Enquiry Form was sent to Irish Water in relation to the proposed development, and Irish Water issued a Confirmation of Feasibility. The PUNCH proposed foul network designs was then submitted to Irish Water for Design Vetting and Irish Water issued a Statement of Design Acceptance.



Ordnance Survey Ireland Licence No. EN 0003721
© Ordnance Survey Ireland/Government of Ireland

© PUNCH Consulting Engineers
This drawing and any design hereon is the copyright of the Consultants and must not be reproduced without their written consent.
All drawings remain the property of the Consultants.
Figured dimension only to be taken from this drawing.
Consultants to be informed immediately of any discrepancies before work proceeds.
COLOUR DRAWING

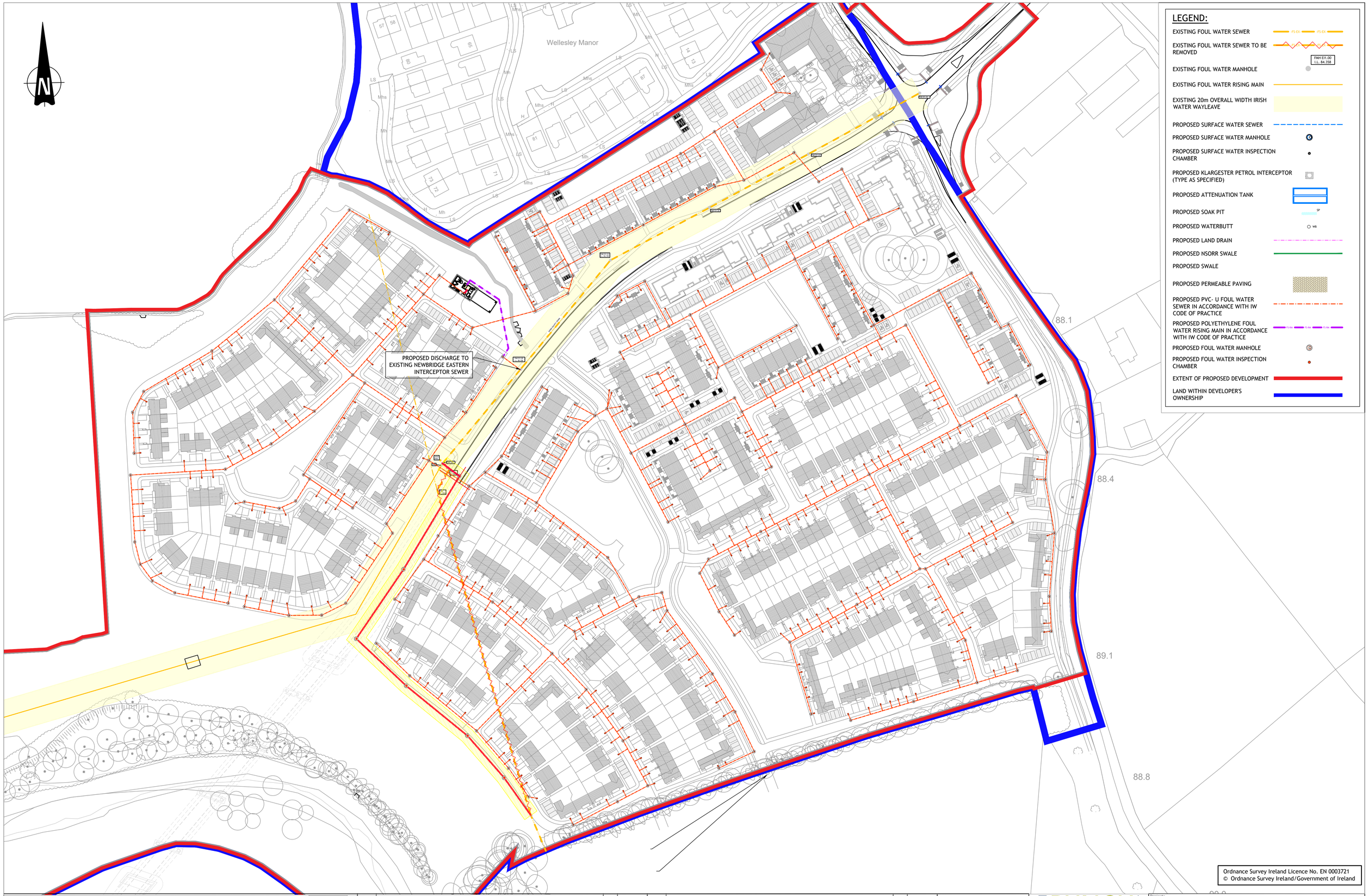
BUILDING INFORMATION MODELLING (BIM) I.S. EN ISO 19650-2:2018
NSAI Certified

Rev	Amendment	By	Date	Rev	Amendment	By	Date
C01	ISSUED FOR PLANNING	IBS	2022-03-28				

Client:

PUNCH consulting engineers
Dublin | Limerick | Cork | Galway | Glasgow
97 Henry Street, Limerick, V94 YC2H
t +353 61 221 200 | w punchconsulting.com

Project: GREAT CONNELL SHD, NEWBRIDGE				
Title: PROPOSED OVERALL WATERMAIN LAYOUT				
Drawn: IBS	Date drawn: MARCH 2022	Technician Check: PJM	Engineer Check: SOC	Approved: LB
Project No: 192229	Model Ref: 192229-PUNCH-XX-XX-M2-C-0114		Drawing Status: A0 PLANNING	
Scale @ A1: 1:1000	Document No: 192229-PUNCH-XX-XX-DR-C-0114			Revision No: C01



LEGEND:

- EXISTING FOUL WATER SEWER
- EXISTING FOUL WATER SEWER TO BE REMOVED
- EXISTING FOUL WATER MANHOLE (FMH ET1.00 I.L. 84.358)
- EXISTING FOUL WATER RISING MAIN
- EXISTING 20m OVERALL WIDTH IRISH WATER WAYLEAVE
- PROPOSED SURFACE WATER SEWER
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED SURFACE WATER INSPECTION CHAMBER
- PROPOSED KLARGESTER PETROL INTERCEPTOR (TYPE AS SPECIFIED)
- PROPOSED ATTENUATION TANK
- PROPOSED SOAK PIT (SP)
- PROPOSED WATERBUTT (WB)
- PROPOSED LAND DRAIN
- PROPOSED NSORR SWALE
- PROPOSED SWALE
- PROPOSED PERMEABLE PAVING
- PROPOSED PVC- U FOUL WATER SEWER IN ACCORDANCE WITH IW CODE OF PRACTICE
- PROPOSED POLYETHYLENE FOUL WATER RISING MAIN IN ACCORDANCE WITH IW CODE OF PRACTICE
- PROPOSED FOUL WATER MANHOLE
- PROPOSED FOUL WATER INSPECTION CHAMBER
- EXTENT OF PROPOSED DEVELOPMENT
- LAND WITHIN DEVELOPER'S OWNERSHIP

Ordnance Survey Ireland Licence No. EN 0003721
© Ordnance Survey Ireland/Government of Ireland

© PUNCH Consulting Engineers
This drawing and any design hereon is the copyright of the Consultants and must not be reproduced without their written consent.
All drawings remain the property of the Consultants.
Figured dimension only to be taken from this drawing.
Consultants to be informed immediately of any discrepancies before work proceeds.
COLOUR DRAWING

BUILDING INFORMATION MODELLING (BIM) I.S. EN ISO 19650-2:2018 NSAI Certified

Rev	Amendment	By	Date	Rev	Amendment	By	Date
C01	ISSUED FOR PLANNING	IBS	2022-03-28				

Client:

PUNCH consulting engineers
Dublin | Limerick | Cork | Galway | Glasgow
97 Henry Street, Limerick, V94 YC2H
t +353 61 221 200 | w punchconsulting.com

Project: GREAT CONNELL SHD, NEWBRIDGE
Title: PROPOSED OVERALL FOUL WATER LAYOUT

Drawn:	Date drawn:	Technician Check:	Engineer Check:	Approved:
IBS	MARCH 2022	PJM	SOC	LB

Project No:	Model Ref:	Drawing Status:
192229	192229-PUNCH-XX-XX-M2-C-0113	A0 PLANNING

Scale @ A1:	Document No:	Revision No:
1:1000	192229-PUNCH-XX-XX-DR-C-0113	C01

3.9.3 Surface Water Drainage

The drainage system was designed using Causeway Flow software in accordance with the Department of Environment and Local Government's guidance document "Recommendations for Site Development Works for Housing Areas", with guidance taken from the "Greater Dublin Strategic Drainage Study" (GDSDS) and the Newbridge Development Plan. An allowance of 20% made for climate change.

Due to the topography it is not possible to drain the entire development site to one outfall. Therefore, after a series of design iterations, the final system includes gravity discharges to four new outlets on the drainage ditch in the north of the site and two new outlet to the River Liffey to the west.

The section of NSOORR will have a separate drainage system. Due to level and vertical clearance constraints imposed by the existing 900mm diameter foul sewer traversing the site two outfalls are required.

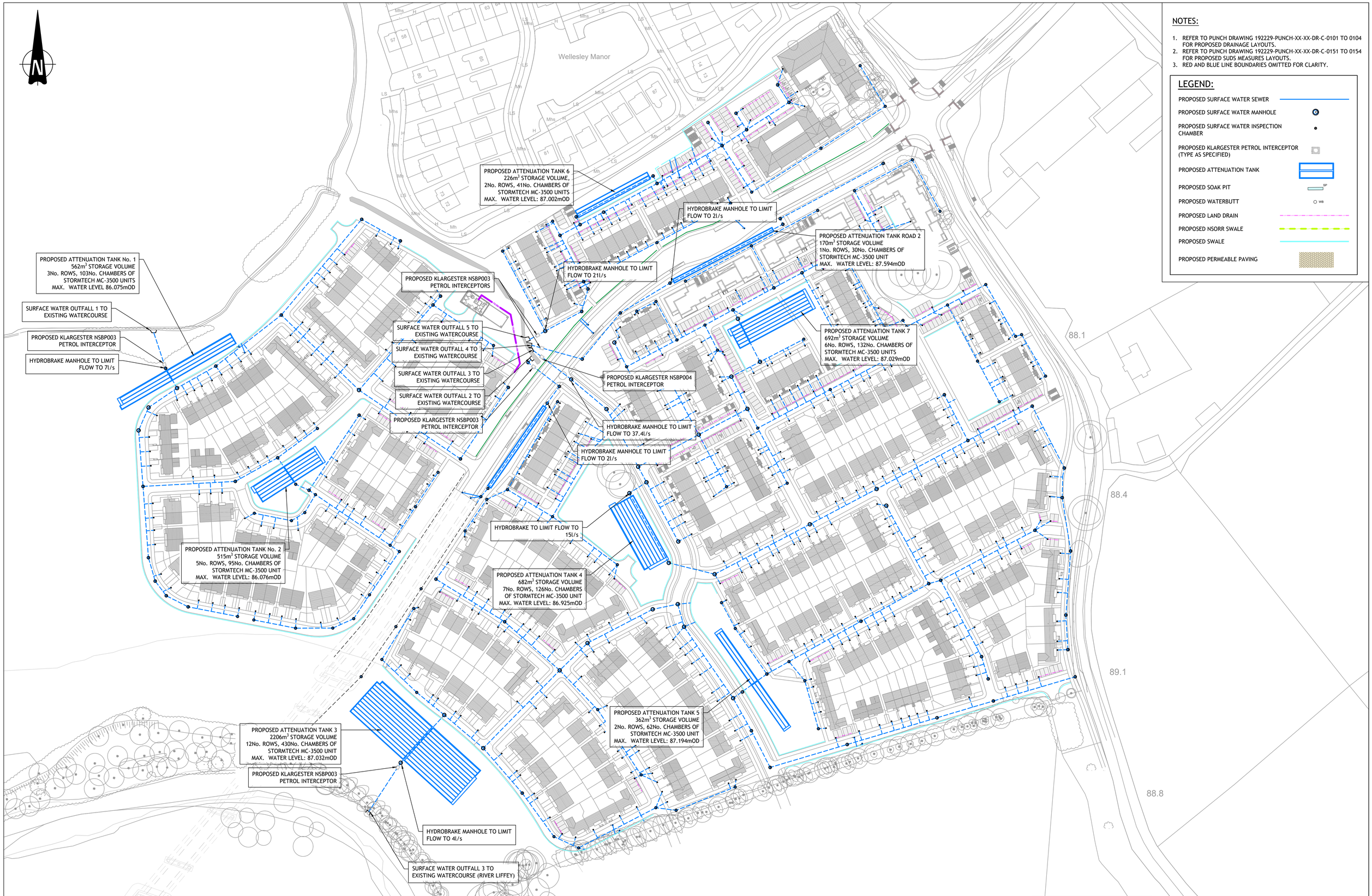
Seven underground attenuation tanks with a combined capacity of 5,387m^3, will serve the residential development and two underground tanks (combined volume of 320m^3) will serve the section of the NSOORR, as shown on Drawing 192229-PUNCH-XX-XX-DR-C-0160. All of the tanks will be fitted with flow regulation devices designed to maintain the flow rates to the water courses at pre-development greenfield rates.

Class 1 Bypass Hydrocarbon Separators will be located downstream of all the attenuation tanks. The discharge points to the ditch and the river will be fitted with non-return valves to prevent water from the river surcharging up through the surface water drainage network.

In addition to the underground attenuation tanks, the following Sustainable Urban Drainage Systems (SuDs) are incorporated into the design:

- Permeable paving
- Swales/Bioswales
- Green Roofs
- Soakaways/Soak Pits
- Rainwater Harvesting

The drainage system design takes account effects of coincidental flooding and is in accordance with the Greater Dublin Strategic Drainage Study (GDSDS) Volume 5 Guidance for combination flood events. A Site-Specific Flood Risk Assessment (SSFRA) was completed by JBA Consulting and the findings are discussed in Chapter 7.



NOTES:

1. REFER TO PUNCH DRAWING 192229-PUNCH-XX-XX-DR-C-0101 TO 0104 FOR PROPOSED DRAINAGE LAYOUTS.
2. REFER TO PUNCH DRAWING 192229-PUNCH-XX-XX-DR-C-0151 TO 0154 FOR PROPOSED SUDS MEASURES LAYOUTS.
3. RED AND BLUE LINE BOUNDARIES OMITTED FOR CLARITY.

LEGEND:

- PROPOSED SURFACE WATER SEWER
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED SURFACE WATER INSPECTION CHAMBER
- PROPOSED KLARGESTER PETROL INTERCEPTOR (TYPE AS SPECIFIED)
- PROPOSED ATTENUATION TANK
- PROPOSED SOAK PIT (SP)
- PROPOSED WATERBUTT (WB)
- PROPOSED LAND DRAIN
- PROPOSED NSORR SWALE
- PROPOSED SWALE
- PROPOSED PERMEABLE PAVING

© PUNCH Consulting Engineers
This drawing and any design hereon is the copyright of the Consultants and must not be reproduced without their written consent.
All drawings remain the property of the Consultants.
Figured dimension only to be taken from this drawing.
Consultants to be informed immediately of any discrepancies before work proceeds.
COLOUR DRAWING

BUILDING INFORMATION MODELLING (BIM) I.S. EN ISO 19650-2:2018 NSAI Certified

Rev	Amendment	By	Date	Rev	Amendment	By	Date
C01	ISSUED FOR PLANNING	IBS	2022-03-22				
C02	ISSUED FOR PLANNING	IBS	2022-03-28				

Client:

PUNCH consulting engineers
Dublin | Limerick | Cork | Galway | Glasgow
97 Henry Street, Limerick, V94 YC2H
t +353 61 221 200 | w punchconsulting.com

Project: GREAT CONNELL SHD, NEWBRIDGE
Title: PROPOSED OVERALL SURFACE WATER LAYOUT

Drawn:	Date drawn:	Technician Check:	Engineer Check:	Approved:
IBS	AUGUST 2021	PJM	ET	LB

Project No:	Model Ref:	Drawing Status:
192229	192229-PUNCH-XX-XX-M2-C-0160	A0 PLANNING

Scale @ A1:	Document No:	Revision No:
1:1000	192229-PUNCH-XX-XX-DR-C-0160	C02

3.9.4.4 Power Supply

The existing overhead electrical power lines running from the north-east to south-west through the site and along the southern site boundary will be diverted underground. Upgrade works are required to meet the development's projected energy requirements of 3 Megavolt-ampere (MVA). This loading is based on ESB electrical loading guidelines for Houses and Apartments. A freestanding Medium Voltage/Low Voltage (MV/LV) Substation will be provided near the crèche. The MV/LV Substation will supply 8no 630kVA sub-stations located in areas that are optimal for efficient cable distribution.

3.10 Flood Compensatory Measures

Measures will be provided to compensate for the loss of the overland flood flow paths across the site. The measures were designed by PUNCH based on the JBA Consulting SFRA. The PUNCH Engineering Planning Report should be consulted for details of the design calculations

PUNCH carried out a number of detailed assessments using 'Civils 3D' ground modelling software comparing the 1:100 year flood plain surface with the pre development and post development ground surfaces to calculate the existing and required flood compensation storage volumes. This identified a short fall of 884m$^{3.}$

PUNCH designed compensatory storage areas, which will be in the south and south west of the site (Drawing 192229-PUNCH-XX-XX-DR-C-0813), and will provide a surplus 1,278m^3 flood storage compared to pre-development conditions. The storage areas are designed to drain by gravity back to the River Liffey after flooding recedes.

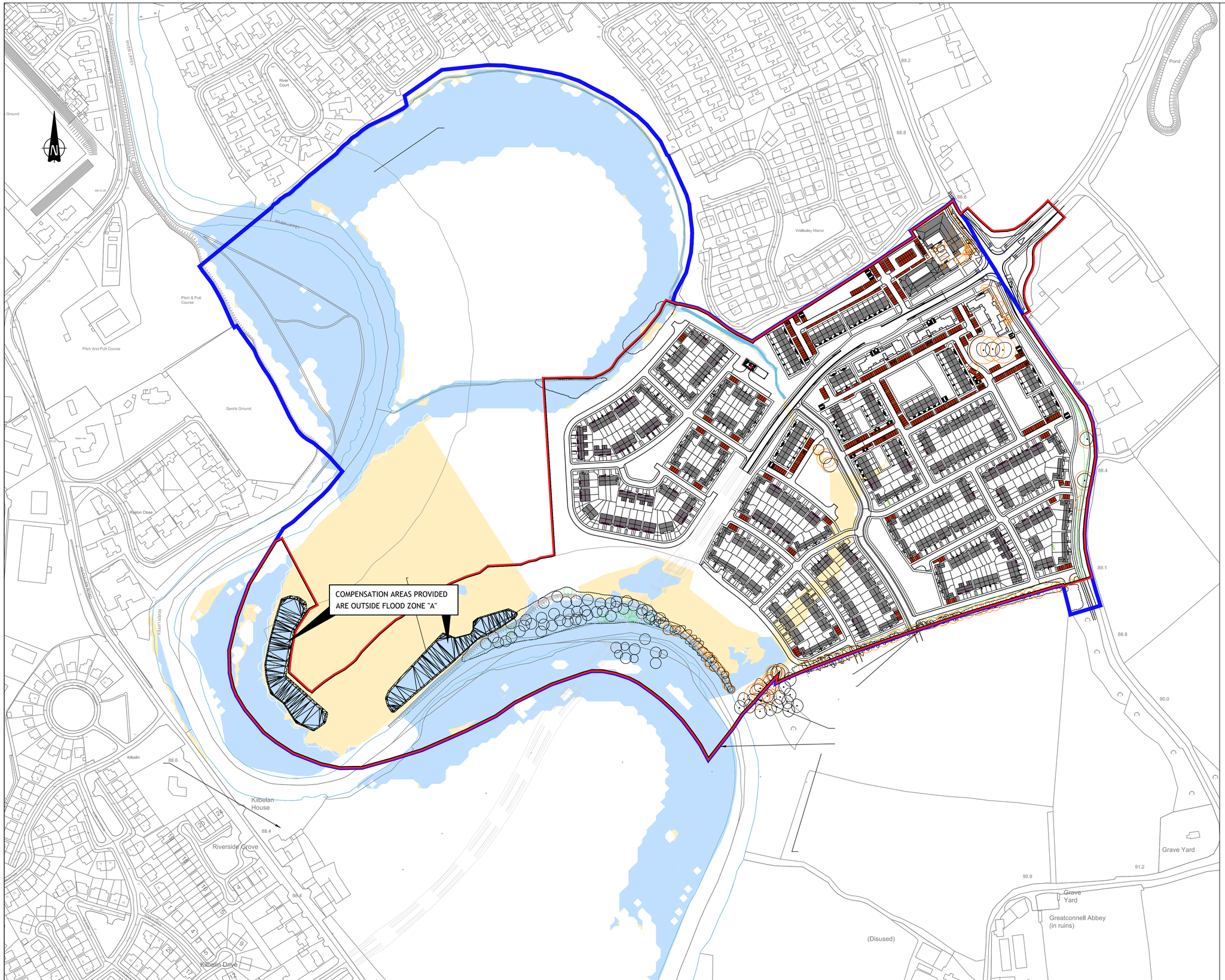
3.11 Construction Stage

3.11.1 Development Phases

The proposed phasing of the works is shown on Drawing No PA-008.

Phase 1: Northern Area of Site

- Construction of 169 residential units and the neighbourhood centre including the crèche.
- Construction of the signalised junction and Great Connell Roundabout.
- Demolition of private residences and removal of trees.
- Diversion of Athgarvan foul sewer to connect to Upper Liffey Valley Sewerage Scheme
- Undergrounding of overhead power lines.
- Construction of relevant infrastructural works including new foul sewer and pumping station, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.



SURFACE LEVEL DATA					
NUMBER	MINIMUM LEVEL	MAXIMUM LEVEL	COLOUR	AREA	VOLUME
16	0.00	0.20		31941.519m2	29925.037m3
17	0.20	0.40		26448.145m2	23922.799m3
18	0.40	0.60		23903.001m2	18667.366m3
19	0.60	0.80		20007.155m2	14647.683m3
20	0.80	1.00		14931.074m2	10894.683m3
21	1.00	1.20		8294.460m2	8697.846m3
22	1.20	1.40		5706.435m2	7339.677m3
23	1.40	1.60		4406.024m2	6338.635m3
24	1.60	1.80		3696.217m2	5545.515m3
25	1.80	2.00		3313.836m2	4841.687m3
26	2.00	2.20		4722.533m2	4101.458m3
27	2.20	2.40		7908.198m2	2765.708m3
28	2.40	2.60		4697.209m2	1452.496m3
29	2.60	2.80		2696.842m2	778.381m3
30	2.80	3.00		1579.724m2	321.364m3
31	3.00	3.20		638.270m2	118.410m3
32	3.20	3.40		189.802m2	43.792m3
33	3.40	3.60		102.247m2	16.866m3
34	3.60	3.80		33.747m2	2.391m3
35	3.80	4.00		2.919m2	0.133m3

LEGEND

LANDS WITHIN STUDY AREA THAT ARE ABOVE Q100 FLOOD PLAIN

Ordnance Survey Ireland Licence No. CYAL50252568
© Ordnance Survey Ireland/Government of Ireland

© PUNCH Consulting Engineers
This drawing and any design hereon is the copyright of the Consultants and must not be reproduced without their written consent.
All drawings remain the property of the Consultants.
Figured dimension only to be taken from this drawing.
Consultants to be informed immediately of any discrepancies before work proceeds.
COLOUR DRAWING

BUILDING INFORMATION MODELLING (BIM) I.S. EN ISO 19650-2:2018
NSAI Certified

Rev	Amendment	By	Date	Rev	Amendment	By	Date
C01	ISSUED FOR PLANNING	PJM	2022-03-23				

Client:

PUNCH consulting engineers
Dublin | Limerick | Cork | Galway | Glasgow
97 Henry Street, Limerick, V94 YC2H
t +353 61 221 200 | w punchconsulting.com

Project: GREAT CONNELL SHD, NEWBRIDGE
Title: FLOOD MODEL - Q100 - POST-DEVELOPMENT - (WITH COMPENSATION)

Drawn:	Date drawn:	Technician Check:	Engineer Check:	Approved:
PJ Mulcahy	MARCH 2022	PJM	JT	LB
Project No: 192229	Model Ref: 192229-PUNCH-XX-XX-M3-C-0813		Drawing Status: A0 PLANNING	
Scale @ A1: 1:2000	Document No: 192229-PUNCH-XX-XX-DR-C-0813			Revision No: C01

A1

PHASE 1: 169 UNITS

PHASE 2: 103 UNITS

PHASE 3: 99 UNITS

PHASE 4: 198 UNITS

NEWBRIDGE SOUTHERN ORBITAL RELIEF ROAD (NSORR)

(NSORR EXTENDED ROAD AND BRIDGE CROSSING SUBJECT TO SEPARATE PLANNING APPLICATION WITH KILDARE COUNTY COUNCIL—SECTION 247 KCC PRE-PLANNING CONSULTATION REFERENCE: PP5299)

PHASE 1 WORKS TO BE COMPLETED:

- 169 RESIDENTIAL UNITS AND THE NEIGHBOURHOOD CENTRE INCL. CRECHE ARE TO BE CONSTRUCTED;
- THE SIGNALISED JUNCTION THAT IS TO REPLACE THE EXISTING GREAT CONNELL ROUNDABOUT & C. 350m EXTENT OF THE NSORR THAT IS TO SERVE THE PROPOSED DEVELOPMENT IS TO BE COMPLETED;
- EXISTING FOUL SEWER LINE THROUGH THE SITE IS TO BE DIVERTED;
- EXISTING OVERHEAD ESB LINES THROUGH THE SITE ARE TO BE DIVERTED UNDERGROUND;
- RELEVANT INFRASTRUCTURAL WORKS TO SERVE THE PROPOSED PHASE (FOUL PUMPED SYSTEM, SURFACE WATER, UTILITIES, ROADS, FOOTPATHS ETC.) ARE TO BE COMPLETED.
- OPEN SPACES 9, 10, 11, 12, A, B & C ARE TO BE COMPLETED ALONG WITH RELEVANT LANDSCAPING & FLOOD COMPENSATION STORAGE WORKS WITHIN THE RIPARIAN / ZONED AMENITY LANDS;

PHASE 4 WORKS TO BE COMPLETED:

- 198 RESIDENTIAL UNITS ARE TO BE CONSTRUCTED;
- OPEN SPACES 1, 4, 5, 6, 7, 8, D & E ARE TO BE COMPLETED;
- RELEVANT INFRASTRUCTURAL WORKS TO SERVE THE PROPOSED PHASE (FOUL GRAVITY SYSTEM, SURFACE WATER, UTILITIES, ROADS, FOOTPATHS ETC.) ARE TO BE COMPLETED.

PHASE 3 WORKS TO BE COMPLETED:

- 99 RESIDENTIAL UNITS ARE TO BE CONSTRUCTED;
- OPEN SPACES 3 & F ARE TO BE COMPLETED;
- RELEVANT INFRASTRUCTURAL WORKS TO SERVE THE PROPOSED PHASE (FOUL GRAVITY SYSTEM, SURFACE WATER, UTILITIES, ROADS, FOOTPATHS ETC.) ARE TO BE COMPLETED.

PHASE 2 WORKS TO BE COMPLETED:

- 103 RESIDENTIAL UNITS ARE TO BE CONSTRUCTED;
- OPEN SPACE 2 IS TO BE COMPLETED ALONG WITH RELEVANT LANDSCAPING WORKS WITHIN THE RIPARIAN / ZONED AMENITY LANDS;
- RELEVANT INFRASTRUCTURAL WORKS TO SERVE THE PROPOSED PHASE (FOUL GRAVITY SYSTEM, SURFACE WATER, UTILITIES, ROADS, FOOTPATHS ETC.) ARE TO BE COMPLETED.

RIVER LIFFEY
Sports Ground
Wellesley Manor
Greatconnell
GREATCONNELL
RESERVED FOR FUTURE SOUTHERN RELIEF ROAD CONNECTION
Pond
River Liffey
88.6
88.1
88.4
89.1
88.8
N

SITE LAYOUT SHOWING PROPOSED PHASING PLAN @ 1:1,250

NOTES:

DO NOT SCALE, USE ONLY FIGURED DIMENSIONS WHICH SHOULD BE CHECKED ON SITE BEFORE WORK COMMENCES.

ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH THE LATEST BUILDING REGULATIONS.

REFER TO STRUCTURAL ENGINEER'S DRAWINGS AND SPECIFICATION FOR ALL STRUCTURAL WORK.

THIS DRAWING IS COPYRIGHT.

NO.:	REVISIONS:	DATE:	H		DATE:
A			I		
B			J		
C			K		
D			L		
E			M		
F			N		
G			O		

LEGEND:

OFA
O'FLYNN ARCHITECTS,
LOWER EYRE STREET,
NEWBRIDGE,
CO.KILDARE.
TEL.: 045 433400
EMAIL:info@oflynnarchitects.ie
WEB: www.oflynnarchitect.ie
RIAI Practice Member 2021

PROJECT:	PROPOSED GREAT CONNELL SHD AT NEWBRIDGE, CO. KILDARE.		
TITLE:	SITE LAYOUT SHOWING PROPOSED PHASING PLAN.		
CLIENT:	ASTON LTD.	STAGE:	PLANNING
PROJECT NO.:	19070	DRG. NO.:	PA-008
SCALE:	1:1,250	DRAWN:	POF
DATE:	FEBRUARY 2022	CHECKED:	POF

- Completion of flood compensation storage works within the riparian/zoned amenity lands
- Open Spaces landscaping in Zones 9,10,11,13, A & B.

Phase 2: **South of Phase 1**

- Construction of 103 residential units.
- Construction of relevant infrastructural works including new foul sewer, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.
- Provision of Open Space 2, along with relevant landscape works within the riparian zone.

Phase 3: **East of Phase 2**

- Construction of 99 residential units.
- Construction of relevant infrastructural works including new foul sewer, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.
- Open space landscaping to Areas 3 & F, including treatment works to this section of the Great Connell Road.

Phase 4: **North of Phase 3**

- Construction of 198 residential units.
- Construction of relevant infrastructural works including new foul sewer, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.
- Open space landscaping to areas 1, 4, 5, 6, 7, 8, D & E, including treatment works to the section of the Great Connell Road.

3.11.2 Construction Compound

The compound will include a site office and welfare facilities, hardstanding for plant and machinery and a designated waste storage areas. Initially it will be serviced with electrical power from an on-site generator and will include Portaloo toilet facilities until a connection to the municipal foul sewer has been established.

The exact location of the compound will be confirmed in advance of commencement of the works (and agreed with Kildare County Council). The compound may be relocated during the construction phases.

3.11.3 Site Preparatory Works

Site preparatory works involve Site Set Up by the Main Contractor which will include:

- Setting of access control to the development areas;
- Provision of secure compound for the storage of all on-site machinery and materials;
- Confirming the buffer distances from site boundaries and sensitive locations;
- Permanent and temporary fencing; and
- Erection of signage.

Prior to the commencement of the works the Main Contractor will check records and drawings to establish the location of existing buried services/utilities. Where it is necessary to disconnect services/utilities during the works for an extended period, temporary altrnative provisions will be provided.

3.11.4 Working Hours

The normal working hours will be 08:00 to 18:00 Monday to Friday (excluding bank holidays) and 08:00 to 16:00 Saturdays, subject to restrictions that may be imposed by the planning permission. Works will not be carried out on Sundays and Public Holidays. Subject to the agreement of the Kildare County Council out of hours activities may be required for certain elements e.g. connections to water mains and foul sewer.

3.11.5 Plant & Equipment

Construction materials will be delivered in heavy goods vehicles and concrete mixing trucks. The construction plant items will include tracked excavators, dozers, dump trucks, telescopic handlers, backhoe loaders, lifting platforms, mobile cranes, mobile generators and asphalt paving machines

3.11.6 Excavation Works

Top soils and subsoils will be excavated to establish formation level for the buildings, roads and underground services, including the surface water attenuation tanks.

3.11.7 Concrete Works

Concrete batching will take place off site. Excess concrete will be removed from the site and concrete washout will not be permitted. Concrete pouring will be monitored to ensure there is no accidental discharge. Accidental spills will not be hosed down.

3.11.8 Surface Water Management

A 10m buffer zone will be provided around the drainage ditches in the north of the site. The only works carried out inside the 80 m riparian area along the Liffey will be the provision of bound gravel bitmac paths. A minimum 10m buffer will be maintained between the river bank and the operational area when the paths are being laid.

3.11. Materials – Source and Transportation

The selection and specification of construction materials will be informed by the local availability of these materials. Subject to the necessary constraints of performance, durability and cost, construction materials will be sourced from local suppliers and manufacturers, where possible.

3.11.10 Oils and Chemical Storage

All oils, fuels, paints and other chemicals will be stored in a secure, bunded, hardstand area. The bund capacity of bulk oil storage tanks will at a minimum be 110% of the tank. For drum storage, a bund capacity of 25% of the maximum volume of material stored is required. Generators will have an integral double contained fuel storage tank. The refuelling and servicing of mobile plant and equipment will only be carried out in a designated hardstand area which is at least 50m from any drains and water courses.

3.11.11 Traffic Management

A Traffic Management Plan (TMP) will be prepared prior to the start of the construction stage and submitted to Kildare County Council for its approval. There will be a single entrance to Phases 1 to 4 off the Great Connell Road. Access to the area west of the Liffey will be via the R 416 and the Section of the NSOORR being delivered as part of the Ardstone development.

Traffic will include:

- Private vehicles use by construction site staff;
- Construction vehicles (excavators and dump trucks);
- Materials delivery vehicles, typically heavy goods vehicles (HGV).

3.11.2 Resource and Waste Management Plan

A Preliminary Resource and Waste Management Plan (RWP) has been prepared that describes the measures that will be implemented in the Design Stage and the Construction Stage to' design out' waste, minimise the volumes of waste generated, ensure that the wastes that do arise are managed appropriately and maximise the recycling/recovery of those materials. A copy of the Preliminary RWP is in Appendix 2.

3.11.13 Construction Environmental Management Plan

A Preliminary Construction Environmental Management Plan (CEMP) has been prepared that describes the prevention and mitigation measures that will be implemented in the Construction Stage to minimise the risk of adverse environmental impacts, nuisance and impairment of amenity value. It includes an Invasive Species Management Plan. A copy of the Preliminary CEWP is in Appendix 3.

3.11.14 Health and Safety

As required by the Safety, Health and Welfare at Work (Construction) Regulations 2013, the Main Contractor appointed to complete the development will prepare a Health and Safety Plan that addresses site specific health and safety issues from the start to the completion of the construction stages.

The Contractor will provide 'Site Induction' training for all construction staff and ensure all site staff have current 'Safe Pass' cards. All construction staff will receive a full safety briefing and will be provided with all of the safety equipment required for their assigned tasks.

3.11.15 Site Security

The Contractor will be responsible for site security in the construction stage, including erecting and maintaining adequate fencing.

3.12 Cumulation

3.12.1 Scoping

The cumulative impacts of existing, permitted and projects at the planning stage within one kilometre zone of influence (ZoI) of the proposed development site were included in the assessment of the effects on Land & Soil, Air, and Population and Health: Noise & Vibration. This ZoI was determined by the fact that such impacts are effectively mitigated by distance.

The ZoI for the Archaeological, Architectural and Cultural Heritage was 500m from the proposed development site boundary as this was considered a distance outside of which ground disturbance would not inadvertently occur.

The ZoI for climate was defined by the national boundary given Ireland's binding commitments to meet national greenhouse gas emission targets. The ZoI for Population & Health extends to 2km from the proposed development site to include the assessment of effects on social infrastructure, as this is the distance typically covered in a 20 minute walk. The ZoI of the Materials Assets: Traffic & Transport was defined by the consultation with Kildare County Council

The ZoI for Biodiversity and Water was determined by the presence of hydrological pathways between the proposed development site and Natura 2000 Sites in Dublin Bay and the Flood Risks presented by dam failure upstream in the River Liffey.

The ZoI for the Landscape & Visual Impact Assessment was determined by the public view points, including existing residential and commercial activities and the public roads.

3.12.2 Cumulative Projects

In October 2018 permission (ABP Ref. 302141-18) was granted on lands to the southwest of the site, on the opposite side of the River Liffey, for 343 residential units comprising 60 apartments and 283 houses. This scheme, which also includes the delivery of a section of the NSOORR, is currently being constructed.

In November 2021 planning permission (Planning Ref No 211248) was granted to Barola Capital DAC for a Distribution Warehouse, Ancillary Office Accommodation and Ancillary Buildings on a 15.42 ha site to the north-east of the proposed development. The site enabling works has started. The upgrade works to the Ballyfarm Road included bus stops and resurfacing of footpaths and this road is scheduled to open in June 2022. Given the progress to date, the Distribution Warehouse will be operational before the construction of Phase 1 of the proposed development begins.

In December 2021, Murphy Ireland International Ltd lodged an application (Planning Ref No 21780) for two manufacturing buildings at their compound to the east of the proposed development. If the construction of the buildings overlaps with Phase I of the proposed development there is the potential for cumulative effects on air quality.

The completion of the section of the NSOORR between Great Connell Roundabout and the Athgarvan Road requires the extension of the roadway and the construction of a bridge over the Liffey to tie into the section of the NSSORR being delivered as part of the Ardstone development currently under construction to the south west of the propose development site. This will be involve a separate planning application and will be subject of EIA. Aston Ltd has engaged with Kildare County Council on progressing this application. At the time of the preparation of this EIAR the alignment and design of the bridge are indicative only.

4 ALTERNATIVES

4.1 Introduction

This Chapter describes the reasonable alternatives to the proposed development that were considered, including location and layout site layout and describes the likely baseline scenario of the evolution of the current state of the environment without the implementation of the project. The development design iterations took into account the findings and recommendations of the following:

- Planning Engineering Report prepared by PUNCH;
- Site Specific Flood Risk Assessment prepared by JBA Consultants;
- Landscape Design Plan prepared by TBS;
- Arborist Report prepared by Arborist Associates Ltd;
- Biodiversity Assessment completed by Dixon Brosnan;
- Noise and Vibration Assessment completed by dBA, and
- The consultation process with Kildare County Council and the Bord.

The Chapter was prepared by OCM in consultation with O'Flynn Architects, who prepared the Architectural Design Statement for the development, which is included in the application under separate cover.

4.2 Methodology

The design and evaluation of alternative site layouts was determined by a combination of the site's physical constraints, existing built environment and relevant policy and guidance documents.

The physical constraints are defined by:

- The site topography, ground conditions, hydrology including flood risk, biodiversity and site access;
- An existing 10m wide Irish Water Wayleave for the 900mm foul sewer that runs from north-east to south-west across the site.
- The land zoning objectives in the Newbridge LAP, including an 80m buffer along the banks of the River Liffey.
- Movement Policy SRO5 of the Newbridge LAP relating to the delivery of the NSOORR whose indicative route traverses the site.

The existing built environment in the vicinity of the site predominantly consists of existing two storey housing to the north; the permitted residential development to the south-west currently under construction comprising mainly two storey housing, but with some three storey housing and three storey apartment blocks and the existing larger scale industrial and associated office buildings to the north-east.

The design had regard to the following policy and guidance documents:

1. Kildare County Development Plan 2017–2023;

2. Newbridge LAP 2013-2019 extended;

3. Department of Housing, Planning and Local Government's Sustainable Urban Housing: Design Standards for New Apartments—Guidelines for Planning Authorities (2020);

4. Department of Housing, Planning and Local Government's Urban Development and Building Heights—Guidelines for Planning Authorities (December 2018);

5. Department of the Environment, Community and Local Government's Design Manual for Urban Roads and Streets (2019);

6. Department of the Environment, Heritage and Local Government's Sustainable Residential Development in Urban Areas—Guidelines for Planning Authorities (May 2009);

7. Department of the Environment, Heritage and Local Government's Quality Housing for Sustainable Communities—Best Practice Guidelines for Delivering Homes Sustaining Communities (2007); and

8. Department of the Environment, Community and Local Government's Urban Design Manual (May 2009) (DMURS).

4.3 Location

The location was selected based on its position relative to the Newbridge urban development, the land zoning for residential development and open space in the Newbridge LAP and the landownership. The lands are in the transition between the suburban development of the town to the north and the rural hinterland to the south; however, once the new NSOORR links the proposed development to the housing estate currently being constructed to the south west, the urban fabric of Newbridge in this location will be further consolidated.

The main portion of the site is zoned C – New Residential, which allows new residential development and associated ancillary services. The area adjacent to the river is zoned F – Open Space & Amenity (an 80 m deep strip along the bank of the Liffey), where the objectives are to protect recreation open space and amenity areas, maintain and improve amenity lands, preserve private open space and provide recreational facilities.

New residential areas must be developed in accordance with a comprehensive plan detailing the layout of services, roads, pedestrian and cycle routes and the landscaping of open space. The purpose of the proposed development is to provide a sensitively designed mix of houses and apartments with a small, high quality design neighbourhood centre and crèche in a landscaped setting incorporating open

amenity and recreational areas and maximising the distinctive amenity of its location adjacent to the River Liffey

As the potential of the lands have been identified and considered in the LAP, which was subjected to robust Strategic Environmental Assessment, the alternatives are limited to zoned residential land in the LAP.

4.4 Alternative Site Layout

Figure 4.1 shows the original redline boundary, the River Liffey. Wellesley Manor; the Irish Water wayleave shaded yellow; the Ardstone development to the south-west and the proposed route of the NSOORR, including the river crossing.

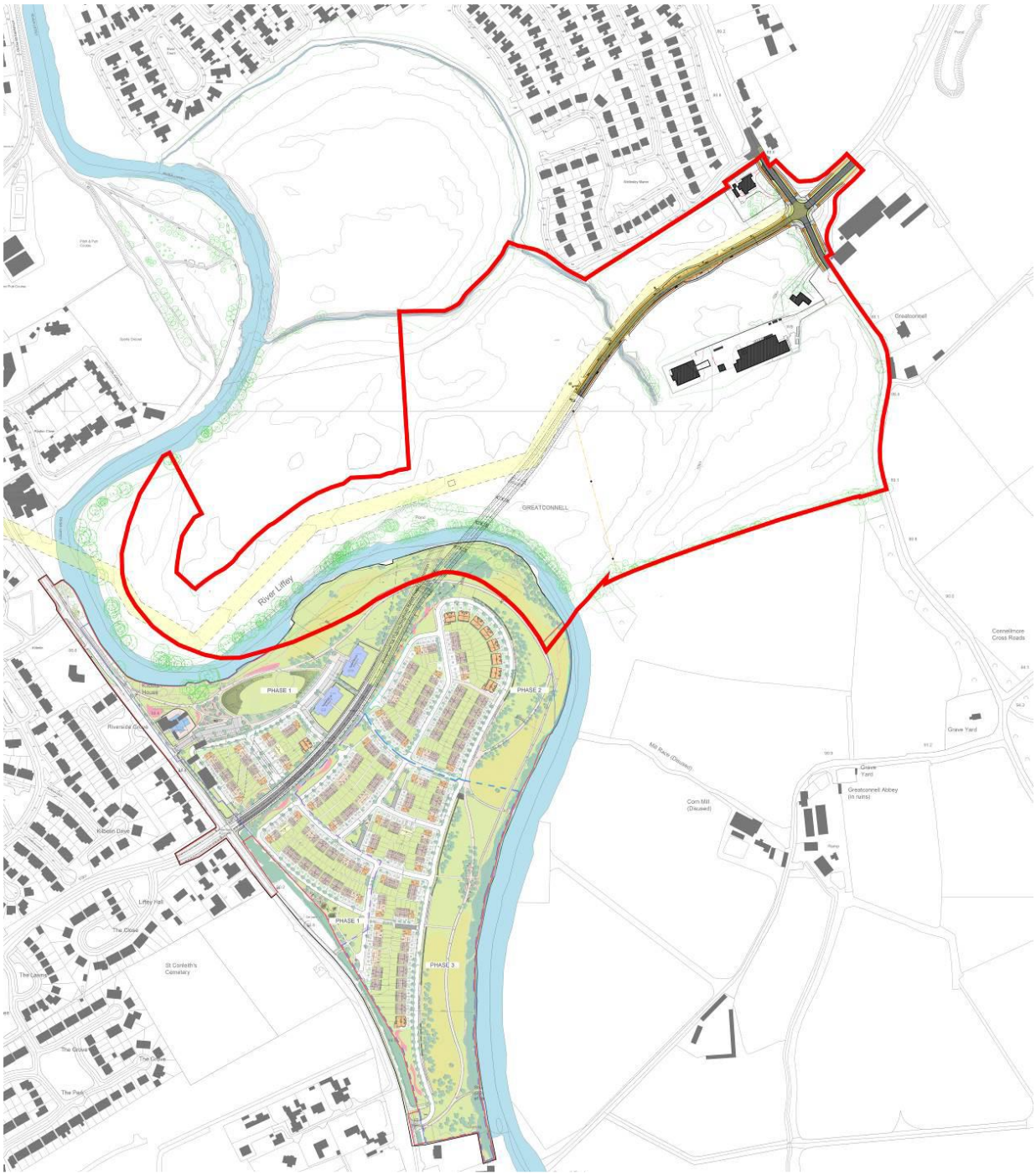


Figure 4.1 Design Constraints

From the beginning the Design Team was cognisant of the need to integrate the Irish Water Sewer wayleave with the proposed route of the NSOORR, while taking into consideration the alignment with the section of the NSOOR being delivered by the development west of the Liffey. The other key design objectives were to:

- Retain, to the greatest extent possible, the existing hedgerows, trees and water courses;
- Maximise the distinctive amenity value of the River Liffey;
- Accommodate flood compensatory measures;
- Provide high quality open spaces within easy reach of all units, and
- Integrate the development into the existing built environment.

This first scheme layout (Figure 4.2) was an early look at positioning housing blocks to take advantage of the River Liffey and its amenity value. The positioning of the neighbourhood centre and crèche close to the existing housing to the north was based on these amenities serving both the new and existing communities. Possible connection points to neighbouring lands were also investigated.

Figure 4.2 Iteration 1

Iteration 2 was issued for an initial pre-planning meeting with Kildare County Council (Figure 4.3).

Figure 4.3 Iteration 2

The Council's key comments on the proposed lay out were:

- The urban edge treatment along the NSOORR and the Great Connell Road needed to be developed to provide a more continuous streetscape (particularly when turning the corner at the roundabout).
- Unit layout and massing needed to be refined.
- Design, detailing, proportioning and usability of public open spaces needed to be developed.

Iteration 3 (Figure 4.3) was issued for the Section 247 pre-planning meeting with the Council. The urban edge treatment along the NSOORR and the Great Connell Road and at the junction of these two routes was revised to enhance the sense of enclosure and continuity of the street for it to be a more pleasant urban environment for pedestrians and cyclists.

The design objective for the NSOORR is for it to appear like an urban street and not a distributor road that caters primarily to car users. This was achieved by removing the roads parallel to the NSOORR and Great Connell Road thereby bringing the building forward closer to the street edge. This iteration also sought to better articulate the open spaces, refine the housing blocks and achieve a better balance and

hierarchy to the open space areas to improve their functionality. The existing watercourses and their riparian zones were accomodated within the open space provision.

The permeability and connectivity to adjacent lands was also improved to provide potential vehicle and pedestrian linkage points to the existing residential lands to the north and to the amenity lands to the south-west, west, and north-west. Vehicle, pedestrian and cycling routes were provided to serve the new residential zoned lands to the south and a footpath and cycle path was provided to the full boundary extent of the site along the Great Connell Road. The feedback on this scheme layout was generally positive, with further clarity and detail on the open space areas sought, along with additional information on the proposed boundary treatment.

Figure 4.4 Iteration 3

Following the Section 247 Meeting with the Council further minor revisions were completed to develop the boundary treatment proposals and the design and detail of the open spaces for the scheme layout issued for the pre-application tripartite meeting with the Council and the Bord. (Figure 4.5. Iteration 4)

Figure 4.5 Iteration 4

After the pre-application tripartite meeting the final version of the scheme design sought to further incorporate the existing trees and hedgerows on the site while also further developing the design of the communal and public open spaces throughout the site.

In response to comments made by the Council's Parks Section, and the findings of a tree survey that was carried out, the scheme was updated to retain the existing hedge line to the south of the site. No dwellings now back on to this boundary and housing is oriented to face on to this boundary to better incorporate this existing site feature into the scheme design. These amendments also allow better access and connectivity in this area of the site to the River Park to the west.

Open space areas within the development site have also been reconfigured and updated to incorporate existing trees, hedgerows and site features and to retain existing trees and hedgerows along the Great Connell Road. Other open spaces have also been updated to reduce the impact and extent of car parking and additional open space was provided to the south-east of the development.

The scheme now demonstrates that the open space provision is consolidated into a clear hierarchy that provides a range of active and passive recreational activity options (within central parks, local square/ civic square, river park, communal courtyards etc.). The final design is in Figure 4.6

Figure 4.6 Final Scheme Layout (Excluding Landscaping Overlay)

4.5 Alternative Services Design

It was a design objective to provide a gravity foul water drainage system with a single connection to the municipal foul sewer. However the site topography did not facilitate this approach and required the provision of a pumped system.

Several surface-water flow attenuation designs were assessed by PUNCH, including the provision of above-ground attenuation in the west of the site. However to achieve the required storage this would at times result in water being up to 2m deep. In the interest of safety and to ensure the usability of this open space, it was considered necessary to provide underground attenuation.

4.6 Alternative Mitigation Measures

The mitigation measures proposed by the competent experts are deemed appropriate for the proposed development and represent best practice and therefore alternative measures were not considered.

5 CLIMATE

5.1 Introduction

This Chapter examines the potential effects of the proposed development on climate and the vulnerability of the development to the potential effects of climate change. It identifies the prevention and mitigation and monitoring measures that will be implemented to reduce the significance of the effects and assesses the residual potential impacts.

The assessment was completed by Dr. Michael Fogarty, Lisa Smith and Simon Welchman of Katestone. Mr Fogarty is a Senior Air Quality Consultant with 13 years of experience in Ireland and Australia. He holds a B.Eng, M.Eng and PhD from the UCD College of Engineering and Architecture. He specialises in the areas of air quality and odour impact assessment.

Ms Smith is a Senior Consultant with Katestone Environmental. Lisa is a qualified engineer with a chemical engineering background. She graduated from University of Queensland with a Bachelor of Engineering in 1999 and has more recently completed a Masters qualification in environmental management and policy. Ms Smith has significant industrial experience in greenhouse gas reporting and management, sustainability and eco-efficiency and extended her understanding in these areas through her post-graduate studies of the European context and her work with the Queensland Government's ecoBiz program in Australia.

Mr. Welchaman B Eng has been a director of Katestone since 2004 with more than twenty-three years' experience working as an air quality expert in the private sector and for the environmental regulator.

5.2 Relevant Legislation and Guidance

The legislation and guidance documents relating to EIA are listed in Sections 1.2 and 1.5. The legislation and guidelines relevant to climate that were taken into account in the preparation of this Chapter include:

- European Commission (2019) 2030 Climate & Energy Framework.
- European Commission (2013) The EU Strategy on Adaptation to Climate Change.
- European Commission (2021) Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change.
- European Commission (2018) Revised Energy Performance of Buildings Directive (EPBD) (2018/844/EU).
- United Nations (1992) United Nations Framework Convention on Climate Change.

- United Nations (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change.

- United Nations (2016) The Paris Agreement 'Accord de Paris'. The United Nations Framework Convention on Climate Change (UNFCCC).

- United Nation (1992) United Nations Framework Convention on Climate Change. First steps to a Safer Future.

- DECC, (2013) National Policy Position on Climate Action and Low Carbon Development (National Policy Position) 2013.

- Department of the Environment, Climate and Communications (2017) National Mitigation Plan.

- Department of the Environment, Climate and Communications (2021) Climate Action Plan 2021 (DECC, 2021).

- Department of the Environment, Climate and Communications (2018) National Adaptation Framework (NAF).

- Department of the Environment, Climate and Communications (2015) Ireland's Transition to a Low Carbon Energy Future 2015-2030.

- Department of Environment, Heritage and Local Government (2016) Climate Action and Low Carbon Development Act 2015, as amended.

- Department of the Environment, Climate and Communications (2021), Climate Action and Low Carbon Development (Amendment) Act 2021 (Act 32 of 2021).

- European Commission (2009a) Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.

- EPA (2019) Integrating climatic factors into the strategic environmental assessment process in Ireland - A Guidance Note.

5.3 Methodology

The predominant source of greenhouse gas emissions in the construction stage is associated with the manufacturing and transportation of construction materials, construction activities and end of life phases. These are commonly referred to as embodied greenhouse gas emissions.

Walsh and McAuliffe (2020) describe a study of the embodied carbon emissions in a traditional 4-bedroom masonry residential house versus a 4-bedroom timber-frame house. Overall outcomes from the study are summarised in Table 5.1.

Table 5-1 The Outcomes of the Walsh and McAuliffe (2020) Study

Parameter	Masonry	Timber Frame	Unit
LCA Assessment Period	60		Years
Floor Area of dwelling	201	216	m²
Total LCA Emissions per dwelling	156780	140940	kg CO_2e
LCA Emissions per year per unit floor area of dwelling	13.0	10.9	kg CO_2e/m²/year
LCA Emissions per dwelling per year	2613	2349	kg CO_2e/year
Percentage of total LCA emissions (Product Stage[1])	38.9%	27.5%	%
Percentage of total LCA emissions (Transport[2])	0.5%	0.3%	%
Percentage of total LCA emissions (Construction installation process[3])	5.0%	5.8%	%
Percentage of total LCA emissions of the product stage and construction process stage[4])	44.4%	33.6%	%
LCA emissions per year per unit floor area (Product stage and construction process stage[4])	1160	789.3	kg CO_2e/m²/year
LCA emissions per dwelling per year (Product stage and construction process stage[4])	69,610	47,356	kg CO_2e/year

[1] A1, A2 and A3
[2] B1
[3] B2
[4] A1, A2 and A3, B1 and B2

The study found that greenhouse gas emissions from the product stage and construction process stage of a dwelling are 44.4% of total LCA emissions for a masonry dwelling and 33.6% of total LCA emissions for a timber frame dwelling resulting in emission of 69,610 kg CO_2e/dwelling for the construction phase of the masonry dwelling and 47,356 kg CO_2e/dwelling for the construction phase of the timber frame dwelling. These figures include the contribution of embodied emissions.

The estimation of the emissions from the construction phase of the proposed development assumed that all dwellings at the proposed development had emissions equivalent to the masonry dwelling from Walsh and McAuliffe (2020). This was a highly conservative assumption.

There is limited data on the greenhouse gas emissions from the construction phase of the commercial element of the proposed development (neighbourhood centre and the crèche). The emissions from the construction if these elements were calculated as the product of the LCA emission factor per unit area (m²) of the masonry dwelling from Walsh and McAuliffe (2020) and the area of the proposed neighbourhood centre and the crèche..

5.3.1 Assessment of Operational Impact: Dwellings

Greenhouse gas emissions associated with the proposed development will contribute to climate change. The main sources of emissions in the operational phase will be from residential activities commercial activities at the neighbourhood centre and the crèche and additional road traffic.

The source of direct and indirect emissions from residential activities will be limited as:

- There will be no on-site combustion of fossil fuels to heat buildings.
- The heating needs of buildings will be achieved using heat pumps that are increasingly powered by electricity from renewable sources.
- Each residential unit will incorporate PV Panels into the proposed design to reduce reliance on the national grid.
- Each residential unit will have the capacity to charge an electric car.
- There will be minimal direct emissions associated with the onsite handling of residential wastes.

The Sustainable Energy Authority of Ireland (SEAI) has published a guide (SEAI Guide) that rate a range of typical Irish dwellings based on indicative annual CO_2 emissions associated with space heating, ventilation, water heating and lighting, with each type of dwelling assigned a Building Energy Rating (BER).

There are 15 BER categories (A1, A2, A3, BI, B2, B3, C1, C2, C3, D1, D2, E1, E2, F and G) with A1 being the most energy efficient thereby having the lowest annual CO_2 emissions for space heating, ventilation, water heating and lighting and G being the least energy efficient with the highest annual emissions of CO_2.

The Nearly Zero Energy Building (NZEB) Regulations were transposed from the EU Energy Performance in Buildings Directive (EPBD) and stipulate that from 1 November 2019 all new dwelling (houses and apartments will typically require an A2 BER.

The annual CO_2 emissions for space and water heating in dwellings with an A2 BER are presented in Table 5-2. These emission rates were applied to residences at the proposed development to estimate the ongoing greenhouse gas emissions associated with space and water heating when the development is occupied

Table 5-2 Annual Emissions of CO_2 for Space and Water Heating A2 BER Dwelling

Description of Dwelling	CO_2 Emissions (Tonnes/Year)
2-bed apartment	0.8
3-bed Semi-detached	1.1
4-bed Semi-detached	1.6
Detached house	2.2

The SEAI estimates[5] that in 2018 61% of all energy used in households was for space heating, 19% for water heating, 17% for lighting & appliances, and 2% for cooking. As a breakdown between lighting & appliances is not provided it was conservatively assumed that the 17% attributed to lighting & appliances was used in appliances and that 20% of energy usage was for purposes other than space and water heating. The emissions due to residential activities during the operational phase of the proposed development were calculated based on:

[5] https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/residential/ Accessed November 2021.

- The number and type of dwellings at the proposed development;
- The emissions of CO_2 from space and water heating based on the data in Table **5-**-2, and
- The assumption that emissions of CO_2 from space and water heating are 80% of emissions from residential activities

The emissions from the operational phase of the neighbourhood centre and the crèche were calculated based on energy usage data from the Building Energy Efficiency Survey (BEES) published by the Department for Business, Energy & Industrial Strategy in the United Kingdom (Department for Business, Energy & Industrial Strategy, 2016).

The BEES reported on the energy usage of non-domestic building stock in England and Wales in 2014–15, including small shops. It was assumed that the emission factors for small shops provides a conservative estimation of emissions for the activities associated with a crèche and the neighbourhood centre which will have commercial units including a small shop, doctor/dentist/physio units, a café, a restaurant and five shop/convenience services units.

The emissions from the operation of the neighbourhood centre and the crèche were based on:

- The proposed floorspace of the neighbourhood centre and the crèche;
- The energy consumption per m² of floor area for small shops as reported in the BEES, and
- The intensity of electricity produced on the Irish electricity network in 2020 (SEAI, 2020).

T**able 5-2 Emission Factors for the Neighbourhood Centre and Crèche**

Parameter	Value	Units
Energy Consumption (Small shops in England and Wales)[1]	11,600	GWh/yr
Gross internal area (GIA) (Small shops in England and Wales) [1]	60,000,000	m²
Energy Consumption per m² of floor area	0.000193	GWh/yr/m²
Energy Consumption per m² of floor area	193.3	kWh/yr/m²
Emission Factor for Energy Consumption in Ireland – 2019[2]	0.324	$kgCO_2$-e/kWh
Adopted Emission Factor for Energy Consumption	62.6	$kgCO_2$-e/yr/m²

[1] Department for Business, Energy & Industrial Strategy, 2016
[2] SEAI, 2020

5.3.2 Assessment of Operational Impact: Traffic

The assessment of transport related impacts was based on Design Manual for Roads and Bridges (DMRB) (Highways Agency England, 2021). The DMRB provides a framework for assessing, mitigating and reporting the effects of motorways and all-purpose trunk road projects on climate. The impact of a project is considered using a scoping assessment based on the following criteria

- During operation, will roads meet or exceed any of the following criteria:

  a) a change of more than 10% in the Average Annual Daily Traffic;

b) a change of more than 10% to the number of heavy duty vehicles; and

c) a change in daily average speed of more than 20 km/hr.

Where the response to one or more of the scoping assessment questions is 'yes', further assessment mustl be undertaken. For operational road user greenhouse gas emissions, the study area must be consistent with the affected road network (ARN) defined in the development's traffic model. All roads that trigger the traffic screening criteria in the air quality assessment (Chapter 9) and adjoining roads within 200m define the ARN.

If further assessment is required greenhouse gas emissions from the operational phase must be quantified. The Highways Agency air quality spreadsheet is a tool for the calculation of emissions of carbon dioxide from road transport. The latest version (Version 8) incorporates emissions derived from the Emissions Factor Toolkit Version 10.1 (DEFRA, 2020).

5.4 Evaluation Criteria – Climate Change and Policy Context

5.4.1 Global Climate Change Response

Ireland is a party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, which together provide an international legal framework for addressing climate change.

The Doha Amendment to the Kyoto Protocol was adopted at the Conference of the Parties (COP)18 in December 2012 and came into force on ratification on 31 December 2020. Parties, to the Doha Amendment, including the European Union, committed to reduce greenhouse gas emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020.

In the EU each member state committed to differing emission reduction targets in the EU's effort-sharing decision of 2009. Ireland's greenhouse gas emissions reduction commitment is 20% below 2005 levels over the 2013 to 2020 period, with annual targets within the period of the Doha Amendment.

The Paris Agreement is the most recent legally binding, global agreement addressing climate change under the UNFCCC. It aims to limit global temperature increases to no more than 2°C above pre-industrial levels, with a commitment to pursue efforts to limit this rise to 1.5°C. This legally binding agreement, represents a global milestone in international efforts to achieve a peaking of greenhouse gas emissions as soon as possible and to achieve net zero emissions by the second half of the century.

Each party to the agreement must commit to a Nationally Determined Contribution (NDC) that shall increase in ambition over time, with progress being tracked by a series of global stocktakes, to be held every five years, starting in 2023. Ireland's contribution to the Paris Agreement will be via the NDC tabled by the EU on behalf of its Member States. The EU has committed to reducing its greenhouse gas emissions by at least 40% by 2030, compared to 1990 levels.

The European Green Deal Communication launched a new growth strategy for the EU that aims to transform the EU into a fair and prosperous society, improving the quality of life of current and future generations, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use. The European Green Deal reaffirms the Commission's ambition to make Europe the first climate-neutral continent by 2050.

The European Climate Law, which came into force in July 2021, enacts the goal set out in the European Green Deal for Europe's economy and society to become climate-neutral by 2050. The Law also sets the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.

The European Commission (EC) has a range of strategies and targets to reduce greenhouse gas including:

- 2020 Climate & Energy Package.
- 2030 Climate & Energy Framework.
- 2050 Long-Term Strategy.

The 2030 Climate and Energy Framework includes EU-wide targets and policy objectives for the period from 2021 to 2030.

The Effort Sharing Regulation[6] *(*ESR*)* establishes binding greenhouse gas emission targets for Member States, for the periods 2013-2020 and 2021-2030 required to fulfil the EU's commitments under the Paris Agreement. It also details the rules on determining annual emission allocations and for the evaluation of national progress towards meeting minimum contributions. The ESR aims for emissions reduction targets include:

- 43% in the European Union emissions trading system (ETS') laid down in Directive 2003/87/EC of the European Parliament and of the Council by 2030 compared to 1990 levels;
- 30 % in the non-ETS sectors by 2030 compared to 1990 levels, and
- 80-95 % by 2050 compared to 1990 levels.

Overall, the EU has adopted an interim objective of reducing greenhouse gas emissions of 40% by 2030 through a combination of the ETS and individual targets for each EU Member State for non-ETS sectors. Complementary to this, the European Commission's Climate and Energy Framework includes targets of 32% renewable energy and an energy efficiency improvement of at least 32.5% across the EU by 2030.

In July 2020 a proposal[7] to amend the ESR was tabled by the European Commission. Its aim is to assign strengthened emission reduction targets to each Member State for buildings, road and domestic maritime transport, agriculture, waste and small industries. These targets recognise the different starting points and capacities of each country.

[6] Regulation (EU) 2018/842 - Binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013

[7] Proposal for a Regulation amending Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement. https://opac.oireachtas.ie/Data/Library3/Documents%20Laid/2021/pdf/DECCdocslaid270821a_270821_162547.pdf

5.4.2 National Policy and Long-Term Vision

In 2014, the Government adopted the National Policy Position on Climate Action and Low Carbon Development (National Policy Position) that established the fundamental national objective of achieving transition to a competitive, low carbon, climate-resilient and environmentally sustainable economy by 2050. It sets out the context for the objective, clarifies the level of greenhouse gas mitigation ambition envisaged and establishes the process to pursue and achieve the overall objective. Specifically, the National Policy Position envisages that policy development will be guided by a long-term vision based on:

- An aggregate reduction in carbon dioxide (CO_2) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors, and

- In parallel, an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production.

With 2015 greenhouse gas emission as a starting point this equates to average annual reductions of 0.75MtCO_2 compared to the projected position in 2035, which requires average annual reductions of almost 2 MtCO_2.

The White Paper on Energy Policy, *Ireland's Transition to a Low Carbon Energy Future 2015-2030* recognised that a radical transformation of Ireland's energy system was needed to meet national, EU and international climate objectives and set a course for an energy sector where the State will provide the supports that enable consumers to become active energy citizens.

The vision is to reduce greenhouse gas emissions from the energy sector by between 80% and 95% compared to 1990 levels by 2050, while ensuring that secure supplies of competitive and affordable energy remain available to citizens and businesses. This energy transition will depend on accelerated and diversified renewable energy generation, and a renewed focus on energy efficiency.

The *Climate Action and Low Carbon Development Act 2015* established the statutory basis for the national transition objective of progressively pursuing a low carbon, climate resilient and environmentally sustainable economy by 2050. It provided the legislative framework for the development of national mitigation plans and national adaptation frameworks. The Act was amended in July 2021

The Climate Action and Low Carbon Development (Amendment) Act 2021 provides the legally binding path to net-zero emissions no later than 2050, and to a 51% reduction in emissions (compared to 2018 levels) by 2030 in Ireland. Ireland's statutory national climate objective and 2030 targets are now aligned with Ireland's obligations under the Paris Agreement and with the European Union's objective to reduce greenhouse emissions by at least 55% by 2030, compared to 1990 levels and to achieve climate neutrality in the European Union by 2050 (DECC, 2021).

At a national level, Ireland adopted the Climate Action Plan 2021, which was published in November 2021 (DECC, 2021). It sets out the measures required to reach Ireland's targets in each sector of the economy. The Climate Action Plan compliments the National Policy position and includes provisions relevant to the management of missions at a national level, including a detailed plan for taking decisive action to achieve a 51% reduction in overall emissions by 2030 and setting Ireland on a path to reach net-zero emissions by no later than 2050.

5.4.3 Kildare - Regional Commitments

Kildare County Council signed up to the Global Covenant of Mayors (COM) for Climate and Energy in 2019, a Global movement by local and regional authorities to address climate change. As a signatory to the COM, Kildare County Council has made a voluntary commitment to transition to a low-carbon society by reducing CO_2 emissions by at least 40% by 2030. As part of the COM commitment, Kildare County Council prepared a Sustainable Energy and Climate Action Plan (SECAP) in 2018 and has also committed to reporting every 2 years on the implementation of the mitigation and adaptation actions in the plan.

5.5 Development Description

Chapter 3 provides a detailed description of the proposed developments. In relation to the effects on climate it involves the construction and habitation of residential housing units on a greenfield site which has the potential to:

- Impact on climate due to greenhouse gas emissions from construction activities, in the operational stage (heating, ventilation and lighting) and from the additional traffic associated with the proposed development, and

- Be impacted upon by the potential effects of climate change.

5.6 Receiving Environment

5.6.1 Greenhouse Gas Emissions

Ireland's Final Greenhouse Gas Emissions 1990-2020 (EPA, 2022) presents a detailed summary of national emissions for 2020 together with an overview of national emissions from 1990 until 2020. Ireland's national greenhouse gas emissions for 2020 were estimated to be 57,7i6 ktCO2-e (excluding Land Use, Land-use Change and Forestry or LULUCF) with 7,114 ktCO_2-e (12.3%) attributable to the residential sector.

In 2021, the EPA published *Ireland's Greenhouse Gas Emissions Projections 2020-2040* (EPA, 2021b). It assesses Ireland's total projected greenhouse gas emissions from 2020 to 2040, updated using the latest inventory data for 2020. The report also evaluates Ireland's progress towards achieving its emission reduction targets for 2020 and 2030 as set out under the EU ESR. Ireland's Greenhouse Gas Emissions Projections 2019-2040 data is presented in Ireland's Greenhouse Gas Emissions Projections 2019-2040 (EPA 2021 b). Key findings are:

- Implementation of "Additional Measures" (including those in the 2019 Climate Action Plan) is projected to save 58 Mt CO_2eq over the period 2021-2030 compared to the "With Existing Measures". This represents a reduction of 1.8% per annum in emissions over the period;

- These projections made in the report indicate that Ireland can meet its non-ETS EU targets over the period 2021 to 2030 assuming full implementation of the 2019 Climate Action Plan and the use of the flexibilities available. Future, more ambitious targets as presented in the European Climate Law and Ireland's Climate Bill will require many (as yet unidentified) additional measures;

- Increased renewable electricity generation, including a projected 5 GW of offshore wind generation, is expected to contribute to a 70% contribution of renewable energy in electricity generation by 2030. Energy industries emissions are projected to decrease by one third by 2030 compared to the most recent figures in 2019, and

- The Covid-19 pandemic highlighted the need for homes to become far more efficient, particularly in the context recent regulations to encourage working from home. Implementing the 2019 Climate Action Plan measure for the installation of over 600,000 heat-pumps by 2030 as well as retrofitting 500,000 homes to a B2 equivalent BER will help achieve this.

As well as defining legally binding emission reduction commitments, the Climate Action and Low Carbon Development (Amendment) Act (2021) supports Ireland's transition to net-zero and the achievement of a climate neutral economy no later than 2050. It also establishes a legally binding framework with clear targets and commitments, to ensure the necessary structures and processes are in place to deliver our national, EU and international climate goals and obligations in the near and long term.

In light of the increase in ambition under the Climate Action Plan significant additional measures have been introduced, to be undertaken across the whole of Irish society and across the economy, in order to achieve the level of change required to meet the 2030 target. The Climate Action Plan also assumes full implementation of the 2019 plan. In the medium term, Ireland is still projected to meet its 2030 target under the Climate Action and Low Carbon Development (Amendment) Act.

The binding annual greenhouse gas emission target for Ireland under the ESR for non-ETS sectors is a 30% reduction in emissions by 2030 compared to 2005 levels. This target will be amended following the European Council's decision to increase ambition from its existing EU-wide 2030 target of a 40% reduction to at least 55%, compared to 1990 levels. Annual greenhouse gas emissions for non-ETS sectors were 47,869 Mt CO_2 eq in 2005 (SEAI, 2021). Ireland's greenhouse gas emission target for non-ETS sections is 33,508 kt CO_2 eq in 2030.

The binding annual greenhouse gas emission target for Ireland under the Climate Action and Low Carbon Development (Amendment) Act is a reduction of 51% in emissions by 2030 compared to 2018 levels. Annual greenhouse gas emissions for Ireland were 60,242 kt CO_2 eq in 2018 (comprising 13,441 kt CO_2 eq of ETS emissions and 46,801 kt CO_2 eq of non-ETS emissions). Under the Climate Action and Low Carbon Development (Amendment) Act Ireland's greenhouse gas emission target is 29,886 kt CO_2 eq in 2030.

The baseline greenhouse gas emissions for the assessment were taken from EPA (2021) and are presented in Table 5-4. The data reported in 2021, with additional measures, does not include any measures from the Climate Action and Low Carbon Development (Amendment) Act.

Table 5-4 Baseline Greenhouse Gas Emissions

Projected Greenhouse Gas Emissions	Year	Non-ETS emissions (kt CO_2 eq.)	Total emissions (kt CO_2 eq.)
Projected emissions (with existing measures)	2024	42,991	61,727
Projected emissions (with additional measures)	2024	40,044	56,897
Projected emissions (with existing measures)	2039	42,067	62,650
Projected emissions (with additional measures)	2039	33,226	50,623

5.6.2 Climate Vulnerability

In addition to the impact of the proposed development on climate change, the potential vulnerability of the development to the impacts of climate change is considered in this Chapter. In relation to climate change Kildare County Council issued its Climate Change Adaptation Strategy 2019 - 2024 (Kildare County Council, 2019). The baseline climate of the receiving environment is described in Section 9.4 of Chapter 9 – Air Quality. The assessment of climatic hazards identified four main categories:

- Wind storms.
- Extreme heat/drought events.
- Extreme rainfall events.
- Freezing conditions/snow events.

Combination events described as two extreme climatic events occurring simultaneously are also identified and such combinations give rise to more severe and destructive impacts.

The greatest risk of climate change to the proposed development is from extreme rainfall events leading to flooding, due to the proximity of the proposed development to the River Liffey. A SFRA has been undertaken and the findings were included in the design criteria for the proposed development's flood compensatory measures and stormwater management system. The SFRA Report is in Appendix 5 and the findings are discussed in Chapter 7.

5.7 Impacts

5.7.1 Construction Stage

Greenhouse gas emissions from the construction stage include emissions from manufacturing and transportation of construction materials (commonly referred to as embodied emissions) and construction activities. The greenhouse gas emissions calculated for the construction of the residences are presented in Table **5-**5. The emissions calculated for the construction of the neighbourhood centre and the crèche are presented in Table 5.6. The emissions from the construction phase of the proposed development as a proportion of projected non-ETS emissions in Ireland in 2024 are presented in Table 5.7.

Table 5-5 Greenhouse Gas Emissions - Construction of Residences.

Parameter	Value	Units
Total houses in the proposed development	325	Houses
Total apartments in the proposed development	244	Units
Total Dwellings	568	Dwellings
Assumed emissions due to the construction phase of each dwelling	69,610	kg CO_2e
Total emissions from the construction phase of residences at the proposed development	39,538,662	kg CO_2e
Total emissions from the construction phase of residences at the proposed development	39.5	kt CO_2e

Table 5-6 Greenhouse Gas Emissions - Construction of the Neighbourhood Centre and Crèche

Parameter	Value	Units
LCA emissions per m² dwelling (Product stage and construction process stage[4])	347.2	kg CO_2e/m²
Neighbourhood centre and the crèche floorspace	3,271	m²
Total emissions from the construction phase of the neighbourhood centre and the crèche	1,135,638	kg CO_2e
Total emissions from the construction phase of the neighbourhood centre and the crèche	1,135.6	Tn CO_2e
Total emissions from the construction phase of the neighbourhood centre and the crèche	1.1	kt CO_2e

Table 5.7 Greenhouse Gas Emissions - Construction Stage as a Proportion of Projected non-ETS Emissions in Ireland in 2024

Parameter	Value	Units
Total emissions from the construction phase of the proposed development	40.6	kt CO_2e
Projected non-ETS emissions (with existing measures) - 2024	42,991	kt CO_2e
Projected non-ETS emissions (with additional measures) - 2024	40,044	kt CO_2e
Construction phase contribution to projected non-ETS emissions (with existing measures) - 2024	0.09%	%
Construction phase contribution to projected non-ETS emission (with additional measures) - 2024	0.10%	%

The greenhouse gas emissions associated with the construction phase are conservatively estimated to be 0.09% of non-ETS GHG emissions (if existing measures are applied to GHG reduction) in 2024 and 0.10% of non-ETS GHG emissions (if additional measures are applied to GHG reduction) in 2024.

The greenhouse gas emissions from the construction stage will form part of the non-ETS emissions, which in the case of the proposed development is required to facilitate the construction of residences needed for a growing population.

5.7.2 Operational Stage-Traffic-Do Something

The operational stage will result in greenhouse gas emissions due to the increase in residential traffic. The traffic data derived from the Punch Consulting Engineers Traffic & Transport Assessment (Appendix 14) was used for assessment purposes.

The scoping assessment methodology described in Highways Agency England DMRB was used to determine if further assessment was required. There will be no changes in speed band due to the proposed development. There will be no change in HGV AADT stage as the proposed development is residential.

The percentage difference in AADT under the do-nothing and do-something scenarios for the road links on the affected road network in the opening year and in the design year is presented in Table 5.8.

Table 5.8 Changes in AADT under the Do-Nothing and Do-Something Scenarios

Road	Difference in AADT from do-nothing scenario	
	Opening Year 2024 (Phase 1)	Design Year 2039 (Phase 2)
Great Connell Road (North of Great Connell Roundabout)	4.3%	7.1%
Great Connell Road (South of Great Connell Roundabout)	4.1%	6.9%
Southern Relief Road (East of Great Connell Roundabout)	15.2%	21.2%
Southern Relief Road (West of Great Connell Roundabout)	22.0%	27.1%

There are two roads that trigger the traffic scoping criteria as the change in AADT between the do something and do-nothing traffic on these roads is more than 10%. These roads include:

- The Southern Relief Road (East of Great Connell Roundabout)
- The Southern Relief Road (West of Great Connell Roundabout)

The CO_2 emissions on the two roads that trigger the requirement for futher assessment and the adjoining roads on the ARN were calculated using the Air Quality Spreadsheet issued by the Highways Agency in England (Highways Agency, 2021).

The CO_2 emissions are a function of the increase in AADT and the length of the road link on the ARN. The increase in CO_2 emissions due traffic from the proposed development in the opening year and the design year on roads that trigger the scoping requirements of the DMRB Framework are presented in Table 5.9.

Table 5.9 Increase in CO_2 Emissions from Traffic in the Opening Year and the Design Year.

Road	Increase in CO_2 emissions due to traffic from the proposed development	
	Tn/Year - CO_2	
	Opening Year 2024 (Phase 1)	Design Year 2039 (Phase 2)
West Great Connell Roundabout	98.8	142.3
East Great Connell Roundabout	95.3	149.2
South Great Connell Roundabout	33.8	60.4
North Great Connell Roundabout	9.6	17.2
South - Hall Junction	301.2	15.0
North - Hall Junction	21.4	30.6
West - Hall Junction	14.1	25.2
Total	**574.1**	**439.9**

5.7.3 Operational Stage: Dwellings

The annual CO_2 emissions from the space heating, ventilation, water heating and lighting of each dwelling type and in total from all dwellings are presented in Table 5.10.

Table 5.10 Annual CO_2 Emissions From Dwellings

Dwelling type	Number of dwellings	CO_2/dwelling/Year	CO_2/Yr
		Tonnes	Tonnes
Two-bedroom houses	64	1.1	70.4
Three-bedroom houses	175	1.1	192.5
Four-bedroom houses	86	1.6	137.6
Own-door one-bedroom apartments	20	0.8	16.0
Own-door two-bedroom apartments	78	0.8	62.4
Own-door three-bedroom duplex apartments	66	1.1	72.6
One-bedroom apartments	17	0.8	13.6
Two-bedroom apartments	53	0.8	42.4
Three-bedroom apartments.	9	1.1	9.9
CO_2 emissions per annum from space and water heating in dwellings at the proposed development			**617.4**
CO_2 emissions from space and water heating as a percentage of total dwelling CO_2 emissions			**80%**
CO_2 emissions per annum (total emissions) at the proposed development			**771.8**

The annual emissions of CO_2 resulting from space heating, ventilation, water heating and lighting of the neighbourhood centre and the crèche at the proposed development at the operational phase of the proposed development are presented in Table 5.11.

Table 5.11 Annual CO_2 Emission from the Neighbourhood Centre and Crèche.

Parameter	Value	Units
Energy Consumption per unit area	193.3	kWh/yr/m²
Neighbourhood and Childcare centre floorspace	3271.0	m²
Energy Consumption per annum	632393.3	kWh/yr
Emission Factor for Energy Consumption in Ireland - 2019	0.324	Kg CO_2-e/kWh
Emissions from the neighbourhood centre and the crèche	204895	Kg CO_2-e/yr
Emissions from the neighbourhood centre and the crèche	204.9	t CO_2-e/yr

The total greenhouse gas emissions in the operational stage and as a proportion of the projected non-ETS emissions are presented in Table 5. 12

Table 5. 12 Total Greenhouse Gas Emissions and the Proportion as a % of Ireland's 2030 Target

Parameter	Increase in CO_2 emissions due to traffic from the proposed development	
	kt/Year - CO_2	
	Opening Year 2024 (Phase 1)	Design Year 2039 (Phase 2)
Operational - Traffic Emissions	0.574	0.440
Operational - Neighbourhood and Crèche Emissions	0.205	0.205
Operational - Residential Emissions	0.772	0.772

Operational - Total Emissions	1.55	1.42
Projected non-ETS emissions (with additional measures)[1]	40,044	33,226
Emissions from the proposed development as a percentage of projected non-ETS emissions (with additional measures)	0.0039%	0.0035%
[1] From EPA (2021) Ireland's Greenhouse Gas Emissions Projections. 2020 - 2040		

The total greenhouse gas emissions in the operational stage will be be insignificant in the opening year and the design year in the context of Ireland's projected non-ETS emissions.

5.8 Baseline Scenario

If the development does not proceed there will be no additional greenhouse gas emissions.

5.9 Prevention & Mitigation Measures

5.9.1 Design Stage

The proposed development incorporates a number of measures into the building design that will minimise emissions of greenhouse gasses. The buildings will comply with the revised Energy Performance of Buildings Directive (2018/844/EU) that came into effect on 1st November 2019. The Directive defines a Nearly Zero Energy Building as a building that has a high energy performance, typically, an A2 rating, which is applicable to the proposed development. (Refer Section 3.3 Building Energy Performance).

5.9.2 Construction Stage

The impact of greenhouse gas emissions from the construction stage on climate was determined to be not significant. Therefore no site specific mitigation is required to reduce impacts on climate, however construction best practices should be implemented to minimise greenhouse gas emissions, where possible.

The emission sources include construction traffic, the use of fossil fuels to power onsite equipment and the generation of onsite waste. Emissions from these activities can be minimised through:

- Planning to optimise schedules and haul routes for the delivery and removal of construction related materials;
- Efficient use of construction equipment and resources, and
- Minimisation of waste generated from construction activities.

5.9.3 Operational Stage

Due to the mitigation measures incorporated into the building design, the impact of emissions in the operational stage was determined to be insignificant and therefore no additional site specific mitigation measures are required. The risks associated with the impacts of climate change on the proposed development are addressed in the SFRA and in the design of the surface water drainage system (Chapter 7).

5.10 Monitoring

Monitoring is not required during the construction and operational stages.

5.11 Cumulative Impacts

For the assessment of cumulative effects it was assumed the the NSOORR connecting Great Connell Roundabout to the Athgarvan Road will be operational and it was assessed based on the predicted AADT and HDV AADT.

The EIAR prepared for the permitted distribution centre to the north-east of the proposed development site conlcuded that in the operational phase the distrbution centre will have an imperceptible, negative and long term impact on climate. The enabling works for the construcion of the distribution centre are scheduled for May 2022 and the centre will be operatoinal before the start of Phase 1 of the propose development.

5.12 Residual Impacts

The greenhouse gas emissions from the construction stage, in the context of non-ETS Emissions, are considered slight, negative and long-term. The total greenhouse gas emissions in the operational stage will be ininsignificant the context of Ireland's projected non-ETS emissions. The impact of the operational stage will be imperceptible, negative and long-term**.**

Table 5.11 Residual Impacts

Likely Significant Effect	Quality	Significance	Extent	Probability	Duration
Construction Stage					
Greenhouse Gas Emissions	Negative	Slight	National	Likely	Long Term
Operational Stage					
Greenhouse Gas Emissions	Negative	Imperceptible	National	Likely	Long Term

5.13 References

DEFRA, 2020, Emissions Factors Toolkit v10.1. User Guide. August 2020. https://laqm.defra.gov.uk/documents/EFTv10.1-user-guide-v1.0.pdf

DEHLG (2004) Quarries and Ancillary Activities Guidelines for Planning Authorities. https://www.housing.gov.ie/sites/default/files/migrated-files/en/Publications/DevelopmentandHousing/Planning/FileDownLoad%2C1606%2Cen.pdf

DEHLG (2011) Air Quality Standards Regulations (2011). S.I. No. 180/2011, as amended - Air Quality Standards Regulations 2011. http://www.irishstatutebook.ie/eli/2011/si/180/made/en/print

EPA (2012) Ambient Air Monitoring at Newbridge, Co. Kildare 1st October 2009 – 24th May 2010. https://www.epa.ie/publications/monitoring--assessment/air/ambient-air-monitoring/Newbridge-report-FINAL-.pdf

EPA. (2017). Guidelines on the information to be contained in Environmental Impact Assessment Reports, Draft August 2017 .

EPA (2018) Air Quality in Ireland 2017 - Indicators of Air Quality. Environmental Protection Agency, An Ghníomhaireacht um Chaomhnú Comhshaoil, PO Box 3000, Johnstown Castle Estate, County Wexford, Ireland. http://www.epa.ie/pubs/reports/air/quality/Air%20Quality%20In%20Ireland%202017.pdf

EPA (2019) Air Quality in Ireland 2018 - Indicators of Air Quality. Environmental Protection Agency, An Ghníomhaireacht um Chaomhnú Comhshaoil, PO Box 3000, Johnstown Castle Estate, County Wexford, Ireland. https://www.epa.ie/publications/monitoring--assessment/air/air-quality-in-ireland-2018.php

EPA (2021a) Ireland's Provisional Greenhouse Gas emissions 1990-2020 https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-provisional-greenhouse-gas-emissions-1990-2020.php

EPA (2021b) Ireland's Greenhouse Gas Emissions Projections. 2020 - 2040. June 2021. https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/EPA-Irelands-Greenhouse-Gas-Emissions-Projections-report-2020-2040v2.pdf

EPA (2021c) Ireland's Greenhouse Gas Emissions Projections 2019-2040 data. Ireland_2020_GHG_Emission_Projections_2019-2040.xlsx https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/Ireland_2020_GHG_Emission_Projections_2019-2040.xlsx

DECC (2013) National Policy Position on Climate Action and Low Carbon Development. Department of the Environment, Climate and Communications. Last Updated 27 January 2021. https://assets.gov.ie/76420/0446f442-67e0-45b4-9e2f-6957e15aab62.pdf

DECC (2021) Climate Action and Low Carbon Development (Amendment) Act 2021 (Act 39 of 2021). Department of the Environment, Climate and Communications. https://data.oireachtas.ie/ie/oireachtas/act/2021/32/eng/enacted/a3221.pdf

Highways England (2019) Design Manual for Roads and Bridges. Volume 11. Part 1. LA 105 Air Quality. Highways England Company Limited (formerly the Highways Agency), Guildford, United Kingdom. Available online: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3

Highways England (2021) Design Manual for Roads and Bridges index GG 000 29 September 2021. https://www.standardsforhighways.co.uk/prod/attachments/066b3135-59f4-4eb4-837a-7c43c6c6a790?inline=true

Highways Agency, 2021, Personal Communication.

IAQM (2014) Guidance on the assessment of dust from demolition and construction. http://iaqm.co.uk/wp-content/uploads/guidance/iaqm_guidance_report_draft1.4.pdf

NRA (2011) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes. National Roads Authority . https://www.tii.ie/technical-services/environment/planning/Guidelines-for-the-Treatment-of-Air-Quality-during-the-Planning-and-Construction-of-National-Road-Schemes.pdf

Ricardo Energy and Environment, 2019, NOx to NO2 Conversion Spreadsheet (Version 7.1, June 2019). https://laqm.defra.gov.uk/air-quality/air-quality-assessment/nox-to-no2-calculator/

SEAI (2021) Ireland's Energy Statistics - CO_2 Emissions 2018. https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/co2/

Walsh and McAuliffe (2020) Study of the Embodied Carbon in Traditional Masonry Construction vs Timber Frame Construction in Housing. September 2020. Jeremy Walsh Project Management, 10 Gas Terrace, Balloonagh, Tralee, Co. Kerry, V92 YF6Y https://www.jeremywalsh.ie/wp-content/uploads/2021/04/Embodied-Energy-JWPM.pdf

.

6 LAND & GEOLOGY

6.1 Introduction

This Chapter describes the land and geology at the facility and the impacts the proposed development will have on the land and geology within the development boundary, including a 'baseline' scenario. It identifies the prevention and mitigation measures and monitoring that will be implemented to reduce the significance of the impacts and assesses the residual impacts.

The Chapter was prepared by Mr Austin Hynes MSc and Mr Sean Moran of OCM. Mr Hynes has a BSc and MSc in Geology and has over 6 years' experience of geological assessments including the supervision of site investigations, soil sampling, contaminated land assessment and the preparation of interpretive reports.

Mr. Moran holds an MSc in Hydrogeology and is a member of the Institute of Geologists of Ireland (P.Geol.) and the European Federation of Geologists (Eur. Geol.) and Chartered Institute of Water and Environmental Management. He has over 30 years of experience in the geological assessment including the preparation of Environmental Impact Assessments. He has been involved in the preparation of the Land & Geology Chapters of EIARs for large scale infrastructure projects including residential and commercial developments, railway and road infrastructure, windfarms and landfills throughout Ireland.

6.2 Relevant Legislation & Guidance

In addition to the legislation and guidance listed in Sections 1.2 and 1.5, the assessment took into consideration the Institute of Geologists of Ireland (IGI) 'Guidelines for the Preparation of Soils Geology and Hydrogeology Chapters of Environmental Impact Statements' (2013).

6.3 Methodology

The assessment was based on a walkover survey of the site to establish the current land use and morphology; a desk study of databases maintained by the Geological Survey of Ireland (GSI), EPA, Teagasc and the Central Statistics Office (CSO) and findings of a geotechnical investigation carried out by Byrne Looby in 2021.

The latter comprised the installation of 25 no. trial pits, 30 no. cable tool boreholes, 2 no. rotary core boreholes, dynamic probing, infiltration and plate bearing tests in selected trial pits, groundwater level monitoring and soil quality laboratory tests. The Byrne Looby Factual Report is in Appendix 4

6.4 Development Description

Chapter 3 provides a full description of the proposed development. Those aspects of the development of relevance to Land & Geology are;

- Site clearance including stripping and stockpiling of soils;

- Construction works including building demolition; excavations for foundations and underground services and new building and road construction, and

- Landscaping measures.

6.5 Receiving Environment

6.5.1 Land Use

The majority of the site is in tillage, currently barley. There is an agricultural yard containing paved and unpaved areas and three buildings in the eastern part of the site. There is a former residential dwelling to the east of the compound and a second in the north-east corner of the site.

6.5.2 Geology

The GSI Subsoil Distribution Maps indicate the subsoils in the western half of the site are Alluvium, with the eastern half underlain Gravels derived from Limestone (Figure 6.1). Alluvium is river sediment and indicative of previous historical flooding. This is most likely a historic river terrace, associated with a former meander of the River Liffey, the remnants of which form the north western boundary.

The March 2021 ground investigation confirms the GSI soil distribution description. Topsoil was encountered at the surface of all locations, with an average depth of approximately 0.2m. The borehole logs of the cable percussion boreholes in the eastern half of the site confirm the subsoils are dominated by Sand and Gravel deposits, with some thin layers (0.2-0.4m) of SILT/CLAY.

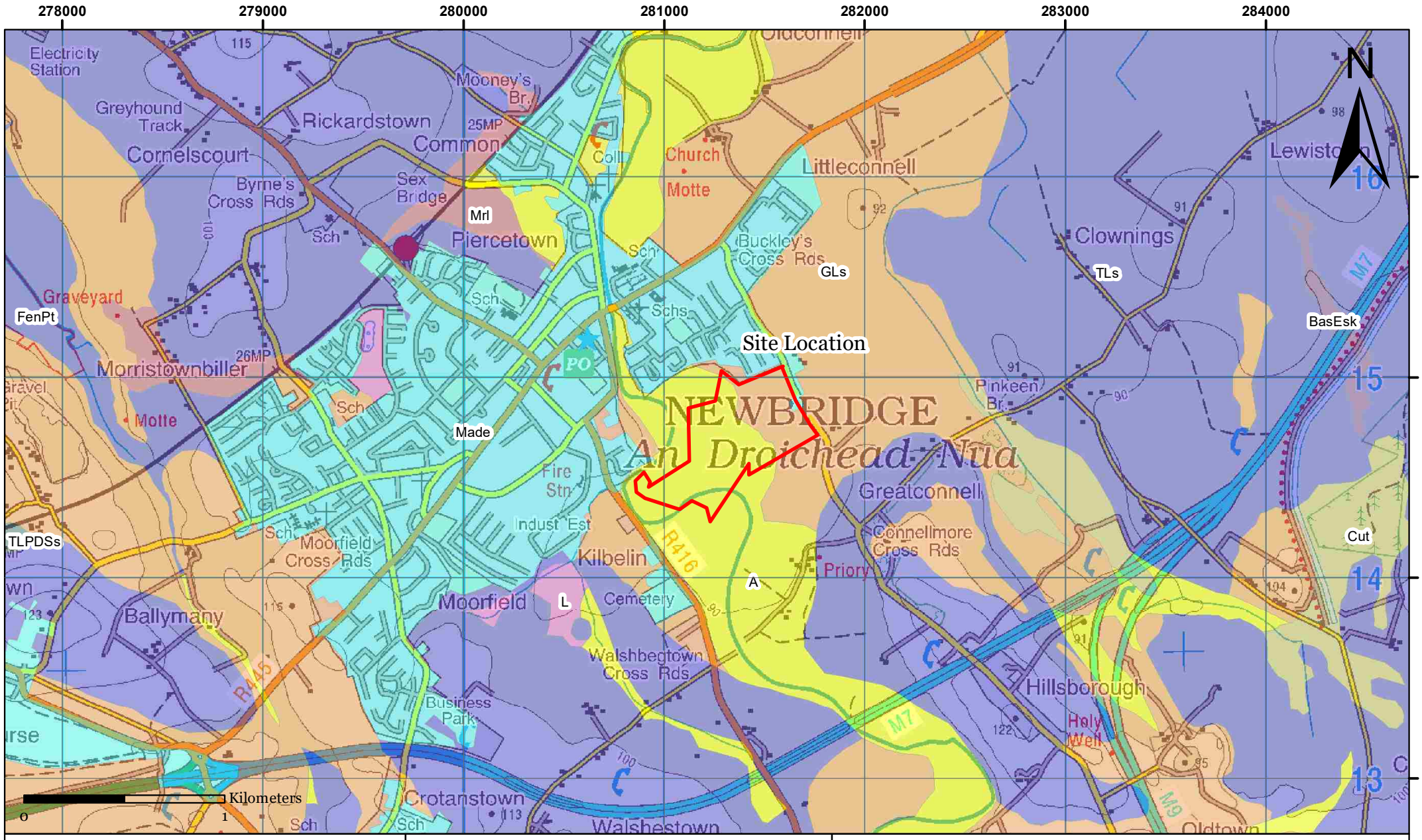
The subsoils encountered in the western half of the site comprise mainly CLAY with layers of GRAVEL circa. 1.0-1.5m thickness at some locations.

Bedrock was not encountered in any of the cable percussion boreholes, but the depth of the subsoils was proven in the two rotary core boreholes which encountered the bedrock at between 16.5 m and 18m below ground level.

The GSI Bedrock Geology map (Figure 6.2) indicates the site is underlain by a massive, unbedded, cherty and often dolomitised limestone of the Rickardstown Formation. This formation is Dinantian (Lower Carboniferous) and is thought to be more than 100m thick. Variable cherty limestones make up the lower part of this Formation and the upper part generally consists of dark grey fine grained dolomite with abundant chert. The site investigation confirmed the GSI's bedrock description.

6.5.3 Soil Quality

A subsoil quality assessment was completed during the site investigation which comprised the collection and analysis of soil samples from 6 no. trial pits (TP02, TP10, TP12, TP15, TP17 and TP25) (Figure 6.3). The samples were analysed for metals, BTEX (benzene, toluene, ethylbenzene and xylene), total petroleum hydrocarbons (TPH) aliphatic and aromatic hydrocarbons, Polychlorinated Biphenyls (PCB), Mineral Oil and Polyaromatic Hydrocarbons (PAH). The results are in Table 6.1.



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com
Environmental Management for Business

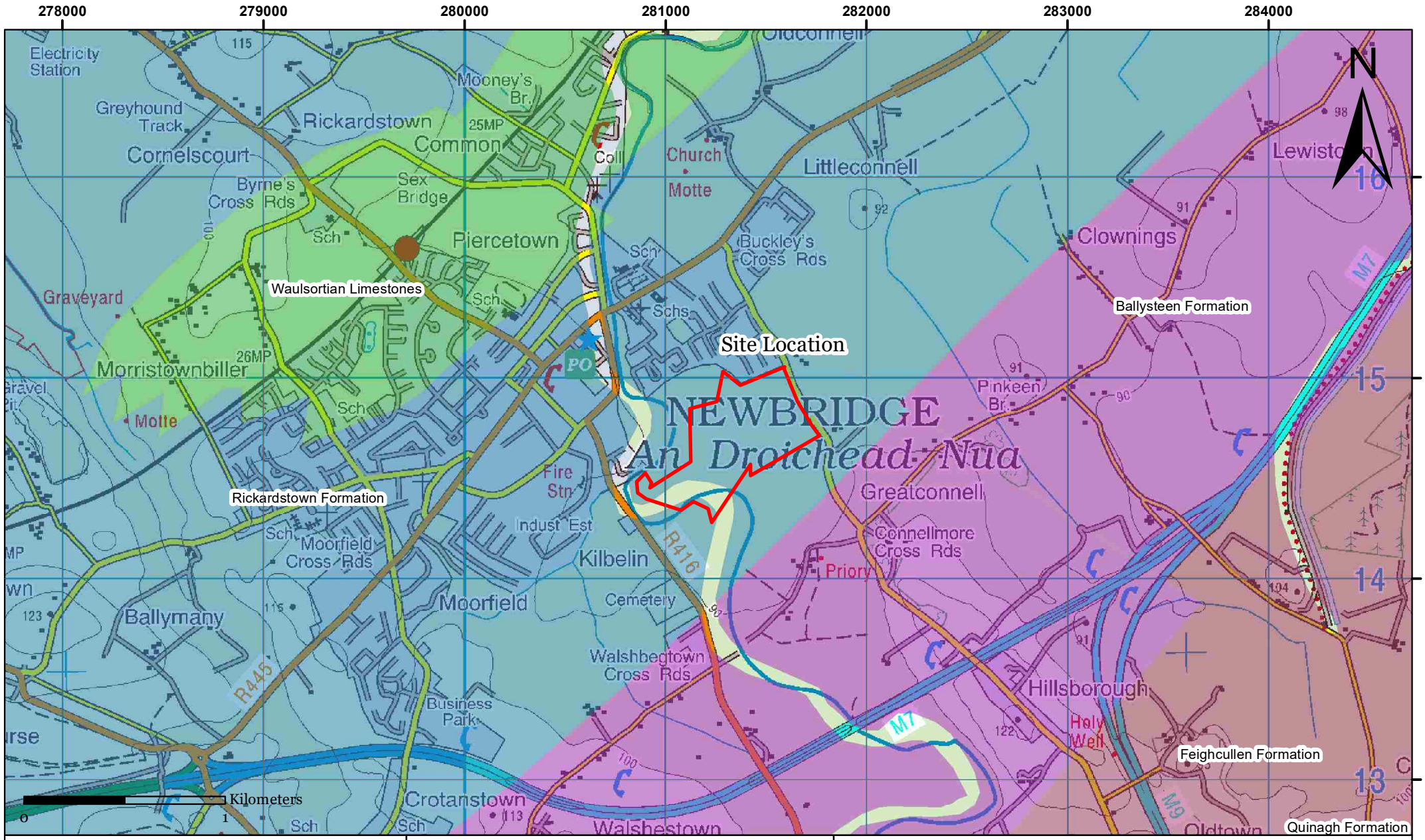
This drawing is the property of O'Callaghan Moran & Associates and shall not be used, produced or disclosed to anyone without the prior written permission at O'Callaghan Moran & Associates and shall be returned upon request.

CLIENT
Aston Ltd

TITLE
Subsoils

Details:
- Site Layout
- A - Alluvium undifferentiated
- BasEsk - Basic Esker Deposit
- Cut
- FenPt - Fen Peat
- GLs - Limestone sands and gravels (Carboniferous)
- L - Lake sediments undifferentiated
- Made - Made Ground
- Mrl - Marl
- TLPDSs - Sandstone Till
- TLs - Limestone till (Carboniferous)

Figure 6.1



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com
Environmental Management for Business

This drawing is the property of O'Callaghan Moran & Associates and shall not be used, produced or disclosed to anyone without the prior written permission at O'Callaghan Moran & Associates and shall be returned upon request.

CLIENT

Aston Ltd

TITLE

Bedrock Geology

Details:

- Site Layout
- Ballysteen Formation - Dark, Muddy Limestone, Shale
- Feighcullen Formation - Skeletal, Oolitic and Micritic Limestone
- Quinagh Formation - Lenticular Mudstone and Coarse Siltstone
- Rickardstown Formation - Cherty often Dolomitised Limestone
- Waulsortian Limestones - Massive, Unbedded Lime-Mudstone

Figure 6.2

O'Callaghan Moran & Associates
environmental management for business
www.ocallaghanmoran.com

O'Callaghan Moran & Associates
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
Email: info@ocallaghanmoran.com

Title: Site Investigation Location (Extract from IGSL Report)

Project: Environmental Impact Assessment Report

Client: Aston Ltd

Details:
- cable percussive boreholes (BH01-BH30)
- dynamic probes (DP01 - DP17)
- dynamic probes (DP01 - DP17)
- trial pits (TP 01 - TP19, omitting TP19)
- trial pit with plate bearing test (PB)
- trial pit with infiltration tests (SA)
- trial pit with infiltration and plate bearing tests

This drawing is the property of O'Callaghan Moran & Associates and shall not be used, reproduced or disclosed to anyone without the prior written permission of O'Callaghan Moran & Associates and shall be returned upon request.

Figure 6.3

BTEX, TPH and PCBs were not detected. Trace levels of PAH were detected in one sample. The combustion of organic matter is a source of PAH and those detected are likely associated with burning of stubble, evidence of which was identified in the archaeological field surveys (Chapter 13). The levels are not of environmental significance. The metal levels are were within the range of naturally occurring levels in unpolluted Irish Soils[8].

Table 6.1 Soil Quality

Location		TP02	TP10	TP12	TP15	TP17	TP25
	Depth (mbgl)	0.6	1	0.5	0.8	1	1
Parameter	Units						
Moisture	%	6.3	6.4	14	23	22	23
Boron	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Sulphur	mg/kg	2.3	2.4	1.3	1.4	1.5	1.2
Cyanide	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Sulphide	mg/kg	2	2.2	2.8	1.7	2	1.9
Sulphate	%	0.014	0.013	0.041	< 0.01	0.023	0.034
Arsenic	mg/kg	15	16	20	5.7	19	21
Barium	mg/kg	34	36	84	23	54	82
Cadmium	mg/kg	0.48	0.84	1.3	0.52	0.84	1.3
Chromium	mg/kg	13	14	21	14	13	20
Molybdenum	mg/kg	< 2.0	2.3	< 2.0	< 2.0	< 2.0	< 2.0
Antimony	mg/kg	< 2.0	5.3	< 2.0	< 2.0	< 2.0	< 2.0
Copper	mg/kg	9.5	11	17	9.7	9.7	17
Mercury	mg/kg	< 0.10	0.12	< 0.10	< 0.10	< 0.10	< 0.10
Nickel	mg/kg	16	17	35	19	17	35
Lead	mg/kg	17	18	24	13	16	24
Selenium	mg/kg	< 0.20	< 0.20	0.25	< 0.20	< 0.20	0.33
Zinc	mg/kg	13	56	110	57	44	110
Hexavalent Chromium	mg/kg	< 0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Mineral Oil	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
TPH	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
BTEX	ug/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
phenol	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Total PAH	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	12
Total PCB	mg/kg	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

6.6 Impacts

6.6.1 Land Take

Land take is the loss of agricultural, forest and other semi-natural and natural land to urban and other artificial land development. It affects habitats and ecosystems, both directly by reducing their area, and indirectly through fragmentation and degradation. This in turn can affect the delivery of important

[8] https://www.teagasc.ie/media/website/publications/2011/Soil_Geochemical_AtlasofIreland.pdf

ecosystem services, such as producing e.g. food crops and water; regulating, e.g. the control of climate and disease; supporting, such as nutrient cycles and crop pollination; and cultural, such as spiritual and recreational benefits.

The development site is ca 27.64 ha, of which approximately 16.3 ha will be occupied by the residences, neighbourhood centre, crèche, roads, foul sewer pumping station and electrical substations. Approximately 3 ha will be retained as landscaped, public open space and pocket parks including swales, with a further 8.3 ha as open amenity space in the riparian zone along the Liffey. The construction and operational stages will result in the permanent loss of approximately 23 ha of arable land.

6.6.2 Construction Stage

The development will involve excavation of the soils and subsoils for the building foundations and underground services including a stormwater attenuation system.

The soils excavated for the services and foundations will be retained on site for use as fill. Additional soils will be imported to raise the ground level to achieve the building Final Floor Levels

There is the potential for spills/leaks to occur in areas where polluting substances (e.g. oils) are handled and when refuelling mobile plant that could impact the exposed subsoils.

6.6.3 Operational Stage

In the operational stage, rainwater will infiltrate to ground in the open spaces and where permeable paving/swales has been provided. There is the potential for minor oil leaks from the residents and visitor vehicles to occur at the ground surface and for leaks from the sanitary wastewater sewers to infiltrate to ground.

6.7 Baseline Scenario

If the proposed development does not proceed there will be no land take, soils and subsoils will not be excavated and there will be no change to the potential for impact on land and geology.

6.8 Prevention and Mitigation Measures

6.8.1 Design

Given the nature of the development there are no stage prevention and mitigation measures to reduce the effects of land take. However it was a design objective to maximise the areas of open, landscaped space for amenity use. The site layout includes 11.359 ha of public open space, or 41% of the total site area 27.635 ha.

All of the soils and subsoils excavated in the construction stage will be retained on site and used to raise the ground levels to achieve the specified building floor levels.

SuDS measures are incorporated into the surface water management system designed by PUNCH, as detailed in their Planning Engineering Report in Appendix 1. The measures include permeable paving in trafficked areas and soakaways for surplus rainwater run-from building roofs. The permeable paving is designed to absorb the small amounts of oil that may leak from vehicles in the operational stage.

6.8.2 Construction Stage

A Preliminary CEMP describing the proposed construction mitigation measures has been prepared and a copy is in Appendix 3. This document will be updated in advance of the construction stage to take into consideration any additional measures that may be required by conditions attached to planning permission. It will also be updated for each of the development phases. The mitigation measures will include:

- A construction compound will be established at selected locations in each development phase. All construction materials with the potential to impact on soils, for example oils will be stored in secure bunded areas within the site compound.

- Drip trays provided for drum storage shall be capable of holding at least 25% of the drum capacity. Where more than one drum is stored, the drip tray will be capable of holding 25% of the aggregate capacity of the drums stored. All waste containers (including all ancillary equipment such as vent pipes and refuelling hoses) will be stored within a secondary containment system.

- Refuelling of the mobile plant will be undertaken by trained personnel in a designated area where appropriated spill control materials are to hand.

- Provision and maintenance of appropriate spill clean-up equipment and training of staff in its proper use. Any spillages will be immediately contained and contaminated soil removed from the site and disposed of in a licensed waste facility.

- All construction and demolition plant will be regularly checked to ensure there are no leaks or drips of oils to ground. Plant maintenance will not be undertaken on site.

- The stripping and stockpiling of topsoil will only be undertaken when absolutely necessary as long term exposure of bare ground can lead to sediment run off and leaching of nutrients from soils.

- Excavated soils not immediately reused will be stockpiled to minimise the effects of weathering.

6.8.3 Operational Stage

Soft landscaping will use clean top soils and planting which will enhance the quality of the soil environment.

6.9 Monitoring

In the construction stage the Ecologicl Clerk of Works will complete regular inspections ot the works are to ensure that materials handling and storage are in accordance with the Preliminary CEMP. Monitoring will not be required in the operational stage.

6.10 Cumulative Impacts

To the south-west, across the River Liffey, a 343 unit residential development (Belin Wood) is currently under construction on an 18.4ha site that was formerly used for pasture. In November 2021 Barola Capital DAC was granted planning permission for a warehouse, office and ancillary buildings on a 15.42 ha site, predominately arable land, to the north-east of the proposed development. Both permitted developments involve the permanent land take of agricultural lands.

6.11 Residual Impacts

The proposed changes will involve land take and ground disturbance including the stripping of topsoils and the excavation of subsoils in the construction stage. The excavated soils will be retained on site. Once the construction works have been completed, the land take area will be permanently occupied by the buildings, roads and open amenity spaces.

The development will result in the loss of approximately 23 ha of arable land currently used for cereal production. The CSO databases stated that there was 4.9 million hectares of Agricultural Area Used (AAU) in 2016 in Ireland, including 280,400 of cereals[9]. In the Mid East and Dublin Region, where the development site is located, 81,000 ha were used for cereal production. The loss of the arable land used for cereals will have an imperceptible, negative impact on crop production.

The proposed development includes SuDS measures that involve the infiltration of rainwater to ground. Rainwater from the building roofs will be clean and the design of the permeable paving will remove the small amounts of oil that may be present from vehicle leaks. In combination the construction and operational stages will a negative, imperceptible impact on the soils, have no impact on the bedrock and will have a long term, imperceptible negative impact on land.

Table 6.2 Residual Impacts

Likely Significant Effect	Quality	Significance	Extent	Probability	Duration
Land Take	Negative	Imperceptible	Development Site	Likely	Long Term
Soil Contamination	Negative	Imperceptible	Development Site	Likely	Temporary

[9] https://www.cso.ie/en/releasesandpublications/ep/p-fss/farmstructuresurvey2016/da/lu/

6.12 References

EPA (2018) Corinne Land Cover dataset, COPERNICUS Land Monitoring service https://data.gov.ie/dataset/corine-landcover-2018

Teagasc (Kinsealy), EPA and GSI (2006), National Subsoil Map, last updated in 2017 https://gis.epa.ie/EPAMaps/

GSI Bedrock Map scale 1:100000, data viewer access https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=bc0dba38f3f5477c8fd400f66b5eedcd/

Central Statistics Office: Farm Structure Survey 2016 https://www.cso.ie/en/releasesandpublications/ep/p-fss/farmstructuresurvey2016/da/lu/

https://www.teagasc.ie/media/website/publications/2011/Soil_Geochemical_AtlasofIreland.pdf

Teagsc & EPA Soil Geochemical Atlas of Ireland (2007)

7 WATER

7.1 Introduction

This Chapter describes the surface water and the groundwater conditions at the site and the impacts that the proposed development will have on surface water and groundwater within and outside the site boundary, including a 'baseline' scenario. It identifies the prevention and mitigation measures and monitoring that will be implemented to reduce the significance of the impacts and assesses the residual impacts.

The Chapter was prepared by Ms Marzena Nowakowska MSc and Mr Sean Moran of OCM, with contributions from Ms Orla Hannon BSc and Mr Ross Bryant BSc MSc CEnv MCIWEM C.WEM of JBA Consulting.

Ms Nowakowska has an MSc in Geology, majoring in mineral and water resource management and has over 15 years' experience in water resource and hydrogeological assessments including water quality monitoring, hydrogeological mapping and water resource management at regional level.

Mr. Moran holds an MSc in Hydrogeology and is a member of the Institute of Geologists of Ireland (P.Geol.) and the European Federation of Geologists (Eur. Geol.) and Chartered Institute of Water and Environmental Management. He has over 30 years of experience in the field hydrological and hydrogeological assessment including the preparation of Environmental Impact Assessments. . He has been involved in the preparation of the Water Chapters of EIARs for large scale infrastructure projects including residential and commercial developments sites, railway and road infrastructure, windfarms and landfills throughout Ireland.

7.2 Relevant Legislation & Guidance

The general EIA legislation and guidance documents are listed in Sections 1.2 and 1.5. The legislation and guidelines relevant to Water considered in the preparation of this Chapter include:

- Local Government Water Pollution Acts 1977 & 1992, as amended
- European Union Water Framework Directive (2000/60/EC)
- European Communities Environmental Objectives (Groundwater) Regulations (SI No 9 of 2010), as amended.
- European Communities Environmental Objectives (Surface Water) Regulations (S.I. No 272 of 2009), as amended.
- River Basin Management Plan 2018-2021.
- Geologists of Ireland (IGI) 'Guidelines for the Preparation of Soils Geology and Hydrogeology Chapters of Environmental Impact Statements' (2013).

7.3 Methodology

Waters encompass surface and groundwater. The assessment was based on a walkover survey of the site to establish the local drainage patterns and a desk study, whose sources included:

- Newbridge LAP;
- River Basin Management Plan (RBMP);
- Hydrogeological databases maintained by the GSI;
- EPA water quality databases;
- Groundwater level and quality monitoring carried out in on-site wells by Byrne Looby;
- Engineering Report prepared by PUNCH, and

  Site Specific Flood Risk Assessment completed by JBA Consulting.

7.3.1 Consultation

Kildare County Council and the Bord raised a number of queries in relation to the surface water management and flood risk in the course of the statutory consultation process. The queries and the detailed responses prepared by PUNCH are in Section 2 of the PUNCH Engineering Planning Report in Appendix 1.

PUNCH engaged with Irish Water in relation to the proposed connections to the Irish Water foul sewer and mains water supply and also consulted with Inland Fisheries and Waterways Ireland in relation to the design of the proposed surface water drainage system.

JBA engaged with Kildare County Council in relation to the flood risk assessment and the Council made a number of comments which JBA responded to as detailed in Appendix D of their report, a copy of which is in Appendix 5.

7.4 Development Description

Chapter 3 provides a full description of the proposed development. Those aspects of the development of relevance to Water are;

- Site clearance including stripping and stockpiling of soils;
- Construction works including building demolition; excavations for foundations and underground services and new buildings and roads;
- Provision of surface water and foul water drainage systems, and
- Flood Risk

7.5 Receiving Environment

7.5.1 Hydrology

The local and regional hydrological conditions are shown on Figure 7.1. The site is in the catchment of the River Liffey, whose main channel runs through the site close to the south-western boundary. An open, but overgrown drainage ditch runs along the northern border and in central area of the site, following the alignment of an historic meander on the Liffey.

The Liffey catchment contains the largest population of any in Ireland and is characterised by a sparsely populated, upland south eastern area and a densely populated, flat, low lying area over the remainder of the catchment basin.

The Liffey rises on the western slopes of Tonduff in the Wicklow Mountains. It flows west joining the Brittas River before entering the Pollaphuca Reservoir, which was constructed in the 1930s. It flows out of the reservoir through the Pollaphuca generating station and into the reservoir and generating station at Golden Falls, upstream of Ballymore Eustace. It then flows west through Kilcullen and Newbridge, Sallins, Clane, Celbridge and into the Leixlip reservoir and generating station after which it is joined by the Ryewater. It flows past Islandbridge, where it becomes tidal, and through Dublin City centre and Dublin Port into Dublin Bay.

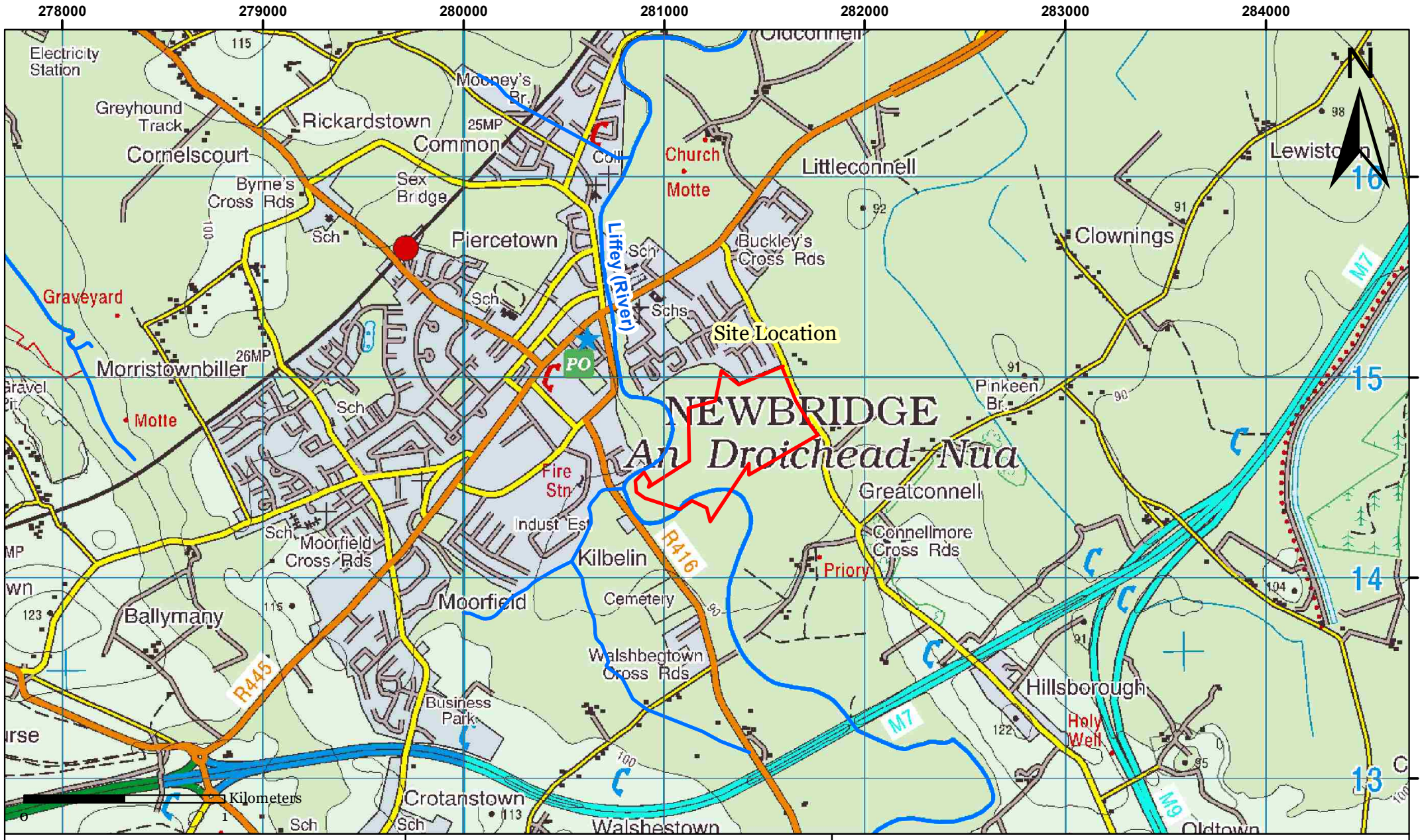
The Liffey is part of the IE_EA_Liffey Water Management Unit (WMU) originally designated in the first cycle Eastern River Basin District (EBRD) Management Plan prepared under the EU Water Framework Directive (WFD). The second cycle national River Basin Management Plan (RBMP) was launched in 2018.

The WMU comprises various Water Bodies and the site is in the Liffey_080 River Water Body. Status Reports have been prepared this Water Body. Status means the condition of the water in a watercourse and is defined by its ecological and chemical conditions, whichever is worse. Water Bodies are ranked in one of five classes,' High', 'Good', 'Moderate', 'Poor' and 'Bad'.

The WFD requires measures to ensure waters achieve at least 'Good Status' by 2015 and that their current status does not deteriorate. Where necessary, for example in heavily impacted or modified watercourses, extended deadlines (2021 and 2027) were set for achieving the following objectives:

- Prevent Deterioration
- Restore Good Status
- Reduce Chemical Pollution
- Achieve Protected Areas Objectives

The objectives for particular watercourses are based on 'Pressure and Impact Assessments' of human activity, including point and diffuse emissions, land use and morphological conditions on surface waters to identify those water bodies that are 'At Risk' of failing to meet the WFD objectives. The ecological status/potential of the LIFFEY_080 is classified as 'Good' and the river is 'Not at Risk' of meeting its RBMP objectives.



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com
Environmental Management for Business

This drawing is the property of O'Callaghan Moran & Associates and shall not be used, produced or disclosed to anyone without the prior wrtiten permission at O'Callaghan Moran & Associates and shall be returned upon request

CLIENT
Aston Ltd

TITLE
Hydrology

Details:
Site Layout
Rivers

Figure 7.1

7.5.2 Hydrogeology

The sands and gravels in the eastern part of the site belong to the Curragh East Groundwater Body and are classified as a locally important aquifer. (Figure 7.2). The underlying bedrock is a regionally important karstified (Rkd) aquifer.

A review of the GSI groundwater well database identified that the closest recorded borehole is ca 0.8 km to the west. This borehole was drilled for geotechnical purposes and the depth to bedrock is reported as 29.3m. The closest recorded abstraction well is ca 2.4km to the south-west. The use of the well is unknown, but the reported yield is 109.1 m^3/day.

The GSI groundwater vulnerability map indicates the aquifer vulnerability of the site is 'High' Gravel was encountered between 0.20-3.00 m below ground level in the east of site, indicating the local aquifer vulnerability rating range from High to Extreme (Figure 7.3).

Byrne Looby conducted groundwater level monitoring out on 7 occasions (April 2021 – January 2022) and the results are in Table 1: B1747 of the Byrne Looby Report in Appendix 4. The levels indicate the groundwater flow direction is from south-east to north- west across the site towards the River Liffey. The water level ranges from 1.0 to 2.92m below ground level.

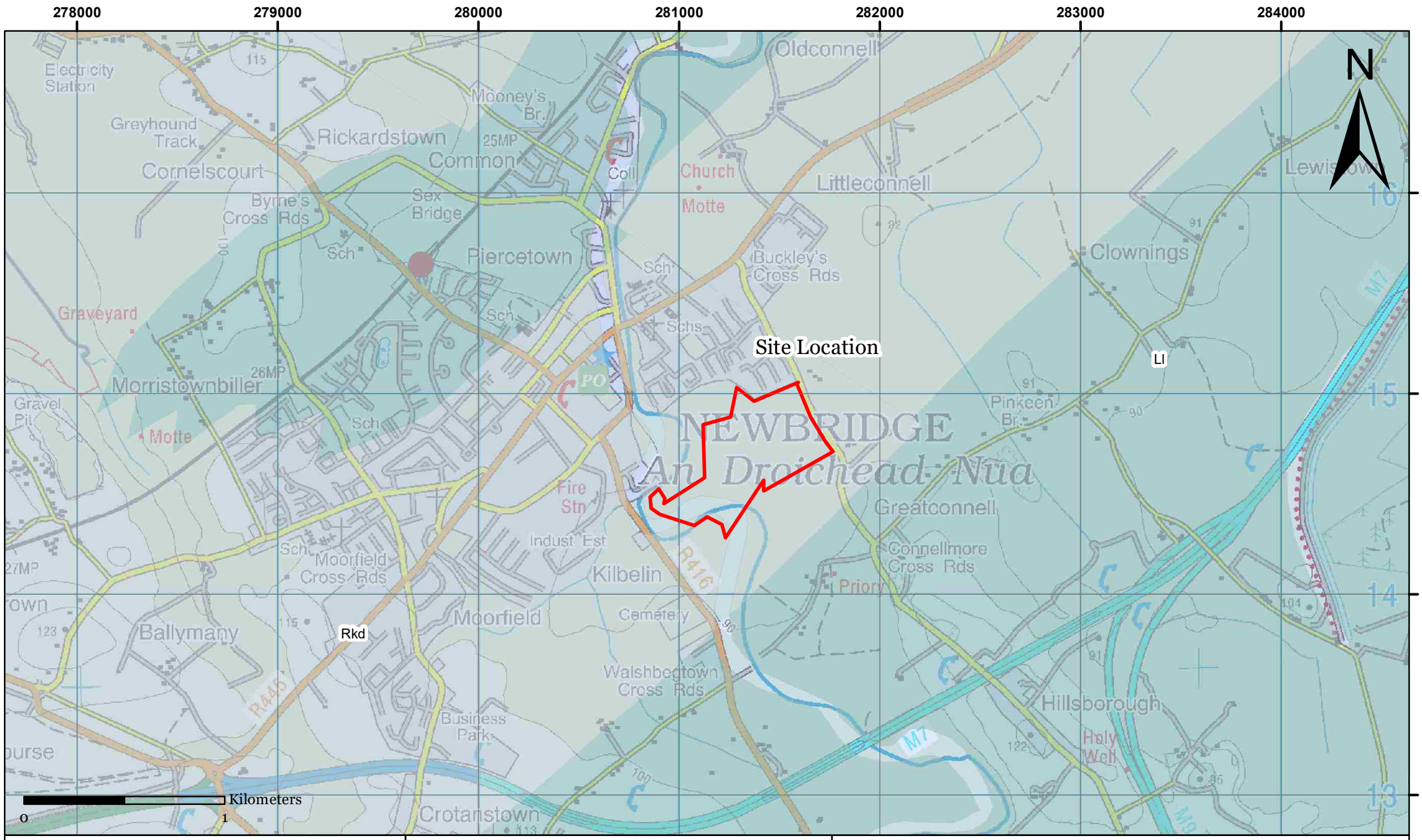
7.5.3 Groundwater Quality

The sand and gravels are part of the Curragh Gravels East Groundwater Body (IE_EA_G_017) designated in the RBMP. The condition of a groundwater Water Body is defined by its chemical and quantitative status, whichever is worse, and groundwater quality is ranked in one of two status classes: Good or Poor. The Curragh Gravels East Groundwater Body is categorised as being of 'Good' status and is 'Not At Risk' of failing to achieve its objective of protecting the existing status.

Byrne Looby collected groundwater samples from four of the on-site subsoil wells on the 20th July 2021. One of the wells (BH-02) is in the alluvium, with the other three (BH-05, BH12 and BH17) in the gravels (Refer Figure 7.3).

The samples were analysed for pH, electrical conductivity, chloride, ammonia, dissolved metals, total hydrocarbon, BTEX and volatile organic compounds (VOCs). The results are presented in Table , which also include the Interim Guideline Values (IGV) published by the EPA and the Groundwater Threshold Values (GTV) set out in the European Communities Environmental Objectives (Groundwater) Regulations (S.I. 9 of 2010), as amended.

The IGVs are not statutory but were developed to assist in the assessment of impacts on groundwater quality. They are based on, but are more conservative than the Drinking Water quality standards. GTVs have only been established for core indicator parameters and, as IGVs have been established for a wider range of parameters, they continue to be used for assessment purposes.



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

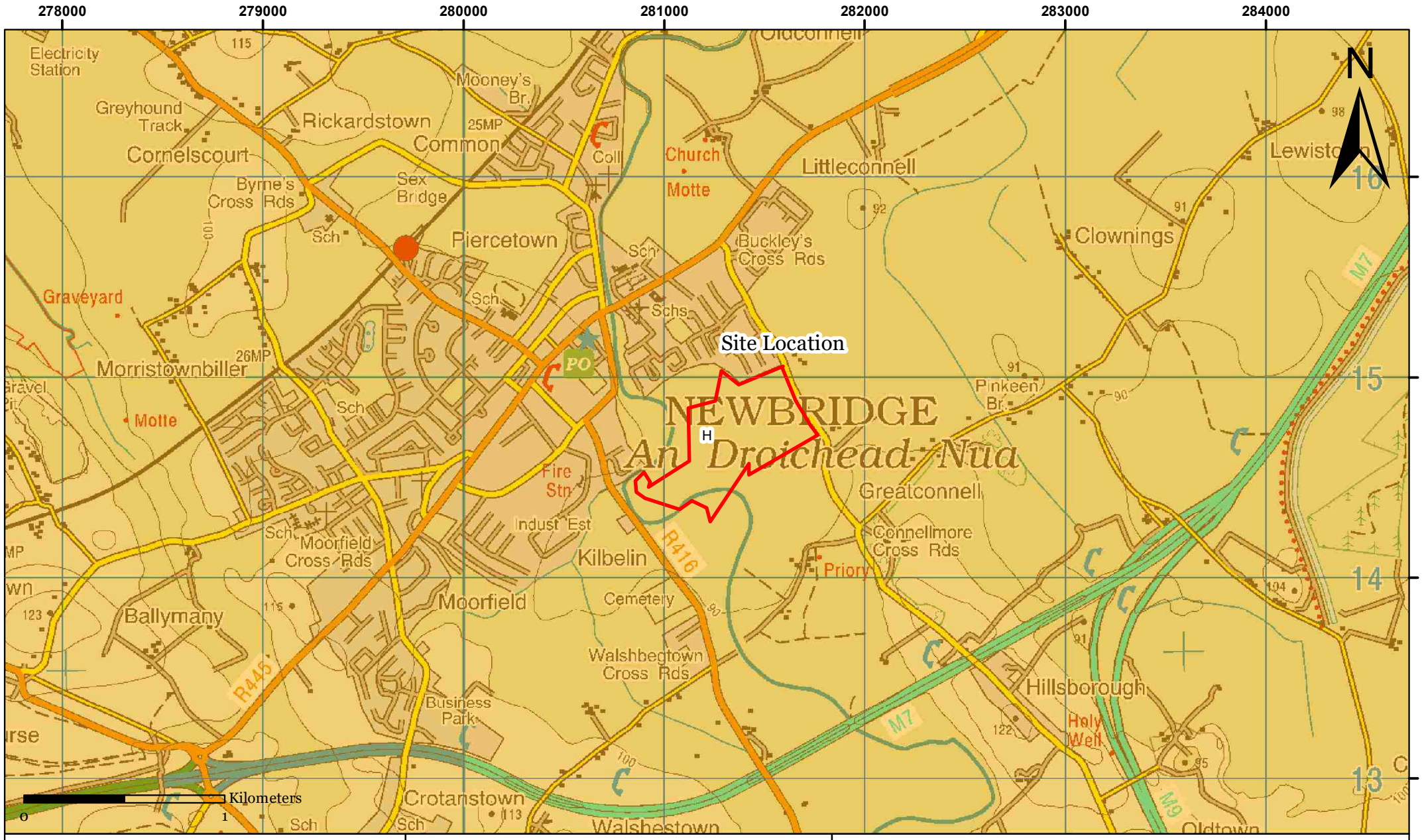
CLIENT
Aston Ltd

TITLE
Aquifer Classification

Details:
- Site Layout
- S&G_Aquifer
- LI - Locally Important Aquifer. Mod. Productive only in Local Zones
- Rkd - Regionally Important Aquifer. Karstified Bedrock dominated by diffuse flow

Figure 7.2

This drawing is the property of O'Callaghan Moran & Associates and shall not be used, produced or disclosed to anyone without the prior written permission at O'Callaghan Moran & Associates and shall be returned upon request.



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com
Environmental Management for Business

This drawing is the property of O'Callaghan Moran & Associates and shall not be used, produced or disclosed to anyone without the prior written permission at O'Callaghan Moran & Associates and shall be returned upon request.

CLIENT
Murphy International

TITLE
Groundwater Vulnerability

Details:
- Site Layout
- X - Bedrock near Surface
- E - Extreme
- H - High
- M - Moderate
- L - Low

Figure 7.3

Table .7.1 Groundwater Monitoring Results (Table 2: B1747 Byrne Looby Report in Appendix 4)

Parameter	Units	BH02	BH05	BH12	BH17	EPA IGV	EU GTV
pH		8.1	8.1	8	8		
Electrical Conductivity	**uS/cm**	600	670	610	580		1875
Chloride	**mg/l**	23	22	18	13	30	187.5
Ammonia (Free)	**mg/l**	0.15	< 0.05	< 0.05	< 0.05		0.18
Nitrate	**mg/l**	1.8	22	19	11	25	37.5
Cadmium	**ug/l**	0.54	0.26	< 0.11	< 0.11	5	
Chromium	**ug/l**	6.8	11	11	11	30	37.5
Copper	**ug/l**	0.8	1.4	0.95	0.73	30	
Nickel	**ug/l**	1.8	1	< 0.5	0.59	20	
Lead	**ug/l**	< 0.5	2	< 0.5	< 0.5	10	7.5
Tin	**ug/l**	0.9	< 0.5	< 0.5	< 0.5		
Zinc	**ug/l**	27	20	27	12	100	75
Total TPH (C6-C40)	**ug/l**	< 10	< 10	< 10	< 10	10	7.5
VOC	**ug/l**	ND	ND	ND	ND		
BTEX	**ug/l**	ND	ND	ND	ND		

The results confirm the quality of the groundwater is good, with no evidence of contamination.

7.5.4 Flood Risk

The development site has been the subject of the following previous predicative flood mapping studies;

- Newbridge Strategic Flood Risk Assessment (SFRA), and
- Eastern Catchment Flood Risk Assessment and Management Study (CFRAM).

The Eastern CFRAM is the most detailed assessment of flood extent and supersedes the fluvial flood outlines presented by the Newbridge SFRA.

The Newbridge SFRA was completed in 2013 as part of the LAP and before the CRFAM maps were published. The SFRA Flood Maps shows part of the development site in an area that requires a site-specific Flood Risk Assessment appropriate to the scale of the proposed development. The LAP requires development proposals in such areas to:

- Indicate and quantify loss of floodplain storage arising from the development;
- Provide compensatory storage within or adjacent to the proposed development;
- Indicate measures to ensure that water-vulnerable elements of the development would not be flooded during the 1000 year flood, and
- Ensure that existing flow paths for flood water will not be compromised.

An assessment of flood risk must be in accordance with the 2009 Department of the Environment, Heritage and Local Government/ Office of Public Works Guidelines, 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (Guidelines).

The Guidelines define flood zones on the basis of the probability of flooding from rivers and the sea. Because of the generally more dynamic nature of coastal flooding compared to river flooding, a lower probability of coastal flooding is used to define the highest-risk zone.

- **Zone A** is at highest risk and has a 1 in 100 (or 1%) chance of flooding in any one year from rivers and a 1 in 200 (or 0.5%) chance of flooding from the sea.

- **Zone B** is at moderate risk of flooding from rivers and the sea and its outer limit is defined by a 1 in 1000 (or 0.1%) chance of flooding in any one year.

- **Zone C** is the low risk area, with a less than 1 in 1000 (<0.1%) chance of flooding from rivers, estuaries or the sea in any one year. It includes all areas that are not in Zones A and B

The CFRAM flood map, which supersedes the LAP SFRA, indicates that the development site is primarily in Flood Zone C. However, the map indicates there is an overland flow path from the River Liffey across the site that could occur as part of the 1% and 0.1% AEP events (Flood Zone A & B). This flow path follows the historic meander of the Liffey.

JBA Consulting were commissioned to prepare an SSFRA and a copy of their report is in Appendix 5. JBA modelled the flood risk and this predicted higher water levels and flows when compared with the CFRAM model, and so is more conservative. The JBA model indicates a number of overland flow paths across the applications land in the 0.1% AEP event in additional to the one identified by the CFRAM Study. These overland flows routes also occur in the 1% AEP + 20% climate change scenario.

The main reason for the differing results is the higher roughness values used in the JBA model. These higher values were adopted as sensitivity testing of the model showed the proposed site was sensitive to these values, i.e., when higher roughness values are applied in the model, there is an increase in water levels and additional overland flow routes through the applicant's land. Roughness values in the channel and floodplain are seasonal. Additional vegetation growth in the summer can lead to higher roughness values, whereas in winter roughness values maybe be lower. The model suggests there is an increased risk to the lands during periods of higher roughness/vegetation.

7.6 Impacts

7.6.1 Construction Stage

The development will involve excavation of the soils and subsoils for the building foundations and underground services including a stormwater attenuation system. The excavations will not extend into the water table. The soils excavated for the foundations will be retained on site for use as fill. Additional soils will be imported to raise the ground level to achieve the building Final Floor Levels

In the construction stage there is the potential for spills/leaks to occur in areas where polluting substances (e.g. oils) are stored and when refuelling mobile plant that could infiltrate to groundwater.

7.6.2 Operational Stage

The development site is ca 27.64 ha, of which approximately 16.3 ha will be occupied by the residences, neighbourhood centre, crèche, roads, foul sewer pumping station and electrical substations. Approximately 3 ha will be retained as landscaped, public open space and pocket parks including swales, with a further 8.3 ha as open amenity space in the riparian zone along the Liffey.

The provision of extensive paved areas will result in an increase in the volume of run-off from the development site to the nearest water courses and will also reduce the groundwater recharge rate. There is the potential for minor oil leaks from resident's vehicles to enter the surface water drainage system.

The development will result in the loss of the overland flood flow paths from the Liffey across the site.

In the operational stage, rainwater will infiltrate to ground in the open spaces and where permeable paving/swales has been provided. There is the potential for minor oil leaks from the residents and visitor vehicles to occur at the ground surface.

7.7 Baseline Scenario

If the proposed development does not proceed the current land use will continue to operate and there will be no change to the potential impacts on flood risk, surface water and groundwater.

7.8 Prevention & Mitigation Measures

7.8.1 Design Stage

<u>Flood Risk</u>

Based on the potential flood risk and the requirements of the LAP JBA Consulting were commissioned to complete a Site Specific Flood Risk Assessment (SFRA) to:

- Identify potential sources of flood risk;
- Confirm the level of flood risk and identify key hydraulic features;
- Assess the impact that the proposed development has on flood risk, and
- Develop appropriate flood risk mitigation and management measures which will allow for the long-term development of the site.

The JBA Consulting Great Connell SHD, Newbridge Flood Risk Assessment (2022) report is in Appendix 5 and the findings are summarised herein. This summary should not be taken to be a detailed description of the Flood Risk Assessment and its conclusions.

JBA completed hydraulic modelling using two software packages: Estry and TUFLOW by BMT-WBM, which when used in conjunction form what is termed a 'linked-model'. A linked-model allows flow in a river channel and structures to be represented using 1D modelling equations and allows any out-of-bank volumes to be represented by 2D routing equations.

The modelling, which took into consideration the development on the left bank has been granted planning permission and is currently in the construction phase, established the baseline conditions. The site is primarily within Flood Zone C. This means the probability of fluvial flooding is low (less than 0.1% or 1 in 1000): however, there are three overland flow paths from the River Liffey across the site that are within Flood Zone B meaning there is a risk of flooding in this section during the 0.1% AEP event. These three overland flow routes also occur in the 1% AEP plus climate change scenario. One of these flow paths is also within Flood Zone A so there is a risk during the 1% AEP event[10].

JBA then modelled two post development scenarios. The first included the proposed SHD development and the proposed bridge and the second had proposed SHD development without the bridge. The second design scenario is the less likely condition where the SHD development is constructed without the bridge. When the land is raised for the proposed development the overland flow routes through the site are removed.

Compensatory storage is provided to compensate for the loss of Flood Zone A, particularly the loss of the overland flow routes as a result of the SHD development. This is a standard which is in accordance with the Planning System and Flood Risk Management Guidelines and the Kildare County Development Plan. This has been designed and modelled as part of the post-development scenario and confirms the proposed development does not increase flood levels or extents in the 1% AEP event for which it has been designed.

The first scenario, which included the proposed bridge crossing as well as the SHD development, confirms that both developments do not increase the flood risk to the surrounding area in the 1% AEP event and has minimal impacts in the 0.1% AEP event. There is an additional overland flow path within the lands under the ownership and control of the applicant. Outside of the blue line boundary, there are some increases in flood depths in the 0.1% AEP event downstream of the proposed bridge. In areas where the increases in depths are adjacent to properties there is still sufficient freeboard between the water levels and FFL.

The second scenario, which does not include the proposed bridge crossing, is the less likely condition to occur as the applicant and Kildare County Council are actively progressing the consenting and funding for the bridge. Aston Limited are also progressing with the planning application for the Road and Bridge (Ref:5299). In this scenario, there are some localised increases in flood extents and depths in addition to the increases noted in Scenario 1 above. In areas where there is an increase in extent (green fields), there are no receptors, so in both cases the risk has not increased at the 0.1% AEP standard.

JBA concluded that the bridge design is in line with the requirements of Section 50 of the Arterial Drainage Act 1945 and within the tolerance limits of afflux. The proposed design has negligible impacts on water levels and extents at the site and there is no increase in risk to surrounding receptors. The bridge design is therefore appropriate.

JBA recommended a number of design measures which included;

[10] Section 4.3 of the JBA Report

- Setting the Finished Floor Levels (FFL) above the 0.1% AEP flood level with an additional 500mm freeboard. This would also protect the development from the 1% AEP plus climate change event. JBA also recommended to set the FFL 150mm above nearby road levels to prevent surface water inundation during an exceedance event.

- Provision of compensatory storage for Flood Zone A which required the extension of the red line boundary towards the Liffey to create space for storage.

- The attenuation system should be designed to relevant standards, to mitigate against pluvial flooding on the site and the risk of increase due to the changes at the site to a hardstanding area. This should be prepared in accordance with the Kildare County Development Plan and should also include the comprehensive use of a Sustainable Drainage System.

Table 5.1 of the JBA Report (reproduced below) identifies the types of development appropriate to each flood zone and those that would be required to meet a 'Justification Test'. The objective of the 'Justification Test' is to rigorously assess the appropriateness, or otherwise, of particular developments being considered in areas of moderate or high flood risk.

	Flood Zone A	**Flood Zone B**	**Flood Zone C**
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water Compatible Development	Appropriate	Appropriate	Appropriate

Figure 5-1: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test (Table 3:2 of the Planning Guidelines)

All development types are appropriate for Flood Zone C. Developments within Flood Zone A are recommended to be water compatible, i.e. car parking and green spaces, while less vulnerable developments such as retail or commercial uses are recommended for Flood Zone B. Any other developments in these zoning types must apply and pass the Justification Test.

As the proposed development is partially located in Flood Zone A and B the Justification Test has been undertaken to confirm the site is appropriate for development.

To pass the Justification Test, it must be shown that the impact on surrounding water levels is not significant, and that the development can manage the risk to itself. The Justification Test was applied and passed as the hydraulic modelling confirmed the impact on surrounding water levels is not significant and the development can manage the risk to itself.

A peer review of the JBA Flood Risk Assessment was carried out by ARUP, who concurred with the proposed design and recommendations (Appendix E of the JBA Report).

Sustainable Urban Drainage Systems (SuDs)

SuDS measures were incorporated into the design of the surface water management system completed by PUNCH as detailed in their Engineering Report in Appendix 1 and summarised below. The measures, which are designed to reduce the volumes discharged to the surface water courses and ensure that the flow rate of the water that is discharged is the same as that from the undeveloped site, include:

- Extensive Sedum Green Roofs (1,766m^2) on apartment;
- Permeable Pavement (6,104m^2) in parking bays and driveways, which can accommodate rainfall events of up to 5mm before run-off occurs;
- Engineered Swales (5,098m^3);
- Attenuation Tanks (1,986m^2), designed for a 1:100-year storm return period storm with 20% additional rainfall to allow for climate change;
- Rainwater Harvesting in the operational stage (provision of water butts at each unit with overflows to soakaways comprising geo-cellular units wrapped in a geotextile(total 1009m^2) in the gardens with the exception of 34 houses in the north-west of the site where the depth to the water table (1m) means soakaways are not practical.

These measures will reduce the runoff from the site to the greenfield runoff rate of 76.31 litre/second.

Silt Traps and Oil Interceptors

All surface water run-off from trafficked areas will outfall via Class 1 Bypass Separators located downstream of the proposed attenuation tanks, as shown on Drawing 92229-PUNCH-XX-XX-DR-C-0160. These will remove hydrocarbons and fine sediment particles from the runoff and lower the risk of downstream contamination following an oil spillage on site. Petrol Interceptors will also be provided on the separate drainage system for the link road (NSOORR).

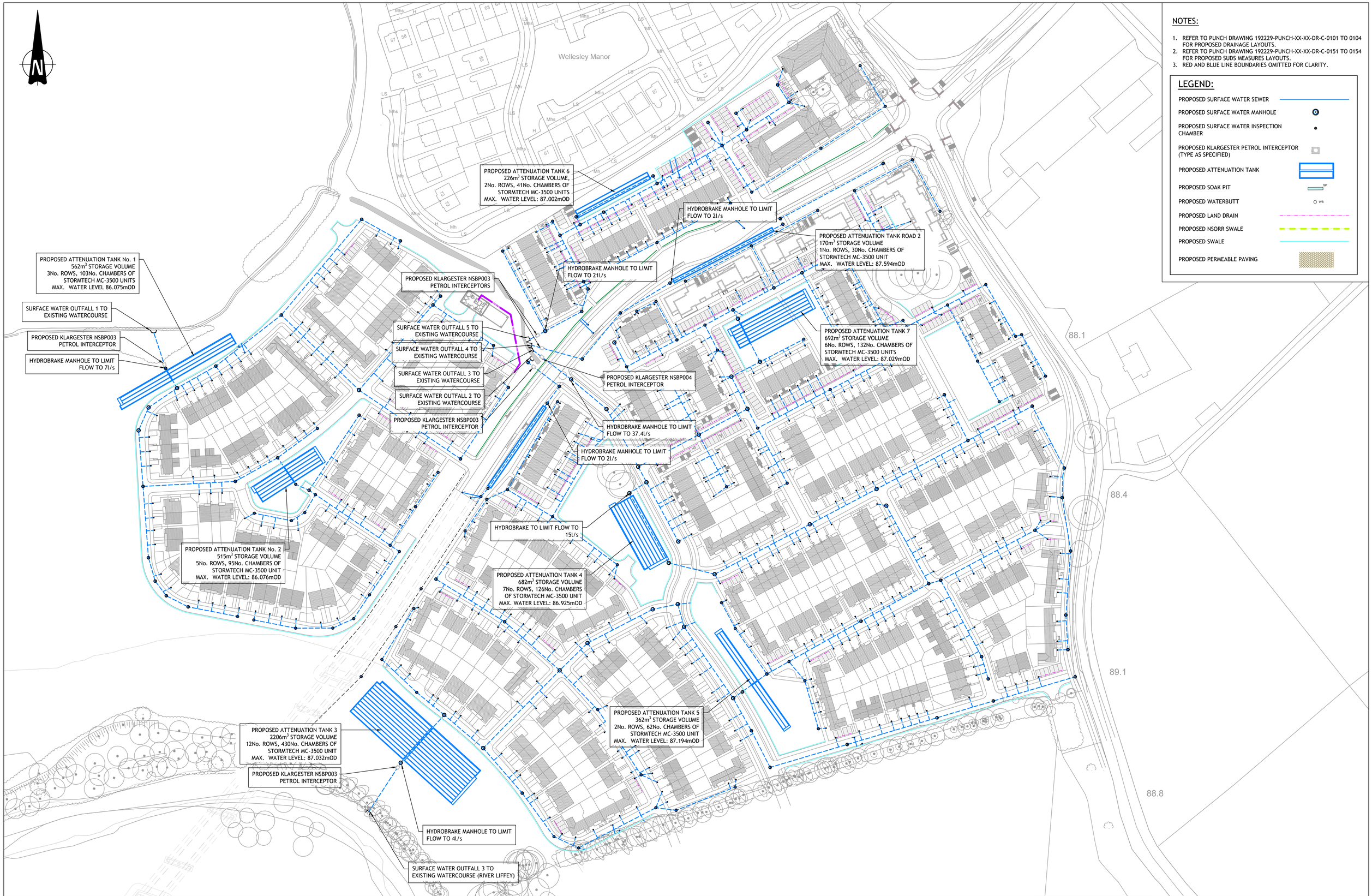
Bypass separators fully treat all flows generated by rainfall rated of up 6.5mm/hour, which covers over 99% of all rainfall events. Flows from events above this rate are allowed to bypass the separator. Bypass separators are used at sites where it is considered the risk of a large spillage and heavy rainfall occurring at the same time is small, which includes residential developments. A Class 1 interceptor is designed to achieve an oil concentration in the outflow of less than 5mg/l.

The permeable paving, while allowing rain fall to infiltrate to ground, is also designed to filter out silt and adsorb and subsequently biodegrade low level oil contamination.

7.8.2 Construction Stage

The measures that will be implemented to mitigate the effects of soils (Section 6.7.1) apply equally to surface water and groundwater. In addition the following measures will be carried out.

- Excavation and the stripping soil/made ground will not be undertaken until absolutely necessary to prevent sediment run off and leaching of nutrients from soils into drains.



NOTES:

1. REFER TO PUNCH DRAWING 192229-PUNCH-XX-XX-DR-C-0101 TO 0104 FOR PROPOSED DRAINAGE LAYOUTS.
2. REFER TO PUNCH DRAWING 192229-PUNCH-XX-XX-DR-C-0151 TO 0154 FOR PROPOSED SUDS MEASURES LAYOUTS.
3. RED AND BLUE LINE BOUNDARIES OMITTED FOR CLARITY.

LEGEND:

- PROPOSED SURFACE WATER SEWER
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED SURFACE WATER INSPECTION CHAMBER
- PROPOSED KLARGESTER PETROL INTERCEPTOR (TYPE AS SPECIFIED)
- PROPOSED ATTENUATION TANK
- PROPOSED SOAK PIT (SP)
- PROPOSED WATERBUTT (WB)
- PROPOSED LAND DRAIN
- PROPOSED NSORR SWALE
- PROPOSED SWALE
- PROPOSED PERMEABLE PAVING

© PUNCH Consulting Engineers
This drawing and any design hereon is the copyright of the Consultants and must not be reproduced without their written consent.
All drawings remain the property of the Consultants.
Figured dimension only to be taken from this drawing.
Consultants to be informed immediately of any discrepancies before work proceeds.
COLOUR DRAWING

BUILDING INFORMATION MODELLING (BIM) I.S. EN ISO 19650-2:2018 NSAI Certified

Rev	Amendment	By	Date	Rev	Amendment	By	Date
C01	ISSUED FOR PLANNING	IBS	2022-03-22				
C02	ISSUED FOR PLANNING	IBS	2022-03-28				

Client:

PUNCH consulting engineers
Dublin | Limerick | Cork | Galway | Glasgow
97 Henry Street, Limerick, V94 YC2H
t +353 61 221 200 | w punchconsulting.com

Project: GREAT CONNELL SHD, NEWBRIDGE
Title: PROPOSED OVERALL SURFACE WATER LAYOUT

Drawn:	Date drawn:	Technician Check:	Engineer Check:	Approved:
IBS	AUGUST 2021	PJM	ET	LB

Project No:	Model Ref:	Drawing Status:
192229	192229-PUNCH-XX-XX-M2-C-0160	A0 PLANNING

Scale @ A1:	Document No:	Revision No:
1:1000	192229-PUNCH-XX-XX-DR-C-0160	C02

- The following measures will be used to control the interaction of wash down water from concrete and cementitious material with surface water and groundwater:

  All batching and mixing activities will be located in contained areas;

  Pouring of cementitious materials will be carried out where possible in the dry;

  Pumped concrete will be monitored to ensure no accidental discharge;

  Excess concrete will not be discharged to ground;

  There will be no hosing into the ground surface of spills of concrete, cement, grout or similar materials;

  Washout from mixing plant or concrete trucks will not be permitted on the site.

The surface water outfalls to the existing watercourse and the River Liffey will be constructed in accordance with Inland Fisheries Ireland "Guidelines on the Protection of Fisheries During Construction Works In and Adjacent to Waters 2016"

7.8.3 Operational Stage

The flood mitigation measures incorporated in to the site design will ensure that in the operational stage intense rainfall events will not result in flooding of the units and water displaced by the development will not result in off-site flooding. The flow rate to the drainage ditch and the river will be maintained at greenfield levels.

The provision and maintenance of the Class 1 oil interceptors on the outflow from the attenuation tanks system will ensure that minor leaks that occur in the roads and vehicle parking areas will not adversely affect the water quality in the receiving water courses.

In the areas where the permeable paving is provided the majority of silt is trapped within the top 30mm of the jointing material between the blocks, while the biodegradation of hydrocarbons occurs within the subbase.

The swales will provide treatment via evapotranspiration within the topsoil layers with water compatible vegetation. Infiltration into the ground below is feasible due to the permeable sand and gravel layers below. Low level earth dams will be provided along the swales to enable build-up of water for treatment.

The permeable paving, soakaways and swales in conjunction with the open amenity space will allow the infiltration of rainfall to ground which will act as recharge to the aquifer.

7.9 Monitoring

In the construction stage the Ecologicl Clerk of Works will complete regular inspections ot the works are to ensure that the appropriate buffer distances are maintained between the water courses and that materials handling and storage are in accordance with the Preliminary CEMP. Monitoring will not be required in the operational stage.

7.10 Cumulative Impacts

To the south-west, across the River Liffey, a 343 unit residential development (Belin Wood) is currently under construction on an 18.4ha site. In November 2021, Barola Capital DAC was granted planning permission for a warehouse, office and ancillary buildings on a 15.42 ha site to the north-east of the proposed development.

Both permitted developments involve the construction of impermeable areas and the provision of new storm water drainage systems. Both will result in an increase in the volume of rainwater run-off compared to greenfield conditions; however design mitigation measures ensure that the run-off rate does not exceed greenfield rates and that the quality of the run-off will not be significantly affected. Both will also result in a reduction in groundwater recharge.

7.11 Residual Impacts

7.11.1 Flood Risk

The JBA flood risk assessment identified the main sources of residual risk to the development as structure blockage and failure of the upstream dams. JBA considered the potential risk of blockage for the proposed bridge and concluded that the bridge abutments and piers, which have a span of 40m and are located outside of the riverbed, greatly reduce the potential for blockage and therefore the risk of blockage is considered low.

JBA identified a failure of the ESB Golden Falls and/or Pollaphuca dams as the second residual risk. JBA tested a high flow scenario, where the 1% flows were increased by over 60m³/s. This high flow scenario is above both the 0.1% AEP event and the climate change event. Even with this increase there is still a minimum of 170mm freeboard above the proposed FFL.

7.11.2 Surface Water

The development will result in an increase in the volume of rainwater run-off from the site compared to baseline conditions; however the surface water drainage system is designed to maintain the run-off flows at greenfield rates. The oil interceptors should ensure that run-off from the development will not adversely impact on surface water quality. The residual impacts will be imperceptible, negative and long term.

7.11.3 Groundwater

The development will result in a reduction in groundwater recharge due to the provision of impermeable roads and buildings. However this will be somewhat off-set by the retention of open space and the provision of, soakways swales and permeable paving which will allow rainfall to infiltrate to ground.

The design of the permeable paving minimises the risk of contamination associated with the minor oil leaks that can occur in vehicle parking areas infiltrating to groundwater. Of the total site (27.64 ha) approximately 16ha (57.9%) will be covered with impermeable surfaces with approximately 12.64 ha (45.7%) remaining permeable. Therefore there will be a corresponding 57.9% reduction in recharge.

The development will have an imperceptible, negative, long term impact on the qualitative and quantitative status of the aquifer beneath the site.

7.11.4 Summary of Residual Effects

Likely Significant Effect	Quality	Significance	Extent	Probability	Duration
Construction Stage					
Hydrology Water Quality	Negative	Imperceptible	River Liffey	Unlikely	Temporary
Groundwater Quality	Negative	Imperceptible	Bedrock Aquifer	Unlikely	Temporary
Operational Stage					
Hydrology Water Quality	Negative	Imperceptible	River Liffey	Unlikely	Temporary
Hydrology Flooding	Negative	Imperceptible	Development Site	Unlikely	Temporary
Groundwater Qualitative Status	Negative	Imperceptible	Bedrock Aquifer	Unlikely	Long Term
Groundwater Quantitative Status	Negative	Imperceptible	Bedrock Aquifer	Likely	Long Term

7.12 References

EPA WFD Water Flow Network Maps, WFD River Waterbodies Risk, WFD Groundwater bodies Status (viewer data access) https://gis.epa.ie/EPAMaps/

GSI Groundwater Resources Bedrock Aquifers 1:100000, Groundwater Resources Sand and Gravel Aquifers 1:40000, Groundwater Wells and Springs, Groundwater Vulnerability Map 1:40000 (viewer data access)
https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=bc0dba38f3f5477c8fd400f66b5eedcd/

EPA Catchment Science & Management Unit (2021), Liffey River and Dublin Bay Catchment Report, WFD 3rd Cycle
https://catchments.ie/wpcontent/files/catchmentassessments/09%20Liffey%20and%20Dublin%20Bay%20Catchment%20Summary%20WFD%20Cycle%203.pdf

Kildare County Council, Newbridge Local Area Plan, The Newbridge Strategic Flood Risk Assessment (2013)
https://www.kildare.ie/CountyCouncil/AllServices/Planning/LocalAreaPlans/LocalAreaPlans/NewbridgeLAP2013-2019/Draft%20SFRA.pdf

Kildare County Council, Strategic Flood Risk Assessment of the Kildare County Development Plan 2017-2023
https://www.kildare.ie/CountyCouncil/AllServices/Planning/DevelopmentPlans/KildareCountyDevelopmentPlan2017-2023/EnviromentalReports/SFRA%20Report.pdf

8 BIODIVERSITY

8.1 Introduction

This Chapter describes the biodiversity of the site and the impacts the proposed development will have on flora (plants), fauna (animals), and habitats in both the terrestrial and aquatic environment. The biodiversity assessment addresses the potential likely significant direct, indirect and cumulative effects of the proposed development, evaluates the need for prevention and mitigation measure and monitoring to avoid or minimise adverse effects, describes those measures and evaluates the residual impacts. It also assesses the baseline scenario.

Chapter 3 Project Characteristics, provides a full description of the proposed development. An Appropriate Assessment (AA) Screening and Natura Impact Statement (NIS) have also been prepared and these will be submitted to An Bord Pleanála as part of the planning application documentation.

The potential effects on biodiversity in this chapter should be considered in conjunction with the other chapters of the EIAR including Chapter 3 Project Characteristics, Chapter 6 Climate, Chapter 7 Land, Geology, Chapter 8 Water, Chapter 10 Air, Chapter 12 Population & Human Health – Noise & Vibration, Chapter 13 Land & Visual Impact, Chapter 15 Material Assets – Services, Chapter 17 Interaction of the Foregoing and the Construction Environmental Management Plan (CEMP) in Appendix 3.

The Chapter was prepared by Carl Dixon MSc (Ecological Monitoring) and Dr. Sorcha Sheehy PhD (Ecology/ornithology). Fieldwork was conducted by Cian Gill MSc (Ecological Monitoring) and Mark Donnelly BSc (Forestry).

Carl Dixon MSc (Ecology) is a senior ecologist who has over 25 years' experience in ecological and water quality assessments. Mr. Dixon holds an Honours Degree (BSc) in Ecology and a Masters (MSc) in Ecological Monitoring from UCC. Prior to setting up DixonBrosnan Environmental Consultants in 2000, he managed Core Environmental Services which included Rural Environmental Protection Scheme (REPS) planning for landowners and ecological assessments.

Mr. Dixon has particular experience in freshwater ecology including electrofishing fish stock assessments and water quality assessments. He also has considerable experience in habitat mapping and mammal ecology including survey work and reporting in relation to badgers and bats. Other competencies include surveys for invasive species and bird surveys. He has extensive experience with regards to EIAR and NIS mitigation and impact assessment. He has particular experience in large-scale industrial developments with extensive experience in complex assessments as part of multi-disciplinary teams. Such projects include gas pipelines, incinerators, electrical cable routes, oil refineries and quarries.

Dr. Sorcha Sheehy PhD (ecology/ornithology) is an experienced ecological consultant specialising in bird behaviour. Ms Sheehy received a BSc in Applied Ecology from UCC and subsequently went on to receive a PhD in behavioural ornithology at UCC. During her PhD research, she studied bird-aircraft collision with a particular focus on bird behaviour, included field-based behavioural observations at airports, bird cadaver examination and collision classification and the use of radar tracking to model collision risk. Sorcha has worked for over 12 years in a professional ecology role and specialises in the coordination of ecology projects and assessments. She has coordinated and contributed to Habitats Directive Assessments (AA screenings and NIS) and Environmental Impact Assessment Reports (EIAR) for a range of small and large-scale projects with particular expertise in assessing impacts on birds.

Notable projects include Arklow Bank Wind Park, Shannon Technology and Energy Park and Waste to Energy Facility Ringaskiddy.

Mark Donnelly (Forestry) holds a BSc. Hons in Forestry from Bangor University, Wales, and is a member of the Institute of Chartered Foresters. He worked as an arboricultural consultant for the National Trust in Wales for 22 years and was a lecturer in Forest Ecology at Bangor University. In Ireland, he has completed landscape assessments for a range of projects including wind farms, quarries, local authorities, housing developments, roads and pipelines.

Cian Gill MSc (Ecology) is a qualified ecologist with ten years' experience working with wildlife and ecology-based NGOs and public bodies in Ireland, the UK and the US. Past projects include invasive species planning for the city of Rosemount, Minnesota, and the Under The Sea project for Essex Wildlife Trust. Recent projects include ecological reports for Cork-based housing and private developments.

8.2 Relevant Legislation & Guidance

The legislation and guidance relating to EIA are in Sections 1.2 and 1.5. The following legislation and guidance were taken into consideration in the completion of this Chapter.

8.2.1 Legislation

Flora and fauna in Ireland are protected at a national level by the Wildlife Act 1976, as amended, and the European Communities (Birds and Natural Habitats) Regulations 2011. They are also protected at a European level by the EU Habitats Directive (92/43/EEC) and the EU Birds Directive (2009/147/EC).

Under this legislation, sites of nature conservation importance are then designated in order to legally protect faunal and floral species and important/vulnerable habitats.

The relevant categories of designation are as follows:

- Special Areas of Conservation (SAC) are designated under the European Communities (Birds and Natural Habitats) Regulations 2011 to meet the EU Habitats Directive (92/43/EEC);
- Special Protection Areas (SPAs) are designated under the EU Birds Directive (79/409/EEC) amended in 2009 as the Directive 2009/147/EC; and
- Natural Heritage Areas (NHAs) and Proposed Natural Heritage Areas (pNHA) are listed under the Wildlife (Amendment) Act 2000. A NHA is designated for its wildlife value and receives statutory protection. A list of proposed NHAs (pNHAs) was published on a non-statutory basis in 1995, but these have not since been statutorily proposed or designated.

Relevant European Legislation

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (The Habitats Directive);
- Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds (The Birds Directive);
- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (The Water Framework Directive);

- Directive 2006/44/EC of the European Parliament and of the Council of 6 September 2006 on the quality of fresh waters needing protection or improvement in order to support fish life (The Fish Directive (consolidated)).

Relevant Irish Legislation

- The Wildlife Act 1976, as amended by the Wildlife Act 1976 (Protection of Wild Animals) Regulations, 1980, the Wildlife (Amendment) Act 2000, the Wildlife (Amendment) Act 2010, Wildlife (Amendment) Act 2012, European Communities (Wildlife Act, 1976) (Amendment) Regulations 2017. (The Wildlife Act);
- European Communities (Conservation of Wild Birds) Regulations 1985 (S.I. 291/1985) as amended by S.I. 31/1995;
- European Communities (Natural Habitats) Regulations, S.I. 94/1997 as amended by S.I. 233/1998 & S.I. 378/2005 (The Habitats Regulations);
- Fisheries (Consolidation) Act, 1959 (as amended), hereafter referred to as the Fisheries Act;
- European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477/2011);
- The Flora (Protection) Order, 2015 (S.I. No. 356/2015).

8.2.2 Guidance

The assessment had regard to the guidance documents on EIA listed in Section 1.5 and the following that are relevant to the assessment of biodiversity

- *Guidelines on Ecological Impact Assessment in the UK and Ireland, 2nd edition* (Chartered Institute of Ecology and Environmental Management CIEEM 2016)
- *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, Version 1.1* (CIEEM, 2018).
- *Managing Natura 2000 Sites: The Provision of Article 6 of the Habitats Directive 92/43/EEC* (EC Environment Directorate-General, 2018);
- *Guidance on integrating climate changes and biodiversity into environmental impact assessment* (EU Commission 2013);
- *Assessment of plans & projects in relation to N2K sites – Methodological Guidance* (EC 2021);
- *Guidance document on the strict protection of animal species of Community interest under the Habitats Directive* (EC 2021);
- *Guidelines for Assessment of Ecological Impacts of National Road Schemes (National Roads Authority* (NRA) 2009);
- *Best Practice Guidance for Habitat Survey and Mapping* (Heritage Council, 2011);
- *A Guide to Habitats in Ireland* (Fossitt, 2000);

- *Guidelines for the treatment of Badgers prior to the construction of National Road Schemes. National Roads Authority, Dublin* (National Roads Authority (NRA) 2005a);

- *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes* (National Roads Authority (NRA) 2005b).

- *Guidelines for the treatment of bats during the construction of national road schemes* (National Roads Authority (NRA) 2005c);

- *Guidelines for the protection and preservation of trees, hedgerows and scrub prior to, during and post construction of national road schemes*. (National Roads Authority (NRA) 2006).

- *Guidelines for the treatment of Otters prior to the construction of National Road Schemes* (National Roads Authority (NRA) 2008);

- *Bird Census Techniques* Bibby, C.J., Burgess, N.D., Hill, D.A. & Mustoe, S.H. (2000)

- *Bird Monitoring Methods - a Manual of Techniques for Key UK Species*. Gilbert, G., Gibbons, D.W. & Evans, J. (1998) and

- *Bat Surveys for Professional Ecologists: Good Practice Guidelines* (3rd ed)' (Collins, 2016)

8.3 Methodology

The assessment was carried out in three stages:

1. Desktop assessment to determine existing information and records in relation to:

    - Sites, species, and habitats protected under Council Directive 92/43/EEC (Habitats Directive), and sites and species protected under Council Directive 2009/147/EC (Birds Directive), within the Zone of Influence (ZoI) of the proposed development and more distant hydrologically linked sites. The ZoI comprises the area within which the proposed development has the potential to affect the conservation objectives (or qualifying interests) of a Natura 2000 site.

    - Biodiversity, habitats, and species present near the proposed development.

2. Site visits and field surveys by the specialist ecologists to establish the existing ecological conditions within the footprint of the proposed development and within the vicinity of all the proposed development elements.

3. Evaluation of the proposed development and determination of the scale and extent of potential likely direct and indirect significant effects on biodiversity (i.e., flora, fauna, and habitats) and the identification of appropriate mitigation and monitoring which may be required.

8.3.1 Desktop Study

The desktop study collated the available information on the local ecological environment to identify features of ecological value within the proposed development boundary and those near to it that have the potential to be affected by the proposed development. The review allows the key ecological issues

to be identified early in the assessment process and facilitates the planning of surveys. The study information sources included:

- National Parks and Wildlife Service (NPWS) - www.npws.ie;
- Environmental Protection Agency (EPA) – www.epa.ie;
- National Biodiversity Data Centre (NBDC) – www.biodiversityireland.ie;
- Bat Conservation Ireland - www.batconservationireland.org;
- Birdwatch Ireland - www.birdwatchireland.ie
- National Biodiversity Action Plan 2017-2021 (NPWS 2017).
- Kildare County Development Plan 2017-2023
- County Kildare Biodiversity Plan
- Newbridge Biodiversity Action Plan 2021-2025

8.3.2 Site Surveys

Survey surveys were carried out on the 3rd December 2020, 19th May 2021, 9th September 2021 and 8th March 2022 to identify the habitats, flora and fauna present at the site. The survey area included all lands within the proposed development site boundary as shown on Drawing No PA-002. The following surveys were completed:

- Habitat mapping was carried out in line with the methodology outlined in the Heritage Council Publication, Best Practice Guidance for Habitat Survey and Mapping (Heritage Council, 2011). The terrestrial and aquatic habitats within or adjacent to the proposed development site was classified using the classification scheme outlined in the Heritage council publication A Guide to Habitats in Ireland (Fossitt, 2000) and cross referenced with Annex I Habitats where required. The survey results are representative of the habitats within the application site and include the dominant and characteristic species of flora. Invasive species were also recorded.

  The survey results are representative of the habitats within the application site and include the dominant and characteristic species of flora.

- The breeding bird survey was based on the British Trust for Ornithology (BTO) Common Bird Census (CBC) methodology and Breeding Bird Survey (BBS) (Gilbert *et al*. 1998 and Bibby *et al.* 2000) which aims to capture a snapshot of breeding bird activity within a survey area. The survey focused on terrestrial habitats within the development boundary.

  Visits were made during favourable weather conditions and all habitats within 50m of all potential nesting features were surveyed. The ornithological surveyor slowly walked through the site, stopping at regular intervals to scan with binoculars and to listen for bird calls or song. Birds were identified by sight and song. All species seen or heard in the survey area and immediate environs were recorded, including those in flight. .

- General mammal surveys were conducted in conjunction with the habitat surveys. The surveys focused on protected mammal species (Wildlife Act 1976, as amended) in particular on Badger *Meles meles* and Otter *Lutra lutra* and identifying potential habitat for bats (NRA 2005a, NRA 2005b, NRA 2005c, NRA 2008).

  Field signs of Badger are characteristic and sometimes quite obvious and include tufts of hair caught on barbed wire fences, conspicuous Badger paths, footprints, small excavated pits or latrines in which droppings are deposited, scratch marks on trees, and snuffle holes, which are small scrapes where Badgers have searched for insects and plant tubers.

  The Otter survey methodology followed the guidance in NRA (2008) and included searches for breeding or resting sites within 150m of the proposed development site boundary. The River Liffey as well as internal drainage channels were assessed for signs of Otter and evidence including spraints, footprints, or feeding remains, was recorded where present.

- A bat survey was carried out using the guidance set out in '*Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd ed)*' (Collins, 2016). Bat activity surveys were conducted within the proposed development boundary under suitable weather conditions for bats (air temperature >14°C approximately, still conditions). A night-time bat survey was carried out on the 19 May 2021 using a Batbox Duet and Echo Meter Touch Bat Detector. Dusk activity surveys commenced at 15 minutes before sunset and ended two hours after sunset (Collins 2016).

  The objectives of the surveys were to assess usage of structures and habitats located within the proposed development boundary and identify foraging and/or commuting routes i.e. hedgerows/treelines, riparian habitats, River Liffey etc.

The site visits and surveys were carried out in accordance with best practice and, in the expert opinion of the authors, are considered sufficient to assess the potential significant ecological effects associated with the proposed development. The standard literature was checked for reference to the site and locality, as were the listings of sites of conservation importance in Kildare held by the NPWS of the Department of the Environment, Heritage and Local Government (www.npws.ie).

8.3.3 Assessment of Impacts

Section 1.6 of this EIAR lists the definitions[11] used to assess the effects of the proposed development. Annex III of the amended Directive 2014/52/EU requires that the EIAR should assess:

The magnitude and spatial extent of the impact (for example geographical area and size of the population likely to be affected)

- The nature of the impact
- The transboundary nature of the impact
- The intensity and complexity of the impact
- The probability of the impact
- The expected onset, duration, frequency and reversibility of the impact

[11] Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017).

- The cumulation of the impact with the impacts of other existing and/or approved projects and
- The possibility of effectively reducing the impact.

Potential effects of the construction, operational and decommissioning phases of proposed development on biodiversity include:

- Potential Effects on Habitats
- Potential Effects on Mammals
- Potential Effects on Birds
- Potential Effects on Amphibians and Reptiles
- Potential Effects on Other Species
- Potential Effects on Amphibians and Reptiles
- Potential Effects from Non-native Invasive Species
- Potential Effects on Water Quality and Aquatic Ecology

In relation to the assessment of the 'extent' & context' Dixon Brosnan adopted the geographic frame of reference applied to determining impact significance by the NRA (2009) in Ireland and CIEEM (2019) in Ireland and the UK, in tandem with the EPA's qualitative significance criteria.

A geographic frame of reference is a good fit for the assessment of biodiversity impacts because it allows clear judgements to be made about the scale of significance, with reference to published estimates for the population size of a given species at county, national and / or international scales or areas of habitats at such scales. The proportion of a known feature impacted at county scale (i.e., 1% of the known or estimated population in a given county) is measurably different from that impacted at national scale (i.e., 1 % of the known or estimated national population).

Table 8.1 compares the qualitative versus geographic approaches to determining the significance of effects.

Table 8.1. Definitions of Significance of Effects Using a Geographic vs. Qualitative Scale of Reference

Geographic Scale of Significance (NRA, 2009; CIEEM, 2019)	**Qualitative Scale of Significance of Effects (EPA 2017)**
Negligible or Local Importance (Lower Value). No significant effects predicted to significant ecological features.	Imperceptible. An effect capable of measurement but without significant consequences. Not significant. An effect which causes noticeable changes in the character of the environment but without significant consequences.
Local Importance (Higher Value), County, National, Regional, or International.	Slight / Moderate / Significant / Very Significant / Profound i.e. effects can be slight, moderate, significant, very significant, or profound at Local scale, subject to the proportion of the local population/habitat area affected.

8.3.4 Consultation

The consultation process which informed the scope of this EIAR is described in Section 1.10 . No specific comments or guidance with regard to biodiversity were provided during the consultation process, with the exception of a request from Kildare County Council that the installation of the surface water outfalls to the drainage ditch and the Liffey be carried out in accordance with IFI Guidance.

8.4 Development Description

Chapter 3 presents a detailed description of the proposed development and those aspects that are relevant to biodiversity are described in this section.

The proposed residential development provides for 569 residential dwellings and supporting commercial development in Great Connell, Newbridge. To facilitate the development it is necessary to demolish the existing structures on the site which comprise; 'Great Connell' a two-storey dwelling of 331.9 sqm with detached single storey garage and outhouses of 48 sqm; 'Valencia Lodge' a single storey dwelling of 135.6 sqm with a single storey garage of 17.8 sqm; two no. single storey sheds of 1,440 sqm and 595 sqm, and a three-sided shed of 54 sqm.

A total of 18 no. landscaped public open spaces will be provided including, Central Parks, Linear Park and a Local Square/Civic Square. Together these open spaces have a net area of 2.595 ha and exclude the areas of the proposed swales and any area less than 10 metres wide. In addition, the scheme includes an 8.31 ha Ecological River Park in the riparian area of the River Liffey.

8.5 Receiving Environment

8.5.1 General Landscape

The development site is approximately 1km southwest of Newbridge town centre. The M7 motorway is approximately 1.2km south of the site. Lands to the north, east and west are dominated by existing urban development which includes residential dwellings and retail developments. The lands to the south and southwest are largely agricultural, with a mixture of tillage and pasture.

The River Liffey flows through the southwestern corner of the site, with an area of treelines and woodland along its boundary. A drainage ditch at the centre of the site connects to another drainage ditch on the northern boundary, which ultimately flows into the River Liffey to the west of the proposed development site boundary. The Ryston Sports and Social Club is located just west of the site on the other side of the River Liffey.

The proposed development site covers an area of 27.64 ha, most of which is used for tillage. Three former agricultural buildings are located in centre of the site. There is a former residential dwelling is located along the eastern boundary and a second residence in the north-east corner of the site.

8.5.2 Designated Sites/Conservation Areas

European Sites

The SACs, candidate SACs and SPAs protected under the European Communities (Birds and Natural Habitats) Regulations 2011, as amended are collectively referred to as Natura 2000 or European sites.

All of the Natura 2000 Sites and Conservation Areas (NHA and pNHA) that could potentially be affected by the proposed development were identified in accordance with the European Commission Methodological Guidance (EC 2018). These are listed in Table 8.2 and their locations are shown on Figures 8.1 and 8.2.

The proposed development is not located within a Natura 2000 Site. A potential source-pathway-receptor (S-P-R) risk assessment identified a potential S-P-R link between the proposed development (S) and five Natura 2000 sites (R) (South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA, South Dublin Bay & River Tolka Estuary SPA and Poulaphuca Reservoir SPA). The potential pathway (P) pathways (discharge of surface water run-off during construction/operation, wastewater discharges during operation and operation and the spread of invasive species).

Details on each of the Natura Sites that are potentially susceptible to impacts associated with the proposed development are provided below.

Table 8.2. Designated Sites within the ZoI of the Proposed Development Natura 2000 Sites	**Site Code**	**Distance at closest point and potential source-pathway-receptor link**
Special Area of Conservation (SAC)		
Pollardstown Fen SAC	000396	2.6km west/northwest.
Mouds Bog SAC	002331	3.2km north
Ballynafagh Lake SAC	001387	10.5km north
Ballynafagh Bog SAC	000391	12.4km north
River Barrow and River Nore SAC	002162	12.9km southwest
South Dublin Bay SAC	000210	43.6km northeast (59.2km downstream)
North Dublin Bay SAC	000206	45.4km northeast (61.8km downstream)
Special Protection Area (SPA)		
Poulaphuca Reservoir SPA	004063	14.7km southeast.
South Dublin Bay and River Tolka Estuary SPA	004024	41.8km northeast (59.2km downstream)
North Bull Island SPA	004006	43.0km northeast (61.8km downstream)
Natural Heritage Area (NHA)/proposed Natural Heritage Area (pNHA)		
Curragh Kildare pNHA	000392	2.6km southwest
Grand Canal pNHA	002104	2.7km southeast
Pollardstown Fen pNHA	000396	2.6km northwest
Liffey Bank Above Athgarven	001396	3.0km south
Mouds Bog pNHA	000395	3.2km north

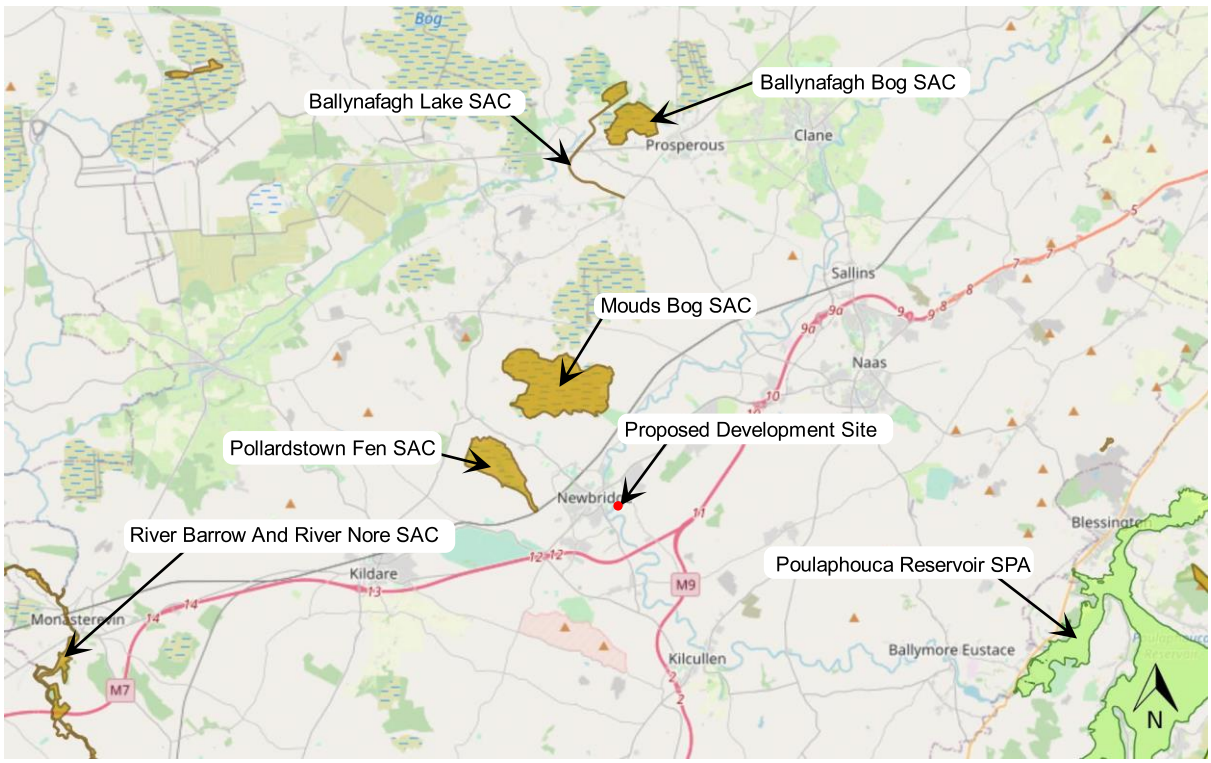


Figure 8.1. Location of the Proposed Development Site and Natura 2000 sites within the potential ZoI Source: EPA Envision mapping https://gis.epa.ie/EPAMaps/) | Not to scale

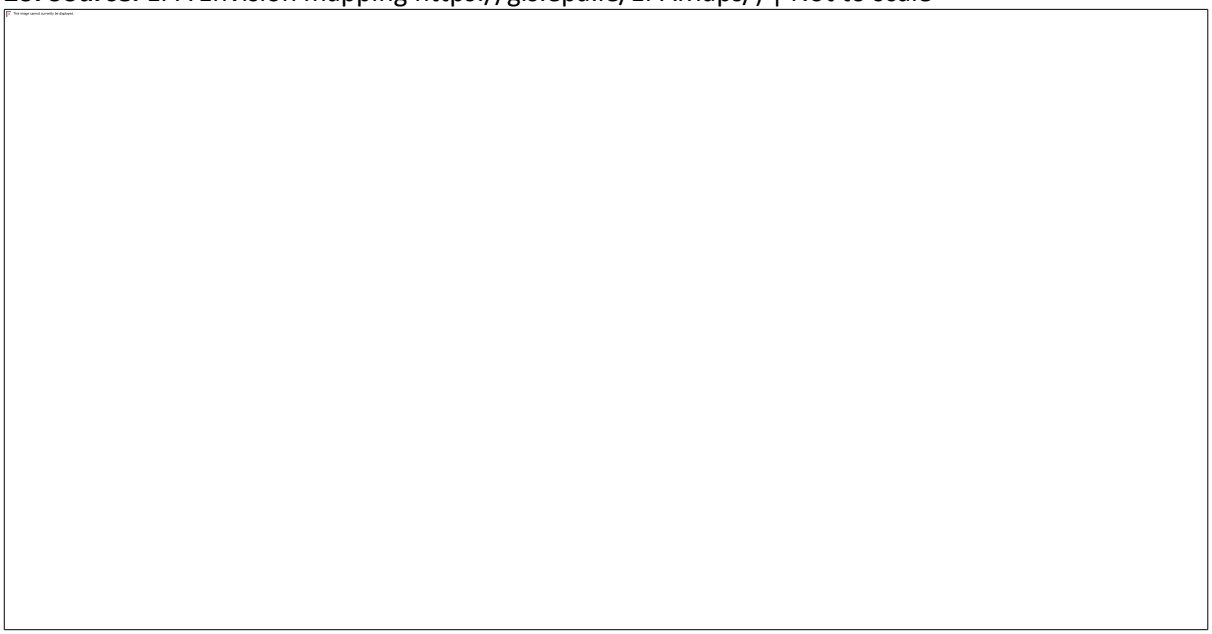


Figure 8.2. Location of the Proposed Development site and Natura 2000 sites within potential ZoI Source: EPA Envision mapping https://gis.epa.ie/EPAMaps/) | Not to scale

North Bull Island SAC

The North Bull Island SAC sand spit is a relatively recent depositional feature, formed as a result of improvements to Dublin Port during the 18th and 19th centuries. The North Bull Island dune system is one of the most important systems on the east coast and is one of the few in Ireland that is actively accreting. It possesses extensive and mostly good quality examples of embryonic, shifting marram and fixed dunes, as well as excellent examples of humid dune slacks.

Both Atlantic and Mediterranean salt marshes are well represented and a particularly good marsh zonation is shown. The salt marshes grade into mudflats and sandflats, some of which are dominated by annual Salicornia species. *Petalophyllum ralfsii* occurs at its only known station away from the western seaboard. The site has five Red Data Book vascular plant species and four Red Data Book bryophyte species.

The site is one of the most important sites for wintering waterfowl in Ireland, with internationally important populations of *Branta bernicla horta*, *Calidris canutus* and *Limosa lapponica*, plus nationally important numbers of a further 14 species. 20% of the national total of *Pluvialis squatarola* occurs here. Formerly it had important colony of *Sterna albifrons*.

North Dublin Bay SAC

North Dublin Bay is nationally important for three insect species. The scientific interests of the site have been well documented and future prospects are good owing to the various designations assigned to site.

South Dublin Bay SAC

The intertidal South Dublin Bay SAC extends from the South Wall at Dublin Port to the West Pier at Dun Laoghaire, a distance of approximately 5 km. At their widest, the intertidal flats extend for almost 3 km. The seaward boundary is marked by the low tide mark, while the landward boundary is now almost entirely artificially embanked.

The site possesses a fine and fairly extensive example of intertidal flats. Sediment type is predominantly sand, with muddy sands in the more sheltered areas. A typical macro-invertebrate fauna exists.

It has the largest stand of Zostera on the east coast and supports part of the important wintering waterfowl populations of Dublin Bay and regularly has an internationally population of *Branta bernicila horta*, plus nationally important numbers of at least a further 6 species, including *Limosa lapponica*. It is a regular autumn roosting ground for significant numbers of *Sterna* terns, including *S. dougallii*. The scientific interests of the site have been well documented.

North Bull Island SPA

The North Bull Island SPA sand spit is a relatively recent depositional feature, formed as a result of improvements to Dublin Port during the 18th and 19th centuries. It is almost 5km long and 1km wide and runs parallel to the coast between Clontarf and Sutton. The site is among the top ten sites for wintering waterfowl in the country.

The site provides both feeding and roosting areas for the waterfowl species. It supports internationally important populations of *Branta bernicila hrota* and *Limosa lapponica* and is the top site in the country for both of these species. A further 14 species have populations of national importance, with particular notable numbers of *Tadorna tadorna* (8.5% of national total), *Anas acuta* (11.6% of national total), *Pluvialis squatarola* (6.9% of national total), *Calidris canutus* (10.5% of national total). North Bull Island SPA is a regular site for passage waders such as *Philomachus pugnax, Calidris ferruginea* and *Tringa erythropus*. The site supports *Asio flammeus* in winter. Formerly the site had an important colony of *Sterna albifrons* but breeding has not occurred in recent years.

Habitat quality for most of the estuarine habitats is very good. The site has a population of the rare *Petalophyllum ralfsii* which is the only known station away from the western seaboard as well as five

Red Data Book vascular plant species and four bryophyte species. It is nationally important for three insect species.

South Dublin Bay and River Tolka SPA

The South Dublin Bay and River Tolka Estuary SPA site comprises a substantial part of Dublin Bay. It includes virtually all of the intertidal area in the South Bay, as well as much of the Tolka Estuary to the north of the River Liffey. The site possesses extensive intertidal flats which support wintering waterfowl which are part of the overall Dublin Bay population. It regularly has an internationally important population of *Branta bernicla hrota*, which feeds on *Zostera noltii* in the autumn.

It has nationally important numbers of a further 6 species: *Haematopus ostralegus, Charadrius hiaticula, Calidris canutus, Calidris alba, Calidris alpina* and *Limosa lapponica*. It is an important site for wintering gulls, especially *Larus ridibundus* and *Larus canus*. South Dublin Bay is the premier site in Ireland for *Larus melanocephalus*, with up to 20 birds present at times. It is a regular autumn roosting ground for significant numbers of terns, including *Sterna dougallii, S. hirundo* and S*. paradisaea*.

Poulaphouca Reservoir SPA

Poulaphouca Reservoir SPA, located in the western foothills of the Wicklow Mountains, was created in 1944 by damming of the River Liffey to generate electricity from hydropower. The reservoir covers approximately 20 square kilometres and is the largest inland water body in the mid- east and south-east regions. The reservoir receives water from two main sources, the River Liffey at the northern end, and the Kings River at the southern end. The site is an SPA for special conservation interest for the following species: Greylag Goose and Lesser Black- backed Gull.

The potential impacts on designated Natura 2000 sites (SAC/cSAC/SPA) are specifically addressed in the Report in Support of Appropriate Assessment (AA) Screening Report and Natura Impact Statement (NIS) which are in Appendices 6 and 7 respectively.

The AA Screening Report concludes:

Although the likelihood of effects on the South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA is low, using an abundance of caution potential impact pathways have been identified and a NIS is being prepared for the proposed development.

The NIS concludes:

It has been objectively concluded following an examination, analysis and evaluation of the relevant information, including in particular the nature of the predicted effects from the proposed development and with the implementation of the mitigation measures proposed, that the construction and operation of the proposed development will not adversely affect (either directly or indirectly) the integrity of any European site, either alone or in combination with other plans or projects. There is no reasonable scientific doubt in relation to this conclusion. The competent authority will make the final determination in this regard.

Nationally Protected Sites

The Natural Heritage Areas (pNHAs) located in the vicinity of the proposed development site are and are shown in **Figure** 8.3.

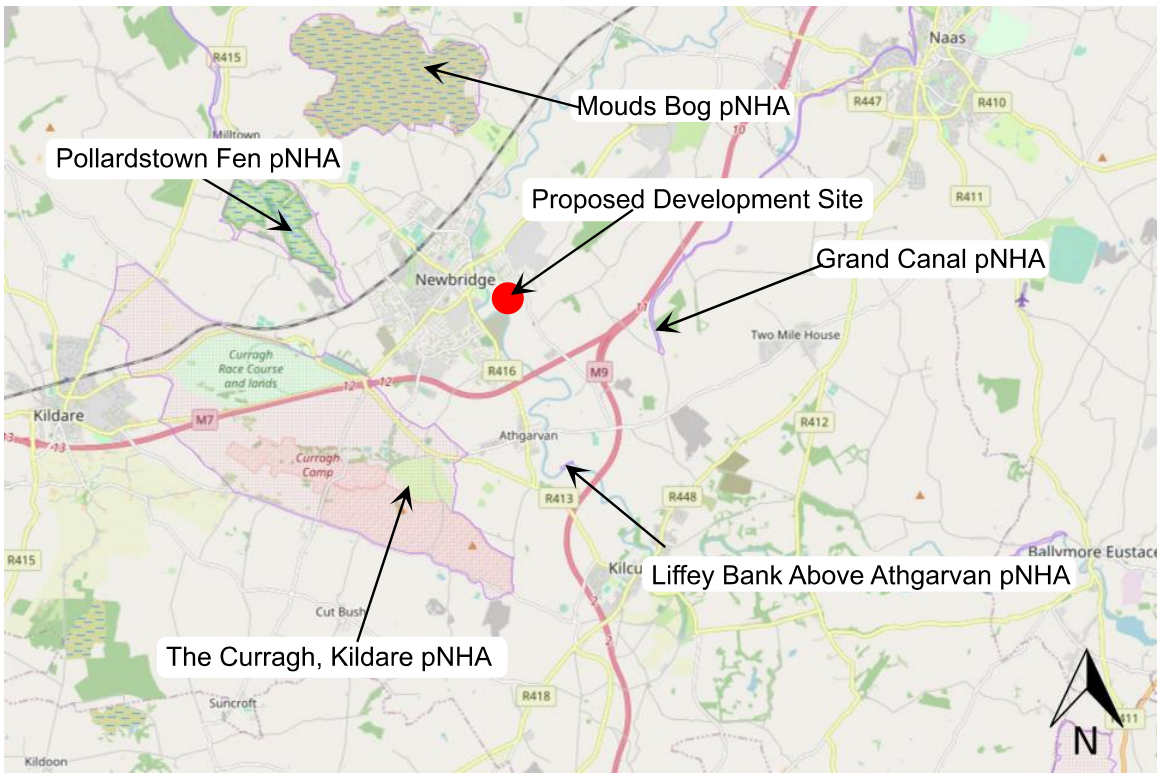


Figure 8.3 Natural Heritage Areas (NHA) in the vicinity of the Proposed Development Site | Source EPA envision mapping | Not to scale

While the proposed development site is located in proximity to a number of pNHAs, it is not hydrologically connected to any of them. Pollardstown Fen pNHA (site code 00396) and Moud's Bog Fen SAC (site code 000395) are 2.6km northwest and 3.2km north respectively from the proposed development site. Although these pNHAs are within the Liffey catchment, they are upstream of the proposed development site and in separate sub catchments.

The Curragh Kildare pNHA (site code 000392), Liffey Bank Above Athgarven pNHA (site code 001396) and the Grand Canal pNHA (site code 002104) are also located upstream of the proposed development site. There is no hydrological or hydrogeological pathway between these pNHAs and the proposed development site and therefore no pathway for impact has been identified.

8.5.3 Habitats

The ecological value of habitats was defined using the classification scheme outlined in the *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (National Roads Authority, 2009) which is in Appendix 8.

The value of a habitat is site specific and partially related to the amount of that habitat in the surrounding landscape. Habitats that are considered to be good examples of Annex I and Priority habitats are classed as being of International or National Importance. Semi-natural habitats with high biodiversity in a county context and that are vulnerable are considered to be of County Importance. Habitats that are semi-natural, or locally important for wildlife, are considered to be of Local Importance (higher value) and sites containing small areas of semi-natural habitat or maintain connectivity between habitats are considered to be of Local Importance (lower value).

An overview of habitats recorded within the site is shown in Figure 8.4. The habitats recorded onsite, as well as their ecological value is detailed in Table 8.2. Site photographs are in Appendix 9. No rare

plant species were recorded during the site survey and given the modified nature of the habitats within the proposed development area, they are unlikely to occur.

Table 8.2. Habitats Within the Proposed Development Site

Habitat	Comments	Habitat value (NRA Guidelines)
Arable Crops BC1	The primary land use is for arable crops. The most common crop is Spring Barley *Hordeum vulgare*, which has been sown as a monocrop over much of the site area. Fields cultivated for arable crops are characterised by a limited diversity of grasses and herbaceous species. Species noted including Common Poppy *Papaver rhoes* and Common Field-Speedwell *Veronica persica* which are common weed species of this type of agricultural land. This habitat does not have links to Annex I habitat.	**Local importance (Lower value)**
Dry meadow and grassy verges GS2	This habitat has developed on a bank between an existing hedgerow and drain. This habitat is dominated by common species including Cocksfoot *Dactylis glomerata*, Common Vetch *Vicia sativa* and Bramble *Rubus fruiticosus*. In absence of active management scrub species are likely to become more dominant. Dry meadow and grassy verge loosely corresponds to the annexed habitat, 'lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) (6510)'. The dry meadow and grassy verge habitat within the study area is not a valuable example of this habitat type.	**Local importance (Higher value)**
Dry meadow and grassy verges GS2/Tall Herb Swamp FS2	The section of the site south of the river is a mosaic of formerly grazed grassland and tall herb swamp vegetation along the riverbank. Currently this habitat is not either actively managed or grazed with a preponderance of coarse grasses including False Oat Grass *Arrhenatherum elatius* and Cock's Foot *Dactylus glomerata* are common. Links with Annex I: *Corresponds to the annexed habitat, 'lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) (6510)'.* Areas of this habitat closer to the riverbank have some characteristics of tall herb swamp. These areas are occasionally waterlogged. They are	**Local importance (Higher value)**

Habitat	Comments	Habitat value (NRA Guidelines)
	dominated by Fool's Watercress *Apium nodiflorum* and Hemlock Water Droplet *Oenanthe crocata.* Patches of Soft Rush *Juncus effusus* and Common Reed *Phragmites australis* are present but not dominant. Occasional trees, particularly Willow *Salix sp.,* are present with a small copse of Hawthorn *Crataegus monogynus* was also noted. Links with Annex I: Tall-herb swamps can include pockets of the annexed habitat 'hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)'. In Ireland, however, stands of the latter are usually fragmented and poorly developed. This is not a valuable example of this habitat type.	
Hedgerows WL1/ Treelines WL2/	The site is generally bordered by hedgerows and treelines. These linear vegetated boundaries are not homogenous. Those along the southern and western boundaries of the site are classified as treelines, with taller trees (5m+). The dominant mature trees include Beech *Fagus sylvatica*, Sycamore *Acer pseudoplatanus* and Scots Pine *Pinus sylvestris*. Poplar *Populus sp.* also occurs. Understorey species include Bramble *Rubus fruticosus*, Elder *Sambucus nigra*, Cleavers *Galium aparine* and Common Vetch. Along the northern and eastern borders, linear vegetation is thinner and generally under 5m in height and these linear features are classified as hedgerows. The occasional, trees recorded include those mentioned above as well as Hawthorn and Sessile Oak *Quercus petraea*. Scrub vegetation is common and dominates in parts. Species noted include Rosebay Willowherb *Chamaenerion angustifolium*, Cow Parsley *Anthriscus sylvestris*, Guelder-Rose *Viburnum opulus*, Hedge Mustard *Sisymbrium officinale*, Groundsel *Senecio vulgaris*, Silverweed *Argentina anserine* and Dandelion *Taraxicum* spp. This habitat does not correspond to an Annex I habitat.	**Local importance (Higher value)**

Habitat	Comments	Habitat value (NRA Guidelines)
Mixed Broadleaved Woodland WD1	Some areas of wider woodland border the river in the southern section of the site. Some conifers are present, however broadleaved species predominate. The tallest and most mature specimens are Beech and Sessile Oak. Some Scots Pine and Sycamore are also present. The understory includes Sycamore, Hawthorn, Bracken *Pteridium aquilinum* and Common Vetch. There is a strong component of willow including Crack Willow *Salix fragilis* and Goat Willow *Salix caprea*. It therefore has elements of Riparian woodland but is unlikely to have significant levels of flooding. This habitat does not correspond to an Annex I habitat.	**Local importance (Higher value)**
Drainage Ditch FW4	A drainage ditch runs through the site and along part of the northern site boundary. The channel is approximately 2m wide and flows are limited with isolated pools during low flow conditions. Instream vegetation includes Water Crowfoot *Ranunculus aquatalis* and Blanket Weed *Chlamydomonas* spp. Drier sections of the ditch support Soft Rush *Juncus effusus* and Meadow Grass *Poa annua.* Minnow *Phoxinus phoxinus* were noted in small pools, although this species is unlikely to persist during drier periods when the drain is essentially stagnant or dry. As this species is common in the River Liffey it can readily recolonise the drain when flows increase. Therefore, this habitat is not considered a critical resource for this species. The banks are overgrown with Bramble, Rosebay Willowherb, and Soft Rush. Given the limited size of the drain, limited prey availability and frequent dog usage this habitat is unlikely to be of significant value for Otter. No signs of Otter were recorded during site surveys. This habitat does not correspond to an Annex I habitat.	**Local importance (Lower value)**

Habitat	Comments	Habitat value (NRA Guidelines)
Depositing/Lowland Rivers FW2	A meander of the River Liffey borders the south-western corner of the site. At this location the river is approximately 23m wide and fast-flowing with low, sloping banks. Filamentous algae along the stretch of the river covers a significant proportion of the riverbed, greatly reducing the overall value of the sites in terms of spawning and, to a lesser extent, nursery habitat. Bankside vegetation along the site boundary is dense with Bramble forming thickets. Bankside vegetation includes Elder, Beech, Sycamore, Hawthorn and the understory includes Bramble, Bracken, Nettle *Urtica dioica* and Hogweed *Heracleum sphondylium*. Hemlock Water-Dropwort *Oenanthe crocata* is very common at the water's edge. In-stream vegetation includes Water Crowfoot *Ranunculus peltatus*. The River Liffey supports Otter and it is considered probable that otter utilise the river and riparian habitat where the site borders the river. There is dense vegetation between the site and the river with dense bramble and mature trees which limits access. No evidence of Otter including spraints, slides, couches, feeding signs or holts were recorded. However taking a worst case scenario approach it is assumed that the Liffey where it adjoins the site is used by otter for foraging. FW2 has links to the Annex I habitat Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260). The River Liffey has not been designated as a Natura 2000 site but is considered a high value habitat at a regional level.	**County importance**

Habitat	Comments	Habitat value (NRA Guidelines)
Buildings and Artificial Surfaces BL3	This habitat includes a number of buildings in the eastern section of the site. These include the main central barn-shaped warehouse structure, a smaller warehouse structure, a one-storey dwelling, and a two-storey dwelling. Also included within the category are the existing roundabout, paths and yards surrounding these buildings. The warehouse buildings have concrete lower sections, with upper sections and roofs of Kingspan cladding. The residential houses are stone/concrete with tiled roofs and are currently in use. All structures are relatively modern and none have openings accessible to or suitable for bats. The only openings present are ventilator shafts on the large warehouse, but these are modern and well-maintained. This habitat does not have links to Annex I habitat	**Local importance (Lower value)**
Riparian Woodland WN5	The section of the drainage ditch which runs parallel to the northern boundary has narrow strips of riparian woodland where periodic flooding occurs. Willows *Salix* spp are dominant with Alder *Alnus glutinosa and Gorse* also present. Wetland species such as Common Reed *Phragmites australis* and Reed Canary Grass *Phalaris arundinacea* are present but do not dominate. Other species noted include Nettle, Hemlock Water-Dropwort and Creeping Buttercup. WN5 has Links with *Annex I. Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0).* This is a small isolated area of habitat which is not of significant ecological value.	**Local importance (Higher value)**

8.5.4 Flora

The proposed development lies within Ordnance Survey National Grid 10km square (hectad) N81. The National Biodiversity Data Centre (NBDC) online database provides data on the distribution of mammals, birds, and invertebrates within the 10km squares. Some 336 flowering plants are listed by the NBDC as present in the hectad N81. **Table 8.3** lists the threatened species.

Table 8.3. NBDC listed flowering and endangered flowering plants for hectad N81

Hectad	Flowering plant Species	Latin Name	Designations/Status
N81	Green-flowered Helleborine	Epipactis phyllanthes	Endangered
	Cornflower	Centaurea cyanus	Regionally Extinct

Source NBDC database 11/02/22

The NBDC database lists two threated plant species within N81 i.e., Cornflower (*Centaurea cyanus*) and Green-flowered Helleborine (*Epipactis phyllanthes*). These species are not included in the Flora Protection Order 2015 (S.I. No. 356 of 2015).

Green-flowered Helleborine is one of Ireland's rarest orchids and is only found in a few locations, usually in shaded areas under trees, in wet riverside woodland and in beech and birch woods. It blends into the background so well that it is quite difficult to see it at first. This species was not recorded during the site surveys.

Cornflower was previously a common arable weed; however now it is more commonly found on waste ground and roadsides. This species was not recorded during the site surveys. No rare or protected plant species were recorded during the site survey and given the current maintenance regime/intensive farming practices, are unlikely to occur

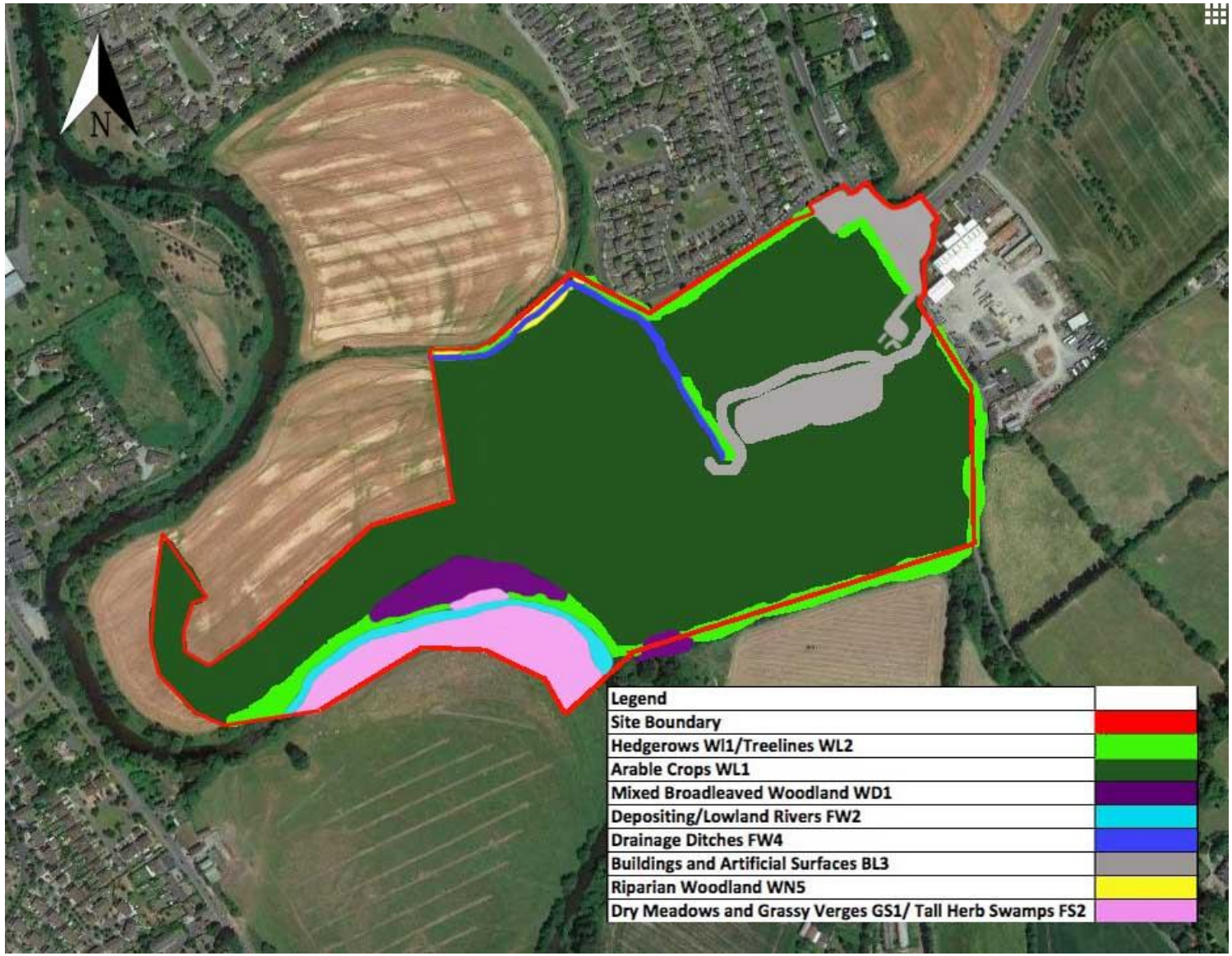


Figure 8.4 Habitats Recorded within Proposed Development Site Boundary

8.5.5 Invasive Species

Non-native plants are those introduced outside of their native range by humans and their activities, either purposefully or accidentally. Invasive non-native species typically display one or more of the following characteristics or features: (1) prolific reproduction through seed dispersal and/or re-growth from plant fragments; (2) rapid growth patterns; and (3) resistance to standard weed control methods.

Where a non-native species displays invasive qualities and is not managed it can potentially: (1) out compete native vegetation, affecting plant community structure and habitat for wildlife; (2) cause damage to infrastructure including road carriageways, footpaths, walls and foundations; and, (3) have an adverse effect on landscape quality.

The NBDC lists a number of both aquatic and terrestrial high impact invasive plant species which have been recorded within hectad N81 (Table 8.4). It should be noted that this data relates to the entire 10km^2 area and these species will not necessarily occur within the proposed development site boundary.

Table 8.4. NBDC Records of High Impact Invasive Species from N81

Species Group	***Species name***
Flatworm (Turbellaria)	*Arthurdendyus triangulatus*
Flowering plant	*Cherry Laurel (Prunus laurocerasus)*
Flowering plant	*Indian Balsam (Impatiens glandulifera)*
Flowering plant	*Japanese Knotweed (Fallopia japonica)*
Insect - beetle (Coleoptera)	*Harlequin Ladybird (Harmonia axyridis)*
Terrestrial mammal	*American Mink (Mustela vison)*
Terrestrial mammal	*Brown Rat (Rattus norvegicus)*
Terrestrial mammal	*Eastern Grey Squirrel (Sciurus carolinensis)*
Terrestrial mammal	*Fallow Deer (Dama dama)*
Terrestrial mammal	*House Mouse (Mus musculus)*
Terrestrial mammal	*Sika Deer (Cervus nippon)*

Source: NBDC 11/02/22

The control of invasive species in Ireland is regulated by the Wildlife (Amendment) Act 2000, which stipulates that:

'*Any person who— [...] plants or otherwise causes to grow in a wild state in any place in the State any species of flora, or the flowers, roots, seeds or spores of flora, ['refers only to exotic species thereof'][...] otherwise than under and in accordance with a licence granted in that behalf by the Minister shall be guilty of an offence*.'

The Birds and Natural Habitats Regulations 2011 (SI 477 of 2011), Section 49(2) prohibits the introduction and dispersal of species listed in the Third Schedule, which includes Japanese Knotweed *Fallopia japonica*, as follows: "*any person who plants, disperses, allows or causes to disperse, spreads or otherwise causes to grow [….] shall be guilty of an offence*."

Himalayan Balsam *Impatiens glandulifera,* which is listed in the third Schedule, was recorded along the banks of the River Liffey at the proposed development site **(Figure 8.5**). Himalayan Balsam is a member of the Busy Lizzie family (Balsaminacea) and as its name suggests, is native to the Himalaya region of Asia.

It was introduced as a garden plant in the mid-1800's (Royal Horticultural Society 2008a) and quite swiftly became established along waterways and in other damp places. It is an annual plant forming dense upright stands approximately 1m tall where it effectively out- competes surrounding herbs and grasses. It is tolerant of shade and does very well in the canopy of riparian woodland. In the autumn it dies back leaving the ground bare and vulnerable to erosion.

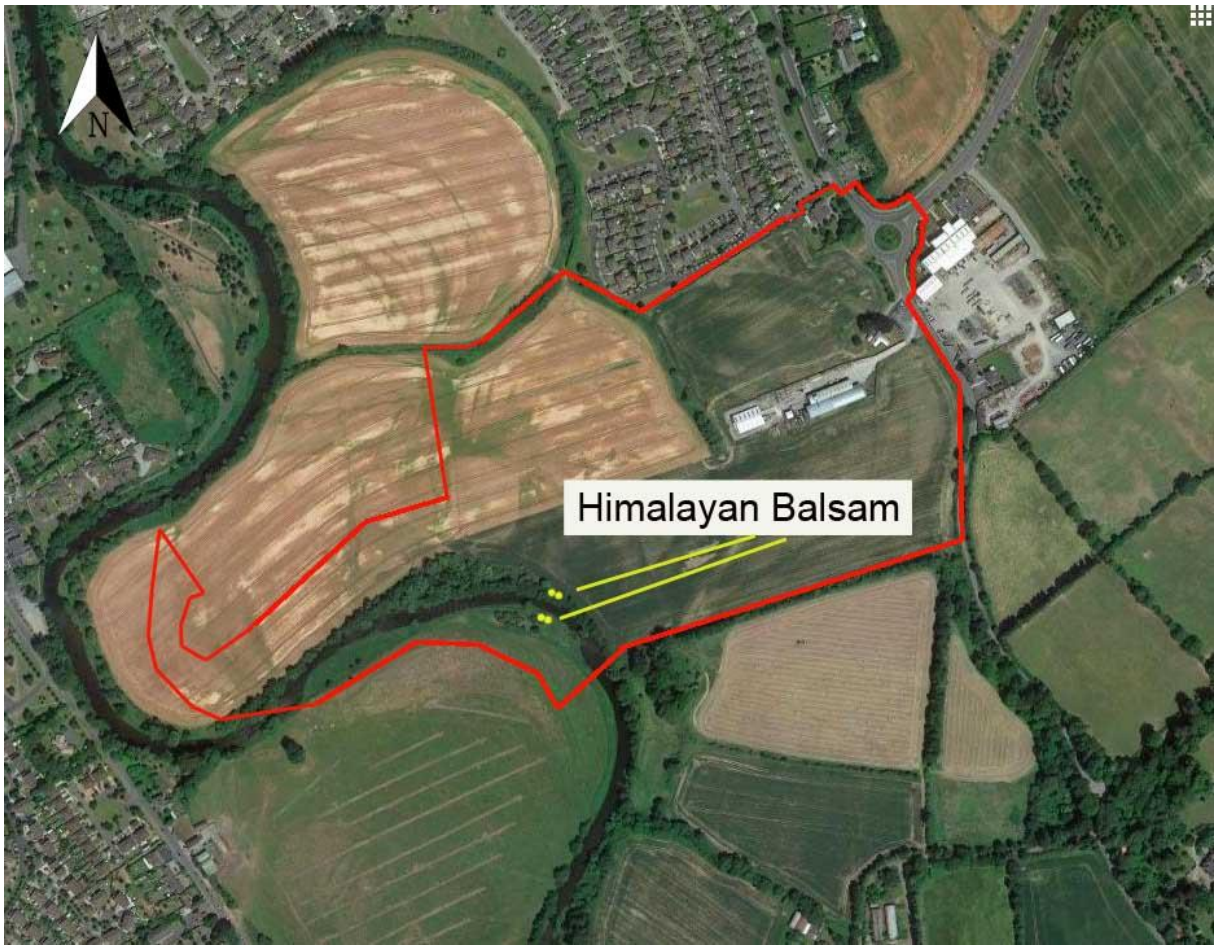


Figure 8.5. Himalayan Balsam Locations| not to scale

8.5.6 Bats

In Ireland, nine species of bat are currently known to be resident and are classified into two Families: the Rhinolophidae (Horseshoe bats) and the Vespertilionidae (Common bats). The Lesser Horseshoe Bat Rhinolophus hipposideros is the only representative of the Horseshoe Bat Family in Ireland.

All the other species belong to the Common Bat Family and these include three pipistrelle species: Common Pipistrellus pipistrellus, Soprano Pipistrellus pygmaeus and Nathusius' Pipistrellus nathusii, four Myotids: Natterer's Myotis nattereri, Daubenton's *Myotis daubentonii*, Whiskered *Myotis mystacinus*, Brandt's *Myotis brandtii*, the Brown Long-eared *Plecotus auritus* and Leisler's *Nyctalus leisleri* bats.

Whiskered and Natterer's bats are listed as 'Threatened in Ireland', while the other species are listed as 'Internationally Important' in the Irish Red Data Book 2: Vertebrates (Whilde, 1993). The population status of both Whiskered and Natterer's Bats was considered 'indeterminate' because of the small numbers known of each, a few hundred and approximately a thousand respectively. Ireland is considered to be an international stronghold for Leisler's Bat, whose global status is described as being at 'low risk, near threatened' (LR; nt) by the IUCN (Hutson, *et al*., 2001).

Near threatened status is applied to those taxa that are close to being listed as vulnerable (facing a high risk of extinction in the wild in the medium-term future on the basis of a range of criteria defined by the IUCN). The Irish population of the Lesser Horseshoe Bat is estimated at 14,000 individuals and is considered of International Importance because the species has declined dramatically and become extinct in many other parts of Europe. Data collected shows that the species increased significantly between from the early 1990s to present.

A review of existing bat records within the Hectad of the proposed development site boundary (sourced from Bat Conservation Ireland's (BCI) National Bat Records Database via the NBDC) indicates that six of the nine Irish bat species listed in Table 8.5, have been recorded within N81.

Nathusius's Pipistrelle have not been included in this database, but they could potentially occur in this general area.; however, the closest record for Nathusius's Pipistrelle is approximately 23km southwest of the site at Donard, County Wicklow (NBDC). Lesser Horseshoe Bat is the only bat species listed on Annex II of the Habitats Directive (Directive 92/43/EEC). The range of the Lesser Horseshoe Bat in Ireland is, for the most part, limited to six western counties – Clare, Cork, Galway, Kerry, Limerick and Mayo and there are no records of this species within County Kildare or its adjoining counties.

Table 8.5. Presence of Irish bat Species within Hectad N81

Common name	Scientific name	Presence
Lesser Noctule	*Nyctalus leisleri*	Present
Pipistrelle	*Pipistrellus pipistrellus sensu lato*	Present
Soprano Pipistrelle	*Pipistrellus pygmaeus*	Present
Daubenton's Bat	*Myotis daubentoniid*	Present
Natterer's Bat	*Myotis nattereri*	Present
Brown Long-eared Bat	*Plecotus auratus*	Present
Whiskered Bat	*Myotis mystacinus*	Absent
Lesser Horseshoe	*Rhinolophus hipposideros*	Absent
Nathusius's Pipistrelle	*Pipistrellus nathusii*	Absent

Source NBDC 11/02/22

All bat species are protected under the Wildlife Act 1976, as amended, which make it an offence to wilfully interfere with or destroy the breeding or resting place of all species; however, the Acts permit limited exemptions for certain kinds of development. All species of bats in Ireland are listed in Schedule 5 of the 1976 Act and are therefore subject to the provisions of Section 23 which make it an offence to:

- Intentionally kill, injure, or take a bat
- Possess or control any live or dead specimen or anything derived from a bat
- Wilfully interfere with any structure or place used for breeding or resting by a bat
- Wilfully interfere with a bat while it is occupying a structure or place which it uses for that purpose.

All bats are listed in Annex IV of the EU Habitats Directive. The domestic legislation implementing this Directive provides strict protection to individual bats and their breeding and resting places. This means that any works interfering with bats and especially their roosts, including for instance, the installation of lighting in the vicinity of the latter, may only be carried out under a derogation licence under the European Communities (Birds and Natural Habitats) Regulations 2011 issued by NPWS.

The details with regards to appropriate assessments, the strict parameters within which derogation licences may be issued and the procedures by which and the order, in relation to the planning and development regulations, such licences should be obtained, are set out in Circular Letter NPWS 2/07 "*Guidance on Compliance with Regulation 23 of the Habitats Regulations 1997 – strict protection of certain species/applications for derogation licences*" issued on behalf of the Minister of the Environment, Heritage and Local Government on the 16th of May 2007.

Table 8.6 summarises the protection given to bats by national and international legislation and conventions.

Table 8.6 Legislative Protection for Bats

Legislation/Convention	Relevance to Irish bats
The Wildlife Act 1976, as amended	It is an offence to wilfully interfere with or destroy the breeding or resting place of bats, (with some exemptions for certain kinds of construction development). Provides for the creation of NHAs.
EC Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (Directive 92/43/EEC), commonly known as the 'Habitats Directive, transposed into Irish law by the European Communities (Birds and Natural Habitats) Regulations 2011	Lists all the vesper bats in Annex IV as in need of strict protection and also encourages Member States to conserve landscape features such as river corridors, field boundaries, ponds, and woodlands. It also requests that Member States establish a system to monitor the incidental capture and killing of the animals listed in Annex IV. The lesser horseshoe bat is further listed in Annex II of the EU Habitats Directive The level of protection offered to lesser horseshoe bats effectively means that areas important for this species are designated as Special Areas of Conservation.
The Convention on the Conservation of European Wildlife and Natural Habitats, commonly known as the 'Berne Convention'.	It obliges states to protect and conserve animals and their habitats, especially those listed as endangered or vulnerable. Also obliges parties to promote national policies for the conservation of wild fauna and natural habitats
The Convention on the Conservation of Migratory Species of Wild Animals, commonly known as the 'Bonn Convention'.	This led to the European Bats Agreement (EUROBATS), which lists a wide range of objectives, including promoting research programmes relating to the conservation and management of bats, promoting bat conservation and public awareness of bats, and identifying and protecting important feeding areas of bats from damage and disturbance.

A study by Lundy *et al.* (2011) examined the relative importance of landscape and habitat associations across Ireland. Maximum Entropy Models (MEM) were constructed for each bat species using records from the National Bat Database from 2000-2009. This method allows species' records that have not been collected in a systematic survey to be analysed. The results help explain patterns of species' occurrence and predict where species might occur.

Landcover (CORINE), topography, climate, soil pH, riparian habitat and human bias factors were incorporated into the models. The analyses provide a picture of the broad scale geographic patterns of occurrence and local roosting habitat requirements for Irish bat species. This also provides a 'habitat suitability' index. The index ranges from 0 to 100, with 0 being least favourable and 100 most favourable for bats. The habitat indices for all Irish bats for the landscape within the vicinity of the proposed development site at Newbridge is shown in Table 8.7.

Table 8.7. Model Predicted Habitat Suitability Indices for all Irish Bat Species in the Study Area

Latin Name	Common Name	Habitat indices
All Bats		27.33
Pipistrellus pygmaeus	Soprano pipistrelle	41
Plecotus auratus	Brown long-eared bat	40
Pipistrellus pipistrellus	Common pipistrelle	41
Rhinolophus hipposideros	Lesser horseshoe	0
Nyctalus leisleri	Leisler's bat	54
Myotis mystacinus	Whiskered bat	16
Myotis daubentoniid	Daubenton's bat	20
Pipistrellus nathusii	Nathusius' pipistrelle	9
Myotis nattereri	Natterer's bat	25

Source: NBDC 14/02/22

Building Survey

A preliminary roost assessment of the buildings earmarked for demolition was carried out. Evidence of bat activity associated with potential roost sites includes bat droppings, urine staining, feeding remains and dead/alive bats. Indicators that potential roost locations and access points are likely to be inactive include the presence of cobwebs and general detritus within the apertures.

The two detached dwellings were inspected **(Photographs 1-4**). Building 1 is a single storey structure which consists of the main dwelling and an attached garage. The walls are brick and roof is pitched, with vinyl membrane covering. The building is currently in use and staff members come and go on a regular basis. No broken doors or windows are evident, and no entry points for bats were recorded. No entry/exit points for bats or roost features were recorded on this building and the potential for roosting bats is low.

Building 2 is a single storey former residential building with garage and stables/storerooms. The main structure is brick with a tile, pitched roof. This building is in use, with staff members coming and going on a regular basis. No broken doors or windows are evident and no entry points for bats were noted. No external PRFs were recorded. The garage and storerooms include some rooms open to the elements. Brick walls with gaps and wooden beams on the interior provide some potential roosting habitat but no evidence of bats noted. The potential for roosting bats at this building is low.

The sheds have concrete lower sections, with the upper sections and roofs constructed of aluminium cladding. The structures are relatively modern and none have openings accessible to bats. The only openings present are ventilator shafts on the largest structure, but these are modern and well-maintained. No suitable cracks of crevices were recorded within external walls or linear stone walls that are of significant value for roosting bats (Photographs 5-6).

Photograph 1. Building 1, showing attached garage

Photograph 2. Building 1, north side

Photograph 3. Building 2

Photograph 4. Garage attached Building 2.

Photograph 5. Smaller warehouse structure, southern edge.

Photograph 6. Main large central warehouse structure BL3. Eastern edge of structure.

Tree Survey

While the arboriculture assessment was used in support of the Preliminary Roost Assessment, the conclusions on the value of each tree for bats was determined by the ecologist and not the arboriculture assessment.

Bats generally make use of large mature trees that contain Potential Roost Features (PRF) such as natural holes, cracks/splits in major limbs, loose bark, hollows/cavities, dense epicormic growth (bats may roost within it) and bird and bat boxes. The importance of trees to bats varies with species, season, and foraging behaviour. Evidence indicating bat presence, includes dark stains running below holes or cracks, bat droppings, odours, or scratch marks.

The proposed development has been designed to minimise tree removal and only a small proportion of the mature trees within the proposed boundary will be affected. Where possible, crown reduction or removal of branches will be used.

Trees considered to be of negligible value for bats (generally young trees, trees without dense ivy and trees with smooth bark without PRFs such as cracks and crevices) are not discussed further as these were excluded as potential bat habitats based on an initial preliminary ground level assessment (Table 8.8).

PRFs that can occur in trees as detailed in Collins (2016) include the following:

- rot holes
- hazard beams
- other vertical or horizontal cracks and splits (such as frost cracks) in stems or branches
- partially detached platey bark
- knot holes arising from naturally shed branches, or branches previously pruned back to the branch collar
- man-made holes (e.g cavities that have developed from flush cuts) or cavities created by branches tearing from the parent stems
- cankers (caused by localised bark death) in which cavities have developed
- other hollows or cavities including butt rot
- double-leaders forming compression forks which included bark and potential cavities
- gaps between over lapping stems or branches
- partially detached ivy with stem diameters in excess of 50mm
- bat or bird boxes.

None of the trees to be removed are considered of significant value for bats, although taking a worst case scenario approach, the presence of occasional roosting bats cannot be altogether ruled out. No trees which are considered of high value as potential bat roosts were recorded. Ivy was recorded on a number of trees; however, with the exception of one oak tree (which has moderate value for roosting bats) all trees earmarked for removal are of negligible to low value as potential roosting sites.

Bat Activity Survey

Bats also often use features such as hedgerows, treelines, woodland edges and waterways as commuting pathways between roosts and foraging areas. Sheltering vegetation, such as treelines and woodland, not only acts as cover from potential predators and the weather, but also provides structure for acoustic orientation and navigation. Sheltered areas also allow insects to gather and therefore support bat foraging.

Activity surveys focused on site buildings, treelines and the River Liffey which runs through the southwest corner of the site. Small numbers of bats were recorded foraging in the vicinity of warehouse buildings i.e. one Common Pipistrelle and two Soprano Pipistrelle. However no emergence from the buildings was recorded.

Table 8.8. Trees Included in Preliminary Roost Assessment

Tree Number (where available)	Tree description	Tree photograph	Bat roost value
----	Non-native Sycamore. Large, mature. No significant structures but large amount of ivy.		Presence of occasional roosting bat cannot be altogether excluded Low value.
----	Beech. Large, mature. No significant ivy cover but some small crevices.		Presence of occasional roosting bat cannot be altogether excluded Low value
----	Large, mature.) No significant ivy cover but some small crevices. Presence of occasional roosting bat cannot be altogether excluded		Presence of roosting bats cannot be altogether excluded Low value
----	Native Oak. Large, mature. Extensive ivy cover and crevices.		Presence of roosting bats cannot be altogether excluded Moderate value

Tree Number (where available)	Tree description	Tree photograph	Bat roost value
----	Semi-mature Significant ivy cover.		Presence of roosting bats cannot be altogether excluded Low value
1813	Beech. Large, mature. Some ivy cover.		Presence of occasional roosting bat cannot be altogether excluded Low value
1811	Native Ash Large, mature. Some ivy cover.		Presence of occasional roosting bat cannot be altogether excluded Low value

Higher numbers of bats i.e. Common Pipistrelle, Soprano Pipistrelle, Leisler's Bat and Daubuenton's Bat were recorded foraging along the treeline bordering the River Liffey in the southwest section of the site.

Three Common Pipistrelle, two Soprano Pipistrelle, two Leisler's Bat and two Daubenton's Bat were recorded foraging in this area. The Daubenton's Bats were observed foraging over the river surface, while the other species were recorded foraging along the treeline and commuting above the treeline.

Soprano and Common Pipistrelle were also recorded foraging along the southern treeline in small numbers. No bats were recorded along the central treeline adjacent to the drainage ditch.

Common Pipistrelle are crevice dwellers. They use many features on and in a building but relatively rarely enter the roof void. Features used in summer include soffits, fascia's, barge-boards, weather boarding, between roof felt/membrane and tiles/slates, around window frames, in cavity walls, under

hanging tiles and lead flashing. In winter, pipistrelle species may use cavity walls or crevices deep in solid walls.

Soprano Pipistrelle is a habitat generalist although it tends to occur more often in the vicinity of broadleaved woodland. Lintott *et al.* (2014) found that in female soprano pipistrelles typically exploit woodlands which are well connected, with lower clutter, more mature trees and a lower edge to interior ratio. Habitat quality and the composition of the surrounding landscape appears to be less limiting to males (Lintott *et al.* 2014). Although generally found roosting in buildings the Soprano Pipistrelle also roosts in tree holes and crevices.

Leisler's bats forage in a variety of habitats including over pasture, rivers, lakes, canals, forestry and around streetlights/flood lights, but they prefer open habitats and rivers or lakes (Vaughan *et al.* 1997). Maternity colonies form in late spring/early summer, mainly in buildings but also occasionally in hollow trees. Hibernation records are scarce but most are from hollows and crevices in trees.

Daubenton's Bat feeds close to the surface of water, either over rivers, canals, ponds, lakes or reservoirs but it can also be found foraging in woodlands. Flying at 15 kilometres per hour, it gaffs insects with its over-sized feet as they emerge from the surface of the water – feeding on caddis flies, moths, mosquitoes, midges etc. It is often roosts beneath bridges or in tunnels and also makes use of hollows in trees.

The woodland, treelines and hedgerow habitat on the southern boundary of the proposed development site, in conjunction with the River Liffey, provides high value foraging habitat for bats at a local level. The remaining habitats within the proposed development site provide some limited foraging and commuting habitat for bats and are considered of low to moderate value at a local level.

8.5.7 Otter

Otter *Lutra lutra*, along with their breeding and resting places are protected under the provisions of the Wildlife Act 1976, as amended. Otters have additional protection because of their inclusion in Annex II and Annex IV of the Habitats Directive which is transposed into Irish law in the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I 477 of 2011), as amended. Otters are also listed as requiring strict protection in Appendix II of the Berne Convention on the Conservation of European Wildlife and Natural Habitats and are included in the Convention on International Trade of Endangered species (CITES).

Although rare in parts of Europe, they are widely distributed in the Irish countryside in both marine and freshwater habitats. Otters are solitary and nocturnal and as such are rarely seen. Thus, surveys for Otters rely on detecting signs of their presence. These include spraints (faeces), anal gland secretions, paths, slides, footprints, and remains of prey items.

Spraints are of value as they are used as territorial markers and are often found on prominent locations such as grass tussocks, stream junctions and under bridges. In addition, they are relatively straightforward to identify.

Otters occasionally dig out their own burrows but generally they make use of existing cavities as resting places or for breeding sites. Suitable locations include eroded riverbanks, under trees along rivers, under fallen trees, within rock piles or in dry drainage pipes or culverts etc. If ground conditions are suitable, the holt may consist of a complex tunnel and chamber system.

Otters often lie out above ground especially within reed beds where depressions in the vegetation called “couches” are formed. (NRA, 2008). Generally, holts or resting areas can be located by detecting signs such as spraints or tracks.

In contrast natal holts which are used by breeding females can be extremely difficult to locate. They are often located a considerable distance from any aquatic habitats and Otters may also use habitats adjoining small streams with minimal or no fish populations. In addition, natal holts are usually carefully hidden and without obvious sprainting sites. Otters do not have a well-defined breeding season. Otters are largely nocturnal, particularly in areas subject to high levels of disturbance as evidenced by the presence of Otters in the centre of Cork and Limerick City.

A review of existing records within hectad N81 showed that Otter or signs of Otter have been recorded on 11 occasions, with the most recent record from April 2018. Otter are widespread throughout this stretch of the River Liffey. A fisheries assessment of the Liffey in Kildare surveyed the area of the River Liffey to the immediate west of the proposed development site in September 2020 (Triturus 2020). No signs of Otter were recorded within the development site boundary and the closest signs were recorded Athgarven Bridge approximately 4km upstream of the proposed development site.

The stretch of the Liffey in the southwestern corner of the proposed development site provides potential Otter habitat and is dense and hard to access. No signs of Otter were recorded within 150m of the proposed development site and it is noted that large areas of the site are unsuitable for breeding Otter due to frequent access by people and dogs.

Although no signs of otter were recorded, the River Liffey is a high value habitat for this species and, taking a worst case scenario approach, it is assumed that otters forage within the river where it flows through the site. The drainage ditch supports Minnow and could potentially be used sporadically by otter, however this is a low value habitat which does not provide critical resources for this species.

8.5.8 Other Mammals

Seventeen other species of terrestrial mammal have been recorded within grid square N81. Nine of these are protected under the Wildlife Act; Badger *Meles meles*, Irish Stoat *Mustela erminea hibernica*, Irish Hare *Lepus timidus hibernicus* , Hedgehog *Erinaceus europaeus*, Red Squirrel *Sciurus vulgaris*, Pygmy Shrew *Sorex minutus*, Pine Marten *Martes martes*, Sika Deer *Cervus nippon*, and Fallow Deer *Dama dama*. Badgers, Irish Stoat, Irish Hare Red Squirrel, Hedgehog and Pine Marten are also protected under Appendix III of the Berne Convention which has been transposed into Irish law.

It is an offence to intentionally, knowingly or unknowingly kill or injure a protected species, or to wilfully interfere with or destroy their breeding sites or resting places.

8.5.8.1 Badger

Badger setts are formed by a complex group of interlinked tunnels and therefore works in proximity to setts can potentially cause damage a protected species. Badgers are known to occur within the wider landscape around the proposed development site. The NBDC lists 36 records of Badger within N81, the most recent being September 2017 (NBDC). No signs of Badger, were recorded during site surveys.

8.5.8.2 Irish Stoat

Irish stoats occur in most habitats with sufficient cover, including urban areas. The single record of Irish Stoat in R81 dates back to 1985. Given their broad habitat use, Stoat could potentially use the proposed development site.

8.5.8.3 Irish Hare

The Irish Hare is one of three lagomorphs found on the Island of Ireland and the only native lagomorph. It is listed on Appendix III of the Berne Convention, Annex V(a) of the EC Habitats Directive (92/43/EEC) and as an internationally important species in the Irish Red Data Book.

The Irish Hare is adaptable and lives in a wide variety of habitats. It typically reaches its highest densities on farmland, particularly where there is a mix of grassland and arable fields along with hedgerows and other cover. There are 11 records of Irish Hare in R81, the most recent from June 2018. No signs of Hare were recorded in the field surveys, although this species is likely to occur.

8.5.8.4 Red Squirrel

Red Squirrel is found throughout Ireland. They feed mainly on tree seeds, although they can use fungi, fruit and buds as they become available in the woodland. They are found in all types of habitat, but typically are in higher densities in mature mixed broadleaved forests. They can also survive in monoculture coniferous woodland. Red squirrel is known to occur in the wider area (NBDC records). The woodland habitat on the boundary of the site could potentially provide habitat for this species. However no signs of Red Squirrel was recorded during the site surveys.

8.5.8.5 Pygmy Shrew

Pygmy Shrew is common throughout mainland Ireland. It is found in a variety of habitats ranging from areas bordering coniferous and deciduous woodland to any area with good ground cover such as grasslands, heaths, hedgerows, peatlands and sand dunes. They are largely absent from heavily forested areas. The Pygmy Shrew requires dense vegetation for cover from its many predators and to provide adequate foraging areas for insects. Due to the habitats present within the proposed site it is likely that Pygmy Shrew are present.

8.5.8.6 Hedgehog

Hedgehog is found throughout Ireland, with male Hedgehogs having an annual range of around 56 hectares. Although no evidence of Hedgehogs was observed during the field surveys, it is likely to occur.

8.5.8.7 Pine Marten

Pine Marten are habitat specialists, requiring forest or scrub habitat to exist in an area. They are adept at climbing trees. The species is primarily active at night and individuals live in territories that can vary in size from 50 hectares to 400 hectares. Males typically have bigger territories than females and there can be partial overlap between adjacent territories. Pine Marten could potentially use the habitats onsite, however no signs of this species were recorded during site surveys.

8.5.8.8 Sika Deer

Sika Deer prefer forest with dense understorey, thickets, natural woodlands and commercial plantations, but will also forage in open grassy areas with dense cover nearby. They are highly opportunistic feeders, foraging on grasses to a range of shrubs and tree species. They have very large daily ranges, moving up to 2.5km per day and are classified as intermediate grazer-browsers due to their feeding patterns. Given the habitats present onsite, Sika Deer are unlikely to occur.

8.5.8.9 Fallow Deer

Fallow Deer are Ireland's second largest deer species and are the most widespread, found in nearly every county of the island. They mainly reside in mature deciduous or mixed woodlands close to open grassland. From the NBDC records, there is one record of Fallow deer within Hectad N81, in May 2018; however given the habitats present onsite, Fallow Deer are unlikely to occur.

8.5.9 Amphibians

The NBDC list two species of amphibian in Hectad N81 i.e., Common Frog *Rana temporaria* and Smooth Newt *Lissotriton vulgaris*. Common Frog is listed in Annex V of the EU Habitats Directive and is protected under the Wildlife Act. The drainage ditches provide potential habitats for Common Frog. This habitat was actively searched for signs of Common Frog during the summer and spring surveys, but no sign of was recorded during either survey.

The Smooth Newt is the only member of the Urodela (the tailed amphibians) found in Ireland. While commonly encountered near water bodies, adult newts are actually terrestrial, only returning to water bodies to breed. They tend to prefer habitats that offer protection from desiccation, such as long grass, woodland and scrubland. Newts will over-winter in refugia such as woodpiles and rotting logs, which offer them some protection from the elements. The proposed development site does not provide waterbodies suitable for this species.

8.5.10 Reptiles

The NBDC has no record of any reptile species within Hectad N81. No reptiles were recorded during site surveys.

8.5.11 Birds

The NBDC online data base lists 96 species of bird recorded within Hectad N81. Of these species, the following are listed under Annex I of the Birds Directive i.e. Kingfisher *Alcedo atthis*, Corn Crake *Crex crex*, Golden Plover *Pluvialis apricari*, Hen Harrier *Circus cyaneus*, Little Egret *Egretta garzetta*, Short-eared Owl *Asio flammeus* and Whooper Swan *Cygnus cygnus*.

Breeding bird surveys were carried out on the 19th May 2021, 9th September 2021 and 8th March 2022. Winter birds were recorded on the 3rd December 2020. During the survey, all birds seen or heard within the development site were recorded. Bird species listed in Annex I of the Birds Directive are considered a conservation priority. Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland (BOCCI). These are bird species suffering declines in population size. BirdWatch Ireland and the Royal Society for the Protection of Birds have identified and classified these species by the rate of decline into Red and Amber lists.

Red List bird species are of high conservation concern and the Amber List species are of medium conservation. Green listed species are regularly occurring bird species whose conservation status is

currently considered favourable. Species recorded within the development site boundary are shown in **Table 8.9**.

Table 8.9. Bird Species Recorded during Site Surveys

Species		**Birds Directive Annex**	**BOCCI**	
		I	**Red List**	**Amber List**
Blackbird	*Tardus Turdus merula*			
Blue Tit	*Cyanistes caeruleus*			
Bullfinch	*Pyrrhula pyrrhula*			
Buzzard	*Buteo buteo*			
Chaffinch	*Fringilla coelebs*			
Chiffchaff	*Phylloscopus collybita*			
Collared Dove	*Streptopelia decaocta*			
European Swallow	*Hirundo rustica*			x
Great Tit	*Parus major*			
Hooded Crow	*Corvus cornix*			
House Sparrow	*Passer domesticus*			
Jackdaw	*Corvus monedula*			
Mistle Thrush	*Turdus piscivorus*			
Pheasant	*Phasianus colchicus*			
Robin	*Erithacus rubecula.*			
Rook	*Corvus frugiligus*			
Song Thrush	*Turdus philomelos*			
Willow Warbler	*Phylloscopus trochilus*			x
Wood Pigeon	*Columba palumbus*			
Yellowhammer	*Emberiza citrinella*		x	

Overall, the proposed development site is of local value for the terrestrial bird species that are relatively common in the Irish countryside. Good quality treelines, woodland and hedgerows at the site provide a range of nesting habitat for common bird species.

No Annex I species were recorded. The River Liffey, which runs through the southwestern corner of the site, could potentially provide foraging habitat for Kingfisher *Alcedo atthis*. However, no signs of Kingfisher were recorded during site surveys and due to the low sloping river banks at the site there is no suitable nesting habitat within the site or in proximity to the site boundary.

No signs of wintering waders or waterfowl were recorded; however, Whooper Swans are known to forage on agricultural grassland and cereal stubble in autumn and winter (Robinson *et al*, 2004). While Whooper Swan could potentially forage at the site during the winter months, given the large areas of arable farming in the region the area within the proposed development site does not provide critical habitat for this species.

One Red List Species Yellowhammer *Emberiza citronella* (one singing male) was recorded within the treeline/hedgerow on the southern end of the site. Historically, this species was widespread throughout the country but has suffered declines due to the decrease in cereal crop cultivation in Ireland.

Due to this decline, the majority of the Yellowhammer population is confined to the east and south of Ireland. An adult Yellowhammer will mainly feed on the grains produced by grasses and cereals with the young being fed various insect species. In Ireland, the Yellowhammer is strongly associated with cereal cultivation and by extension, is most commonly found in farmland, in close proximity to such crops.

Two Amber List species Swallow *Hirundo rustica* and Willow Warbler *Phylloscopus trochilus* were recorded. Swallow were recorded foraging at the site but no nest sites were recorded. Nesting Willow Warbler were recorded within the woodland habitat on the southern end of the site.

The Red List species Yellowhammer and Amber List species Willow Warbler were recorded within the site boundary but overall the site supports a mixture of terrestrial bird species that are relatively common in the Irish countryside. No Annex I species, were recorded Although more specialised species such as Grey Heron and Dipper may utilise riverine habitats, no signs of Kingfisher were noted.

8.5.12 Other Species

The NBDC does not have any records any protected, rare or notable species of invertebrates within 2km of the proposed development site (N81C). One rare invertebrate species was listed for the adjacent 2km square (N81H) i.e. the mayfly *Ephemerella notata*. While no site is without invertebrate interest, it is considered unlikely that the proposed development site supports any protected invertebrate species as the habitats to be affected are common.

The River Liffey is known to support Brown Trout *Salmo trutta,* European eel *Anguilla anguilla,* Lamprey *Lampetra* sp. Minnow *Phoxinus phoxinu*s, Roach *Rutilus rutilus*, Three-spined Stickleback *Gasterosteus aculeatus*, Pike *Esox lucius*, Perch *Perca fluviatilis* and Stone Loach *Barbatula barbatula* (Kelly *et al.,* 2010, 2011, 2014; Macklin & Brazier, 2018; Champ, 2005). The Liffey catchment also supports the Annex II species White-Clawed Crayfish *Austropotamobius pallipes* which are one of the main prey species for Otter.

A section of the River Liffey located approximately 400m upstream of the proposed development site boundary was surveyed by Triturus (2020) as part of a fisheries assessment of the Upper Liffey. They noted the presence of Brown Trout, lamprey species (not specified), Minnow and Stone Loach (Triturus (2020)). White-clawed Crayfish were present at low densities as the flow rate was too high to be optimal habitat. Triturus (2020) classified this section of the Liffey as having an overall good quality of salmonid habitat. However, high levels of eutrophication (enrichment) were evident.

The area assessed by DixonBrosnan is generally similar in terms of its characteristics, flow patterns and riparian habitats and a similar species mix (Brown Trout, lamprey species (not specified), Minnow, Stone Loach and White-clawed Crayfish) is likely to occur. However high nutrient levels leading to excessive algal and plant development has reduced the overall ecological value of this section of river and its value as spawning and nursery habitat.

8.6 Construction Stage Impacts

In the absence of mitigation measures, construction phase impacts have the potential to remove a range of habitats and disturb or displace protected species for the duration of construction. Significant potential impacts on biodiversity include habitat loss, noise and visual/light disturbance of protected fauna species, and the potential for suspended solids or other contaminants to impact on local watercourses.

8.6.1 Habitats

Most of the habitats within the site interior will be removed during the construction phase. Potential impacts on habitats, are detailed in Table 8.10. It must be borne in mind that the value of a habitat is site specific and partially related to the amount of that habitat in the surrounding landscape. The classification scheme, used in Table 8.10 for the value of habitats and the impacts on them, is detailed in the NRA publication *Guidelines for assessment of ecological impacts of National Road Schemes* (**Appendix 8**).

Table 8.10. Potential Impacts on Habitats

Habitats	Ecological value (NRA guidelines)	Potential impacts
Arable Crops BC1	Local importance (Lower value)	This habitat will be removed. Negative, not significant, long-term
Dry meadow and grassy verges GS2	Local importance (Higher value)	This habitat will be removed. Negative, slight, long-term
Dry meadow and grassy verges GS2/Tall Herb Swamp FS2	Local importance (Higher value)	This habitat will be retained. No impact
Hedgerows WL1/ Treelines WL2/	Local importance (Higher value)	While most of this habitat will be retained, habitat along the eastern boundary of the habitat will be removed. Minor works may be required in these habitats for a proposed surface water outfall for the River Liffey and flood compensation areas. However, no mature trees will be removed. Negative, slight, long-term
Mixed Broadleaved Woodland WD1	Local importance (Higher value)	This habitat will be retained. No impact
Drainage Ditch FW4	Local importance (Lower value)	The central drainage ditch will be removed. The northern drainage ditch will be retained Two proposed surface water outfalls will discharge to the northern drainage ditch. Negative, slight, long-term (indirect impacts discussed below)
Depositing/Lowland Rivers FW2	County importance	There will be no works within the River Liffey. A proposed surface water outfall will discharge to the river and there may be impacts on the riverbank. Negative, slight, short-term
Buildings and Artificial Surfaces BL3	Local importance (Lower value)	A number of buildings at the site are earmarked for demolition

Habitats	Ecological value (NRA guidelines)	Potential impacts
		Negative, not significant, long-term
Riparian Woodland WN5	Local importance (Higher value)	This habitat will be largely retained. A small area of this habitat will be removed for a pedestrian path and surface water outfalls. Negative, not significant, long-term

Impacts on terrestrial habitats are generally restricted to direct removal of habitats and possible impacts from the spread of invasive species. Indirect impacts may occur via damage and disturbance arising from vehicular activities and storage of stripped soils and materials.

Levels of dust during construction are predicted to be low and effectively managed by mitigation. The impact on vegetation in adjoining habitats from wind-blown dust is predicted to be imperceptible. No rare floral species were recorded within the proposed development site.

The potential impact of the proposed development on qualifying habitats within Natura 2000 sites is discussed in the AA screening and NIS reports. These reports concluded that there will be no direct (or indirect) impacts on protected habitats as a result of the proposed development. There will be no impacts on NHAs or pNHAs as a result of the proposed development

8.6.2 Invasive Species

Himalayan Balsam was recorded within the proposed development site boundary. This is a Third Schedule species under SI 477 of 2011 and has been shown to have an adverse impact on landscape quality and native biodiversity and infrastructure. In the absence of management, this species is likely to continue to spread within the proposed development site boundary.

8.6.3 Mammals

8.6.3.1 Bats

The two dwellings that will be demolished are of low value as potential roosting habitat for bats. The three sheds that will also be demolished are modern structures of negligible value as potential roosting habitat. No signs of roosting bats were recorded during daytime surveys and no emergence from the buildings was noted during night-time surveys.

There are a number of mature trees within the proposed development site boundary. These are largely confined to the southern treeline and the area around the River Liffey, where treelines grade into broadleaved woodland habitat. The trees along the southern site boundary will be largely retained. There will be no tree removal along the River Liffey or along Great Connell Road. However mature trees in the vicinity of the dwellings will be removed.

An assessment of the trees earmarked for removal indicates that they are generally considered of low potential value although the presence of occasional roosting bat cannot be altogether excluded. One large oak was identified as being of moderate potential value for bats, as small numbers of bats could use the mature ivy on the tree. No significant PRFs were recorded in any of the trees earmarked for removal nor are they likely to occur.

Collins (2016) notes that surveying trees for bat roosts can be more challenging than surveying buildings because many species that use trees for roosts exhibit switching behaviour, including Daubentons Bat, Natterers Bat, Leislers Bat, Common Pipistrelle. Roost switching has been observed in Natterers Bat on average every three days and Leislers Bat between every two and ten days.

As noted in Kelleher and Marnell (2006), confirmation of the presence of bats may be attempted by using bat detectors for an emergence survey at an appropriate time of the year, but the nomadic nature of tree-dwelling bats means that the success rate is likely to be very low.

Tree removal has been minimised and the loss of a small number or trees will not have a significant impact on local bat populations. It is also noted that along the River Liffey there are a large number of mature trees of comparable or higher value which will not be affected. However the presence of occasional roosting bats cannot be altogether ruled out and in the absence of mitigation, the removal of these trees could potentially impact on small numbers of bats.

The woodland, treelines and hedgerow habitat on the southern boundary of the site in conjunction with the River Liffey provides moderate to high value foraging habitat for bats at a local level. Common Pipistrelle, Soprano Pipistrelle, Leisler's Bat and Daubuenton's Bat were recorded in this area.

The remaining habitats within the development site boundary provide some limited foraging and commuting habitat for bats and small numbers of Soprano and Common Pipistrelle were in the vicinity of warehouse buildings. No bats were recorded foraging along the central drainage ditch or along the northern or eastern treeline/hedgerows. Arable habitats have low potential for foraging bats and no bats were recorded using this habitat. Overall the site, with the exception of habitats along the southern boundary, provides limited foraging resources for bats and is considered of low value at a local level.

Continuous treeline and hedgerow provides connectivity within the landscape for bats commuting between foraging sites and between roosts and foraging sites. Even gaps as small as 10m may prevent bats using hedgerows and treelines (JNCC 2001). The removal of treeline has the potential to lead to the loss of connectivity to the wider area. However, this boundary does not provide valuable foraging habitat and the impact on this is predicted to be negative, slight and long-term.

Noise and lighting during construction has the potential to impact on foraging bats. However, construction works will be confined to daytime hours and therefore disturbance from lighting will be minimal.

Overall, the loss of semi-natural habitat and increased lighting and disturbance during construction will have a slight local impact on bats. The impact on foraging bats from habitat loss and construction activities will be negative, slight and long term impact at a local geographic level. The impact on roosting bats has the potential to have a negative, slight and long-term impact on local bat populations in the absence of mitigation.

8.6.3.2 Otter

No signs of Otter were recorded within 150m of the proposed development site however the River Liffey is likely to be a high value foraging resource for this species. Construction works could potentially indirectly affect fish stocks and aquatic invertebrates such as White-clawed Crayfish downstream via impacts on water quality. Potential impacts on surface water and aquatic species is discussed in further detail in Section 8.6.8.

Minnow were recorded in the drainage ditch at the centre of the site, however no signs of Common Frog were recorded. Frequent disturbance from dogs and humans means the area is unlikely to provide high value Otter habitat. However the removal of the drainage ditch will result in the loss of low value Otter foraging habitat. .

A proposed surface water outfall will be installed along the River Liffey. This is likely to require minor earthworks in the vicinity of the river. In the absence of mitigation this could potentially cause temporary disturbance impacts to Otter. However, there will be no loss of foraging habitat for Otter as a result of these works.

During the construction phase noise levels will increase. Construction works will primarily take place during daytime hours which will avoid the largely nocturnal foraging habits of Otter. While there may be some short-term displacement of Otter, increased noise and disturbance during the construction phase is unlikely to significantly impact on Otter due to their ability to move away from and/or adapt to short-term disturbance.

The River Liffey in this area has the potential to provide a valuable foraging resource for Otter and as part of the Kildare County Development Plan no works are permitted adjacent to the River Liffey. The retention of vegetation along the river will reduce any disturbance impacts on Otter. Overall, the effects on Otter would be negative, slight and short-term at a local geographic level in the absence of mitigation.

8.6.3.3 Other mammals

While no other protected mammal species were recorded at the proposed development site, Hedgehog, Pygmy Shrew and Red Squirrel could potentially use this site. The habitats that will be affected are common and there is no evidence to indicate they are of particular value for these species in the context of the surrounding countryside. Effects on these species during construction due to loss of habitat, increased noise and disturbance and lighting will be negative, slight and short-term at a local geographic level in the absence of mitigation.

8.6.4 Amphibians

Common Frog could potentially use the drainage ditch in the centre of the site. Construction works could lead to habitat loss and in the absence of mitigation, direct mortality or injury during vegetation clearance will occur. However this species was not recorded during the site survey and the impact on the proposed development is predicted to be negative, not significant and long-term at a local geographic level.

8.6.5 Reptiles

No signs of reptiles were recorded and there are no records of reptile species in this area. There is large areas of comparable habitat in the surrounding landscape and the impact on this species during construction will be negative, not significant and long-term at a local geographic level.

8.6.6 Birds

The most significant impacts on breeding birds will be direct impacts during the construction phase through habitat loss, fragmentation and modification. Areas of treeline, hedgerow and a small area of riparian woodland will be removed as well as areas of arable land. This could result in loss of connectivity with the wider environment, as well as loss of habitat for birds.

There will be indirect impacts due to disturbance, which is likely to displace foraging and breeding birds. Noise levels will fall off quickly outside the site boundary even during peak construction works. Although the habitats within the site are valuable, they are common in the immediate vicinity of the site. Given the mobile nature of birds, and the presence of similar habitats in the immediate vicinity, the impact from disturbance will be moderate at a local level.

One territory of the Red List species Yellowhammer will be removed during construction. While displaced birds are likely to use habitats in the vicinity, intensification of agriculture and the loss of suitable habitats is a significant threat to these species. However, given the availability of alternative foraging habitat in the vicinity and the retention of treelines at the site, Yellowhammer could continue to use the site post construction. However, the proposed development will lead to a loss of foraging habitat for this species.

The Amber List species Willow Warbler and Swallow may be displaced from the site during construction. Several territories of many common Green List bird species (Blackbird, Mistle Thrush, Wren etc) will be removed. In the absence of mitigation, potential impacts include disturbance and injury to eggs, young and nests, and long-term loss of potential nesting sites and foraging habitat. Overall the impact on breeding birds is likely to be negative, moderate and long-term at a local level in the absence of mitigation.

8.6.7 *Other Species*

The habitats that will be affected support common species of invertebrates and there is no evidence to indicate that the proposed development areas are of particular value for other species in the context of the surrounding countryside. No significant effects on invertebrate species have been identified.

Minnow were recorded in drainage ditch at the centre of the site. This drainage ditch is not suitable for salmonids and/or lamprey species. However, this drainage ditch will be removed leading to habitat loss for common fish species.

New surface water outfalls will be installed on the drainage ditch and the River Liffey. This is likely to require minor earthworks in the vicinity of the river, however no instream works are required. In the absence of mitigation this could potentially cause temporary impacts on water quality.

Riverbank habitats with overhanging vegetation provide important habitat for fish and invertebrates. These marginal areas also provide protection from predators and direct sunlight and consequently fish may remain in these areas for extensive periods of time. While some crown reduction may be required in the vicinity of the outfall pipe, no trees or significant areas of vegetation will be impacted by the surface water outfall. The impacts on fish and aquatic invertebrates will be negative, slight and long term at a local level in the absence of mitigation.

8.6.8 Water Quality and Aquatic Ecology

In the absence of appropriate design and mitigation, high levels of silt in surface water run-off from construction works area could impact on fish and invertebrate species in the River Liffey and the adjoining drainage ditch. It is noted that additional information on potential impacts on water quality is provided in Chapter 7 Water.

Depending on the severity, adult fish can be affected by increased silt levels as gills may become damaged by exposure to elevated suspended solids levels. Excessive siltation can cause eggs and fry

to be smothered. If of sufficient severity, aquatic invertebrates may be smothered by excessive deposits of silt from suspended solids. In areas of stony substrate, silt deposits may result in a change in the macro-invertebrate species composition, favouring less diverse assemblages and impacting on sensitive species.

Aquatic plant communities may also be affected by increased siltation. Submerged plants may be stunted and photosynthesis may be reduced. Accidental spillages of hydrocarbons could introduce toxic chemicals into the aquatic environment via surface water run-off or groundwater contamination and have a direct toxicological impact on habitats and fauna.

There is potential for accidental or unplanned surface water pollution to occur during the construction phase. Potential polluting activities include accidental fuel spillages during refuelling of plant/vehicles, and leaks from plant/vehicles reaching the surface drainage network.

In the absence of mitigation and given the proximity of the River Liffey, contaminated surface water runoff during construction could impact on local water quality and aquatic species, including the Annex II species White-clawed Crayfish and Lamprey species, which is known to occur within the River Liffey. This impact would negative, moderate and long term in the absence of mitigation.

8.7 Operational Phase

In the absence of mitigation measures, significant operational phase impacts could include light spillage onto retained vegetation/valuable habitats outside the site boundary used for foraging or breeding by protected species. Impacts on surface water, both in the River Liffey and the retained drainage ditch on the northern boundary, could affect aquatic species and habitats. Disturbance to protected species could occur from noise or vibration associated with traffic and human use.

8.7.1 Habitats

Habitat loss and the spread of invasive species within the proposed development site in the Construction Phase has been considered above in Section 8.6.1 and 8.6.2.

During operation, all surface water drainage within the site will fall via gravity to the various surface water outfalls. Flows from the development will be limited to greenfield runoff rates and appropriate attenuation will be provided. The total discharge will be limited to the greenfield runoff rate of 76.31 l/s. Four outfall pipes will be located on the northern drainage ditch and two on the River Liffey. The impacts of the new surface water network is assessed under construction impacts. There will be no direct impacts on freshwater or terrestrial habitats during the operational phase.

Updated baseline modelling carried out by JBA Consulting as part of the SFRA confirms that the site is partially within Flood Zone A and B from overland flow routes of the River Liffey. The proposed development provides compensatory storage the loss of Flood Zone A. Overall the proposed development will be at low risk of flooding and will not increase the flood risk to the surrounding areas. Therefore there will be no significant impacts on habitats within the proposed development site from flooding during the operational phase.

8.7.2 Invasive species

No impacts predicted to occur.

8.7.3 Mammals

8.7.3.1 Bats

Increased activity and human presence, noise and artificial lighting may impact and disturb or displace bats in the operational phase. Lighting around the proposed buildings and outdoor areas including parking areas and access roads means that bat foraging in these areas is likely to be reduced. Light spillage from the development onto the treeline boundary habitats could prevent bats from foraging within these area.

Myotis species, including Daubenton's Bat are particularly sensitive to light. The River Liffey provides high value foraging habitat for Daubenton's Bat. Pipistrelle species appear to be more tolerant to light and disturbance (Speakman 1991; Stones et al. 2009; Haffner 1986). It is also noted that Leisler's Bats will opportunistically feed on insect gatherings in lit areas (Bat Conservation Ireland 2010).

While there will be new pedestrian paths and amenity areas in the vicinity of the River Liffey, the retention of treelines and woodland along this area will prevent disturbance and light spillage onto the river. However some light spillage will occur on the southern treeline habitat and this will reduce its value for foraging/commuting bats. Small numbers of Soprano and Common Pipistrelle were recorded foraging in this area. While, as noted above, these species are more tolerant of light spillage, light spillage will lead to slight impacts on this foraging habitat. However, there will be no light spillage onto high value bat foraging habitat along the River Liffey.

Within the proposed development site, where habitats have been removed, bats are unlikely to forage in the operational phase. However, bats will continue to forage over habitats adjoining the site particularly in dark areas along the River Liffey and its adjoining habitats. However, foraging along the southern site boundary will reduce due to increased lighting. The impact on bats is predicted to be negative, slight and long-term.

8.7.3.2 Otter

Increased activity and human presence, noise and artificial lighting may impact and disturb or displace Otter during the operational phase, including light spillage onto previously unlit boundary habitats. Badly designed lighting could displace Otter from nearby habitats and create a barrier to connectively in the wider area.

There will be no direct impacts on the River Liffey. However newly landscaped areas and footpaths at the west of the site, will increase disturbance in the vicinity of the river during operation. As described above this area frequently used by walkers and dogs.

It is noted that Otters are largely nocturnal, particularly within urban areas and any Otters which forage here are likely to be habituated to comparable levels of disturbance. Woodland and treeline habitat around the river will be retained and paths will not be lit. Retained habitats around the Liffey will continue to provide areas of cover for Otter using this stretch of the river. During operation the impact of the proposed development will be negative, slight and long-term at a local level.

8.7.3.3 Other Mammals

Increased activity and human presence, noise, fencing and additional lighting may disturb or displace other mammal species such Hedgehog and Pygmy Shrew from favoured foraging habitats during the operational phase. However, given the availability of similar habitat in the vicinity and the mobile

nature of these species, impacts on other mammals are predicted to be negative, slight and long-term at a local level.

8.7.4 Amphibians

Common Frog could potentially use the retained drainage ditch on the northern site boundary. Given that Common Frog was not recorded at the site operational impacts on this species will be negative, imperceptible and long-term at a local geographic level.

8.7.5 Reptiles

No operational impact on reptiles is predicted to occur.

8.7.6 Birds

Following habitat removal during construction the Red List species Yellowhammer and Amber List species Willow Warbler could potentially be displaced from the site. However it is noted that both species were recorded in habitats which will be retained and this species may recolonise the site during the operational stage.

The numbers of common bird species which the site supports will be reduced due to the loss of treeline/hedgerow and agricultural habitats. Increased human presence and increased noise and lighting may prevent birds from nesting or foraging in habitats adjacent to the site. In areas where nesting habitat is retained within the site e.g. woodland/treeline, increased disturbance may impact on breeding birds.

The impact on birds during operation is predicted to be negative, slight and long-term at a local level due to disturbance and/or displacement of bird species.

8*.7.7 Other species*

A new surface water sewer network shall be provided for the proposed development. The proposed surface water drainage network will drain the whole site. Due to the topography across the site, it is not possible to drain the entire site via one outfall. As such it is proposed to discharge to the existing ditch which passes through the northern portion of the site as well as the River Liffey.

All surface water drainage within the site will fall via gravity to the various surface water outfalls. Flows from the development will be limited to greenfield runoff rates and appropriate attenuation will be provided. The total discharge will be limited to the greenfield runoff rate of 76.78 l/s.

The proposed link road that will traverse the site is to be drained separately to the development drainage. A dedicated surface water drainage line will be provided for the road which will discharge to a dedicated attenuation system. The flow from the road will also be limited to greenfield rates and will connect to the proposed development drainage downstream of the hydrobrake.

It is proposed that all surface water run-off will outfall via Class 1 Bypass Separator located downstream ofall of the proposed attenuation tanks. These devices will remove hydrocarbons and fine sediment particles from the site runoff and lower the risk of downstream contamination following an oil spillage on site.

In addition to the underground attenuation tanks, the following Sustainable Urban Drainage Systems (SuDs) are incorporated into the design including permeable paving, swales/bioswales, green roofs, soakaways/soak pits and rainwater harvesting.

Given the operational design measures, the impacts on fish and aquatic invertebrate species are predicted to be negative, not significant and long-term.

No significant impacts on terrestrial invertebrates during the operational phase have been identified.

8.8 Baseline Scenario

Most of the site i.e. arable lands has been significantly modified from the natural state by human activity. The management regime, include harvesting, fertilising and pest control means that there is limited diversity of flora or fauna within this habitat, which dominates the site. If left untreated, Himalayan Balsam will continue to spread at a slow but cumulative rate. Agricultural inputs could potentially impact on water quality in the River Liffey.

Areas of semi-natural habitat i.e. treelines/hedgerow and woodland are present at the site and these will remain largely intact in the absence of development and no significant changes to the boundary habitats are likely to occur.

8.9 Prevention & Mitigation

The prevention and mitigation measures are in line with current best practice and include an avoidance of sensitive habitats at the design stage and site specific mitigation measures to effectively prevent significant ecological impacts.

8.9.1 Design Stage

The design stage prevention measures in relation to habitats included retaining the existing boundary hedgerows and treelines to the greatest extent possible and minimising the removal of mature trees inside the site. These were informed by an arborist's assessment.

A detailed landscape plan has been prepared. It is proposed to plant native trees along with smaller specimen trees/multi-stem shrubs, wildflower and herbaceous planting. This will benefit pollinators and create habitat for local flora and fauna. The detailed planting scheme is included in the *Landscape Development Report* (TBS 2022).

The surface water drainage system was designed to meet the SuDs requirements to ensure that flow rates remained at greenfield levels, while taking account of the implications of climate change. The system design also included measures (permeable paving and oil interceptors) to prevent/minimise impacts on water quality.

The lighting scheme design takes account best practice measures to mitigate impacts on bats, as published by the UK Bat Conservation Trust.

- LED lanterns do not emit any ultraviolet or infra-red radiation, this again being a desirable feature in relation to impact upon bats, in terms of causing spatial exclusion from artificially lit areas.

- The lighting configuration has been carefully selected to achieve recommended illuminance levels whilst minimising light spill. This is achieved by a combination of optimised column height, luminaire Wattage, optical setting and column location.
- All luminaires proposed have high performance optics designed to get the light onto the target area thus minimising spill light.
- The ULR of all proposed luminaires is 0%. The colour temperature of the LEDs is 3000K with a peak wavelength greater than 550nm. Also rear/front louvres are available (retrofittable) if required to further minimise the amount of back/front spill light.
- Lanterns will be the fully cut off type with no light output above the horizontal plane.
- Height of columns kept as low as possible taking cognisance of need to make lanterns vandal resistant
- Screening by existing trees will be retained.
- Spacing between lights will be maximised

8.9.2 Construction Stage

A Preliminary Construction Environmental Management Plan (CEMP) has been prepared (Appendix 3) that specifies the construction stage mitigation measures to prevent significant adverse impacts on human beings, water and air quality and biodiversity.

In the case of the latter there is particular emphasis on the need to protect the valuable habitats adjoining the site i.e. River Liffey and treeline/woodland habitats. To achieve this it is essential that all construction staff, including all sub-contractors, are fully informed of these habitats and of the control measures that must be implemented to prevent adverse impacts.

The mitigation measures specified in the CEMP to prevent/minimise nuisance to human beings and protect air and water quality apply equally to biodiversity. In addition the following biodiversity specific measures will be implemented.

8.9.2.1 Lighting

Lighting associated with the site works could cause disturbance/displacement of fauna and if of sufficient intensity and duration, there could be impacts on reproductive success. Site lighting will typically be provided by tower mounted temporary portable construction floodlights. The floodlights will be cowled and angled downwards to minimise spillage to surrounding properties.

The mitigation measures will be in accordance with *Bats & Lighting Guidance Notes for: Planners, engineers, architects and developers* (Bat Conservation Ireland, 2010) and will include:

- Lighting will be provided with the minimum luminosity necessary for safety and security purposes. Where possible, lighting will be restricted to the working area and using the cowl and angling noted above, will minimise overspill and shadows on sensitive habitats outside the construction area and
- Lighting will be positioned and directed so that it does not to unnecessarily intrude on adjacent ecological receptors. The primary area of concern is the potential impact at the woodland and

treelines along the River Liffey. There will be no directional lighting focused towards these areas and cowling and focusing lights downwards will minimise light spillage.

8.9.2.2 Habitats

The Wildlife Act 1976, as amended, makes it an offence to cut, grub, burn or destroy any vegetation on uncultivated land or such growing in any hedge or ditch from the 1st March to the 31st August. Exemptions include the clearance of vegetation in the course of road or other construction works or in the development or preparation of sites on which any building or other structure is intended to be provided. Where possible trees will be removed outside the period 1st March to 31st August.

The mitigation measures to protect the trees that will be retained were prepared by a qualified Arborist, who will prepare an Arboriculture Method Statement for any works within the root protection area of any tree to be retained and the measures outlined shall be strictly enforced on site.

Trees will be protected in accordance with BS: 5837:2012 Trees in relation to design, demolition and construction. Recommendations and any further agreed procedures. Reinstatement of trees and vegetation will be undertaken by a suitably qualified landscape contractor

Works on the surface water outfall pipes in the vicinity of the River Liffey and drainage ditch will comply with The IFI's *Guidelines on protection of fisheries during construction Works in and adjacent to waters* (IFI, 2016). No instream works are required.

8.9.2.3 Bats

The general mitigation measures for bats will follow the National Road Authority's '*Guidelines for the Treatment of Bats during the Construction of National Road Schemes'* NRA (2005c) and *'Bat Mitigation Guidelines for Ireland: Irish Wildlife Manuals, No. 25'* (Kelleher, C. & Marnell, F. (2006)) that identify the measures to be applied in the site clearance stage to minimise negative effects on roosting bats, and prevent avoidable effects resulting from significant alterations to the immediate landscape.

Although no bat roosts were recorded within the site boundary, the presence of occasional roosting bats cannot be altogether ruled out. The development involves the demolition of a number of buildings. No signs of bats were recorded within these buildings and they have a low potential as roosting habitat. However, as a precautionary measure, the following measures will be implemented prior to and/or during demolition.

- Ideally work on buildings will take place outside the summer season between and October March inclusive when bats will be hibernating as the buildings to be removed have negligible potential as winter hibernation sites.

- In all cases immediately in advance of demolition a bat specialist/ Ecological Clerk of Works will undertake an examination of the building. Emergence surveys will be carried out if buildings are affected during the April to September period. If bats are present at the time of examination it is essential to determine the nature of the roost (i.e. number, species, whether it is a breeding population) as well as its exact location.

- If bats are recorded in buildings earmarked for demolition, special mitigation measures to protect bats will be put in place and a license to derogate from the conservation legislation will be sought from the NPWS.

- The contractor will take all required measures to ensure works do not harm individuals by altering working methods or timing to avoid bats, if necessary.

- If roosting habitat for bats is removed, replacement habitat will be provided.

- A number of trees will be removed prior to/during construction. The bat specialist/Ecological Clerk of Works will work with the contractor to ensure that the loss of trees is minimised and that trees earmarked for retention are adequately protected.

- Tree-felling will be undertaken in the period September to late October/early November. During this period bats are capable of flight and may avoid the risks of tree-felling if proper measures are undertaken.

- Felled trees will not be mulched immediately. Such trees will be left lying several hours and preferably overnight before any further sawing or mulching. This will allow any bats within the tree to emerge and avoid accidental death. The bat specialist will be on-hand during felling operations to inspect felled trees for bats. If bats are seen or heard in a tree that has been felled, work will cease and the local NPWS Conservation Ranger will be contacted.

- Trees will be retained where possible and no 'tidying up' of dead wood and spilt limbs on tree specimens will be undertaken unless necessary for health and safety.

- Treelines outside the proposed development area but adjacent to it and thus at risk, will be clearly marked by a bat specialist to avoid any inadvertent damage.

- During construction directional lighting will be employed to minimise light spill onto adjacent areas. Where practicable during night-time works, there will be no directional lighting focused towards the River Liffey or boundary habitats and focusing lights downwards will be utilised to minimise light spillage.

- If bats are recorded by the bat specialist within any trees or buildings, no works will proceed without a relevant derogation licence from the NPWS.

- As a biodiversity enhancement measure it is proposed that bat boxes will be put up within the study area. It is proposed that 10 bat boxes will be located within the site (https://www.wildcare.co.uk/vincent-pro-bat-box-10651.html for box proposed or similar). The boxes will be erected by the Ecological Clerk of Works taking into account landscape plans, vehicle movements and lighting.

- As noted above, lighting mitigation measures will follow *Bats & Lighting Guidance Notes for: Planners, engineers, architects and developers* (Bat Conservation Ireland, 2010) and *Guidance note 08/18. Bats and artificial lighting in the UK. Bats and the built environment series* (Bat Conservation Trust 2018).

- All mitigation measures including detailed method statements will be agreed with the NPWS prior to commencement of works, which could affect any bat populations on site.

8.9.2.4 Birds

As noted above vegetation will be removed outside of the breeding season where possible and in particular, removal during the peak-breeding season (April-June inclusive) will be avoided. This will also minimise the potential disturbance of breeding birds outside of the study area boundary.

As a biodiversity enhancement measure ten bird nesting boxes (various types including open fronted and entrance hole) will be located within the site boundary at locations specified by the Ecological Clerk of Works.

The provision of tree planting and the use of more diverse grassland planting will provide additional nesting and feeding sites for birds, particularly as these habitats mature.

8.9.2.5 Invasive species

Prior to the commencement of construction works an invasive species survey will be undertaken within the proposed development boundary by a competent ecologist to determine if invasive species listed under Part 1 of the Third Schedule of S.I No. 477 of 2011 have established in other areas in the period between pre-planning and post consent.

Site Hygine At Contaminated Area

Construction equipment, vehicles and footwear may provide a vector for the spread of invasive species. Maintaining site hygiene at all times in an area affected by invasive species is essential to prevent further spread.

The following site hygiene measures will be implemented for the contaminated area:

- Understand the potential extent of the rhizome (root) system underground – up to seven metres horizontally and three metres vertically.
- Where possible, the contaminated area will be avoided and fenced off, or the extent of the rhizomes clearly marked.
- If possible, the use of machinery with tracks will be avoid contaminated areas. Movement of machinery between contaminated and non-contaminated areas must be controlled and adequate power washing measures implemented.
- Areas where contaminated soil is to be stockpiled on site will be clearly identified and marked out.
- Designated entry and exit points will be identified for personnel on foot and for small mobile equipment. A delineated access track, to be maintained free of Japanese Knotweed and Himalayan will be established through the site to minimise the spread of Knotweed species by permitted vehicles accessing the site.
- Vehicles, including footwear and tools, leaving the site will be inspected for any plant material and washed down (using a pressure washer) in a dedicated vehicular wheel wash down facility, which will drain into a contained area within the site. Particular care is required with tracked machines.

- Vehicles used in the transport of contaminated material will be visually checked and washed down into a contained area before being used for any other work, either in the same area or on a different site.
- Only vehicles required for essential works including site investigation works will be brought on site and the number of visits minimised as much as practicable.
- Material gathered in the dedicated wash down contained areas will be appropriately disposed of off-site.
- For any subsoil or topsoil entering the site, the supplier will be required to provide an assurance that it is free of Japanese Knotweed and Himalayan Knotweed.
- All site personnel will be made aware of measures to be taken and will be informed of the requirements of the ISMP.
- Site hygiene signage, in relation to the management of invasive species, will be erected.

Management Options

In addition to the possible advance treatment works and pre-construction survey, when the works areas become available to the contractor for enabling works, areas identified as requiring specific invasive species treatment will be demarcated and the designated control measures implemented at the earliest possible stage to reduce the risk of spread along the proposed scheme or beyond the land take.

Any Himalayan Balsam within the works area will be hand-pulled and bagged prior to the commencement or site works. It will be then placed in a designated area of the site to decay. The seeds are not particularly robust but may survive for 18 months so a two-year programme of control, which will extend beyond the construction period, will be required. All machinery leaving the site will be washed down in a designated wash down area in proximity to the site exit to prevent seeds from being spread outside the site boundary.

To avoid additional spread do not disturb plants if seeds pods are visible (usually sometime after May). Programmes should be undertaken in April or early May. If hand pulling after this time, bag plant tops to prevent seed spread.

If and where contaminated soil or heaps of high-risk invasive species (i.e. Himalayan Balsam) are to be stockpiled, the area will be clearly marked out on site. These areas will preferably not be within 20m of any watercourse or flood zone.

No significant impediments to the successful implementation of these control measures have been identified and it is expected that the treatment programme will successfully eradicate these species from the applicant's landholding.

8.9.3 Operational Stage

Additional mitigation measures are not required in the operational stage.

8.10 Monitoring

A bat specialist will examine the buildings prior to demolition and the mature trees prior to removal to determine the presence/absence of bats.

8.11 Cumulative Effects

A number of developments/plans are proposed and permitted in the vicinity of the proposed development and the potential for cumulative impacts with these projects/plans were considered. These projects are assessed below in **Table 8.13**.

Table 8.13 Potential Cumulative Effects

Plans and Key Policies/Issues/Objectives		
River Basin Management Plan 2018-2021	The project should comply with the environmental objectives of the Irish RBMP which are to be achieved generally by 2021. Ensure full compliance with relevant EU legislation Prevent deterioration Meeting the objectives for designated protected areas Protect high status waters Implement targeted actions and pilot schemes in focus sub-catchments aimed at: targeting water bodies close to meeting their objective and addressing more complex issues which will build knowledge for the third cycle.	The implementation in accordance with key environmental policies, issues and objectives of this management plan will result in positive cumulative effects to European sites. The implementation of this plan will have a positive impact for the biodiversity. It will not contribute to cumulative impacts with the proposed development.
Inland Fisheries Ireland Corporate Plan 2016 -2020	To ensure that Ireland's fish populations are managed and protected to ensure their conservation status remains favourable. That they provide a basis for a sustainable world class recreational angling product, and that pristine aquatic habitats are also enjoyed for other recreational uses. To develop and improve fish habitats and ensure that the conditions required for fish populations to thrive are sustained and protected. To grow the number of anglers and ensure the needs of IFI's other key stakeholders are being	The implementation in accordance with key environmental issues and objectives of this corporate plan will result in positive on-combination effects to European sites. The implementation of this corporate plan will have a positive impact for biodiversity of inland fisheries and ecosystems. It will not contribute to cumulative impacts with the proposed works.

	met in a sustainable conservation focused manner. EU (Quality of Salmonid Waters) Regulations 1988. All works during development and operation of the project must aim to conserve fish and other species of fauna and flora habitat; biodiversity of inland fisheries and ecosystems and protect spawning salmon and trout.	
Irish Water Capital Investment Plan 2014-2016	Proposals to upgrade and secure water services and water treatment services countrywide.	Likely net positive impact due to water conservation and more effective treatment of water.
Water Services Strategic Plan (WSSP, 2015)	Irish Water has prepared a Water Services Strategic Plan (WSSP, 2015), under Section 33 of the Water Service No. 2 Act of 2013 to address the delivery of strategic objectives which will contribute towards improved water quality and biodiversity requirements through reducing: Habitat loss and disturbance from new / upgraded infrastructure; Species disturbance; Changes to water quality or quantity; and Nutrient enrichment /eutrophication.	The WSSP forms the highest tier of asset management plans (Tier 1) which Irish Water prepare, and it sets the overarching framework for subsequent detailed implementation plans (Tier 2) and water services projects (Tier 3). The WSSP sets out the challenges we face as a country in relation to the provision of water services and identifies strategic national priorities. It includes Irish Water's short, medium, and long-term objectives and identifies strategies to achieve these objectives. As such, the plan provides the context for subsequent detailed implementation plans (Tier 2) which will document the approach to be used for key water service areas such as water resource management, wastewater compliance and sludge management. The WSSP also sets out the strategic objectives against which the Irish Water Capital Investment Programme is developed. The current version of the CAP outlines the proposals for capital expenditure in terms of upgrades and new builds within the Irish Water owned assets. The overarching strategy was subject to AA and highlighted additional plan/project environmental assessments to be carried out at the tier 2 and tier 3 level. Therefore, no likely significant cumulative effects are envisaged.

WWTP discharges	Upper Liffey Sewerage Scheme	Discharges from municipal WWTPs are to meet water quality standards. Irish Water Capital Investment Plan 2014-2016 and 2017 – 2021 proposes to upgrade water treatment services countrywide. Discharges from municipal WWTPs are to meet water quality standards Given that no significant effect on water quality is predicted from this proposed project no significant cumulative effects on water quality will occur.
Other developments	In November 2021 planning permission (Planning Ref No 211248) was granted to Barola Capital DAC for a Distribution Warehouse, Ancillary Office Accommodation and Ancillary Buildings on a 15.42 ha site to the north-east of the proposed development. The site enabling works for the main contract due to start in May 2022. The works to the Ballyfarm Road including upgraded bus stops and resurfacing of footpaths are scheduled for completion in June 2022. Given the progress to date, the Distribution Centre will be operational before the construction of Phase 1 of the proposed development begins. In December 2021, Murphy Ireland International Ltd. lodged an application (Ref No 21780) for two manufacturing buildings at their compound to the east of the proposed development. The pipe repair and testing operation in the centre of the development area will be relocated to these buildings. If the construction of the buildings overlaps with Phase I of the proposed development there is the potential for cumulative effects on air quality.	A worst-case scenario would occur if the construction of these projects were to run concurrently with proposed developments. In the event of this there is potential for in-combination disturbance effects, as the sites are located in proximity to each other. Should this situation arise, construction activities will be planned and phased, in consultation with construction management teams. A worst-case scenario is of construction for both projects running concurrently. Given the dilution provided in the River Liffey and implementation mitigation measures, no significant effect on water quality or in-combination effects will occur in the event that the projects run concurrently. This project has the potential to increase levels of noise and disturbance. In the context of the existing environment which is subject to background noise and disturbance, the increase in noise and disturbance associated with this project will not be significant. Taking a worst-case scenario approach of both projects being constructed concurrently, and given the implementation of detailed site-specific mitigation, no significant in-combination effect from noise and disturbance during construction will occur. Likewise in the context of existing levels of noise and disturbance, no significant combination effects will occur during operation.

		No cumulative impacts are predicted to occur within the Natura 2000 sites as a result of these proposed and permitted projects.
Other Plans	The completion of the section of the NSOORR between Great Connell Roundabout and the Athgarvan Road requires the extension of the roadway and the construction of a bridge over the Liffey to tie into the section of the NSSORR being delivered as part of the residential development currently under construction to the south west of the propose development site. This will be the subject of a separate planning application and will be subject of EIA. At the time of the preparation of this EIAR the alignment and design of the bridge are indicative only.	Other plans The completion of the section of the NSOORR between Great Connell Roundabout and the Athgarvan Road requires the extension of the roadway and the construction of a bridge over the Liffey to tie into the section of the NSSORR being delivered as part of the residential development currently under construction to the south west of the propose development site. This will be the subject of a separate planning application and will be subject of EIA. At the time of the preparation of this EIAR the alignment and design of the bridge are indicative only. The proposed development has avoided significant impact on the River Liffey and its surrounding habitats at the design stage. In this context, cumulative impacts will only arise in relation to noise/disturbance and water quality impacts. A worst-case scenario would occur if the construction of these projects were to run concurrently with proposed developments. In the event of this there is potential for in-combination disturbance effects, as the sites are located in proximity to each other. Should this situation arise, construction activities will be planned and phased, in consultation with construction management teams. A worst-case scenario is of construction for both projects running concurrently. Given the dilution provided in the River Liffey and implementation mitigation measures, no significant effect on water quality or in-combination effects will occur in the event that the projects run concurrently. This project has the potential to increase levels of noise and disturbance. In the context of the existing environment which is subject to background noise

		and disturbance, the increase in noise and disturbance associated with this project will not be significant. Taking a worst-case scenario approach of both projects being constructed concurrently, and given the implementation of detailed site-specific mitigation, no significant in-combination effect from noise and disturbance during construction will occur. During operation, the proposed NSSORR bridge will lead to increased disturbance on the River Liffey. While the proposed development will increase activity in this area, the lighting design, landscaping and habitat retention measures have been designed to avoid significant impact on fauna on the River Liffey. While significant impacts from the new bridge cannot be ruled out in the absence of a full assessment, no significant operational disturbance impacts have been identified from the proposed development. Therefore there will be no significant cumulative disturbance impacts during operation. No cumulative impacts are predicted to occur within the Natura 2000 sites as a result of these proposed and permitted projects.

8.12 Residual Impacts

8.12.1 Habitats

Replacement planting of native and non-native tree species within the site will provide alternative forging and commuting habitat for birds, bats and other fauna. This will compensate for some of the habitat loss at the site including scrub and treeline habitat. The replacement planting will ensure there is no net loss of trees at the site, although there will be a nett loss of common habitats such as the arable lands.

8.12.2 Non -Native Invasive Species

Any potential risks from these species will be managed during the construction phase and therefore no residual effect from the spread of invasive species will occur.

8.12.3 Bats

Specific mitigation measures will be put in place to ensure impacts on bats from tree removal are avoided. Given the low roost value of trees that will be removed and the proposed mitigation measures the removal of the trees will have no significant impact. It is noted that bat boxes will be provided which will provide bat roosting habitat which is likely to be of higher value for bats than that provided by the trees to be removed.

Lit areas of the site will be avoided by bats, although they are likely to continue to forage in dark areas. Construction and operational lighting design will ensure that dark areas are maintained at the site.

The proposed development will result in a nett loss of low to moderate value feeding habitat. Replacement planting of native and non-native tree species within the site boundary will provide alternative foraging and commuting habitat for bats. This will also help to shield retained boundary habitats from lighting in the new dwellings and common areas. The residual impact of the proposed development is expected to be negative, slight and long-term at a local level on Common Pipistrelle, Soprano Pipistrelle, Daubenton's Bat and Leisler's Bat.

8.12.4 Otter

During construction and operation noise and activity at the site will increase. It is noted that the surrounding landscape, with extensive areas of existing housing development and road networks is already subject to high levels of disturbance from traffic and human activity and Otters currently using the area are expected to be habituated to ongoing disturbance factors in these circumstances. Given the levels of disturbance within the adjacent habitats and the proposed lighting design measures the impact from disturbance will not be significant.

The River Liffey is likely to be a high value resources for Otter. The drainage ditch at the centre of the site which will be removed is not a high value resource. The residual impact on this species is predicted to the negative, slight and long-term at a local level.

8.12.4 Other Mammals

Other protected mammal species such as Hedgehog, Pygmy Shrew and Red Squirrel could potentially use the proposed development site. These are mobile species which can move away from the site of disturbance. There will be a net loss of feeding habitat. The residual impact on these species is predicted to the negative, slight and long-term at a local level.
Hedgehog and Pygmy Shrew are likely to recolonise newly planted hedgerows/treelines at the site following construction and continue to use retained habitats. Retained woodland habitat will mean the potential habitat for Red Squirrel to occur will not be impacted. The impact is predicted to the negative, not significant and long-term at a local level.

8.12.5 Amphibians and Reptiles

There will be a nett loss of potential habitat for Common Frog. The impact with the negative, slight and long term at a local level.

8.12.6 Birds

Breeding birds will be displaced from relatively common habitats within the site boundary. Noise levels during construction are likely to be significant and birds will be displaced during peak construction works. In the operational stage and following the implementation of the landscape plan, common

woodland edge bird species are likely to recolonise landscaped areas at the site, albeit in lower numbers.

Yellowhammer and Willow Warbler may continue to use retained habitats at the site, however it is noted that increased disturbance is likely to displace these species. The residual impact will be negative, slight and long-term at a local level.

8.12.7 Other Species

No residual impacts identified.

8.12.8 Summary of Residual Effects

Likely Significant Effect	Quality	Significance	Extent	Probability	Duration
Habitats	Negative	Imperceptible		Unlikely	Temporary
Bats	Negative	Slight	Local	Likely	Long Term
Otter	Negative	Slight	Local	Likely	Long Term
Other Mammals	Negative	Not Significant	Local	Likely	Long Term
Amphibians & Reptiles	Negative	Slight	Local	Likely	Long Term
Birds	Negative	Slight	Local	Likely	Long Term

8.13 References

Bat Conservation Trust (2018). Guidance note 08/18. Bats and artificial lighting in the UK. Bats and the built environment series

Champ, T. (2005). River Liffey fish stock survey from upstream of Ballymore Eustace (Driver's Ford) to disused Railway Bridge at Harristown, September 2005. Central Fisheries Board.

CIEEM. (2019). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. September 2018. Version 1.1 - Updated September 2019.

Cranswick, P, Bowler, JM, Delany, SN, Einarsson, O, Gardarsson, A, McElwaine, JG, Merne, OJ, Rees, EC, & Wells, JH. 1996. Numbers of Whooper Swans Cygnus cygnus in Iceland, Ireland and Britain in January 1995: results of international Whooper Swan census, Wildfowl 47: 17-30.

EPA (2017). Guidelines on the Information to Be Contained in Environmental Impact Assessment Reports. Draft. August 2017. Environmental Protection Agency, Wexford.

European Commission (EC) (2018) Managing Natura 2000 Sites: The Provision of Article 6 of the Habitats Directive 92/43/EEC (EC Environment Directorate-General, 2018)

Fossitt, J.A. (2007). A Guide to Habitats in Ireland, 2007 reprint. The Heritage Council, Kilkenny.

Gilbert, G., Stanbury, A. and Lewis, L. (2021). Birds of Conservation Concern in Ireland 4: 2020-2026. Irish Birds 43; 1-23

JNCC (2001). Habitat management for bats; A guide for land managers, land owners and their advisors Kelleher, C. & Marnell, F. (2006) *'Bat Mitigation Guidelines for Ireland: Irish Wildlife Manuals, No. 25'*

Kelly, F., Matson, R., Wightman, G., Connor, L., Feeney, R., Morrissey, E., O'Callaghan, R., Hanna, G., Rocks, K. & Harrison, A. (2010). Eastern River Basin District Rivers. Sampling fish for the Water

Framework Directive – Rivers 2008. Central and Regional Fisheries Boards. Available at http://www.wfdfish.ie/wp-content/uploads/2010/04/ERFB_rivers_report_2008.pdf

Kelly, F.L., Harrison, A., Connor, L., Wightman, G., Matson, Hanna, G., Feeney, R., Morrissey, E., O'Callaghan, R., Wogerbauer, C. and Rocks, K. (2011). Eastern River Basin District Rivers. Sampling fish for the Water Framework Directive – Rivers 2009. Central and Regional Fisheries Boards.

Kelly, F.L., Matson, R., Connor, L., Feeney, R., Morrissey, E., Coyne, J. and Rocks, K. (2014). Water Framework Directive Fish Stock Survey of Rivers in the Eastern River Basin District. Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland. Available at: http://wfdfish.ie/wp-content/uploads/2011/11/ERBD_rivers_report_2013.pdf

Lintott PR, Bunnefeld N, Fuentes-Montemayor E, Minderman J, Mayhew RJ, Olley L, Park KJ. 2014 City life makes females fussy: sex differences in habitat use of temperate bats in urban areas. R. Soc. open sci. 1: 140200.

Macklin, R., Brazier, B. & Gallagher, C. (2018). Fisheries assessment of selected weir sites on the River Barrow, Counties Carlow & Kilkenny. Unpublished report prepared by Triturus Environmental Services for McCarthy-Keville O'Sullivan on behalf of Waterways Ireland.

NRA (2006a). Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes. National Roads Authority, Dublin.
NRA (2006b). Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes. National Roads Authority, Dublin.

NRA (2009). Guidelines for Assessment of Ecological Impacts of National Road Schemes. Revision 2, 1st June 2009. National Roads Authority, Dublin.

NRA (2010). Guidelines for the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads. National Roads Authority.

NRA 2005. *Guidelines for the Treatment of Bats during the Construction of National Road Schemes*

Parnell, J. & Curtis, T. (2012). Webb's An Irish Flora. Cork University Press, Cork.

Robinson JA, K Colhoun, JG McElwaine & EC Rees. 2004. Whooper Swan Cygnus cygnus (Iceland population) in Britain and Ireland 1960/61 – 1999/2000.

Waterbird Review Series, The Wildfowl & Wetlands Trust/Joint Nature Conservation Committee, Slimbridge.

The Heritage Council, Kilkenny. Best Practice Guidance for Habitat Survey and Mapping.

Triturus (2020). Fisheries assessment of the River Liffey, Co. Kildare. Unpublished report prepared by Triturus Environmental Ltd. North Kildare Trout & Salmon Anglers Association. December 2020.

Whilde, A. (1993). Irish Red data book 2: Vertebrates. Threatened mammals, birds, amphibians and fish in Ireland

White, S., O'Neill, D., O'Meara, D.B., Shores, C., Harrington, A.P., O'Reilly, C., Weyman, G. and Sleeman D.P. (2013). A non-invasive genetic survey of OtterOtters (Lutra lutra) in an urban environment: a pilot study with citizen scientists IUCN OtterOtter Specialist Group Bulletin.

Wyse-Jackson, M., FitzPatrick, Ú., Cole, E., Jebb, M., McFerran, D. & Sheehy Skeffington, M Wright, M. (2016). Ireland Red List No. 10: Vascular Plants. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin.

9 AIR

9.1 Introduction

This Chapter describes the ambient air quality and the impacts of the proposed development on air quality in the receiving environment within and outside the site boundary, including a 'baseline' scenario. It focuses on the local environment in the vicinity of the proposed development, referred to in this chapter as the study area. It identifies the prevention and mitigation measures that are and will be implemented to reduce the significance of the potential impacts and assesses the residual potential impacts.

The assessment was completed by Dr. Micheal Fogarty, Mr Ricky Gellatally and Mr Simon Welchman of Katestone. Micheal is a Senior Air Quality Consultant with 12 years of experience in Ireland and Australia. He holds a B.Eng, M.Eng and PhD from the UCD College of Engineering and Architecture. He specialises in the areas of air quality and odour impact assessment.

Mr Gellatally is the Operations Team Leader at Katestone Environmental with over 10 years of experience in the field of air quality. He oversees and contributes to various projects each year, most using dispersion modelling, and takes a lead role in developing technical approaches and tools for in-house and external use, as well as undertaking regular analytical studies to inform and advance the understanding of trends and other developments in the field of air quality. He specialises in the various areas of air quality assessment including the impact assessment of emissions from traffic

Mr Welchman B.Eng has been a director of Katestone since 2004 with more than twenty-three years' experience working as an air quality expert in the private sector and for an environmental regulator.

9.2 Relevant Legislation and Guidance

The general EIA guidelines and legislation are listed in Sections 1.2 and 1.5 and the specific legislation and guidelines relevant to air quality that set out the general principles and suitable methods to complete the air quality assessment taken into account in the preparation of this Chapter are:

- Air Pollution Act 1987, as amended.
- Environmental Protection Agency Acts 1992, as amended
- Air Quality Standards Regulations 2011 (S.I. No. 180 / 2011), as amended.
- The Ambient Air Quality and Cleaner Air for Europe (CAFE) Directive (2008/50/EC).
- The fourth Daughter Directive (2004/107/EC).
- EPA (2020) Air Dispersion Modelling from Industrial Installations Guidance Note (AG4).
- NRA (2011) Treatment of Air Quality During the Planning and Construction of National Road Schemes.

- UK Highways Agency (2019) Design Manual for Roads and Bridges - Sustainability & Environment Appraisal- Air quality - LA 105.

- NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide.

- Institute of Air Quality Management (IAQM) (2014) Guidance on the assessment of dust from demolition and construction.

- DEHLG (2004) Quarries and Ancillary Activities Guidelines for Planning Authorities.

The Air Pollution Act 1987, as amended (Act) is the primary legislation related to air quality in Ireland. It provides for the control of air pollution and other matters connected with air pollution. Section 4 of the Act defines air pollution as

> "a condition of the atmosphere in which a pollutant is present in such a quantity as to be liable to —
> (i) be injurious to public health, or
> (ii) have a deleterious effect on flora or fauna or damage property, or
> iii) impair or interfere with amenities or with the environment."

The EU Air Quality Framework Directive (1996) and its four "daughter" directives set limits for specific air pollutants:

- 1st Daughter Directive: Sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead.

- 2nd Daughter Directive: Carbon monoxide and benzene.

- 3rd Daughter Directive: Ozone.

- 4th Daughter Directive: Polyaromatic hydrocarbons, arsenic, nickel, cadmium and mercury in ambient air.

The Framework and four "daughter" directives were repealed and replaced by the Ambient Air Quality and Cleaner Air for Europe (CAFE) Directive (2008/50/EC). The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011), as amended (DEHLG, 2011).

The Regulations establish limit values; and, as appropriate, alert thresholds for concentrations of certain pollutants in ambient air intended to avoid, prevent or reduce harmful effects on human health and the environment as a whole. The limit values specified in Regulations were used in the assessment of air quality impacts..

9.3 Methodology

The following sections describe the legislation and guidance that are relevant to the assessment of emissions to air from the proposed development, and the methodology that underpins the assessment of air quality.

9.3.1 Air Quality Information Sources

The following source were used in the preparation of this air quality assessment:

- EPA (2012) Ambient Air Monitoring at Newbridge, Co. Kildare 1st October 2009 – 24th May 2010.
- EPA (2018) Air Quality in Ireland 2017 – Indicators of Air Quality.
- EPA (2019) Air Quality in Ireland 2018 – Indicators of Air Quality.
- EPA (2020) Air Quality in Ireland 2019 – Indicators of Air Quality.
- EPA (2021) Newbridge air quality monitoring station.
- Met Éireann (2021) meteorological monitoring data.

9.3.2 Assessment of Construction Impact

The following section describes the methodology applied to assess the potential impacts of air contaminants from the construction of the proposed developments including residences, the neighbourhood centre and the crèche.

The National Road Authority (NRA) guidance document titled Treatment of Air Quality During the Planning and Construction of National Road Schemes (NRA, 2011) addresses the potential impacts of construction activities on local air quality. It states *"The potential impact of both dust and vehicle emissions during the construction phase should be considered within the EIS. Dust emissions can lead to elevated PM_{10} and $PM_{2.5}$ concentrations and may also cause dust soiling."* The predominant emission of concern in the construction stage will be dust.

The DEHLG guidance document Quarries and Ancillary Activities Guidelines for Planning Authorities, states the following in relation to potential impacts of dust emissions *Residents living in proximity to quarries can potentially be affected by dust up to 0.5km from the source, although continual or severe concerns about dust are most likely to be experienced within about 100m of the dust source.*

The Institute of Air Quality Management (IAQM) 2014 Guidance provide guidance on how to undertake a construction impact assessment (including demolition and earthworks as appropriate). It describes a stepped assessment procedure to consider potential impacts from construction activities. Katestone considers the methodology described in IAQM Guidance to be the most comprehensive and robust guidance for the assessment of impacts during the construction stage of proposed developments and adopted this approach.

Step 1 is to determine the likelihood of significant impacts based on the distance between the works and sensitive receptors, both human and ecological. If there are no receptors within the specified distance of the works then no further assessment is required. If there are receptors within the distances then a more detailed assessment of the dust impacts (Step 2) is required.

This is done for four activities (demolition; earthworks; construction; and trackout) and takes account of the scale and nature of the works, which determines the potential dust emission magnitude (Step 2A); and the sensitivity of the area (Step 2B). These factors are combined in Step 2C to give the risk of dust impacts.

Step 3 is to determine the site-specific mitigation for each of the four activities listed in Step 2. Step 4 is to examine the residual effects and to determine whether or not these are significant and Step 5 is the preparation of the dust assessment report.

The Step 1 screening criteria that trigger the Step 2 assessment are

- a 'human receptor' within:
    - 350 m of the boundary of the site; or
    - 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s)
- an 'ecological receptor' within: - 50 m of the boundary of the site; or
    - 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

The risk of dust arising in sufficient quantities to cause annoyance and/or health and/or ecological impacts are determined using four risk categories: negligible, low, medium and high risk. A site specific risk category is based on two factors:

- The scale and nature of the works, which determines the potential dust emission magnitude as small, medium or large (Step 2A); and

- The sensitivity of the area to dust impacts (Step 2B), which is defined as low, medium or high sensitivity.

The two factors are combined in Step 2C to determine the risk of dust impacts with no mitigation applied.

The parameter used to characterise each construction activity and the limits used to define the extent of the activity in Step 2 are in Table 9-1. The sensitivity of an area to dust impacts (Step 2B) is dependent on:

- The type of receptors (human health and dust soiling impacts)
- The number of receptors in a potentially affected area (human health and dust soiling impacts)
- The distance of the receptors from the source of emissions or if known, from the dust generating activities (human health and dust soiling impacts)
- Background levels of PM_{10} (human health impacts only).

The classification of areas with high sensitivity, medium sensitivity and low sensitivity based on the type of receptors is presented in the following tables:

- Table 9-2 for Dust Soiling Effects
- Table 9-3 for the Health Effects of PM_{10}.

Once the type of receptors has been determined, the sensitivity of an area to dust impacts (Step 2B) can then be determined by combining this information with the number of receptors in a potentially affected area, the distance of the receptors from the source of emissions or if known, from the dust generating activities and background levels of PM_{10} (human health impacts only) using the frameworks described in the following tables:

- Table 9-4 for Dust Soiling Effects on People and Property
- Table 9-5 Human Health impacts from Emissions of PM_{10}.

Table 9-1 Parameters Used to Characterise Each Construction Activity

Activity	Parameter	Parameter unit	Categories - Scale of activity		
			Small	Medium	Large
Demolition	Total building volume	m^3	<20000	20,000 - 50,000	>50000
Earthworks	Total site area	m^2		2,500 – 10,000	>10,000
Construction	Total building volume	m^3	<25,000	25,000 – 100,000	>100,000
Trackout	HDV (>3.5t) outward movements	movements/day	<10	10 - 50	>50

Table 9-2 Indicative Examples used to characterise location sensitivity to dust soiling effects

Receptor sensitivity	Indicative examples listed in IAQM (2014)
High sensitivity receptor	dwellings, museum and other culturally important collections, medium and long term car parks and car showrooms
Medium sensitivity receptor	parks and places of work
Low sensitivity receptor	playing fields, farmland (unless commercially sensitive horticultural), footpaths, short term car parks and roads.

Table 9-3 Indicative examples used to characterise location sensitivity to the health effects of PM_{10}

Receptor sensitivity	Indicative examples listed in IAQM (2014)
High sensitivity receptor	residential properties. Hospitals, schools and residential care homes
Medium sensitivity receptor	office and shop workers
Low sensitivity receptor	public footpaths, playing fields, parks and shopping streets

Table 9-4 Framework used to determine the sensitivity of an area to dust soiling effects.

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10 -100	High	Medium	Low	Low
	1 - 10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 9-5 Framework used to determine the sensitivity of a location to human health impacts from emissions of PM_{10}

Receptor Sensitivity	Annual Mean PM_{10} concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m³	>100	High	High	High	Medium	Low
		10 -100	High	High	Medium	Low	Low
		1 - 10	High	Medium	Low	Low	Low
	28-32 µg/m³	>100	High	High	Low	Low	Low
		10 -100	High	Medium	Low	Low	Low
		1 - 10	High	Medium	Low	Low	Low
	24-28 µg/m³	>100	High	Medium	Low	Low	Low
		10 -100	High	Medium	Low	Low	Low
		1 - 10	Medium	Low	Low	Low	Low
	<24 µg/m³	>100	Medium	Low	Low	Low	Low
		10 -100	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1 - 10	Medium	Low	Low	Low	Low
Low	-	>10	Low	Low	Low	Low	Low

Step 2C combines the sensitivity of an area and the magnitude of dust emissions to determine the risk of dust impacts which is determined separately demolition, earthworks, construction and trackout. The frameworks used to determine the risk of dust impacts is presented in:

- **Error! Not a valid bookmark self-reference.** for Demolition Activities
- Table 9-7 for Earthwork and Construction Activities
- Table 9-8 for Trackout Activities.

Step 3 is to determine the site-specific mitigation measures based on the risk categories for each of the four activities. The final step (Step 4) is to determine whether there are significant effects arising from the construction phase of a proposed development. Significance is only assigned to the effect after considering the mitigation measures.

Table 9-6 Framework used to determine the risk of dust impacts - demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table 9-7 Framework used to determine the risk of dust impacts – earthworks/construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 9-8 Framework used to determine the risk of dust impacts - trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

9.3.3 Assessment of Operational Impact

The source of emissions in the operational stage will be from road transport associated with the proposed development, including residential and commercial traffic associated with the neighbourhood centre and crèche.

Road transport associated with a development can generate emissions of several air pollutants, which are also produced by a wide range of industrial, commercial and domestic processes. The pollutants of most concern near roads are nitrogen dioxide (NO_2) and particles (PM_{10}) in relation to human health and oxides of nitrogen (NO_x) in relation to vegetation and ecosystems.

The assessment of potential transport related air quality impacts from the proposed developments was conducted using the screening method set out in the Design Manual for Roads and Bridges (DMRB) (Highways England, 2021).

The DMRB provides a framework for assessing, mitigating and reporting the effects of motorway and all-purpose trunk road projects on air quality by determining whether the impacts of a project on human health or designated habitats can trigger a significant air quality effect.

The DMRB describes a methodology for the assessment of air quality impacts from road schemes. It includes assessment methodologies to consider the impact of traffic emissions on a range of sensitive interests including human health and ecological health including the health of protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity.

The methodology includes a scoping approach to determine whether the air quality impacts of a project can be scoped out or require an assessment based on the changes between the do something traffic (with the project) compared to the do minimum traffic (without the project) in the opening year.

If a project triggers the traffic scoping criteria, either a simple or detailed assessment is required and the level of assessment is determined by the level of risk and the stage of assessment for a project.

The scoping assessment methodology uses the following traffic criteria to determine whether the air quality impacts can be scoped out or require an assessment based on the changes between the do something traffic (with the project) compared to the do minimum traffic (without the project) in the opening year:

1) Annual average daily traffic (AADT) >=1,000; or
2) Heavy duty vehicle (HDV) AADT >=200; or
3) A change in speed band; or
4) A change in carriageway alignment by >=5m.

All roads that trigger the traffic screening criteria and adjoining roads within 200m is defined as the affected road network (ARN) (Highways England 2019).

The development will deliver a section of the NSOORR from Great Connell Roundabout to the south-western boundary of the site. A further section of the NSOOR including a bridge over the River Liffey is currently being planned and is likely to be will be delivered in the six year construction phase of the proposed development. The assessment therefore considered the impact of traffic on air quality due to the proposed development with the road layout configured with the extension of the NSOORR over the River Liffey.

In relation to the identification of sensitive receptors to consider the impacts on human health the DMBR stipulates that *"Sensitive receptors shall be chosen within 200m of the ARN and include residential properties, schools and hospitals for the assessment of annual mean air quality thresholds. Where there is a risk of the short-term air quality thresholds being exceeded."*

In relation to selecting sensitive ecological receptors the DMBR states *"Internationally, nationally and locally designated sites of ecological conservation importance on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity (known as designated habitats) within 200m of the ARN shall be included in the air quality assessment."*

If the scoping assessment indicates that an assessment is required the DMBR provides a risk-based mechanism to determine whether a simple or detailed air quality assessment is required. The level of assessment is determined by the level of risk and the stage of assessment for a project.

A simple assessment provides sufficient information to confirm that the project does not result in any exceedances of the air quality thresholds. A detailed assessment is more likely where there is a risk of exceeding air quality threshold. To determine whether a simple or detailed air quality assessment is required the project risk potential (Table 9-9) and the receiving environment sensitivity (Table 9-10) must be determined.

Table 9-9 Project Risk Potential

Risk	Project examples
High	1) large smart motorway projects, bypass and major motorway junction improvements.
Low	1) junction congestion relief project i.e. small junction improvements, signalling changes; 2) short smart motorway projects.

Table 9-10 Receiving Environment Sensitivity

Sensitivity	Features of receiving environment
High	1) large number of receptors (human and / or ecological) within 50m of roads triggering traffic screening criteria; 2) base line monitoring data indicates concentrations above the AQS Objective / EU limit value; 3) monitoring indicates exceedances of short term AQS Objectives / EU limit value; 4) projecting forward monitored concentrations to the opening year, indicates exceedances of AQS Objectives / EU limit value; 5) AQMAs or reported EU limit value exceedances within project's study area.
Medium	1) receptors (human or ecological) within 50m of roads triggering traffic change criteria; 2) base line monitoring data illustrates annual mean NO_2 concentrations >36µg/m³; 3) projections indicate annual mean NO_2 concentrations>36µg/m³ in opening year; 4) AQMAs or EU limit value exceedances within project's study area.
Low	1) few receptors located close to roads triggering traffic change criteria; 2) base line monitoring data illustrates concentrations in base year below an annual mean of 36µg/m³; 3) no AQMAs or EU limit value exceedances within project's study area.

The project risk potential and the receiving environment sensitivity are combined to determine whether a simple or detailed air quality assessment is required based on the framework presented in Table 9-11. The DMBR states that *"Low risk projects are likely to result in traffic changes that are localised to the project and high risk projects are likely to impact traffic flows over a much wider area."*

Table 9-11 Framework to determine whether a simple or detailed air quality assessment is required

Risk potential of project	Receiving environment sensitivity		
	High	Medium	Low
High	Detailed	Detailed	Simple
Low	Detailed	Simple	Simple

The elements of simple and detailed air quality assessments are presented in Table 9-12.

Table 9-12 Simple and detailed assessment elements

	Simple assessment	Detail assessment
Traffic input	1) AADT / AAWT	1) period flows: 2) morning (AM); 3) inter peak period (IP); 4) evening peak period (PM); and 5) overnight period (OP).
Air quality modelling	1) qualitative statement; or 2) where required the Overseeing Organisation's air quality spreadsheet model.	1) detail air quality dispersion model
Receptors	1) a proportionate number of representative receptors which are located in areas with the highest concentrations and largest improvements and worsening as a result of the project.	1) representative; 2) all receptors with the likelihood to exceed air quality threshold.

The Highways Agency considers that the main potential impacts on air quality from increased traffic associated with development is from PM_{10}, NO_2 and NO_x. Levels of sulphur dioxide, carbon monoxide and benzene are highly unlikely to be exceeded in Ireland and within the study area due to increased traffic from the proposed development at the operational stage and have therefore not been considered further.

The impact of $PM_{2.5}$ has not been considered in the traffic assessment as Highways Agency (2019) states *"There should be no need to model $PM_{2.5}$ as the UK currently meets its legal requirements for the achievement of the $PM_{2.5}$ air quality thresholds and the modelling of PM_{10} can be used to demonstrate that the project does not impact on the $PM_{2.5}$ air quality threshold."* Ireland also meets its legal requirements for the achievement of the $PM_{2.5}$ air quality thresholds and therefore $PM_{2.5}$ has not been considered further.

9.3.6 Method for the Conversion of NO_x to NO_2

Combustion processes release a group of compounds collectively known as oxides of nitrogen (NO_x). Oxides of nitrogen include both nitric oxide (NO), nitrogen dioxide (NO_2) and nitrous oxide (N_2O). NO_2 and NO undergo a series of complex reactions in air, that involve NO, ozone (O_3) and nitrogen dioxide NO_2 in the presence of sunlight.

- Equation 1: $NO + O_3 \rightarrow NO_2 + O_2$
- Equation 2: $NO_2 + \text{sunlight} \rightarrow NO + O$
- Equation 3: $O + O_2 \rightarrow O_3$

This assessment has converted the NO to NO_2 in accordance with the NO_x to NO_2 Conversion Spreadsheet (Version 7.1, June 2019) (Ricardo Energy and Environment, 2019). This requires regional concentrations of ozone, oxides of nitrogen and nitrogen dioxide above the surface layer and the fraction of nitrogen oxides emitted as nitrogen dioxide to be specified.

The NRA[12] specifies that the UK region that best characterises regional concentrations of ozone, oxides of nitrogen and nitrogen dioxide in Ireland is Craigavon in Northern Ireland. The NO_x to NO_2 Conversion Spreadsheet (Version 7.1) specifies concentrations of ozone, oxides of nitrogen and nitrogen dioxide for Armagh City, Banbridge and Craigavon, and the latter was selected to represent the site of the proposed development. The fraction of nitrogen oxides emitted as nitrogen dioxide was determined based on the "All other urban UK traffic" option in the spreadsheet.

9.3.7 Evaluation Criteria

Air Quality

The significance of air quality impacts in the operational stage were determined based on compliance with the limit values of the *Air Quality Standards Regulations 2011, (S.I. No. 180 / 2011)* as amended (Air Quality Standards), which are presented in Table 9-13. The annual average limit values for SO_2 and NO_x are for the protection of vegetation and ecosystems, respectively. All other limit values specified in the Table are for the protection of human health.

Table 9-13 Limit values of the Air Quality Standards Regulations 2011 (S.I. No. 180/2011), as amended (Based on the CAFE Directive 2008/50/EC)

Air contaminant	Averaging period	Limit value (µg/m³)	Basis of application of limit value
CO	8-hour	10000	Maximum
NO_2	1-hour	200	Not to be exceeded more than 18 times in a calendar year
	annual	40	Average
PM_{10}	24-hour	50	35th Highest
	annual	40	Average
$PM_{2.5}$	annual	25	Average
SO_2	1-hour	350	Not to be exceeded more than 24 times in a calendar year
	24-hour	125	Not to be exceeded more than 3 times in a calendar year
	annual	20	Average
NO_x	annual	30	Average

The criteria used to determine the significance of air quality impacts from traffic during the operational stage in the NRA's 2011 publication were applied to assess traffic impacts. The NRA methodology involves categorising the magnitude of change in concentrations of air contaminants according to the criteria identified in **Error! Reference source not found.**.

The NRA defines impact magnitude for changes in the number of days with PM_{10} concentration greater than 50 µg/m³ and for changes in annual mean $PM_{2.5}$. **Error! Reference source not found.** has been modified from the NRA publication to exclude these as the Highway Agency's latest spreadsheet calculates annual average concentrations of NO_x and PM_{10} and not shorter-term average concentrations.

[12] • NRA (2011) Treatment of Air Quality During the Planning and Construction of National Road Schemes.

Table 9-14 Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations (NRA, 2011)

Magnitude of Change	Annual Mean NO_2/PM_{10}
Large	Increase/decrease ≥4 µg/m³
Medium	Increase/decrease 2 - <4 µg/m³
Small	Increase/decrease 0.4 - <2 µg/m³
Imperceptible	Increase/decrease <0.4 µg/m³

Table 9-15 Air quality Impact Descriptors for Changes to Annual Mean NO2 and PM_{10} Concentrations at a Receptor

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration a		
	Small	Medium	Large
Above Objective/Limit Value With Scheme (≥40 µg/m³ of NO_2 or PM_{10})	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (36-<40 µg/m³ of NO_2 or PM_{10})	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (30-<36 µg/m³ of NO_2 or PM_{10})	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<30 µg/m³ of NO_2 or PM_{10})	Negligible	Negligible	Slight Adverse

The relationship between the annual average and 1-hour average concentration is discussed in NRA 2011 publication which states:

> *The standards for nitrogen dioxide are expressed in terms of both the annual mean and the number of hours above 200 µg/m³. It is not straightforward to predict exceedances of the 1-hour standard and all models are inevitably poorer at predicting short-term peaks than they are at predicting annual mean concentrations. However, empirical data suggest that the hourly mean standard is unlikely to be exceeded at roadside locations unless the annual mean is above 60 µg/m³.*

The relationship between the annual average and the number of exceedances of the 24-hour average concentration standard for PM_{10} is also discussed which states:

The standards for PM_{10} are expressed as the annual mean and the number of days above 50 µg/m³. Dispersion models are inherently less accurate at predicting exceedances of the 24-hour mean PM_{10} standard than for the annual mean standard. An empirical relationship between the annual mean concentration and the number of days >50 µg/m³ PM_{10} has been derived in LAQM.TG(09) and takes the form:

No. 24-hour mean exceedances = -18.5 + 0.00145 x annual mean³ + (206/annual mean)

This relationship has been adopted to determine if the impact of traffic emissions on air quality is likely to result in exceedances of the 24-hour average concentration standard for PM_{10}.

Nuisance Dust

Dust particles in the ambient environment can cause nuisance. Localised increases in dust particles are often associated with exposure of soil surfaces, or activities that involve the disturbance of soil or rock-based materials, such as agricultural and construction activities.

Whether dust deposition becomes an issue for the general public depends on a variety of factors including the sensitivity of nearby locations, the repetition of any dust deposition occurring and the characteristics of the deposited materials. The focus for dust control and emissions is on minimising the potential for a nuisance occurring in the first instance and implementing good site practices where practicable.

There are currently no Irish or European Union air quality standards for deposited dust. In 2004, the DEHLG issued Quarries and Ancillary Activities Guidelines for Planning Authorities, which states "There are currently no Irish statutory standards or EPA guidelines relating specifically to dust deposition thresholds for inert mineral/aggregate dust"

A subsequent report issued by the EPA and titled: Environmental Management Guidelines - Environmental Management in the Extractive Industry (EPA, 2006) states:

The impact of dust is usually monitored by measuring rates of dust deposition (DoE, 1995). There are currently no Irish statutory standards or EPA guidelines relating specifically to dust deposition thresholds for inert mineral dust. There are a number of methods to measure dust deposition but only the German TA Luft Air Quality Standards (TA Luft, 1986) specify a method of measuring dust deposition – The Bergerhoff Method (German Standard VDI 2119, 1972) – with dust nuisance. It is the only enforceable method available.

The TA Luft air quality standard has become the most commonly used method for the assessment of dust deposition. This involves determining a mass dust deposition rate per unit area over a given time period, using a direct collection pot with standard dimensions of either glass or plastic. The system benefits from being a direct collection method i.e. less transferring of material and consequent reduction in sampling errors. This method is defined as an internationally recognised standard and has been adopted by the EPA as the method of choice for measuring deposited dust associated with licensed facilities.

The TA Luft has recommended a threshold guideline value of 350 mg/m²/day for dust deposition. Below this threshold guideline value dust deposition problems are considered less likely. The EPA and local authorities commonly apply the TA Luft guideline to development consents and Waste Licences

9.4 Development Description

A detailed description of the proposed development is set out in Chapter 3. The nature of the proposed development, involving the construction and habitation of residential housing units on a greenfield site, has the potential to impact on air quality in the construction and operational stage due to construction activities and additional traffic.

9.5 Receiving Environment

9.5.1 Local Meteorological Conditions

The dominant influence on Ireland's climate is the Atlantic Ocean. Consequently, Ireland does not suffer from the extremes of temperature experienced by many other countries at similar latitude. The warm North Atlantic Drift has a marked influence on sea temperatures. This maritime influence is strongest near the Atlantic coasts and decreases with distance inland. The hills and mountains, many of which are near the coasts, provide shelter from strong winds and from the direct oceanic influence. Winters tend to be cool and windy, while summers, when the depression track is further north and depressions less deep, are mostly mild and less windy (Met Eireann https://www.met.ie/climate/climate-of-ireland).

The nearest meteorological station operated by Met Eireann is at Casement Aerodrome, which is approximately 25 km northeast of the proposed development site. Meteorological parameters observed at Casement Aerodrome and averaged over the 30 years between 1981 and 2010 are presented in Table 9-16. The data from Casement Aerodrome presents an accurate indication of the meteorological conditions at the site of the proposed development.

Table 9-16 30-year Average Meteorological Data Casement Aerodrome (1981 to 2010)

Parameter	30-year average
Mean Temperature (°C)	9.7
Mean Relative Humidity (9 AM UTC) (%)	83.6
Mean Daily Sunshine Duration (Hours)	3.7
Annual Rainfall (mm)	754.2
Averaged total rainfall (mm) (Summer)	189
Averaged total rainfall (mm) (Winter)	213.2
Average Windspeed (m/s)	5.5
Monthly average Windspeed (m/s) (Summer)	4.5
Monthly average Windspeed (m/s) (Winter)	6.4

Wind speed and wind direction are important parameters for the transport and dispersion of air pollutants from a source. A wind rose representing the annual distribution of 1-hour average winds at Casement Aerodrome is presented in Figure 9-1. Figure 9-2 and Figure 9-3 are diurnal and seasonal Windroses for Casement Aerodrome. The prevailing wind is from the southwest. Winds from the north and southeast are infrequent. The winter months are wetter and windier than the summer months.

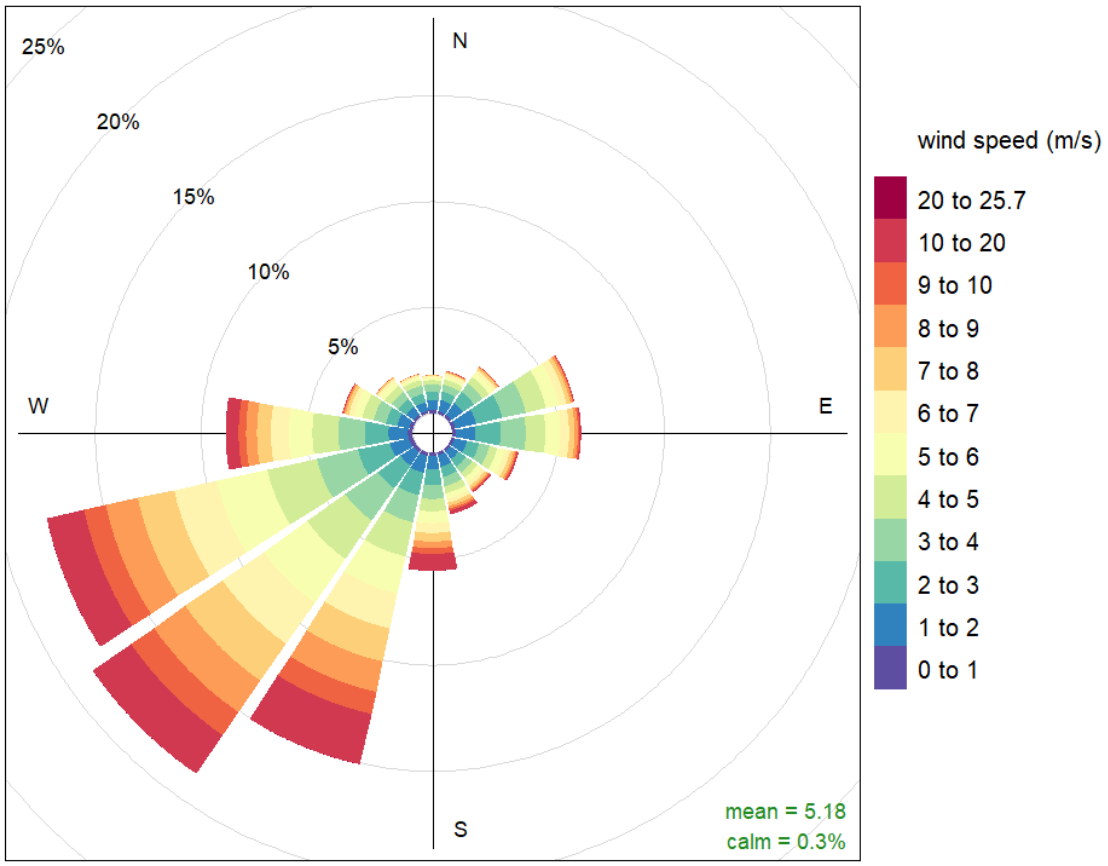


Figure 9-1 Annual windrose for Casement Aerodrome (Source of data: Met Eireann)

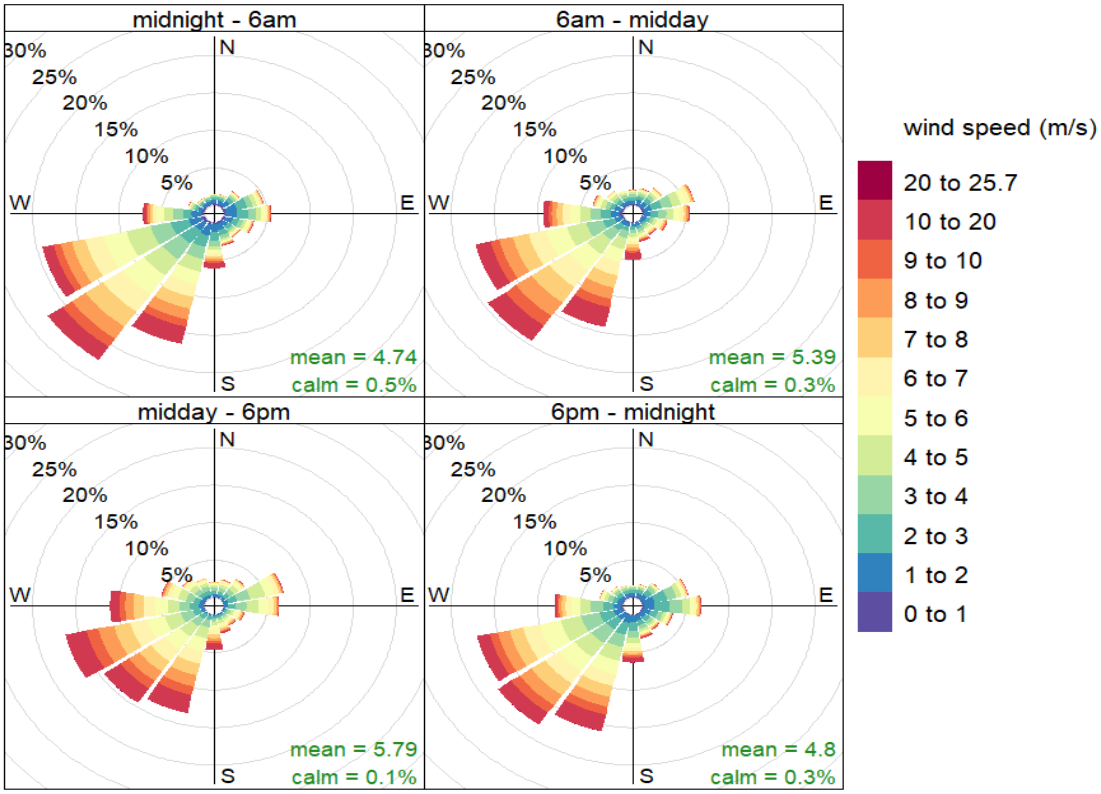


Figure 9-2 **Diurnal Windroses Casement Aerodrome (Source of data: Met Eireann)**

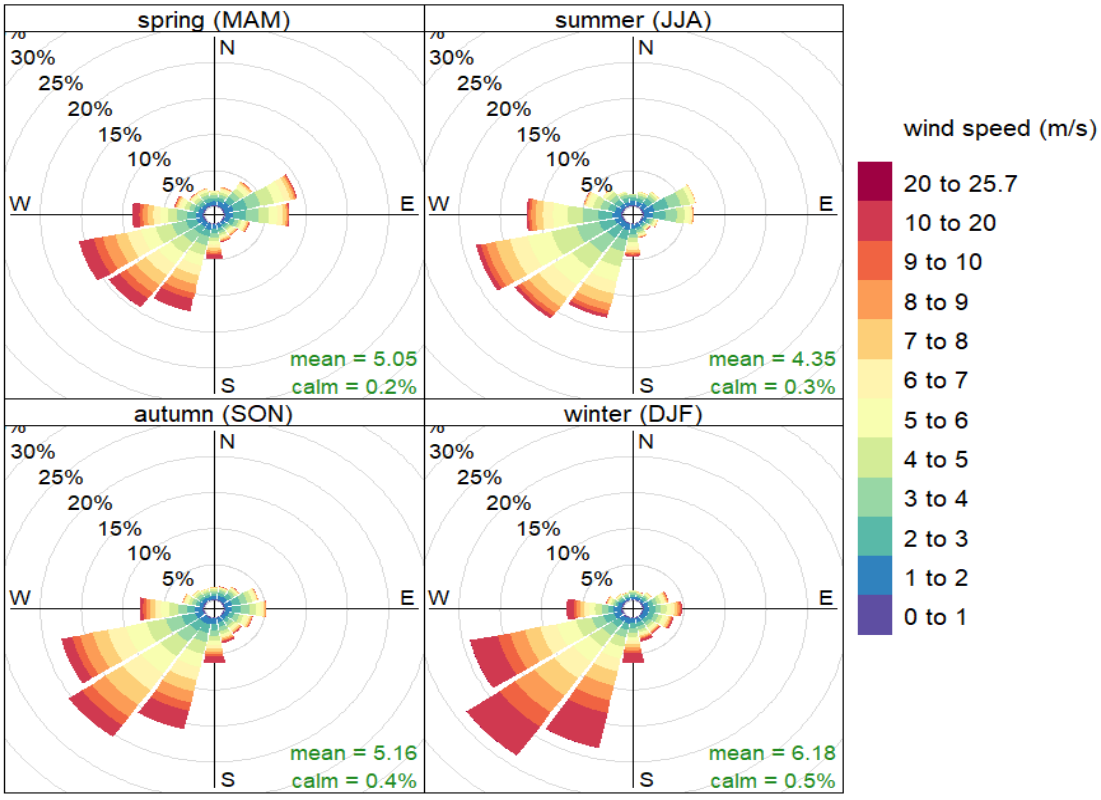


Figure 9-3 **Seasonal Windroses Casement Aerodrome (Source of data: Met Eireann)**

9.5.2 Baseline Air Quality

EPA monitoring data was used to determine the baseline air quality for the study area with data sourced from:

- Ongoing air quality monitoring data from an indicative monitoring station installed in as part of the National Air Monitoring Network in 2020 (EPA, 2021).
- An air quality monitoring report presenting data collected in Newbridge between 01 October 2009 and 24 May 2010 (EPA, 2012).
- EPA Annual Air Quality in Ireland Reports.

The locations of the EPA monitoring stations in relation to the proposed development are presented in Figure 9-4.

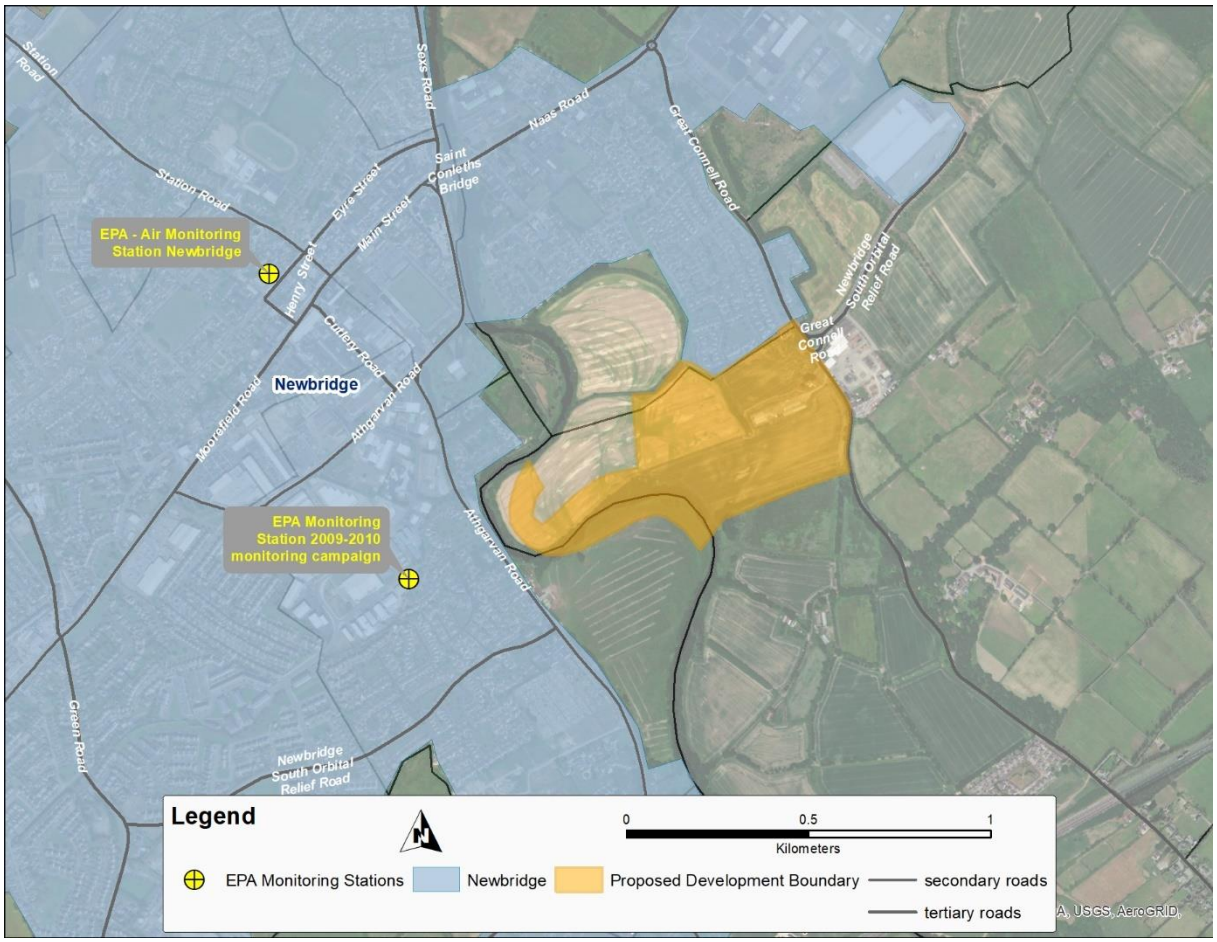


Figure 9-4 Location of EPA Monitoring Stations

The active monitoring station is in a small carpark adjacent to Henry Street in the centre of Newbridge and is approximately 1.1 km from the nearest housing unit of the proposed development. The monitoring location is in a typical town centre where the magnitude of measured of air contaminants is heavily influenced by local traffic, emissions from residential areas of Newbridge and from local businesses.

The air contaminants currently monitored include inhalable particles, with diameters that are generally 10 micrometers and smaller (PM_{10}) and inhalable particles, with diameters that are generally 2.5 micrometers and smaller $PM_{2.5}$.

The air contaminants assessed in the 2009-2010 monitoring include carbon monoxide, sulphur dioxide, nitrogen dioxide and oxides of nitrogen, PM_{10} and benzene. The monitoring station was located in Kildare County Council Roads Yard, approximately 750 m from the nearest housing unit of the proposed development. The monitoring location is typical of the urban areas of small towns in Ireland being bordered by residential areas to the south and east and the Newbridge Industrial Estate to the north and west. The magnitude of measured concentrations are influenced by emissions from residential areas, businesses in the Newbridge Industrial Estate and local traffic.

Under the CAFE Directive, EU member states must designate "Zones" for the purpose of managing air quality. In Ireland, four zones are defined in the Air Quality Standards Regulations 2011 (S.I. No. 180 / 2011), as amended. The site is in Zone C, which is described as other cities (outside of Dublin and Cork) and large towns comprising Limerick, Galway, Waterford, Drogheda, Dundalk, Bray, Navan, Ennis, Tralee, Kilkenny, Carlow, Naas, Sligo, Newbridge, Mullingar, Wexford, Letterkenny, Athlone, Celbridge, Clonmel, Balbriggan, Greystones, Leixlip and Portlaoise..

Long-term background air quality data for Zone C was obtained from three reports published by EPA that present air quality data from a network for air quality monitoring stations across Ireland. The reports include:

- EPA (2018) Air Quality in Ireland 2017 – Indicators of Air Quality.
- EPA (2019) Air Quality in Ireland 2018 – Indicators of Air Quality.
- EPA (2020) Air Quality in Ireland 2019 – Indicators of Air Quality.

Nitrogen Dioxide

EPA monitoring data was used to determine the baseline level of NO_2 for the study area with data sourced from EPA (2012) and EPA Annual Air Quality in Ireland Reports. The mean and maximum 1-hour concentration measured at the monitoring location in Newbridge between 01 October 2009 and 24 May 2010 is presented in Table 9-17. Summary statistics derived from long-term monitoring of NO_2 in Zone C Locations between 2017 and 2019 is presented in Table 9-18.

Table 9-17 Mean and Hourly Maximum NO_2 between 01 October 2009 and 24 May 20

Station	Averaging Period	Concentration of NO_2
Newbridge	Mean[1]	15.4
	1-hr maximum	104.3
[1] The monitoring period was from 01 October 2009 and 24 May 2010, which included winter months but not summer months		

The mean concentration of NO_2 between 01 October 2009 and 24 May 2010 was 15.4 µg/m³. The corresponding maximum 1-hour concentration was 104.3 µg/m³. The annual average concentration, based on long-term monitoring data between 2017 and 2019 from Zone C Locations was 14 µg/m³. The corresponding maximum 1-hour average was 144 µg/m³.

Table 9-18 Summary Data for Hourly NO_2 concentrations in Zone C 2017 and 2019

Year	Parameter	Waterford (Browns Rd)	Limerick (Peoples Park)	Kilkenny Seville Lodge	Portlaoise	Dundalk
		µg/m³				
2017	Annual Mean	-	-	5.2	10.8	-
	NO_2 values >200	-	-	0	0	-
	1-hr maximum	-	-	57.5	80	-
2018	Annual Mean	-	-	6	11	14
	NO_2 values >200	-	-	0	0	0
	1-hr maximum	-	-	71	119	91
2019	Annual Mean	8	13	5	11	12
	NO_2 values >200	0	0	0	0	0
	1-hr maximum	83	91	59	77	144

This mean concentration measured in Newbridge between 01 October 2009 and 24 May 2010 is greater that the annual average reported in other Zone C locations between 2017 and 2019. Emissions from home heating are likely to be one of the greatest contributors to the levels of NO_2 observed in the 2009 to 2010 monitoring, as the period included colder months of the year did not extend over the summer months when emissions from home emissions would be negligible. It is highly likely that if the monitoring period extended to a full year that included summer months that the mean annual average concentration would be lower than the values reported for the nine months of monitoring.

The maximum annual average concentration of NO_2 at a Zone C location measured over a full twelve months is considered an appropriate representation of the baseline annual average concentration of in the study area. This baseline annual average concentration 14 µg/m³ is below the limit values specified in the Air Quality Standards.

PM10

Katestone sourced raw monitoring data measured at the active EPA monitoring station in Newbridge from EPA. The data was processed to extract parameters for comparison to the limit values specified in the Air Quality Standards. The monitoring commenced in July 2020 with data available to September 2021. In the 15-month monitoring period the hourly average concentrations of PM_{10} are reported for 90.5% of hours with 9.5% of hours missing data.

The 24-hour maximum, number of days when the concentration of PM_{10} was greater than 50 µg/m³ and the mean concentration of PM_{10} measured at the monitoring location in Newbridge between 13 July 2020 and 04 September 2021 is presented in Table 9-19. Summary statistics derived from long-term monitoring of PM_{10} in Zone C Locations between 2017 and 2019 is presented in Table 9-20.

The maximum running annual average concentration measured in Newbridge for each day between 13 July 2020 and 04 September 2020 and the subsequent 365 days was 8.6 µg/m³. The maximum 24-hour concentration between 13 July 2020 and 04 September 2021 was 32.2 µg/m³. The annual average concentration, based on long-term monitoring data between 2017 and 2019 from Zone C Locations was 28 µg/m³. The corresponding maximum 24-hour average concentration was 154 µg/m³. The maximum number of days when the 24-hour average concentration was greater than 50 µg/m³ was 12.

The EPA's Newbridge monitoring data and the long-term monitoring data from Zone C locations indicates that the annual average concentrations of PM_{10} are well below the limit values specified in the Air Quality Standards, which require that a 50 µg/m³ limit value may not be breached more than 35 times in a calendar year. The maximum number of times that the 24-hour average 50 µg/m³ limit value at any Zone C monitoring location was 12 times in a calendar year between 2017 and 2019. The EPA's Newbridge monitoring station data indicates that the level of PM_{10} is lower compared to other Zone C Locations.

The maximum annual average concentration of PM_{10} at a Zone C Location measured over a full twelve months is considered an appropriate representation of the baseline annual average concentration of PM_{10} in the study area. Therefore a baseline annual average concentration of 17 µg/m³ in the study area was adopted for this assessment. This is considered conservative as the indicative PM_{10} monitoring currently being undertaken along with the nine months of data recorded over the winter period (when urban PM_{10} is typically higher due to residential heating using fossil fuels) has measured concentrations of PM_{10} that are approximately half of this value.

The assumed baseline level is higher than the annual average levels recorded at other Zone C locations with the exception of those with reported elevated wintertime PM_{10} levels caused by fossil fuel combustion (e.g. Ennis and Tralee).

$\underline{PM_{2.5}}$

Katestone sourced raw monitoring data measured at the EPA's monitoring station at Newbridge. In the 15-month monitoring period hourly average concentrations of $PM_{1.5}$ are reported for 90.5% of hours with 9.5% of hours missing data.

The mean concentration measured at between 13 July 2020 and 04 September 2021 is presented in Table 9-21. Summary statistics derived from long-term monitoring of $PM_{2.5}$ in Zone C locations between 2017 and 2019 is presented in Table 9-22.

The maximum running annual average concentration of $PM_{2.5}$ measured in Newbridge for each day between 13 July 2020 and 04 September 2020 and the subsequent 365 days was 5.9 µg/m³. The annual average concentration, based on long-term monitoring data between 2017 and 2019 from Zone C locations, was 23 µg/m³.

The EPA's monitoring station at Newbridge and the long-term monitoring data from Zone C locations indicates that the annual average concentrations of $PM_{2.5}$ are well below the limit values specified in the Air Quality Standards Regulations 2011. The EPA's Newbridge monitoring station data indicates that the level of $PM_{2.5}$ is lower compared to other Zone C locations.

Table 9-19 Monitoring Data in Newbridge between 13 July 2020 and 04 September 2021

Station	Parameter	Value	Unit
Newbridge	Mean Concentration of PM_{10}[1]	8.6	µg/m³
	Daily values above 50 µg/m³	0	days
	Daily Max Concentration of PM_{10}	32.3	µg/m³

[1] A running annual average concentration was determined by calculating the annual average concentration of PM_{10} each day between 13 July 2020 and 04 September 2020 for the subsequent 365 days. The maximum running annual average concentration is reported here.

Table 9-20 Summary Statistics Monitoring of PM_{10} in Zone C Locations between 2017 and 2019

Year	Averaging Period/Statistic	Portlaoise	Ennis	Galway (Rahoon)	Dundalk	Carlow Town	Waterford (Browns Rd)	Kilkenny Seville Lodge	Letterkenny	Limerick (Peoples Park)	Athlone	Tralee
		µg/m³										
2017	Annual Mean	9.5	15.8	-	-	-	-	-	-	-	-	-
	Daily values above 50	0	9	-	-	-	-	-	-	-	-	-
	Daily Max	25.5	90.2	-	-	-	-	-	-	-	-	-
2018	Annual Mean	11	16	15	15	12	15	-	-	-	-	-
	Daily values above 50	1	4	0	0	0	0	-	-	-	-	-
	Daily Max	53	64	27	42	31	26	-	-	-	-	-
2019	Annual Mean	15	18	13	14	11	15	18	17	13	17	28
	Daily values above 50	0	12	0	2	0	3	7	9	4	0	2
	Daily Max	40	94	49	64	46	154	63	121	67	42	55

Table 9-21 Mean concentration of $PM_{2.5}$ measured at the monitoring location in Newbridge between 13 July 2020 and 04 September 2021

Station	Averaging Period	Concentration of NO_2
		µg/m³
Newbridge	Mean[1]	5.9
[1] A running annual average concentration was determined by calculating the annual average concentration of $PM_{2.5}$ each day between 13 July 2020 and 04 September 2020 for the subsequent 365 days. The maximum running annual average concentration is reported here.		

Table 9-22 Summary Statistics $PM_{2.5}$ in Zone C Locations between 2017 and 2019

Year	Averaging Period/Statistic	Bray	Ennis	Carlow Town	Waterford (Browns Rd)	Letterkenny	Limerick (Peoples Park)	Athlone	Tralee	Navan
		µg/m³								
2017	Annual Mean	5.2	10.6	-	-	-	-	-	-	-
2018	Annual Mean	6	10	8	9	-	-	-	-	-
2019	Annual Mean	7	14	8	11	13	9	14	23	11

SO_2

Summary statistics derived from long-term monitoring of SO_2 in Zone C locations between 2017 and 2019 is presented in Table 9-23. The annual average concentration, based on long-term monitoring data was 3.8 µg/m³. The corresponding maximum 24-hour average concentration was 27.7 µg/m³ and the maximum 1-hour average concentration was 92 µg/m³. The maximum number of days when the average 24-hour average concentration was greater than 50 µg/m³ was 12.

The monitoring data from Zone C locations indicates that the annual average concentrations of SO_2 are well below the limit values specified in the Air Quality Standards.

Table 9-23 Summary Statistics SO_2 in Zone C Locations between 2017 and 2019

Year	Averaging Period/Statistic	Ennis	Dundalk	Portlaoise
	µg/m³			
2017	Annual Mean	3.4	-	2.4
	Daily Max	20	-	7.6
	Hourly Max	54.8	-	22.9
2018	Annual Mean	3.2	3.8	3
	Daily Max	18	10	18
	Hourly Max	67	33	40
2019	Annual Mean	3.6	1.5	1.3
	Daily Max	27.7	6.4	3.2
	Hourly Max	92	19.7	17.8

Carbon Monoxide

Summary statistics derived from long-term monitoring of CO in Zone C Locations between 2017 and 2019 is presented in Table 9-24. The maximum rolling 8-hour average concentration, based on long-term monitoring data between 2017 and 2019 at Zone C Locations, was 2.8 mg/m³. The monitoring data indicates that the annual average concentrations are well below the limit values specified in the Air Quality Standards Regulations.

Table 9-24 Summary Statistics CO in Zone C Locations between 2017 and 2019

Year	Averaging Period/Statistic	Portlaoise	Dundalk
	mg/m³		
2017	Rolling 8-hr Max	1.2	-
2018	Rolling 8-hr Max	2.8	-
2019	Rolling 8-hr Max	1.0	2.0

Benzene

Summary statistics derived from long-term monitoring of benzene in Zone C Locations between 2017 and 2019 is presented in Table 9-25. The maximum annual average concentration, based on long-term monitoring data from Zone C Locations, was 2.8 mg/m³, which is well below the limit values specified in the Air Quality Standard Regulations.

Table 9-25 Summary Statistics Benzene in Zone C Locations: 2017 and 2019

Year	Averaging Period/Statistic	Kilkenny Seville Lodge	Longford
	mg/m³		
2017	Annual Average	0.18	-
2018	Annual Average	0.16	0.21
2019	Annual Average	0.12	0.21

Oxides of Nitrogen

Summary statistics derived from long-term monitoring of oxides of nitrogen in Zone C between 2017 and 2019 is presented in Table 9-26. The maximum annual average concentration, based on long-term monitoring data between 2017 and 2019 from Zone C Locations, was 24.9 mg/m³. The monitoring data from Zone C Locations indicates that the annual average concentrations of NO_x are well below the limit values specified in the Air Quality Standards

Table 9-26 Summary Statistics Oxides of Nitrogen in Zone C Locations: 2017 and 2019

Year	Parameter	Waterford (Browns Rd)	Limerick (Peoples Park)	Kilkenny Seville Lodge	Portlaoise	Dundalk
2017	Annual Mean	-	-	7.9	15.7	-
2018	Annual Mean	-	-	7	16	21
2019	Annual Mean	13.4	24.9	7.6	14.8	19.4

9.5.3 Sensitive Receptors

The sensitive receptors that are of greatest interest are residential locations in close proximity to construction activities and the ARN. Construction activities including demolition, earthworks, construction and trackout will occur in close proximity to residential and commercial areas. The sensitive receptors included in the assessment of construction stage impacts are presented in Table 9-27 and shown on Figure 9-5. The sensitive receptors that represent the most impacted locations include:

- Receptors 1 to 3 are commercial neighbours of the proposed development
- Receptors 4 to 6 are existing residential areas north of the proposed development
- Receptor 7 is the closest house in a development that is currently under construction southwest of the proposed development.

Table 9-27 Sensitive Receptors

Receptor ID	x-coordinate	y-coordinate
	UTM (m)	
DR1	648556	5894228
DR2	648491	5894321
DR3	648493	5894364
DR4	648344	5894429
DR5	648283	5894376
DR6	648159	5894320
DR7	648055	5893875

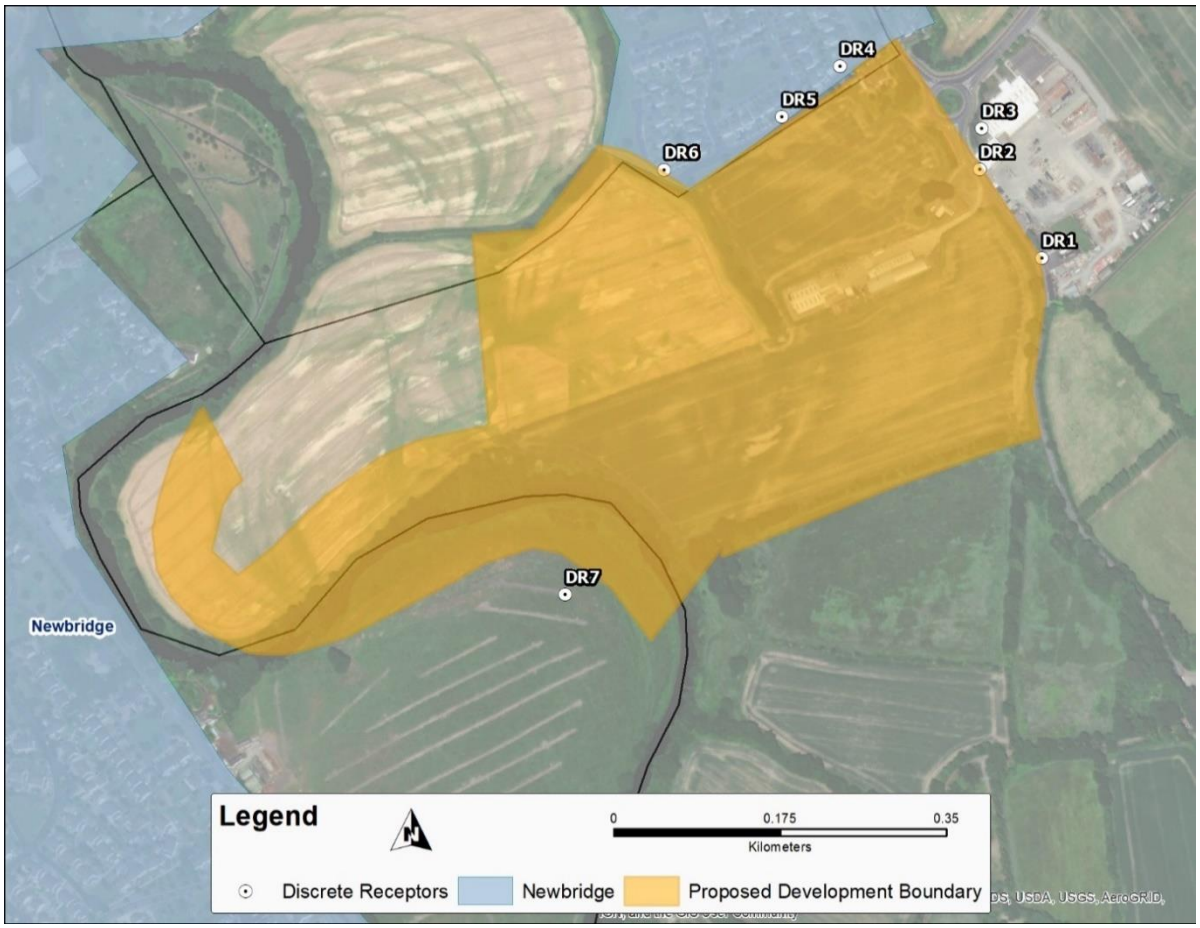


Figure 9-5 Sensitive Receptors Construction Stage

The sensitive receptors included in the assessment of the operational stage of the proposed development are presented in Table 9-28 and shown on Figure 9-6.

Receptor ID	x-coordinate	y-coordinate
	UTM (m)	
DR1	648382	5894497
DR2	648397	5894444
DR3	648525	5894446
DR4	648498	5894311
DR5	648402	5894372
DR6	648302	5894306
DR7	648187	5894148
DR8	647919	5893742
DR9	647773	5893576
DR10	647602	5893542
DR11	647704	5893667

Table 9-28 Sensitive Receptors Operational Stage

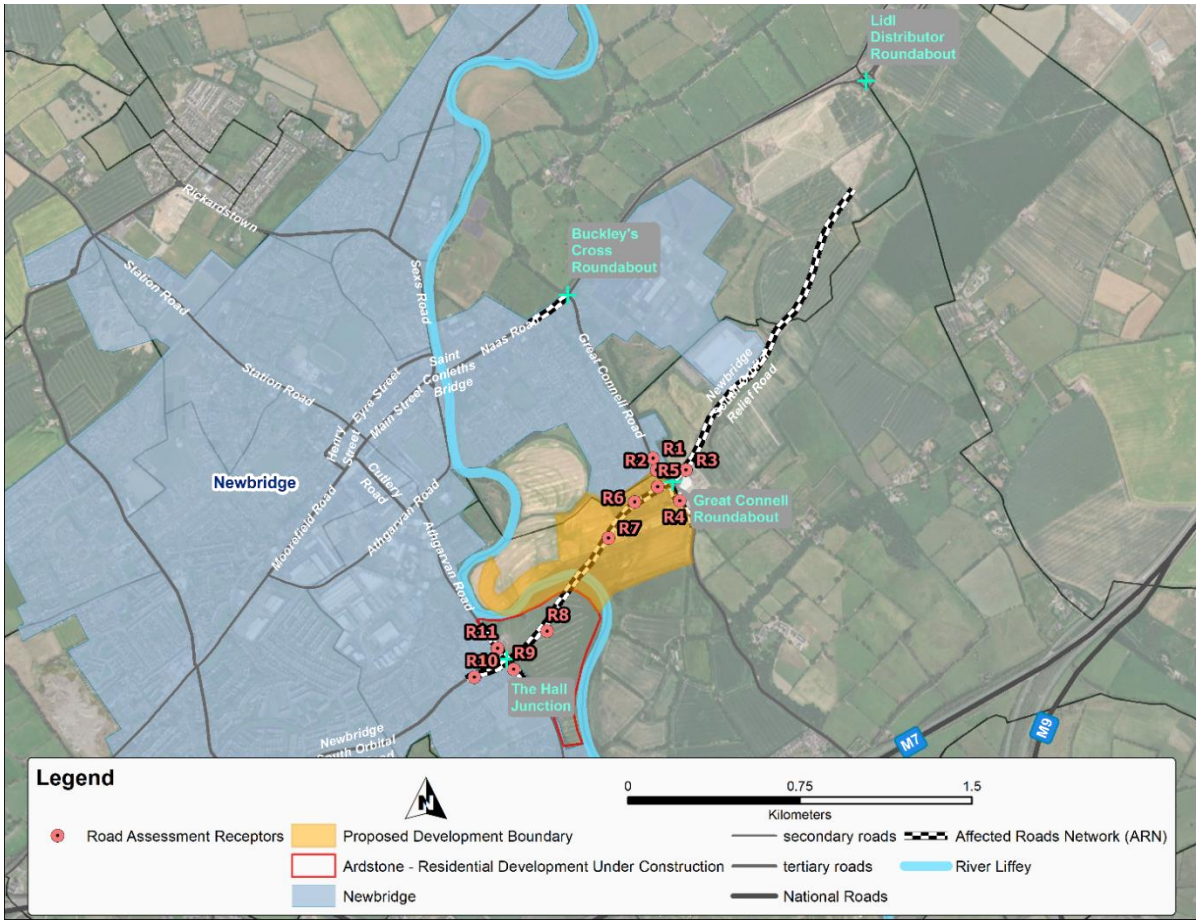


Figure 9-6 Sensitive Receptors Operational Stage

There are two ecological sensitive sites within 10 km of the proposed development including the Pollardstown Fen Special Area of Conservation (SAC) and the Moulds Bog SAC. The location of these SACs in relation to the proposed development are presented in Figure 9-7. The shortest distance between the proposed development and either of these two SACs is over 2.7 km.

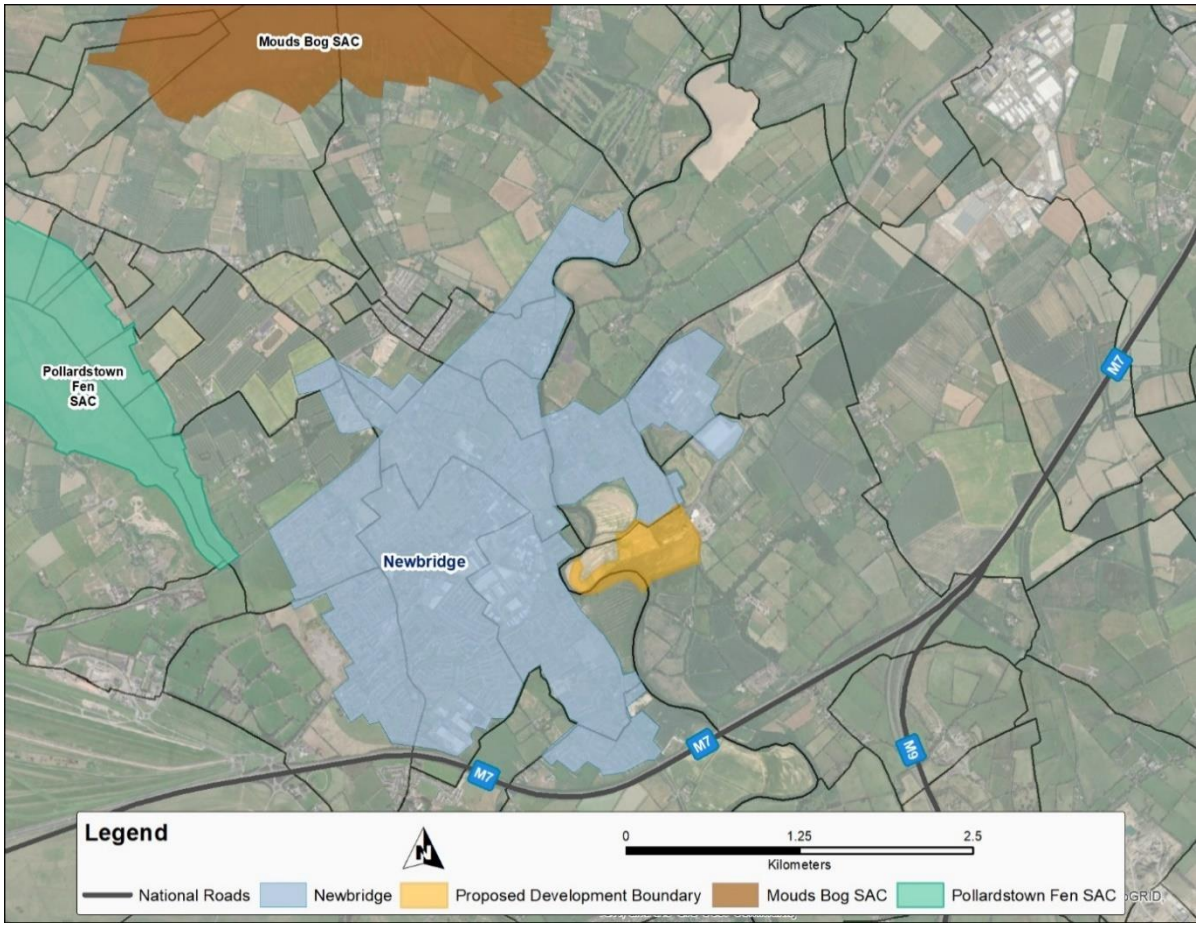


Figure 9-7 Location of Natura 2000 Sites Within 10 km of the Proposed Development

9.6 Impacts

9.6.1 Construction Stage

The potential impact of both dust and vehicle emissions during the construction phases associated with the development of residences, the neighbourhood centre and the crèche should be considered.

Dust emissions can lead to elevated PM_{10} and $PM_{2.5}$ concentrations and may also cause dust soiling. The predominant emission of concern from the construction phase of the proposed development will be from the generation of dust from the various stages of construction associated with residences, the neighbourhood centre and the crèche.

Potential temporary impacts on air quality associated with the construction stage are dusts and vehicle exhaust emissions. Dusts are likely to arise from the following activities (IAQN, 2014):

- Earthworks;
- Wind blow from temporary stockpiles;
- Handling of construction materials;
- Landscaping; and
- Construction traffic movements (Trackout).

The primary generators of traffic in the construction stage will be contractor staff and the delivery of construction materials. It is estimated that the delivery of materials will require a maximum of between 10 and 50 HGV trips per day.

The screening assessment, conducted in accordance with in accordance with IAQM (2014), indicated that more detailed assessment was required as there are human receptors within 350m of the development site boundary and within 50 m of the routes used by construction traffic.

There are no ecological receptors within 50 m of the site boundary or within 50 m of the route(s) used by construction vehicles on the public highway. Therefore the effect of the construction stage on ecological receptors can therefore be screened out meaning that the effects are not significant, negative and temporary.

The air quality assessment on senstive human receptors inlcuded the the following phases of construction:

- Demolition
- Earthworks
- Construction
- Trackout.

Existing buildings in the centre and northeast corner of the site will be demolished. The estimated volume of demolition materials is between 20,000 and 50,000 m^3. According to IAQM (2014) size categories, demolition activities are therefore classified as medium.

Earthworks are required to level the site and for the installation of services. The maximum land area on which earthworks will take place is greater than 10,000 m^2. According to IAQM (2014) size categories, earthwork activities are therefore classified as large.

The development will involve house building, services installation and road construction. The maximum land area on which construction will take place is greater than 100,000 m^2. According to IAQM (2014) size categories, construction activities are therefore classified as large.

Construction will involve the delivery and removal of construction and demolition materials using heavy duty vehicles (HDVs). The maximum number of HDVs on any one day will be between 10 and 50. According to IAQM (2014) size categories, trackout is therefore classified as medium.

The size of each construction activity based on the IAQM (2014) Guidance is presented in Table 9-29.

Table 9-29 Size of Each Construction Activity

Activity	Size	Magnitude Of Activity	Unit of Activity
Demolition	Medium	20,000 – 50,000	m^3 of structures demolished
Earthworks	Large	>10,000	m^2 of earthworks area
Construction	Large	>100,000	m^2 of construction area
Trackout	Medium	10 to 50	maximum number of vehicles per day

Demolition, earthworks, construction and trackout will take place in relatively close proximity to existing residential properties. According to IAQM (2014) residential locations are classified as “highly sensitive receptor” in terms of potential dust soiling effects and human health effects.

Demolition

Demolition activities will take place in the north-eastern corner and in the centre of the proposed development site. The closest building that will be demolished is over 20 m from the nearest residential property with a further six (6) residential properties within 50 m of the demolition works.

In line with IAQM (2014) the sensitivity of the area to dust soiling and human health impacts are as follows:

- Dust soiling: sensitivity is low because there are fewer than 10 highly sensitive receptors located at distances between 20 m and 50 m from demolition activities.

- Human health impacts: sensitivity is low because the baseline PM_{10} levels are below 24 µg/m³ and fewer than 10 highly sensitive receptors are located at distances between 20 m and 50 m from demolition activities.

Considering the dust emissions magnitude and sensitivity of the area to dust impacts from demolition activities, the unmitigated risk of dust impacts is classified as a low risk for both dust soiling and health effects of PM_{10}.

Earthworks and Construction

Earthworks and construction will take place in relatively close proximity to existing residential properties north of the site and residential properties that are currently under construction southwest of the site. In line with IAQM (2014) the sensitivity of the area to:

- Dust soiling: sensitivity is medium because:
    - Between one (1) and ten (10) highly sensitive receptors are located at distances less than 20 m from earthworks and construction activities.
    - Between ten (10) and 100 highly sensitive receptors are located at distances between 20 m and 100 m from earthworks and construction activities.

- Human health impacts: sensitivity is low as baseline PM_{10} levels are below 24 µg/m³ and fewer than 10 highly sensitive receptors are located at distances less than 20 m from earthworks and construction activities.

Considering the dust emissions magnitude and sensitivity of the area to dust impacts from earthworks and construction activities, the unmitigated risk of dust impacts is classified as:

- A medium risk for dust soiling impacts

- A low risk for health effects of PM_{10}.

Trackout

Trackout activities will take place in relatively close proximity to existing residential properties located along Great Connell Road north of Great Connell Roundabout. According to IAQM (2014) the sensitivity of the area to dust soiling and human health impacts are as follows:

- Dust soiling: sensitivity is medium because:

  - Between one (1) and ten (10) highly sensitive receptors are located at distances less than 500 m from the site entrance and 20 m from trackout activities.
  - Between ten (10) and 100 highly sensitive receptors are located at distances less than 500 m from the site entrance and between 20 m and 100 m from earthworks and construction activities.
- Human health impacts: sensitivity is low because baseline PM_{10} levels are below 24 µg/m³ and fewer than 100 highly sensitive receptors are located at distances less than 20 m from trackout activities.

Considering the dust emissions magnitude and sensitivity of the area the unmitigated risk of dust impacts is classified as a low risk for both dust soiling and health effects of PM_{10}.

Overall Risk

A summary of the unmitigated risk of dust impacts from various construction activities is presented in Table 9-30.

Table 9-30 Summary of the Unmitigated Risk of Dust Impacts: Construction Stage

Construction Activity	Dust Soiling	Health Effect PM_{10}
Demolition	Low Risk	Low Risk
Earthworks	Medium Risk	Low Risk
Construction	Medium Risk	Low Risk
Trackout	Low Risk	Low Risk

The unmitigated impact in terms of dust soiling is as negative, moderate and temporary effects. The unmitigated impact in terms of health effect is negative, not significant and temporary effects. Mitigation is required to reduce potential impacts of construction activities to levels that can be described as not significant.

9.6.2 Operational Stage: Do Something

The potential for air quality impacts in the Operational Stage are linked to traffic associated with the proposed development. The air contaminants of concern include NO_x, NO_2 and PM_{10}. Traffic data from Punch Consulting Engineers Traffic and Transport Assessment to determine the potential for air quality impacts in the Operational Stage. Traffic data was provided for the following road links:

- Great Connell Road (North of Great Connell Roundabout)
- Great Connell Road (South of Great Connell Roundabout)
- Southern Relief Road (East of Great Connell Roundabout)
- Southern Relief Road (West of Great Connell Roundabout)
- Southern Relief Road (West of Hall Junction)
- R416 Athgarvan Road (North of Hall Junction)
- R416 Athgarvan Road (South of Hall Junction).

There will be no changes in speed band and no change in carriageway alignment by >=5m due to the proposed development. There will be no change in HDV AADT, as the proposed development is residential.

A section of the NSOORR (west of Great Connell Roundabout) will be built as part of the proposed development so it has been assessed based on the predicted AADT and HDV AADT.

The scoping assessment indicated that that there are two roads that trigger the traffic scoping criteria as the changes in AADT between the do something traffic compared to the do minimum traffic in the opening year is greater than 1000. The road links that trigger the scoping criteria include:

- Southern Relief Road (East of Great Connell Roundabout)
- Southern Relief Road (West of Great Connell Roundabout).

The extent of the ARN is presented in Figure 9-6. The ARN therefore includes the two roads that trigger the scoping criteria and the road links within 200 m of these roads including:

- The road link extending 200 m north of the Great Connell Roundabout
- The road link extending 200 m south of the Great Connell Roundabout.
- The road link extending 200 m north of Hall Junction
- The road link extending 200 m west of Hall Junction
- The road link extending 200 m south of Hall Junction.

The risk potential for each of these road links is low. The receiving environment sensitivity was determined to be low for the following reasons:

- There are few receptors located close to roads triggering traffic change criteria
- The baseline monitoring data illustrates concentrations in base year below an annual mean of 36µg/m³
- No AQMAs or EU limit value exceedances within project's study area.

Combining the risk potential and the receiving environment sensitivity in the framework described in Table 9-12 determined that a simple air quality assessment was required to consider the impacts on the ARN.

The results of the simple assessment are presented for the modelled receptors on each of the road links on the ARN. The magnitude of differences in predicted concentrations of NO_x, PM_{10} and NO_2 between the do-nothing scenarios in the opening and design year and the do-something scenario in the opening and design year form the basis for determining the significance of air quality impacts caused by traffic in the Operational Stage.

The predicted concentrations of NO_x, PM_{10} and NO_2 assoicated with traffic related to the proposed development in isolation and in combination with background traffic are presented in:

- Table 9-31 for the do-nothing scenario in the opening year
- Table 9-32 for the do-something scenario in the opening year
- Table 9-33 for the do-nothing scenario in the design year
- Table 9-34 for the do-something scenario in the design year

Table 9-31 The predicted concentrations of NO_x, PM_{10} and NO_2 due to traffic associated with the proposed development in isolation and in combination with background for the do-nothing scenario in the opening year

Receptor ID	Road Contribution			Background		Road + Background	
	NO_x	PM_{10}	NO_2	NO_2	PM_{10}	NO_2	PM_{10}
	µg/m³						
R1	3.5	0.7	1.8	14	17	15.8	17.7
R2	3.8	0.8	2.0	14	17	16.0	17.8
R3	5.8	1.2	3.1	14	17	17.1	18.2
R4	4.0	0.8	2.1	14	17	16.1	17.8
R5	5.4	1.1	2.9	14	17	16.9	18.1
R6	6.4	1.3	3.4	14	17	17.4	18.3
R7	5.4	1.1	2.9	14	17	16.9	18.1
R8	3.4	0.7	1.8	14	17	15.8	17.7
R9	10.5	2.1	5.5	14	17	19.5	19.1
R10	4.2	0.8	2.2	14	17	16.2	17.8
R11	11.5	2.3	6.0	14	17	20.0	19.3

Table 9-32 The predicted concentrations of NO_x, PM_{10} and NO_2 due to traffic associated with the proposed development in isolation and in combination with background for the do-something scenario in the opening year

Receptor ID	Road Contribution			Background		Road + Background	
	NO_x	PM_{10}	NO_2	NO_2	PM_{10}	NO_2	PM_{10}
	µg/m³						
R1	3.6	0.7	1.9	14	17	15.9	17.7
R2	4.0	0.8	2.1	14	17	16.1	17.8
R3	6.7	1.4	3.5	14	17	17.5	18.4
R4	4.1	0.8	2.2	14	17	16.2	17.8
R5	6.6	1.3	3.5	14	17	17.5	18.3
R6	7.8	1.6	4.1	14	17	18.1	18.6
R7	6.6	1.3	3.5	14	17	17.5	18.3
R8	4.2	0.9	2.2	14	17	16.2	17.9
R9	10.6	2.1	5.5	14	17	19.5	19.1
R10	4.3	0.9	2.3	14	17	16.3	17.9
R11	11.9	2.4	6.2	14	17	20.2	19.4

Table 9-33 The predicted concentrations of NO_x, PM_{10} and NO_2 due to traffic associated with the proposed development in isolation and in combination with background for the do-nothing scenario in the design year

Receptor ID	Road Contribution			Background		Road + Background	
	NO_x	PM_{10}	NO_2	NO_2	PM_{10}	NO_2	PM_{10}
	µg/m³						
R1	2.2	0.8	1.1	14.0	17.0	15.1	17.8
R2	2.4	0.9	1.3	14.0	17.0	15.3	17.9
R3	3.9	1.5	2.0	14.0	17.0	16.0	18.5
R4	2.5	0.9	1.3	14.0	17.0	15.3	17.9
R5	3.8	1.4	1.9	14.0	17.0	15.9	18.4
R6	4.4	1.7	2.3	14.0	17.0	16.3	18.7
R7	3.8	1.4	1.9	14.0	17.0	15.9	18.4
R8	2.4	0.9	1.2	14.0	17.0	15.2	17.9
R9	6.6	2.5	3.4	14.0	17.0	17.4	19.5
R10	2.6	1.0	1.4	14.0	17.0	15.4	18.0
R11	7.5	2.8	3.9	14.0	17.0	17.9	19.8

Table 9-34 The predicted concentrations of NO_x, PM_{10} and NO_2 due to traffic associated with the proposed development in isolation and in combination with background for the do-nothing scenario in the design year

Receptor ID	Road Contribution			Background		Road + Background	
	NO_x	PM_{10}	NO_2	NO_2	PM_{10}	NO_2	PM_{10}
	µg/m³						
R1	2.4	0.9	1.2	14.0	17.0	15.2	17.9
R2	2.6	1.0	1.3	14.0	17.0	15.3	18.0
R3	4.7	1.8	2.4	14.0	17.0	16.4	18.8
R4	2.7	1.0	1.4	14.0	17.0	15.4	18.0
R5	4.8	1.8	2.5	14.0	17.0	16.5	18.8
R6	5.6	2.1	2.9	14.0	17.0	16.9	19.1
R7	4.8	1.8	2.5	14.0	17.0	16.5	18.8
R8	3.0	1.1	1.6	14.0	17.0	15.6	18.1
R9	6.7	2.5	3.4	14.0	17.0	17.4	19.5
R10	2.7	1.0	1.4	14.0	17.0	15.4	18.0
R11	7.9	3.0	4.0	14.0	17.0	18.0	20.0

The number of days that the predicted 24-hour average concentration of PM_{10} was predicted to exceed the standard for PM_{10} was also calculated using the equation from Section 0. For do-something scenario in the design year, a maximum of three (3) exceedances of the PM_{10} standard of 50 µg/m³ were predicted. The standard allows up to 35 exceedances of 50 µg/m³ in an annual period. The modelling therefore shows that at the compliance with the 24-hour average standard for PM_{10} will be achieved at the worst affected receptor.

The difference in predicted concentrations of NO_x, PM_{10} and NO_2 due to traffic associated with the proposed development in isolation and in combination with background are presented in:

- Table 9-35 for the do-something scenario and the do-nothing scenario in the opening year
- Table 9-36 for the do-something scenario and the do-nothing scenario in the design year

Table 9-35 Difference in predicted concentrations of NO_x, PM_{10} and NO_2 due to traffic isolation and in combination with background do-something scenario and the do-nothing scenario in the opening year

Receptor ID	NO_x	PM_{10}	NO_2	PM_{10}	NO_2
	µg/m³			Magnitude of Change	
R1	0.15	0.03	0.08	Imperceptible	Imperceptible
R2	0.16	0.03	0.09	Imperceptible	Imperceptible
R3	0.89	0.18	0.46	Imperceptible	Small
R4	0.16	0.03	0.08	Imperceptible	Imperceptible
R5	1.19	0.24	0.61	Imperceptible	Small
R6	1.40	0.28	0.73	Imperceptible	Small
R7	1.19	0.24	0.61	Imperceptible	Small
R8	0.76	0.15	0.40	Imperceptible	Small
R9	0.08	0.02	0.04	Imperceptible	Imperceptible
R10	0.13	0.03	0.07	Imperceptible	Imperceptible
R11	0.40	0.08	0.20	Imperceptible	Imperceptible

Table 9-36 Difference in predicted concentrations of NO_x, PM_{10} and NO_2 due to traffic isolation and in combination with background do-something scenario and the do-nothing scenario in the opening year

Receptor ID	NO_x	PM_{10}	NO_2	PM_{10}	NO_2
	µg/m³			Magnitude of Change	
R1	0.16	0.06	0.08	Imperceptible	Imperceptible
R2	0.2	0.06	0.1	Imperceptible	Imperceptible
R3	0.8	0.31	0.42	Imperceptible	Small
R4	0.17	0.06	0.09	Imperceptible	Imperceptible
R5	1.02	0.38	0.52	Imperceptible	Small
R6	1.20	0.45	0.61	Small	Small
R7	1.0	0.38	0.52	Imperceptible	Small
R8	0.65	0.24	0.34	Imperceptible	Imperceptible
R9	0.0	0.02	0.0	Imperceptible	Imperceptible
R10	0.1	0.05	0.1	Imperceptible	Imperceptible
R11	0.34	0.13	0.17	Imperceptible	Imperceptible

Considering the worst case magnitude of change is “small” and the baseline annual average concentrations of PM_{10} and NO_2 in the study area are less than 30 µg/m³, the potential impact of the

operational phase of the proposed develop on air quality is found to be negligible, negative and long-term.

In relation to ecological sites, there are no nationally and locally designated sites of ecological conservation importance on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity (known as designated habitats) within 200m of the ARN. The impact of the proposed development on ecological sites is therefore imperceptible, negative and long-term**.**

9.7 Baseline Scenario

In the do-nothing scenario, no development of the site will take place. Air quality at the site will remain at baseline levels. Baseline air quality levels at the site will change with time in line with general trends in air quality for Newbridge Town and the wider surrounding area.

9.8 Prevention & Mitigation Measures

9.8.1 Construction Stage

A Preliminary CEMP has been prepared. The CEMP was informed by the level of risk of adverse air quality impacts identified for each construction activity and the controls identified and the controls identified in IAQM (2014) to mitigate that risk. The CEMP will also incorporate any additional measures required by the conditions attached to the planning permission to mitigate that risk.

The key aspects of dust control include:

- Water spraying of exposed earthworks and site haul road during dry weather using mobile bowser units
- Provision of a power washing at the site access road to remove dirt from vehicles prior to exiting the site
- Control of vehicle speeds

- Material drop heights from plant to plant or from plant to stockpile will be minimised.

9.8.2 Operational Stage

The impact of the proposed development was considered in accordance with regulatory guidance and determined to be imperceptible. Therefore no additional mitigation is required to further reduce operational impacts on air quality.

9.9 Monitoring

In the construction stage dust deposition monitoring will be carried out at the frequencies and locations agreed with Kildare County Council. The monitoring results will be submitted to the Council.

9.10 Cumulative Impacts

For the assessment of cumulative effects it was assumed the the NSOORR connecting Great Connell Roundabout to the Athgarvan Road will be operational and it was assessed based on the predicted AADT and HDV AADT.

It the construction of the permitted distribution centre to the north-east of the proposed development site overlaps with the Phase 1 construction there is the potentiall for cumulative dust impacts on sensitive receptors.

The cumulative effects on air quality that will occur if the construction phases overlap are described as not significant because:

- There will be a high level of dust control as described in the CEMP to mitigate impacts.
- The baseline air quality for the area is good.
- The construction sites will be separated by at least 180 m. The IAQM (2014) risk assessment of dust impacts indicates that the risk of adverse dust impacts at distances greater than 100 m is low in areas with annual mean concentrations of PM10 less than 24 µg/m³ (as is the case in Newbridge). The cumulative impact of two construction sites, each with a low risk of impact will be low.

9.11 Residual Impacts

9.11.1 Construction Stage

The implementation of the CEMP will ensure that levels of impact identified in the assessment of construction impacts will be minimised to levels that are imperceptible, negative and temporary.

9.11.2 Operational Stage

The impact of the operational stage on human health will be not significant**,** negative and long-term. In relation to ecological sites the impact of the proposed development will be imperceptible, negative and long-term.

9.11.3 Summary of Residual Impacts

Likely Significant Effect	Quality	Significance	Extent	Probability	Duration
Construction Stage					
Dust Emissions	Negative	Imperceptible	Local	Likely	Temporary
Operational Stage					
NOx, NO^2 PM_{10} Emissions	Negative	Imperceptible	Local	Likely	Long Term

9.12 References

DEFRA, 2020, Emissions Factors Toolkit v10.1. User Guide. August 2020. https://laqm.defra.gov.uk/documents/EFTv10.1-user-guide-v1.0.pdf

DEHLG (2004) Quarries and Ancillary Activities Guidelines for Planning Authorities. https://www.housing.gov.ie/sites/default/files/migrated-files/en/Publications/DevelopmentandHousing/Planning/FileDownLoad%2C1606%2Cen.pdf

DEHLG (2011) Air Quality Standards Regulations (2011). S.I. No. 180/2011, as amended - Air Quality Standards Regulations 2011. http://www.irishstatutebook.ie/eli/2011/si/180/made/en/print

EPA (2012) Ambient Air Monitoring at Newbridge, Co. Kildare 1st October 2009 – 24th May 2010. https://www.epa.ie/publications/monitoring--assessment/air/ambient-air-monitoring/Newbridge-report-FINAL-.pdf

EPA. (2017). Guidelines on the information to be contained in Environmental Impact Assessment Reports, Draft August 2017 .

EPA (2018) Air Quality in Ireland 2017 - Indicators of Air Quality. Environmental Protection Agency, An Ghníomhaireacht um Chaomhnú Comhshaoil, PO Box 3000, Johnstown Castle Estate, County Wexford.
http://www.epa.ie/pubs/reports/air/quality/Air%20Quality%20In%20Ireland%202017.pdf

EPA (2019) Air Quality in Ireland 2018 - Indicators of Air Quality. Environmental Protection Agency, An Ghníomhaireacht um Chaomhnú Comhshaoil, PO Box 3000, Johnstown Castle Estate, County Wexford,
https://www.epa.ie/publications/monitoring--assessment/air/air-quality-in-ireland-2018.php

EPA (2020) Air Quality in Ireland 2019 - Indicators of Air Quality. Environmental Protection Agency, An Ghníomhaireacht um Chaomhnú Comhshaoil, PO Box 3000, Johnstown Castle Estate, County Wexford, Ireland. https://www.epa.ie/publications/monitoring--assessment/air/air-quality-in-ireland-2019.php

EPA (2021). Newbridge air quality monitoring station https://airquality.ie/station/TNO3953

EPA (2021a) EPA Air quality homepage https://airquality.ie/

Highways England (2019) Design Manual for Roads and Bridges. Volume 11. Part 1. LA 105 Air Quality. Highways England Company Limited (formerly the Highways Agency), Guildford, United Kingdom. Available online: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3

Highways England (2021) Design Manual for Roads and Bridges index GG 000 29 September 2021. https://www.standardsforhighways.co.uk/prod/attachments/066b3135-59f4-4eb4-837a-7c43c6c6a790?inline=true

Highways Agency, 2021, Personal Communication.

IAQM (2014) Guidance on the assessment of dust from demolition and construction. http://iaqm.co.uk/wp-content/uploads/guidance/iaqm_guidance_report_draft1.4.pdf

NRA (2011) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes. National Roads Authority . https://www.tii.ie/technical-services/environment/planning/Guidelines-for-the-Treatment-of-Air-Quality-during-the-Planning-and-Construction-of-National-Road-Schemes.pdf

Ricardo Energy and Environment, 2019, NOx to NO2 Conversion Spreadsheet (Version 7.1, June 2019). https://laqm.defra.gov.uk/air-quality/air-quality-assessment/nox-to-no2-calculator/

TA Luft (1986) Technical Instructions on Air Quality Control – TA Luft in accordance with Article 48 of the Federal Emission Control Law (BImSchG) dated 15th March 1974 (BGBI, I p. 721). Federal Ministry for Environment, Bonn 1986 and amendments.

10 POPULATION & HUMAN HEALTH

10.1 Introduction

This Chapter describes the population distribution in the vicinity of the proposed development and assesses the impacts of the proposed development on the population and human health. The assessment considered a 'baseline' scenario and identifies the prevention and mitigation measures that are and will be implemented to reduce the significance of the impacts and assesses the residual impacts.

The term "human health" is not defined in the 2014 EIA Directive. . There is a close interrelationship between the SEA Directive and the 2014 EIA Directive. The term "human health" is contained in both the SEA and EIA Directives and a common interpretation can be assumed. Therefore the consideration of human health effects resulting from the construction and operation of a project should focus on health issues arising in the context of the other relevant environmental factors listed in Article 3 of the Directive[13], namely:

- Population
- Biodiversity, with particular attention to protected species and habitats
- Land, soil, water, air and climate
- Material assets, cultural heritage and the landscape
- Interactions between the above factors

The EIA Directive and transposing regulations do not generally require assessment of land-use planning, demographic issues or detailed socio-economic analysis and this should be avoided in an EIAR, unless issues such as economic or settlement patterns give rise directly to specific new developments and associated effects[14]. Given the nature of the proposed development these aspects have been considered.

This Chapter was prepared by Jim O'Callaghan of OCM. Mr O'Callaghan holds a BA Moderatorship in Geography and an MSc in Environmental Science. He is a Chartered Member of the Institution of Waste Management a Chartered Environmentalist and Registered Principle Environmental Auditor with the Institute of Environmental Management and Assessment. He has over 35 years' experience in the field of environmental science including the preparation of Environmental Impact Assessment Reports.

[13] • Government of Ireland Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (2018).

[14] Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA 2017).

10.2 Methodology

The assessment was based on the planning zoning status, the land use in the vicinity of the development site, population density and employment sectors and a Social Infrastructure Assessment completed by KPMG Analytical Services (KPMG), whose report is in Appendix 9. It takes into consideration the Universal Access Statement prepared by O'Flynn Architects, a daylight and sun light and shadow assessment completed by 3D Design Burea and the findings of the assessment of impacts on human health associated with emissions to air (Chapter 9), noise and vibration (Chapter 11) and flood risk (Chapter 7).

Background information was derived from

- CSO databases (Unemployment Life Register and Labour Force Surveys);
- Kildare Census 2016 Profile Demographics and 2016 Profile Employment, Industry and Occupation commissioned by the Kildare County Council & Local Community Development Committee;
- Kildare County Development Plan (2017 – 2023), and
- Newbridge LAP.
- 2016 and 2011 Census Boundaries and Statistics;
- 2021 OSI and ESRI Ireland Basemaps;
- 2022 Google Places Dataset;
- 2021 OSM Ireland POI Datasets – Ireland and Northern Ireland;
- 2012-2021 Department of Education and Skills - Irish Schools;
- 2021 QQI Register of Private Higher Education Institutions in Ireland;
- 2022 Tusla Early Years Inspectorate Reports – Registered Childcare Facilities; and
- 2022 HSE Records – 'Find Your Local Health Service

10.2.1 Consultation

In the statutory consultation stage Kildare County Council emphasised the need for high-quality landscaping and design and the provision storage for the units. The Bord requested that the open spaces should incorporate high-quality design to ensure that they are useable and functional for all sectors of the community.

10.3 Development Description

A detailed description of the proposed development is in Chapter 3. The aspects relevant to Population & Human Health are:

- The construction and occupancy of;

- 569 residential units (325 house and 224 apartments),
- A neighbourhood centre with 11 commercial units and,
- A crèche with the capacity of 154 children and 18 open space areas. There

- Existing Social Infrastructure
- Flood Risk

10.4 Receiving Environment: Population

10.4.1 Surrounding Land Use

The proposed development site is on the eastern outskirts of Newbridge, ca 1km from the Town Centre and main retail area, as shown on Figure 10.1. To the south and south-east are agricultural lands, primarily used for tillage. To the east, across the Great Connell Road, are the Murphy Ireland Ltd offices and compound.

To the north, the site bounds the Wellesley Manor, which is characterised by two-storey detached and semi-detached houses arranged around public open spaces. It has closest residential dwellings, with the houses in the south of the estate being approximately 10 m from the north-eastern development site boundary.

The Dr Pepper beverage manufacturing plant (formerly Lidl distribution centre) is ca 500m to the north-east. The Pfizer manufacturing complex, which is Europe's largest manufacturers of solid dose pharmaceuticals is ca 800m to the north. The Baroda Stud Farm is ca 500m to the south-east. To the south-west, across the River Life, a 343 unit residential development (Ardstone) is currently under construction (ABP-302141-18).

Figure 15.1 Site Location (KPMG)

10.4.2 Demographics

For the purposes of their assessment KPMG defined the study area as comprising the seventy five CSO Small Area Boundaries within a 2km radius of the development site, as shown on Figure 10.1 derived from the KPMG Report. The area is equivalent to a 15 to 25 minute walking distance from the development and was selected by KPMG to provide an insight into the character of the local population with respect to demographic trends in the locality and a comparison with trends in County Kildare.

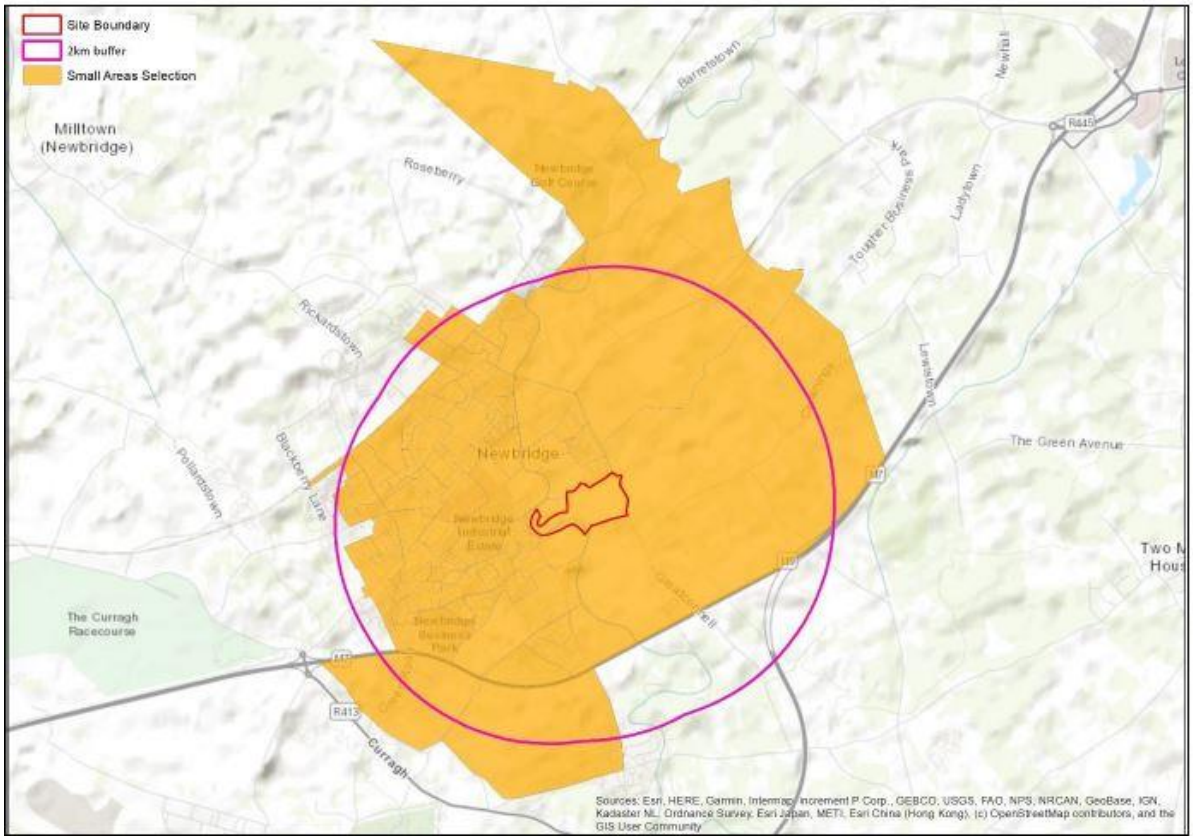


Figure 10.1 Study Area (KPMG)

Kildare is one of the most populated counties in the State, with a population of 222,504 recorded in the 2016 Census it has the fifth highest population of all local authority areas in Ireland. Only Dublin City, Cork County, Fingal and South Dublin are larger.

Kildare has experienced major and consistent population expansion in recent years as a result of both a high birth rate and high levels of inward migration. Between 2011 and 2016 the population of the county increased by 12,192 (6%) while in the study are the increase (723) represented a lower growth rate of 4%.

The different age groups of a population have different requirements, with young families in need of educational and childcare services, a working age population requiring employment opportunities, and those of retirement age in need of care and health services.

In 2011, 67% of the population in the study area was in the 'working age' group (15 to 64 year), 25% were aged between 0-14, with 8% being over 65. This was similar to the overall trends in County Kildare in 2011, with a maximum of 1% differences in each age group. By 2016. The 0-14 age group

had decreased by 1.2%, the working age group had increased by 22%. The overall trends were similar to County Kildare as a whole.

KPMG undertook a custom population projection exercise to estimate population change for study area shown on 10.2. It consist of. CSO Electoral Division Boundaries within a 2km radius of the development that contain most of the Newbridge urban area.

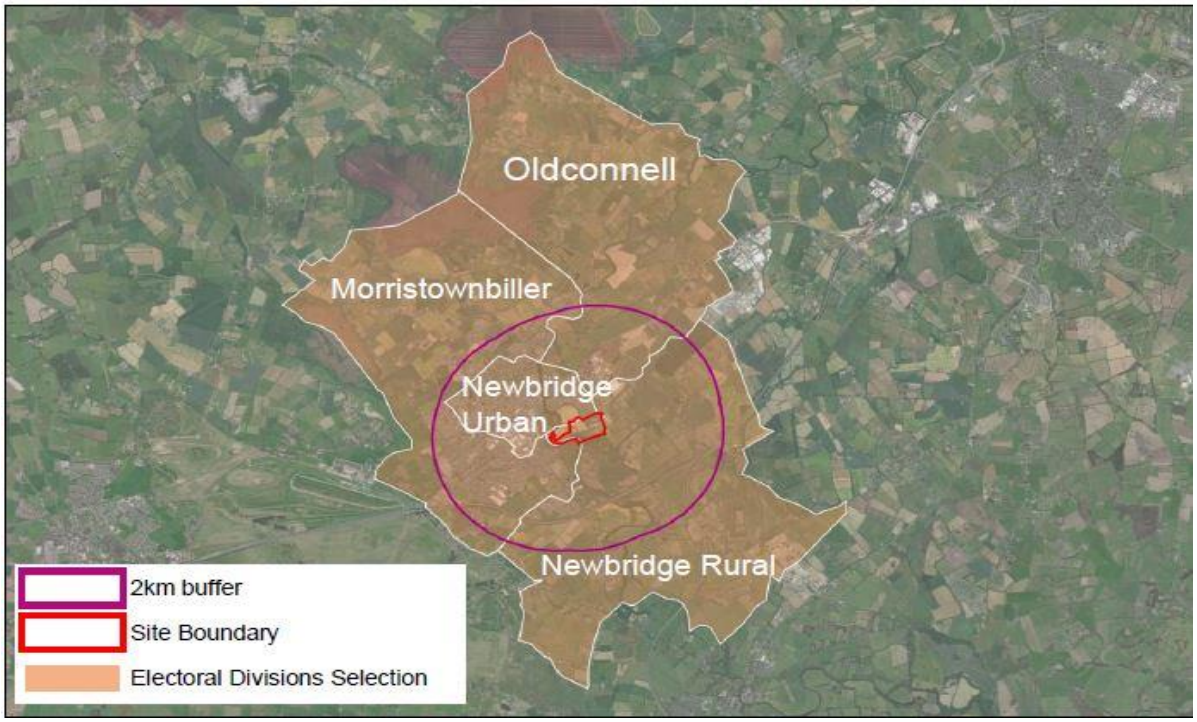


Figure 10.2 Population Growth Study Area (KPMG)

The study area experienced a significant increase in its population between 2006 and 2016 when it increased from 21,727 to 26,258; however the population in Newbridge Urban area decreased slightly from 7,888 to 7,762. KPMG predicts that in 2031 the study area will have a population of 32,721, with the population in the Newbridge Urban area likely to be 9,532.

KPMG predict that Study Area in 2031 will be dominated by those that are of 'working age' (c.68.8%), with a smaller number of younger people (c.17.1%) and older people (c.14.1%). The age profile of the Newbridge Urban area in 2031 will also have large number of 'working age' population albeit slightly lower (c. 65.3%) compared with the overall study area.

10.4.3 Economy

The term 'industry' used for Census of Population purposes is not confined to manufacturing industry and is synonymous with the term "sector of economic activity". There are eight broad industrial groups: 'Agriculture, Forestry and Fishing', 'Building and Construction', 'Manufacturing Industries', 'Commerce and Trade', 'Transport and Communications', 'Public Administration', 'Professional Services' and 'Other'. The dominant industrial sectors for Kildare workers are 'Commerce and Trade' (26.6%) and 'Professional Services' (22.8%) - both accounting for nearly half of all Kildare resident workers.

10.4.4 Employment

In 2015 there were 10,314 active enterprises in Kildare. Of these, only 15 (0.1%) employed more than 250 persons. A total of 9,598 (93.1%) enterprises employed less than 10 people, marginally higher than the State average of 92.2%. Relative to the State total of 248,843, Kildare accounts for 4.1% of all active enterprise.

The economic profile of the study area is similar to County Kildare as a whole, with the majority of the population categorised under 'At Work' in 2016. Within the Study Area, there was a lower percentage (55%) of people at work compared to the county level (57%), with the level of unemployment being higher (8%) within the study area compared to the County (6%). The number of students in the study area (10%) was a higher percentage of students (12%) than the study area (10%),was slightly less than in the County, but the study area contained marginally more 'Retired' persons (12%) than the County.

10.4.5 Connectivity

Newbridge train station is approximately 2 km to the north-west of the site, within 40 minutes walking distance. It provides access to Dublin, Galway and Waterford, with over thirty daily departures to Heuston Station and Grand Canal Dock, with commuting time of less than 60minutes. There are a number of bus services within 25 minutes walking distance from the site, including bus routes 120B, 126 and 726 that connect to major terminals in Dublin such as Dublin Airport, Connolly Station and Grand Canal Dock. The M7 motorway south of site provides access to the national motorway network.

10.4.6 Social Infrastructure

Given its position on the outskirts of Newbridge and its zoning for residential development there are many social services within 2 km of the development. KPMG conducted a social infrastructure audit of the types of facilities listed in Table 10.1 that align with the policies set out in the Kildare County Development Plan. The study area was within a 2km radius of the development site.

Table 10.1 Facility Types/Social Infrastructure

Category	Facility Type
Health	Health Centres, General Practitioner (GP) Practices, Dental Practices, Physiotherapist, Pharmacies, Nursing Homes and Specialist Services
Childcare	Registered Childcare Facilities incl. Full Day, Part-Time and Sessional services
Education & Training	Primary Schools, Post-Primary Schools, Further Education and Training Facilities
Social & Community	Credit Unions, Post Offices, Community Facilities, Emergency Services, Garda Stations, Fire Stations and Libraries
Open Space, Sports & Recreation	Parks, Playgrounds, Dedicated Public Open Space and Amenity Areas, Sports Centres and Formal Club Facilities, Green Corridors, Natural / Semi Natural Green Spaces and Other Open Spaces
Faith	Churches/Places of Worship, Cemeteries
Arts & Culture	Theatre, Museum, Performance and outdoor events spaces, Music, Speech / Drama and Dance, Tourism Amenities
Other Facilities including Neighbourhood Centres	District, town, neighbourhood, and local centres

KPMG identified more than 120 no. social infrastructure facilities and services identified within and immediately bordering the study area that contribute to the quality of life in the vicinity of the development site. These are shown on Figure 10.3 and a detailed breakdown of each type, including where relevant the available capacities, are in the KPMG report (Appendix 9)

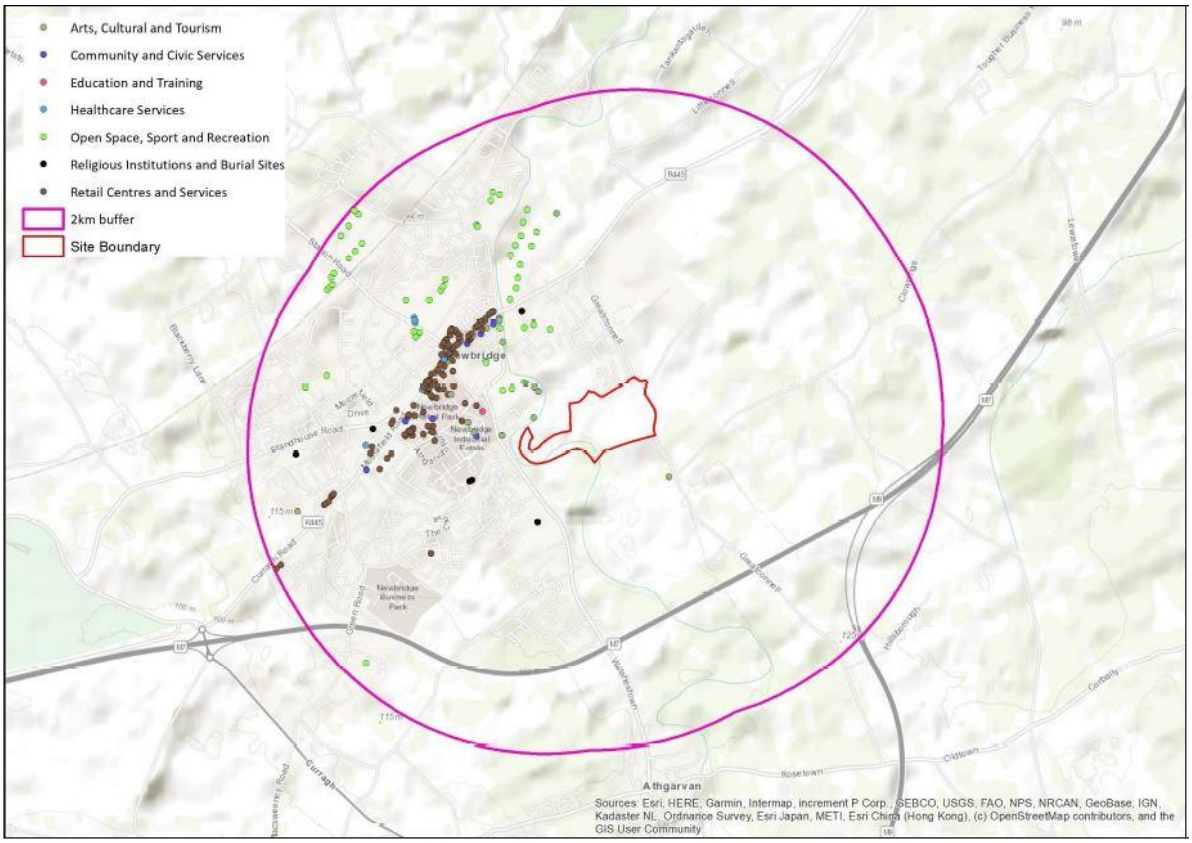


Figure 10.3 Social Facilities

10.5 Receiving Environment: Human Health

Given the residential nature of the development the environmental factors that are considered relevant to human health are Major Accidents/Natural Disasters and impacts that either directly impinge on standards designed to protect health (Air Quality), or are indirectly associated with nuisance, which can induce stress (Noise).

10.5.1 Major Accidents/Natural Disasters

Major Accidents

The Seveso II Directive 96/82/EC is concerned with the prevention of major accidents that involve dangerous substances and the limitation of their consequences for humans and the environment. It applies to establishments where dangerous substances are produced, used, handled or stored.

The Directive was transposed into Irish law by the "European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations" S.I No 476 of 2000 implements this Directive in Irish law. The National Authority for Occupational Safety Health (the Health and Safety Authority (HSA) is designated as the central competent authority for enforcement of these regulations.

Facilities that are subject to the Regulations are ranked as Upper and Lower Tier Establishments based on scale. There are two Seveso facilities in Kildare, both Lower Tier Establishments located in Collinstown Industrial Park in Leixlip and at Clonagh in Enfield respectively and both more than 5km from the proposed development.

Natural Disasters

The development site is not in an area at risk of land instability. The majority of the site is at low risk of flooding; however there is an overland flow path through the site that would be impacted by a 1:100 and 1:1000 year flood event. (Chapter 7).

10.5.2 Air Quality

The ambient air quality at and in the vicinity of the proposed development is good with monitoring conducted by the EPA demonstrating that air contaminants with the potential to affect human health are below the relevant Air Quality Standard limit values (Ref Section 9.3).

10.5.3 Noise & Vibration

A baseline noise assessment has established that the main noise source audible at development site is from traffic on the surrounding road network, which is continuously audible at all times in the background throughout daytime, evening and night-time periods. Other noise sources of significance are birdsong and aircraft. (Chapter 11).

10.6 Impacts

Large scale residential developments have the potential to impact both positively and negatively on population and human health.

10.6.1 Construction Stage

In the construction stage there is an economic benefit to local shops and businesses and construction material suppliers; however noise and air emissions from have the potential to result in localised, if temporary, nuisance.

10.6.2 Operational Stage

The provision of additional housing units is a positive in the context of the current national housing demand; however, depending on the location, an increase in local population can impose burdens on the local social infrastructure and wider material assets (water supply and wastewater treatment) that negatively affect both the existing population and the new residents.

A relatively rapid (1 to 5 years) significant increase in the local population can, depending on the location, severely stress existing social infrastructure, including child care, schools, medical facilities, recreational amenities and emergency response services. Increases in the volume of sanitary wastewater and additional demands on the mains supply have the potential to adversely impact the performance of the existing water and wastewater infrastructure with consequent effects on both residential and commercial activities.

Traffic associated with a development has the potential to contribute to a deterioration in local air quality, with consequent effect on human health, while traffic noise be a source of persistent nuisance.

10.7 Baseline Scenario

At present there are no occupied private residences within the development boundary. If the development does not proceed there will be:

- No local economic benefits and potential nuisances associated with the construction stage;
- No contribution to meeting the national demand for new housing units;
- No impacts on the local material assets;
- No impacts on the existing social infrastructure, and
- No impacts on air quality.

In terms of the evolution of the environment, the majority of the lands are greenfield and used for agricultural purposes, primarily tillage and this land use would continue.

10.8 Prevention & Mitigation Measures

10.8.1 Design Stage

Amenity and Public Realm

The design stage took into consideration the need to provide a decent standard of amenity and a safe and secure public realm for the residents. The site layout includes 11.359 ha of public open space, or 41% of the total site area 27.635 ha boundary). Every home has access to a generous area of useable private outdoor space that is located immediately adjacent to the main living spaces in the home: whether it is balcony and terrace spaces for apartments or private gardens for housing.

The public realm was considered to be a useable integrated element in the design of the development. The public space and realm is enclosed and overlooked by surrounding housing and apartments so that this amenity will be owned by the residents and be safe to use. Play areas are located where they are overlooked and safe.

Noise

The design stage took into consideration the need to minimise noise impact both on existing residents in the vicinity of the development and future occupants and details are provided in Section 11.9.1.

Daylight, Sunlight and Shadow Assessment.

3D Design Bureau completed a comprehensive BRE daylight and sunlight assessment and shadow survey of the proposed development and a copy of their report is included in the application under a separate cover. The assessment encompassed

- Impact assessment: Effect on the surrounding environment and properties, which includes vertical sky component (VSC), Annual Probable Sunlight Hours (APSH), Winter Probable Sunlight Hours (WPSH) and the Sun on Ground (SOG) and sunlighting analysis. The effects were assessed in the baseline state versus the proposed state;

- Scheme Performance: Daylight and sunlight assessment of the proposed development, which includes sunlighting to the proposed amenity spaces and internal daylighting Average Daylight Factor (ADF) to the habitable rooms.

The impact assessment evaluated the effect of the proposed development on the existing surrounding environment and properties, including those in Wellesley Manor.

The assessment concluded that the proposed development would have an imperceptible impact on the VSC of the neighbouring properties and imperceptible impacts on the APSH, ADF, WPSH and the SoG on the existing neighbouring gardens/amenity areas and the proposed amenity areas.

Flood Risk Assessment

The design stage also involved the completion of a detailed flood risk assessment that identified the appropriate mitigation measures, which were then incorporated into the building design and the storm water management system to ensure that the development will not give rise to flooding inside, or outside the development boundary (Refer Chapter 7 Water).

Social Infrastructure

The development includes the provision of a crèche and neighbourhood centre which will service the existing residential areas and those in the proposed development.

10.8.2 Construction Stage.

The Preliminary CEMP (Appendix 3) includes the mitigation measures to prevent and mitigate adverse impact on human beings.

10.9 Monitoring

Noise monitoring will be carried out in the construction stage at frequencies and locations to be agreed with Kildare County Council. The results will be submitted to the Council.

10.10 Cumulative Impacts

The assessment of the impacts on air, water and noise took into account the cumulative effects of the permitted Murphy International and Barolo developments and the delivery of the planned NSOORR and bridge crossing. KPMG took account of predicted increased in population in their assessment of the capacity of the existing social infrastructure.

10.11 Residual Impacts

The development will have a temporary, slight, positive impact on the local economy during the construction stage. In the operational stage the local economy will also benefit from residents availing of local services.

The KPMG Social Infrastructure Audit concludes that the existing social infrastructure provision identified within the c. 2km of the study area, in conjunction with the proposed neighbourhood centre, crèche and open space areas will be capable of serving the existing population and potential demand generated by the proposed development scheme, with no significant gaps in the existing services network being identified.

Currently the air quality in the vicinity of the site is good. The assessment of the impacts on air quality concluded that the proposed development will have an imperceptible, negative, long term impact on air, but will not present any public health risk (Chapter 9).

The noise and vibration assessment (Chapter 11) concludes that the development will have a slight, adverse, temporary impact in the construction stage, with an imperceptible impact on the local population and human health in the operational stage.

10.11.1 Summary of Residual Impacts

Likely Significant Effect	Quality	Significance	Extent	Probability	Duration
Construction Stage					
Economy	Positive	Slight	Newbridge Environs	Likely	Temporary
Operational Stage					
Economy	Positive	Slight	Newbridge Environs	Likely	Long Term
Social Infrastructure	Neutral	Imperceptible	Newbridge Environs	Likely	Long Term
Human Health Air Quality	Negative	Imperceptible	Local	Likely	Long Term
Human Health Noise	Neutral	Imperceptible	No Receptors Affected	Unlikely	Long Term

11 POPULATION & HUMAN HEALTH – NOISE & VIBRATION

11.1 Introduction

This Chapter describes the potential noise and vibration impacts associated with the proposed development and includes an assessment of effects on human health. The assessment considered a 'baseline' scenario and identifies the prevention and mitigation measures that are and will be implemented to reduce the significance of the impacts and assesses the residual impacts.

The Chapter was prepared by Damian Brosnan of Damian Brosnan Acoustics (dBA) who has over 20 years' experience in scoping and carrying out such impact assessments. His qualifications are as follows:

- BSc (Honours) 1993 (University College Cork).
- Diploma in Acoustics & Noise Control 2009 (Institute of Acoustics).
- MSc (Distinction) in Applied Acoustics 2015 (University of Derby).
- Member of Institute of Acoustics (MIOA) & secretary of Irish branch.
- Founding member of Association of Acoustic Consultants of Ireland (AACI).
- Member of Engineers Ireland (MIEI).
- Lead author of Environmental Noise Guidance For Local Authority Planning & Enforcement Departments (AACI, 2019).
- 1996-2001: Noise Officer with Cork County Council.
- 2001-2014: Partner with DixonBrosnan Environmental Consultants, specialising in EIA.
- 2015--: Principal at Damian Brosnan Acoustics.

11.2 Relevant Legislation and Guidance

In addition to the guidance documents referenced in 1.5 of the EIAR the following legislation and guidance were taken into consideration.

- Report RI 8507: Structural Response And Damage Produced By Ground Vibration From Surface Mines Blasting (US Bureau Of Mines, 1980).

- British Standard BS 7385-2:1993 Evaluation And Measurement For Vibration In Buildings – Part 2: Guide To Damage Levels From Groundborne Vibration (1993).

- Guidelines On Community Noise (World Health Organisation, 1999).

- Directive 2002/49/EC Of The European Parliament And Of The Council Relating To The Assessment And Management Of Environmental Noise (2002), Transposed Into Irish Law By The European Communities (Environmental Noise) Regulations 2018 (SI No. 549/2018).

- NANR116: Open/Closed Window Research – Sound Insulation Through Ventilated Domestic Windows (prepared by the Napier University Building Performance Centre for DEFRA, 2007)

- Night Noise Guidelines For Europe (World Health Organisation, 2009).

- Design Manual For Roads And Bridges (UK Highways Agency, 2011).

- British Standard BS 4142:2014 Methods For Rating And Assessing Industrial And Commercial Sound (2014).
- British Standard BS 5228-1:2009+A1:2014 Code Of Practice For Noise And Vibration Control On Construction And Open Sites – Part 1: Noise (2014)
- British Standard BS 5228-2:2009+A1:2014 Code Of Practice For Noise And Vibration Control On Construction And Open Sites – Part 2: Vibration (2014).
- British Standard BS 8233:2014 Guidance On Sound Insulation And Noise Reduction For Buildings (2014).
- Good Practice Guidance For The Treatment Of Noise During The Planning Of National Road Schemes (National Roads Authority (Now Transport Infrastructure Ireland), 2014).
- Technical Guidance Document TGD-021-5: Acoustic Performance In New Primary & Post Primary School Buildings (Department of Education & Skills, 2015).
- NG4 Guidance Note For Noise: Licence Applications, Surveys And Assessments In Relation To Scheduled Activities (Environmental Protection Agency, 2016).
- ProPg Planning & Noise: Professional Practice Guidance On Planning & Noise – New Residential Development (Association Of Noise Consultants, Institute Of Acoustics & Chartered Institute Of Environmental Health, 2017).
- Environmental Noise Guidelines For The European Region (World Health Organisation, 2018).
- Third Noise Action Plan 2019-2023 (Kildare County Council, 2019).

11.3 Methodology

Potential impacts fall into the following categories:

- Construction stage noise impacts on surrounding receptors.
- Construction stage vibration impacts on surrounding receptors.
- Operational stage noise impacts on surrounding receptors.
- Operational stage vibration impacts on surrounding receptors
  .
- Noise impacts within the completed development from external sources (‘inward impacts’).

A preliminary scoping exercise concluded that the proposed development will not give rise to any vibration impacts in the operational stage and this category was therefore scoped out. The remaining four categories are assessed in this Chapter.

Typical ambient noise levels across the local area were measured and used to identify appropriate construction phase noise criteria. Likely construction plant were identified and their noise emissions

data used to predict likely noise levels at surrounding receptors. Predicted levels were assessed in the context of recognised criteria, and mitigation measures identified where required. Potential sources of vibration during the construction phase were identified and impacts assessed by reference to commonly applied criteria.

Noise sources associated with the commissioned development were reviewed, and potential impacts assessed. Such impacts relate chiefly to traffic. In line with emerging best practice, an assessment of inward noise impacts was undertaken, and the requirement for enhanced façade treatments was assessed.

11.3.1 Construction Phase Noise Guidance

There are no national mandatory noise limits relating to temporary construction works. In granting planning permission, a local authority may stipulate construction phase noise limits applicable to daytime, evening, night-time and weekend hours as appropriate. There are no national guidelines available regarding the selection of such limits. Many local authorities chose to apply a 65 dB $L_{Aeq\ T}$ limit.

The chief noise guidance document applied in Ireland and the UK in construction phase noise assessments is British Standard BS 5228:2009+A1:2014 Code Of Practice For Noise And Vibration Control On Construction And Open Sites Part 1: Noise (2014).

Annex E of the document sets out several methods to draw up suitable noise criteria applicable to the construction phase of a project. The most appropriate method here is considered to be the 'ABC method', which provides for the selection of criteria based on existing ambient noise data. On the basis of noise data recorded at the study site, as discussed below, a daytime $L_{Aeq\ 1\ h}$ criterion of 65 dB is identified. This criterion is identical to that typically applied by local authorities, and is thus applied in this assessment. The $L_{Aeq\ 1\ h}$ parameter describes the total noise emissions from all construction sources occurring during any 1 h period, averaged over that hour.

BS 5228:2009 states that the 65 dB criterion is applicable to the periods Monday-Friday 0700-1900 h and Saturday 0700-1300 h. Construction operations are unlikely to be undertaken during evening or night-time hours or on Sundays. This assessment therefore applies the 65 dB criterion in respect of all construction works.

The 65 dB criterion is considered applicable to surrounding receptors, in their immediate curtilage. In this regard, the EPA document NG4 Guidance Note For Noise: Licence Applications, Surveys And Assessments In Relation To Scheduled Activities (2016) defines a noise sensitive location as:

> 'Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or area of high amenity which for its proper enjoyment requires absence of noise at nuisance levels.'

As construction projects tend to be relatively short, and as construction works areas are usually localised and mobile, the 65 limit is usually not subject to any additional criteria such as tone and impulse restrictions.

With respect to construction of the proposed Newbridge Southern Outer Orbital Relief Road (NSOORR), reference may be made to The Good Practice Guidance For The Treatment Of Noise During The Planning Of National Road Schemes (National Roads Authority, now Transport Infrastructure Ireland), 2014). This document recommends an $L_{Aeq\ 1\ h}$ limit of 70 dB at receptors, and a L_{ASmax} limit of 80 dB with respect to short term events.

11.3.2 Construction Phase Vibration Guidance

As with noise, there are no national limits relating to groundborne vibration, and reference is usually made to guidance set out in British Standard BS 5228-2:2009+A1:2014 Code Of Practice For Noise And Vibration Control On Construction And Open Sites – Part 2: Vibration (2014). Table 11.1 presents guidance included in the document with respect to human perception of peak particle velocity (PPV), the most commonly applied descriptor of groundborne vibration.

PPV	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10.0 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Table 11.1 Human Perception of Vibration, from BS 5228-2:2009

During construction projects, reference is usually made to criteria relevant to buildings, in order to avoid potential cosmetic or structural damage. The National Roads Authority (NRA) document identified above has seen increasing application to non-road projects due to the absence of any other Irish guidance. NRA criteria, listed in Table 11.2, are informed by documents such as British Standard BS 7385-2:1993 Evaluation And Measurement For Vibration In Buildings – Part 2: Guide To Damage Levels From Groundborne Vibration (1993). The criteria apply to the closest part of any relevant building or structure.

Frequency	<10 Hz	10-50 Hz	>50 Hz
PPV	8 mm/s	12.5 mm/s	20 mm/s

Table 11.2 Building vibration criteria, from NRA (2014)

The NRA limits set out above are considerably lower than criteria recommended by two respected international authorities, as presented in Table 11.3. The criteria presented are those below which cosmetic damage (hairline cracking, etc.) to buildings is unlikely to occur. Limits relating to structural damage are significantly higher.

Structure	Lower frequencies	Higher frequencies	Source
Modern dwellings	<40 Hz: 19 mm/s	>40 Hz: 51 mm/s	1
Older dwellings	<40 Hz: 12.7 mm/s	>40 Hz: 51 mm/s	1
Industrial & heavy commercial	4-15 Hz: 50 mm/s	>15 Hz: 50 mm/s	2 & 3
Residential & light commercial	4-15 Hz: 15-20 mm/s	>15 Hz: 20-50 mm/s	2 & 3

Table 11.3 Recommended vibration limits

Sources:

1 US Bureau Of Mines Report RI 8507: Structural Response And Damage Produced By Ground Vibration From Surface Mines Blasting (1980).

2 BS 5228-2:2009+A1:2014 Code Of Practice For Noise And Vibration Control On Construction And Open Sites – Part 1: Vibration (2014).

3 BS 7385-02: 1993 Evaluation And Measurement For Vibration In Buildings – Part 2: Guide To Damage Levels From Ground Borne Vibration (1993).

11.3.3 Post-Completion Noise Guidance

There are no national mandatory noise limits applicable to commissioned developments. While a number of guidance documents have been issued with respect to certain sectors, none relate to residential developments. Two elements of the commissioned development may give rise to noise emissions (outside of those associated with external residential activities such as children playing and grass cutting): proposed non-residential elements (termed 'commercial' for the purposes of this assessment), and traffic. These are typically assessed differently.

With respect to commercial noise emissions, most environmental noise guidance documents issued across Europe ultimately derive limits from guidance issued by the World Health Organisation (WHO). The WHO document Guidelines On Community Noise (1999) sets out the guideline values considered necessary to protect communities from environmental noise. With respect to residential settings, the WHO Document notes that an outdoor $L_{Aeq\ 16\ h}$ level of 55 dB is an indicator of serious annoyance during daytime and evening hours, with 50 dB being an indicator of moderate annoyance.

The 55 dB criterion has become the de facto daytime limit applied by most Irish regulatory authorities to commercial and industrial operators. Although the WHO criterion applies to daytime periods of 16 hours, authorities typically specify shorter periods, and thus limits such as $L_{Aeq\ 15\ min}$, $L_{Aeq\ 30\ min}$ and $L_{Aeq\ 1\ h}$ are variously applied. In issuing licences to industrial facilities, the EPA typically specifies a daytime $L_{Aeq\ T}$ limit of 55 dB at receptors. The EPA currently considers daytime to refer to 0700-1900 h. A similar daytime limit is usually included in noise conditions attached to planning permission issued by local authorities.

The WHO's 1999 Guidance Document recommends an external night-time criterion of 45 dB to prevent sleep disturbance. Although the WHO document Night Noise Guidelines For Europe (2009) makes reference to a 40 dB night-time criterion, this relates to the $L_{night,outside}$ parameter, which is the long term average measured throughout a whole year. The 45 dB criterion is considered more appropriate for short term measurement intervals. As before, $L_{Aeq\ 15\ min}$, $L_{Aeq\ 30\ min}$ and $L_{Aeq\ 1\ h}$ night-time intervals are variously applied by regulatory authorities, rather than the 8 hour period to which the WHO's 45 dB criterion applies. The EPA considers that night-time refers to 2300-0700 h.

Neither of the WHO Documents listed above makes reference to evening periods, and indeed their 1999 document assumes that daytime extends to 2300 h. However, a trend towards the separate assessment of evening impacts is currently evident, partly driven by the EPA's NG4 document. The original 2012 version of the document introduced the evening period 1900-2300 h. The NG4 document recommends an evening criterion of 50 dB, applicable externally at receptors.

Many authorities require that a penalty be added to measured noise levels where emissions are tonal and/or impulsive. NG4 specifies the addition of a 5 dB penalty to site specific $L_{Aeq\ T}$ levels measured during daytime or evening hours. During night-time hours, the EPA prohibits tones and impulses entirely, stating that such characteristics should not be 'clearly audible or measurable'. With respect to short term impulsive sources, the WHO recommends a night-time L_{Amax} limit of 60 dB outside bedroom windows during night-time hours. No L_{Amax} limit is recommended for daytime periods.

The above criteria, summarised in Table 11.4, are considered relevant to commercial sources at the proposed development. Rather than allowing daytime and evening levels to be rated for tonal or impulsive features, the table assumes that such features are avoided at all times. Criteria apply externally at receptors.

Period	Parameter	Limit
0700-1900 h	$L_{Aeq\,T}$	55 dB
1900-2300 h	$L_{Aeq\,T}$	50 dB
2300-0700 h	$L_{Aeq\,T}$	45 dB
2300-0700 h	L_{AFmax}	60 dB

Table 11.4 Noise criteria appropriate to commercial emissions

In addition to the absolute criteria above, the impact of noise emissions from commercial sources may be assessed by reference to relative criteria. The most commonly applied standard here is British Standard BS 4142:2014 Methods For Rating And Assessing Industrial And Commercial Sound (2014) which provides for the comparison of specific $L_{Aeq\,T}$ levels (i.e. noise levels attributable to the source in question) with background levels, and provides an indication of impact depending on the difference. Specific levels may be rated to take tonal, impulsive and other characteristics into account. The standard notes that the background noise environment may include existing industrial emissions unrelated to the specific source.

BS 4142:2014 states that a difference of 10 dB or more between specific and background levels is indicative of a significant adverse impact. A difference of 5 dB suggests an adverse impact, with lower differences suggesting reduced impacts. The standard adds that the perception of impact will be increased or reduced depending on local context.

Local offsite receptors are currently subject to existing traffic noise levels on the surrounding road network. The proposed development will increase traffic volumes locally, with a consequent increase in traffic noise levels. The Design Manual For Roads And Bridges (UK Highway Agency, 2011) notes that the resulting noise impact is linked to the magnitude of the noise increase. Table 11.5 sets out the DMRB guidance. Included in the table are impact categories listed by the EPA in their 2017 document Draft Guidelines On The Information To Be Contained In Environmental Impact Assessment Reports.

Increase	Subjective reaction	DMRB impact	EPA impact
0 dB	None	No change	Neutral
0-3 dB	Imperceptible	Negligible	Imperceptible to not significant
3-5 dB	Perceptible	Minor	Not significant to slight
5-10 dB	Up to a doubling of loudness	Moderate	Slight to moderate
>10 dB	Doubling of loudness or greater	Major	Significant to profound

Table 11.5 DMRB assessment guidance

The WHO document Environmental Noise Guidelines For The European Region (2018) updates their guidance with respect to certain sources. Of relevance here are updated guidelines in relation to traffic. In this regard, the document states:

> 'For average noise exposure, the GDG (Guideline Development Group) strongly recommends reducing noise levels produced by road traffic below 53 decibels (dB) L_{den}, as road traffic noise above this level is associated with adverse health effects.
>
> For night noise exposure, the GDG strongly recommends reducing noise levels produced by road traffic during night time below 45 dB L_{night}, as night-time road traffic noise above this level is associated with adverse effects on sleep.'

It is noted that the 53 L_{den} and 45 dB L_{night} criteria recommended in the 2018 document are lower than criteria set out in other documents. In this regard, the 2018 guidelines are considered

aspirational rather than obligatory, and are likely to form the basis of national and local policy over the next two decades.

11.3.4 Inward Noise Guidance

The assessment of inward noise impacts on proposed residential developments is a relatively new feature in the Irish planning system, and no national guidance has been issued to date. In the absence of Irish guidance, assessments are typically undertaken in accordance with UK guidance.

Most UK assessments are now carried out using ProPg Planning & Noise: Professional Practice Guidance On Planning & Noise – New Residential Development (2017), jointly issued by the Association of Noise Consultants, the Institute of Acoustics and the Chartered Institute of Environmental Health. ProPG provides for good acoustic design through a five step process:

- Stage 1: Initial noise risk assessment of the proposed development site.
- Stage 2 element 1: Demonstrating a good acoustic design process.
- Stage 2 element 2: Observing internal noise level guidelines.
- Stage 2 element 3: Undertaking an external amenity area noise assessment.
- Stage 2 element 4: Consideration of other relevant issues.

Internal noise guidelines recommended by ProPG, drawn from British Standard BS 8233:2014 Guidance On Sound Insulation And Noise Reduction For Buildings (2014), are presented in Table 11.6.

Activity	**Location**	**0700-2300 h**	**2300-0700 h**
Resting	Living room	$L_{Aeq\ 16\ h}$ 35 dB	-
Dining	Dining area	$L_{Aeq\ 16\ h}$ 40 dB	-
Sleeping or daytime resting	Bedroom	$L_{Aeq\ 16\ h}$ 35 dB	L_{Aeq8h} 30 dB

Table 11.6 Recommended internal criteria from BS 8233:2014 and ProPG

BS 8233:2014 adds that:

> ‘Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values.’

ProPG adds further advice here:

> ‘In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events to not normally exceed 45 dB L_{AmaxF} more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events.’

With respect to external amenity areas such as gardens in the curtilage of dwellings, BS 8233:2014 states:

> ‘For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq\ T}$, with an upper guideline value of 55 dB $L_{Aeq\ T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where

> development might be desirable. In higher noise areas, such a city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces, but should not be prohibited.'

With respect to the proposed crèche, there are no specific crèche criteria in force. Reference may be made to Technical Guidance Document TGD-021-5: Acoustic Performance In New Primary & Post Primary School Buildings (Department of Education & Skills, 2015). The document recommends an indoor ambient $L_{Aeq\ 30\ min}$ level of 35 dB. This criterion is applied in this assessment. The document adds that where the external $L_{Aeq\ 30\ min}$ level does not exceed 51-55 dB (range dependent on ventilation type) at the façade, opening windows and vents may be suitable.

11.3.5 Noise Action Plan

The Third Noise Action Plan 2019-2023 (Kildare County Council, 2019) is based on noise mapping undertaken in 2017 ('round 3' mapping). Preparation of the Plan is a requirement of Directive 2002/49/EC Of The European Parliament And Of The Council Relating To The Assessment And Management Of Environmental Noise (2002), transposed into Irish law by the European Communities (Environmental Noise) Regulations 2018 (SI No. 549/2018).

The Directive requires preparation of Noise Action Plans for all roads with annual traffic volumes over 3 million vehicles. The nearest roads subject to mapping are the M7 motorway (1100 m southeast of the proposed development site), regional route R416 (200 m southwest of the site, and route R445 (770 m northwest of the site). Larger rail lines are also subject to mapping, including the Dublin-Cork line 1750 m northwest of the site.

The Noise Action Plan does not specify noise criteria to which future developments will be subject. Instead it refers to 'arbitrary threshold values' taken from Guidance Note For Noise Action Planning (EPA, 2009) as follows:

- 70 dB L_{den}.
- 57 dB L_{night}.

The Noise Action Plan also states:

> 'In the scenario where new residential properties or other noise sensitive premises are introduced into an existing climate of environmental noise, there is currently no clear national planning guidance on noise from the Department of Housing, Planning and Local Government (DHPLG). Kildare Local Authority may develop and publish its own set of guidance on noise assessment and control which would be applicable throughout the county. In the interim, Kildare Local Authority shall require shall require quantifiable noise assessments to be carried where any part of the residential developments is located with 150m of a rail corridor or adjacent to the 'Major Roads' within the county. The quantifiable assessment of environmental noise shall include, inter alia, the situation internally with open windows and externally in the amenity areas of development.'

The proposed development site does not lie within 150 m of any major roads. However, the future proposed NSOORR will run directly through the site, within 50 m of dwellings. Given that the NSORR is likely to achieve major road status following its opening, it is considered that a quantifiable noise assessment of future noise impacts is warranted.

The Noise Action Plan states:

> 'Whilst the control of external levels of environmental noise constitutes one aspect of noise management within planning and aims to provide benefit to amenity spaces, the control of noise levels within residential properties and other noise sensitive premises also plays an important role. In the scenario where new noise sensitive premises are introduced to locations already exposed to significant levels of long term environmental noise as set out in the Environmental Noise Regulations, i.e. 70 dB (A) L_{den} and 57 dB (A) L_{night}, it is considered appropriate to consider aiming to achieve target internal noise levels within noise sensitive rooms, such as living rooms and bedrooms.'

In this regard the Noise Action Plan adds that target internal noise levels can be drawn from guidance including WHO documents, British Standard BS 8233:2014 and ProPG. These documents are discussed above, and inform this assessment.

11.3.6 Kildare County Council Roads Transportation and Public Safety Department

In their Strategic Housing Development Stage 2 Report dated 07/10/20, prepared by the Council in response to the consultation process conducted by the Aston Ltd, the Roads Transport Department recommended the following:

> 2h The design of the Road Objective is to have full consideration to the 'Guidelines for the Treatment of Noise and Vibration in National Road Schemes' 2004 and the 'Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes' March 2014 in meeting a day-evening-night sound level of 60 dB L_{den} (free-field residential façade criterion) for the Road Objective having a speed limit of 50 km/h.
>
> 2i The design of the Road Objective shall ensure proposed residential development, creche and neighbourhood centre shall not be exposed to L_{den} noise levels in excess of 70 dB (A) anf L_{night} noise levels in excess of 57 dB (A) as the Road Objective incorporating a bridge crossing the River Liffey will qualify as a 'Major Road' pursuant to the European Communities Environmental Noise Regulations 2018, S.I. No. 549 / 2018 once fully operational. The detailed design is to incorporate noise amelioration / mitigation measures and the omission / relocation of development set back from the Road Objective in achieving this.
>
> 3. In conjunction with item 2 d and 2 e set out in the foregoing, the applicant is requested to submit an Acoustic Design Statement for the Road Objective having 3 million vehicle passages + per annum as it will qualify as a 'Major Road' pursuant to the European Communities Environmental Noise Regulations 2018, S.I. No. 549 / 2018 once the Road Objective is fully operational. This Acoustic Design Statement is to contain noise amelioration / mitigation measures (as required) and demonstrate the following:
>
> a. The predicted post mitigation L_{den} noise levels at 1.5 metres above ground level and 1.5 metres above all floor levels are below the 70 dB (A) L_{den} threshold of the Kildare County Council Third Noise Action Plan 2019-2023 so as not to negatively impacts on the useability of open space (both public and private) and the ability of future residents to have patio doors /windows open during the summer months. Predicted noise level contours are to be indicated on Site Layout Plan drawings at scales of 1:500.
>
> b. The predicted post mitigation L_{night} noise levels at 1.5 metres above all floor levels are below the 57 dB (A) L_{night} threshold of the Kildare County Council Third Noise Action Plan

2019-2023. Predicted noise levels contours are to be indicated on Site Layout Plan drawings at scales of 1:500.

c. The predicted internal noise levels of the proposed residential units to be in accordance with the recommended indoor ambient noise levels for a dwelling as prescribed under the British Standards BS 8233:2014. This is also to have an assessment with regard to opening windows at night (in summer months) and the impact on internal noise levels. This assessment shall also provide an estimate the approximate number of L_{AFmax} events from 11 pm to 7:00 am having regard to potential sleep disturbance.

d. The statement is to incorporate noise amelioration / mitigation measures and the omission / relocation of development set back from the Road Objective in achieving compliance with the L_{den} and L_{night} thresholds. Noise amelioration / mitigation measures and the omission /relocation of development set back from the Road Objective are to be indicated on Site Layout Plan drawings at scales of 1:500.

e. A concluding statement for the overall development indicating full compliance with the Kildare County Council Third Noise Action Plan 2019-2023 and the British Standards BS 8233:2014.

The Kildare County Council Noise Action Plan and BS 8233:2014 criteria have been discussed above. This assessment sets out the requested information, and constitutes an Acoustic Design Statement. It is important to note that the 60 dB L_{den} criterion requested under point 2h is not directly applicable, as this criterion applies solely to national roads, particularly roads running through open areas. The 60 dB L_{den} criterion is not considered achievable, practical or relevant to urban roads in built up areas. Moreover, the 60 dB L_{den} criterion is not consistent with the 70 dB criterion set out in the Noise Action Plan. This assessment therefore focusses on the 70 dB L_{den} and 57 dB L_{night} criteria specified by the Noise Action Plan.

11.3.7 Summary Of Criteria

Noise and vibration criteria relevant to the construction phase are summarised in Table 11.7.

Type	Parameter	Criterion	Period	Comment
Noise	$L_{Aeq\ 1\ h}$	65 dB	M-Sa working hours	Externally at offsite receptors
Vibration	PPV	<10 Hz: 8 mm/s 10-50 Hz: 12.5 mm/s >50 Hz: 20 mm/s	Working hours	Offsite buildings & structures

Table 13.7 Summary of construction phase noise and vibration criteria

Noise criteria relevant to the commissioned development are listed in Table 11.8. Several L_{den} criteria are recommended by various authorities. Vibration criteria are not relevant.

Type	Parameter	Criterion	Period	Comment
Traffic	$L_{Aeq\ T}$	Minimal increase over existing	All periods	Externally at offsite receptors
Inward	$L_{Aeq\ 16\ h}$	35 dB	0700-2300 h	Internally in proposed living rooms
Inward	$L_{Aeq\ 16\ h}$	40 dB	0700-2300 h	Internally in proposed dining areas
Inward	$L_{Aeq\ 16\ h}$	35 dB	0700-2300 h	Internally in proposed bedrooms
Inward	$L_{Aeq\ 8\ h}$	30 dB	2300-0700 h	Internally in proposed bedrooms
Inward	L_{AFmax}	45 dB	2300-0700 h	<10 events in bedrooms

Inward	$L_{Aeq\ 16\ h}$	50-55 dB	0700-2300 h	External amenity areas
Inward	$L_{Aeq\ 30\ min}$	35 dB	Daytime	Internal crèche rooms
Inward	$L_{Aeq\ 30\ min}$	51-55 dB	Daytime	External crèche facade
Inward	L_{den}	70 dB	24 h	Façade incident level
Inward	L_{night}	57 dB	2300-0700 h	Façade incident level

Table 11.8 Summary of Operational Phase Noise Criteria

11.4 Proposed Development

Chapter 3 presents a detailed description of the proposed development. It is proposed to carry out the following:

- Demolish two dwellings and three former agricultural buildings on the site.
- Construct 569 residential units, consisting of a mix of two-storey terraced and semi-detached dwellings, three-storey terraced dwellings, duplex units, and apartments in a mixture of two-storey, three-storey and four-storey blocks.
- Provide a 'neighbourhood centre' building with 11 commercial units, a childcare facility, and 13 apartments.
- Provide a series of interconnected parks, amenity areas and open spaces.
- Construct an onsite roadway 350 m in length, which will ultimately connect to the offsite segments of the NSOORR under construction or at planning.
- Ancillary works including ground works, landscaping, installation of water, sewage and electrical infrastructure including a foul water pumping station.
- Access to the proposed development site will be from the existing roundabout on Great Connell Road near the northeast corner of the site. The roundabout will be upgraded to a signalised junction. Construction will be carried out on a phased basis, and is expected to last approximately six years.

11.5 Receiving Environment

11.5.1 Location

The proposed development site consists of a 27.6 ha plot and is accessed from Great Connell Road which runs south from regional route R445. The site lies 830 m south of their junction. The eastern boundary of the site is formed by Great Connell Road.

The northeast corner adjoins Wellesley Manor residential estate. Most of the remainder of the boundaries adjoin land in agricultural use. A large residential development (Belin Woods) is under construction on a site to the southwest. The NSOORR will continue through this development. The River Liffey flows through the western end of the site. The site is shown in Figure 11.1.

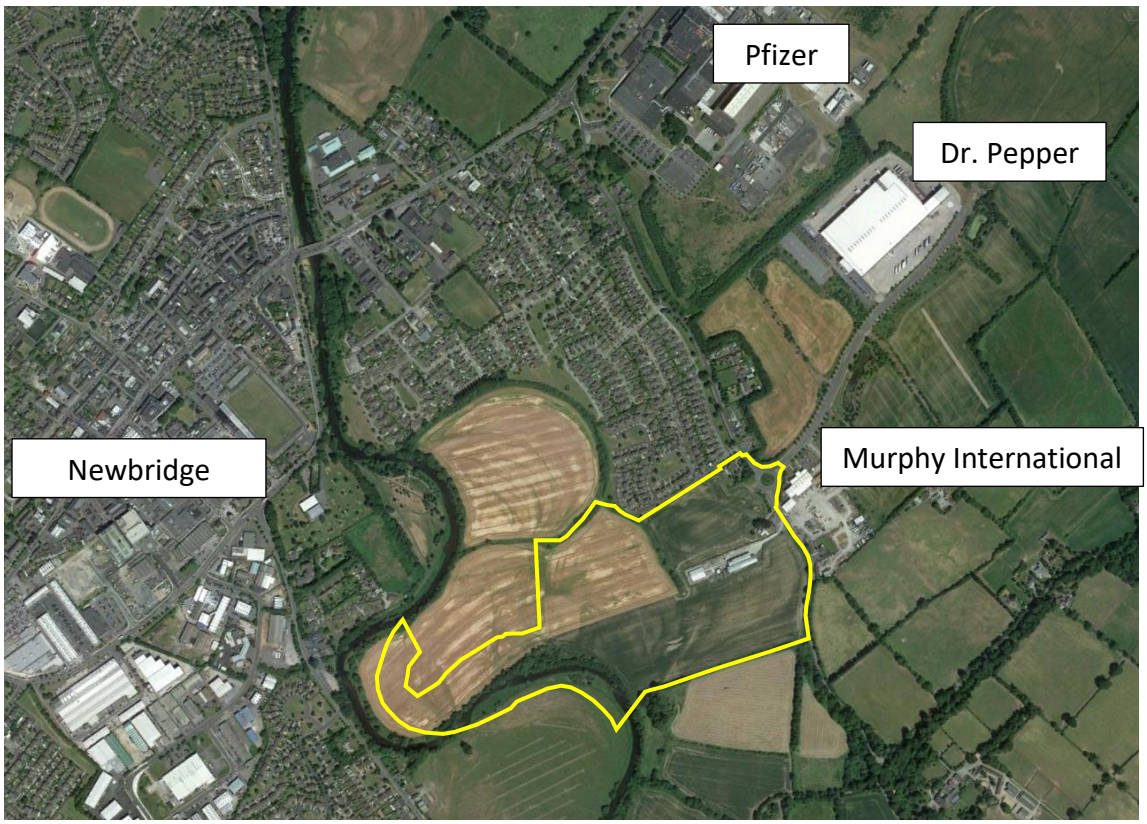


Figure 11.1 Site location, with site shown yellow

The topography is level across the site. The site is currently used for arable farming. A cluster of buildings is located on the eastern boundary, consisting of a detached dwelling and three former agricultural buildings. A second detached dwelling is located at the north-east corner.

The local landscape is semi-urban in character, although quickly becomes entirely urban to the north and west. To the south and east, the landscape is rural. A number of industrial facilities lie to the northeast, including the Pfizer and Dr. Pepper manufacturing installations.

The Murphy International facility lies to the immediate east of the site, on the opposite side of Great Connell Road. A large distribution facility is proposed on a site to the immediate east and northeast of the Murphy International facility. Thus the proposed development site adjoins the Newbridge urban area (north, northwest, west and southwest), Newbridge industrial area (northeast and east) and rural farmland (south and southeast).

The main roads in the area are regional route R445 770 m to the north at its closest, Great Connell Road which forms the eastern boundary, Athgarvan Road which runs to the west across the river, and the M7 motorway 1100 m to the south. The proposed NSOORR will run through the proposed development site when completed, connecting the R445 to Athgarvan Road, and onwards to Green Road.

11.5.2 Receptors

Two on-site dwellings will be demolished as part of the proposed development and are therefore not noise sensitive locations for the purposes of this assessment. The nearest off-site dwellings are located at Wellesley Manor, a residential estate adjoining the northeast boundary of the site. Approximately 33 dwellings lie within 100 m of the boundary. Wellesley Manor continues north, and joins other residential estates further north and northwest.

On the opposite side of Great Connell Road, a row of detached dwellings approaches the roundabout outside the north-east corner of the proposed development site. One of the dwellings lies opposite the north-east corner. Outside of these, the area to the east and north-east consists of a mixture of rural and industrial zones. Scattered dwellings to the east are relatively removed from the site, with the nearest being 280 m from the boundary. The area to the south and south-east is also quite rural, with scattered dwellings. The nearest of these is 440 m southeast of the site.

In contrast, the landscape to the northwest, west and southwest is urban, with a large number of residential estates and commercial areas located along the western side of the River Life. The nearest dwellings here lie on the opposite side of the river to the western extremity of the site. To the immediate southwest of the proposed development site, Ardstone residential development is under construction. Once completed, dwellings here will be approximately 40 m from the proposed development site boundary, and approximately 200 m from the proposed units. The intervening area will form an amenity zone.

For noise and vibration assessments residential dwellings are considered to be sensitive receptors. The nearest receptors to the proposed development site are divided into the following zones:

- Wellesley Manor outside the northeast corner, and detached dwellings on the other side of Great Connell Road.
- Residential estates along Athgarvan Road to the west, particularly a small estate close to the river.
- The Ardstone residential development under construction to the immediate southwest of the site.

All other receptors, including those to the east, southeast and south, are relatively removed from the site. Apart from a guesthouse on Athgarvan Road, all receptors identified above consist of residential dwellings. No other receptors such as crèches, schools, care centres or nursing homes have been identified in the immediate area. Commercial and industrial facilities (including their office spaces) to the east, northeast, west and northwest are not considered noise sensitive locations.

11.5.3 Noise Mapping

The Kildare County Council Noise Action Plan includes maps relating to the road network in the vicinity of Newbridge, including the M7, R445, and Athgarvan Road, as required by Directive 2002/49/EC Relating To The Assessment And Management Of Environmental Noise. Relevant traffic mapping is shown in Figures 11.2 and 11.3. Traffic volumes on Great Connell Road are lower than mapping thresholds.

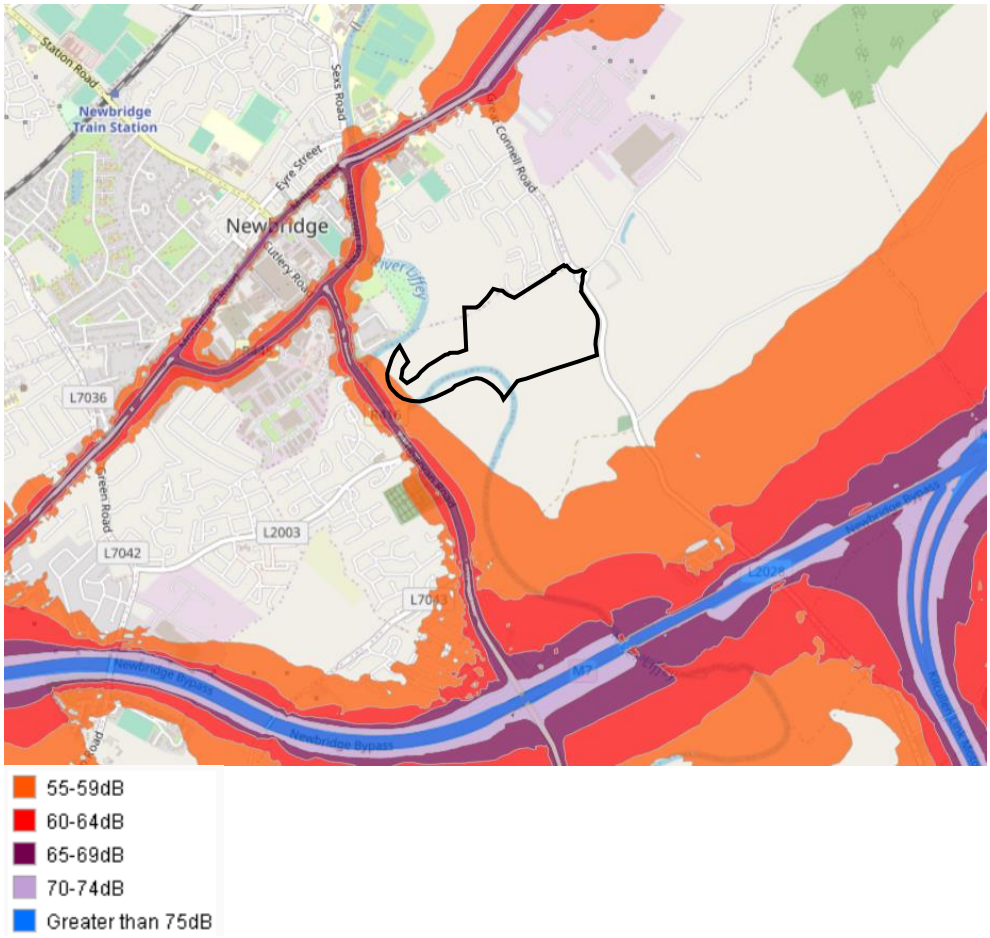


Figure 11.2 Road Traffic L_{den} Contours

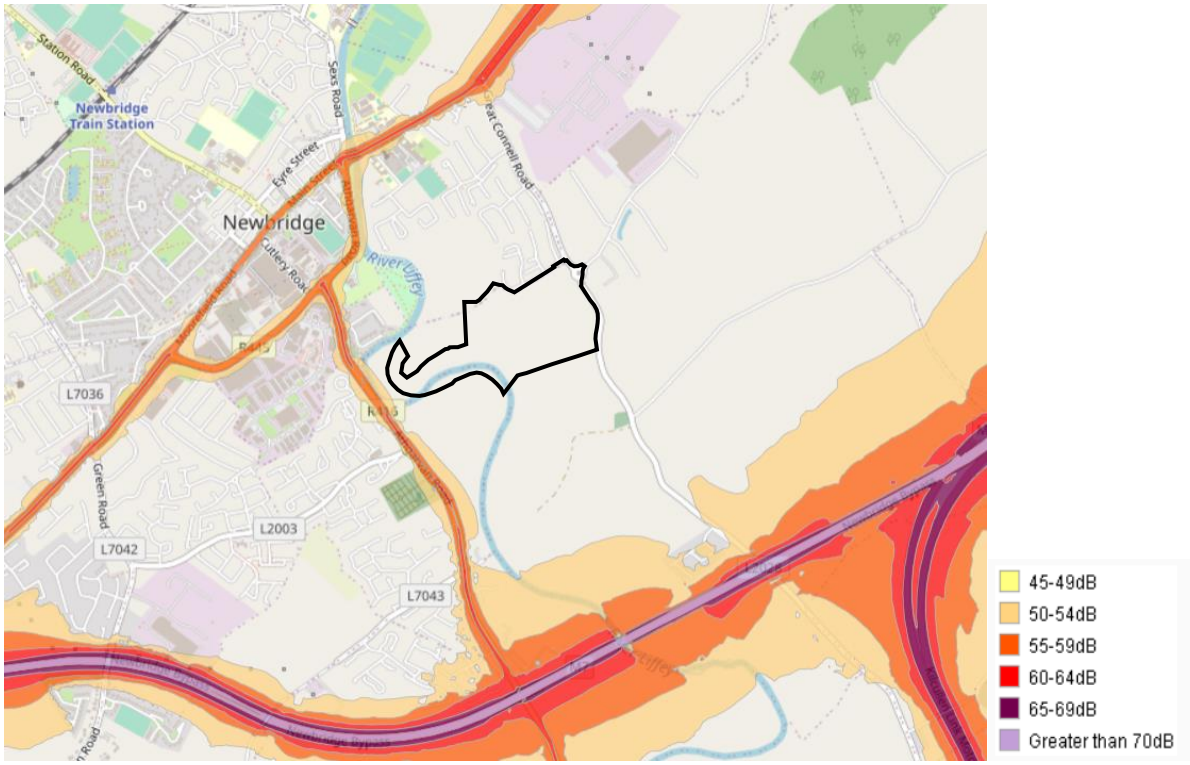


Figure 11.3 Road traffic L_{night} contours

The maps indicate that L_{den} and L_{night} contours do not extend to the proposed development site, being lower than 55 dB and 45 dB respectively. Levels across the site are thus considerably lower than the 70 dB L_{den} and 57 dB L_{night} action criteria set out in the Noise Action Plan. Mapping undertaken by Iarnrod Eireann with respect to the national rail network, shown in Figures 11.4 and 11.5, does not extend to the proposed development site.

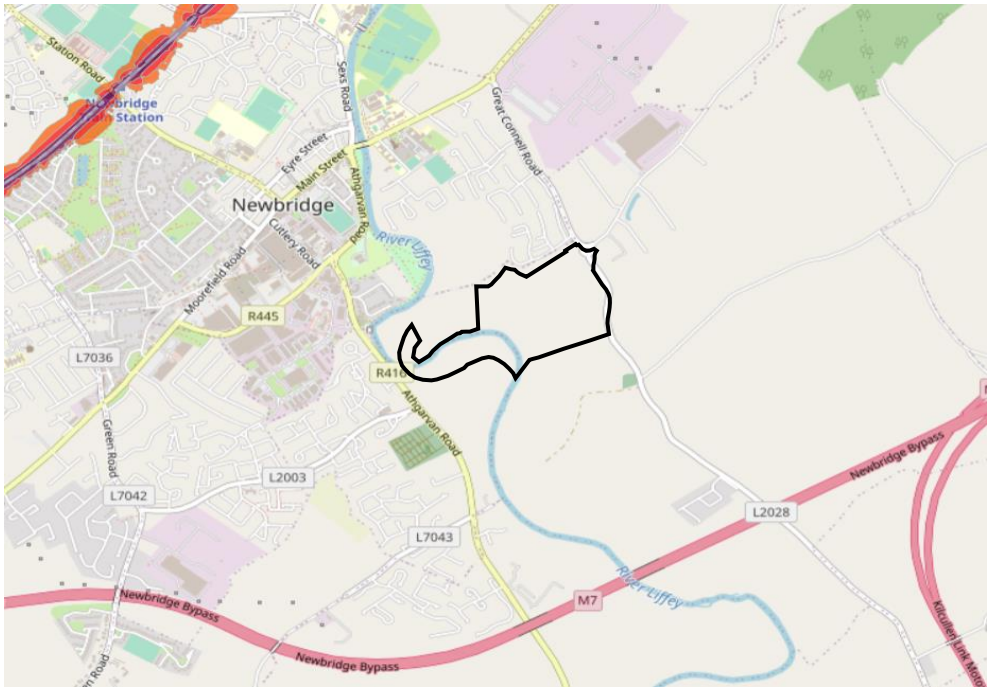


Figure 11.4 Rail traffic L_{den} Contours

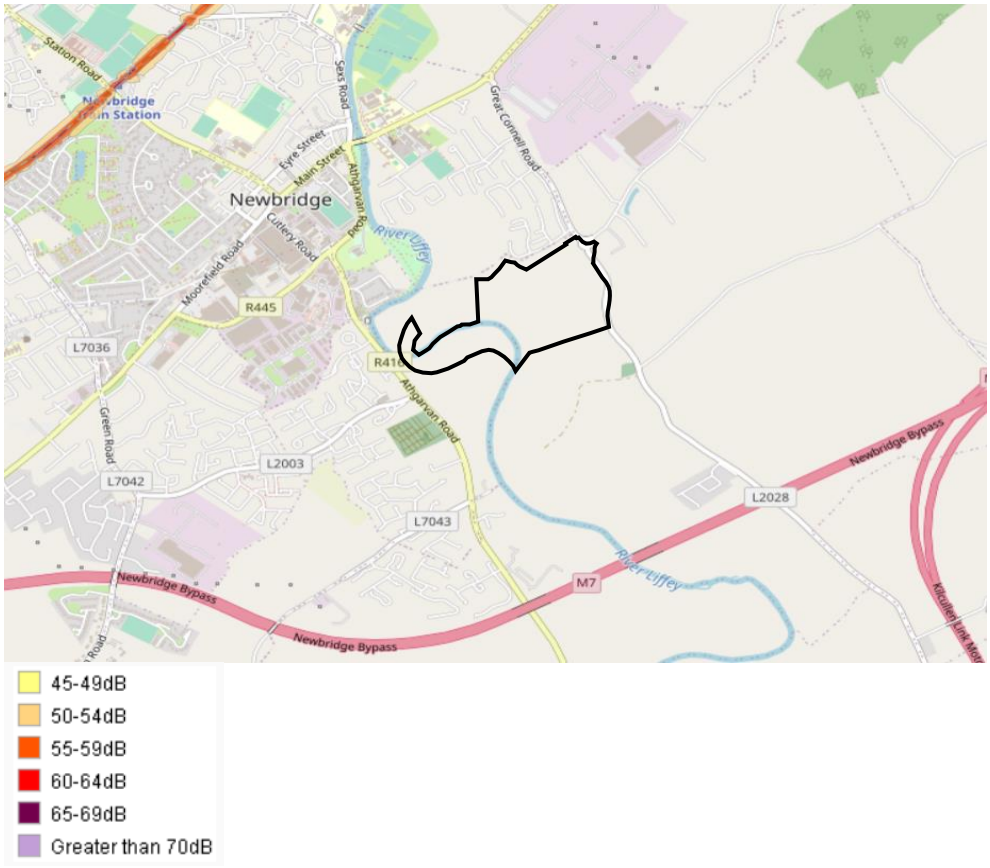


Figure 11.5 Rail traffic L_{night} Contours

11.5.4 Noise Survey

A baseline noise survey was carried out at the proposed development site over a 24 h period beginning Thursday 21/10/21. The objective was to provide up to date ambient noise data and to allow subsequent calibration of the noise model.

Monitoring was carried out at three onsite locations shown in Figure 11.6 and Photographs 11.1 to 11.3, and described in Table 11.9. Survey methodology, equipment specifications and weather conditions are listed in Appendix 10. Recorded time history profiles are shown in Figures 13.7 to 13.9. Noise data are presented in Table 11.10. 15 minute interval data were also extracted, and are summarised in Table 11.11.

Figure 11.6 Baseline noise locations

Station	NGR	Reason for selection
N1	681623 714844	To quantify noise levels near Great Connell Road roundabout
N2	681723 714545	To quantify noise levels from Great Connell Road (south)
N3	681487 714650	To quantify Great Connell Road traffic noise reduction across the site

Table 11.9 Noise stations

Photograph 11.1 Station N1 looking northwest

Photograph 11.2 Station N2 looking northeast

Photograph 11.3 Station N3 looking west

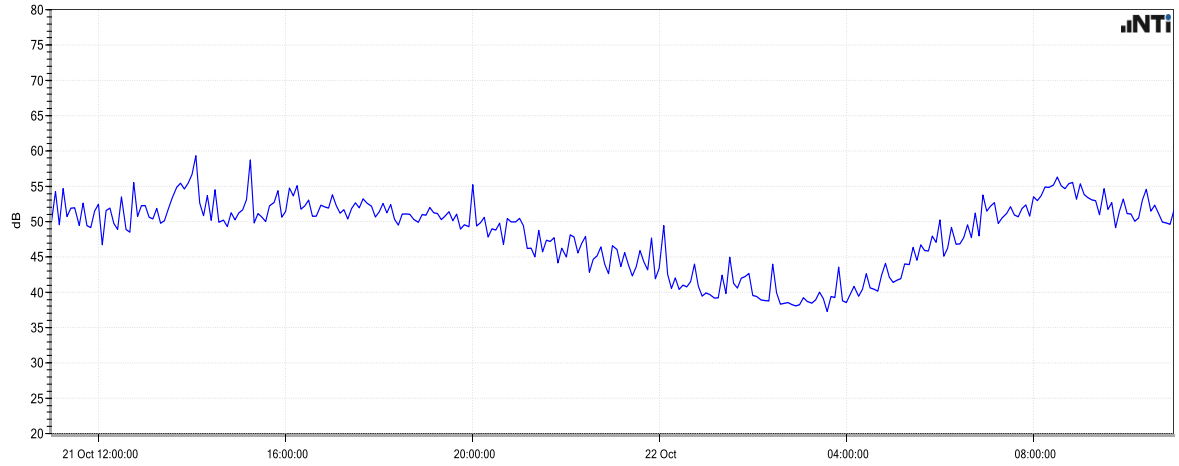


Figure 11.7 $L_{Aeq\,1\,s}$ Profile at N1

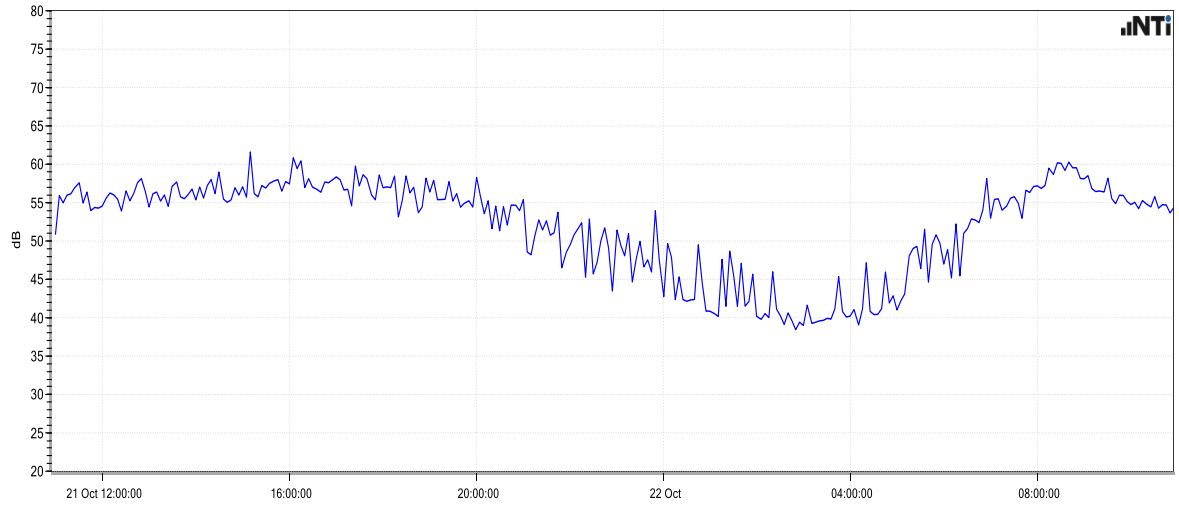


Figure 11.8 $L_{Aeq\,1\,s}$ Profile at N2

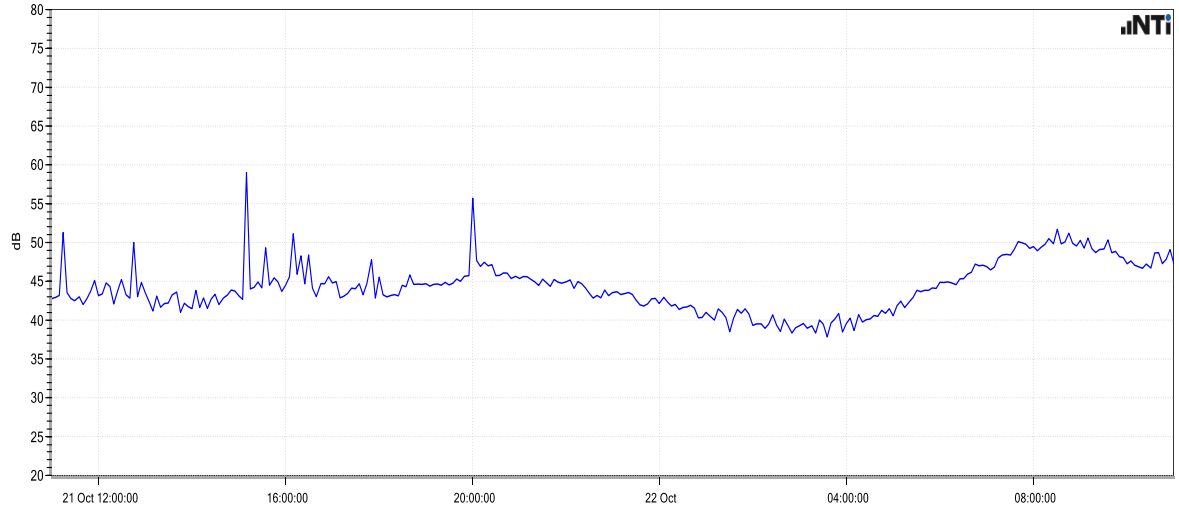


Figure 11.9 $L_{Aeq\,1\,s}$ Profile at N3

Period	N1		N2		N3	
	$L_{Aeq\ 1\ h}$	$L_{AF90\ 1\ h}$	$L_{Aeq\ 1\ h}$	$L_{AF90\ 1\ h}$	$L_{Aeq\ 1\ h}$	$L_{AF90\ 1\ h}$
1100-1200	52	45	56	47	45	41
1200-1300	52	45	56	48	45	42
1300-1400	54	45	56	48	42	40
1400-1500	53	45	57	49	43	41
1500-1600	53	45	58	49	50	42
1600-1700	53	46	58	49	47	42
1700-1800	52	45	57	46	45	42
1800-1900	51	44	57	45	44	43
1900-2000	51	44	56	45	48	44
2000-2100	50	45	54	45	46	45
2100-2200	47	43	51	44	45	44
2200-2300	46	41	50	42	44	42
2300-0000	45	40	49	42	43	41
0000-0100	43	39	45	40	42	39
0100-0200	42	38	45	39	41	38
0200-0300	40	37	41	37	39	37
0300-0400	40	37	41	37	39	37
0400-0500	41	38	43	39	41	38
0500-0600	46	41	48	42	43	41
0600-0700	49	44	53	45	46	44
0700-0800	52	47	56	48	49	47
0800-0900	55	49	59	50	50	49
0900-1000	53	47	56	48	49	47
1000-1100	52	46	55	46	48	46
07-23h $L_{Aeq\ 16\ h}$	52	-	56	-	47	-
23-07h $L_{Aeq\ 8\ h}$	44	-	47	-	42	-
L_{den}	54	-	57	-	50	-

Table 11.10 Noise Data (dB)

Period	Parameter	N1	N2	N3
07-19h	$L_{Aeq\ 15\ min}$ range	50-56	54-60	42-55
	$L_{Aeq\ 15\ min}$ average	52	57	46
	$L_{AF90\ 15\ min}$ range	43-51	44-53	40-49
	$L_{AF90\ 15\ min}$ average	46	48	44
19-23h	$L_{Aeq\ 15\ min}$ range	45-52	48-56	43-52
	$L_{Aeq\ 15\ min}$ average	48	53	45
	$L_{AF90\ 15\ min}$ range	41-45	42-46	42-46
	$L_{AF90\ 15\ min}$ average	43	44	44
23-07h	$L_{Aeq\ 15\ min}$ range	38-52	39-56	39-47
	$L_{Aeq\ 15\ min}$ average	43	45	42
	$L_{AF90\ 15\ min}$ range	36-46	37-47	36-46
	$L_{AF90\ 15\ min}$ average	39	40	40

Table 11.11 15 Minute Interval Data (dB)

The main noise source audible at all three stations was traffic on the surrounding road network, which was continuously audible at all times in the background throughout daytime, evening and

night-time periods. Distant M7 traffic maintained an $L_{AF90\ 15\ min}$ floor of 39-40 dB during the night-time. Stations N1 and N2 were additionally affected by traffic on Great Connell Road.

Other noise sources of significance were birdsong and aircraft. Sporadic noise emissions from the Murphy International facility were insufficient to affect baseline data. Construction activity at a residential project to the southwest across the river may have marginally affected N3 data during the daytime.

At N1, L_{AFmax} levels during the night-time due to passing road traffic typically reached 55-59 dB. One vehicle resulted in a once-off L_{AFmax} level of 72 dB. At N2, night-time L_{AFmax} events were higher due to greater traffic speeds away from the roundabout, and here L_{AFmax} levels were 60-70 dB. Night-time L_{AFmax} levels at N3 did not exceed 55 dB, with events caused solely by birdsong in the early morning. The data suggest that L_{AFmax} events above 60 dB occur only at the southeast corner of the site.

As previously indicated by mapping, measured L_{den} and L_{night} levels are lower than the respective 70 dB and 57 dB thresholds set out in the Noise Action Plan. Measured and mapped data are consistent.

11.5.5 Noise Risk Assessment

The ProPG document includes guidance on undertaking a risk assessment with respect to inward noise affecting a proposed development site. The ProPG risk assessment is based on Figure 13.10. Data presented in Table 13.9 suggest that the entire site is low risk. In this regard, ProPG states that:

> '…the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an acoustic design statement which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.'

ProPG notes that the risk category of a particular site will be influenced by the number of L_{AFmax} events which exceed 60 dB externally during night-time hours. Where the number of such events exceeds 10, mitigation may be required even where L_{night} levels are below relevant criteria, and ProPG notes that:

> 'An indication that there may be more than 10 noise events at night (2300-0700) with $L_{Amax,F}$ > 60 dB means the site should not be regarded as negligible risk.'

Measured data suggest that L_{AFmax} levels due to passing traffic on Great Connell Road do not exceed the 10x60 dB criterion across most of the site. At the south-east corner, levels approach 70 dB, and more than 10 such events occur during night-time hours. Modelling suggests that the >60 dB zone extends approximately 70-80 m into the site.

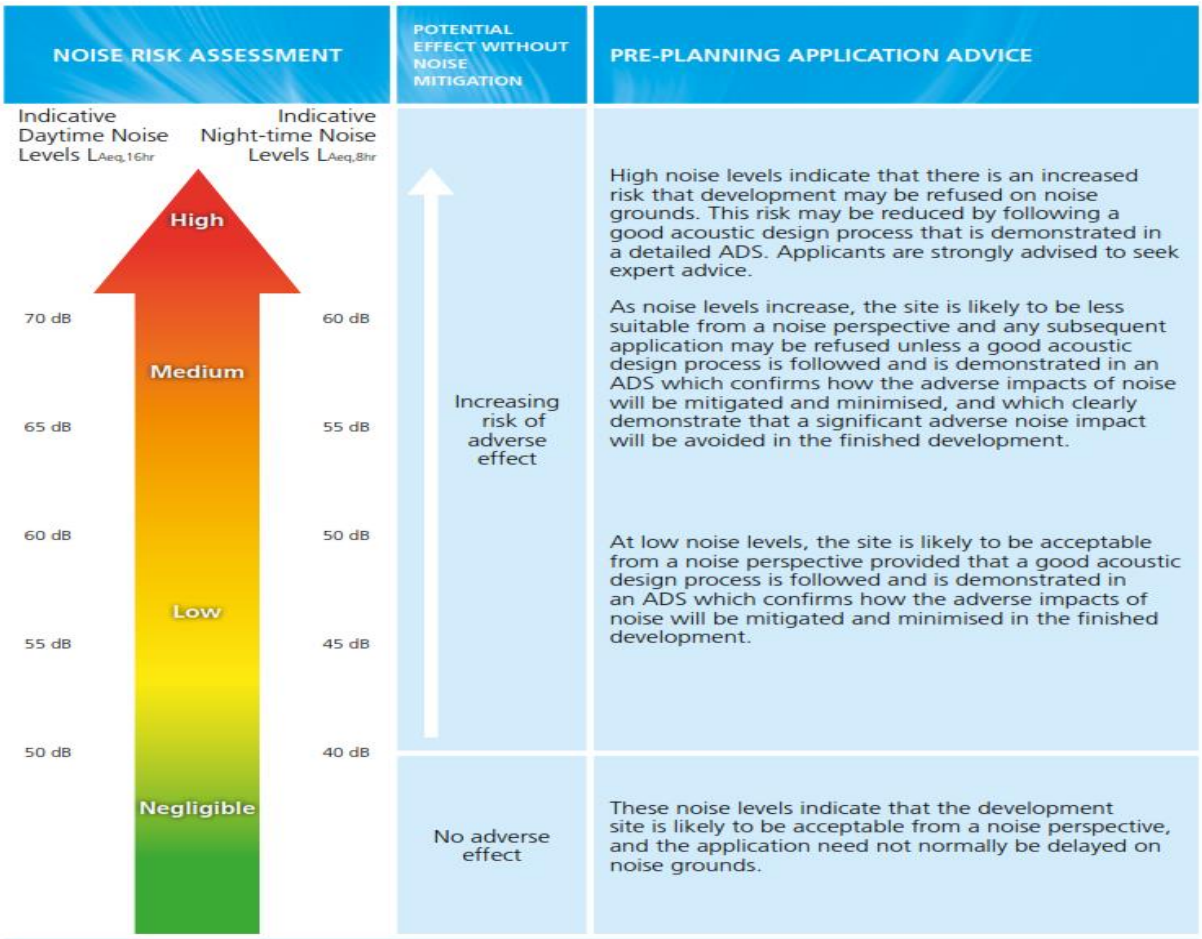


Figure 11.10 ProPG Noise Risk categories

11.6 Impacts Construction Stage

11.6.1 Noise Sources

Construction will be undertaken on a phased basis, beginning within six months of grant of planning permission, and will be managed from a temporary on-site compound. The overall construction project is expected to last approximately six years. Construction hours will be 0800-1800 h Monday-Saturday.

Construction works will include the following activities, undertaken variously throughout the construction phase and in different areas of the site:

- Soil stripping & temporary stockpiling.
- Installation of temporary site compound.
- Provision of hardcore stone on onsite roadways.
- Demolition of two dwellings and three former agricultural sheds.
- Excavation of foundations.
- Excavation of ground services trenches.
- Installation of services including sewerage network.
- Steel frame erection in larger buildings.
- Pouring & floating of concrete floor slabs.
- Block work and roof work.
- Building finishing (windows, doors, etc.).

- Internal fit out in buildings.
- Laying of asphalt.
- Site landscaping.

During the construction phase the chief source of noise emissions will be the plant used on-site at various stages. These are listed in Table 11.12, which includes details of typical sound pressure levels, taken from BS 5228-1:2009.

Plant	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Total L_{Aeq}
Asphalt paving machine & tipper truck	78	77	72	72	71	69	62	56	75
Discharging concrete mixer truck	80	69	66	70	71	69	64	58	75
Tracked excavator (22 t)	80	83	76	73	72	70	69	66	78
Wheeled backhoe loader (9 t)	68	67	63	62	62	61	54	47	67
Consaw	73	67	70	68	73	78	78	77	84
Lifting platform	78	76	62	63	60	59	58	49	67
Mobile generator	78	71	66	62	59	55	56	49	65
Mobile crane (35 t)	80	76	71	63	64	63	56	50	70
Dumper	84	81	74	73	72	68	61	53	76
Dump truck	88	90	80	79	76	71	65	61	81
Dozer	83	81	76	77	82	70	65	58	83
Telescopic handler	85	79	69	67	64	62	56	47	71
Truck (driving)	73	78	78	78	74	73	68	66	80

Table 11.12 Expected Construction Plant Required Across Site (dB at 10 m)

The noise emissions during the construction stage will vary considerably due to following factors:

- The site is relatively large. Emissions will arise from plant operating across the site, and thus the site will not constitute a single point source.

- The large construction area will result in differing noise propagation conditions with respect to receptors at different locations.

- The construction phase will last several years. During this time plant associated with different activities will relocate around the site as required.

- Different plant will be required at different times, and construction operations will vary on a daily basis. There may be extended periods during the construction phase with minimal noise emissions.

- Each item of plant may operate under different loading conditions or be in varying states of repair.

- Construction works may be concentrated for certain periods, followed by periods of inactivity. Localised works may require several hours of intense activity.

- During later stages of the construction phase, emissions from some activities will be screened by the constructed buildings.

- A number of different construction firms may contracted, each using different plant.

- With respect to particular plant, the models selected may change depending on requirements. The method of construction may be modified shortly before commencement, resulting in the need to import different equipment. Construction projects tend to be fluid in nature, with plant requirements changing as the site is progressed and circumstances change on the ground. The need for specific plant may often be established only following the start of a project.

From the foregoing, it is clear that construction phase noise emissions will vary, and it is neither possible nor practical to calculate a single sound power output figure for the entire site. With respect to surrounding noise sensitive receptors, worst case scenario emissions will arise when localised works are undertaken close to their respective boundaries.

11.6.2 Construction Noise Modelling

Construction noise emissions will vary in time and location, and it is not possible to determine a single overall noise output figure for the construction phase. Therefore the most suitable approach is to assess worst case scenario emissions. In extreme worst case scenario consists of construction activity simultaneously occurring at the nearest points to off-site receptors, involving plant with the greatest noise output. In this scenario, operations may occur simultaneously in five zones:

- Zone 1: Construction works at the north-east corner of the site, adjacent to Wellesley Manor, and near a detached dwelling on the opposite side of the road.
- Zone 2: Works along the northern boundary, close to the southwest corner of Wellesley Manor.
- Zone 3: Works near the western end of the site, at the closest point to receptors along Athgarvan Road.
- Zone 4: Works near the southern end of the site, in proximity to dwellings at Belin Woods, which may possibly be completed and occupied when zone 4 works are undertaken.
- Zone 5: Roadway works at the eastern end of the site.

For the purposes of modelling, it is assumed that operations in Zone 1 and 2 will involve a tracked excavator, discharging mixer truck, consaw, dumper and telescopic handler in simultaneous use at the nearest point of the works zone, and all positioned within a 100 m wide operations area. Such a scenario is unlikely to arise, but is applied here to represent an extreme worst case scenario. It is assumed that works in Zones 3 and 4 will involve use of a tracked excavator and dumper. Zone 5 works will involve a dozer and excavator, and several 6x6 dump trucks tracking back and forth along the roadway corridor.

Noise emissions from the above were modelled using DGMR iNoise v2022 software. Input parameters were as follows:

- Model algorithm: International Standard ISO 9613-2:1996 Acoustics: Attenuation Of Sound During Propagation Outdoors – Part 2 General Method Of Calculation (1996).
- Bare and compacted ground assumed in works areas (G = 0.7).
- No screening.
- Receiver height: 4 m.
- Plant output data taken from Tables 13.12 and 13.13.

- 31.5 Hz levels (not provided in BS 5228) assumed to be same as 63 Hz levels.
- Plant on-times per hour: excavator (80 %), mixer truck (50 %), consaw (10 %).
- Dozer, dumper and handler movements continuous.

The model output is shown in Figure 11.11. $L_{Aeq\ 1\ h}$ levels predicted at the nearest dwellings at Wellesley Manor will reach 63 dB at their highest. Levels at other receptors in this area, including the dwelling across the road, will be lower. $L_{Aeq\ 1\ h}$ levels at dwellings along Athgarvan Road will be lower than 50 dB.

Where operations are carried out at the southwest boundary, in proximity to occupied dwellings at Belin Woods, $L_{Aeq\ 1\ h}$ levels will reach 62 dB at their highest. In all cases, $L_{Aeq\ 1\ h}$ levels will be lower than the 65 dB criterion discussed in Section 11.2.3.

In all cases the, $L_{Aeq\ 1\ h}$ levels will be lower than the 65 dB criterion discussed in Section 11.2.3 above, and considerably lower than the NRA recommendation relating to road construction noise.

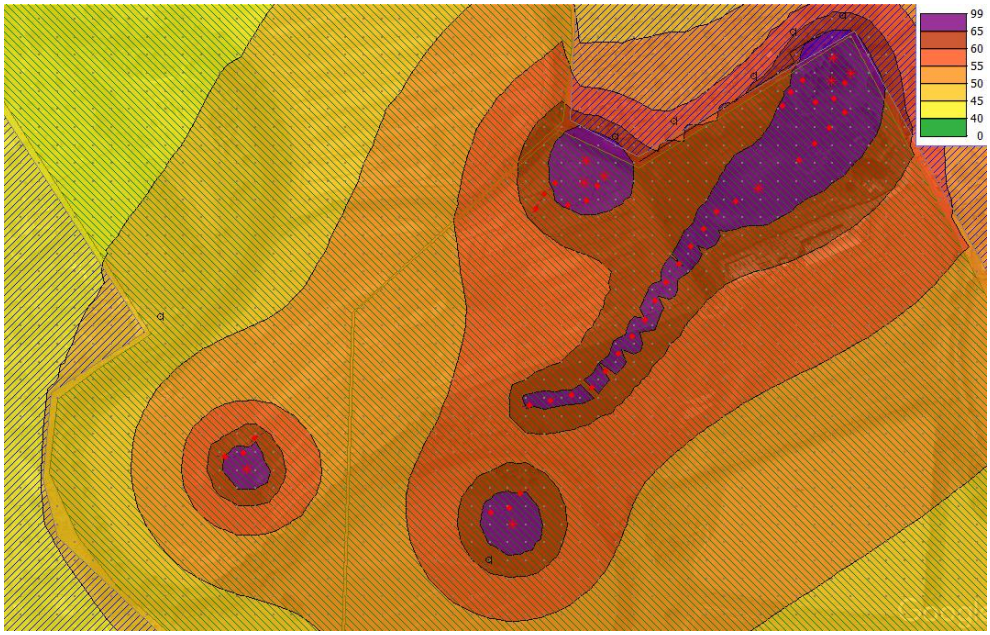


Figure 11.11 Predicted construction phase $L_{Aeq\ 1\ h}$ levels in extreme worst case scenario

11.6.3 Construction Noise Impacts

Construction phase noise levels at all receptors will be lower than the 65 dB criterion recommended by BS 5228-1:2009. Cumulative levels associated with simultaneous building construction and NSOORR construction will also be lower than the 65 dB criterion, and considerably lower than the 70 dB NRA road construction criterion.

The site is relatively large, and works throughout most of the construction phase will benefit from large separation distances to offsite receptors. Where works occur in proximity to receptors, received levels will remain below the 65 dB criterion at all times.

BS 5228:2009 source noise data suggest that construction phase emissions will not be tonal. Apart from hammering, emissions are also unlikely to be impulsive. Hammering will be sporadic, typically occurring during roofing, and scaffolding erection and dismantling. Associated noise emissions will be brief and localized.

It must be emphasise that the above predictions are based on an extreme worst case scenario, involving simultaneous construction activities at two zones, groundworks at two additional zones, and roadway construction works. These activities are highly unlikely to be undertaken at the same time due to project phasing and working logistics. Typically, most operations at a particular location onsite require just 1-2 machines.

Therefore throughout the entire construction phase, $L_{Aeq\ 1\ h}$ levels at receptors are expected to be considerably lower than the 65 dB criterion. On this basis, construction phase noise impacts will be temporary, and not significant to slight adverse.

11.6.4 Construction Traffic Noise

Throughout the construction stage, vehicles will arrive at, and depart from, the site during the working day. Vehicle movements will be associated with workers' arrival and departure and the delivery of materials. The approximate numbers of workers employed onsite over the entire construction period will fluctuate depending on schedules. Numbers are unlikely to exceed 50 at any time, due to project phasing.

Personnel and deliveries will access the proposed development site via the surrounding road network, with the majority of vehicles expected to access the site via the R445 and Great Connell Road. On all roads, construction traffic volumes will be inconsequential in the context of existing traffic volumes. Thus construction phase traffic noise impacts are not expected to be significant.

11.6.5 Construction Vibration Impacts

Potential sources of groundborne vibration during the construction phase are as follows:

- Delivery Truck Movements: Trucks may give rise to vibration at positions adjacent to the road. However, such emissions are typically imperceptible beyond 10 m, and are highly unlikely to be perceptible at dwellings alongside site access routes.

- Plant Movements: The on-site movement of plant is not considered to constitute a source of groundborne vibration, and is not listed in typical vibration documents such as BS 5228-2:2009. In addition, plant machinery used on-site is likely to be small to mid-sized, and similar to those used in other urban construction projects.

- Ground Works: Excavation of trenches and pits for foundation and services will be required. These activities are not typically associated with offsite groundborne vibration impacts. Piling and rock breaking will not be required.

- Vibro-rolling: While the vibro-roller will generate high levels of vibration at the point of operation, experience at other sites indicates that such vibration is typically immeasurable beyond 50 m.

On the basis of the foregoing, PPV levels at all receptors are expected to be considerably lower than criteria listed in Tables 11.1, 11.2 and 11.3, and indeed are expected to be below measurement threshold. It follows that construction operations are unlikely to be perceptible offsite, or to cause cosmetic or structural damage to buildings.

11.7 Impacts Operational Stage

11.7.1 Operational Noise Sources

Noise sources in the operational stage will vary. Across most of the site, noise emissions will be typical of residential estates, such as playing children, lawnmowers and car movements. Emissions will also arise from vans associated with deliveries and waste collection trucks. All such emissions are highly unlikely to be significant either on or off-site. On-site traffic speeds will be low, thus minimising tyre rolling noise.

At the proposed commercial/retail units, external noise emissions may arise from air handling units such as fans, vents and air conditioning cassettes installed on external walls. Emissions from these are highly unlikely to be audible beyond 20 m, and therefore will not be significant. Noise emissions from vehicle movements associated with these units, including delivery and visitor traffic, will be minimal in the context of surrounding road traffic noise.

On the basis of the foregoing, it is highly unlikely that noise emissions from on-site operational noise sources will be audible beyond the site boundary. It follows that these sources will not be audible at receptors in the surrounding area.

The proposed site layout incorporates open spaces that will be grassed and planted with trees. It is likely that a maintenance contract will be awarded to one or more local landscaping companies. Maintenance activities site will chiefly include regular mowing of open green areas. While mower emissions are likely to be audible at the nearest receptors, such emissions will blend into the urban soundscape, particularly during the summer when the daytime/evening noise environment in any urban area tends to include at least one mower audible in the distance at any time.

Pumps at the proposed foul water pumping station will be submerged, and will not be audible above ground level.

11.7.2 Post-Completion Traffic

Noise impacts at offsite receptors attributable to car movements on roadways within the completed site are expected to be negligible due to a combination of low traffic speeds, increasing prevalence of electric vehicles, relatively low numbers of movements, screening by buildings, and separation distance.

Traffic noise levels at receptors across the surrounding area are likely to increase following completion of the project, due to increased traffic on the surrounding road network. The traffic impact assessment report indicates that the total number of vehicle movements through Great Connell roundabout in the design year 2039 will be 20,500 per day (AADT) if the proposed residential development is constructed.

This is considerably higher than the 12,500 AADT figure relating to the 2039 do-nothing scenario (development not constructed). This represents an increase of 64 %, resulting in a 1.8 dB rise in traffic noise levels. A 3 dB increase is generally considered to be the smallest change perceptible by the human ear. From Table 11.5 above, an increase of less than 2 dB will be negligible, and the resulting impact will be imperceptible to not significant.

11.7.3 Inward Noise

Inward impacts relate to noise emissions received at a receptor due to emissions emitted by one or more sources. Emerging best practice provides for the design of new developments such that occupants of residential elements are not subject to high internal noise due to existing (and potential future) external noise sources. Such sources usually consist of transport (road, rail and aircraft), and industry. Internal and external criteria considered appropriate to new residential developments are set out in Table 11.8 above.

This section focuses on inward impacts at onsite residential units. Impacts at the proposed crèche are also assessed. Inward impacts at the proposed retail units are not considered to be relevant. Inward noise will arise from the following sources:

- Onsite vehicle movements associated with residents, and employees/visitors to the retail units and crèche. Noise levels from these will be relatively low at onsite receptors due to low traffic speeds. Inward noise impacts are typically associated with rolling noise at higher speeds, and such emissions are unlikely to arise onsite.

- Noise from delivery vehicles across the site and from waste management vehicles. These levels will be similarly low due to low speed.

- Noise from offsite roads, chiefly Great Connell Road, the R445 to the north, Athgarvan Road to the west, and the M7 motorway to the south.

- The proposed NSOORR segment through the site centre, from Great Connell Road roundabout to Athgarvan Road. Completion of this NSOORR segment is likely to increase traffic flows on offsite segments to the northeast and southwest. Although the NSOORR and bridge will be subject to a separate planning application and EIAR, it is prudent to include NSOORR traffic here to provide for future changes in noise levels.

All of the sources of inward noise are road traffic. Rail noise is not audible at the site and aircraft noise is not a major contributor. While a number of industrial and commercial sites are situated to the east and north-east, including the Murphy International premises directly across Great Connell Road, dBA site inspections indicate that noise emissions from these do not contribute to the soundscape at the proposed development site.

Noise levels measured at the site indicate that L_{den} levels close to Great Connell Road are 54-57 dB, being highest near the south-east corner where the roundabout does not reduce traffic speeds. The L_{night} levels reach 44-47 dB. Levels falls with increasing distance from Great Connell Road, with L_{den} and L_{night} levels near the site centre falling to 47 and 42 dB respectively. The levels do not fall below this floor due to distant M7 traffic.

The L_{den} and L_{night} levels across the site are currently lower than Noise Action Plan thresholds. The ProPG risk assessment concludes that the proposed development site is currently low risk. It is also concluded that night-time L_{AFmax} levels require consideration at the south-east corner of the site, within approximately 70-80 m of Great Connell Road.

11.7.4 Inward Noise Modelling

To quantify noise levels across the site, predictive modelling was undertaken using DGMR iNoise v2022 software. The existing baseline scenario was initially modelled, and calibrated using noise levels measured onsite. The following input parameters were applied:

- Model algorithm: International Standard ISO 9613-2:1996 Acoustics: Attenuation Of Sound During Propagation Outdoors – Part 2 General Method Of Calculation (1996).
- Contours taken from mapping.
- Modelled heights: 4 m.
- Road traffic volumes taken from traffic count data provided by the design team. Evening (1900-2300 h) and night-time (2300-0700 h) AADT contributions of 10 % each were assumed, with a HGV proportion of 3 %.
- M7 traffic taken from TII counter data.
- Light vehicle and HGV noise emissions taken from CNOSSUS-EU database.
- Traffic speeds 50-120 km/h, depending on road.

The model output is shown in Figures 11.12 and 11.13. Table 11.13 presents a comparison between modelled and measured L_{den} and L_{night} levels. Modelled levels at baseline stations N1 and N2 are within 2 dB of measured levels, and the model is considered valid for the purposes of this assessment.

At N3, the larger discrepancy (4 dB) is most likely a result of possible daytime intrusion from construction works at a site to the southwest, and traffic noise across the town of Newbridge which cannot be modelled predictably.

Modelled L_{den} and L_{night} levels at N3 are likely to be within 1-2 dB of noise levels directly attributable to traffic on larger roads, and thus the model is likely to be reasonably valid at N3 for the purposes of modelling local traffic noise.

Parameter		N1 (4 m)	N2 (4 m)	N3 (2 m)
L_{den}	Measured	54	57	50
	Modelled	54	57	46
L_{night}	Measured	44	47	42
	Modelled	45	49	38

Table 11.14 Modelled and Measured Baseline L_{den} and L_{night} levels

To provide for future increases in noise levels, the model was modified to include traffic volumes predicted by Punch Consulting Engineers with respect to the design year 2039. The following elements were added to the revised model:

- Offsite road traffic, based on traffic team and TII projections.
- The completed development, as proposed.
- The proposed NSOORR through the site, including the proposed bridge.

Figure 11.12 Baseline L_{den} levels at 4 m

Figure 11.13 Baseline L_{night} levels at 4 m

The model was run at heights of 1.5 m, 4.4 m, 7.4 m and 10.3 m to assess noise levels 1.5 m above floor heights of the proposed development, as requested by KCC. The model was also run at heights of 5.1 m, 7.9 m and 11.0 m, relating to apartments in the neighbourhood centre building. The model output is in Appendix 10 and levels with respect to units overlooking roads are summarised in Table 11.15.

Receptors	L_{den}	$L_{Aeq\ 16\ h}$	L_{night}
Units facing N side of NSOORR	58-61	56-59	49-53
Units facing S side of NSOORR	60-63	58-61	52-54
Neighbourhood centre	59-62	57-59	50-53
Units facing Great Connell Road	61-63	59-61	53-55

Table 11.15 Predicted incident noise levels at most exposed units

Received noise levels are generally consistent at each façade, regardless of height, with upper floor levels being within 1 dB of ground floor levels in all cases. The variation shown in the range of values is chiefly horizontal, being dependent on the proximity of units to roadways. As an example, levels at facades facing the NSOORR are higher near the roundabout than at the western end of the development.

Incident L_{den} levels are considerably lower than the 70 dB criterion set out in the local authority Noise Action Plan. L_{night} levels are also lower than the 57 dB criterion.

ProPG notes that the risk category will be influenced by the number of L_{AFmax} events which exceed 60 dB externally during night-time hours. Measured data suggest that L_{AFmax} levels due to passing traffic exceed 60 dB approximately 70-80 m into the site from Great Connell Road, and the number of such movements considerably exceeds 10 during night-time hours.

It follows that bedrooms on façades which face the road are likely to receive more than 10 L_{AFmax} events above 60 dB during night-time hours. Bedrooms of facades which are less than 90 degrees to the road, and within 80 m, are likely to be similarly exposed. Such L_{AFmax} events require consideration in the design of glazing requirements.

Bedrooms on facades facing the proposed NSOORR are also likely to receive elevated L_{AFmax} levels due to traffic, and the number of such events will exceed 10 per night. However, the width of the affected corridor along the NSOORR is likely to be considerably lower than the Great Connell Road corridor, due to lower NSOORR traffic speeds. The width of the NSOORR corridor is likely to be less than 50 m, and it follows that only facades directly overlooking the NSOORR will be affected. Again, L_{AFmax} events here require consideration in glazing specifications.

Bedrooms on other facades across the wider development are likely to be satisfactory in this context, with any L_{AFmax} events likely to be entirely due to local onsite traffic movements.

11.6.5 ProPG Assessment

Stage 1: Risk assessment

The model indicates that future noise levels, based on increased traffic and the introduction of the NSOORR, will result in incident $L_{Aeq\ 16\ h}$ levels that reach 61 dB at their highest at units facing roads. Levels across the majority of the site will be considerably lower. L_{night} levels will be highest at units facing Great Connell Road and the NSOORR, reaching 55 dB. Again, L_{night} levels across the majority of the site will be considerably lower. Most of the development area will continue to be 'low risk' into

the future, with risk increasing to 'low-medium' at units fronting Great Connell Road and the NSOORR.

At units within approximately 80 m of Great Connell Road, bedrooms on facades facing the road, or turned within 90 degrees, are likely to receive external L_{AFmax} levels over 60 dB, and the number of such events is likely to exceed 10 per night. This scenario will also apply to bedrooms on facades directly overlooking the NSOORR.

Stage 2: Element 1 – Good Acoustic Design Process

In designing the overall site layout, the following principles of good acoustic design have been applied:

- The majority of the proposed residential units are located deep within the residential area, away from Great Connell Road and the proposed NSOORR. A small proportion of facades will face the road network.
- Traffic speeds on the NSOORR are likely to be restricted, minimising traffic noise levels including L_{AFmax} levels.
- The proposed residential area incorporates several green spaces for the benefit of residents.
- Cell layouts have been arranged so that rear gardens are screened from roads by intervening buildings.
- Apartment blocks have been designed to minimise the number of balconies overlooking Great Connell Road or the NSOORR.
- Similarly, duplex unit layout has been arranged so than no amenity spaces overlook roads .
- Open play areas at the proposed crèche are entirely screened from traffic noise.

Stage 2: Element 2 – Internal Noise Level Guidelines

Internal noise criteria are discussed in Section 11.2.6. Assuming a 15 dB reduction through an open window (the conventionally accepted value, identified in NANR116: Open/Closed Window Research – Sound Insulation Through Ventilated Domestic Windows, prepared by the Napier University Building Performance Centre for DEFRA, 2007), the following conclusions are drawn.

The recommended internal daytime $L_{Aeq\,16\,h}$ criteria are 35-40 dB. These criteria will be met with open windows where incident levels do not exceed 50-55 dB. The criteria will be met across most of the residential area with windows open. At dwellings and apartments fronting Great Connell Road and the NSOORR, standard thermal glazing with a minimum R_W value of 30 dB will achieve compliance with windows closed.

The recommended L_{night} criterion in bedrooms is 30 dB. As before, this criterion will be met across most of the site with windows open. Installation of standard thermal glazing will allow internal night-time criteria to be achieved at bedrooms facing Great Connell Road and the NSOORR.

Facades within 80 m of Great Connell Road, and facades overlooking the NSOORR, will be exposed to more than 10 L_{AFmax} events at night which exceed 60 dB. The WHO recommends that L_{AFmax} levels in bedrooms should not exceed 45 dB to prevent sleep disturbance. Where the number of events exceeds 10 per night, the objective is to ensure than internal L_{AFmax} levels with windows closed remain below 45 dB. Standard thermal glazing will reduce internal L_{AFmax} levels below 45 dB in all bedrooms across the site, including those in proximity to Great Connell Road and the NSOORR.

Stage 2: Element 3 – External Amenity Area Noise Assessment

BS 8233:2014 recommends that $L_{Aeq\ 16\ h}$ levels should ideally not exceed 50-55 dB in external amenity areas. This criterion will be met in the rear gardens of all housing units, with marginal exceptions in less sheltered areas of rear gardens of several units facing Great Connell Road. The criterion will be exceeded at the balconies of certain units as follows:

- South and east facing apartments at the neighbourhood centre, where $L_{Aeq\ 16\ h}$ levels will reach 58 dB.

- Duplex Block 6, where $L_{Aeq\ 16\ h}$ levels in the amenity area of the southernmost unit will reach 55 dB.

Where $L_{Aeq\ 16\ h}$ levels in amenity areas exceed 50-55 dB, BS 8233:2014 states that:

> 'These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces but should not be prohibited.'

In this regard, ProPG adds:

> 'Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to…a relatively quiet, protected, publicly accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance).'

The proposed development involves the provision of a number of on-site open green spaces, all within proximity to units. The spaces include a large riverside amenity area extending along the south-west side of the site. Residents of all units, including apartment buildings, will therefore benefit from provision of an extensive open, accessible and quiet on-site realm. On this basis, noise levels in amenity areas including apartment balconies will be satisfactory.

Stage 2: Element 4 – Assessment of Other Relevant Issues

Other issues assessed, as recommended by ProPG, include the following:

- Compliance with relevant national and local policy: The most relevant policies are those set out in the County Kildare Noise Action Plan. The plan proposes that mitigation will be applied where L_{den} levels exceed 70 dB, and L_{night} levels exceed 57 dB. Onsite L_{den} levels do not exceed the 70 dB criteria, and are not expected to exceed them in the future. L_{night} levels are also lower than the 57 dB criterion across the site, and will continue to meet the criterion in the future.

- Magnitude and extend of compliance with ProPG: $L_{Aeq\ 16\ h}$ and L_{night} levels in proposed units will meet identified criteria without a requirement for specific acoustic mitigation measures. standard thermal glazing with a minimum R_W value of 30 dB will achieve compliance with internal criteria.

- Likely occupants of the development: The proposed development is expected to be occupied by a typical sample of the population, and is unlikely to see a predominance of any particularly sensitive group.

- Acoustic design versus unintended adverse consequences: No adverse consequences have been identified.

- Acoustic design versus wider planning objectives: No issues have been identified.

At the proposed crèche, incident $L_{Aeq\ 16\ h}$ levels along the NSOORR façade will reach 58-60 dB. $L_{Aeq\ 30\ min}$ levels may be 1-2 dB higher during peak periods. Internal ambient levels will achieve compliance with the 35 dB criterion recommended by Technical Guidance Document TGD-021-5 where standard thermal glazing with a minimum R_W value to 30 dB is used.

However, external $L_{Aeq\ 30\ min}$ levels will exceed the 51-55 dB limit suggested in relation to opening windows for cooling purposes. Internal ambient temperatures will therefore require an alternative method of control in crèche rooms 1-5.

11.7.5 Operational Noise Impacts

No onsite noise sources of significance will arise. Expected sources will be entirely consistent with typical urban residential soundscapes. Noise impacts directly attributable to the proposed residential development will be neutral.

Incident L_{den} levels will in all cases be considerably lower than the 70 dB criterion set out in the local authority Noise Action Plan. L_{night} levels will also be lower than the 57 dB criterion. A ProPg assessment indicates that most of the development area will continue to be 'low risk' into the future, with risk increasing to 'low-medium' at units fronting Great Connell Road and the NSOORR. Standard thermal glazing with a minimum R_W value of 30 dB will achieve satisfactory internal noise levels. External noise levels will also be satisfactory.

11.8 Baseline Scenario

If the proposed development does not proceed, the local noise environment is likely to remain semi-urban in character, with the chief background noise sources being local and distant traffic. In the medium term, traffic noise levels are likely to increase across the study area, due to continuing development across Newbridge, particularly at industrial areas to the east and northeast.

While engine noise emissions will reduce due to increasing take-up of electric vehicles, it is noted that traffic noise above 40-50 km/h arises chiefly from tyre noise, and such tyre noise is unlikely to be less in electric vehicles. The planned completion of the NSOORR is likely to alter the soundscape considerably.

With respect to the development site itself, it is expected that, should the proposed development not proceed (the 'do nothing' scenario), no noise emissions are expected to arise other than those from land management practices, depending on how the site is used into the future.

11.9 Prevention & Mitigation Measures

11.9.1 Design Stage

The operational stage mitigation required relates solely to inward impacts associated with road traffic noise. Internal $L_{Aeq\,T}$ criteria will be met at residential units using standard thermal glazing with a minimum R_W value of 30 dB. Table 11.16 shows the recommended glazing specification required to meet this criterion.

Band	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	Total R_W
All facades	26	18	24	34	40	36	30

Table 11.16 Minimum glazing specification (dB)

This glazing specification will be applied to bedrooms and living/dining rooms on facades overlooking the NSOORR and Great Connell Road, as well as facades within 90 degrees. The specification will also be required on bedrooms within 80m of Great Connell Road. Given that the specification is consistent with standard thermal glazing such as 4-10-4 or 6-10-4, its installation will satisfy BS 8233:2014 criteria. Trickle vents with a minimum $D_{n,e}$ value of 33 dB are recommended.

The required thermal glazing specifications are readily achievable, and a number of suppliers offer suitable products. The glazing R_W value must be guaranteed by the window supplier rather than by the individual glazing and frame manufacturers. Potential suppliers will be advised that levels in each octave band should be achieved as a minimum. Compliance with the overall R_W value should only be assessed by reference to the R_W+C_{tr} value, typically 4-5 dB higher than the R_W value alone.

11.9.2 Construction Stage

Construction phase $L_{Aeq\,1\,h}$ levels at all receptors will be lower than the 65 dB criterion recommended by BS 5228-1:2009. No vibration impacts will arise.

Although construction phase noise emissions will be short term, and will not exceed construction phase criteria, the applicant nonetheless proposes to apply the following mitigation measures throughout the construction phase:

- Construction operations will in general be confined to the period Monday-Friday 0800-1800 and Saturday 0800-1600

- Where it is proposed to operate plant during the period 0700-0800 h at locations within 100 m of offsite receptors, standard 'beeper' reversing alarms will be replaced with flat spectrum alarms.

- Hooting will be prohibited onsite. Drivers of plant and vehicles will be instructed to avoiding hooting at all times.

- Plant used onsite during the construction phase will be maintained in a satisfactory condition and in accordance with manufacturer recommendations. In particular, exhaust silencers will

be fitted and operating correctly at all times. Defective silencers will be immediately replaced.

- Queuing of trucks near off-site receptors will be prohibited.
- Machinery not in active use will be shut down.
- A site representative will be appointed as a liaison officer with the local community.
- Where evening or night-time operations are required, local residents will be notified through the liaison officer.
- All complaints of noise received during the construction phase will be logged in a register, and investigated immediately. Details of follow-up action will be included in the register.
- Where it is proposed to import potentially noisy plant to the site, the potential impact of noise emissions will be assessed in advance.
- Where generators or compressors are required within 100 m of offsite receptors, or previously completed receptors onsite, these will be fitted with manufacturers' acoustic enclosures, or alternatively will be screened by a local acoustic screen or soil stockpile.
- Guidance set out in British Standard BS 5228-1:2009 with respect to noise control will be applied throughout the construction phase.

11.9.3 Operational Stage

The completed development will not give rise to noise or vibration emissions at offsite receptors, and no mitigation requirements have been identified in this regard. At the proposed retail units, noise emissions may arise from dispersed sources such as extraction fans, vents and air conditioning cassettes. Noise emissions from these sources are unlikely to be audible beyond 10 m, and are thus highly unlikely to affect offsite receptors.

Noise emissions associated with deliveries and visitors to retail units are unlikely to negatively impact surrounding receptors, whether onsite or offsite. Increases in traffic noise levels on the surrounding road network due to the development will be minor, and no specific mitigation measures are required.

Operational phase mitigation required onsite relates solely to inward impacts associated with road traffic noise. Internal $L_{Aeq\,T}$ criteria will be met at residential units using standard thermal glazing with a minimum R_W value of 30 dB. Standard thermal glazing, as per Table 11.16, will achieve satisfactory internal noise levels at the proposed crèche. Mechanical ventilation will be required in crèche rooms 1-5.

Noise levels in external amenity areas will be satisfactory in the context of WHO and ProPG criteria, on the basis that residents of apartment units at the neighbourhood centre will benefit from onsite green spaces.

11.10 Monitoring

In the construction stage noise monitoring will be carried out at noise sensitive locations and frequency agreed with Kildare County Council. The monitoring will be in accordance with International Standard ISO 1996-2:2017 Acoustics – Description, measurement and assessment of environmental noise, Part 2: Determination of environmental noise levels (2017). The noise limits will be as conditioned in the planning permission.

11.11 Cumulative Impacts

No cumulative impacts have been identified with respect to the operational stage. The only potential cumulative impacts which may arise relate to the construction phase, specifically the possible overlap of onsite construction with construction of the onsite NSOORR and bridge, as well as the Belin Woods site to the southwest.

The most vulnerable receptors here are those at Wellesley Manor, and dwellings to the west. While some dwellings at Belin Woods and the Aston SHD site may be completed and occupied, any construction noise emissions affecting these receptors are likely to originate from local activity at their respective sites (i.e. ongoing construction of new phases).

For the purposes of assessment of cumulative construction noise impacts at Wellesley Manor and other offsite receptors, the model was rerun with NSOORR construction and bridge construction added. The cumulative model assumes that road construction will involve a dozer and excavator, and that several 6x6 dump trucks will track back and forth along the road corridor. In addition, it is assumed that piling activity at the bridge is underway.

The model output is shown in Figure 11.14. $L_{Aeq\ 1\ h}$ levels predicted at the nearest receptors at Wellesley Manor will reach 63 dB at their highest. Levels at other receptors in this area, including the dwelling across the road, will be lower. $L_{Aeq\ 1\ h}$ levels at dwellings off Athgarvan Road will be lower than 55 dB. In all cases, $L_{Aeq\ 1\ h}$ levels will be lower than the 65 dB criterion. Cumulative impacts are therefore expected to be not significant to slight, adverse, and temporary.

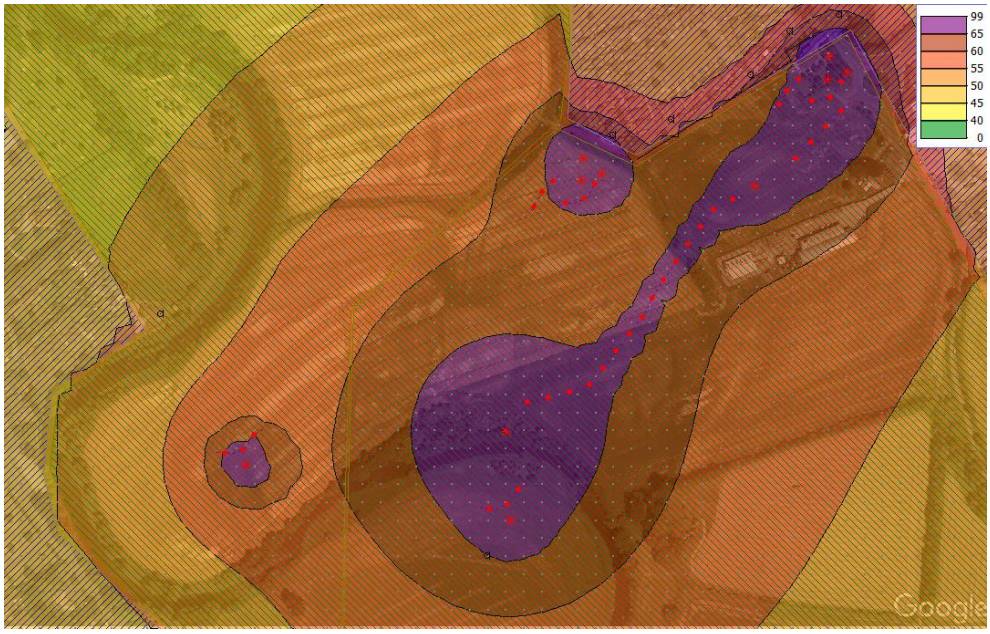


Figure 11.14 Predicted cumulative construction phase $L_{Aeq\ 1\ h}$ levels

11.12 Residual Impact

11.12.1 Construction Stage

The construction stage is expected to last up to 6 years. Construction will be undertaken in phases, and is unlikely to extend beyond two years in any particular zone. While construction noise emissions at the north and north-east sides of the site are likely to be audible at the nearest receptors, noise levels will be lower than relevant criteria. Emissions will be temporary and there will be extended periods when little or no emissions arise. Impacts will range from not significant to slight adverse, will be localised to the nearest sensitive receptors and will be temporary. No vibration impacts will arise.

11.12.2 Operational Stage

The completed development will not give rise to noise or vibration emissions at offsite receptors, and thus impacts will be neutral. Noise emissions arising within the completed development will be identical in character to emissions arising across the nearby fringes of Newbridge. Emissions will be urban-residential in character, and will not give rise to offsite impacts.

Noise impacts at offsite receptors attributable to vehicle movements on roadways within the completed site will be imperceptible.

Noise impacts at offsite receptors attributable to vehicle movements on roadways within the completed site will not be significant. While increases in traffic on the surrounding road network will arise as a result of completion of the NSOORR project through the site, most of the increase will be attributable to through-traffic. The road will benefit the wider town.

At the completed development inward noise emissions will arise from the surrounding road network, including the NSOORR. The future noise risk is low across most of the site when assessed using ProPG guidance, increasing to low-medium at units directly fronting public roads. These properties will benefit from appropriate glazing on facades facing these roads.

Apartment residents will benefit from onsite green spaces, thus offsetting traffic noise levels on balconies facing roadways. Noise levels in amenity areas and at the proposed crèche will be lower than relevant criteria.

Once completed, noise impacts at surrounding receptors associated with local traffic increases will be imperceptible. No indirect impacts or interactive effects have been identified. There will be no adverse noise impact on the local population or on human health.

Internal noise levels across the site, when completed, will entirely comply with criteria set out in BS 8233:2014. External levels will also comply, with the exception of apartment balconies at the neighbourhood centre which overlook Great Connell Road and the NSOOR, and the southernmost unit at duplex block 6. BS 8233:2014 criteria here will be exceeded by several decibels. However, in keeping with BS 8233:2014 recommendations, residents will benefit from onsite green spaces in close proximity.

Noise levels across the development will entirely comply with the 70 dB L_{den} and 57 dB L_{night} criteria set out in the Kildare County Council Third Noise Action Plan 2019-2023.

11.12.3 Population & Human Health

The assessment of impacts on human health is typically undertaken by reference to WHO guidance, which has been revised over the last four decades according as noise and health studies have been published. The WHO currently recommends the following:

- In residential settings, a daytime/evening $L_{Aeq\ 16\ h}$ level of 50 dB is an indicator of moderate annoyance.
- A night-time $L_{Aeq\ 8\ h}$ level of 45 dB is recommended to prevent sleep disturbance.
- With respect to short term impulsive sources, the WHO recommends a night-time L_{Amax} limit of 60 dB outside bedroom windows during night-time hours.

Impacts assessed above may be reviewed in light of the WHO recommendations, as follows:

- Following completion and occupation of residential units, daytime and night-time WHO criteria will not be exceeded at any offsite receptor as a result of onsite emissions.
- On the local road network, traffic noise increases directly attributable to the proposed development will be small, resulting in an imperceptible change in noise levels.
- With respect to inward impacts, external noise levels will be generally satisfactory in the context of WHO guidance. Internal noise levels at these units will also be satisfactory.

On this basis, it is considered that there will be no adverse noise impact on the local population or on human health.

11.12.14 Summary of Residual Impacts

Likely Significant Effect	Quality	Significance	Extent	Probability	Duration
Construction Stage					
External Noise	Negative	Not significant to Slight	Nearest Noise Sensitive Receptors	Likely	Temporary
Operational Stage					
External Noise	Neutral	Imperceptible	No Receptors affected	Unlikely	Permanent
Human Health Noise	Neutral	Imperceptible	No Receptors affected	Unlikely	Permanent

12 LANDSCAPE & VISUAL IMPACT

12.1 Introduction

This chapter provides as assessment of the potential landscape and visual impacts of the proposed development on the surrounding landscape. The landscape and visual impact assessment examines and evaluates the implications of the proposed scheme in terms of landscape character and visual alterations arising from the scheme. The assessment also outlines the proposed landscape mitigation measures and monitoring that will attempt to achieve a longer-term integration of the proposed development with its surrounding landscape area. The Chapter was prepared by The Big Space landscape architects who have over fifteen years' experience of Landscape and Visual Impact Assessment.

12.2 Relevant Legislation & Guidance

The legislation and guidance relating to EIA are listed in Section 1.5 of this EIAR. The structure for assessing the landscape impact of the proposed development is based upon the following guidelines:

- Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, July 2017)
- Guidelines for Landscape and Visual Impact Assessment (Landscape Institute & I.E.M.A., UK 2013)

The criteria for describing the significance, quality and duration of the effects of the proposed development are outlined in Table 13.1 below:

Significance of Effects	**Criteria**
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound Effects	An effect which obliterates sensitive characteristics
Quality of Effects	**Criteria**

Positive Effects	A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
Neutral Effects	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
Negative/adverse Effects	A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Significance of Effects	**Criteria**
Duration and Frequency of Effects	**Criteria**
Momentary Effects	Effects lasting from seconds to minutes
Brief Effects	Effects lasting less than a day
Temporary Effects	Effects lasting less than a year
Short-term Effects	Effects lasting one to seven years.
Medium-term Effects	Effects lasting seven to fifteen years.
Long-term Effects	Effects lasting fifteen to sixty years.
Permanent Effects	Effects lasting over sixty years
Reversible Effects	Effects that can be undone, for example through remediation or restoration

Table 12.1: Landscape – Visual Assessment Criteria (as per Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA - July 2017)

A series of photomontages were prepared by 3D Design Bureau to represent, as accurately as possible, the physical and visual characteristics of the proposed development from a variety of distances and direction around the site. Priority was given to views from the public domain, such as main roads and to views from potentially sensitive locations such as such as residential areas. The location of all views are shown on Figure 12.13. For each of the visuals, an existing and a proposed view is presented and where the proposed development is not visible in the view the elements of the development will be shown as a red outline.

12.3 Methodology

The procedure used for the landscape and visual assessment entailed:

- A desk top study of the site in relation to its overall context both locally and regionally.
- Visiting the site and its environs to assess the following:
    - Quality and type of views of the area
    - The character and quality of the site area and the surrounding landscape

12.4 Development Description

A detailed description of the proposed development is in Chapter 3. Those aspects that are relevant to the landscape and visual impact assessment are:

- A series of 18 no. public open spaces and pocket parks are proposed throughout the residential development (2.613 ha net area).
- Provision of an 8.31 ha amenity area adjoining the River Liffey.
- Vehicular access to the proposed development from Great Connell road via a circa 350 metre section of the Newbridge South Orbital Relief Road (NSOOR), including footpaths and cycle paths. It is proposed to upgrade the existing Great Connell Roundabout to a signalised junction, and provide footpaths and cycle paths within the subject site along the Great Connell Road.
- Proposed development facilitates future potential pedestrian, cycle and vehicular links to adjoining residential development and undeveloped lands.
- All enabling and site development works, landscaping, boundary treatments, lighting, services and connections, including connection to permitted wastewater pumping station, waste management, ESB substations, compensatory flood storage and all other ancillary works above and below ground on a site of 27.64 ha.

12.4.1 Landscape Proposals

The landscape proposals are discussed in further detail within the Landscape Development Report (Appendix 11 of this EIAR) and are shown on landscape drawings 300-311 submitted with the application under separate cover. The landscape incorporating green infrastructure (GI) is an important aspect of the character of the lands, which informed the urban structure of the plan.

The design approach to the public realm within the subject lands is to produce a coherent and well considered design theme with a strong identity and distinctive sense of place that fosters a connection and attachment between existing and new residents and their surrounding environment. This will be achieved by creating a legible environment for people to live within and move through by using a hierarchy of spaces which include:

- Central Parks
- Western Park
- Local square/ Civic plaza
- River Park

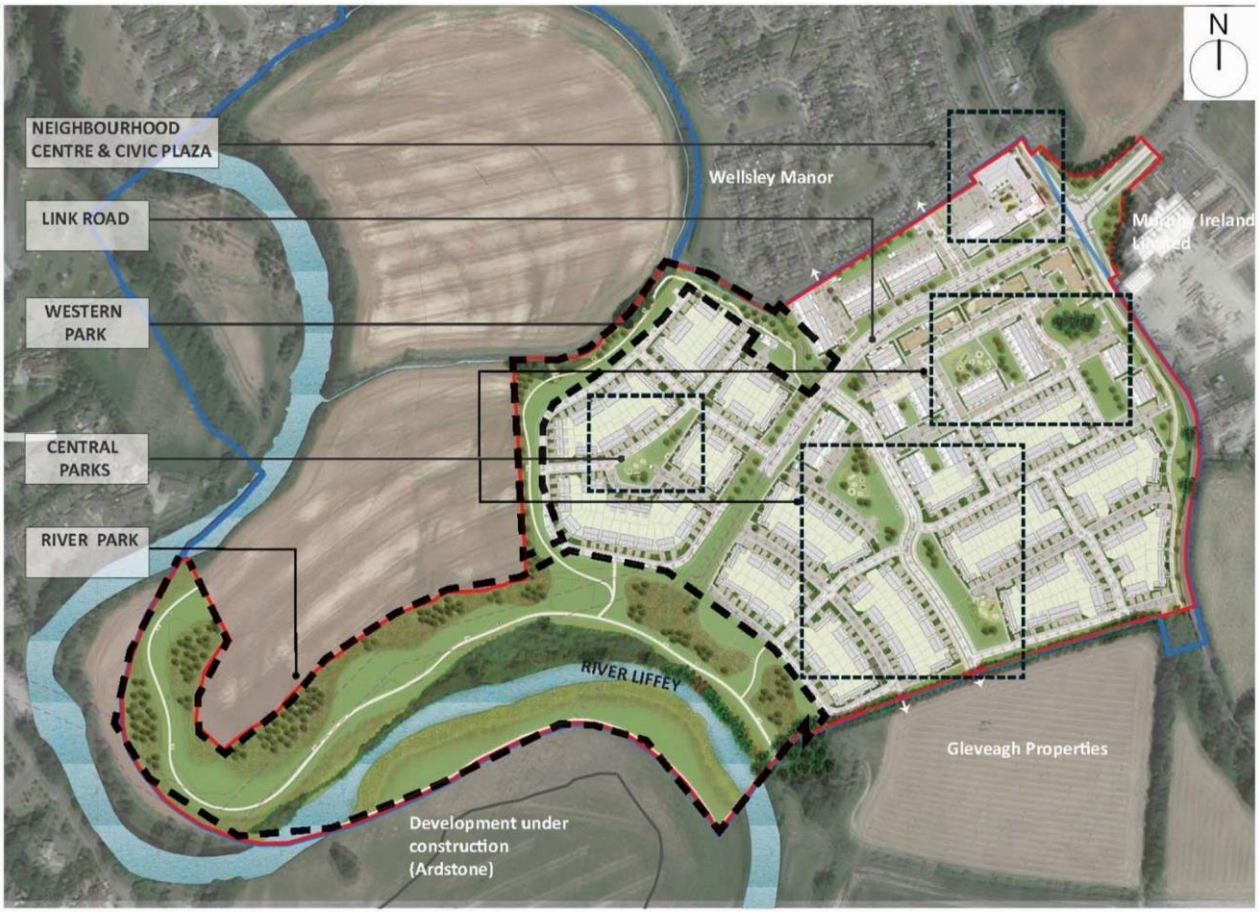


Figure 12.1: Landscape Plan (Source: TBS, 2022)

These spaces are designed to incorporate a spectrum of uses such as:

- Informal play spaces (suitable for unstructured play activities and social interaction)
- Kick-about area and informal kick-about area (active and structure play)
- Seating areas located to appeal to the sunny aspect and desired views (for sedentary activity)
- Natural play (for active play with age inclusive equipment 1-13 yrs. & +13 yrs.)
- Proposed native trees, maintained lawn and wildflower planting (nature activities)
- Ground modelling
- Existing trees and hedgerows retained (nature activities)
- Woodland Planting (nature activities)
- High quality paving materials and street furniture
- Walking, running and cycling trails
- Exercise stations (intended for age +13)
- Attenuation features

The inception of the approach to the scheme is to retain existing trees and hedge rows where possible (Refer to Arboricutural Asssesssment prepared by Arborist Associates Ltd submitted with this application under separate cover) and supplement them where necessary. It is proposed to use native tree planting as much as possible and smaller specimen trees /multi-stem shrubs will also be used along with wildflower and herbaceous planting which benefit pollinators and reinforce the biodiversity within the development (Refer to Planting Schedule & Landscape Drawing 308 submitted with the application under separate cover).

Figure 13.2: Proposed Site Layout with context of the Ardstone development (SHD granted under ref. no. ABP-302141-18, under construction) to the south

12.5 Receiving Environment

12.5.1 Landscape Context & Site Description

The subject site is located to the east of Newbridge town centre, Newbridge train station is located approximately 2.5 km to the north-west and the closest M7 interchange is located 3.5km to the south. A residential dwelling and industrial buildings are located within the eastern part of the site, both accessed off the Great Connell Road. The lands within and surrounding the subject site can be described as gently undulating and are largely composed of agricultural grassland, with mature hedgerows and trees along the field boundaries.

The subject site is accessed off the Great Connell Road located to the east of the site. The development is bound to the north-east by the Wellesley Manor residential development, by the River Liffey to the south-west and agricultural lands to the south and west. The topography of the lands varies with a fall towards the River Liffey from the Great Connell Road of approximately 2.0m (+86.50 to +88.50).

12.5.2 Planning Policy Context

The main texts that were referred to in the compilation of this report were:

- Kildare County Development Plan 2017 – 2023
- Newbridge Local Area Plan 2013-2019 (extended)
- Landscape Character Assessment within Kildare County Development Plan 2005-2011

Figure 12.3: Site Location & Context (Source: TBS, 2022)

Newbridge Local Area Plan 2013-2019 (extended)

Within the Newbridge LAP 2013-2019 the following land use zoning objectives relate to the subject site:

- The majority of the subject site contains the land use zoning objective "C12 and C13 – New Residential: To provide for new residential development".
    - "Specific Objectives: C12 and C13 - to contribute to the strategic objective of delivering a southern relief road in accordance with Objective SRO 5."
    - "Specific Objective: C13 - The provision of a small, high quality designed neighbourhood centre to serve the local population will be acceptable as part of the overall development of these lands".

- The lands adjoining the River Liffey are zoned "F – Open Space & Amenity: To protect and provide for open space, amenity and recreational provision".

The Newbridge LAP 2013-2019 also includes the "Movement Objective A-B: The Southern Relief Road from the R445 at Littleconnell (A) to the R416 Athgarvan Road at Kilbelin (B), including a new crossing over the River Liffey", that runs through the centre of the subject site.

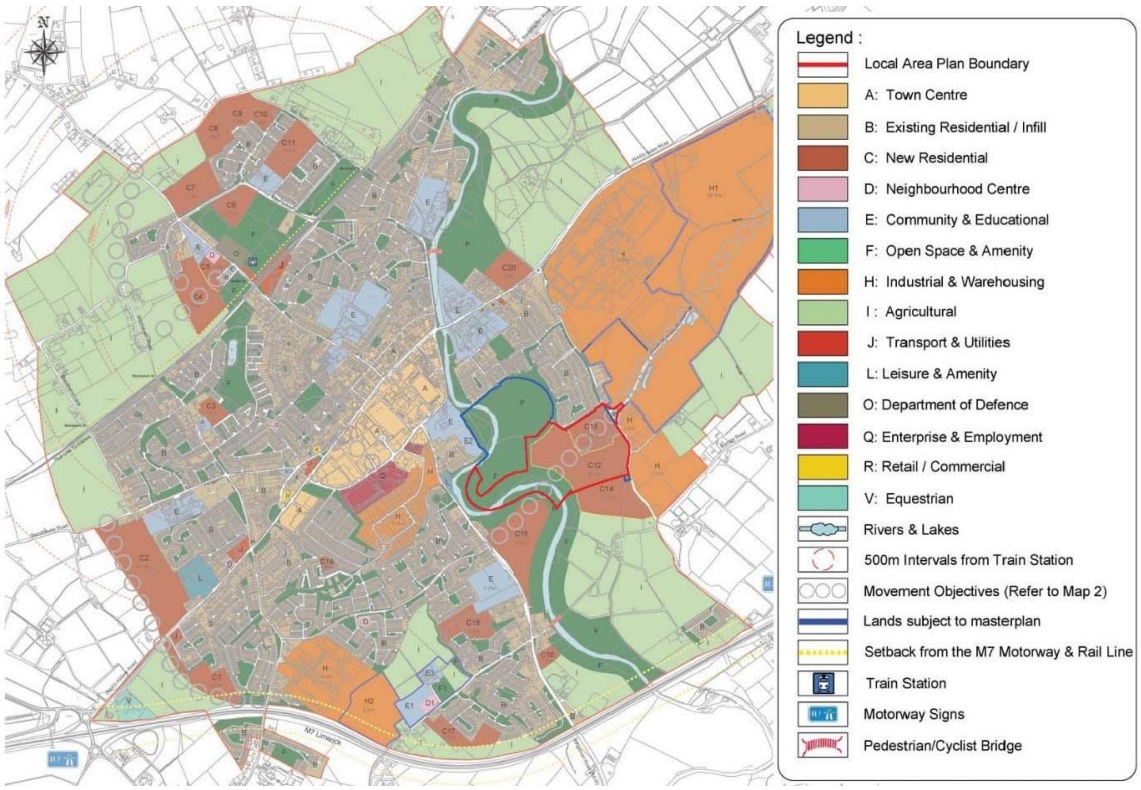


Figure 12.4: Land use zoning objectives (Source: Newbridge LAP 2013-2019 & TBS annotations 2022)

Kildare County Development Plan 2017-2023

The relevant objectives contained within the KCDP 2017-2023 in relation to landscape are listed in Table 12.2:

Obj. No.	Description
LO 1	Have regard to the Landscape Sensitivity Factors in the vicinity of sites in the consideration of any significant development proposals.
LO 2	Ensure landscape assessment will be an important factor in all land-use proposals.
LO 3	Investigate the feasibility of preparing a Landscape Conservation Area Assessment within the county to identify any area(s) or place(s) within the county as a Landscape Conservation Area, in accordance with the Planning and Development Act 2000 (as amended).
LO 4	Protect the visual and scenic amenities of County Kildare's built and natural environment.
LO 5	Preserve the character of all important views and prospects, particularly upland, river, canal views, views across the Curragh, views of historical or cultural significance (including buildings and townscapes) and views of natural beauty.
LO 6	Preserve and protect the character of those views and prospects obtainable from scenic routes identified in this Plan.
LO 7	Encourage appropriate landscaping and screen planting of developments along scenic routes. Where scenic routes run through settlements, street trees and ornamental landscaping may also be required.

Table 12.2: Landscape Objectives - KCDP 2017-2023)

12.5.3 Views & Prospects

12.5.3.1 Protected Views & Prospects

In relation to protected views and scenic routes it is the objective of Kildare County Development Plan (KCDP) 2017 – 2023 to:

- *"LO 4 Protect the visual and scenic amenities of County Kildare's built and natural environment.*
- *LO 6 Preserve and protect the character of those views and prospects obtainable from scenic routes identified in this Plan.*
- *LO 7 Encourage appropriate landscaping and screen planting of developments along scenic routes. Where scenic routes run through settlements, street trees and ornamental landscaping may also be required*."

In relation to 'Water Course and Canal Corridor Views' it is the policy of Kildare County Council to:

- *"WV 1 - Curtail any further development along the canal and river banks that could cumulatively affect the quality of a designated view.*
- *WV 2 - Preserve and enhance the scenic amenity of the river valleys and canal corridors and the quality of the vistas available from designated views.*
- *WV 3 - Prevent inappropriate development along canal and river banks and to preserve these areas in the interests of biodiversity, built and natural heritage and amenity by creating or maintaining buffer zones, where development should be avoided."*

There are no Listed Views or Prospects within or in close proximity to the subject site, those closest to the site are illustrated on Figures 13.5 and 13.12 and the closest protected view is:

RL 9 New Bridge Droichead Nua (Newbridge) - Views of the River Liffey from Bridges - From St. Conleth's Bridge (Main St.), looking south-east (Protected View). Refer to verified view number 6, which is discussed below.

12.5.3.2 Visibility Into and From the Site

The primary views towards the subject site are from public roads, public opens spaces and residential areas in the immediate vicinity of the subject site. Further views of the subject site are restricted by the intervening topography, the existing mature trees, woodland and hedgerows and the residential developments on the adjoining lands.

12.5.4 Protected Structures or Recorded Monuments

Recorded Monuments are structures that are protected under the National Monuments (Amendment) Act, 1994 and Protected Structures are structures that are considered to be of special architectural, historic, archaeological, artistic, cultural, scientific, social or technical interest.

There are no Protected Structures located within the subject site, Table 12.3 and Figure 12.6 illustrates those closest to subject site.

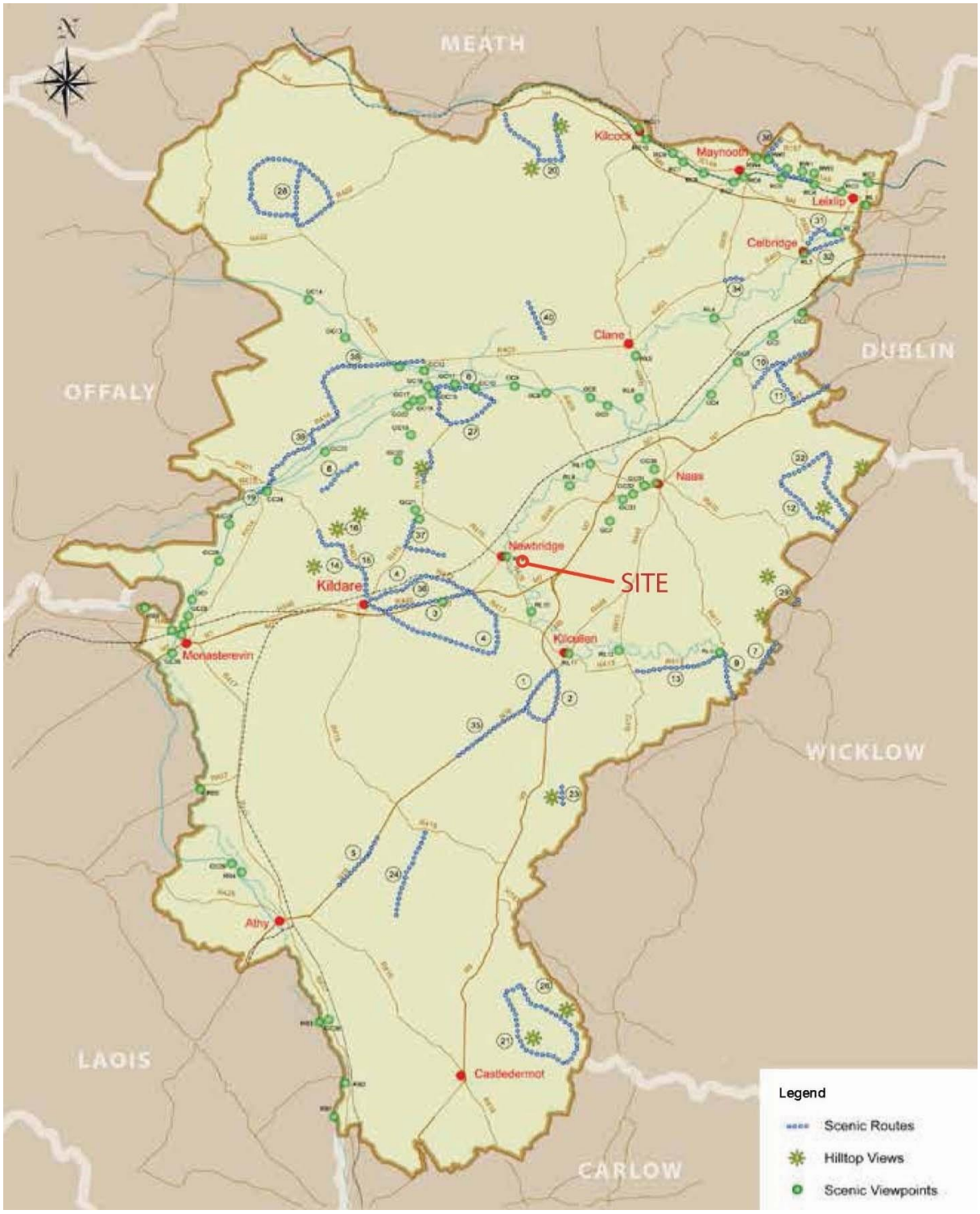


Figure 12.5: Scenic Routes & Viewpoints (Source: KCDP 2017–2023 & TBS annotations 2022)

RPS No.	Structure Name	Townland	Description
B23-08	Ruins of Great Connell Abbey & Medieval Carved Stone	Greatconnell	Abbey and Standing Stone

Table 12.3: Protected Structures (Source: KCDP 2017 – 2023)

There are no Recorded Monuments located within the subject site, Table 12.4 and Figure 12.6 illustrates those closest to subject site.

Reference	Townland	Description
KD023-015	Greatconnell	Standing Stone
KD023-016	Greatconnell	Religious house - Augustinian Abbey/Priory/ Friary Includes: KD023-016001 – Graveyard KD023-016002 - Sheela-na-gig KD023-016004 - Settlement deserted – medieval KD023-016005 - Town defences KD023-016006 - Water mill KD023-016007 - Ford KD023-016008 - Tomb – effigial
KD023-017	Greatconnell	Holy Well

Table 12.4: Recorded Monuments (Source: KCDP 2017 – 2023)

Architectural Conservation Area (ACA): a place, area, group of structures or townscape that is of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest or value, or contributes to the appreciation of protected structures.

There are no Architectural Conservation Areas located within or in close proximity to the subject site.

12.5.5 Designated Areas

There are no Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Natural Heritage Areas (NHA) within the subject site, as shown on Figures 12.7 – 12.8.

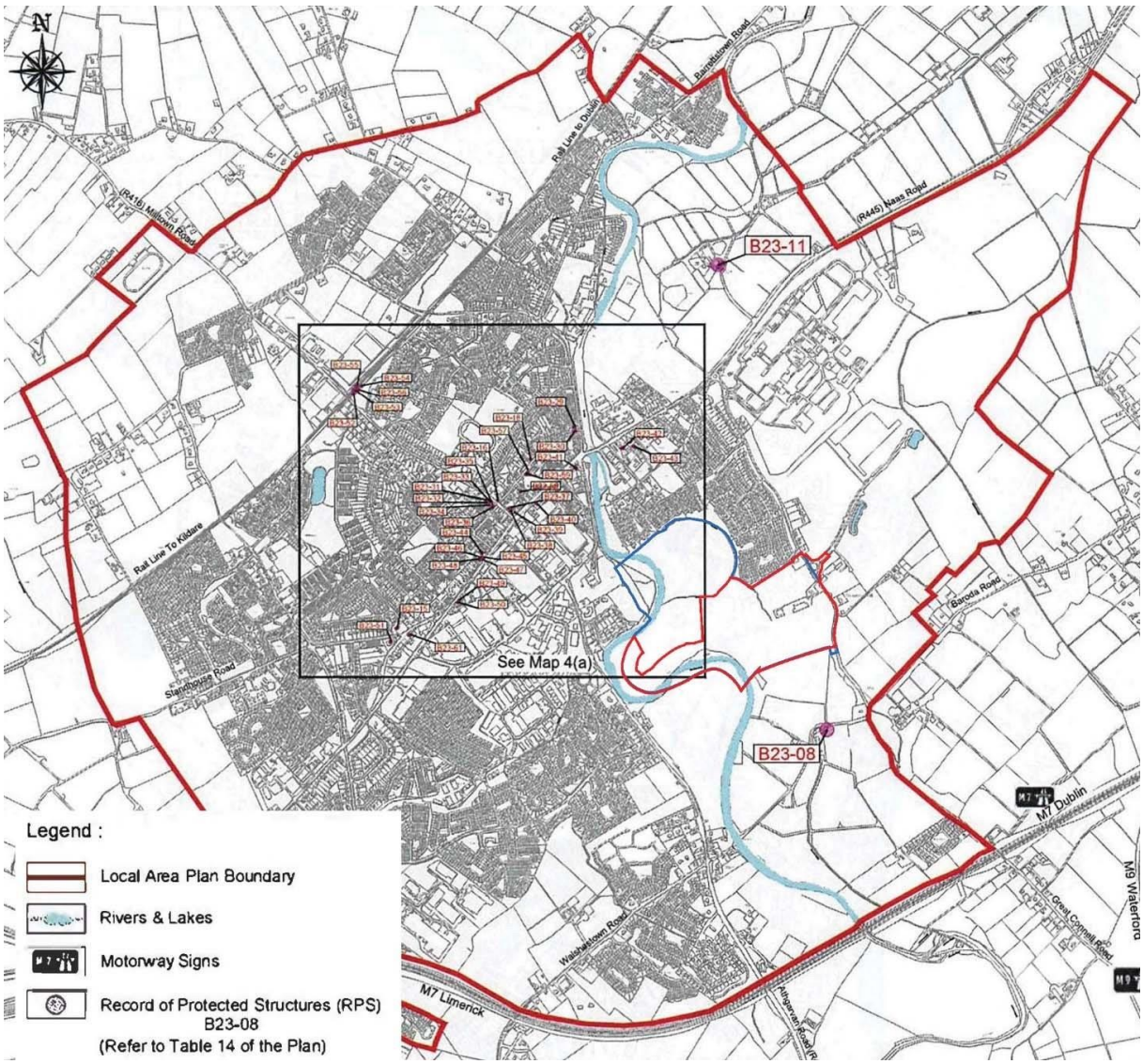


Figure 12.6: Built Heritage (Source: Newbridge LAP 2013-2019 & TBS annotations 2022)

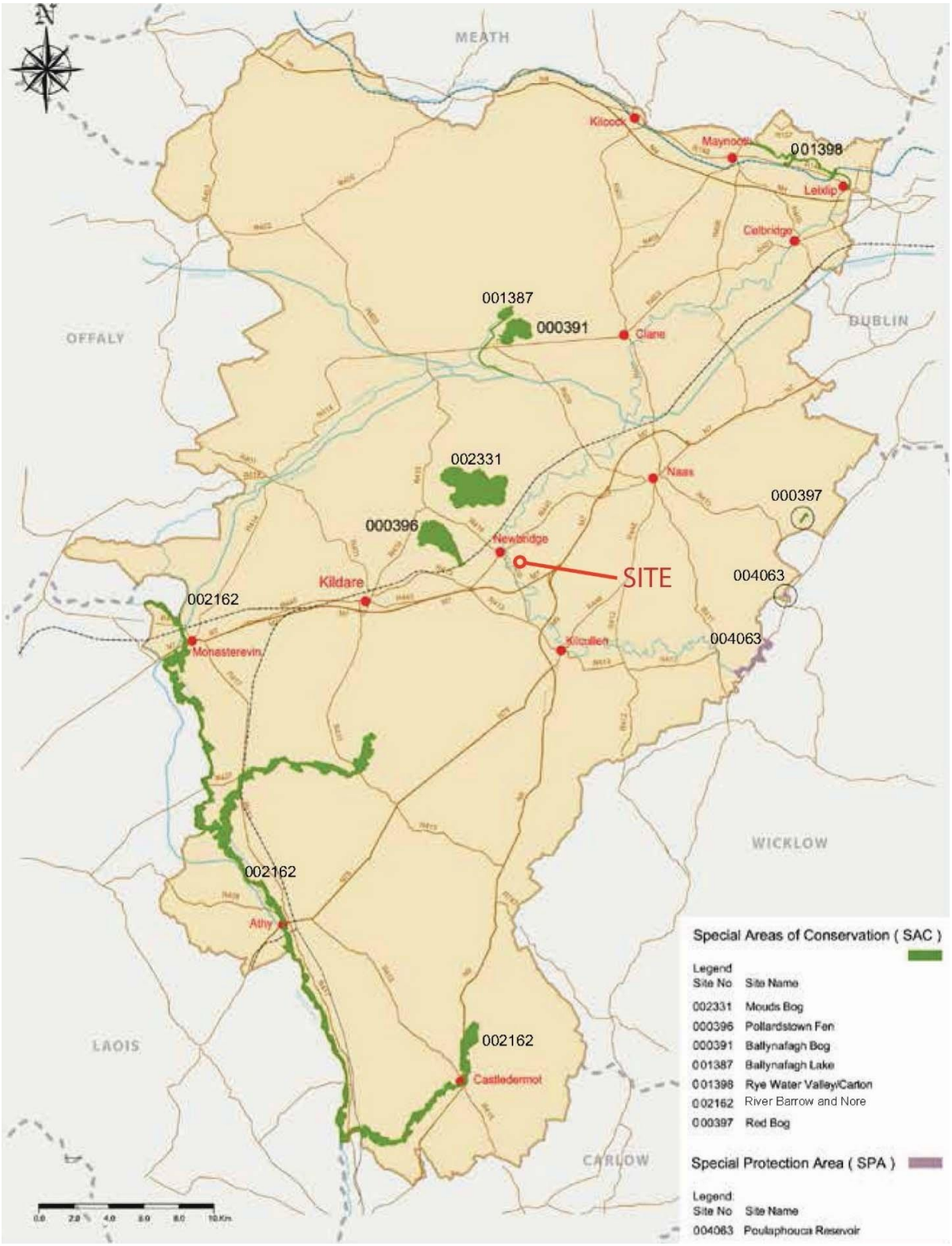


Figure 12.7: Special Areas of Conservation (SAC) (Source: KCDP 2017 – 2023 & TBS annotations 2022)

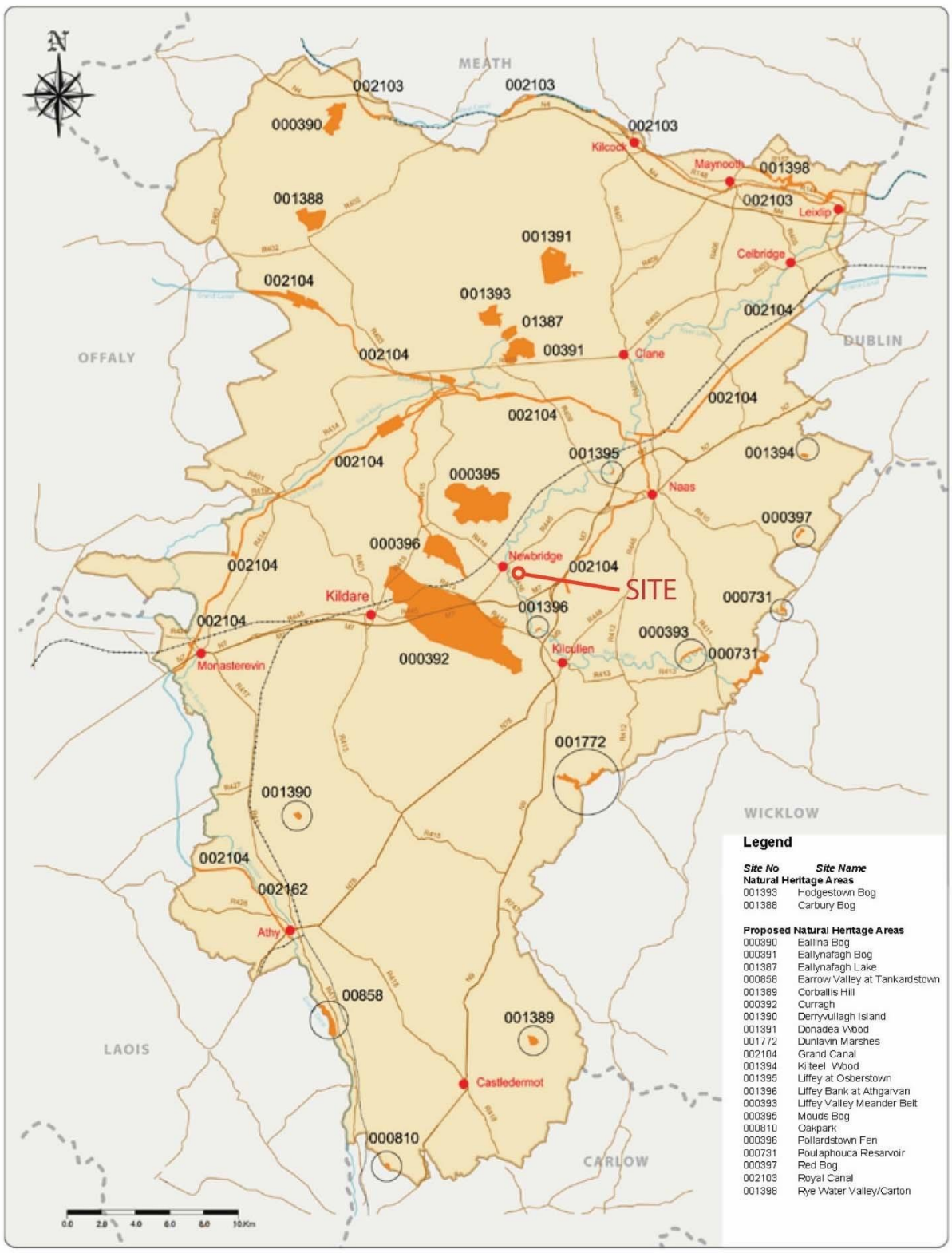


Figure 12.8: Natural Heritage Areas (Source: KCDP 2017 – 2023 & TBS annotations 2022)

12.5.6 Green Infrastructure

The Kildare County Development Plan 2017 - 2023 outlines a number of green infrastructural policies that are relevant to the subject site and its surrounding area, as listed in Table 12.5.

GI Policy No.	Description
GI 1	Ensure the protection, enhancement and maintenance of Green Infrastructure and recognise the health benefits as well as the economic, social, environmental and physical value of green spaces through the integration of Green Infrastructure (GI) planning and development in the planning process.
GI 2	Develop and support the implementation of a Green Infrastructure Strategy for County Kildare taking full account of the Actions for Green Infrastructure in the GDA identified in the Regional Planning Guidelines 2010-2022.
GI 3	Identify Green Infrastructure resources within and on the edge of the settlement boundaries by expanding the existing programme of Green Infrastructure mapping and to include, during the review process of Local Area Plans, Green Infrastructure policies and objectives.
GI 4	Require that all Local Area Plans protect and manage the Green Infrastructure network in an integrated and coherent manner and add additional Green Infrastructure where possible.
GI 5	Encourage, pursuant to Article 10 of the Habitats Directive, the management of features of the landscape, such as traditional field boundaries and laneways, important for the ecological coherence of the Natura 2000 network and essential for the migration, dispersal and genetic exchange of wild species.
GI 6	Provide for the incorporation of underpasses and/or Green Bridges at ecologically sensitive locations on the county's road and rail corridors that will facilitate the free movement of people and species through the urban and rural environment.
GI 7	Provide for the incorporation of underpasses and/or Green Bridges at ecologically sensitive locations on the county's road and rail corridors that will facilitate the free movement of people and species through the urban and rural environment.

Table 12.5: Green infrastructural policies - KCDP 2017 – 2023

The Newbridge LAP 2013-2019 contains a number of green infrastructure policies as listed within Table 12.6 and illustrated on Figure 12.9.

GI Policy No.	Description
GI 1	To require all proposals for major developments to submit, as part of the landscaping plan for the proposal, details of how any green infrastructure proposed as part of the development (e.g. green open spaces, hedgerows, tree lines, etc.) contribute positively to the development and protection of the overall green infrastructure assets of Newbridge as identified on Map 6 and how it protects and enhance linkages to the wider natural landscape features.
GI 2	To seek the provision of links between larger areas of green infrastructure (particularly areas of public open space) where appropriate.
GI 3	To ensure biodiversity conservation and /or enhancement measures, as appropriate, are included in all proposals for new development.
GI 4	To ensure that green infrastructure provision and management does not lead to the spread of invasive species.
GI 5	To ensure all planting within developments is of native species.

GI 6	To ensure old stones walls are protected where appropriate and the contribution they make to green infrastructure is protected.
GI 7	To support the development and correct management of semi natural grasslands within new developments and existing amenity grassland areas.
GI 8	To ensure key hedgerows, identified on Map 6, and the linkages they provide to larger areas of green infrastructure and the wider countryside, are retained where appropriate and integrated into the design of new developments.
GI 9	To support the development of small wooded areas within new developments.
GI 10	To seek the creation of new wetlands and/or enhancement of existing through the provision for Sustainable Urban Drainage Systems (SuDS) and Integrated Constructed Wetlands (ICW) where appropriate.
GI 11	To develop links between larger areas of green infrastructure such as the River Liffey, the banks and buffer zones of the railway/ motorway, the National Stud, the Curragh and the surrounding countryside.
GI 12	To manage against the spread of invasive species.
GI 13	To ensure replacement planting of semi mature trees where mature trees are removed within developments. Semi mature trees are defined by the BSI as 'Trees with an overall height in excess of 4 metres and or a stem girth measurement circumference of 20 centimetres or larger.
GI 14	To avoid development within the root protection area of the trees/hedgerows to be retained in a development.

Table 12.6: Green infrastructural policies – Newbridge LAP 2013-2019

The GI policy within this LAP that is most relevant to the site is ‘GI 8’ as the south-eastern boundary of the subject site is referred to as a ‘Key Hedgerow’, as shown on Figure 12.9.

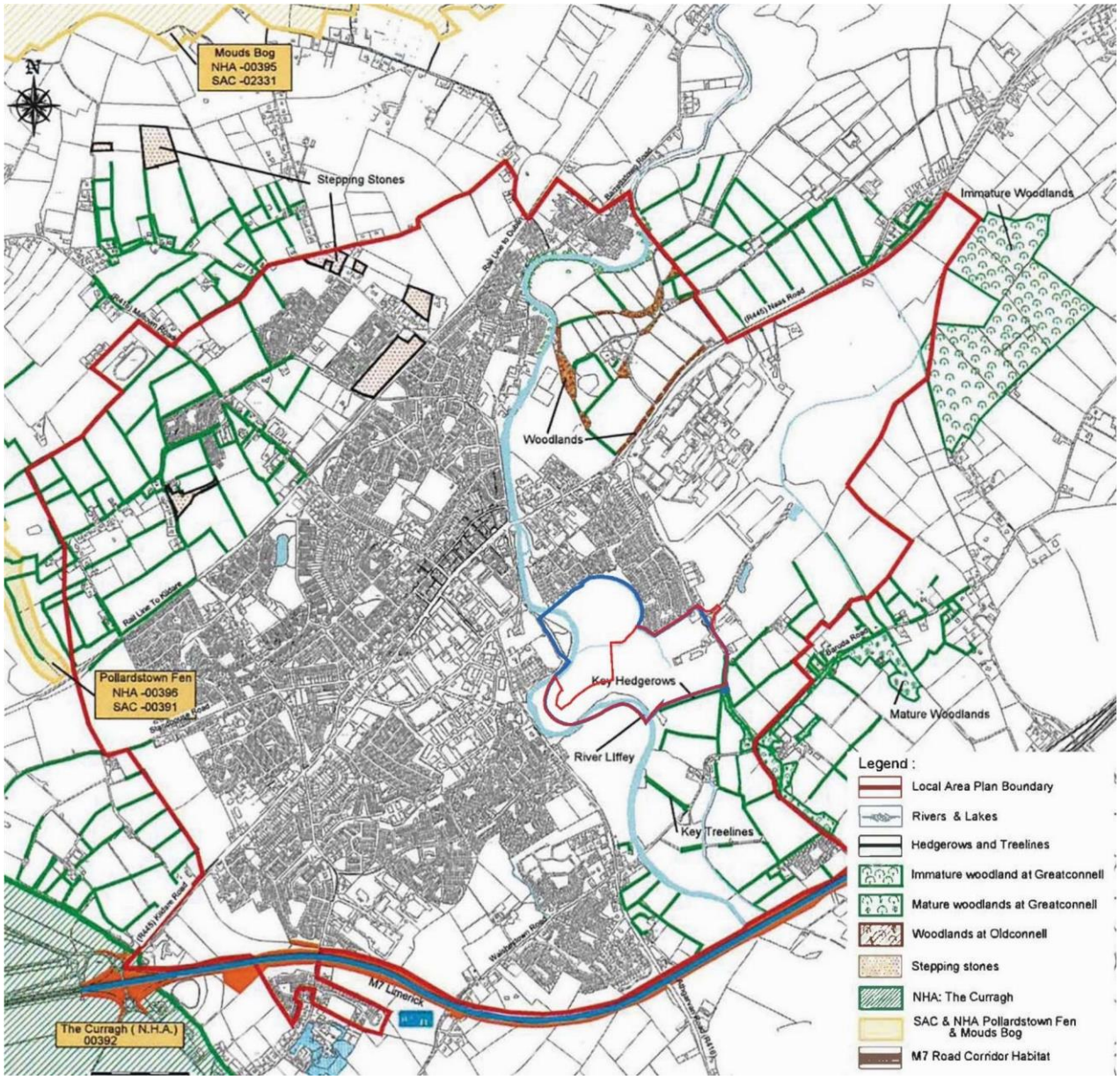


Figure 13.9: Green infrastructure objectives (Source: Newbridge LAP 2013-2019 & TBS annotations 2022)

12.5.7 *Landscape Character Assessment & Historic Landscape Characterisation*

12.5.7.1 Landscape Character Assessment

The KCDP 2017-2023 indicates that the majority of the subject site is classified as 'Northern Lowlands', with the lands adjoining the River Liffey are classified as 'River Valley', as shown on Figure 13.10. The full Landscape Character Assessment contained within the KCDP 2005-2011 states that the 'Northern Lowlands Character Type' is described as:

"This extensive lowland area to the north-east of the County is bisected by the River Liffey valley. The Royal Canal runs along its northern boundary and the Grand Canal corridor follows a northeast to south-west alignment. This area is characterised by generally flat terrain and open lands with regular (medium sized) field patterns. Hedgerows are generally well maintained and low, with scattered trees along the field boundaries that partially screen the lowest lying areas. Nevertheless, the generally low-lying vegetation of the area allows long-distance and extensive visibility. Distant

views include the skylines of the Eastern Uplands, the Newtown Hills to the west, and the Chair of Kildare hilltops to the south-west.

The predominant landuse in this area is pasture, with large areas of non-irrigated arable lands (mainly tillage). A number of coniferous plantations and deciduous woodlands can also be found, as well as large patches of bogland and peat extraction sites. Settlement patterns in this area are linked to the closeness of Dublin City. Critical Landscape Factors:

- *Smooth Terrain: Smooth terrain and the generally flat topography and landform that characterise this landscape character unit, allow vistas over long distances without disruption. As a result development can have a disproportionate visual impact, due to an inherent inability to be visually absorbed.*
- *Undulating topography: Gently undulating topography is presented at certain areas of this character unit, providing the potential for local visual enclosure thereby absorbing development where it does not break the skyline (i.e. it renders visually unobtrusive of the overall landscape scale). St. Patrick's Hill, Ardrass, Celbridge represents an important topographical feature within the Northern Lowlands area.*
- *Low Vegetation: The grassland, tillage fields and generally low hedgerows of this area provide similar characteristics to smooth terrain in landscape terms, and the two are often interrelated due to soil attributes. Grassland vegetation and agricultural crops are usually uniform in appearance, failing to break up vistas, and allowing long distance visibility. Existing low hedgerows partially screen the lowest land parcels, nevertheless the common low vegetation proves unable to visually absorb new development.*
- *Shelter Vegetation: Shelter vegetation is represented at some stretches of this unit by coniferous plantations, deciduous woodlands and the presence of trees that grow on field hedgerows. In a similar manner to undulating topography, shelter vegetation has a shielding and absorbing quality in landscape terms. It can provide a natural visual barrier and also adds to the complexity of a vista, breaking it up to provide scale and containment for built forms.*
- *Localised River and Canal Views: River valleys and canal corridors are generally visually enclosed and highly localised areas of very distinctive character with a high degree of visual consistency. This character unit includes sections of the River Liffey and the Grand and Royal Canals. Due to the low lying nature of this area, many views of the river valley and the canal corridors are available from the local roads and from the viewing points located on bridges."*

Within this Landscape Character Assessment (KCDP 2005-2011) the 'River Valley (Liffey) Character Type' is described as:

"The Liffey Valley is located on the north-eastern quarter of the County, flowing in a north-east to southeast pattern and its waters winding along the central lowlands. Many towns have become well established along the riverbanks, such as Leixlip, Celbridge, Clane, Newbridge, Kilcullen and Ballymore Eustace, where the River Liffey flows into Pollaphuca Reservoir. This lowland unit, characterised mostly by smooth terrain and low vegetation, has extensive open mountain views (i.e. the Chair of Kildare to the west and the Eastern Uplands to the east; distant views including the neighbouring Wicklow Mountains).

Soils in the area are classified as Regosols (of alluvial origin) and are widely suitable for tillage, pasture, meadow and forestry. Generally, the river valley is identifiable by its floodplain levels and slopes of naturally occurring shrubs and trees with a slow progression to grasslands. At some sections, pasturelands directly occur on the floodplains, whilst conifer and deciduous forest occupy some other parcels. Large tillage fields with few inner boundaries are also common in this area, with

well-trimmed and thus low hedgerows that allow for long-distance visibility. The river valley lands gently undulate as it runs through the upland areas of the County. Along this section, deciduous woodlands are commonly found on the gentle slopes that rise from the valley. This landscape character unit is perceived as having significant landscape value, and as being both special in landscape terms and sensitive to development. It is also perceived as having high amenity value, preferred scenic drives running along its corridor. The river valley is considered to be a landmark of the County - particularly between Kilcullen and Ballymore Eustace. The rich mix of water and land features along the valley and the extent of the corridor, characterise this area of the County.

The fertile Liffey Valley area is well drained providing good soil conditions and the potential for a variety of agricultural and horticultural uses. A large proportion of the river shore is occupied by natural vegetation. Although pasturelands generally occupy the riverbanks, there are also a significant number of large tillage fields. Small parcels of coniferous and deciduous forests also occur along the river valley. The local population of County Kildare is largely concentrated along the Liffey Valley. Major urban centres include Leixlip, Celbridge, Clane, and Newbridge. Smaller settlements can also be found (e.g. Kilcullen, Ballymore Eustace, Straffan, Athgarvan). Scattered houses and farm structures are dispersed in the rural hinterland. The Liffey Valley embraces a high population density.

Critical Landscape Factors:

- *Smooth Terrain Smooth terrain and the generally gentle topography and landform that characterise this landscape character unit, allow vistas over long distances without disruption along the river corridor. As a result development on the shores of the river can have a disproportionate visual impact, due to an inherent inability to be visually absorbed.*

- *Undulating topography Undulating topography is presented at some sections of this character unit (particularly to the southeast) where the land gently rises at floodplain slopes. This provides a physical shielding and has the potential to visually enclose the built form within the river valley, where it does not break the skyline.*

- *Low Vegetation The grassland, tillage fields and generally low hedgerows along the river corridor are commonly uniform in appearance, failing to break up vistas, allowing long distance visibility and proving unable to visually absorb new development.*

- *Shelter Vegetation Shelter vegetation is represented at some stretches of this unit by the presence of natural and native woodland that grows on the floodplains of the river, as well as by conifer plantation in adjacent lands. In a similar manner to undulating topography, shelter vegetation has a shielding and absorbing quality in landscape terms. It can provide a natural visual barrier as well as add to the complexity of a vista.*

- *Localised River Views This character unit follows the path of the Liffey River, which is easily accessible by the local roads. Many views of the river valley are available from the local roads and from vantage points and bridges located along the water corridor."*

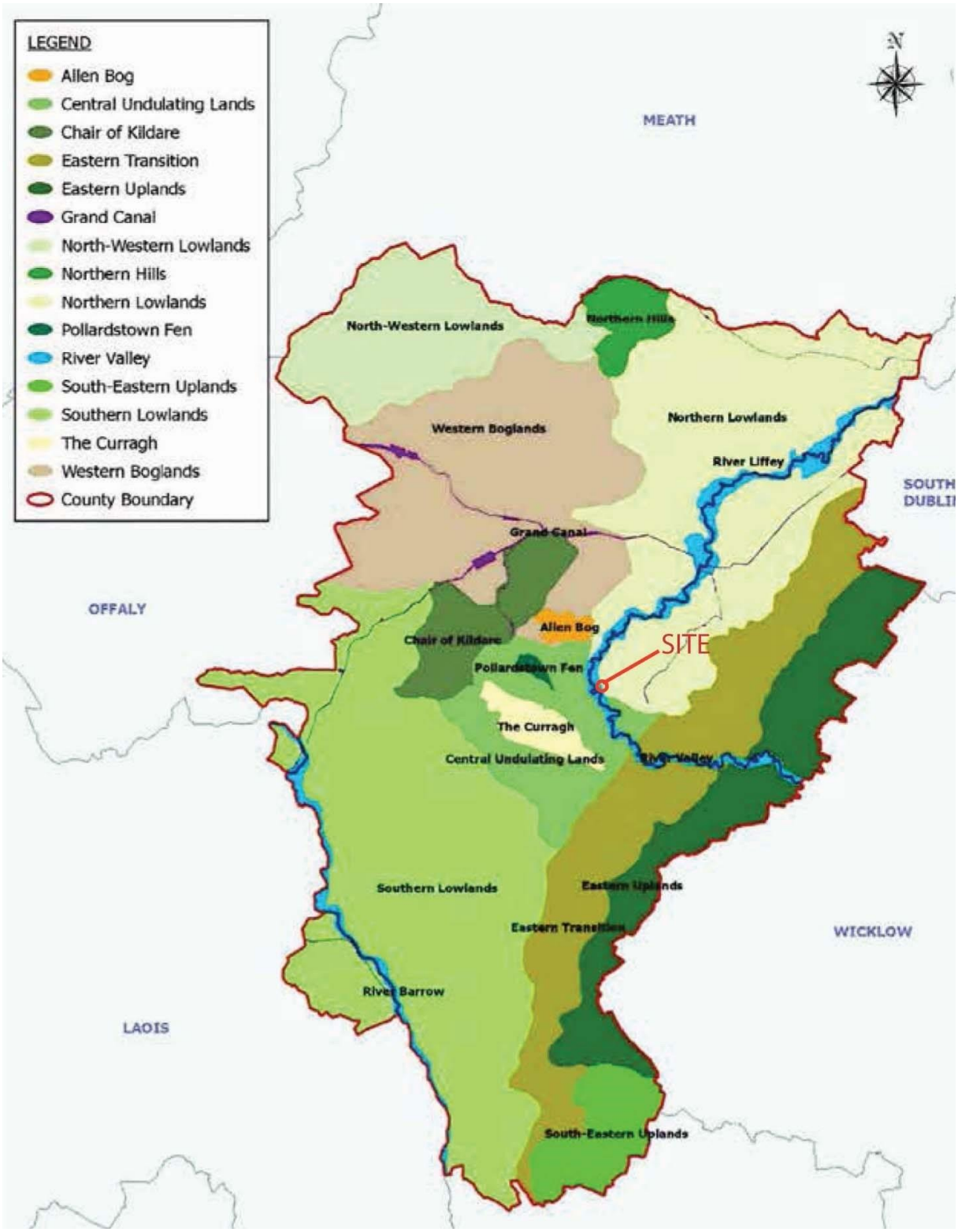


Figure 12.10: Landscape Character Types (Source: KCDP 2017 – 2023 & TBS annotations 2022)

12.5.7.2 Landscape Character Types-Sensitivity

Within this Landscape Character assessment the Northern Lowlands Character Type is categorised as 'Class 1 – Low Sensitivity', which is described as *"Areas with the capacity to generally accommodate a wide range of uses without significant adverse effects on the appearance or character of the area".*

The River Liffey Character Type is categorised as 'Class 4 – Special', which means that these are *"Areas with low capacity to accommodate uses without significant adverse effects on the appearance or character of the landscape having regard to special sensitivity factors".*

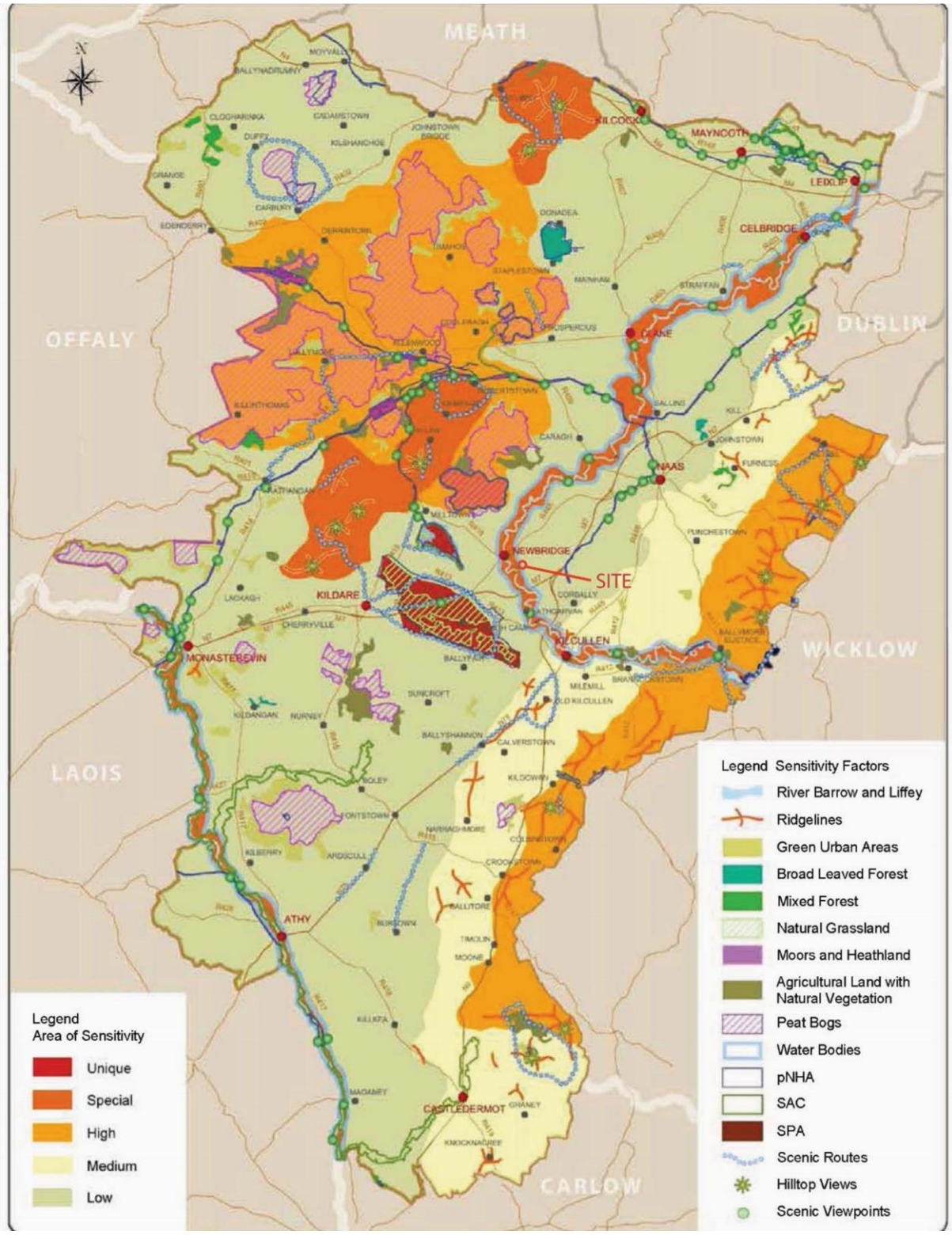


Figure 13.11: Landscape Sensitivity Areas (Source: KCDP 2017 – 2023 & TBS annotations 2022)

12.5.7.3 Historic Landscape Characterisation

No Historic Landscape Characterisation has been carried out for this area yet.

12.5.7.4 Existing Trees, Woodlands and Hedgerows

12.5.7.5 Kildare County Development Plan 2017-2023

In relation to trees, woodlands and hedgerows it is the policy of Kildare County Council to:

"GI 8: Contribute towards the protection of and manage existing networks of woodlands, trees and hedgerows which are of amenity or biodiversity value and/or contribute to landscape character, and to strengthen local networks.

GI 9: Ensure that proper provision is made for the consideration, protection and management of existing networks of woodlands, trees and hedgerows when undertaking, approving or authorising development.

GI 10: Ensure a Tree Management Plan is provided to ensure that trees are adequately protected during development and incorporated into the design of new developments.

GI 11: Ensure that hedgerow removal to facilitate development is kept to an absolute minimum and, where unavoidable, a requirement for mitigation planting will be required comprising a hedge of similar length and species composition to the original, established as close as is practicable to the original and where possible linking in to existing adjacent hedges. Native plants of a local provenance should be used for any such planting.

GI 12: Restrict the cutting of hedges during the bird-nesting season (1st March until 31st August), except in certain legally defined circumstances, in accordance with the provisions of the Wildlife (Amendment) Act 2000.

GI 13: Recognise the biodiversity and archaeological importance of townland boundaries, including hedgerows, and promote their protection and retention.

GI 14: Contribute towards the protection where possible of the trees which are considered an important component of demesne landscapes.

GI 15: Encourage the protection of historic hedgerows or significant hedgerows which serve to link habitat areas to each other and the surrounding countryside.

GI 16: Encourage the planting of woodlands, trees and hedgerows as part of new developments using native plants of local provenance."

The Newbridge LAP 2013-2019 indicates trees that are to be protected within the LAP boundary (refer to Figure 12.12) and those that are in close proximity to the subject site are listed on Table 12.7 below:

No. on Map	Description
4	Trees in the park along the east and west bank of the Liffey Valley Park
5	Trees in grounds of Ryston along Athgarvan Road and at main entrance. Also includes trees along boundary to residential development to the south.
6	Trees along west bank of River Liffey on Athgarvan Rd.

Table 13.7: Protected trees – Newbridge LAP 2013-2019

Within the Newbridge LAP the hedgerow along the south-eastern boundary of the subject site is referred to as a 'Key Hedgerow', as shown on Figure 13.9.

Tree Preservation Orders:

There are no Tree Preservation Orders located within or in close proximity to the subject site.

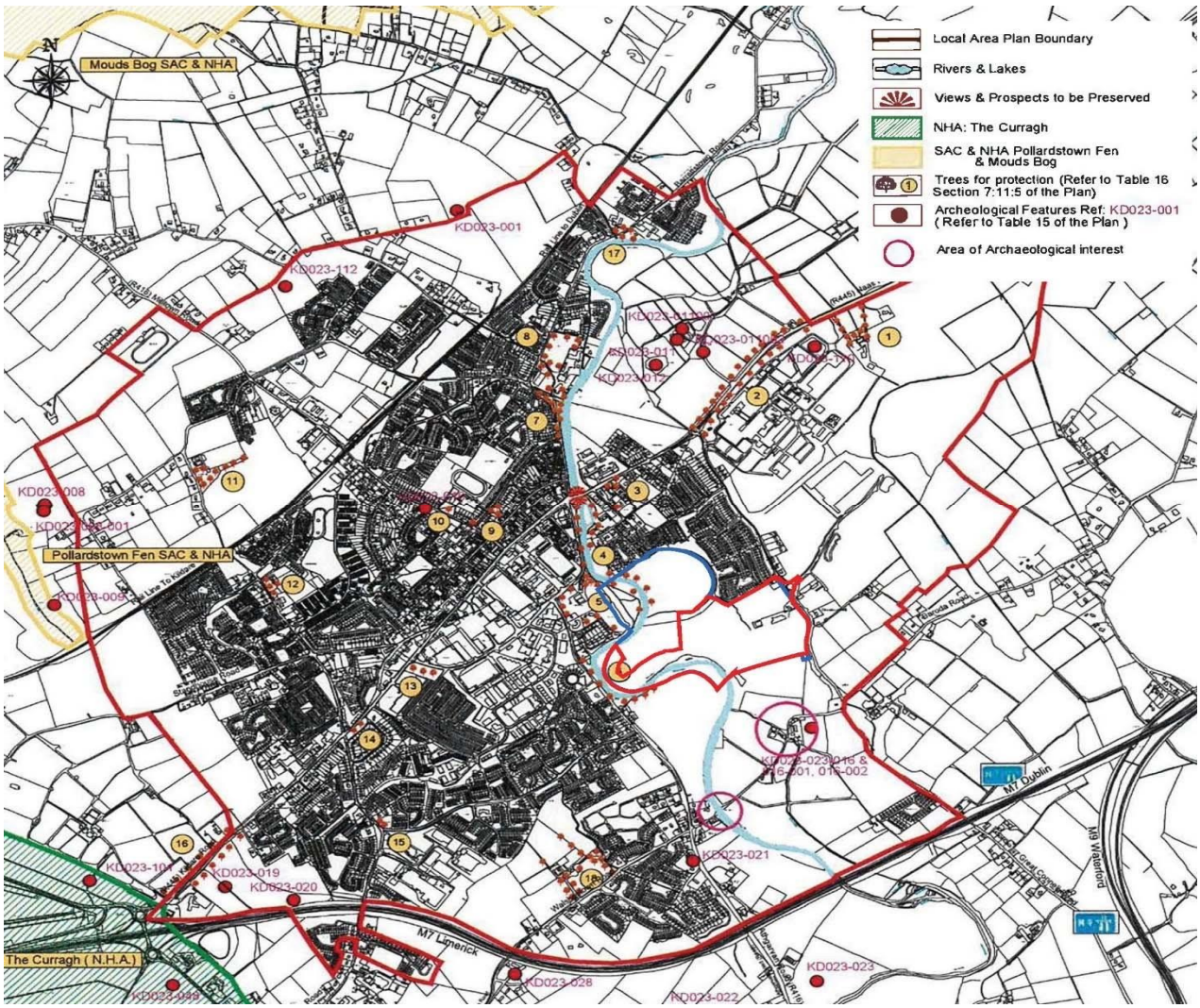


Figure 12.12: Natural & Archaeological Heritage (Source: Newbridge LAP 2013-2019 & TBS annotations 2022)

12.5.7.6 Site Tree & Hedgerow Survey

A comprehensive arboricultural survey was carried out by Arborist Associates Ltd, which was submitted with this application under separate cove and should be read in conjunction with this Chapter.

"At the north-eastern end of the site area, there are site offices and associated machinery sheds and car parking located centrally, along with two houses and they all have access off the local road to the east. The most northerly located house is known as "Carraig" while the house to the south of it is known as "Valencia Lodge". The bulk of the trees on this site area are located around these houses and yards and consist of a mix of ornamental tree species planted as part of the landscaping of these properties over the years with most of an early mature age class. Located along the boundary of the second house, there is a prominent group of trees made up of two mature Copper Beech (Nos.1841 & 1842) and one mature Sycamore (Nos.1843). Trees around the formal grounds of the first house of quality include Tree Nos.1811, 1814, 1818, 1825 & 1827 which have been given a category grade of 'B' and Tree No.1833 which has been given a category grade of 'A'.

The site area outside these houses and yards is in agricultural use with the bulk of this currently in use for tillage farming with crops of cereals. The 'River Liffey' runs along part of the western boundary of the site area. There are a number of overhead utility lines traversing the site, mainly located along the southern boundary and also extending across the site in a broadly south -west to northeast direction. These fields within the site area are bounded by hedgerows to the south and east while the boundary to the west and part of the northern boundary are undefined. The boundary of these fields to the existing residential development (Wellesley Manor) to the north consists mainly of a concrete block wall with a small section consisting of Cherry Laurel hedge. The hedgerows on the site are typical of the agricultural hedgerows in this area and consist mainly of Hawthorn with Elder with an understory of Bramble and Dogrose which in places due to lapsed management are encroaching out on the adjoining fields. Within some of the hedgerows, Ash and Sycamore trees have grown up above the hedge line and are forming part of the upper canopy formation. These trees are mainly in the mature age category and some are of prominence, in particular (Nos.1844-1846) within the treescape of this area.

A line of Poplar trees are located along the southern side of the southern hedgerow (No.4) and these have developed into a line of trees of some prominence within the treescape of the local area. This line of trees has been broken into three sections (Tree Line Nos.1-3) based on their different past management which has seen all of Tree Line No.2 and parts of Tree Line Nos. 1 & 3 being heavily cut down/topped as part of their management due to their proximity to the overhead utility line to the north. These lines of Poplar trees are also beginning to seed/sucker themselves into this area creating a broader line of trees in places due to the lapse in management of the surrounding hedgerow. In the south-west corner, there is a small group of large mature Poplar (Nos.1849-1852) and a linear woodland belt which extends southwards outside the site area. This woodland consists of a tree species such as Oak and Beech of a mature age class and the trees within this woodland closest to the site boundary have been numbered (Nos.1853-1859) and this woodland belt is of prominence within the treescape of this area. Extending north-south along the bank of the 'River Liffey' is a hedgerow (No.5) and this has extended out to create a scrub woodland belt area which is of some visual value to the treescape of this area and most likely of ecological value. It is made up of Goat and Crack Willow with an understory of Bramble and Dogrose. Within the overall site area 69 No. Trees have been individually tagged with 6 Hedges, 3 Tree Lines, 3 Scrub Areas, 1 Scrub Woodland Belt, 1 Shrub Border and 1
Woodland Belt being numbered numerically."
(Source: Arborist Associates Ltd., 2022)

12.6 Impacts

12.6.1 Impacts on Existing Trees & Hedgerows

The retention of the existing trees and hedgerows are a priority of the landscape strategy as they strongly contribute to setting of the development and will assist in screening the proposed structures from the adjoining lands and road, as well as providing visual amenity and biodiversity benefits. The design of the development has where possible followed the pattern of exiting field boundaries to ensure retention of existing trees and hedgerows where possible and to retain the historical patterns of the landscape. However in order to facilitate the construction of the proposed buildings, access road and car parking, a number of trees and hedgerows will need to be removed.

The Arborist Associates Ltd. report discusses the implication of the proposed development on the existing trees and hedgerows in their report, including the summary below:

"..38 of the 69No.indivual trees surveyed plus 17 trees from Tree Line No.1, two full hedges and c.124m of hedging made of small sections of other hedges plus one Shrub Border are being proposed for removal to accommodate the proposed development or as part of active management and this is made up of a mix of tree species, age classes and sizes.
The trees for removal are broken down into the following category grades:

- *2 Category 'U' trees.*
- *1 Category 'A' trees.*
- *9 Category 'B' trees.*
- *26 Category 'C' trees plus 17 trees from Tree Line No.1."*

(Source: Arborist Associates Ltd., 2022)

The 'Key Hedgerow' identified in the Newbridge LAP (shown on Figure 13.9) that runs along the southern boundary of the subject site, is to be largely retained and incorporated into the proposed development, apart from where future vehicular, pedestrian and cyclist linkages are proposed. In order to mitigate against the impact of the existing vegetation being removed, a tree, hedge and shrub planting programme within the subject site has been proposed, as shown on the landscape drawings 308 and Figure 13.1. During the construction phase the existing trees and vegetation that are to be retained will be protected from construction traffic, material storage, ground level changes and any other disturbances, in accordance with the recommendations set out in BS5837: 2012 and detailed in the arborist's report.

Due to the necessary removal of a number of trees and hedgerows the overall impact of the proposed development on the existing trees and hedgerows will be **slight and negative** during the construction phase, prior to the establishment of proposed trees, hedge and shrub planting throughout the site.

During the operational phase, and with consideration for the proposed planting measures it is anticipated that the proposed development will have a **not significant-slight and negative** impact in the short term, reducing to **slight and neutral** impact on trees and hedgerows in the long term, as the proposed planting becomes more established and matures.

12.6.2 Impacts on Landscape Character

The proposed development of the subject site will result in a change to the landscape character which will be most noticeable locally, such as from the Great Connell Road. However, the

development of the subject site will be appropriate to the site's setting, by reason of its close proximity Newbridge town centre and to other residential developments, such as Wellesley Manor and Belin Woods.

The conversion of the agricultural land into a more suburban environment will mean that this area will experience an intensification of use. This may be perceived during the construction phase, due to the presence of construction cranes, lighting and other visual disturbances caused by construction, as a moderate and negative impact on the character of this landscape.

However, the land is zoned for a development of this scale and its impact will lessen once the scheme is operational and the planting mitigation measures establish and mature. In this context the operational phase of the proposed development will have a slight and negative on the landscape character in this area, in the long term, as the proposed development is consistent with emerging and existing developments in the surrounding area.

12.6.3 Impact on Views

12.6.3.1 General Impacts

Construction Stage:

During the construction phase, the following elements of the proposed development have the potential to cause visual impacts, they will however be short to medium term in duration:

- Entrance into the proposed development
- Temporary site works – hoarding, lighting, cranes, car parking, storage areas
- Construction traffic – dust and emissions
- Tree and vegetation clearance
- Groundworks – cut and fill excavations
- Laying of foundations and site services

Operational Stage

The principal elements which are likely to give rise to landscape and visual impact visual impact in the long term are:

- Road entrance into the proposed development
- Alterations to ground levels
- Height of the proposed building
- New structures, road, lighting, boundaries and pathways
- Proposed tree and shrub planting
- Change of character due to intensification of use

12.6.3.2 Impact on Protected Views

There are no Listed Views or Prospects within or in close proximity to the subject site, those closest to the site are illustrated on Figures 13.5 and 13.12 and the closest protected view is:

- RL 9 New Bridge Droichead Nua (Newbridge) - Views of the River Liffey from Bridges - From St. Conleth's Bridge (Main St.), looking south-east (Protected View). Refer to verified view number 6, which is discussed below.

12.6.3.3 Impact on Visibility into the Site

For this visual impact assessment, viewpoints were selected to represent the likely visual impact from a variety of distances and direction around the site. Priority was given to views from the public domain, such as main roads, public open spaces and to views from potentially sensitive locations such as adjacent residential areas. Photomontages were compiled from the viewpoints shown in Figure 12.13. The section below should be read in conjunction with document produced by 3D Design Bureau, which contains the full-size versions of the photomontages being discussed.

Figure 12.13: Verified Viewpoint Locations (Source: 3DDB, 2022)

Visual 1: From Athgarvan Road (R416) looking east

Existing View:

From this location on the Athgarvan Road (R416) looking north-east towards the subject site the dominant features are the tree-line and the hedgerow that forms the field boundary and the construction site associated with the Belin Woods residential development (SHD Granted Under Ref. No.: ABP-302141-18) (as shown on Figure 13.2).

Proposed Changes and Visual Impact:

It is anticipated that there will be limited glimpsed views of the proposed dwellings within the western part of the proposed subject site, from this location due to the presence of the existing trees and hedgerows.

Construction Phase:

During the construction phase, while it is likely that the majority of the construction machinery and lighting will not be visible from this location, portions of the cranes that will be required may be visible and therefore the impact may be not significant-slight and negative, with much of the impacts screened by the existing vegetation and the intervening topography.

Operational Phase:

During the operational phase it is anticipated that there will be glimpsed views of the proposed development and the impact on views from this location may be not significant and negative in the short term. However, as the existing trees and hedgerows continue to mature and the proposed tree planting becomes more established it is anticipated that this impact will lessen to imperceptible and neutral in the long term.

Visual 2: From arable field east of the river looking north-east

Existing View:

The location of this viewpoint from within the arable field east of the river looking north-east towards the subject site, permits views of the arable field with mature trees and hedgerows to its boundaries and along the river-bank. There are partial views of the dwellings within the Wellesley Manor and the Baroda Court residential developments in the background. The buildings associated with Murphy Construction that are located within the subject site and across the Great Connell Road are also visible in the background from this location.

Proposed Changes and Visual Impact:

It is anticipated that the dwellings within the southern part of the proposed development will be visible from this location, due to the relatively flat terrain between this location and the subject site. However, it is likely that the existing trees and hedgerows and the planting proposals along the boundary of the subject site will assist in screening the lower parts of the proposed dwellings.

Construction Phase:

Due to the anticipated presence of construction machinery, site hoarding, construction cranes and lighting during the construction phase of the development, the impact on views from this location will likely be moderate and negative.

Operational Phase:

During the operational phase the impact on views from this location may be ***moderate and negative*** in the short term, however as the existing trees and hedgerows continue to mature and the proposed tree planting becomes more established it is anticipated that this impact will lessen to slight and negative in the long term.

Visual 3: From amenity pathway within 'The Strand Liffey Linear Park' looking south-east

Existing View:

From this location within The Strand Liffey Linear Park the tree planting along the western bank of the river dominates the view and it also permits views over the River Liffey towards the subject site.

This location also allows views of the arable field within the subject site, the tree lined banks of the river and the mature trees to the east of the subject site are visible in the distant background.

Proposed Changes and Visual Impact:

It is anticipated that there will be partials views of the dwellings that are proposed within the western part of the subject site from this location. The existing trees in conjunction with the proposed tree and hedge planting to the boundary of the subject site, assist in screening views of the proposed development from this location.

Construction Phase:

Due to the anticipated presence of construction machinery, site hoarding, construction cranes and lighting during the construction phase of the development, the impact on views from this location will likely be moderate and negative.

Operational Phase:

During the operational phase the impact on views from this location may be moderate and negative in the short term, however as the existing trees and hedgerows continue to mature and the proposed tree planting becomes more established it is anticipated that this impact will lessen to slight and negative in the long term.

Visual 4: From amenity pathway within 'The Strand Liffey Linear Park' looking south-east

Existing View:

From this location within the public park, the exercise equipment, seating and tree planting dominate the view. The tree lined banks of the River Liffey are also visible from this location and the breaks in this tree-line provide glimpsed views into the subject site.

Proposed Changes and Visual Impact:

It is anticipated that due to the intervening existing trees and hedgerows and the proposed planting located between the subject site and this viewpoint, the proposed development will be largely screened from this location. It is likely that there will only be filtered views of the upper floors of the proposed dwellings in the most southern part of the subject site from the public park.

Construction Phase:

Due to the anticipated presence of construction machinery, site hoarding, construction cranes and lighting during the construction phase of the development, the impact on views from this location will likely be slight and negative.

Operational Phase:

During the operational phase the impact on views from this location may be slight and negative in the short term, however as the existing trees and hedgerows continue to mature and the proposed tree planting becomes more established it is anticipated that this impact will lessen to **not** significant and negative in the long term.

Visual 5: From road within the residential area 'River Court' looking south-east

Existing View:

From this location within the 'River Court' residential development looking towards the subject site, the dwellings and front garden boundaries dominate the foreground, while the existing trees and hedgerows located along the subject site's boundaries and the banks of the River Liffey are visible in the background.

Proposed Changes and Visual Impact:

Due to the intervening topography, trees and hedgerows located between the subject site and this viewpoint, it is anticipated that the proposed development will not be visible from this location.

Construction Phase and Operational Phase:

During the construction and operational phases, it is anticipated that the proposed development will not be visible from this location and therefore the visual impact will be imperceptible and neutral.

Visual 6: From St. Conleth's Bridge (Main St.), looking south-east (Protected View)

Existing View:

This view from St. Conleth's Bridge on the Main Street through Newbridge town centre is a Protected View as listed in the KCDP 2017-2023:

"RL 9: New Bridge Droichead Nua (Newbridge) - Views of the River Liffey from Bridges." The bridge permits a view of great scenic quality of the River Liffey and the mature trees along the banks of the river.

Proposed Changes and Visual Impact:

Due to the intervening topography and existing trees located between the subject site and this viewpoint, it is anticipated that the proposed development will not be visible from this location.

Construction Phase and Operational Phase:

During the construction and operational phases, it is anticipated that the proposed development will not be visible from this location and therefore the visual impact will be imperceptible and neutral.

Visual 7: From arable field within the subject site, looking south-east

Existing View:

This location within the arable field to the north of the subject site, permits views of the mature trees and hedgerows that border the site and banks of the River Liffey.

Proposed Changes and Visual Impact:

From this location it is anticipated that the upper floors of the proposed dwellings located in the northern part of the site will be visible above the existing hedgerow and it is likely there will be more expansive views of the proposed dwellings where there are breaks in the hedgerow.

Construction Phase:

Due to the anticipated presence of construction machinery, site hoarding, construction cranes and lighting during the construction phase of the development, the impact on views from this location will likely be moderate and negative.

Operational Phase:

During the operational phase the impact on views from this location may be moderate and negative in the short term, however as the existing trees and hedgerows continue to mature and the proposed tree planting becomes more established it is anticipated that this impact will lessen to slight and negative in the long term.

Visual 8: From residential area of Ash Road, looking south-east

Existing View:
The dwellings along Ash Road and Baroda Court and the planting within and along the boundary of public open space within the subject site are visible from this location.

Proposed Changes and Visual Impact:

It is anticipated that due to the local topography, the existing vegetation and buildings, the majority of the proposed development will not be visible from this location.

Construction Phase:

During the construction phase it is likely that there will be limited views of the construction machinery, scaffolding and cranes within the subject site, from this location, resulting in a slight and negative visual impact.

Operational Phase:

During the operational phase, the impact on views from this location may be not significant-slight and negative in the short term, however as the existing trees continues to mature and the proposed tree planting becomes more established it is anticipated that this impact may lessen to not significant and neutral in the long term.

Visual 9: From residential area of Wellesley Manor, looking south-east

Existing View:

From this location within Wellesley Manor, the dwellings, road and boundary hedge dominate the viewpoint. The trees located within and along boundaries of the subject site are also visible in the background.

Proposed Changes and Visual Impact:

Due to the close proximity of this viewpoint to the subject site, it is anticipated that there will be views of the upper floor and rooftops of the dwellings (Unit No.s: 422-426, 431-435 and 446-452) that are proposed in the northern part of the site. The existing boundary vegetation and the proposed tree planting will assist in filtering the views of the proposed development.

Construction Phase:

During the construction phase, due to the presence of construction traffic, construction cranes, site hoarding and lighting, it is likely that there will be slight-moderate and negative impact on views from this location.

Operational Phase:

During the operational phase, while it is anticipated that there will be views of the upper floors of the proposed dwellings as listed above, the majority of the proposed development will not be visible, due to the existing structures on the adjoining lands, the local topography and the existing trees and hedgerows. It is anticipated that the visual impact from this location will be slight-moderate and negative in the short term. In the long term, as the proposed planting becomes more established and the existing trees and hedgerows continue to mature it is likely that the visual impact from this location will lessen to slight and negative.

Visual 10: From residential area of Wellesley Manor, looking south-east

Existing View:

This viewpoint affords views of the road, dwellings and public open space within Wellesley Manor. The existing industrial buildings located within the subject site are also visible beyond the boundary wall of this residential development.

Proposed Changes and Visual Impact:

It is anticipated that due to the close proximity of this view to the subject site, there will be partial views of the 'Duplex Block 9, Apartment Blocks A and B 'that are proposed in the north-eastern part of the site. However, it is likely that the majority of the views of the proposed development will be screened by the existing residential buildings.

Construction Phase:

During the construction phase, due to the presence of construction traffic, construction cranes, site hoarding and lighting, it is likely that there will be slight-moderate and negative impact on views from this location.

Operational Phase:

During the operational phase, while it is anticipated that there will be partial views of the proposed dwellings as listed above, the majority of the proposed development will not be visible, due to the existing dwellings on the adjoining lands and the local topography. It is anticipated that the visual impact from this location will be slight-moderate and negative in the short term. In the long term,

as the proposed planting becomes established and the existing trees and hedgerows continue to mature it is likely that the visual impact from this location will lessen to slight and negative.

Visual 11: From Great Connell Road, looking south

Existing View:

The dwellings, pathways, planting, lighting and roundabout along the Great Connell Road dominate the view from this location. The entrance, hedge planting and boundary fence within the Wellesley Manor residential development are also visible from this location. The existing dwelling and associated boundary wall and planting that are located in the most north-eastern part of the subject site are also from this location

Proposed Changes and Visual Impact:

It is anticipated that one of the main changes that will be most noticeable from this location will be the removal of the existing trees, boundary wall and dwelling (that are located in the north-eastern corner of the subject site). While the existing planting and dwellings within Wellesley Manor will screen much of the views of the proposed development from this location, there will be partial views of the proposed 'Neighbourhood Centre and Apartments', 'Apartment Block C' and the tree and hedge planting proposed along the boundary with Great Connell Road.

Construction Phase:

During the construction phase the impact on views from this location will be likely be moderate and negative, due to the anticipated increase in construction vehicles, the presence of site hoarding, construction cranes, lighting and ground works that will be taking place onsite, such as the removal of the existing boundary walls and vegetation.

Operational Phase:

When the subject site is in the operational phase and the proposed tree and hedge plating matures, it is anticipated that the impact on views from this location would lessen to slight-moderate and negative in the short term and likely continue to lessen to slight and negative in the long term.

Visual 12: From roundabout on Great Connell Road, looking south-west

Existing View:

From this location at the roundabout on the Great Connell Road, the road and associated infrastructure, such as lighting, signage, pathways, traffic islands and planting dominate the view. This viewpoint also affords views of the existing industrial buildings and boundary planting within the subject site. The trees that line the banks of the River Liffey are also visible in the background.

Proposed Changes and Visual Impact:

From this location it is anticipated that the changes that will be most noticeable will be:

- The proposed signalised junction and the associated structures and planting, that will replace the existing roundabout.
- The removal of the existing trees, boundary wall and dwelling (that are located in the north-eastern corner of the subject site).

- The proposed buildings that will front onto Great Connell Road and the proposed access road, such as the 'Neighbourhood Centre and Apartments', 'Apartment Blocks A, B and C' and Duplex Blocks.
- Proposed tree, hedge and shrub planting, which will assist in the screening of the proposed development in the long term.

Construction Phase:

During the construction phase it is likely that there will be views of the construction machinery, site hoarding, construction cranes and lighting within the subject site, from this location, resulting in a moderate-significant and negative visual impact**.**

Operational Phase:

During the operational phase as the proposed planting becomes established and matures, it is anticipated that the visual impact will be moderate-significant and negative in the short term and as the existing vegetation continues to mature and the proposed planting becomes more established, it is likely that the visual impact will lessen to slight-moderate and negative in the long term, as the development is also consistent with existing and emerging development of the land in this area.

Visual 13: From Great Connell Road, at the entrance to the Murphy Group complex, looking southwest

Existing View:

This viewpoint at the entrance to the Murphy Group complex permits views of the existing mature trees that line this road, pathways, roundabout, lighting and signage. The existing industrial buildings and boundary planting within the subject site and the trees that line the banks of the River Liffey are also visible in the background.

Proposed Changes and Visual Impact:
From this location it is anticipated that the changes that will be most noticeable will be:

- The proposed signalised junction and the associated structures and planting, that will replace the existing roundabout
- The removal of the existing trees and boundary wall (that are located in the north-eastern corner of the subject site).
- Partial views of the proposed buildings that will front onto Great Connell Road and the proposed access road, such as the 'Neighbourhood Centre and Apartments', 'Apartment Blocks A, B and C' and Duplex Blocks.
- Proposed tree, hedge and shrub planting, that will assist in the screening of the proposed development in the long term.

Construction Phase:

During the construction phase it is likely that there will be views of the construction machinery, site hoarding, construction cranes and lighting within the subject site, from this location, resulting in a moderate and negative visual impact.

Operational Phase:

During the operational phase as the proposed planting becomes established and matures, it is anticipated that the visual impact will be moderate and negative in the short term and as the existing vegetation continues to mature and the proposed planting becomes more established, it is likely that the visual impact will lessen to slight and negative in the long term, as the development is also consistent with existing and emerging development of the land in this area.

Visual 14: From Great Connell Road, looking north-west

Existing View:

From this location along the Great Connell Road, the mature trees and hedgerows that line the road dominate the view. The existing industrial buildings and boundary planting within the subject site are also visible from this location.

Proposed Changes and Visual Impact:

While it is anticipated that the existing trees and hedgerows will screen much of the proposed development, it is likely that there will be partial views of the proposed dwellings 142-147, beyond the proposed trees and hedgerow.

Construction Phase:

During the construction phase, due to the presence of construction traffic, construction cranes, site hoarding and lighting, it is likely that there will be slight-moderate and negative impact on views from this location.

Operational Phase:

During the operational phase, while it is anticipated that there will be partial views of the proposed dwellings as listed above, the majority of the proposed development will not be visible, due to the existing trees and hedgerows and the local topography, it is anticipated that the visual impact from this location will be slight-moderate and negative in the short term. In the long term, as the proposed planting becomes established and the existing trees and hedgerows continue to mature it is likely that the visual impact from this location will lessen to slight and negative.

Visual 15: From Great Connell Road, looking north-west

Existing View:

The location of this viewpoint at a junction on the Great Connell Road, near the Baroda Stud, is dominated by the mature trees and hedgerows that line this road.

Proposed Changes and Visual Impact:

It is anticipated that due to the intervening mature tree-belts, located between the subject site and this viewpoint, the proposed development will not be visible from this location.

Construction Phase and Operational Phase:

During the construction and operational phases, it is anticipated that the proposed development will not be visible from this location and therefore the visual impact will **be imperceptible and neutral.**

Visual 16: From Harbour Road bridge over the M7/ M9, looking west

Existing View:

This elevated viewpoint on the Harbour Road Bridge over the M7/M9 interchange affords views over these motorways and the associated boundary fence and planting. The mature tree belts and small areas of woodland that are located within and along the boundaries of fields between this viewpoint and the subject site are also visible in the background.

Proposed Changes and Visual Impact:

Due to the intervening topography, trees and hedgerows located between the subject site and this viewpoint, it is anticipated that the proposed development will not be visible from this location.

Construction Phase and Operational Phase:

During the construction and operational phases, it is anticipated that the proposed development will not be visible from this location and therefore the visual impact will be imperceptible and neutral.

Visual 17: From Great Connell bridge over the M7, looking north-west

Existing View:

From this elevated position on a bridge over the M7 motorway, looking north-west towards the subject site, the bridge's guardrail, the mature tree planting bordering the motorway and the Great Connell road.

Proposed Changes and Visual Impact:

Due to the intervening topography, trees and hedgerows located between the subject site and this viewpoint, it is anticipated that the proposed development will not be visible from this location.

Construction Phase and Operational Phase:

During the construction and operational phases, it is anticipated that the proposed development will not be visible from this location and therefore the visual impact will be imperceptible and neutral.

Visual 18: From Athgarvan Road (R416) looking north-east

Existing View:

From this location on the Athgarvan Road (R416) the view is dominated by the Belin Woods residential development (SHD Granted Under Ref. No.: ABP-302141-18) which is currently under construction. The mature trees that line the banks of the River Liffey are also visible in the background.

Proposed Changes and Visual Impact:

It is anticipated that this view will show the southern entrance into the Belin Woods residential development and the public open space adjoining the River Liffey (as shown in Figure 13.2). Due to the intervening topography, trees and the buildings within the Belin Woods residential development, which are located between the subject site and this viewpoint, it is anticipated that the proposed development will not be visible from this location.

Construction Phase and Operational Phase:

During the construction and operational phases, it is anticipated that the proposed development will not be visible from this location and therefore the visual impact will be imperceptible and neutral.

12.7 Baseline Scenario

If this particular development is not undertaken it is likely that the land will continue in its current use, as agricultural lands. The lands within which the subject site is located are zoned for 'residential development' and it is likely that some form of development will take place on this site in the near future.

12.8 Prevention & Mitigation

12.8.1 Design Stage

Consideration was given to the avoidance of impacts wherever possible during the design of the proposed development. However, as with any development some degree of impact is inevitable and wherever possible measures have been proposed to mitigate the adverse nature of these impacts.

12.8.2 Construction Phase:

Careful attention will be paid to avoiding any potentially adverse construction related effects on the adjacent residences. Operating a well-managed, organised and planned construction site, with adequate control of construction traffic and working activity, is key to avoiding/minimising such impacts. In addition, any lighting required during the construction phase should be located sensitively to avoid unnecessary light spill into the surrounding residential areas.

12.8.3 Operational Phase:

The careful and considered approach to the layout of the proposed development is to minimise negative visual impact both locally and from the wider surrounding area and to prioritise the retention of the existing field boundaries. The landscape strategy details the landscape proposals that will assist in mitigating the landscape and visual impacts of the proposed development: (refer to landscape drawings) and the Landscape Development Report (Appendix 11 of this EIAR). The key objectives include:

- Retention of as much of the existing vegetation as possible and where tree removal is required to facilitate construction works or site development, replacement planting will take place where long-term tree growth is sustainable.
- Integration of the development into the surrounding area, minimising landscape and visual impact in particular upon nearby residential developments.
- Provide planting at the subject site's entrance and boundaries, in order to mitigate against the visual impact of the development
- Provide amenity opportunities for the future residents and the public
- Lighting of pedestrian walkways will be by means of high quality, modern standing fixtures. They should include full cut-off (FCO), low level and energy efficient lighting where practicable to reduce the impacts of light pollution on the surrounding area.

Planting Specification:

Refer to the Landscape Development Report (Appendix 11 of this EIAR) for the indicative planting schedule and landscape drawing 308.

12.9 Monitoring

Monitoring, particularly during construction phase will be on an ongoing basis and will be crucial at certain stages such as:

- During site establishment stage– prior to any works taking place, clearly identify trees and hedgerows that are to be retained and protected – ensuring tree protection measures are then place. Clearly identify trees and vegetation that are to be removed.

- During site excavation stage – ensure existing vegetation is being adequately protected and that topsoil is being correctly stripped and stored for landscape reinstatement

- During construction stage: ensure that landscape proposals are being implemented correctly

- Post-construction stage: periodic visits will be required to ensure that any defects that may occur are rectified, that the landscape proposals are successfully establishing and being correctly maintained.

12.10 Cumulative Impacts

There is a mix of residential and commercial developments in close proximity to the subject site, such as:

- Wellesley Manor residential development, to the north
- Murphy Group complex, to the north-east
- Belin Woods residential development (currently under construction), to the south-west

Cumulatively these developments together with the proposed development, in the absence of any mitigation measures have the potential to have a slight-moderate and negative impact on the character and views of the landscape, due to the intensification of land use, as it changes from agricultural to suburban development with its associated structures and infrastructural works. However, if the proposed mitigation measures proposed as part of this development, are fully implemented:

- The proposed planting will provide an attractive visual backdrop and assist in screening this development.

- Proposed tree planting to the edges of the development to minimise the visual impact of the proposed development.

- Retention and enhancement of vegetation within the existing field boundaries as much as possible, through replanting and strengthen existing hedgerows that are in poor condition

The majority of the subject site is zoned as "C12 and C13 – New Residential: To provide for new residential development", within the Newbridge LAP 2013-2019. Due to the existing zoning objectives for these lands, infrastructural and residential development will take place within the subject site and therefore there will be some degree of negative impact on the views towards these lands and on the landscape, as it changes from agricultural to suburban in character.

It is anticipated that once the mitigation measures that are proposed within this development are implemented, the cumulative impact on the landscape and views from the surrounding areas will be reduced to slight and negative, and their visual impact will continue to lessen as the planting proposals establish and mature.

12.11 Residual Impacts

Given the planning policy for the area and the subject site's proximity to Newbridge town centre, development of this site is inevitable, and it is likely that any proposed viable development will give rise to impacts of a similar nature. While none of the proposed measures, as discussed in the previous section, can fully mitigate against the intensification of land use, as it changes from agricultural land into a residential development, the proposals will be of benefit both locally and to the wider surrounding area by:

- Providing recreational amenities for future residents and the public through the creation of the public open space.

- Creating attractive, high-quality open spaces that will improve visual amenity and recreational qualities of the surrounding area.

- Reinforcing the existing field boundaries with additional native species where required

Whilst it is inevitable that there will be some negative impacts arising from this development, it's considered that the benefits outweigh the negative aspects, resulting in the potential for slight and negative-neutral residual impacts.

12.12 References

The following documents were referred to in relation to planning policies, objectives, statutory designations, context and visualisation in respect of the proposed site and the surrounding area:

- Kildare County Development Plan 2017-2023
- Newbridge Local Area Plan 2013-2019 (extended)
- Landscape Character Assessment within Kildare County Development Plan 2005-2011
- Aerial photography
- Photomontages prepared by 3D Design Bureau
- Arboriculturist Report and survey, Arborist Associates Ltd., 2022
- Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, July 2017)
- Guidelines for Landscape and Visual Impact Assessment (Landscape Institute & I.E.M.A., UK 2013)

13 ARCHAEOLOGY, ARCHITECTURE & CULTURAL HERITAGE

13.1 Introduction

Cultural Heritage has been defined by UNESCO as "the legacy of physical artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations" (Tangible Cultural Heritage, UNESCO http://www.unesco.org/new/en/cairo/culture/tangible-cultural-heritage).

Cultural Heritage is assumed to include all humanly created features on the landscape, including portable artefacts, which might reflect the prehistoric, historic, architectural, engineering and/or social history of the area. Where appropriate, it also includes for non-physical aspects of heritage, such as history, linguistics, folklore, etc.

The Cultural Heritage of the area of the proposed project was examined through an Archaeological, Architectural Heritage and Historical study. The Archaeological and Architectural studies involved a documentary/cartographic search and focussed field inspection of the area, while the Historical study involved a documentary search.

This Chapter describes the archaeological, architectural and cultural heritage significance of the development site and its environs and assesses the impact of the proposed development including a 'baseline' scenario and the residual impacts.

The assessment was completed by Martin E Byrne MA, Dip. EIA Mgmt., MIAI of Byrne Mullins & Associates Archaeological & Historical Heritage Consultants, who has in excess of 30 years' experience in preparing Archaeological and Cultural Heritage Assessments Mr Byrne was a member of the National Monuments Service Expert Advisory Committee (2009-2010) tasked with reviewing the proposed National Monuments (Consolidated) Act with respect to the area of Monument Protection and to bring forward proposals for associated statutory regulations; he is founding Board Member and former Chairperson of the Institute of Archaeologists of Ireland (IAI) and represented the IAI on the Royal Irish Academy Standing Committee for Archaeology (2014-2018). He is currently a company member of The Discovery Programme – Centre for Irish Archaeological Research, representing the IAI.

13.2 Relevant Legislation and Guidelines

The general EIA legislation and guidance documents are referenced in Sections 1.2 and 1.5 of this EIAR. In addition the Heritage Act (1995) contains a list of various aspects of heritage, including archaeological monuments and objects, architectural heritage, fauna, flora, geology, heritage gardens and parks, heritage objects, inland waterways, landscapes, monuments, seascapes, wildlife habitats, and wrecks.

13.3 Methodology

The overall Cultural Heritage components of the study comprise the results of a survey and evaluation of sites of archaeological and architectural heritage architectural potential within, and in the immediate environs of, the proposed development area, together with historical research of the

subject area and environs. The work consists of the results of a paper survey, field inspection and programme of archaeological testing.

13.3.1 Paper Survey

As part of a documentary/cartographic search, the following principal sources were examined from which a list of sites and areas of Cultural Heritage interest/potential was compiled:

- Record of Monuments and Places – Co. Kildare (RMP)
- Sites and Monuments Record of the Archaeological Survey of Ireland (SMR) – www.archaeology.ie
- Topographical Files of the National Museum of Ireland
- Annual Archaeological Excavations Bulletin – www.excavations.ie
- Aerial Photographic & Cartographic Archive of the Ordnance Survey of Ireland – www.osi.ie
- National Inventory of Architectural Heritage (NIAH) – www.buildingsofireland.ie
- Place names Commission – www.logainm.ie
- GSI Open Topographic Data Viewer (LiDAR information) – www.dcent.maps.arcgis.com
- Documentary and cartographic sources in Kildare County Library (see Appendix 11.1)
- Kildare County Development Plan 2017 – 2023 (KCDP)
- Newbridge Local Area Plan 2013-2019, as extended (NLAP)
- Heritage Council Heritage Maps – www.heritagemaps.ie
- National Folklore Collection (The School's Collection) – www.duchas.ie

13.3.2 Field Inspection

Following completion of the preceding paper survey, a preliminary field inspection was undertaken late-October 2020. This entailed a surface reconnaissance of the subject lands and inspections of the surrounding lands, where possible. Additional detailed surface reconnaissance surveys of the subject lands were undertaken in February and April 2021, the latter after the ploughing of the lands. Surveys of watercourses were undertaken in late July 2021.

13.3.3 Geophysical Survey

A high resolution magnetic gradiometer survey was undertaken by Target Archaeological Geophysics in December 2020, under Licence No. 20R0242 from the Department of Culture, Heritage and the Gaeltacht. A number of subsurface anomalies were detected, some of archaeological potential, as summarised below and a copy of the report is in Appendix 12.

13.3.4 Archaeological Testing

A programme of archaeological testing of the subject proposed development lands was undertake from 1st – 5th March 2021, under licence (Ref: 21E0106) from the Department of Culture, Heritage and the Gaeltacht. The results of the testing are summarised below and presented in Appendix 12.

13.4 Proposed Development

Chapter 3 of the EIAR presents a detailed description of the proposed development. Those aspects that are relevant to the overall Cultural Heritage Assessment are the construction of the residential units, neighbourhood centre, crèche and recreational and landscaped areas involving extensive ground disturbance including the stripping and stockpiling of top soil and subsoils and excavation of subsoils for building foundations, the installation of underground services and the construction of access roads,

the construction of a river crossing and the provision of surface water management and flood relief measures.

13.5 Receiving Environment

13.5.1 Defined Study Area

The development lands (red-line boundary) and an area of 500m surrounding the boundary were determined to be the Study Area for Cultural Heritage. The extent of the Study Area reflects an appropriate context for the development, beyond which it was considered that a development of this nature would have no direct/indirect impacts.

13.5.2 Historical Background

The subject lands form parts of the townlands of Great Connell and Kilbelin, in civil parish of Great Connell and barony of Connell. The origin of the name Great Connell is unclear; the Irish form of the name Connail Mhór; (Place names Commission – www.logainm.ie) may be translated as the 'great pleasant area' or great area of [Corn] stalks or stubble; Kilbelin derives from *Coill Bhéalain* – 'Belin's Wood'.

Prior to the Anglo-Norman invasions, the general region where the proposed development is located formed part of the territories of the Uí Faelain, who controlled at ford over the River Liffey at Great Connell, approximately 720m to the south of the southern site boundary. This ford, which still exists close to Walshestown Cross on the Athgarvan Road, is called 'Connell Ford'; there is no documentary evidence to indicate whether any possible settlement was located at the ford.

Following the Anglo-Norman invasions, the lands at Kildare and the surrounding region was granted to Meyler FitzHenry, a grandson of Henry I. In 1202 Meiler founded a priory at Great Connell. Augustinian Canons from the Monastery of Llanthony in Monmouthshire, Wales were brought to fill the foundation, which was dedicated to the Blessed Virgin and St. David. Meiler bestowed rectories which stretched across Kildare and Laois and into the dioceses of Clonfert and Killaloe on his monastery, thus ensuring its wealth and power.

Meiler subsequently exchanged his original grant of land in Kildare for an estate in Laois, but on his death in 1220 he was buried in the chapter house of his foundation at Great Connell. The inscription of his tomb read (quoted in Fitzgerald, 1898, 305): 'Entombed are the bones of him they noble Meyler call who was the tameless tamer of the Irish nation all'.

Like many of the religious houses founded in Ireland by the early Norman settlers, the priory at Great Connell became part of the Norman defence against the native Irish. As a key to the southern approaches to the Pale, the priory provided a safe haven for Government officials on their journeys into more dangerous territories.

The Lord Deputy and his retinue could ride from Dublin and reach the Abbey before nightfall, where they would enjoy the hospitality of the canons before travelling on to more inhospitable parts. On the rare occasion when the King came to Ireland, Great Connell was one of the places fit to receive him. When Richard II was in Ireland in 1395 he visited Connell and 'in the great hall within the abbey' he received homage from O'Connor of Offaly (Curtis, 1927, 193).

The Augustinian canons were soldiers as well as monks. In 1406, for example, the prior and twenty Englishmen defeated 200 of the Irish on the Curragh. The abbey was a fortress and was subject to

frequent attacks by the Irish. In 1427 it is reported that the 'town' of Connell was burnt and again in 1458 the priory was 'wasted by the Irish enemy'. On this occasion, Henry VI granted the prior the rectory and towns of Morristown and Ladytown. This added to the income of the priory so that repairs could be made.

Connell was also a place of culture and learning and a copy of Eusebius' *Ecclesiastica Historia* was written there in 1237 and is preserved in the library of Hereford Cathedral (Valkenburg, 1970, 524).

The prior of Great Connell was an influential figure. He had the right to sit in the Irish Parliament as a lord spiritual and thus there was a strong political dimension to the position. For the fifty years succeeding the accession of Garret Mór as 8th Earl of Kildare, the Fitzgeralds were the virtual rulers of Ireland, as for mort of this period they held the position of Lord Deputy.

There is strong physical evidence that Garrett Mór had strong links with the priory. A number of paving tiles from Connell are held in the National Museum of Ireland which display the Geraldine shield and motto with a Tudor rose in four corners. The design includes G for Garrett and E for Elizabeth, his wife (Valkenburg, 1970, 527). The other type of tile found at Connell is a duplicate of tiles found at the Augustinian house in Trim (Leask, 1941-2), 273-4). This association with the Earls of Kildare meant that Connell was often the centre of political events in Ireland. In May 1478, for example, Garrett held his first parliament in Naas, adjourned to Dublin and then to Connell Priory where it was dissolved in September.

In 1519 Walter Wellesley became prior of Connell. Wellesley came from an influential and powerful family and was well connected to many of the more important Anglo-Irish families of the Pale. He subsequently became Bishop of Kildare (1529) with permission to retain the priory of Connell (Valkenburg, 1970, 535).

In 1535 the suppression of the monasteries in England began, following Henry VIII's breaking away from the pope and becoming supreme head of the church. There was a delay in commencing the dissolution of monasteries in Ireland, as parliament, at first, refused to enact the legislation. However, by 1539 the writing was on the wall for the monasteries. This was the last year of Wellesley's life and he made efforts to ward off confiscation of Great Connell. However, his efforts were in vain, although he died before the monastery was finally surrendered in 1540 by his successor, and probable nephew, Robert Wellesley.

The jurors appointed to enquire into the extent of the priory found that "all the buildings were standing as at the time of dissolution; the body of the church had been the parish church from time immemorial, the chancel and chapel of the Blessed Mary to the north of it could be demolished, but the belfry could be converted into a castle or fortilage to defend the town and district by the farmer who would need all other buildings, etc., on the 4-acres site; there was a dove-cote on the town walls, the demesne being 131 acres, and the possessions included over 1,260 acres, a mill, five castles, many messuages and cottages, and c. 12 parish churches" (Gwynn & Hadcock, 1970, 177).

The property was initially granted to Edward Randolfe but re-granted in 1560 to Sir Nicholas White. It was subsequently granted to Sir Edmond Butler in 1566. The wealth of the priory property was again assessed in 1606, which revealed that the possessions included eighteen townlands together with churches, rectories, chapels and tithes of twenty five others, all in county Kildare, besides large possessions in Queen's County (Fitzgerald, 1898, 212-3).

The Civil Survey of 1656-8 notes that the townland of Great Connell was then known as Connelmore and comprised 1319 plantation acres of profitable land; in 1641 it is recorded that it formed part of an extensive landholding owned by Sir Nicholas White of Leixlip but ownership had been transferred to

Arthur Jones by 1670; a census of 1659 recorded a population of 7 English - www.downsurvey.tcd.ie. Maps of the area in 1656-8 and 1670 are illustrated in Figures 13.1 and 13.2.

In 1697 an Act was passed in the Irish Parliament 'for banishing all Papists exercising any ecclesiastical jurisdiction, and all regulars of the popish clergy out of the kingdom'. Although diocesan priests were allowed to stay, they were forced to register in court and could not carry out their functions in churches. This led to the establishment of unauthorised 'mass houses' across the country.

In 1731 a report by the protestant minister of Great and Old Connell notes that a 'mass house' existed at Connell in 1731 and that he had it 'pulled down' as it had been located 'in the direct road to my church and not far from it' (Connolly, 2001, 38). The exact location of this 'mass house' is unclear. It had been assumed that it was located in Great Connell but, at there was no Protestant church in the townland at this time, it must have been in the neighbouring townland of Old Connell where a Protestant church is known to have existed at that time, as indicated on Noble and Keenan's *Grand Jury Map* of 1752 (Figure 13.3).

However, a Protestant church was subsequently built at Great Connell, adjacent Connellmore Crossroad, is indicated in Taylor's map of 1783 (Figure 13.4). There appears to be some confusion about this church as Connolly (2001, 49), quoting from the visitation notebooks of Charles Lindsay, Bishop of Kildare, dating to 1804-8, notes that the church had never been finished, while Lewis, writing in 1837 (Vol. 1, 393), notes that the church, consisting of a small plain edifice, had been built for over fifty years and that the Ecclesiastical Commissioners had recently made a grant towards it repair. The church was subsequently abandoned, although the ruined remains are still extant today.

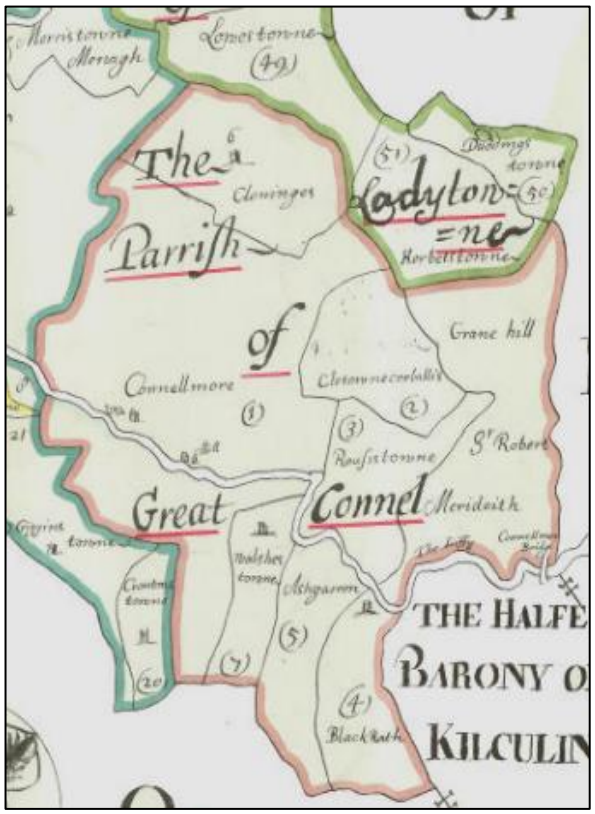


Figure 13.1 Extract from Civil Survey Map of 1656-8 (North to left)

Figure 13.2 Extract from 1670 Map

Figure 13.3 Extract from Noble & Keenan - 1752

Both Noble & Keenan (1752; Figure 11.3) and Taylor (1783; Figure 13.4) indicate a 'New Bridge' crossing the Liffey to the north of the subject lands; this was an eighteenth century replacement bridge to that constructed in the early fourteenth century which was washed away by floods. The replacement bridge was constructed slightly downstream of the original and the road from Naas was realigned from its junction with Great Connell Road (Buckley's Cross) to serve the bridge. Taylor's map (Figure 13.4) illustrates the realigned road together with some structures (cabins/cottages) along Great Connell Road; the map also indicates the ruinous abbey and a mill with associated mill race and the recently constructed church to the south of the subject lands.

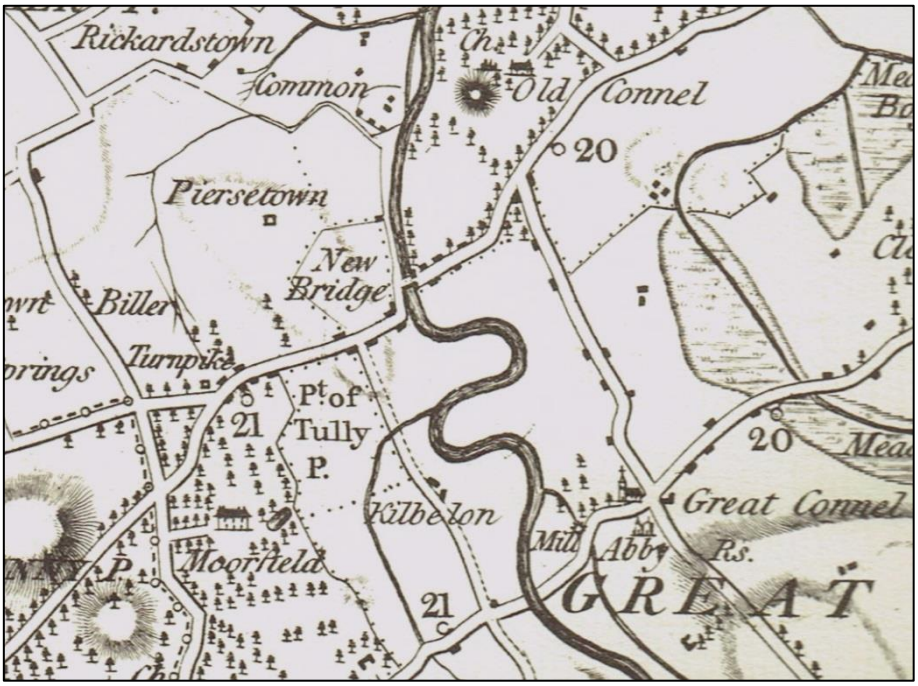


Figure 13.4 Extract from Taylor (1783)

The former abbey at Great Connell was allowed to fall into ruin after its dissolution, although it was used for agricultural purposes. It was described by Austin Cooper in 1781 (Harbison, 2000, 18; Figure 13.5) as being 'so decayed that scarcely any descriptive Acct. can be given of its remaining Ruins. One part, which I suppose to be both the Nave and Choir, but between which no distance separation can be made, measures about 200 ft. broad, in part whereof are two entire Gothic Windows, the only ones

which have resisted the Ravages of Time &c. There are very extensive ruins adjoining in which are some Pillars &c. with curious Capitals'.

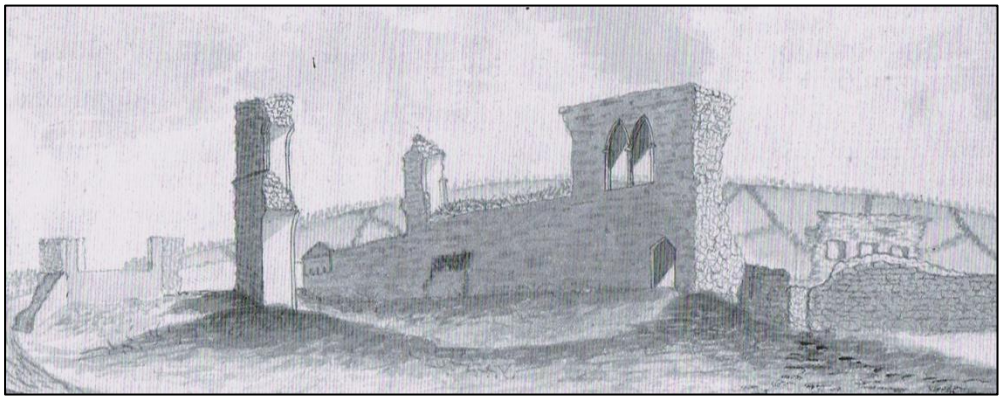


Figure 13.5 Western View of Great Connell Abbey (Cooper 1781)

In 1813, work commenced on the construction of a Military Barracks at Newbridge, during which time much of the abbey remains described by Cooper were demolished to provide construction stone (Costello, 1991, 66). The remains were subsequently described by Lewis (1837, Vol. 1, 393) as consisting "chiefly of the east gable of the church, with a great extent of ruinous walls, and many fragments of masonry, among which is the mutilated tomb of the Prior Wellesley, Bishop of Kildare.

Over a gateway, on one side, is a small sculpture of the Crucifixion, and on the other, Our Saviour crowned with thorns, and a mitred ecclesiastic; and on another fragment is the figure of St. Peter, bearing the keys. It is said that, within the memory of persons still living, a round tower, 75 feet high, was destroyed during the minority of the present proprietor's father". The tomb and effigy were removed from the site in 1971 by the Kildare Historical and Archaeological Society and re-erected in Kildare Cathedral. This project was financed by the 7th Duke of Wellington, the then head of the Wellesley family.

Lewis (ibid) also notes that the population of Great Connell civil parish, including that of the 'post-town' of Newbridge, numbered 1911 and that the land were chiefly under tillage, and that an improved system of agriculture was making gradual progress. Much of the lands in the area at this time (1837), including the subject landholding, were owned by Thomas Eyre Powell, including a residence named Great Connell Lodge. The main street within the town of Newbridge had been established by this time, running west from the bridge and lined with houses and shops, generally along the northern side, with the barracks positioned on the southern side of the street.

The Ordnance Survey (6-inch) map of 1837 (Figure 13.6) illustrates the layout of the landholding at this time. The existing southern boundary, and much of the northern, had been established by this time. The extent of the subject lands comprised three fields and portions of two others and some of the field boundaries are indicated as being planted with trees. A curving stream is shown running in northern direction through the central area of the site, much of which is bounded by a linear copse of trees; in addition, a linear copse of trees is also indicated along the eastern road frontage and a building (cottage) is shown at the south-eastern corner of the site. In addition, the map indicates that a section of the townland boundary between Great Connell and Kilbelin was formed by the western edge of the River Liffey.

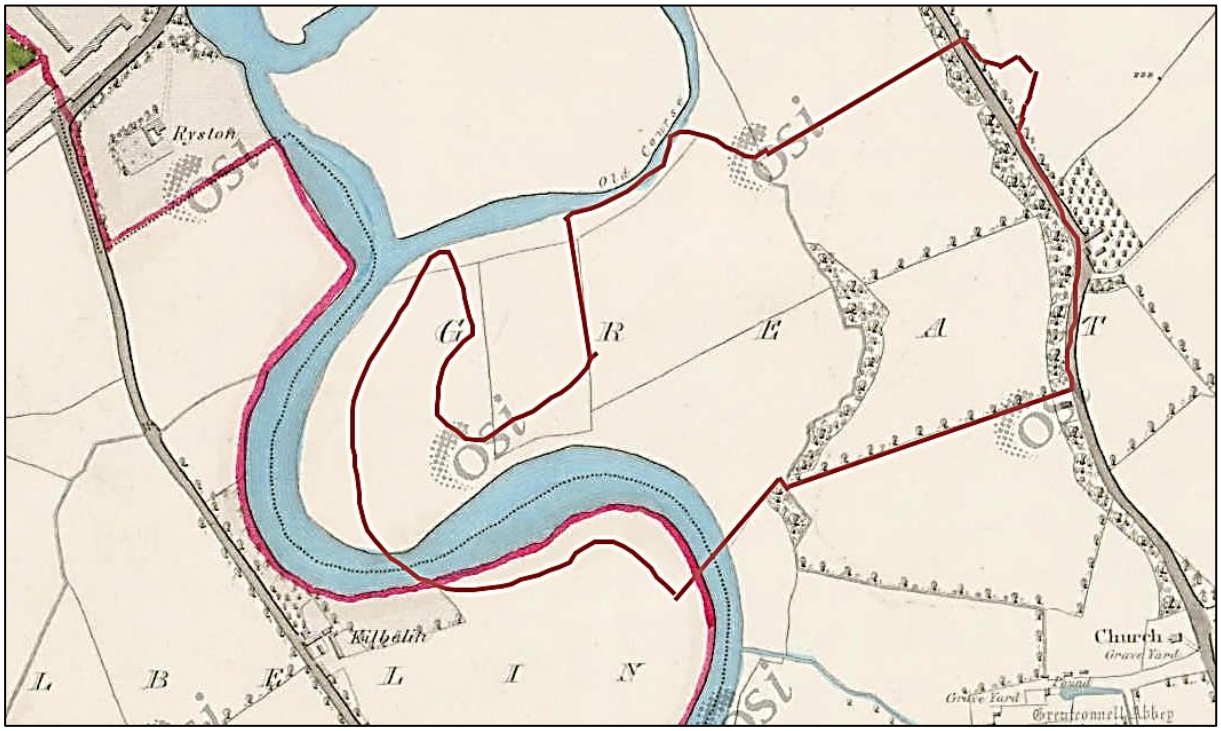


Figure 13.6 Extract from Ordnance Survey 6-inch Map of 1837

Griffith's Valuation (*Primary Valuation of Ireland 1848-64*) of 1854 indicates that the subject lands formed part of the overall estate lands of Eyre Powell; the western extent formed part of a landholding of approximately 61 acres, including a herd's house, leased by Patrick Farrell; the southern two fields, totalling approximately 23 acres, including a herd's house and offices (outbuildings) were lease by Anne Farrell; the northern two fields, totalling approximately 21 acres, including some plantation, were leased by Jerimiah Kelly.

The Ordnance Survey (25-inch) map of 1909 (Figure 13.7) illustrates the layout of the landholding at this time. Some changes to the field division layout in the southern area is indicated; much of the tree planting along the road frontage has been removed, but the inner fence-line is indicated, with a small oval-shaped feature (pond?) indicated inside the roadside boundary in the south-eastern quadrant; some additional planting is evident in the central area along the frontage. A residence with outbuildings is indicated across the road from the eastern extent and named 'Great Connell'

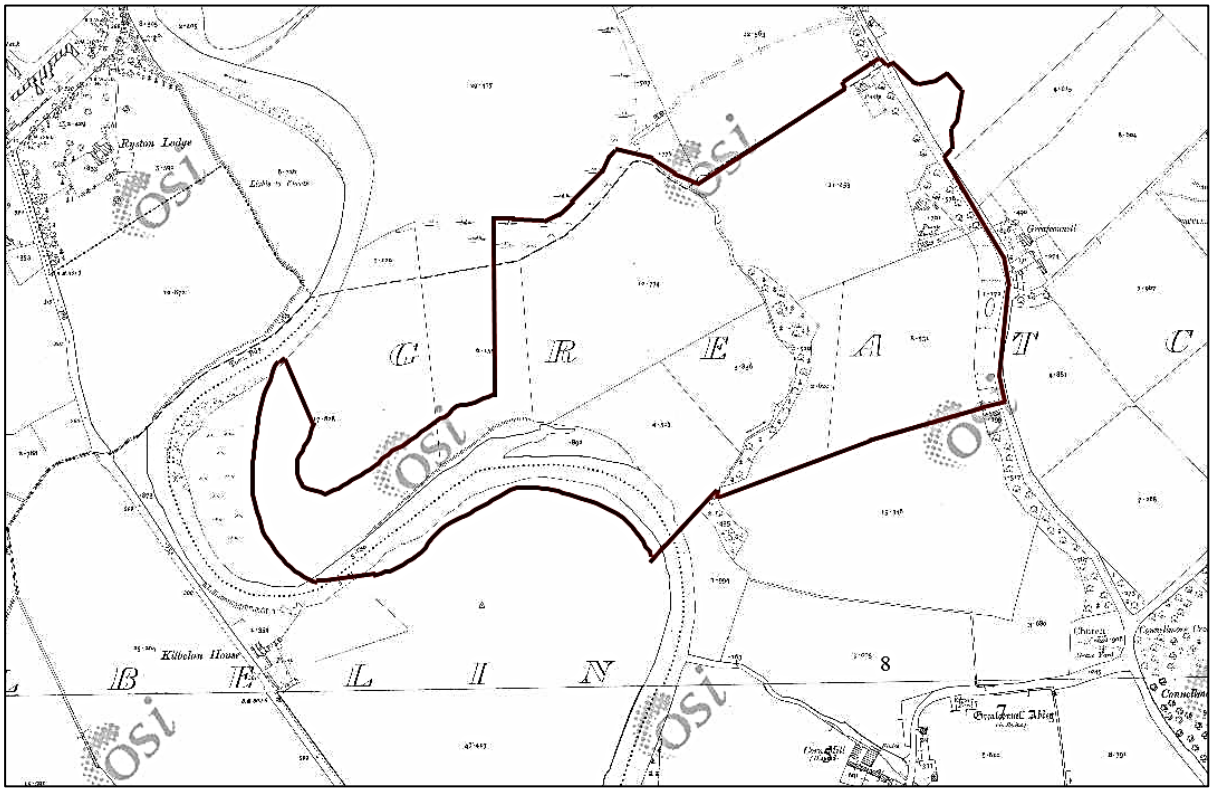


Figure 13.7 Extract from Ordnance Survey 25-inch Map of 1909

The Ordnance Survey (6-inch) map of 1939 (Figure 13.8) indicates the field boundaries in the southern area of the site have been removed, as has all the tree planting along the stream and along the road frontage. A residential plot is indicated along the eastern side, fronting onto the road and another residential plot is indicated at the north-eastern corner. In addition, part of the northern boundary is indicated as forming part of the (Newbridge) 'Town Boundary'.

In more recent years a commercial facility has been constructed adjacent the residence along the eastern road frontage; the internal field boundaries have been removed and much of the stream has been culverted, with the lands used for tillage crops. In addition, there is a large commercial facility located across the road to the east, incorporating the former residence, beyond which is Great Connell Business Park, the initial development of which included some upgrade works to Great Connell Road, including the construction of a roundabout – Plate 13.1 A foul water sewer was routed west-east through the centre of the subject lands in 2019-20. A large residential development is currently under construction on the western side of the Liffey.

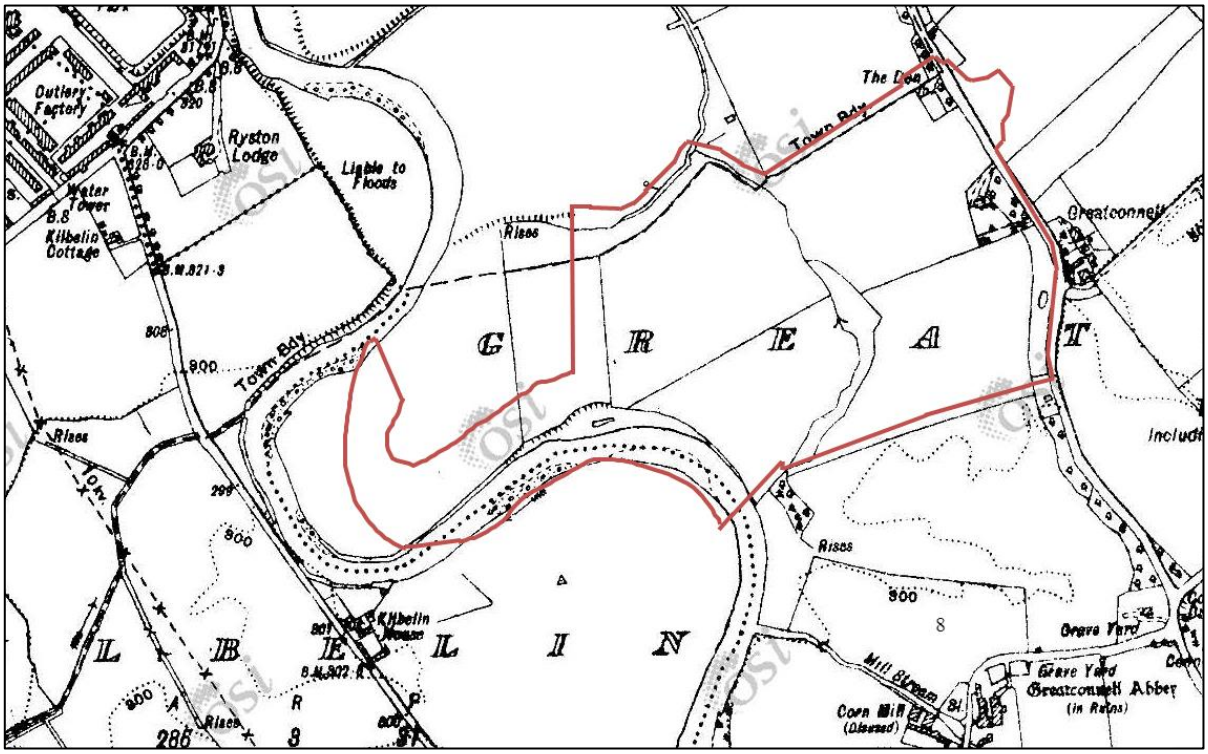


Figure 13.8 Extract from Ordnance Survey 6-inch Map of 1939

Plate 13.1 Aerial View of Site and immediate environs

13.5.3 Archaeological Heritage

Archaeology is the study of past societies through their material remains and the landscapes they lived in. 'Archaeological Heritage consists of such material remains (whether in the form of sites and monuments or artefacts in the sense of moveable objects) and environmental evidence' (Dept. of Arts, Heritage & Gaeltacht, 1999, 9).

Archaeological heritage comprises all material remains of past societies, with the potential to enhance our understanding of such societies. It includes the remains of features such as settlements, burials, ships and boats and portable objects of all kinds, from the everyday to the very special. It also includes evidence of the environment in which those societies lived. The terms "site" or "monument" are used generally to refer to fixed structures or areas of activity, as opposed to particular moveable objects. Historic wrecks are also part of the archaeological heritage (Dept. of Housing, Local Government & Heritage, 2021, 3).

Statutory Protections

The statutory and administrative framework of development control in zone of archaeological potential or in proximity to recorded monuments has two main elements:

(a) Archaeological preservation and licensing under the National Monuments Acts and
(b) Development plans and planning applications under the Planning Acts.

A. National Monuments Acts

Section 12 (1) of the National Monuments (Amendment) Act, 1994 provides that the Minister for the Environment, Heritage and Local Government shall establish and maintain a record of monuments and places where the Minister believes there are monuments, such record to be comprised of a list of monuments and relevant places and a map or maps showing each monument and relevant place in respect to each county of the State. This is referred to as the 'Record of Monuments and Places' (RMP), and monuments entered into it are referred to as 'Recorded Monuments'.

Section 12(3) of the National Monuments (Amendment) Act 1994 provides for the protection of monuments and places in the record, stating that
"*When the owner or occupier (not being the Minister) of a monument or place which has been recorded under subsection (1) of this section or any person proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such monument or place, he shall give notice in writing of his proposal to carry out the work to the Minister and shall not, except in the case of urgent necessity and with the consent of the Minister, commence work for a period of two months after having given the notice.*

B. Kildare County Development Plan 2017 - 2023

The following relevant Archaeological Heritage Objectives are set out in Section 12.9.1 of the Plan:

AH1	Manage development in a manner that protects and conserves the archaeological heritage of the county, avoids adverse impacts on sites, monuments, features or objects of significant historical or archaeological interest and secures the preservation in-situ or by record of all sites and features of historical and archaeological interest. The Council will favour preservation in – situ in accordance with the recommendation of the Framework and Principals for the Protection of Archaeological Heritage (1999) or any superseding national policy.
AH2	Have regard to the Record of Monuments and Places (RMP), the Urban Archaeological Survey and archaeological sites identified subsequent to the publication of the RMP when assessing planning applications for development. No development shall be permitted in the vicinity of a recorded feature, where it detracts from the setting of the feature or which is injurious to its cultural or educational value.
AH3	Secure the preservation (in-situ or by record) of all sites, monuments and features of significant historical or archaeological interest, included in the Record of Monuments and Places and their settings, in accordance with the recommendations of the Framework and

	Principles for the Protection of Archaeological Heritage, DAHG (1999), or any superseding national policy document
AH4	Ensure that development in the vicinity of a site of archaeological interest is not detrimental to the character of the archaeological site or its setting by reason of its location, scale, bulk or detailing and to ensure that such proposed developments are subject to an archaeological assessment. Such an assessment will seek to ensure that the development can be sited and designed in such a way as to avoid impacting on archaeological heritage that is of significant interest including previously unknown sites, features and objects.

C. Newbridge Local Area Plan 2013-2019

The following relevant Archaeological Heritage Policies are set out in Section 7.11.2 of the Plan:

AH 7	It is the policy of the Council to require an appropriate archaeological assessment to be carried out by a licensed archaeologist in respect of any proposed development likely to have an impact on a Recorded Monument or its setting

NOTE: The RMP for County Kildare was published in 1996 Any archaeological monuments and sites discovered since the publication are not subject to protections under the National Monuments Acts, unless specifically the subject of a Preservation order, but are protected in the Kildare County Development Plan under Policy AH2 above.

Archaeological Inventory

A. Terrestrial Archaeology

There are no previously identified archaeological monuments located within the subject development lands. No surface features of archaeological potential were noted by cartographic or aerial photographic research and no surface traces of archaeological potential are noted by LiDar Survey, as indicated in Figure 13.9; this does indicate the presence of a number of former geological alluvial channels; likewise, no features of archaeological potential interest were noted by detailed surface reconnaissance surveys, plough surveys or watercourse surveys.

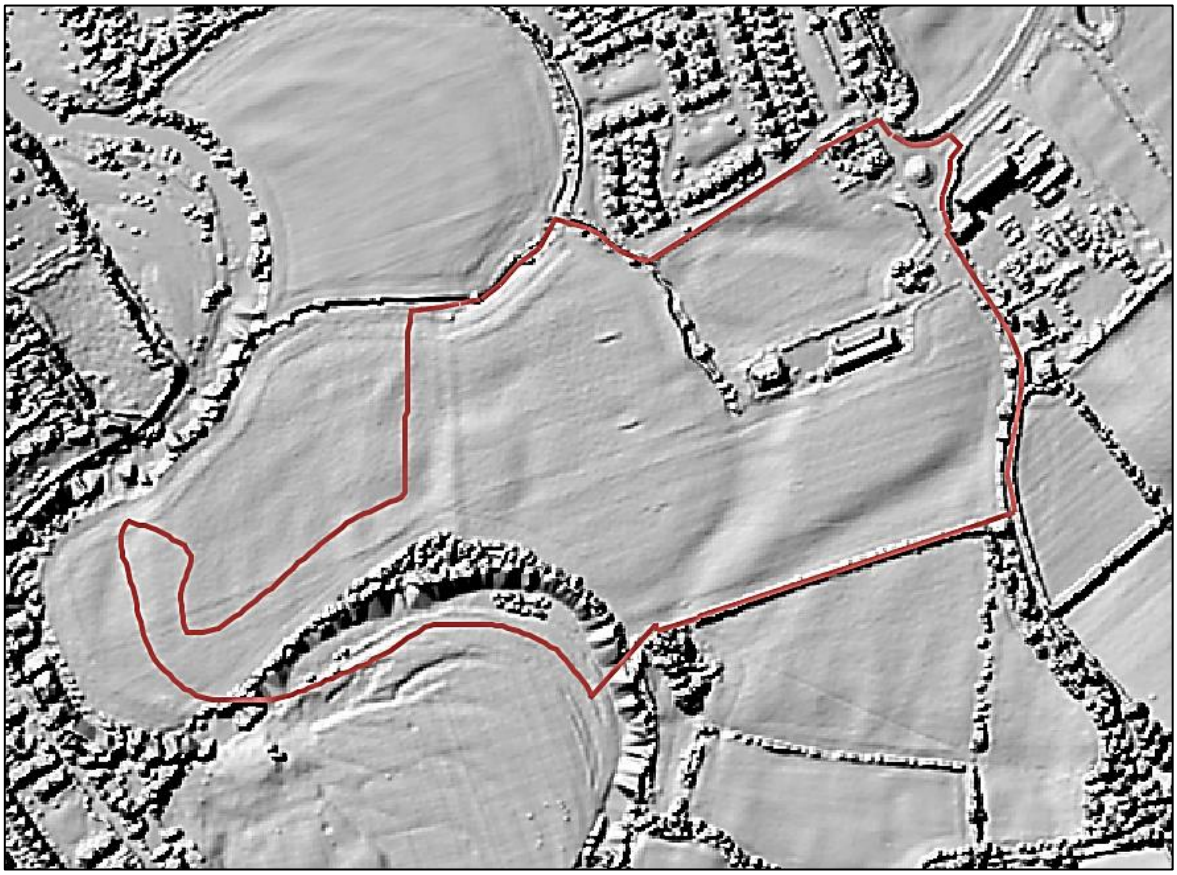


Figure 13.9 LiDar Survey of subject lands and environs

The subject lands are located between 70 – 250m outside the northern extent of the Zone of Archaeological Potential/Notification established for Great Connell Ecclesiastical and Secular Settlement Complex as illustrated below in Figure 11.10. This is designated SITE CH-1 and is associated with the Augustinian Friary of Great Connell and associated (secular) settlement site. It includes a number of individual monument/features, as follows:

Site No.	SMR No.	Classification
CH-1:1	KD023-016007	Ford
CH-1:2	KD023-127	Enclosure
CH-1:3	KD023-126	Enclosure
CH-1:4	KD023-016005	Town Defences
CH-1:5	KD023-016006	Watermill – unclassified
CH-1:6	KD023-016003	Dovecote
CH-1:7	KD023-016 KD023-016001 KD023-016002	Religious House Graveyard Sheela-na-Gig
CH-1:8	KD023-016004	Deserted Settlement - medieval

Table 13.1 List of Monuments located within CH-1

Figure 13.10 Site Location with respect to overall extent of SITE CH-1

The classifications of these individual monuments are defined in Appendix ? and they are described in Appendix ?

B. Underwater Archaeology

Watercourses have always attracted human activity for a variety of reasons, as a source of water and food, as transport routes, as a source of energy and for their spiritual, religious or ritual associations. They also act as depositories for archaeological artefacts.

There are a number of watercourses within the overall study area, including the River Liffey along the western extent of the subject lands and streams through the central and along western length of the northern boundary.

Wade surveys of the streams, utilising a batyscope/aquascope underwater viewer, were undertaken in late July 2021, and nothing of archaeological or structural interest was noted; likewise a limited wade survey of the River Liffey was undertaken and nothing of interest was noted. Furthermore, visual examinations undertaken of exposed soils along the edges of the streams and river did not reveal anything of archaeological, structural or historical interest.

13.5.4 Artefactual Discoveries

A search of the Topographical Files of the National Museum of Ireland determined that two 'stray' objects have been reported from within the defined study area. Both of these were discovered within the extent of Great Connell Abbey and are described as follows:

- *NMI Reg. No. 1937:2778*. – Fragment of a tile 'found in the abbey of Connell More of Great Connell, Co. Kildare on 1st March 1936. It was lying amidst dead leaves and other rubbish' (NMI habitat: C14: 7)
- *NMI Reg. 1943:5*. 'Medieval flooring tile from Great Connell Abbey, Co. Kildare. The tile was found in the summer of 1942, during digging operations for a drain immediately south of the graveyard at Great Connell Abbey' (NMI habitat: B3: 1). It is of pale red brick; glazed measuring 3 3/4 inches square and is 1 1/8 inches thick, it has a lion with an elaborate tail framed within a border. It is similar to a type found in western England near Chester from the Fourteenth Century.

13.5. 5 Results of Previous Archaeological Investigations

A search undertaken of the annual Archaeological Excavations Bulletin (www.excavations.ie) indicates that a number of previous licenced archaeological investigations have been undertaken in the area, both within the subject lands and wider defined study area, as follows:

Great Connell (Excavations.ie Ref: 2000:0508)
Martin Byrne, Byrne Mullins & Associates – Licence No: 00E0702

A programme of Archaeological Monitoring of topsoil-stripping associated with the infrastructural development of Great Connell Business Park, the construction of a section of the Newbridge Relief Road and a distribution centre development (former Lidl) was undertaken in September-October 2000. Such works were undertaken within lands across the road to the east of the subject site. All topsoil-stripping was carried out using mechanical excavators fitted with toothless buckets. No features, structures or finds of archaeological or historical interest were revealed during the course of the work.

Newhall & Great Connell (Excavations.ie Ref: 2016:335
Paul Duffy, IAC Ltd – Licence No: 16E0418

A programme of test trenching was carried out in two phases in greenfield areas within the proposed Upper Liffey Valley Sewerage Scheme Contract 2A (Network) pipeline footprint, located to the south and east of Newbridge, Co. Kildare. Phase 1 testing was undertaken within the construction corridor of the pipeline, including the section extending through the subject development lands and continuing through the lands to the immediate west. No features or deposits of archaeological potential were identified in these areas.

Kilbelin (Excavations.ie Ref: 2017:673)
Liam Coen, Archer Heritage – Licence No: 17E0606

This site is located across the river to the west of the subject lands. A total of 26 trenches (3514 linear metres) were excavated across the site. The trenches were targeted to assess the general potential of the location of the proposed development with two trenches, 6 & 26, located to investigate potential archaeological features identified through a geophysical survey (Detection licence no. 17R0199). Excavation proceeded in level spits no greater than 0.2m.

A series of sand, silt and gravel horizons deposited by river action underlay the topsoil. Glacially deposited boulder clay was not encountered and the trenches were only excavated to a depth of 1.2m for safety purposes. There were extensive post-medieval and modern finds throughout the upper soil levels including pottery sherds, clay pipe fragments and ferrous artefacts. Occasional animal bone fragments were present in the lower deposits. No archaeological features were identified in any of the trenches.

Great Connell
Aidan O'Connell, Archer Heritage – Licence No: 20E0099

A programme of archaeological testing was undertaken following a geophysical survey of lands located along the southern edge of the main access road through Great Connell Business Park, to other east of the subject lands. A total of 38 trenches were excavated and nothing of archaeological interest was uncovered.

13.5.6 Summary Results of Geophysical Survey

A high resolution magnetic gradiometer survey was undertaken by Target Archaeological Geophysics (Licence No: 20R0242) in December 2020, the interpretative plots of which are illustrated in Figures 13.11 and 13.12. For the purposes of the survey, the lands located to the north of the commercial facility were designated M1, with the remaining areas designated M2. The geophysical survey report is in Appendix ? and the results are summarised as follows:

Area	Response	Description	Interpretation
M1	1	Group of strongly magnetic small-scale positive responses of uncertain origin; location adjacent to stream may indicate a concentration of modern ferrous material or potential remains of a pit-type feature or burnt/fired material associated with a burnt mound	?? Archaeology
M2	2 - 5	Curving ditch-type responses suggest probable northern limits of settlement activity associated with Great Connell Abbey to the south; these anomalies extend for up to 350m and may, in part, represent an ancient road or track	Archaeology Trend
M2	6 - 9	Network of sub rectangular enclosures, represented by discrete positive and linear responses; possibly associated with medieval settlement activity concentrated in the lands to the south. Responses 8-9 may , in part, be associated with former field divisions indicated on historic O.S. mapping	Archaeology Trend
M2	10	Parallel linear responses in proximity to former field boundaries and possible enclosure remains; may be of archaeological potential or represent more recent landuse.	? Archaeology
M2	11 - 12	Poorly defined responses in proximity to former field boundary; and other features indicate don historic OS mapping; an archaeological interpretation is highly tentative.	?? Archaeology / Increased Response
M2	13 - 14	Strong magnetic discrete positive responses adjacent route of culverted stream and trees; an archaeological interpretation is highly tentative.	?? Archaeology
M2	15	Curvilinear trends of uncertain origin; might be associated with former landuse or a natural/geological source.	Trend

Table 13.2 Summary of Geophysical Survey Responses

Figure 13.11 Geophysical Interpretations – Plot 1

Figure 13.12 Geophysical Interpretations – Plot 2

13.5.7 Summary of Site Specific Programme of Archaeological Testing

A total of 27 test trenches were excavated within the overall extent of the subject lands from 1st – 5th March 2021, under licence (Ref: 21E0106) from the Department of Housing, Local Government and Heritage. The centre-line locations of the test trenches are illustrated in Figure 11.13 and were chosen to reflect the results of the geophysical survey, proposed layout and general topographical nature of the site.

Detailed results of the archaeological testing are included in Appendix ? and are summarised as follows:

- Many of the geophysical anomalies were determined to be of geological derivation, associated with natural variations in the subsoil, including iron-panning or associated with modern disturbance or recent agricultural practices, including ploughing and the burning of cereal stubble. In one case (T14), evidence of a former land division (ditch), detected by the geophysical survey, proved to be a shallow ditch (drain?) feature; the fill contained 19th century pottery and it's possible that this was associated with a former residential plot in the south-easternmost area of the site.

- A possible ditch or road/trackway feature, detected by the geophysical survey, was proved to be associated a former alluvial channel (Figure 13.9 above), the base of which was largely formed by clay marl in contrast to the immediate surrounding gravels and sands.

- Some possible narrow ditch or furrow features were uncovered in the southern area of T8; both were filled with orange/red silty sand clay, possibly dumps of burnt material. There were detected by the geophysical survey (Anomaly 6) but no artefactual material was recovered that might aid in the dating of the features.

- A series of three 'cut-features' – F12-1, F12-2 & F12-3 – were uncovered in the southern area of **T12**, commencing at approximately 11m from the southern trench end; these appear to be evidence for Anomaly 7 (possible narrow ditch features associated with potential small sub-rectangular field enclosures); however, limited investigation indicated that, although the features are of probable medieval date, based on artefactual material recovered from the surface areas of the respective fills, the features appear to represent a series of pits rather than ditches. All three features extended under the eastern edge of the trench and, consequently, their full extents were not determined.

- A narrow (300mm) trench of red-clay material, representing an un-fired brick-making clamp, was uncovered in the central northern area of T21; this extended diagonally across the trench (and extended outside the excavated limits. The brick-clay was not very firm and there was no evidence for burning along the edges of the clamp or between the bricks; instead, these areas were filled with a dark grey/light black organic soils, possibly representing decayed/desiccated wood.

- No other features of archaeological interest/potential were noted by the testing, which included areas where no geophysical anomalies were detected.

- A total of 30 sherds of pottery were recovered during the testing process; specialist analysis by Clare McCutcheon indicated that 14 were of medieval date and included sherds of Leinster Cooking Ware, Dublin-type cooking ware, Dublin-type ware, Dublin-type fineware and Kildare-type ware, dating from the late-12th to early 14th centuries. The only medieval pottery associated with subsurface features related to the probable pits uncovered in T21. The remaining post-medieval

pottery, dating from the late-17th to later-19th/early 20th centuries, comprised Glazed red earthenware, Shell-edged ware, Spongeware, Whiteware and Stoneware; the only subsurface feature which produced post-medieval pottery was the possible drain in T14.

Figure 13.13 Locations of Archaeological Test Trenches

13.6 Architectural Heritage

Architectural heritage has several definitions and meanings for people. A useful rule of thumb (which is actually the legal situation) is set out in the Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 1999 which provides the following definition:

a) Structures and buildings together with their settings and attendant grounds, fixtures and fittings,

b) Groups of such structures and buildings, and

c) Sites, which are of architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest.

A rich architectural heritage has survived to the present day in County Kildare. While there are impressive demesne features and large houses in the County, many of the County's architectural heritage has come from vernacular traditions with local craftsmen sometimes borrowing from the traditions of classical architecture to construct buildings that met local needs. This rich architectural heritage contributes enormously to the overall built environment and, indeed, helps to give it definition in terms of place and character for those that live and work in the county as well as those who visit here.

13.6.1 Record of Protected Structures (Kildare County Development Plan 2017-2023 & Newbridge Local Area Plan 2013-2019)

Section 51 of the Planning and Development Act, 2000 (as amended) requires the Development Plan to include a record of structures. These structures form part of the architectural heritage of the County and are to be protected.

Kildare County Council has drawn up this list, referred to as the Record of Protected Structures (RPS), in which each structure is given a reference number and is a constituent part of the County Development Plan; where applicable, these structures are also contained in relevant Local Area Plans (e.g. Newbridge Local Area Plan 2013-2019).

There is one structure listed in the Record of Protected Structures (RPS) of the Kildare County Development Plan 2017-2023 as being located within the subject study area associated with the development; this is the 'ruins of Great Connell Abbey and Medieval Carved Stone' – RPS No: B23-08 – and is referred to above with respect to Archaeological Heritage as SITE CH-1:7 (Section 11.4.3.2; Table 1; Figure 13.10)

13.6.2 National Inventory of Architectural Heritage (NIAH)

The National Inventory of Architectural Heritage (NIAH) is a state initiative under the administration of the Department of Culture, Heritage and the Gaeltacht. It was established on a statutory basis under the provisions of the Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act 1999. Its purpose is to identify, record, and evaluate the post-1700 architectural heritage of Ireland, uniformly and consistently as an aid in the protection and conservation of the built heritage. It is intended that the NIAH will provide the basis for the recommendations of the Minister for Culture, Heritage and the Gaeltacht to the planning authorities. The NIAH includes structures and garden features.

There are no structures of Architectural Heritage interest listed by the non-statutory NIAH as being located within the subject study area; likewise, there are no NIAH Garden Survey sites located within the defined study area.

13.7 Impacts

13.7.1 Construction Phase

Local History

The general historical background to the subject development area is discussed above in Section 13.4.2. In summary, there are no significant historical events associated with the proposed development lands which have the ability to be impacted upon by the proposed development.

Archaeological Heritage

The general archaeological background to the subject development area is discussed above in Section 13.4.3. There are no previously identified monuments situated within the extent of the subject development lands which are located between 70 – 250m outside the northern extent of the Zone of Archaeological Potential/Notification established for Great Connell Ecclesiastical and Secular Settlement Complex (SITE CH-1), as illustrated in Figure 13.10.

No surface features of archaeological potential were noted by cartographic or aerial photographic research and none are noted by LiDar Survey, as indicated in Figure 11.9; this does indicate the presence of a number of former geological alluvial channels. Likewise, no features of archaeological potential interest were noted by detailed surface reconnaissance surveys, plough surveys or watercourse surveys.

An archaeo-geophysical survey of the site revealed a number of subsurface anomalies, as summarised above in Section 13.4.3.5.; while some of the responses were interpreted as being of archaeological potential, others were considered to be associated with past agricultural land-use practices or of geological origin.

A programme of archaeological testing was subsequently undertaken; a total of 27 test trenches were excavated, the locations of which were chosen to reflect the results of the geophysical survey, proposed layout and general topographical nature of the site (Figure 13.13). The results of the testing are summarised above; these largely proved the interpretative analysis of the geophysical survey and many of the detected anomalies were demonstrated to be associated with past agricultural land-use or of geological origin.

A series of three 'cut-features' – F12-1, F12-2 & F12-3 – were uncovered in the southern area of T12, which appear to be evidence for Anomaly 7 (possible narrow ditch features associated with potential small sub-rectangular field enclosures); however, limited investigation indicated that, although the features are of probable medieval date, based on artefactual material recovered from the surface areas of the respective fills, the features appear to represent a series of pits rather than ditches. All three features extended under the eastern edge of the trench and, consequently, their full extents were not determined. It is considered that these features are associated agricultural practices and may be related to the medieval activities of Great Connell Abbey.

A narrow (300mm) trench of red-clay material, representing an un-fired brick-making clamp, was uncovered in the central northern area of T21; this extended diagonally across the trench (and extended outside the excavated limits. Given the nature of this feature, it is considered that it is of nineteenth or early twentieth century date.

The subsurface features of archaeological interest/potential are located in areas where construction-related elements of the proposed development will be undertaken. This will require disturbance to, and/or removal of, the features.

Furthermore, based on the results of the geophysical survey and archaeological testing, it is considered that there is low-moderate potential for further subsurface archaeological remains to be uncovered within the site, with increased potential for the recovery of additional archaeological artefacts, particularly pottery/ceramics.

Architectural Heritage

As noted above, there are no structures listed in the Record of Protected Structures (RPS) of the Kildare County Development Plan 2017-2023 or the Newbridge Local Area Plan 2013-2019(as extended) as being located within the subject development lands; the nearest protected structure, which is also an archaeological monument (SITE CH-1:7) is the ruinous remains of Great Connell Abbey, located a distance of 320m outside the southern extent of the subject lands. Likewise, no structures or gardens are listed by the National Inventory of Architectural Heritage (NIAH) as being located within the subject development lands or wider defined Cultural Heritage Study Area. Consequently, no structures of

architectural heritage interest have the ability to be impacted by the construction phase of the development.

13.7.2 Post-Construction/Operational Phase

There are no extant archaeological monuments or structures of architectural heritage interest located within, or in the general environs of, the subject development lands; the nearest extant archaeological monument, which is also protected in the architectural heritage record, is the ruinous remains of Great Connell Abbey (SITE CH-1) and located at a distance of 320m from the southern site boundary. Consequently, it is not predicted that the visual setting of any archaeological monument or architectural heritage structure will be impacted following the completion of the proposed development

13.8 Baseline Scenario

If the development does not proceed the site will remain in its current condition, with no changes to the potential impacts on the overall cultural heritage.

13.9 Prevention and Mitigation Measures

13.9.1 Construction Stage

As noted above in Sections 13.5.1.1 and 13.5.1.3, it is not considered that the development, as proposed will have any direct impacts on any historical or architectural heritage features or structures.

However, a number of subsurface features were determined to be of archaeological interest by the programme of archaeological testing; these include a series of three 'cut-features' (pits) of medieval date – F12-1, F12-2 & F12-3 – uncovered in the southern area of T12, and evidence of nineteenth century or early twentieth century brick making in T21. The overall extent of these features has not been determined, although based on the results of the archaeological testing and geophysics, they are likely to be small-scale in form and of very localised extent.

The subsurface features are located in areas where construction-related elements of the proposed development will be undertaken, resulting in disturbance to, and/or removal of, the features. Furthermore, based on the results of the geophysical survey and archaeological testing, it is considered that there is low-moderate potential for further subsurface archaeological remains to be uncovered within the site, with increased potential for the recovery of additional archaeological artefacts, particularly pottery/ceramics.

None of the subsurface archaeological features are directly associated with any previously identified archaeological monuments or defined zones of archaeological potential. Consequently, based on the above, the following mitigation measures with respect to archaeological heritage are suggested (subject to agreement with the Planning Authority and the National Monuments Service, Department of Housing, Local Government and Heritage):

1. Prior to the commencement of development, a suitably qualified and experienced, licence-eligible archaeologist will be appointed to undertake all mitigation measures. In that regard, the appointed archaeologist shall obtain an Archaeological Excavation Licence from the Department of Housing, Local Government and Housing.

2. All topsoil stripping/general ground reduction works onto the surface of the underlying subsoils will be monitored by the archaeologist.

3. As part of the initial phase of topsoil stripping, the overall extents of Features F12-1, F12-2 and F12-3, together with the brick-making feature uncovered in T21, should be determined. These features should be subject to a process of archaeological excavation (preservation by record).

4. In the event of additional subsurface features of archaeological interest being uncovered during the course of such monitoring, works in the immediate area of such features should cease and the advice of the National Monuments Service, Department of Housing, Local Government and Heritage should be sought to determine what additional action should be implemented.

5. Should additional archaeological/historical artefactual material be recovered during such works, then the requirements of the National Museum of Ireland with regard to such items should be implemented. This will include specialist archaeological identification and reporting and conservation, if required.

6. Following completion of the combined programmes of archaeological excavation and monitoring, and any other possible archaeological interventions/investigations, the archaeologist shall prepare a full and final report for submission to the Planning Authority and the Department of Housing, Local Government and Housing and National Museum of Ireland.

13.9.2 Post-Construction/Operational Phase

It is determined that no impacts will occur to the visual setting of any archaeological monuments or architectural heritage structures following completion of the proposed subject development. Consequently, no mitigation measures are deemed necessary.

13.10 Monitoring

The top soil stripping in the construction stage will be monitored by an experienced archaeologis.

13.11 Cumulative Impact

The cumulative impact of the proposed development, together with the proposals for an extension of the NSOORR and associated bridge crossing of the River Liffey, as well as other existing and/or approved developments in the area was assessed by taking into account the existing baseline environment and the predicted impacts of this and other approved developments in the area. It is not envisaged that any negative cumulative effects will occur with respect to Cultural Heritage assets as a result of the subject development proceeding as proposed.

13.12 Residual Impact

13.11.1 Archaeological Monuments

In terms of historical and architectural heritage, both at construction and post-constructional/operational phases, it is not considered likely that any impacts will occur; likewise, it is determined that no impacts will occur to any archaeological monuments upon completion of the

development. Consequently, the overall impact of the development on archaeological monuments will be neutral and of imperceptible significance.

13.11.2 Archaeological Heritage

In terms of Archaeological Heritage at the construction phase, the subsurface features of archaeological interest uncovered in T12 and T21 are located in areas of construction-related elements of the overall development will occur.

In the absence of mitigation, such works will results in disturbance and probable destruction of such features, resulting in a potential localised negative and profound impact on the features, with permanent and irreversible effects.; likewise, any such additional features or artefactual material that might exist within the topsoil or cut into the underlying subsoils would be destroyed and not recorded, resulting in a potential very significant and negative impact, with a permanent and irreversible effect.

However, subject to the adoption and implementation of the mitigation measures set-out above in Section 13.9.1, it is considered that any negative impacts can be negated, resulting in a positive value to the archaeological heritage record, particularly in terms of wider area of Newbridge, as well as a positive, significant impact of overall indirect effect.

13.11.3 Cultural Heritage

in terms of the overall Cultural Heritage of the wider Newbridge area, it is considered that the Residual Impact to occur as a results of the development proceeding will be related to the subsurface archaeological features contained within the site; these will be subject to a process of 'preservation by record, adding a significant value to the archaeological heritage record of the area.

13.11.4 Summary of Residual Impacts

Likely Significant Effect	Quality	Significance	Extent/Magnitude	Probability	Duration
Archaeological Monuments	Neutral	Imperceptible	Development Site	Unlikely	Long Term
Archaeological Heritage	Positive	Significant	Greater Greatconnell Area	Likely	Long Term
Cultural Heritage	Positive	Significant	Greater Greatconell Area	Likely	Long Term

13.13 References

Aalen, F.H.A, Whelan, K & Stout, M. 1997. *Atlas of the Irish Rural Landscape.* Cork University Press.

2011. *Atlas of the Irish Rural Landscape (Revised & Expanded Second Edition), Cork University Press.*

Archdall, M. 1786. *Monasticon Hibernicum or A history of the Abbies Priories and Other Religious Houses in Ireland,* Luke White Press Dublin.

Bonsall, J & Gimson, H. 2006. *Great Connell Abbey, Newbridge, Co. Kildare: Archaeological Geophysics report.* Unpublished report prepared for Byrne Mullins & Associates – Archaeological & Historical Heritage Consultants (detection licence: 06R0098). Earthsound Archaeological Geophysics

2014. *Land to the south of Great Connell Abbey, Great Connell, Newbridge, Co. Kildare: Archaeological Geophysical Survey.* Unpublished Report prepared as part of the Great Connell Abbey Exploration Project (Year 2) – detection licence: 13R0096. Earthsound Archaeological Geophysics

Bonsall, J & Loughlin, T. 2014. 'Reduce, recycle, reconstruct: resurrecting the architecture and landscape of Great Connell Priory, Newbridge, Co. Kildare'. Unpublished paper presented to *Irish Conference of Medievalists,* UCD, 2nd July 2014.

Barry, T.B. 1987. *The Archaeology of Medieval Ireland.* Routeledge, London.

Byrne, J. 2004. *Byrne's Dictionary of Irish Local History – from earliest times to c. 1900.* Mercier Press, Cork.

Clancy, P. 2006. 'The Curragh, Co. Kildare: the archaeology of an ancient grassland'. *Archaeology Ireland Heritage Guide, No. 31.* Wordwell, Bray.

Connolly, M. 2001. *from Connell to Droichead Nua – Aspects of the History of Newbridge, Co. Kildare.* Leinster Leader, Naas.

Comerford, M. Rev. 1884. *Collections relating to the Diocese of Kildare and Leighlin, II,* pp. 256-268. Dublin

Costello, C. 1991. *Guide to Kildare and West Wicklow.* Leinster Leader, Naas.

Department of Arts, Heritage, Gaeltacht and the Islands. 1999. *Framework and Principles for the Protection of the Archaeological Heritage*. Stationery Office, Dublin.

Department of Housing, Local Government & Heritage. 2021. *Archaeology in the Planning Process.* Office of Planning Regulations.

Harbison, P. 1992. Guide to the National and Historic Monuments of Ireland. Gill & Macmillan.

2000. *Cooper's Ireland. Drawings and Notes from an Eighteenth-Century Gentleman.* O'Brien Press, Dublin.

Halpin, A. & Newman, C. 2006. *Ireland: An Oxford Archaeological Guide to Sites from earliest times to AD 1600.* Oxford University Press.

Healy, P. 1976. *Buildings of Architectural Interest in County Kildare*, An Foras Forbartha, Dublin

Herity, M (ed). 2002. *Ordnance Survey Letters Kildare – Letters Containing Information Relative to the Antiquities of the County of Kildare Collected During The Progress Of The Ordnance Survey In 1837, 1838 and 1839.* Four Masters Press, Dublin.

Hogg, W.E. 1998. *The Millers & The Mills of Ireland of about 1850.* Millbrook Printing, Dublin

Hutchinson, S. 2003. *Towers, Spires and Pinnacles – A history of the cathedrals and churches of the Church of Ireland.* Wordwell, Bray

Gimson, H. 2012. *Lands surrounding Great Connell Abbey, Great Connell, Newbridge, Co. Kildare: Archaeological Geophysical Survey.* Unpublished Report prepared as part of the Great Connell Abbey Exploration Project – detection licence: 12R0126. Earthsound Archaeological Geophysics

Gwynn, A. & Hadcock, R.N. 1970. *Medieval Religious Houses: Ireland.* Dublin.

Killanin, Lord. & Duignan, M.V. 1989. *The Shell Guide to Ireland*. McGraw-Hill Ryerston, Montreal (Revised & Updated edition by P. Harbison).

Lewis, S. 1837. *A Topographical Dictionary of Ireland.* 2 Vols. London.

Lyons, MA. 2000. *Church and Society in County Kildare, c. 1470 – 1547.* Four Courts Press, Dublin.
MacLysaght, E. 1969. *Irish life in the seventeenth century.* Shannon
Moriarty, C. 2018. *The River Liffey: History and Heritage.* The Collins Press, Cork
Murphy, M & Potterton, M. 2010. *The Dublin Region in the Middle Ages. Settlement, Land-Use and Economy.* Four Courts Press/The Discovery Programme.
Nolan, W & McGrath, T (eds). 2006. *Kildare History and Society – Interdisciplinary essays on the history of an Irish County.* Geography Publications, Dublin.
O'Farrell, P. 2003. *A History of County Kildare.* Gill & Macmillan, Dublin.
O'Grady, J.S. 1905. 'Capella de Ballymany' in *J.K.A.S.,* IV, pp. 376-7.
O'Keeffe, T. 2000. *Medieval Ireland – Archaeology.* Tempus Publishing Ltd, Stroud
Ó Ríordáin, S.P. 1979. *Antiquities of the Irish Countryside*. Lilliput Press.
Price, L. (ed). 1942. *An Eighteenth Century Antiquary, The Sketches and Diaries of Austin Cooper*, Falconer Press, Dublin
Rynne, C. 2006. 2006. *Industrial Ireland, 1750-1930. An Archaeology*. Collins Press, Cork.
Sherlock, Archdeacon. 1910. 'Some notes on the Fords and Bridges over the River Liffey', *J.K.A.S. VI,* **4**, pp. 293-305.
Simmington, R.C. (ed). 1954. *The Civil Survey – Co. Kildare, 1654-56.* Irish Manuscripts Commission, Dublin.
Swift, M. 1999. *Historical Maps of Ireland.* Parkgate Books, London.
Taylor & Skinner. 1783. *Maps of the Roads of Ireland*. 2nd edition, Dublin.
Thomas, A. 1992. *The Walled Towns of Ireland.* Vol. 2. pp. 228-9. Irish Academic Press, Dublin.
Valkenburg, A. 1970. 'Walter Wellesley, Bishop of Kildare', in *J.K.A.S.* xiv, pp. 518-43.
White, N. D. 1943. *The Extents of Irish Monastic Possessions 1540-41*. Government Publications, Dublin

14 MATERIAL ASSETS: SITE SERVICES

14.1 Introduction

This Chapter describes the material assets on and in the environs of the site. It identifies the potential impacts, describes the proposed prevention and mitigation measures and assesses the impacts, including residual impacts. It also addresses a 'baseline' scenario.

Material Assets as defined in the 'Advice Guidelines on the Information to be contained in Environmental Impact Assessment Reports DRAFT' (EPA, 2017) as 'built services and infrastructure'. This includes roads and traffic, electricity, telecommunications, gas, water supply infrastructure, sewerage (built infrastructure) and waste management.

This Chapter was prepared by Mr Jim O'Callaghan MSc. Mr O'Callaghan has a BA (Mod) in Geography and MSc in Environmental Science. He is a Chartered Member of the Institution of Waste Management a Chartered Environmentalist and Registered Principle Environmental Auditor with the Institute of Environmental Management and Assessment. He has over thirty-five years' experience of environmental impact assessment including land use, socio-economics and resource use.

14.2 Relevant Legislation & Guidance

In addition to the guidance documents referenced in Section ? of the EIAR the following legislation and guidance were taken into consideration.

- Building Regulations Part G (S.I. No. 335/2008), Part H (S.I. No. 561/2010) and Part L (S.I. No 292/2019 –
- European Commission (2018) Revised Energy Performance of Buildings Directive (EPBD) (2018/844/EU)
- European Union (Energy Performance of Buildings) (No.2) Regulations 2019),
- Part L and European Union (Energy Performance of Buildings) (No. 2) Regulations 2019 Technical Guidance Document (Department of Housing, Planning and Local Government).
- European Union (Energy Performance of Buildings) Regulations 2021 (S.I. No. 393 of 2021).
- Sustainable Urban Housing: Design Standards for New Apartments—Guidelines for Planning Authorities (2020)
- The Waste Management Act 1996, as amended,
- Waste Action Plan for a Circular Economy (Department of Environment, Climate & Communications 2021.
- Sustainable Urban Housing: Design Standards for New Apartments—Guidelines for Planning Authorities (2020)

14.3 Methodology

The assessment was based on the PUNCH Planning Engineering Services Report in Appendix 1, the Metec Consultant Engineers ESB Infrastructure Report in Appendix 10, the PUNCH Traffic & Transport Assessment in Appendix 14 and the PUNCH Outline Mobility Plan submitted with this application under separate cover. The PUNCH Planning Engineering Report should be consulted for the detailed information on the existing and proposed water supply, wastewater and surface water services.

14.3.1 Consultation

A Pre-Connection Enquiry Form was sent to Irish Water in relation to the proposed development, and Irish Water issued a Confirmation of Feasibility. The PUNCH proposed foul network main supply proposals were then submitted to Irish Water for Design Vetting and Irish Water issued a Statement of Design Acceptance.

14.4 Proposed Development

Chapter 3 of the EIAR presents a detailed description of the proposed development. Those aspects that are relevant to the Materials Assets: Services the connections to the mains water, electricity and energy supplies, surface water drainage, waste management, and natural resource consumption.

14.5 Receiving Environment

14.5.1 Water Supply

There is an Irish Water 300mm watermain running along the Great Connell Road to the east of the site. This supplies the Wellesley Manor residential estate via a 100mm uPVC network (Figure 14.1)

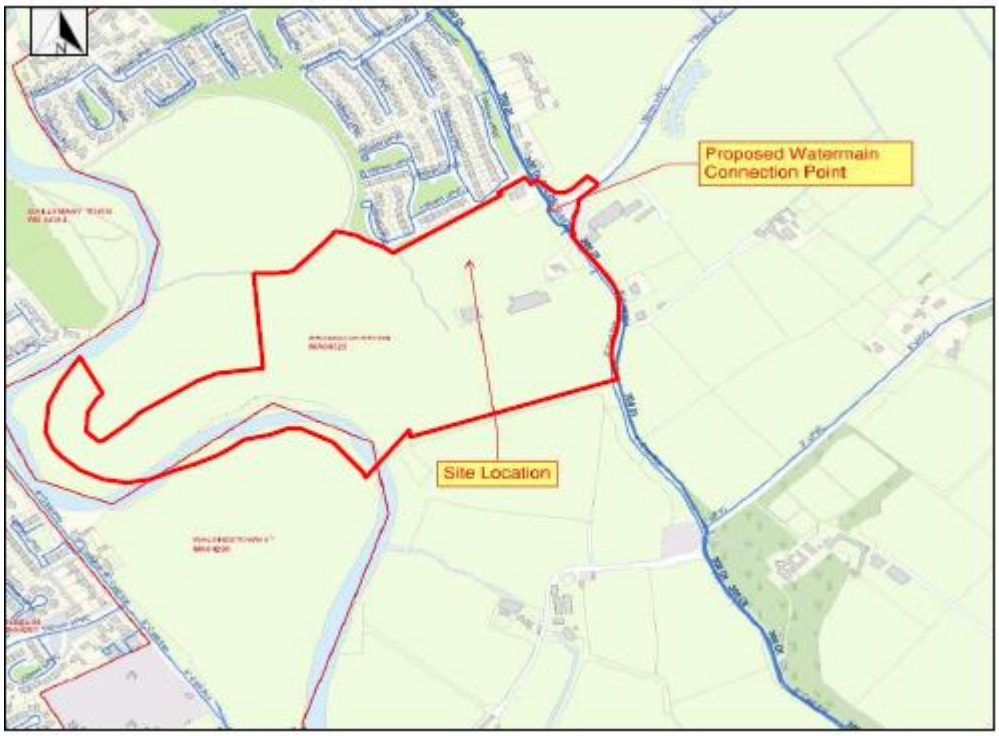


Figure 14-1: Existing watermain surrounding the site (Extract from Irish Water records)

14.5.2 Surface Water Drainage

Currently the surface water drainage network in the vicinity of the development site is limited. There is an existing 1000mm concrete storm water sewer that flows from north-east to south-west along the north-eastern boundary and discharges into a small stream that then flows into the Liffey. This storm sewer serves Wellesley Manor (Figure 14.2).

Figure 14.2 Existing Surface Water Network (Extract from Irish Water records)

14.5.3 Foul Water Drainage

The Kilcullen/Athgarvan 450mm concrete foul sewer traverses north across the site. Foul drainage From the Wellesley Manor housing development is collected in a network of 150mmm to 300mm foul sewers and discharges into this 450mm foul sewer at the northern boundary of the proposed development site. The newly constructed 600mm pumped rising main/900mm gravity Newbridge Eastern Interceptor Sewer traverses the subject site west-east.

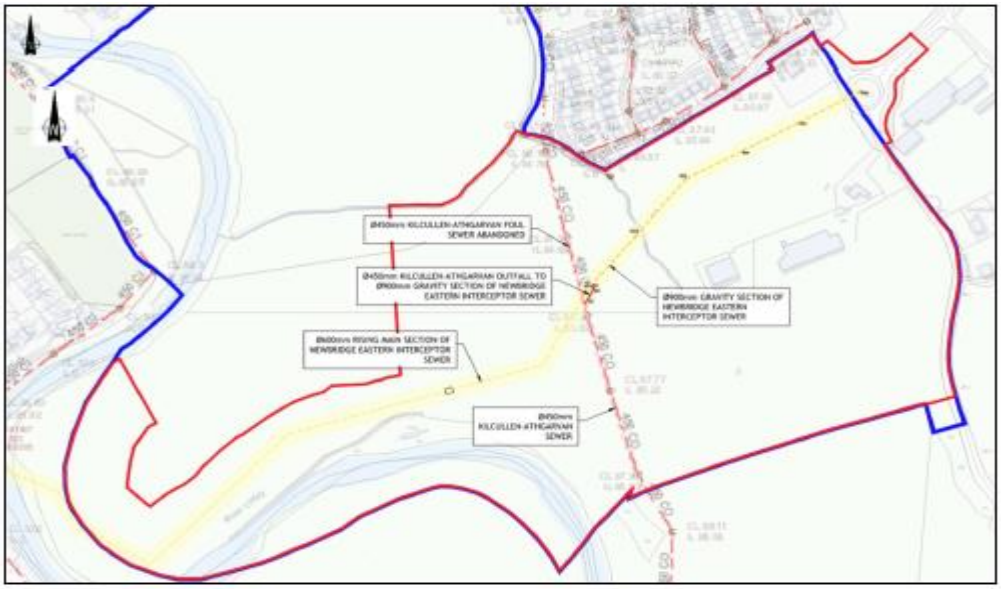


Figure 14. Existing foul drainage surrounding the site (Extract from Irish Water records)

14.5.4 Energy

Electricity

There is an existing overhead 10 kV Medium Voltage overhead electricity line traversing the site which drops to underground for a section of its run.

14.5.5 Waste Management

There is no waste management infrastructure at the existing site.

14.6 Impacts

14.6.1 Water Supply

In the construction stage pending the connection to the Irish Water mains bottled water will be provided for staff use. The development will connect to the Irish Water mains water supply via a 200mm diameter connection from the existing watermain on the Great Connell Road. This may require a temporary disruption to the supply locally in the construction stage. PUNCH estimate the average daily demand will be 254,868 litres when the development is complete.

14.6.2 Foul Water

The development will connect to the Irish Water Upper Liffey Valley Sewerage Scheme. The existing 450mm foul sewer that runs across the site from south to north will be diverted to connect to the Upper Liffey Valley Sewerage Scheme existing 900 mm diameter sewer. Due to the site topography there will be foul water system will gravity feed to a pumping station from where it will be pumped to the 900mm sewer..

PUNCH estimate the average daily discharge to the Irish Water foul sewer will be 280,355 litres when the development is complete.

In the construction stage the foul water will comprise sanitary wastewater and sink waste from staff welfare facilities. This will be collected in and sent off-site for treatment. In the operational stage the foul water will comprise kitchen sink and sanitary wastewater (toilets, baths/shower/sinks) from the housing units, the neighbourhood centre and the crèche. This will discharge to the Irish Water foul sewer.

14.6.3 Surface Water Drainage

Similar to the foul water drainage system, due to the topography it is not possible to drain the entire development site to one outfall. The alternative is proposed to discharge via gravity to outlets on the existing ditch that passes through the north of the site, as well as the River Liffey to the west.

The proposed section of NSOORR that will run through the site will have a separate drainage system. Due to level and vertical clearance constraints imposed by the existing 900mm diameter foul sewer traversing the site two outfalls are required.

14.6.4 Energy

Electricity

The existing overhead electrical power lines running from the north-east to south-west through the site and along the southern site boundary will be diverted underground. This may require a temporary disruption of supply locally.

Upgrade works are required to meet the development's projected energy requirements of 3 Megavolt-ampere (MVA). The projected load is based on ESB electrical loading guidelines for Houses and Apartments. A freestanding Medium Voltage/Low Voltage Substation will be provided near the crèche. The MV/LV Substation will supply 8no 630kVA sub-stations dispersed throughout the site.

In the construction stage electricity will be required for site lighting and power in the Construction Compound. In the operational stage electricity will be needed in the housing units for internal lighting, ventilation, cooking, heating and home entertainment. It will also be needed for external street lighting and in the foul water pumping station.

14.6.5 Waste Management

Waste will be generated in both the construction and operational stage. In the construction stage the majority of the wastes will be construction materials, with a smaller amount of domestic type waste from the construction staff welfare facilities. In the operational stage the wastes will predominantly comprise household wastes, with a smaller proportion of commercial wastes from the neighbourhood centre.

14.6.6 Natural Resource Consumption

The development will result in an increase in the consumption of natural resources in the construction and operational stage associated with the use of construction materials, vehicle fuels, energy, water and man-made goods.

14.7 Baseline Scenario

If the proposed development does not proceed there will be no new connections to the mains water, foul water system, electrical and gas networks and consequently no additional demand on these services. Wastes will not be generated and there will be no demand on the existing waste management service providers.

14.8 Prevention & Mitigation Measures

14.8.1 Design Stage

The design stage included a comprehensive evaluation of the local material assets and engagement with Irish Water in relation to water supply and wastewater treatment, which established that the existing infrastructure has the capacity to accommodate the scale of the proposed development.

Water Supply

The watermain layout is designed in accordance with "Irish Water Code of Practice for Water Infrastructure" and will be constructed in accordance with Irish Water Code of Practice and the Local Authority's requirements. The average person in Ireland uses 133 litres of water per day, which is broken down as follows:

Taps	30%
Bath/Shower	28%
Toilet	26%
Dish and Clothes Washing Machines	12%
Garden Watering	4%

Water conservation is primarily a behavioural issue with limited scope to 'design in' conservation measures. However to reduce the demand the operational stage water the following measures will be incorporated into the housing unit construction:

- Dual flush toilets, and
- Rainwater harvesting.

Foul Water

The foul network was designed using Causeway Flow software in accordance with Irish Water's Code of Practice for Wastewater Infrastructure and the Department of the Environment's Recommendations for Site Development Works for Housing Areas. The foul water loading was calculated in accordance with the Code of Practice for Wastewater Infrastructure, with a 10% allowance for infiltration. The conservation measures incorporated into the design of sanitary facilities will reduce the volumes discharging to the foul sewer.

Surface Water Drainage

The drainage system was designed using Causeway Flow software in accordance with the Department of Environment and Local Government's guidance document "Recommendations for Site Development Works for Housing Areas" and with regard to the "Greater Dublin Strategic Drainage Study" (GDSDS) and the Newbridge Development Plan.

The flows to the water courses will be limited to greenfield runoff rates (total of 76.31l/s) through the provision of appropriate attenuation. Nine underground attenuation tanks with a combined capacity of 5,707m^3, will serve the residential development. Two underground tanks (combined volume of 320m^3) will serve the section of the NSOORR. Underground tanks were selected, as the alternative surface ponds would be up to 2m deep and present an unacceptable safety risk to future occupants.

Class 1 Bypass Hydrocarbon Separators will be located downstream of the attenuation tanks. The discharge points to the ditch and the river will be fitted with non-return valves to prevent water from the river surcharging up through the surface water drainage network.

In addition to the underground attenuation tanks, the following Sustainable Urban Drainage Systems (SuDs) are incorporated into the design to minimise the volumes of run-off discharged to the existing watercourses:

- Permeable paving
- Swales/Bioswales
- Green Roofs
- Soakaways/Soak Pits
- Rainwater Harvesting

Energy

The residential sector has the second largest final energy demand in Ireland after the transport sector[15]. The energy use in an average Irish home in 2016[16] was as follows:

Space heating 61%

Water heating 19%

Lighting and appliances 17%

Cooking 3%

Energy conservation is a critical design element given the need to meet the Nearly Zero Energy Building requirements of the EPBD. The energy conservation and building performance measures that will be considered at the design stage are described in Section 3.3.

Waste Management

The design measures to minimise waste generation in the construction stage will be identified in the Detailed Resource & Waste Management Plan that will be prepared at the detailed design stage of the proposed development.

Own door apartments and terrace housing will have appropriate storage locations for refuse bins Each apartment will be provided with storage/utility rooms to satisfy the criteria in the DHPLG's Sustainable Urban Housing: Design Standards for New Apartments—Guidelines for Planning Authorities (2020) and The Kildare County Development Plan 2017–2023. Each apartment block will be provided with suitably screened areas where materials can be sorted and stored prior to collection for recycling).

Natural Resource Consumption

The design mitigation measures implemented to minimise water and energy usage will also reduce natural resource consumption.

[15] https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/energy-use-overview/
[16] https://www.seai.ie/publications/Energy-in-the-Residential-Sector-2018-Final.pdf

14.8.2 Construction Stage

Water Supply

The construction stage will have no likely significant effects on the mains water supply system

Foul Water

The construction stage will have no likely significant effects on the municipal foul water drainage system

Surface Water Drainage

The mitigation measures that will be applied during the construction of the surface water drainage system are described in Section 7.?

Energy

The connection to the national electricity grid may require temporary disruptions to the supplies locally. The connections will be managed by ESB Networks respectively which should limit any disruption and ensure that residents/ businesses in the affected areas receive advance notice of the planned disruptions.

Natural Resource Consumption

The Resource & Waste Management Plan will identify all of the measures to maximise the reuse/recovery of construction and demolition waste generated by the development as alternatives to the use of natural materials. All soils excavated in the construction stage will be retained on-site for use in landscaping and raising ground levels.

The use of fuels by the construction traffic and the plant and equipment will be minimised by:

- Optimising schedules for the delivery and removal of construction related materials;
- Prohibition of vehicle idling, and
- The proper maintenance and efficient use of construction plant and equipment.

14.8.3 Operational Stage

Water

Responsibility for water conservation measures will rest with the residents, occupants of the neighbourhood centre and the operator of the crèche. There is no scope for achievable mitigation in addition to those already 'designed in'.

Foul Water

The foul water pumping station will be the subject of regular inspection and a preventative maintenance programme to ensure it continues to function properly.

Energy

Energy usage will be determined by the personal choices of the residents, occupiers of the neighbourhood centre and the operator of the crèche. All occupants of the development will be provided with sufficient information about the building, the fixed services, controls and their maintenance requirements to facilitate the use of the building to use no more fuel and energy than is reasonably required (Refer Section 3.3).

Waste Management

Responsibility for complying with waste management regulations and contributing to the achievement of national and regional objectives on waste reduction, recovery and re-use will rest with the residents, the occupants of the Neighbourhood Centre and the operator of the crèche.

The proposed development site is in an area currently served by private waste collection companies that provide kerb side collection for household recyclables, glass, food waste and residual municipal solid waste; source separated commerical waste collections and once off collections for small scale construction works (extensions and renovations) and house/commercial clearances[17].

Household and commercial wastes will be generated at the residential units and the neighbourhood centre & crèche respectively. .The household wastes will be collected by authorised waste collectors that provide a four bin (food waste; dry recyclables; glass and residual non-recoverable/recyclables) service. The waste from the neighbourhood centre and crèche will be collected by a commercial waste contractor, who also provides a source separated collection service.

However, as with water and energy conservation, the management of waste is primarily a behavioural issue, with no scope for mitigation measures additional to those already 'designed in'.

Natural Resource Consumption

The mitigation measures for the reduction of the impact on water usage and energy demands will contribute to the mitigation of the impacts on natural resource consumption; however the behavioural caveats in relation to water and energy conservation and waste management apply equally to resource consumption.

14.9 Monitoring

Monitoring is not required in the construction stage. In the operational stage energy and water usage will be monitored at the individual units and the foul water pumping station will be regularly inspected.

14.10 Cumulative Effects

In the operational stage the residential development, neighbourhood centre and crèche will contribute to natural resource consumption and waste generation rates.

[17] http://iwma.ie/commercial-waste/iwma-members-in-your-area/

14.11 Residual Impacts

The proposed development will result in an increased demand on the Irish Water mains water supply and foul water treatment systems and on the electricity and natural gas supplies. In relation to waste generation, while this will increase locally there will not be a significant addition at a national level, as the majority of the future occupants are already living in Ireland. There will be an increase in natural resource consumption.

Table 14.9.1 Residual Impacts

Likely Significant Effect	Quality	Significance	Extent	Probability	Duration
Construction Stage					
Waste Management	Negative	Not Significant	Development Site	Likely	Temporary
Operational Stage					
Water Usage:	Negative	Not Significant	Local Supply System	Likely	Long Term
Energy: Natural Gas:	Negative	Not Significant	Local Supply System	Likely	Long Term
Energy: Electricity	Negative	Not Significant	Local Supply System	Likely	Long Term
Resource Consumption:	Negative	Not Significant	Newbridge Environs	Likely	Long Term
Waste Management	Negative	Not Significant	Newbridge Environs	Likely	Long Term

15 MATERIAL ASSETS - TRAFFIC & TRANSPORT

15.1 Introduction

This chapter describes the existing road network and traffic conditions and the impacts of the proposed development, including a 'baseline' scenario. It identifies the prevention and mitigation measures that will be implemented to reduce the significance of the impacts and assesses the residual impacts.

The assessment was completed by Julie Tiernan of PUNCH. Julie is a chartered engineer with over 15 years' experience in a wide range of civil engineering projects. She specialises in the field of Traffic and Transport Assessments. Julie is an expert in the in the use of Traffic Engineering Modelling Software (TRICS, ARCADY, PICADY, LINSIG, etc)

A full Traffic and Transportation Assessment was undertaken to assess the effect of the proposed development in accordance with the relevant legislation and guidelines outlines below. This included a Traffic and Transportation Assessment, a detailed Outline Mobility Management Plan, DMURS Compliance Statement and a Stage 1 Road Safety Audit. These reports and the associated design and documentation are included in the planning application for this development. A copy of the Traffic & Transport Assessment is in Appendix 11.

This Chapter of the EIAR therefore represents a summary of the detailed assessment undertaken as part of the Strategic Housing Development (SHD) Application to An Bord Pleanála (ABP) for the proposed development.

15.2 Relevant Legislation & Guidance

In addition to the guidance documents referenced in Section X of the EIAR the following legislation and guidance were taken into consideration.

- Transport Infrastructure Ireland (TII) Traffic and Transport Assessment Guidelines PEPDV-02045 (May 2014)
- Project Appraisal Guidelines (PAG) – Unit 5.3 - Travel Demand Projections (TII October 2021).
- Design Standards for New Apartments (DHLGH 2018)
- 'Sustainable Urban Housing: Design Standards for New Apartments – Guidelines for Planning Authorities (DHLGH 2018)'.
- Design Manual for Urban Roads & Streets (2019) (DTTS & DHPLG)
- Newbridge Local Area Plan (2013-2019), as extended
- Kildare County Development Plan (2017-2023)

15.3 Methodology

The assessment was completed in accordance with Transport Infrastructure Irelands' Traffic and Transport Assessment Guidelines PEPDV-02045 (May 2014). Information from the Newbridge Local Area Plan (2013-2019) and the Kildare County Council Development Plan (2017- 2023) was used to describe the development location and its local context in relation to transportation objectives.

Classified turning count traffic surveys of relevant junctions were completed by IDASO on Wednesday the 10th of November 2021. The surveys were undertaken at a time when schools were fully open and the government was not advising work from home during the Covid-19 pandemic.

While it may be that more people were working at home at the time of the surveys compared to period to pre-Covid, it is expected this change in behaviour will become the norm in future years and it is therefore deemed the traffic survey results are appropriate for future analysis.

The road/street layout together with pedestrian and cycle facilities took into consideration the design principles set out in the Design Manual for Roads and Streets (DMURS) and a DMURS Compliance Statement for the proposed development has been prepared.

The site layout is designed to provide adequate turning provision and fire tender access. Autotrack analyses were completed to ensure there are no issues with swept paths and the manoeuvrability of heavy goods vehicles within the proposed development.

Car parking spaces were determined in accordance with the guidance for "*peripheral and/or less accessible urban locations*" in the Design Standards for New Apartments (2018) section 4.22. Car parking spaces serving the houses, crèche and neighbourhood centre are based on the requirements of the Kildare County Council Development Plan (2017-2023) 'Table 17.9'.

The bicycle parking spaces are also in accordance with Table 17.10 of the Plan, as well as the standards the 'Sustainable Urban Housing: Design Standards for New Apartments – Guidelines for Planning Authorities (March 2018)'.

15.3.1 Consultation

A tripartite meeting occurred online on 22nd October 2021. Below is the text extract from ABP's opinion report relating to traffic and transport:

1. Traffic and Transport

   Further consideration and/or justification of the documents as they relate to the traffic and transport provision. The submitted documentation should address the requirements of the Newbridge Local Area Plan 2013-2019 (as extended) for the delivery of the Newbridge Southern Outer Orbital Relief Road (NSOORR) and

compliance with Objective SRO5a. Regard should be given to the submission of a Traffic and Transport Assessment, including, inter alia, potential scenarios with and without the bridge, capacity of the surrounding junctions and the impact of the proposed development on the surrounding road network. Plans and particulars should clearly indicate compliance with the required upgrades stated in the Transport Section Report, including any third-party consents required for works, the need for signalised junctions in the vicinity of the site and the DUMRS standards for the internal network.

Consultation was undertaken with Kildare County Council Roads, Transportation & Public Safety Department on numerous occasions throughout 2021 via meetings (see main meeting dates below) and email correspondence to allow them to express their views/comments regarding the proposed development prior to the submission of the planning application.

1. 23 March 2021 –Preplanning Meeting - Kildare County Council Consultation Reference: PP5026

2. 15th April 2021- Kildare County Council Roads, Transportation & Public Safety Department

3. 22nd October 2021 – SHD Pre-Application 311390 – Tripartite Meeting

4. 1st March 2022 – Pre-Planning meeting for road and bridge application for remainder of NSORR - Section 247 Kildare County Council Consultation Reference: PP2559

The comments received from Kildare County Council throughout the design development were taken into consideration.

15.4 Proposed Development

Chapter 3 presents a detailed description of the proposed development and those aspects that are relevant to the Traffic and Transport Assessment are the vehicle, cycle and pedestrian access off the Great Connell Road; the local road network including key junctions in the vicinity of the site and the Belin Wood residential development currently under construction on the western side of the Liffey.

The proposed development will deliver approx. 350m of the Newbridge Southern Outer Orbital Relief Road (NSOORR) from Great Connell Roundabout to the furthest access point within the development site along the new road. The NSOORR splits the proposed development into two distinct sections, north and south.

A bridge over the River Liffey is required to complete the NSOORR delivery in accordance with the requirements of the Newbridge Local Area Plan and it will eventually tie in with the section of the NSORR to be delivered under Planning Reference: ABP-302141-18, on the western side of the River Liffey.

Aston Ltd has commenced the planning process with Kildare County Council to deliver this final road and bridge connection of the NSORR under a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559). Aston Ltd has taken on this element in order to expedite the approval process and ensure that the connection can be made in a shorter timeframe than if Kildare County Council were to progress under public procurement

15.5 Receiving Environment

15.5.1 Location

The proposed development site is located to the east of Newbridge town centre on the eastern side of the River Liffey. The site is within the Newbridge Local Area Plan. There are three existing access points onto the site from Great Connell Road to the east. The proposed site is bounded by the existing Wellesley Manor residential developments to the north-east, Great Connell Road to the east and existing farmland to the south. The River Liffey and existing farmland are located to the west.

Ardstone Homes Limited were granted planning for 343 residential units on the site located on the western side of the River Liffey under planning approval grant ABP-302141-18. This development is now under construction.

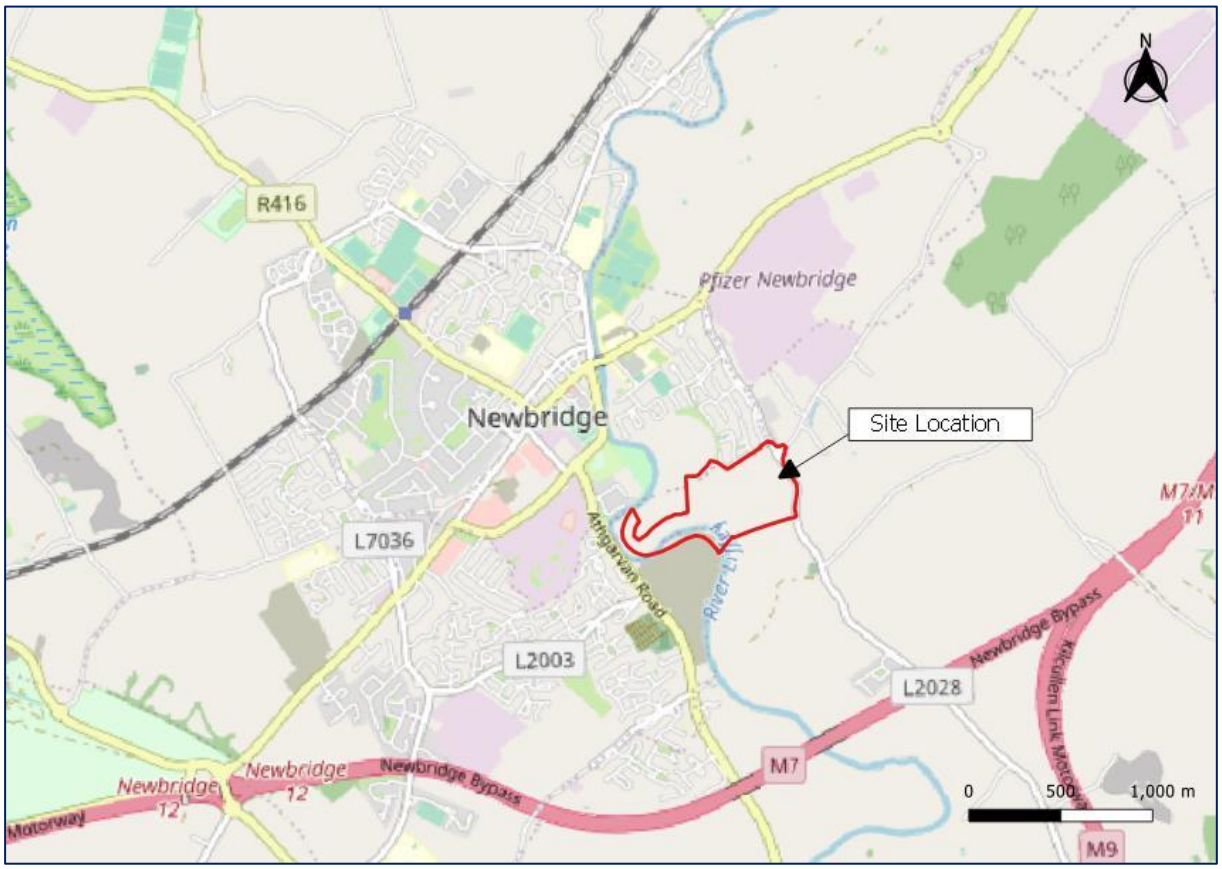


Figure 15.1 Site Location

15.5.2 Local Road Network

The road network in the vicinity of the site is shown on Figure 12.1

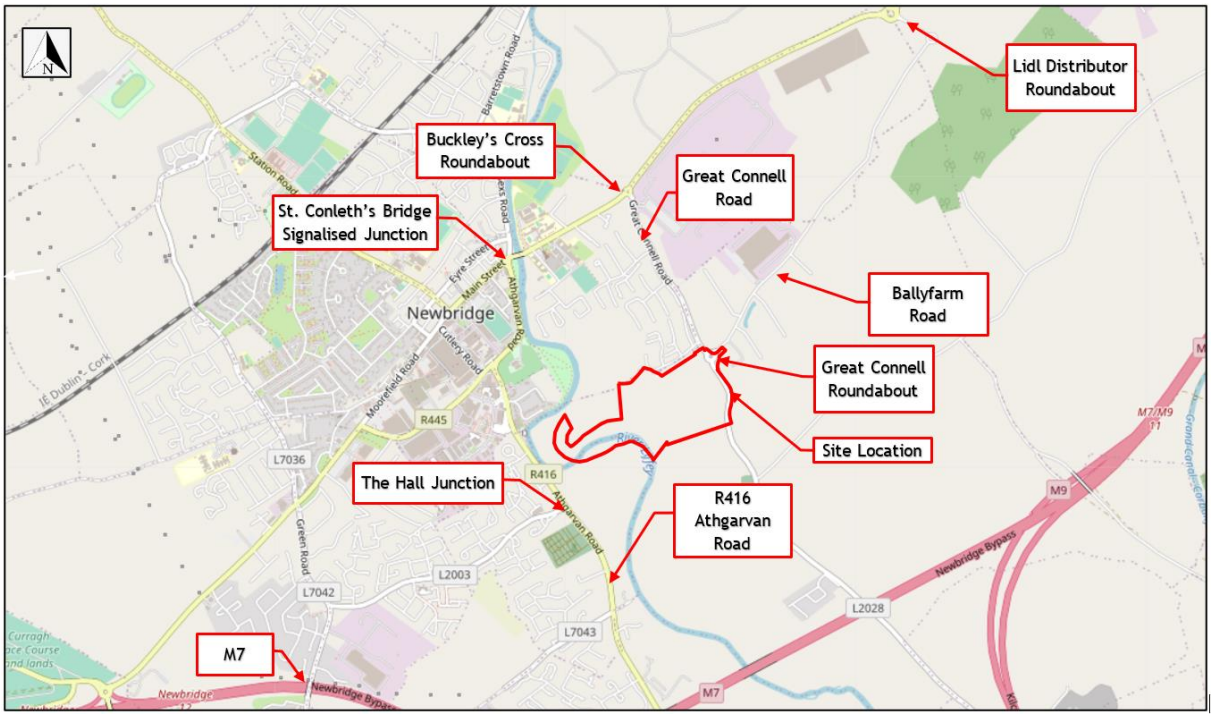


Figure 15.2 Local Road Network

The R416 Athgravan Road to the west is a Regional Road linking Newbridge and Athgarvan. It is a single lane two-way carriageway with footpaths on both side of the carriageway mainly along developed areas. There are no cycle lanes.

Photograph 15.1 R416 Athgarvan Road (Looking north-west) © Google Maps

The Great Connell Road is a Local Primary Road linking the R445 with the L2032. It is a single lane two-way carriageway, with a footpath on the western side between the R445 junction and the Great Connell Roundabout. The roundabout provides access to the residences on the western side of the Great Connell Road, the Murphy International offices and compounds and the Dr. Pepper manufacturing plant.

Photograph 15.2 Great Connell Road (Looking south-east) © Google Maps

The Ballyfarm Road connects the Great Connell Roundabout to the Lidl Distributor Roundabout. It forms part of the NSORR and is fully constructed 6m wide carriageway with verges, footpaths and cycle paths on either side. The road will be taken in charge by Kildare County Council in Q2 2022.

Figure 15.3: Ballyfarm Road at Connection to Great Connell Roundabout

The Hall continues onto Curragh Grange and links Green Road with Athgarvan Road. The Hall is a single lane two-way carriageway with wide footpaths on both sides, but no cycle lanes. It provides access to a number of residential estates.

Photograph 15.4 The Hall (Looking east towards Athgarvan Junction) © Google Maps

15.5.3 Existing Traffic Flows

A classified turning count traffic survey of the below listed junctions was completed by IDASO on Wednesday the 10th of November 2021.

1. Great Connell Roundabout
2. Lidl Distributor Roundabout
3. The Hall / R416 Athgarvan Road / New NSORR (East) Signalised Junction.
4. St. Conleth's Bridge Signalised Junction
5. Buckley's Cross Roundabout.

The survey locations and peak hour survey results are included in Appendix A of the TTA and shown on Figure 15.3.

15.5.4 Public Transport

The Outline Mobility Management Plan (MMP) included in this application provides an assessment of the existing and proposed public transport networks. The proposals included in the Outline MMP aim to ensure effective results from any investment in sustainable travel associated with the development.

The MMP concluded that the site is well connected to the local, regional and national public transport network. Where public transport links in Newbridge Town include Bus, Rail, Car-Share and Taxis. The development includes for the provision of 2 no. bus stops and a car sharing facility within the site. This will further increase the connectivity of the site for residents.

Daily bus routes operate between (among others) Newbridge, Celbridge, Naas, Kildare, Kilcullen, Portlaoise, Carlow, Dublin Airport and Dublin. Daily rail services also operate through Newbridge on the South Western Commuter Line between Galway, Limerick, Cork, Waterford and Dublin. The MMP recommends that a Mobility Manager / Travel Plan Coordinator be appointed to ensure agreement of stakeholders in the provision, maintenance and expansion of the public transport network with respect to the needs of the development and its residents.

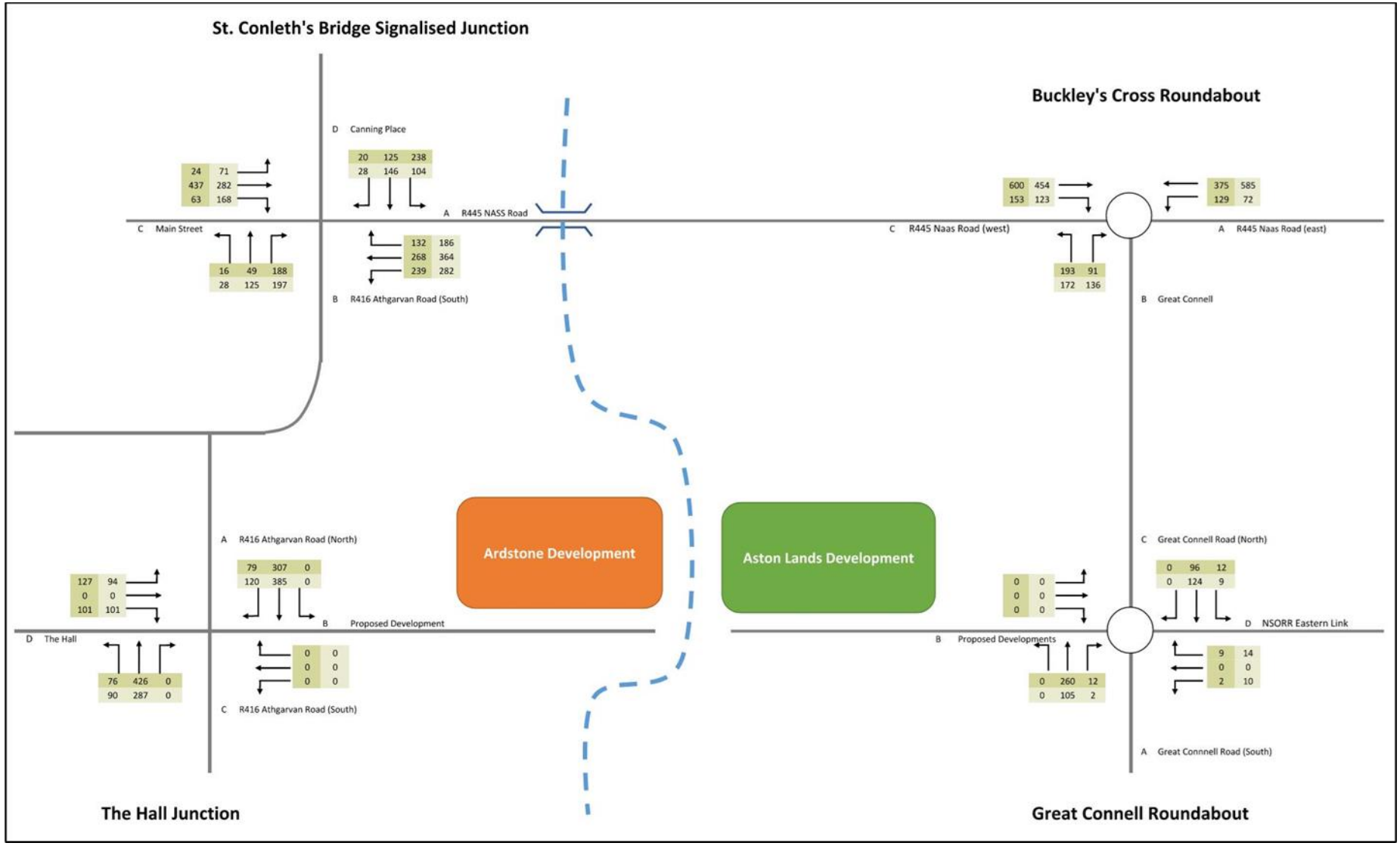


Figure 15-3: November 2021 Peak Hour Traffic Survey Results (PCUs)

15.5.4 Public Transport

The Outline Mobility Management Plan (MMP) submitted in this application under separate cover provides an assessment of the existing and proposed public transport networks. The proposals included in the Outline MMP aim to ensure effective results from any investment in sustainable travel associated with the development.

The MMP concluded that the site is well connected to the local, regional and national public transport network. Where public transport links in Newbridge Town include Bus, Rail, Car-Share and Taxis. The development includes for the provision of 2 no. bus stops and a car sharing facility within the site. This will further increase the connectivity of the site for residents.

Daily bus routes operate between (among others) Newbridge, Celbridge, Naas, Kildare, Kilcullen, Portlaoise, Carlow, Dublin Airport and Dublin. Daily rail services also operate through Newbridge on the South Western Commuter Line between Galway, Limerick, Cork, Waterford and Dublin. The MMP recommends that a Mobility Manager / Travel Plan Coordinator be appointed to ensure agreement of stakeholders in the provision, maintenance and expansion of the public transport network with respect to the needs of the development and its residents.

15.5.5 Pedestrian & Cycle Networks

The Outline MMP also provides an assessment of the existing and proposed pedestrian and cycle networks. The proposals included in the Outline MMP aim to reduce car dependency by improving the quality of and awareness of pedestrian and cycle networks adjacent to the site. The Plan shows the proposed cycle routes as part of the Mid –Kildare Sector of the Greater Dublin Area Cycle Network Plan (Figure 15.4) and indicates the existing and future connectivity of the site (Figure 15.5).

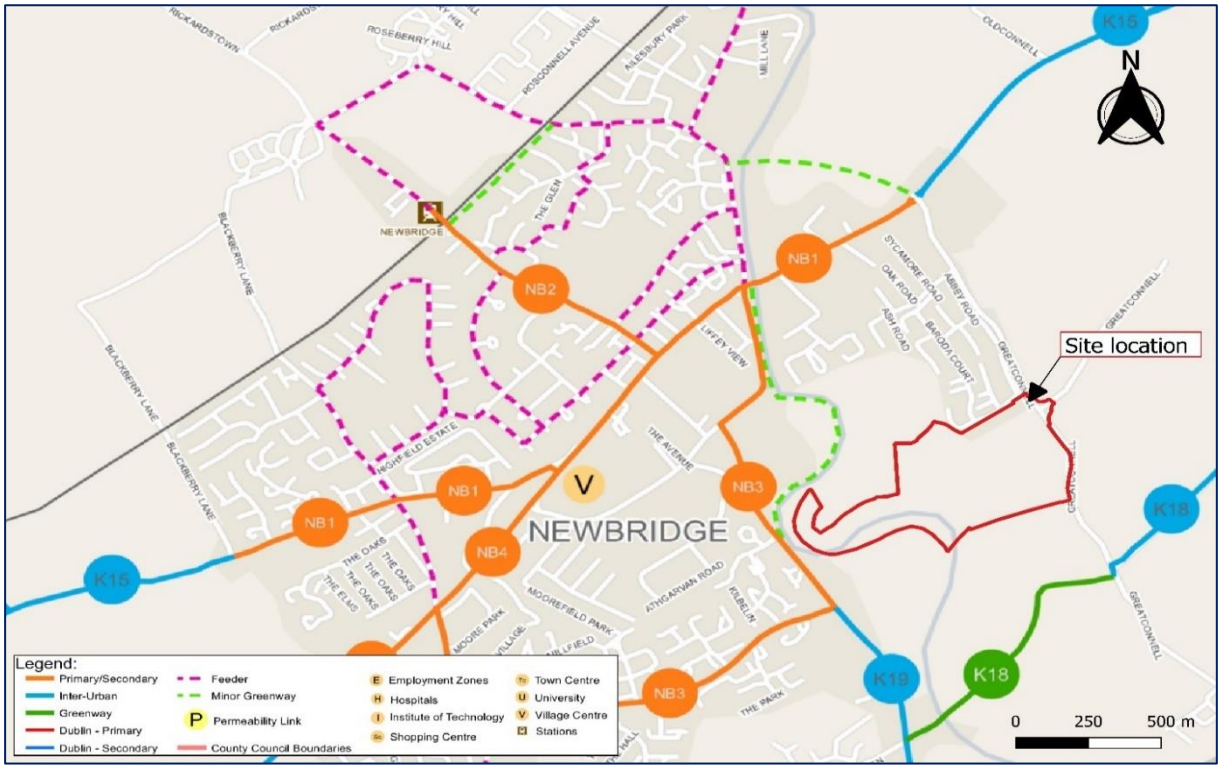


Figure 15-4: Proposed cycle routes as part of the Greater Dublin Area Cycle Network Plan (Ref: https://www.nationaltransport.ie)

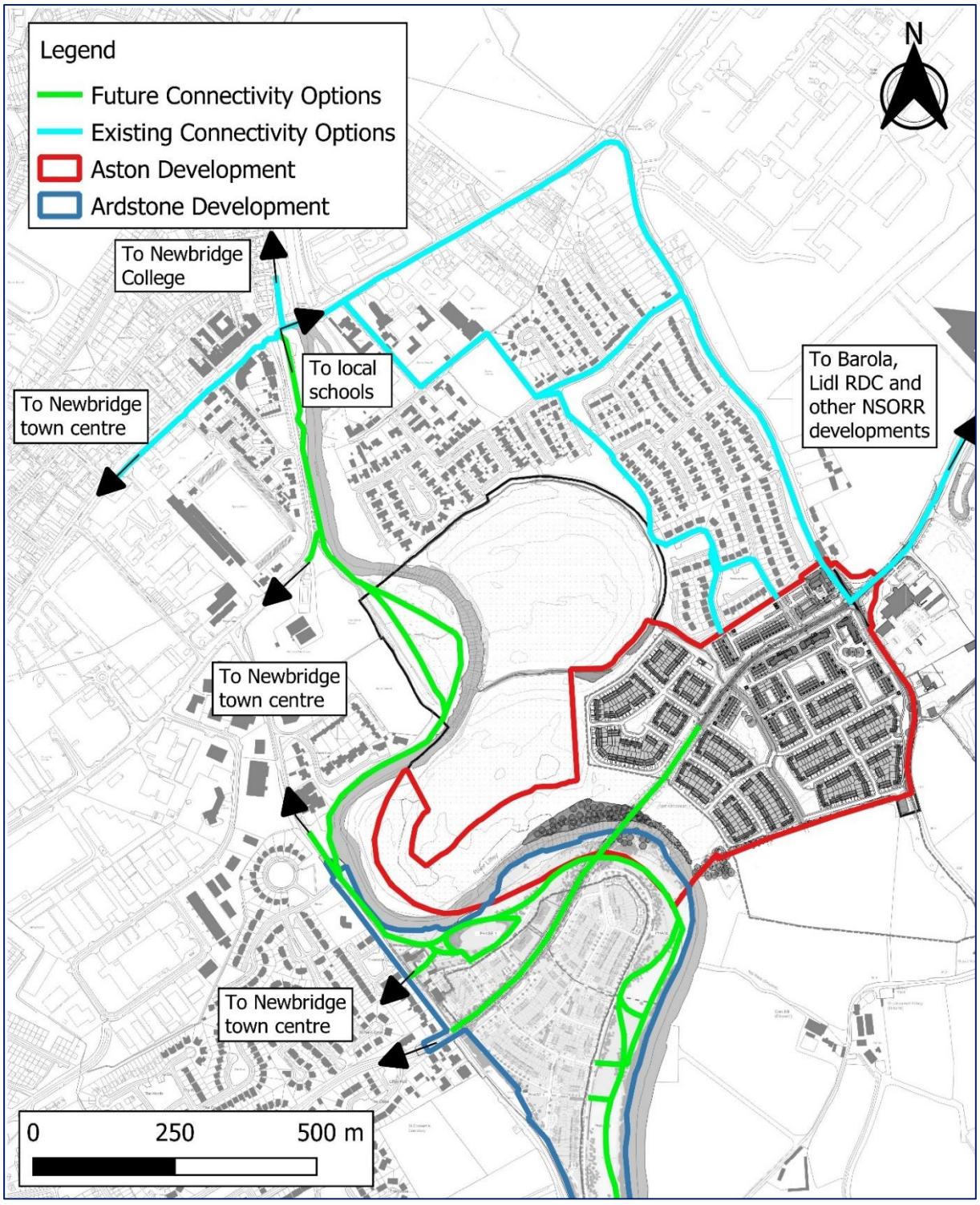


Figure 15-5: Future External Connectivity Options

15.6 Impacts: Construction Stage

Access to the site during the construction stage shall be via the existing Great Connell Roundabout and the NSORR, thereby avoiding travelling through Newbridge Town Centre. During the construction stage, traffic to and from the development site will comprise of construction staff private vehicles and materials delivery vehicles, including articulated and rigid body trucks and ready mix concrete trucks. Internal movements will include excavators, dump trucks and cherry pickers.

The traffic volume associated with the construction phase site is not considered to be excessive and will be spread out over the duration of the construction of the development. Construction staff will generally arrive before 08:00 and leave at 17.00 thereby avoiding the morning and evening peak hour traffic. Many of the staff will arrive in shared vehicles. Given the scale of the development it is likely that between 40-50 construction workers will be on site at any time.

Deliveries will be spread evenly throughout the course of the day to reduce the impact during peak traffic periods. It is anticipated that 10-50 HGVs will access the site per day during the busiest period of construction.

As the construction works are off-line there will be no significant disruption to the traffic flows in the area as a result of the construction of the development. Existing public footpaths are unlikely to be impacted by the project, as all works will be within the proposed development site boundary.

15.7 Impacts Operational Stage

15.7.1 Vehicle Trip Generation

As the proposed development is primarily residential, peak traffic flows will typically occur on weekdays between 07:00 and 09:00 and 16:00 and 18:00. To estimate the traffic volumes generated by the residential units, the trip rates approved by Kildare County Council for the Ardstone development were applied pro-rata to the number of houses, apartments and the crèche in the Aston development.

Trip rates derived from Trip Rate Information Computer System (TRICS) were applied pro-rata to the proposed neighbourhood centre. Although the TRICS data is predominantly UK based it provides a reasonable indication of traffic generation linked to proposed developments in Ireland. Full details of the TRICS analysis are in Appendix B of the TTA. The estimated trip rates for the morning and evening peak hours are shown in Table 15.1

Land Use	Calculation Factor		Trip rate				Additional Number of Trips			
			AM Peak		PM Peak		AM Peak		PM Peak	
	GFA m2/100	No. of Units / Children	AM Arriv	AM Depart	PM Arriv	PM Depart	AM Arriv	AM Depart	PM Arriv	PM Depart
Apartments	-	244	0.055	0.147	0.158	0.077	13	36	39	19
Houses	-	325	0.138	0.276	0.28	0.194	45	90	91	63
Creche (per child)	-	154	0.198	0.166	0.061	0.094	31	26	9	15
Commercial	21.4	-	1.579	1.507	1.981	2.117	34	32	42	45
Total							**123**	**184**	**181**	**142**

Table 15-1: Morning and Evening Peak Trips

15.7.2 Trip Assignment & Distribution

The proposed development traffic was apportioned during the analysis in accordance with the directional flow of the 2021 surveyed traffic. Following the completion of the NSOORR there will be a redistribution of traffic on the local network due to the new link between the two regional routes, the Athgarvan Road (R416) and the Naas Road (R445) and the intermediary connection with the Great Connell Road. This will provide an alternative route for motorists to passing the Liffey bridge signalised junction in Newbridge Town Centre.

15.7.3 Traffic Forecasting

The TII Project Appraisal Guidelines (PAG) – Unit 5.3 - Travel Demand Projections publication by the TII (May 2019) were used to forecast future traffic growth for the assessment completed.

15.7.4 Junctions

Detailed scoping discussions with Kildare County Council Roads, Transportation & Public Safety Department identified the need to assess the following junctions:

1. Great Connell Roundabout
2. Lidl Distributor Roundabout
3. The Hall / R416 Athgarvan Road / New NSOOR (East) Signalised Junction.
4. St. Conleth's Bridge Signalised Junction
5. Buckley's Cross (Roundabout/Signalised Solutions)

The junctions are shown on Figure 15.6.

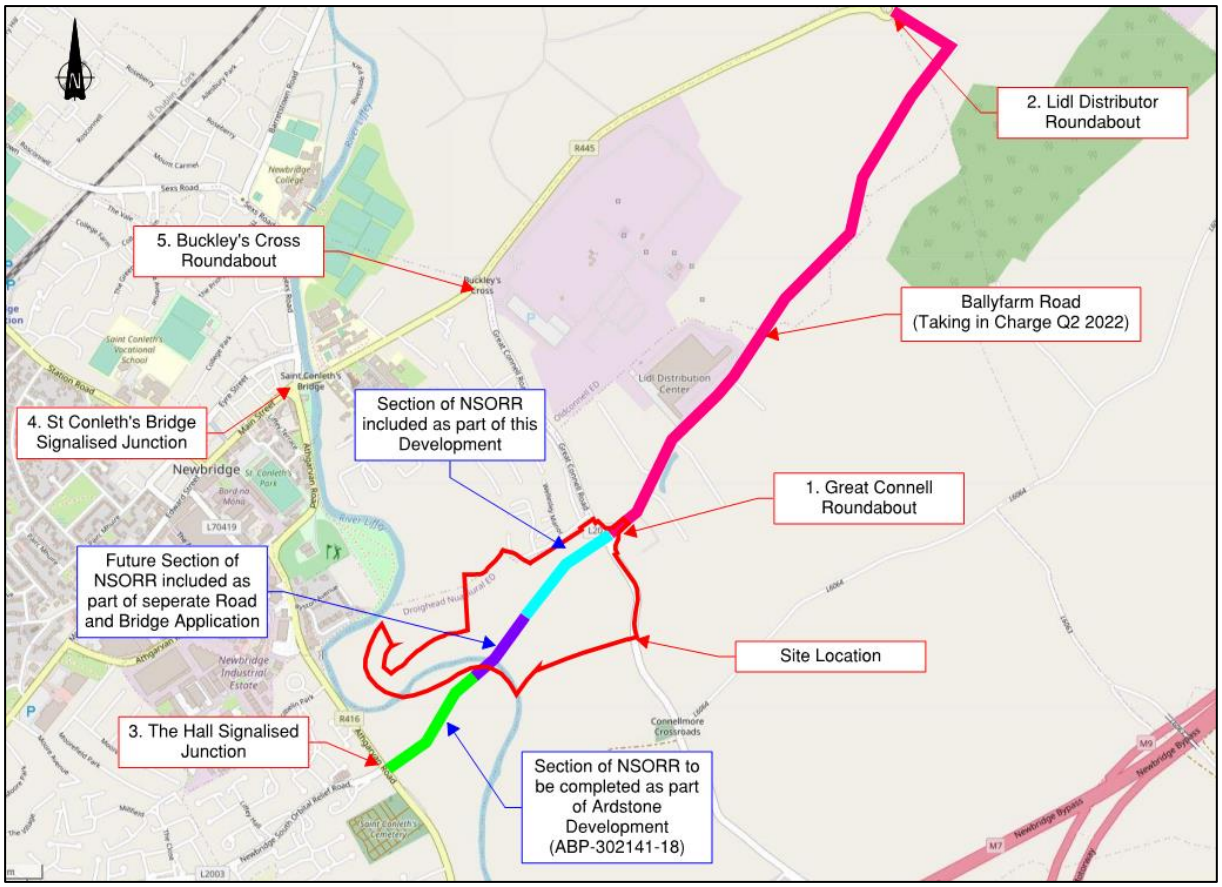


Figure 15.6 Junctions Assessment Locations

The following scenarios were agreed with the Council.

A. No section of the NSORRR open – current day scenario

B. Only Ballyfarm Road section of NSORR open

C. NSORR fully complete

The following were analysed at all junctions for each of the above scenarios:

1. Opening year: 2024

2. Design year: opening year + 5 years: 2029

3. Design year: opening year + 15 years: 2039

The analysis involved examining the projected traffic flows on the local road network both 'with' and 'without' the proposed development in place. The morning evening peak periods were examined to assess the busiest case in terms of local traffic on the road network and traffic generated by the proposed development.

LinSig software was used for the analysis of the signalised junctions. Junctions 9 ARCADY software was used for the analysis of the roundabouts.

The following assumptions were made:

1. For NSORR open Scenarios the results shown assume that the connections are complete in the Opening Year 2024
2. Aston Lands Phasing assumptions:
    a. Phase 1 (north of NSORR) Opening Year 2024 – 169 units & Commercial & Crèche
    b. Phases 2-4 (south of NSORR) from Design Year 2029 – 400 units
3. Traffic generation from the permitted developments noted in Section 3.5 above are included in the 'Without Development' scenario results.

The traffic flows for Scenarios A, B, C are included in Appendix C of the TTA. Detailed analyses for each junction are in Appendices D to J of the TTA and summarised in Tables 15.2 to 15.6.

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Yes Ballyfarm Road		Scenario C - NSORR Fully Complete	
	Without Development	With Proposed Development	Without Development	With Proposed Development	Without Development	With Proposed Development
Peak Hour Flow	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC
AM 2024 Opening Year	20%	20%	20%	20%	23%	23%
AM 2029 Design Year	22%	23%	21%	23%	25%	26%
AM 2039 Design Year	24%	24%	23%	24%	29%	30%
PM 2024 Opening Year	11%	17%	11%	13%	23%	26%
PM 2029 Design Year	12%	24%	13%	17%	26%	34%
PM 2039 Design Year	13%	24%	13%	18%	30%	36%

Table 15.2 Summary of Junctions 9 Analysis Results for Great Connell Roundabout

Great Connell Roundabout is large enough to be considered well within the design threshold of RFC<85% in all scenarios. The opening of the NSOORR moves traffic onto this roundabout, which has capacity to receive it. By the Design Year 2039 the junction will be operating within the design threshold during both the AM and PM peak hours for all scenarios.

Kildare County Council requested that the Great Connell Roundabout is signalised for safety reasons rather than capacity reasons. It is proposed to provide a new signalised junction to replace the existing large roundabout. The junction will include for toucan crossings on all arms for enhanced safety of vulnerable road users. These works will be delivered as part of the proposed development (Figure 15.7).

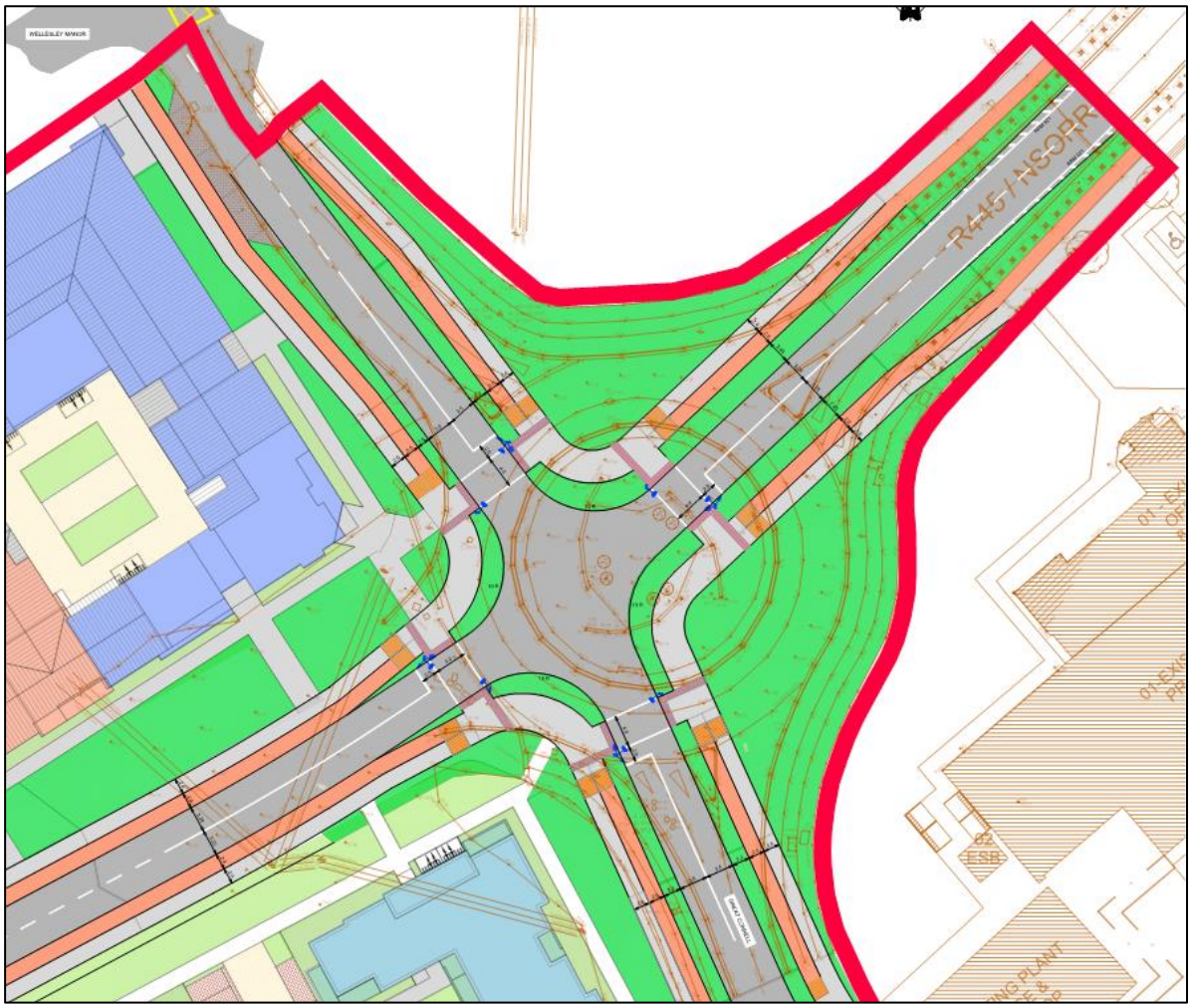


Figure 15 7: Great Connell Roundabout converted to a Signalised Junction (Extract from drawing 192229-PUNCH-XX-XX-DR-C-0431)

	Scenario B - No Bridge/ Yes Ballyfarm Road	Scenario C - NSORR Fully Complete
	With Proposed Development	With Proposed Development
Peak Hour Flow	Maximum DOS	Maximum DOS
AM 2024 Opening Year	30%	57%
AM 2029 Design Year	40%	66%
AM 2039 Design Year	42%	71%
PM 2024 Opening Year	21%	48%
PM 2029 Design Year	31%	59%
PM 2039 Design Year	32%	63%

Table 15.3 Summary of Linsig Analysis Results for Great Connell Roundabout as a signalised junction

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Yes Ballyfarm Road		Scenario C - NSORR Fully Complete	
	Without Development	With Proposed Development	Without Development	With Proposed Development	Without Development	With Proposed Development
Peak Hour Flow	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC
AM 2024 Opening Year	48%	52%	44%	45%	41%	44%
AM 2029 Design Year	56%	62%	51%	54%	49%	51%
AM 2039 Design Year	60%	66%	55%	58%	52%	55%
PM 2024 Opening Year	41%	44%	38%	39%	35%	37%
PM 2029 Design Year	47%	52%	44%	46%	40%	44%
PM 2039 Design Year	50%	56%	47%	49%	43%	47%

Table 15-4: Summary of Junctions 9 Analysis Results for Lidl Distributor Roundabout

The Lidl Distributor Roundabout is large enough to be well within the design threshold of RFC<85% in all of the above scenarios explored. The relative impact of the proposed development is also improved with the opening of the NSORR.

The existing roundabout was constructed in 2020 in accordance with current design standards and includes segregated cycle and pedestrian lanes on all existing arms for safe crossing of vulnerable road users, cyclists do not have to join the roundabout carriageway to cross the junction.

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Yes Ballyfarm Road		Scenario C - NSORR Fully Complete	
	Without Development	With Proposed Development	Without Development	With Proposed Development	Without Development	With Proposed Development
Peak Hour Flow	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS
AM 2024 Opening Year	55%	55%	55%	55%	70%	73%
AM 2029 Design Year	62%	63%	62%	63%	78%	85%
AM 2039 Design Year	67%	67%	67%	67%	87%	95%
PM 2024 Opening Year	50%	50%	50%	50%	61%	65%
PM 2029 Design Year	61%	61%	61%	61%	68%	80%
PM 2039 Design Year	65%	65%	65%	65%	78%	85%

Table 15.5 Summary of LinSig Analysis Results for The Hall Signalised Junction

The Hall Signalised Junction operates under a Microprocessor Optimised Vehicle Actuation (MOVA) system that reacts to traffic as it approaches the junction. Existing signal phase/stage information received from Kildare County Council was input to the LinSig model. A Cycle Time of 120 seconds was assumed with pedestrians called every cycle.

The opening of the Ballyfarm Road section of the NSORR has no impact on the existing signalised junction capacity as development traffic cannot connect to this junction over the River Liffey.

The opening of the Bridge section of the NSOORR moves traffic onto this signalised junction due to traffic rerouting from the NSORR.

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Yes Ballyfarm Road		Scenario C - NSORR Fully Complete	
	Without Development	With Proposed Development	Without Development	With Proposed Development	Without Development	With Proposed Development
Peak Hour Flow	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS
AM 2024 Opening Year	144%	148%	144%	148%	114%	116%
AM 2029 Design Year	160%	167%	160%	167%	127%	129%
AM 2039 Design Year	173%	179%	173%	179%	137%	139%
PM 2024 Opening Year	129%	132%	129%	132%	96%	99%
PM 2029 Design Year	148%	153%	148%	153%	107%	111%
PM 2039 Design Year	159%	164%	159%	164%	115%	119%

Table 15.6 Summary of LinSig Analysis Results for St. Conleth Bridge Signalised Junction

St Conleth's Bridge Signalised Junction operates under a Split Cycle Offset Optimisation Technique (SCOOT) system which reacts to traffic as it approaches the junction. Existing signal phase/stage information received from Kildare County Council was entered in the LinSig model. A Cycle Time of 144 seconds was assumed, with pedestrians called every cycle.

St. Conleth's Bridge signalised junction with the current stage/phase timings is already operating above design capacity in the AM and PM Peaks Opening Year without the proposed development traffic. The opening of the Ballyfarm Road section of the NSOORR has no impact on the existing signalised junction as the traffic rerouting from the NSORR does not occur in this scenario.

With the addition of the Phase 1 traffic, the DOS increases by a maximum of only 4% in the opening year Scenario B and 3% in Scenario C. With the full development traffic in 2039 the DOS increases by a maximum of only 6% in Scenario B and 4% in Scenario C.

The opening of the bridge section of the NSOORR significantly improves the DOS such that it would not reach the existing level of DOS by 2039, even with the full the development traffic added. The relative impact of the proposed development on the existing junction is also improved with the full opening of the NSORR.

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Yes Ballyfarm Road		Scenario C - NSORR Fully Complete	
	Without Development	With Proposed Development	Without Development	With Proposed Development	Without Development	With Proposed Development
Peak Hour Flow	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC
AM 2024 Opening Year	103%	111%	99%	103%	80%	81%
AM 2029 Design Year	120%	135%	115%	121%	89%	90%
AM 2039 Design Year	129%	144%	123%	129%	96%	98%
PM 2024 Opening Year	80%	88%	77%	81%	57%	59%
PM 2029 Design Year	94%	107%	88%	97%	65%	66%
PM 2039 Design Year	101%	114%	96%	104%	70%	71%

Table 15.6 Summary of Junctions 9 Analysis Results for Existing Buckley's Cross Roundabout Modelled with Queuing

The analysis simulated the queuing at the existing roundabout. Buckley's Cross Roundabout is above design capacity (>85%RFC) in the Opening Year in the current scenario without any development is place.

With the addition of the Phase 1 traffic the DOS increases by a maximum of only 4% in the opening year Scenario B and 2% in Scenario C. With the full development traffic in 2039 the DOS increases by a maximum of only 8% in Scenario B and 2% in Scenario C.

The opening of Ballyfarm Road improves the existing scenario and the taking in charge of this road is to be completed by Q2 2022 however the AM Peak is still above the design threshold in the opening year (with Phase 1 development). This level of congestion with Phase 1 development (167 units plus Neighbourhood Centre and Créche) would be considered acceptable in the norms of an urban environment.

When the full NSORR is operational, the capacity of Buckley's Cross Roundabout will be significantly improved, and it will be below the design threshold for roundabout capacity in the PM Peak up to the design Year 2039 and in approximately 2027 (with full development) in the AM Peak.

It is planned by Kildare County Council to signalise Buckley's Cross in the future therefore we have considered the impact in relation to the proposed development. Figure 15-8 shows an indicative layout of a proposed signalised junction design at Buckley's Cross. It should be noted that the design presented below is based on topographical survey from December 2021, and allowances for cycle lanes have been made as the R445 is identified as a primary route in the Strategic Cycle Network Plan for County Kildare.

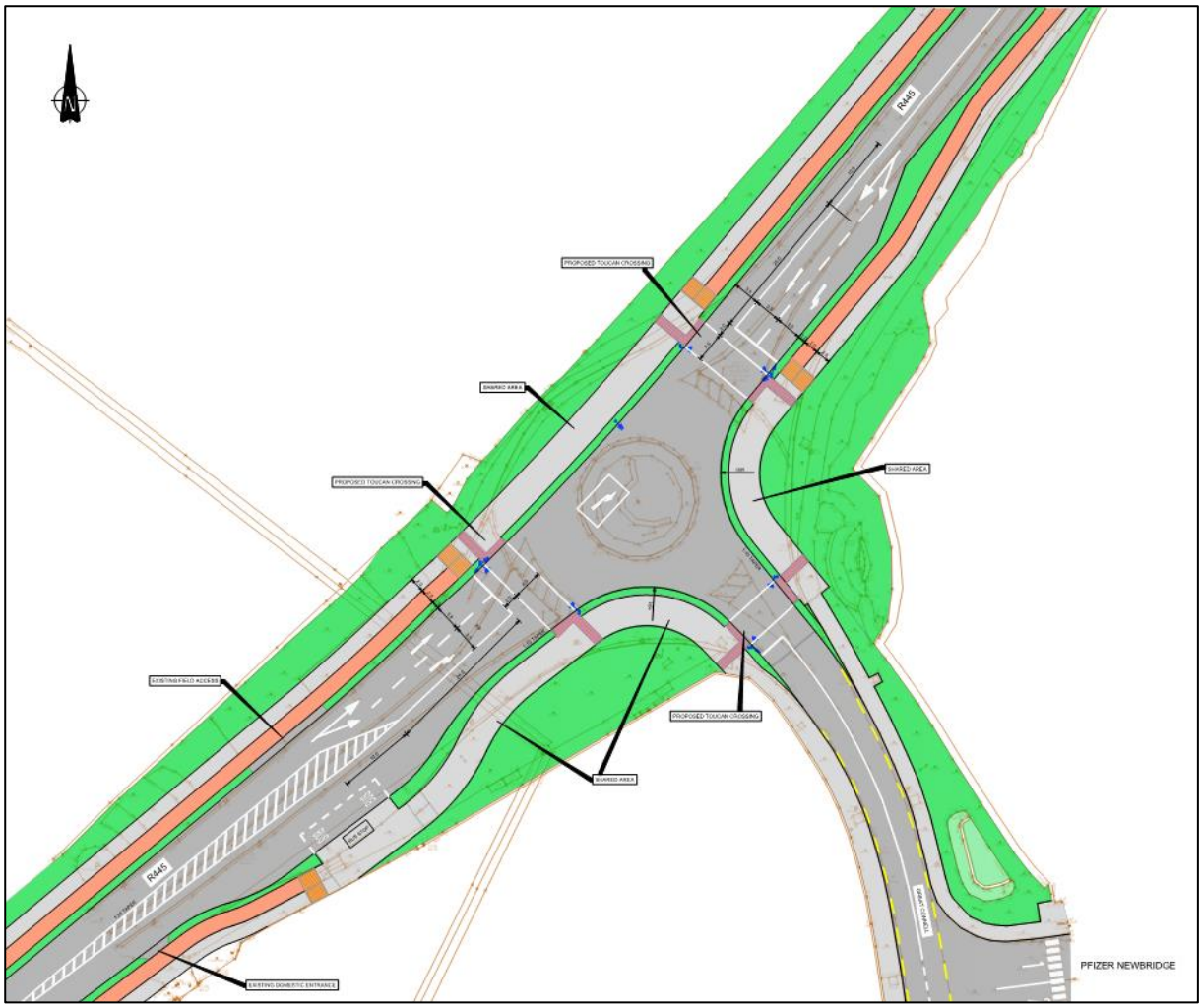


Figure 15.8 Indicative Layout Buckley's Cross

	Scenario B - No Bridge/ Yes Ballyfarm Road	Scenario C - NSORR Fully Complete
	With Proposed Development	With Proposed Development
Peak Hour Flow	Maximum DOS	Maximum DOS
AM 2024 Opening Year	74%	56%
AM 2029 Design Year	87%	62%
AM 2039 Design Year	93%	67%
PM 2024 Opening Year	70%	41%
PM 2029 Design Year	85%	46%
PM 2039 Design Year	93%	49%

Table 15-2: Summary of LinSig Analysis Results for proposed Buckley's Cross Signalised Junction

It is possible to provide a signalised junction of Buckley's Cross that would be at design capacity for both design scenarios up to the Design Year 2039 with the existing levels of traffic accounted for. With the addition of the full Aston Lands development traffic the design capacity is within the norms of urban development.

15.8 Baseline Scenario

If the proposed development does not proceed the performance of the existing junctions in the local road network will remain be as per Scenario A results presented in the TTA.

15.9 Prevention & Mitigation Measures

15.9.1 Design

The proposed development layout incorporates measures to comply with DMURS, whose primary objectives are;

1 Prioritise pedestrians and cyclists in urban settings without unduly compromising vehicular movement.

2 Provide good pedestrian permeability and connectivity in urban environments to encourage walking.

3 Implement speed reduction measures to provide safe interaction between pedestrians, cyclists and motorists, and

4 Create attractive streetscapes through the design of roads and footpaths with careful consideration given to landscaping and selection of surface finishes.

The measures were identified by the Design Team comprising architects, landscape architects; civil engineers; environmental consultants; hydrology consults; and transport planners. The measures include:

- Great Connell Roundabout will be signalised for safety reasons rather than capacity reasons. The junction will include for toucan crossings on all arms for enhanced safety of vulnerable road users.

- Permeable pedestrian and cyclist linkages to the surrounding network, including access to Wellesley Manor and the private Ballyfarm Road at the Great Connell Road roundabout.

- A permeable traffic-calmed strategy including the provision of designated turning areas for visitors/deliveries/drop offs. Occupants of the houses will mainly have off street parking, with apartment residents using on-street parking.

- The design speed for the streets is 30km/hour and will be achieved by the use of short lengths of straight road, tight radii and change of surface materials. This also means that minimal signage is required on the streets.

- Street lighting will meet the standards required by Kildare County Council. Light emitting diode (LED) luminaires will be used and positioned to ensure a uniform lighting spread is achieved and dark corners are avoided.

- Footway widths are typically 2m and meet the minimum DMURS 1.8m requirement. High quality and slip resistant materials will be used in the construction and gradients are sufficiently shallow to make allow access for users of all abilities.

- A signalised Toucan Pedestrian/Cyclist crossing point will be provided on the NSORR at a point to be agreed with Kildare County Council.

- Bus Stops will be installed on either side of the NSORR

- The corner radii of the main access roads off the NSORR will be 4.5m to allow for occasional larger vehicle access. The corner radii of "local streets" within the development will be 3.0m. These tight radii will assist in traffic calming and also enable pedestrians to cross the road with as short a travel path as possible.

- The width of the road carriageways are:

    - 6.5m along the section of the NSORR to be delivered by the proposed development, along with 2 x 2m wide cycleways and 2 x 2m wide footways;

    - 6m on the main access roads along with 2 x 2m wide footpaths and;

    - 5.5m on the local roads along with 2 x 2m wide footpaths

  These road widths will facilitate two-way vehicular traffic and the relevant design vehicle turning manoeuvres (i.e. fire tender and refuse vehicle).

- Forward and junction visibility on the local streets comply with a 30kph design speed. The forward and junction visibility on section of the main NSORR comply with a 50kph design speed.

- The parking spaces for the houses and apartments meet the minimum requirements of the Kildare County Council Development Plan. Breaking continuous runs of parking into smaller groups along with planting and crossing areas to break the visual continuity of the parking;

15.9.2 Construction Stage

All traffic associated with the Construction Stage will be subject to a Traffic Management Plan that will be part of the Construction Environmental Management Plan. The scope of the Traffic Management Plan will be agreed in advance Kildare County Council. The objective of the plan is to minimise traffic disruption in the vicinity of the site and ensure the safety of both residents and construction staff.

15.9.3 Operational Stage

Based on the measures incorporated into the development design additional mitigations measures are not required in the operational stage.

15.10 Cumulative Efffects

The assessment of the traffic impacts linked to the proposed development took into consideration the cumulative effects of the existing traffic and junction capacities, the Ardstone development across the River Liffey, the construction of the Newbridge Southern Relief Roads and future predicted traffic growth rates.

15.11 Residual Impacts

15.10.1 Construction Stage

Based on the scale and phasing of the development, the haul routes and the implementation of Traffic Management Plan, construction stage traffic will not result in any localised traffic congestion either in the vicinity of the development site, or in Newbridge Town Centre and its key corridors. Construction traffic will have a short term, imperceptible, negative impact on the local road network.

15.10.2 Operational Stage

Ballyfarm Road will be taken in charge by Kildare County Council in Q2 2022. Scenario A (where Ballyfarm Road is not open) is only included in the results above to prove the impact of the partial/full opening of the NSORR.

As noted previously, Aston Ltd is progressing the delivery of an additional section of the NSORR as part of this proposed development as well as progressing a separate planning application for a section of the NSORR (Section 247 Kildare County Council Consultation Reference: PP2559) which will expedite the delivery of the full NSORR. Therefore, it is highly likely that the Scenario C results for each junction are the most appropriate results for the entire network analysis.

The Great Connell Roundabout and Lidl Distributor Roundabout are large enough to cater for the proposed development traffic into the design year of 2039 and are well within the design threshold of RFC<85% for all of the scenarios considered.

The Lidl Distributor Roundabout existing design has segregated cycle and pedestrian lanes on all arms for safe crossing of vulnerable road users, cyclists do not have to join the roundabout carriageway. No improvements are proposed.

It is proposed to alter the Great Connell junction from a roundabout to a signalised junction in order to improve the safety for vulnerable road users. Aston Ltd will deliver this upgrade as part of the proposed development.

Whilst the capacity of Buckley's Cross Roundabout is above the design standards at completion of Phase 1 (167 units plus Commercial and Crèche) when the Ballyfarm Road is operational, the level of congestion is commensurate with that to be generally expected in urban areas. The opening of the proposed bridge section of the NSOORR further improves the capacity of the roundabout.

Aston Ltd have commenced the proposed planning application for the extended road and bridge through Kildare County Council. Kildare County Council are actively seeking funding for the bridge construction, and it is reasonable to assume that the bridge could be open within the Design Year 2029.

An alternative signalised junction design of Buckley's Cross has been provided which improves capacity for all scenarios if the bridge cannot be progressed. The works to signalise this junction will be completed by Kildare County Council with an agreement for appropriate contributions to be made with Aston Ltd.

The Hall signalised junction works harder once the bridge section of the NSORR is opened but it is still considered an acceptable design capacity and within the norms of an urban environment for all of the scenarios considered.

The St. Conleth Bridge signalised junction is already operating above design capacity without the proposed development traffic. With the addition of the Phase 1 traffic the DOS increases by a maximum of only 4% in the opening year and 6% in the 2039 design year with the full development traffic. The opening of the Ballyfarm Road section of the NSORR has no impact on the existing signalised junction as the traffic rerouting from the NSORR does not occur in this scenario. The opening of the bridge section of the NSORR improves the DOS such that it would not reach the existing level of DOS by 2039, even with the full the development traffic added.

It is considered that in urban areas a certain level of congestion is to be expected during peak times.

The results should be viewed more for a comparative assessment of with and without the proposed Aston Lands development which is deemed to be low in all scenarios.

The assessment is consistent with the submissions of Kildare County Council and the determination of An Bord Pleanála on the Vacant Site appeal under ABP Reference: Inspectors Report ABP-303069-18 where ABP noted that the existing road network is adequate to support housing on the site and that the delivery of the NSORR would not prevent or delay the provision of housing on the site.

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Ballyfarm Road		Scenario C - NSORR Fully Complete	
Junction	2039 Without Development RFC/DOS	2039 With Development RFC/DOS	2039 Without Development RFC/DOS	2039 With Development RFC/DOS	2039 Without Development RFC/DOS	2039 With Development RFC/DOS
Great Connell Roundabout	24%	24%	23%	24%	29%	30%
Great Connell Signalised (Proposed 90 second cycle time)	-	-	-	42%	-	71%
Lidl Distributor Roundabout	60%	66%	55%	58%	52%	55%
The Hall Signalised Junction (Existing 120 second cycle time)	67%	67%	67%	67%	87%	95%
Conleth Bridge Signalised Junction (Existing 144 second cycle time)	173%	179%	173%	179%	137%	139%
Buckley's Cross Roundabout	129%	144%	123%	129%	96%	98%
Buckley's Cross Proposed Signalised Junction (Proposed 120 second cycle time)	-	-	-	93%	-	67%

Table 15-9: Summary Results all Surrounding Junctions

16 INTERACTION OF THE FOREGOING

16.1 Introduction

Previous Chapters describe the impacts associated with the proposed development and the prevention and mitigation measures that will be implemented. This Chapter discusses the significance of the actual and potential direct, indirect and cumulative effects of the changes due to interaction between relevant receptor. It is based on the physical and environmental conditions of the proposed development site and the predicted impacts of the development.

16.2 Population & Health/Air/Traffic

The development has the potential to impact on human beings from, air quality (including vehicle exhaust gases) and noise. The proposed construction methodology, building design and site layout have taken these into account, effective mitigation measures identified and incorporated into the design, construction and operational stages and the residual impacts assessed.

16.3 Water & Biodiversity

In the construction stage there is the potential for run-off from the site to impact on water quality in the drainage ditch and the River Liffey with consequent impacts on Biodiversity. The proposed construction methodology and the design of the surface water drainage system have taken these into consideration, effective mitigation measures identified and incorporated into the design and construction stages, and the residual impacts assessed.

16.4 Climate & Water

The effects of Climate Change were factored into the design of the surface water drainage system and the site specific flood risk assessment. Appropriate mitigation measures were identified, incorporated into the development design and the residual impacts assessed.

16.5 Climate/Traffic/Material Assets

The development will impact on Climate as a result of increased greenhouse gas emissions from traffic and the raw materials consumption in the construction stage and the energy consumption in the operational stage. The cumulative impacts of these interactions were assessed and mitigation measures to minimise impacts were incorporated into the development design.

16.6 Land & Geology/Biodiversity

The land take, involving the long term loss of arable land, will reduce the habitat and impact on the use of the site by Bat, Otter, Other Mammals and Birds. The impacts were taken into consideration and appropriate mitigation measures identified.

Table 16.1 Interaction

	Climate	Land & Geology	Water	Biodiversity	Air	Population & Human Health	Population & Human Health Noise	Landscape	Cultural Heritage	Materials Assets	Material Assets Traffic
Climate		√	√							√	√
Land & Geology				√							
Water				√							
Biodiversity											
Air	√										
Population & Human Health					√						
Population & Human Health: Noise											
Landscape						√					
Cultural Heritage											
Material Assets : Services											
Material Assets : Traffic						√					

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Volume III

APPENDICES

ASTON LTD

Great Connell
Strategic Housing Development
Newbridge
County Kildare

O'Callaghan Moran & Associates
ENVIRONMENTAL MANAGEMENT FOR BUSINESS

April 2022

O'Callaghan Moran & Associates
Unit 15,
Melbourne Business Park,
Model Farm Road,
Cork.

021-4345366
info@ocallaghanmoran.com
www.ocallaghanmoran.com

APPENDIX 1

PUNCH PLANNING ENGINEERING REPORT

PUNCH
consulting engineers

Great Connell SHD – Newbridge

Engineering Planning Report
192229-PUNCH-XX-XX-RP-C-0001

April 2022

Document Control

Document Number: 192229-PUNCH-XX-XX-RP-C-0001

Status	Revision	Description	Date	Prepared	Checked	Approved
A0	C01	SHD Stage 1	28/07/2021	K. Mullins	S. O'Coileir	J. Tiernan
A0	C02	SHD Stage 3	04/04/2022	S. O'Coileir	MC. Daly	L. Brennan

Table of Contents

Document Control i
Table of Contents ii
1 Introduction 4
1.1 Proposed Development 5
2 Stormwater Drainage Design 7
2.1 Existing Stormwater Drainage 7
2.2 Proposed Stormwater Drainage 9
2.2.1 Mean Annual Peak Greenfield Flow (Qbar) Calculation 10
2.2.2 Causeway Flow Modelling – General 11
2.2.3 Climate Change 12
2.2.4 Discharge to the River Liffey 12
2.2.5 Hydro-Brakes 13
2.2.6 Trapped Road Gullies 14
2.3 SuDS Proposals 15
2.3.1 Permeable Surfacing 15
2.3.2 Swales/Bioswales 16
2.3.3 Soakaways/Soakpits 16
2.3.4 Rainwater Harvesting 17
2.3.5 Green Roofs 17
2.3.6 Attenuation Tanks 18
2.3.7 Petrol Interceptor 18
2.3.8 Interception Storage Calculation 19
2.4 Surface Water Drainage Proposals 20
3 Foul Water Drainage Design 21
3.1 Existing Foul Water Drainage 21
3.2 Kilcullen-Athgarvan Sewer Diversion 22
3.3 Proposed Foul Water Drainage 23
3.4 Foul Pump Station Design 26
3.4.1 Pump station Layout 26
3.4.2 Pump Station Philosophy 26
3.4.3 Pump Selection 26
3.4.4 Design Specification 27
3.4.5 Emergency Storage tank 27
3.4.6 Foul Rising Main and Discharge 28

3.5 Correspondence with Irish Water 28
3.6 Foul Water Drainage Proposal Drawings 28
4 Watermain Design 30
4.1 Existing Watermain 30
4.2 Proposed Watermain 32
4.3 Correspondence with Irish Water 33
4.4 Watermain Proposal Drawings 33
5 Flood Compensation 34
6 Traffic & Transport 37
7 Tri Partite Meeting Comments 38
7.1 An Bord Pleanála Notice of Pre-Application Consultation Opinion 38
7.1.1 Opinion Item 3, Sub-Section 4 38
7.2 Kildare County Council SHD Stage 2 Report (Ref:SHD202105 – Stage 2 Opinion) 38
7.2.1 Engineering Items raised in Section 4.1 Internal Reports 38
7.2.2 Engineering Items raised in Section 5 - Opinion and Reasons: Sub-Section 3 and 7 39
7.2.3 KCC SHD Stage 2 Report Appendix B (Pages 45-46) - Kildare County Council Fire Service Report 39
7.2.4 Kildare County Council Water Services – Appendix B (Pages 69 – 70) Irish Water Issues (Foul & Water Supply) 40
7.2.5 Kildare County Council Water Services – Appendix B (Pages 70 – 74) Surface Water & Flood Risk 44
7.3 Irish Water – Ref CDS20007443 59
7.3.1 In respect to Wastewater 59
7.3.2 In respect to Water 60
7.3.3 IW Planning Observations: 60
Appendix A Existing Record Drawings ..... A
Appendix B Qbar Calculation Report ..... B
Appendix C Met Eireann Rainfall Data C
Appendix D Surface Water Calculations – Causeway Flow Modelling ..... D
Appendix E Foul Water Calculations – Causeway Flow Modelling ..... E
Appendix F Irish Water – Confirmation of Feasibility ..... F
Appendix G Irish Water Statement of Design Acceptance ..... G
Appendix H Irish Water Diversion Confirmation of Feasibility ..... H
Appendix I Extracts from IGSL Limited Factual Ground Investigation Report (Report No. 23110, April 2021) I
Appendix J Additional Groundwater Monitoring Records ..... J

1 Introduction

PUNCH Consulting Engineers were commissioned by Aston Ltd to provide Civil & Structural Consulting Engineering services for the proposed Strategic Housing Development located at Great Connell, Newbridge, County Kildare. The site location is shown in Figure 1-1 below.

The existing site is approximately 27.635 hectares and is part brownfield/ part greenfield site with 3 no. existing buildings on the eastern side, and the majority of the existing land used for agriculture. The proposed development is located to the east of Newbridge town centre on the eastern side of the River Liffey. The site is within the Newbridge Local Area Plan.

There is one existing access route onto the site from Great Connell Road to the east.

The proposed site is bounded by the existing Wellesley Manor residential developments to the north-east, Great Connell Road to the east and existing farmland to the south. The River Liffey and existing farmland are located to the west. Ardstone Homes Limited were granted planning for 343 residential units on the site located on the western side of the River Liffey under planning approval grant ABP-302141-18.

Murphy International Limited headquarters/offices are located adjacent the site on the eastern side of Great Connell Road. The site is approximately 2km from Newbridge Town (St Conleth's Bridge), 2.9km from Newbridge Train Station and approximately 4.9km from the Newbridge/M7 junction. Distances are taken from the proposed site entrance on Great Connell Road.

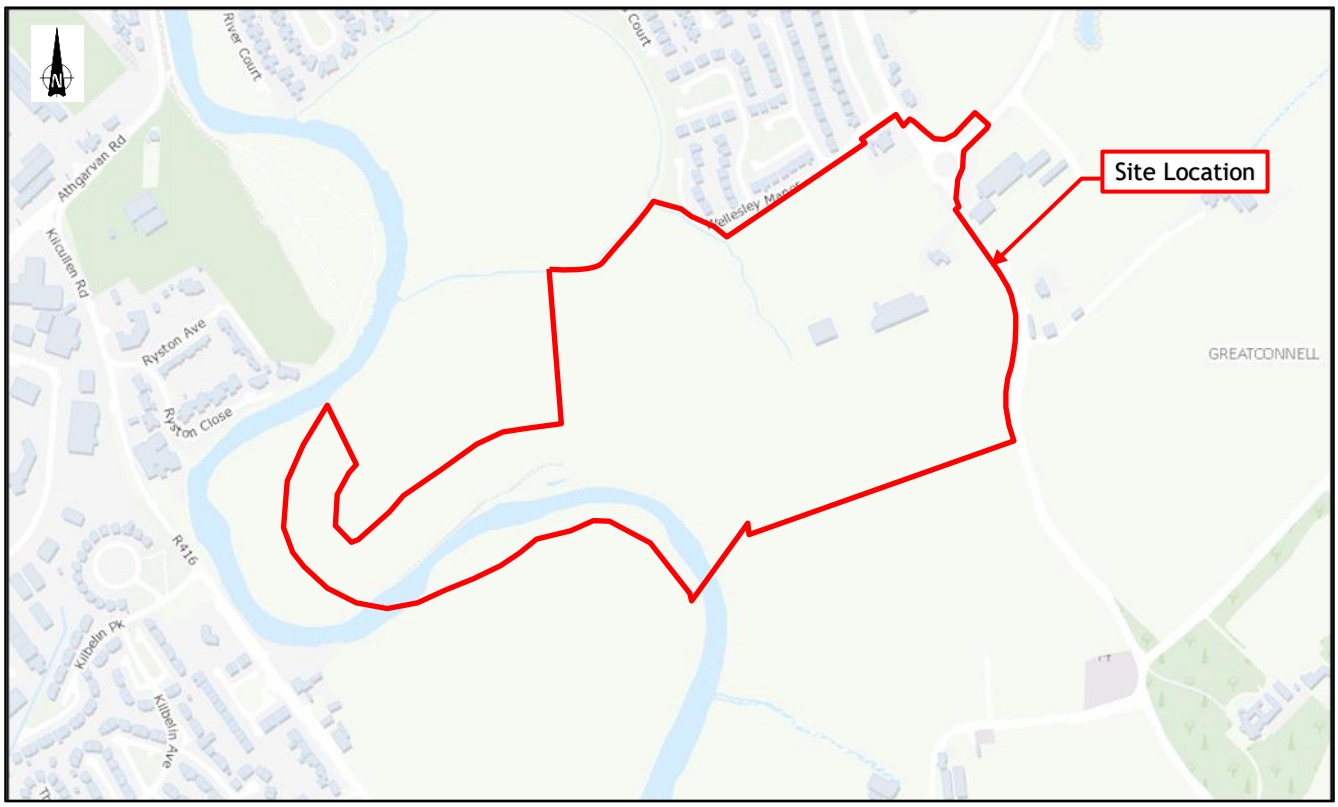


Figure 1-1: Site Location Plan
(Ref: https://viewer.myplan.ie/)

1.1 Proposed Development

Aston Limited intend to apply to An Bord Pleanála for permission for a strategic housing development at this site at Great Connell, Newbridge, County Kildare. This subject site comprises the lands surrounding and including the dwellings of 'Greatconnell' and 'Valencia Lodge', Great Connell, Newbridge, Co. Kildare, Eircodes: W12 TW29 and W12 V382.

The development will consist of the demolition of existing site structures (2,622.3 sqm) and the construction of 569 no. residential units, a neighbourhood centre with 11 no. units (commercial floor area 2,141 sqm) and a childcare facility (886 sqm), a circa 350 metre section of distributor road, and all ancillary and associated works on a site of 27.64 ha. The proposed development comprises:

1. Demolition of existing site structures (total 2,622.3 sqm) comprising; 'Great Connell' a two-storey dwelling of 331.9 sqm with detached single storey garage and outhouses of 48 sqm; 'Valencia Lodge' a single storey dwelling of 135.6 sqm with a single storey garage of 17.8 sqm; two no. single storey sheds of 1,440 sqm and 595 sqm, and a three-sided shed of 54 sqm.
2. Construction of 569 no. new residential dwellings (325 no. houses and 244 no. apartments) comprising:
    - 64 no. two-bed houses; 173 no. three-bed houses; and 88 no. four-bed houses (ranging in height from 2 to 3 storeys).
    - Apartment Block A (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
    - Apartment Block B (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
    - Apartment Block C (Part 3 and 4 Storeys): 4 no. one-bed apartments; 19 no. two-bed apartments and 4 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 87 sqm.
    - 13 no. apartments above the proposed Neighbourhood Centre comprising; 4 no. own-door two-bed apartments; 3 no. shared-access one-bed apartments; and 6 no. shared-access two-bed apartments. These proposed units have private balconies or terraces.
    - 160 no. own-door apartments in 2- and 3- storey buildings comprising; 16 no. one-bed apartments; 78 no. two-bed apartments, 66 no. three-bed duplex apartments. These units will have private amenity areas in the form of terraces, balconies and/or rear gardens.
3. Provision of Neighbourhood Centre (ranging in height between 2 and 4 storeys) with 11 no. commercial units comprising: a convenience shop of 909 sqm (unit 1); 3 no. doctor/dentist/physio units of 120 sqm, 120 sqm and 90 sqm (units 6, 7, and 8, respectively); a café of 125 sqm (unit 4); a restaurant of 213 sqm (unit 9); and 5 no. shop/convenience services units of 112 sqm, 49 sqm, 171 sqm, 100sqm and 100 sqm (units 2, 3, 5,10 and 11, respectively). The proposed Neighbourhood Centre includes an external roof terrace of 176 sqm.
4. Provision of a childcare facility (886 sqm) within the Neighbourhood Centre with capacity for in the order of 154 no. children.
5. Provision of 1,008 no. car parking spaces comprising 650 no. spaces for the proposed houses; 312 no. spaces for the proposed apartments; and 46 no. spaces to serve the Neighbourhood Centre.
6. Provision of 732 bicycle parking spaces comprising 536 no. secure residential spaces, 134 no. residential visitor spaces, and 62 no. spaces to serve the Neighbourhood Centre.
7. A series of 18 no. public open spaces and pocket parks are proposed throughout the residential development (2.613 ha net area).
8. Provision of a 8.31 ha amenity area adjoining the River Liffey.

9. Vehicular access to the proposed development from Great Connell road via a circa 350 metre section of the Newbridge South Orbital Relief Road (NSORR), including footpaths and cycle paths. It is proposed to upgrade the existing Great Connell Roundabout to a signalised junction and provide footpaths and cycle paths within the subject site along the Great Connell Road.
10. Proposed development facilitates future potential pedestrian, cycle and vehicular links to adjoining residential development and undeveloped lands.
11. All enabling and site development works, landscaping, boundary treatments, lighting, services and connections, including connection to permitted wastewater pumping station, waste management, ESB substations, compensatory flood storage and all other ancillary works above and below ground on a site of 27.64 ha.
12. A 7-year permission is sought.

The proposed layout for the development is detailed in the series of drawings by OFA Architects accompanying this report.

2 Stormwater Drainage Design

2.1 Existing Stormwater Drainage

Within the proposed site for development there is no existing surface water piped drainage network. From a review of Kildare County Council's service record drawings, the following existing sewers are noted:

1. 1000mm concrete surface water sewer that flows adjacent to the northeast boundary of the site, from the Great Connell Road in a southwest direction along Wellesley Manor and discharges to a small stream that then flows into the Liffey.
2. An existing drainage system serving the Wellesley Manor residential estate to the north of the site, which connects to the 1000mm concrete surface water drain.

Refer to Figure 2-1 and Figure 2-2 below.

Figure 2-1: Existing Surface Water Network Surrounding the Proposed Site.
(Extract from Irish Water records)

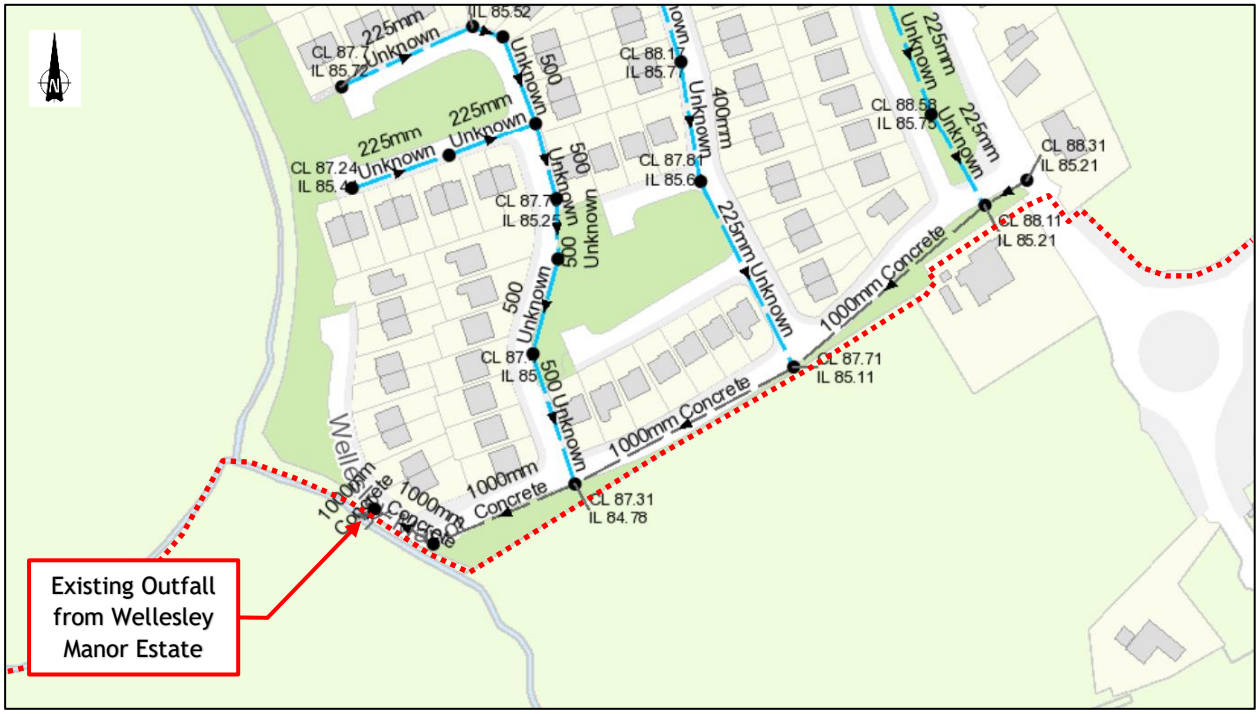


Figure 2-2: Existing Surface Water Network Serving Wellesley Manor Estate. (Extract from Irish Water records)

The proposed development occupies agricultural land situated adjacent to the River Liffey. The site area is approximately 27.635 ha, with a zoned land extent of 17.346 ha. The site topography is varied, with a fall in a northwest direction of approximately 2.74m (+85.49m to +88.23).

There is an existing ditch on the site that crosses from south to north. The ditch joins the River Liffey further downstream of the site. The ditch has invert levels in the region of 84.7 mAOD.

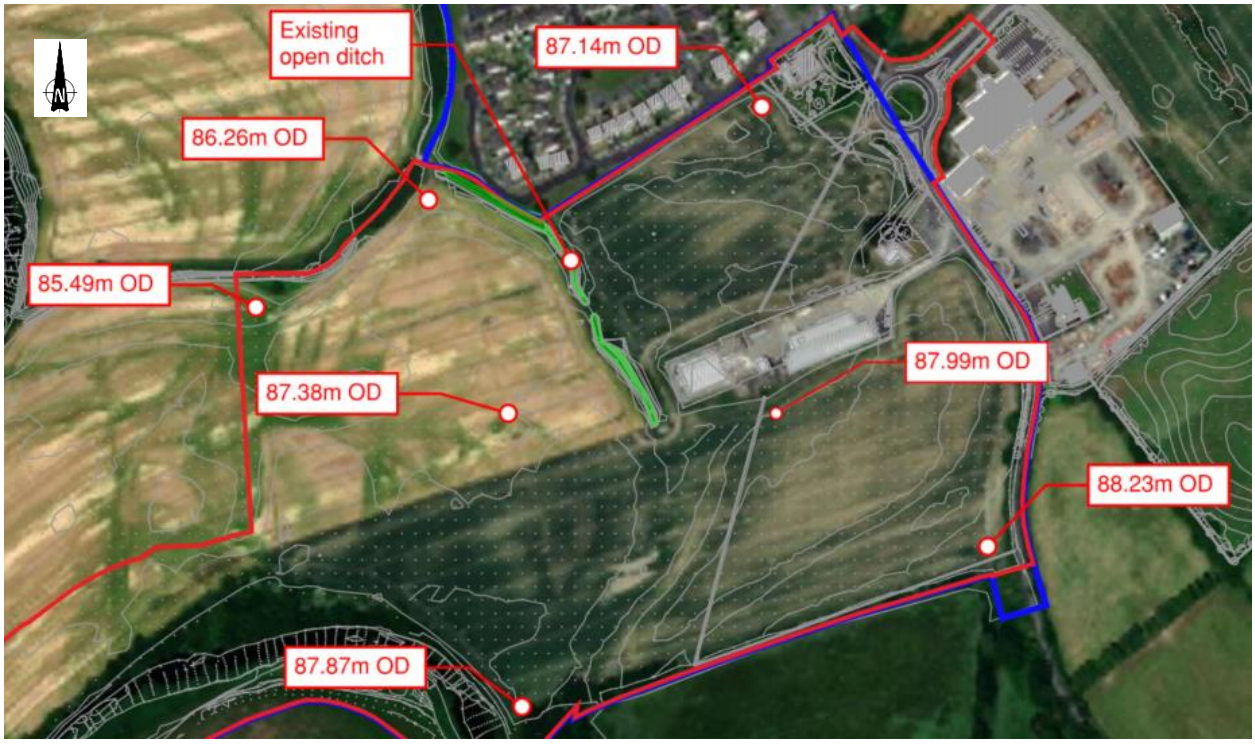


Figure 2-3: Existing Site Levels

2.2 Proposed Stormwater Drainage

A new surface water drainage network will be provided for the proposed development. The proposed surface water drainage system has been designed, analysed, and simulated using Causeway Flow software with reference to the following documents:

a) Kildare Development Plan 2017-2023
b) CIRIA SuDS Manual 2015 C753 – The SuDS Manual
c) CIRIA Publications C644 – Building Greener
d) Greater Dublin Strategic Drainage Study (GDSDS)
e) Greater Dublin Regional Code of Practice for Drainage Works
f) Recommendations for Site Development Works for Housing Areas - Department of the Environment and Local Government

The proposed surface water drainage network will serve the developed section of the site. Due to the topography across the site, it is not possible to drain the entire site via one outfall. As such it is proposed to discharge via four outlets to the existing ditch which passes through the mid-northern portion of the site and two outlets to the River Liffey to the west. Please refer to drawings 192229-PUNCH-XX-XX-DR-C-0101, 192229-PUNCH-XX-XX-DR-C-0102, 192229-PUNCH-XX-XX-DR-C-0103 and 192229-PUNCH-XX-XX-DR-C-0104 for plans of the proposed drainage network and discharge points from the development site.

All surface water drainage within the site will fall via gravity to the various surface water outfalls. Flows from the development will be limited to the greenfield runoff rate. Interception, treatment and attenuation measures will be provided to reduce, treat and restrict outflow from the site.

As detailed in the following sections, the sum of the discharge rates from the six outfalls have been restricted to ensure Qbar from the full site is not exceeded for the 1 in 100-year rainfall event with 20% climate change. Therefore, total discharge will be limited to the greenfield runoff rate of 76.31 l/s.

The proposed section of NSORR road that will traverse the site is to be drained by a network that is separate to the residential development drainage. Dedicated surface water drainage lines will be provided for the road that will discharge to 2 no. dedicated attenuation systems. Due to level and vertical clearance constraints imposed by the existing 900mm dia. Newbridge Eastern Interceptor Sewer traversing the site, 2 no. outfalls are required for the road drainage.

The site conditions have been reviewed through desktop study and site investigations and the design parameters outlined in Table 2-1 have been identified.

The SuDS measures provided will ensure that all surface water from the proposed development will pass through at least one SuDS element, which includes bio-swales, soakpits, permeable paving and attenuation tanks. This will ensure the surface water discharge from the development is restricted to Qbar for the 1 in 100 year storm with 20% climate change allowance.

Table 2-1: Stormwater Drainage Design Parameters

Description	Value
Drainage Area	16.8 ha
SOIL type	Soil Type 3 *(As confirmed through site investigation carried out by IGSL Limited)*
SPR Value	0.4 *(Due to SOIL Type)*
Standard Average Annual Rainfall (SAAR)	899mm *(Source = Met Eireann Data)*
Flow reduction parameter	Qbar *(Mean annual peak greenfield flow)*
Maximum Allowable Controlled Outflow	76.31 l/s
Flow restriction method	Hydro-brake included at each outfall
Infiltration Rate (soakaway design & car park permeable paving design)	Varies – Minimum infiltration rate 0.132 m/hr based on Site Investigation infiltration tests carried out within the development site boundary. Refer to extracts from Site Investigation report in Appendix I.
Attenuation Volume	5707m^3
Return Period used for Pipework Design	5 year
Return Periods used in Simulations	30 year and 100 year
Climate Change	20%

There is an existing ditch south of the distributor road to be infilled to accommodate the proposed development. The ditch currently drains a portion of the site. The catchment of the ditch included in the proposed drainage network will cater for this area following removal of a portion of the ditch.

2.2.1 Mean Annual Peak Greenfield Flow (Qbar) Calculation

As there is no drainage network within the existing site, all surface water runoff on the existing site, currently infiltrates to the natural ground or runs overland to the open ditch to the north of the site or River Liffey.

Site investigations carried out by IGSL Limited found the following:

1. SOIL Type: a mixture of generally permeable soils at the site were identified, including gravels and sands with some silt and clay encountered also. This soil type conforms with Soil Type 3 as per the GDSDS.
2. Infiltration rate: Infiltration testing to inform soakaway design was carried out during the site investigations. The results of the infiltration tests determined the soil to be permeable with a minimum infiltration rate of 0.132 m/hr determined by the Site Investigation infiltration tests carried out within the development site boundary.
3. Groundwater levels: Groundwater monitoring was carried out from April 2021 to January 2022, with seven groundwater level readings taken during this period. The results of the groundwater monitoring are included in Appendix J. The base of all proposed infiltration SuDS systems are 1m above the top groundwater level measured near the proposed SuDS system.

The Standard Average Annual Rainfall (SAAR) for the development site has been sourced from the Met Éireann 1981-2010 Annual Average Rainfall Grid.

Using the parameters listed in Table 2-1 above, the Qbar discharge rate has been calculated in accordance with IH124 (GDSDS drainage design criterion 2). A copy of the calculation report for this assessment can be found in Appendix B. Based on a Soil Type 3, a drained area of 16.8 Ha and the rainfall parameters noted above, Qbar has been calculated for the site as 76.31 l/s. This is split into two catchments as shown on Table 2-2.

Table 2-2: Qbar rates and restricted outflow rates assigned to each catchment

Catchment	Area Served (ha)	Qbar (l/s)	Restricted Outflow Rate (l/s)
1. NSORR road that will traverse the site	0.8	3.46	4
2. Residential development	16.0	72.85	72.3
TOTAL	**16.8**	**76.31**	**76.3**

2.2.2 Causeway Flow Modelling – General

The proposed surface water drainage system has been designed using Causeway Flow software in accordance with the Department of Environment and Local Government's guidance document "Recommendations for Site Development Works for Housing Areas", with guidance taken from the "Greater Dublin Strategic Drainage Study" (GDSDS) and the Newbridge Development Plan.

The model has analysed a range of storms at the 1% AEP (1 in 100-year return period storm), taking account of the predicted daily maximum water level in the River Liffey as modelled by JBA Flooding Consultants, with 20% additional rainfall to allow for climate change.

The network has been modelled with the 9 no. proposed attenuation tanks and their respective volumes and the associated hydro-brake control outlets included. Conservatively, in the Causeway Flow model all hard surfaces have been assumed to be 100% impermeable and discharge to the piped network in the drainage model, i.e., intercepting SuDS such as permeable paving, green roofs and bio-swales have not been included in the model. Due to the permeable nature of the site, and the level of SuDS provided at the development, the runoff entering the drainage network will be less than indicated in the Causeway Flow model, particularly for low-level rainfall events.

Depths of water in the network model (including pipework, manholes, the attenuation tanks) have been assessed for surcharging and flood risk. The model is established such that a flood risk is identified in the

simulation results if the water rises to within 300mm of the cover level. If the water level rises to a level below this, it is identified as a surcharge within the model results. It is important to note that this warning is given related to proposed ground level at the node and not related to Finished Floor level. The maximum water level in the attenuation tanks is more than 500mm below the Finished Floor level of the adjacent property. This aligns with Criterion 3 of the GDSDS.

Causeway includes a design setting called "additional storage". This is included in the software to account for storage volume in the network provided by secondary drainage including gullies, access junctions, inspection chambers, service connections etc. This provides additional storage in the network above the storage provided within the attenuation tank and primary drainage network. 20m^3/ha is the standard allowance provided for in Causeway Flow and was utilised for this design.

Please refer to detailed Causeway calculations (inputs and outputs) enclosed in Appendix D for details.

2.2.3 Climate Change

An allowance of 20% was allowed for climate change in the drainage design as per the KCC Development plan (2017-2023).

2.2.4 Discharge to the River Liffey

The proposed site is located beside the River Liffey and the proposed surface water drainage system will discharge to the river. As such the proposed network has been designed to account for the effects of coincidental flooding. The Greater Dublin Strategic Drainage Study (GDSDS) recommends a pragmatic approach to joint probability analysis for combination flood events.

The proposed network has been designed in accordance with GDSDS Volume 5 guidance for combination flood events. The network has also been designed for a 1 in 100-year return period storm with an allowance for 20% climate change as per industry standard. The 4 design criteria chosen are as follows:

1. 100-year rainfall event
2. 30-year rainfall event with 0.25-year river
3. 5-year rainfall event with 1-year river
4. 1 year rainfall with 5-year river.

An estimate for the water levels for the 10-year river were calculated by JBA Consulting, and the ESB also provided JBA Consulting the 2-year River release flows from the Golden Falls Dam upstream of the proposed development, which was used to calculate the water levels in the 2-year River event.

A Site-Specific Flood Risk Assessment (SSFRA) was completed for the site by JBA Consulting (Document Number: COQ-JBAI-00-00-RP-HM-0012 is included under separate cover as part of this planning application). The flood model prepared as part of this assessment was used to estimate the river levels. Refer to Table 2-3 below for the JBA estimated water levels.

Table 2-3: Surcharge Modelling River Liffey Water Levels

Flow (m^3/s)	Outfall 1	Outfall 3	Outfalls 2, 4, 5, & 6
	Water Level (Mod)		
58.75 (2 Year)	85.30	87.15	85.90
91.91 (10 Year)	85.62	87.53	85.91

The SSFRA prepared by JBA calculated maximum predicted flood levels for the site. The development Finished Floor levels have been set to ensure the finished floor levels are above the predicted flood levels in the relevant areas. Refer to JBA's SSFRA for further information on the maximum predicted flood levels.

These river flood levels were modelled in Causeway Flow as a surcharge at the outfall of the surface water drainage network. This impacted the surface water network by simulating when the proposed outfall would be submerged. For the design the worst-case scenario was assumed, and the river was assumed to be at its peak level throughout the duration of the rainfall event.

As an additional factor of safety, more conservative water levels surcharge models than those required by the GDSDS have been developed as listed below:

1. 100-year rainfall event
2. 30-year rainfall event with 2-year river
3. 5-year rainfall event with 10-year river
4. 1 year rainfall with 10-year river.

Results of the surcharge models for the above events can be found in Appendix D.

The proposed surface water discharge points will incorporate a non-return valves to prevent water from the river surcharging up through the surface water drainage network.

Regarding protection of the water quality of the River Liffey, the surface water will be routed through SuDS prior to connection to carrier drainage system. This will filter and treat the surface water, reducing silts and oils entering the drainage network. This is described in further detail in Section 2.3 below. As an additional treatment measure, the surface water will be routed through petrol interceptors prior to discharge to the River Liffey.

All works carried out adjacent to or into the River Liffey and/or site watercourses will be in compliance with the requirement of Waterways Ireland and Inland Fisheries Ireland document "Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters"

2.2.5 Hydro-Brakes

It is proposed that Hydro-brakes® flow controls are to be used before each outfall to restrict the flows to Qbar. The below table provides the restricted max flow rates at each outfall

Table 2-4: Hydro-Brake Diameter and Design Flows

Outfall	Hydro-Brake Orifice Dia (m)	Design Flow (l/s)	Hydro-Brake® Product Number
Outfall 1	0.143	9.9	CTL-SHE-0143-9900-1143-9900
Outfall 2 (NSORR)	0.065	2.0	CTL-SHE-0065-2000-1143-2000
Outfall 3	0.093	4.0	CTL-SHE-0093-4000-1143-4000
Outfall 4	0.250	37.4	CTL-SHE-0250-3740-1800-3740
Outfall 5	0.193	21.0	CTL-SHE-0193-2100-1661-2100
Outfall 6 (NSORR)	0.065	2.0	CTL-SHE-0065-2000-1143-2000

2.2.6 Trapped Road Gullies

All gullies will contain a silt trap to prevent silt entering the connecting SuDS or carry drain system. Please refer to drawing 192229-PUNCH-XX-XX-DR-C-0501 for trapped gully typical detail.

2.3 SuDS Proposals

The proposed development has been assessed in relation to Sustainable Urban Drainage Systems (SuDS). A variety of SuDS measures have been proposed to comply with Council recommendations. All SuDS measures are to be implemented with reference to the UK SuDS Manual and Kildare City Council drainage requirements. With regards to the use of attenuation ponds within the proposed development, the volumes of water needed to be attenuated in the proposed tanks locations, would have resulted in the water being up to 2m in depth at times. In the interest of safety and to ensure the useability of this open space, it was considered necessary to provide underground attenuation tanks in these locations.

Relatively small volumes of rainwater collected on the respective SuDS systems will enter the public sewer network during typical low intensity storms. This is because the proposed SuDS measures will retain rainwater until it is either used via evapotranspiration in the green areas or infiltrated to the ground.

The SuDS processes decrease the impact of the development on the receiving environment by providing amenity and biodiversity in many cases. Regular maintenance of the SuDS proposals is required to ensure they are operating to their optimal level throughout their design life.

2.3.1 Permeable Surfacing

It is proposed to provide 6046m^2 of permeable paving across the site. Permeable paving will be provided in parking bays and driveways throughout the site, including the parking for the neighbourhood centre. Permeable paving will be located as shown on drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154*.

The treatment processes that occur within permeable pavements include:

I. Filtration of silt and the attached pollutants – the majority of silt is trapped within the top 30mm of the jointing material between the blocks.
II. Biodegradation of organic pollutants, such as petrol and diesel within the pavement construction.
III. Adsorption of pollutants (pollutants attach or bind to surfaces within the construction) which depends on factors such as texture, aggregate structure, and moisture content.
IV. Settlement and retention of solids.

The use of permeable pavers for this purpose is supported by the treatment processes outlined above. CIRIA C753 (The SuDS Manual) notes that regarding interception design of pervious pavements, studies have shown that runoff typically does not occur from pervious pavements for rainfall events up to 5 mm. Please refer to drawing *192229-PUNCH-XX-XX-DR-C-0551* for permeable paving detail.

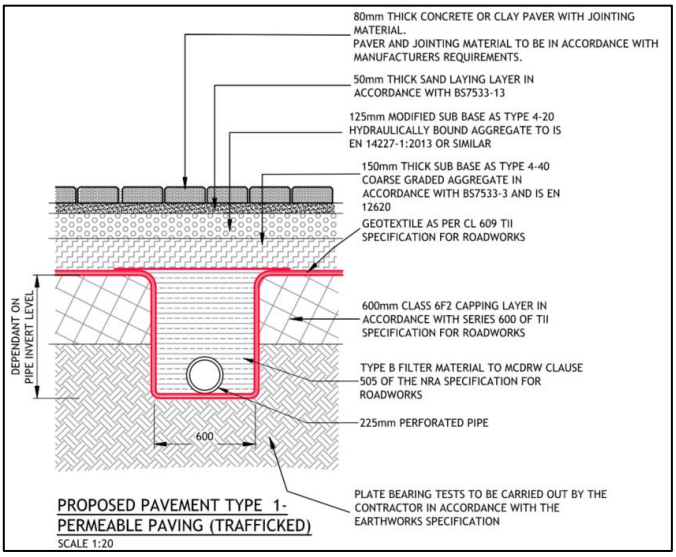


Figure 2-4: Proposed permeable paving (trafficked) detail as per PUNCH Detail drawing*192229-PUNCH-XX-XX-DR-C-0551*

2.3.2 Swales/Bioswales

Swales are to be provided along the edges of roadways within green areas and on the northern side of the section of NSORR. The swales will provide treatment via evapotranspiration within the topsoil layers with water compatible vegetation. Infiltration into the ground below is feasible due to the permeable sand and gravel layers below. Low level earth dams will be provided along the swales to enable build-up of water for treatment. Please refer to drawing *192229-PUNCH-XX-XX-DR-C-0503* for typical swale detail.

The swales will incorporate a high-flow overflow with a screened outlet to the drainage network to accommodate removal of water in high flow circumstance. Swales will be located as shown on drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154*.

CIRIA C753 (The SuDS Manual) Table 24.6 notes that regarding interception design of swales, pavements drained by swales can be considered to provide interception, i.e. it can be assumed that there will be zero runoff from the first 5 mm rainfall for 80% of events during the summer and 50% in winter.

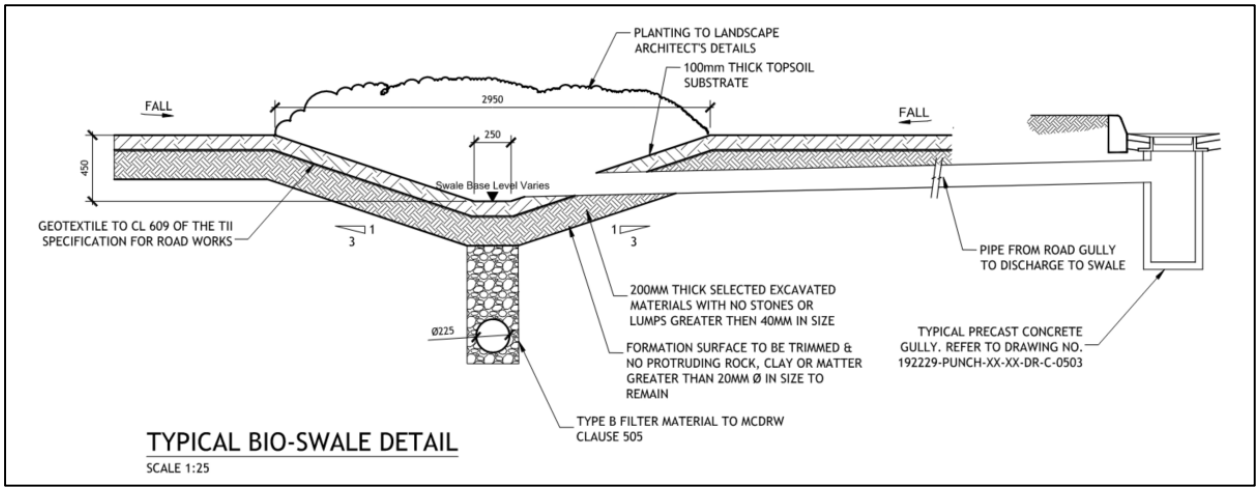


Figure 2-5: Proposed bio-swale detail as per PUNCH Detail drawing *192229-PUNCH-XX-XX-DR-C-0503*

2.3.3 Soakaways/Soakpits

Soakaways are excavations filled with a void-forming material e.g stone or a geo-cellular material that allows the temporary storage of water before it soaks into the ground. On this project it is proposed to form the soakaways using geo-cellular units wrapped in a geotextile.

Locations of proposed soakaways are shown on drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154*. Soakaways are proposed in the rear gardens of nearly all the housing units. Locations where houses without soakaways are proposed are shown on drawing *192229-PUNCH-XX-XX-DR-C-0151*.

Rainwater is to discharge to soakaways from the rear of houses and rear gardens hardstanding areas. Please refer to drawing *192229-PUNCH-XX-XX-DR-C-0501* for soakaway standard detail.

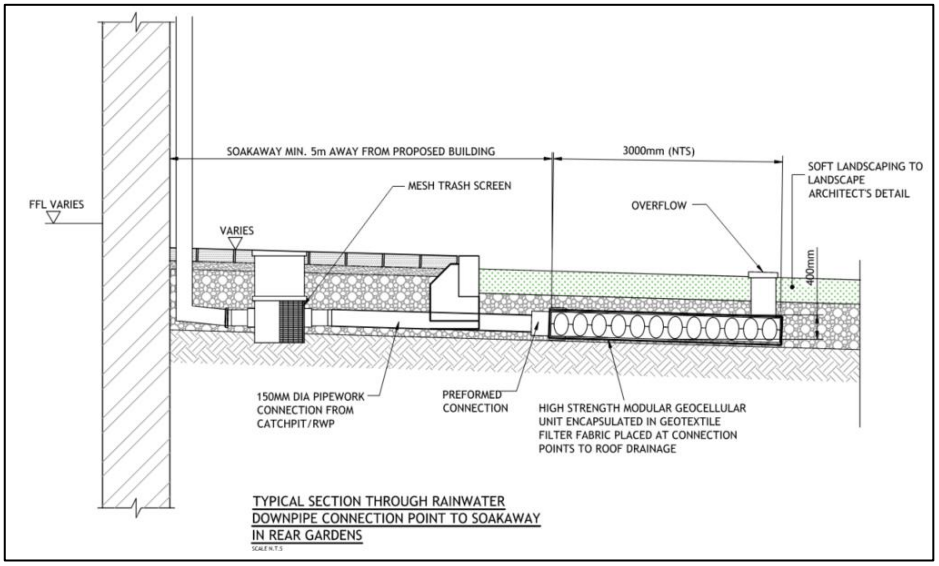


Figure 2-6: Proposed soakaway in rear gardens detail as per PUNCH Detail drawing *192229-PUNCH-XX-XX-DR-C-0501*

2.3.4 Rainwater Harvesting

Rainwater harvesting (RWH) is the collection of rainwater runoff for use. Runoff can be collected from roofs and other impermeable areas, stored, treated (where required) and then used as a supply of water for domestic, commercial, industrial and/or institutional properties. RWH systems have a number of key benefits:

- They can meet some of the building's water demand, delivering sustainability and climate resilience benefits.
- They can help reduce the volume of runoff from a site.
- They can help reduce the volume of attenuation storage required on the site.

The proposed development will incorporate rainwater harvesting. Rainwater harvesting/water butts will be provided to the houses and apartments. As noted above, where soakaways are present, rainwater will discharge to them from the rear sections of house roofs. Locations of proposed rainwater harvesting units are shown on drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154*.

2.3.5 Green Roofs

Green roofs are areas of living vegetation, installed on the top of buildings, for a range of reasons including visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. Green roofs are widely recognised as an effective SuDS solution and an important tool in mitigating the adverse effects of development on rainfall run-off and for managing urban flood risk. Please refer to Architects drawing for details of green roofs and associated roof drainage and access systems.

Research in the UK (Kellagher and Lauchlan, 2005, CIRIA, 2007) indicates that green roofs are effective in providing both attenuation and volume reduction in runoff for small rainfall events but suggests that these advantages are reduced (but not completely lost) for larger rainfall events.

It is proposed to provide green roofs on sections of the proposed apartment blocks and a portion of the neighbourhood centre in the form of sedum green roofs. Refer to drawing *192229-PUNCH-XX-XX-DR-C0154* for proposed locations. Green roofs will also be provided on bicycle stands across the site. Details for perimeters, drainage outlets, fire breaks, fall arrest system incorporation and penetrations will be installed as per the relevant standard detail specific to the manufacturer's system. Ultimately the

drainage layers within the extensive roof system will drain to roof perimeter outlets with subsequent discharge via downpipes to the site's drainage network.

Please refer to Figure 2-7 for a typical green roof detail.

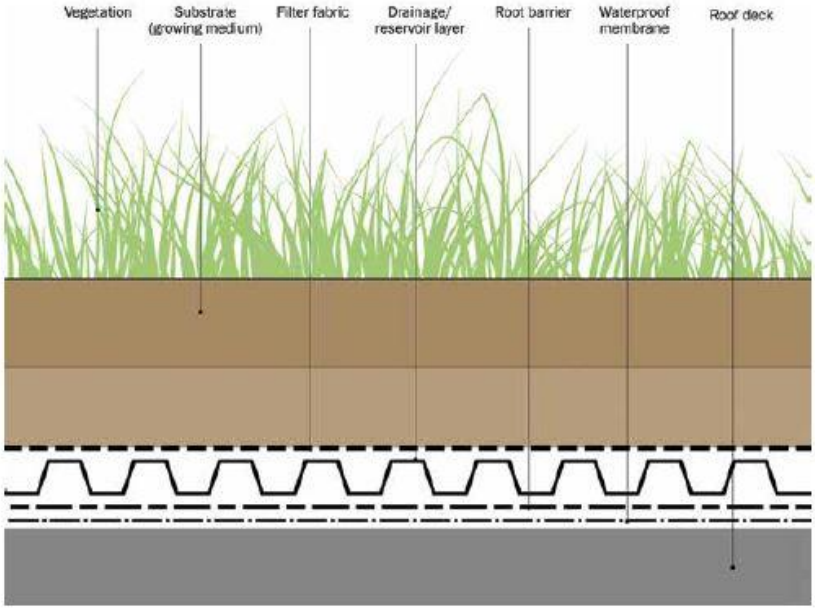


Figure 2-7: Typical Green Roof Detail (Source: SuDS manual - Figure 12.1)

2.3.6 Attenuation Tanks

The proposed attenuation tanks are sized to reduce the runoff from the site to the greenfield runoff rate of 76.31 l/s. The attenuation system has been designed for a 1:100-year storm return period storm with 20% additional rainfall to allow for climate change.

9 no. attenuation tanks are proposed to serve the proposed development with a total of 5707m^3 attenuation volume required. Two of the attenuation tanks with an attenuation volume of 320m^3 will be provided separate to the main development drainage network to cater for surface water flows from the NSORR road passing through the site. Please refer to drawing *192229-PUNCH-XX-XX-DR-C-0112* for catchment areas associated with each tank. Hydrobrakes placed downstream of the attenuation tanks will work to ensure effective use of the attenuation tanks.

The surface water runoff from the buildings and the hardstanding areas will collect and discharge to the attenuation tanks via the proposed SuDS measures discussed above.

Attenuation tank locations can be seen on the PUNCH drainage drawings *192229-PUNCH-XX-XX-DR-C-0101-0104* accompanying this report. Please refer to drawing *192229-PUNCH-XX-XX-DR-C-0505* for typical attenuation tank detail and schedule of proposed tanks.

2.3.7 Petrol Interceptor

In addition to the treatment provided by SuDS, it is proposed that all surface water run-off from all trafficked areas will outfall via Class 1 Bypass Separator located downstream of the proposed attenuation tanks. These devices will remove hydrocarbons and fine sediment particles from the site runoff and lower the risk of downstream contamination following an oil spillage on site. Petrol Interceptors will be provided prior to the attenuation tanks for the NSORR drainage.

Bypass separators fully treat all flows generated by rainfall rates of up to 6.5mm/hr. This covers over 99% of all rainfall events. Flows above this rate are allowed to bypass the separator. These separators are used when it is considered an acceptable risk not to provide full treatment for high flows, for example where the risk of a large spillage and heavy rainfall occurring at the same time is small.

Class 1 devices are designed to achieve a concentration of less than 5mg/l of oil under standard test conditions.

Treatment will also be provided by routing the drainage through swales/bioswales and permeable paving. This will provide an additional level of treatment prior to a petrol interceptor.

Please refer to drawings *192229-PUNCH-XX-XX-DR-C-0101-0104* for the locations of the proposed petrol interceptors and drawing *192229-PUNCH-XX-XX-DR-C-0509* for typical petrol interceptor detail.

2.3.8 Interception Storage Calculation

The interception storage volume is calculated based on:

- Entirety of the paved / roof area
- 5mm rainfall depth
- 80% runoff factor

Interception storage is to be provided within the green roof, permeable paving, swales and soakaways. The volumes to be provided for each are outlined in Table 2-5 below.

Table 2-5: Interception Storage Provision Calculation

Type	Plan Area of SuDS Element	Rate Calculation	Rate	Treatment Volume Provided	Detail
Extensive Green Roof	1766m^2	150mm deep sedum moss	5l/sq.m	8.8m^3	Treatment within green roof landscape component
Permeable Pavement	6104m^2	Deemed to provide treatment for own area only 325mm deep drainage layer at 30% voids	Area x 0.005 x 0.8	24.4m^3	Treatment within pervious layers and pervious pavement
Engineered Swales	5098m^2	Treatment provided by swale for impervious area 5 times the swale area	Area x 0.005 x 0.8 x 5	20.4m^3	Treatment within topsoil layer, no infiltration
Soakaways	1009m^2	Treatment provided for rear section of roof and for rear garden hard standing areas	291 No. Houses with Soakaways x 36 sq.m x 0.8 x 0.005	41.9m^3	Treatment within soakaway and subsoil sands and gravels.

2.4 Surface Water Drainage Proposals

With reference to the above Section 2, please refer to the following PUNCH Drawings:

192229-PUNCH-XX-XX-DR-C-0101	PROPOSED DRAINAGE LAYOUT - SHEET 1
192229-PUNCH-XX-XX-DR-C-0102	PROPOSED DRAINAGE LAYOUT - SHEET 2
192229-PUNCH-XX-XX-DR-C-0103	PROPOSED DRAINAGE LAYOUT - SHEET 3
192229-PUNCH-XX-XX-DR-C-0104	PROPOSED DRAINAGE LAYOUT - SHEET 4
192229-PUNCH-XX-XX-DR-C-0111	TYPICAL SuDS SCHEMATIC DETAIL PLAN
192229-PUNCH-XX-XX-DR-C-0112	PROPOSED OUTFALL CATCHMENTS LAYOUT
192229-PUNCH-XX-XX-DR-C-0150	PROPOSED SuDS MEASURES LAYOUT - SHEET 1
192229-PUNCH-XX-XX-DR-C-0151	PROPOSED SuDS MEASURES LAYOUT - SHEET 2
192229-PUNCH-XX-XX-DR-C-0152	PROPOSED SuDS MEASURES LAYOUT - SHEET 3
192229-PUNCH-XX-XX-DR-C-0153	PROPOSED SuDS MEASURES LAYOUT - SHEET 4
192229-PUNCH-XX-XX-DR-C-0154	PROPOSED SuDS MEASURES LAYOUT - SHEET 5
192229-PUNCH-XX-XX-DR-C-0160	PROPOSED OVERALL SURFACE WATER LAYOUT
192229-PUNCH-XX-XX-DR-C-0200	PROPOSED SURFACE WATER NETWORK LONG SECTIONS - SHEET 1
192229-PUNCH-XX-XX-DR-C-0201	PROPOSED SURFACE WATER NETWORK LONG SECTIONS - SHEET 2
192229-PUNCH-XX-XX-DR-C-0202	PROPOSED SURFACE WATER NETWORK LONG SECTIONS - SHEET 3
192229-PUNCH-XX-XX-DR-C-0203	PROPOSED SURFACE WATER NETWORK LONG SECTIONS - SHEET 4
192229-PUNCH-XX-XX-DR-C-0204	PROPOSED SURFACE WATER NETWORK LONG SECTIONS - SHEET 5
192229-PUNCH-XX-XX-DR-C-0205	PROPOSED SURFACE WATER NETWORK LONG SECTIONS - SHEET 6
192229-PUNCH-XX-XX-DR-C-0206	PROPOSED SURFACE WATER NETWORK LONG SECTIONS - SHEET 7
192229-PUNCH-XX-XX-DR-C-0207	PROPOSED SURFACE WATER NETWORK LONG SECTIONS - SHEET 8
192229-PUNCH-XX-XX-DR-C-0208	PROPOSED SURFACE WATER NETWORK LONG SECTIONS - SHEET 9
192229-PUNCH-XX-XX-DR-C-0209	PROPOSED SURFACE WATER NETWORK LONG SECTIONS - SHEET 10
192229-PUNCH-XX-XX-DR-C-0210	PROPOSED SURFACE WATER NETWORK LONG SECTIONS - SHEET 11
192229-PUNCH-XX-XX-DR-C-0501	TYPICAL DRAINAGE DETAILS - SHEET 1
192229-PUNCH-XX-XX-DR-C-0502	TYPICAL DRAINAGE DETAILS - SHEET 2
192229-PUNCH-XX-XX-DR-C-0503	TYPICAL DRAINAGE DETAILS - SHEET 3
192229-PUNCH-XX-XX-DR-C-0505	TYPICAL ATTENUATION TANK DETAILS
192229-PUNCH-XX-XX-DR-C-0509	TYPICAL PETROL INTERCEPTOR DETAILS
192229-PUNCH-XX-XX-DR-C-0551	TYPICAL PAVEMENT BUILD-UP DETAILS

3 Foul Water Drainage Design

3.1 Existing Foul Water Drainage

From reviewing the Kildare County Councils/Irish Water record drawings it can be seen that there is a:

- Kilcullen/Athgarvan 450mm concrete foul sewer traverses north across the site. Foul drainage from Wellesley Manor housing development is collected in a network of 150mmm to 300mm foul sewers and discharges into this 450mm foul sewer at the northern boundary of the proposed development site
- The newly constructed 600mm pumped rising main/900mm gravity Newbridge Eastern Interceptor Sewer traverses the subject site west-east.

Refer to Appendix A for Record Drawings indicating the 450mm Kilcullen Sewer and also including Irish Water As-Built record drawings detailing the 600mm rising main/900mm gravity Newbridge Eastern Interceptor Sewer.

The recently constructed Newbridge Eastern Interceptor Sewer (wayleave) and 450mm Kilcullen-Athgarvan Sewer are indicated in

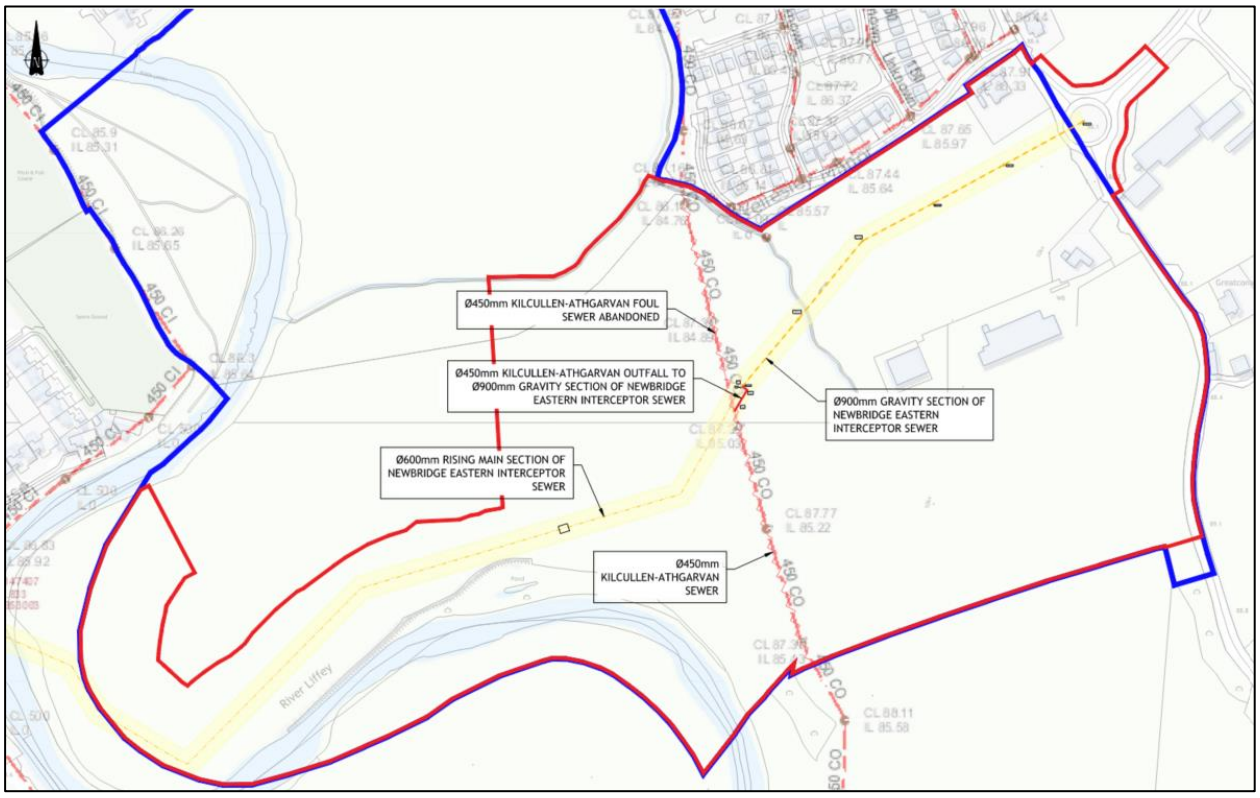


Figure 3-1 below.

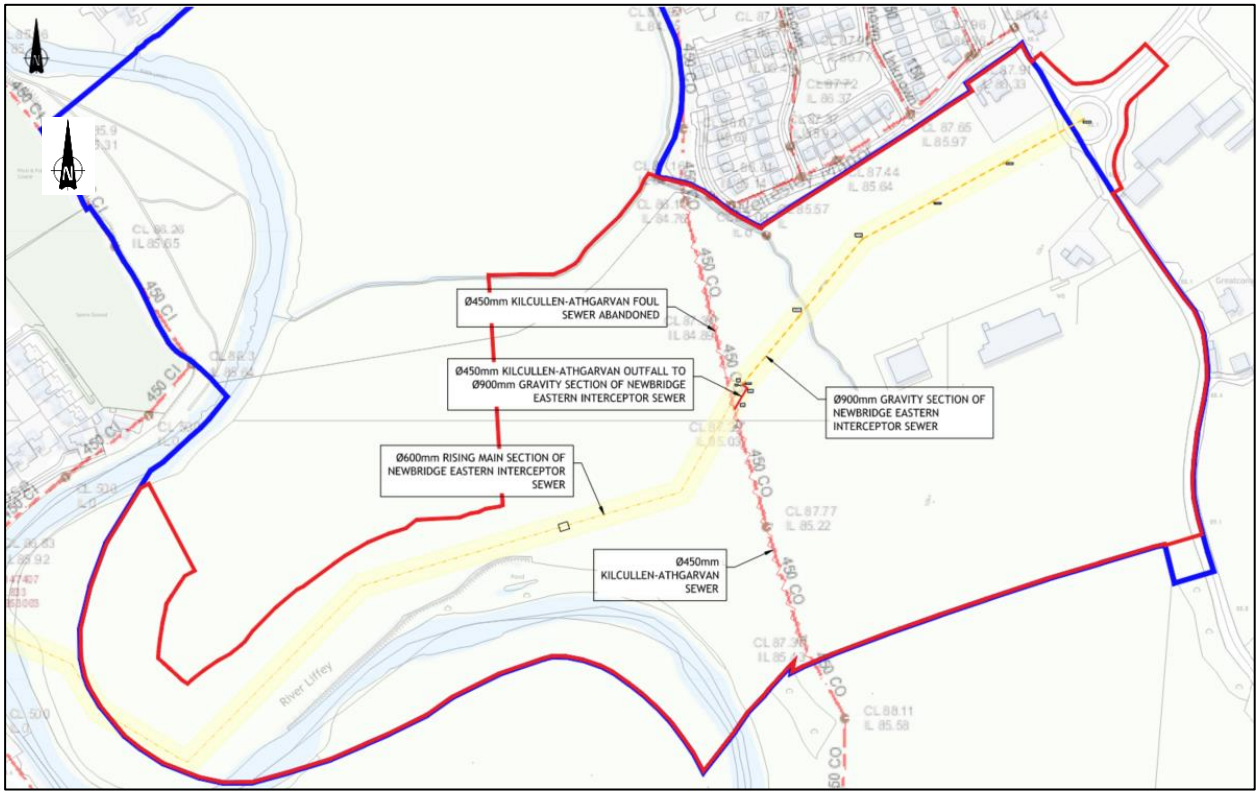


Figure 3-1: Existing foul drainage surrounding the site
(Extract from Irish Water Records / Newbridge Eastern Interceptor sewer As-Built records)

The proposed development occupies agricultural land situated adjacent to the River Liffey. The site topography is varied, with a fall northwards of approximately 1.9m (+86.18m to +88.05). The site includes existing treelines and hedgerows which will be retained where possible.

3.2 Kilcullen-Athgarvan Sewer Diversion

The existing 450mm Kilcullen Athgarvan foul sewer traverses the site in a north westerly direction and discharges into the newly constructed 900mm Newbridge Eastern Interceptor Sewer which runs along the route of the proposed section of the Newbridge Southern Orbital Ring Road (NSORR) proposed under this SHD application.

The proposed development impacts on the existing 450mm sewer route and it is thus necessary to divert the sewer to run along the southern edge of the development and then along the proposed Newbridge Southern Orbital Ring Road (NSORR) before discharging into the 900mm Newbridge Eastern Interceptor Sewer, as shown in Figure 3-2 below.

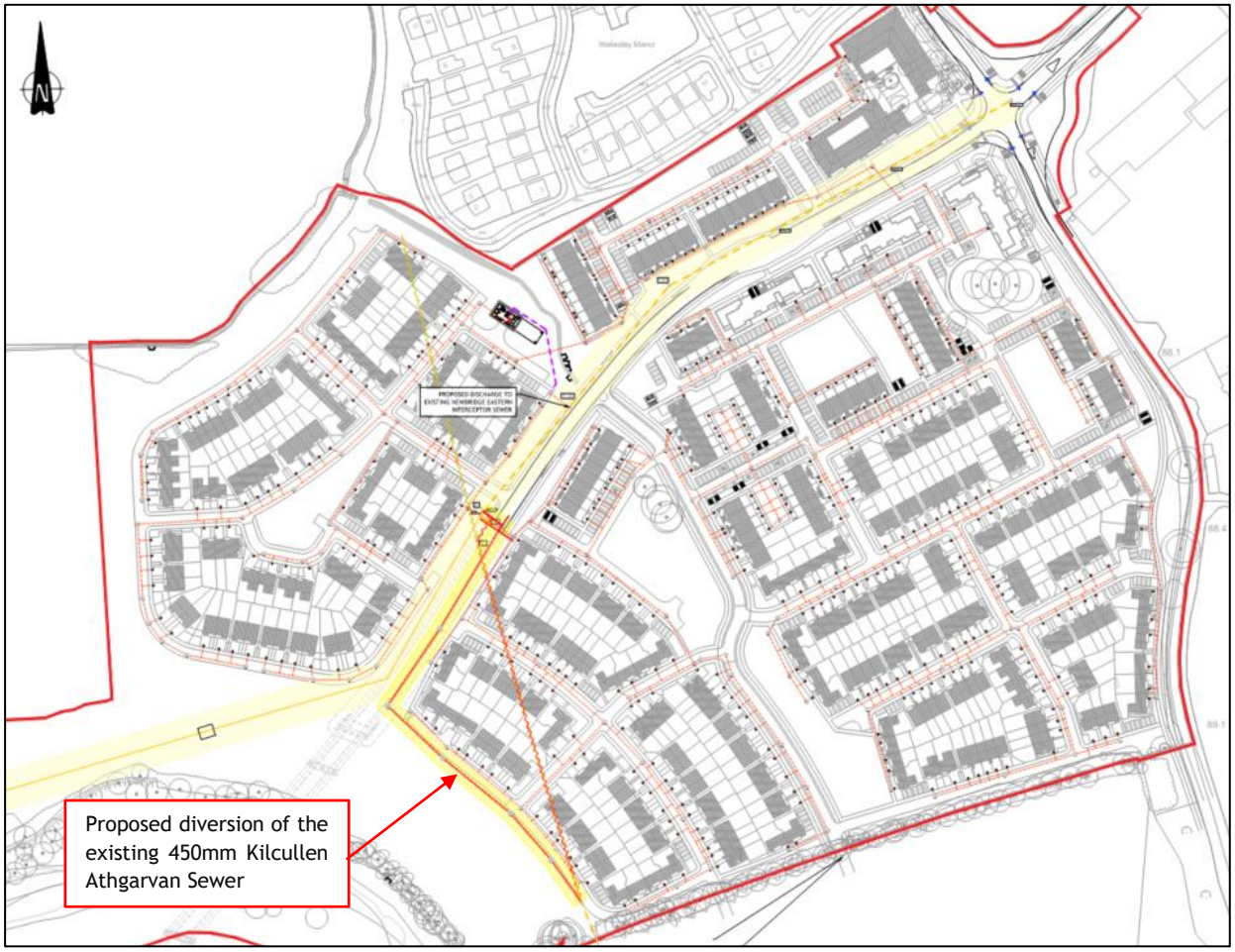


Figure 3-2: Proposed diversion of the existing 450mm Kilcullen Athgarvan foul sewer. Refer to PUNCH drawing 192229-PUNCH-XX-XX-DR-C-0130

PUNCH Diversion proposals for the 450mm sewer were presented to Irish Water and following detailed discussion and design development a Confirmation of Feasibility for the Diversion Applications (DIV21230) has been issued by Irish Water and is included in Appendix H. The final approved design is for a 600mm thermoplastic twin wall pipe laid at a 1 in 600 gradient meeting the requirements set out in Irish Water Code of Practice for Wastewater Infrastructure (Document IW -CDS-5030-03)

Please refer to the following PUNCH Drawings detailing the proposed diversion:

1. 192229-PUNCH-XX-XX-DR-C-0130
2. 192229-PUNCH-XX-XX-DR-C-0131
3. 192229-PUNCH-XX-XX-DR-C-0184
4. 192229-PUNCH-XX-XX-DR-C-0508

3.3 Proposed Foul Water Drainage

On this scheme it has not been feasible to connect the development into the 900mm gravity Newbridge Eastern Interceptor Sewer by gravity. Instead, all site drainage is collected by gravity and brought to a foul pump station servicing the entire development which is located north of the NSORR close to Wellesley Manor site boundary.

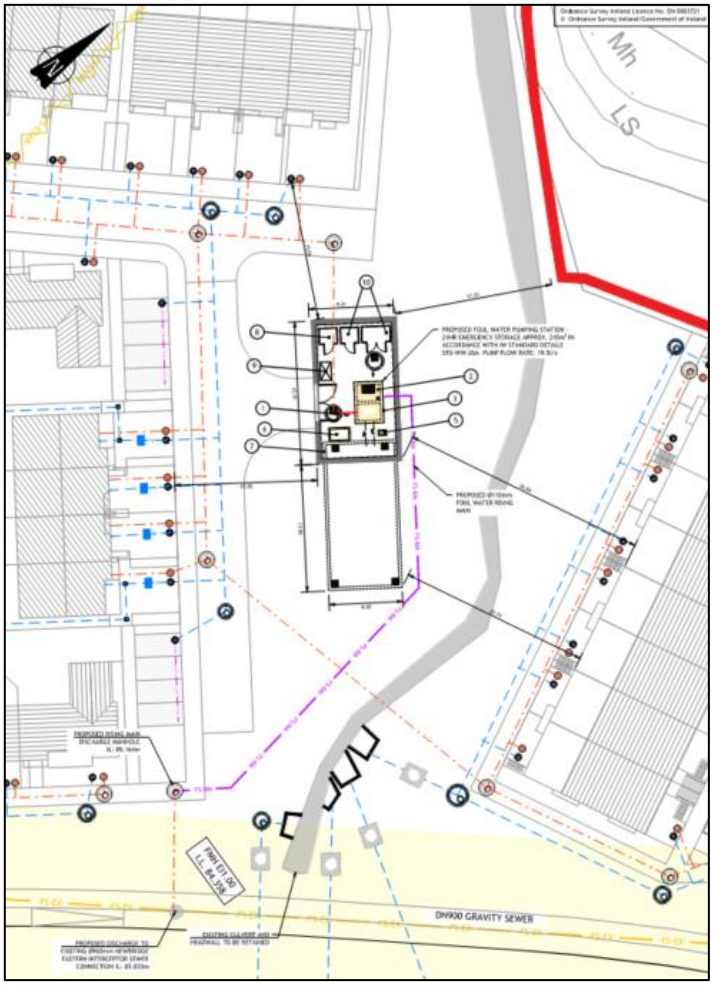


Figure 3-3: Proposed Foul Pump Station Location. Refer to PUNCH drawing 192229-PUNCH-XX-XX-DR-C-0110

Irish Water's Wastewater Code of Practice (Document IW-CDS-5030-03) sets out the minimum gradient requirements for works in residential developments. In addition, the further considerations of a large site area and the relatively flat site topography forces the depths of the foul drainage network to be significantly below the level of the 900mm Newbridge Eastern Interceptor Sewer at any potential direct gravity outfall.

Where possible, floor levels of houses and adjoining lands have been raised up significantly while tying into the level of the existing boundaries and road infrastructure to attempt a gravity connection. An assessment of the road levels and foul drainage plans, and long sections will thus confirm that a gravity connection is not feasible.

The foul network design proposals take full account of the Irish Water wayleave for the 600mm diam. rising main/900mm diam. Newbridge Eastern Interceptor Sewer and the proposed pipe and manholes are set back from the wayleave in accordance with Irish Water Wastewater Code of Practice (Document IW-CDS-5030-03) requirements.

For full details of the proposed foul drainage network please refer to PUNCH drawings *192229-PUNCH-XX-XX-DR-C-0101-0104* for full details of the proposed foul drainage network.

The proposed foul water sewers have been designed using Causeway Flow software in accordance with Irish Water's *Code of Practice for Wastewater Infrastructure* and the DOE's *Recommendations for Site Development Works for Housing Areas*. The foul loading has been calculated in accordance with the *Code of Practice for Wastewater Infrastructure (*particularly Section 3.6, Appendix C and Appendix D) published by Irish Water.

All foul water drainage shall be designed in accordance with Irish Water's Wastewater Code of Practice and Standard Details. The Commercial Peaking Factor was found from Table 2.7 in the Irish Water Code of Practice.

A 10% allowance for infiltration has been included in all calculations in accordance with the Irish Water code of Practice. This factor has been applied to the flow rates used to calculate the peak flows detailed in Table 3-1 below. Table 3-1 describes the foul water drainage design parameters used.

Table 3-1: Foul Water Drainage Design Parameters

Description	Value
Commercial Flow Rate	330 l/day/100m2 of retail/commercial space
Residential Flow Rate	165 l/person/day
Creche Flow Rate	99 l/person/day
Infiltration	10%
Peaking Factor	3DWF (Commercial) 6DWF (Residential)
Minimum Self Cleansing Velocity	0.75m/s
Minimum Pipe Diameter	150mm

Table 3-2: Foul Sewerage Flows

Source	Quantity	Flow	Flow unit	Daily	DWF	DWF	6 DWF
				(litres/ day)	m^3/day	litres/ sec	litres/ sec
Residential	1536 residents	165	l/person/day	253,490	253,490	2.934	17.603
Commercial	2,141 m2	330	l/day/100m^2	7,065	7,065	0.082	0.491
Creche	200 people	99	l/person/day	19,800	19.800	0.229	1.375
Total				**280,355**	**280,355**	**3.245**	**19.469**

3.4 Foul Pump Station Design

The proposed foul pump station and foul rising main have been designed in accordance with the Irish Water code of Practice for Wastewater Infrastructure and Irish Water Wastewater Standard Details. For full details of the proposed pump station design and the proposed rising main route refer to PUNCH Drawings *192229-PUNCH-XX-XX-DR-C-0101, 192229-PUNCH-XX-XX-DR-C-0507,* and *192229-PUNCH-XX-XX-DR-C-0509.*

3.4.1 Pump station Layout

The proposed foul pump station is a reinforced concrete structure. The 24-hour emergency storage tank will be constructed as a pre-cast concrete structure. A precast form of construction is proposed in order that the construction has the least impact on the surrounding area.

The proposed pump station design includes the following elements:

- Wet well
- Dry valve chamber
- 3 no. submersible pumps
- Flow meter chamber and inlet chamber with penstock
- Emergency Storage Tank providing 24-hour emergency storage (245m^3 storage volume)
- Control panels housed within kiosk structures.
- Dosing and Odour Control units

3.4.2 Pump Station Philosophy

The 3 pumps within the station will operate as a duty, assist and standby pump respectively with water levels in the wet well dictating start and stop times for each pump. The operation of the pumps will be controlled via ultrasonic level transmitters in the wet wells. Submersible pumps have variable speed drives for efficient operation. The pump operation arrangement is as follows:

Table 3-3 - Pump Operation Arrangement

	Role	Flow Rate
Pump 1	Duty	19.5 l/s
Pump 2	Assist	Variable to achieve self-cleansing velocity
Pump 3	Standby	Standby

All pumps shall be capable of automatic ramp up with increasing flow. Ramp up and ramp down times for each pump are to be in accordance with the manufacturer's recommendations. Provision shall be made for a portable generator in the event of a power failure.

3.4.3 Pump Selection

The pumping station design and pump selection have been made in accordance with the Irish Water code of practice. A preliminary pump curve has been selected based on the information available at present.

In line with the Irish Water Wastewater Code of Practice the chosen pumps will be able to provide a peak flow of 6 dry weather flow, calculated to be 19.5l/s.

3.4.4 Design Specification

The foul pump station will have the seven primary alarm signals:

1. High-high level
2. Low-low level
3. Emergency stop
4. Flowmeter fault
5. Temperature (motor)
6. Pump trip/fail
7. Level sensor fault

Notification will be sent to both Irish Water and Kildare County Council in the case of any alarm signal and forward flow will be limited in the case of an alarm through the use of interlocks.

3.4.5 Emergency Storage tank

The foul pumping station will include an emergency storage tank. Section 5.11 of the Irish Water Wastewater Code of Practice outlines the storage volumes required per number of residential units, as per the following table:

Houses	Storage Hours	Max Storage Volume (m^3)
0 – 250	24	112
250 - 333	24 for 250 and 18 thereafter	139
334 - 1667	24 for 250, 18 up to 333 and 12 thereafter	437
1668 - 3333	24 for 250, 18 up to 333, 12 up to 1667 and 10 thereafter	746

Figure 3-4: Table from Section 5.11 of the Irish Water Wastewater Code of Practice outlining storage volume requirements

As such it is proposed to provide the following storage volume:

Table 3-4 - Pump Operation Arrangement

	Unit numbers	No.	Type	Storage hours (hr)	Storage Volume (m^3)
Residential Units	0-250	250	houses	24	111
Residential Units	251-569	319	houses	18	107
Creche		200	people	24	20
Commercial		2141	m^2	24	7
Total					**245**

The total storage volume to be provided with the foul pumping station is 245m^3. The pump station will deliver a peak flow of 6 times the DWF calculated above which equals 19.5l/s.

3.4.6 Foul Rising Main and Discharge

The proposed foul pump station will pump the foul discharge to the 900mm gravity Newbridge Eastern Interceptor Sewer. The route is as shown on PUNCH drawings *192229-PUNCH-XX-XX-DR-C-0101*. This route will be the discharge route in the short to medium term condition. The proposed rising main will be 110mm OD.

The pumped main will discharge to a decompression manhole with a gravity connection to the existing 900mm gravity Newbridge Eastern Interceptor Sewer.

Detailed design of the proposed pumping station will be carried out and submitted for approval to Irish Water, following grant of the application. All proposed wastewater drainage infrastructure, installed to serve the proposed development is to be offered to Irish Water to be taken in charge.

3.5 Correspondence with Irish Water

A Pre-Connection Enquiry Form has been issued to Irish Water in relation to the proposed development and Irish Water has issued a Confirmation of Feasibility for the proposals. This Confirmation of Feasibility can be seen in Appendix F.

All new watermain infrastructure installed to serve the proposed development will be taken in charge by Irish Water.

PUNCH foul drainage network proposals have been issued to Irish Water for Design Vetting. Following discussions and further design development a Statement of Design Acceptance (CDS20007443) for the proposals has been received, which is included in Appendix G.

3.6 Foul Water Drainage Proposal Drawings

With reference to the above Section 3, please refer to the following PUNCH Drawings:

192229-PUNCH-XX-XX-DR-C-0101	PROPOSED DRAINAGE LAYOUT - SHEET 1
192229-PUNCH-XX-XX-DR-C-0102	PROPOSED DRAINAGE LAYOUT - SHEET 2
192229-PUNCH-XX-XX-DR-C-0103	PROPOSED DRAINAGE LAYOUT - SHEET 3
192229-PUNCH-XX-XX-DR-C-0104	PROPOSED DRAINAGE LAYOUT - SHEET 4
192229-PUNCH-XX-XX-DR-C-0110	PROPOSED FOUL WATER PUMPING STATION - DETAIL PLAN
192229-PUNCH-XX-XX-DR-C-0113	PROPOSED OVERALL FOUL WATER LAYOUT
192229-PUNCH-XX-XX-DR-C-0130	PROPOSED DIVERSION OF KILCULLEN-ARTHGARVAN FOUL WATER SEWER - PLAN
192229-PUNCH-XX-XX-DR-C-0131	EXISTING KILCULLEN-ARTHGARVAN FOUL WATER SEWER - LONG SECTIONS
192229-PUNCH-XX-XX-DR-C-0175	PROPOSED FOUL WATER NETWORK LONG SECTIONS - SHEET 1
192229-PUNCH-XX-XX-DR-C-0176	PROPOSED FOUL WATER NETWORK LONG SECTIONS - SHEET 2
192229-PUNCH-XX-XX-DR-C-0177	PROPOSED FOUL WATER NETWORK LONG SECTIONS - SHEET 3
192229-PUNCH-XX-XX-DR-C-0178	PROPOSED FOUL WATER NETWORK LONG SECTIONS - SHEET 4
192229-PUNCH-XX-XX-DR-C-0179	PROPOSED FOUL WATER NETWORK LONG SECTIONS - SHEET 5
192229-PUNCH-XX-XX-DR-C-0180	PROPOSED FOUL WATER NETWORK LONG SECTIONS - SHEET 6
192229-PUNCH-XX-XX-DR-C-0181	PROPOSED FOUL WATER NETWORK LONG SECTIONS - SHEET 7
192229-PUNCH-XX-XX-DR-C-0182	PROPOSED FOUL WATER NETWORK LONG SECTIONS - SHEET 8

192229-PUNCH-XX-XX-DR-C-0183	PROPOSED FOUL WATER NETWORK LONG SECTIONS - SHEET 9
192229-PUNCH-XX-XX-DR-C-0184	PROPOSED FOUL WATER NETWORK LONG SECTIONS - SHEET 10
192229-PUNCH-XX-XX-DR-C-0501	TYPICAL DRAINAGE DETAILS - SHEET 1
192229-PUNCH-XX-XX-DR-C-0506	FOUL PUMPING STATION DETAILS
192229-PUNCH-XX-XX-DR-C-0507	FOUL PUMPING STATION EMERGENCY STORAGE TANK DETAILS
192229-PUNCH-XX-XX-DR-C-0508	PROPOSED KILCULLEN FOUL WATER SEWER DIVERSION DETAILS

4 Watermain Design

4.1 Existing Watermain

Record drawings provided by Irish Water indicate the presence of an existing 300mm Dia. watermain running along the Great Connell Road to the east of the site. The housing estate to the north contains a 100mm uPVC watermain network and a 150mm PVC network running in the Newbridge town to the west.

Please refer to Appendix A for Record Drawings illustrating the existing watermain arrangement. An extract is shown in Figure 4-1 below.

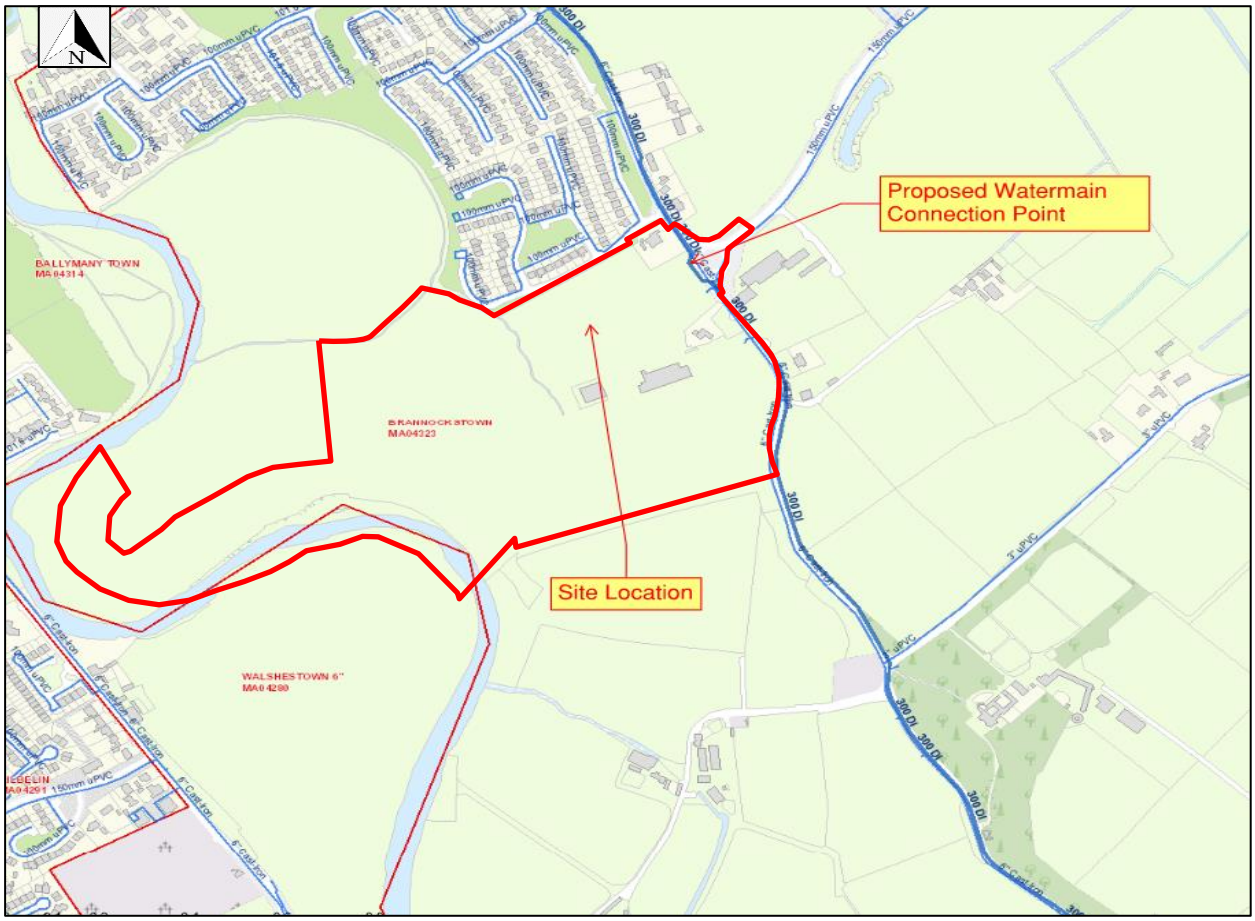


Figure 4-1: Existing Watermains Surrounding the Site (Extract From Irish Water Records)

The proposed development occupies agricultural land situated adjacent to the River Liffey. The site topography is varied, with a fall northwards of approximately 1.9m (+86.18m to +88.05). The site includes existing treelines and hedgerows which will be retained where possible.

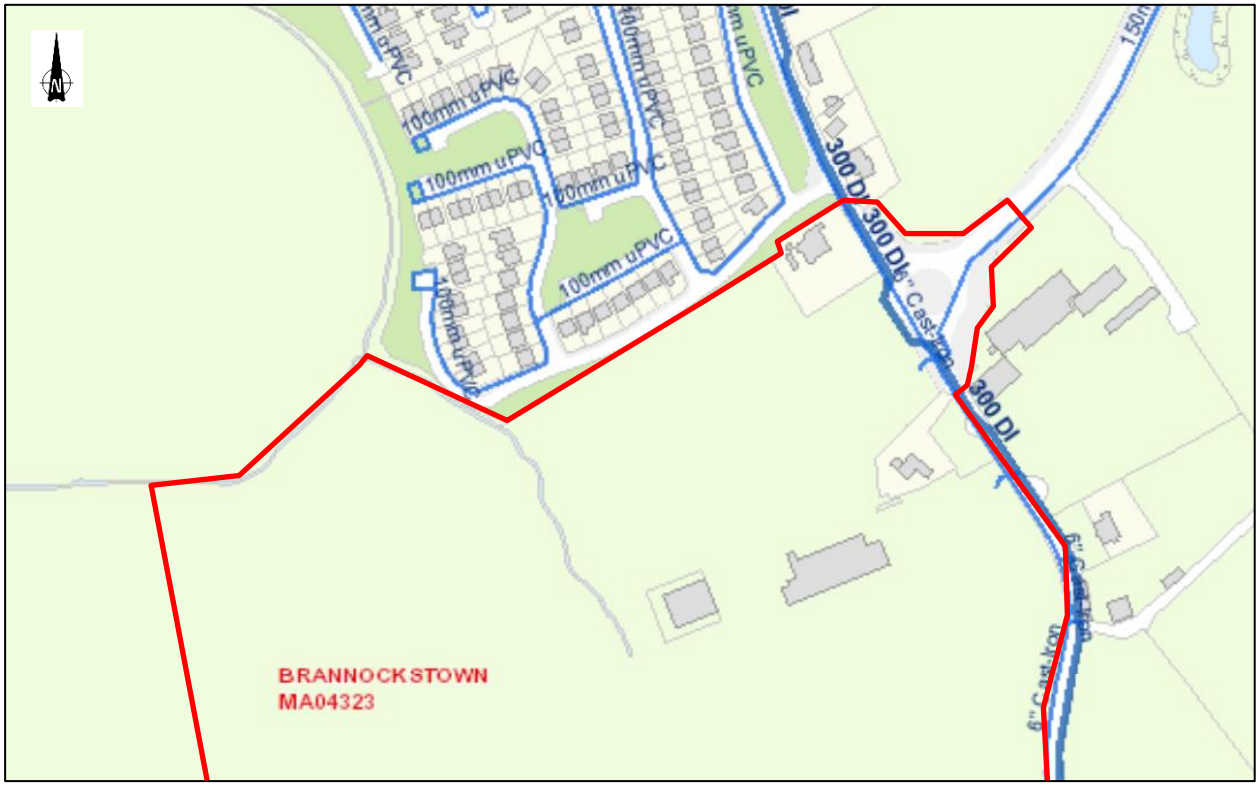


Figure 4-2: Existing Watermains in the Northeast of the Site (Extract From Irish Water Records)

4.2 Proposed Watermain

All watermain proposals have been designed in accordance with Irish Water's Water Code of Practice and Standard Details.

It is proposed to construct a new 200mm diameter watermain to service the proposed development. The watermain will connect to the existing watermain located in the roundabout to the north-east of the site. Please refer to PUNCH Consulting Engineers drawings accompanying this report which detail the watermain proposals for the site. Table 4-1 describes the watermain design parameters used.

Table 4-1: Watermain Design Parameters

Description	Value
Residential Flow Rate	150 l/person/day
Commercial Flow Rate	300 l/day/per 100m^2 of retail space
Creche Flow Rate	90 l/person/day
Average Demand	1.25 DWF
Peak Demand	5 DWF

Table 4-2: Watermain Design Calculation

Category	Quantity	Flow	Flow unit	Daily Flow (l/day)	DWF (l/s)	Average Demand (1.25DWF) (l/s)	Peak Demand (5*Average DWF) (l/s)
Residential	1536 residents	150	l/person/day	230,400	2.667	3.334	16.670
Commercial	2,141 m2	300	l/day/100m^2	6,423	0.074	0.093	0.465
Creche	200 people	90	l/person/day	18,000	0.208	0.260	1.302
Total				**254,868**	**2.950**	**3.687**	**18.437**

The watermain layout has been designed in accordance with "Irish Water Code of Practice for Water Infrastructure". All watermains are to be constructed in accordance with Irish Water Code of Practice and the Local Authority's requirements.

To reduce the water demand on Local Authority water supplies and to reduce the foul discharge from the development, water conservation measures will be incorporated in the sanitary facilities throughout the development, e.g. dual flush toilets.

4.3 Correspondence with Irish Water

A Pre-Connection Enquiry Form has been issued to Irish Water in relation to the proposed development and Irish Water has issued a Confirmation of Feasibility for the proposals. This Confirmation of Feasibility can be seen in Appendix F.

All new watermain infrastructure installed to serve the proposed development will be taken in charge by Irish Water.

The watermain proposals have been issued to Irish Water for design vetting. Irish Water have issued a Statement of Design Acceptance for the proposals, which is included in Appendix G.

4.4 Watermain Proposal Drawings

With reference to the above Section 4, please refer to the following PUNCH Drawings:

192229-PUNCH-XX-XX-DR-C-0114	PROPOSED OVERALL WATERMAIN LAYOUT
192229-PUNCH-XX-XX-DR-C-0301	PROPOSED WATERMAIN LAYOUT - SHEET 1
192229-PUNCH-XX-XX-DR-C-0302	PROPOSED WATERMAIN LAYOUT - SHEET 2
192229-PUNCH-XX-XX-DR-C-0303	PROPOSED WATERMAIN LAYOUT - SHEET 3
192229-PUNCH-XX-XX-DR-C-0304	PROPOSED WATERMAIN LAYOUT - SHEET 4

5 Flood Compensation

A Flood Risk Assessment Report has been prepared by JBA Consulting and accompanies this planning application. Document Number: COQ-JBAI-00-00-RP-HM-0012.

Section 6.2 of JBA's Flood Risk Assessment Report describes the Compensation Storage required because of the loss of volume in the floodplain due to the SHD development.

Utilising 'Civils 3D' ground modelling software PUNCH carried out a number of detailed assessments comparing the 1% AEP floodplain surface with the pre development and post development ground surfaces to calculate 1) the volume of flood compensation storage required due to displacement by the SHD development and 2) the volume flood compensation storage provided. The outputs of the assessments are described below:

Table 5-1 compares the pre and post development floodplain surfaces, on a level for level basis at 200mm intervals below the floodplain surface, without providing any flood compensation. The shortfall calculated amounted to approx. 884m3 and is thus the required Flood Compensation Storage Volume

Table 5-1: Post Development – Without Any Flood Compensation

Post Development Without Any Flood Compensation

FLOOD STORAGE

Height Range (Below flood plain)		Preworks (Refer to drawing 192229-PUNCH-XX-XX-DR-C-0811)	Post-Works (Refer to drawing 192229-PUNCH-XX-XX-DR-C-0812)	Shortfall	Additional
(m)	(m)	(m3)	(m3)	(m3)	(m3)
0.00	0.20	29127.881	28484.902	-642.979	
0.20	0.40	23317.669	23208.552	-109.117	
0.40	0.60	18712.786	18660.316	-52.470	
0.60	0.80	14693.045	14647.683	-45.362	
0.80	1.00	10923.473	10894.683	-28.790	
1.00	1.20	8702.552	8697.846	-4.706	
1.20	1.40	7339.686	7339.677	-0.009	
1.40	1.60	6338.635	6338.635	0.000	
1.60	1.80	5545.515	5545.515	0.000	
1.80	2.00	4841.687	4841.687	0.000	
2.00	2.20	4101.458	4101.458	0.000	
2.20	2.40	2765.708	2765.708	0.000	
2.40	2.60	1452.496	1452.496	0.000	
2.60	2.80	778.381	778.381	0.000	
2.80	3.00	321.364	321.364	0.000	
3.00	3.20	118.410	118.410	0.000	
3.20	3.40	43.792	43.792	0.000	
3.40	3.60	16.866	16.866	0.000	
3.60	3.80	2.391	2.391	0.000	
4.00	4.20	0.133	0.133	0.000	
		139143.928	138260.495	-883.433	0.000

Flood Compensation Areas were then introduced (Figure 5-1) by slightly lowering landscaped/amenity areas in pre-development Flood Zone C. Table 5-2 again compares the pre and post development floodplain surfaces; this time taking account of the flood compensation storage provided. Due to the site topography, it has not been feasible to provide a level for level provision at 5 of the height ranges but with the additional flood compensation areas there is now a surplus of approx. 1278m3 flood storage volume provided overall compared to the pre-development scenario.

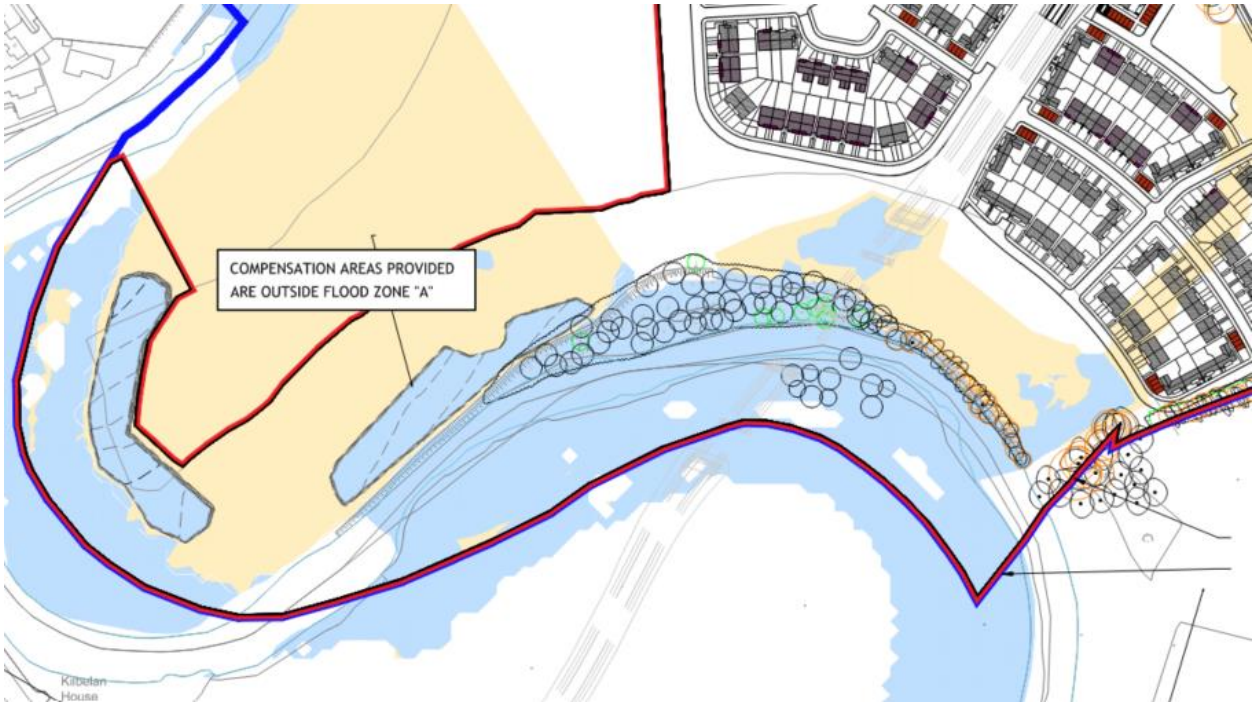


Figure 5-1: Flood Compensation Areas (Extract From 192229-PUNCH-XX-XX-DR-C-0813)

)

Table 5-2: Post Development – With Flood Compensation

Post-Development With Flood Compensation

FLOOD STORAGE

Height Range (Below flood plain)		Preworks (Refer to drawing 192229-PUNCH-XX-XX-DR-C-0811)	Post-Works (Refer to drawing 192229-PUNCH-XX-XX-DR-C-0813)	Shortfall	Additional
(m)	(m)	(m3)	(m3)	(m3)	(m3)
0.00	0.20	29127.881	29925.037		797.156
0.20	0.40	23317.669	23922.799		605.130
0.40	0.60	18712.786	18667.366	-45.420	
0.60	0.80	14693.045	14647.683	-45.362	
0.80	1.00	10923.473	10894.683	-28.790	
1.00	1.20	8702.552	8697.846	-4.706	
1.20	1.40	7339.686	7339.677	-0.009	
1.40	1.60	6338.635	6338.635	0.000	
1.60	1.80	5545.515	5545.515	0.000	
1.80	2.00	4841.687	4841.687	0.000	
2.00	2.20	4101.458	4101.458	0.000	
2.20	2.40	2765.708	2765.708	0.000	
2.40	2.60	1452.496	1452.496	0.000	
2.60	2.80	778.381	778.381	0.000	
2.80	3.00	321.364	321.364	0.000	
3.00	3.20	118.410	118.410	0.000	
3.20	3.40	43.792	43.792	0.000	
3.40	3.60	16.866	16.866	0.000	
3.60	3.80	2.391	2.391	0.000	
3.80	4.00	0.133	0.133	0.000	
		139143.928	140421.927	-124.287	1402.286

Now with the required flood compensation areas assessed and provided for in Flood Zone C areas, ground levels were also lowered between the development footprint and the River Liffey to reinstate an overland flow route within the floodplain, which re-enters the channel approx. 180m downstream. Table 5-3 compares the pre and post development floodplain surfaces; with the additional flowpaths included this time.

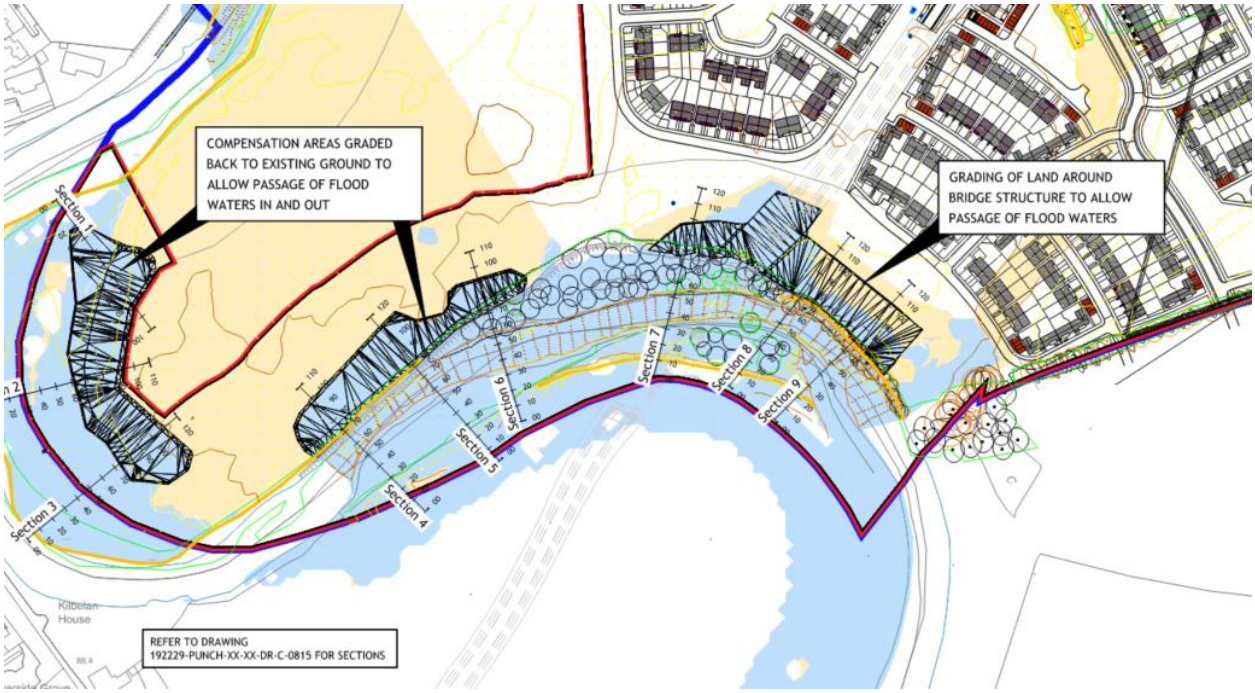


Figure 5-2: Flood Compensation Areas (Extract From 192229-PUNCH-XX-XX-DR-C-0814)

Table 5-3: Post Development (Final) – Incl Flowpaths

Post-Development (Final) includes flow paths in and out of flood compensation area and around the bridge structure

		FLOOD STORAGE			
Height Range (Below flood plain)		Preworks (Refer to drawing 192229-PUNCH-XX-XX-DR-C-0811)	Post-Works (Refer to drawing 192229-PUNCH-XX-XX-DR-C-0814)	Shortfall	Additional
(m)	(m)	(m3)	(m3)	(m3)	(m3)
0.00	0.20	29127.881	30657.397		1529.516
0.20	0.40	23317.669	24284.356		966.69
0.40	0.60	18712.786	18670.793	-41.99	
0.60	0.80	14693.045	14647.667	-45.38	
0.80	1.00	10923.473	10894.616	-28.86	
1.00	1.20	8702.552	8697.744	-4.81	
1.20	1.40	7339.686	7339.560	-0.13	
1.40	1.60	6338.635	6338.524	-0.11	
1.60	1.80	5545.515	5545.428	-0.09	
1.80	2.00	4841.687	4841.642	-0.05	
2.00	2.20	4101.458	4101.476		0.02
2.20	2.40	2765.708	2765.720		0.01
2.40	2.60	1452.496	1452.496	0.00	
2.60	2.80	778.381	778.381	0.00	
2.80	3.00	321.364	321.364	0.00	
3.00	3.20	118.410	118.410	0.00	
3.20	3.40	43.792	43.792	0.00	
3.40	3.60	16.866	16.866	0.00	
3.60	3.80	2.391	2.391	0.00	
3.80	4.00	0.133	0.133	0.00	
		139143.928	141518.756	-121.40	2496.23

Refer to PUNCH drawing 19229-PUNCH-XX-XX-DR-C-0815 for sections indicating the excavations for the flood compensation storage areas and the including flowpaths and regrading of the lands back towards the River Liffey.

Relevant Section 5 Drawings

192229-PUNCH-XX-XX-DR-C-0811	FLOOD MODEL– Q100 PRE-DEVELOPMENT
192229-PUNCH-XX-XX-DR-C-0812	FLOOD MODEL– Q100 POST DEVELOPMENT – NO COMPENSATION
192229-PUNCH-XX-XX-DR-C-0813	FLOOD MODEL – Q100 POST DEVELOPMENT – (WITH COMPENSATION
192229-PUNCH-XX-XX-DR-C-0814	FLOOD MODEL–Q100 POST DEVELOPMENT – (FINAL)
192229-PUNCH-XX-XX-DR-C-0815	CROSS-SECTIONS – Q100 POST DEVELOPMENT – (FINAL)

6 Traffic & Transport

Traffic & Transportation Assessment Report has been prepared by Punch consulting engineers and accompanies this planning application. Document Number: 192229-PUNCH-XX-XX-RP-C-0004.

7 Tri Partite Meeting Comments

This section of the report addresses the Engineering items raised in the ABP Notice of Pre-Application Consultation Opinion issued following the ABP Tri Partite meeting.

7.1 An Bord Pleanála Notice of Pre-Application Consultation Opinion

7.1.1 Opinion Item 3, Sub-Section 4

"Furthermore, Pursuant to article 285(5)(b) of the Planning and Development (Strategic Housing Development) Regulations 2017, the prospective applicant is hereby notified that, in addition to the requirements as specified in articles 297 and 298 of the Planning and Development (Strategic Housing Development) Regulations 2017, the following specific information should be submitted with any application for permission:

Sub Section Item 4 - Response to issues raised in Appendix B of Planning Authority Report, which includes the internal reports of the Drainage Dept. relating to the SUDS hierarchy, and the Park Department relating, inter alia, design approach and landscaping etc"

PUNCH Response to Opinion Item 3 Sub-Section Item 4:

Refer to our comments below in response to *KCC SHD Stage 2 Opinion (SHD202105)*.

7.2 Kildare County Council SHD Stage 2 Report (Ref:SHD202105 – Stage 2 Opinion)

7.2.1 Engineering Items raised in Section 4.1 Internal Reports

"Water Services Department: Recommendations made including that a detailed hydraulic modelling and condition assessment should be undertaken. Firefighting requirements should be identified and met. The need for a site WWPS should be reviewed and with IW as this development could be served by gravity connection in some way particularly as it is immediately adjacent to a brand new sewerage system i.e. 900mm diameter gravity NEIS. The proposed 10% infiltration allowance in the wastewater network design (EPR section 3.2) is not included in the submitted network simulation at EPR Appendix D. The minimum permitted sewer pipe diameter is 150mm, however in the submitted network simulation a multitude of oversized 225mm pipes have been used and consideration shall be given to reducing these to 150mm and the network simulation pipe sections so not correspond to the submitted drainage layout drawings. The achievable proportional velocities are all below the minimum self-cleansing velocities of 0.75mps, predicted pipe flow rates are minimal compared to the values given in ERP Table 3-2, some pipes sections have zero flow rates and the number of dwellings is nowhere near the proposed 606 units plus creche and neighbourhood centre.

The proposed SuDS strategy is not considered acceptable and a number of recommendations including a substantial redesign of the proposal to maximise both sustainability and amenity. A justification for any deviation from the nature based solutions and natural water retention measures should be submitted. At least 6 months of groundwater monitoring should be undertaken including a winter season.

A revised Site Specific Flood Risk Assessment is required to take account of additional information as well as third party expert scrutiny. The current proposal contravenes the Planning System Flood Risk Management Guidelines as it appears to suggest a relocation of the flood waters to adjoining property outside the site. It should also be revised following a revised SuDS strategy as recommended.

The Applicant should have regard to the planning history relating to Irish Water and Water services matters for adjoining properties including the adjacent Ardstone-Glenveagh SHD to the West.

Fire Service: Recommendations made regarding turning facilities, fire safety certificates, location of fire hydrants and water supply requirements."

PUNCH Response to Engineering Items raised in Section 4.1:

Refer to our comments below in response to *KCC SHD Stage 2 Opinion (SHD202105)*.

7.2.2 Engineering Items raised in Section 5 - Opinion and Reasons: Sub-Section 3 and 7

*3. "The proposed **SuDS strategy** is not considered acceptable and a number of recommendations including a substantial redesign of the proposal to maximise both sustainability and amenity. A justification for any deviation from the nature based solutions and natural water retention measures should be submitted. At least 6 months of groundwater monitoring should be undertaken including a winter season.*

7. Consideration should be given to providing green roofs throughout the scheme on all flat roof structures including apartments blocks, the neighbourhood centre and bin and bike stores."

PUNCH Response to items raised in Section 5 – Item 3 and 7:

Refer to our comments below in response to *KCC SHD Stage 2 Opinion (SHD202105)*.

7.2.3 KCC SHD Stage 2 Report Appendix B (Pages 45-46) - Kildare County Council Fire Service Report

1. *"The Applicant shall obtain Fire Safety Certificates in accordance with the requirements of the Building Control Act.*
2. *Where access roadways are provided with the site of a building, turning facilities for fire appliances, in accordance with the requirements of Table 5.1 should be provided in any dead-end access route that is more than 20m long.*
3. *A minimum of 1,100 litres/min of water is to be available in the mains at 2 bar pressure for firefighting.*
4. *All mains are to be equipped with fire hydrants to the relevant British Standard and no building is to be further than 46 metres from any hydrant measured along a hose route.*
5. *All hydrants are to be in boxes to B.S. 750 and the top of any hydrant is to be no more than 200mm below cover level.*
6. *All hydrants are to be marked in accordance with BS 3251 (All covers shall be painted yellow with road marking paint and with a unique identification number on the underside).*
7. *No hydrant is to be placed in a roadway. If placed in a grassed area it should have a 200mm concrete surround, level with the ground. Hydrants should preferably be in the centre of footpaths, away from gateways."*

PUNCH Response to KCC Fire Service Report Comments:

1. Noted.
2. Noted. Fire tender vehicles autotracks have been prepared and submitted with the application, confirming KCC requirements for turning movements can be achieved. Refer to PUNCH drawings *192229-PUNCH-XX-XX-DR-C-0600 to 0603*.
3. Noted. Water supply for firefighting will be provided to meet KCC and the Fire Safety Certificate Conditions.

4. Noted. Fire hydrants coverage on site is in accordance with KCC requirements and no building is further than 46m from a hydrant.
5. Noted. Fire hydrants to be constructed to B.S. 750 and KCC requirements.
6. Noted. Fire hydrants to be constructed to KCC requirements.
7. Noted. All hydrants are located off roadways and Fire hydrants to be constructed to KCC requirements.

7.2.4 Kildare County Council Water Services - Appendix B (Pages 69 - 70) Irish Water Issues (Foul & Water Supply)

1. *KCC WSD Comment 1.1:*

"Irish Water issues pertaining to foul water drainage and water supply that are known to KCC WSD are included in this report to provide context to the board. However IW as the national water services authority are responsible for these matters and as a prescribed body under planning legislation are a party to the SHD process and usually make a submission to the board at Stage 2 before the tripartite meeting is held."

PUNCH Response to KCC WSD Comment 1.1:

Noted. The applicant has obtained a Confirmation of Feasibility *(CoF – CDS20007443)* letter and Statement of Design Acceptance (CDS20007443) from Irish Water in response to the PUNCH design submission. The PUNCH design submission to support this application, takes due account of the items raised by Kildare County Council and Irish Water at Stage 2.

2. *KCC WSD Comment 1.2:*

"IW will be making a submission on the full planning application if and when that is received."

PUNCH Response to KCC WSD Comment 1.2:

Noted.

3. *KCC WSD Comment 1.3:*

"The newly constructed 600mm pumped rising main-900mm gravity Newbridge Eastern Interceptor Sewer which traverses the subject site west – east shall be provided with a suitable wayleave to IW specific requirements. The proposed diversion of the existing 450mm Kilcullen-Athgarvan sewer which traverses the subject site south-north shall also be provided with a wayleave and diversion agreement. KCC recived diversion application for this (DIV21230 Great Connell, Newbridge, Co Kildare) from John Dixon of IW Diversions, Connections and Developer Services week commencing 13/09/21.The treatment of the northern section of 450mm Kilcullen-Athgarvan sewer before it picks up Wellesley Manor and Baroda Court must be addressed by IW."

PUNCH Response to KCC WSD Comment 1.3:

Noted. The proposed development takes account of the wayleaves to the Irish Water 600mm rising main and 900mm gravity Newbridge Eastern Interceptor Sewer. A Diversion Confirmation of Feasiblity letter (DIV21230) of the 450mm Kilcullen-Athgarvan sewer has been obtained from Irish Water. A wayleave has been provided for this diversion to meet Irish Water requirements.

4. KCC WSD Comment 1.4:

*"The Irish Water (IW) Confirmation of Feasibility (CoF – CDS20007443) dated 28/01/21 for 620 units (submitted Engineering Planning Report (EPR) Appendix F) states that connections to IW networks are feasible **at the present time** following **a desk top analysis** of the **capacity currently available** in IW networks.*
Given the level of ongoing development and extant permissions in Newbridge which may make connections before the proposed development, WSD is recommending to IW that detailed hydraulic modelling and condition assessment of both networks but particularly modelling of the local water networks to access the impact of the development on the level of demand in Newbridge and the effect to existing customers be carried out. Flow and pressure analysis should also be carried out and reported on before planning application stage or at the very least, the connection application stage to identify unknown network capacity and condition constraints which would need to be removed to facilitate connection of the proposed development.

Before connection agreements are finalised, agreement shall be reached on the removal of any network constraints and where they are not funded and implemented by IW, they should be funded by the prospective applicant, in part or in full and implemented by IW."

PUNCH Response to KCC WSD Comment 1.4:

Noted. These Kildare Co Co comments are for Irish Water to address in considering this SHD application. It should be noted however that the 600mm rising main/900mm gravity Newbridge Eastern Interceptor Sewer was a major Irish Water Capital Infrastructure Project constructed to faciltitate previously restricted zoned development in the Newbridge Area, of which this SHD application form part, and we expect took due consideration of before issuing their Confirmation of Feasibility (CoF – CDS20007443) and Statement of Design Acceptance (CDS20007443)

5. KCC WSD Comment 1.5:

"Connections to the IW water and wastewater networks and their locations will be the subject of connection agreements between IW and the prospective applicant prior to commencement of the development should permsission be granted and it will be a matter for IW to sanction the appropriate connection location at that stage.

Furthermore, WSD would aslo recommend to IW that no development is commenced should permission be granted until such a time as a contract for any network upgrades has been signed and that no units or only a limited number of units are occupied in the proposed development prior to completion and commisssiong of any required network upgrades."

PUNCH Response to KCC WSD Comment 1.5:

Noted. It should be noted however that the 600mm rising main/900mm gravity Newbridge Eastern Interceptor Sewer was a major Irish Water Capital Infrastructure Project constructed to faciltitate previously restricted zoned development in the Newbridge Area, of which this SHD application form part, and we expect took due consideration of before issuing their Confirmation of Feasibility (CoF – CDS20007443) and Statement of Design Acceptance (CDS20007443) without a requirement for additional upgrades.

6. KCC WSD Comment 1.6:

"Pre-connection applications do not consider fire fighting water supply requirements for the proposed development. Therefore, the prospective applicant should consult the KCC Fire Service to ascertain their requirements and IW to identify available pressures and flows in the public mains, respectively prior to submitting the full planning applications."

PUNCH Response to KCC WSD Comment 1.6:

KCC Fire Service have noted their requirement of a minimum of 1,100 litres/min of water at 2 bar pressure for firefighting. Water supply for firefighting will be provided to meet KCC Fire Service Department requirements and any future Fire Safety Certificate Conditions.

7. KCC WSD Comment 1.7:

"The need for a site WWPS should be reviwed with IW as this development could be served by gravity connection in some way particularly as it is immediately adjacent to a brand new sewerage system i.e. 900mm diameter gravity NEIS."

PUNCH Response to KCC WSD Comment 1.7:

A gravity connection for the entire development was asssessed in detail in the process of preparing the foul drainage submission with the aim of avoiding the use of an onsite WWPS. However, to achieve Irish Water's minimum design requirements including minimum gradients, self-cleansing velocities and minimum vertical clearance between services, a WWPS is therefore required for western section of the development. Irish Water have provided a Statement of Design Acceptence (CDS20007443) on the basis of this design.

8. KCC WSD Comment 1.8:

"The Statement of Design Acceptance (SoDA) from IW approving the proposed wastewater and water supply designs and layouts must be submitted with any planning application. The proposed foul drainage including the proposed site WWPS and water supply systems shall be designed and constructed in accordance with the IW Standards Details and Codes of Practice.

The water services design shall also have regard to the wastewater drainage and water supply policies and objectives contained in the applicable CDP and the Newbridge LAP at the time of making a planning application. The sewers shall be provided in roadways to the maximum extent possible including the proposed 450mm Kilcullen- Athgarvan diversion sewer.

The proposed 10% infiltration allowance in the wastewater network design (EPR section 3.2) is not included in the submitted network simulation at ERP Appendix D. The minimum permitted sewer pipe diameter is 150mm, however in the submitted network simulation a multitude of oversized 225mm pipes have been used and consideration shall be given to reducing these to 150mm and the network simulation pipe sections so not correspond to the submitted drainage layout drawings.

The achievable proportional velocities are all below the minimum self-cleansing velocities of 0.75mps, predicted pipe flow rates are minimal compared to the values given in ERP Table 3-2, some pipes sections have zero flow rates and the number of dwellings is nowhere near the proposed 606 units plus creche and neighbourhood centre.

Adequate vertical separation shall be provided between services especially foul water and surface waterpipes where they intersect."

PUNCH Response to KCC WSD Comment 1.8:

a) We confirm all proposed foul and water proposals are in compliance with Irish Water Standard Details and Codes of Practice. Irish Water have provided a Statement of Design Acceptence (CDS20007443) on the basis of this design.
b) An additional flow of 10% infiltration flow has been included in the Causeway flow model wastewater network calculations provided in this submission (Appendix E).
c) Pipe diameters have been provided in compliance with Irish Water's Wastewater Code of Practice. Pipe diameters of up to 300mm in some locations are required to cater for the peak flow rates/number of units served.
d) Updated drainage calculations have been prepared and are included in Appendix E. The pipe network has been designed in accordance with the Irish Water WWCoP. Irish Water have provided a Statement of Design Acceptence (CDS20007443) on the basis of this design.
e) Vertical separation of 300mm between services is maintained throughout the site in compliance with the requirements of the IW Code of Practice.

9. KCC WSD Comment 1.9:

"With regard to the above issues the prospective applicant is advised to continue their ongoing dialogue with IW and consult KCC WSD to reach agreement on the above issues before submitting the full planning applications to the Board."

PUNCH Response to KCC WSD Comment 1.9:

Noted. Irish Water have provided a Statement of Design Acceptence (CDS20007443) on the basis of this design.

7.2.5 Kildare County Council Water Services - Appendix B (Pages 70 – 74) Surface Water & Flood Risk

Surface Water:

1. *KCC WSD Comment 2.1:*

"The site watercourses and any site open drainage channels shall be retained in open channel including the "drain to the north of the subject site" (submitted SSFRA section 5.1 post development fluvial flood modelling scenario) and any exisiting site pipework should be "de-culverted" in order to comply with GDSDS Sustainability Stormwater Drainage Design Principle and to promote biodiversity and provide amenity value for future residents and vistors alike (see submitted Engineering Planning Report section 2.2 regarding filling in the existing ditch south of NSORR)."

PUNCH Response to KCC WSD Comment 2.1:

All existing site watercourses and drainage channels have been retained with the exception of a short section of the open drain to the south of the Newbridge Southern Orbital Relief Road (NSORR). The development proposals have been evaluted by the Environmental Consultant and the SHD submission includes an EIAR. SuDS measures include swales, permeable paving, soakways and stormtech attenuation systems which adhere to the principles of GDSDS sustainability stormwater drainage design. The Landscape Architects proposals outline in detail additional proposals which addresses biodiversity across the site.

2. *KCC WSD Comment 2.2:*

"Section 50 consent shall be obatained where required for any changes to, crossing-bridging of the river Liffey (agreement with other parties including Ardstone-Glenveagh and KCC Roads Department regarding bridge construction shall also be address although it appears the proposed development red-line boundry and description does not emcompass the construction of the bridge) and existing site watercourses as a result of the proposed development. The OPW consents shall be included in the engineering report submitted with any planning application."

PUNCH Response to KCC WSD Comment 2.2:

Section 50 requirements have been addressed in JBA's Site Specific Flood Risk Assessment, and the proposed development takes account of their requirements. Please note there is no bridge crossing of the River Liffey included in this SHD application.

3. *KCC WSD Comment 2.3:*

"The proposed drainage and SuDS strategy for the mixed use development and Newbridge Southern Orbital Relief Road (NSORR) is fairly typical, limited and predicated on a mixture of traditional pipe and gulley systems and limited SuDS including driveway and parking bay permeable paving, swales, and proprietary underground attenuation storage geocellular structures. (Tree pits, rain gardens and filter drains are mentioned at submitted Engineering Planning Report (EPR) section 2.3 but not included on the submitted drainage layout drawings).*

**It is noted that the mixed use development drainage and NSORR drainage have been separated. The drainage strategy including for the mixed use development and NSORR submitted with any planning application shall comply with the surface water management policies and objectives contained in the relevant Newbridge LAP and CDP and clearly demonstrate that the proportion of impermeable surfaces have been reduced as much as possible e.g. pervious surfacing can be introduced in in all roadways, pavements and footpaths in private areas and management company controlled areas which will not be taken in charge including at apartment blocks and the neighbourhood centre area. All remaining*

Impermeable surface areas shall be discharged to at least 1 SuDS feature before connecting to the proposed drainage pipe network and outfall, ultimately to the river Liffey. The connection of the proposed rainwater harvesting and butts to filter drains-soakaways in rear gardens (EPR 23.6) shall be clarified e.g. are these overflows?

NB the environmental Implications of discharging surface water to the site watercourses, river Liffey and to ground where feasible shall be adequately assessed."

PUNCH Response to KCC WSD Comment 2.3:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. The Soil Infiltration Test results (Site Investigation – Appendix I) have been utilised to maximise the level of infiltration on the site. The extent of impermeable surfacing has been reduced across the site with housing driveways and carparking spaces and roadways in private managed areas at Apartments and the Neighbourhood Centre discharging to ground where infiltration rates allow. Where possible, all efforts have been made to allow stormwater on impermeable surface areas to pass through at least 1 SuDS feature such as green roofs, soakaways, swales etc before connecting to the drainage pipe network.

The utilisation of these SuDS measures provide interception storage and treatment volumes of surface water run-off that enhance the environmental charaterisitics of the surface water run-off; by filtration of silts and other pollutants; biodegradation of organic pollutants such as petrol and diesel and settlement/retention of solids. These measures will ensure that any environmental implications of discharging run-off to the site watercourses, River Liffey and ground is mitigated. Refer also to Section 2.3 of this report and SuDS Drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154*.

4. *KCC WSD Comment 2.4:*

"The proposed SuDS strategy is not acceptable and shall be revised and demonstrably maximise the potential to remove-reduce and treat runoff by increasing the proportion of roads ***including NSORR****, pavements, footpaths and roofs discharging to SuDS features in the following structured and hierarchical manner."*

PUNCH Response to KCC WSD Comment 2.5:

Noted: Refer to PUNCH response to specific items raised by KCC WSD below

5. *KCC WSD Comment 2.5:*

"Nature based solutions (NBS) and Natural Water Retention Measures (NWRM) SuDS which reduce and treat runoff shall be prioritised in the first Instance eg green-blue roofs in management company controlled buildings, constructed wetlands, bioretention areas, bioswales, retention ponds, tree trenches-pits (with tree root barriers close to dralnage, roads, footpaths, pavements, buildings and structures), house planters and rain gardens which also promote biodiversity in flora and fauna and provide amenity value.

WSD recommend that the proposed swales be converted to bloswales and NSORR and the internal roadways should discharge direct to the bioswales through gaps in the roadside kerbs and the 9 no large underground attenuation storage structures be replaced with NBS-NWRM SuDS.

The planting schemes for NBS and NWRM SuDS shall be devised by landscape architects, conform to recommended industry guidance including CIRIA SuDS Manual (see item 2.20.2 below).

WSD consider that NBS-NWRM SuDS provided in open space areas eg ponds, bioswales or bioretention areas should count towards the 15% open space requirement."

PUNCH Response to KCC WSD Comment 2.5:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. Green sedum roofs are provided on all Apartment Buildings (as well as bicycle sheds). The extent of impermeable surfacing has been reduced across the site with housing driveways and carparking spaces and roadways in private managed areas at Apartments and the Neighbourhood Centre discharging to ground where infiltration rates allow. Where possible, all efforts have been made to allow stormwater on impermeable surface areas to pass through at least 1 SuDS feature such as green roofs, soakaways, swales etc before connecting to the drainage pipe network.

All road surface water run-off, including the NSORR, will discharge to bioswales. The bioswales will incorporate a wildflower mix designed in agreement with the landscape architect, to promote bodiversity and is included within the overall scheme of SuDS measures. The utilisation of these SuDS measures provide interception storage and treatment volumes of surface water run-off that enhance the environmental charaterisitics of the surface water run-off; by filtration of silts and other pollutants; biodegradation of organic pollutants such as petrol and diesel and settlement/retention of solids. Refer also to Section 2.3 of this report and SuDS Drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154.*

6. *KCC WSD Comment 2.6:*

"Where NBS and NWRM SuDS are not included in the proposed drainage-SuDS strategy to be submitted with any planning application, a clear and plausible rationale for this approach must be included in the engineering report submitted with any planning application.

Absence of NBS-NWRM SuDS without an acceptable justification will lead to a pre-commencement condition where permission is granted seeking clarification on this absence with potential construction delays and in extreme cases, a recommendation for refusal of the planning application."

PUNCH Response to KCC WSD Comment 2.6:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. Nature based solutions and natural water retention measures have been maximised within the development such as green sedum roofs, soakaways, swales and permeable paving and Stormtech attenuation storage systems. Please refer to the section 2.3 of this report and SuDS Drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154.*

It has not been feasible to utilise detention basins/ponds for attenuation storage. Detention basins/ponds used for surface water storage require a very large footprint area and would by necessity be located within the green/open space areas of the housing. Locating the detention basins/ponds in the green/open spaces would significantly reduce the available amenity area for residents. In addition the flat nature of the site would result in deep detention basins/ponds being required. Their location, in green/open space areas, would pose a potential health and safety risk to vulnerable users such as children. The proposed use of Stormtech attenuation systems will provide enhanced environmental characteristics of the surface water run-off compared to conventional geocelluar storage structures by the filtration of silts and other pollutants; biodegradation of organic pollutants such as petrol and diesel and settlement/retention of solids.

7. *KCC WSD Comment 2.7:*

"Only where the run-off from the site impermeable surface areas cannot be discharged to these nature-based SuDS, shall other SuDS types be considered, starting with infiltration system SuDS which discharge runoff to ground.

Infiltration system SuDS can be either shallow or deep depending on their invert level and depth of runoff discharge."

PUNCH Response to KCC WSD Comment 2.7:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. The Soil Infiltration Test results (Site Investigation – Appendix I) have been utilised to maximise the level of infiltration on the site. Nature based solutions and natural water retention measures have been maximised within the development such as green sedum roofs, soakaways, swales and permeable paving and Stormtech attenuation storage systems. Please refer to the section 2.3 of this report and SuDS Drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154.*

8. *KCC WSD Comment 2.8:*

*"**Subject to expert geotechnical advice**, shallow infiltration SuDS including the proposed driveway and parking bay permeable paving and in management company controlled areas and other private areas and small tree pits-trenches which can be provided along internal roadways Including NSORR can be unlined and along with infiltration SuDS in areas of fill may not be subject to soil infiltration tests and groundwater monitoring due to their location in the unconsolidated soil upper layers and above typical groundwater levels (subject to check of nearest groundwater level results to ensure they are above maximum recorded groundwater levels) and if the fill material is sufficiently permeable, the fill layer suitably deep and-or the underlying existing ground formation is treated appropriately,*

**It is vital to ensure that these upper soil layers are not over-compacted during or after the construction stage in locations where shallow infiltration system SuDS are proposed so as to maintain sufficient upper soil layer infiltration values.*

Expert geotechnical advice shall also be sought on soil replacement-remediation measures where over-compaction of the upper soil layers occurs.

Drainage provision in gardens including the house rear garden soak pits and open space areas shall be carefully addressed where over-compaction of the upper soil layers may occur during and after construction phase (see Item 2.11 below)."

PUNCH Response to KCC WSD Comment 2.8:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. The Soil Infiltration Test results (Site Investigation – Appendix I) have been utilised to maximise the level of infiltration on the site. The ground water levels have also been assessed over a 6 month period (Site Investigations Appendix J) and unlined SuDS infiltration systems are used where ground water levels are more than 1m below the base of the infiltation system, as recommended by CIRIA 753 – The SuDS Manual.

A detailed Construction Management Plan to be submitted to KCC for planning compliance will be prepared by the contractor to address the requirements in relation to appropriate care to the over-compaction of upper soil layers during and after construction phase.

Refer to the section 2.3 of this report and SuDS Drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154.*

9. *KCC WSD Comment 2.9:*

"Deeper infiltration system SuDS such as soakaways, infiltration trenches and unlined underground attenuation storage structures are subject to adequate soil permeability and favourable site groundwater regimes.

Soil permeability shall be assessed by conducting BRE Digest 365 soil infiltration tests carried out at the locations and depths of the proposed infiltration SuDS.

A site investigation report has been submitted and Infiltration to ground has been ruled out (submitted Engineering Planning Report (EPR) Table 21) presumably on the basis of relatively high groundwater levels recorded in boreholes and trial pits notwithstanding the predominance of sand and particularly gravel sub-soil layers and very good recorded soil Infiltration rates. This shall be clarified in the engineering report submitted with any planning application."

PUNCH Response to KCC WSD Comment 2.9:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. The Soil Infiltration Tests in accordance with BRE Digest 365 were carried out across the site and the results are included in Appendix I and summarised on SuDS drawings 192229-PUNCH-XX-XX-DR-C-0151 to 0154. The extent of deeper infiltration systems SuDS such as soakaways, infiltration trenches has been maximised across the site taking account of the recorded results and depths to groundwater.

The recommendation CIRIA C753 – The SuDS Manual is that ground water levels should not be within 1m of the base of the unlined attenuation tanks. Site investigations (Appendix I and Appendix J) have confirmed that ground water levels are within 1m of the base of all attenuation tanks and as such lined/tanked attenuation tanks are proposed.

10. *KCC WSD Comment 2.10:*

"Single day borehole or trial pit records are not considered to be an accurate depiction of site groundwater conditions which are subject to meteorological and climatic variations as noted in the submitted SI report.

To that end, standpipes were installed in seven boreholes to enable monitoring of groundwater levels. Groundwater monitoring should be carried out at the locations of the proposed deep infiltration system SuDS and ***lasts at least 6 months and include at least one winter season****.*

However, groundwater levels have only been measured on one date i.e. 06.04.2021 and it appears that only three standpipes were located adjacent to one of the nine proposed underground attenuation storage structures."

PUNCH Response to KCC WSD Comment 2.10:

Additional ground water monitoring over a 6 month period, from April 2021 to January 2022, has been carried out to take account of KCC WSD comments. Ground water levels vary from 0.93mBGL to 2.92mBGL across the site. The results are included in the Site Investigation Report (Appendix I and Appendix J) and the results are summarised on SuDS drawings 192229-PUNCH-XX-XX-DR-C-0151 to 0154. The extent of deeper infiltration systems SuDS such as soakaways, infiltration trenches has been maximised across the site taking account of the recorded results and depths to groundwater.

11. *KCC WSD Comment 2.11:*

"With the abundance of groundwater strikes recorded during the site Investigation exercise, WSD would caution again the provision of the proposed soakpits in every house rear garden pending expert geotechnical-hydrogeological advice and further monitoring of groundwater levels as item 2.13 below."

PUNCH Response to KCC WSD Comment 2.11:

Ground water monitoring took place over a 6 month period, from April 2021 to January 2022 and established that water levels vary from 0.93mBGL to 2.92mBGL across the site. The results are included in the Site Investigation Report (Appendix I and Appendix J) and the results summarised on SuDS drawings 192229-PUNCH-XX-XX-DR-C-0151 to 0154.

Soakpits have been proposed in gardens where a minimum height of 1m separation from the measured maximum ground water table is feasible. In all cases a high-level overflow to the main drainage network is proposed in the event the soakpit is not operating effectively. Refer to *192229-PUNCH-XX-XX-DR-C-0501* for details.

12. KCC WSD Comment 2.12:

"Notwithstanding the abundance of groundwater strikes during the site Investigation which was conducted in February and March 2021 (during the Covid lockdown), more detailed examination of the borehole and trial pit logs revealed the potential to mobilise infiltration to ground above highest recorded groundwater levels at some locations of the subject site ***subject to expert geotechnical-hydrogeological advice****. For example, recorded groundwater levels in the northern and eastern site portions were somewhat lower than the rest of the site and discharge of runoff to ground* ***may*** *be feasible at proposed underground attenuation storage structures (where they are retained) #1 and #2 for Newbridge Southern Orbital Relief Road and #5 and #7 for the residential development.*

These issues should be clarified in the engineering report submitted with any planning application."

PUNCH Response to KCC WSD Comment 2.12:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. Ground water monitoring took place over a 6 month period, from April 2021 to January 2022 and established that water levels vary from 0.93mBGL to 2.92mBGL across the site. The results are included in the Site Investigation Report (Appendix I and Appendix J) and the results summarised on SuDS drawings 192229-PUNCH-XX-XX-DR-C-0151 to 0154.

SuDS measures have been designed taking into account the ground water monitoring data. The extent of deeper infiltration systems SuDS such as soakaways, has been maximised across the site taking account of the recorded results and depths to groundwater and the recommendation of CIRIA C753 – The SuDS Manual that ground water levels should not be within 1m of the base of unlined infiltration systems. Refer to the section 2.3 of this report and SuDS Drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154.*

13. KCC WSD Comment 2.13:

"It is recommended that the prospective applicant shall immediately commence a regular on-site groundwater monitoring programme to accurately determine the prevailing groundwater regime and finalise the SuDS strategy before submitting a planning application.

Otherwise, a pre-commencement condition where permission is granted may be included to this effect and requesting submission of the groundwater monitoring (and soil infiltration test) results and finalisation of a SuDS strategy agreed with the Planning Authority before any development commences."

PUNCH Response to KCC WSD Comment 2.13:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. Ground water monitoring took place over a 6 month period, from April 2021 to January 2022 and established that water levels vary from 0.93mBGL to 2.92mBGL across the site. The results are

included in the Site Investigation Report (Appendix I and Appendix J) and the results summarised on SuDS drawings 192229-PUNCH-XX-XX-DR-C-0151 to 0154.

14. KCC WSD Comment 2.14:

"Discharge from infiltration system SuDS should be located a safe distance from buildings, structures, and roads to prevent damage to sub-structures or their foundation layers shall be lined-tanked."

PUNCH Response to KCC WSD Comment 2.14:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. Where feasible, infiltration system SuDS measures are located more than 5m from structures. Where systems are less than 5m to foundations they are lined.

15. KCC WSD Comment 2.15:

"A drainage layout drawing with the various Infiltration test and groundwater monitoring locations and results is a useful tool in optimising the SuDS strategy and should be included in any planning application submission."

PUNCH Response to KCC WSD Comment 2.15:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* accompanying this report.

16. KCC WSD Comment 2.16:

*"Where infiltration system SuDS are not feasible and **as item 2.6 above**, only then shall filtration system SuDS such as lined permeable paving, bioswales which are connected to the proposed drainage pipe network and filter drains-strips be considered in the drainage and SuDS strategies. They are typically narrow and linear so are suitable where space is restricted e.g. along roads including the NSORR.*

The proposed use of under-draining filter drains below lined permeable paving (EPR section 2.3.2) is not standard practice and shall be reviewed."

PUNCH Response to KCC WSD Comment 2.16:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* accompanying this report.

It is proposed to use an unlined permeable paving system that will infiltrate to ground. Filter drain pipes will also be included as an overflow to the main drainage collector system in line with the UK SuDS manual CIRIA C753. This will provide a fail-safe in the event the infiltration is ineffective in operation.

17. KCC WSD Comment 2.17:

*"Finally, detention system SuDS i.e. detention basins and lined underground attenuation storage structures such as the proposed large structures should only be considered as a last resort where the other SuDS types are not deemed feasible and **as item 2.6 above**."*

PUNCH Response to KCC WSD Comment 2.17:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* accompanying this report.

The recommendation of the UK SuDS Manual CIRIA C753 is that ground water levels should not be within 1m of the base of the unlined attenuation tanks. Site investigations have confirmed that ground water levels are within 1m of the base of all attenuation tanks and as such lined/tanked Stormtech attenuation tanks are proposed. The proposed use of Stormtech attenuation systems will provide enhanced environmental characteristics of the surface water run-off compared to conventional geocelluar storage structures by the filtration of silts and other pollutants; biodegradation of organic pollutants such as petrol and diesel and settlement/retention of solids.

It has not been feasible to utilise detention basins/ponds for attenuation storage. Detention basins/ponds used for surface water storage require a very large footprint area and would by necessity be located within the green/open space areas of the housing. Locating the detention basins/ponds in the green/open spaces would significantly reduce the available amenity area for residents. In addition the flat nature of the site would result in deep detention basins/ponds being required. Their location, in green/open space areas, would pose a potential health and safety risk to vulnerable users such as children. The proposed use of Stormtech attenuation systems will provide enhanced environmental characteristics of the surface water run-off compared to conventional geocelluar storage structures by the filtration of silts and other pollutants; biodegradation of organic pollutants such as petrol and diesel and settlement/retention of solids.

18. *KCC WSD Comment 2.18:*

"A review of the site layout shall be undertaken to ensure maximum provision of SuDS."

PUNCH Response to KCC WSD Comment 2.18:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. The provision of SuDS has been maximised. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* accompanying this report.

19. *KCC WSD Comment 2.19:*

"Any surface level storage of surface water runoff in SuDS and also access to the site watercourses, open drainage channels including de-culverted pipe work and river Liffey should be subject to a risk assessment especially the risk of young children drowning in even shallow depths of water.

The safety issues raised at EPR section 2.3.4 regarding surface storage can be adequately mitigated in the opinion of WSD with reference to available design guidance especially CIRIA SuDS Manual."

PUNCH Response to KCC WSD Comment 2.19:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* accompanying this report.

The SuDS strategy has been maximised to include swales, soak pits, permeable paving and Stormtech attenuation systems.

It has not been feasible to utilise detention basins/ponds for attenuation storage. Detention basins/ponds used for surface water storage require a very large footprint area and would by necessity be located within the green/open space areas of the housing. Locating the detention basins/ponds in the green/open spaces would significantly reduce the available amenity area for residents. In addition the flat nature of the site would result in deep detention basins/ponds being required. Their location, in green/open space areas, would pose a potential health and safety risk to vulnerable users such as children. The proposed use of Stormtech attenuation systems will provide enhanced environmental characteristics of the surface water run-off compared to conventional geocelluar storage structures by the filtration of silts and other pollutants; biodegradation of organic pollutants such as petrol and diesel and settlement/retention of solids.

Detention ponds were not provided in green open areas, due to the large footprint of the pond would render the open space areas unusable to residents. In addition the depths required would result in very deep ponds which was deemed to be a health and safety issue.

20. KCC WSD Comment 2.20:

"Prior to finalising the alternative drainage and SuDS strategies the applicant shall consult Development Control (also see item 2.30 below), Roads and Parks departments as follows:

2.20.1 regarding future maintenance of drainage and SuDS Including for NSORR and particularly NBS-NWRM SuDS, flow control devices and outfall non-return values where they will be put forward for taking in charge, and

2.20.2 the planting schemes for any NBS-NWRM SuDS shall be agreed with Parks department and

2.20.3 the numbers, size, locations and type of underground attenuation storage structure where they are used and

2.20.4 consider whether separation of the management company-controlled drainage and drainage to be taken in charge (Roads and Development Control departments) is required."

PUNCH Response to KCC WSD Comment 2.20:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* accompanying this report. The drainage design has been undertaken in compliance with the GDSDS and the UK CIRIA C753 SuDS manual 2015 best practice guidelines.

The updated proposals have been discussed/circulated to KCC Roads and Parks Departments and address comments received. The NSORR Roads and Development surface water drainage are on separate drainage systems.

21. KCC WSD Comment 2.21:

"Regarding details of the proposed receiving surface water drainage networks i.e. the existing site watercourses and the river Liffey as follows:

2.21.1 Consent for the applicant to discharge runoff to ***both*** *receiving watercourses and Liffey, and*

2.21.2 Capacity assessment of receiving watercourses to adequately cater for existing flows therein (including existing 1000mm outfall pipe from adjoining Wellesley Manor development as per submitted Engineering Planning Report (EPR) Appendix A) and the restricted discharges from the proposed development, and

2.21.3 Condition assessment of watercourses which identifies any faults therein and which must be remedied to accept runoff from the development, and

2.21.4 Agreed remedial measures to the watercourses including timeframe for delivery thereof and

2.21.5 Maintenance arrangements of the site watercourses to safeguard flow conveyance capacity of the watercourses, which shall be primarily the responsibility of the prospective applicant where no other party is deemed responsible and

2.21.6 Where discharge to the existing watercourses is problematic, consideration of alternatives shall be made."

PUNCH Response to KCC WSD Comment 2.21:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments.

Inland Fisheries and Waterways Ireland have been notified of the proposals and have made no adverse comments. Any surface water outfalls to the existing watercourses and the River Liffey will be constructed in accordance with Inland Fisheries Ireland "Guidelines on the Protection of Fisheries During Construction Works In and Adjacent to Waters 2016" and take account of any planning conditions attached to this SHD permission

The proposed development has been desgined in accordance with GDSDS which ensures the development does not exceed the pre-development greenfield run-off rate. Thus there is no net increase in surface water flows into the River Liffey or adjoining watercourses.

In addition, JBA Consultants have carried out a Site Specific Flood Risk Assessment, incorporating modelling of the River Liffey, and the associated linked watercourses, and have concluded that the proposed development does not pose an increased risk of flooding.

Refer to the environmental consultant's Construction Management Plan for protection measures proposed to protect the adjoining water courses during construction.

22. KCC WSD Comment 2.22:

"The proposed SuDS shall be designed in accordance with GDSDS and CIRIA SuDS Manual and construction detail drawings of all proposed SuDS features shall be submitted with any planning application.

Permeable paving at roof downpipe outlets should be provided with a diffuser to prevent point loading of run-off and washing out of finer stone base granular material."

PUNCH Response to KCC WSD Comment 2.22:

The proposed drainage and SuDS strategy has been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* accompanying this report. The drainage design has been undertaken in compliance with the GDSDS and the UK CIRIA C753 SuDS manual 2015 best practice guidelines.

The drawings include a detail of a permeable paving roof downpipe outlet with a diffuser to prevent point loading of run-off and washing out of finer stone base granualr material.

23. KCC WSD Comment 2.23:

"SuDS like traditional drainage systems are prone to failure and lack of proper maintenance therefore they should be designed with an appropriate factor of safety, overflows and planned flood routing to green areas, surface water outfalls and away from buildings and strategic roads.

It is noted at submitted EPR Appendix E page 31 that a low design safety of factor for the proposed underground attenuation storage structures has been used."

PUNCH Response to KCC WSD Comment 2.23:

The proposed drainage and SuDS strategy and calculations have been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* accompanying this report. The drainage design has been undertaken in compliance with the GDSDS and the UK CIRIA C753 SuDS manual 2015 best practice guidelines.

Safety factors for the proposed attenuation storage have been increased to a more conservative figure. (Appendix D)

24. KCC WSD Comment 2.24:

"The submitted drainage design details are preliminary in nature and the design submitted with any planning application shall demonstrably comply with GDSDS Volume 2 Chapter 6 Stormwater Drainage design criteria 1-4.

It shall be made clear in the engineering report submitted with any planning application exactly how adequate interception, treatment (criterion 1) and long-term storage (criterion 4) shall be provided."

PUNCH Response to KCC WSD Comment 2.24:

The proposed drainage and SuDS strategy and calculations have been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* and also refer to calculations on interception, treatment and long term storage contained within section 2 of this report.

25. KCC WSD Comment 2.25:

"The relevant site areas for each building element i.e. roads, roofs, footpaths and pavements used in the drainage design and the runoff coefficients applied thereto shall be unambiguous and consistent in the engineering documentation submitted with any planning application.

For example, in the submitted EPR the total site area is given as 25ha (Section Introduction), 17.9ha at Table 2-1 and 17.905ha at Appendix B."

PUNCH Response to KCC WSD Comment 2.25:

The proposed drainage and SuDS strategy and calculations have been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* and the Engineering Planning Report has been updated with consistent site areas and justification for figures used is set out.

26. KCC WSD Comment 2.26:

"Qbar runoff discharge rate shall be calculated in accordance with IH124 (GDSDS drainage design criterion 2). The total controlled outflow of 113.8 l/s appears unduly large even for a large site such as the subject site and the SOIL Type value shall consider the outcome of the site Investigation exercise. The position of the flow control manhole at proposed attenuation tank #3 shall be reviewed.

The two Qbar calculations at EPR Appendix B shall be explained (NSORR and mixed use development?) and the discrepancies and omissions in flow control manholes in EPR Appendix E and the submitted drainage layout drawings shall be rectified in any planning application."

PUNCH Response to KCC WSD Comment 2.26:

The proposed drainage and SuDS strategy and calculations have been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* and the Engineering Planning Report. Further to receipt of final site investigation results a revised Qbar has been calculated using the IH124 method. Updated Qbar calculations are included in Appendix B of this Engineering Planning Report.

27. *KCC WSD Comment 2.27:*

*"Attenuation storage volume design calculations for 100 year storm event plus **20% climate change factor** (10% In submitted EPR section 2.2.2 and Appendix E) using the appropriate soil infiltration rate where runoff discharge is to ground or the Qbar restricted discharge rate where runoff is discharged to a pipe network or watercourse.*

As per Items 2.22 and 2.23 above, overflows should be provided from attenuation storage SuDS with flow control manholes where deemed necessary.

The proposed provision of 'additional storage' in secondary drainage elements shall be reviewed (EPR section 2.2.2)."

PUNCH Response to KCC WSD Comment 2.27:

The proposed drainage and SuDS strategy and calculations have been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* and Section 2 of this Engineering Planning Report.

Calculations have been updated to show attenuation storage volume design calculations for the 100-year event with 20% additional allowance for climate change, with discharge flows limited to Qbar.

SuDS system include overflow where appropriate such as in soakways and permeable paving systems.

A more conservative additional storage of 20 l/ha has been used in the updated calculations. Note this is a conservative approach as additional storage volumes in places such as gullies, inspections chambers etc. are not taken account of in the model's analysis.

28. *KCC WSD Comment 2.28:*

*"The drainage pipe network simulations (EPR Appendix E) submitted with any planning application shall use a **20% climate change factor**."*

PUNCH Response to KCC WSD Comment 2.28:

The proposed drainage and SuDS strategy and calculations have been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings 192229-PUNCH-XX-XX-DR-C-0151 to 0154.

The calculations included an updated "20% climate change factor" in the stormwater drainage network simulations.

29. KCC WSD Comment 2.29:

"GDSDS sustainability design principle precludes unduly large pipes and the pipe sizes for pipe sections 9.004, 11.001, 11.003-5, 12.000, 13.001, 17.000-1, 17.013, 18.000-1, 22.001-3, 23.000-5, 28.004, 34.007 (EPR Appendix E) shall be considered for reduction in size.

Pipe section 1.007 should be considered for a diameter Increase to ensure adequate hydraulic flow capacity is available.

The predicted super-capacity flows at pipe sections 1.014-16, 24.007-12, 36.007 and zero flows and proportional velocities at pipe sections 5.000, 5.001, 8.000 etc. shall be clarified.

The drainage pipe network sections 23.000-3 do not correspond to the submitted drainage layout drawing.

Proportional flow velocities less than the minimum permitted self-cleansing velocity of 0.75 mps at pipe sections 5.002, 6.000 and 7.000 etc. shall be reviewed.

Pipe section 11.001 should be reduced below 90m length."

PUNCH Response to KCC WSD Comment 2.29:

The proposed drainage and SuDS strategy and calculations have been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* and Section 2 of this Engineering Planning Report.

The pipe sizes have been reviewed and updated throughout. Pipes have been designed to accommodate the required flows, minimum gradients, minimum velocities for self-cleansing, and vertical separation from other pipes.

30. KCC WSD Comment 2.30:

"Unduly shallow and deep sections of pipe should be avoided with unavoidable shallow sections being appropriately protected to prevent damage.

Deep pipe sections and manholes especially adjacent to houses may preclude individual house connections to the collecting sewer pipe but where necessary deep manholes shall be wide enough and have required safety features to facilitate safe access by operatives.

Adequate vertical separation shall be provided between services especially surface water and foul water pipes where they intersect.

The longitudinal section drawings submitted with any planning application shall be clearly legible and include SuDS Including any underground attenuation storage facilities.

The prospective applicant shall consult the Development Control department on these issues prior to finalising the drainage design to be submitted with any planning application."

PUNCH Response to KCC WSD Comment 2.30:

The proposed drainage and SuDS strategy and calculations have been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* and Section 2 of this Engineering Planning Report. The drawings and report include the following:

- Pipes with reduced cover will be protected with a concrete surround
- Deep pipes and manholes have been reduced as far as possible. Where required, they will be constructed to ensure safe access for maintenance can be achieved.
- 300mm vertical separation has been achieved between foul and stormwater drainage lines where they cross.
- Longitudinal sections include attenuation storage facilities

31. KCC WSD Comment 2.31:

"It appears from the submitted documentation that there are no basements in proposed development including in apartment blocks A, B and C."

PUNCH Response to KCC WSD Comment 2.31:

The proposed drainage and SuDS strategy and calculations have been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* and Section 2 of this Engineering Planning Report. Note there are no basements in the proposed development.

Flood Risk:

Note: Refer to JBA Consulting Engineers for all Site Specific Flood Risk Assessment/Modelling responses. PUNCH response below addresses any specific surface water drainage queries raised in relation to flood risk.

1. KCC WSD Comment 2.32.4.2 and 2.32.4.3

*"2.32.4.2 Compliance with GDSDS Stormwater Drainage Design Criterion 3 Site Flooding Level of Service for the **proposed** drainage systems based on the **revised drainage and SuDS strategies and designs** that emerge from the review to be carried out as outlined at section 2 above shall be demonstrated by submission of **separate** 30 and 100 year event plus **20% climate change factor** pipe network simulations covering event durations up to 10,080 minutes and FFLs shall have a minimum freeboard of 500mm above the top water level in the drainage systems including pipe network and attenuation storage for the 100 year event plus 20% event.*

2.32.4.3 Where planned overspills occur from the drainage system for storm events greater than the climate change adjusted 30 year event, the flow routing shall be directed towards safe areas e.g. surface water outfalls and open spaces and away from other adjacent properties and roads and the flow routing shall not be obstructed."

PUNCH Response to KCC WSD Comment 2.32.4:

The proposed drainage and SuDS strategy and calculations have been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings *192229-PUNCH-XX-XX-DR-C-0151 to 0154* and Section 2 of this Engineering Planning Report.

Causeway Flow calculations have been prepared for the stormwater drainage network for 30 year and 100-year rainfall events with a 20% climate change allowance for event durations up to 10,080 minutes.

In accordance with GDSDS Criterion 3 Level of service (flooding) for the site, the finish floor levels are at least 500mm above the maximum river level and adjacent on-site attenuation storage for the 100 year plus 20% event.

Modelling has determined overspills are not occurring from the drainage system for storm events greater than the 20% climate change adjusted 30 year or 100 year events.

2. *KCC WSD Comment 2.35:*

"The prospective applicant should have regard to pre-planning meeting details, previous planning decisions and Irish Water and KCC WSD reports and conditions on the subject and adjacent sites, including the adjacent Ardstone-Glenveagh SHD."

PUNCH Response to KCC WSD Comment 2.35:

The proposed drainage and SuDS strategy and calculations have been further developed to take account of KCC WSD comments. This information has been included on the SuDS strategy drawings 192229-PUNCH-XX-XX-DR-C-0151 to 0154 and Section 2 of this Engineering Planning Report.

The final design has regard to pre-planning meeting details, previous planning decision and Irish Water and KCC WSD reports and conditions on the subject and adjacent sites including the adjacent Ardstone-Glenveagh SHD.

7.3 Irish Water – Ref CDS20007443

7.3.1 In respect to Wastewater

IW – Waste Water Item 1:

"A connection to service this development proposal must be made to the new 900mm sewer traversing the proposed site. The newly constructed 600mm pumped rising main-900mm gravity Newbridge Eastern Interceptor Sewer which traverses the subject site west-east shall be provided with a suitable wayleave to IW specific requirements."

PUNCH Response to IW – Waste Water Item 1:

As outlined in Section 3 of this Engineering Planning Report, it is proposed to connect the development to the 900mm gravity Newbridge Easter Interceptor Sewer at the locations indicated on the drawings accompanying this SHD application. The Irish Water wayleave for this 600mm diam. rising main/900mm diam. gravity sewer is indicated on the submitted drawings and the scheme is set back from the wayleave in accordance with Irish Water Wastewater Code of Practice (Document IW-CDS-5030-03) requirements. We are in receipt of the Irish Water Statement of Design Acceptance (CDS20007443) for the proposed scheme. Post receipt of grant of Planning Permission via the SHD process it is intended to submit a Connection Application to Irish Water.

IW – Waste Water Item 2:

"The applicant has engaged with Irish Water in relation to a proposed diversion (DIV21230) of the existing 450mm Kilcullen-Athgarvan sewer which traverses the subject site south-north which shall also be provided with a wayleave. This assessment is currently ongoing and further information has been requested including calculations to ensure that the diversion route will maintain self-cleansing conditions. The applicant is required to continue to engage with Irish Water Diversions to confirm feasibility of assessment of any potential diversion(s) prior to progressing to SHD application."

PUNCH Response to IW – Waste Water Item 2:

The requested additional information has been submitted to Irish Water in support of the Diversion application. The information demonstrates compliance with Irish Water Wastewater Code of Practice (Document IW-CDS-5030-03) and includes details of the wayleave and calculations demonstrating self-cleansing conditions are met. We are in receipt of the Irish Water Diversion Confirmation of Feasiblity letter (DIV21230) for the proposed diversion.

IW – Waste Water Item 3:

"The need for the proposed site wastewater pump station (WWPS) will be agreed with IW as part of any connection agreement as it may be feasible to serve the development by gravity connection given the sites adjacency to a new IW public new sewerage system i.e. 900mm diameter gravity sewer"

PUNCH Response to IW – Waste Water Item 3:

The proposed site wastewater pumping station is required for the western section of the proposed development in order to comply with the requirements of the Irish Water Wastewater Code of Practice (Document IW-CDS-5030-03 dated July 2020) and in particular, minimum gradients, self-cleansing velocities and minimum vertical clearance between services.

A gravity connection for the entire development was asssessed in detail in the process of preparing the foul drainage design with the aim of avoiding the use of an onsite WWPS. However, to achieve Irish Water's minimum design requirements including minimum gradients, self-cleansing velocities and minimum vertical clearance between services, a WWPS is therefore required for western section of the development. Irish Water have provided a Statement of Design Acceptence (CDS20007443) on the basis of this design.

7.3.2 In respect to Water

IW - Water Item 1:

"Connection is feasible to the existing 300mm DI main. A new connection main has to be a 200mm ID pipe. A bulk meter is to be installed on the connection main, meter to be connected to telemetry online"

PUNCH Response to IW –Water Item 1:

As outlined in Section 4 of the report and as indicated on the drawings accompanying this SHD application it is proposed to serve this SHD development via a 200mm ID connection off the existing 300mm watermain on Great Connell Road together with a bulk meter at the take-off point to Irish Water standard details.

7.3.3 IW Planning Observations:

"Connection(s) to the public network are subject to a Connection Agreement with Irish Water.

All development is to be carried out in compliance with Irish Waters Standards Codes and Practices and that design layouts for the development proposal, within the redline boundary have been submitted to Irish Water and that a Statement of Design Acceptance has been issued to the applicant by Irish Water ahead of any SHD Application.

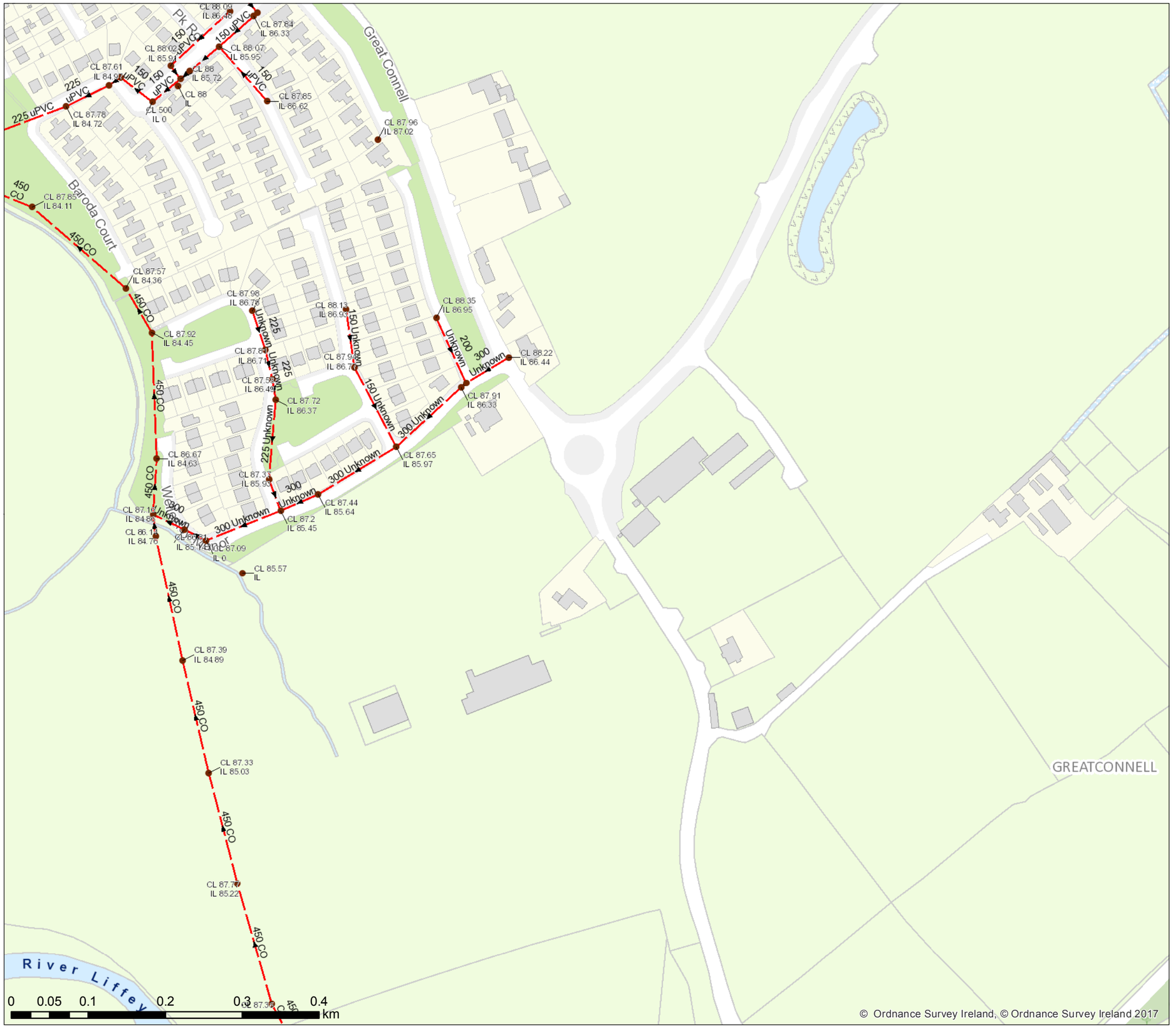
Irish Water does not permit build over of its assets and the separation distances as per Irish Waters Standards Codes and Practices which must be achieved. The applicant has engaged with Irish Waters Diversions in order to ensure appropriate and access to existing infrastructure(s) to agree to assess feasibility of any potential build over/diversion(s) which may be required, separation distances, appropriate wayleaves and or access ahead of any SHD application."

PUNCH Response to IW Planning Observations:

Noted. Drawings submitted to Irish Water and accompanying this SHD application include wayleaves and separation distances in compliance with Irish Water Stand Details and Codes of Practice.

Appendix A Existing Record Drawings

Irish Water Web Map



UISCE ÉIREANN : IRISH WATER

Print Date: 12/11/2020

Printed by:Irish Water

1. No part of this drawing may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Irish Wateras copyrightholder except as agreed for use on the project for which the document was originally issued.

2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other worksbeing carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

© Copyright Irish Water

Reproduced from the Ordnance Survey Of Ireland by Permission of the Government.
License No. 3-3-34

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the information
(including maps or mapping data).
NOTE: DIAL BEFORE YOU DIG Phone: 1850 427 747 or e-mail dig@gasnetworks.ie - The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication,
'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Irish Water Web Map

UISCE ÉIREANN : IRISH WATER

Print Date: 12/11/2020

Printed by:Irish Water

1. No part of this drawing may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Irish Wateras copyrightholder except as agreed for use on the project for which the document was originally issued.

2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other worksbeing carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

© Copyright Irish Water

Reproduced from the Ordnance Survey Of Ireland by Permission of the Government.
License No. 3-3-34

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the information
(including maps or mapping data).
NOTE: DIAL BEFORE YOU DIG Phone: 1850 427 747 or e-mail dig@gasnetworks.ie - The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication,
'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Irish Water Web Map

UISCE ÉIREANN : IRISH WATER

Print Date: 12/11/2020

Printed by:Irish Water

1. No part of this drawing may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Irish Wateras copyrightholder except as agreed for use on the project for which the document was originally issued.

2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other worksbeing carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

© Copyright Irish Water

Reproduced from the Ordnance Survey Of Ireland by Permission of the Government.
License No. 3-3-34

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the information
(including maps or mapping data).
NOTE: DIAL BEFORE YOU DIG Phone: 1850 427 747 or e-mail dig@gasnetworks.ie - The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication,
'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

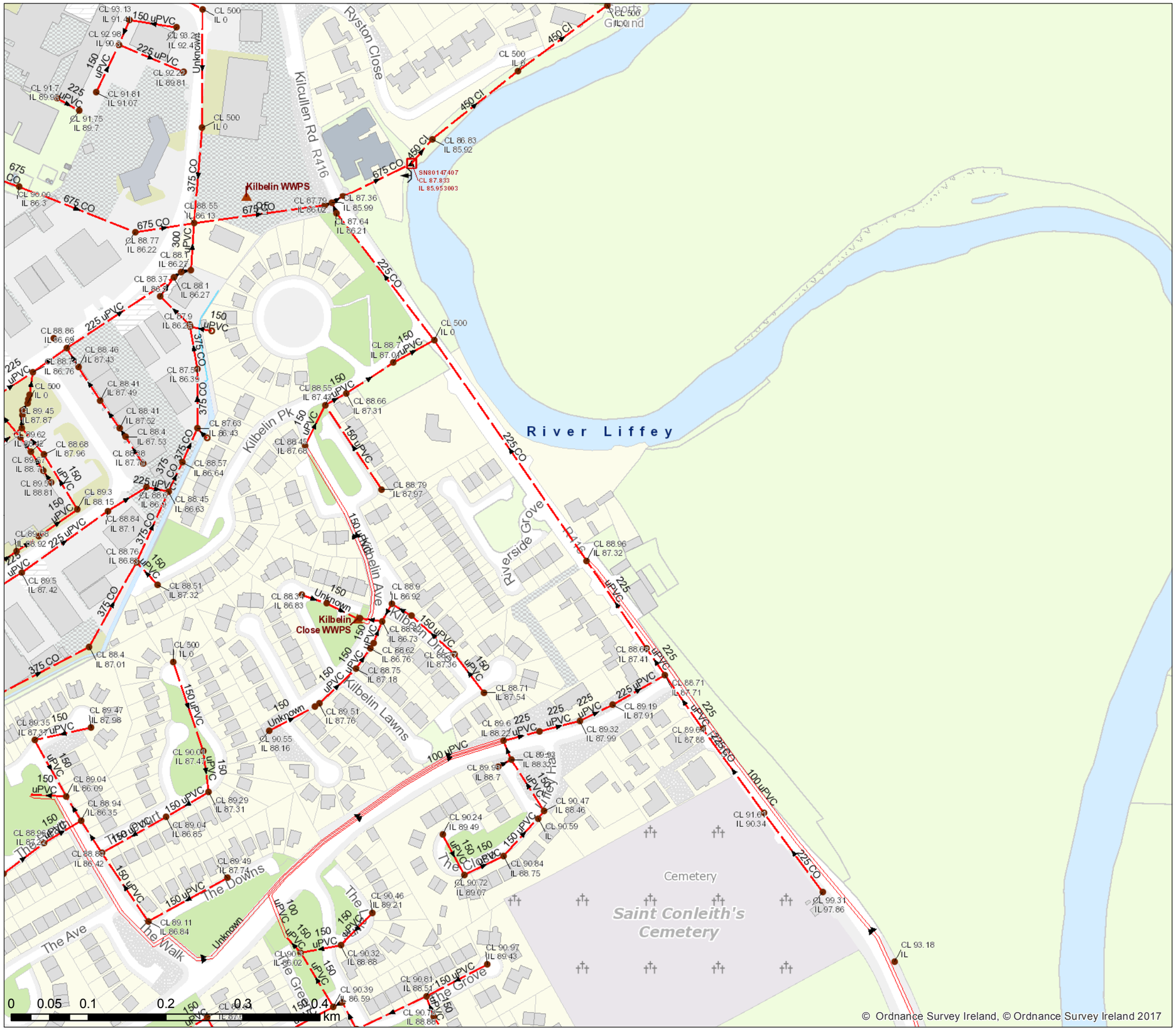
ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Irish Water Web Map



UISCE ÉIREANN : IRISH WATER

Print Date: 12/11/2020

Printed by:Irish Water

1. No part of this drawing may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Irish Wateras copyrightholder except as agreed for use on the project for which the document was originally issued.

2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other worksbeing carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

© Copyright Irish Water

Reproduced from the Ordnance Survey Of Ireland by Permission of the Government.
License No. 3-3-34

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the information
(including maps or mapping data).
NOTE: DIAL BEFORE YOU DIG Phone: 1850 427 747 or e-mail dig@gasnetworks.ie - The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication,
'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

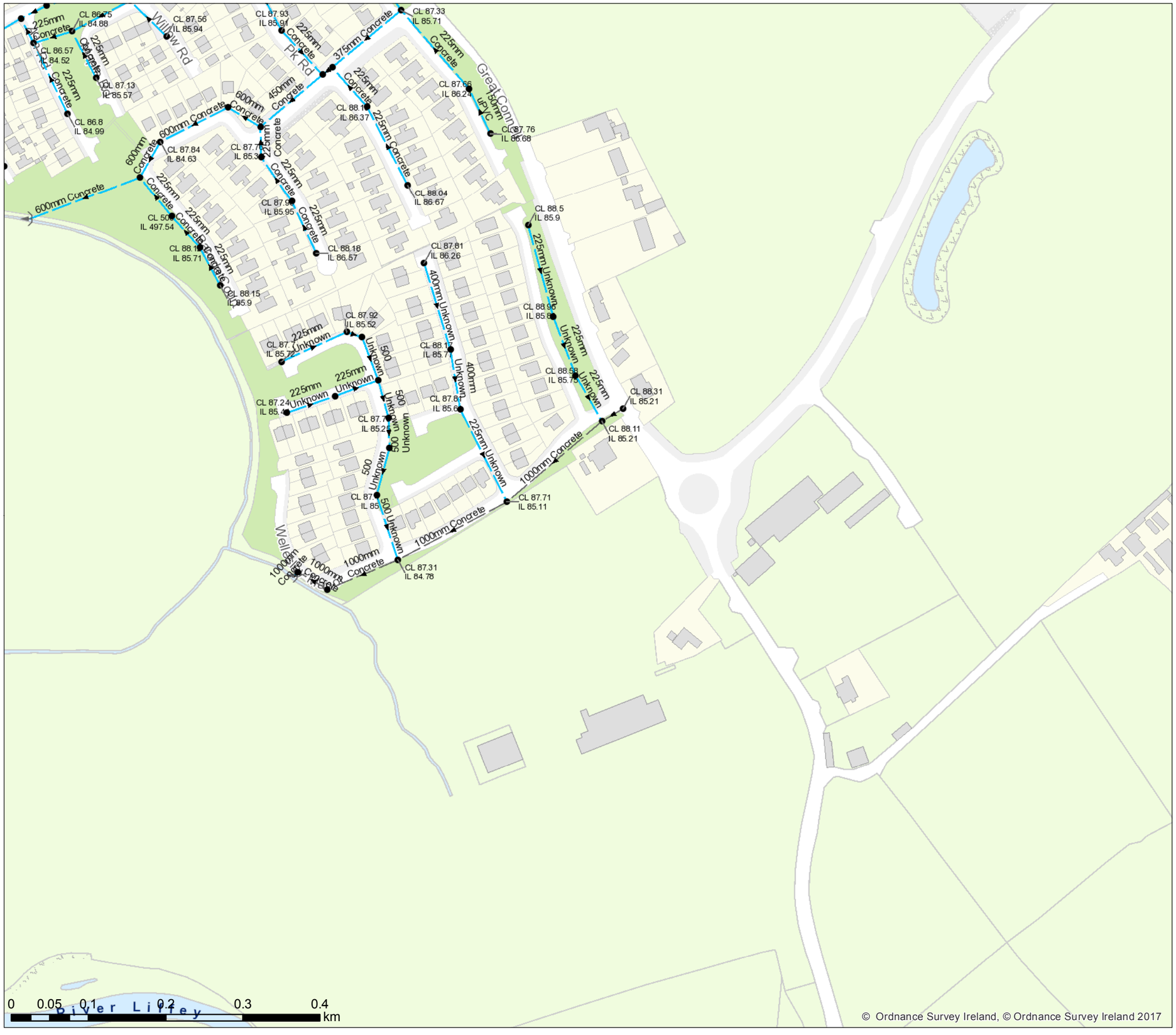
ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Irish Water Web Map



UISCE ÉIREANN : IRISH WATER

Print Date: 13/11/2020

Printed by:Irish Water

1. No part of this drawing may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Irish Wateras copyrightholder except as agreed for use on the project for which the document was originally issued.

2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other worksbeing carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

© Copyright Irish Water

Reproduced from the Ordnance Survey Of Ireland by Permission of the Government.
License No. 3-3-34

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the information
(including maps or mapping data).
NOTE: DIAL BEFORE YOU DIG Phone: 1850 427 747 or e-mail dig@gasnetworks.ie - The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication,
'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Irish Water Web Map

UISCE ÉIREANN : IRISH WATER

Print Date: 13/11/2020

Printed by:Irish Water

1. No part of this drawing may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Irish Wateras copyrightholder except as agreed for use on the project for which the document was originally issued.

2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other worksbeing carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

© Copyright Irish Water

Reproduced from the Ordnance Survey Of Ireland by Permission of the Government.
License No. 3-3-34

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the information
(including maps or mapping data).
NOTE: DIAL BEFORE YOU DIG Phone: 1850 427 747 or e-mail dig@gasnetworks.ie - The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication,
'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

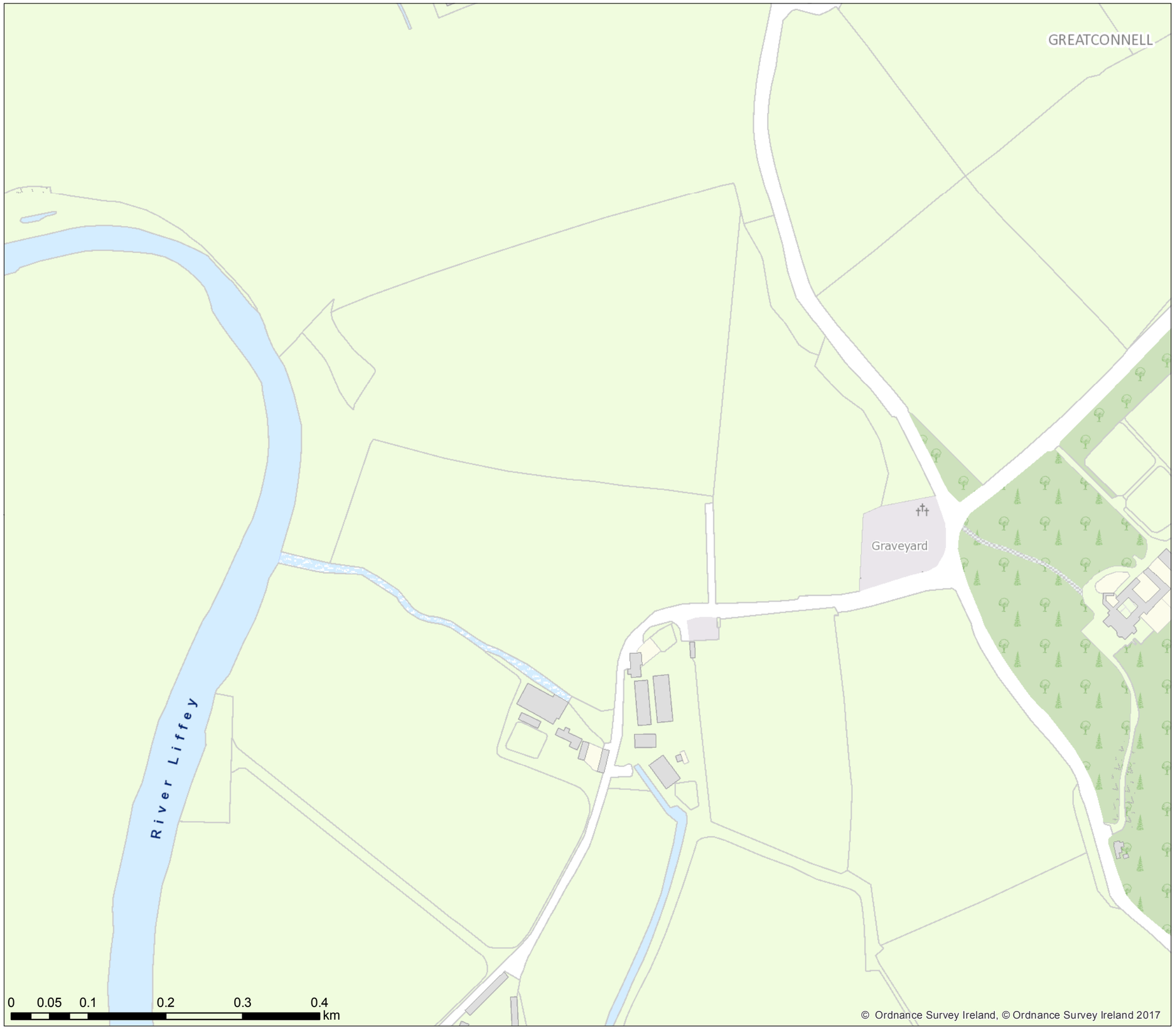
ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Irish Water Web Map



UISCE ÉIREANN : IRISH WATER

Print Date: 13/11/2020

Printed by:Irish Water

1. No part of this drawing may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Irish Wateras copyrightholder except as agreed for use on the project for which the document was originally issued.

2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other worksbeing carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

© Copyright Irish Water

Reproduced from the Ordnance Survey Of Ireland by Permission of the Government.
License No. 3-3-34

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the information
(including maps or mapping data).
NOTE: DIAL BEFORE YOU DIG Phone: 1850 427 747 or e-mail dig@gasnetworks.ie - The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication,
'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

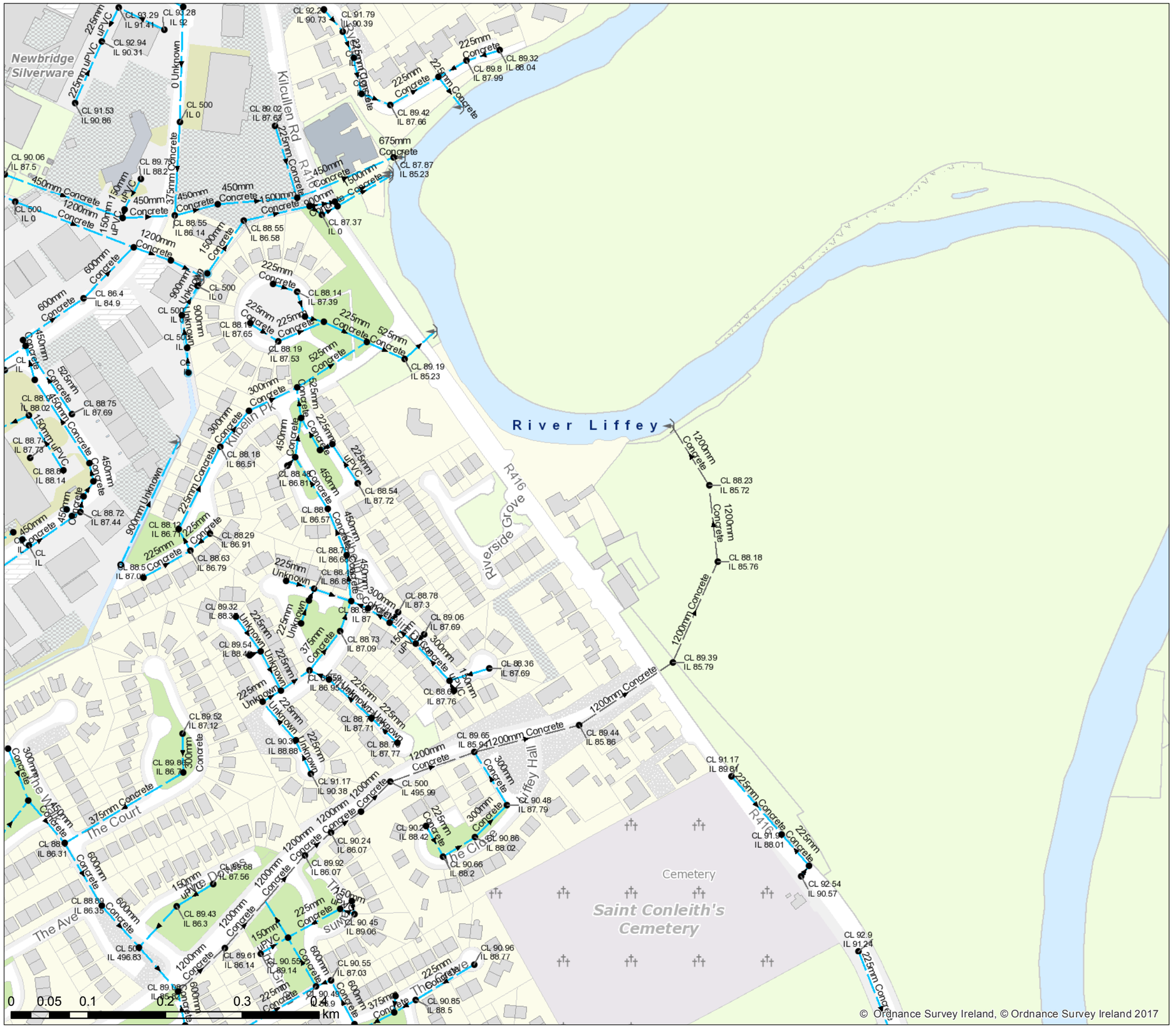
ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Irish Water Web Map



UISCE ÉIREANN : IRISH WATER

Print Date: 13/11/2020

Printed by:Irish Water

1. No part of this drawing may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Irish Wateras copyrightholder except as agreed for use on the project for which the document was originally issued.

2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other worksbeing carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

© Copyright Irish Water

Reproduced from the Ordnance Survey Of Ireland by Permission of the Government.
License No. 3-3-34

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the information
(including maps or mapping data).
NOTE: DIAL BEFORE YOU DIG Phone: 1850 427 747 or e-mail dig@gasnetworks.ie - The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication,
'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

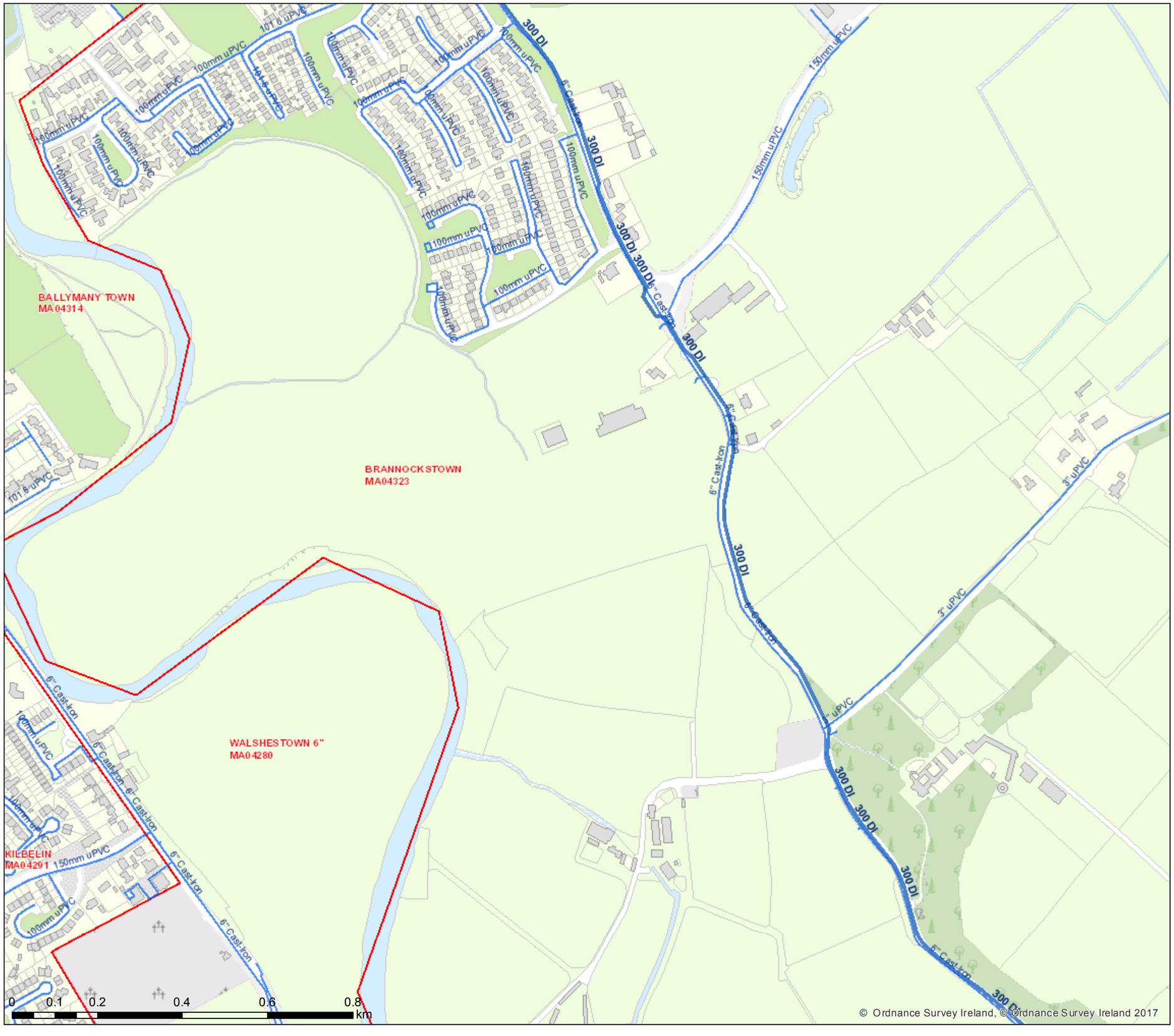
ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Irish Water Web Map



UISCE ÉIREANN : IRISH WATER

Print Date: 13/11/2020

Printed by:Irish Water

1. No part of this drawing may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Irish Wateras copyrightholder except as agreed for use on the project for which the document was originally issued.

2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other worksbeing carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

© Copyright Irish Water

Reproduced from the Ordnance Survey Of Ireland by Permission of the Government.
License No. 3-3-34

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the information
(including maps or mapping data).
NOTE: DIAL BEFORE YOU DIG Phone: 1850 427 747 or e-mail dig@gasnetworks.ie - The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication,
'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

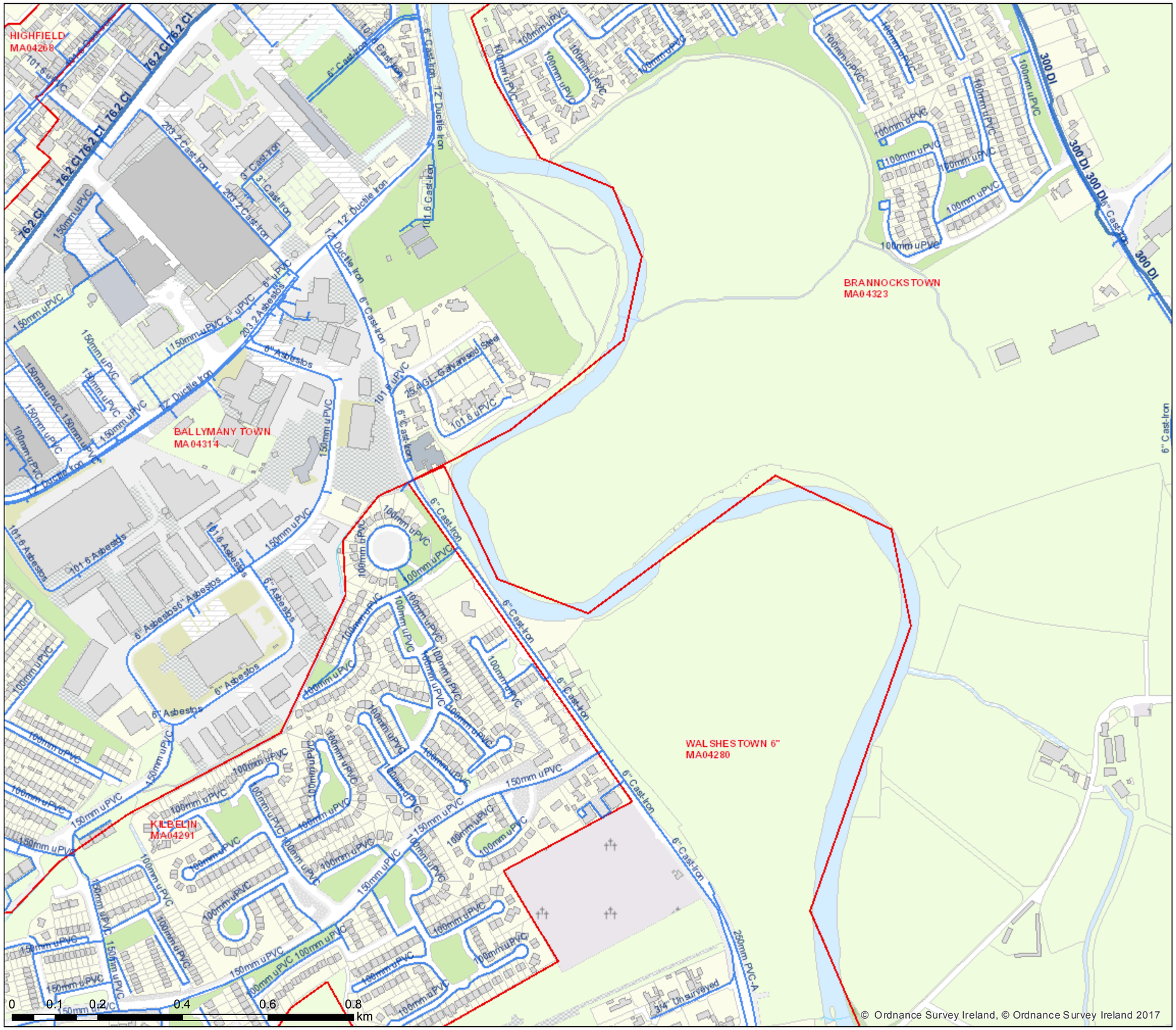
ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Irish Water Web Map



UISCE ÉIREANN : IRISH WATER

Print Date: 13/11/2020

Printed by:Irish Water

1. No part of this drawing may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Irish Wateras copyrightholder except as agreed for use on the project for which the document was originally issued.

2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other worksbeing carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

© Copyright Irish Water

Reproduced from the Ordnance Survey Of Ireland by Permission of the Government.
License No. 3-3-34

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the information
(including maps or mapping data).
NOTE: DIAL BEFORE YOU DIG Phone: 1850 427 747 or e-mail dig@gasnetworks.ie - The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication,
'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Appendix B Qbar Calculation Report

Mean Annual Flood Flow Rate Equation for Greenfield Catchments IH124

(Based on Institute of Hydrology report No. 124)

Project title: **Aston SHD, Newbridge**

Project no.: **192229**

Designed: **S. O'Coileir** Date: **07/03/2022**

(Complete figures in **blue** only)

$Q\ Bar = 0.00108 \times Area^{0.89} \times SAAR^{1.17} \times Soil^{2.17}$

Where			Units
Q Bar	=	Mean Annual Peak Flow	m^3/s
Area	=	Catchment area	km^2
SARR	=	Standard Annual Average Rainfall	mm
Soil	=	Soil Index	-

Table 1

Soil	WRAP	Runoff	Soil value	Soil Characteristics
1	Very high	Very low	0.15	Sandy, well drained
2	High	Low	0.3	Intermediate soils (sandy)
3	Moderate	Moderate	0.4	Intermediate soils (silty)
4	Low	High	0.45	Clayey, poorly drained
5	Very low	Very high	0.5	Steel, rocky areas

Area description: Full Site - Impervious Areas

Soil characteristics: Soil type (See Table 1) **3** (Intermediate soils - Silty)
=> Soil index = 0.40 **See SI report**

Area = 0.5 km^2 (**167373** m^2)

Where developments are smaller than 50 ha, the analysis for determining the peak greenfield discharge rate should use 50 ha in the formula and linearly interpolate the flow rate value based on the ratio of the development to 50 ha.(Ref: Interim Code of Practice for Sustainable Drainage Systems)

SAAR = 899 mm

Refer to Annual Average Rainfall Diagram & Data on next tab

Q Bar = 0.228 m^3/s

= 227.97 l/s

or

= 4.56 l/s/ha

Linear Interpolation of Q Bar based on ratio of development to 50 ha

Peak greenfield discharge rate, Q_{Bar} = 76.31 l/s

Growth Curve

Region: Greater Dublin

Growth curves are adopted from "Comment on Estimation of Greenfield Runoff Rates" - A.M.Crawley & C.Cunnane - National Hydrology Seminar 2003 where possible.

Return Period Q_{t1}:	1	year
Growth Factor for Q_{t1}:	0.85	
Allowable Discharge for 1 year return period:	**64.86**	**l/s**

Discharge rate equal to 1 year greenfield site peak runoff rate or 2l/s/ha, whichever is the greater. Site critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Return Period Q_{t2}:	5	year
Growth Factor for Q_{t2}:	1.4	
Allowable Discharge for 5 year return period:	**106.84**	**l/s**
Return Period Q_{t3}:	25	year
Growth Factor for Q_{t3}:	2.05	
Allowable Discharge for 25 year return period:	**156.44**	**l/s**
Return Period Q_{t4}:	100	year
Growth Factor for Q_{t4}:	2.61	
Allowable Discharge for 100 year return period:	**199.17**	**l/s**

Discharge rate equal to 1 in 100 year critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Mean Annual Flood Flow Rate Equation for Greenfield Catchments IH124

(Based on Institute of Hydrology report No. 124)

Project title: **Aston SHD, Newbridge**

Project no.: **192229**

Designed: **S. O'Coileir** Date: **07/03/2022**

(Complete figures in **blue** only)

$Q\ Bar = 0.00108 \times Area^{0.89} \times SAAR^{1.17} \times Soil^{2.17}$

Where			Units
Q Bar	=	Mean Annual Peak Flow	m^3/s
Area	=	Catchment area	km^2
SARR	=	Standard Annual Average Rainfall	mm
Soil	=	Soil Index	-

Table 1

Soil	WRAP	Runoff	Soil value	Soil Characteristics
1	Very high	Very low	0.15	Sandy, well drained
2	High	Low	0.3	Intermediate soils (sandy)
3	Moderate	Moderate	0.4	Intermediate soils (silty)
4	Low	High	0.45	Clayey, poorly drained
5	Very low	Very high	0.5	Steel, rocky areas

Area description: Impervious Areas

Soil characteristics: Soil type (See Table 1) **3** (Intermediate soils - Silty)
=> Soil index = 0.40 **See SI report**

Area = 0.5 km^2 (**159780** m^2)

Where developments are smaller than 50 ha, the analysis for determining the peak greenfield discharge rate should use 50 ha in the formula and linearly interpolate the flow rate value based on the ratio of the development to 50 ha.(Ref: Interim Code of Practice for Sustainable Drainage Systems)

SAAR = 899 mm

Refer to Annual Average Rainfall Diagram & Data on next tab

Q Bar = 0.228 m^3/s

= 227.97 l/s

or

= 4.56 l/s/ha

Linear Interpolation of Q Bar based on ratio of development to 50 ha

Peak greenfield discharge rate, Q_{Bar} = 72.85 l/s

Growth Curve

Region: Greater Dublin

Growth curves are adopted from "Comment on Estimation of Greenfield Runoff Rates" - A.M.Crawley & C.Cunnane - National Hydrology Seminar 2003 where possible.

Return Period Q_{t1}:	1	year
Growth Factor for Q_{t1}:	0.85	
Allowable Discharge for 1 year return period:	**61.92**	**l/s**

Discharge rate equal to 1 year greenfield site peak runoff rate or 2l/s/ha, whichever is the greater. Site critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Return Period Q_{t2}:	5	year
Growth Factor for Q_{t2}:	1.4	
Allowable Discharge for 5 year return period:	**101.99**	**l/s**
Return Period Q_{t3}:	25	year
Growth Factor for Q_{t3}:	2.05	
Allowable Discharge for 25 year return period:	**149.34**	**l/s**
Return Period Q_{t4}:	100	year
Growth Factor for Q_{t4}:	2.61	
Allowable Discharge for 100 year return period:	**190.14**	**l/s**

Discharge rate equal to 1 in 100 year critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Mean Annual Flood Flow Rate Equation for Greenfield Catchments IH124

(Based on Institute of Hydrology report No. 124)

Project title: **Aston SHD, Newbridge**

Project no.: **192229**

Designed: **S. O'Coileir** Date: **07/03/2022**

(Complete figures in **blue** only)

$Q\ Bar = 0.00108 \times Area^{0.89} \times SAAR^{1.17} \times Soil^{2.17}$

Where			Units
Q Bar	=	Mean Annual Peak Flow	m^3/s
Area	=	Catchment area	km^2
SARR	=	Standard Annual Average Rainfall	mm
Soil	=	Soil Index	-

Table 1

Soil	WRAP	Runoff	Soil value	Soil Characteristics
1	Very high	Very low	0.15	Sandy, well drained
2	High	Low	0.3	Intermediate soils (sandy)
3	Moderate	Moderate	0.4	Intermediate soils (silty)
4	Low	High	0.45	Clayey, poorly drained
5	Very low	Very high	0.5	Steel, rocky areas

Area description: NSORR Only - Impervious Areas

Soil characteristics: Soil type (See Table 1) **3** (Intermediate soils - Silty)

=> Soil index = 0.40 **See SI report**

Area = 0.5 km^2 (**7593** m^2)

Where developments are smaller than 50 ha, the analysis for determining the peak greenfield discharge rate should use 50 ha in the formula and linearly interpolate the flow rate value based on the ratio of the development to 50 ha.(Ref: Interim Code of Practice for Sustainable Drainage Systems)

SAAR = 899 mm

Refer to Annual Average Rainfall Diagram & Data on next tab

Q Bar = 0.228 m^3/s

= 227.97 l/s

or

= 4.56 l/s/ha

Linear Interpolation of Q Bar based on ratio of development to 50 ha

Peak greenfield discharge rate, Q_{Bar} = 3.46 l/s

Growth Curve

Region: Greater Dublin

Growth curves are adopted from "Comment on Estimation of Greenfield Runoff Rates" - A.M.Crawley & C.Cunnane - National Hydrology Seminar 2003 where possible.

Return Period Q_{t1}: 1 year

Growth Factor for Q_{t1}: 0.85

Allowable Discharge for 1 year return period: 2.94 l/s

Discharge rate equal to 1 year greenfield site peak runoff rate or 2l/s/ha, whichever is the greater. Site critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Return Period Q_{t2}: 5 year

Growth Factor for Q_{t2}: 1.4

Allowable Discharge for 5 year return period: 4.85 l/s

Return Period Q_{t3}: 25 year

Growth Factor for Q_{t3}: 2.05

Allowable Discharge for 25 year return period: 7.10 l/s

Return Period Q_{t4}: 100 year

Growth Factor for Q_{t4}: 2.61

Allowable Discharge for 100 year return period: 9.04 l/s

Discharge rate equal to 1 in 100 year critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Appendix C Met Eireann Rainfall Data

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 281600, Northing: 214761,

	Interval		Years												
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.6,	3.6,	4.1,	4.9,	5.4,	5.8,	7.1,	8.5,	9.5,	10.8,	11.9,	12.8,	14.2,	15.2,	16.1,	N/A ,
10 mins	3.7,	5.0,	5.8,	6.8,	7.6,	8.1,	9.9,	11.9,	13.2,	15.0,	16.6,	17.9,	19.8,	21.2,	22.4,	N/A ,
15 mins	4.3,	5.9,	6.8,	8.0,	8.9,	9.5,	11.7,	14.0,	15.5,	17.7,	19.6,	21.0,	23.3,	25.0,	26.4,	N/A ,
30 mins	5.7,	7.7,	8.8,	10.4,	11.4,	12.2,	14.8,	17.6,	19.5,	22.0,	24.3,	26.0,	28.6,	30.7,	32.3,	N/A ,
1 hours	7.5,	10.1,	11.4,	13.3,	14.6,	15.6,	18.7,	22.2,	24.4,	27.4,	30.1,	32.1,	35.2,	37.6,	39.6,	N/A ,
2 hours	10.0,	13.2,	14.8,	17.2,	18.7,	19.9,	23.7,	27.9,	30.5,	34.2,	37.3,	39.7,	43.4,	46.2,	48.5,	N/A ,
3 hours	11.7,	15.4,	17.2,	19.9,	21.7,	23.0,	27.3,	31.9,	34.8,	38.8,	42.3,	45.0,	49.0,	52.1,	54.6,	N/A ,
4 hours	13.2,	17.2,	19.2,	22.1,	24.0,	25.5,	30.1,	35.0,	38.2,	42.5,	46.3,	49.1,	53.4,	56.7,	59.3,	N/A ,
6 hours	15.5,	20.0,	22.3,	25.6,	27.8,	29.4,	34.6,	40.1,	43.6,	48.4,	52.5,	55.6,	60.3,	63.9,	66.8,	N/A ,
9 hours	18.3,	23.4,	26.0,	29.7,	32.1,	34.0,	39.7,	45.8,	49.7,	55.0,	59.5,	63.0,	68.1,	72.0,	75.2,	N/A ,
12 hours	20.5,	26.1,	29.0,	33.0,	35.6,	37.6,	43.8,	50.4,	54.6,	60.2,	65.1,	68.8,	74.3,	78.4,	81.8,	N/A ,
18 hours	24.2,	30.5,	33.7,	38.3,	41.2,	43.4,	50.3,	57.6,	62.3,	68.5,	73.8,	77.9,	83.9,	88.4,	92.1,	N/A ,
24 hours	27.1,	34.1,	37.6,	42.5,	45.7,	48.1,	55.5,	63.4,	68.3,	75.0,	80.7,	85.0,	91.4,	96.3,	100.2,	113.3,
2 days	32.1,	39.7,	43.4,	48.7,	52.0,	54.5,	62.3,	70.5,	75.6,	82.4,	88.2,	92.5,	98.9,	103.7,	107.6,	120.7,
3 days	36.5,	44.7,	48.6,	54.2,	57.8,	60.5,	68.7,	77.2,	82.5,	89.6,	95.6,	100.0,	106.7,	111.6,	115.6,	128.9,
4 days	40.5,	49.2,	53.4,	59.4,	63.1,	65.9,	74.5,	83.5,	89.0,	96.3,	102.6,	107.2,	114.0,	119.1,	123.2,	136.9,
6 days	47.8,	57.5,	62.2,	68.7,	72.8,	75.9,	85.2,	94.9,	100.9,	108.7,	115.4,	120.3,	127.6,	133.0,	137.4,	151.8,
8 days	54.4,	65.0,	70.1,	77.2,	81.6,	84.9,	95.0,	105.3,	111.7,	120.1,	127.1,	132.3,	140.0,	145.7,	150.3,	165.5,
10 days	60.7,	72.1,	77.5,	85.1,	89.8,	93.4,	104.1,	115.1,	121.8,	130.6,	138.1,	143.6,	151.6,	157.6,	162.4,	178.3,
12 days	66.6,	78.8,	84.6,	92.6,	97.7,	101.4,	112.7,	124.3,	131.3,	140.6,	148.4,	154.2,	162.6,	168.9,	173.9,	190.4,
16 days	77.9,	91.5,	98.0,	106.9,	112.4,	116.5,	129.0,	141.6,	149.3,	159.4,	167.9,	174.1,	183.2,	190.0,	195.4,	213.1,
20 days	88.6,	103.6,	110.6,	120.3,	126.3,	130.8,	144.3,	157.9,	166.2,	177.0,	186.1,	192.7,	202.5,	209.7,	215.5,	234.4,
25 days	101.5,	118.0,	125.7,	136.3,	142.9,	147.8,	162.4,	177.2,	186.1,	197.9,	207.6,	214.8,	225.3,	233.0,	239.2,	259.4,

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

M5/60 = 15.6, Ratio R = 0.286

Appendix D Surface Water Calculations – Causeway Flow Modelling

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Inverts
M5-60 (mm)	15.600	Minimum Backdrop Height (m)	0.000
Ratio-R	0.286	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1-0	0.012	5.00	88.550	1350	681728.297	714559.265	1.550
1-1	0.025	5.00	88.200	1350	681727.082	714579.948	1.264
1-2	0.032	5.00	88.200	1350	681729.935	714618.237	1.383
1-3	0.025	5.00	88.150	1350	681724.880	714650.182	1.433
1-4	0.012	5.00	88.050	1350	681726.157	714667.886	1.388
1-5	0.042	5.00	88.201	1350	681706.946	714704.913	1.668
2-0	0.012	5.00	88.588	1200	681654.345	714711.728	1.425
1-6	0.170	5.00	88.523	1350	681668.442	714684.340	2.077
1-7	0.171	5.00	88.681	1350	681613.809	714655.342	2.358
1-8	0.133	5.00	88.553	1350	681573.837	714634.246	2.320
1-9	0.182	5.00	88.321	1350	681516.849	714604.369	2.216
1-10	0.055	5.00	88.495	1350	681489.411	714611.148	2.437
1-11			88.016	1800	681465.859	714652.863	2.095
3-0	0.013	5.00	88.471	1200	681495.121	714623.928	1.680
1-12	0.101	5.00	88.157	1350	681476.088	714659.384	2.256
4-0		5.00	88.200	1200	681714.921	714722.862	1.115
4-1	0.028	5.00	88.200	1200	681700.576	714747.663	1.259
4-2			88.200	1200	681696.983	714746.664	1.278
4-3	0.029	5.00	88.321	1200	681679.139	714777.631	1.579
5-0		5.00	88.100	1200	681687.188	714707.538	0.975
5-1	0.043	5.00	88.000	1200	681674.194	714731.842	1.038
4-4	0.076	5.00	88.227	1200	681656.262	714765.409	1.616
4-5	0.040	5.00	88.128	1200	681631.788	714752.351	1.657
4-6			88.062	1200	681629.584	714756.232	1.614
4-7	0.066	5.00	87.821	1200	681618.718	714752.021	1.432
6-0	0.020	5.00	87.900	1200	681651.744	714821.450	1.029
6-1	0.040	5.00	88.070	1200	681635.217	714852.261	1.405
6-2	0.021	5.00	88.000	1200	681600.572	714833.783	1.567
6-3	0.098	5.00	87.930	1200	681613.963	714808.759	1.665
4-8	0.132	5.00	87.727	1350	681593.233	714797.616	1.601
7-0		5.00	88.100	1200	681598.010	714732.199	1.525
4-9	0.150	5.00	87.721	1350	681569.162	714784.678	1.680
8-0		5.00	87.700	1200	681578.569	714821.954	1.410
9-0		5.00	87.700	1200	681499.419	714779.633	1.301
8-1	0.095	5.00	87.400	1200	681538.921	714800.785	1.280
4-10	0.051	5.00	87.822	1350	681552.322	714775.627	1.819
10-0		5.00	87.635	1200	681456.887	714742.982	0.874
10-1	0.039	5.00	87.816	1200	681464.184	714728.460	1.151
11-0		5.00	87.700	1200	681470.270	714761.709	1.175
11-1	0.036	5.00	87.700	1200	681481.748	714767.493	1.251
10-2	0.075	5.00	87.700	1200	681494.310	714744.490	1.406
12-0		5.00	87.588	1200	681518.601	714738.418	1.425
10-3	0.104	5.00	87.724	1200	681511.067	714753.407	1.625
4-11	0.111	5.00	87.850	1500	681527.859	714762.478	1.898
4-12			87.850	1500	681530.789	714757.146	1.906
13-0		5.00	87.600	1200	681570.228	714744.973	1.425
4-13	0.042	5.00	87.400	1500	681544.032	714731.413	1.496
4-14	0.039	5.00	87.500	1500	681526.924	714722.557	1.623
14-0	0.027	5.00	88.142	1200	681632.181	714739.287	1.989
14-1	0.143	5.00	87.334	1200	681586.068	714714.847	1.318
15-0	0.007	5.00	88.094	1200	681560.301	714658.807	1.825
14-2	0.222	5.00	87.521	1350	681542.637	714691.750	1.634
4-15	0.076	5.00	87.418	1500	681536.496	714703.253	1.565
16-0		5.00	88.000	1200	681524.006	714656.720	1.425
17-0		5.00	87.625	1200	681491.700	714717.223	1.425
4-16	0.262	5.00	87.823	1500	681507.377	714687.844	2.006
1-13	0.083	5.00	88.078	1500	681471.112	714668.653	2.301
18-0		5.00	87.800	1200	681422.878	714707.549	1.375
19-0	0.025	5.00	88.150	1200	681367.542	714630.246	1.425

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
19-1	0.020	5.00	87.600	1200	681380.523	714649.147	1.010
18-1	0.075	5.00	87.750	1200	681392.936	714654.934	1.682
20-0	0.024	5.00	87.550	1200	681458.635	714610.046	1.306
18-2	0.178	5.00	87.900	1350	681419.839	714638.804	1.961
18-3	0.102	5.00	87.724	1350	681442.714	714678.477	1.927
18-4	0.029	5.00	87.871	1350	681452.487	714687.900	2.101
1-14	0.065	5.00	87.871	1500	681458.950	714691.294	2.119
1-15	0.032	5.00	87.781	1500	681452.167	714703.160	2.042
1-16	0.056	5.00	87.570	2100	681431.016	714720.912	1.858
PI 4			87.100	1500	681413.439	714734.297	1.516
Outfall 4			86.490	1500	681407.762	714738.679	0.917
21-0	0.005	5.00	88.540	1350	681732.623	714543.018	1.282
21-1	0.054	5.00	88.225	1350	681683.674	714528.552	1.125
21-2	0.032	5.00	88.405	1350	681649.964	714518.491	1.414
21-3	0.107	5.00	88.691	1350	681596.221	714502.522	1.873
21-4	0.056	5.00	88.367	1350	681550.069	714488.810	1.698
21-5	0.062	5.00	88.456	1350	681538.872	714510.770	1.858
22-0	0.025	5.00	88.245	1350	681680.587	714541.754	1.150
22-1	0.024	5.00	88.298	1350	681676.628	714555.083	1.243
23-0	0.035	5.00	88.357	1350	681708.590	714630.655	1.196
22-2	0.279	5.00	88.564	1350	681652.175	714600.736	1.657
24-0	0.008	5.00	88.655	1350	681619.602	714645.364	1.555
22-3	0.105	5.00	88.563	1350	681644.994	714598.737	1.678
22-4	0.133	5.00	89.151	1350	681604.492	714576.263	2.398
25-0		5.00	88.704	1200	681578.956	714511.950	1.425
25-1	0.062	5.00	88.700	1200	681570.824	714540.652	1.597
22-5	0.125	5.00	88.931	1350	681561.371	714552.096	2.319
26-0		5.00	88.550	1200	681520.981	714587.351	1.425
26-1	0.017	5.00	88.550	1200	681529.224	714571.926	1.528
22-6	0.059	5.00	88.890	1350	681548.127	714544.673	2.316
22-7			88.500	1350	681533.514	714533.960	1.971
21-6	0.069	5.00	88.369	1500	681527.948	714530.232	1.857
21-7	0.148	5.00	88.161	1500	681498.591	714572.945	1.761
21-8	0.029	5.00	88.218	1500	681494.806	714586.463	1.843
21-9	0.013	5.00	88.083	1500	681479.812	714583.385	1.735
21-10	0.087	5.00	87.929	1500	681440.788	714563.200	1.657
27-0		5.00	88.114	1500	681350.118	714601.420	1.792
27-1	0.144	5.00	87.900	1500	681391.219	714575.945	1.625
28-0	0.039	5.00	88.108	1350	681472.874	714484.377	1.630
28-1	0.162	5.00	87.846	1350	681446.895	714523.359	1.513
21-11	0.213	5.00	88.117	1500	681424.130	714546.888	1.885
29-0	0.002	5.00	88.510	1200	681529.152	714477.102	1.125
29-1	0.026	5.00	88.500	1200	681493.847	714463.154	1.339
29-2	0.017	5.00	88.289	1200	681481.690	714464.705	1.201
29-3	0.059	5.00	88.782	1200	681435.452	714440.649	2.002
29-4	0.025	5.00	88.880	1200	681420.740	714447.405	2.196
29-5	0.060	5.00	88.851	1200	681401.736	714473.443	2.364
21-12	0.180	5.00	88.730	1500	681378.428	714500.325	2.561
30-0	0.010	5.00	88.750	1200	681336.824	714583.857	1.425
30-1	0.021	5.00	88.700	1200	681318.656	714552.623	1.638
30-2	0.049	5.00	88.800	1200	681338.498	714532.780	1.904
21-13	0.094	5.00	88.850	1500	681354.275	714520.630	2.712
21-14			88.070	1500	681331.006	714494.008	1.966
PI 3			88.070	1500	681328.921	714490.869	2.073
Outfall 3			87.300	1500	681310.005	714462.485	1.362
31-0		5.00	88.586	1200	681241.100	714577.004	1.811
31-1	0.061	5.00	88.460	1200	681266.075	714572.105	1.835
31-2	0.026	5.00	88.375	1200	681288.357	714572.144	2.029
31-4	0.021	5.00	88.412	1200	681300.880	714577.792	2.238
31-5	0.021	5.00	88.350	1200	681310.328	714592.053	2.390
31-6	0.055	5.00	88.000	1200	681328.209	714617.952	2.355
32-0		5.00	87.750	1200	681351.362	714665.315	1.625
32-1	0.023	5.00	87.750	1200	681337.837	714644.743	1.770
31-7	0.004	5.00	87.894	1200	681322.684	714621.696	2.289
34-0	0.027	5.00	87.225	1200	681241.403	714640.836	1.425
34-1	0.037	5.00	87.366	1200	681263.636	714636.398	1.700
34-2	0.019	5.00	87.322	1200	681271.591	714641.215	1.711
31-8	0.143	5.00	87.387	1200	681277.979	714651.973	2.003
33-0		5.00	87.400	1200	681304.110	714699.473	1.725
31-9	0.052	5.00	87.385	1350	681274.152	714654.584	2.289

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
31-10			87.260	1800	681266.162	714658.164	2.189
35-0	0.025	5.00	87.091	1200	681280.289	714692.365	1.432
31-11	0.063	5.00	86.850	1350	681255.367	714674.032	1.834
31-12	0.079	5.00	86.901	1350	681230.026	714659.891	1.968
36-0		5.00	88.558	1200	681231.376	714579.073	1.658
36-1	0.066	5.00	88.383	1200	681201.801	714584.854	1.661
36-2	0.022	5.00	88.162	1200	681188.714	714591.490	1.587
36-3	0.018	5.00	87.954	1200	681182.045	714600.247	1.489
36-4	0.010	5.00	87.676	1200	681178.035	714614.258	1.357
31-13	0.198	5.00	87.231	1350	681174.797	714656.902	2.456
31-14	0.052	5.00	87.000	1350	681172.134	714690.391	2.283
31-15	0.020	5.00	86.950	1350	681178.112	714704.102	2.259
37-0		5.00	88.000	1200	681393.391	714716.054	1.425
37-1	0.051	5.00	87.736	1200	681364.767	714673.338	1.464
38-0	0.034	5.00	87.352	1200	681384.526	714741.184	1.675
39-0		5.00	87.171	1200	681352.807	714770.696	1.056
38-1	0.111	5.00	87.147	1200	681348.326	714765.422	1.727
37-2	0.272	5.00	87.247	1200	681304.036	714714.518	2.103
40-0		5.00	87.200	1200	681328.813	714803.744	1.425
40-1	0.026	5.00	87.075	1200	681305.668	714816.641	1.456
37-3	0.272	5.00	87.021	1350	681257.516	714759.392	2.077
37-4	0.088	5.00	86.930	1350	681218.378	714728.860	2.108
31-16	0.100	5.00	86.850	1500	681195.150	714715.697	2.195
31-17			86.440	2100	681189.329	714725.568	1.809
PI 1			86.440	1500	681186.333	714730.649	1.920
Outfall 1			85.570	1500	681181.220	714748.846	1.069
41-0	0.051	5.00	88.250	1200	681603.924	714908.556	1.550
41-1	0.035	5.00	88.250	1200	681618.947	714884.229	1.667
41-2	0.060	5.00	87.800	1200	681580.497	714859.153	1.405
41-3	0.044	5.00	87.500	1200	681539.046	714832.914	1.306
42-0	0.087	5.00	87.868	1200	681554.612	714897.046	1.294
42-1	0.122	5.00	87.996	1200	681561.361	714886.575	1.473
43-0	0.018	5.00	88.018	1200	681529.669	714880.070	1.425
42-2	0.096	5.00	88.148	1200	681536.014	714870.226	1.749
44-0	0.019	5.00	88.248	1200	681512.910	714874.563	1.825
41-4	0.089	5.00	88.226	1350	681521.339	714860.680	2.167
45-0	0.057	5.00	87.573	1200	681450.416	714820.912	1.161
41-5	0.087	5.00	87.879	1350	681482.391	714838.085	1.959
41-6			87.897	1350	681480.058	714842.579	1.998
41-7			87.523	1350	681434.036	714818.133	1.785
41-8	0.027	5.00	87.523	1350	681436.400	714813.481	1.806
46-0		5.00	87.430	1200	681419.932	714815.536	1.425
41-9	0.037	5.00	87.480	1350	681424.329	714807.040	1.806
47-0		5.00	87.950	1200	681526.464	714826.290	1.425
47-1	0.058	5.00	87.550	1200	681482.339	714802.714	1.442
41-10	0.123	5.00	87.430	1350	681438.489	714779.369	2.030
41-11	0.023	5.00	87.390	1350	681441.127	714775.003	2.005
41-12	0.030	5.00	87.450	1800	681437.310	714761.518	2.103
48-0		5.00	87.450	1200	681389.971	714797.634	1.150
41-13	0.158	5.00	87.350	1800	681415.501	714749.863	2.075
PI 5			87.350	1500	681410.913	714747.274	2.185
Outfall 5			86.400	1500	681406.210	714744.800	1.252
50-0		5.00	91.041	1200	681272.880	714510.934	2.141
50-1	0.075	5.00	90.205	1200	681305.334	714543.097	2.205
50-2	0.043	5.00	89.346	1200	681326.122	714573.010	2.146
50-3	0.036	5.00	88.831	1350	681341.206	714595.670	2.631
50-4	0.109	5.00	88.427	1350	681376.057	714649.341	2.425
50-5	0.141	5.00	88.100	1350	681423.923	714716.689	2.279
PI 2			87.100	1350	681408.828	714728.225	1.480
Outfall 2			86.501	1350	681405.225	714730.997	0.891
49-0		5.00	87.806	1350	681617.771	714850.092	1.612
49-1	0.130	5.00	87.191	1350	681553.609	714815.717	1.222
49-2	0.017	5.00	87.245	1350	681537.854	714803.050	1.339
49-3	0.108	5.00	87.547	1350	681490.130	714778.489	1.748
49-4	0.057	5.00	87.734	1350	681460.413	714760.641	2.004
49-5	0.051	5.00	87.899	1350	681437.601	714733.019	2.219
PI 6			87.889	1350	681413.647	714739.599	2.363
Outfall 6			86.490	1350	681408.322	714741.891	0.986

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.017	PI 4	Outfall 4	7.171	0.600	85.584	85.573	0.011	652.0	600	15.93	35.2
1.016	1-16	PI 4	22.093	0.600	85.712	85.684	0.028	789.0	600	15.80	35.3
1.015	1-15	1-16	27.613	0.600	85.739	85.712	0.027	1030.0	600	15.37	35.8
1.014	1-14	1-15	13.668	0.600	85.752	85.739	0.013	1030.0	600	14.76	36.6
1.013	1-13	1-14	25.701	0.600	85.777	85.752	0.025	1030.0	600	14.46	37.0
18.004	18-4	1-14	7.300	0.600	85.770	85.756	0.014	504.0	375	7.72	50.0
18.003	18-3	18-4	13.576	0.600	85.797	85.770	0.027	504.0	375	7.57	50.0
18.002	18-2	18-3	45.795	0.600	85.939	85.797	0.142	322.5	375	7.29	50.0
18.001	18-1	18-2	31.368	0.600	86.068	85.939	0.129	243.2	300	6.53	50.0
20.000	20-0	18-2	48.292	0.600	86.244	85.959	0.285	169.4	225	5.80	50.0
18.000	18-0	18-1	60.538	0.600	86.425	86.068	0.357	169.6	225	6.01	50.0
19.001	19-1	18-1	13.696	0.600	86.590	86.509	0.081	169.1	225	5.61	50.0
19.000	19-0	19-1	22.929	0.600	86.725	86.590	0.135	169.8	225	5.38	50.0
1.012	1-12	1-13	10.520	0.600	85.901	85.884	0.017	634.0	450	13.89	37.8
4.016	4-16	1-13	41.030	0.600	85.817	85.777	0.040	1030.0	600	12.77	39.4
16.000	16-0	4-16	35.288	0.600	86.575	86.367	0.208	169.7	225	5.59	50.0
17.000	17-0	4-16	33.300	0.600	86.200	86.003	0.197	169.0	225	5.55	50.0
4.015	4-15	4-16	32.945	0.600	85.853	85.817	0.036	908.0	600	11.86	40.9
14.002	14-2	4-15	13.040	0.600	85.887	85.861	0.026	504.0	375	7.38	50.0
4.014	4-14	4-15	21.547	0.600	85.877	85.853	0.024	908.0	600	11.17	42.1
4.013	4-13	4-14	19.264	0.600	85.904	85.877	0.027	723.0	500	10.72	43.0
13.000	13-0	4-13	29.498	0.600	86.175	86.001	0.174	169.5	225	5.49	50.0
4.012	4-12	4-13	28.941	0.600	85.944	85.904	0.040	723.0	500	10.32	43.8
4.011	4-11	4-12	6.084	0.600	85.952	85.944	0.008	723.0	500	9.72	45.0
4.010	4-10	4-11	27.773	0.600	86.003	85.952	0.051	545.0	400	9.59	45.3
10.003	10-3	4-11	19.085	0.600	86.099	86.027	0.072	264.0	225	6.55	50.0
10.002	10-2	10-3	18.982	0.600	86.294	86.182	0.112	169.5	225	6.15	50.0
12.000	12-0	10-3	16.776	0.600	86.163	86.099	0.064	264.0	225	5.35	50.0
11.001	11-1	10-2	26.210	0.600	86.449	86.294	0.155	169.1	225	5.65	50.0
10.001	10-1	10-2	34.125	0.600	86.665	86.464	0.201	169.8	225	5.84	50.0
10.000	10-0	10-1	16.252	0.600	86.761	86.665	0.096	169.3	225	5.27	50.0
11.000	11-0	11-1	12.853	0.600	86.525	86.449	0.076	169.1	225	5.21	50.0
4.009	4-9	4-10	19.118	0.600	86.041	86.003	0.038	504.0	375	9.01	46.6

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
1.017	0.946	267.5	356.9	0.916	0.317	3.746	0.0	600
1.016	0.859	242.8	358.4	1.258	0.816	3.746	0.0	600
1.015	0.750	212.1	358.2	1.442	1.258	3.690	0.0	600
1.014	0.750	212.1	362.8	1.519	1.442	3.658	0.0	600
1.013	0.750	212.1	314.8	1.701	1.519	3.140	0.0	600
18.004	0.800	88.4	61.3	1.726	1.740	0.453	0.0	230
18.003	0.800	88.4	57.5	1.552	1.726	0.424	0.0	221
18.002	1.003	110.8	43.6	1.586	1.552	0.322	0.0	163
18.001	1.004	70.9	16.3	1.382	1.661	0.120	0.0	98
20.000	1.001	39.8	3.3	1.081	1.716	0.024	0.0	44
18.000	1.001	39.8	0.0	1.150	1.457	0.000	0.0	0
19.001	1.002	39.9	6.1	0.785	1.016	0.045	0.0	59
19.000	1.000	39.8	3.4	1.200	0.785	0.025	0.0	44
1.012	0.800	127.2	100.8	1.806	1.744	0.985	0.0	304
4.016	0.750	212.1	221.3	1.406	1.701	2.072	0.0	525
16.000	1.001	39.8	0.0	1.200	1.231	0.000	0.0	0
17.000	1.003	39.9	0.0	1.200	1.595	0.000	0.0	0
4.015	0.800	226.1	200.7	0.965	1.406	1.810	0.0	442
14.002	0.800	88.4	54.1	1.259	1.182	0.399	0.0	212
4.014	0.800	226.1	152.4	1.023	0.965	1.335	0.0	362
4.013	0.800	157.1	150.9	0.996	1.123	1.296	0.0	396
13.000	1.001	39.8	0.0	1.200	1.174	0.000	0.0	0
4.012	0.800	157.1	148.7	1.406	0.996	1.254	0.0	390
4.011	0.800	157.1	153.0	1.398	1.406	1.254	0.0	402
4.010	0.801	100.7	109.2	1.419	1.498	0.889	0.0	400
10.003	0.800	31.8	34.4	1.400	1.598	0.254	0.0	225
10.002	1.001	39.8	20.3	1.181	1.317	0.150	0.0	114
12.000	0.800	31.8	0.0	1.200	1.400	0.000	0.0	0
11.001	1.002	39.9	4.9	1.026	1.181	0.036	0.0	53
10.001	1.000	39.8	5.3	0.926	1.011	0.039	0.0	55
10.000	1.002	39.8	0.0	0.649	0.926	0.000	0.0	0
11.000	1.002	39.9	0.0	0.950	1.026	0.000	0.0	0
4.009	0.800	88.4	93.9	1.305	1.444	0.743	0.0	339

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
8.001	8-1	4-10	28.505	0.600	86.120	86.003	0.117	243.6	300	6.41	50.0
8.000	8-0	8-1	44.945	0.600	86.290	86.120	0.170	264.0	225	5.94	50.0
9.000	9-0	8-1	44.809	0.600	86.399	86.229	0.170	264.0	225	5.93	50.0
4.008	4-8	4-9	27.328	0.600	86.126	86.041	0.085	321.5	375	8.61	47.6
7.000	7-0	4-9	59.885	0.600	86.575	86.222	0.353	169.6	225	6.00	50.0
6.003	6-3	4-8	23.535	0.600	86.265	86.126	0.139	169.3	225	7.10	50.0
4.007	4-7	4-8	52.234	0.600	86.389	86.126	0.263	198.6	255	8.16	48.8
4.006	4-6	4-7	11.653	0.600	86.448	86.389	0.059	197.5	255	7.29	50.0
4.005	4-5	4-6	4.463	0.600	86.471	86.448	0.023	194.1	255	7.10	50.0
4.004	4-4	4-5	27.740	0.600	86.611	86.471	0.140	198.1	255	7.03	50.0
5.001	5-1	4-4	38.057	0.600	86.962	86.737	0.225	169.1	225	6.09	50.0
4.003	4-3	4-4	25.937	0.600	86.742	86.611	0.131	198.0	255	6.56	50.0
4.002	4-2	4-3	35.740	0.600	86.922	86.742	0.180	198.6	255	6.13	50.0
4.001	4-1	4-2	3.729	0.600	86.941	86.922	0.019	196.3	255	5.54	50.0
4.000	4-0	4-1	28.651	0.600	87.085	86.941	0.144	199.0	255	5.48	50.0
5.000	5-0	5-1	27.560	0.600	87.125	86.962	0.163	169.1	225	5.46	50.0
6.002	6-2	6-3	28.382	0.600	86.433	86.265	0.168	168.9	225	6.71	50.0
6.001	6-1	6-2	39.265	0.600	86.665	86.433	0.232	169.2	225	6.24	50.0
6.000	6-0	6-1	34.964	0.600	86.871	86.665	0.206	169.7	225	5.58	50.0
14.001	14-1	14-2	49.191	0.600	86.016	85.887	0.129	380.0	300	7.11	50.0
15.000	15-0	14-2	37.380	0.600	86.269	86.048	0.221	169.1	225	5.62	50.0
14.000	14-0	14-1	52.189	0.600	86.153	86.016	0.137	380.0	300	6.09	50.0
1.011	1-11	1-12	12.131	0.600	85.921	85.901	0.020	600.0	400	13.67	38.1
3.000	3-0	1-12	40.242	0.600	86.791	86.554	0.237	169.8	225	5.67	50.0
1.010	1-10	1-11	47.904	0.600	86.058	85.921	0.137	349.7	400	13.40	38.5
1.009	1-9	1-10	28.263	0.600	86.105	86.058	0.047	600.0	400	12.61	39.7
1.008	1-8	1-9	64.345	0.600	86.233	86.105	0.128	504.0	375	11.99	40.7
1.007	1-7	1-8	45.197	0.600	86.323	86.233	0.090	504.0	375	10.65	43.1
1.006	1-6	1-7	61.852	0.600	86.446	86.323	0.123	504.0	375	9.71	45.0
1.005	1-5	1-6	43.656	0.600	86.533	86.446	0.087	504.0	375	8.42	48.1
2.000	2-0	1-6	30.803	0.600	87.163	86.981	0.182	169.2	225	5.51	50.0
1.004	1-4	1-5	41.714	0.600	86.662	86.533	0.129	323.4	375	7.51	50.0
1.003	1-3	1-4	17.750	0.600	86.717	86.662	0.055	322.7	375	6.82	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
8.001	1.003	70.9	12.9	0.980	1.519	0.095	0.0	86
8.000	0.800	31.8	0.0	1.185	1.055	0.000	0.0	0
9.000	0.800	31.8	0.0	1.076	0.946	0.000	0.0	0
4.008	1.005	111.0	76.5	1.226	1.305	0.593	0.0	230
7.000	1.001	39.8	0.0	1.300	1.274	0.000	0.0	0
6.003	1.002	39.8	24.3	1.440	1.376	0.179	0.0	127
4.007	1.002	51.2	37.3	1.177	1.346	0.282	0.0	162
4.006	1.004	51.3	29.3	1.359	1.177	0.216	0.0	138
4.005	1.013	51.8	29.3	1.402	1.359	0.216	0.0	137
4.004	1.003	51.2	23.9	1.361	1.402	0.176	0.0	122
5.001	1.002	39.8	5.8	0.813	1.265	0.043	0.0	58
4.003	1.003	51.2	7.7	1.324	1.361	0.057	0.0	66
4.002	1.002	51.2	3.8	1.023	1.324	0.028	0.0	46
4.001	1.008	51.5	3.8	1.004	1.023	0.028	0.0	46
4.000	1.001	51.1	0.0	0.860	1.004	0.000	0.0	0
5.000	1.002	39.9	0.0	0.750	0.813	0.000	0.0	0
6.002	1.003	39.9	11.0	1.342	1.440	0.081	0.0	80
6.001	1.002	39.8	8.1	1.180	1.342	0.060	0.0	69
6.000	1.000	39.8	2.7	0.804	1.180	0.020	0.0	40
14.001	0.800	56.6	23.0	1.018	1.334	0.170	0.0	133
15.000	1.002	39.8	0.9	1.600	1.248	0.007	0.0	24
14.000	0.800	56.6	3.7	1.689	1.018	0.027	0.0	51
1.011	0.763	95.9	89.9	1.695	1.856	0.871	0.0	309
3.000	1.000	39.8	1.8	1.455	1.378	0.013	0.0	32
1.010	1.003	126.1	90.8	2.037	1.695	0.871	0.0	252
1.009	0.763	95.9	87.7	1.816	2.037	0.816	0.0	303
1.008	0.800	88.4	69.9	1.945	1.841	0.634	0.0	252
1.007	0.800	88.4	58.5	1.983	1.945	0.501	0.0	223
1.006	0.800	88.4	40.3	1.702	1.983	0.330	0.0	178
1.005	0.800	88.4	19.3	1.293	1.702	0.148	0.0	118
2.000	1.002	39.8	1.6	1.200	1.317	0.012	0.0	31
1.004	1.002	110.7	14.4	1.013	1.293	0.106	0.0	90
1.003	1.003	110.8	12.7	1.058	1.013	0.094	0.0	85

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.002	1-2	1-3	32.342	0.600	86.817	86.717	0.100	323.4	375	6.52	50.0
1.001	1-1	1-2	38.395	0.600	86.936	86.817	0.119	322.6	375	5.98	50.0
1.000	1-0	1-1	20.719	0.600	87.000	86.936	0.064	323.7	375	5.34	50.0
21.015	PI 3	Outfall 3	34.110	0.600	85.997	85.938	0.059	578.1	600	15.16	36.1
21.014	21-14	PI 3	3.768	0.600	86.104	86.097	0.007	538.3	600	14.60	36.8
21.013	21-13	21-14	35.358	0.600	86.138	86.104	0.034	1030.0	600	14.53	36.9
21.012	21-12	21-13	31.554	0.600	86.169	86.138	0.031	1030.0	600	13.75	38.0
30.002	30-2	21-13	19.913	0.600	86.896	86.778	0.118	168.8	225	6.34	50.0
30.001	30-1	30-2	28.062	0.600	87.062	86.896	0.166	169.0	225	6.01	50.0
30.000	30-0	30-1	36.134	0.600	87.325	87.062	0.263	137.4	225	5.54	50.0
21.011	21-11	21-12	65.244	0.600	86.232	86.169	0.063	1030.0	600	13.05	39.0
29.005	29-5	21-12	35.580	0.600	86.487	86.277	0.210	169.4	225	8.09	48.9
29.004	29-4	29-5	32.236	0.600	86.684	86.487	0.197	163.6	225	7.50	50.0
29.003	29-3	29-4	16.189	0.600	86.780	86.684	0.096	168.6	225	6.97	50.0
29.002	29-2	29-3	52.121	0.600	87.088	86.780	0.308	169.2	225	6.70	50.0
29.001	29-1	29-2	12.256	0.600	87.161	87.088	0.073	167.9	225	5.83	50.0
29.000	29-0	29-1	37.960	0.600	87.385	87.161	0.224	169.5	225	5.63	50.0
21.010	21-10	21-11	23.315	0.600	86.272	86.232	0.040	582.9	500	11.60	41.3
27.001	27-1	21-11	43.903	0.600	86.275	86.232	0.043	1030.0	600	7.05	50.0
28.001	28-1	21-11	32.739	0.600	86.333	86.232	0.101	324.2	375	6.32	50.0
28.000	28-0	28-1	46.846	0.600	86.478	86.333	0.145	323.1	375	5.78	50.0
27.000	27-0	27-1	48.356	0.600	86.322	86.275	0.047	1030.0	600	6.07	50.0
21.009	21-9	21-10	43.935	0.600	86.348	86.272	0.076	578.1	500	11.16	42.1
21.008	21-8	21-9	15.307	0.600	86.375	86.348	0.027	566.9	500	10.35	43.7
21.007	21-7	21-8	14.038	0.600	86.400	86.375	0.025	561.5	500	10.06	44.3
21.006	21-6	21-7	51.829	0.600	86.512	86.400	0.112	462.8	500	9.81	44.8
21.005	21-5	21-6	22.318	0.600	86.598	86.534	0.064	348.7	400	8.95	46.8
22.007	22-7	21-6	6.699	0.600	86.529	86.512	0.017	394.1	400	8.52	47.8
22.006	22-6	22-7	18.119	0.600	86.574	86.529	0.045	402.7	400	8.40	48.1
22.005	22-5	22-6	15.182	0.600	86.612	86.574	0.038	399.5	400	8.08	49.0
26.001	26-1	22-6	33.167	0.600	87.022	86.826	0.196	169.2	225	5.84	50.0
26.000	26-0	26-1	17.489	0.600	87.125	87.022	0.103	169.8	225	5.29	50.0
22.004	22-4	22-5	49.431	0.600	86.753	86.612	0.141	350.6	400	7.81	49.7

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
1.002	1.002	110.6	9.4	1.008	1.058	0.069	0.0	73
1.001	1.003	110.8	5.0	0.889	1.008	0.037	0.0	54
1.000	1.001	110.6	1.6	1.175	0.889	0.012	0.0	32
21.015	1.005	284.3	257.7	1.473	0.762	2.635	0.0	451
21.014	1.042	294.7	262.9	1.366	1.373	2.635	0.0	444
21.013	0.750	212.1	263.4	2.112	1.366	2.635	0.0	600
21.012	0.750	212.1	253.2	1.961	2.112	2.461	0.0	600
30.002	1.003	39.9	10.8	1.679	1.847	0.080	0.0	80
30.001	1.003	39.9	4.2	1.413	1.679	0.031	0.0	49
30.000	1.113	44.3	1.4	1.200	1.413	0.010	0.0	27
21.011	0.750	212.1	221.0	1.285	1.961	2.092	0.0	524
29.005	1.001	39.8	25.1	2.139	2.228	0.189	0.0	130
29.004	1.019	40.5	17.5	1.971	2.139	0.129	0.0	103
29.003	1.004	39.9	14.1	1.777	1.971	0.104	0.0	92
29.002	1.002	39.8	6.1	0.976	1.777	0.045	0.0	59
29.001	1.006	40.0	3.8	1.114	0.976	0.028	0.0	47
29.000	1.001	39.8	0.3	0.900	1.114	0.002	0.0	14
21.010	0.892	175.2	171.9	1.157	1.385	1.534	0.0	405
27.001	0.750	212.1	19.5	1.025	1.285	0.144	0.0	122
28.001	1.001	110.5	27.2	1.138	1.510	0.201	0.0	126
28.000	1.002	110.7	5.3	1.255	1.138	0.039	0.0	55
27.000	0.750	212.1	0.0	1.192	1.025	0.000	0.0	0
21.009	0.896	175.9	165.2	1.235	1.157	1.447	0.0	387
21.008	0.905	177.7	169.9	1.343	1.235	1.434	0.0	394
21.007	0.909	178.6	168.6	1.261	1.343	1.405	0.0	389
21.006	1.003	196.9	152.7	1.357	1.261	1.257	0.0	333
21.005	1.005	126.3	40.1	1.458	1.435	0.316	0.0	154
22.007	0.944	118.7	113.1	1.571	1.457	0.872	0.0	314
22.006	0.934	117.4	113.8	1.916	1.571	0.872	0.0	319
22.005	0.938	117.9	105.7	1.919	1.916	0.796	0.0	297
26.001	1.002	39.8	2.3	1.303	1.839	0.017	0.0	36
26.000	1.000	39.8	0.0	1.200	1.303	0.000	0.0	0
22.004	1.002	125.9	82.1	1.998	1.919	0.609	0.0	236

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
25.001	25-1	22-5	14.843	0.600	87.103	87.015	0.088	168.7	225	5.74	50.0
25.000	25-0	25-1	29.832	0.600	87.279	87.103	0.176	169.5	225	5.50	50.0
22.003	22-3	22-4	46.319	0.600	86.885	86.753	0.132	350.9	400	6.98	50.0
22.002	22-2	22-3	7.454	0.600	86.907	86.885	0.022	338.8	400	6.21	50.0
24.000	24-0	22-3	53.093	0.600	87.100	86.949	0.151	351.6	400	5.88	50.0
22.001	22-1	22-2	51.789	0.600	87.055	86.907	0.148	349.9	400	6.09	50.0
23.000	23-0	22-2	63.858	0.600	87.161	86.964	0.197	324.2	375	6.06	50.0
22.000	22-0	22-1	13.905	0.600	87.095	87.055	0.040	347.6	400	5.23	50.0
21.004	21-4	21-5	24.650	0.600	86.669	86.598	0.071	347.2	400	8.58	47.7
21.003	21-3	21-4	48.146	0.600	86.818	86.669	0.149	323.1	375	8.17	48.7
21.002	21-2	21-3	56.065	0.600	86.991	86.818	0.173	324.1	375	7.37	50.0
21.001	21-1	21-2	35.179	0.600	87.100	86.991	0.109	322.7	375	6.43	50.0
21.000	21-0	21-1	51.042	0.600	87.258	87.100	0.158	323.0	375	5.85	50.0
31.017	PI 1	Outfall 1	18.902	0.600	84.520	84.501	0.019	1020.0	600	11.45	41.6
31.016	31-17	PI 1	5.899	0.600	84.631	84.620	0.011	536.2	600	11.03	42.4
31.015	31-16	31-17	11.460	0.600	84.655	84.631	0.024	477.5	600	10.94	42.6
31.014	31-15	31-16	20.609	0.600	84.691	84.655	0.036	572.5	450	10.76	42.9
37.004	37-4	31-16	26.698	0.600	84.822	84.744	0.078	342.3	375	9.70	45.0
37.003	37-3	37-4	49.639	0.600	84.944	84.822	0.122	406.9	375	9.25	46.1
37.002	37-2	37-3	64.636	0.600	85.144	84.944	0.200	323.2	300	8.32	48.3
40.001	40-1	37-3	74.807	0.600	85.619	85.178	0.441	169.6	225	6.69	50.0
40.000	40-0	40-1	26.496	0.600	85.775	85.619	0.156	169.8	225	5.44	50.0
38.001	38-1	37-2	67.475	0.600	85.420	85.144	0.276	244.5	300	6.85	50.0
37.001	37-1	37-2	73.376	0.600	86.272	85.840	0.432	169.9	225	7.08	50.0
37.000	37-0	37-1	51.420	0.600	86.575	86.272	0.303	169.7	225	5.86	50.0
38.000	38-0	38-1	43.565	0.600	85.677	85.420	0.257	169.5	225	5.73	50.0
39.000	39-0	38-1	6.921	0.600	86.115	86.074	0.041	168.8	225	5.11	50.0
31.013	31-14	31-15	14.958	0.600	84.717	84.691	0.026	575.3	450	10.36	43.7
31.012	31-13	31-14	33.595	0.600	84.775	84.717	0.058	579.2	450	10.06	44.3
31.011	31-12	31-13	55.310	0.600	84.933	84.775	0.158	350.1	400	9.39	45.7
36.004	36-4	31-13	42.767	0.600	86.319	85.891	0.428	100.0	225	6.56	50.0
36.003	36-3	36-4	14.574	0.600	86.465	86.319	0.146	100.0	225	6.01	50.0
36.002	36-2	36-3	11.007	0.600	86.575	86.465	0.110	100.0	225	5.83	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
25.001	1.004	39.9	8.4	1.372	1.691	0.062	0.0	70
25.000	1.001	39.8	0.0	1.200	1.372	0.000	0.0	0
22.003	1.002	125.9	64.5	1.278	1.998	0.476	0.0	203
22.002	1.019	128.1	49.2	1.257	1.278	0.363	0.0	171
24.000	1.001	125.7	1.1	1.155	1.214	0.008	0.0	26
22.001	1.003	126.0	6.6	0.843	1.257	0.049	0.0	62
23.000	1.001	110.5	4.7	0.821	1.225	0.035	0.0	52
22.000	1.006	126.5	3.4	0.750	0.843	0.025	0.0	45
21.004	1.007	126.5	32.8	1.298	1.458	0.254	0.0	139
21.003	1.002	110.7	26.2	1.498	1.323	0.198	0.0	123
21.002	1.001	110.5	12.3	1.039	1.498	0.091	0.0	84
21.001	1.003	110.8	8.0	0.750	1.039	0.059	0.0	68
21.000	1.002	110.7	0.7	0.907	0.750	0.005	0.0	21
31.017	0.754	213.2	225.1	1.320	0.469	1.996	0.0	537
31.016	1.044	295.3	229.3	1.209	1.220	1.996	0.0	399
31.015	1.107	313.1	230.2	1.595	1.209	1.996	0.0	383
31.014	0.842	134.0	121.1	1.809	1.745	1.042	0.0	337
37.004	0.973	107.5	104.3	1.733	1.731	0.854	0.0	299
37.003	0.892	98.5	95.7	1.702	1.733	0.766	0.0	300
37.002	0.869	61.4	61.3	1.803	1.777	0.468	0.0	247
40.001	1.001	39.8	3.5	1.231	1.618	0.026	0.0	45
40.000	1.000	39.8	0.0	1.200	1.231	0.000	0.0	0
38.001	1.001	70.7	19.7	1.427	1.803	0.145	0.0	108
37.001	1.000	39.8	6.9	1.239	1.182	0.051	0.0	63
37.000	1.001	39.8	0.0	1.200	1.239	0.000	0.0	0
38.000	1.001	39.8	4.6	1.450	1.502	0.034	0.0	51
39.000	1.003	39.9	0.0	0.831	0.848	0.000	0.0	0
31.013	0.840	133.6	121.0	1.833	1.809	1.022	0.0	337
31.012	0.837	133.2	116.4	2.006	1.833	0.970	0.0	327
31.011	1.003	126.0	81.3	1.568	2.056	0.656	0.0	234
36.004	1.307	52.0	15.7	1.132	1.115	0.116	0.0	85
36.003	1.307	52.0	14.4	1.264	1.132	0.106	0.0	80
36.002	1.307	52.0	11.9	1.362	1.264	0.088	0.0	73

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
36.001	36-1	36-2	14.673	0.600	86.722	86.575	0.147	100.0	225	5.69	50.0
36.000	36-0	36-1	30.135	0.600	86.900	86.722	0.178	169.3	225	5.50	50.0
31.010	31-11	31-12	29.020	0.600	85.016	84.933	0.083	349.6	400	8.47	47.9
31.009	31-10	31-11	19.192	0.600	85.071	85.016	0.055	348.9	400	7.99	49.2
35.000	35-0	31-11	30.939	0.600	85.659	85.476	0.183	169.1	225	5.51	50.0
31.008	31-9	31-10	8.755	0.600	85.096	85.071	0.025	350.2	400	7.67	50.0
31.007	31-8	31-9	4.633	0.600	85.384	85.369	0.015	308.9	300	7.53	50.0
34.000	33-0	31-9	53.968	0.600	85.675	85.357	0.318	169.7	225	5.90	50.0
31.006	31-7	31-8	53.993	0.600	85.605	85.384	0.221	244.3	300	7.44	50.0
33.002	34-2	31-8	12.512	0.600	85.611	85.537	0.074	169.1	225	5.74	50.0
33.001	34-1	34-2	9.300	0.600	85.666	85.611	0.055	169.1	225	5.53	50.0
33.000	34-0	34-1	22.672	0.600	85.800	85.666	0.134	169.2	225	5.38	50.0
31.005	31-6	31-7	6.674	0.600	85.645	85.605	0.040	166.9	225	6.54	50.0
32.001	32-1	31-7	27.582	0.600	85.980	85.817	0.163	169.2	225	5.87	50.0
32.000	32-0	32-1	24.620	0.600	86.125	85.980	0.145	169.8	225	5.41	50.0
31.004	31-5	31-6	31.472	0.600	85.960	85.645	0.315	100.0	225	6.43	50.0
31.003	31-4	31-5	17.107	0.600	86.174	85.960	0.214	80.0	225	6.03	50.0
31.002	31-2	31-4	13.738	0.600	86.346	86.174	0.172	80.0	225	5.83	50.0
31.001	31-1	31-2	22.282	0.600	86.625	86.346	0.279	80.0	225	5.68	50.0
31.000	31-0	31-1	25.451	0.600	86.775	86.625	0.150	169.7	225	5.42	50.0
41.014	PI 5	Outfall 5	5.314	0.600	85.165	85.148	0.017	312.6	500	11.01	42.4
41.013	41-13	PI 5	5.268	0.600	85.275	85.265	0.010	526.8	500	10.94	42.6
41.012	41-12	41-13	24.728	0.600	85.347	85.275	0.072	343.4	400	10.84	42.7
48.000	48-0	41-13	54.165	0.600	86.300	85.758	0.542	100.0	225	5.69	50.0
41.011	41-11	41-12	14.015	0.600	85.385	85.347	0.038	368.8	400	10.44	43.5
41.010	41-10	41-11	5.101	0.600	85.400	85.385	0.015	340.1	400	10.20	44.0
41.009	41-9	41-10	31.084	0.600	85.674	85.578	0.096	323.8	375	10.11	44.2
47.001	47-1	41-10	49.677	0.600	86.108	85.815	0.293	169.5	225	6.53	50.0
47.000	47-0	47-1	50.028	0.600	86.525	86.108	0.417	120.0	225	5.70	50.0
41.008	41-8	41-9	13.682	0.600	85.717	85.674	0.043	318.2	375	9.60	45.3
46.000	46-0	41-9	9.566	0.600	86.005	85.948	0.057	167.8	225	5.16	50.0
41.007	41-7	41-8	5.218	0.600	85.738	85.717	0.021	248.5	375	9.37	45.8
41.006	41-6	41-7	52.111	0.600	85.899	85.738	0.161	323.7	375	9.29	46.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
36.001	1.307	52.0	8.9	1.436	1.362	0.066	0.0	63
36.000	1.002	39.8	0.0	1.433	1.436	0.000	0.0	0
31.010	1.003	126.1	75.0	1.434	1.568	0.577	0.0	222
31.009	1.004	126.2	65.2	1.789	1.434	0.489	0.0	204
35.000	1.002	39.9	3.4	1.207	1.149	0.025	0.0	44
31.008	1.003	126.0	66.3	1.889	1.789	0.489	0.0	206
31.007	0.889	62.8	59.2	1.703	1.716	0.437	0.0	233
34.000	1.001	39.8	0.0	1.500	1.803	0.000	0.0	0
31.006	1.001	70.8	28.6	1.989	1.703	0.211	0.0	133
33.002	1.002	39.9	11.2	1.486	1.625	0.083	0.0	81
33.001	1.002	39.9	8.7	1.475	1.486	0.064	0.0	71
33.000	1.002	39.8	3.7	1.200	1.475	0.027	0.0	46
31.005	1.009	40.1	24.9	2.130	2.064	0.184	0.0	129
32.001	1.002	39.8	3.1	1.545	1.852	0.023	0.0	43
32.000	1.000	39.8	0.0	1.400	1.545	0.000	0.0	0
31.004	1.307	52.0	17.5	2.165	2.130	0.129	0.0	90
31.003	1.463	58.2	14.6	2.013	2.165	0.108	0.0	77
31.002	1.463	58.2	11.8	1.804	2.013	0.087	0.0	68
31.001	1.463	58.2	8.3	1.610	1.804	0.061	0.0	57
31.000	1.001	39.8	0.0	1.586	1.610	0.000	0.0	0
41.014	1.223	240.1	140.4	1.685	0.752	1.221	0.0	275
41.013	0.939	184.4	140.8	1.575	1.585	1.221	0.0	329
41.012	1.013	127.2	123.1	1.703	1.675	1.063	0.0	319
48.000	1.307	52.0	0.0	0.925	1.367	0.000	0.0	0
41.011	0.977	122.7	121.9	1.605	1.703	1.033	0.0	328
41.010	1.018	127.9	120.5	1.630	1.605	1.010	0.0	311
41.009	1.001	110.6	99.3	1.431	1.477	0.829	0.0	279
47.001	1.001	39.8	7.9	1.217	1.390	0.058	0.0	67
47.000	1.192	47.4	0.0	1.200	1.217	0.000	0.0	0
41.008	1.010	111.6	97.2	1.431	1.431	0.792	0.0	272
46.000	1.006	40.0	0.0	1.200	1.307	0.000	0.0	0
41.007	1.145	126.4	95.0	1.410	1.431	0.765	0.0	244
41.006	1.001	110.6	95.3	1.623	1.410	0.765	0.0	270

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
41.005	41-5	41-6	5.064	0.600	85.920	85.899	0.021	241.1	375	8.43	48.1
41.004	41-4	41-5	45.028	0.600	86.059	85.920	0.139	323.9	375	8.35	48.3
45.000	45-0	41-5	36.295	0.600	86.412	86.198	0.214	169.6	225	5.60	50.0
41.003	41-3	41-4	32.932	0.600	86.194	86.059	0.135	243.9	300	7.60	50.0
42.002	42-2	41-4	17.507	0.600	86.399	86.327	0.072	243.1	300	6.00	50.0
44.000	44-0	41-4	16.241	0.600	86.423	86.327	0.096	169.2	225	5.27	50.0
42.001	42-1	42-2	30.162	0.600	86.523	86.399	0.124	243.2	300	5.71	50.0
43.000	43-0	42-2	11.712	0.600	86.593	86.524	0.069	169.7	225	5.20	50.0
42.000	42-0	42-1	12.458	0.600	86.574	86.523	0.051	244.3	300	5.21	50.0
41.002	41-2	41-3	49.058	0.600	86.395	86.194	0.201	244.1	300	7.06	50.0
41.001	41-1	41-2	45.904	0.600	86.583	86.395	0.188	244.2	300	6.24	50.0
41.000	41-0	41-1	28.592	0.600	86.700	86.583	0.117	244.4	300	5.48	50.0
49.006	PI 2	Outfall 2	4.546	0.600	85.620	85.610	0.010	454.6	450	9.22	46.1
49.005	50-5	PI 2	18.999	0.600	85.821	85.763	0.058	327.6	400	9.14	46.3
49.004	50-4	50-5	82.625	0.600	86.002	85.821	0.181	456.5	400	8.84	47.0
49.003	50-3	50-4	63.994	0.600	86.200	86.002	0.198	323.2	400	7.27	50.0
49.002	50-2	50-3	27.221	0.600	87.200	86.860	0.340	80.0	225	6.25	50.0
49.001	50-1	50-2	36.427	0.600	88.000	87.545	0.455	80.0	225	5.94	50.0
49.000	50-0	50-1	45.692	0.600	88.900	88.329	0.571	80.0	225	5.52	50.0
50.006	PI 6	Outfall 6	5.797	0.600	85.526	85.504	0.022	263.5	450	9.69	45.1
50.005	49-5	PI 6	24.841	0.600	85.680	85.626	0.054	460.0	450	9.62	45.2
50.004	49-4	49-5	35.824	0.600	85.730	85.680	0.050	720.0	450	9.18	46.2
50.003	49-3	49-4	34.665	0.600	85.799	85.730	0.069	500.0	375	8.38	48.2
50.002	49-2	49-3	53.673	0.600	85.906	85.799	0.107	500.0	375	7.66	50.0
50.001	49-1	49-2	20.216	0.600	85.969	85.906	0.063	320.9	375	6.55	50.0
50.000	49-0	49-1	72.790	0.600	86.194	85.969	0.225	323.5	375	6.21	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
41.005	1.162	128.4	99.7	1.584	1.623	0.765	0.0	249
41.004	1.001	110.6	81.2	1.792	1.584	0.621	0.0	240
45.000	1.001	39.8	7.7	0.936	1.456	0.057	0.0	67
41.003	1.002	70.8	25.7	1.006	1.867	0.190	0.0	125
42.002	1.004	70.9	43.8	1.449	1.599	0.323	0.0	171
44.000	1.002	39.8	2.6	1.600	1.674	0.019	0.0	38
42.001	1.003	70.9	28.3	1.173	1.449	0.209	0.0	132
43.000	1.000	39.8	2.4	1.200	1.399	0.018	0.0	37
42.000	1.001	70.8	11.8	0.994	1.173	0.087	0.0	82
41.002	1.002	70.8	19.8	1.105	1.006	0.146	0.0	108
41.001	1.001	70.8	11.7	1.367	1.105	0.086	0.0	82
41.000	1.001	70.8	6.9	1.250	1.367	0.051	0.0	63
49.006	0.947	150.6	50.5	1.030	0.441	0.404	0.0	179
49.005	1.037	130.3	50.7	1.879	0.937	0.404	0.0	173
49.004	0.877	110.2	33.5	2.025	1.879	0.263	0.0	151
49.003	1.044	131.2	20.9	2.231	2.025	0.154	0.0	107
49.002	1.463	58.2	16.0	1.921	1.746	0.118	0.0	80
49.001	1.463	58.2	10.2	1.980	1.576	0.075	0.0	64
49.000	1.463	58.2	0.0	1.916	1.651	0.000	0.0	0
50.006	1.247	198.4	44.3	1.913	0.536	0.363	0.0	144
50.005	0.941	149.7	44.5	1.769	1.813	0.363	0.0	167
50.004	0.750	119.3	39.1	1.554	1.769	0.312	0.0	177
50.003	0.803	88.7	33.3	1.373	1.629	0.255	0.0	159
50.002	0.803	88.7	19.9	0.964	1.373	0.147	0.0	120
50.001	1.006	111.1	17.6	0.847	0.964	0.130	0.0	101
50.000	1.002	110.6	0.0	1.237	0.847	0.000	0.0	0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.017	7.171	652.0	600	Circular	87.100	85.584	0.916	86.490	85.573	0.317
1.016	22.093	789.0	600	Circular	87.570	85.712	1.258	87.100	85.684	0.816
1.015	27.613	1030.0	600	Circular	87.781	85.739	1.442	87.570	85.712	1.258
1.014	13.668	1030.0	600	Circular	87.871	85.752	1.519	87.781	85.739	1.442
1.013	25.701	1030.0	600	Circular	88.078	85.777	1.701	87.871	85.752	1.519
18.004	7.300	504.0	375	Circular	87.871	85.770	1.726	87.871	85.756	1.740
18.003	13.576	504.0	375	Circular	87.724	85.797	1.552	87.871	85.770	1.726
18.002	45.795	322.5	375	Circular	87.900	85.939	1.586	87.724	85.797	1.552
18.001	31.368	243.2	300	Circular	87.750	86.068	1.382	87.900	85.939	1.661
20.000	48.292	169.4	225	Circular	87.550	86.244	1.081	87.900	85.959	1.716
18.000	60.538	169.6	225	Circular	87.800	86.425	1.150	87.750	86.068	1.457
19.001	13.696	169.1	225	Circular	87.600	86.590	0.785	87.750	86.509	1.016
19.000	22.929	169.8	225	Circular	88.150	86.725	1.200	87.600	86.590	0.785
1.012	10.520	634.0	450	Circular	88.157	85.901	1.806	88.078	85.884	1.744
4.016	41.030	1030.0	600	Circular	87.823	85.817	1.406	88.078	85.777	1.701
16.000	35.288	169.7	225	Circular	88.000	86.575	1.200	87.823	86.367	1.231
17.000	33.300	169.0	225	Circular	87.625	86.200	1.200	87.823	86.003	1.595
4.015	32.945	908.0	600	Circular	87.418	85.853	0.965	87.823	85.817	1.406
14.002	13.040	504.0	375	Circular	87.521	85.887	1.259	87.418	85.861	1.182
4.014	21.547	908.0	600	Circular	87.500	85.877	1.023	87.418	85.853	0.965
4.013	19.264	723.0	500	Circular	87.400	85.904	0.996	87.500	85.877	1.123
13.000	29.498	169.5	225	Circular	87.600	86.175	1.200	87.400	86.001	1.174
4.012	28.941	723.0	500	Circular	87.850	85.944	1.406	87.400	85.904	0.996
4.011	6.084	723.0	500	Circular	87.850	85.952	1.398	87.850	85.944	1.406
4.010	27.773	545.0	400	Circular	87.822	86.003	1.419	87.850	85.952	1.498
10.003	19.085	264.0	225	Circular	87.724	86.099	1.400	87.850	86.027	1.598
10.002	18.982	169.5	225	Circular	87.700	86.294	1.181	87.724	86.182	1.317
12.000	16.776	264.0	225	Circular	87.588	86.163	1.200	87.724	86.099	1.400
11.001	26.210	169.1	225	Circular	87.700	86.449	1.026	87.700	86.294	1.181
10.001	34.125	169.8	225	Circular	87.816	86.665	0.926	87.700	86.464	1.011
10.000	16.252	169.3	225	Circular	87.635	86.761	0.649	87.816	86.665	0.926
11.000	12.853	169.1	225	Circular	87.700	86.525	0.950	87.700	86.449	1.026
4.009	19.118	504.0	375	Circular	87.721	86.041	1.305	87.822	86.003	1.444
8.001	28.505	243.6	300	Circular	87.400	86.120	0.980	87.822	86.003	1.519

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.017	PI 4	1500	Manhole	Adoptable	Outfall 4	1500	Manhole	Adoptable
1.016	1-16	2100	Manhole	Adoptable	PI 4	1500	Manhole	Adoptable
1.015	1-15	1500	Manhole	Adoptable	1-16	2100	Manhole	Adoptable
1.014	1-14	1500	Manhole	Adoptable	1-15	1500	Manhole	Adoptable
1.013	1-13	1500	Manhole	Adoptable	1-14	1500	Manhole	Adoptable
18.004	18-4	1350	Manhole	Adoptable	1-14	1500	Manhole	Adoptable
18.003	18-3	1350	Manhole	Adoptable	18-4	1350	Manhole	Adoptable
18.002	18-2	1350	Manhole	Adoptable	18-3	1350	Manhole	Adoptable
18.001	18-1	1200	Manhole	Adoptable	18-2	1350	Manhole	Adoptable
20.000	20-0	1200	Manhole	Adoptable	18-2	1350	Manhole	Adoptable
18.000	18-0	1200	Manhole	Adoptable	18-1	1200	Manhole	Adoptable
19.001	19-1	1200	Manhole	Adoptable	18-1	1200	Manhole	Adoptable
19.000	19-0	1200	Manhole	Adoptable	19-1	1200	Manhole	Adoptable
1.012	1-12	1350	Manhole	Adoptable	1-13	1500	Manhole	Adoptable
4.016	4-16	1500	Manhole	Adoptable	1-13	1500	Manhole	Adoptable
16.000	16-0	1200	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
17.000	17-0	1200	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
4.015	4-15	1500	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
14.002	14-2	1350	Manhole	Adoptable	4-15	1500	Manhole	Adoptable
4.014	4-14	1500	Manhole	Adoptable	4-15	1500	Manhole	Adoptable
4.013	4-13	1500	Manhole	Adoptable	4-14	1500	Manhole	Adoptable
13.000	13-0	1200	Manhole	Adoptable	4-13	1500	Manhole	Adoptable
4.012	4-12	1500	Manhole	Adoptable	4-13	1500	Manhole	Adoptable
4.011	4-11	1500	Manhole	Adoptable	4-12	1500	Manhole	Adoptable
4.010	4-10	1350	Manhole	Adoptable	4-11	1500	Manhole	Adoptable
10.003	10-3	1200	Manhole	Adoptable	4-11	1500	Manhole	Adoptable
10.002	10-2	1200	Manhole	Adoptable	10-3	1200	Manhole	Adoptable
12.000	12-0	1200	Manhole	Adoptable	10-3	1200	Manhole	Adoptable
11.001	11-1	1200	Manhole	Adoptable	10-2	1200	Manhole	Adoptable
10.001	10-1	1200	Manhole	Adoptable	10-2	1200	Manhole	Adoptable
10.000	10-0	1200	Manhole	Adoptable	10-1	1200	Manhole	Adoptable
11.000	11-0	1200	Manhole	Adoptable	11-1	1200	Manhole	Adoptable
4.009	4-9	1350	Manhole	Adoptable	4-10	1350	Manhole	Adoptable
8.001	8-1	1200	Manhole	Adoptable	4-10	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
8.000	44.945	264.0	225	Circular	87.700	86.290	1.185	87.400	86.120	1.055
9.000	44.809	264.0	225	Circular	87.700	86.399	1.076	87.400	86.229	0.946
4.008	27.328	321.5	375	Circular	87.727	86.126	1.226	87.721	86.041	1.305
7.000	59.885	169.6	225	Circular	88.100	86.575	1.300	87.721	86.222	1.274
6.003	23.535	169.3	225	Circular	87.930	86.265	1.440	87.727	86.126	1.376
4.007	52.234	198.6	255	Circular	87.821	86.389	1.177	87.727	86.126	1.346
4.006	11.653	197.5	255	Circular	88.062	86.448	1.359	87.821	86.389	1.177
4.005	4.463	194.1	255	Circular	88.128	86.471	1.402	88.062	86.448	1.359
4.004	27.740	198.1	255	Circular	88.227	86.611	1.361	88.128	86.471	1.402
5.001	38.057	169.1	225	Circular	88.000	86.962	0.813	88.227	86.737	1.265
4.003	25.937	198.0	255	Circular	88.321	86.742	1.324	88.227	86.611	1.361
4.002	35.740	198.6	255	Circular	88.200	86.922	1.023	88.321	86.742	1.324
4.001	3.729	196.3	255	Circular	88.200	86.941	1.004	88.200	86.922	1.023
4.000	28.651	199.0	255	Circular	88.200	87.085	0.860	88.200	86.941	1.004
5.000	27.560	169.1	225	Circular	88.100	87.125	0.750	88.000	86.962	0.813
6.002	28.382	168.9	225	Circular	88.000	86.433	1.342	87.930	86.265	1.440
6.001	39.265	169.2	225	Circular	88.070	86.665	1.180	88.000	86.433	1.342
6.000	34.964	169.7	225	Circular	87.900	86.871	0.804	88.070	86.665	1.180
14.001	49.191	380.0	300	Circular	87.334	86.016	1.018	87.521	85.887	1.334
15.000	37.380	169.1	225	Circular	88.094	86.269	1.600	87.521	86.048	1.248
14.000	52.189	380.0	300	Circular	88.142	86.153	1.689	87.334	86.016	1.018
1.011	12.131	600.0	400	Circular	88.016	85.921	1.695	88.157	85.901	1.856
3.000	40.242	169.8	225	Circular	88.471	86.791	1.455	88.157	86.554	1.378
1.010	47.904	349.7	400	Circular	88.495	86.058	2.037	88.016	85.921	1.695
1.009	28.263	600.0	400	Circular	88.321	86.105	1.816	88.495	86.058	2.037
1.008	64.345	504.0	375	Circular	88.553	86.233	1.945	88.321	86.105	1.841
1.007	45.197	504.0	375	Circular	88.681	86.323	1.983	88.553	86.233	1.945
1.006	61.852	504.0	375	Circular	88.523	86.446	1.702	88.681	86.323	1.983
1.005	43.656	504.0	375	Circular	88.201	86.533	1.293	88.523	86.446	1.702
2.000	30.803	169.2	225	Circular	88.588	87.163	1.200	88.523	86.981	1.317
1.004	41.714	323.4	375	Circular	88.050	86.662	1.013	88.201	86.533	1.293
1.003	17.750	322.7	375	Circular	88.150	86.717	1.058	88.050	86.662	1.013
1.002	32.342	323.4	375	Circular	88.200	86.817	1.008	88.150	86.717	1.058
1.001	38.395	322.6	375	Circular	88.200	86.936	0.889	88.200	86.817	1.008

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
8.000	8-0	1200	Manhole	Adoptable	8-1	1200	Manhole	Adoptable
9.000	9-0	1200	Manhole	Adoptable	8-1	1200	Manhole	Adoptable
4.008	4-8	1350	Manhole	Adoptable	4-9	1350	Manhole	Adoptable
7.000	7-0	1200	Manhole	Adoptable	4-9	1350	Manhole	Adoptable
6.003	6-3	1200	Manhole	Adoptable	4-8	1350	Manhole	Adoptable
4.007	4-7	1200	Manhole	Adoptable	4-8	1350	Manhole	Adoptable
4.006	4-6	1200	Manhole	Adoptable	4-7	1200	Manhole	Adoptable
4.005	4-5	1200	Manhole	Adoptable	4-6	1200	Manhole	Adoptable
4.004	4-4	1200	Manhole	Adoptable	4-5	1200	Manhole	Adoptable
5.001	5-1	1200	Manhole	Adoptable	4-4	1200	Manhole	Adoptable
4.003	4-3	1200	Manhole	Adoptable	4-4	1200	Manhole	Adoptable
4.002	4-2	1200	Manhole	Adoptable	4-3	1200	Manhole	Adoptable
4.001	4-1	1200	Manhole	Adoptable	4-2	1200	Manhole	Adoptable
4.000	4-0	1200	Manhole	Adoptable	4-1	1200	Manhole	Adoptable
5.000	5-0	1200	Manhole	Adoptable	5-1	1200	Manhole	Adoptable
6.002	6-2	1200	Manhole	Adoptable	6-3	1200	Manhole	Adoptable
6.001	6-1	1200	Manhole	Adoptable	6-2	1200	Manhole	Adoptable
6.000	6-0	1200	Manhole	Adoptable	6-1	1200	Manhole	Adoptable
14.001	14-1	1200	Manhole	Adoptable	14-2	1350	Manhole	Adoptable
15.000	15-0	1200	Manhole	Adoptable	14-2	1350	Manhole	Adoptable
14.000	14-0	1200	Manhole	Adoptable	14-1	1200	Manhole	Adoptable
1.011	1-11	1800	Manhole	Adoptable	1-12	1350	Manhole	Adoptable
3.000	3-0	1200	Manhole	Adoptable	1-12	1350	Manhole	Adoptable
1.010	1-10	1350	Manhole	Adoptable	1-11	1800	Manhole	Adoptable
1.009	1-9	1350	Manhole	Adoptable	1-10	1350	Manhole	Adoptable
1.008	1-8	1350	Manhole	Adoptable	1-9	1350	Manhole	Adoptable
1.007	1-7	1350	Manhole	Adoptable	1-8	1350	Manhole	Adoptable
1.006	1-6	1350	Manhole	Adoptable	1-7	1350	Manhole	Adoptable
1.005	1-5	1350	Manhole	Adoptable	1-6	1350	Manhole	Adoptable
2.000	2-0	1200	Manhole	Adoptable	1-6	1350	Manhole	Adoptable
1.004	1-4	1350	Manhole	Adoptable	1-5	1350	Manhole	Adoptable
1.003	1-3	1350	Manhole	Adoptable	1-4	1350	Manhole	Adoptable
1.002	1-2	1350	Manhole	Adoptable	1-3	1350	Manhole	Adoptable
1.001	1-1	1350	Manhole	Adoptable	1-2	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	20.719	323.7	375	Circular	88.550	87.000	1.175	88.200	86.936	0.889
21.015	34.110	578.1	600	Circular	88.070	85.997	1.473	87.300	85.938	0.762
21.014	3.768	538.3	600	Circular	88.070	86.104	1.366	88.070	86.097	1.373
21.013	35.358	1030.0	600	Circular	88.850	86.138	2.112	88.070	86.104	1.366
21.012	31.554	1030.0	600	Circular	88.730	86.169	1.961	88.850	86.138	2.112
30.002	19.913	168.8	225	Circular	88.800	86.896	1.679	88.850	86.778	1.847
30.001	28.062	169.0	225	Circular	88.700	87.062	1.413	88.800	86.896	1.679
30.000	36.134	137.4	225	Circular	88.750	87.325	1.200	88.700	87.062	1.413
21.011	65.244	1030.0	600	Circular	88.117	86.232	1.285	88.730	86.169	1.961
29.005	35.580	169.4	225	Circular	88.851	86.487	2.139	88.730	86.277	2.228
29.004	32.236	163.6	225	Circular	88.880	86.684	1.971	88.851	86.487	2.139
29.003	16.189	168.6	225	Circular	88.782	86.780	1.777	88.880	86.684	1.971
29.002	52.121	169.2	225	Circular	88.289	87.088	0.976	88.782	86.780	1.777
29.001	12.256	167.9	225	Circular	88.500	87.161	1.114	88.289	87.088	0.976
29.000	37.960	169.5	225	Circular	88.510	87.385	0.900	88.500	87.161	1.114
21.010	23.315	582.9	500	Circular	87.929	86.272	1.157	88.117	86.232	1.385
27.001	43.903	1030.0	600	Circular	87.900	86.275	1.025	88.117	86.232	1.285
28.001	32.739	324.2	375	Circular	87.846	86.333	1.138	88.117	86.232	1.510
28.000	46.846	323.1	375	Circular	88.108	86.478	1.255	87.846	86.333	1.138
27.000	48.356	1030.0	600	Circular	88.114	86.322	1.192	87.900	86.275	1.025
21.009	43.935	578.1	500	Circular	88.083	86.348	1.235	87.929	86.272	1.157
21.008	15.307	566.9	500	Circular	88.218	86.375	1.343	88.083	86.348	1.235
21.007	14.038	561.5	500	Circular	88.161	86.400	1.261	88.218	86.375	1.343
21.006	51.829	462.8	500	Circular	88.369	86.512	1.357	88.161	86.400	1.261
21.005	22.318	348.7	400	Circular	88.456	86.598	1.458	88.369	86.534	1.435
22.007	6.699	394.1	400	Circular	88.500	86.529	1.571	88.369	86.512	1.457
22.006	18.119	402.7	400	Circular	88.890	86.574	1.916	88.500	86.529	1.571
22.005	15.182	399.5	400	Circular	88.931	86.612	1.919	88.890	86.574	1.916
26.001	33.167	169.2	225	Circular	88.550	87.022	1.303	88.890	86.826	1.839
26.000	17.489	169.8	225	Circular	88.550	87.125	1.200	88.550	87.022	1.303
22.004	49.431	350.6	400	Circular	89.151	86.753	1.998	88.931	86.612	1.919
25.001	14.843	168.7	225	Circular	88.700	87.103	1.372	88.931	87.015	1.691
25.000	29.832	169.5	225	Circular	88.704	87.279	1.200	88.700	87.103	1.372
22.003	46.319	350.9	400	Circular	88.563	86.885	1.278	89.151	86.753	1.998

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1-0	1350	Manhole	Adoptable	1-1	1350	Manhole	Adoptable
21.015	PI 3	1500	Manhole	Adoptable	Outfall 3	1500	Manhole	Adoptable
21.014	21-14	1500	Manhole	Adoptable	PI 3	1500	Manhole	Adoptable
21.013	21-13	1500	Manhole	Adoptable	21-14	1500	Manhole	Adoptable
21.012	21-12	1500	Manhole	Adoptable	21-13	1500	Manhole	Adoptable
30.002	30-2	1200	Manhole	Adoptable	21-13	1500	Manhole	Adoptable
30.001	30-1	1200	Manhole	Adoptable	30-2	1200	Manhole	Adoptable
30.000	30-0	1200	Manhole	Adoptable	30-1	1200	Manhole	Adoptable
21.011	21-11	1500	Manhole	Adoptable	21-12	1500	Manhole	Adoptable
29.005	29-5	1200	Manhole	Adoptable	21-12	1500	Manhole	Adoptable
29.004	29-4	1200	Manhole	Adoptable	29-5	1200	Manhole	Adoptable
29.003	29-3	1200	Manhole	Adoptable	29-4	1200	Manhole	Adoptable
29.002	29-2	1200	Manhole	Adoptable	29-3	1200	Manhole	Adoptable
29.001	29-1	1200	Manhole	Adoptable	29-2	1200	Manhole	Adoptable
29.000	29-0	1200	Manhole	Adoptable	29-1	1200	Manhole	Adoptable
21.010	21-10	1500	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
27.001	27-1	1500	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
28.001	28-1	1350	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
28.000	28-0	1350	Manhole	Adoptable	28-1	1350	Manhole	Adoptable
27.000	27-0	1500	Manhole	Adoptable	27-1	1500	Manhole	Adoptable
21.009	21-9	1500	Manhole	Adoptable	21-10	1500	Manhole	Adoptable
21.008	21-8	1500	Manhole	Adoptable	21-9	1500	Manhole	Adoptable
21.007	21-7	1500	Manhole	Adoptable	21-8	1500	Manhole	Adoptable
21.006	21-6	1500	Manhole	Adoptable	21-7	1500	Manhole	Adoptable
21.005	21-5	1350	Manhole	Adoptable	21-6	1500	Manhole	Adoptable
22.007	22-7	1350	Manhole	Adoptable	21-6	1500	Manhole	Adoptable
22.006	22-6	1350	Manhole	Adoptable	22-7	1350	Manhole	Adoptable
22.005	22-5	1350	Manhole	Adoptable	22-6	1350	Manhole	Adoptable
26.001	26-1	1200	Manhole	Adoptable	22-6	1350	Manhole	Adoptable
26.000	26-0	1200	Manhole	Adoptable	26-1	1200	Manhole	Adoptable
22.004	22-4	1350	Manhole	Adoptable	22-5	1350	Manhole	Adoptable
25.001	25-1	1200	Manhole	Adoptable	22-5	1350	Manhole	Adoptable
25.000	25-0	1200	Manhole	Adoptable	25-1	1200	Manhole	Adoptable
22.003	22-3	1350	Manhole	Adoptable	22-4	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
22.002	7.454	338.8	400	Circular	88.564	86.907	1.257	88.563	86.885	1.278
24.000	53.093	351.6	400	Circular	88.655	87.100	1.155	88.563	86.949	1.214
22.001	51.789	349.9	400	Circular	88.298	87.055	0.843	88.564	86.907	1.257
23.000	63.858	324.2	375	Circular	88.357	87.161	0.821	88.564	86.964	1.225
22.000	13.905	347.6	400	Circular	88.245	87.095	0.750	88.298	87.055	0.843
21.004	24.650	347.2	400	Circular	88.367	86.669	1.298	88.456	86.598	1.458
21.003	48.146	323.1	375	Circular	88.691	86.818	1.498	88.367	86.669	1.323
21.002	56.065	324.1	375	Circular	88.405	86.991	1.039	88.691	86.818	1.498
21.001	35.179	322.7	375	Circular	88.225	87.100	0.750	88.405	86.991	1.039
21.000	51.042	323.0	375	Circular	88.540	87.258	0.907	88.225	87.100	0.750
31.017	18.902	1020.0	600	Circular	86.440	84.520	1.320	85.570	84.501	0.469
31.016	5.899	536.2	600	Circular	86.440	84.631	1.209	86.440	84.620	1.220
31.015	11.460	477.5	600	Circular	86.850	84.655	1.595	86.440	84.631	1.209
31.014	20.609	572.5	450	Circular	86.950	84.691	1.809	86.850	84.655	1.745
37.004	26.698	342.3	375	Circular	86.930	84.822	1.733	86.850	84.744	1.731
37.003	49.639	406.9	375	Circular	87.021	84.944	1.702	86.930	84.822	1.733
37.002	64.636	323.2	300	Circular	87.247	85.144	1.803	87.021	84.944	1.777
40.001	74.807	169.6	225	Circular	87.075	85.619	1.231	87.021	85.178	1.618
40.000	26.496	169.8	225	Circular	87.200	85.775	1.200	87.075	85.619	1.231
38.001	67.475	244.5	300	Circular	87.147	85.420	1.427	87.247	85.144	1.803
37.001	73.376	169.9	225	Circular	87.736	86.272	1.239	87.247	85.840	1.182
37.000	51.420	169.7	225	Circular	88.000	86.575	1.200	87.736	86.272	1.239
38.000	43.565	169.5	225	Circular	87.352	85.677	1.450	87.147	85.420	1.502
39.000	6.921	168.8	225	Circular	87.171	86.115	0.831	87.147	86.074	0.848
31.013	14.958	575.3	450	Circular	87.000	84.717	1.833	86.950	84.691	1.809
31.012	33.595	579.2	450	Circular	87.231	84.775	2.006	87.000	84.717	1.833
31.011	55.310	350.1	400	Circular	86.901	84.933	1.568	87.231	84.775	2.056
36.004	42.767	100.0	225	Circular	87.676	86.319	1.132	87.231	85.891	1.115
36.003	14.574	100.0	225	Circular	87.954	86.465	1.264	87.676	86.319	1.132
36.002	11.007	100.0	225	Circular	88.162	86.575	1.362	87.954	86.465	1.264
36.001	14.673	100.0	225	Circular	88.383	86.722	1.436	88.162	86.575	1.362
36.000	30.135	169.3	225	Circular	88.558	86.900	1.433	88.383	86.722	1.436
31.010	29.020	349.6	400	Circular	86.850	85.016	1.434	86.901	84.933	1.568
31.009	19.192	348.9	400	Circular	87.260	85.071	1.789	86.850	85.016	1.434

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
22.002	22-2	1350	Manhole	Adoptable	22-3	1350	Manhole	Adoptable
24.000	24-0	1350	Manhole	Adoptable	22-3	1350	Manhole	Adoptable
22.001	22-1	1350	Manhole	Adoptable	22-2	1350	Manhole	Adoptable
23.000	23-0	1350	Manhole	Adoptable	22-2	1350	Manhole	Adoptable
22.000	22-0	1350	Manhole	Adoptable	22-1	1350	Manhole	Adoptable
21.004	21-4	1350	Manhole	Adoptable	21-5	1350	Manhole	Adoptable
21.003	21-3	1350	Manhole	Adoptable	21-4	1350	Manhole	Adoptable
21.002	21-2	1350	Manhole	Adoptable	21-3	1350	Manhole	Adoptable
21.001	21-1	1350	Manhole	Adoptable	21-2	1350	Manhole	Adoptable
21.000	21-0	1350	Manhole	Adoptable	21-1	1350	Manhole	Adoptable
31.017	PI 1	1500	Manhole	Adoptable	Outfall 1	1500	Manhole	Adoptable
31.016	31-17	2100	Manhole	Adoptable	PI 1	1500	Manhole	Adoptable
31.015	31-16	1500	Manhole	Adoptable	31-17	2100	Manhole	Adoptable
31.014	31-15	1350	Manhole	Adoptable	31-16	1500	Manhole	Adoptable
37.004	37-4	1350	Manhole	Adoptable	31-16	1500	Manhole	Adoptable
37.003	37-3	1350	Manhole	Adoptable	37-4	1350	Manhole	Adoptable
37.002	37-2	1200	Manhole	Adoptable	37-3	1350	Manhole	Adoptable
40.001	40-1	1200	Manhole	Adoptable	37-3	1350	Manhole	Adoptable
40.000	40-0	1200	Manhole	Adoptable	40-1	1200	Manhole	Adoptable
38.001	38-1	1200	Manhole	Adoptable	37-2	1200	Manhole	Adoptable
37.001	37-1	1200	Manhole	Adoptable	37-2	1200	Manhole	Adoptable
37.000	37-0	1200	Manhole	Adoptable	37-1	1200	Manhole	Adoptable
38.000	38-0	1200	Manhole	Adoptable	38-1	1200	Manhole	Adoptable
39.000	39-0	1200	Manhole	Adoptable	38-1	1200	Manhole	Adoptable
31.013	31-14	1350	Manhole	Adoptable	31-15	1350	Manhole	Adoptable
31.012	31-13	1350	Manhole	Adoptable	31-14	1350	Manhole	Adoptable
31.011	31-12	1350	Manhole	Adoptable	31-13	1350	Manhole	Adoptable
36.004	36-4	1200	Manhole	Adoptable	31-13	1350	Manhole	Adoptable
36.003	36-3	1200	Manhole	Adoptable	36-4	1200	Manhole	Adoptable
36.002	36-2	1200	Manhole	Adoptable	36-3	1200	Manhole	Adoptable
36.001	36-1	1200	Manhole	Adoptable	36-2	1200	Manhole	Adoptable
36.000	36-0	1200	Manhole	Adoptable	36-1	1200	Manhole	Adoptable
31.010	31-11	1350	Manhole	Adoptable	31-12	1350	Manhole	Adoptable
31.009	31-10	1800	Manhole	Adoptable	31-11	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
35.000	30.939	169.1	225	Circular	87.091	85.659	1.207	86.850	85.476	1.149
31.008	8.755	350.2	400	Circular	87.385	85.096	1.889	87.260	85.071	1.789
31.007	4.633	308.9	300	Circular	87.387	85.384	1.703	87.385	85.369	1.716
34.000	53.968	169.7	225	Circular	87.400	85.675	1.500	87.385	85.357	1.803
31.006	53.993	244.3	300	Circular	87.894	85.605	1.989	87.387	85.384	1.703
33.002	12.512	169.1	225	Circular	87.322	85.611	1.486	87.387	85.537	1.625
33.001	9.300	169.1	225	Circular	87.366	85.666	1.475	87.322	85.611	1.486
33.000	22.672	169.2	225	Circular	87.225	85.800	1.200	87.366	85.666	1.475
31.005	6.674	166.9	225	Circular	88.000	85.645	2.130	87.894	85.605	2.064
32.001	27.582	169.2	225	Circular	87.750	85.980	1.545	87.894	85.817	1.852
32.000	24.620	169.8	225	Circular	87.750	86.125	1.400	87.750	85.980	1.545
31.004	31.472	100.0	225	Circular	88.350	85.960	2.165	88.000	85.645	2.130
31.003	17.107	80.0	225	Circular	88.412	86.174	2.013	88.350	85.960	2.165
31.002	13.738	80.0	225	Circular	88.375	86.346	1.804	88.412	86.174	2.013
31.001	22.282	80.0	225	Circular	88.460	86.625	1.610	88.375	86.346	1.804
31.000	25.451	169.7	225	Circular	88.586	86.775	1.586	88.460	86.625	1.610
41.014	5.314	312.6	500	Circular	87.350	85.165	1.685	86.400	85.148	0.752
41.013	5.268	526.8	500	Circular	87.350	85.275	1.575	87.350	85.265	1.585
41.012	24.728	343.4	400	Circular	87.450	85.347	1.703	87.350	85.275	1.675
48.000	54.165	100.0	225	Circular	87.450	86.300	0.925	87.350	85.758	1.367
41.011	14.015	368.8	400	Circular	87.390	85.385	1.605	87.450	85.347	1.703
41.010	5.101	340.1	400	Circular	87.430	85.400	1.630	87.390	85.385	1.605
41.009	31.084	323.8	375	Circular	87.480	85.674	1.431	87.430	85.578	1.477
47.001	49.677	169.5	225	Circular	87.550	86.108	1.217	87.430	85.815	1.390
47.000	50.028	120.0	225	Circular	87.950	86.525	1.200	87.550	86.108	1.217
41.008	13.682	318.2	375	Circular	87.523	85.717	1.431	87.480	85.674	1.431
46.000	9.566	167.8	225	Circular	87.430	86.005	1.200	87.480	85.948	1.307
41.007	5.218	248.5	375	Circular	87.523	85.738	1.410	87.523	85.717	1.431
41.006	52.111	323.7	375	Circular	87.897	85.899	1.623	87.523	85.738	1.410
41.005	5.064	241.1	375	Circular	87.879	85.920	1.584	87.897	85.899	1.623
41.004	45.028	323.9	375	Circular	88.226	86.059	1.792	87.879	85.920	1.584
45.000	36.295	169.6	225	Circular	87.573	86.412	0.936	87.879	86.198	1.456
41.003	32.932	243.9	300	Circular	87.500	86.194	1.006	88.226	86.059	1.867
42.002	17.507	243.1	300	Circular	88.148	86.399	1.449	88.226	86.327	1.599

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
35.000	35-0	1200	Manhole	Adoptable	31-11	1350	Manhole	Adoptable
31.008	31-9	1350	Manhole	Adoptable	31-10	1800	Manhole	Adoptable
31.007	31-8	1200	Manhole	Adoptable	31-9	1350	Manhole	Adoptable
34.000	33-0	1200	Manhole	Adoptable	31-9	1350	Manhole	Adoptable
31.006	31-7	1200	Manhole	Adoptable	31-8	1200	Manhole	Adoptable
33.002	34-2	1200	Manhole	Adoptable	31-8	1200	Manhole	Adoptable
33.001	34-1	1200	Manhole	Adoptable	34-2	1200	Manhole	Adoptable
33.000	34-0	1200	Manhole	Adoptable	34-1	1200	Manhole	Adoptable
31.005	31-6	1200	Manhole	Adoptable	31-7	1200	Manhole	Adoptable
32.001	32-1	1200	Manhole	Adoptable	31-7	1200	Manhole	Adoptable
32.000	32-0	1200	Manhole	Adoptable	32-1	1200	Manhole	Adoptable
31.004	31-5	1200	Manhole	Adoptable	31-6	1200	Manhole	Adoptable
31.003	31-4	1200	Manhole	Adoptable	31-5	1200	Manhole	Adoptable
31.002	31-2	1200	Manhole	Adoptable	31-4	1200	Manhole	Adoptable
31.001	31-1	1200	Manhole	Adoptable	31-2	1200	Manhole	Adoptable
31.000	31-0	1200	Manhole	Adoptable	31-1	1200	Manhole	Adoptable
41.014	PI 5	1500	Manhole	Adoptable	Outfall 5	1500	Manhole	Adoptable
41.013	41-13	1800	Manhole	Adoptable	PI 5	1500	Manhole	Adoptable
41.012	41-12	1800	Manhole	Adoptable	41-13	1800	Manhole	Adoptable
48.000	48-0	1200	Manhole	Adoptable	41-13	1800	Manhole	Adoptable
41.011	41-11	1350	Manhole	Adoptable	41-12	1800	Manhole	Adoptable
41.010	41-10	1350	Manhole	Adoptable	41-11	1350	Manhole	Adoptable
41.009	41-9	1350	Manhole	Adoptable	41-10	1350	Manhole	Adoptable
47.001	47-1	1200	Manhole	Adoptable	41-10	1350	Manhole	Adoptable
47.000	47-0	1200	Manhole	Adoptable	47-1	1200	Manhole	Adoptable
41.008	41-8	1350	Manhole	Adoptable	41-9	1350	Manhole	Adoptable
46.000	46-0	1200	Manhole	Adoptable	41-9	1350	Manhole	Adoptable
41.007	41-7	1350	Manhole	Adoptable	41-8	1350	Manhole	Adoptable
41.006	41-6	1350	Manhole	Adoptable	41-7	1350	Manhole	Adoptable
41.005	41-5	1350	Manhole	Adoptable	41-6	1350	Manhole	Adoptable
41.004	41-4	1350	Manhole	Adoptable	41-5	1350	Manhole	Adoptable
45.000	45-0	1200	Manhole	Adoptable	41-5	1350	Manhole	Adoptable
41.003	41-3	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable
42.002	42-2	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
44.000	16.241	169.2	225	Circular	88.248	86.423	1.600	88.226	86.327	1.674
42.001	30.162	243.2	300	Circular	87.996	86.523	1.173	88.148	86.399	1.449
43.000	11.712	169.7	225	Circular	88.018	86.593	1.200	88.148	86.524	1.399
42.000	12.458	244.3	300	Circular	87.868	86.574	0.994	87.996	86.523	1.173
41.002	49.058	244.1	300	Circular	87.800	86.395	1.105	87.500	86.194	1.006
41.001	45.904	244.2	300	Circular	88.250	86.583	1.367	87.800	86.395	1.105
41.000	28.592	244.4	300	Circular	88.250	86.700	1.250	88.250	86.583	1.367
49.006	4.546	454.6	450	Circular	87.100	85.620	1.030	86.501	85.610	0.441
49.005	18.999	327.6	400	Circular	88.100	85.821	1.879	87.100	85.763	0.937
49.004	82.625	456.5	400	Circular	88.427	86.002	2.025	88.100	85.821	1.879
49.003	63.994	323.2	400	Circular	88.831	86.200	2.231	88.427	86.002	2.025
49.002	27.221	80.0	225	Circular	89.346	87.200	1.921	88.831	86.860	1.746
49.001	36.427	80.0	225	Circular	90.205	88.000	1.980	89.346	87.545	1.576
49.000	45.692	80.0	225	Circular	91.041	88.900	1.916	90.205	88.329	1.651
50.006	5.797	263.5	450	Circular	87.889	85.526	1.913	86.490	85.504	0.536
50.005	24.841	460.0	450	Circular	87.899	85.680	1.769	87.889	85.626	1.813
50.004	35.824	720.0	450	Circular	87.734	85.730	1.554	87.899	85.680	1.769
50.003	34.665	500.0	375	Circular	87.547	85.799	1.373	87.734	85.730	1.629
50.002	53.673	500.0	375	Circular	87.245	85.906	0.964	87.547	85.799	1.373
50.001	20.216	320.9	375	Circular	87.191	85.969	0.847	87.245	85.906	0.964
50.000	72.790	323.5	375	Circular	87.806	86.194	1.237	87.191	85.969	0.847

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
44.000	44-0	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable
42.001	42-1	1200	Manhole	Adoptable	42-2	1200	Manhole	Adoptable
43.000	43-0	1200	Manhole	Adoptable	42-2	1200	Manhole	Adoptable
42.000	42-0	1200	Manhole	Adoptable	42-1	1200	Manhole	Adoptable
41.002	41-2	1200	Manhole	Adoptable	41-3	1200	Manhole	Adoptable
41.001	41-1	1200	Manhole	Adoptable	41-2	1200	Manhole	Adoptable
41.000	41-0	1200	Manhole	Adoptable	41-1	1200	Manhole	Adoptable
49.006	PI 2	1350	Manhole	Adoptable	Outfall 2	1350	Manhole	Adoptable
49.005	50-5	1350	Manhole	Adoptable	PI 2	1350	Manhole	Adoptable
49.004	50-4	1350	Manhole	Adoptable	50-5	1350	Manhole	Adoptable
49.003	50-3	1350	Manhole	Adoptable	50-4	1350	Manhole	Adoptable
49.002	50-2	1200	Manhole	Adoptable	50-3	1350	Manhole	Adoptable
49.001	50-1	1200	Manhole	Adoptable	50-2	1200	Manhole	Adoptable
49.000	50-0	1200	Manhole	Adoptable	50-1	1200	Manhole	Adoptable
50.006	PI 6	1350	Manhole	Adoptable	Outfall 6	1350	Manhole	Adoptable
50.005	49-5	1350	Manhole	Adoptable	PI 6	1350	Manhole	Adoptable
50.004	49-4	1350	Manhole	Adoptable	49-5	1350	Manhole	Adoptable
50.003	49-3	1350	Manhole	Adoptable	49-4	1350	Manhole	Adoptable
50.002	49-2	1350	Manhole	Adoptable	49-3	1350	Manhole	Adoptable
50.001	49-1	1350	Manhole	Adoptable	49-2	1350	Manhole	Adoptable
50.000	49-0	1350	Manhole	Adoptable	49-1	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-0	681728.297	714559.265	88.550	1.550	1350				
						0	1.000	87.000	375
1-1	681727.082	714579.948	88.200	1.264	1350		1	1.000	86.936	375
						0	1.001	86.936	375
1-2	681729.935	714618.237	88.200	1.383	1350		1	1.001	86.817	375
						0	1.002	86.817	375
1-3	681724.880	714650.182	88.150	1.433	1350		1	1.002	86.717	375
						0	1.003	86.717	375
1-4	681726.157	714667.886	88.050	1.388	1350		1	1.003	86.662	375
						0	1.004	86.662	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-5	681706.946	714704.913	88.201	1.668	1350	1	1.004	86.533	375
						0	1.005	86.533	375
2-0	681654.345	714711.728	88.588	1.425	1200	0	2.000	87.163	225
1-6	681668.442	714684.340	88.523	2.077	1350	1	2.000	86.981	225
						2	1.005	86.446	375
						0	1.006	86.446	375
1-7	681613.809	714655.342	88.681	2.358	1350	1	1.006	86.323	375
						0	1.007	86.323	375
1-8	681573.837	714634.246	88.553	2.320	1350	1	1.007	86.233	375
						0	1.008	86.233	375
1-9	681516.849	714604.369	88.321	2.216	1350	1	1.008	86.105	375
						0	1.009	86.105	400
1-10	681489.411	714611.148	88.495	2.437	1350	1	1.009	86.058	400
						0	1.010	86.058	400
1-11	681465.859	714652.863	88.016	2.095	1800	1	1.010	85.921	400
						0	1.011	85.921	400
3-0	681495.121	714623.928	88.471	1.680	1200	0	3.000	86.791	225
1-12	681476.088	714659.384	88.157	2.256	1350	1	3.000	86.554	225
						2	1.011	85.901	400
						0	1.012	85.901	450
4-0	681714.921	714722.862	88.200	1.115	1200	0	4.000	87.085	255
4-1	681700.576	714747.663	88.200	1.259	1200	1	4.000	86.941	255
						0	4.001	86.941	255
4-2	681696.983	714746.664	88.200	1.278	1200	1	4.001	86.922	255
						0	4.002	86.922	255
4-3	681679.139	714777.631	88.321	1.579	1200	1	4.002	86.742	255
						0	4.003	86.742	255
5-0	681687.188	714707.538	88.100	0.975	1200	0	5.000	87.125	225
5-1	681674.194	714731.842	88.000	1.038	1200	1	5.000	86.962	225
						0	5.001	86.962	225
4-4	681656.262	714765.409	88.227	1.616	1200	1	5.001	86.737	225
						2	4.003	86.611	255
						0	4.004	86.611	255

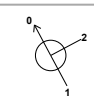
Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
4-5	681631.788	714752.351	88.128	1.657	1200	1	4.004	86.471	255
						0	4.005	86.471	255
4-6	681629.584	714756.232	88.062	1.614	1200	1	4.005	86.448	255
						0	4.006	86.448	255
4-7	681618.718	714752.021	87.821	1.432	1200	1	4.006	86.389	255
						0	4.007	86.389	255
6-0	681651.744	714821.450	87.900	1.029	1200	0	6.000	86.871	225
6-1	681635.217	714852.261	88.070	1.405	1200	1	6.000	86.665	225
						0	6.001	86.665	225
6-2	681600.572	714833.783	88.000	1.567	1200	1	6.001	86.433	225
						0	6.002	86.433	225
6-3	681613.963	714808.759	87.930	1.665	1200	1	6.002	86.265	225
						0	6.003	86.265	225
4-8	681593.233	714797.616	87.727	1.601	1350	1	6.003	86.126	225
						2	4.007	86.126	255
						0	4.008	86.126	375
7-0	681598.010	714732.199	88.100	1.525	1200	0	7.000	86.575	225
4-9	681569.162	714784.678	87.721	1.680	1350	1	7.000	86.222	225
						2	4.008	86.041	375
						0	4.009	86.041	375
8-0	681578.569	714821.954	87.700	1.410	1200	0	8.000	86.290	225
9-0	681499.419	714779.633	87.700	1.301	1200	0	9.000	86.399	225
8-1	681538.921	714800.785	87.400	1.280	1200	1	9.000	86.229	225
						2	8.000	86.120	225
						0	8.001	86.120	300
4-10	681552.322	714775.627	87.822	1.819	1350	1	8.001	86.003	300
						2	4.009	86.003	375
						0	4.010	86.003	400
10-0	681456.887	714742.982	87.635	0.874	1200	0	10.000	86.761	225
10-1	681464.184	714728.460	87.816	1.151	1200	1	10.000	86.665	225
						0	10.001	86.665	225
11-0	681470.270	714761.709	87.700	1.175	1200	0	11.000	86.525	225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
11-1	681481.748	714767.493	87.700	1.251	1200	1	11.000	86.449	225
						0	11.001	86.449	225
10-2	681494.310	714744.490	87.700	1.406	1200	1	11.001	86.294	225
						2	10.001	86.464	225
						0	10.002	86.294	225
12-0	681518.601	714738.418	87.588	1.425	1200				
						0	12.000	86.163	225
10-3	681511.067	714753.407	87.724	1.625	1200	1	12.000	86.099	225
						2	10.002	86.182	225
						0	10.003	86.099	225
4-11	681527.859	714762.478	87.850	1.898	1500	1	10.003	86.027	225
						2	4.010	85.952	400
						0	4.011	85.952	500
4-12	681530.789	714757.146	87.850	1.906	1500	1	4.011	85.944	500
						0	4.012	85.944	500
13-0	681570.228	714744.973	87.600	1.425	1200				
						0	13.000	86.175	225
4-13	681544.032	714731.413	87.400	1.496	1500	1	13.000	86.001	225
						2	4.012	85.904	500
						0	4.013	85.904	500
4-14	681526.924	714722.557	87.500	1.623	1500	1	4.013	85.877	500
						0	4.014	85.877	600
14-0	681632.181	714739.287	88.142	1.989	1200				
						0	14.000	86.153	300
14-1	681586.068	714714.847	87.334	1.318	1200	1	14.000	86.016	300
						0	14.001	86.016	300
15-0	681560.301	714658.807	88.094	1.825	1200				
						0	15.000	86.269	225
14-2	681542.637	714691.750	87.521	1.634	1350	1	15.000	86.048	225
									
						2	14.001	85.887	300
						0	14.002	85.887	375
4-15	681536.496	714703.253	87.418	1.565	1500	1	14.002	85.861	375
						2	4.014	85.853	600
						0	4.015	85.853	600
16-0	681524.006	714656.720	88.000	1.425	1200				
						0	16.000	86.575	225
17-0	681491.700	714717.223	87.625	1.425	1200				
						0	17.000	86.200	225
4-16	681507.377	714687.844	87.823	2.006	1500	1	17.000	86.003	225
						2	16.000	86.367	225
						3	4.015	85.817	600
						0	4.016	85.817	600

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-13	681471.112	714668.653	88.078	2.301	1500	1	4.016	85.777	600
						2	1.012	85.884	450
						0	1.013	85.777	600
18-0	681422.878	714707.549	87.800	1.375	1200	0	18.000	86.425	225
19-0	681367.542	714630.246	88.150	1.425	1200	0	19.000	86.725	225
19-1	681380.523	714649.147	87.600	1.010	1200	1	19.000	86.590	225
						0	19.001	86.590	225
18-1	681392.936	714654.934	87.750	1.682	1200	1	19.001	86.509	225
						2	18.000	86.068	225
						0	18.001	86.068	300
20-0	681458.635	714610.046	87.550	1.306	1200	0	20.000	86.244	225
18-2	681419.839	714638.804	87.900	1.961	1350	1	20.000	85.959	225
						2	18.001	85.939	300
						0	18.002	85.939	375
18-3	681442.714	714678.477	87.724	1.927	1350	1	18.002	85.797	375
						0	18.003	85.797	375
18-4	681452.487	714687.900	87.871	2.101	1350	1	18.003	85.770	375
						0	18.004	85.770	375
1-14	681458.950	714691.294	87.871	2.119	1500	1	18.004	85.756	375
						2	1.013	85.752	600
						0	1.014	85.752	600
1-15	681452.167	714703.160	87.781	2.042	1500	1	1.014	85.739	600
						0	1.015	85.739	600
1-16	681431.016	714720.912	87.570	1.858	2100	1	1.015	85.712	600
						0	1.016	85.712	600
PI 4	681413.439	714734.297	87.100	1.516	1500	1	1.016	85.684	600
						0	1.017	85.584	600
Outfall 4	681407.762	714738.679	86.490	0.917	1500	1	1.017	85.573	600
21-0	681732.623	714543.018	88.540	1.282	1350	0	21.000	87.258	375
21-1	681683.674	714528.552	88.225	1.125	1350	1	21.000	87.100	375
						0	21.001	87.100	375
21-2	681649.964	714518.491	88.405	1.414	1350	1	21.001	86.991	375
						0	21.002	86.991	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
21-3	681596.221	714502.522	88.691	1.873	1350	1 0	21.002	86.818	375
						0	21.003	86.818	375
21-4	681550.069	714488.810	88.367	1.698	1350	1 0	21.003	86.669	375
						0	21.004	86.669	400
21-5	681538.872	714510.770	88.456	1.858	1350	1 0	21.004	86.598	400
						0	21.005	86.598	400
22-0	681680.587	714541.754	88.245	1.150	1350	 0	22.000	87.095	400
22-1	681676.628	714555.083	88.298	1.243	1350	1 0	22.000	87.055	400
						0	22.001	87.055	400
23-0	681708.590	714630.655	88.357	1.196	1350	 0	23.000	87.161	375
22-2	681652.175	714600.736	88.564	1.657	1350	1 2 0	23.000 22.001	86.964 86.907	375 400
						0	22.002	86.907	400
24-0	681619.602	714645.364	88.655	1.555	1350	 0	24.000	87.100	400
22-3	681644.994	714598.737	88.563	1.678	1350	1 2 0	24.000 22.002	86.949 86.885	400 400
						0	22.003	86.885	400
22-4	681604.492	714576.263	89.151	2.398	1350	1 0	22.003	86.753	400
						0	22.004	86.753	400
25-0	681578.956	714511.950	88.704	1.425	1200	 0	25.000	87.279	225
25-1	681570.824	714540.652	88.700	1.597	1200	1 0	25.000	87.103	225
						0	25.001	87.103	225
22-5	681561.371	714552.096	88.931	2.319	1350	1 2 0	25.001 22.004	87.015 86.612	225 400
						0	22.005	86.612	400
26-0	681520.981	714587.351	88.550	1.425	1200	 0	26.000	87.125	225
26-1	681529.224	714571.926	88.550	1.528	1200	1 0	26.000	87.022	225
						0	26.001	87.022	225
22-6	681548.127	714544.673	88.890	2.316	1350	1 2 0	26.001 22.005	86.826 86.574	225 400
						0	22.006	86.574	400
22-7	681533.514	714533.960	88.500	1.971	1350	1 0	22.006	86.529	400
						0	22.007	86.529	400

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
21-6	681527.948	714530.232	88.369	1.857	1500	1	22.007	86.512	400
						2	21.005	86.534	400
						0	21.006	86.512	500
21-7	681498.591	714572.945	88.161	1.761	1500	1	21.006	86.400	500
						0	21.007	86.400	500
21-8	681494.806	714586.463	88.218	1.843	1500	1	21.007	86.375	500
						0	21.008	86.375	500
21-9	681479.812	714583.385	88.083	1.735	1500	1	21.008	86.348	500
						0	21.009	86.348	500
21-10	681440.788	714563.200	87.929	1.657	1500	1	21.009	86.272	500
						0	21.010	86.272	500
27-0	681350.118	714601.420	88.114	1.792	1500	0	27.000	86.322	600
27-1	681391.219	714575.945	87.900	1.625	1500	1	27.000	86.275	600
						0	27.001	86.275	600
28-0	681472.874	714484.377	88.108	1.630	1350	0	28.000	86.478	375
28-1	681446.895	714523.359	87.846	1.513	1350	1	28.000	86.333	375
						0	28.001	86.333	375
21-11	681424.130	714546.888	88.117	1.885	1500	1	28.001	86.232	375
						2	27.001	86.232	600
						3	21.010	86.232	500
						0	21.011	86.232	600
29-0	681529.152	714477.102	88.510	1.125	1200	0	29.000	87.385	225
29-1	681493.847	714463.154	88.500	1.339	1200	1	29.000	87.161	225
						0	29.001	87.161	225
29-2	681481.690	714464.705	88.289	1.201	1200	1	29.001	87.088	225
						0	29.002	87.088	225
29-3	681435.452	714440.649	88.782	2.002	1200	1	29.002	86.780	225
						0	29.003	86.780	225
29-4	681420.740	714447.405	88.880	2.196	1200	1	29.003	86.684	225
						0	29.004	86.684	225
29-5	681401.736	714473.443	88.851	2.364	1200	1	29.004	86.487	225
						0	29.005	86.487	225
21-12	681378.428	714500.325	88.730	2.561	1500	1	29.005	86.277	225
						2	21.011	86.169	600
						0	21.012	86.169	600

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
30-0	681336.824	714583.857	88.750	1.425	1200		0	30.000	87.325	225
30-1	681318.656	714552.623	88.700	1.638	1200		1 0	30.000 30.001	87.062 87.062	225 225
30-2	681338.498	714532.780	88.800	1.904	1200		1 0	30.001 30.002	86.896 86.896	225 225
21-13	681354.275	714520.630	88.850	2.712	1500		1 2 0	30.002 21.012 21.013	86.778 86.138 86.138	225 600 600
21-14	681331.006	714494.008	88.070	1.966	1500		1 0	21.013 21.014	86.104 86.104	600 600
PI 3	681328.921	714490.869	88.070	2.073	1500		1 0	21.014 21.015	86.097 85.997	600 600
Outfall 3	681310.005	714462.485	87.300	1.362	1500		1	21.015	85.938	600
31-0	681241.100	714577.004	88.586	1.811	1200		0	31.000	86.775	225
31-1	681266.075	714572.105	88.460	1.835	1200		1 0	31.000 31.001	86.625 86.625	225 225
31-2	681288.357	714572.144	88.375	2.029	1200		1 0	31.001 31.002	86.346 86.346	225 225
31-4	681300.880	714577.792	88.412	2.238	1200		1 0	31.002 31.003	86.174 86.174	225 225
31-5	681310.328	714592.053	88.350	2.390	1200		1 0	31.003 31.004	85.960 85.960	225 225
31-6	681328.209	714617.952	88.000	2.355	1200		1 0	31.004 31.005	85.645 85.645	225 225
32-0	681351.362	714665.315	87.750	1.625	1200		0	32.000	86.125	225
32-1	681337.837	714644.743	87.750	1.770	1200		1 0	32.000 32.001	85.980 85.980	225 225
31-7	681322.684	714621.696	87.894	2.289	1200		1 2 0	32.001 31.005 31.006	85.817 85.605 85.605	225 225 300
34-0	681241.403	714640.836	87.225	1.425	1200		0	33.000	85.800	225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
34-1	681263.636	714636.398	87.366	1.700	1200	1	33.000	85.666	225
						0	33.001	85.666	225
34-2	681271.591	714641.215	87.322	1.711	1200	1	33.001	85.611	225
						0	33.002	85.611	225
31-8	681277.979	714651.973	87.387	2.003	1200	1	33.002	85.537	225
						2	31.006	85.384	300
						0	31.007	85.384	300
33-0	681304.110	714699.473	87.400	1.725	1200				
						0	34.000	85.675	225
31-9	681274.152	714654.584	87.385	2.289	1350	1	34.000	85.357	225
						2	31.007	85.369	300
						0	31.008	85.096	400
31-10	681266.162	714658.164	87.260	2.189	1800	1	31.008	85.071	400
						0	31.009	85.071	400
35-0	681280.289	714692.365	87.091	1.432	1200				
						0	35.000	85.659	225
31-11	681255.367	714674.032	86.850	1.834	1350	1	35.000	85.476	225
						2	31.009	85.016	400
						0	31.010	85.016	400
31-12	681230.026	714659.891	86.901	1.968	1350	1	31.010	84.933	400
						0	31.011	84.933	400
36-0	681231.376	714579.073	88.558	1.658	1200				
						0	36.000	86.900	225
36-1	681201.801	714584.854	88.383	1.661	1200	1	36.000	86.722	225
						0	36.001	86.722	225
36-2	681188.714	714591.490	88.162	1.587	1200	1	36.001	86.575	225
						0	36.002	86.575	225
36-3	681182.045	714600.247	87.954	1.489	1200	1	36.002	86.465	225
						0	36.003	86.465	225
36-4	681178.035	714614.258	87.676	1.357	1200	1	36.003	86.319	225
						0	36.004	86.319	225
31-13	681174.797	714656.902	87.231	2.456	1350	1	36.004	85.891	225
						2	31.011	84.775	400
						0	31.012	84.775	450
31-14	681172.134	714690.391	87.000	2.283	1350	1	31.012	84.717	450
						0	31.013	84.717	450
31-15	681178.112	714704.102	86.950	2.259	1350	1	31.013	84.691	450
						0	31.014	84.691	450

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
37-0	681393.391	714716.054	88.000	1.425	1200		0	37.000	86.575	225
37-1	681364.767	714673.338	87.736	1.464	1200		1	37.000	86.272	225
							0	37.001	86.272	225
38-0	681384.526	714741.184	87.352	1.675	1200		0	38.000	85.677	225
39-0	681352.807	714770.696	87.171	1.056	1200		0	39.000	86.115	225
38-1	681348.326	714765.422	87.147	1.727	1200		1	39.000	86.074	225
							2	38.000	85.420	225
							0	38.001	85.420	300
37-2	681304.036	714714.518	87.247	2.103	1200		1	38.001	85.144	300
							2	37.001	85.840	225
							0	37.002	85.144	300
40-0	681328.813	714803.744	87.200	1.425	1200		0	40.000	85.775	225
40-1	681305.668	714816.641	87.075	1.456	1200		1	40.000	85.619	225
							0	40.001	85.619	225
37-3	681257.516	714759.392	87.021	2.077	1350		1	40.001	85.178	225
							2	37.002	84.944	300
							0	37.003	84.944	375
37-4	681218.378	714728.860	86.930	2.108	1350		1	37.003	84.822	375
							0	37.004	84.822	375
31-16	681195.150	714715.697	86.850	2.195	1500		1	37.004	84.744	375
							2	31.014	84.655	450
							0	31.015	84.655	600
31-17	681189.329	714725.568	86.440	1.809	2100		1	31.015	84.631	600
							0	31.016	84.631	600
PI 1	681186.333	714730.649	86.440	1.920	1500		1	31.016	84.620	600
							0	31.017	84.520	600
Outfall 1	681181.220	714748.846	85.570	1.069	1500		1	31.017	84.501	600
41-0	681603.924	714908.556	88.250	1.550	1200		0	41.000	86.700	300
41-1	681618.947	714884.229	88.250	1.667	1200		1	41.000	86.583	300
							0	41.001	86.583	300
41-2	681580.497	714859.153	87.800	1.405	1200		1	41.001	86.395	300
							0	41.002	86.395	300

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
41-3	681539.046	714832.914	87.500	1.306	1200	1 0	41.002 41.003	86.194 86.194	300 300
42-0	681554.612	714897.046	87.868	1.294	1200	0	42.000	86.574	300
42-1	681561.361	714886.575	87.996	1.473	1200	1 0	42.000 42.001	86.523 86.523	300 300
43-0	681529.669	714880.070	88.018	1.425	1200	0	43.000	86.593	225
42-2	681536.014	714870.226	88.148	1.749	1200	1 2 0	43.000 42.001 42.002	86.524 86.399 86.399	225 300 300
44-0	681512.910	714874.563	88.248	1.825	1200	0	44.000	86.423	225
41-4	681521.339	714860.680	88.226	2.167	1350	1 2 3 0	44.000 42.002 41.003 41.004	86.327 86.327 86.059 86.059	225 300 300 375
45-0	681450.416	714820.912	87.573	1.161	1200	0	45.000	86.412	225
41-5	681482.391	714838.085	87.879	1.959	1350	1 2 0	45.000 41.004 41.005	86.198 85.920 85.920	225 375 375
41-6	681480.058	714842.579	87.897	1.998	1350	1 0	41.005 41.006	85.899 85.899	375 375
41-7	681434.036	714818.133	87.523	1.785	1350	1 0	41.006 41.007	85.738 85.738	375 375
41-8	681436.400	714813.481	87.523	1.806	1350	1 0	41.007 41.008	85.717 85.717	375 375
46-0	681419.932	714815.536	87.430	1.425	1200	0	46.000	86.005	225
41-9	681424.329	714807.040	87.480	1.806	1350	1 2 0	46.000 41.008 41.009	85.948 85.674 85.674	225 375 375
47-0	681526.464	714826.290	87.950	1.425	1200	0	47.000	86.525	225
47-1	681482.339	714802.714	87.550	1.442	1200	1 0	47.000 47.001	86.108 86.108	225 225
41-10	681438.489	714779.369	87.430	2.030	1350	1 2 0	47.001 41.009 41.010	85.815 85.578 85.400	225 375 400

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
41-11	681441.127	714775.003	87.390	2.005	1350	1	41.010	85.385	400
						0	41.011	85.385	400
41-12	681437.310	714761.518	87.450	2.103	1800	1	41.011	85.347	400
						0	41.012	85.347	400
48-0	681389.971	714797.634	87.450	1.150	1200	0	48.000	86.300	225
41-13	681415.501	714749.863	87.350	2.075	1800	1	48.000	85.758	225
						2	41.012	85.275	400
						0	41.013	85.275	500
PI 5	681410.913	714747.274	87.350	2.185	1500	1	41.013	85.265	500
						0	41.014	85.165	500
Outfall 5	681406.210	714744.800	86.400	1.252	1500	1	41.014	85.148	500
50-0	681272.880	714510.934	91.041	2.141	1200	0	49.000	88.900	225
50-1	681305.334	714543.097	90.205	2.205	1200	1	49.000	88.329	225
						0	49.001	88.000	225
50-2	681326.122	714573.010	89.346	2.146	1200	1	49.001	87.545	225
						0	49.002	87.200	225
50-3	681341.206	714595.670	88.831	2.631	1350	1	49.002	86.860	225
						0	49.003	86.200	400
50-4	681376.057	714649.341	88.427	2.425	1350	1	49.003	86.002	400
						0	49.004	86.002	400
50-5	681423.923	714716.689	88.100	2.279	1350	1	49.004	85.821	400
						0	49.005	85.821	400
PI 2	681408.828	714728.225	87.100	1.480	1350	1	49.005	85.763	400
						0	49.006	85.620	450
Outfall 2	681405.225	714730.997	86.501	0.891	1350	1	49.006	85.610	450
49-0	681617.771	714850.092	87.806	1.612	1350	0	50.000	86.194	375
49-1	681553.609	714815.717	87.191	1.222	1350	1	50.000	85.969	375
						0	50.001	85.969	375
49-2	681537.854	714803.050	87.245	1.339	1350	1	50.001	85.906	375
						0	50.002	85.906	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
49-3	681490.130	714778.489	87.547	1.748	1350	1	50.002	85.799	375
						0	50.003	85.799	375
49-4	681460.413	714760.641	87.734	2.004	1350	1	50.003	85.730	375
						0	50.004	85.730	450
49-5	681437.601	714733.019	87.899	2.219	1350	1	50.004	85.680	450
						0	50.005	85.680	450
PI 6	681413.647	714739.599	87.889	2.363	1350	1	50.005	85.626	450
						0	50.006	85.526	450
Outfall 6	681408.322	714741.891	86.490	0.986	1350	1	50.006	85.504	450

Simulation Settings

Rainfall Methodology	FSR	Summer CV	0.750	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Winter CV	0.840	Additional Storage (m³/ha)	20.0
M5-60 (mm)	15.600	Analysis Speed	Normal	Check Discharge Rate(s)	x
Ratio-R	0.286	Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	20	0	0

Node 21-14 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	86.104	Product Number	CTL-SHE-0093-4000-1143-4000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.0	Min Node Diameter (mm)	1200

Node 31-17 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	84.631	Product Number	CTL-SHE-0143-9900-1143-9900
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	9.9	Min Node Diameter (mm)	1200

Node 50-5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.821	Product Number	CTL-SHE-0065-2000-1143-2000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 1-11 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.921	Product Number	CTL-SHE-0173-1500-1143-1500
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	15.0	Min Node Diameter (mm)	1500

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Node 41-13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.275	Product Number	CTL-SHE-0193-2100-1661-2100
Design Depth (m)	1.661	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	21.0	Min Node Diameter (mm)	1800

Node 1-16 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	85.712	Product Number	CTL-SHE-0250-3740-1800-3740
Design Depth (m)	1.800	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	37.4	Min Node Diameter (mm)	1800

Node 49-5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.680	Product Number	CTL-SHE-0065-2000-1143-2000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 21-14 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	86.104
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	2120.0	0.0	1.143	2120.0	0.0	1.144	0.0	0.0

Node 31-17 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	84.631
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	540.0	0.0	1.143	540.0	0.0	1.144	0.0	0.0

Node 41-7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.738
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.89	Time to half empty (mins)	224

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	350.0	0.0	1.143	350.0	0.0	1.144	0.0	0.0

Node 31-10 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.071
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.90	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	500.0	0.0	1.143	500.0	0.0	1.144	0.0	0.0

Node 4-12 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.944
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.89	Time to half empty (mins)	244

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	680.0	0.0	1.143	680.0	0.0	1.144	0.0	0.0

Node 1-11 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.921
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	655.0	0.0	1.143	655.0	0.0	1.144	0.0	0.0

Node 49-3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.799
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.87	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	150.0	0.0	1.143	150.0	0.0	1.144	0.0	0.0

Node 50-5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.821
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.87	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	183.0	0.0	1.143	183.0	0.0	1.144	0.0	0.0

Node 22-7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	86.529
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.88	Time to half empty (mins)	2880

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	360.0	0.0	1.143	360.0	0.0	1.144	0.0	0.0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 98.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1-0	13	87.722	0.722	22.6	1.1447	0.0000	SURCHARGED
15 minute winter	1-1	13	87.707	0.771	78.9	1.4092	0.0000	SURCHARGED
15 minute winter	1-2	13	87.629	0.812	59.9	1.5376	0.0000	SURCHARGED
15 minute winter	1-3	13	87.620	0.903	147.9	1.6069	0.0000	SURCHARGED
15 minute winter	1-4	13	87.609	0.947	73.6	1.5189	0.0000	SURCHARGED
15 minute winter	1-5	13	87.622	1.089	106.1	2.1073	0.0000	SURCHARGED
15 minute winter	2-0	13	87.679	0.516	7.7	0.6702	0.0000	SURCHARGED
15 minute winter	1-6	13	87.582	1.136	123.6	3.4864	0.0000	SURCHARGED
15 minute winter	1-7	13	87.464	1.141	115.1	3.2885	0.0000	SURCHARGED
15 minute winter	1-8	12	87.338	1.105	135.6	2.8487	0.0000	SURCHARGED
15 minute winter	1-9	11	87.101	0.996	172.6	3.0614	0.0000	SURCHARGED
600 minute winter	1-10	570	86.955	0.897	35.0	1.6891	0.0000	SURCHARGED
600 minute winter	1-11	570	86.955	1.034	46.4	618.7478	0.0000	SURCHARGED
240 minute winter	3-0	192	87.048	0.257	1.1	0.3307	0.0000	SURCHARGED
240 minute winter	1-12	192	87.048	1.147	16.7	2.6694	0.0000	SURCHARGED
15 minute winter	4-0	13	87.732	0.647	13.3	0.7315	0.0000	SURCHARGED
15 minute winter	4-1	14	87.716	0.775	23.6	1.2217	0.0000	SURCHARGED
15 minute winter	4-2	14	87.715	0.793	28.8	0.8969	0.0000	SURCHARGED
15 minute winter	4-3	13	87.713	0.971	54.7	1.4552	0.0000	SURCHARGED
15 minute winter	5-0	13	87.773	0.648	6.1	0.7324	0.0000	SURCHARGED
15 minute winter	5-1	13	87.718	0.756	33.7	1.4811	0.0000	FLOOD RISK
15 minute winter	4-4	13	87.709	1.098	44.3	2.2751	0.0000	SURCHARGED
15 minute winter	4-5	13	87.628	1.157	45.4	1.8671	0.0000	SURCHARGED
15 minute winter	4-6	13	87.595	1.147	48.9	1.2968	0.0000	SURCHARGED
15 minute winter	4-7	13	87.534	1.145	59.0	2.3507	0.0000	FLOOD RISK
15 minute winter	6-0	12	87.685	0.814	7.5	1.2369	0.0000	FLOOD RISK
15 minute winter	6-1	12	87.683	1.018	32.7	1.7300	0.0000	SURCHARGED
15 minute winter	6-2	12	87.622	1.189	44.3	1.6634	0.0000	SURCHARGED
15 minute winter	6-3	12	87.535	1.270	54.0	2.9322	0.0000	SURCHARGED
15 minute winter	4-8	11	87.243	1.117	141.9	3.4419	0.0000	SURCHARGED
15 minute summer	7-0	10	87.257	0.682	19.9	0.7711	0.0000	SURCHARGED
15 minute winter	4-9	10	87.141	1.100	188.1	3.5400	0.0000	SURCHARGED
240 minute winter	8-0	192	87.055	0.765	1.6	0.8654	0.0000	SURCHARGED
240 minute winter	9-0	196	87.055	0.656	1.9	0.7419	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1-0	1.000	1-1	20.5	0.323	0.186	2.2852	
15 minute winter	1-1	1.001	1-2	-66.4	-0.743	-0.600	4.2349	
15 minute winter	1-2	1.002	1-3	50.1	0.647	0.452	3.5672	
15 minute winter	1-3	1.003	1-4	-114.6	-1.135	-1.034	1.9578	
15 minute winter	1-4	1.004	1-5	73.7	0.692	0.666	4.6009	
15 minute winter	1-5	1.005	1-6	-90.3	-0.819	-1.022	4.8151	
15 minute winter	2-0	2.000	1-6	12.2	0.620	0.307	1.2251	
15 minute winter	1-6	1.006	1-7	90.5	0.820	1.024	6.8221	
15 minute winter	1-7	1.007	1-8	115.7	1.049	1.309	4.9851	
15 minute winter	1-8	1.008	1-9	143.6	1.302	1.625	7.0971	
15 minute winter	1-9	1.009	1-10	177.0	1.414	1.846	3.5382	
600 minute winter	1-10	1.010	1-11	34.1	0.918	0.270	5.9971	
600 minute winter	1-11	Hydro-Brake®	1-12	14.8				
240 minute winter	3-0	3.000	1-12	1.1	0.440	0.028	1.6005	
240 minute winter	1-12	1.012	1-13	14.5	0.317	0.114	1.6668	
15 minute winter	4-0	4.000	4-1	-13.3	-0.260	-0.260	1.4629	
15 minute winter	4-1	4.001	4-2	14.4	0.747	0.279	0.1904	
15 minute winter	4-2	4.002	4-3	-28.8	-0.564	-0.563	1.8249	
15 minute winter	4-3	4.003	4-4	-36.1	-0.707	-0.704	1.3243	
15 minute winter	5-0	5.000	5-1	-6.1	0.245	-0.154	1.0961	
15 minute winter	5-1	5.001	4-4	-17.6	0.809	-0.442	1.5136	
15 minute winter	4-4	4.004	4-5	41.8	0.822	0.816	1.4164	
15 minute winter	4-5	4.005	4-6	48.9	0.958	0.945	0.2279	
15 minute winter	4-6	4.006	4-7	51.4	1.008	1.003	0.5950	
15 minute winter	4-7	4.007	4-8	63.1	1.235	1.233	2.6670	
15 minute winter	6-0	6.000	6-1	9.9	0.456	0.248	1.3906	
15 minute winter	6-1	6.001	6-2	20.3	0.764	0.509	1.5616	
15 minute winter	6-2	6.002	6-3	28.2	0.708	0.706	1.1288	
15 minute winter	6-3	6.003	4-8	54.9	1.381	1.379	0.9360	
15 minute winter	4-8	4.008	4-9	147.4	1.337	1.329	3.0142	
15 minute summer	7-0	7.000	4-9	-19.9	-0.640	-0.501	2.3817	
15 minute winter	4-9	4.009	4-10	190.5	1.727	2.156	2.1087	
240 minute winter	8-0	8.000	8-1	-1.6	-0.042	-0.049	1.7875	
240 minute winter	9-0	9.000	8-1	-1.9	-0.070	-0.059	1.7821	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 98.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	8-1	196	87.055	0.935	8.0	2.4448	0.0000	SURCHARGED
240 minute winter	4-10	196	87.055	1.052	63.8	2.0952	0.0000	SURCHARGED
15 minute winter	10-0	12	87.274	0.513	10.3	0.5805	0.0000	SURCHARGED
15 minute winter	10-1	12	87.298	0.633	33.0	1.1443	0.0000	SURCHARGED
15 minute winter	11-0	11	87.289	0.764	8.7	0.8646	0.0000	SURCHARGED
15 minute winter	11-1	11	87.289	0.840	27.8	1.4339	0.0000	SURCHARGED
15 minute winter	10-2	11	87.255	0.961	48.3	2.1127	0.0000	SURCHARGED
15 minute winter	12-0	11	87.075	0.912	10.2	1.0318	0.0000	SURCHARGED
15 minute winter	10-3	11	87.065	0.966	82.3	2.3302	0.0000	SURCHARGED
240 minute winter	4-11	196	87.054	1.102	89.0	3.2352	0.0000	SURCHARGED
240 minute winter	4-12	196	87.053	1.109	155.1	673.2071	0.0000	SURCHARGED
240 minute winter	13-0	196	87.052	0.877	0.7	0.9920	0.0000	SURCHARGED
240 minute winter	4-13	196	87.052	1.148	69.5	2.6738	0.0000	SURCHARGED
240 minute winter	4-14	192	87.051	1.174	66.5	2.6396	0.0000	SURCHARGED
15 minute winter	14-0	11	87.078	0.925	13.6	1.2962	0.0000	SURCHARGED
15 minute winter	14-1	12	87.109	1.093	67.3	3.6081	0.0000	FLOOD RISK
240 minute winter	15-0	192	87.051	0.782	1.2	0.9447	0.0000	SURCHARGED
240 minute winter	14-2	192	87.051	1.164	32.1	4.8296	0.0000	SURCHARGED
240 minute winter	4-15	192	87.051	1.198	64.0	3.2796	0.0000	SURCHARGED
240 minute winter	16-0	192	87.050	0.475	1.4	0.5372	0.0000	SURCHARGED
240 minute winter	17-0	196	87.050	0.850	0.8	0.9610	0.0000	SURCHARGED
240 minute winter	4-16	192	87.050	1.233	45.1	5.3987	0.0000	SURCHARGED
240 minute winter	1-13	192	87.048	1.271	45.4	3.1647	0.0000	SURCHARGED
15 minute winter	18-0	13	87.203	0.778	18.1	0.8797	0.0000	SURCHARGED
15 minute winter	19-0	13	87.296	0.571	24.0	0.8458	0.0000	SURCHARGED
15 minute winter	19-1	13	87.287	0.697	18.2	1.0647	0.0000	SURCHARGED
15 minute winter	18-1	13	87.263	1.195	54.3	2.4182	0.0000	SURCHARGED
15 minute winter	20-0	13	87.231	0.987	10.4	1.4789	0.0000	SURCHARGED
15 minute winter	18-2	12	87.223	1.284	84.8	4.1701	0.0000	SURCHARGED
15 minute winter	18-3	13	87.128	1.331	103.3	3.3130	0.0000	SURCHARGED
15 minute winter	18-4	13	87.063	1.293	112.2	2.2079	0.0000	SURCHARGED
240 minute winter	1-14	192	87.048	1.296	39.0	3.0859	0.0000	SURCHARGED
240 minute winter	1-15	192	87.047	1.308	37.1	2.7230	0.0000	SURCHARGED
240 minute winter	1-16	192	87.047	1.335	38.3	5.4266	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	8-1	8.001	4-10	6.8	0.186	0.096	2.0073	
240 minute winter	4-10	4.010	4-11	63.3	0.566	0.628	3.4769	
15 minute winter	10-0	10.000	10-1	-10.3	-0.278	-0.258	0.6464	
15 minute winter	10-1	10.001	10-2	-19.2	0.716	-0.484	1.3572	
15 minute winter	11-0	11.000	11-1	-8.7	-0.438	-0.218	0.5112	
15 minute winter	11-1	11.001	10-2	-17.2	-0.435	-0.430	1.0424	
15 minute winter	10-2	10.002	10-3	50.2	1.262	1.261	0.7549	
15 minute winter	12-0	12.000	10-3	-10.2	-0.317	-0.320	0.6672	
15 minute winter	10-3	10.003	4-11	84.7	2.131	2.665	0.7590	
240 minute winter	4-11	4.011	4-12	88.3	1.424	0.562	1.1901	
240 minute winter	4-12	4.012	4-13	-68.6	-0.351	-0.437	5.6611	
240 minute winter	13-0	13.000	4-13	-0.7	-0.030	-0.018	1.1732	
240 minute winter	4-13	4.013	4-14	-66.0	-0.337	-0.420	3.7682	
240 minute winter	4-14	4.014	4-15	-63.2	-0.225	-0.280	6.0693	
15 minute winter	14-0	14.000	14-1	16.8	0.239	0.297	3.6751	
15 minute winter	14-1	14.001	14-2	47.8	0.679	0.845	3.4640	
240 minute winter	15-0	15.000	14-2	-0.6	0.246	-0.016	1.4866	
240 minute winter	14-2	14.002	4-15	30.9	0.420	0.350	1.4383	
240 minute winter	4-15	4.015	4-16	44.9	0.297	0.199	9.2799	
240 minute winter	16-0	16.000	4-16	-1.4	-0.042	-0.035	1.4034	
240 minute winter	17-0	17.000	4-16	-0.8	-0.036	-0.020	1.3244	
240 minute winter	4-16	4.016	1-13	45.4	0.314	0.214	11.5572	
240 minute winter	1-13	1.013	1-14	36.4	0.277	0.172	7.2394	
15 minute winter	18-0	18.000	18-1	-18.1	-0.586	-0.454	2.4077	
15 minute winter	19-0	19.000	19-1	-15.2	0.629	-0.382	0.9119	
15 minute winter	19-1	19.001	18-1	23.9	0.884	0.599	0.5447	
15 minute winter	18-1	18.001	18-2	37.7	0.605	0.532	2.2089	
15 minute winter	20-0	20.000	18-2	9.3	-0.251	0.234	1.9206	
15 minute winter	18-2	18.002	18-3	82.7	0.750	0.746	5.0511	
15 minute winter	18-3	18.003	18-4	106.0	0.961	1.200	1.4974	
15 minute winter	18-4	18.004	1-14	114.9	1.042	1.300	0.8052	
240 minute winter	1-14	1.014	1-15	37.1	0.352	0.175	3.8500	
240 minute winter	1-15	1.015	1-16	37.2	0.204	0.175	7.7780	
240 minute winter	1-16	1.016	PI 4	37.3	0.426	0.154	1.9351	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 98.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	PI 4	10	85.907	0.323	37.4	0.5700	0.0000	OK
15 minute summer	Outfall 4	1	85.900	0.327	42.4	0.0000	0.0000	OK
15 minute winter	21-0	11	87.291	0.033	1.9	0.0491	0.0000	OK
30 minute winter	21-1	22	87.257	0.157	17.9	0.3763	0.0000	OK
30 minute winter	21-2	22	87.235	0.244	27.4	0.4598	0.0000	OK
30 minute winter	21-3	21	87.244	0.426	59.3	1.0965	0.0000	SURCHARGED
30 minute winter	21-4	21	87.223	0.554	73.1	1.1584	0.0000	SURCHARGED
10080 minute winter	21-5	7440	87.220	0.622	1.7	1.3052	0.0000	SURCHARGED
15 minute winter	22-0	13	87.800	0.705	27.0	1.3163	0.0000	SURCHARGED
15 minute winter	22-1	13	87.761	0.706	48.6	1.2827	0.0000	SURCHARGED
15 minute winter	23-0	12	87.843	0.682	32.6	1.3761	0.0000	SURCHARGED
15 minute winter	22-2	12	87.790	0.883	123.4	4.2379	0.0000	SURCHARGED
15 minute winter	24-0	13	87.723	0.623	37.4	0.9549	0.0000	SURCHARGED
15 minute winter	22-3	12	87.749	0.864	143.1	2.3180	0.0000	SURCHARGED
15 minute winter	22-4	12	87.580	0.827	169.1	2.1014	0.0000	SURCHARGED
30 minute winter	25-0	23	87.356	0.077	3.5	0.0871	0.0000	OK
30 minute winter	25-1	23	87.346	0.243	18.9	0.4627	0.0000	SURCHARGED
30 minute winter	22-5	23	87.337	0.725	165.6	1.8188	0.0000	SURCHARGED
30 minute winter	26-0	23	87.271	0.146	5.0	0.1652	0.0000	OK
30 minute winter	26-1	23	87.264	0.242	9.5	0.3279	0.0000	SURCHARGED
30 minute winter	22-6	23	87.266	0.692	186.9	1.3429	0.0000	SURCHARGED
10080 minute winter	22-7	7440	87.220	0.691	4.7	219.8322	0.0000	SURCHARGED
10080 minute winter	21-6	7440	87.220	0.708	5.2	1.7767	0.0000	SURCHARGED
15 minute winter	21-7	13	87.300	0.900	229.7	3.1048	0.0000	SURCHARGED
15 minute winter	21-8	12	87.353	0.978	184.3	2.0371	0.0000	SURCHARGED
15 minute winter	21-9	12	87.402	1.054	177.7	2.0205	0.0000	SURCHARGED
15 minute winter	21-10	12	87.482	1.210	178.1	3.4086	0.0000	SURCHARGED
15 minute winter	27-0	12	87.486	1.164	61.5	2.0564	0.0000	SURCHARGED
15 minute winter	27-1	12	87.506	1.231	164.8	4.3567	0.0000	SURCHARGED
15 minute winter	28-0	12	87.624	1.146	41.7	2.1889	0.0000	SURCHARGED
15 minute winter	28-1	12	87.580	1.247	68.3	4.4572	0.0000	FLOOD RISK
15 minute winter	21-11	12	87.519	1.287	202.1	5.1831	0.0000	SURCHARGED
15 minute winter	29-0	13	87.768	0.383	15.7	0.4472	0.0000	SURCHARGED
15 minute winter	29-1	14	87.773	0.612	23.8	0.9302	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	PI 4	1.017	Outfall 4	37.5	0.243	0.140	1.1163	538.0
15 minute winter	21-0	21.000	21-1	1.7	0.122	0.016	0.8075	
30 minute winter	21-1	21.001	21-2	17.6	0.645	0.159	2.1066	
30 minute winter	21-2	21.002	21-3	26.7	0.591	0.242	5.2202	
30 minute winter	21-3	21.003	21-4	56.0	0.827	0.506	5.3104	
30 minute winter	21-4	21.004	21-5	57.0	0.789	0.451	3.0859	
10080 minute winter	21-5	21.005	21-6	1.7	0.309	0.013	2.7940	
15 minute winter	22-0	22.000	22-1	20.9	0.419	0.165	1.7408	
15 minute winter	22-1	22.001	22-2	-40.1	-0.393	-0.318	6.4835	
15 minute winter	23-0	23.000	22-2	22.8	0.257	0.206	7.0434	
15 minute winter	22-2	22.002	22-3	112.3	0.897	0.877	0.9332	
15 minute winter	24-0	24.000	22-3	-34.6	-0.422	-0.275	6.6467	
15 minute winter	22-3	22.003	22-4	130.1	1.039	1.034	5.7987	
15 minute winter	22-4	22.004	22-5	163.9	1.310	1.302	6.1883	
30 minute winter	25-0	25.000	25-1	-3.5	-0.149	-0.088	0.7723	
30 minute winter	25-1	25.001	22-5	18.6	0.952	0.466	0.5903	
30 minute winter	22-5	22.005	22-6	163.8	1.309	1.390	1.9006	
30 minute winter	26-0	26.000	26-1	-5.0	-0.269	-0.126	0.5862	
30 minute winter	26-1	26.001	22-6	5.2	0.595	0.130	1.3191	
30 minute winter	22-6	22.006	22-7	181.8	2.138	1.549	2.2683	
10080 minute winter	22-7	22.007	21-6	3.4	0.360	0.028	0.8386	
10080 minute winter	21-6	21.006	21-7	5.2	0.369	0.026	10.1382	
15 minute winter	21-7	21.007	21-8	-186.3	-0.952	-1.043	2.7460	
15 minute winter	21-8	21.008	21-9	-178.1	-0.911	-1.002	2.9942	
15 minute winter	21-9	21.009	21-10	-174.9	0.916	-0.994	8.5941	
15 minute winter	21-10	21.010	21-11	174.5	0.945	0.996	4.5606	
15 minute winter	27-0	27.000	27-1	-61.5	-0.463	-0.290	13.6208	
15 minute winter	27-1	27.001	21-11	-113.9	-0.523	-0.537	12.3665	
15 minute winter	28-0	28.000	28-1	-27.9	-0.340	-0.252	5.1670	
15 minute winter	28-1	28.001	21-11	65.3	0.595	0.590	3.6110	
15 minute winter	21-11	21.011	21-12	213.0	0.915	1.004	18.3778	
15 minute winter	29-0	29.000	29-1	-15.1	-0.511	-0.380	1.5097	
15 minute winter	29-1	29.001	29-2	18.2	0.679	0.455	0.4874	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 98.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	29-2	14	87.777	0.689	21.7	0.9737	0.0000	SURCHARGED
15 minute winter	29-3	14	87.736	0.956	34.8	1.6446	0.0000	SURCHARGED
15 minute winter	29-4	14	87.703	1.019	30.1	1.3855	0.0000	SURCHARGED
15 minute winter	29-5	13	87.615	1.128	45.0	1.8492	0.0000	SURCHARGED
15 minute winter	21-12	12	87.531	1.362	249.1	4.3222	0.0000	SURCHARGED
15 minute winter	30-0	13	87.653	0.328	23.9	0.4165	0.0000	SURCHARGED
15 minute winter	30-1	13	87.614	0.552	48.2	0.7660	0.0000	SURCHARGED
15 minute winter	30-2	13	87.585	0.689	31.8	1.1340	0.0000	SURCHARGED
15 minute winter	21-13	12	87.558	1.420	266.5	3.4927	0.0000	SURCHARGED
10080 minute winter	21-14	7440	87.220	1.116	12.6	2154.4030	0.0000	SURCHARGED
5760 minute winter	PI 3	2820	86.740	0.743	4.0	1.3130	0.0000	SURCHARGED
15 minute summer	Outfall 3	1	86.740	0.802	0.0	0.0000	0.0000	OK
15 minute summer	31-0	1	86.775	0.000	0.0	0.0000	0.0000	OK
15 minute winter	31-1	10	86.725	0.100	22.9	0.1787	0.0000	OK
15 minute winter	31-2	12	86.589	0.243	32.3	0.3373	0.0000	SURCHARGED
15 minute winter	31-4	12	86.537	0.363	37.3	0.4788	0.0000	SURCHARGED
15 minute winter	31-5	12	86.440	0.480	43.4	0.6269	0.0000	SURCHARGED
15 minute winter	31-6	12	86.206	0.561	58.8	0.8967	0.0000	SURCHARGED
15 minute summer	32-0	1	86.125	0.000	0.0	0.0000	0.0000	OK
15 minute winter	32-1	12	86.073	0.093	8.6	0.1296	0.0000	OK
15 minute winter	31-7	12	86.066	0.461	66.9	0.5377	0.0000	SURCHARGED
1440 minute winter	34-0	1140	86.001	0.201	0.6	0.3039	0.0000	OK
1440 minute winter	34-1	1140	86.001	0.335	1.5	0.5250	0.0000	SURCHARGED
1440 minute winter	34-2	1140	86.001	0.390	1.9	0.5280	0.0000	SURCHARGED
1440 minute winter	31-8	1140	86.001	0.617	10.2	1.5796	0.0000	SURCHARGED
1440 minute winter	33-0	1140	86.001	0.326	0.2	0.3692	0.0000	SURCHARGED
1440 minute winter	31-9	1140	86.001	0.905	11.4	1.7072	0.0000	SURCHARGED
1440 minute winter	31-10	1140	86.001	0.930	17.0	420.9549	0.0000	SURCHARGED
1440 minute winter	35-0	1140	86.001	0.342	0.6	0.5064	0.0000	SURCHARGED
1440 minute winter	31-11	1140	86.001	0.985	10.1	2.0866	0.0000	SURCHARGED
1440 minute winter	31-12	1140	86.001	1.068	9.2	2.3861	0.0000	SURCHARGED
15 minute summer	36-0	1	86.900	0.000	0.0	0.0000	0.0000	OK
15 minute winter	36-1	10	86.840	0.118	24.8	0.2277	0.0000	OK
15 minute winter	36-2	10	86.723	0.148	32.6	0.2084	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	29-2	29.002	29-3	24.3	0.622	0.610	2.0729	
15 minute winter	29-3	29.003	29-4	29.4	0.911	0.738	0.6439	
15 minute winter	29-4	29.004	29-5	33.4	0.863	0.823	1.2821	
15 minute winter	29-5	29.005	21-12	42.4	1.067	1.066	1.4151	
15 minute winter	21-12	21.012	21-13	262.4	1.096	1.237	8.8880	
15 minute winter	30-0	30.000	30-1	-21.0	-0.539	-0.474	1.4371	
15 minute winter	30-1	30.001	30-2	-37.2	-0.987	-0.934	1.1161	
15 minute winter	30-2	30.002	21-13	35.6	1.126	0.893	0.7920	
15 minute winter	21-13	21.013	21-14	282.0	2.414	1.330	5.0771	
10080 minute winter	21-14	Hydro-Brake®	PI 3	4.0				
5760 minute winter	PI 3	21.015	Outfall 3	4.0	0.014	0.014	9.6080	720.3
15 minute summer	31-0	31.000	31-1	0.0	0.000	0.000	0.2073	
15 minute winter	31-1	31.001	31-2	22.5	1.116	0.386	0.6120	
15 minute winter	31-2	31.002	31-4	29.4	1.206	0.506	0.5464	
15 minute winter	31-4	31.003	31-5	36.0	1.249	0.619	0.6804	
15 minute winter	31-5	31.004	31-6	41.0	1.032	0.790	1.2517	
15 minute winter	31-6	31.005	31-7	58.7	1.475	1.462	0.2654	
15 minute summer	32-0	32.000	32-1	0.0	0.000	0.000	0.1289	
15 minute winter	32-1	32.001	31-7	8.3	0.643	0.208	0.7624	
15 minute winter	31-7	31.006	31-8	67.8	0.962	0.957	3.8022	
1440 minute winter	34-0	33.000	34-1	0.6	0.264	0.015	0.8758	
1440 minute winter	34-1	33.001	34-2	1.5	0.434	0.038	0.3699	
1440 minute winter	34-2	33.002	31-8	1.9	0.513	0.048	0.4976	
1440 minute winter	31-8	31.007	31-9	10.2	0.664	0.162	0.3263	
1440 minute winter	33-0	34.000	31-9	-0.2	-0.006	-0.004	2.1464	
1440 minute winter	31-9	31.008	31-10	11.1	0.686	0.088	1.0960	
1440 minute winter	31-10	31.009	31-11	-10.0	0.450	-0.079	2.4026	
1440 minute winter	35-0	35.000	31-11	0.6	0.368	0.015	1.2305	
1440 minute winter	31-11	31.010	31-12	-9.2	0.424	-0.073	3.6330	
1440 minute winter	31-12	31.011	31-13	8.5	0.330	0.067	6.9243	
15 minute summer	36-0	36.000	36-1	0.0	0.000	0.000	0.3070	
15 minute winter	36-1	36.001	36-2	24.3	0.994	0.467	0.3581	
15 minute winter	36-2	36.002	36-3	32.1	1.109	0.617	0.3186	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 98.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	36-3	11	86.626	0.161	38.9	0.2211	0.0000	OK
15 minute winter	36-4	11	86.480	0.161	42.3	0.2052	0.0000	OK
1440 minute winter	31-13	1140	86.001	1.226	11.3	3.7318	0.0000	SURCHARGED
1440 minute winter	31-14	1140	86.001	1.284	11.5	2.4226	0.0000	SURCHARGED
1440 minute winter	31-15	1140	86.001	1.310	11.5	2.1061	0.0000	SURCHARGED
15 minute winter	37-0	13	86.942	0.367	19.4	0.4147	0.0000	SURCHARGED
15 minute winter	37-1	13	86.874	0.602	41.1	1.1006	0.0000	SURCHARGED
15 minute winter	38-0	12	86.896	1.219	36.2	1.8734	0.0000	SURCHARGED
15 minute winter	39-0	12	86.870	0.755	8.6	0.8536	0.0000	SURCHARGED
15 minute winter	38-1	12	86.881	1.461	54.6	3.5294	0.0000	FLOOD RISK
15 minute winter	37-2	12	86.802	1.658	131.0	6.1645	0.0000	SURCHARGED
15 minute winter	40-0	12	86.167	0.392	12.4	0.4428	0.0000	SURCHARGED
15 minute winter	40-1	11	86.200	0.581	25.2	0.8641	0.0000	SURCHARGED
15 minute winter	37-3	12	86.123	1.179	196.9	4.7770	0.0000	SURCHARGED
1440 minute winter	37-4	1140	86.001	1.179	19.3	2.6712	0.0000	SURCHARGED
1440 minute winter	31-16	1140	86.001	1.346	28.1	3.6037	0.0000	SURCHARGED
1440 minute winter	31-17	1140	86.001	1.370	28.0	566.6603	0.0000	SURCHARGED
30 minute winter	PI 1	24	84.916	0.396	10.5	0.6989	0.0000	OK
15 minute summer	Outfall 1	1	84.910	0.409	9.0	0.0000	0.0000	OK
15 minute winter	41-0	12	87.502	0.802	19.1	1.4349	0.0000	SURCHARGED
15 minute winter	41-1	12	87.460	0.877	47.7	1.3602	0.0000	SURCHARGED
15 minute winter	41-2	12	87.467	1.072	41.8	2.1274	0.0000	SURCHARGED
15 minute winter	41-3	12	87.387	1.193	55.8	2.1526	0.0000	FLOOD RISK
15 minute winter	42-0	12	87.574	1.000	32.7	2.4753	0.0000	FLOOD RISK
15 minute winter	42-1	12	87.564	1.041	69.9	2.9010	0.0000	SURCHARGED
15 minute winter	43-0	12	87.459	0.866	6.8	1.1981	0.0000	SURCHARGED
15 minute winter	42-2	12	87.455	1.056	95.3	2.3539	0.0000	SURCHARGED
15 minute winter	44-0	12	87.304	0.881	18.4	1.1800	0.0000	SURCHARGED
15 minute winter	41-4	12	87.297	1.238	171.4	2.7897	0.0000	SURCHARGED
15 minute winter	45-0	12	86.940	0.528	21.4	1.1165	0.0000	SURCHARGED
15 minute winter	41-5	12	86.898	0.978	212.8	2.2688	0.0000	SURCHARGED
360 minute winter	41-6	272	86.809	0.910	44.7	1.3015	0.0000	SURCHARGED
360 minute winter	41-7	272	86.806	1.068	48.1	334.3096	0.0000	SURCHARGED
360 minute winter	41-8	272	86.806	1.089	19.5	1.8837	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	36-3	36.003	36-4	38.8	1.296	0.747	0.4425	
15 minute winter	36-4	36.004	31-13	42.3	1.436	0.814	1.2604	
1440 minute winter	31-13	31.012	31-14	10.8	0.349	0.081	5.3229	
1440 minute winter	31-14	31.013	31-15	11.2	0.345	0.084	2.3700	
1440 minute winter	31-15	31.014	31-16	11.4	0.268	0.085	3.2654	
15 minute winter	37-0	37.000	37-1	-19.4	-0.641	-0.487	2.0450	
15 minute winter	37-1	37.001	37-2	32.3	0.844	0.813	2.9182	
15 minute winter	38-0	38.000	38-1	-24.2	-0.665	-0.607	1.7326	
15 minute winter	39-0	39.000	38-1	-8.6	0.366	-0.215	0.2753	
15 minute winter	38-1	38.001	37-2	42.6	0.606	0.602	4.7515	
15 minute winter	37-2	37.002	37-3	113.5	1.612	1.848	4.5516	
15 minute winter	40-0	40.000	40-1	-12.4	-0.469	-0.311	1.0538	
15 minute winter	40-1	40.001	37-3	18.7	0.549	0.470	2.9752	
15 minute winter	37-3	37.003	37-4	200.9	1.822	2.040	5.4750	
1440 minute winter	37-4	37.004	31-16	19.2	0.483	0.179	2.9447	
1440 minute winter	31-16	31.015	31-17	28.0	0.757	0.089	3.2280	
1440 minute winter	31-17	31.016	PI 1	9.9	0.327	0.033	0.7769	
30 minute winter	PI 1	31.017	Outfall 1	14.0	0.070	0.066	3.7963	145.7
15 minute winter	41-0	41.000	41-1	17.4	0.671	0.246	2.0134	
15 minute winter	41-1	41.001	41-2	30.1	0.700	0.425	3.2325	
15 minute winter	41-2	41.002	41-3	40.3	0.793	0.569	3.4546	
15 minute winter	41-3	41.003	41-4	52.9	0.751	0.747	2.3190	
15 minute winter	42-0	42.000	42-1	24.2	0.494	0.341	0.8773	
15 minute winter	42-1	42.001	42-2	58.7	0.839	0.828	2.1240	
15 minute winter	43-0	43.000	42-2	7.9	0.532	0.198	0.4658	
15 minute winter	42-2	42.002	41-4	89.1	1.265	1.256	1.2328	
15 minute winter	44-0	44.000	41-4	-11.7	0.604	-0.293	0.6459	
15 minute winter	41-4	41.004	41-5	170.9	1.550	1.546	4.9665	
15 minute winter	45-0	45.000	41-5	17.3	0.720	0.436	1.4435	
15 minute winter	41-5	41.005	41-6	212.0	1.923	1.652	0.5585	
360 minute winter	41-6	41.006	41-7	44.5	0.992	0.402	5.7477	
360 minute winter	41-7	41.007	41-8	19.5	0.394	0.154	0.5755	
360 minute winter	41-8	41.008	41-9	19.6	0.403	0.176	1.5091	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 98.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	46-0	272	86.805	0.800	0.2	0.9047	0.0000	SURCHARGED
360 minute winter	41-9	272	86.805	1.131	19.7	2.0821	0.0000	SURCHARGED
360 minute winter	47-0	272	86.803	0.278	0.8	0.3149	0.0000	SURCHARGED
360 minute winter	47-1	272	86.803	0.695	3.7	1.3456	0.0000	SURCHARGED
360 minute winter	41-10	272	86.803	1.403	20.1	3.7087	0.0000	SURCHARGED
360 minute winter	41-11	272	86.803	1.418	20.2	2.3546	0.0000	SURCHARGED
360 minute winter	41-12	272	86.801	1.454	20.3	4.1161	0.0000	SURCHARGED
360 minute winter	48-0	272	86.800	0.500	1.2	0.5652	0.0000	SURCHARGED
360 minute winter	41-13	272	86.800	1.525	23.2	6.2026	0.0000	SURCHARGED
15 minute winter	PI 5	9	85.901	0.736	20.8	1.3011	0.0000	SURCHARGED
15 minute summer	Outfall 5	1	85.900	0.752	20.6	0.0000	0.0000	OK
15 minute summer	50-0	1	88.900	0.000	0.0	0.0000	0.0000	OK
15 minute winter	50-1	10	88.113	0.113	28.2	0.2041	0.0000	OK
15 minute winter	50-2	10	87.353	0.153	43.6	0.2338	0.0000	OK
1440 minute winter	50-3	1110	87.345	1.144	3.6	1.9514	0.0000	SURCHARGED
1440 minute winter	50-4	1110	87.345	1.343	5.8	3.1284	0.0000	SURCHARGED
1440 minute winter	50-5	1110	87.345	1.524	8.9	186.1237	0.0000	SURCHARGED
15 minute winter	PI 2	16	85.902	0.282	1.8	0.4031	0.0000	OK
15 minute summer	Outfall 2	1	85.900	0.290	2.2	0.0000	0.0000	OK
960 minute winter	49-0	900	86.937	0.743	0.9	1.0626	0.0000	SURCHARGED
960 minute winter	49-1	900	86.937	0.968	4.1	3.4435	0.0000	FLOOD RISK
960 minute winter	49-2	900	86.937	1.031	3.8	1.7365	0.0000	SURCHARGED
960 minute winter	49-3	900	86.937	1.138	8.2	151.4838	0.0000	SURCHARGED
960 minute winter	49-4	900	86.937	1.207	1.9	2.4131	0.0000	SURCHARGED
960 minute winter	49-5	900	86.937	1.257	2.0	2.3761	0.0000	SURCHARGED
15 minute winter	PI 6	13	85.902	0.376	1.8	0.5377	0.0000	OK
15 minute summer	Outfall 6	1	85.900	0.396	1.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	46-0	46.000	41-9	-0.2	-0.027	-0.005	0.3805	
360 minute winter	41-9	41.009	41-10	19.8	0.399	0.179	3.4285	
360 minute winter	47-0	47.000	47-1	-0.8	-0.030	-0.018	1.9897	
360 minute winter	47-1	47.001	41-10	3.0	0.385	0.076	1.9757	
360 minute winter	41-10	41.010	41-11	20.2	0.353	0.158	0.6386	
360 minute winter	41-11	41.011	41-12	20.3	0.329	0.166	1.7545	
360 minute winter	41-12	41.012	41-13	20.5	0.216	0.161	3.0957	
360 minute winter	48-0	48.000	41-13	-1.2	-0.048	-0.023	2.1542	
360 minute winter	41-13	Hydro-Brake®	PI 5	21.0				
15 minute winter	PI 5	41.014	Outfall 5	20.8	0.106	0.087	1.0395	123.4
15 minute summer	50-0	49.000	50-1	0.0	0.000	0.000	0.0000	
15 minute winter	50-1	49.001	50-2	27.5	1.424	0.472	0.7049	
15 minute winter	50-2	49.002	50-3	43.1	1.561	0.740	0.7508	
1440 minute winter	50-3	49.003	50-4	3.3	0.281	0.025	8.0114	
1440 minute winter	50-4	49.004	50-5	5.7	0.408	0.051	10.3438	
1440 minute winter	50-5	Hydro-Brake®	PI 2	2.2				
15 minute winter	PI 2	49.006	Outfall 2	3.4	0.032	0.023	0.4827	25.9
960 minute winter	49-0	50.000	49-1	-0.9	-0.013	-0.008	8.0285	
960 minute winter	49-1	50.001	49-2	3.3	0.284	0.030	2.2298	
960 minute winter	49-2	50.002	49-3	3.7	0.369	0.042	5.9200	
960 minute winter	49-3	50.003	49-4	1.9	0.107	0.021	3.8234	
960 minute winter	49-4	50.004	49-5	1.9	0.075	0.016	5.6761	
960 minute winter	49-5	Hydro-Brake®	PI 6	1.9				
15 minute winter	PI 6	50.006	Outfall 6	3.1	0.022	0.016	0.8382	24.9

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Inverts
M5-60 (mm)	15.600	Minimum Backdrop Height (m)	0.000
Ratio-R	0.286	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1-0	0.012	5.00	88.550	1350	681728.297	714559.265	1.550
1-1	0.025	5.00	88.200	1350	681727.082	714579.948	1.264
1-2	0.032	5.00	88.200	1350	681729.935	714618.237	1.383
1-3	0.025	5.00	88.150	1350	681724.880	714650.182	1.433
1-4	0.012	5.00	88.050	1350	681726.157	714667.886	1.388
1-5	0.042	5.00	88.201	1350	681706.946	714704.913	1.668
2-0	0.012	5.00	88.588	1200	681654.345	714711.728	1.425
1-6	0.170	5.00	88.523	1350	681668.442	714684.340	2.077
1-7	0.171	5.00	88.681	1350	681613.809	714655.342	2.358
1-8	0.133	5.00	88.553	1350	681573.837	714634.246	2.320
1-9	0.182	5.00	88.321	1350	681516.849	714604.369	2.216
1-10	0.055	5.00	88.495	1350	681489.411	714611.148	2.437
1-11			88.016	1800	681465.859	714652.863	2.095
3-0	0.013	5.00	88.471	1200	681495.121	714623.928	1.680
1-12	0.101	5.00	88.157	1350	681476.088	714659.384	2.256
4-0		5.00	88.200	1200	681714.921	714722.862	1.115
4-1	0.028	5.00	88.200	1200	681700.576	714747.663	1.259
4-2			88.200	1200	681696.983	714746.664	1.278
4-3	0.029	5.00	88.321	1200	681679.139	714777.631	1.579
5-0		5.00	88.100	1200	681687.188	714707.538	0.975
5-1	0.043	5.00	88.000	1200	681674.194	714731.842	1.038
4-4	0.076	5.00	88.227	1200	681656.262	714765.409	1.616
4-5	0.040	5.00	88.128	1200	681631.788	714752.351	1.657
4-6			88.062	1200	681629.584	714756.232	1.614
4-7	0.066	5.00	87.821	1200	681618.718	714752.021	1.432
6-0	0.020	5.00	87.900	1200	681651.744	714821.450	1.029
6-1	0.040	5.00	88.070	1200	681635.217	714852.261	1.405
6-2	0.021	5.00	88.000	1200	681600.572	714833.783	1.567
6-3	0.098	5.00	87.930	1200	681613.963	714808.759	1.665
4-8	0.132	5.00	87.727	1350	681593.233	714797.616	1.601
7-0		5.00	88.100	1200	681598.010	714732.199	1.525
4-9	0.150	5.00	87.721	1350	681569.162	714784.678	1.680
8-0		5.00	87.700	1200	681578.569	714821.954	1.410
9-0		5.00	87.700	1200	681499.419	714779.633	1.301
8-1	0.095	5.00	87.400	1200	681538.921	714800.785	1.280
4-10	0.051	5.00	87.822	1350	681552.322	714775.627	1.819
10-0		5.00	87.635	1200	681456.887	714742.982	0.874
10-1	0.039	5.00	87.816	1200	681464.184	714728.460	1.151
11-0		5.00	87.700	1200	681470.270	714761.709	1.175
11-1	0.036	5.00	87.700	1200	681481.748	714767.493	1.251
10-2	0.075	5.00	87.700	1200	681494.310	714744.490	1.406
12-0		5.00	87.588	1200	681518.601	714738.418	1.425
10-3	0.104	5.00	87.724	1200	681511.067	714753.407	1.625
4-11	0.111	5.00	87.850	1500	681527.859	714762.478	1.898
4-12			87.850	1500	681530.789	714757.146	1.906
13-0		5.00	87.600	1200	681570.228	714744.973	1.425
4-13	0.042	5.00	87.400	1500	681544.032	714731.413	1.496
4-14	0.039	5.00	87.500	1500	681526.924	714722.557	1.623
14-0	0.027	5.00	88.142	1200	681632.181	714739.287	1.989
14-1	0.143	5.00	87.334	1200	681586.068	714714.847	1.318
15-0	0.007	5.00	88.094	1200	681560.301	714658.807	1.825
14-2	0.222	5.00	87.521	1350	681542.637	714691.750	1.634
4-15	0.076	5.00	87.418	1500	681536.496	714703.253	1.565
16-0		5.00	88.000	1200	681524.006	714656.720	1.425
17-0		5.00	87.625	1200	681491.700	714717.223	1.425
4-16	0.262	5.00	87.823	1500	681507.377	714687.844	2.006
1-13	0.083	5.00	88.078	1500	681471.112	714668.653	2.301
18-0		5.00	87.800	1200	681422.878	714707.549	1.375
19-0	0.025	5.00	88.150	1200	681367.542	714630.246	1.425

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
19-1	0.020	5.00	87.600	1200	681380.523	714649.147	1.010
18-1	0.075	5.00	87.750	1200	681392.936	714654.934	1.682
20-0	0.024	5.00	87.550	1200	681458.635	714610.046	1.306
18-2	0.178	5.00	87.900	1350	681419.839	714638.804	1.961
18-3	0.102	5.00	87.724	1350	681442.714	714678.477	1.927
18-4	0.029	5.00	87.871	1350	681452.487	714687.900	2.101
1-14	0.065	5.00	87.871	1500	681458.950	714691.294	2.119
1-15	0.032	5.00	87.781	1500	681452.167	714703.160	2.042
1-16	0.056	5.00	87.570	2100	681431.016	714720.912	1.858
PI 4			87.100	1500	681413.439	714734.297	1.516
Outfall 4			86.490	1500	681407.762	714738.679	0.917
21-0	0.005	5.00	88.540	1350	681732.623	714543.018	1.282
21-1	0.054	5.00	88.225	1350	681683.674	714528.552	1.125
21-2	0.032	5.00	88.405	1350	681649.964	714518.491	1.414
21-3	0.107	5.00	88.691	1350	681596.221	714502.522	1.873
21-4	0.056	5.00	88.367	1350	681550.069	714488.810	1.698
21-5	0.062	5.00	88.456	1350	681538.872	714510.770	1.858
22-0	0.025	5.00	88.245	1350	681680.587	714541.754	1.150
22-1	0.024	5.00	88.298	1350	681676.628	714555.083	1.243
23-0	0.035	5.00	88.357	1350	681708.590	714630.655	1.196
22-2	0.279	5.00	88.564	1350	681652.175	714600.736	1.657
24-0	0.008	5.00	88.655	1350	681619.602	714645.364	1.555
22-3	0.105	5.00	88.563	1350	681644.994	714598.737	1.678
22-4	0.133	5.00	89.151	1350	681604.492	714576.263	2.398
25-0		5.00	88.704	1200	681578.956	714511.950	1.425
25-1	0.062	5.00	88.700	1200	681570.824	714540.652	1.597
22-5	0.125	5.00	88.931	1350	681561.371	714552.096	2.319
26-0		5.00	88.550	1200	681520.981	714587.351	1.425
26-1	0.017	5.00	88.550	1200	681529.224	714571.926	1.528
22-6	0.059	5.00	88.890	1350	681548.127	714544.673	2.316
22-7			88.500	1350	681533.514	714533.960	1.971
21-6	0.069	5.00	88.369	1500	681527.948	714530.232	1.857
21-7	0.148	5.00	88.161	1500	681498.591	714572.945	1.761
21-8	0.029	5.00	88.218	1500	681494.806	714586.463	1.843
21-9	0.013	5.00	88.083	1500	681479.812	714583.385	1.735
21-10	0.087	5.00	87.929	1500	681440.788	714563.200	1.657
27-0		5.00	88.114	1500	681350.118	714601.420	1.792
27-1	0.144	5.00	87.900	1500	681391.219	714575.945	1.625
28-0	0.039	5.00	88.108	1350	681472.874	714484.377	1.630
28-1	0.162	5.00	87.846	1350	681446.895	714523.359	1.513
21-11	0.213	5.00	88.117	1500	681424.130	714546.888	1.885
29-0	0.002	5.00	88.510	1200	681529.152	714477.102	1.125
29-1	0.026	5.00	88.500	1200	681493.847	714463.154	1.339
29-2	0.017	5.00	88.289	1200	681481.690	714464.705	1.201
29-3	0.059	5.00	88.782	1200	681435.452	714440.649	2.002
29-4	0.025	5.00	88.880	1200	681420.740	714447.405	2.196
29-5	0.060	5.00	88.851	1200	681401.736	714473.443	2.364
21-12	0.180	5.00	88.730	1500	681378.428	714500.325	2.561
30-0	0.010	5.00	88.750	1200	681336.824	714583.857	1.425
30-1	0.021	5.00	88.700	1200	681318.656	714552.623	1.638
30-2	0.049	5.00	88.800	1200	681338.498	714532.780	1.904
21-13	0.094	5.00	88.850	1500	681354.275	714520.630	2.712
21-14			88.070	1500	681331.006	714494.008	1.966
PI 3			88.070	1500	681328.921	714490.869	2.073
Outfall 3			87.300	1500	681310.005	714462.485	1.362
31-0		5.00	88.586	1200	681241.100	714577.004	1.811
31-1	0.061	5.00	88.460	1200	681266.075	714572.105	1.835
31-2	0.026	5.00	88.375	1200	681288.357	714572.144	2.029
31-4	0.021	5.00	88.412	1200	681300.880	714577.792	2.238
31-5	0.021	5.00	88.350	1200	681310.328	714592.053	2.390
31-6	0.055	5.00	88.000	1200	681328.209	714617.952	2.355
32-0		5.00	87.750	1200	681351.362	714665.315	1.625
32-1	0.023	5.00	87.750	1200	681337.837	714644.743	1.770
31-7	0.004	5.00	87.894	1200	681322.684	714621.696	2.289
34-0	0.027	5.00	87.225	1200	681241.403	714640.836	1.425
34-1	0.037	5.00	87.366	1200	681263.636	714636.398	1.700
34-2	0.019	5.00	87.322	1200	681271.591	714641.215	1.711
31-8	0.143	5.00	87.387	1200	681277.979	714651.973	2.003
33-0		5.00	87.400	1200	681304.110	714699.473	1.725
31-9	0.052	5.00	87.385	1350	681274.152	714654.584	2.289

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
31-10			87.260	1800	681266.162	714658.164	2.189
35-0	0.025	5.00	87.091	1200	681280.289	714692.365	1.432
31-11	0.063	5.00	86.850	1350	681255.367	714674.032	1.834
31-12	0.079	5.00	86.901	1350	681230.026	714659.891	1.968
36-0		5.00	88.558	1200	681231.376	714579.073	1.658
36-1	0.066	5.00	88.383	1200	681201.801	714584.854	1.661
36-2	0.022	5.00	88.162	1200	681188.714	714591.490	1.587
36-3	0.018	5.00	87.954	1200	681182.045	714600.247	1.489
36-4	0.010	5.00	87.676	1200	681178.035	714614.258	1.357
31-13	0.198	5.00	87.231	1350	681174.797	714656.902	2.456
31-14	0.052	5.00	87.000	1350	681172.134	714690.391	2.283
31-15	0.020	5.00	86.950	1350	681178.112	714704.102	2.259
37-0		5.00	88.000	1200	681393.391	714716.054	1.425
37-1	0.051	5.00	87.736	1200	681364.767	714673.338	1.464
38-0	0.034	5.00	87.352	1200	681384.526	714741.184	1.675
39-0		5.00	87.171	1200	681352.807	714770.696	1.056
38-1	0.111	5.00	87.147	1200	681348.326	714765.422	1.727
37-2	0.272	5.00	87.247	1200	681304.036	714714.518	2.103
40-0		5.00	87.200	1200	681328.813	714803.744	1.425
40-1	0.026	5.00	87.075	1200	681305.668	714816.641	1.456
37-3	0.272	5.00	87.021	1350	681257.516	714759.392	2.077
37-4	0.088	5.00	86.930	1350	681218.378	714728.860	2.108
31-16	0.100	5.00	86.850	1500	681195.150	714715.697	2.195
31-17			86.440	2100	681189.329	714725.568	1.809
PI 1			86.440	1500	681186.333	714730.649	1.920
Outfall 1			85.570	1500	681181.220	714748.846	1.069
41-0	0.051	5.00	88.250	1200	681603.924	714908.556	1.550
41-1	0.035	5.00	88.250	1200	681618.947	714884.229	1.667
41-2	0.060	5.00	87.800	1200	681580.497	714859.153	1.405
41-3	0.044	5.00	87.500	1200	681539.046	714832.914	1.306
42-0	0.087	5.00	87.868	1200	681554.612	714897.046	1.294
42-1	0.122	5.00	87.996	1200	681561.361	714886.575	1.473
43-0	0.018	5.00	88.018	1200	681529.669	714880.070	1.425
42-2	0.096	5.00	88.148	1200	681536.014	714870.226	1.749
44-0	0.019	5.00	88.248	1200	681512.910	714874.563	1.825
41-4	0.089	5.00	88.226	1350	681521.339	714860.680	2.167
45-0	0.057	5.00	87.573	1200	681450.416	714820.912	1.161
41-5	0.087	5.00	87.879	1350	681482.391	714838.085	1.959
41-6			87.897	1350	681480.058	714842.579	1.998
41-7			87.523	1350	681434.036	714818.133	1.785
41-8	0.027	5.00	87.523	1350	681436.400	714813.481	1.806
46-0		5.00	87.430	1200	681419.932	714815.536	1.425
41-9	0.037	5.00	87.480	1350	681424.329	714807.040	1.806
47-0		5.00	87.950	1200	681526.464	714826.290	1.425
47-1	0.058	5.00	87.550	1200	681482.339	714802.714	1.442
41-10	0.123	5.00	87.430	1350	681438.489	714779.369	2.030
41-11	0.023	5.00	87.390	1350	681441.127	714775.003	2.005
41-12	0.030	5.00	87.450	1800	681437.310	714761.518	2.103
48-0		5.00	87.450	1200	681389.971	714797.634	1.150
41-13	0.158	5.00	87.350	1800	681415.501	714749.863	2.075
PI 5			87.350	1500	681410.913	714747.274	2.185
Outfall 5			86.400	1500	681406.210	714744.800	1.252
50-0		5.00	91.041	1200	681272.880	714510.934	2.141
50-1	0.075	5.00	90.205	1200	681305.334	714543.097	2.205
50-2	0.043	5.00	89.346	1200	681326.122	714573.010	2.146
50-3	0.036	5.00	88.831	1350	681341.206	714595.670	2.631
50-4	0.109	5.00	88.427	1350	681376.057	714649.341	2.425
50-5	0.141	5.00	88.100	1350	681423.923	714716.689	2.279
PI 2			87.100	1350	681408.828	714728.225	1.480
Outfall 2			86.501	1350	681405.225	714730.997	0.891
49-0		5.00	87.806	1350	681617.771	714850.092	1.612
49-1	0.130	5.00	87.191	1350	681553.609	714815.717	1.222
49-2	0.017	5.00	87.245	1350	681537.854	714803.050	1.339
49-3	0.108	5.00	87.547	1350	681490.130	714778.489	1.748
49-4	0.057	5.00	87.734	1350	681460.413	714760.641	2.004
49-5	0.051	5.00	87.899	1350	681437.601	714733.019	2.219
PI 6			87.889	1350	681413.647	714739.599	2.363
Outfall 6			86.490	1350	681408.322	714741.891	0.986

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.017	PI 4	Outfall 4	7.171	0.600	85.584	85.573	0.011	652.0	600	15.93	35.2
1.016	1-16	PI 4	22.093	0.600	85.712	85.684	0.028	789.0	600	15.80	35.3
1.015	1-15	1-16	27.613	0.600	85.739	85.712	0.027	1030.0	600	15.37	35.8
1.014	1-14	1-15	13.668	0.600	85.752	85.739	0.013	1030.0	600	14.76	36.6
1.013	1-13	1-14	25.701	0.600	85.777	85.752	0.025	1030.0	600	14.46	37.0
18.004	18-4	1-14	7.300	0.600	85.770	85.756	0.014	504.0	375	7.72	50.0
18.003	18-3	18-4	13.576	0.600	85.797	85.770	0.027	504.0	375	7.57	50.0
18.002	18-2	18-3	45.795	0.600	85.939	85.797	0.142	322.5	375	7.29	50.0
18.001	18-1	18-2	31.368	0.600	86.068	85.939	0.129	243.2	300	6.53	50.0
20.000	20-0	18-2	48.292	0.600	86.244	85.959	0.285	169.4	225	5.80	50.0
18.000	18-0	18-1	60.538	0.600	86.425	86.068	0.357	169.6	225	6.01	50.0
19.001	19-1	18-1	13.696	0.600	86.590	86.509	0.081	169.1	225	5.61	50.0
19.000	19-0	19-1	22.929	0.600	86.725	86.590	0.135	169.8	225	5.38	50.0
1.012	1-12	1-13	10.520	0.600	85.901	85.884	0.017	634.0	450	13.89	37.8
4.016	4-16	1-13	41.030	0.600	85.817	85.777	0.040	1030.0	600	12.77	39.4
16.000	16-0	4-16	35.288	0.600	86.575	86.367	0.208	169.7	225	5.59	50.0
17.000	17-0	4-16	33.300	0.600	86.200	86.003	0.197	169.0	225	5.55	50.0
4.015	4-15	4-16	32.945	0.600	85.853	85.817	0.036	908.0	600	11.86	40.9
14.002	14-2	4-15	13.040	0.600	85.887	85.861	0.026	504.0	375	7.38	50.0
4.014	4-14	4-15	21.547	0.600	85.877	85.853	0.024	908.0	600	11.17	42.1
4.013	4-13	4-14	19.264	0.600	85.904	85.877	0.027	723.0	500	10.72	43.0
13.000	13-0	4-13	29.498	0.600	86.175	86.001	0.174	169.5	225	5.49	50.0
4.012	4-12	4-13	28.941	0.600	85.944	85.904	0.040	723.0	500	10.32	43.8
4.011	4-11	4-12	6.084	0.600	85.952	85.944	0.008	723.0	500	9.72	45.0
4.010	4-10	4-11	27.773	0.600	86.003	85.952	0.051	545.0	400	9.59	45.3
10.003	10-3	4-11	19.085	0.600	86.099	86.027	0.072	264.0	225	6.55	50.0
10.002	10-2	10-3	18.982	0.600	86.294	86.182	0.112	169.5	225	6.15	50.0
12.000	12-0	10-3	16.776	0.600	86.163	86.099	0.064	264.0	225	5.35	50.0
11.001	11-1	10-2	26.210	0.600	86.449	86.294	0.155	169.1	225	5.65	50.0
10.001	10-1	10-2	34.125	0.600	86.665	86.464	0.201	169.8	225	5.84	50.0
10.000	10-0	10-1	16.252	0.600	86.761	86.665	0.096	169.3	225	5.27	50.0
11.000	11-0	11-1	12.853	0.600	86.525	86.449	0.076	169.1	225	5.21	50.0
4.009	4-9	4-10	19.118	0.600	86.041	86.003	0.038	504.0	375	9.01	46.6

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
1.017	0.946	267.5	356.9	0.916	0.317	3.746	0.0	600
1.016	0.859	242.8	358.4	1.258	0.816	3.746	0.0	600
1.015	0.750	212.1	358.2	1.442	1.258	3.690	0.0	600
1.014	0.750	212.1	362.8	1.519	1.442	3.658	0.0	600
1.013	0.750	212.1	314.8	1.701	1.519	3.140	0.0	600
18.004	0.800	88.4	61.3	1.726	1.740	0.453	0.0	230
18.003	0.800	88.4	57.5	1.552	1.726	0.424	0.0	221
18.002	1.003	110.8	43.6	1.586	1.552	0.322	0.0	163
18.001	1.004	70.9	16.3	1.382	1.661	0.120	0.0	98
20.000	1.001	39.8	3.3	1.081	1.716	0.024	0.0	44
18.000	1.001	39.8	0.0	1.150	1.457	0.000	0.0	0
19.001	1.002	39.9	6.1	0.785	1.016	0.045	0.0	59
19.000	1.000	39.8	3.4	1.200	0.785	0.025	0.0	44
1.012	0.800	127.2	100.8	1.806	1.744	0.985	0.0	304
4.016	0.750	212.1	221.3	1.406	1.701	2.072	0.0	525
16.000	1.001	39.8	0.0	1.200	1.231	0.000	0.0	0
17.000	1.003	39.9	0.0	1.200	1.595	0.000	0.0	0
4.015	0.800	226.1	200.7	0.965	1.406	1.810	0.0	442
14.002	0.800	88.4	54.1	1.259	1.182	0.399	0.0	212
4.014	0.800	226.1	152.4	1.023	0.965	1.335	0.0	362
4.013	0.800	157.1	150.9	0.996	1.123	1.296	0.0	396
13.000	1.001	39.8	0.0	1.200	1.174	0.000	0.0	0
4.012	0.800	157.1	148.7	1.406	0.996	1.254	0.0	390
4.011	0.800	157.1	153.0	1.398	1.406	1.254	0.0	402
4.010	0.801	100.7	109.2	1.419	1.498	0.889	0.0	400
10.003	0.800	31.8	34.4	1.400	1.598	0.254	0.0	225
10.002	1.001	39.8	20.3	1.181	1.317	0.150	0.0	114
12.000	0.800	31.8	0.0	1.200	1.400	0.000	0.0	0
11.001	1.002	39.9	4.9	1.026	1.181	0.036	0.0	53
10.001	1.000	39.8	5.3	0.926	1.011	0.039	0.0	55
10.000	1.002	39.8	0.0	0.649	0.926	0.000	0.0	0
11.000	1.002	39.9	0.0	0.950	1.026	0.000	0.0	0
4.009	0.800	88.4	93.9	1.305	1.444	0.743	0.0	339

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
8.001	8-1	4-10	28.505	0.600	86.120	86.003	0.117	243.6	300	6.41	50.0
8.000	8-0	8-1	44.945	0.600	86.290	86.120	0.170	264.0	225	5.94	50.0
9.000	9-0	8-1	44.809	0.600	86.399	86.229	0.170	264.0	225	5.93	50.0
4.008	4-8	4-9	27.328	0.600	86.126	86.041	0.085	321.5	375	8.61	47.6
7.000	7-0	4-9	59.885	0.600	86.575	86.222	0.353	169.6	225	6.00	50.0
6.003	6-3	4-8	23.535	0.600	86.265	86.126	0.139	169.3	225	7.10	50.0
4.007	4-7	4-8	52.234	0.600	86.389	86.126	0.263	198.6	255	8.16	48.8
4.006	4-6	4-7	11.653	0.600	86.448	86.389	0.059	197.5	255	7.29	50.0
4.005	4-5	4-6	4.463	0.600	86.471	86.448	0.023	194.1	255	7.10	50.0
4.004	4-4	4-5	27.740	0.600	86.611	86.471	0.140	198.1	255	7.03	50.0
5.001	5-1	4-4	38.057	0.600	86.962	86.737	0.225	169.1	225	6.09	50.0
4.003	4-3	4-4	25.937	0.600	86.742	86.611	0.131	198.0	255	6.56	50.0
4.002	4-2	4-3	35.740	0.600	86.922	86.742	0.180	198.6	255	6.13	50.0
4.001	4-1	4-2	3.729	0.600	86.941	86.922	0.019	196.3	255	5.54	50.0
4.000	4-0	4-1	28.651	0.600	87.085	86.941	0.144	199.0	255	5.48	50.0
5.000	5-0	5-1	27.560	0.600	87.125	86.962	0.163	169.1	225	5.46	50.0
6.002	6-2	6-3	28.382	0.600	86.433	86.265	0.168	168.9	225	6.71	50.0
6.001	6-1	6-2	39.265	0.600	86.665	86.433	0.232	169.2	225	6.24	50.0
6.000	6-0	6-1	34.964	0.600	86.871	86.665	0.206	169.7	225	5.58	50.0
14.001	14-1	14-2	49.191	0.600	86.016	85.887	0.129	380.0	300	7.11	50.0
15.000	15-0	14-2	37.380	0.600	86.269	86.048	0.221	169.1	225	5.62	50.0
14.000	14-0	14-1	52.189	0.600	86.153	86.016	0.137	380.0	300	6.09	50.0
1.011	1-11	1-12	12.131	0.600	85.921	85.901	0.020	600.0	400	13.67	38.1
3.000	3-0	1-12	40.242	0.600	86.791	86.554	0.237	169.8	225	5.67	50.0
1.010	1-10	1-11	47.904	0.600	86.058	85.921	0.137	349.7	400	13.40	38.5
1.009	1-9	1-10	28.263	0.600	86.105	86.058	0.047	600.0	400	12.61	39.7
1.008	1-8	1-9	64.345	0.600	86.233	86.105	0.128	504.0	375	11.99	40.7
1.007	1-7	1-8	45.197	0.600	86.323	86.233	0.090	504.0	375	10.65	43.1
1.006	1-6	1-7	61.852	0.600	86.446	86.323	0.123	504.0	375	9.71	45.0
1.005	1-5	1-6	43.656	0.600	86.533	86.446	0.087	504.0	375	8.42	48.1
2.000	2-0	1-6	30.803	0.600	87.163	86.981	0.182	169.2	225	5.51	50.0
1.004	1-4	1-5	41.714	0.600	86.662	86.533	0.129	323.4	375	7.51	50.0
1.003	1-3	1-4	17.750	0.600	86.717	86.662	0.055	322.7	375	6.82	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
8.001	1.003	70.9	12.9	0.980	1.519	0.095	0.0	86
8.000	0.800	31.8	0.0	1.185	1.055	0.000	0.0	0
9.000	0.800	31.8	0.0	1.076	0.946	0.000	0.0	0
4.008	1.005	111.0	76.5	1.226	1.305	0.593	0.0	230
7.000	1.001	39.8	0.0	1.300	1.274	0.000	0.0	0
6.003	1.002	39.8	24.3	1.440	1.376	0.179	0.0	127
4.007	1.002	51.2	37.3	1.177	1.346	0.282	0.0	162
4.006	1.004	51.3	29.3	1.359	1.177	0.216	0.0	138
4.005	1.013	51.8	29.3	1.402	1.359	0.216	0.0	137
4.004	1.003	51.2	23.9	1.361	1.402	0.176	0.0	122
5.001	1.002	39.8	5.8	0.813	1.265	0.043	0.0	58
4.003	1.003	51.2	7.7	1.324	1.361	0.057	0.0	66
4.002	1.002	51.2	3.8	1.023	1.324	0.028	0.0	46
4.001	1.008	51.5	3.8	1.004	1.023	0.028	0.0	46
4.000	1.001	51.1	0.0	0.860	1.004	0.000	0.0	0
5.000	1.002	39.9	0.0	0.750	0.813	0.000	0.0	0
6.002	1.003	39.9	11.0	1.342	1.440	0.081	0.0	80
6.001	1.002	39.8	8.1	1.180	1.342	0.060	0.0	69
6.000	1.000	39.8	2.7	0.804	1.180	0.020	0.0	40
14.001	0.800	56.6	23.0	1.018	1.334	0.170	0.0	133
15.000	1.002	39.8	0.9	1.600	1.248	0.007	0.0	24
14.000	0.800	56.6	3.7	1.689	1.018	0.027	0.0	51
1.011	0.763	95.9	89.9	1.695	1.856	0.871	0.0	309
3.000	1.000	39.8	1.8	1.455	1.378	0.013	0.0	32
1.010	1.003	126.1	90.8	2.037	1.695	0.871	0.0	252
1.009	0.763	95.9	87.7	1.816	2.037	0.816	0.0	303
1.008	0.800	88.4	69.9	1.945	1.841	0.634	0.0	252
1.007	0.800	88.4	58.5	1.983	1.945	0.501	0.0	223
1.006	0.800	88.4	40.3	1.702	1.983	0.330	0.0	178
1.005	0.800	88.4	19.3	1.293	1.702	0.148	0.0	118
2.000	1.002	39.8	1.6	1.200	1.317	0.012	0.0	31
1.004	1.002	110.7	14.4	1.013	1.293	0.106	0.0	90
1.003	1.003	110.8	12.7	1.058	1.013	0.094	0.0	85

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.002	1-2	1-3	32.342	0.600	86.817	86.717	0.100	323.4	375	6.52	50.0
1.001	1-1	1-2	38.395	0.600	86.936	86.817	0.119	322.6	375	5.98	50.0
1.000	1-0	1-1	20.719	0.600	87.000	86.936	0.064	323.7	375	5.34	50.0
21.015	PI 3	Outfall 3	34.110	0.600	85.997	85.938	0.059	578.1	600	15.16	36.1
21.014	21-14	PI 3	3.768	0.600	86.104	86.097	0.007	538.3	600	14.60	36.8
21.013	21-13	21-14	35.358	0.600	86.138	86.104	0.034	1030.0	600	14.53	36.9
21.012	21-12	21-13	31.554	0.600	86.169	86.138	0.031	1030.0	600	13.75	38.0
30.002	30-2	21-13	19.913	0.600	86.896	86.778	0.118	168.8	225	6.34	50.0
30.001	30-1	30-2	28.062	0.600	87.062	86.896	0.166	169.0	225	6.01	50.0
30.000	30-0	30-1	36.134	0.600	87.325	87.062	0.263	137.4	225	5.54	50.0
21.011	21-11	21-12	65.244	0.600	86.232	86.169	0.063	1030.0	600	13.05	39.0
29.005	29-5	21-12	35.580	0.600	86.487	86.277	0.210	169.4	225	8.09	48.9
29.004	29-4	29-5	32.236	0.600	86.684	86.487	0.197	163.6	225	7.50	50.0
29.003	29-3	29-4	16.189	0.600	86.780	86.684	0.096	168.6	225	6.97	50.0
29.002	29-2	29-3	52.121	0.600	87.088	86.780	0.308	169.2	225	6.70	50.0
29.001	29-1	29-2	12.256	0.600	87.161	87.088	0.073	167.9	225	5.83	50.0
29.000	29-0	29-1	37.960	0.600	87.385	87.161	0.224	169.5	225	5.63	50.0
21.010	21-10	21-11	23.315	0.600	86.272	86.232	0.040	582.9	500	11.60	41.3
27.001	27-1	21-11	43.903	0.600	86.275	86.232	0.043	1030.0	600	7.05	50.0
28.001	28-1	21-11	32.739	0.600	86.333	86.232	0.101	324.2	375	6.32	50.0
28.000	28-0	28-1	46.846	0.600	86.478	86.333	0.145	323.1	375	5.78	50.0
27.000	27-0	27-1	48.356	0.600	86.322	86.275	0.047	1030.0	600	6.07	50.0
21.009	21-9	21-10	43.935	0.600	86.348	86.272	0.076	578.1	500	11.16	42.1
21.008	21-8	21-9	15.307	0.600	86.375	86.348	0.027	566.9	500	10.35	43.7
21.007	21-7	21-8	14.038	0.600	86.400	86.375	0.025	561.5	500	10.06	44.3
21.006	21-6	21-7	51.829	0.600	86.512	86.400	0.112	462.8	500	9.81	44.8
21.005	21-5	21-6	22.318	0.600	86.598	86.534	0.064	348.7	400	8.95	46.8
22.007	22-7	21-6	6.699	0.600	86.529	86.512	0.017	394.1	400	8.52	47.8
22.006	22-6	22-7	18.119	0.600	86.574	86.529	0.045	402.7	400	8.40	48.1
22.005	22-5	22-6	15.182	0.600	86.612	86.574	0.038	399.5	400	8.08	49.0
26.001	26-1	22-6	33.167	0.600	87.022	86.826	0.196	169.2	225	5.84	50.0
26.000	26-0	26-1	17.489	0.600	87.125	87.022	0.103	169.8	225	5.29	50.0
22.004	22-4	22-5	49.431	0.600	86.753	86.612	0.141	350.6	400	7.81	49.7

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
1.002	1.002	110.6	9.4	1.008	1.058	0.069	0.0	73
1.001	1.003	110.8	5.0	0.889	1.008	0.037	0.0	54
1.000	1.001	110.6	1.6	1.175	0.889	0.012	0.0	32
21.015	1.005	284.3	257.7	1.473	0.762	2.635	0.0	451
21.014	1.042	294.7	262.9	1.366	1.373	2.635	0.0	444
21.013	0.750	212.1	263.4	2.112	1.366	2.635	0.0	600
21.012	0.750	212.1	253.2	1.961	2.112	2.461	0.0	600
30.002	1.003	39.9	10.8	1.679	1.847	0.080	0.0	80
30.001	1.003	39.9	4.2	1.413	1.679	0.031	0.0	49
30.000	1.113	44.3	1.4	1.200	1.413	0.010	0.0	27
21.011	0.750	212.1	221.0	1.285	1.961	2.092	0.0	524
29.005	1.001	39.8	25.1	2.139	2.228	0.189	0.0	130
29.004	1.019	40.5	17.5	1.971	2.139	0.129	0.0	103
29.003	1.004	39.9	14.1	1.777	1.971	0.104	0.0	92
29.002	1.002	39.8	6.1	0.976	1.777	0.045	0.0	59
29.001	1.006	40.0	3.8	1.114	0.976	0.028	0.0	47
29.000	1.001	39.8	0.3	0.900	1.114	0.002	0.0	14
21.010	0.892	175.2	171.9	1.157	1.385	1.534	0.0	405
27.001	0.750	212.1	19.5	1.025	1.285	0.144	0.0	122
28.001	1.001	110.5	27.2	1.138	1.510	0.201	0.0	126
28.000	1.002	110.7	5.3	1.255	1.138	0.039	0.0	55
27.000	0.750	212.1	0.0	1.192	1.025	0.000	0.0	0
21.009	0.896	175.9	165.2	1.235	1.157	1.447	0.0	387
21.008	0.905	177.7	169.9	1.343	1.235	1.434	0.0	394
21.007	0.909	178.6	168.6	1.261	1.343	1.405	0.0	389
21.006	1.003	196.9	152.7	1.357	1.261	1.257	0.0	333
21.005	1.005	126.3	40.1	1.458	1.435	0.316	0.0	154
22.007	0.944	118.7	113.1	1.571	1.457	0.872	0.0	314
22.006	0.934	117.4	113.8	1.916	1.571	0.872	0.0	319
22.005	0.938	117.9	105.7	1.919	1.916	0.796	0.0	297
26.001	1.002	39.8	2.3	1.303	1.839	0.017	0.0	36
26.000	1.000	39.8	0.0	1.200	1.303	0.000	0.0	0
22.004	1.002	125.9	82.1	1.998	1.919	0.609	0.0	236

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
25.001	25-1	22-5	14.843	0.600	87.103	87.015	0.088	168.7	225	5.74	50.0
25.000	25-0	25-1	29.832	0.600	87.279	87.103	0.176	169.5	225	5.50	50.0
22.003	22-3	22-4	46.319	0.600	86.885	86.753	0.132	350.9	400	6.98	50.0
22.002	22-2	22-3	7.454	0.600	86.907	86.885	0.022	338.8	400	6.21	50.0
24.000	24-0	22-3	53.093	0.600	87.100	86.949	0.151	351.6	400	5.88	50.0
22.001	22-1	22-2	51.789	0.600	87.055	86.907	0.148	349.9	400	6.09	50.0
23.000	23-0	22-2	63.858	0.600	87.161	86.964	0.197	324.2	375	6.06	50.0
22.000	22-0	22-1	13.905	0.600	87.095	87.055	0.040	347.6	400	5.23	50.0
21.004	21-4	21-5	24.650	0.600	86.669	86.598	0.071	347.2	400	8.58	47.7
21.003	21-3	21-4	48.146	0.600	86.818	86.669	0.149	323.1	375	8.17	48.7
21.002	21-2	21-3	56.065	0.600	86.991	86.818	0.173	324.1	375	7.37	50.0
21.001	21-1	21-2	35.179	0.600	87.100	86.991	0.109	322.7	375	6.43	50.0
21.000	21-0	21-1	51.042	0.600	87.258	87.100	0.158	323.0	375	5.85	50.0
31.017	PI 1	Outfall 1	18.902	0.600	84.520	84.501	0.019	1020.0	600	11.45	41.6
31.016	31-17	PI 1	5.899	0.600	84.631	84.620	0.011	536.2	600	11.03	42.4
31.015	31-16	31-17	11.460	0.600	84.655	84.631	0.024	477.5	600	10.94	42.6
31.014	31-15	31-16	20.609	0.600	84.691	84.655	0.036	572.5	450	10.76	42.9
37.004	37-4	31-16	26.698	0.600	84.822	84.744	0.078	342.3	375	9.70	45.0
37.003	37-3	37-4	49.639	0.600	84.944	84.822	0.122	406.9	375	9.25	46.1
37.002	37-2	37-3	64.636	0.600	85.144	84.944	0.200	323.2	300	8.32	48.3
40.001	40-1	37-3	74.807	0.600	85.619	85.178	0.441	169.6	225	6.69	50.0
40.000	40-0	40-1	26.496	0.600	85.775	85.619	0.156	169.8	225	5.44	50.0
38.001	38-1	37-2	67.475	0.600	85.420	85.144	0.276	244.5	300	6.85	50.0
37.001	37-1	37-2	73.376	0.600	86.272	85.840	0.432	169.9	225	7.08	50.0
37.000	37-0	37-1	51.420	0.600	86.575	86.272	0.303	169.7	225	5.86	50.0
38.000	38-0	38-1	43.565	0.600	85.677	85.420	0.257	169.5	225	5.73	50.0
39.000	39-0	38-1	6.921	0.600	86.115	86.074	0.041	168.8	225	5.11	50.0
31.013	31-14	31-15	14.958	0.600	84.717	84.691	0.026	575.3	450	10.36	43.7
31.012	31-13	31-14	33.595	0.600	84.775	84.717	0.058	579.2	450	10.06	44.3
31.011	31-12	31-13	55.310	0.600	84.933	84.775	0.158	350.1	400	9.39	45.7
36.004	36-4	31-13	42.767	0.600	86.319	85.891	0.428	100.0	225	6.56	50.0
36.003	36-3	36-4	14.574	0.600	86.465	86.319	0.146	100.0	225	6.01	50.0
36.002	36-2	36-3	11.007	0.600	86.575	86.465	0.110	100.0	225	5.83	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
25.001	1.004	39.9	8.4	1.372	1.691	0.062	0.0	70
25.000	1.001	39.8	0.0	1.200	1.372	0.000	0.0	0
22.003	1.002	125.9	64.5	1.278	1.998	0.476	0.0	203
22.002	1.019	128.1	49.2	1.257	1.278	0.363	0.0	171
24.000	1.001	125.7	1.1	1.155	1.214	0.008	0.0	26
22.001	1.003	126.0	6.6	0.843	1.257	0.049	0.0	62
23.000	1.001	110.5	4.7	0.821	1.225	0.035	0.0	52
22.000	1.006	126.5	3.4	0.750	0.843	0.025	0.0	45
21.004	1.007	126.5	32.8	1.298	1.458	0.254	0.0	139
21.003	1.002	110.7	26.2	1.498	1.323	0.198	0.0	123
21.002	1.001	110.5	12.3	1.039	1.498	0.091	0.0	84
21.001	1.003	110.8	8.0	0.750	1.039	0.059	0.0	68
21.000	1.002	110.7	0.7	0.907	0.750	0.005	0.0	21
31.017	0.754	213.2	225.1	1.320	0.469	1.996	0.0	537
31.016	1.044	295.3	229.3	1.209	1.220	1.996	0.0	399
31.015	1.107	313.1	230.2	1.595	1.209	1.996	0.0	383
31.014	0.842	134.0	121.1	1.809	1.745	1.042	0.0	337
37.004	0.973	107.5	104.3	1.733	1.731	0.854	0.0	299
37.003	0.892	98.5	95.7	1.702	1.733	0.766	0.0	300
37.002	0.869	61.4	61.3	1.803	1.777	0.468	0.0	247
40.001	1.001	39.8	3.5	1.231	1.618	0.026	0.0	45
40.000	1.000	39.8	0.0	1.200	1.231	0.000	0.0	0
38.001	1.001	70.7	19.7	1.427	1.803	0.145	0.0	108
37.001	1.000	39.8	6.9	1.239	1.182	0.051	0.0	63
37.000	1.001	39.8	0.0	1.200	1.239	0.000	0.0	0
38.000	1.001	39.8	4.6	1.450	1.502	0.034	0.0	51
39.000	1.003	39.9	0.0	0.831	0.848	0.000	0.0	0
31.013	0.840	133.6	121.0	1.833	1.809	1.022	0.0	337
31.012	0.837	133.2	116.4	2.006	1.833	0.970	0.0	327
31.011	1.003	126.0	81.3	1.568	2.056	0.656	0.0	234
36.004	1.307	52.0	15.7	1.132	1.115	0.116	0.0	85
36.003	1.307	52.0	14.4	1.264	1.132	0.106	0.0	80
36.002	1.307	52.0	11.9	1.362	1.264	0.088	0.0	73

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
36.001	36-1	36-2	14.673	0.600	86.722	86.575	0.147	100.0	225	5.69	50.0
36.000	36-0	36-1	30.135	0.600	86.900	86.722	0.178	169.3	225	5.50	50.0
31.010	31-11	31-12	29.020	0.600	85.016	84.933	0.083	349.6	400	8.47	47.9
31.009	31-10	31-11	19.192	0.600	85.071	85.016	0.055	348.9	400	7.99	49.2
35.000	35-0	31-11	30.939	0.600	85.659	85.476	0.183	169.1	225	5.51	50.0
31.008	31-9	31-10	8.755	0.600	85.096	85.071	0.025	350.2	400	7.67	50.0
31.007	31-8	31-9	4.633	0.600	85.384	85.369	0.015	308.9	300	7.53	50.0
34.000	33-0	31-9	53.968	0.600	85.675	85.357	0.318	169.7	225	5.90	50.0
31.006	31-7	31-8	53.993	0.600	85.605	85.384	0.221	244.3	300	7.44	50.0
33.002	34-2	31-8	12.512	0.600	85.611	85.537	0.074	169.1	225	5.74	50.0
33.001	34-1	34-2	9.300	0.600	85.666	85.611	0.055	169.1	225	5.53	50.0
33.000	34-0	34-1	22.672	0.600	85.800	85.666	0.134	169.2	225	5.38	50.0
31.005	31-6	31-7	6.674	0.600	85.645	85.605	0.040	166.9	225	6.54	50.0
32.001	32-1	31-7	27.582	0.600	85.980	85.817	0.163	169.2	225	5.87	50.0
32.000	32-0	32-1	24.620	0.600	86.125	85.980	0.145	169.8	225	5.41	50.0
31.004	31-5	31-6	31.472	0.600	85.960	85.645	0.315	100.0	225	6.43	50.0
31.003	31-4	31-5	17.107	0.600	86.174	85.960	0.214	80.0	225	6.03	50.0
31.002	31-2	31-4	13.738	0.600	86.346	86.174	0.172	80.0	225	5.83	50.0
31.001	31-1	31-2	22.282	0.600	86.625	86.346	0.279	80.0	225	5.68	50.0
31.000	31-0	31-1	25.451	0.600	86.775	86.625	0.150	169.7	225	5.42	50.0
41.014	PI 5	Outfall 5	5.314	0.600	85.165	85.148	0.017	312.6	500	11.01	42.4
41.013	41-13	PI 5	5.268	0.600	85.275	85.265	0.010	526.8	500	10.94	42.6
41.012	41-12	41-13	24.728	0.600	85.347	85.275	0.072	343.4	400	10.84	42.7
48.000	48-0	41-13	54.165	0.600	86.300	85.758	0.542	100.0	225	5.69	50.0
41.011	41-11	41-12	14.015	0.600	85.385	85.347	0.038	368.8	400	10.44	43.5
41.010	41-10	41-11	5.101	0.600	85.400	85.385	0.015	340.1	400	10.20	44.0
41.009	41-9	41-10	31.084	0.600	85.674	85.578	0.096	323.8	375	10.11	44.2
47.001	47-1	41-10	49.677	0.600	86.108	85.815	0.293	169.5	225	6.53	50.0
47.000	47-0	47-1	50.028	0.600	86.525	86.108	0.417	120.0	225	5.70	50.0
41.008	41-8	41-9	13.682	0.600	85.717	85.674	0.043	318.2	375	9.60	45.3
46.000	46-0	41-9	9.566	0.600	86.005	85.948	0.057	167.8	225	5.16	50.0
41.007	41-7	41-8	5.218	0.600	85.738	85.717	0.021	248.5	375	9.37	45.8
41.006	41-6	41-7	52.111	0.600	85.899	85.738	0.161	323.7	375	9.29	46.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
36.001	1.307	52.0	8.9	1.436	1.362	0.066	0.0	63
36.000	1.002	39.8	0.0	1.433	1.436	0.000	0.0	0
31.010	1.003	126.1	75.0	1.434	1.568	0.577	0.0	222
31.009	1.004	126.2	65.2	1.789	1.434	0.489	0.0	204
35.000	1.002	39.9	3.4	1.207	1.149	0.025	0.0	44
31.008	1.003	126.0	66.3	1.889	1.789	0.489	0.0	206
31.007	0.889	62.8	59.2	1.703	1.716	0.437	0.0	233
34.000	1.001	39.8	0.0	1.500	1.803	0.000	0.0	0
31.006	1.001	70.8	28.6	1.989	1.703	0.211	0.0	133
33.002	1.002	39.9	11.2	1.486	1.625	0.083	0.0	81
33.001	1.002	39.9	8.7	1.475	1.486	0.064	0.0	71
33.000	1.002	39.8	3.7	1.200	1.475	0.027	0.0	46
31.005	1.009	40.1	24.9	2.130	2.064	0.184	0.0	129
32.001	1.002	39.8	3.1	1.545	1.852	0.023	0.0	43
32.000	1.000	39.8	0.0	1.400	1.545	0.000	0.0	0
31.004	1.307	52.0	17.5	2.165	2.130	0.129	0.0	90
31.003	1.463	58.2	14.6	2.013	2.165	0.108	0.0	77
31.002	1.463	58.2	11.8	1.804	2.013	0.087	0.0	68
31.001	1.463	58.2	8.3	1.610	1.804	0.061	0.0	57
31.000	1.001	39.8	0.0	1.586	1.610	0.000	0.0	0
41.014	1.223	240.1	140.4	1.685	0.752	1.221	0.0	275
41.013	0.939	184.4	140.8	1.575	1.585	1.221	0.0	329
41.012	1.013	127.2	123.1	1.703	1.675	1.063	0.0	319
48.000	1.307	52.0	0.0	0.925	1.367	0.000	0.0	0
41.011	0.977	122.7	121.9	1.605	1.703	1.033	0.0	328
41.010	1.018	127.9	120.5	1.630	1.605	1.010	0.0	311
41.009	1.001	110.6	99.3	1.431	1.477	0.829	0.0	279
47.001	1.001	39.8	7.9	1.217	1.390	0.058	0.0	67
47.000	1.192	47.4	0.0	1.200	1.217	0.000	0.0	0
41.008	1.010	111.6	97.2	1.431	1.431	0.792	0.0	272
46.000	1.006	40.0	0.0	1.200	1.307	0.000	0.0	0
41.007	1.145	126.4	95.0	1.410	1.431	0.765	0.0	244
41.006	1.001	110.6	95.3	1.623	1.410	0.765	0.0	270

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
41.005	41-5	41-6	5.064	0.600	85.920	85.899	0.021	241.1	375	8.43	48.1
41.004	41-4	41-5	45.028	0.600	86.059	85.920	0.139	323.9	375	8.35	48.3
45.000	45-0	41-5	36.295	0.600	86.412	86.198	0.214	169.6	225	5.60	50.0
41.003	41-3	41-4	32.932	0.600	86.194	86.059	0.135	243.9	300	7.60	50.0
42.002	42-2	41-4	17.507	0.600	86.399	86.327	0.072	243.1	300	6.00	50.0
44.000	44-0	41-4	16.241	0.600	86.423	86.327	0.096	169.2	225	5.27	50.0
42.001	42-1	42-2	30.162	0.600	86.523	86.399	0.124	243.2	300	5.71	50.0
43.000	43-0	42-2	11.712	0.600	86.593	86.524	0.069	169.7	225	5.20	50.0
42.000	42-0	42-1	12.458	0.600	86.574	86.523	0.051	244.3	300	5.21	50.0
41.002	41-2	41-3	49.058	0.600	86.395	86.194	0.201	244.1	300	7.06	50.0
41.001	41-1	41-2	45.904	0.600	86.583	86.395	0.188	244.2	300	6.24	50.0
41.000	41-0	41-1	28.592	0.600	86.700	86.583	0.117	244.4	300	5.48	50.0
49.006	PI 2	Outfall 2	4.546	0.600	85.620	85.610	0.010	454.6	450	9.22	46.1
49.005	50-5	PI 2	18.999	0.600	85.821	85.763	0.058	327.6	400	9.14	46.3
49.004	50-4	50-5	82.625	0.600	86.002	85.821	0.181	456.5	400	8.84	47.0
49.003	50-3	50-4	63.994	0.600	86.200	86.002	0.198	323.2	400	7.27	50.0
49.002	50-2	50-3	27.221	0.600	87.200	86.860	0.340	80.0	225	6.25	50.0
49.001	50-1	50-2	36.427	0.600	88.000	87.545	0.455	80.0	225	5.94	50.0
49.000	50-0	50-1	45.692	0.600	88.900	88.329	0.571	80.0	225	5.52	50.0
50.006	PI 6	Outfall 6	5.797	0.600	85.526	85.504	0.022	263.5	450	9.69	45.1
50.005	49-5	PI 6	24.841	0.600	85.680	85.626	0.054	460.0	450	9.62	45.2
50.004	49-4	49-5	35.824	0.600	85.730	85.680	0.050	720.0	450	9.18	46.2
50.003	49-3	49-4	34.665	0.600	85.799	85.730	0.069	500.0	375	8.38	48.2
50.002	49-2	49-3	53.673	0.600	85.906	85.799	0.107	500.0	375	7.66	50.0
50.001	49-1	49-2	20.216	0.600	85.969	85.906	0.063	320.9	375	6.55	50.0
50.000	49-0	49-1	72.790	0.600	86.194	85.969	0.225	323.5	375	6.21	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
41.005	1.162	128.4	99.7	1.584	1.623	0.765	0.0	249
41.004	1.001	110.6	81.2	1.792	1.584	0.621	0.0	240
45.000	1.001	39.8	7.7	0.936	1.456	0.057	0.0	67
41.003	1.002	70.8	25.7	1.006	1.867	0.190	0.0	125
42.002	1.004	70.9	43.8	1.449	1.599	0.323	0.0	171
44.000	1.002	39.8	2.6	1.600	1.674	0.019	0.0	38
42.001	1.003	70.9	28.3	1.173	1.449	0.209	0.0	132
43.000	1.000	39.8	2.4	1.200	1.399	0.018	0.0	37
42.000	1.001	70.8	11.8	0.994	1.173	0.087	0.0	82
41.002	1.002	70.8	19.8	1.105	1.006	0.146	0.0	108
41.001	1.001	70.8	11.7	1.367	1.105	0.086	0.0	82
41.000	1.001	70.8	6.9	1.250	1.367	0.051	0.0	63
49.006	0.947	150.6	50.5	1.030	0.441	0.404	0.0	179
49.005	1.037	130.3	50.7	1.879	0.937	0.404	0.0	173
49.004	0.877	110.2	33.5	2.025	1.879	0.263	0.0	151
49.003	1.044	131.2	20.9	2.231	2.025	0.154	0.0	107
49.002	1.463	58.2	16.0	1.921	1.746	0.118	0.0	80
49.001	1.463	58.2	10.2	1.980	1.576	0.075	0.0	64
49.000	1.463	58.2	0.0	1.916	1.651	0.000	0.0	0
50.006	1.247	198.4	44.3	1.913	0.536	0.363	0.0	144
50.005	0.941	149.7	44.5	1.769	1.813	0.363	0.0	167
50.004	0.750	119.3	39.1	1.554	1.769	0.312	0.0	177
50.003	0.803	88.7	33.3	1.373	1.629	0.255	0.0	159
50.002	0.803	88.7	19.9	0.964	1.373	0.147	0.0	120
50.001	1.006	111.1	17.6	0.847	0.964	0.130	0.0	101
50.000	1.002	110.6	0.0	1.237	0.847	0.000	0.0	0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.017	7.171	652.0	600	Circular	87.100	85.584	0.916	86.490	85.573	0.317
1.016	22.093	789.0	600	Circular	87.570	85.712	1.258	87.100	85.684	0.816
1.015	27.613	1030.0	600	Circular	87.781	85.739	1.442	87.570	85.712	1.258
1.014	13.668	1030.0	600	Circular	87.871	85.752	1.519	87.781	85.739	1.442
1.013	25.701	1030.0	600	Circular	88.078	85.777	1.701	87.871	85.752	1.519
18.004	7.300	504.0	375	Circular	87.871	85.770	1.726	87.871	85.756	1.740
18.003	13.576	504.0	375	Circular	87.724	85.797	1.552	87.871	85.770	1.726
18.002	45.795	322.5	375	Circular	87.900	85.939	1.586	87.724	85.797	1.552
18.001	31.368	243.2	300	Circular	87.750	86.068	1.382	87.900	85.939	1.661
20.000	48.292	169.4	225	Circular	87.550	86.244	1.081	87.900	85.959	1.716
18.000	60.538	169.6	225	Circular	87.800	86.425	1.150	87.750	86.068	1.457
19.001	13.696	169.1	225	Circular	87.600	86.590	0.785	87.750	86.509	1.016
19.000	22.929	169.8	225	Circular	88.150	86.725	1.200	87.600	86.590	0.785
1.012	10.520	634.0	450	Circular	88.157	85.901	1.806	88.078	85.884	1.744
4.016	41.030	1030.0	600	Circular	87.823	85.817	1.406	88.078	85.777	1.701
16.000	35.288	169.7	225	Circular	88.000	86.575	1.200	87.823	86.367	1.231
17.000	33.300	169.0	225	Circular	87.625	86.200	1.200	87.823	86.003	1.595
4.015	32.945	908.0	600	Circular	87.418	85.853	0.965	87.823	85.817	1.406
14.002	13.040	504.0	375	Circular	87.521	85.887	1.259	87.418	85.861	1.182
4.014	21.547	908.0	600	Circular	87.500	85.877	1.023	87.418	85.853	0.965
4.013	19.264	723.0	500	Circular	87.400	85.904	0.996	87.500	85.877	1.123
13.000	29.498	169.5	225	Circular	87.600	86.175	1.200	87.400	86.001	1.174
4.012	28.941	723.0	500	Circular	87.850	85.944	1.406	87.400	85.904	0.996
4.011	6.084	723.0	500	Circular	87.850	85.952	1.398	87.850	85.944	1.406
4.010	27.773	545.0	400	Circular	87.822	86.003	1.419	87.850	85.952	1.498
10.003	19.085	264.0	225	Circular	87.724	86.099	1.400	87.850	86.027	1.598
10.002	18.982	169.5	225	Circular	87.700	86.294	1.181	87.724	86.182	1.317
12.000	16.776	264.0	225	Circular	87.588	86.163	1.200	87.724	86.099	1.400
11.001	26.210	169.1	225	Circular	87.700	86.449	1.026	87.700	86.294	1.181
10.001	34.125	169.8	225	Circular	87.816	86.665	0.926	87.700	86.464	1.011
10.000	16.252	169.3	225	Circular	87.635	86.761	0.649	87.816	86.665	0.926
11.000	12.853	169.1	225	Circular	87.700	86.525	0.950	87.700	86.449	1.026
4.009	19.118	504.0	375	Circular	87.721	86.041	1.305	87.822	86.003	1.444
8.001	28.505	243.6	300	Circular	87.400	86.120	0.980	87.822	86.003	1.519

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.017	PI 4	1500	Manhole	Adoptable	Outfall 4	1500	Manhole	Adoptable
1.016	1-16	2100	Manhole	Adoptable	PI 4	1500	Manhole	Adoptable
1.015	1-15	1500	Manhole	Adoptable	1-16	2100	Manhole	Adoptable
1.014	1-14	1500	Manhole	Adoptable	1-15	1500	Manhole	Adoptable
1.013	1-13	1500	Manhole	Adoptable	1-14	1500	Manhole	Adoptable
18.004	18-4	1350	Manhole	Adoptable	1-14	1500	Manhole	Adoptable
18.003	18-3	1350	Manhole	Adoptable	18-4	1350	Manhole	Adoptable
18.002	18-2	1350	Manhole	Adoptable	18-3	1350	Manhole	Adoptable
18.001	18-1	1200	Manhole	Adoptable	18-2	1350	Manhole	Adoptable
20.000	20-0	1200	Manhole	Adoptable	18-2	1350	Manhole	Adoptable
18.000	18-0	1200	Manhole	Adoptable	18-1	1200	Manhole	Adoptable
19.001	19-1	1200	Manhole	Adoptable	18-1	1200	Manhole	Adoptable
19.000	19-0	1200	Manhole	Adoptable	19-1	1200	Manhole	Adoptable
1.012	1-12	1350	Manhole	Adoptable	1-13	1500	Manhole	Adoptable
4.016	4-16	1500	Manhole	Adoptable	1-13	1500	Manhole	Adoptable
16.000	16-0	1200	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
17.000	17-0	1200	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
4.015	4-15	1500	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
14.002	14-2	1350	Manhole	Adoptable	4-15	1500	Manhole	Adoptable
4.014	4-14	1500	Manhole	Adoptable	4-15	1500	Manhole	Adoptable
4.013	4-13	1500	Manhole	Adoptable	4-14	1500	Manhole	Adoptable
13.000	13-0	1200	Manhole	Adoptable	4-13	1500	Manhole	Adoptable
4.012	4-12	1500	Manhole	Adoptable	4-13	1500	Manhole	Adoptable
4.011	4-11	1500	Manhole	Adoptable	4-12	1500	Manhole	Adoptable
4.010	4-10	1350	Manhole	Adoptable	4-11	1500	Manhole	Adoptable
10.003	10-3	1200	Manhole	Adoptable	4-11	1500	Manhole	Adoptable
10.002	10-2	1200	Manhole	Adoptable	10-3	1200	Manhole	Adoptable
12.000	12-0	1200	Manhole	Adoptable	10-3	1200	Manhole	Adoptable
11.001	11-1	1200	Manhole	Adoptable	10-2	1200	Manhole	Adoptable
10.001	10-1	1200	Manhole	Adoptable	10-2	1200	Manhole	Adoptable
10.000	10-0	1200	Manhole	Adoptable	10-1	1200	Manhole	Adoptable
11.000	11-0	1200	Manhole	Adoptable	11-1	1200	Manhole	Adoptable
4.009	4-9	1350	Manhole	Adoptable	4-10	1350	Manhole	Adoptable
8.001	8-1	1200	Manhole	Adoptable	4-10	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
8.000	44.945	264.0	225	Circular	87.700	86.290	1.185	87.400	86.120	1.055
9.000	44.809	264.0	225	Circular	87.700	86.399	1.076	87.400	86.229	0.946
4.008	27.328	321.5	375	Circular	87.727	86.126	1.226	87.721	86.041	1.305
7.000	59.885	169.6	225	Circular	88.100	86.575	1.300	87.721	86.222	1.274
6.003	23.535	169.3	225	Circular	87.930	86.265	1.440	87.727	86.126	1.376
4.007	52.234	198.6	255	Circular	87.821	86.389	1.177	87.727	86.126	1.346
4.006	11.653	197.5	255	Circular	88.062	86.448	1.359	87.821	86.389	1.177
4.005	4.463	194.1	255	Circular	88.128	86.471	1.402	88.062	86.448	1.359
4.004	27.740	198.1	255	Circular	88.227	86.611	1.361	88.128	86.471	1.402
5.001	38.057	169.1	225	Circular	88.000	86.962	0.813	88.227	86.737	1.265
4.003	25.937	198.0	255	Circular	88.321	86.742	1.324	88.227	86.611	1.361
4.002	35.740	198.6	255	Circular	88.200	86.922	1.023	88.321	86.742	1.324
4.001	3.729	196.3	255	Circular	88.200	86.941	1.004	88.200	86.922	1.023
4.000	28.651	199.0	255	Circular	88.200	87.085	0.860	88.200	86.941	1.004
5.000	27.560	169.1	225	Circular	88.100	87.125	0.750	88.000	86.962	0.813
6.002	28.382	168.9	225	Circular	88.000	86.433	1.342	87.930	86.265	1.440
6.001	39.265	169.2	225	Circular	88.070	86.665	1.180	88.000	86.433	1.342
6.000	34.964	169.7	225	Circular	87.900	86.871	0.804	88.070	86.665	1.180
14.001	49.191	380.0	300	Circular	87.334	86.016	1.018	87.521	85.887	1.334
15.000	37.380	169.1	225	Circular	88.094	86.269	1.600	87.521	86.048	1.248
14.000	52.189	380.0	300	Circular	88.142	86.153	1.689	87.334	86.016	1.018
1.011	12.131	600.0	400	Circular	88.016	85.921	1.695	88.157	85.901	1.856
3.000	40.242	169.8	225	Circular	88.471	86.791	1.455	88.157	86.554	1.378
1.010	47.904	349.7	400	Circular	88.495	86.058	2.037	88.016	85.921	1.695
1.009	28.263	600.0	400	Circular	88.321	86.105	1.816	88.495	86.058	2.037
1.008	64.345	504.0	375	Circular	88.553	86.233	1.945	88.321	86.105	1.841
1.007	45.197	504.0	375	Circular	88.681	86.323	1.983	88.553	86.233	1.945
1.006	61.852	504.0	375	Circular	88.523	86.446	1.702	88.681	86.323	1.983
1.005	43.656	504.0	375	Circular	88.201	86.533	1.293	88.523	86.446	1.702
2.000	30.803	169.2	225	Circular	88.588	87.163	1.200	88.523	86.981	1.317
1.004	41.714	323.4	375	Circular	88.050	86.662	1.013	88.201	86.533	1.293
1.003	17.750	322.7	375	Circular	88.150	86.717	1.058	88.050	86.662	1.013
1.002	32.342	323.4	375	Circular	88.200	86.817	1.008	88.150	86.717	1.058
1.001	38.395	322.6	375	Circular	88.200	86.936	0.889	88.200	86.817	1.008

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
8.000	8-0	1200	Manhole	Adoptable	8-1	1200	Manhole	Adoptable
9.000	9-0	1200	Manhole	Adoptable	8-1	1200	Manhole	Adoptable
4.008	4-8	1350	Manhole	Adoptable	4-9	1350	Manhole	Adoptable
7.000	7-0	1200	Manhole	Adoptable	4-9	1350	Manhole	Adoptable
6.003	6-3	1200	Manhole	Adoptable	4-8	1350	Manhole	Adoptable
4.007	4-7	1200	Manhole	Adoptable	4-8	1350	Manhole	Adoptable
4.006	4-6	1200	Manhole	Adoptable	4-7	1200	Manhole	Adoptable
4.005	4-5	1200	Manhole	Adoptable	4-6	1200	Manhole	Adoptable
4.004	4-4	1200	Manhole	Adoptable	4-5	1200	Manhole	Adoptable
5.001	5-1	1200	Manhole	Adoptable	4-4	1200	Manhole	Adoptable
4.003	4-3	1200	Manhole	Adoptable	4-4	1200	Manhole	Adoptable
4.002	4-2	1200	Manhole	Adoptable	4-3	1200	Manhole	Adoptable
4.001	4-1	1200	Manhole	Adoptable	4-2	1200	Manhole	Adoptable
4.000	4-0	1200	Manhole	Adoptable	4-1	1200	Manhole	Adoptable
5.000	5-0	1200	Manhole	Adoptable	5-1	1200	Manhole	Adoptable
6.002	6-2	1200	Manhole	Adoptable	6-3	1200	Manhole	Adoptable
6.001	6-1	1200	Manhole	Adoptable	6-2	1200	Manhole	Adoptable
6.000	6-0	1200	Manhole	Adoptable	6-1	1200	Manhole	Adoptable
14.001	14-1	1200	Manhole	Adoptable	14-2	1350	Manhole	Adoptable
15.000	15-0	1200	Manhole	Adoptable	14-2	1350	Manhole	Adoptable
14.000	14-0	1200	Manhole	Adoptable	14-1	1200	Manhole	Adoptable
1.011	1-11	1800	Manhole	Adoptable	1-12	1350	Manhole	Adoptable
3.000	3-0	1200	Manhole	Adoptable	1-12	1350	Manhole	Adoptable
1.010	1-10	1350	Manhole	Adoptable	1-11	1800	Manhole	Adoptable
1.009	1-9	1350	Manhole	Adoptable	1-10	1350	Manhole	Adoptable
1.008	1-8	1350	Manhole	Adoptable	1-9	1350	Manhole	Adoptable
1.007	1-7	1350	Manhole	Adoptable	1-8	1350	Manhole	Adoptable
1.006	1-6	1350	Manhole	Adoptable	1-7	1350	Manhole	Adoptable
1.005	1-5	1350	Manhole	Adoptable	1-6	1350	Manhole	Adoptable
2.000	2-0	1200	Manhole	Adoptable	1-6	1350	Manhole	Adoptable
1.004	1-4	1350	Manhole	Adoptable	1-5	1350	Manhole	Adoptable
1.003	1-3	1350	Manhole	Adoptable	1-4	1350	Manhole	Adoptable
1.002	1-2	1350	Manhole	Adoptable	1-3	1350	Manhole	Adoptable
1.001	1-1	1350	Manhole	Adoptable	1-2	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	20.719	323.7	375	Circular	88.550	87.000	1.175	88.200	86.936	0.889
21.015	34.110	578.1	600	Circular	88.070	85.997	1.473	87.300	85.938	0.762
21.014	3.768	538.3	600	Circular	88.070	86.104	1.366	88.070	86.097	1.373
21.013	35.358	1030.0	600	Circular	88.850	86.138	2.112	88.070	86.104	1.366
21.012	31.554	1030.0	600	Circular	88.730	86.169	1.961	88.850	86.138	2.112
30.002	19.913	168.8	225	Circular	88.800	86.896	1.679	88.850	86.778	1.847
30.001	28.062	169.0	225	Circular	88.700	87.062	1.413	88.800	86.896	1.679
30.000	36.134	137.4	225	Circular	88.750	87.325	1.200	88.700	87.062	1.413
21.011	65.244	1030.0	600	Circular	88.117	86.232	1.285	88.730	86.169	1.961
29.005	35.580	169.4	225	Circular	88.851	86.487	2.139	88.730	86.277	2.228
29.004	32.236	163.6	225	Circular	88.880	86.684	1.971	88.851	86.487	2.139
29.003	16.189	168.6	225	Circular	88.782	86.780	1.777	88.880	86.684	1.971
29.002	52.121	169.2	225	Circular	88.289	87.088	0.976	88.782	86.780	1.777
29.001	12.256	167.9	225	Circular	88.500	87.161	1.114	88.289	87.088	0.976
29.000	37.960	169.5	225	Circular	88.510	87.385	0.900	88.500	87.161	1.114
21.010	23.315	582.9	500	Circular	87.929	86.272	1.157	88.117	86.232	1.385
27.001	43.903	1030.0	600	Circular	87.900	86.275	1.025	88.117	86.232	1.285
28.001	32.739	324.2	375	Circular	87.846	86.333	1.138	88.117	86.232	1.510
28.000	46.846	323.1	375	Circular	88.108	86.478	1.255	87.846	86.333	1.138
27.000	48.356	1030.0	600	Circular	88.114	86.322	1.192	87.900	86.275	1.025
21.009	43.935	578.1	500	Circular	88.083	86.348	1.235	87.929	86.272	1.157
21.008	15.307	566.9	500	Circular	88.218	86.375	1.343	88.083	86.348	1.235
21.007	14.038	561.5	500	Circular	88.161	86.400	1.261	88.218	86.375	1.343
21.006	51.829	462.8	500	Circular	88.369	86.512	1.357	88.161	86.400	1.261
21.005	22.318	348.7	400	Circular	88.456	86.598	1.458	88.369	86.534	1.435
22.007	6.699	394.1	400	Circular	88.500	86.529	1.571	88.369	86.512	1.457
22.006	18.119	402.7	400	Circular	88.890	86.574	1.916	88.500	86.529	1.571
22.005	15.182	399.5	400	Circular	88.931	86.612	1.919	88.890	86.574	1.916
26.001	33.167	169.2	225	Circular	88.550	87.022	1.303	88.890	86.826	1.839
26.000	17.489	169.8	225	Circular	88.550	87.125	1.200	88.550	87.022	1.303
22.004	49.431	350.6	400	Circular	89.151	86.753	1.998	88.931	86.612	1.919
25.001	14.843	168.7	225	Circular	88.700	87.103	1.372	88.931	87.015	1.691
25.000	29.832	169.5	225	Circular	88.704	87.279	1.200	88.700	87.103	1.372
22.003	46.319	350.9	400	Circular	88.563	86.885	1.278	89.151	86.753	1.998

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1-0	1350	Manhole	Adoptable	1-1	1350	Manhole	Adoptable
21.015	PI 3	1500	Manhole	Adoptable	Outfall 3	1500	Manhole	Adoptable
21.014	21-14	1500	Manhole	Adoptable	PI 3	1500	Manhole	Adoptable
21.013	21-13	1500	Manhole	Adoptable	21-14	1500	Manhole	Adoptable
21.012	21-12	1500	Manhole	Adoptable	21-13	1500	Manhole	Adoptable
30.002	30-2	1200	Manhole	Adoptable	21-13	1500	Manhole	Adoptable
30.001	30-1	1200	Manhole	Adoptable	30-2	1200	Manhole	Adoptable
30.000	30-0	1200	Manhole	Adoptable	30-1	1200	Manhole	Adoptable
21.011	21-11	1500	Manhole	Adoptable	21-12	1500	Manhole	Adoptable
29.005	29-5	1200	Manhole	Adoptable	21-12	1500	Manhole	Adoptable
29.004	29-4	1200	Manhole	Adoptable	29-5	1200	Manhole	Adoptable
29.003	29-3	1200	Manhole	Adoptable	29-4	1200	Manhole	Adoptable
29.002	29-2	1200	Manhole	Adoptable	29-3	1200	Manhole	Adoptable
29.001	29-1	1200	Manhole	Adoptable	29-2	1200	Manhole	Adoptable
29.000	29-0	1200	Manhole	Adoptable	29-1	1200	Manhole	Adoptable
21.010	21-10	1500	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
27.001	27-1	1500	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
28.001	28-1	1350	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
28.000	28-0	1350	Manhole	Adoptable	28-1	1350	Manhole	Adoptable
27.000	27-0	1500	Manhole	Adoptable	27-1	1500	Manhole	Adoptable
21.009	21-9	1500	Manhole	Adoptable	21-10	1500	Manhole	Adoptable
21.008	21-8	1500	Manhole	Adoptable	21-9	1500	Manhole	Adoptable
21.007	21-7	1500	Manhole	Adoptable	21-8	1500	Manhole	Adoptable
21.006	21-6	1500	Manhole	Adoptable	21-7	1500	Manhole	Adoptable
21.005	21-5	1350	Manhole	Adoptable	21-6	1500	Manhole	Adoptable
22.007	22-7	1350	Manhole	Adoptable	21-6	1500	Manhole	Adoptable
22.006	22-6	1350	Manhole	Adoptable	22-7	1350	Manhole	Adoptable
22.005	22-5	1350	Manhole	Adoptable	22-6	1350	Manhole	Adoptable
26.001	26-1	1200	Manhole	Adoptable	22-6	1350	Manhole	Adoptable
26.000	26-0	1200	Manhole	Adoptable	26-1	1200	Manhole	Adoptable
22.004	22-4	1350	Manhole	Adoptable	22-5	1350	Manhole	Adoptable
25.001	25-1	1200	Manhole	Adoptable	22-5	1350	Manhole	Adoptable
25.000	25-0	1200	Manhole	Adoptable	25-1	1200	Manhole	Adoptable
22.003	22-3	1350	Manhole	Adoptable	22-4	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
22.002	7.454	338.8	400	Circular	88.564	86.907	1.257	88.563	86.885	1.278
24.000	53.093	351.6	400	Circular	88.655	87.100	1.155	88.563	86.949	1.214
22.001	51.789	349.9	400	Circular	88.298	87.055	0.843	88.564	86.907	1.257
23.000	63.858	324.2	375	Circular	88.357	87.161	0.821	88.564	86.964	1.225
22.000	13.905	347.6	400	Circular	88.245	87.095	0.750	88.298	87.055	0.843
21.004	24.650	347.2	400	Circular	88.367	86.669	1.298	88.456	86.598	1.458
21.003	48.146	323.1	375	Circular	88.691	86.818	1.498	88.367	86.669	1.323
21.002	56.065	324.1	375	Circular	88.405	86.991	1.039	88.691	86.818	1.498
21.001	35.179	322.7	375	Circular	88.225	87.100	0.750	88.405	86.991	1.039
21.000	51.042	323.0	375	Circular	88.540	87.258	0.907	88.225	87.100	0.750
31.017	18.902	1020.0	600	Circular	86.440	84.520	1.320	85.570	84.501	0.469
31.016	5.899	536.2	600	Circular	86.440	84.631	1.209	86.440	84.620	1.220
31.015	11.460	477.5	600	Circular	86.850	84.655	1.595	86.440	84.631	1.209
31.014	20.609	572.5	450	Circular	86.950	84.691	1.809	86.850	84.655	1.745
37.004	26.698	342.3	375	Circular	86.930	84.822	1.733	86.850	84.744	1.731
37.003	49.639	406.9	375	Circular	87.021	84.944	1.702	86.930	84.822	1.733
37.002	64.636	323.2	300	Circular	87.247	85.144	1.803	87.021	84.944	1.777
40.001	74.807	169.6	225	Circular	87.075	85.619	1.231	87.021	85.178	1.618
40.000	26.496	169.8	225	Circular	87.200	85.775	1.200	87.075	85.619	1.231
38.001	67.475	244.5	300	Circular	87.147	85.420	1.427	87.247	85.144	1.803
37.001	73.376	169.9	225	Circular	87.736	86.272	1.239	87.247	85.840	1.182
37.000	51.420	169.7	225	Circular	88.000	86.575	1.200	87.736	86.272	1.239
38.000	43.565	169.5	225	Circular	87.352	85.677	1.450	87.147	85.420	1.502
39.000	6.921	168.8	225	Circular	87.171	86.115	0.831	87.147	86.074	0.848
31.013	14.958	575.3	450	Circular	87.000	84.717	1.833	86.950	84.691	1.809
31.012	33.595	579.2	450	Circular	87.231	84.775	2.006	87.000	84.717	1.833
31.011	55.310	350.1	400	Circular	86.901	84.933	1.568	87.231	84.775	2.056
36.004	42.767	100.0	225	Circular	87.676	86.319	1.132	87.231	85.891	1.115
36.003	14.574	100.0	225	Circular	87.954	86.465	1.264	87.676	86.319	1.132
36.002	11.007	100.0	225	Circular	88.162	86.575	1.362	87.954	86.465	1.264
36.001	14.673	100.0	225	Circular	88.383	86.722	1.436	88.162	86.575	1.362
36.000	30.135	169.3	225	Circular	88.558	86.900	1.433	88.383	86.722	1.436
31.010	29.020	349.6	400	Circular	86.850	85.016	1.434	86.901	84.933	1.568
31.009	19.192	348.9	400	Circular	87.260	85.071	1.789	86.850	85.016	1.434

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
22.002	22-2	1350	Manhole	Adoptable	22-3	1350	Manhole	Adoptable
24.000	24-0	1350	Manhole	Adoptable	22-3	1350	Manhole	Adoptable
22.001	22-1	1350	Manhole	Adoptable	22-2	1350	Manhole	Adoptable
23.000	23-0	1350	Manhole	Adoptable	22-2	1350	Manhole	Adoptable
22.000	22-0	1350	Manhole	Adoptable	22-1	1350	Manhole	Adoptable
21.004	21-4	1350	Manhole	Adoptable	21-5	1350	Manhole	Adoptable
21.003	21-3	1350	Manhole	Adoptable	21-4	1350	Manhole	Adoptable
21.002	21-2	1350	Manhole	Adoptable	21-3	1350	Manhole	Adoptable
21.001	21-1	1350	Manhole	Adoptable	21-2	1350	Manhole	Adoptable
21.000	21-0	1350	Manhole	Adoptable	21-1	1350	Manhole	Adoptable
31.017	PI 1	1500	Manhole	Adoptable	Outfall 1	1500	Manhole	Adoptable
31.016	31-17	2100	Manhole	Adoptable	PI 1	1500	Manhole	Adoptable
31.015	31-16	1500	Manhole	Adoptable	31-17	2100	Manhole	Adoptable
31.014	31-15	1350	Manhole	Adoptable	31-16	1500	Manhole	Adoptable
37.004	37-4	1350	Manhole	Adoptable	31-16	1500	Manhole	Adoptable
37.003	37-3	1350	Manhole	Adoptable	37-4	1350	Manhole	Adoptable
37.002	37-2	1200	Manhole	Adoptable	37-3	1350	Manhole	Adoptable
40.001	40-1	1200	Manhole	Adoptable	37-3	1350	Manhole	Adoptable
40.000	40-0	1200	Manhole	Adoptable	40-1	1200	Manhole	Adoptable
38.001	38-1	1200	Manhole	Adoptable	37-2	1200	Manhole	Adoptable
37.001	37-1	1200	Manhole	Adoptable	37-2	1200	Manhole	Adoptable
37.000	37-0	1200	Manhole	Adoptable	37-1	1200	Manhole	Adoptable
38.000	38-0	1200	Manhole	Adoptable	38-1	1200	Manhole	Adoptable
39.000	39-0	1200	Manhole	Adoptable	38-1	1200	Manhole	Adoptable
31.013	31-14	1350	Manhole	Adoptable	31-15	1350	Manhole	Adoptable
31.012	31-13	1350	Manhole	Adoptable	31-14	1350	Manhole	Adoptable
31.011	31-12	1350	Manhole	Adoptable	31-13	1350	Manhole	Adoptable
36.004	36-4	1200	Manhole	Adoptable	31-13	1350	Manhole	Adoptable
36.003	36-3	1200	Manhole	Adoptable	36-4	1200	Manhole	Adoptable
36.002	36-2	1200	Manhole	Adoptable	36-3	1200	Manhole	Adoptable
36.001	36-1	1200	Manhole	Adoptable	36-2	1200	Manhole	Adoptable
36.000	36-0	1200	Manhole	Adoptable	36-1	1200	Manhole	Adoptable
31.010	31-11	1350	Manhole	Adoptable	31-12	1350	Manhole	Adoptable
31.009	31-10	1800	Manhole	Adoptable	31-11	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
35.000	30.939	169.1	225	Circular	87.091	85.659	1.207	86.850	85.476	1.149
31.008	8.755	350.2	400	Circular	87.385	85.096	1.889	87.260	85.071	1.789
31.007	4.633	308.9	300	Circular	87.387	85.384	1.703	87.385	85.369	1.716
34.000	53.968	169.7	225	Circular	87.400	85.675	1.500	87.385	85.357	1.803
31.006	53.993	244.3	300	Circular	87.894	85.605	1.989	87.387	85.384	1.703
33.002	12.512	169.1	225	Circular	87.322	85.611	1.486	87.387	85.537	1.625
33.001	9.300	169.1	225	Circular	87.366	85.666	1.475	87.322	85.611	1.486
33.000	22.672	169.2	225	Circular	87.225	85.800	1.200	87.366	85.666	1.475
31.005	6.674	166.9	225	Circular	88.000	85.645	2.130	87.894	85.605	2.064
32.001	27.582	169.2	225	Circular	87.750	85.980	1.545	87.894	85.817	1.852
32.000	24.620	169.8	225	Circular	87.750	86.125	1.400	87.750	85.980	1.545
31.004	31.472	100.0	225	Circular	88.350	85.960	2.165	88.000	85.645	2.130
31.003	17.107	80.0	225	Circular	88.412	86.174	2.013	88.350	85.960	2.165
31.002	13.738	80.0	225	Circular	88.375	86.346	1.804	88.412	86.174	2.013
31.001	22.282	80.0	225	Circular	88.460	86.625	1.610	88.375	86.346	1.804
31.000	25.451	169.7	225	Circular	88.586	86.775	1.586	88.460	86.625	1.610
41.014	5.314	312.6	500	Circular	87.350	85.165	1.685	86.400	85.148	0.752
41.013	5.268	526.8	500	Circular	87.350	85.275	1.575	87.350	85.265	1.585
41.012	24.728	343.4	400	Circular	87.450	85.347	1.703	87.350	85.275	1.675
48.000	54.165	100.0	225	Circular	87.450	86.300	0.925	87.350	85.758	1.367
41.011	14.015	368.8	400	Circular	87.390	85.385	1.605	87.450	85.347	1.703
41.010	5.101	340.1	400	Circular	87.430	85.400	1.630	87.390	85.385	1.605
41.009	31.084	323.8	375	Circular	87.480	85.674	1.431	87.430	85.578	1.477
47.001	49.677	169.5	225	Circular	87.550	86.108	1.217	87.430	85.815	1.390
47.000	50.028	120.0	225	Circular	87.950	86.525	1.200	87.550	86.108	1.217
41.008	13.682	318.2	375	Circular	87.523	85.717	1.431	87.480	85.674	1.431
46.000	9.566	167.8	225	Circular	87.430	86.005	1.200	87.480	85.948	1.307
41.007	5.218	248.5	375	Circular	87.523	85.738	1.410	87.523	85.717	1.431
41.006	52.111	323.7	375	Circular	87.897	85.899	1.623	87.523	85.738	1.410
41.005	5.064	241.1	375	Circular	87.879	85.920	1.584	87.897	85.899	1.623
41.004	45.028	323.9	375	Circular	88.226	86.059	1.792	87.879	85.920	1.584
45.000	36.295	169.6	225	Circular	87.573	86.412	0.936	87.879	86.198	1.456
41.003	32.932	243.9	300	Circular	87.500	86.194	1.006	88.226	86.059	1.867
42.002	17.507	243.1	300	Circular	88.148	86.399	1.449	88.226	86.327	1.599

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
35.000	35-0	1200	Manhole	Adoptable	31-11	1350	Manhole	Adoptable
31.008	31-9	1350	Manhole	Adoptable	31-10	1800	Manhole	Adoptable
31.007	31-8	1200	Manhole	Adoptable	31-9	1350	Manhole	Adoptable
34.000	33-0	1200	Manhole	Adoptable	31-9	1350	Manhole	Adoptable
31.006	31-7	1200	Manhole	Adoptable	31-8	1200	Manhole	Adoptable
33.002	34-2	1200	Manhole	Adoptable	31-8	1200	Manhole	Adoptable
33.001	34-1	1200	Manhole	Adoptable	34-2	1200	Manhole	Adoptable
33.000	34-0	1200	Manhole	Adoptable	34-1	1200	Manhole	Adoptable
31.005	31-6	1200	Manhole	Adoptable	31-7	1200	Manhole	Adoptable
32.001	32-1	1200	Manhole	Adoptable	31-7	1200	Manhole	Adoptable
32.000	32-0	1200	Manhole	Adoptable	32-1	1200	Manhole	Adoptable
31.004	31-5	1200	Manhole	Adoptable	31-6	1200	Manhole	Adoptable
31.003	31-4	1200	Manhole	Adoptable	31-5	1200	Manhole	Adoptable
31.002	31-2	1200	Manhole	Adoptable	31-4	1200	Manhole	Adoptable
31.001	31-1	1200	Manhole	Adoptable	31-2	1200	Manhole	Adoptable
31.000	31-0	1200	Manhole	Adoptable	31-1	1200	Manhole	Adoptable
41.014	PI 5	1500	Manhole	Adoptable	Outfall 5	1500	Manhole	Adoptable
41.013	41-13	1800	Manhole	Adoptable	PI 5	1500	Manhole	Adoptable
41.012	41-12	1800	Manhole	Adoptable	41-13	1800	Manhole	Adoptable
48.000	48-0	1200	Manhole	Adoptable	41-13	1800	Manhole	Adoptable
41.011	41-11	1350	Manhole	Adoptable	41-12	1800	Manhole	Adoptable
41.010	41-10	1350	Manhole	Adoptable	41-11	1350	Manhole	Adoptable
41.009	41-9	1350	Manhole	Adoptable	41-10	1350	Manhole	Adoptable
47.001	47-1	1200	Manhole	Adoptable	41-10	1350	Manhole	Adoptable
47.000	47-0	1200	Manhole	Adoptable	47-1	1200	Manhole	Adoptable
41.008	41-8	1350	Manhole	Adoptable	41-9	1350	Manhole	Adoptable
46.000	46-0	1200	Manhole	Adoptable	41-9	1350	Manhole	Adoptable
41.007	41-7	1350	Manhole	Adoptable	41-8	1350	Manhole	Adoptable
41.006	41-6	1350	Manhole	Adoptable	41-7	1350	Manhole	Adoptable
41.005	41-5	1350	Manhole	Adoptable	41-6	1350	Manhole	Adoptable
41.004	41-4	1350	Manhole	Adoptable	41-5	1350	Manhole	Adoptable
45.000	45-0	1200	Manhole	Adoptable	41-5	1350	Manhole	Adoptable
41.003	41-3	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable
42.002	42-2	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
44.000	16.241	169.2	225	Circular	88.248	86.423	1.600	88.226	86.327	1.674
42.001	30.162	243.2	300	Circular	87.996	86.523	1.173	88.148	86.399	1.449
43.000	11.712	169.7	225	Circular	88.018	86.593	1.200	88.148	86.524	1.399
42.000	12.458	244.3	300	Circular	87.868	86.574	0.994	87.996	86.523	1.173
41.002	49.058	244.1	300	Circular	87.800	86.395	1.105	87.500	86.194	1.006
41.001	45.904	244.2	300	Circular	88.250	86.583	1.367	87.800	86.395	1.105
41.000	28.592	244.4	300	Circular	88.250	86.700	1.250	88.250	86.583	1.367
49.006	4.546	454.6	450	Circular	87.100	85.620	1.030	86.501	85.610	0.441
49.005	18.999	327.6	400	Circular	88.100	85.821	1.879	87.100	85.763	0.937
49.004	82.625	456.5	400	Circular	88.427	86.002	2.025	88.100	85.821	1.879
49.003	63.994	323.2	400	Circular	88.831	86.200	2.231	88.427	86.002	2.025
49.002	27.221	80.0	225	Circular	89.346	87.200	1.921	88.831	86.860	1.746
49.001	36.427	80.0	225	Circular	90.205	88.000	1.980	89.346	87.545	1.576
49.000	45.692	80.0	225	Circular	91.041	88.900	1.916	90.205	88.329	1.651
50.006	5.797	263.5	450	Circular	87.889	85.526	1.913	86.490	85.504	0.536
50.005	24.841	460.0	450	Circular	87.899	85.680	1.769	87.889	85.626	1.813
50.004	35.824	720.0	450	Circular	87.734	85.730	1.554	87.899	85.680	1.769
50.003	34.665	500.0	375	Circular	87.547	85.799	1.373	87.734	85.730	1.629
50.002	53.673	500.0	375	Circular	87.245	85.906	0.964	87.547	85.799	1.373
50.001	20.216	320.9	375	Circular	87.191	85.969	0.847	87.245	85.906	0.964
50.000	72.790	323.5	375	Circular	87.806	86.194	1.237	87.191	85.969	0.847

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
44.000	44-0	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable
42.001	42-1	1200	Manhole	Adoptable	42-2	1200	Manhole	Adoptable
43.000	43-0	1200	Manhole	Adoptable	42-2	1200	Manhole	Adoptable
42.000	42-0	1200	Manhole	Adoptable	42-1	1200	Manhole	Adoptable
41.002	41-2	1200	Manhole	Adoptable	41-3	1200	Manhole	Adoptable
41.001	41-1	1200	Manhole	Adoptable	41-2	1200	Manhole	Adoptable
41.000	41-0	1200	Manhole	Adoptable	41-1	1200	Manhole	Adoptable
49.006	PI 2	1350	Manhole	Adoptable	Outfall 2	1350	Manhole	Adoptable
49.005	50-5	1350	Manhole	Adoptable	PI 2	1350	Manhole	Adoptable
49.004	50-4	1350	Manhole	Adoptable	50-5	1350	Manhole	Adoptable
49.003	50-3	1350	Manhole	Adoptable	50-4	1350	Manhole	Adoptable
49.002	50-2	1200	Manhole	Adoptable	50-3	1350	Manhole	Adoptable
49.001	50-1	1200	Manhole	Adoptable	50-2	1200	Manhole	Adoptable
49.000	50-0	1200	Manhole	Adoptable	50-1	1200	Manhole	Adoptable
50.006	PI 6	1350	Manhole	Adoptable	Outfall 6	1350	Manhole	Adoptable
50.005	49-5	1350	Manhole	Adoptable	PI 6	1350	Manhole	Adoptable
50.004	49-4	1350	Manhole	Adoptable	49-5	1350	Manhole	Adoptable
50.003	49-3	1350	Manhole	Adoptable	49-4	1350	Manhole	Adoptable
50.002	49-2	1350	Manhole	Adoptable	49-3	1350	Manhole	Adoptable
50.001	49-1	1350	Manhole	Adoptable	49-2	1350	Manhole	Adoptable
50.000	49-0	1350	Manhole	Adoptable	49-1	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-0	681728.297	714559.265	88.550	1.550	1350				
						0	1.000	87.000	375
1-1	681727.082	714579.948	88.200	1.264	1350		1	1.000	86.936	375
						0	1.001	86.936	375
1-2	681729.935	714618.237	88.200	1.383	1350		1	1.001	86.817	375
						0	1.002	86.817	375
1-3	681724.880	714650.182	88.150	1.433	1350		1	1.002	86.717	375
						0	1.003	86.717	375
1-4	681726.157	714667.886	88.050	1.388	1350		1	1.003	86.662	375
						0	1.004	86.662	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-5	681706.946	714704.913	88.201	1.668	1350	1	1.004	86.533	375
						0	1.005	86.533	375
2-0	681654.345	714711.728	88.588	1.425	1200	0	2.000	87.163	225
1-6	681668.442	714684.340	88.523	2.077	1350	1	2.000	86.981	225
						2	1.005	86.446	375
						0	1.006	86.446	375
1-7	681613.809	714655.342	88.681	2.358	1350	1	1.006	86.323	375
						0	1.007	86.323	375
1-8	681573.837	714634.246	88.553	2.320	1350	1	1.007	86.233	375
						0	1.008	86.233	375
1-9	681516.849	714604.369	88.321	2.216	1350	1	1.008	86.105	375
						0	1.009	86.105	400
1-10	681489.411	714611.148	88.495	2.437	1350	1	1.009	86.058	400
						0	1.010	86.058	400
1-11	681465.859	714652.863	88.016	2.095	1800	1	1.010	85.921	400
						0	1.011	85.921	400
3-0	681495.121	714623.928	88.471	1.680	1200	0	3.000	86.791	225
1-12	681476.088	714659.384	88.157	2.256	1350	1	3.000	86.554	225
						2	1.011	85.901	400
						0	1.012	85.901	450
4-0	681714.921	714722.862	88.200	1.115	1200	0	4.000	87.085	255
4-1	681700.576	714747.663	88.200	1.259	1200	1	4.000	86.941	255
						0	4.001	86.941	255
4-2	681696.983	714746.664	88.200	1.278	1200	1	4.001	86.922	255
						0	4.002	86.922	255
4-3	681679.139	714777.631	88.321	1.579	1200	1	4.002	86.742	255
						0	4.003	86.742	255
5-0	681687.188	714707.538	88.100	0.975	1200	0	5.000	87.125	225
5-1	681674.194	714731.842	88.000	1.038	1200	1	5.000	86.962	225
						0	5.001	86.962	225
4-4	681656.262	714765.409	88.227	1.616	1200	1	5.001	86.737	225
						2	4.003	86.611	255
						0	4.004	86.611	255

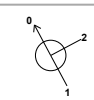
Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
4-5	681631.788	714752.351	88.128	1.657	1200	1	4.004	86.471	255
						0	4.005	86.471	255
4-6	681629.584	714756.232	88.062	1.614	1200	1	4.005	86.448	255
						0	4.006	86.448	255
4-7	681618.718	714752.021	87.821	1.432	1200	1	4.006	86.389	255
						0	4.007	86.389	255
6-0	681651.744	714821.450	87.900	1.029	1200	0	6.000	86.871	225
6-1	681635.217	714852.261	88.070	1.405	1200	1	6.000	86.665	225
						0	6.001	86.665	225
6-2	681600.572	714833.783	88.000	1.567	1200	1	6.001	86.433	225
						0	6.002	86.433	225
6-3	681613.963	714808.759	87.930	1.665	1200	1	6.002	86.265	225
						0	6.003	86.265	225
4-8	681593.233	714797.616	87.727	1.601	1350	1	6.003	86.126	225
						2	4.007	86.126	255
						0	4.008	86.126	375
7-0	681598.010	714732.199	88.100	1.525	1200	0	7.000	86.575	225
4-9	681569.162	714784.678	87.721	1.680	1350	1	7.000	86.222	225
						2	4.008	86.041	375
						0	4.009	86.041	375
8-0	681578.569	714821.954	87.700	1.410	1200	0	8.000	86.290	225
9-0	681499.419	714779.633	87.700	1.301	1200	0	9.000	86.399	225
8-1	681538.921	714800.785	87.400	1.280	1200	1	9.000	86.229	225
						2	8.000	86.120	225
						0	8.001	86.120	300
4-10	681552.322	714775.627	87.822	1.819	1350	1	8.001	86.003	300
						2	4.009	86.003	375
						0	4.010	86.003	400
10-0	681456.887	714742.982	87.635	0.874	1200	0	10.000	86.761	225
10-1	681464.184	714728.460	87.816	1.151	1200	1	10.000	86.665	225
						0	10.001	86.665	225
11-0	681470.270	714761.709	87.700	1.175	1200	0	11.000	86.525	225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
11-1	681481.748	714767.493	87.700	1.251	1200	1	11.000	86.449	225
						0	11.001	86.449	225
10-2	681494.310	714744.490	87.700	1.406	1200	1	11.001	86.294	225
						2	10.001	86.464	225
						0	10.002	86.294	225
12-0	681518.601	714738.418	87.588	1.425	1200				
						0	12.000	86.163	225
10-3	681511.067	714753.407	87.724	1.625	1200	1	12.000	86.099	225
						2	10.002	86.182	225
						0	10.003	86.099	225
4-11	681527.859	714762.478	87.850	1.898	1500	1	10.003	86.027	225
						2	4.010	85.952	400
						0	4.011	85.952	500
4-12	681530.789	714757.146	87.850	1.906	1500	1	4.011	85.944	500
						0	4.012	85.944	500
13-0	681570.228	714744.973	87.600	1.425	1200				
						0	13.000	86.175	225
4-13	681544.032	714731.413	87.400	1.496	1500	1	13.000	86.001	225
						2	4.012	85.904	500
						0	4.013	85.904	500
4-14	681526.924	714722.557	87.500	1.623	1500	1	4.013	85.877	500
						0	4.014	85.877	600
14-0	681632.181	714739.287	88.142	1.989	1200				
						0	14.000	86.153	300
14-1	681586.068	714714.847	87.334	1.318	1200	1	14.000	86.016	300
						0	14.001	86.016	300
15-0	681560.301	714658.807	88.094	1.825	1200				
						0	15.000	86.269	225
14-2	681542.637	714691.750	87.521	1.634	1350	1	15.000	86.048	225
									
						2	14.001	85.887	300
						0	14.002	85.887	375
4-15	681536.496	714703.253	87.418	1.565	1500	1	14.002	85.861	375
						2	4.014	85.853	600
						0	4.015	85.853	600
16-0	681524.006	714656.720	88.000	1.425	1200				
						0	16.000	86.575	225
17-0	681491.700	714717.223	87.625	1.425	1200				
						0	17.000	86.200	225
4-16	681507.377	714687.844	87.823	2.006	1500	1	17.000	86.003	225
						2	16.000	86.367	225
						3	4.015	85.817	600
						0	4.016	85.817	600

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-13	681471.112	714668.653	88.078	2.301	1500	1	4.016	85.777	600
						2	1.012	85.884	450
						0	1.013	85.777	600
18-0	681422.878	714707.549	87.800	1.375	1200	0	18.000	86.425	225
19-0	681367.542	714630.246	88.150	1.425	1200	0	19.000	86.725	225
19-1	681380.523	714649.147	87.600	1.010	1200	1	19.000	86.590	225
						0	19.001	86.590	225
18-1	681392.936	714654.934	87.750	1.682	1200	1	19.001	86.509	225
						2	18.000	86.068	225
						0	18.001	86.068	300
20-0	681458.635	714610.046	87.550	1.306	1200	0	20.000	86.244	225
18-2	681419.839	714638.804	87.900	1.961	1350	1	20.000	85.959	225
						2	18.001	85.939	300
						0	18.002	85.939	375
18-3	681442.714	714678.477	87.724	1.927	1350	1	18.002	85.797	375
						0	18.003	85.797	375
18-4	681452.487	714687.900	87.871	2.101	1350	1	18.003	85.770	375
						0	18.004	85.770	375
1-14	681458.950	714691.294	87.871	2.119	1500	1	18.004	85.756	375
						2	1.013	85.752	600
						0	1.014	85.752	600
1-15	681452.167	714703.160	87.781	2.042	1500	1	1.014	85.739	600
						0	1.015	85.739	600
1-16	681431.016	714720.912	87.570	1.858	2100	1	1.015	85.712	600
						0	1.016	85.712	600
PI 4	681413.439	714734.297	87.100	1.516	1500	1	1.016	85.684	600
						0	1.017	85.584	600
Outfall 4	681407.762	714738.679	86.490	0.917	1500	1	1.017	85.573	600
21-0	681732.623	714543.018	88.540	1.282	1350	0	21.000	87.258	375
21-1	681683.674	714528.552	88.225	1.125	1350	1	21.000	87.100	375
						0	21.001	87.100	375
21-2	681649.964	714518.491	88.405	1.414	1350	1	21.001	86.991	375
						0	21.002	86.991	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
21-3	681596.221	714502.522	88.691	1.873	1350	1 0	21.002	86.818	375
						0	21.003	86.818	375
21-4	681550.069	714488.810	88.367	1.698	1350	1 0	21.003	86.669	375
						0	21.004	86.669	400
21-5	681538.872	714510.770	88.456	1.858	1350	1 0	21.004	86.598	400
						0	21.005	86.598	400
22-0	681680.587	714541.754	88.245	1.150	1350	 0	22.000	87.095	400
22-1	681676.628	714555.083	88.298	1.243	1350	1 0	22.000	87.055	400
						0	22.001	87.055	400
23-0	681708.590	714630.655	88.357	1.196	1350	 0	23.000	87.161	375
22-2	681652.175	714600.736	88.564	1.657	1350	1 2 0	23.000 22.001	86.964 86.907	375 400
						0	22.002	86.907	400
24-0	681619.602	714645.364	88.655	1.555	1350	 0	24.000	87.100	400
22-3	681644.994	714598.737	88.563	1.678	1350	1 2 0	24.000 22.002	86.949 86.885	400 400
						0	22.003	86.885	400
22-4	681604.492	714576.263	89.151	2.398	1350	1 0	22.003	86.753	400
						0	22.004	86.753	400
25-0	681578.956	714511.950	88.704	1.425	1200	 0	25.000	87.279	225
25-1	681570.824	714540.652	88.700	1.597	1200	1 0	25.000	87.103	225
						0	25.001	87.103	225
22-5	681561.371	714552.096	88.931	2.319	1350	1 2 0	25.001 22.004	87.015 86.612	225 400
						0	22.005	86.612	400
26-0	681520.981	714587.351	88.550	1.425	1200	 0	26.000	87.125	225
26-1	681529.224	714571.926	88.550	1.528	1200	1 0	26.000	87.022	225
						0	26.001	87.022	225
22-6	681548.127	714544.673	88.890	2.316	1350	1 2 0	26.001 22.005	86.826 86.574	225 400
						0	22.006	86.574	400
22-7	681533.514	714533.960	88.500	1.971	1350	1 0	22.006	86.529	400
						0	22.007	86.529	400

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
21-6	681527.948	714530.232	88.369	1.857	1500	1	22.007	86.512	400
						2	21.005	86.534	400
						0	21.006	86.512	500
21-7	681498.591	714572.945	88.161	1.761	1500	1	21.006	86.400	500
						0	21.007	86.400	500
21-8	681494.806	714586.463	88.218	1.843	1500	1	21.007	86.375	500
						0	21.008	86.375	500
21-9	681479.812	714583.385	88.083	1.735	1500	1	21.008	86.348	500
						0	21.009	86.348	500
21-10	681440.788	714563.200	87.929	1.657	1500	1	21.009	86.272	500
						0	21.010	86.272	500
27-0	681350.118	714601.420	88.114	1.792	1500	0	27.000	86.322	600
27-1	681391.219	714575.945	87.900	1.625	1500	1	27.000	86.275	600
						0	27.001	86.275	600
28-0	681472.874	714484.377	88.108	1.630	1350	0	28.000	86.478	375
28-1	681446.895	714523.359	87.846	1.513	1350	1	28.000	86.333	375
						0	28.001	86.333	375
21-11	681424.130	714546.888	88.117	1.885	1500	1	28.001	86.232	375
						2	27.001	86.232	600
						3	21.010	86.232	500
						0	21.011	86.232	600
29-0	681529.152	714477.102	88.510	1.125	1200	0	29.000	87.385	225
29-1	681493.847	714463.154	88.500	1.339	1200	1	29.000	87.161	225
						0	29.001	87.161	225
29-2	681481.690	714464.705	88.289	1.201	1200	1	29.001	87.088	225
						0	29.002	87.088	225
29-3	681435.452	714440.649	88.782	2.002	1200	1	29.002	86.780	225
						0	29.003	86.780	225
29-4	681420.740	714447.405	88.880	2.196	1200	1	29.003	86.684	225
						0	29.004	86.684	225
29-5	681401.736	714473.443	88.851	2.364	1200	1	29.004	86.487	225
						0	29.005	86.487	225
21-12	681378.428	714500.325	88.730	2.561	1500	1	29.005	86.277	225
						2	21.011	86.169	600
						0	21.012	86.169	600

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
30-0	681336.824	714583.857	88.750	1.425	1200		0	30.000	87.325	225
30-1	681318.656	714552.623	88.700	1.638	1200		1 0	30.000 30.001	87.062 87.062	225 225
30-2	681338.498	714532.780	88.800	1.904	1200		1 0	30.001 30.002	86.896 86.896	225 225
21-13	681354.275	714520.630	88.850	2.712	1500		1 2 0	30.002 21.012 21.013	86.778 86.138 86.138	225 600 600
21-14	681331.006	714494.008	88.070	1.966	1500		1 0	21.013 21.014	86.104 86.104	600 600
PI 3	681328.921	714490.869	88.070	2.073	1500		1 0	21.014 21.015	86.097 85.997	600 600
Outfall 3	681310.005	714462.485	87.300	1.362	1500		1	21.015	85.938	600
31-0	681241.100	714577.004	88.586	1.811	1200		0	31.000	86.775	225
31-1	681266.075	714572.105	88.460	1.835	1200		1 0	31.000 31.001	86.625 86.625	225 225
31-2	681288.357	714572.144	88.375	2.029	1200		1 0	31.001 31.002	86.346 86.346	225 225
31-4	681300.880	714577.792	88.412	2.238	1200		1 0	31.002 31.003	86.174 86.174	225 225
31-5	681310.328	714592.053	88.350	2.390	1200		1 0	31.003 31.004	85.960 85.960	225 225
31-6	681328.209	714617.952	88.000	2.355	1200		1 0	31.004 31.005	85.645 85.645	225 225
32-0	681351.362	714665.315	87.750	1.625	1200		0	32.000	86.125	225
32-1	681337.837	714644.743	87.750	1.770	1200		1 0	32.000 32.001	85.980 85.980	225 225
31-7	681322.684	714621.696	87.894	2.289	1200		1 2 0	32.001 31.005 31.006	85.817 85.605 85.605	225 225 300
34-0	681241.403	714640.836	87.225	1.425	1200		0	33.000	85.800	225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
34-1	681263.636	714636.398	87.366	1.700	1200	1	33.000	85.666	225
						0	33.001	85.666	225
34-2	681271.591	714641.215	87.322	1.711	1200	1	33.001	85.611	225
						0	33.002	85.611	225
31-8	681277.979	714651.973	87.387	2.003	1200	1	33.002	85.537	225
						2	31.006	85.384	300
						0	31.007	85.384	300
33-0	681304.110	714699.473	87.400	1.725	1200				
						0	34.000	85.675	225
31-9	681274.152	714654.584	87.385	2.289	1350	1	34.000	85.357	225
						2	31.007	85.369	300
						0	31.008	85.096	400
31-10	681266.162	714658.164	87.260	2.189	1800	1	31.008	85.071	400
						0	31.009	85.071	400
35-0	681280.289	714692.365	87.091	1.432	1200				
						0	35.000	85.659	225
31-11	681255.367	714674.032	86.850	1.834	1350	1	35.000	85.476	225
						2	31.009	85.016	400
						0	31.010	85.016	400
31-12	681230.026	714659.891	86.901	1.968	1350	1	31.010	84.933	400
						0	31.011	84.933	400
36-0	681231.376	714579.073	88.558	1.658	1200				
						0	36.000	86.900	225
36-1	681201.801	714584.854	88.383	1.661	1200	1	36.000	86.722	225
						0	36.001	86.722	225
36-2	681188.714	714591.490	88.162	1.587	1200	1	36.001	86.575	225
						0	36.002	86.575	225
36-3	681182.045	714600.247	87.954	1.489	1200	1	36.002	86.465	225
						0	36.003	86.465	225
36-4	681178.035	714614.258	87.676	1.357	1200	1	36.003	86.319	225
						0	36.004	86.319	225
31-13	681174.797	714656.902	87.231	2.456	1350	1	36.004	85.891	225
						2	31.011	84.775	400
						0	31.012	84.775	450
31-14	681172.134	714690.391	87.000	2.283	1350	1	31.012	84.717	450
						0	31.013	84.717	450
31-15	681178.112	714704.102	86.950	2.259	1350	1	31.013	84.691	450
						0	31.014	84.691	450

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
37-0	681393.391	714716.054	88.000	1.425	1200		0	37.000	86.575	225
37-1	681364.767	714673.338	87.736	1.464	1200		1	37.000	86.272	225
							0	37.001	86.272	225
38-0	681384.526	714741.184	87.352	1.675	1200		0	38.000	85.677	225
39-0	681352.807	714770.696	87.171	1.056	1200		0	39.000	86.115	225
38-1	681348.326	714765.422	87.147	1.727	1200		1	39.000	86.074	225
							2	38.000	85.420	225
							0	38.001	85.420	300
37-2	681304.036	714714.518	87.247	2.103	1200		1	38.001	85.144	300
							2	37.001	85.840	225
							0	37.002	85.144	300
40-0	681328.813	714803.744	87.200	1.425	1200		0	40.000	85.775	225
40-1	681305.668	714816.641	87.075	1.456	1200		1	40.000	85.619	225
							0	40.001	85.619	225
37-3	681257.516	714759.392	87.021	2.077	1350		1	40.001	85.178	225
							2	37.002	84.944	300
							0	37.003	84.944	375
37-4	681218.378	714728.860	86.930	2.108	1350		1	37.003	84.822	375
							0	37.004	84.822	375
31-16	681195.150	714715.697	86.850	2.195	1500		1	37.004	84.744	375
							2	31.014	84.655	450
							0	31.015	84.655	600
31-17	681189.329	714725.568	86.440	1.809	2100		1	31.015	84.631	600
							0	31.016	84.631	600
PI 1	681186.333	714730.649	86.440	1.920	1500		1	31.016	84.620	600
							0	31.017	84.520	600
Outfall 1	681181.220	714748.846	85.570	1.069	1500		1	31.017	84.501	600
41-0	681603.924	714908.556	88.250	1.550	1200		0	41.000	86.700	300
41-1	681618.947	714884.229	88.250	1.667	1200		1	41.000	86.583	300
							0	41.001	86.583	300
41-2	681580.497	714859.153	87.800	1.405	1200		1	41.001	86.395	300
							0	41.002	86.395	300

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
41-3	681539.046	714832.914	87.500	1.306	1200	1 0	41.002 41.003	86.194 86.194	300 300
42-0	681554.612	714897.046	87.868	1.294	1200	0	42.000	86.574	300
42-1	681561.361	714886.575	87.996	1.473	1200	1 0	42.000 42.001	86.523 86.523	300 300
43-0	681529.669	714880.070	88.018	1.425	1200	0	43.000	86.593	225
42-2	681536.014	714870.226	88.148	1.749	1200	1 2 0	43.000 42.001 42.002	86.524 86.399 86.399	225 300 300
44-0	681512.910	714874.563	88.248	1.825	1200	0	44.000	86.423	225
41-4	681521.339	714860.680	88.226	2.167	1350	1 2 3 0	44.000 42.002 41.003 41.004	86.327 86.327 86.059 86.059	225 300 300 375
45-0	681450.416	714820.912	87.573	1.161	1200	0	45.000	86.412	225
41-5	681482.391	714838.085	87.879	1.959	1350	1 2 0	45.000 41.004 41.005	86.198 85.920 85.920	225 375 375
41-6	681480.058	714842.579	87.897	1.998	1350	1 0	41.005 41.006	85.899 85.899	375 375
41-7	681434.036	714818.133	87.523	1.785	1350	1 0	41.006 41.007	85.738 85.738	375 375
41-8	681436.400	714813.481	87.523	1.806	1350	1 0	41.007 41.008	85.717 85.717	375 375
46-0	681419.932	714815.536	87.430	1.425	1200	0	46.000	86.005	225
41-9	681424.329	714807.040	87.480	1.806	1350	1 2 0	46.000 41.008 41.009	85.948 85.674 85.674	225 375 375
47-0	681526.464	714826.290	87.950	1.425	1200	0	47.000	86.525	225
47-1	681482.339	714802.714	87.550	1.442	1200	1 0	47.000 47.001	86.108 86.108	225 225
41-10	681438.489	714779.369	87.430	2.030	1350	1 2 0	47.001 41.009 41.010	85.815 85.578 85.400	225 375 400

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
41-11	681441.127	714775.003	87.390	2.005	1350	1	41.010	85.385	400
						0	41.011	85.385	400
41-12	681437.310	714761.518	87.450	2.103	1800	1	41.011	85.347	400
						0	41.012	85.347	400
48-0	681389.971	714797.634	87.450	1.150	1200	0	48.000	86.300	225
41-13	681415.501	714749.863	87.350	2.075	1800	1	48.000	85.758	225
						2	41.012	85.275	400
						0	41.013	85.275	500
PI 5	681410.913	714747.274	87.350	2.185	1500	1	41.013	85.265	500
						0	41.014	85.165	500
Outfall 5	681406.210	714744.800	86.400	1.252	1500	1	41.014	85.148	500
50-0	681272.880	714510.934	91.041	2.141	1200	0	49.000	88.900	225
50-1	681305.334	714543.097	90.205	2.205	1200	1	49.000	88.329	225
						0	49.001	88.000	225
50-2	681326.122	714573.010	89.346	2.146	1200	1	49.001	87.545	225
						0	49.002	87.200	225
50-3	681341.206	714595.670	88.831	2.631	1350	1	49.002	86.860	225
						0	49.003	86.200	400
50-4	681376.057	714649.341	88.427	2.425	1350	1	49.003	86.002	400
						0	49.004	86.002	400
50-5	681423.923	714716.689	88.100	2.279	1350	1	49.004	85.821	400
						0	49.005	85.821	400
PI 2	681408.828	714728.225	87.100	1.480	1350	1	49.005	85.763	400
						0	49.006	85.620	450
Outfall 2	681405.225	714730.997	86.501	0.891	1350	1	49.006	85.610	450
49-0	681617.771	714850.092	87.806	1.612	1350	0	50.000	86.194	375
49-1	681553.609	714815.717	87.191	1.222	1350	1	50.000	85.969	375
						0	50.001	85.969	375
49-2	681537.854	714803.050	87.245	1.339	1350	1	50.001	85.906	375
						0	50.002	85.906	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
49-3	681490.130	714778.489	87.547	1.748	1350	1	50.002	85.799	375
						0	50.003	85.799	375
49-4	681460.413	714760.641	87.734	2.004	1350	1	50.003	85.730	375
						0	50.004	85.730	450
49-5	681437.601	714733.019	87.899	2.219	1350	1	50.004	85.680	450
						0	50.005	85.680	450
PI 6	681413.647	714739.599	87.889	2.363	1350	1	50.005	85.626	450
						0	50.006	85.526	450
Outfall 6	681408.322	714741.891	86.490	0.986	1350	1	50.006	85.504	450

Simulation Settings

Rainfall Methodology	FSR	Summer CV	0.750	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Winter CV	0.840	Additional Storage (m³/ha)	20.0
M5-60 (mm)	15.600	Analysis Speed	Normal	Check Discharge Rate(s)	x
Ratio-R	0.286	Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0

Node 21-14 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	86.104	Product Number	CTL-SHE-0093-4000-1143-4000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.0	Min Node Diameter (mm)	1200

Node 31-17 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	84.631	Product Number	CTL-SHE-0143-9900-1143-9900
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	9.9	Min Node Diameter (mm)	1200

Node 50-5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.821	Product Number	CTL-SHE-0065-2000-1143-2000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 1-11 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.921	Product Number	CTL-SHE-0173-1500-1143-1500
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	15.0	Min Node Diameter (mm)	1500

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Node 41-13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.275	Product Number	CTL-SHE-0193-2100-1661-2100
Design Depth (m)	1.661	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	21.0	Min Node Diameter (mm)	1800

Node 1-16 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	85.712	Product Number	CTL-SHE-0250-3740-1800-3740
Design Depth (m)	1.800	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	37.4	Min Node Diameter (mm)	1800

Node 49-5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.680	Product Number	CTL-SHE-0065-2000-1143-2000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 21-14 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	86.104
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	2120.0	0.0	1.143	2120.0	0.0	1.144	0.0	0.0

Node 31-17 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	84.631
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	540.0	0.0	1.143	540.0	0.0	1.144	0.0	0.0

Node 41-7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.738
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.89	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	350.0	0.0	1.143	350.0	0.0	1.144	0.0	0.0

Node 31-10 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.071
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.90	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	500.0	0.0	1.143	500.0	0.0	1.144	0.0	0.0

Node 4-12 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.944
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.89	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	680.0	0.0	1.143	680.0	0.0	1.144	0.0	0.0

Node 1-11 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.921
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	655.0	0.0	1.143	655.0	0.0	1.144	0.0	0.0

Node 49-3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.799
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.87	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	150.0	0.0	1.143	150.0	0.0	1.144	0.0	0.0

Node 50-5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.821
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.87	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	183.0	0.0	1.143	183.0	0.0	1.144	0.0	0.0

Node 22-7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	86.529
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.88	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	360.0	0.0	1.143	360.0	0.0	1.144	0.0	0.0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 87.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1-0	11	87.031	0.031	1.6	0.0486	0.0000	OK
15 minute winter	1-1	11	86.987	0.051	4.8	0.0939	0.0000	OK
15 minute winter	1-2	11	86.885	0.068	8.5	0.1291	0.0000	OK
15 minute winter	1-3	12	86.799	0.082	11.3	0.1466	0.0000	OK
15 minute winter	1-4	12	86.745	0.083	12.4	0.1329	0.0000	OK
15 minute winter	1-5	12	86.639	0.106	16.6	0.2044	0.0000	OK
15 minute winter	2-0	11	87.193	0.030	1.6	0.0390	0.0000	OK
15 minute winter	1-6	14	86.630	0.184	36.7	0.5652	0.0000	OK
15 minute winter	1-7	13	86.617	0.294	54.3	0.8471	0.0000	OK
15 minute winter	1-8	13	86.591	0.358	62.6	0.9228	0.0000	OK
15 minute winter	1-9	12	86.556	0.451	82.0	1.3865	0.0000	SURCHARGED
15 minute winter	1-10	12	86.528	0.470	95.8	0.8855	0.0000	SURCHARGED
720 minute winter	1-11	510	86.242	0.321	14.1	192.4048	0.0000	OK
15 minute winter	3-0	11	86.822	0.031	1.7	0.0394	0.0000	OK
240 minute winter	1-12	168	86.230	0.329	6.9	0.7653	0.0000	OK
15 minute summer	4-0	1	87.085	0.000	0.0	0.0000	0.0000	OK
15 minute winter	4-1	11	86.989	0.048	3.7	0.0756	0.0000	OK
15 minute winter	4-2	11	86.967	0.045	3.5	0.0507	0.0000	OK
15 minute winter	4-3	11	86.805	0.063	7.1	0.0945	0.0000	OK
15 minute summer	5-0	1	87.125	0.000	0.0	0.0000	0.0000	OK
15 minute winter	5-1	11	87.018	0.056	5.6	0.1094	0.0000	OK
15 minute winter	4-4	11	86.726	0.115	21.6	0.2385	0.0000	OK
15 minute winter	4-5	13	86.702	0.231	26.6	0.3720	0.0000	OK
15 minute winter	4-6	13	86.692	0.244	25.5	0.2759	0.0000	OK
15 minute winter	4-7	13	86.672	0.283	31.8	0.5808	0.0000	SURCHARGED
15 minute winter	6-0	11	86.909	0.038	2.6	0.0581	0.0000	OK
15 minute winter	6-1	11	86.731	0.066	7.7	0.1118	0.0000	OK
15 minute winter	6-2	12	86.657	0.224	17.9	0.3137	0.0000	OK
15 minute winter	6-3	12	86.634	0.369	22.3	0.8521	0.0000	SURCHARGED
15 minute winter	4-8	12	86.610	0.484	68.5	1.4914	0.0000	SURCHARGED
15 minute winter	7-0	13	86.577	0.002	0.5	0.0028	0.0000	OK
15 minute winter	4-9	12	86.583	0.542	81.6	1.7440	0.0000	SURCHARGED
15 minute winter	8-0	11	86.629	0.339	12.9	0.3830	0.0000	SURCHARGED
15 minute winter	9-0	12	86.630	0.231	11.6	0.2614	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1-0	1.000	1-1	1.5	0.241	0.014	0.1376	
15 minute winter	1-1	1.001	1-2	4.6	0.408	0.041	0.4355	
15 minute winter	1-2	1.002	1-3	8.2	0.522	0.074	0.5094	
15 minute winter	1-3	1.003	1-4	11.0	0.620	0.100	0.3186	
15 minute winter	1-4	1.004	1-5	12.2	0.564	0.110	0.9060	
15 minute winter	1-5	1.005	1-6	15.9	0.454	0.180	1.7232	
15 minute winter	2-0	2.000	1-6	1.5	0.484	0.038	0.0959	
15 minute winter	1-6	1.006	1-7	34.4	0.628	0.390	4.4587	
15 minute winter	1-7	1.007	1-8	50.3	0.720	0.570	4.5458	
15 minute winter	1-8	1.008	1-9	72.5	0.755	0.820	7.0377	
15 minute winter	1-9	1.009	1-10	92.9	0.874	0.969	3.5382	
15 minute winter	1-10	1.010	1-11	107.1	2.029	0.849	3.0364	
720 minute winter	1-11	Hydro-Brake®	1-12	7.6				
15 minute winter	3-0	3.000	1-12	1.6	0.490	0.040	0.1291	
240 minute winter	1-12	1.012	1-13	6.9	0.274	0.055	1.3407	
15 minute summer	4-0	4.000	4-1	0.0	0.000	0.000	0.0920	
15 minute winter	4-1	4.001	4-2	3.5	0.569	0.068	0.0235	
15 minute winter	4-2	4.002	4-3	3.5	0.446	0.068	0.2824	
15 minute winter	4-3	4.003	4-4	7.0	0.443	0.137	0.4166	
15 minute summer	5-0	5.000	5-1	0.0	0.000	0.000	0.1017	
15 minute winter	5-1	5.001	4-4	5.3	0.697	0.133	0.2883	
15 minute winter	4-4	4.004	4-5	21.7	0.786	0.423	0.9446	
15 minute winter	4-5	4.005	4-6	25.5	0.833	0.493	0.2204	
15 minute winter	4-6	4.006	4-7	25.2	0.838	0.491	0.5903	
15 minute winter	4-7	4.007	4-8	36.1	0.710	0.706	2.6670	
15 minute winter	6-0	6.000	6-1	2.5	0.366	0.064	0.2464	
15 minute winter	6-1	6.001	6-2	7.5	0.701	0.189	0.9586	
15 minute winter	6-2	6.002	6-3	15.9	0.538	0.400	1.1280	
15 minute winter	6-3	6.003	4-8	25.4	0.639	0.638	0.9360	
15 minute winter	4-8	4.008	4-9	73.8	0.701	0.665	3.0142	
15 minute winter	7-0	7.000	4-9	-0.5	-0.021	-0.012	1.1931	
15 minute winter	4-9	4.009	4-10	89.1	0.827	1.008	2.1087	
15 minute winter	8-0	8.000	8-1	-12.9	-0.407	-0.407	1.7875	
15 minute winter	9-0	9.000	8-1	11.9	-0.375	0.374	1.7821	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 87.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	8-1	12	86.561	0.441	34.3	1.1522	0.0000	SURCHARGED
15 minute summer	4-10	12	86.537	0.534	114.2	1.0643	0.0000	SURCHARGED
15 minute summer	10-0	1	86.761	0.000	0.0	0.0000	0.0000	OK
15 minute winter	10-1	11	86.718	0.053	5.1	0.0962	0.0000	OK
15 minute winter	11-0	12	86.574	0.049	3.1	0.0557	0.0000	OK
15 minute winter	11-1	12	86.577	0.128	8.5	0.2177	0.0000	OK
15 minute winter	10-2	12	86.571	0.277	21.1	0.6099	0.0000	SURCHARGED
15 minute winter	12-0	12	86.545	0.382	7.0	0.4323	0.0000	SURCHARGED
15 minute winter	10-3	11	86.545	0.446	36.0	1.0756	0.0000	SURCHARGED
15 minute winter	4-11	11	86.510	0.558	172.7	1.6401	0.0000	SURCHARGED
240 minute winter	4-12	168	86.234	0.290	41.8	175.9819	0.0000	OK
240 minute winter	13-0	168	86.233	0.058	0.2	0.0656	0.0000	OK
240 minute winter	4-13	168	86.233	0.329	21.3	0.7660	0.0000	OK
240 minute winter	4-14	168	86.232	0.355	21.8	0.7985	0.0000	OK
240 minute winter	14-0	168	86.232	0.079	0.9	0.1109	0.0000	OK
240 minute winter	14-1	168	86.232	0.216	5.4	0.7130	0.0000	OK
15 minute winter	15-0	11	86.292	0.023	0.9	0.0278	0.0000	OK
240 minute winter	14-2	168	86.232	0.345	11.4	1.4307	0.0000	OK
240 minute winter	4-15	168	86.232	0.379	25.6	1.0369	0.0000	OK
15 minute summer	16-0	1	86.575	0.000	0.0	0.0000	0.0000	OK
240 minute winter	17-0	168	86.231	0.031	0.1	0.0348	0.0000	OK
240 minute winter	4-16	168	86.231	0.414	27.8	1.8123	0.0000	OK
240 minute winter	1-13	168	86.230	0.453	29.4	1.1272	0.0000	OK
15 minute summer	18-0	1	86.425	0.000	0.0	0.0000	0.0000	OK
15 minute winter	19-0	10	86.768	0.043	3.3	0.0637	0.0000	OK
15 minute winter	19-1	11	86.650	0.060	5.8	0.0909	0.0000	OK
240 minute winter	18-1	168	86.230	0.162	3.8	0.3269	0.0000	OK
15 minute winter	20-0	11	86.286	0.042	3.1	0.0624	0.0000	OK
240 minute winter	18-2	168	86.230	0.291	9.6	0.9435	0.0000	OK
240 minute winter	18-3	168	86.229	0.432	11.4	1.0768	0.0000	SURCHARGED
240 minute winter	18-4	168	86.229	0.459	11.7	0.7840	0.0000	SURCHARGED
240 minute winter	1-14	168	86.229	0.477	34.3	1.1361	0.0000	OK
240 minute winter	1-15	168	86.228	0.489	34.7	1.0184	0.0000	OK
240 minute winter	1-16	168	86.227	0.515	35.4	2.0955	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	8-1	8.001	4-10	31.5	0.447	0.444	2.0073	
15 minute summer	4-10	4.010	4-11	118.2	1.082	1.174	3.4769	
15 minute summer	10-0	10.000	10-1	0.0	0.000	0.000	0.0565	
15 minute winter	10-1	10.001	10-2	4.9	0.667	0.124	0.4318	
15 minute winter	11-0	11.000	11-1	-3.1	-0.216	-0.078	0.1903	
15 minute winter	11-1	11.001	10-2	12.0	0.366	0.301	0.8254	
15 minute winter	10-2	10.002	10-3	25.7	0.790	0.646	0.7549	
15 minute winter	12-0	12.000	10-3	-7.0	-0.298	-0.220	0.6672	
15 minute winter	10-3	10.003	4-11	38.1	0.958	1.198	0.7590	
15 minute winter	4-11	4.011	4-12	179.4	2.568	1.142	0.6050	
240 minute winter	4-12	4.012	4-13	21.0	0.229	0.134	3.6775	
240 minute winter	13-0	13.000	4-13	-0.2	-0.009	-0.005	0.7058	
240 minute winter	4-13	4.013	4-14	21.6	0.199	0.138	2.7469	
240 minute winter	4-14	4.014	4-15	22.1	0.159	0.098	3.8903	
240 minute winter	14-0	14.000	14-1	0.9	0.122	0.015	1.8035	
240 minute winter	14-1	14.001	14-2	4.3	0.223	0.076	3.0677	
15 minute winter	15-0	15.000	14-2	0.9	0.363	0.022	0.4888	
240 minute winter	14-2	14.002	4-15	10.4	0.339	0.118	1.4092	
240 minute winter	4-15	4.015	4-16	26.0	0.240	0.115	6.5022	
15 minute summer	16-0	16.000	4-16	0.0	0.000	0.000	0.0000	
240 minute winter	17-0	17.000	4-16	-0.1	-0.008	-0.003	0.7162	
240 minute winter	4-16	4.016	1-13	28.3	0.266	0.133	8.9349	
240 minute winter	1-13	1.013	1-14	29.8	0.230	0.141	6.0209	
15 minute summer	18-0	18.000	18-1	0.0	0.000	0.000	0.5198	
15 minute winter	19-0	19.000	19-1	3.2	0.479	0.081	0.1559	
15 minute winter	19-1	19.001	18-1	5.7	0.703	0.144	0.1117	
240 minute winter	18-1	18.001	18-2	3.5	0.229	0.050	1.7012	
15 minute winter	20-0	20.000	18-2	3.0	0.223	0.076	1.0698	
240 minute winter	18-2	18.002	18-3	8.3	0.311	0.075	4.6240	
240 minute winter	18-3	18.003	18-4	10.8	0.273	0.122	1.4974	
240 minute winter	18-4	18.004	1-14	11.6	0.205	0.131	0.8052	
240 minute winter	1-14	1.014	1-15	34.3	0.303	0.162	3.3244	
240 minute winter	1-15	1.015	1-16	34.7	0.207	0.164	6.9543	
240 minute winter	1-16	1.016	PI 4	35.4	0.383	0.146	2.0410	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 87.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PI 4	11	85.916	0.332	33.8	0.5860	0.0000	OK
15 minute summer	Outfall 4	1	85.910	0.337	31.2	0.0000	0.0000	OK
15 minute winter	21-0	11	87.277	0.019	0.7	0.0288	0.0000	OK
15 minute winter	21-1	11	87.163	0.063	7.6	0.1515	0.0000	OK
15 minute winter	21-2	12	87.068	0.077	11.0	0.1443	0.0000	OK
15 minute winter	21-3	11	86.931	0.113	23.4	0.2907	0.0000	OK
10080 minute winter	21-4	10080	86.841	0.172	0.8	0.3602	0.0000	OK
10080 minute winter	21-5	10080	86.841	0.243	1.0	0.5106	0.0000	OK
15 minute winter	22-0	10	87.138	0.043	3.3	0.0812	0.0000	OK
15 minute winter	22-1	11	87.114	0.059	6.3	0.1065	0.0000	OK
15 minute winter	23-0	11	87.211	0.050	4.6	0.1004	0.0000	OK
15 minute winter	22-2	12	87.107	0.200	46.0	0.9616	0.0000	OK
15 minute winter	24-0	12	87.124	0.024	1.0	0.0366	0.0000	OK
15 minute winter	22-3	11	87.087	0.202	53.8	0.5432	0.0000	OK
15 minute summer	22-4	11	87.056	0.303	63.6	0.7704	0.0000	OK
15 minute summer	25-0	1	87.279	0.000	0.0	0.0000	0.0000	OK
15 minute winter	25-1	11	87.173	0.070	8.1	0.1332	0.0000	OK
15 minute winter	22-5	10	87.009	0.397	98.2	0.9966	0.0000	OK
15 minute summer	26-0	1	87.125	0.000	0.0	0.0000	0.0000	OK
15 minute winter	26-1	11	87.057	0.035	2.2	0.0474	0.0000	OK
15 minute winter	22-6	10	86.984	0.410	114.9	0.7958	0.0000	SURCHARGED
10080 minute winter	22-7	10200	86.841	0.312	2.6	99.3609	0.0000	OK
10080 minute winter	21-6	10200	86.841	0.329	3.8	0.8264	0.0000	OK
10080 minute winter	21-7	10020	86.841	0.441	4.2	1.5216	0.0000	OK
10080 minute winter	21-8	10020	86.841	0.466	4.2	0.9709	0.0000	OK
10080 minute winter	21-9	10020	86.841	0.493	4.2	0.9457	0.0000	OK
10080 minute winter	21-10	10020	86.841	0.569	4.4	1.6037	0.0000	SURCHARGED
10080 minute winter	27-0	10020	86.841	0.519	0.1	0.9177	0.0000	OK
10080 minute winter	27-1	10020	86.841	0.566	0.4	2.0042	0.0000	OK
10080 minute winter	28-0	10080	86.841	0.363	0.1	0.6939	0.0000	OK
10080 minute winter	28-1	10080	86.841	0.508	0.6	1.8160	0.0000	SURCHARGED
10080 minute winter	21-11	10260	86.841	0.609	5.7	2.4535	0.0000	SURCHARGED
15 minute winter	29-0	11	87.397	0.012	0.3	0.0138	0.0000	OK
15 minute winter	29-1	11	87.206	0.045	3.6	0.0683	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PI 4	1.017	Outfall 4	35.7	0.222	0.133	1.1569	125.5
15 minute winter	21-0	21.000	21-1	0.6	0.088	0.005	0.3664	
15 minute winter	21-1	21.001	21-2	7.1	0.507	0.064	0.4965	
15 minute winter	21-2	21.002	21-3	10.4	0.479	0.094	1.2294	
15 minute winter	21-3	21.003	21-4	22.4	0.712	0.202	1.5336	
10080 minute winter	21-4	21.004	21-5	0.8	0.263	0.006	1.6182	
10080 minute winter	21-5	21.005	21-6	1.0	0.304	0.008	2.0416	
15 minute winter	22-0	22.000	22-1	3.2	0.361	0.025	0.1292	
15 minute winter	22-1	22.001	22-2	6.0	0.183	0.048	1.9099	
15 minute winter	23-0	23.000	22-2	4.3	0.283	0.039	1.5007	
15 minute winter	22-2	22.002	22-3	41.2	0.755	0.322	0.4703	
15 minute winter	24-0	24.000	22-3	0.9	0.240	0.007	1.1001	
15 minute winter	22-3	22.003	22-4	56.9	0.813	0.452	3.7638	
15 minute summer	22-4	22.004	22-5	74.4	0.841	0.591	5.5467	
15 minute summer	25-0	25.000	25-1	0.0	0.000	0.000	0.1521	
15 minute winter	25-1	25.001	22-5	7.8	0.768	0.196	0.1511	
15 minute winter	22-5	22.005	22-6	106.9	1.081	0.907	1.8995	
15 minute summer	26-0	26.000	26-1	0.0	0.000	0.000	0.0331	
15 minute winter	26-1	26.001	22-6	2.1	0.500	0.053	0.5575	
15 minute winter	22-6	22.006	22-7	124.6	2.284	1.061	1.1505	
10080 minute winter	22-7	22.007	21-6	2.6	0.336	0.022	0.7208	
10080 minute winter	21-6	21.006	21-7	3.8	0.359	0.019	8.2786	
10080 minute winter	21-7	21.007	21-8	4.1	0.357	0.023	2.6167	
10080 minute winter	21-8	21.008	21-9	4.2	0.364	0.024	2.9473	
10080 minute winter	21-9	21.009	21-10	4.2	0.327	0.024	8.5831	
10080 minute winter	21-10	21.010	21-11	4.3	0.277	0.025	4.5606	
10080 minute winter	27-0	27.000	27-1	-0.1	-0.003	0.000	12.9297	
10080 minute winter	27-1	27.001	21-11	0.3	0.056	0.001	12.2325	
10080 minute winter	28-0	28.000	28-1	0.1	0.103	0.001	5.1429	
10080 minute winter	28-1	28.001	21-11	0.5	0.102	0.005	3.6110	
10080 minute winter	21-11	21.011	21-12	5.5	0.233	0.026	18.3778	
15 minute winter	29-0	29.000	29-1	0.2	0.077	0.005	0.1217	
15 minute winter	29-1	29.001	29-2	3.5	0.527	0.087	0.0817	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 87.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	29-2	11	87.144	0.056	5.6	0.0793	0.0000	OK
15 minute winter	29-3	11	86.872	0.092	12.8	0.1580	0.0000	OK
10080 minute winter	29-4	10320	86.841	0.157	0.4	0.2139	0.0000	OK
10080 minute winter	29-5	10320	86.841	0.354	0.6	0.5807	0.0000	SURCHARGED
10080 minute winter	21-12	10260	86.841	0.672	6.6	2.1330	0.0000	SURCHARGED
15 minute winter	30-0	11	87.351	0.026	1.3	0.0327	0.0000	OK
15 minute winter	30-1	11	87.109	0.047	3.9	0.0647	0.0000	OK
15 minute winter	30-2	11	86.975	0.079	10.0	0.1293	0.0000	OK
10080 minute winter	21-13	10020	86.841	0.703	7.0	1.7299	0.0000	SURCHARGED
10080 minute winter	21-14	10140	86.841	0.737	6.9	1423.5240	0.0000	SURCHARGED
10080 minute winter	PI 3	10320	86.841	0.844	0.1	1.4917	0.0000	SURCHARGED
15 minute summer	Outfall 3	1	87.530	1.592	0.0	0.0000	0.0000	OK
15 minute summer	31-0	1	86.775	0.000	0.0	0.0000	0.0000	OK
15 minute winter	31-1	10	86.680	0.055	8.0	0.0994	0.0000	OK
15 minute winter	31-2	10	86.415	0.069	11.2	0.0953	0.0000	OK
15 minute winter	31-4	11	86.250	0.076	13.7	0.1009	0.0000	OK
15 minute winter	31-5	11	86.046	0.086	16.4	0.1126	0.0000	OK
15 minute winter	31-6	11	85.782	0.137	23.2	0.2184	0.0000	OK
15 minute summer	32-0	1	86.125	0.000	0.0	0.0000	0.0000	OK
15 minute winter	32-1	11	86.021	0.041	3.0	0.0570	0.0000	OK
15 minute winter	31-7	11	85.729	0.124	26.3	0.1442	0.0000	OK
15 minute winter	34-0	10	85.844	0.044	3.5	0.0668	0.0000	OK
15 minute winter	34-1	10	85.739	0.073	8.2	0.1150	0.0000	OK
15 minute winter	34-2	11	85.694	0.083	10.5	0.1125	0.0000	OK
15 minute winter	31-8	10	85.636	0.252	53.7	0.6444	0.0000	OK
15 minute summer	33-0	1	85.675	0.000	0.0	0.0000	0.0000	OK
15 minute winter	31-9	10	85.611	0.515	69.3	0.9709	0.0000	SURCHARGED
4320 minute winter	31-10	2880	85.574	0.503	4.3	227.6436	0.0000	SURCHARGED
15 minute winter	35-0	11	85.702	0.043	3.3	0.0639	0.0000	OK
4320 minute winter	31-11	2880	85.574	0.558	4.1	1.1821	0.0000	SURCHARGED
4320 minute winter	31-12	2880	85.575	0.642	3.4	1.4337	0.0000	SURCHARGED
15 minute summer	36-0	1	86.900	0.000	0.0	0.0000	0.0000	OK
15 minute winter	36-1	10	86.785	0.063	8.6	0.1208	0.0000	OK
15 minute winter	36-2	10	86.650	0.075	11.3	0.1056	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	29-2	29.002	29-3	5.5	0.485	0.138	0.5976	
15 minute winter	29-3	29.003	29-4	12.7	0.803	0.318	0.2559	
10080 minute winter	29-4	29.004	29-5	0.4	0.281	0.010	1.1191	
10080 minute winter	29-5	29.005	21-12	0.6	0.270	0.015	1.4151	
10080 minute winter	21-12	21.012	21-13	6.5	0.211	0.031	8.8880	
15 minute winter	30-0	30.000	30-1	1.2	0.303	0.028	0.1524	
15 minute winter	30-1	30.001	30-2	3.8	0.423	0.096	0.2562	
15 minute winter	30-2	30.002	21-13	9.8	0.820	0.247	0.2389	
10080 minute winter	21-13	21.013	21-14	6.9	0.360	0.033	9.9595	
10080 minute winter	21-14	Hydro-Brake®	PI 3	0.1				
10080 minute winter	PI 3	21.015	Outfall 3	0.0	0.000	0.000	9.6080	0.0
15 minute summer	31-0	31.000	31-1	0.0	0.000	0.000	0.0930	
15 minute winter	31-1	31.001	31-2	7.8	0.878	0.134	0.1984	
15 minute winter	31-2	31.002	31-4	11.0	1.000	0.190	0.1516	
15 minute winter	31-4	31.003	31-5	13.8	1.066	0.237	0.2211	
15 minute winter	31-5	31.004	31-6	16.4	0.837	0.315	0.6168	
15 minute winter	31-6	31.005	31-7	23.0	0.972	0.573	0.1587	
15 minute summer	32-0	32.000	32-1	0.0	0.000	0.000	0.0588	
15 minute winter	32-1	32.001	31-7	2.8	0.581	0.071	0.1342	
15 minute winter	31-7	31.006	31-8	25.8	0.627	0.364	2.3872	
15 minute winter	34-0	33.000	34-1	3.4	0.414	0.086	0.1896	
15 minute winter	34-1	33.001	34-2	8.0	0.655	0.201	0.1141	
15 minute winter	34-2	33.002	31-8	10.3	0.811	0.259	0.1871	
15 minute winter	31-8	31.007	31-9	62.9	1.152	1.001	0.2872	
15 minute summer	33-0	34.000	31-9	0.0	0.000	0.000	1.0732	
15 minute winter	31-9	31.008	31-10	96.3	1.994	0.764	0.5594	
4320 minute winter	31-10	31.009	31-11	4.1	0.343	0.032	2.4026	
15 minute winter	35-0	35.000	31-11	3.2	0.602	0.079	0.1627	
4320 minute winter	31-11	31.010	31-12	3.3	0.337	0.026	3.6330	
4320 minute winter	31-12	31.011	31-13	3.4	0.208	0.027	6.9243	
15 minute summer	36-0	36.000	36-1	0.0	0.000	0.000	0.1313	
15 minute winter	36-1	36.001	36-2	8.4	0.816	0.161	0.1510	
15 minute winter	36-2	36.002	36-3	11.2	0.908	0.215	0.1352	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 87.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	36-3	11	86.547	0.082	13.5	0.1124	0.0000	OK
15 minute winter	36-4	11	86.402	0.083	14.7	0.1059	0.0000	OK
4320 minute winter	31-13	2880	85.576	0.801	4.1	2.4381	0.0000	SURCHARGED
4320 minute winter	31-14	2880	85.575	0.858	4.3	1.6200	0.0000	SURCHARGED
4320 minute winter	31-15	2940	85.575	0.884	4.6	1.4208	0.0000	SURCHARGED
15 minute summer	37-0	1	86.575	0.000	0.0	0.0000	0.0000	OK
15 minute winter	37-1	11	86.330	0.058	6.7	0.1056	0.0000	OK
15 minute winter	38-0	11	85.726	0.049	4.4	0.0759	0.0000	OK
15 minute summer	39-0	1	86.115	0.000	0.0	0.0000	0.0000	OK
4320 minute winter	38-1	2940	85.574	0.154	0.7	0.3732	0.0000	OK
4320 minute winter	37-2	2880	85.575	0.431	2.3	1.6010	0.0000	SURCHARGED
15 minute summer	40-0	1	85.775	0.000	0.0	0.0000	0.0000	OK
15 minute winter	40-1	11	85.660	0.041	3.4	0.0610	0.0000	OK
4320 minute winter	37-3	2880	85.575	0.631	3.5	2.5544	0.0000	SURCHARGED
4320 minute winter	37-4	2880	85.575	0.753	3.7	1.7057	0.0000	SURCHARGED
4320 minute winter	31-16	2880	85.575	0.920	7.1	2.4647	0.0000	SURCHARGED
4320 minute winter	31-17	2880	85.574	0.943	7.1	466.8336	0.0000	SURCHARGED
4320 minute winter	PI 1	2700	85.543	1.023	0.2	1.8079	0.0000	SURCHARGED
15 minute summer	Outfall 1	1	85.620	1.119	0.0	0.0000	0.0000	OK
15 minute winter	41-0	10	86.761	0.061	6.7	0.1089	0.0000	OK
15 minute winter	41-1	11	86.661	0.078	11.1	0.1213	0.0000	OK
15 minute winter	41-2	11	86.496	0.101	18.2	0.2011	0.0000	OK
15 minute winter	41-3	11	86.453	0.259	24.9	0.4681	0.0000	OK
15 minute winter	42-0	10	86.662	0.088	11.4	0.2185	0.0000	OK
15 minute winter	42-1	10	86.650	0.127	27.0	0.3534	0.0000	OK
15 minute winter	43-0	10	86.631	0.038	2.4	0.0520	0.0000	OK
15 minute winter	42-2	11	86.573	0.174	41.1	0.3876	0.0000	OK
15 minute winter	44-0	10	86.461	0.038	2.5	0.0510	0.0000	OK
15 minute winter	41-4	11	86.414	0.355	83.9	0.7994	0.0000	OK
15 minute winter	45-0	10	86.476	0.064	7.4	0.1357	0.0000	OK
15 minute summer	41-5	11	86.355	0.435	99.3	1.0098	0.0000	SURCHARGED
15 minute summer	41-6	11	86.340	0.441	103.8	0.6310	0.0000	SURCHARGED
360 minute winter	41-7	232	86.110	0.372	22.4	116.5393	0.0000	OK
360 minute winter	41-8	232	86.110	0.393	12.4	0.6799	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	36-3	36.003	36-4	13.5	1.040	0.260	0.1916	
15 minute winter	36-4	36.004	31-13	14.5	1.116	0.280	0.5574	
4320 minute winter	31-13	31.012	31-14	4.2	0.221	0.032	5.3229	
4320 minute winter	31-14	31.013	31-15	4.5	0.215	0.034	2.3700	
4320 minute winter	31-15	31.014	31-16	4.8	0.167	0.036	3.2654	
15 minute summer	37-0	37.000	37-1	0.0	0.000	0.000	0.1976	
15 minute winter	37-1	37.001	37-2	5.7	0.719	0.144	0.5866	
15 minute winter	38-0	38.000	38-1	4.3	0.373	0.107	0.5182	
15 minute summer	39-0	39.000	38-1	0.0	0.000	0.000	0.0000	
4320 minute winter	38-1	38.001	37-2	0.7	0.197	0.010	3.6091	
4320 minute winter	37-2	37.002	37-3	2.1	0.304	0.034	4.5516	
15 minute summer	40-0	40.000	40-1	0.0	0.000	0.000	0.0622	
15 minute winter	40-1	40.001	37-3	2.9	0.555	0.073	0.9169	
4320 minute winter	37-3	37.003	37-4	3.3	0.323	0.034	5.4750	
4320 minute winter	37-4	37.004	31-16	3.7	0.330	0.034	2.9447	
4320 minute winter	31-16	31.015	31-17	7.1	0.440	0.023	3.2280	
4320 minute winter	31-17	31.016	PI 1	0.2	0.226	0.001	1.6616	
4320 minute winter	PI 1	31.017	Outfall 1	0.0	0.000	0.000	5.3243	0.0
15 minute winter	41-0	41.000	41-1	6.5	0.538	0.092	0.3531	
15 minute winter	41-1	41.001	41-2	10.8	0.609	0.152	0.8145	
15 minute winter	41-2	41.002	41-3	17.8	0.717	0.251	2.1004	
15 minute winter	41-3	41.003	41-4	34.3	0.607	0.485	2.2253	
15 minute winter	42-0	42.000	42-1	11.1	0.488	0.156	0.2839	
15 minute winter	42-1	42.001	42-2	26.5	0.755	0.374	1.0633	
15 minute winter	43-0	43.000	42-2	2.4	0.517	0.060	0.0612	
15 minute winter	42-2	42.002	41-4	40.9	1.031	0.577	0.6949	
15 minute winter	44-0	44.000	41-4	2.5	0.524	0.062	0.1490	
15 minute winter	41-4	41.004	41-5	87.9	0.878	0.795	4.9140	
15 minute winter	45-0	45.000	41-5	7.2	0.655	0.180	0.6547	
15 minute summer	41-5	41.005	41-6	103.8	1.002	0.809	0.5585	
15 minute summer	41-6	41.006	41-7	114.9	2.032	1.039	2.9955	
360 minute winter	41-7	41.007	41-8	12.2	0.378	0.096	0.5752	
360 minute winter	41-8	41.008	41-9	12.4	0.373	0.111	1.5091	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 87.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	46-0	232	86.109	0.104	0.1	0.1179	0.0000	OK
360 minute winter	41-9	232	86.109	0.435	12.7	0.8013	0.0000	SURCHARGED
15 minute summer	47-0	1	86.525	0.000	0.0	0.0000	0.0000	OK
15 minute winter	47-1	11	86.172	0.064	7.6	0.1238	0.0000	OK
360 minute winter	41-10	232	86.108	0.708	14.7	1.8707	0.0000	SURCHARGED
360 minute winter	41-11	232	86.107	0.722	14.9	1.1997	0.0000	SURCHARGED
360 minute winter	41-12	232	86.106	0.759	15.3	2.1490	0.0000	SURCHARGED
15 minute summer	48-0	1	86.300	0.000	0.0	0.0000	0.0000	OK
360 minute winter	41-13	232	86.105	0.830	17.5	3.3761	0.0000	SURCHARGED
7200 minute summer	PI 5	3240	85.911	0.746	5.9	1.3181	0.0000	SURCHARGED
15 minute summer	Outfall 5	1	85.910	0.762	0.0	0.0000	0.0000	OK
15 minute summer	50-0	1	88.900	0.000	0.0	0.0000	0.0000	OK
15 minute winter	50-1	10	88.062	0.062	9.8	0.1129	0.0000	OK
15 minute winter	50-2	11	87.280	0.080	15.0	0.1223	0.0000	OK
15 minute winter	50-3	11	86.302	0.102	19.3	0.1734	0.0000	OK
960 minute winter	50-4	690	86.195	0.193	3.5	0.4496	0.0000	OK
960 minute winter	50-5	690	86.195	0.374	4.9	60.5330	0.0000	OK
60 minute winter	PI 2	35	85.911	0.291	1.7	0.4157	0.0000	OK
15 minute summer	Outfall 2	1	85.910	0.300	0.5	0.0000	0.0000	OK
15 minute summer	49-0	1	86.194	0.000	0.0	0.0000	0.0000	OK
960 minute winter	49-1	675	86.131	0.162	1.7	0.5779	0.0000	OK
960 minute winter	49-2	675	86.131	0.225	1.7	0.3798	0.0000	OK
960 minute winter	49-3	675	86.131	0.332	2.9	44.2611	0.0000	OK
960 minute winter	49-4	675	86.131	0.401	1.6	0.8027	0.0000	OK
960 minute winter	49-5	675	86.131	0.451	1.8	0.8535	0.0000	SURCHARGED
60 minute summer	PI 6	39	85.910	0.384	1.2	0.5500	0.0000	OK
15 minute summer	Outfall 6	1	85.910	0.406	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	46-0	46.000	41-9	-0.1	-0.017	-0.003	0.2317	
360 minute winter	41-9	41.009	41-10	12.8	0.378	0.115	3.4285	
15 minute summer	47-0	47.000	47-1	0.0	0.000	0.000	0.2236	
15 minute winter	47-1	47.001	41-10	6.9	0.753	0.173	0.6561	
360 minute winter	41-10	41.010	41-11	14.7	0.278	0.115	0.6386	
360 minute winter	41-11	41.011	41-12	15.0	0.274	0.122	1.7545	
360 minute winter	41-12	41.012	41-13	15.4	0.158	0.121	3.0957	
15 minute summer	48-0	48.000	41-13	0.0	0.000	0.000	0.7142	
360 minute winter	41-13	Hydro-Brake®	PI 5	17.5				
7200 minute summer	PI 5	41.014	Outfall 5	5.9	0.030	0.024	1.0395	515.7
15 minute summer	50-0	49.000	50-1	0.0	0.000	0.000	0.0000	
15 minute winter	50-1	49.001	50-2	9.4	1.076	0.162	0.3209	
15 minute winter	50-2	49.002	50-3	14.9	1.213	0.257	0.3357	
15 minute winter	50-3	49.003	50-4	19.2	0.568	0.146	2.1779	
960 minute winter	50-4	49.004	50-5	3.1	0.376	0.028	7.5005	
960 minute winter	50-5	Hydro-Brake®	PI 2	1.8				
60 minute winter	PI 2	49.006	Outfall 2	1.7	0.015	0.011	0.5011	20.7
15 minute summer	49-0	50.000	49-1	0.0	0.000	0.000	0.8220	
960 minute winter	49-1	50.001	49-2	1.5	0.293	0.013	1.1609	
960 minute winter	49-2	50.002	49-3	1.5	0.284	0.017	4.6286	
960 minute winter	49-3	50.003	49-4	1.5	0.099	0.017	3.7025	
960 minute winter	49-4	50.004	49-5	1.7	0.067	0.014	5.5100	
960 minute winter	49-5	Hydro-Brake®	PI 6	1.8				
60 minute summer	PI 6	50.006	Outfall 6	1.2	0.008	0.006	0.8543	9.8

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Inverts
M5-60 (mm)	15.600	Minimum Backdrop Height (m)	0.000
Ratio-R	0.286	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1-0	0.012	5.00	88.550	1350	681728.297	714559.265	1.550
1-1	0.025	5.00	88.200	1350	681727.082	714579.948	1.264
1-2	0.032	5.00	88.200	1350	681729.935	714618.237	1.383
1-3	0.025	5.00	88.150	1350	681724.880	714650.182	1.433
1-4	0.012	5.00	88.050	1350	681726.157	714667.886	1.388
1-5	0.042	5.00	88.201	1350	681706.946	714704.913	1.668
2-0	0.012	5.00	88.588	1200	681654.345	714711.728	1.425
1-6	0.170	5.00	88.523	1350	681668.442	714684.340	2.077
1-7	0.171	5.00	88.681	1350	681613.809	714655.342	2.358
1-8	0.133	5.00	88.553	1350	681573.837	714634.246	2.320
1-9	0.182	5.00	88.321	1350	681516.849	714604.369	2.216
1-10	0.055	5.00	88.495	1350	681489.411	714611.148	2.437
1-11			88.016	1800	681465.859	714652.863	2.095
3-0	0.013	5.00	88.471	1200	681495.121	714623.928	1.680
1-12	0.101	5.00	88.157	1350	681476.088	714659.384	2.256
4-0		5.00	88.200	1200	681714.921	714722.862	1.115
4-1	0.028	5.00	88.200	1200	681700.576	714747.663	1.259
4-2			88.200	1200	681696.983	714746.664	1.278
4-3	0.029	5.00	88.321	1200	681679.139	714777.631	1.579
5-0		5.00	88.100	1200	681687.188	714707.538	0.975
5-1	0.043	5.00	88.000	1200	681674.194	714731.842	1.038
4-4	0.076	5.00	88.227	1200	681656.262	714765.409	1.616
4-5	0.040	5.00	88.128	1200	681631.788	714752.351	1.657
4-6			88.062	1200	681629.584	714756.232	1.614
4-7	0.066	5.00	87.821	1200	681618.718	714752.021	1.432
6-0	0.020	5.00	87.900	1200	681651.744	714821.450	1.029
6-1	0.040	5.00	88.070	1200	681635.217	714852.261	1.405
6-2	0.021	5.00	88.000	1200	681600.572	714833.783	1.567
6-3	0.098	5.00	87.930	1200	681613.963	714808.759	1.665
4-8	0.132	5.00	87.727	1350	681593.233	714797.616	1.601
7-0		5.00	88.100	1200	681598.010	714732.199	1.525
4-9	0.150	5.00	87.721	1350	681569.162	714784.678	1.680
8-0		5.00	87.700	1200	681578.569	714821.954	1.410
9-0		5.00	87.700	1200	681499.419	714779.633	1.301
8-1	0.095	5.00	87.400	1200	681538.921	714800.785	1.280
4-10	0.051	5.00	87.822	1350	681552.322	714775.627	1.819
10-0		5.00	87.635	1200	681456.887	714742.982	0.874
10-1	0.039	5.00	87.816	1200	681464.184	714728.460	1.151
11-0		5.00	87.700	1200	681470.270	714761.709	1.175
11-1	0.036	5.00	87.700	1200	681481.748	714767.493	1.251
10-2	0.075	5.00	87.700	1200	681494.310	714744.490	1.406
12-0		5.00	87.588	1200	681518.601	714738.418	1.425
10-3	0.104	5.00	87.724	1200	681511.067	714753.407	1.625
4-11	0.111	5.00	87.850	1500	681527.859	714762.478	1.898
4-12			87.850	1500	681530.789	714757.146	1.906
13-0		5.00	87.600	1200	681570.228	714744.973	1.425
4-13	0.042	5.00	87.400	1500	681544.032	714731.413	1.496
4-14	0.039	5.00	87.500	1500	681526.924	714722.557	1.623
14-0	0.027	5.00	88.142	1200	681632.181	714739.287	1.989
14-1	0.143	5.00	87.334	1200	681586.068	714714.847	1.318
15-0	0.007	5.00	88.094	1200	681560.301	714658.807	1.825
14-2	0.222	5.00	87.521	1350	681542.637	714691.750	1.634
4-15	0.076	5.00	87.418	1500	681536.496	714703.253	1.565
16-0		5.00	88.000	1200	681524.006	714656.720	1.425
17-0		5.00	87.625	1200	681491.700	714717.223	1.425
4-16	0.262	5.00	87.823	1500	681507.377	714687.844	2.006
1-13	0.083	5.00	88.078	1500	681471.112	714668.653	2.301
18-0		5.00	87.800	1200	681422.878	714707.549	1.375
19-0	0.025	5.00	88.150	1200	681367.542	714630.246	1.425

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
19-1	0.020	5.00	87.600	1200	681380.523	714649.147	1.010
18-1	0.075	5.00	87.750	1200	681392.936	714654.934	1.682
20-0	0.024	5.00	87.550	1200	681458.635	714610.046	1.306
18-2	0.178	5.00	87.900	1350	681419.839	714638.804	1.961
18-3	0.102	5.00	87.724	1350	681442.714	714678.477	1.927
18-4	0.029	5.00	87.871	1350	681452.487	714687.900	2.101
1-14	0.065	5.00	87.871	1500	681458.950	714691.294	2.119
1-15	0.032	5.00	87.781	1500	681452.167	714703.160	2.042
1-16	0.056	5.00	87.570	2100	681431.016	714720.912	1.858
PI 4			87.100	1500	681413.439	714734.297	1.516
Outfall 4			86.490	1500	681407.762	714738.679	0.917
21-0	0.005	5.00	88.540	1350	681732.623	714543.018	1.282
21-1	0.054	5.00	88.225	1350	681683.674	714528.552	1.125
21-2	0.032	5.00	88.405	1350	681649.964	714518.491	1.414
21-3	0.107	5.00	88.691	1350	681596.221	714502.522	1.873
21-4	0.056	5.00	88.367	1350	681550.069	714488.810	1.698
21-5	0.062	5.00	88.456	1350	681538.872	714510.770	1.858
22-0	0.025	5.00	88.245	1350	681680.587	714541.754	1.150
22-1	0.024	5.00	88.298	1350	681676.628	714555.083	1.243
23-0	0.035	5.00	88.357	1350	681708.590	714630.655	1.196
22-2	0.279	5.00	88.564	1350	681652.175	714600.736	1.657
24-0	0.008	5.00	88.655	1350	681619.602	714645.364	1.555
22-3	0.105	5.00	88.563	1350	681644.994	714598.737	1.678
22-4	0.133	5.00	89.151	1350	681604.492	714576.263	2.398
25-0		5.00	88.704	1200	681578.956	714511.950	1.425
25-1	0.062	5.00	88.700	1200	681570.824	714540.652	1.597
22-5	0.125	5.00	88.931	1350	681561.371	714552.096	2.319
26-0		5.00	88.550	1200	681520.981	714587.351	1.425
26-1	0.017	5.00	88.550	1200	681529.224	714571.926	1.528
22-6	0.059	5.00	88.890	1350	681548.127	714544.673	2.316
22-7			88.500	1350	681533.514	714533.960	1.971
21-6	0.069	5.00	88.369	1500	681527.948	714530.232	1.857
21-7	0.148	5.00	88.161	1500	681498.591	714572.945	1.761
21-8	0.029	5.00	88.218	1500	681494.806	714586.463	1.843
21-9	0.013	5.00	88.083	1500	681479.812	714583.385	1.735
21-10	0.087	5.00	87.929	1500	681440.788	714563.200	1.657
27-0		5.00	88.114	1500	681350.118	714601.420	1.792
27-1	0.144	5.00	87.900	1500	681391.219	714575.945	1.625
28-0	0.039	5.00	88.108	1350	681472.874	714484.377	1.630
28-1	0.162	5.00	87.846	1350	681446.895	714523.359	1.513
21-11	0.213	5.00	88.117	1500	681424.130	714546.888	1.885
29-0	0.002	5.00	88.510	1200	681529.152	714477.102	1.125
29-1	0.026	5.00	88.500	1200	681493.847	714463.154	1.339
29-2	0.017	5.00	88.289	1200	681481.690	714464.705	1.201
29-3	0.059	5.00	88.782	1200	681435.452	714440.649	2.002
29-4	0.025	5.00	88.880	1200	681420.740	714447.405	2.196
29-5	0.060	5.00	88.851	1200	681401.736	714473.443	2.364
21-12	0.180	5.00	88.730	1500	681378.428	714500.325	2.561
30-0	0.010	5.00	88.750	1200	681336.824	714583.857	1.425
30-1	0.021	5.00	88.700	1200	681318.656	714552.623	1.638
30-2	0.049	5.00	88.800	1200	681338.498	714532.780	1.904
21-13	0.094	5.00	88.850	1500	681354.275	714520.630	2.712
21-14			88.070	1500	681331.006	714494.008	1.966
PI 3			88.070	1500	681328.921	714490.869	2.073
Outfall 3			87.300	1500	681310.005	714462.485	1.362
31-0		5.00	88.586	1200	681241.100	714577.004	1.811
31-1	0.061	5.00	88.460	1200	681266.075	714572.105	1.835
31-2	0.026	5.00	88.375	1200	681288.357	714572.144	2.029
31-4	0.021	5.00	88.412	1200	681300.880	714577.792	2.238
31-5	0.021	5.00	88.350	1200	681310.328	714592.053	2.390
31-6	0.055	5.00	88.000	1200	681328.209	714617.952	2.355
32-0		5.00	87.750	1200	681351.362	714665.315	1.625
32-1	0.023	5.00	87.750	1200	681337.837	714644.743	1.770
31-7	0.004	5.00	87.894	1200	681322.684	714621.696	2.289
34-0	0.027	5.00	87.225	1200	681241.403	714640.836	1.425
34-1	0.037	5.00	87.366	1200	681263.636	714636.398	1.700
34-2	0.019	5.00	87.322	1200	681271.591	714641.215	1.711
31-8	0.143	5.00	87.387	1200	681277.979	714651.973	2.003
33-0		5.00	87.400	1200	681304.110	714699.473	1.725
31-9	0.052	5.00	87.385	1350	681274.152	714654.584	2.289

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
31-10			87.260	1800	681266.162	714658.164	2.189
35-0	0.025	5.00	87.091	1200	681280.289	714692.365	1.432
31-11	0.063	5.00	86.850	1350	681255.367	714674.032	1.834
31-12	0.079	5.00	86.901	1350	681230.026	714659.891	1.968
36-0		5.00	88.558	1200	681231.376	714579.073	1.658
36-1	0.066	5.00	88.383	1200	681201.801	714584.854	1.661
36-2	0.022	5.00	88.162	1200	681188.714	714591.490	1.587
36-3	0.018	5.00	87.954	1200	681182.045	714600.247	1.489
36-4	0.010	5.00	87.676	1200	681178.035	714614.258	1.357
31-13	0.198	5.00	87.231	1350	681174.797	714656.902	2.456
31-14	0.052	5.00	87.000	1350	681172.134	714690.391	2.283
31-15	0.020	5.00	86.950	1350	681178.112	714704.102	2.259
37-0		5.00	88.000	1200	681393.391	714716.054	1.425
37-1	0.051	5.00	87.736	1200	681364.767	714673.338	1.464
38-0	0.034	5.00	87.352	1200	681384.526	714741.184	1.675
39-0		5.00	87.171	1200	681352.807	714770.696	1.056
38-1	0.111	5.00	87.147	1200	681348.326	714765.422	1.727
37-2	0.272	5.00	87.247	1200	681304.036	714714.518	2.103
40-0		5.00	87.200	1200	681328.813	714803.744	1.425
40-1	0.026	5.00	87.075	1200	681305.668	714816.641	1.456
37-3	0.272	5.00	87.021	1350	681257.516	714759.392	2.077
37-4	0.088	5.00	86.930	1350	681218.378	714728.860	2.108
31-16	0.100	5.00	86.850	1500	681195.150	714715.697	2.195
31-17			86.440	2100	681189.329	714725.568	1.809
PI 1			86.440	1500	681186.333	714730.649	1.920
Outfall 1			85.570	1500	681181.220	714748.846	1.069
41-0	0.051	5.00	88.250	1200	681603.924	714908.556	1.550
41-1	0.035	5.00	88.250	1200	681618.947	714884.229	1.667
41-2	0.060	5.00	87.800	1200	681580.497	714859.153	1.405
41-3	0.044	5.00	87.500	1200	681539.046	714832.914	1.306
42-0	0.087	5.00	87.868	1200	681554.612	714897.046	1.294
42-1	0.122	5.00	87.996	1200	681561.361	714886.575	1.473
43-0	0.018	5.00	88.018	1200	681529.669	714880.070	1.425
42-2	0.096	5.00	88.148	1200	681536.014	714870.226	1.749
44-0	0.019	5.00	88.248	1200	681512.910	714874.563	1.825
41-4	0.089	5.00	88.226	1350	681521.339	714860.680	2.167
45-0	0.057	5.00	87.573	1200	681450.416	714820.912	1.161
41-5	0.087	5.00	87.879	1350	681482.391	714838.085	1.959
41-6			87.897	1350	681480.058	714842.579	1.998
41-7			87.523	1350	681434.036	714818.133	1.785
41-8	0.027	5.00	87.523	1350	681436.400	714813.481	1.806
46-0		5.00	87.430	1200	681419.932	714815.536	1.425
41-9	0.037	5.00	87.480	1350	681424.329	714807.040	1.806
47-0		5.00	87.950	1200	681526.464	714826.290	1.425
47-1	0.058	5.00	87.550	1200	681482.339	714802.714	1.442
41-10	0.123	5.00	87.430	1350	681438.489	714779.369	2.030
41-11	0.023	5.00	87.390	1350	681441.127	714775.003	2.005
41-12	0.030	5.00	87.450	1800	681437.310	714761.518	2.103
48-0		5.00	87.450	1200	681389.971	714797.634	1.150
41-13	0.158	5.00	87.350	1800	681415.501	714749.863	2.075
PI 5			87.350	1500	681410.913	714747.274	2.185
Outfall 5			86.400	1500	681406.210	714744.800	1.252
50-0		5.00	91.041	1200	681272.880	714510.934	2.141
50-1	0.075	5.00	90.205	1200	681305.334	714543.097	2.205
50-2	0.043	5.00	89.346	1200	681326.122	714573.010	2.146
50-3	0.036	5.00	88.831	1350	681341.206	714595.670	2.631
50-4	0.109	5.00	88.427	1350	681376.057	714649.341	2.425
50-5	0.141	5.00	88.100	1350	681423.923	714716.689	2.279
PI 2			87.100	1350	681408.828	714728.225	1.480
Outfall 2			86.501	1350	681405.225	714730.997	0.891
49-0		5.00	87.806	1350	681617.771	714850.092	1.612
49-1	0.130	5.00	87.191	1350	681553.609	714815.717	1.222
49-2	0.017	5.00	87.245	1350	681537.854	714803.050	1.339
49-3	0.108	5.00	87.547	1350	681490.130	714778.489	1.748
49-4	0.057	5.00	87.734	1350	681460.413	714760.641	2.004
49-5	0.051	5.00	87.899	1350	681437.601	714733.019	2.219
PI 6			87.889	1350	681413.647	714739.599	2.363
Outfall 6			86.490	1350	681408.322	714741.891	0.986

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.017	PI 4	Outfall 4	7.171	0.600	85.584	85.573	0.011	652.0	600	15.93	35.2
1.016	1-16	PI 4	22.093	0.600	85.712	85.684	0.028	789.0	600	15.80	35.3
1.015	1-15	1-16	27.613	0.600	85.739	85.712	0.027	1030.0	600	15.37	35.8
1.014	1-14	1-15	13.668	0.600	85.752	85.739	0.013	1030.0	600	14.76	36.6
1.013	1-13	1-14	25.701	0.600	85.777	85.752	0.025	1030.0	600	14.46	37.0
18.004	18-4	1-14	7.300	0.600	85.770	85.756	0.014	504.0	375	7.72	50.0
18.003	18-3	18-4	13.576	0.600	85.797	85.770	0.027	504.0	375	7.57	50.0
18.002	18-2	18-3	45.795	0.600	85.939	85.797	0.142	322.5	375	7.29	50.0
18.001	18-1	18-2	31.368	0.600	86.068	85.939	0.129	243.2	300	6.53	50.0
20.000	20-0	18-2	48.292	0.600	86.244	85.959	0.285	169.4	225	5.80	50.0
18.000	18-0	18-1	60.538	0.600	86.425	86.068	0.357	169.6	225	6.01	50.0
19.001	19-1	18-1	13.696	0.600	86.590	86.509	0.081	169.1	225	5.61	50.0
19.000	19-0	19-1	22.929	0.600	86.725	86.590	0.135	169.8	225	5.38	50.0
1.012	1-12	1-13	10.520	0.600	85.901	85.884	0.017	634.0	450	13.89	37.8
4.016	4-16	1-13	41.030	0.600	85.817	85.777	0.040	1030.0	600	12.77	39.4
16.000	16-0	4-16	35.288	0.600	86.575	86.367	0.208	169.7	225	5.59	50.0
17.000	17-0	4-16	33.300	0.600	86.200	86.003	0.197	169.0	225	5.55	50.0
4.015	4-15	4-16	32.945	0.600	85.853	85.817	0.036	908.0	600	11.86	40.9
14.002	14-2	4-15	13.040	0.600	85.887	85.861	0.026	504.0	375	7.38	50.0
4.014	4-14	4-15	21.547	0.600	85.877	85.853	0.024	908.0	600	11.17	42.1
4.013	4-13	4-14	19.264	0.600	85.904	85.877	0.027	723.0	500	10.72	43.0
13.000	13-0	4-13	29.498	0.600	86.175	86.001	0.174	169.5	225	5.49	50.0
4.012	4-12	4-13	28.941	0.600	85.944	85.904	0.040	723.0	500	10.32	43.8
4.011	4-11	4-12	6.084	0.600	85.952	85.944	0.008	723.0	500	9.72	45.0
4.010	4-10	4-11	27.773	0.600	86.003	85.952	0.051	545.0	400	9.59	45.3
10.003	10-3	4-11	19.085	0.600	86.099	86.027	0.072	264.0	225	6.55	50.0
10.002	10-2	10-3	18.982	0.600	86.294	86.182	0.112	169.5	225	6.15	50.0
12.000	12-0	10-3	16.776	0.600	86.163	86.099	0.064	264.0	225	5.35	50.0
11.001	11-1	10-2	26.210	0.600	86.449	86.294	0.155	169.1	225	5.65	50.0
10.001	10-1	10-2	34.125	0.600	86.665	86.464	0.201	169.8	225	5.84	50.0
10.000	10-0	10-1	16.252	0.600	86.761	86.665	0.096	169.3	225	5.27	50.0
11.000	11-0	11-1	12.853	0.600	86.525	86.449	0.076	169.1	225	5.21	50.0
4.009	4-9	4-10	19.118	0.600	86.041	86.003	0.038	504.0	375	9.01	46.6

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
1.017	0.946	267.5	356.9	0.916	0.317	3.746	0.0	600
1.016	0.859	242.8	358.4	1.258	0.816	3.746	0.0	600
1.015	0.750	212.1	358.2	1.442	1.258	3.690	0.0	600
1.014	0.750	212.1	362.8	1.519	1.442	3.658	0.0	600
1.013	0.750	212.1	314.8	1.701	1.519	3.140	0.0	600
18.004	0.800	88.4	61.3	1.726	1.740	0.453	0.0	230
18.003	0.800	88.4	57.5	1.552	1.726	0.424	0.0	221
18.002	1.003	110.8	43.6	1.586	1.552	0.322	0.0	163
18.001	1.004	70.9	16.3	1.382	1.661	0.120	0.0	98
20.000	1.001	39.8	3.3	1.081	1.716	0.024	0.0	44
18.000	1.001	39.8	0.0	1.150	1.457	0.000	0.0	0
19.001	1.002	39.9	6.1	0.785	1.016	0.045	0.0	59
19.000	1.000	39.8	3.4	1.200	0.785	0.025	0.0	44
1.012	0.800	127.2	100.8	1.806	1.744	0.985	0.0	304
4.016	0.750	212.1	221.3	1.406	1.701	2.072	0.0	525
16.000	1.001	39.8	0.0	1.200	1.231	0.000	0.0	0
17.000	1.003	39.9	0.0	1.200	1.595	0.000	0.0	0
4.015	0.800	226.1	200.7	0.965	1.406	1.810	0.0	442
14.002	0.800	88.4	54.1	1.259	1.182	0.399	0.0	212
4.014	0.800	226.1	152.4	1.023	0.965	1.335	0.0	362
4.013	0.800	157.1	150.9	0.996	1.123	1.296	0.0	396
13.000	1.001	39.8	0.0	1.200	1.174	0.000	0.0	0
4.012	0.800	157.1	148.7	1.406	0.996	1.254	0.0	390
4.011	0.800	157.1	153.0	1.398	1.406	1.254	0.0	402
4.010	0.801	100.7	109.2	1.419	1.498	0.889	0.0	400
10.003	0.800	31.8	34.4	1.400	1.598	0.254	0.0	225
10.002	1.001	39.8	20.3	1.181	1.317	0.150	0.0	114
12.000	0.800	31.8	0.0	1.200	1.400	0.000	0.0	0
11.001	1.002	39.9	4.9	1.026	1.181	0.036	0.0	53
10.001	1.000	39.8	5.3	0.926	1.011	0.039	0.0	55
10.000	1.002	39.8	0.0	0.649	0.926	0.000	0.0	0
11.000	1.002	39.9	0.0	0.950	1.026	0.000	0.0	0
4.009	0.800	88.4	93.9	1.305	1.444	0.743	0.0	339

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
8.001	8-1	4-10	28.505	0.600	86.120	86.003	0.117	243.6	300	6.41	50.0
8.000	8-0	8-1	44.945	0.600	86.290	86.120	0.170	264.0	225	5.94	50.0
9.000	9-0	8-1	44.809	0.600	86.399	86.229	0.170	264.0	225	5.93	50.0
4.008	4-8	4-9	27.328	0.600	86.126	86.041	0.085	321.5	375	8.61	47.6
7.000	7-0	4-9	59.885	0.600	86.575	86.222	0.353	169.6	225	6.00	50.0
6.003	6-3	4-8	23.535	0.600	86.265	86.126	0.139	169.3	225	7.10	50.0
4.007	4-7	4-8	52.234	0.600	86.389	86.126	0.263	198.6	255	8.16	48.8
4.006	4-6	4-7	11.653	0.600	86.448	86.389	0.059	197.5	255	7.29	50.0
4.005	4-5	4-6	4.463	0.600	86.471	86.448	0.023	194.1	255	7.10	50.0
4.004	4-4	4-5	27.740	0.600	86.611	86.471	0.140	198.1	255	7.03	50.0
5.001	5-1	4-4	38.057	0.600	86.962	86.737	0.225	169.1	225	6.09	50.0
4.003	4-3	4-4	25.937	0.600	86.742	86.611	0.131	198.0	255	6.56	50.0
4.002	4-2	4-3	35.740	0.600	86.922	86.742	0.180	198.6	255	6.13	50.0
4.001	4-1	4-2	3.729	0.600	86.941	86.922	0.019	196.3	255	5.54	50.0
4.000	4-0	4-1	28.651	0.600	87.085	86.941	0.144	199.0	255	5.48	50.0
5.000	5-0	5-1	27.560	0.600	87.125	86.962	0.163	169.1	225	5.46	50.0
6.002	6-2	6-3	28.382	0.600	86.433	86.265	0.168	168.9	225	6.71	50.0
6.001	6-1	6-2	39.265	0.600	86.665	86.433	0.232	169.2	225	6.24	50.0
6.000	6-0	6-1	34.964	0.600	86.871	86.665	0.206	169.7	225	5.58	50.0
14.001	14-1	14-2	49.191	0.600	86.016	85.887	0.129	380.0	300	7.11	50.0
15.000	15-0	14-2	37.380	0.600	86.269	86.048	0.221	169.1	225	5.62	50.0
14.000	14-0	14-1	52.189	0.600	86.153	86.016	0.137	380.0	300	6.09	50.0
1.011	1-11	1-12	12.131	0.600	85.921	85.901	0.020	600.0	400	13.67	38.1
3.000	3-0	1-12	40.242	0.600	86.791	86.554	0.237	169.8	225	5.67	50.0
1.010	1-10	1-11	47.904	0.600	86.058	85.921	0.137	349.7	400	13.40	38.5
1.009	1-9	1-10	28.263	0.600	86.105	86.058	0.047	600.0	400	12.61	39.7
1.008	1-8	1-9	64.345	0.600	86.233	86.105	0.128	504.0	375	11.99	40.7
1.007	1-7	1-8	45.197	0.600	86.323	86.233	0.090	504.0	375	10.65	43.1
1.006	1-6	1-7	61.852	0.600	86.446	86.323	0.123	504.0	375	9.71	45.0
1.005	1-5	1-6	43.656	0.600	86.533	86.446	0.087	504.0	375	8.42	48.1
2.000	2-0	1-6	30.803	0.600	87.163	86.981	0.182	169.2	225	5.51	50.0
1.004	1-4	1-5	41.714	0.600	86.662	86.533	0.129	323.4	375	7.51	50.0
1.003	1-3	1-4	17.750	0.600	86.717	86.662	0.055	322.7	375	6.82	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
8.001	1.003	70.9	12.9	0.980	1.519	0.095	0.0	86
8.000	0.800	31.8	0.0	1.185	1.055	0.000	0.0	0
9.000	0.800	31.8	0.0	1.076	0.946	0.000	0.0	0
4.008	1.005	111.0	76.5	1.226	1.305	0.593	0.0	230
7.000	1.001	39.8	0.0	1.300	1.274	0.000	0.0	0
6.003	1.002	39.8	24.3	1.440	1.376	0.179	0.0	127
4.007	1.002	51.2	37.3	1.177	1.346	0.282	0.0	162
4.006	1.004	51.3	29.3	1.359	1.177	0.216	0.0	138
4.005	1.013	51.8	29.3	1.402	1.359	0.216	0.0	137
4.004	1.003	51.2	23.9	1.361	1.402	0.176	0.0	122
5.001	1.002	39.8	5.8	0.813	1.265	0.043	0.0	58
4.003	1.003	51.2	7.7	1.324	1.361	0.057	0.0	66
4.002	1.002	51.2	3.8	1.023	1.324	0.028	0.0	46
4.001	1.008	51.5	3.8	1.004	1.023	0.028	0.0	46
4.000	1.001	51.1	0.0	0.860	1.004	0.000	0.0	0
5.000	1.002	39.9	0.0	0.750	0.813	0.000	0.0	0
6.002	1.003	39.9	11.0	1.342	1.440	0.081	0.0	80
6.001	1.002	39.8	8.1	1.180	1.342	0.060	0.0	69
6.000	1.000	39.8	2.7	0.804	1.180	0.020	0.0	40
14.001	0.800	56.6	23.0	1.018	1.334	0.170	0.0	133
15.000	1.002	39.8	0.9	1.600	1.248	0.007	0.0	24
14.000	0.800	56.6	3.7	1.689	1.018	0.027	0.0	51
1.011	0.763	95.9	89.9	1.695	1.856	0.871	0.0	309
3.000	1.000	39.8	1.8	1.455	1.378	0.013	0.0	32
1.010	1.003	126.1	90.8	2.037	1.695	0.871	0.0	252
1.009	0.763	95.9	87.7	1.816	2.037	0.816	0.0	303
1.008	0.800	88.4	69.9	1.945	1.841	0.634	0.0	252
1.007	0.800	88.4	58.5	1.983	1.945	0.501	0.0	223
1.006	0.800	88.4	40.3	1.702	1.983	0.330	0.0	178
1.005	0.800	88.4	19.3	1.293	1.702	0.148	0.0	118
2.000	1.002	39.8	1.6	1.200	1.317	0.012	0.0	31
1.004	1.002	110.7	14.4	1.013	1.293	0.106	0.0	90
1.003	1.003	110.8	12.7	1.058	1.013	0.094	0.0	85

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.002	1-2	1-3	32.342	0.600	86.817	86.717	0.100	323.4	375	6.52	50.0
1.001	1-1	1-2	38.395	0.600	86.936	86.817	0.119	322.6	375	5.98	50.0
1.000	1-0	1-1	20.719	0.600	87.000	86.936	0.064	323.7	375	5.34	50.0
21.015	PI 3	Outfall 3	34.110	0.600	85.997	85.938	0.059	578.1	600	15.16	36.1
21.014	21-14	PI 3	3.768	0.600	86.104	86.097	0.007	538.3	600	14.60	36.8
21.013	21-13	21-14	35.358	0.600	86.138	86.104	0.034	1030.0	600	14.53	36.9
21.012	21-12	21-13	31.554	0.600	86.169	86.138	0.031	1030.0	600	13.75	38.0
30.002	30-2	21-13	19.913	0.600	86.896	86.778	0.118	168.8	225	6.34	50.0
30.001	30-1	30-2	28.062	0.600	87.062	86.896	0.166	169.0	225	6.01	50.0
30.000	30-0	30-1	36.134	0.600	87.325	87.062	0.263	137.4	225	5.54	50.0
21.011	21-11	21-12	65.244	0.600	86.232	86.169	0.063	1030.0	600	13.05	39.0
29.005	29-5	21-12	35.580	0.600	86.487	86.277	0.210	169.4	225	8.09	48.9
29.004	29-4	29-5	32.236	0.600	86.684	86.487	0.197	163.6	225	7.50	50.0
29.003	29-3	29-4	16.189	0.600	86.780	86.684	0.096	168.6	225	6.97	50.0
29.002	29-2	29-3	52.121	0.600	87.088	86.780	0.308	169.2	225	6.70	50.0
29.001	29-1	29-2	12.256	0.600	87.161	87.088	0.073	167.9	225	5.83	50.0
29.000	29-0	29-1	37.960	0.600	87.385	87.161	0.224	169.5	225	5.63	50.0
21.010	21-10	21-11	23.315	0.600	86.272	86.232	0.040	582.9	500	11.60	41.3
27.001	27-1	21-11	43.903	0.600	86.275	86.232	0.043	1030.0	600	7.05	50.0
28.001	28-1	21-11	32.739	0.600	86.333	86.232	0.101	324.2	375	6.32	50.0
28.000	28-0	28-1	46.846	0.600	86.478	86.333	0.145	323.1	375	5.78	50.0
27.000	27-0	27-1	48.356	0.600	86.322	86.275	0.047	1030.0	600	6.07	50.0
21.009	21-9	21-10	43.935	0.600	86.348	86.272	0.076	578.1	500	11.16	42.1
21.008	21-8	21-9	15.307	0.600	86.375	86.348	0.027	566.9	500	10.35	43.7
21.007	21-7	21-8	14.038	0.600	86.400	86.375	0.025	561.5	500	10.06	44.3
21.006	21-6	21-7	51.829	0.600	86.512	86.400	0.112	462.8	500	9.81	44.8
21.005	21-5	21-6	22.318	0.600	86.598	86.534	0.064	348.7	400	8.95	46.8
22.007	22-7	21-6	6.699	0.600	86.529	86.512	0.017	394.1	400	8.52	47.8
22.006	22-6	22-7	18.119	0.600	86.574	86.529	0.045	402.7	400	8.40	48.1
22.005	22-5	22-6	15.182	0.600	86.612	86.574	0.038	399.5	400	8.08	49.0
26.001	26-1	22-6	33.167	0.600	87.022	86.826	0.196	169.2	225	5.84	50.0
26.000	26-0	26-1	17.489	0.600	87.125	87.022	0.103	169.8	225	5.29	50.0
22.004	22-4	22-5	49.431	0.600	86.753	86.612	0.141	350.6	400	7.81	49.7

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
1.002	1.002	110.6	9.4	1.008	1.058	0.069	0.0	73
1.001	1.003	110.8	5.0	0.889	1.008	0.037	0.0	54
1.000	1.001	110.6	1.6	1.175	0.889	0.012	0.0	32
21.015	1.005	284.3	257.7	1.473	0.762	2.635	0.0	451
21.014	1.042	294.7	262.9	1.366	1.373	2.635	0.0	444
21.013	0.750	212.1	263.4	2.112	1.366	2.635	0.0	600
21.012	0.750	212.1	253.2	1.961	2.112	2.461	0.0	600
30.002	1.003	39.9	10.8	1.679	1.847	0.080	0.0	80
30.001	1.003	39.9	4.2	1.413	1.679	0.031	0.0	49
30.000	1.113	44.3	1.4	1.200	1.413	0.010	0.0	27
21.011	0.750	212.1	221.0	1.285	1.961	2.092	0.0	524
29.005	1.001	39.8	25.1	2.139	2.228	0.189	0.0	130
29.004	1.019	40.5	17.5	1.971	2.139	0.129	0.0	103
29.003	1.004	39.9	14.1	1.777	1.971	0.104	0.0	92
29.002	1.002	39.8	6.1	0.976	1.777	0.045	0.0	59
29.001	1.006	40.0	3.8	1.114	0.976	0.028	0.0	47
29.000	1.001	39.8	0.3	0.900	1.114	0.002	0.0	14
21.010	0.892	175.2	171.9	1.157	1.385	1.534	0.0	405
27.001	0.750	212.1	19.5	1.025	1.285	0.144	0.0	122
28.001	1.001	110.5	27.2	1.138	1.510	0.201	0.0	126
28.000	1.002	110.7	5.3	1.255	1.138	0.039	0.0	55
27.000	0.750	212.1	0.0	1.192	1.025	0.000	0.0	0
21.009	0.896	175.9	165.2	1.235	1.157	1.447	0.0	387
21.008	0.905	177.7	169.9	1.343	1.235	1.434	0.0	394
21.007	0.909	178.6	168.6	1.261	1.343	1.405	0.0	389
21.006	1.003	196.9	152.7	1.357	1.261	1.257	0.0	333
21.005	1.005	126.3	40.1	1.458	1.435	0.316	0.0	154
22.007	0.944	118.7	113.1	1.571	1.457	0.872	0.0	314
22.006	0.934	117.4	113.8	1.916	1.571	0.872	0.0	319
22.005	0.938	117.9	105.7	1.919	1.916	0.796	0.0	297
26.001	1.002	39.8	2.3	1.303	1.839	0.017	0.0	36
26.000	1.000	39.8	0.0	1.200	1.303	0.000	0.0	0
22.004	1.002	125.9	82.1	1.998	1.919	0.609	0.0	236

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
25.001	25-1	22-5	14.843	0.600	87.103	87.015	0.088	168.7	225	5.74	50.0
25.000	25-0	25-1	29.832	0.600	87.279	87.103	0.176	169.5	225	5.50	50.0
22.003	22-3	22-4	46.319	0.600	86.885	86.753	0.132	350.9	400	6.98	50.0
22.002	22-2	22-3	7.454	0.600	86.907	86.885	0.022	338.8	400	6.21	50.0
24.000	24-0	22-3	53.093	0.600	87.100	86.949	0.151	351.6	400	5.88	50.0
22.001	22-1	22-2	51.789	0.600	87.055	86.907	0.148	349.9	400	6.09	50.0
23.000	23-0	22-2	63.858	0.600	87.161	86.964	0.197	324.2	375	6.06	50.0
22.000	22-0	22-1	13.905	0.600	87.095	87.055	0.040	347.6	400	5.23	50.0
21.004	21-4	21-5	24.650	0.600	86.669	86.598	0.071	347.2	400	8.58	47.7
21.003	21-3	21-4	48.146	0.600	86.818	86.669	0.149	323.1	375	8.17	48.7
21.002	21-2	21-3	56.065	0.600	86.991	86.818	0.173	324.1	375	7.37	50.0
21.001	21-1	21-2	35.179	0.600	87.100	86.991	0.109	322.7	375	6.43	50.0
21.000	21-0	21-1	51.042	0.600	87.258	87.100	0.158	323.0	375	5.85	50.0
31.017	PI 1	Outfall 1	18.902	0.600	84.520	84.501	0.019	1020.0	600	11.45	41.6
31.016	31-17	PI 1	5.899	0.600	84.631	84.620	0.011	536.2	600	11.03	42.4
31.015	31-16	31-17	11.460	0.600	84.655	84.631	0.024	477.5	600	10.94	42.6
31.014	31-15	31-16	20.609	0.600	84.691	84.655	0.036	572.5	450	10.76	42.9
37.004	37-4	31-16	26.698	0.600	84.822	84.744	0.078	342.3	375	9.70	45.0
37.003	37-3	37-4	49.639	0.600	84.944	84.822	0.122	406.9	375	9.25	46.1
37.002	37-2	37-3	64.636	0.600	85.144	84.944	0.200	323.2	300	8.32	48.3
40.001	40-1	37-3	74.807	0.600	85.619	85.178	0.441	169.6	225	6.69	50.0
40.000	40-0	40-1	26.496	0.600	85.775	85.619	0.156	169.8	225	5.44	50.0
38.001	38-1	37-2	67.475	0.600	85.420	85.144	0.276	244.5	300	6.85	50.0
37.001	37-1	37-2	73.376	0.600	86.272	85.840	0.432	169.9	225	7.08	50.0
37.000	37-0	37-1	51.420	0.600	86.575	86.272	0.303	169.7	225	5.86	50.0
38.000	38-0	38-1	43.565	0.600	85.677	85.420	0.257	169.5	225	5.73	50.0
39.000	39-0	38-1	6.921	0.600	86.115	86.074	0.041	168.8	225	5.11	50.0
31.013	31-14	31-15	14.958	0.600	84.717	84.691	0.026	575.3	450	10.36	43.7
31.012	31-13	31-14	33.595	0.600	84.775	84.717	0.058	579.2	450	10.06	44.3
31.011	31-12	31-13	55.310	0.600	84.933	84.775	0.158	350.1	400	9.39	45.7
36.004	36-4	31-13	42.767	0.600	86.319	85.891	0.428	100.0	225	6.56	50.0
36.003	36-3	36-4	14.574	0.600	86.465	86.319	0.146	100.0	225	6.01	50.0
36.002	36-2	36-3	11.007	0.600	86.575	86.465	0.110	100.0	225	5.83	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
25.001	1.004	39.9	8.4	1.372	1.691	0.062	0.0	70
25.000	1.001	39.8	0.0	1.200	1.372	0.000	0.0	0
22.003	1.002	125.9	64.5	1.278	1.998	0.476	0.0	203
22.002	1.019	128.1	49.2	1.257	1.278	0.363	0.0	171
24.000	1.001	125.7	1.1	1.155	1.214	0.008	0.0	26
22.001	1.003	126.0	6.6	0.843	1.257	0.049	0.0	62
23.000	1.001	110.5	4.7	0.821	1.225	0.035	0.0	52
22.000	1.006	126.5	3.4	0.750	0.843	0.025	0.0	45
21.004	1.007	126.5	32.8	1.298	1.458	0.254	0.0	139
21.003	1.002	110.7	26.2	1.498	1.323	0.198	0.0	123
21.002	1.001	110.5	12.3	1.039	1.498	0.091	0.0	84
21.001	1.003	110.8	8.0	0.750	1.039	0.059	0.0	68
21.000	1.002	110.7	0.7	0.907	0.750	0.005	0.0	21
31.017	0.754	213.2	225.1	1.320	0.469	1.996	0.0	537
31.016	1.044	295.3	229.3	1.209	1.220	1.996	0.0	399
31.015	1.107	313.1	230.2	1.595	1.209	1.996	0.0	383
31.014	0.842	134.0	121.1	1.809	1.745	1.042	0.0	337
37.004	0.973	107.5	104.3	1.733	1.731	0.854	0.0	299
37.003	0.892	98.5	95.7	1.702	1.733	0.766	0.0	300
37.002	0.869	61.4	61.3	1.803	1.777	0.468	0.0	247
40.001	1.001	39.8	3.5	1.231	1.618	0.026	0.0	45
40.000	1.000	39.8	0.0	1.200	1.231	0.000	0.0	0
38.001	1.001	70.7	19.7	1.427	1.803	0.145	0.0	108
37.001	1.000	39.8	6.9	1.239	1.182	0.051	0.0	63
37.000	1.001	39.8	0.0	1.200	1.239	0.000	0.0	0
38.000	1.001	39.8	4.6	1.450	1.502	0.034	0.0	51
39.000	1.003	39.9	0.0	0.831	0.848	0.000	0.0	0
31.013	0.840	133.6	121.0	1.833	1.809	1.022	0.0	337
31.012	0.837	133.2	116.4	2.006	1.833	0.970	0.0	327
31.011	1.003	126.0	81.3	1.568	2.056	0.656	0.0	234
36.004	1.307	52.0	15.7	1.132	1.115	0.116	0.0	85
36.003	1.307	52.0	14.4	1.264	1.132	0.106	0.0	80
36.002	1.307	52.0	11.9	1.362	1.264	0.088	0.0	73

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
36.001	36-1	36-2	14.673	0.600	86.722	86.575	0.147	100.0	225	5.69	50.0
36.000	36-0	36-1	30.135	0.600	86.900	86.722	0.178	169.3	225	5.50	50.0
31.010	31-11	31-12	29.020	0.600	85.016	84.933	0.083	349.6	400	8.47	47.9
31.009	31-10	31-11	19.192	0.600	85.071	85.016	0.055	348.9	400	7.99	49.2
35.000	35-0	31-11	30.939	0.600	85.659	85.476	0.183	169.1	225	5.51	50.0
31.008	31-9	31-10	8.755	0.600	85.096	85.071	0.025	350.2	400	7.67	50.0
31.007	31-8	31-9	4.633	0.600	85.384	85.369	0.015	308.9	300	7.53	50.0
34.000	33-0	31-9	53.968	0.600	85.675	85.357	0.318	169.7	225	5.90	50.0
31.006	31-7	31-8	53.993	0.600	85.605	85.384	0.221	244.3	300	7.44	50.0
33.002	34-2	31-8	12.512	0.600	85.611	85.537	0.074	169.1	225	5.74	50.0
33.001	34-1	34-2	9.300	0.600	85.666	85.611	0.055	169.1	225	5.53	50.0
33.000	34-0	34-1	22.672	0.600	85.800	85.666	0.134	169.2	225	5.38	50.0
31.005	31-6	31-7	6.674	0.600	85.645	85.605	0.040	166.9	225	6.54	50.0
32.001	32-1	31-7	27.582	0.600	85.980	85.817	0.163	169.2	225	5.87	50.0
32.000	32-0	32-1	24.620	0.600	86.125	85.980	0.145	169.8	225	5.41	50.0
31.004	31-5	31-6	31.472	0.600	85.960	85.645	0.315	100.0	225	6.43	50.0
31.003	31-4	31-5	17.107	0.600	86.174	85.960	0.214	80.0	225	6.03	50.0
31.002	31-2	31-4	13.738	0.600	86.346	86.174	0.172	80.0	225	5.83	50.0
31.001	31-1	31-2	22.282	0.600	86.625	86.346	0.279	80.0	225	5.68	50.0
31.000	31-0	31-1	25.451	0.600	86.775	86.625	0.150	169.7	225	5.42	50.0
41.014	PI 5	Outfall 5	5.314	0.600	85.165	85.148	0.017	312.6	500	11.01	42.4
41.013	41-13	PI 5	5.268	0.600	85.275	85.265	0.010	526.8	500	10.94	42.6
41.012	41-12	41-13	24.728	0.600	85.347	85.275	0.072	343.4	400	10.84	42.7
48.000	48-0	41-13	54.165	0.600	86.300	85.758	0.542	100.0	225	5.69	50.0
41.011	41-11	41-12	14.015	0.600	85.385	85.347	0.038	368.8	400	10.44	43.5
41.010	41-10	41-11	5.101	0.600	85.400	85.385	0.015	340.1	400	10.20	44.0
41.009	41-9	41-10	31.084	0.600	85.674	85.578	0.096	323.8	375	10.11	44.2
47.001	47-1	41-10	49.677	0.600	86.108	85.815	0.293	169.5	225	6.53	50.0
47.000	47-0	47-1	50.028	0.600	86.525	86.108	0.417	120.0	225	5.70	50.0
41.008	41-8	41-9	13.682	0.600	85.717	85.674	0.043	318.2	375	9.60	45.3
46.000	46-0	41-9	9.566	0.600	86.005	85.948	0.057	167.8	225	5.16	50.0
41.007	41-7	41-8	5.218	0.600	85.738	85.717	0.021	248.5	375	9.37	45.8
41.006	41-6	41-7	52.111	0.600	85.899	85.738	0.161	323.7	375	9.29	46.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
36.001	1.307	52.0	8.9	1.436	1.362	0.066	0.0	63
36.000	1.002	39.8	0.0	1.433	1.436	0.000	0.0	0
31.010	1.003	126.1	75.0	1.434	1.568	0.577	0.0	222
31.009	1.004	126.2	65.2	1.789	1.434	0.489	0.0	204
35.000	1.002	39.9	3.4	1.207	1.149	0.025	0.0	44
31.008	1.003	126.0	66.3	1.889	1.789	0.489	0.0	206
31.007	0.889	62.8	59.2	1.703	1.716	0.437	0.0	233
34.000	1.001	39.8	0.0	1.500	1.803	0.000	0.0	0
31.006	1.001	70.8	28.6	1.989	1.703	0.211	0.0	133
33.002	1.002	39.9	11.2	1.486	1.625	0.083	0.0	81
33.001	1.002	39.9	8.7	1.475	1.486	0.064	0.0	71
33.000	1.002	39.8	3.7	1.200	1.475	0.027	0.0	46
31.005	1.009	40.1	24.9	2.130	2.064	0.184	0.0	129
32.001	1.002	39.8	3.1	1.545	1.852	0.023	0.0	43
32.000	1.000	39.8	0.0	1.400	1.545	0.000	0.0	0
31.004	1.307	52.0	17.5	2.165	2.130	0.129	0.0	90
31.003	1.463	58.2	14.6	2.013	2.165	0.108	0.0	77
31.002	1.463	58.2	11.8	1.804	2.013	0.087	0.0	68
31.001	1.463	58.2	8.3	1.610	1.804	0.061	0.0	57
31.000	1.001	39.8	0.0	1.586	1.610	0.000	0.0	0
41.014	1.223	240.1	140.4	1.685	0.752	1.221	0.0	275
41.013	0.939	184.4	140.8	1.575	1.585	1.221	0.0	329
41.012	1.013	127.2	123.1	1.703	1.675	1.063	0.0	319
48.000	1.307	52.0	0.0	0.925	1.367	0.000	0.0	0
41.011	0.977	122.7	121.9	1.605	1.703	1.033	0.0	328
41.010	1.018	127.9	120.5	1.630	1.605	1.010	0.0	311
41.009	1.001	110.6	99.3	1.431	1.477	0.829	0.0	279
47.001	1.001	39.8	7.9	1.217	1.390	0.058	0.0	67
47.000	1.192	47.4	0.0	1.200	1.217	0.000	0.0	0
41.008	1.010	111.6	97.2	1.431	1.431	0.792	0.0	272
46.000	1.006	40.0	0.0	1.200	1.307	0.000	0.0	0
41.007	1.145	126.4	95.0	1.410	1.431	0.765	0.0	244
41.006	1.001	110.6	95.3	1.623	1.410	0.765	0.0	270

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
41.005	41-5	41-6	5.064	0.600	85.920	85.899	0.021	241.1	375	8.43	48.1
41.004	41-4	41-5	45.028	0.600	86.059	85.920	0.139	323.9	375	8.35	48.3
45.000	45-0	41-5	36.295	0.600	86.412	86.198	0.214	169.6	225	5.60	50.0
41.003	41-3	41-4	32.932	0.600	86.194	86.059	0.135	243.9	300	7.60	50.0
42.002	42-2	41-4	17.507	0.600	86.399	86.327	0.072	243.1	300	6.00	50.0
44.000	44-0	41-4	16.241	0.600	86.423	86.327	0.096	169.2	225	5.27	50.0
42.001	42-1	42-2	30.162	0.600	86.523	86.399	0.124	243.2	300	5.71	50.0
43.000	43-0	42-2	11.712	0.600	86.593	86.524	0.069	169.7	225	5.20	50.0
42.000	42-0	42-1	12.458	0.600	86.574	86.523	0.051	244.3	300	5.21	50.0
41.002	41-2	41-3	49.058	0.600	86.395	86.194	0.201	244.1	300	7.06	50.0
41.001	41-1	41-2	45.904	0.600	86.583	86.395	0.188	244.2	300	6.24	50.0
41.000	41-0	41-1	28.592	0.600	86.700	86.583	0.117	244.4	300	5.48	50.0
49.006	PI 2	Outfall 2	4.546	0.600	85.620	85.610	0.010	454.6	450	9.22	46.1
49.005	50-5	PI 2	18.999	0.600	85.821	85.763	0.058	327.6	400	9.14	46.3
49.004	50-4	50-5	82.625	0.600	86.002	85.821	0.181	456.5	400	8.84	47.0
49.003	50-3	50-4	63.994	0.600	86.200	86.002	0.198	323.2	400	7.27	50.0
49.002	50-2	50-3	27.221	0.600	87.200	86.860	0.340	80.0	225	6.25	50.0
49.001	50-1	50-2	36.427	0.600	88.000	87.545	0.455	80.0	225	5.94	50.0
49.000	50-0	50-1	45.692	0.600	88.900	88.329	0.571	80.0	225	5.52	50.0
50.006	PI 6	Outfall 6	5.797	0.600	85.526	85.504	0.022	263.5	450	9.69	45.1
50.005	49-5	PI 6	24.841	0.600	85.680	85.626	0.054	460.0	450	9.62	45.2
50.004	49-4	49-5	35.824	0.600	85.730	85.680	0.050	720.0	450	9.18	46.2
50.003	49-3	49-4	34.665	0.600	85.799	85.730	0.069	500.0	375	8.38	48.2
50.002	49-2	49-3	53.673	0.600	85.906	85.799	0.107	500.0	375	7.66	50.0
50.001	49-1	49-2	20.216	0.600	85.969	85.906	0.063	320.9	375	6.55	50.0
50.000	49-0	49-1	72.790	0.600	86.194	85.969	0.225	323.5	375	6.21	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
41.005	1.162	128.4	99.7	1.584	1.623	0.765	0.0	249
41.004	1.001	110.6	81.2	1.792	1.584	0.621	0.0	240
45.000	1.001	39.8	7.7	0.936	1.456	0.057	0.0	67
41.003	1.002	70.8	25.7	1.006	1.867	0.190	0.0	125
42.002	1.004	70.9	43.8	1.449	1.599	0.323	0.0	171
44.000	1.002	39.8	2.6	1.600	1.674	0.019	0.0	38
42.001	1.003	70.9	28.3	1.173	1.449	0.209	0.0	132
43.000	1.000	39.8	2.4	1.200	1.399	0.018	0.0	37
42.000	1.001	70.8	11.8	0.994	1.173	0.087	0.0	82
41.002	1.002	70.8	19.8	1.105	1.006	0.146	0.0	108
41.001	1.001	70.8	11.7	1.367	1.105	0.086	0.0	82
41.000	1.001	70.8	6.9	1.250	1.367	0.051	0.0	63
49.006	0.947	150.6	50.5	1.030	0.441	0.404	0.0	179
49.005	1.037	130.3	50.7	1.879	0.937	0.404	0.0	173
49.004	0.877	110.2	33.5	2.025	1.879	0.263	0.0	151
49.003	1.044	131.2	20.9	2.231	2.025	0.154	0.0	107
49.002	1.463	58.2	16.0	1.921	1.746	0.118	0.0	80
49.001	1.463	58.2	10.2	1.980	1.576	0.075	0.0	64
49.000	1.463	58.2	0.0	1.916	1.651	0.000	0.0	0
50.006	1.247	198.4	44.3	1.913	0.536	0.363	0.0	144
50.005	0.941	149.7	44.5	1.769	1.813	0.363	0.0	167
50.004	0.750	119.3	39.1	1.554	1.769	0.312	0.0	177
50.003	0.803	88.7	33.3	1.373	1.629	0.255	0.0	159
50.002	0.803	88.7	19.9	0.964	1.373	0.147	0.0	120
50.001	1.006	111.1	17.6	0.847	0.964	0.130	0.0	101
50.000	1.002	110.6	0.0	1.237	0.847	0.000	0.0	0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.017	7.171	652.0	600	Circular	87.100	85.584	0.916	86.490	85.573	0.317
1.016	22.093	789.0	600	Circular	87.570	85.712	1.258	87.100	85.684	0.816
1.015	27.613	1030.0	600	Circular	87.781	85.739	1.442	87.570	85.712	1.258
1.014	13.668	1030.0	600	Circular	87.871	85.752	1.519	87.781	85.739	1.442
1.013	25.701	1030.0	600	Circular	88.078	85.777	1.701	87.871	85.752	1.519
18.004	7.300	504.0	375	Circular	87.871	85.770	1.726	87.871	85.756	1.740
18.003	13.576	504.0	375	Circular	87.724	85.797	1.552	87.871	85.770	1.726
18.002	45.795	322.5	375	Circular	87.900	85.939	1.586	87.724	85.797	1.552
18.001	31.368	243.2	300	Circular	87.750	86.068	1.382	87.900	85.939	1.661
20.000	48.292	169.4	225	Circular	87.550	86.244	1.081	87.900	85.959	1.716
18.000	60.538	169.6	225	Circular	87.800	86.425	1.150	87.750	86.068	1.457
19.001	13.696	169.1	225	Circular	87.600	86.590	0.785	87.750	86.509	1.016
19.000	22.929	169.8	225	Circular	88.150	86.725	1.200	87.600	86.590	0.785
1.012	10.520	634.0	450	Circular	88.157	85.901	1.806	88.078	85.884	1.744
4.016	41.030	1030.0	600	Circular	87.823	85.817	1.406	88.078	85.777	1.701
16.000	35.288	169.7	225	Circular	88.000	86.575	1.200	87.823	86.367	1.231
17.000	33.300	169.0	225	Circular	87.625	86.200	1.200	87.823	86.003	1.595
4.015	32.945	908.0	600	Circular	87.418	85.853	0.965	87.823	85.817	1.406
14.002	13.040	504.0	375	Circular	87.521	85.887	1.259	87.418	85.861	1.182
4.014	21.547	908.0	600	Circular	87.500	85.877	1.023	87.418	85.853	0.965
4.013	19.264	723.0	500	Circular	87.400	85.904	0.996	87.500	85.877	1.123
13.000	29.498	169.5	225	Circular	87.600	86.175	1.200	87.400	86.001	1.174
4.012	28.941	723.0	500	Circular	87.850	85.944	1.406	87.400	85.904	0.996
4.011	6.084	723.0	500	Circular	87.850	85.952	1.398	87.850	85.944	1.406
4.010	27.773	545.0	400	Circular	87.822	86.003	1.419	87.850	85.952	1.498
10.003	19.085	264.0	225	Circular	87.724	86.099	1.400	87.850	86.027	1.598
10.002	18.982	169.5	225	Circular	87.700	86.294	1.181	87.724	86.182	1.317
12.000	16.776	264.0	225	Circular	87.588	86.163	1.200	87.724	86.099	1.400
11.001	26.210	169.1	225	Circular	87.700	86.449	1.026	87.700	86.294	1.181
10.001	34.125	169.8	225	Circular	87.816	86.665	0.926	87.700	86.464	1.011
10.000	16.252	169.3	225	Circular	87.635	86.761	0.649	87.816	86.665	0.926
11.000	12.853	169.1	225	Circular	87.700	86.525	0.950	87.700	86.449	1.026
4.009	19.118	504.0	375	Circular	87.721	86.041	1.305	87.822	86.003	1.444
8.001	28.505	243.6	300	Circular	87.400	86.120	0.980	87.822	86.003	1.519

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.017	PI 4	1500	Manhole	Adoptable	Outfall 4	1500	Manhole	Adoptable
1.016	1-16	2100	Manhole	Adoptable	PI 4	1500	Manhole	Adoptable
1.015	1-15	1500	Manhole	Adoptable	1-16	2100	Manhole	Adoptable
1.014	1-14	1500	Manhole	Adoptable	1-15	1500	Manhole	Adoptable
1.013	1-13	1500	Manhole	Adoptable	1-14	1500	Manhole	Adoptable
18.004	18-4	1350	Manhole	Adoptable	1-14	1500	Manhole	Adoptable
18.003	18-3	1350	Manhole	Adoptable	18-4	1350	Manhole	Adoptable
18.002	18-2	1350	Manhole	Adoptable	18-3	1350	Manhole	Adoptable
18.001	18-1	1200	Manhole	Adoptable	18-2	1350	Manhole	Adoptable
20.000	20-0	1200	Manhole	Adoptable	18-2	1350	Manhole	Adoptable
18.000	18-0	1200	Manhole	Adoptable	18-1	1200	Manhole	Adoptable
19.001	19-1	1200	Manhole	Adoptable	18-1	1200	Manhole	Adoptable
19.000	19-0	1200	Manhole	Adoptable	19-1	1200	Manhole	Adoptable
1.012	1-12	1350	Manhole	Adoptable	1-13	1500	Manhole	Adoptable
4.016	4-16	1500	Manhole	Adoptable	1-13	1500	Manhole	Adoptable
16.000	16-0	1200	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
17.000	17-0	1200	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
4.015	4-15	1500	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
14.002	14-2	1350	Manhole	Adoptable	4-15	1500	Manhole	Adoptable
4.014	4-14	1500	Manhole	Adoptable	4-15	1500	Manhole	Adoptable
4.013	4-13	1500	Manhole	Adoptable	4-14	1500	Manhole	Adoptable
13.000	13-0	1200	Manhole	Adoptable	4-13	1500	Manhole	Adoptable
4.012	4-12	1500	Manhole	Adoptable	4-13	1500	Manhole	Adoptable
4.011	4-11	1500	Manhole	Adoptable	4-12	1500	Manhole	Adoptable
4.010	4-10	1350	Manhole	Adoptable	4-11	1500	Manhole	Adoptable
10.003	10-3	1200	Manhole	Adoptable	4-11	1500	Manhole	Adoptable
10.002	10-2	1200	Manhole	Adoptable	10-3	1200	Manhole	Adoptable
12.000	12-0	1200	Manhole	Adoptable	10-3	1200	Manhole	Adoptable
11.001	11-1	1200	Manhole	Adoptable	10-2	1200	Manhole	Adoptable
10.001	10-1	1200	Manhole	Adoptable	10-2	1200	Manhole	Adoptable
10.000	10-0	1200	Manhole	Adoptable	10-1	1200	Manhole	Adoptable
11.000	11-0	1200	Manhole	Adoptable	11-1	1200	Manhole	Adoptable
4.009	4-9	1350	Manhole	Adoptable	4-10	1350	Manhole	Adoptable
8.001	8-1	1200	Manhole	Adoptable	4-10	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
8.000	44.945	264.0	225	Circular	87.700	86.290	1.185	87.400	86.120	1.055
9.000	44.809	264.0	225	Circular	87.700	86.399	1.076	87.400	86.229	0.946
4.008	27.328	321.5	375	Circular	87.727	86.126	1.226	87.721	86.041	1.305
7.000	59.885	169.6	225	Circular	88.100	86.575	1.300	87.721	86.222	1.274
6.003	23.535	169.3	225	Circular	87.930	86.265	1.440	87.727	86.126	1.376
4.007	52.234	198.6	255	Circular	87.821	86.389	1.177	87.727	86.126	1.346
4.006	11.653	197.5	255	Circular	88.062	86.448	1.359	87.821	86.389	1.177
4.005	4.463	194.1	255	Circular	88.128	86.471	1.402	88.062	86.448	1.359
4.004	27.740	198.1	255	Circular	88.227	86.611	1.361	88.128	86.471	1.402
5.001	38.057	169.1	225	Circular	88.000	86.962	0.813	88.227	86.737	1.265
4.003	25.937	198.0	255	Circular	88.321	86.742	1.324	88.227	86.611	1.361
4.002	35.740	198.6	255	Circular	88.200	86.922	1.023	88.321	86.742	1.324
4.001	3.729	196.3	255	Circular	88.200	86.941	1.004	88.200	86.922	1.023
4.000	28.651	199.0	255	Circular	88.200	87.085	0.860	88.200	86.941	1.004
5.000	27.560	169.1	225	Circular	88.100	87.125	0.750	88.000	86.962	0.813
6.002	28.382	168.9	225	Circular	88.000	86.433	1.342	87.930	86.265	1.440
6.001	39.265	169.2	225	Circular	88.070	86.665	1.180	88.000	86.433	1.342
6.000	34.964	169.7	225	Circular	87.900	86.871	0.804	88.070	86.665	1.180
14.001	49.191	380.0	300	Circular	87.334	86.016	1.018	87.521	85.887	1.334
15.000	37.380	169.1	225	Circular	88.094	86.269	1.600	87.521	86.048	1.248
14.000	52.189	380.0	300	Circular	88.142	86.153	1.689	87.334	86.016	1.018
1.011	12.131	600.0	400	Circular	88.016	85.921	1.695	88.157	85.901	1.856
3.000	40.242	169.8	225	Circular	88.471	86.791	1.455	88.157	86.554	1.378
1.010	47.904	349.7	400	Circular	88.495	86.058	2.037	88.016	85.921	1.695
1.009	28.263	600.0	400	Circular	88.321	86.105	1.816	88.495	86.058	2.037
1.008	64.345	504.0	375	Circular	88.553	86.233	1.945	88.321	86.105	1.841
1.007	45.197	504.0	375	Circular	88.681	86.323	1.983	88.553	86.233	1.945
1.006	61.852	504.0	375	Circular	88.523	86.446	1.702	88.681	86.323	1.983
1.005	43.656	504.0	375	Circular	88.201	86.533	1.293	88.523	86.446	1.702
2.000	30.803	169.2	225	Circular	88.588	87.163	1.200	88.523	86.981	1.317
1.004	41.714	323.4	375	Circular	88.050	86.662	1.013	88.201	86.533	1.293
1.003	17.750	322.7	375	Circular	88.150	86.717	1.058	88.050	86.662	1.013
1.002	32.342	323.4	375	Circular	88.200	86.817	1.008	88.150	86.717	1.058
1.001	38.395	322.6	375	Circular	88.200	86.936	0.889	88.200	86.817	1.008

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
8.000	8-0	1200	Manhole	Adoptable	8-1	1200	Manhole	Adoptable
9.000	9-0	1200	Manhole	Adoptable	8-1	1200	Manhole	Adoptable
4.008	4-8	1350	Manhole	Adoptable	4-9	1350	Manhole	Adoptable
7.000	7-0	1200	Manhole	Adoptable	4-9	1350	Manhole	Adoptable
6.003	6-3	1200	Manhole	Adoptable	4-8	1350	Manhole	Adoptable
4.007	4-7	1200	Manhole	Adoptable	4-8	1350	Manhole	Adoptable
4.006	4-6	1200	Manhole	Adoptable	4-7	1200	Manhole	Adoptable
4.005	4-5	1200	Manhole	Adoptable	4-6	1200	Manhole	Adoptable
4.004	4-4	1200	Manhole	Adoptable	4-5	1200	Manhole	Adoptable
5.001	5-1	1200	Manhole	Adoptable	4-4	1200	Manhole	Adoptable
4.003	4-3	1200	Manhole	Adoptable	4-4	1200	Manhole	Adoptable
4.002	4-2	1200	Manhole	Adoptable	4-3	1200	Manhole	Adoptable
4.001	4-1	1200	Manhole	Adoptable	4-2	1200	Manhole	Adoptable
4.000	4-0	1200	Manhole	Adoptable	4-1	1200	Manhole	Adoptable
5.000	5-0	1200	Manhole	Adoptable	5-1	1200	Manhole	Adoptable
6.002	6-2	1200	Manhole	Adoptable	6-3	1200	Manhole	Adoptable
6.001	6-1	1200	Manhole	Adoptable	6-2	1200	Manhole	Adoptable
6.000	6-0	1200	Manhole	Adoptable	6-1	1200	Manhole	Adoptable
14.001	14-1	1200	Manhole	Adoptable	14-2	1350	Manhole	Adoptable
15.000	15-0	1200	Manhole	Adoptable	14-2	1350	Manhole	Adoptable
14.000	14-0	1200	Manhole	Adoptable	14-1	1200	Manhole	Adoptable
1.011	1-11	1800	Manhole	Adoptable	1-12	1350	Manhole	Adoptable
3.000	3-0	1200	Manhole	Adoptable	1-12	1350	Manhole	Adoptable
1.010	1-10	1350	Manhole	Adoptable	1-11	1800	Manhole	Adoptable
1.009	1-9	1350	Manhole	Adoptable	1-10	1350	Manhole	Adoptable
1.008	1-8	1350	Manhole	Adoptable	1-9	1350	Manhole	Adoptable
1.007	1-7	1350	Manhole	Adoptable	1-8	1350	Manhole	Adoptable
1.006	1-6	1350	Manhole	Adoptable	1-7	1350	Manhole	Adoptable
1.005	1-5	1350	Manhole	Adoptable	1-6	1350	Manhole	Adoptable
2.000	2-0	1200	Manhole	Adoptable	1-6	1350	Manhole	Adoptable
1.004	1-4	1350	Manhole	Adoptable	1-5	1350	Manhole	Adoptable
1.003	1-3	1350	Manhole	Adoptable	1-4	1350	Manhole	Adoptable
1.002	1-2	1350	Manhole	Adoptable	1-3	1350	Manhole	Adoptable
1.001	1-1	1350	Manhole	Adoptable	1-2	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	20.719	323.7	375	Circular	88.550	87.000	1.175	88.200	86.936	0.889
21.015	34.110	578.1	600	Circular	88.070	85.997	1.473	87.300	85.938	0.762
21.014	3.768	538.3	600	Circular	88.070	86.104	1.366	88.070	86.097	1.373
21.013	35.358	1030.0	600	Circular	88.850	86.138	2.112	88.070	86.104	1.366
21.012	31.554	1030.0	600	Circular	88.730	86.169	1.961	88.850	86.138	2.112
30.002	19.913	168.8	225	Circular	88.800	86.896	1.679	88.850	86.778	1.847
30.001	28.062	169.0	225	Circular	88.700	87.062	1.413	88.800	86.896	1.679
30.000	36.134	137.4	225	Circular	88.750	87.325	1.200	88.700	87.062	1.413
21.011	65.244	1030.0	600	Circular	88.117	86.232	1.285	88.730	86.169	1.961
29.005	35.580	169.4	225	Circular	88.851	86.487	2.139	88.730	86.277	2.228
29.004	32.236	163.6	225	Circular	88.880	86.684	1.971	88.851	86.487	2.139
29.003	16.189	168.6	225	Circular	88.782	86.780	1.777	88.880	86.684	1.971
29.002	52.121	169.2	225	Circular	88.289	87.088	0.976	88.782	86.780	1.777
29.001	12.256	167.9	225	Circular	88.500	87.161	1.114	88.289	87.088	0.976
29.000	37.960	169.5	225	Circular	88.510	87.385	0.900	88.500	87.161	1.114
21.010	23.315	582.9	500	Circular	87.929	86.272	1.157	88.117	86.232	1.385
27.001	43.903	1030.0	600	Circular	87.900	86.275	1.025	88.117	86.232	1.285
28.001	32.739	324.2	375	Circular	87.846	86.333	1.138	88.117	86.232	1.510
28.000	46.846	323.1	375	Circular	88.108	86.478	1.255	87.846	86.333	1.138
27.000	48.356	1030.0	600	Circular	88.114	86.322	1.192	87.900	86.275	1.025
21.009	43.935	578.1	500	Circular	88.083	86.348	1.235	87.929	86.272	1.157
21.008	15.307	566.9	500	Circular	88.218	86.375	1.343	88.083	86.348	1.235
21.007	14.038	561.5	500	Circular	88.161	86.400	1.261	88.218	86.375	1.343
21.006	51.829	462.8	500	Circular	88.369	86.512	1.357	88.161	86.400	1.261
21.005	22.318	348.7	400	Circular	88.456	86.598	1.458	88.369	86.534	1.435
22.007	6.699	394.1	400	Circular	88.500	86.529	1.571	88.369	86.512	1.457
22.006	18.119	402.7	400	Circular	88.890	86.574	1.916	88.500	86.529	1.571
22.005	15.182	399.5	400	Circular	88.931	86.612	1.919	88.890	86.574	1.916
26.001	33.167	169.2	225	Circular	88.550	87.022	1.303	88.890	86.826	1.839
26.000	17.489	169.8	225	Circular	88.550	87.125	1.200	88.550	87.022	1.303
22.004	49.431	350.6	400	Circular	89.151	86.753	1.998	88.931	86.612	1.919
25.001	14.843	168.7	225	Circular	88.700	87.103	1.372	88.931	87.015	1.691
25.000	29.832	169.5	225	Circular	88.704	87.279	1.200	88.700	87.103	1.372
22.003	46.319	350.9	400	Circular	88.563	86.885	1.278	89.151	86.753	1.998

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1-0	1350	Manhole	Adoptable	1-1	1350	Manhole	Adoptable
21.015	PI 3	1500	Manhole	Adoptable	Outfall 3	1500	Manhole	Adoptable
21.014	21-14	1500	Manhole	Adoptable	PI 3	1500	Manhole	Adoptable
21.013	21-13	1500	Manhole	Adoptable	21-14	1500	Manhole	Adoptable
21.012	21-12	1500	Manhole	Adoptable	21-13	1500	Manhole	Adoptable
30.002	30-2	1200	Manhole	Adoptable	21-13	1500	Manhole	Adoptable
30.001	30-1	1200	Manhole	Adoptable	30-2	1200	Manhole	Adoptable
30.000	30-0	1200	Manhole	Adoptable	30-1	1200	Manhole	Adoptable
21.011	21-11	1500	Manhole	Adoptable	21-12	1500	Manhole	Adoptable
29.005	29-5	1200	Manhole	Adoptable	21-12	1500	Manhole	Adoptable
29.004	29-4	1200	Manhole	Adoptable	29-5	1200	Manhole	Adoptable
29.003	29-3	1200	Manhole	Adoptable	29-4	1200	Manhole	Adoptable
29.002	29-2	1200	Manhole	Adoptable	29-3	1200	Manhole	Adoptable
29.001	29-1	1200	Manhole	Adoptable	29-2	1200	Manhole	Adoptable
29.000	29-0	1200	Manhole	Adoptable	29-1	1200	Manhole	Adoptable
21.010	21-10	1500	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
27.001	27-1	1500	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
28.001	28-1	1350	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
28.000	28-0	1350	Manhole	Adoptable	28-1	1350	Manhole	Adoptable
27.000	27-0	1500	Manhole	Adoptable	27-1	1500	Manhole	Adoptable
21.009	21-9	1500	Manhole	Adoptable	21-10	1500	Manhole	Adoptable
21.008	21-8	1500	Manhole	Adoptable	21-9	1500	Manhole	Adoptable
21.007	21-7	1500	Manhole	Adoptable	21-8	1500	Manhole	Adoptable
21.006	21-6	1500	Manhole	Adoptable	21-7	1500	Manhole	Adoptable
21.005	21-5	1350	Manhole	Adoptable	21-6	1500	Manhole	Adoptable
22.007	22-7	1350	Manhole	Adoptable	21-6	1500	Manhole	Adoptable
22.006	22-6	1350	Manhole	Adoptable	22-7	1350	Manhole	Adoptable
22.005	22-5	1350	Manhole	Adoptable	22-6	1350	Manhole	Adoptable
26.001	26-1	1200	Manhole	Adoptable	22-6	1350	Manhole	Adoptable
26.000	26-0	1200	Manhole	Adoptable	26-1	1200	Manhole	Adoptable
22.004	22-4	1350	Manhole	Adoptable	22-5	1350	Manhole	Adoptable
25.001	25-1	1200	Manhole	Adoptable	22-5	1350	Manhole	Adoptable
25.000	25-0	1200	Manhole	Adoptable	25-1	1200	Manhole	Adoptable
22.003	22-3	1350	Manhole	Adoptable	22-4	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
22.002	7.454	338.8	400	Circular	88.564	86.907	1.257	88.563	86.885	1.278
24.000	53.093	351.6	400	Circular	88.655	87.100	1.155	88.563	86.949	1.214
22.001	51.789	349.9	400	Circular	88.298	87.055	0.843	88.564	86.907	1.257
23.000	63.858	324.2	375	Circular	88.357	87.161	0.821	88.564	86.964	1.225
22.000	13.905	347.6	400	Circular	88.245	87.095	0.750	88.298	87.055	0.843
21.004	24.650	347.2	400	Circular	88.367	86.669	1.298	88.456	86.598	1.458
21.003	48.146	323.1	375	Circular	88.691	86.818	1.498	88.367	86.669	1.323
21.002	56.065	324.1	375	Circular	88.405	86.991	1.039	88.691	86.818	1.498
21.001	35.179	322.7	375	Circular	88.225	87.100	0.750	88.405	86.991	1.039
21.000	51.042	323.0	375	Circular	88.540	87.258	0.907	88.225	87.100	0.750
31.017	18.902	1020.0	600	Circular	86.440	84.520	1.320	85.570	84.501	0.469
31.016	5.899	536.2	600	Circular	86.440	84.631	1.209	86.440	84.620	1.220
31.015	11.460	477.5	600	Circular	86.850	84.655	1.595	86.440	84.631	1.209
31.014	20.609	572.5	450	Circular	86.950	84.691	1.809	86.850	84.655	1.745
37.004	26.698	342.3	375	Circular	86.930	84.822	1.733	86.850	84.744	1.731
37.003	49.639	406.9	375	Circular	87.021	84.944	1.702	86.930	84.822	1.733
37.002	64.636	323.2	300	Circular	87.247	85.144	1.803	87.021	84.944	1.777
40.001	74.807	169.6	225	Circular	87.075	85.619	1.231	87.021	85.178	1.618
40.000	26.496	169.8	225	Circular	87.200	85.775	1.200	87.075	85.619	1.231
38.001	67.475	244.5	300	Circular	87.147	85.420	1.427	87.247	85.144	1.803
37.001	73.376	169.9	225	Circular	87.736	86.272	1.239	87.247	85.840	1.182
37.000	51.420	169.7	225	Circular	88.000	86.575	1.200	87.736	86.272	1.239
38.000	43.565	169.5	225	Circular	87.352	85.677	1.450	87.147	85.420	1.502
39.000	6.921	168.8	225	Circular	87.171	86.115	0.831	87.147	86.074	0.848
31.013	14.958	575.3	450	Circular	87.000	84.717	1.833	86.950	84.691	1.809
31.012	33.595	579.2	450	Circular	87.231	84.775	2.006	87.000	84.717	1.833
31.011	55.310	350.1	400	Circular	86.901	84.933	1.568	87.231	84.775	2.056
36.004	42.767	100.0	225	Circular	87.676	86.319	1.132	87.231	85.891	1.115
36.003	14.574	100.0	225	Circular	87.954	86.465	1.264	87.676	86.319	1.132
36.002	11.007	100.0	225	Circular	88.162	86.575	1.362	87.954	86.465	1.264
36.001	14.673	100.0	225	Circular	88.383	86.722	1.436	88.162	86.575	1.362
36.000	30.135	169.3	225	Circular	88.558	86.900	1.433	88.383	86.722	1.436
31.010	29.020	349.6	400	Circular	86.850	85.016	1.434	86.901	84.933	1.568
31.009	19.192	348.9	400	Circular	87.260	85.071	1.789	86.850	85.016	1.434

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
22.002	22-2	1350	Manhole	Adoptable	22-3	1350	Manhole	Adoptable
24.000	24-0	1350	Manhole	Adoptable	22-3	1350	Manhole	Adoptable
22.001	22-1	1350	Manhole	Adoptable	22-2	1350	Manhole	Adoptable
23.000	23-0	1350	Manhole	Adoptable	22-2	1350	Manhole	Adoptable
22.000	22-0	1350	Manhole	Adoptable	22-1	1350	Manhole	Adoptable
21.004	21-4	1350	Manhole	Adoptable	21-5	1350	Manhole	Adoptable
21.003	21-3	1350	Manhole	Adoptable	21-4	1350	Manhole	Adoptable
21.002	21-2	1350	Manhole	Adoptable	21-3	1350	Manhole	Adoptable
21.001	21-1	1350	Manhole	Adoptable	21-2	1350	Manhole	Adoptable
21.000	21-0	1350	Manhole	Adoptable	21-1	1350	Manhole	Adoptable
31.017	PI 1	1500	Manhole	Adoptable	Outfall 1	1500	Manhole	Adoptable
31.016	31-17	2100	Manhole	Adoptable	PI 1	1500	Manhole	Adoptable
31.015	31-16	1500	Manhole	Adoptable	31-17	2100	Manhole	Adoptable
31.014	31-15	1350	Manhole	Adoptable	31-16	1500	Manhole	Adoptable
37.004	37-4	1350	Manhole	Adoptable	31-16	1500	Manhole	Adoptable
37.003	37-3	1350	Manhole	Adoptable	37-4	1350	Manhole	Adoptable
37.002	37-2	1200	Manhole	Adoptable	37-3	1350	Manhole	Adoptable
40.001	40-1	1200	Manhole	Adoptable	37-3	1350	Manhole	Adoptable
40.000	40-0	1200	Manhole	Adoptable	40-1	1200	Manhole	Adoptable
38.001	38-1	1200	Manhole	Adoptable	37-2	1200	Manhole	Adoptable
37.001	37-1	1200	Manhole	Adoptable	37-2	1200	Manhole	Adoptable
37.000	37-0	1200	Manhole	Adoptable	37-1	1200	Manhole	Adoptable
38.000	38-0	1200	Manhole	Adoptable	38-1	1200	Manhole	Adoptable
39.000	39-0	1200	Manhole	Adoptable	38-1	1200	Manhole	Adoptable
31.013	31-14	1350	Manhole	Adoptable	31-15	1350	Manhole	Adoptable
31.012	31-13	1350	Manhole	Adoptable	31-14	1350	Manhole	Adoptable
31.011	31-12	1350	Manhole	Adoptable	31-13	1350	Manhole	Adoptable
36.004	36-4	1200	Manhole	Adoptable	31-13	1350	Manhole	Adoptable
36.003	36-3	1200	Manhole	Adoptable	36-4	1200	Manhole	Adoptable
36.002	36-2	1200	Manhole	Adoptable	36-3	1200	Manhole	Adoptable
36.001	36-1	1200	Manhole	Adoptable	36-2	1200	Manhole	Adoptable
36.000	36-0	1200	Manhole	Adoptable	36-1	1200	Manhole	Adoptable
31.010	31-11	1350	Manhole	Adoptable	31-12	1350	Manhole	Adoptable
31.009	31-10	1800	Manhole	Adoptable	31-11	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
35.000	30.939	169.1	225	Circular	87.091	85.659	1.207	86.850	85.476	1.149
31.008	8.755	350.2	400	Circular	87.385	85.096	1.889	87.260	85.071	1.789
31.007	4.633	308.9	300	Circular	87.387	85.384	1.703	87.385	85.369	1.716
34.000	53.968	169.7	225	Circular	87.400	85.675	1.500	87.385	85.357	1.803
31.006	53.993	244.3	300	Circular	87.894	85.605	1.989	87.387	85.384	1.703
33.002	12.512	169.1	225	Circular	87.322	85.611	1.486	87.387	85.537	1.625
33.001	9.300	169.1	225	Circular	87.366	85.666	1.475	87.322	85.611	1.486
33.000	22.672	169.2	225	Circular	87.225	85.800	1.200	87.366	85.666	1.475
31.005	6.674	166.9	225	Circular	88.000	85.645	2.130	87.894	85.605	2.064
32.001	27.582	169.2	225	Circular	87.750	85.980	1.545	87.894	85.817	1.852
32.000	24.620	169.8	225	Circular	87.750	86.125	1.400	87.750	85.980	1.545
31.004	31.472	100.0	225	Circular	88.350	85.960	2.165	88.000	85.645	2.130
31.003	17.107	80.0	225	Circular	88.412	86.174	2.013	88.350	85.960	2.165
31.002	13.738	80.0	225	Circular	88.375	86.346	1.804	88.412	86.174	2.013
31.001	22.282	80.0	225	Circular	88.460	86.625	1.610	88.375	86.346	1.804
31.000	25.451	169.7	225	Circular	88.586	86.775	1.586	88.460	86.625	1.610
41.014	5.314	312.6	500	Circular	87.350	85.165	1.685	86.400	85.148	0.752
41.013	5.268	526.8	500	Circular	87.350	85.275	1.575	87.350	85.265	1.585
41.012	24.728	343.4	400	Circular	87.450	85.347	1.703	87.350	85.275	1.675
48.000	54.165	100.0	225	Circular	87.450	86.300	0.925	87.350	85.758	1.367
41.011	14.015	368.8	400	Circular	87.390	85.385	1.605	87.450	85.347	1.703
41.010	5.101	340.1	400	Circular	87.430	85.400	1.630	87.390	85.385	1.605
41.009	31.084	323.8	375	Circular	87.480	85.674	1.431	87.430	85.578	1.477
47.001	49.677	169.5	225	Circular	87.550	86.108	1.217	87.430	85.815	1.390
47.000	50.028	120.0	225	Circular	87.950	86.525	1.200	87.550	86.108	1.217
41.008	13.682	318.2	375	Circular	87.523	85.717	1.431	87.480	85.674	1.431
46.000	9.566	167.8	225	Circular	87.430	86.005	1.200	87.480	85.948	1.307
41.007	5.218	248.5	375	Circular	87.523	85.738	1.410	87.523	85.717	1.431
41.006	52.111	323.7	375	Circular	87.897	85.899	1.623	87.523	85.738	1.410
41.005	5.064	241.1	375	Circular	87.879	85.920	1.584	87.897	85.899	1.623
41.004	45.028	323.9	375	Circular	88.226	86.059	1.792	87.879	85.920	1.584
45.000	36.295	169.6	225	Circular	87.573	86.412	0.936	87.879	86.198	1.456
41.003	32.932	243.9	300	Circular	87.500	86.194	1.006	88.226	86.059	1.867
42.002	17.507	243.1	300	Circular	88.148	86.399	1.449	88.226	86.327	1.599

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
35.000	35-0	1200	Manhole	Adoptable	31-11	1350	Manhole	Adoptable
31.008	31-9	1350	Manhole	Adoptable	31-10	1800	Manhole	Adoptable
31.007	31-8	1200	Manhole	Adoptable	31-9	1350	Manhole	Adoptable
34.000	33-0	1200	Manhole	Adoptable	31-9	1350	Manhole	Adoptable
31.006	31-7	1200	Manhole	Adoptable	31-8	1200	Manhole	Adoptable
33.002	34-2	1200	Manhole	Adoptable	31-8	1200	Manhole	Adoptable
33.001	34-1	1200	Manhole	Adoptable	34-2	1200	Manhole	Adoptable
33.000	34-0	1200	Manhole	Adoptable	34-1	1200	Manhole	Adoptable
31.005	31-6	1200	Manhole	Adoptable	31-7	1200	Manhole	Adoptable
32.001	32-1	1200	Manhole	Adoptable	31-7	1200	Manhole	Adoptable
32.000	32-0	1200	Manhole	Adoptable	32-1	1200	Manhole	Adoptable
31.004	31-5	1200	Manhole	Adoptable	31-6	1200	Manhole	Adoptable
31.003	31-4	1200	Manhole	Adoptable	31-5	1200	Manhole	Adoptable
31.002	31-2	1200	Manhole	Adoptable	31-4	1200	Manhole	Adoptable
31.001	31-1	1200	Manhole	Adoptable	31-2	1200	Manhole	Adoptable
31.000	31-0	1200	Manhole	Adoptable	31-1	1200	Manhole	Adoptable
41.014	PI 5	1500	Manhole	Adoptable	Outfall 5	1500	Manhole	Adoptable
41.013	41-13	1800	Manhole	Adoptable	PI 5	1500	Manhole	Adoptable
41.012	41-12	1800	Manhole	Adoptable	41-13	1800	Manhole	Adoptable
48.000	48-0	1200	Manhole	Adoptable	41-13	1800	Manhole	Adoptable
41.011	41-11	1350	Manhole	Adoptable	41-12	1800	Manhole	Adoptable
41.010	41-10	1350	Manhole	Adoptable	41-11	1350	Manhole	Adoptable
41.009	41-9	1350	Manhole	Adoptable	41-10	1350	Manhole	Adoptable
47.001	47-1	1200	Manhole	Adoptable	41-10	1350	Manhole	Adoptable
47.000	47-0	1200	Manhole	Adoptable	47-1	1200	Manhole	Adoptable
41.008	41-8	1350	Manhole	Adoptable	41-9	1350	Manhole	Adoptable
46.000	46-0	1200	Manhole	Adoptable	41-9	1350	Manhole	Adoptable
41.007	41-7	1350	Manhole	Adoptable	41-8	1350	Manhole	Adoptable
41.006	41-6	1350	Manhole	Adoptable	41-7	1350	Manhole	Adoptable
41.005	41-5	1350	Manhole	Adoptable	41-6	1350	Manhole	Adoptable
41.004	41-4	1350	Manhole	Adoptable	41-5	1350	Manhole	Adoptable
45.000	45-0	1200	Manhole	Adoptable	41-5	1350	Manhole	Adoptable
41.003	41-3	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable
42.002	42-2	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
44.000	16.241	169.2	225	Circular	88.248	86.423	1.600	88.226	86.327	1.674
42.001	30.162	243.2	300	Circular	87.996	86.523	1.173	88.148	86.399	1.449
43.000	11.712	169.7	225	Circular	88.018	86.593	1.200	88.148	86.524	1.399
42.000	12.458	244.3	300	Circular	87.868	86.574	0.994	87.996	86.523	1.173
41.002	49.058	244.1	300	Circular	87.800	86.395	1.105	87.500	86.194	1.006
41.001	45.904	244.2	300	Circular	88.250	86.583	1.367	87.800	86.395	1.105
41.000	28.592	244.4	300	Circular	88.250	86.700	1.250	88.250	86.583	1.367
49.006	4.546	454.6	450	Circular	87.100	85.620	1.030	86.501	85.610	0.441
49.005	18.999	327.6	400	Circular	88.100	85.821	1.879	87.100	85.763	0.937
49.004	82.625	456.5	400	Circular	88.427	86.002	2.025	88.100	85.821	1.879
49.003	63.994	323.2	400	Circular	88.831	86.200	2.231	88.427	86.002	2.025
49.002	27.221	80.0	225	Circular	89.346	87.200	1.921	88.831	86.860	1.746
49.001	36.427	80.0	225	Circular	90.205	88.000	1.980	89.346	87.545	1.576
49.000	45.692	80.0	225	Circular	91.041	88.900	1.916	90.205	88.329	1.651
50.006	5.797	263.5	450	Circular	87.889	85.526	1.913	86.490	85.504	0.536
50.005	24.841	460.0	450	Circular	87.899	85.680	1.769	87.889	85.626	1.813
50.004	35.824	720.0	450	Circular	87.734	85.730	1.554	87.899	85.680	1.769
50.003	34.665	500.0	375	Circular	87.547	85.799	1.373	87.734	85.730	1.629
50.002	53.673	500.0	375	Circular	87.245	85.906	0.964	87.547	85.799	1.373
50.001	20.216	320.9	375	Circular	87.191	85.969	0.847	87.245	85.906	0.964
50.000	72.790	323.5	375	Circular	87.806	86.194	1.237	87.191	85.969	0.847

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
44.000	44-0	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable
42.001	42-1	1200	Manhole	Adoptable	42-2	1200	Manhole	Adoptable
43.000	43-0	1200	Manhole	Adoptable	42-2	1200	Manhole	Adoptable
42.000	42-0	1200	Manhole	Adoptable	42-1	1200	Manhole	Adoptable
41.002	41-2	1200	Manhole	Adoptable	41-3	1200	Manhole	Adoptable
41.001	41-1	1200	Manhole	Adoptable	41-2	1200	Manhole	Adoptable
41.000	41-0	1200	Manhole	Adoptable	41-1	1200	Manhole	Adoptable
49.006	PI 2	1350	Manhole	Adoptable	Outfall 2	1350	Manhole	Adoptable
49.005	50-5	1350	Manhole	Adoptable	PI 2	1350	Manhole	Adoptable
49.004	50-4	1350	Manhole	Adoptable	50-5	1350	Manhole	Adoptable
49.003	50-3	1350	Manhole	Adoptable	50-4	1350	Manhole	Adoptable
49.002	50-2	1200	Manhole	Adoptable	50-3	1350	Manhole	Adoptable
49.001	50-1	1200	Manhole	Adoptable	50-2	1200	Manhole	Adoptable
49.000	50-0	1200	Manhole	Adoptable	50-1	1200	Manhole	Adoptable
50.006	PI 6	1350	Manhole	Adoptable	Outfall 6	1350	Manhole	Adoptable
50.005	49-5	1350	Manhole	Adoptable	PI 6	1350	Manhole	Adoptable
50.004	49-4	1350	Manhole	Adoptable	49-5	1350	Manhole	Adoptable
50.003	49-3	1350	Manhole	Adoptable	49-4	1350	Manhole	Adoptable
50.002	49-2	1350	Manhole	Adoptable	49-3	1350	Manhole	Adoptable
50.001	49-1	1350	Manhole	Adoptable	49-2	1350	Manhole	Adoptable
50.000	49-0	1350	Manhole	Adoptable	49-1	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-0	681728.297	714559.265	88.550	1.550	1350	0	1.000	87.000	375
1-1	681727.082	714579.948	88.200	1.264	1350	1	1.000	86.936	375
						0	1.001	86.936	375
1-2	681729.935	714618.237	88.200	1.383	1350	1	1.001	86.817	375
						0	1.002	86.817	375
1-3	681724.880	714650.182	88.150	1.433	1350	1	1.002	86.717	375
						0	1.003	86.717	375
1-4	681726.157	714667.886	88.050	1.388	1350	1	1.003	86.662	375
						0	1.004	86.662	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-5	681706.946	714704.913	88.201	1.668	1350	1	1.004	86.533	375
						0	1.005	86.533	375
2-0	681654.345	714711.728	88.588	1.425	1200	0	2.000	87.163	225
1-6	681668.442	714684.340	88.523	2.077	1350	1	2.000	86.981	225
						2	1.005	86.446	375
						0	1.006	86.446	375
1-7	681613.809	714655.342	88.681	2.358	1350	1	1.006	86.323	375
						0	1.007	86.323	375
1-8	681573.837	714634.246	88.553	2.320	1350	1	1.007	86.233	375
						0	1.008	86.233	375
1-9	681516.849	714604.369	88.321	2.216	1350	1	1.008	86.105	375
						0	1.009	86.105	400
1-10	681489.411	714611.148	88.495	2.437	1350	1	1.009	86.058	400
						0	1.010	86.058	400
1-11	681465.859	714652.863	88.016	2.095	1800	1	1.010	85.921	400
						0	1.011	85.921	400
3-0	681495.121	714623.928	88.471	1.680	1200	0	3.000	86.791	225
1-12	681476.088	714659.384	88.157	2.256	1350	1	3.000	86.554	225
						2	1.011	85.901	400
						0	1.012	85.901	450
4-0	681714.921	714722.862	88.200	1.115	1200	0	4.000	87.085	255
4-1	681700.576	714747.663	88.200	1.259	1200	1	4.000	86.941	255
						0	4.001	86.941	255
4-2	681696.983	714746.664	88.200	1.278	1200	1	4.001	86.922	255
						0	4.002	86.922	255
4-3	681679.139	714777.631	88.321	1.579	1200	1	4.002	86.742	255
						0	4.003	86.742	255
5-0	681687.188	714707.538	88.100	0.975	1200	0	5.000	87.125	225
5-1	681674.194	714731.842	88.000	1.038	1200	1	5.000	86.962	225
						0	5.001	86.962	225
4-4	681656.262	714765.409	88.227	1.616	1200	1	5.001	86.737	225
						2	4.003	86.611	255
						0	4.004	86.611	255

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
4-5	681631.788	714752.351	88.128	1.657	1200	1	4.004	86.471	255
						0	4.005	86.471	255
4-6	681629.584	714756.232	88.062	1.614	1200	1	4.005	86.448	255
						0	4.006	86.448	255
4-7	681618.718	714752.021	87.821	1.432	1200	1	4.006	86.389	255
						0	4.007	86.389	255
6-0	681651.744	714821.450	87.900	1.029	1200	0	6.000	86.871	225
6-1	681635.217	714852.261	88.070	1.405	1200	1	6.000	86.665	225
						0	6.001	86.665	225
6-2	681600.572	714833.783	88.000	1.567	1200	1	6.001	86.433	225
						0	6.002	86.433	225
6-3	681613.963	714808.759	87.930	1.665	1200	1	6.002	86.265	225
						0	6.003	86.265	225
4-8	681593.233	714797.616	87.727	1.601	1350	1	6.003	86.126	225
						2	4.007	86.126	255
						0	4.008	86.126	375
7-0	681598.010	714732.199	88.100	1.525	1200	0	7.000	86.575	225
4-9	681569.162	714784.678	87.721	1.680	1350	1	7.000	86.222	225
						2	4.008	86.041	375
						0	4.009	86.041	375
8-0	681578.569	714821.954	87.700	1.410	1200	0	8.000	86.290	225
9-0	681499.419	714779.633	87.700	1.301	1200	0	9.000	86.399	225
8-1	681538.921	714800.785	87.400	1.280	1200	1	9.000	86.229	225
						2	8.000	86.120	225
						0	8.001	86.120	300
4-10	681552.322	714775.627	87.822	1.819	1350	1	8.001	86.003	300
						2	4.009	86.003	375
						0	4.010	86.003	400
10-0	681456.887	714742.982	87.635	0.874	1200	0	10.000	86.761	225
10-1	681464.184	714728.460	87.816	1.151	1200	1	10.000	86.665	225
						0	10.001	86.665	225
11-0	681470.270	714761.709	87.700	1.175	1200	0	11.000	86.525	225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
11-1	681481.748	714767.493	87.700	1.251	1200	1	11.000	86.449	225
						0	11.001	86.449	225
10-2	681494.310	714744.490	87.700	1.406	1200	1	11.001	86.294	225
						2	10.001	86.464	225
						0	10.002	86.294	225
12-0	681518.601	714738.418	87.588	1.425	1200				
						0	12.000	86.163	225
10-3	681511.067	714753.407	87.724	1.625	1200	1	12.000	86.099	225
						2	10.002	86.182	225
						0	10.003	86.099	225
4-11	681527.859	714762.478	87.850	1.898	1500	1	10.003	86.027	225
						2	4.010	85.952	400
						0	4.011	85.952	500
4-12	681530.789	714757.146	87.850	1.906	1500	1	4.011	85.944	500
						0	4.012	85.944	500
13-0	681570.228	714744.973	87.600	1.425	1200				
						0	13.000	86.175	225
4-13	681544.032	714731.413	87.400	1.496	1500	1	13.000	86.001	225
						2	4.012	85.904	500
						0	4.013	85.904	500
4-14	681526.924	714722.557	87.500	1.623	1500	1	4.013	85.877	500
						0	4.014	85.877	600
14-0	681632.181	714739.287	88.142	1.989	1200				
						0	14.000	86.153	300
14-1	681586.068	714714.847	87.334	1.318	1200	1	14.000	86.016	300
						0	14.001	86.016	300
15-0	681560.301	714658.807	88.094	1.825	1200				
						0	15.000	86.269	225
14-2	681542.637	714691.750	87.521	1.634	1350	1	15.000	86.048	225
						2	14.001	85.887	300
						0	14.002	85.887	375
4-15	681536.496	714703.253	87.418	1.565	1500	1	14.002	85.861	375
						2	4.014	85.853	600
						0	4.015	85.853	600
16-0	681524.006	714656.720	88.000	1.425	1200				
						0	16.000	86.575	225
17-0	681491.700	714717.223	87.625	1.425	1200				
						0	17.000	86.200	225
4-16	681507.377	714687.844	87.823	2.006	1500	1	17.000	86.003	225
							16.000	86.367	225
						3	4.015	85.817	600
						0	4.016	85.817	600

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-13	681471.112	714668.653	88.078	2.301	1500	1	4.016	85.777	600
						2	1.012	85.884	450
						0	1.013	85.777	600
18-0	681422.878	714707.549	87.800	1.375	1200	0	18.000	86.425	225
19-0	681367.542	714630.246	88.150	1.425	1200	0	19.000	86.725	225
19-1	681380.523	714649.147	87.600	1.010	1200	1	19.000	86.590	225
						0	19.001	86.590	225
18-1	681392.936	714654.934	87.750	1.682	1200	1	19.001	86.509	225
						2	18.000	86.068	225
						0	18.001	86.068	300
20-0	681458.635	714610.046	87.550	1.306	1200	0	20.000	86.244	225
18-2	681419.839	714638.804	87.900	1.961	1350	1	20.000	85.959	225
						2	18.001	85.939	300
						0	18.002	85.939	375
18-3	681442.714	714678.477	87.724	1.927	1350	1	18.002	85.797	375
						0	18.003	85.797	375
18-4	681452.487	714687.900	87.871	2.101	1350	1	18.003	85.770	375
						0	18.004	85.770	375
1-14	681458.950	714691.294	87.871	2.119	1500	1	18.004	85.756	375
						2	1.013	85.752	600
						0	1.014	85.752	600
1-15	681452.167	714703.160	87.781	2.042	1500	1	1.014	85.739	600
						0	1.015	85.739	600
1-16	681431.016	714720.912	87.570	1.858	2100	1	1.015	85.712	600
						0	1.016	85.712	600
PI 4	681413.439	714734.297	87.100	1.516	1500	1	1.016	85.684	600
						0	1.017	85.584	600
Outfall 4	681407.762	714738.679	86.490	0.917	1500	1	1.017	85.573	600
21-0	681732.623	714543.018	88.540	1.282	1350	0	21.000	87.258	375
21-1	681683.674	714528.552	88.225	1.125	1350	1	21.000	87.100	375
						0	21.001	87.100	375
21-2	681649.964	714518.491	88.405	1.414	1350	1	21.001	86.991	375
						0	21.002	86.991	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
21-3	681596.221	714502.522	88.691	1.873	1350	1	21.002	86.818	375
						0	21.003	86.818	375
21-4	681550.069	714488.810	88.367	1.698	1350	1	21.003	86.669	375
						0	21.004	86.669	400
21-5	681538.872	714510.770	88.456	1.858	1350	1	21.004	86.598	400
						0	21.005	86.598	400
22-0	681680.587	714541.754	88.245	1.150	1350				
						0	22.000	87.095	400
22-1	681676.628	714555.083	88.298	1.243	1350	1	22.000	87.055	400
						0	22.001	87.055	400
23-0	681708.590	714630.655	88.357	1.196	1350				
						0	23.000	87.161	375
22-2	681652.175	714600.736	88.564	1.657	1350	1	23.000	86.964	375
						2	22.001	86.907	400
						0	22.002	86.907	400
24-0	681619.602	714645.364	88.655	1.555	1350				
						0	24.000	87.100	400
22-3	681644.994	714598.737	88.563	1.678	1350	1	24.000	86.949	400
						2	22.002	86.885	400
						0	22.003	86.885	400
22-4	681604.492	714576.263	89.151	2.398	1350	1	22.003	86.753	400
						0	22.004	86.753	400
25-0	681578.956	714511.950	88.704	1.425	1200				
						0	25.000	87.279	225
25-1	681570.824	714540.652	88.700	1.597	1200	1	25.000	87.103	225
						0	25.001	87.103	225
22-5	681561.371	714552.096	88.931	2.319	1350	1	25.001	87.015	225
						2	22.004	86.612	400
						0	22.005	86.612	400
26-0	681520.981	714587.351	88.550	1.425	1200				
						0	26.000	87.125	225
26-1	681529.224	714571.926	88.550	1.528	1200	1	26.000	87.022	225
						0	26.001	87.022	225
22-6	681548.127	714544.673	88.890	2.316	1350	1	26.001	86.826	225
						2	22.005	86.574	400
						0	22.006	86.574	400
22-7	681533.514	714533.960	88.500	1.971	1350	1	22.006	86.529	400
						0	22.007	86.529	400

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
21-6	681527.948	714530.232	88.369	1.857	1500		1	22.007	86.512	400
							2	21.005	86.534	400
							0	21.006	86.512	500
21-7	681498.591	714572.945	88.161	1.761	1500		1	21.006	86.400	500
							0	21.007	86.400	500
21-8	681494.806	714586.463	88.218	1.843	1500		1	21.007	86.375	500
							0	21.008	86.375	500
21-9	681479.812	714583.385	88.083	1.735	1500		1	21.008	86.348	500
							0	21.009	86.348	500
21-10	681440.788	714563.200	87.929	1.657	1500		1	21.009	86.272	500
							0	21.010	86.272	500
27-0	681350.118	714601.420	88.114	1.792	1500		0	27.000	86.322	600
27-1	681391.219	714575.945	87.900	1.625	1500		1	27.000	86.275	600
							0	27.001	86.275	600
28-0	681472.874	714484.377	88.108	1.630	1350		0	28.000	86.478	375
28-1	681446.895	714523.359	87.846	1.513	1350		1	28.000	86.333	375
							0	28.001	86.333	375
21-11	681424.130	714546.888	88.117	1.885	1500		1	28.001	86.232	375
							2	27.001	86.232	600
							3	21.010	86.232	500
							0	21.011	86.232	600
29-0	681529.152	714477.102	88.510	1.125	1200		0	29.000	87.385	225
29-1	681493.847	714463.154	88.500	1.339	1200		1	29.000	87.161	225
							0	29.001	87.161	225
29-2	681481.690	714464.705	88.289	1.201	1200		1	29.001	87.088	225
							0	29.002	87.088	225
29-3	681435.452	714440.649	88.782	2.002	1200		1	29.002	86.780	225
							0	29.003	86.780	225
29-4	681420.740	714447.405	88.880	2.196	1200		1	29.003	86.684	225
							0	29.004	86.684	225
29-5	681401.736	714473.443	88.851	2.364	1200		1	29.004	86.487	225
							0	29.005	86.487	225
21-12	681378.428	714500.325	88.730	2.561	1500		1	29.005	86.277	225
							2	21.011	86.169	600
							0	21.012	86.169	600

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
30-0	681336.824	714583.857	88.750	1.425	1200		0	30.000	87.325	225
30-1	681318.656	714552.623	88.700	1.638	1200		1	30.000	87.062	225
							0	30.001	87.062	225
30-2	681338.498	714532.780	88.800	1.904	1200		1	30.001	86.896	225
							0	30.002	86.896	225
21-13	681354.275	714520.630	88.850	2.712	1500		1	30.002	86.778	225
							2	21.012	86.138	600
							0	21.013	86.138	600
21-14	681331.006	714494.008	88.070	1.966	1500		1	21.013	86.104	600
							0	21.014	86.104	600
PI 3	681328.921	714490.869	88.070	2.073	1500		1	21.014	86.097	600
							0	21.015	85.997	600
Outfall 3	681310.005	714462.485	87.300	1.362	1500		1	21.015	85.938	600
31-0	681241.100	714577.004	88.586	1.811	1200		0	31.000	86.775	225
31-1	681266.075	714572.105	88.460	1.835	1200		1	31.000	86.625	225
							0	31.001	86.625	225
31-2	681288.357	714572.144	88.375	2.029	1200		1	31.001	86.346	225
							0	31.002	86.346	225
31-4	681300.880	714577.792	88.412	2.238	1200		1	31.002	86.174	225
							0	31.003	86.174	225
31-5	681310.328	714592.053	88.350	2.390	1200		1	31.003	85.960	225
							0	31.004	85.960	225
31-6	681328.209	714617.952	88.000	2.355	1200		1	31.004	85.645	225
							0	31.005	85.645	225
32-0	681351.362	714665.315	87.750	1.625	1200		0	32.000	86.125	225
32-1	681337.837	714644.743	87.750	1.770	1200		1	32.000	85.980	225
							0	32.001	85.980	225
31-7	681322.684	714621.696	87.894	2.289	1200		1	32.001	85.817	225
							2	31.005	85.605	225
							0	31.006	85.605	300
34-0	681241.403	714640.836	87.225	1.425	1200		0	33.000	85.800	225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
34-1	681263.636	714636.398	87.366	1.700	1200	1	33.000	85.666	225
						0	33.001	85.666	225
34-2	681271.591	714641.215	87.322	1.711	1200	1	33.001	85.611	225
						0	33.002	85.611	225
31-8	681277.979	714651.973	87.387	2.003	1200	1	33.002	85.537	225
						2	31.006	85.384	300
						0	31.007	85.384	300
33-0	681304.110	714699.473	87.400	1.725	1200	0	34.000	85.675	225
31-9	681274.152	714654.584	87.385	2.289	1350	1	34.000	85.357	225
						2	31.007	85.369	300
						0	31.008	85.096	400
31-10	681266.162	714658.164	87.260	2.189	1800	1	31.008	85.071	400
						0	31.009	85.071	400
35-0	681280.289	714692.365	87.091	1.432	1200	0	35.000	85.659	225
31-11	681255.367	714674.032	86.850	1.834	1350	1	35.000	85.476	225
						2	31.009	85.016	400
						0	31.010	85.016	400
31-12	681230.026	714659.891	86.901	1.968	1350	1	31.010	84.933	400
						0	31.011	84.933	400
36-0	681231.376	714579.073	88.558	1.658	1200	0	36.000	86.900	225
36-1	681201.801	714584.854	88.383	1.661	1200	1	36.000	86.722	225
						0	36.001	86.722	225
36-2	681188.714	714591.490	88.162	1.587	1200	1	36.001	86.575	225
						0	36.002	86.575	225
36-3	681182.045	714600.247	87.954	1.489	1200	1	36.002	86.465	225
						0	36.003	86.465	225
36-4	681178.035	714614.258	87.676	1.357	1200	1	36.003	86.319	225
						0	36.004	86.319	225
31-13	681174.797	714656.902	87.231	2.456	1350	1	36.004	85.891	225
						2	31.011	84.775	400
						0	31.012	84.775	450
31-14	681172.134	714690.391	87.000	2.283	1350	1	31.012	84.717	450
						0	31.013	84.717	450
31-15	681178.112	714704.102	86.950	2.259	1350	1	31.013	84.691	450
						0	31.014	84.691	450

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
37-0	681393.391	714716.054	88.000	1.425	1200		0	37.000	86.575	225
37-1	681364.767	714673.338	87.736	1.464	1200		1	37.000	86.272	225
							0	37.001	86.272	225
38-0	681384.526	714741.184	87.352	1.675	1200		0	38.000	85.677	225
39-0	681352.807	714770.696	87.171	1.056	1200		0	39.000	86.115	225
38-1	681348.326	714765.422	87.147	1.727	1200		1	39.000	86.074	225
							2	38.000	85.420	225
							0	38.001	85.420	300
37-2	681304.036	714714.518	87.247	2.103	1200		1	38.001	85.144	300
							2	37.001	85.840	225
							0	37.002	85.144	300
40-0	681328.813	714803.744	87.200	1.425	1200		0	40.000	85.775	225
40-1	681305.668	714816.641	87.075	1.456	1200		1	40.000	85.619	225
							0	40.001	85.619	225
37-3	681257.516	714759.392	87.021	2.077	1350		1	40.001	85.178	225
							2	37.002	84.944	300
							0	37.003	84.944	375
37-4	681218.378	714728.860	86.930	2.108	1350		1	37.003	84.822	375
							0	37.004	84.822	375
31-16	681195.150	714715.697	86.850	2.195	1500		1	37.004	84.744	375
							2	31.014	84.655	450
							0	31.015	84.655	600
31-17	681189.329	714725.568	86.440	1.809	2100		1	31.015	84.631	600
							0	31.016	84.631	600
PI 1	681186.333	714730.649	86.440	1.920	1500		1	31.016	84.620	600
							0	31.017	84.520	600
Outfall 1	681181.220	714748.846	85.570	1.069	1500		1	31.017	84.501	600
41-0	681603.924	714908.556	88.250	1.550	1200		0	41.000	86.700	300
41-1	681618.947	714884.229	88.250	1.667	1200		1	41.000	86.583	300
							0	41.001	86.583	300
41-2	681580.497	714859.153	87.800	1.405	1200		1	41.001	86.395	300
							0	41.002	86.395	300

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
41-3	681539.046	714832.914	87.500	1.306	1200	1	41.002	86.194	300
						0	41.003	86.194	300
42-0	681554.612	714897.046	87.868	1.294	1200	0	42.000	86.574	300
42-1	681561.361	714886.575	87.996	1.473	1200	1	42.000	86.523	300
						0	42.001	86.523	300
43-0	681529.669	714880.070	88.018	1.425	1200	0	43.000	86.593	225
42-2	681536.014	714870.226	88.148	1.749	1200	1	43.000	86.524	225
						2	42.001	86.399	300
						0	42.002	86.399	300
44-0	681512.910	714874.563	88.248	1.825	1200	0	44.000	86.423	225
41-4	681521.339	714860.680	88.226	2.167	1350	1	44.000	86.327	225
						2	42.002	86.327	300
						3	41.003	86.059	300
						0	41.004	86.059	375
45-0	681450.416	714820.912	87.573	1.161	1200	0	45.000	86.412	225
41-5	681482.391	714838.085	87.879	1.959	1350	1	45.000	86.198	225
						2	41.004	85.920	375
						0	41.005	85.920	375
41-6	681480.058	714842.579	87.897	1.998	1350	1	41.005	85.899	375
						0	41.006	85.899	375
41-7	681434.036	714818.133	87.523	1.785	1350	1	41.006	85.738	375
						0	41.007	85.738	375
41-8	681436.400	714813.481	87.523	1.806	1350	1	41.007	85.717	375
						0	41.008	85.717	375
46-0	681419.932	714815.536	87.430	1.425	1200	0	46.000	86.005	225
41-9	681424.329	714807.040	87.480	1.806	1350	1	46.000	85.948	225
						2	41.008	85.674	375
						0	41.009	85.674	375
47-0	681526.464	714826.290	87.950	1.425	1200	0	47.000	86.525	225
47-1	681482.339	714802.714	87.550	1.442	1200	1	47.000	86.108	225
						0	47.001	86.108	225
41-10	681438.489	714779.369	87.430	2.030	1350	1	47.001	85.815	225
						2	41.009	85.578	375
						0	41.010	85.400	400

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
41-11	681441.127	714775.003	87.390	2.005	1350	1	41.010	85.385	400
						0	41.011	85.385	400
41-12	681437.310	714761.518	87.450	2.103	1800	1	41.011	85.347	400
						0	41.012	85.347	400
48-0	681389.971	714797.634	87.450	1.150	1200	0	48.000	86.300	225
41-13	681415.501	714749.863	87.350	2.075	1800	1	48.000	85.758	225
						2	41.012	85.275	400
						0	41.013	85.275	500
PI 5	681410.913	714747.274	87.350	2.185	1500	1	41.013	85.265	500
						0	41.014	85.165	500
Outfall 5	681406.210	714744.800	86.400	1.252	1500	1	41.014	85.148	500
50-0	681272.880	714510.934	91.041	2.141	1200	0	49.000	88.900	225
50-1	681305.334	714543.097	90.205	2.205	1200	1	49.000	88.329	225
						0	49.001	88.000	225
50-2	681326.122	714573.010	89.346	2.146	1200	1	49.001	87.545	225
						0	49.002	87.200	225
50-3	681341.206	714595.670	88.831	2.631	1350	1	49.002	86.860	225
						0	49.003	86.200	400
50-4	681376.057	714649.341	88.427	2.425	1350	1	49.003	86.002	400
						0	49.004	86.002	400
50-5	681423.923	714716.689	88.100	2.279	1350	1	49.004	85.821	400
						0	49.005	85.821	400
PI 2	681408.828	714728.225	87.100	1.480	1350	1	49.005	85.763	400
						0	49.006	85.620	450
Outfall 2	681405.225	714730.997	86.501	0.891	1350	1	49.006	85.610	450
49-0	681617.771	714850.092	87.806	1.612	1350	0	50.000	86.194	375
49-1	681553.609	714815.717	87.191	1.222	1350	1	50.000	85.969	375
						0	50.001	85.969	375
49-2	681537.854	714803.050	87.245	1.339	1350	1	50.001	85.906	375
						0	50.002	85.906	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
49-3	681490.130	714778.489	87.547	1.748	1350	1	50.002	85.799	375
						0	50.003	85.799	375
49-4	681460.413	714760.641	87.734	2.004	1350	1	50.003	85.730	375
						0	50.004	85.730	450
49-5	681437.601	714733.019	87.899	2.219	1350	1	50.004	85.680	450
						0	50.005	85.680	450
PI 6	681413.647	714739.599	87.889	2.363	1350	1	50.005	85.626	450
						0	50.006	85.526	450
Outfall 6	681408.322	714741.891	86.490	0.986	1350	1	50.006	85.504	450

Simulation Settings

Rainfall Methodology	FSR	Summer CV	0.750	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Winter CV	0.840	Additional Storage (m³/ha)	20.0
M5-60 (mm)	15.600	Analysis Speed	Normal	Check Discharge Rate(s)	x
Ratio-R	0.286	Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
5	20	0	0

Node 21-14 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	86.104	Product Number	CTL-SHE-0093-4000-1143-4000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.0	Min Node Diameter (mm)	1200

Node 31-17 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	84.631	Product Number	CTL-SHE-0143-9900-1143-9900
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	9.9	Min Node Diameter (mm)	1200

Node 50-5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.821	Product Number	CTL-SHE-0065-2000-1143-2000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 1-11 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.921	Product Number	CTL-SHE-0173-1500-1143-1500
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	15.0	Min Node Diameter (mm)	1500

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Node 41-13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.275	Product Number	CTL-SHE-0193-2100-1661-2100
Design Depth (m)	1.661	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	21.0	Min Node Diameter (mm)	1800

Node 1-16 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	85.712	Product Number	CTL-SHE-0250-3740-1800-3740
Design Depth (m)	1.800	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	37.4	Min Node Diameter (mm)	1800

Node 49-5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.680	Product Number	CTL-SHE-0065-2000-1143-2000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 21-14 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	86.104
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	2120.0	0.0	1.143	2120.0	0.0	1.144	0.0	0.0

Node 31-17 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	84.631
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	540.0	0.0	1.143	540.0	0.0	1.144	0.0	0.0

Node 41-7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.738
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.89	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	350.0	0.0	1.143	350.0	0.0	1.144	0.0	0.0

Node 31-10 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.071
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.90	Time to half empty (mins)	960

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	500.0	0.0	1.143	500.0	0.0	1.144	0.0	0.0

Node 4-12 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.944
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.89	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	680.0	0.0	1.143	680.0	0.0	1.144	0.0	0.0

Node 1-11 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.921
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	655.0	0.0	1.143	655.0	0.0	1.144	0.0	0.0

Node 49-3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.799
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.87	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	150.0	0.0	1.143	150.0	0.0	1.144	0.0	0.0

Node 50-5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.821
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.87	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	183.0	0.0	1.143	183.0	0.0	1.144	0.0	0.0

Node 22-7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	86.529
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.88	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	360.0	0.0	1.143	360.0	0.0	1.144	0.0	0.0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 85.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1-0	10	87.037	0.037	2.4	0.0586	0.0000	OK
15 minute winter	1-1	11	86.999	0.063	7.3	0.1152	0.0000	OK
15 minute winter	1-2	11	86.902	0.085	13.0	0.1603	0.0000	OK
15 minute winter	1-3	13	86.878	0.161	22.7	0.2859	0.0000	OK
15 minute winter	1-4	13	86.849	0.187	25.7	0.3001	0.0000	OK
15 minute winter	1-5	12	86.880	0.347	33.4	0.6708	0.0000	OK
15 minute winter	2-0	11	87.200	0.037	2.4	0.0475	0.0000	OK
15 minute summer	1-6	12	86.811	0.365	55.3	1.1190	0.0000	OK
15 minute summer	1-7	11	86.820	0.497	72.9	1.4311	0.0000	SURCHARGED
15 minute winter	1-8	11	86.812	0.579	90.6	1.4925	0.0000	SURCHARGED
15 minute winter	1-9	11	86.758	0.653	110.2	2.0067	0.0000	SURCHARGED
15 minute summer	1-10	11	86.672	0.614	111.2	1.1567	0.0000	SURCHARGED
600 minute winter	1-11	480	86.388	0.467	22.4	279.3361	0.0000	SURCHARGED
15 minute winter	3-0	11	86.829	0.038	2.6	0.0486	0.0000	OK
240 minute winter	1-12	176	86.396	0.495	11.2	1.1523	0.0000	SURCHARGED
15 minute summer	4-0	1	87.085	0.000	0.0	0.0000	0.0000	OK
15 minute winter	4-1	11	87.000	0.059	5.5	0.0937	0.0000	OK
15 minute winter	4-2	11	86.977	0.055	5.3	0.0621	0.0000	OK
15 minute winter	4-3	12	86.964	0.222	19.2	0.3331	0.0000	OK
15 minute summer	5-0	1	87.125	0.000	0.0	0.0000	0.0000	OK
15 minute winter	5-1	11	87.031	0.069	8.5	0.1348	0.0000	OK
15 minute winter	4-4	13	86.957	0.346	32.8	0.7178	0.0000	SURCHARGED
15 minute winter	4-5	13	86.920	0.449	34.2	0.7243	0.0000	SURCHARGED
15 minute winter	4-6	13	86.903	0.455	37.1	0.5149	0.0000	SURCHARGED
15 minute winter	4-7	13	86.871	0.482	41.4	0.9899	0.0000	SURCHARGED
15 minute winter	6-0	10	86.918	0.047	4.0	0.0712	0.0000	OK
15 minute winter	6-1	12	86.913	0.248	18.6	0.4220	0.0000	SURCHARGED
15 minute winter	6-2	12	86.877	0.444	18.1	0.6206	0.0000	SURCHARGED
15 minute winter	6-3	12	86.835	0.570	35.6	1.3163	0.0000	SURCHARGED
15 minute winter	4-8	11	86.803	0.677	87.8	2.0858	0.0000	SURCHARGED
15 minute winter	7-0	12	86.756	0.181	16.7	0.2042	0.0000	OK
15 minute winter	4-9	11	86.752	0.711	117.3	2.2883	0.0000	SURCHARGED
15 minute winter	8-0	11	86.810	0.520	19.4	0.5876	0.0000	SURCHARGED
15 minute summer	9-0	11	86.809	0.410	15.8	0.4642	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1-0	1.000	1-1	2.3	0.269	0.021	0.1838	
15 minute winter	1-1	1.001	1-2	7.0	0.458	0.063	0.5907	
15 minute winter	1-2	1.002	1-3	12.7	0.587	0.115	0.9929	
15 minute winter	1-3	1.003	1-4	20.8	0.695	0.188	0.8871	
15 minute winter	1-4	1.004	1-5	30.1	0.594	0.272	3.0271	
15 minute winter	1-5	1.005	1-6	43.0	0.520	0.486	4.5058	
15 minute winter	2-0	2.000	1-6	2.3	0.546	0.057	0.1278	
15 minute summer	1-6	1.006	1-7	62.0	0.645	0.701	6.7936	
15 minute summer	1-7	1.007	1-8	80.4	0.747	0.910	4.9851	
15 minute winter	1-8	1.008	1-9	94.7	0.881	1.072	7.0971	
15 minute winter	1-9	1.009	1-10	109.2	1.008	1.139	3.5382	
15 minute summer	1-10	1.010	1-11	123.6	2.073	0.981	3.0782	
600 minute winter	1-11	Hydro-Brake®	1-12	11.8				
15 minute winter	3-0	3.000	1-12	2.4	0.557	0.061	0.1752	
240 minute winter	1-12	1.012	1-13	11.2	0.270	0.088	1.6668	
15 minute summer	4-0	4.000	4-1	0.0	0.000	0.000	0.1253	
15 minute winter	4-1	4.001	4-2	5.3	0.634	0.103	0.0318	
15 minute winter	4-2	4.002	4-3	5.3	0.497	0.103	0.9806	
15 minute winter	4-3	4.003	4-4	14.1	0.449	0.276	1.2743	
15 minute summer	5-0	5.000	5-1	0.0	0.000	0.000	0.1381	
15 minute winter	5-1	5.001	4-4	8.2	0.771	0.206	0.9079	
15 minute winter	4-4	4.004	4-5	32.1	0.820	0.626	1.4164	
15 minute winter	4-5	4.005	4-6	37.1	0.875	0.718	0.2279	
15 minute winter	4-6	4.006	4-7	38.7	0.820	0.754	0.5950	
15 minute winter	4-7	4.007	4-8	44.0	0.897	0.860	2.6670	
15 minute winter	6-0	6.000	6-1	3.8	0.412	0.096	0.7927	
15 minute winter	6-1	6.001	6-2	16.4	0.751	0.412	1.5616	
15 minute winter	6-2	6.002	6-3	22.3	0.561	0.560	1.1288	
15 minute winter	6-3	6.003	4-8	33.5	0.844	0.842	0.9360	
15 minute winter	4-8	4.008	4-9	92.7	0.841	0.836	3.0142	
15 minute winter	7-0	7.000	4-9	-16.7	-0.475	-0.419	2.2135	
15 minute winter	4-9	4.009	4-10	130.4	1.182	1.475	2.1087	
15 minute winter	8-0	8.000	8-1	-19.4	-0.559	-0.609	1.7875	
15 minute summer	9-0	9.000	8-1	-15.8	-0.494	-0.497	1.7821	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 85.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	8-1	11	86.722	0.602	45.3	1.5746	0.0000	SURCHARGED
15 minute summer	4-10	11	86.693	0.690	154.5	1.3748	0.0000	SURCHARGED
15 minute winter	10-0	13	86.770	0.009	0.8	0.0105	0.0000	OK
15 minute winter	10-1	12	86.778	0.113	7.7	0.2035	0.0000	OK
15 minute winter	11-0	11	86.799	0.274	10.2	0.3101	0.0000	SURCHARGED
15 minute winter	11-1	11	86.795	0.346	18.9	0.5911	0.0000	SURCHARGED
15 minute winter	10-2	11	86.767	0.473	28.5	1.0405	0.0000	SURCHARGED
15 minute winter	12-0	11	86.706	0.543	6.5	0.6142	0.0000	SURCHARGED
15 minute winter	10-3	11	86.701	0.602	48.4	1.4510	0.0000	SURCHARGED
15 minute winter	4-11	10	86.623	0.671	229.4	1.9719	0.0000	SURCHARGED
240 minute winter	4-12	176	86.400	0.456	60.3	276.6558	0.0000	OK
240 minute winter	13-0	176	86.399	0.224	0.5	0.2533	0.0000	OK
240 minute winter	4-13	176	86.399	0.495	28.8	1.1529	0.0000	OK
240 minute winter	4-14	176	86.398	0.521	29.3	1.1719	0.0000	OK
240 minute winter	14-0	176	86.398	0.245	1.2	0.3439	0.0000	OK
240 minute winter	14-1	176	86.398	0.382	7.0	1.2621	0.0000	SURCHARGED
240 minute winter	15-0	176	86.398	0.129	0.5	0.1560	0.0000	OK
240 minute winter	14-2	176	86.398	0.511	15.7	2.1205	0.0000	SURCHARGED
240 minute winter	4-15	176	86.398	0.545	30.8	1.4920	0.0000	OK
15 minute summer	16-0	1	86.575	0.000	0.0	0.0000	0.0000	OK
240 minute winter	17-0	176	86.397	0.197	0.6	0.2231	0.0000	OK
240 minute winter	4-16	176	86.397	0.580	31.8	2.5410	0.0000	OK
240 minute winter	1-13	176	86.396	0.619	34.2	1.5412	0.0000	SURCHARGED
15 minute summer	18-0	1	86.425	0.000	0.0	0.0000	0.0000	OK
15 minute winter	19-0	10	86.778	0.053	5.0	0.0784	0.0000	OK
15 minute winter	19-1	11	86.664	0.074	8.9	0.1133	0.0000	OK
240 minute winter	18-1	176	86.396	0.328	5.4	0.6638	0.0000	SURCHARGED
15 minute winter	20-0	13	86.397	0.153	10.3	0.2289	0.0000	OK
240 minute winter	18-2	176	86.396	0.457	13.4	1.4841	0.0000	SURCHARGED
240 minute winter	18-3	176	86.396	0.599	16.8	1.4911	0.0000	SURCHARGED
240 minute winter	18-4	176	86.396	0.626	17.7	1.0680	0.0000	SURCHARGED
240 minute winter	1-14	176	86.396	0.644	36.2	1.5322	0.0000	SURCHARGED
240 minute winter	1-15	176	86.395	0.656	36.6	1.3646	0.0000	SURCHARGED
240 minute winter	1-16	176	86.394	0.682	37.3	2.7711	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	8-1	8.001	4-10	30.7	0.436	0.433	2.0073	
15 minute summer	4-10	4.010	4-11	157.8	1.261	1.567	3.4769	
15 minute winter	10-0	10.000	10-1	-0.8	-0.099	-0.021	0.1633	
15 minute winter	10-1	10.001	10-2	8.3	0.656	0.209	1.0171	
15 minute winter	11-0	11.000	11-1	-10.2	-0.444	-0.256	0.5112	
15 minute winter	11-1	11.001	10-2	14.2	0.387	0.356	1.0424	
15 minute winter	10-2	10.002	10-3	34.5	0.868	0.868	0.7549	
15 minute winter	12-0	12.000	10-3	-6.5	-0.286	-0.204	0.6672	
15 minute winter	10-3	10.003	4-11	53.1	1.337	1.671	0.7590	
15 minute winter	4-11	4.011	4-12	237.3	2.807	1.510	0.6096	
240 minute winter	4-12	4.012	4-13	28.6	-0.206	0.182	5.5354	
240 minute winter	13-0	13.000	4-13	-0.5	-0.029	-0.012	1.1725	
240 minute winter	4-13	4.013	4-14	29.3	0.166	0.187	3.7656	
240 minute winter	4-14	4.014	4-15	29.7	0.132	0.131	5.6975	
240 minute winter	14-0	14.000	14-1	1.1	0.128	0.019	3.4467	
240 minute winter	14-1	14.001	14-2	5.6	0.236	0.099	3.4640	
240 minute winter	15-0	15.000	14-2	0.3	0.248	0.008	1.1839	
240 minute winter	14-2	14.002	4-15	14.8	0.375	0.168	1.4383	
240 minute winter	4-15	4.015	4-16	31.5	0.266	0.139	9.0246	
15 minute summer	16-0	16.000	4-16	0.0	0.000	0.000	0.0000	
240 minute winter	17-0	17.000	4-16	-0.6	-0.032	-0.015	1.2769	
240 minute winter	4-16	4.016	1-13	32.6	0.286	0.154	11.5021	
240 minute winter	1-13	1.013	1-14	34.8	0.250	0.164	7.2394	
15 minute summer	18-0	18.000	18-1	0.0	0.000	0.000	1.2038	
15 minute winter	19-0	19.000	19-1	4.9	0.535	0.123	0.2109	
15 minute winter	19-1	19.001	18-1	8.7	0.787	0.218	0.1512	
240 minute winter	18-1	18.001	18-2	4.3	0.250	0.061	2.2089	
15 minute winter	20-0	20.000	18-2	7.7	0.233	0.195	1.6530	
240 minute winter	18-2	18.002	18-3	12.2	0.333	0.110	5.0511	
240 minute winter	18-3	18.003	18-4	16.4	0.290	0.186	1.4974	
240 minute winter	18-4	18.004	1-14	17.6	0.205	0.199	0.8052	
240 minute winter	1-14	1.014	1-15	36.3	0.304	0.171	3.8500	
240 minute winter	1-15	1.015	1-16	36.6	0.263	0.173	7.7780	
240 minute winter	1-16	1.016	PI 4	37.2	0.401	0.153	2.0490	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 85.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	PI 4	11	85.914	0.330	36.6	0.5837	0.0000	OK
15 minute summer	Outfall 4	1	85.910	0.337	37.1	0.0000	0.0000	OK
15 minute winter	21-0	11	87.281	0.023	1.0	0.0353	0.0000	OK
15 minute winter	21-1	11	87.178	0.078	11.5	0.1875	0.0000	OK
15 minute winter	21-2	11	87.087	0.096	16.9	0.1800	0.0000	OK
10080 minute winter	21-3	9960	87.072	0.254	0.7	0.6529	0.0000	OK
10080 minute winter	21-4	9960	87.072	0.403	0.9	0.8419	0.0000	SURCHARGED
10080 minute winter	21-5	9960	87.072	0.474	1.1	0.9942	0.0000	SURCHARGED
15 minute summer	22-0	12	87.221	0.126	4.7	0.2348	0.0000	OK
15 minute winter	22-1	12	87.220	0.165	14.4	0.3006	0.0000	OK
15 minute winter	23-0	11	87.222	0.061	6.9	0.1230	0.0000	OK
15 minute winter	22-2	11	87.183	0.276	65.1	1.3249	0.0000	OK
15 minute winter	24-0	12	87.187	0.087	8.1	0.1336	0.0000	OK
15 minute winter	22-3	11	87.170	0.285	82.4	0.7646	0.0000	OK
15 minute summer	22-4	10	87.144	0.391	96.5	0.9924	0.0000	OK
15 minute summer	25-0	1	87.279	0.000	0.0	0.0000	0.0000	OK
15 minute winter	25-1	10	87.192	0.089	12.3	0.1689	0.0000	OK
15 minute summer	22-5	10	87.085	0.473	133.1	1.1876	0.0000	SURCHARGED
15 minute summer	26-0	1	87.125	0.000	0.0	0.0000	0.0000	OK
10080 minute winter	26-1	9960	87.072	0.050	0.1	0.0673	0.0000	OK
10080 minute winter	22-6	9960	87.072	0.498	3.2	0.9660	0.0000	SURCHARGED
10080 minute winter	22-7	9960	87.072	0.543	3.2	172.6898	0.0000	SURCHARGED
10080 minute winter	21-6	9960	87.072	0.560	4.5	1.4051	0.0000	SURCHARGED
10080 minute winter	21-7	9960	87.071	0.671	5.0	2.3138	0.0000	SURCHARGED
10080 minute winter	21-8	10320	87.074	0.699	5.1	1.4543	0.0000	SURCHARGED
10080 minute winter	21-9	10200	87.069	0.721	5.0	1.3824	0.0000	SURCHARGED
10080 minute winter	21-10	10320	87.071	0.799	5.2	2.2518	0.0000	SURCHARGED
10080 minute winter	27-0	10260	87.071	0.749	0.3	1.3237	0.0000	SURCHARGED
10080 minute winter	27-1	10320	87.071	0.796	0.9	2.8175	0.0000	SURCHARGED
10080 minute winter	28-0	10260	87.071	0.593	0.2	1.1331	0.0000	SURCHARGED
10080 minute winter	28-1	10020	87.071	0.738	0.7	2.6375	0.0000	SURCHARGED
10080 minute winter	21-11	10320	87.071	0.839	6.8	3.3787	0.0000	SURCHARGED
15 minute winter	29-0	11	87.400	0.015	0.4	0.0180	0.0000	OK
15 minute winter	29-1	11	87.217	0.056	5.5	0.0857	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	PI 4	1.017	Outfall 4	37.1	0.231	0.139	1.1542	181.3
15 minute winter	21-0	21.000	21-1	0.9	0.100	0.008	0.4976	
15 minute winter	21-1	21.001	21-2	10.9	0.574	0.099	0.6818	
15 minute winter	21-2	21.002	21-3	16.2	0.539	0.147	1.7161	
10080 minute winter	21-3	21.003	21-4	0.7	0.261	0.006	4.5647	
10080 minute winter	21-4	21.004	21-5	0.9	0.277	0.007	3.0854	
10080 minute winter	21-5	21.005	21-6	1.1	0.308	0.009	2.7940	
15 minute summer	22-0	22.000	22-1	5.7	0.405	0.045	0.5210	
15 minute winter	22-1	22.001	22-2	17.8	0.292	0.141	3.6088	
15 minute winter	23-0	23.000	22-2	6.5	0.283	0.059	2.5043	
15 minute winter	22-2	22.002	22-3	63.8	0.794	0.498	0.6994	
15 minute winter	24-0	24.000	22-3	7.2	0.242	0.057	2.3591	
15 minute winter	22-3	22.003	22-4	87.4	0.870	0.694	4.9504	
15 minute summer	22-4	22.004	22-5	104.4	0.942	0.829	6.1691	
15 minute summer	25-0	25.000	25-1	0.0	0.000	0.000	0.2076	
15 minute winter	25-1	25.001	22-5	11.9	0.858	0.299	0.2071	
15 minute summer	22-5	22.005	22-6	136.8	1.189	1.161	1.9006	
15 minute summer	26-0	26.000	26-1	0.0	0.000	0.000	0.0451	
10080 minute winter	26-1	26.001	22-6	0.1	0.246	0.003	0.7674	
10080 minute winter	22-6	22.006	22-7	3.2	0.395	0.027	2.2683	
10080 minute winter	22-7	22.007	21-6	3.1	0.355	0.026	0.8386	
10080 minute winter	21-6	21.006	21-7	4.5	0.369	0.023	10.1382	
10080 minute winter	21-7	21.007	21-8	5.0	0.368	0.028	2.7460	
10080 minute winter	21-8	21.008	21-9	5.0	0.373	0.028	2.9942	
10080 minute winter	21-9	21.009	21-10	4.9	0.328	0.028	8.5941	
10080 minute winter	21-10	21.010	21-11	5.2	0.274	0.029	4.5606	
10080 minute winter	27-0	27.000	27-1	-0.3	-0.003	-0.001	13.6208	
10080 minute winter	27-1	27.001	21-11	-0.8	0.057	-0.004	12.3665	
10080 minute winter	28-0	28.000	28-1	0.2	0.103	0.002	5.1670	
10080 minute winter	28-1	28.001	21-11	0.6	0.102	0.006	3.6110	
10080 minute winter	21-11	21.011	21-12	6.6	0.227	0.031	18.3778	
15 minute winter	29-0	29.000	29-1	0.4	0.094	0.009	0.1697	
15 minute winter	29-1	29.001	29-2	5.3	0.587	0.134	0.1122	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 85.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	29-2	11	87.158	0.070	8.6	0.0991	0.0000	OK
10080 minute winter	29-3	10140	87.071	0.291	0.4	0.5010	0.0000	SURCHARGED
10080 minute winter	29-4	10140	87.071	0.387	0.5	0.5262	0.0000	SURCHARGED
10080 minute winter	29-5	10200	87.071	0.584	0.7	0.9574	0.0000	SURCHARGED
10080 minute winter	21-12	10320	87.071	0.902	8.0	2.8622	0.0000	SURCHARGED
15 minute winter	30-0	11	87.357	0.032	2.0	0.0405	0.0000	OK
15 minute winter	30-1	11	87.120	0.058	6.1	0.0805	0.0000	OK
10080 minute winter	30-2	10320	87.071	0.175	0.3	0.2879	0.0000	OK
10080 minute winter	21-13	10320	87.071	0.933	8.5	2.2952	0.0000	SURCHARGED
10080 minute winter	21-14	10260	87.071	0.967	8.4	1867.1700	0.0000	SURCHARGED
10080 minute winter	PI 3	10320	87.071	1.074	0.1	1.8976	0.0000	SURCHARGED
15 minute summer	Outfall 3	1	87.530	1.592	0.0	0.0000	0.0000	OK
15 minute summer	31-0	1	86.775	0.000	0.0	0.0000	0.0000	OK
15 minute winter	31-1	10	86.694	0.069	12.1	0.1239	0.0000	OK
15 minute winter	31-2	10	86.433	0.087	17.1	0.1211	0.0000	OK
15 minute winter	31-4	10	86.271	0.097	21.0	0.1282	0.0000	OK
15 minute winter	31-5	11	86.069	0.109	24.8	0.1424	0.0000	OK
15 minute winter	31-6	11	85.840	0.195	35.3	0.3120	0.0000	OK
15 minute summer	32-0	1	86.125	0.000	0.0	0.0000	0.0000	OK
15 minute winter	32-1	11	86.031	0.051	4.6	0.0709	0.0000	OK
15 minute winter	31-7	10	85.787	0.182	41.7	0.2125	0.0000	OK
15 minute winter	34-0	10	85.854	0.054	5.3	0.0823	0.0000	OK
15 minute winter	34-1	10	85.772	0.106	12.5	0.1661	0.0000	OK
15 minute summer	34-2	10	85.758	0.147	15.8	0.1990	0.0000	OK
5760 minute winter	31-8	3660	85.748	0.364	2.2	0.9325	0.0000	SURCHARGED
5760 minute winter	33-0	3660	85.748	0.073	0.0	0.0829	0.0000	OK
5760 minute winter	31-9	3660	85.748	0.652	2.4	1.2304	0.0000	SURCHARGED
5760 minute winter	31-10	3660	85.748	0.677	4.8	306.5415	0.0000	SURCHARGED
5760 minute winter	35-0	3660	85.748	0.089	0.1	0.1322	0.0000	OK
5760 minute winter	31-11	3660	85.748	0.732	3.2	1.5511	0.0000	SURCHARGED
5760 minute winter	31-12	3660	85.748	0.815	3.0	1.8214	0.0000	SURCHARGED
15 minute summer	36-0	1	86.900	0.000	0.0	0.0000	0.0000	OK
15 minute winter	36-1	10	86.802	0.080	13.1	0.1532	0.0000	OK
15 minute winter	36-2	10	86.671	0.096	17.2	0.1354	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	29-2	29.002	29-3	8.5	0.539	0.214	0.8297	
10080 minute winter	29-3	29.003	29-4	0.4	0.302	0.010	0.6439	
10080 minute winter	29-4	29.004	29-5	0.5	0.311	0.012	1.2821	
10080 minute winter	29-5	29.005	21-12	0.7	0.270	0.018	1.4151	
10080 minute winter	21-12	21.012	21-13	7.9	0.208	0.037	8.8880	
15 minute winter	30-0	30.000	30-1	1.9	0.347	0.044	0.2080	
15 minute winter	30-1	30.001	30-2	5.9	0.475	0.148	0.3525	
10080 minute winter	30-2	30.002	21-13	-0.3	0.307	-0.008	0.7258	
10080 minute winter	21-13	21.013	21-14	8.4	0.397	0.039	9.9595	
10080 minute winter	21-14	Hydro-Brake®	PI 3	0.1				
10080 minute winter	PI 3	21.015	Outfall 3	0.0	0.000	0.000	9.6080	0.0
15 minute summer	31-0	31.000	31-1	0.0	0.000	0.000	0.1265	
15 minute winter	31-1	31.001	31-2	11.9	0.970	0.204	0.2732	
15 minute winter	31-2	31.002	31-4	16.8	1.098	0.288	0.2104	
15 minute winter	31-4	31.003	31-5	20.9	1.179	0.359	0.3032	
15 minute winter	31-5	31.004	31-6	25.0	0.891	0.481	0.8756	
15 minute winter	31-6	31.005	31-7	36.6	1.067	0.913	0.2347	
15 minute summer	32-0	32.000	32-1	0.0	0.000	0.000	0.0794	
15 minute winter	32-1	32.001	31-7	4.4	0.660	0.110	0.1833	
15 minute winter	31-7	31.006	31-8	43.7	0.728	0.617	3.1101	
15 minute winter	34-0	33.000	34-1	5.2	0.448	0.130	0.2923	
15 minute winter	34-1	33.001	34-2	12.7	0.705	0.319	0.1910	
15 minute summer	34-2	33.002	31-8	16.4	0.773	0.412	0.3944	
5760 minute winter	31-8	31.007	31-9	2.1	0.439	0.034	0.3263	
5760 minute winter	33-0	34.000	31-9	0.0	-0.002	-0.001	1.3755	
5760 minute winter	31-9	31.008	31-10	2.4	0.363	0.019	1.0960	
5760 minute winter	31-10	31.009	31-11	3.2	0.294	0.026	2.4026	
5760 minute winter	35-0	35.000	31-11	0.1	0.246	0.003	0.8422	
5760 minute winter	31-11	31.010	31-12	3.0	0.262	0.024	3.6330	
5760 minute winter	31-12	31.011	31-13	2.5	0.205	0.020	6.9243	
15 minute summer	36-0	36.000	36-1	0.0	0.000	0.000	0.1818	
15 minute winter	36-1	36.001	36-2	12.8	0.891	0.246	0.2107	
15 minute winter	36-2	36.002	36-3	16.9	0.993	0.326	0.1878	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 85.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	36-3	11	86.570	0.105	20.5	0.1435	0.0000	OK
15 minute winter	36-4	11	86.425	0.106	22.5	0.1349	0.0000	OK
5760 minute winter	31-13	3660	85.748	0.973	3.5	2.9626	0.0000	SURCHARGED
5760 minute winter	31-14	3660	85.748	1.031	3.7	1.9459	0.0000	SURCHARGED
7200 minute winter	31-15	4500	85.748	1.057	3.7	1.7003	0.0000	SURCHARGED
15 minute summer	37-0	1	86.575	0.000	0.0	0.0000	0.0000	OK
15 minute winter	37-1	11	86.345	0.073	10.1	0.1330	0.0000	OK
15 minute winter	38-0	12	85.819	0.142	10.7	0.2183	0.0000	OK
15 minute summer	39-0	1	86.115	0.000	0.0	0.0000	0.0000	OK
15 minute summer	38-1	12	85.784	0.364	33.1	0.8794	0.0000	SURCHARGED
15 minute winter	37-2	12	85.793	0.649	81.9	2.4134	0.0000	SURCHARGED
15 minute summer	40-0	1	85.775	0.000	0.0	0.0000	0.0000	OK
5760 minute winter	40-1	3660	85.748	0.129	0.1	0.1924	0.0000	OK
5760 minute winter	37-3	3660	85.748	0.804	4.0	3.2582	0.0000	SURCHARGED
5760 minute winter	37-4	3660	85.748	0.926	4.4	2.0987	0.0000	SURCHARGED
5760 minute winter	31-16	3660	85.748	1.093	7.4	2.9274	0.0000	SURCHARGED
5760 minute winter	31-17	3660	85.748	1.117	7.4	552.8057	0.0000	SURCHARGED
7200 minute winter	PI 1	4020	85.625	1.105	143.4	1.9523	0.0000	SURCHARGED
15 minute summer	Outfall 1	1	85.620	1.119	0.0	0.0000	0.0000	OK
15 minute winter	41-0	10	86.775	0.075	10.1	0.1340	0.0000	OK
15 minute winter	41-1	12	86.682	0.099	16.8	0.1529	0.0000	OK
15 minute winter	41-2	12	86.670	0.275	35.5	0.5458	0.0000	OK
15 minute winter	41-3	11	86.652	0.458	51.5	0.8272	0.0000	SURCHARGED
15 minute winter	42-0	11	86.701	0.127	17.2	0.3144	0.0000	OK
15 minute winter	42-1	11	86.694	0.171	40.7	0.4769	0.0000	OK
15 minute winter	43-0	11	86.657	0.064	3.6	0.0886	0.0000	OK
15 minute winter	42-2	12	86.649	0.250	62.0	0.5573	0.0000	OK
15 minute summer	44-0	12	86.596	0.173	3.6	0.2318	0.0000	OK
15 minute winter	41-4	11	86.589	0.530	107.9	1.1936	0.0000	SURCHARGED
15 minute winter	45-0	10	86.492	0.080	11.3	0.1695	0.0000	OK
15 minute winter	41-5	10	86.454	0.534	138.1	1.2391	0.0000	SURCHARGED
15 minute summer	41-6	10	86.416	0.517	131.3	0.7392	0.0000	SURCHARGED
240 minute winter	41-7	172	86.252	0.514	38.4	160.7457	0.0000	SURCHARGED
240 minute winter	41-8	172	86.251	0.534	17.3	0.9240	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	36-3	36.003	36-4	20.6	1.143	0.396	0.2647	
15 minute winter	36-4	36.004	31-13	22.3	1.248	0.430	0.7658	
5760 minute winter	31-13	31.012	31-14	3.5	0.227	0.027	5.3229	
5760 minute winter	31-14	31.013	31-15	3.7	0.220	0.028	2.3700	
7200 minute winter	31-15	31.014	31-16	3.7	0.162	0.027	3.2654	
15 minute summer	37-0	37.000	37-1	0.0	0.000	0.000	0.2735	
15 minute winter	37-1	37.001	37-2	8.9	0.812	0.223	0.8052	
15 minute winter	38-0	38.000	38-1	10.4	0.413	0.261	1.4413	
15 minute summer	39-0	39.000	38-1	0.0	0.000	0.000	0.0000	
15 minute summer	38-1	38.001	37-2	33.5	0.528	0.474	4.7515	
15 minute winter	37-2	37.002	37-3	73.4	1.043	1.195	4.5516	
15 minute summer	40-0	40.000	40-1	0.0	0.000	0.000	0.0885	
5760 minute winter	40-1	40.001	37-3	0.1	0.246	0.003	2.3702	
5760 minute winter	37-3	37.003	37-4	3.9	0.271	0.039	5.4750	
5760 minute winter	37-4	37.004	31-16	4.3	0.316	0.040	2.9447	
5760 minute winter	31-16	31.015	31-17	7.4	0.438	0.024	3.2280	
5760 minute winter	31-17	31.016	PI 1	12.3	0.160	0.042	1.6616	
7200 minute winter	PI 1	31.017	Outfall 1	6.6	0.024	0.031	5.3243	151.3
15 minute winter	41-0	41.000	41-1	9.9	0.603	0.139	0.4743	
15 minute winter	41-1	41.001	41-2	16.3	0.654	0.231	2.0145	
15 minute winter	41-2	41.002	41-3	34.0	0.740	0.480	3.3863	
15 minute winter	41-3	41.003	41-4	46.7	0.742	0.660	2.3190	
15 minute winter	42-0	42.000	42-1	16.5	0.494	0.233	0.4352	
15 minute winter	42-1	42.001	42-2	39.4	0.799	0.556	1.5674	
15 minute winter	43-0	43.000	42-2	3.5	0.497	0.089	0.1851	
15 minute winter	42-2	42.002	41-4	61.5	1.077	0.866	1.1173	
15 minute summer	44-0	44.000	41-4	15.2	0.587	0.381	0.5872	
15 minute winter	41-4	41.004	41-5	115.1	1.044	1.041	4.9665	
15 minute winter	45-0	45.000	41-5	11.0	0.667	0.276	0.9518	
15 minute winter	41-5	41.005	41-6	140.6	1.275	1.095	0.5585	
15 minute summer	41-6	41.006	41-7	138.3	1.822	1.250	3.6098	
240 minute winter	41-7	41.007	41-8	17.3	0.409	0.137	0.5755	
240 minute winter	41-8	41.008	41-9	17.4	0.411	0.156	1.5091	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 85.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	46-0	172	86.250	0.245	0.2	0.2772	0.0000	SURCHARGED
240 minute winter	41-9	172	86.250	0.576	17.5	1.0605	0.0000	SURCHARGED
15 minute summer	47-0	1	86.525	0.000	0.0	0.0000	0.0000	OK
240 minute winter	47-1	172	86.248	0.140	2.6	0.2713	0.0000	OK
240 minute winter	41-10	172	86.248	0.848	18.2	2.2414	0.0000	SURCHARGED
240 minute winter	41-11	172	86.247	0.862	18.4	1.4323	0.0000	SURCHARGED
240 minute winter	41-12	172	86.246	0.899	18.7	2.5442	0.0000	SURCHARGED
15 minute summer	48-0	1	86.300	0.000	0.0	0.0000	0.0000	OK
240 minute winter	41-13	172	86.244	0.969	20.6	3.9420	0.0000	SURCHARGED
4320 minute winter	PI 5	1500	85.911	0.746	7.9	1.3184	0.0000	SURCHARGED
15 minute summer	Outfall 5	1	85.910	0.762	7.0	0.0000	0.0000	OK
15 minute summer	50-0	1	88.900	0.000	0.0	0.0000	0.0000	OK
15 minute winter	50-1	10	88.078	0.078	14.9	0.1415	0.0000	OK
15 minute winter	50-2	11	87.301	0.101	22.9	0.1548	0.0000	OK
960 minute winter	50-3	735	86.372	0.172	2.9	0.2939	0.0000	OK
960 minute winter	50-4	735	86.372	0.370	4.9	0.8631	0.0000	OK
960 minute winter	50-5	735	86.372	0.551	6.6	89.2589	0.0000	SURCHARGED
15 minute summer	PI 2	17	85.911	0.291	1.7	0.4165	0.0000	OK
15 minute summer	Outfall 2	1	85.910	0.300	1.5	0.0000	0.0000	OK
960 minute winter	49-0	720	86.308	0.114	0.3	0.1628	0.0000	OK
960 minute winter	49-1	720	86.308	0.339	2.4	1.2057	0.0000	OK
960 minute winter	49-2	720	86.308	0.402	2.2	0.6770	0.0000	SURCHARGED
960 minute winter	49-3	720	86.308	0.509	3.9	67.7485	0.0000	SURCHARGED
960 minute winter	49-4	720	86.308	0.578	1.8	1.1555	0.0000	SURCHARGED
960 minute winter	49-5	720	86.308	0.628	1.9	1.1870	0.0000	SURCHARGED
60 minute summer	PI 6	34	85.910	0.384	1.7	0.5501	0.0000	OK
15 minute summer	Outfall 6	1	85.910	0.406	0.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	46-0	46.000	41-9	-0.2	-0.052	-0.006	0.3805	
240 minute winter	41-9	41.009	41-10	17.6	0.392	0.159	3.4285	
15 minute summer	47-0	47.000	47-1	0.0	0.000	0.000	0.3045	
240 minute winter	47-1	47.001	41-10	2.6	0.428	0.065	1.6338	
240 minute winter	41-10	41.010	41-11	18.4	0.338	0.144	0.6386	
240 minute winter	41-11	41.011	41-12	18.5	0.352	0.151	1.7545	
240 minute winter	41-12	41.012	41-13	18.7	0.209	0.147	3.0957	
15 minute summer	48-0	48.000	41-13	0.0	0.000	0.000	1.0771	
240 minute winter	41-13	Hydro-Brake®	PI 5	20.5				
4320 minute winter	PI 5	41.014	Outfall 5	7.9	0.041	0.033	1.0395	737.0
15 minute summer	50-0	49.000	50-1	0.0	0.000	0.000	0.0000	
15 minute winter	50-1	49.001	50-2	14.4	1.207	0.248	0.4371	
15 minute winter	50-2	49.002	50-3	22.7	1.352	0.391	0.4576	
960 minute winter	50-3	49.003	50-4	2.9	0.310	0.022	5.5259	
960 minute winter	50-4	49.004	50-5	4.1	0.384	0.037	10.1737	
960 minute winter	50-5	Hydro-Brake®	PI 2	1.8				
15 minute summer	PI 2	49.006	Outfall 2	1.5	0.013	0.010	0.5017	12.0
960 minute winter	49-0	50.000	49-1	-0.3	-0.009	-0.002	4.8409	
960 minute winter	49-1	50.001	49-2	1.9	0.284	0.017	2.1743	
960 minute winter	49-2	50.002	49-3	1.9	0.322	0.021	5.9200	
960 minute winter	49-3	50.003	49-4	1.8	0.092	0.020	3.8234	
960 minute winter	49-4	50.004	49-5	1.8	0.067	0.015	5.6761	
960 minute winter	49-5	Hydro-Brake®	PI 6	1.8				
60 minute summer	PI 6	50.006	Outfall 6	1.7	0.011	0.008	0.8544	22.3

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Inverts
M5-60 (mm)	15.600	Minimum Backdrop Height (m)	0.000
Ratio-R	0.286	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1-0	0.012	5.00	88.550	1350	681728.297	714559.265	1.550
1-1	0.025	5.00	88.200	1350	681727.082	714579.948	1.264
1-2	0.032	5.00	88.200	1350	681729.935	714618.237	1.383
1-3	0.025	5.00	88.150	1350	681724.880	714650.182	1.433
1-4	0.012	5.00	88.050	1350	681726.157	714667.886	1.388
1-5	0.042	5.00	88.201	1350	681706.946	714704.913	1.668
2-0	0.012	5.00	88.588	1200	681654.345	714711.728	1.425
1-6	0.170	5.00	88.523	1350	681668.442	714684.340	2.077
1-7	0.171	5.00	88.681	1350	681613.809	714655.342	2.358
1-8	0.133	5.00	88.553	1350	681573.837	714634.246	2.320
1-9	0.182	5.00	88.321	1350	681516.849	714604.369	2.216
1-10	0.055	5.00	88.495	1350	681489.411	714611.148	2.437
1-11			88.016	1800	681465.859	714652.863	2.095
3-0	0.013	5.00	88.471	1200	681495.121	714623.928	1.680
1-12	0.101	5.00	88.157	1350	681476.088	714659.384	2.256
4-0		5.00	88.200	1200	681714.921	714722.862	1.115
4-1	0.028	5.00	88.200	1200	681700.576	714747.663	1.259
4-2			88.200	1200	681696.983	714746.664	1.278
4-3	0.029	5.00	88.321	1200	681679.139	714777.631	1.579
5-0		5.00	88.100	1200	681687.188	714707.538	0.975
5-1	0.043	5.00	88.000	1200	681674.194	714731.842	1.038
4-4	0.076	5.00	88.227	1200	681656.262	714765.409	1.616
4-5	0.040	5.00	88.128	1200	681631.788	714752.351	1.657
4-6			88.062	1200	681629.584	714756.232	1.614
4-7	0.066	5.00	87.821	1200	681618.718	714752.021	1.432
6-0	0.020	5.00	87.900	1200	681651.744	714821.450	1.029
6-1	0.040	5.00	88.070	1200	681635.217	714852.261	1.405
6-2	0.021	5.00	88.000	1200	681600.572	714833.783	1.567
6-3	0.098	5.00	87.930	1200	681613.963	714808.759	1.665
4-8	0.132	5.00	87.727	1350	681593.233	714797.616	1.601
7-0		5.00	88.100	1200	681598.010	714732.199	1.525
4-9	0.150	5.00	87.721	1350	681569.162	714784.678	1.680
8-0		5.00	87.700	1200	681578.569	714821.954	1.410
9-0		5.00	87.700	1200	681499.419	714779.633	1.301
8-1	0.095	5.00	87.400	1200	681538.921	714800.785	1.280
4-10	0.051	5.00	87.822	1350	681552.322	714775.627	1.819
10-0		5.00	87.635	1200	681456.887	714742.982	0.874
10-1	0.039	5.00	87.816	1200	681464.184	714728.460	1.151
11-0		5.00	87.700	1200	681470.270	714761.709	1.175
11-1	0.036	5.00	87.700	1200	681481.748	714767.493	1.251
10-2	0.075	5.00	87.700	1200	681494.310	714744.490	1.406
12-0		5.00	87.588	1200	681518.601	714738.418	1.425
10-3	0.104	5.00	87.724	1200	681511.067	714753.407	1.625
4-11	0.111	5.00	87.850	1500	681527.859	714762.478	1.898
4-12			87.850	1500	681530.789	714757.146	1.906
13-0		5.00	87.600	1200	681570.228	714744.973	1.425
4-13	0.042	5.00	87.400	1500	681544.032	714731.413	1.496
4-14	0.039	5.00	87.500	1500	681526.924	714722.557	1.623
14-0	0.027	5.00	88.142	1200	681632.181	714739.287	1.989
14-1	0.143	5.00	87.334	1200	681586.068	714714.847	1.318
15-0	0.007	5.00	88.094	1200	681560.301	714658.807	1.825
14-2	0.222	5.00	87.521	1350	681542.637	714691.750	1.634
4-15	0.076	5.00	87.418	1500	681536.496	714703.253	1.565
16-0		5.00	88.000	1200	681524.006	714656.720	1.425
17-0		5.00	87.625	1200	681491.700	714717.223	1.425
4-16	0.262	5.00	87.823	1500	681507.377	714687.844	2.006
1-13	0.083	5.00	88.078	1500	681471.112	714668.653	2.301
18-0		5.00	87.800	1200	681422.878	714707.549	1.375
19-0	0.025	5.00	88.150	1200	681367.542	714630.246	1.425

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
19-1	0.020	5.00	87.600	1200	681380.523	714649.147	1.010
18-1	0.075	5.00	87.750	1200	681392.936	714654.934	1.682
20-0	0.024	5.00	87.550	1200	681458.635	714610.046	1.306
18-2	0.178	5.00	87.900	1350	681419.839	714638.804	1.961
18-3	0.102	5.00	87.724	1350	681442.714	714678.477	1.927
18-4	0.029	5.00	87.871	1350	681452.487	714687.900	2.101
1-14	0.065	5.00	87.871	1500	681458.950	714691.294	2.119
1-15	0.032	5.00	87.781	1500	681452.167	714703.160	2.042
1-16	0.056	5.00	87.570	2100	681431.016	714720.912	1.858
PI 4			87.100	1500	681413.439	714734.297	1.516
Outfall 4			86.490	1500	681407.762	714738.679	0.917
21-0	0.005	5.00	88.540	1350	681732.623	714543.018	1.282
21-1	0.054	5.00	88.225	1350	681683.674	714528.552	1.125
21-2	0.032	5.00	88.405	1350	681649.964	714518.491	1.414
21-3	0.107	5.00	88.691	1350	681596.221	714502.522	1.873
21-4	0.056	5.00	88.367	1350	681550.069	714488.810	1.698
21-5	0.062	5.00	88.456	1350	681538.872	714510.770	1.858
22-0	0.025	5.00	88.245	1350	681680.587	714541.754	1.150
22-1	0.024	5.00	88.298	1350	681676.628	714555.083	1.243
23-0	0.035	5.00	88.357	1350	681708.590	714630.655	1.196
22-2	0.279	5.00	88.564	1350	681652.175	714600.736	1.657
24-0	0.008	5.00	88.655	1350	681619.602	714645.364	1.555
22-3	0.105	5.00	88.563	1350	681644.994	714598.737	1.678
22-4	0.133	5.00	89.151	1350	681604.492	714576.263	2.398
25-0		5.00	88.704	1200	681578.956	714511.950	1.425
25-1	0.062	5.00	88.700	1200	681570.824	714540.652	1.597
22-5	0.125	5.00	88.931	1350	681561.371	714552.096	2.319
26-0		5.00	88.550	1200	681520.981	714587.351	1.425
26-1	0.017	5.00	88.550	1200	681529.224	714571.926	1.528
22-6	0.059	5.00	88.890	1350	681548.127	714544.673	2.316
22-7			88.500	1350	681533.514	714533.960	1.971
21-6	0.069	5.00	88.369	1500	681527.948	714530.232	1.857
21-7	0.148	5.00	88.161	1500	681498.591	714572.945	1.761
21-8	0.029	5.00	88.218	1500	681494.806	714586.463	1.843
21-9	0.013	5.00	88.083	1500	681479.812	714583.385	1.735
21-10	0.087	5.00	87.929	1500	681440.788	714563.200	1.657
27-0		5.00	88.114	1500	681350.118	714601.420	1.792
27-1	0.144	5.00	87.900	1500	681391.219	714575.945	1.625
28-0	0.039	5.00	88.108	1350	681472.874	714484.377	1.630
28-1	0.162	5.00	87.846	1350	681446.895	714523.359	1.513
21-11	0.213	5.00	88.117	1500	681424.130	714546.888	1.885
29-0	0.002	5.00	88.510	1200	681529.152	714477.102	1.125
29-1	0.026	5.00	88.500	1200	681493.847	714463.154	1.339
29-2	0.017	5.00	88.289	1200	681481.690	714464.705	1.201
29-3	0.059	5.00	88.782	1200	681435.452	714440.649	2.002
29-4	0.025	5.00	88.880	1200	681420.740	714447.405	2.196
29-5	0.060	5.00	88.851	1200	681401.736	714473.443	2.364
21-12	0.180	5.00	88.730	1500	681378.428	714500.325	2.561
30-0	0.010	5.00	88.750	1200	681336.824	714583.857	1.425
30-1	0.021	5.00	88.700	1200	681318.656	714552.623	1.638
30-2	0.049	5.00	88.800	1200	681338.498	714532.780	1.904
21-13	0.094	5.00	88.850	1500	681354.275	714520.630	2.712
21-14			88.070	1500	681331.006	714494.008	1.966
PI 3			88.070	1500	681328.921	714490.869	2.073
Outfall 3			87.300	1500	681310.005	714462.485	1.362
31-0		5.00	88.586	1200	681241.100	714577.004	1.811
31-1	0.061	5.00	88.460	1200	681266.075	714572.105	1.835
31-2	0.026	5.00	88.375	1200	681288.357	714572.144	2.029
31-4	0.021	5.00	88.412	1200	681300.880	714577.792	2.238
31-5	0.021	5.00	88.350	1200	681310.328	714592.053	2.390
31-6	0.055	5.00	88.000	1200	681328.209	714617.952	2.355
32-0		5.00	87.750	1200	681351.362	714665.315	1.625
32-1	0.023	5.00	87.750	1200	681337.837	714644.743	1.770
31-7	0.004	5.00	87.894	1200	681322.684	714621.696	2.289
34-0	0.027	5.00	87.225	1200	681241.403	714640.836	1.425
34-1	0.037	5.00	87.366	1200	681263.636	714636.398	1.700
34-2	0.019	5.00	87.322	1200	681271.591	714641.215	1.711
31-8	0.143	5.00	87.387	1200	681277.979	714651.973	2.003
33-0		5.00	87.400	1200	681304.110	714699.473	1.725
31-9	0.052	5.00	87.385	1350	681274.152	714654.584	2.289

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
31-10			87.260	1800	681266.162	714658.164	2.189
35-0	0.025	5.00	87.091	1200	681280.289	714692.365	1.432
31-11	0.063	5.00	86.850	1350	681255.367	714674.032	1.834
31-12	0.079	5.00	86.901	1350	681230.026	714659.891	1.968
36-0		5.00	88.558	1200	681231.376	714579.073	1.658
36-1	0.066	5.00	88.383	1200	681201.801	714584.854	1.661
36-2	0.022	5.00	88.162	1200	681188.714	714591.490	1.587
36-3	0.018	5.00	87.954	1200	681182.045	714600.247	1.489
36-4	0.010	5.00	87.676	1200	681178.035	714614.258	1.357
31-13	0.198	5.00	87.231	1350	681174.797	714656.902	2.456
31-14	0.052	5.00	87.000	1350	681172.134	714690.391	2.283
31-15	0.020	5.00	86.950	1350	681178.112	714704.102	2.259
37-0		5.00	88.000	1200	681393.391	714716.054	1.425
37-1	0.051	5.00	87.736	1200	681364.767	714673.338	1.464
38-0	0.034	5.00	87.352	1200	681384.526	714741.184	1.675
39-0		5.00	87.171	1200	681352.807	714770.696	1.056
38-1	0.111	5.00	87.147	1200	681348.326	714765.422	1.727
37-2	0.272	5.00	87.247	1200	681304.036	714714.518	2.103
40-0		5.00	87.200	1200	681328.813	714803.744	1.425
40-1	0.026	5.00	87.075	1200	681305.668	714816.641	1.456
37-3	0.272	5.00	87.021	1350	681257.516	714759.392	2.077
37-4	0.088	5.00	86.930	1350	681218.378	714728.860	2.108
31-16	0.100	5.00	86.850	1500	681195.150	714715.697	2.195
31-17			86.440	2100	681189.329	714725.568	1.809
PI 1			86.440	1500	681186.333	714730.649	1.920
Outfall 1			85.570	1500	681181.220	714748.846	1.069
41-0	0.051	5.00	88.250	1200	681603.924	714908.556	1.550
41-1	0.035	5.00	88.250	1200	681618.947	714884.229	1.667
41-2	0.060	5.00	87.800	1200	681580.497	714859.153	1.405
41-3	0.044	5.00	87.500	1200	681539.046	714832.914	1.306
42-0	0.087	5.00	87.868	1200	681554.612	714897.046	1.294
42-1	0.122	5.00	87.996	1200	681561.361	714886.575	1.473
43-0	0.018	5.00	88.018	1200	681529.669	714880.070	1.425
42-2	0.096	5.00	88.148	1200	681536.014	714870.226	1.749
44-0	0.019	5.00	88.248	1200	681512.910	714874.563	1.825
41-4	0.089	5.00	88.226	1350	681521.339	714860.680	2.167
45-0	0.057	5.00	87.573	1200	681450.416	714820.912	1.161
41-5	0.087	5.00	87.879	1350	681482.391	714838.085	1.959
41-6			87.897	1350	681480.058	714842.579	1.998
41-7			87.523	1350	681434.036	714818.133	1.785
41-8	0.027	5.00	87.523	1350	681436.400	714813.481	1.806
46-0		5.00	87.430	1200	681419.932	714815.536	1.425
41-9	0.037	5.00	87.480	1350	681424.329	714807.040	1.806
47-0		5.00	87.950	1200	681526.464	714826.290	1.425
47-1	0.058	5.00	87.550	1200	681482.339	714802.714	1.442
41-10	0.123	5.00	87.430	1350	681438.489	714779.369	2.030
41-11	0.023	5.00	87.390	1350	681441.127	714775.003	2.005
41-12	0.030	5.00	87.450	1800	681437.310	714761.518	2.103
48-0		5.00	87.450	1200	681389.971	714797.634	1.150
41-13	0.158	5.00	87.350	1800	681415.501	714749.863	2.075
PI 5			87.350	1500	681410.913	714747.274	2.185
Outfall 5			86.400	1500	681406.210	714744.800	1.252
50-0		5.00	91.041	1200	681272.880	714510.934	2.141
50-1	0.075	5.00	90.205	1200	681305.334	714543.097	2.205
50-2	0.043	5.00	89.346	1200	681326.122	714573.010	2.146
50-3	0.036	5.00	88.831	1350	681341.206	714595.670	2.631
50-4	0.109	5.00	88.427	1350	681376.057	714649.341	2.425
50-5	0.141	5.00	88.100	1350	681423.923	714716.689	2.279
PI 2			87.100	1350	681408.828	714728.225	1.480
Outfall 2			86.501	1350	681405.225	714730.997	0.891
49-0		5.00	87.806	1350	681617.771	714850.092	1.612
49-1	0.130	5.00	87.191	1350	681553.609	714815.717	1.222
49-2	0.017	5.00	87.245	1350	681537.854	714803.050	1.339
49-3	0.108	5.00	87.547	1350	681490.130	714778.489	1.748
49-4	0.057	5.00	87.734	1350	681460.413	714760.641	2.004
49-5	0.051	5.00	87.899	1350	681437.601	714733.019	2.219
PI 6			87.889	1350	681413.647	714739.599	2.363
Outfall 6			86.490	1350	681408.322	714741.891	0.986

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.017	PI 4	Outfall 4	7.171	0.600	85.584	85.573	0.011	652.0	600	15.93	35.2
1.016	1-16	PI 4	22.093	0.600	85.712	85.684	0.028	789.0	600	15.80	35.3
1.015	1-15	1-16	27.613	0.600	85.739	85.712	0.027	1030.0	600	15.37	35.8
1.014	1-14	1-15	13.668	0.600	85.752	85.739	0.013	1030.0	600	14.76	36.6
1.013	1-13	1-14	25.701	0.600	85.777	85.752	0.025	1030.0	600	14.46	37.0
18.004	18-4	1-14	7.300	0.600	85.770	85.756	0.014	504.0	375	7.72	50.0
18.003	18-3	18-4	13.576	0.600	85.797	85.770	0.027	504.0	375	7.57	50.0
18.002	18-2	18-3	45.795	0.600	85.939	85.797	0.142	322.5	375	7.29	50.0
18.001	18-1	18-2	31.368	0.600	86.068	85.939	0.129	243.2	300	6.53	50.0
20.000	20-0	18-2	48.292	0.600	86.244	85.959	0.285	169.4	225	5.80	50.0
18.000	18-0	18-1	60.538	0.600	86.425	86.068	0.357	169.6	225	6.01	50.0
19.001	19-1	18-1	13.696	0.600	86.590	86.509	0.081	169.1	225	5.61	50.0
19.000	19-0	19-1	22.929	0.600	86.725	86.590	0.135	169.8	225	5.38	50.0
1.012	1-12	1-13	10.520	0.600	85.901	85.884	0.017	634.0	450	13.89	37.8
4.016	4-16	1-13	41.030	0.600	85.817	85.777	0.040	1030.0	600	12.77	39.4
16.000	16-0	4-16	35.288	0.600	86.575	86.367	0.208	169.7	225	5.59	50.0
17.000	17-0	4-16	33.300	0.600	86.200	86.003	0.197	169.0	225	5.55	50.0
4.015	4-15	4-16	32.945	0.600	85.853	85.817	0.036	908.0	600	11.86	40.9
14.002	14-2	4-15	13.040	0.600	85.887	85.861	0.026	504.0	375	7.38	50.0
4.014	4-14	4-15	21.547	0.600	85.877	85.853	0.024	908.0	600	11.17	42.1
4.013	4-13	4-14	19.264	0.600	85.904	85.877	0.027	723.0	500	10.72	43.0
13.000	13-0	4-13	29.498	0.600	86.175	86.001	0.174	169.5	225	5.49	50.0
4.012	4-12	4-13	28.941	0.600	85.944	85.904	0.040	723.0	500	10.32	43.8
4.011	4-11	4-12	6.084	0.600	85.952	85.944	0.008	723.0	500	9.72	45.0
4.010	4-10	4-11	27.773	0.600	86.003	85.952	0.051	545.0	400	9.59	45.3
10.003	10-3	4-11	19.085	0.600	86.099	86.027	0.072	264.0	225	6.55	50.0
10.002	10-2	10-3	18.982	0.600	86.294	86.182	0.112	169.5	225	6.15	50.0
12.000	12-0	10-3	16.776	0.600	86.163	86.099	0.064	264.0	225	5.35	50.0
11.001	11-1	10-2	26.210	0.600	86.449	86.294	0.155	169.1	225	5.65	50.0
10.001	10-1	10-2	34.125	0.600	86.665	86.464	0.201	169.8	225	5.84	50.0
10.000	10-0	10-1	16.252	0.600	86.761	86.665	0.096	169.3	225	5.27	50.0
11.000	11-0	11-1	12.853	0.600	86.525	86.449	0.076	169.1	225	5.21	50.0
4.009	4-9	4-10	19.118	0.600	86.041	86.003	0.038	504.0	375	9.01	46.6

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
1.017	0.946	267.5	356.9	0.916	0.317	3.746	0.0	600
1.016	0.859	242.8	358.4	1.258	0.816	3.746	0.0	600
1.015	0.750	212.1	358.2	1.442	1.258	3.690	0.0	600
1.014	0.750	212.1	362.8	1.519	1.442	3.658	0.0	600
1.013	0.750	212.1	314.8	1.701	1.519	3.140	0.0	600
18.004	0.800	88.4	61.3	1.726	1.740	0.453	0.0	230
18.003	0.800	88.4	57.5	1.552	1.726	0.424	0.0	221
18.002	1.003	110.8	43.6	1.586	1.552	0.322	0.0	163
18.001	1.004	70.9	16.3	1.382	1.661	0.120	0.0	98
20.000	1.001	39.8	3.3	1.081	1.716	0.024	0.0	44
18.000	1.001	39.8	0.0	1.150	1.457	0.000	0.0	0
19.001	1.002	39.9	6.1	0.785	1.016	0.045	0.0	59
19.000	1.000	39.8	3.4	1.200	0.785	0.025	0.0	44
1.012	0.800	127.2	100.8	1.806	1.744	0.985	0.0	304
4.016	0.750	212.1	221.3	1.406	1.701	2.072	0.0	525
16.000	1.001	39.8	0.0	1.200	1.231	0.000	0.0	0
17.000	1.003	39.9	0.0	1.200	1.595	0.000	0.0	0
4.015	0.800	226.1	200.7	0.965	1.406	1.810	0.0	442
14.002	0.800	88.4	54.1	1.259	1.182	0.399	0.0	212
4.014	0.800	226.1	152.4	1.023	0.965	1.335	0.0	362
4.013	0.800	157.1	150.9	0.996	1.123	1.296	0.0	396
13.000	1.001	39.8	0.0	1.200	1.174	0.000	0.0	0
4.012	0.800	157.1	148.7	1.406	0.996	1.254	0.0	390
4.011	0.800	157.1	153.0	1.398	1.406	1.254	0.0	402
4.010	0.801	100.7	109.2	1.419	1.498	0.889	0.0	400
10.003	0.800	31.8	34.4	1.400	1.598	0.254	0.0	225
10.002	1.001	39.8	20.3	1.181	1.317	0.150	0.0	114
12.000	0.800	31.8	0.0	1.200	1.400	0.000	0.0	0
11.001	1.002	39.9	4.9	1.026	1.181	0.036	0.0	53
10.001	1.000	39.8	5.3	0.926	1.011	0.039	0.0	55
10.000	1.002	39.8	0.0	0.649	0.926	0.000	0.0	0
11.000	1.002	39.9	0.0	0.950	1.026	0.000	0.0	0
4.009	0.800	88.4	93.9	1.305	1.444	0.743	0.0	339

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
8.001	8-1	4-10	28.505	0.600	86.120	86.003	0.117	243.6	300	6.41	50.0
8.000	8-0	8-1	44.945	0.600	86.290	86.120	0.170	264.0	225	5.94	50.0
9.000	9-0	8-1	44.809	0.600	86.399	86.229	0.170	264.0	225	5.93	50.0
4.008	4-8	4-9	27.328	0.600	86.126	86.041	0.085	321.5	375	8.61	47.6
7.000	7-0	4-9	59.885	0.600	86.575	86.222	0.353	169.6	225	6.00	50.0
6.003	6-3	4-8	23.535	0.600	86.265	86.126	0.139	169.3	225	7.10	50.0
4.007	4-7	4-8	52.234	0.600	86.389	86.126	0.263	198.6	255	8.16	48.8
4.006	4-6	4-7	11.653	0.600	86.448	86.389	0.059	197.5	255	7.29	50.0
4.005	4-5	4-6	4.463	0.600	86.471	86.448	0.023	194.1	255	7.10	50.0
4.004	4-4	4-5	27.740	0.600	86.611	86.471	0.140	198.1	255	7.03	50.0
5.001	5-1	4-4	38.057	0.600	86.962	86.737	0.225	169.1	225	6.09	50.0
4.003	4-3	4-4	25.937	0.600	86.742	86.611	0.131	198.0	255	6.56	50.0
4.002	4-2	4-3	35.740	0.600	86.922	86.742	0.180	198.6	255	6.13	50.0
4.001	4-1	4-2	3.729	0.600	86.941	86.922	0.019	196.3	255	5.54	50.0
4.000	4-0	4-1	28.651	0.600	87.085	86.941	0.144	199.0	255	5.48	50.0
5.000	5-0	5-1	27.560	0.600	87.125	86.962	0.163	169.1	225	5.46	50.0
6.002	6-2	6-3	28.382	0.600	86.433	86.265	0.168	168.9	225	6.71	50.0
6.001	6-1	6-2	39.265	0.600	86.665	86.433	0.232	169.2	225	6.24	50.0
6.000	6-0	6-1	34.964	0.600	86.871	86.665	0.206	169.7	225	5.58	50.0
14.001	14-1	14-2	49.191	0.600	86.016	85.887	0.129	380.0	300	7.11	50.0
15.000	15-0	14-2	37.380	0.600	86.269	86.048	0.221	169.1	225	5.62	50.0
14.000	14-0	14-1	52.189	0.600	86.153	86.016	0.137	380.0	300	6.09	50.0
1.011	1-11	1-12	12.131	0.600	85.921	85.901	0.020	600.0	400	13.67	38.1
3.000	3-0	1-12	40.242	0.600	86.791	86.554	0.237	169.8	225	5.67	50.0
1.010	1-10	1-11	47.904	0.600	86.058	85.921	0.137	349.7	400	13.40	38.5
1.009	1-9	1-10	28.263	0.600	86.105	86.058	0.047	600.0	400	12.61	39.7
1.008	1-8	1-9	64.345	0.600	86.233	86.105	0.128	504.0	375	11.99	40.7
1.007	1-7	1-8	45.197	0.600	86.323	86.233	0.090	504.0	375	10.65	43.1
1.006	1-6	1-7	61.852	0.600	86.446	86.323	0.123	504.0	375	9.71	45.0
1.005	1-5	1-6	43.656	0.600	86.533	86.446	0.087	504.0	375	8.42	48.1
2.000	2-0	1-6	30.803	0.600	87.163	86.981	0.182	169.2	225	5.51	50.0
1.004	1-4	1-5	41.714	0.600	86.662	86.533	0.129	323.4	375	7.51	50.0
1.003	1-3	1-4	17.750	0.600	86.717	86.662	0.055	322.7	375	6.82	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
8.001	1.003	70.9	12.9	0.980	1.519	0.095	0.0	86
8.000	0.800	31.8	0.0	1.185	1.055	0.000	0.0	0
9.000	0.800	31.8	0.0	1.076	0.946	0.000	0.0	0
4.008	1.005	111.0	76.5	1.226	1.305	0.593	0.0	230
7.000	1.001	39.8	0.0	1.300	1.274	0.000	0.0	0
6.003	1.002	39.8	24.3	1.440	1.376	0.179	0.0	127
4.007	1.002	51.2	37.3	1.177	1.346	0.282	0.0	162
4.006	1.004	51.3	29.3	1.359	1.177	0.216	0.0	138
4.005	1.013	51.8	29.3	1.402	1.359	0.216	0.0	137
4.004	1.003	51.2	23.9	1.361	1.402	0.176	0.0	122
5.001	1.002	39.8	5.8	0.813	1.265	0.043	0.0	58
4.003	1.003	51.2	7.7	1.324	1.361	0.057	0.0	66
4.002	1.002	51.2	3.8	1.023	1.324	0.028	0.0	46
4.001	1.008	51.5	3.8	1.004	1.023	0.028	0.0	46
4.000	1.001	51.1	0.0	0.860	1.004	0.000	0.0	0
5.000	1.002	39.9	0.0	0.750	0.813	0.000	0.0	0
6.002	1.003	39.9	11.0	1.342	1.440	0.081	0.0	80
6.001	1.002	39.8	8.1	1.180	1.342	0.060	0.0	69
6.000	1.000	39.8	2.7	0.804	1.180	0.020	0.0	40
14.001	0.800	56.6	23.0	1.018	1.334	0.170	0.0	133
15.000	1.002	39.8	0.9	1.600	1.248	0.007	0.0	24
14.000	0.800	56.6	3.7	1.689	1.018	0.027	0.0	51
1.011	0.763	95.9	89.9	1.695	1.856	0.871	0.0	309
3.000	1.000	39.8	1.8	1.455	1.378	0.013	0.0	32
1.010	1.003	126.1	90.8	2.037	1.695	0.871	0.0	252
1.009	0.763	95.9	87.7	1.816	2.037	0.816	0.0	303
1.008	0.800	88.4	69.9	1.945	1.841	0.634	0.0	252
1.007	0.800	88.4	58.5	1.983	1.945	0.501	0.0	223
1.006	0.800	88.4	40.3	1.702	1.983	0.330	0.0	178
1.005	0.800	88.4	19.3	1.293	1.702	0.148	0.0	118
2.000	1.002	39.8	1.6	1.200	1.317	0.012	0.0	31
1.004	1.002	110.7	14.4	1.013	1.293	0.106	0.0	90
1.003	1.003	110.8	12.7	1.058	1.013	0.094	0.0	85

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.002	1-2	1-3	32.342	0.600	86.817	86.717	0.100	323.4	375	6.52	50.0
1.001	1-1	1-2	38.395	0.600	86.936	86.817	0.119	322.6	375	5.98	50.0
1.000	1-0	1-1	20.719	0.600	87.000	86.936	0.064	323.7	375	5.34	50.0
21.015	PI 3	Outfall 3	34.110	0.600	85.997	85.938	0.059	578.1	600	15.16	36.1
21.014	21-14	PI 3	3.768	0.600	86.104	86.097	0.007	538.3	600	14.60	36.8
21.013	21-13	21-14	35.358	0.600	86.138	86.104	0.034	1030.0	600	14.53	36.9
21.012	21-12	21-13	31.554	0.600	86.169	86.138	0.031	1030.0	600	13.75	38.0
30.002	30-2	21-13	19.913	0.600	86.896	86.778	0.118	168.8	225	6.34	50.0
30.001	30-1	30-2	28.062	0.600	87.062	86.896	0.166	169.0	225	6.01	50.0
30.000	30-0	30-1	36.134	0.600	87.325	87.062	0.263	137.4	225	5.54	50.0
21.011	21-11	21-12	65.244	0.600	86.232	86.169	0.063	1030.0	600	13.05	39.0
29.005	29-5	21-12	35.580	0.600	86.487	86.277	0.210	169.4	225	8.09	48.9
29.004	29-4	29-5	32.236	0.600	86.684	86.487	0.197	163.6	225	7.50	50.0
29.003	29-3	29-4	16.189	0.600	86.780	86.684	0.096	168.6	225	6.97	50.0
29.002	29-2	29-3	52.121	0.600	87.088	86.780	0.308	169.2	225	6.70	50.0
29.001	29-1	29-2	12.256	0.600	87.161	87.088	0.073	167.9	225	5.83	50.0
29.000	29-0	29-1	37.960	0.600	87.385	87.161	0.224	169.5	225	5.63	50.0
21.010	21-10	21-11	23.315	0.600	86.272	86.232	0.040	582.9	500	11.60	41.3
27.001	27-1	21-11	43.903	0.600	86.275	86.232	0.043	1030.0	600	7.05	50.0
28.001	28-1	21-11	32.739	0.600	86.333	86.232	0.101	324.2	375	6.32	50.0
28.000	28-0	28-1	46.846	0.600	86.478	86.333	0.145	323.1	375	5.78	50.0
27.000	27-0	27-1	48.356	0.600	86.322	86.275	0.047	1030.0	600	6.07	50.0
21.009	21-9	21-10	43.935	0.600	86.348	86.272	0.076	578.1	500	11.16	42.1
21.008	21-8	21-9	15.307	0.600	86.375	86.348	0.027	566.9	500	10.35	43.7
21.007	21-7	21-8	14.038	0.600	86.400	86.375	0.025	561.5	500	10.06	44.3
21.006	21-6	21-7	51.829	0.600	86.512	86.400	0.112	462.8	500	9.81	44.8
21.005	21-5	21-6	22.318	0.600	86.598	86.534	0.064	348.7	400	8.95	46.8
22.007	22-7	21-6	6.699	0.600	86.529	86.512	0.017	394.1	400	8.52	47.8
22.006	22-6	22-7	18.119	0.600	86.574	86.529	0.045	402.7	400	8.40	48.1
22.005	22-5	22-6	15.182	0.600	86.612	86.574	0.038	399.5	400	8.08	49.0
26.001	26-1	22-6	33.167	0.600	87.022	86.826	0.196	169.2	225	5.84	50.0
26.000	26-0	26-1	17.489	0.600	87.125	87.022	0.103	169.8	225	5.29	50.0
22.004	22-4	22-5	49.431	0.600	86.753	86.612	0.141	350.6	400	7.81	49.7

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
1.002	1.002	110.6	9.4	1.008	1.058	0.069	0.0	73
1.001	1.003	110.8	5.0	0.889	1.008	0.037	0.0	54
1.000	1.001	110.6	1.6	1.175	0.889	0.012	0.0	32
21.015	1.005	284.3	257.7	1.473	0.762	2.635	0.0	451
21.014	1.042	294.7	262.9	1.366	1.373	2.635	0.0	444
21.013	0.750	212.1	263.4	2.112	1.366	2.635	0.0	600
21.012	0.750	212.1	253.2	1.961	2.112	2.461	0.0	600
30.002	1.003	39.9	10.8	1.679	1.847	0.080	0.0	80
30.001	1.003	39.9	4.2	1.413	1.679	0.031	0.0	49
30.000	1.113	44.3	1.4	1.200	1.413	0.010	0.0	27
21.011	0.750	212.1	221.0	1.285	1.961	2.092	0.0	524
29.005	1.001	39.8	25.1	2.139	2.228	0.189	0.0	130
29.004	1.019	40.5	17.5	1.971	2.139	0.129	0.0	103
29.003	1.004	39.9	14.1	1.777	1.971	0.104	0.0	92
29.002	1.002	39.8	6.1	0.976	1.777	0.045	0.0	59
29.001	1.006	40.0	3.8	1.114	0.976	0.028	0.0	47
29.000	1.001	39.8	0.3	0.900	1.114	0.002	0.0	14
21.010	0.892	175.2	171.9	1.157	1.385	1.534	0.0	405
27.001	0.750	212.1	19.5	1.025	1.285	0.144	0.0	122
28.001	1.001	110.5	27.2	1.138	1.510	0.201	0.0	126
28.000	1.002	110.7	5.3	1.255	1.138	0.039	0.0	55
27.000	0.750	212.1	0.0	1.192	1.025	0.000	0.0	0
21.009	0.896	175.9	165.2	1.235	1.157	1.447	0.0	387
21.008	0.905	177.7	169.9	1.343	1.235	1.434	0.0	394
21.007	0.909	178.6	168.6	1.261	1.343	1.405	0.0	389
21.006	1.003	196.9	152.7	1.357	1.261	1.257	0.0	333
21.005	1.005	126.3	40.1	1.458	1.435	0.316	0.0	154
22.007	0.944	118.7	113.1	1.571	1.457	0.872	0.0	314
22.006	0.934	117.4	113.8	1.916	1.571	0.872	0.0	319
22.005	0.938	117.9	105.7	1.919	1.916	0.796	0.0	297
26.001	1.002	39.8	2.3	1.303	1.839	0.017	0.0	36
26.000	1.000	39.8	0.0	1.200	1.303	0.000	0.0	0
22.004	1.002	125.9	82.1	1.998	1.919	0.609	0.0	236

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
25.001	25-1	22-5	14.843	0.600	87.103	87.015	0.088	168.7	225	5.74	50.0
25.000	25-0	25-1	29.832	0.600	87.279	87.103	0.176	169.5	225	5.50	50.0
22.003	22-3	22-4	46.319	0.600	86.885	86.753	0.132	350.9	400	6.98	50.0
22.002	22-2	22-3	7.454	0.600	86.907	86.885	0.022	338.8	400	6.21	50.0
24.000	24-0	22-3	53.093	0.600	87.100	86.949	0.151	351.6	400	5.88	50.0
22.001	22-1	22-2	51.789	0.600	87.055	86.907	0.148	349.9	400	6.09	50.0
23.000	23-0	22-2	63.858	0.600	87.161	86.964	0.197	324.2	375	6.06	50.0
22.000	22-0	22-1	13.905	0.600	87.095	87.055	0.040	347.6	400	5.23	50.0
21.004	21-4	21-5	24.650	0.600	86.669	86.598	0.071	347.2	400	8.58	47.7
21.003	21-3	21-4	48.146	0.600	86.818	86.669	0.149	323.1	375	8.17	48.7
21.002	21-2	21-3	56.065	0.600	86.991	86.818	0.173	324.1	375	7.37	50.0
21.001	21-1	21-2	35.179	0.600	87.100	86.991	0.109	322.7	375	6.43	50.0
21.000	21-0	21-1	51.042	0.600	87.258	87.100	0.158	323.0	375	5.85	50.0
31.017	PI 1	Outfall 1	18.902	0.600	84.520	84.501	0.019	1020.0	600	11.45	41.6
31.016	31-17	PI 1	5.899	0.600	84.631	84.620	0.011	536.2	600	11.03	42.4
31.015	31-16	31-17	11.460	0.600	84.655	84.631	0.024	477.5	600	10.94	42.6
31.014	31-15	31-16	20.609	0.600	84.691	84.655	0.036	572.5	450	10.76	42.9
37.004	37-4	31-16	26.698	0.600	84.822	84.744	0.078	342.3	375	9.70	45.0
37.003	37-3	37-4	49.639	0.600	84.944	84.822	0.122	406.9	375	9.25	46.1
37.002	37-2	37-3	64.636	0.600	85.144	84.944	0.200	323.2	300	8.32	48.3
40.001	40-1	37-3	74.807	0.600	85.619	85.178	0.441	169.6	225	6.69	50.0
40.000	40-0	40-1	26.496	0.600	85.775	85.619	0.156	169.8	225	5.44	50.0
38.001	38-1	37-2	67.475	0.600	85.420	85.144	0.276	244.5	300	6.85	50.0
37.001	37-1	37-2	73.376	0.600	86.272	85.840	0.432	169.9	225	7.08	50.0
37.000	37-0	37-1	51.420	0.600	86.575	86.272	0.303	169.7	225	5.86	50.0
38.000	38-0	38-1	43.565	0.600	85.677	85.420	0.257	169.5	225	5.73	50.0
39.000	39-0	38-1	6.921	0.600	86.115	86.074	0.041	168.8	225	5.11	50.0
31.013	31-14	31-15	14.958	0.600	84.717	84.691	0.026	575.3	450	10.36	43.7
31.012	31-13	31-14	33.595	0.600	84.775	84.717	0.058	579.2	450	10.06	44.3
31.011	31-12	31-13	55.310	0.600	84.933	84.775	0.158	350.1	400	9.39	45.7
36.004	36-4	31-13	42.767	0.600	86.319	85.891	0.428	100.0	225	6.56	50.0
36.003	36-3	36-4	14.574	0.600	86.465	86.319	0.146	100.0	225	6.01	50.0
36.002	36-2	36-3	11.007	0.600	86.575	86.465	0.110	100.0	225	5.83	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
25.001	1.004	39.9	8.4	1.372	1.691	0.062	0.0	70
25.000	1.001	39.8	0.0	1.200	1.372	0.000	0.0	0
22.003	1.002	125.9	64.5	1.278	1.998	0.476	0.0	203
22.002	1.019	128.1	49.2	1.257	1.278	0.363	0.0	171
24.000	1.001	125.7	1.1	1.155	1.214	0.008	0.0	26
22.001	1.003	126.0	6.6	0.843	1.257	0.049	0.0	62
23.000	1.001	110.5	4.7	0.821	1.225	0.035	0.0	52
22.000	1.006	126.5	3.4	0.750	0.843	0.025	0.0	45
21.004	1.007	126.5	32.8	1.298	1.458	0.254	0.0	139
21.003	1.002	110.7	26.2	1.498	1.323	0.198	0.0	123
21.002	1.001	110.5	12.3	1.039	1.498	0.091	0.0	84
21.001	1.003	110.8	8.0	0.750	1.039	0.059	0.0	68
21.000	1.002	110.7	0.7	0.907	0.750	0.005	0.0	21
31.017	0.754	213.2	225.1	1.320	0.469	1.996	0.0	537
31.016	1.044	295.3	229.3	1.209	1.220	1.996	0.0	399
31.015	1.107	313.1	230.2	1.595	1.209	1.996	0.0	383
31.014	0.842	134.0	121.1	1.809	1.745	1.042	0.0	337
37.004	0.973	107.5	104.3	1.733	1.731	0.854	0.0	299
37.003	0.892	98.5	95.7	1.702	1.733	0.766	0.0	300
37.002	0.869	61.4	61.3	1.803	1.777	0.468	0.0	247
40.001	1.001	39.8	3.5	1.231	1.618	0.026	0.0	45
40.000	1.000	39.8	0.0	1.200	1.231	0.000	0.0	0
38.001	1.001	70.7	19.7	1.427	1.803	0.145	0.0	108
37.001	1.000	39.8	6.9	1.239	1.182	0.051	0.0	63
37.000	1.001	39.8	0.0	1.200	1.239	0.000	0.0	0
38.000	1.001	39.8	4.6	1.450	1.502	0.034	0.0	51
39.000	1.003	39.9	0.0	0.831	0.848	0.000	0.0	0
31.013	0.840	133.6	121.0	1.833	1.809	1.022	0.0	337
31.012	0.837	133.2	116.4	2.006	1.833	0.970	0.0	327
31.011	1.003	126.0	81.3	1.568	2.056	0.656	0.0	234
36.004	1.307	52.0	15.7	1.132	1.115	0.116	0.0	85
36.003	1.307	52.0	14.4	1.264	1.132	0.106	0.0	80
36.002	1.307	52.0	11.9	1.362	1.264	0.088	0.0	73

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
36.001	36-1	36-2	14.673	0.600	86.722	86.575	0.147	100.0	225	5.69	50.0
36.000	36-0	36-1	30.135	0.600	86.900	86.722	0.178	169.3	225	5.50	50.0
31.010	31-11	31-12	29.020	0.600	85.016	84.933	0.083	349.6	400	8.47	47.9
31.009	31-10	31-11	19.192	0.600	85.071	85.016	0.055	348.9	400	7.99	49.2
35.000	35-0	31-11	30.939	0.600	85.659	85.476	0.183	169.1	225	5.51	50.0
31.008	31-9	31-10	8.755	0.600	85.096	85.071	0.025	350.2	400	7.67	50.0
31.007	31-8	31-9	4.633	0.600	85.384	85.369	0.015	308.9	300	7.53	50.0
34.000	33-0	31-9	53.968	0.600	85.675	85.357	0.318	169.7	225	5.90	50.0
31.006	31-7	31-8	53.993	0.600	85.605	85.384	0.221	244.3	300	7.44	50.0
33.002	34-2	31-8	12.512	0.600	85.611	85.537	0.074	169.1	225	5.74	50.0
33.001	34-1	34-2	9.300	0.600	85.666	85.611	0.055	169.1	225	5.53	50.0
33.000	34-0	34-1	22.672	0.600	85.800	85.666	0.134	169.2	225	5.38	50.0
31.005	31-6	31-7	6.674	0.600	85.645	85.605	0.040	166.9	225	6.54	50.0
32.001	32-1	31-7	27.582	0.600	85.980	85.817	0.163	169.2	225	5.87	50.0
32.000	32-0	32-1	24.620	0.600	86.125	85.980	0.145	169.8	225	5.41	50.0
31.004	31-5	31-6	31.472	0.600	85.960	85.645	0.315	100.0	225	6.43	50.0
31.003	31-4	31-5	17.107	0.600	86.174	85.960	0.214	80.0	225	6.03	50.0
31.002	31-2	31-4	13.738	0.600	86.346	86.174	0.172	80.0	225	5.83	50.0
31.001	31-1	31-2	22.282	0.600	86.625	86.346	0.279	80.0	225	5.68	50.0
31.000	31-0	31-1	25.451	0.600	86.775	86.625	0.150	169.7	225	5.42	50.0
41.014	PI 5	Outfall 5	5.314	0.600	85.165	85.148	0.017	312.6	500	11.01	42.4
41.013	41-13	PI 5	5.268	0.600	85.275	85.265	0.010	526.8	500	10.94	42.6
41.012	41-12	41-13	24.728	0.600	85.347	85.275	0.072	343.4	400	10.84	42.7
48.000	48-0	41-13	54.165	0.600	86.300	85.758	0.542	100.0	225	5.69	50.0
41.011	41-11	41-12	14.015	0.600	85.385	85.347	0.038	368.8	400	10.44	43.5
41.010	41-10	41-11	5.101	0.600	85.400	85.385	0.015	340.1	400	10.20	44.0
41.009	41-9	41-10	31.084	0.600	85.674	85.578	0.096	323.8	375	10.11	44.2
47.001	47-1	41-10	49.677	0.600	86.108	85.815	0.293	169.5	225	6.53	50.0
47.000	47-0	47-1	50.028	0.600	86.525	86.108	0.417	120.0	225	5.70	50.0
41.008	41-8	41-9	13.682	0.600	85.717	85.674	0.043	318.2	375	9.60	45.3
46.000	46-0	41-9	9.566	0.600	86.005	85.948	0.057	167.8	225	5.16	50.0
41.007	41-7	41-8	5.218	0.600	85.738	85.717	0.021	248.5	375	9.37	45.8
41.006	41-6	41-7	52.111	0.600	85.899	85.738	0.161	323.7	375	9.29	46.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
36.001	1.307	52.0	8.9	1.436	1.362	0.066	0.0	63
36.000	1.002	39.8	0.0	1.433	1.436	0.000	0.0	0
31.010	1.003	126.1	75.0	1.434	1.568	0.577	0.0	222
31.009	1.004	126.2	65.2	1.789	1.434	0.489	0.0	204
35.000	1.002	39.9	3.4	1.207	1.149	0.025	0.0	44
31.008	1.003	126.0	66.3	1.889	1.789	0.489	0.0	206
31.007	0.889	62.8	59.2	1.703	1.716	0.437	0.0	233
34.000	1.001	39.8	0.0	1.500	1.803	0.000	0.0	0
31.006	1.001	70.8	28.6	1.989	1.703	0.211	0.0	133
33.002	1.002	39.9	11.2	1.486	1.625	0.083	0.0	81
33.001	1.002	39.9	8.7	1.475	1.486	0.064	0.0	71
33.000	1.002	39.8	3.7	1.200	1.475	0.027	0.0	46
31.005	1.009	40.1	24.9	2.130	2.064	0.184	0.0	129
32.001	1.002	39.8	3.1	1.545	1.852	0.023	0.0	43
32.000	1.000	39.8	0.0	1.400	1.545	0.000	0.0	0
31.004	1.307	52.0	17.5	2.165	2.130	0.129	0.0	90
31.003	1.463	58.2	14.6	2.013	2.165	0.108	0.0	77
31.002	1.463	58.2	11.8	1.804	2.013	0.087	0.0	68
31.001	1.463	58.2	8.3	1.610	1.804	0.061	0.0	57
31.000	1.001	39.8	0.0	1.586	1.610	0.000	0.0	0
41.014	1.223	240.1	140.4	1.685	0.752	1.221	0.0	275
41.013	0.939	184.4	140.8	1.575	1.585	1.221	0.0	329
41.012	1.013	127.2	123.1	1.703	1.675	1.063	0.0	319
48.000	1.307	52.0	0.0	0.925	1.367	0.000	0.0	0
41.011	0.977	122.7	121.9	1.605	1.703	1.033	0.0	328
41.010	1.018	127.9	120.5	1.630	1.605	1.010	0.0	311
41.009	1.001	110.6	99.3	1.431	1.477	0.829	0.0	279
47.001	1.001	39.8	7.9	1.217	1.390	0.058	0.0	67
47.000	1.192	47.4	0.0	1.200	1.217	0.000	0.0	0
41.008	1.010	111.6	97.2	1.431	1.431	0.792	0.0	272
46.000	1.006	40.0	0.0	1.200	1.307	0.000	0.0	0
41.007	1.145	126.4	95.0	1.410	1.431	0.765	0.0	244
41.006	1.001	110.6	95.3	1.623	1.410	0.765	0.0	270

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
41.005	41-5	41-6	5.064	0.600	85.920	85.899	0.021	241.1	375	8.43	48.1
41.004	41-4	41-5	45.028	0.600	86.059	85.920	0.139	323.9	375	8.35	48.3
45.000	45-0	41-5	36.295	0.600	86.412	86.198	0.214	169.6	225	5.60	50.0
41.003	41-3	41-4	32.932	0.600	86.194	86.059	0.135	243.9	300	7.60	50.0
42.002	42-2	41-4	17.507	0.600	86.399	86.327	0.072	243.1	300	6.00	50.0
44.000	44-0	41-4	16.241	0.600	86.423	86.327	0.096	169.2	225	5.27	50.0
42.001	42-1	42-2	30.162	0.600	86.523	86.399	0.124	243.2	300	5.71	50.0
43.000	43-0	42-2	11.712	0.600	86.593	86.524	0.069	169.7	225	5.20	50.0
42.000	42-0	42-1	12.458	0.600	86.574	86.523	0.051	244.3	300	5.21	50.0
41.002	41-2	41-3	49.058	0.600	86.395	86.194	0.201	244.1	300	7.06	50.0
41.001	41-1	41-2	45.904	0.600	86.583	86.395	0.188	244.2	300	6.24	50.0
41.000	41-0	41-1	28.592	0.600	86.700	86.583	0.117	244.4	300	5.48	50.0
49.006	PI 2	Outfall 2	4.546	0.600	85.620	85.610	0.010	454.6	450	9.22	46.1
49.005	50-5	PI 2	18.999	0.600	85.821	85.763	0.058	327.6	400	9.14	46.3
49.004	50-4	50-5	82.625	0.600	86.002	85.821	0.181	456.5	400	8.84	47.0
49.003	50-3	50-4	63.994	0.600	86.200	86.002	0.198	323.2	400	7.27	50.0
49.002	50-2	50-3	27.221	0.600	87.200	86.860	0.340	80.0	225	6.25	50.0
49.001	50-1	50-2	36.427	0.600	88.000	87.545	0.455	80.0	225	5.94	50.0
49.000	50-0	50-1	45.692	0.600	88.900	88.329	0.571	80.0	225	5.52	50.0
50.006	PI 6	Outfall 6	5.797	0.600	85.526	85.504	0.022	263.5	450	9.69	45.1
50.005	49-5	PI 6	24.841	0.600	85.680	85.626	0.054	460.0	450	9.62	45.2
50.004	49-4	49-5	35.824	0.600	85.730	85.680	0.050	720.0	450	9.18	46.2
50.003	49-3	49-4	34.665	0.600	85.799	85.730	0.069	500.0	375	8.38	48.2
50.002	49-2	49-3	53.673	0.600	85.906	85.799	0.107	500.0	375	7.66	50.0
50.001	49-1	49-2	20.216	0.600	85.969	85.906	0.063	320.9	375	6.55	50.0
50.000	49-0	49-1	72.790	0.600	86.194	85.969	0.225	323.5	375	6.21	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
41.005	1.162	128.4	99.7	1.584	1.623	0.765	0.0	249
41.004	1.001	110.6	81.2	1.792	1.584	0.621	0.0	240
45.000	1.001	39.8	7.7	0.936	1.456	0.057	0.0	67
41.003	1.002	70.8	25.7	1.006	1.867	0.190	0.0	125
42.002	1.004	70.9	43.8	1.449	1.599	0.323	0.0	171
44.000	1.002	39.8	2.6	1.600	1.674	0.019	0.0	38
42.001	1.003	70.9	28.3	1.173	1.449	0.209	0.0	132
43.000	1.000	39.8	2.4	1.200	1.399	0.018	0.0	37
42.000	1.001	70.8	11.8	0.994	1.173	0.087	0.0	82
41.002	1.002	70.8	19.8	1.105	1.006	0.146	0.0	108
41.001	1.001	70.8	11.7	1.367	1.105	0.086	0.0	82
41.000	1.001	70.8	6.9	1.250	1.367	0.051	0.0	63
49.006	0.947	150.6	50.5	1.030	0.441	0.404	0.0	179
49.005	1.037	130.3	50.7	1.879	0.937	0.404	0.0	173
49.004	0.877	110.2	33.5	2.025	1.879	0.263	0.0	151
49.003	1.044	131.2	20.9	2.231	2.025	0.154	0.0	107
49.002	1.463	58.2	16.0	1.921	1.746	0.118	0.0	80
49.001	1.463	58.2	10.2	1.980	1.576	0.075	0.0	64
49.000	1.463	58.2	0.0	1.916	1.651	0.000	0.0	0
50.006	1.247	198.4	44.3	1.913	0.536	0.363	0.0	144
50.005	0.941	149.7	44.5	1.769	1.813	0.363	0.0	167
50.004	0.750	119.3	39.1	1.554	1.769	0.312	0.0	177
50.003	0.803	88.7	33.3	1.373	1.629	0.255	0.0	159
50.002	0.803	88.7	19.9	0.964	1.373	0.147	0.0	120
50.001	1.006	111.1	17.6	0.847	0.964	0.130	0.0	101
50.000	1.002	110.6	0.0	1.237	0.847	0.000	0.0	0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.017	7.171	652.0	600	Circular	87.100	85.584	0.916	86.490	85.573	0.317
1.016	22.093	789.0	600	Circular	87.570	85.712	1.258	87.100	85.684	0.816
1.015	27.613	1030.0	600	Circular	87.781	85.739	1.442	87.570	85.712	1.258
1.014	13.668	1030.0	600	Circular	87.871	85.752	1.519	87.781	85.739	1.442
1.013	25.701	1030.0	600	Circular	88.078	85.777	1.701	87.871	85.752	1.519
18.004	7.300	504.0	375	Circular	87.871	85.770	1.726	87.871	85.756	1.740
18.003	13.576	504.0	375	Circular	87.724	85.797	1.552	87.871	85.770	1.726
18.002	45.795	322.5	375	Circular	87.900	85.939	1.586	87.724	85.797	1.552
18.001	31.368	243.2	300	Circular	87.750	86.068	1.382	87.900	85.939	1.661
20.000	48.292	169.4	225	Circular	87.550	86.244	1.081	87.900	85.959	1.716
18.000	60.538	169.6	225	Circular	87.800	86.425	1.150	87.750	86.068	1.457
19.001	13.696	169.1	225	Circular	87.600	86.590	0.785	87.750	86.509	1.016
19.000	22.929	169.8	225	Circular	88.150	86.725	1.200	87.600	86.590	0.785
1.012	10.520	634.0	450	Circular	88.157	85.901	1.806	88.078	85.884	1.744
4.016	41.030	1030.0	600	Circular	87.823	85.817	1.406	88.078	85.777	1.701
16.000	35.288	169.7	225	Circular	88.000	86.575	1.200	87.823	86.367	1.231
17.000	33.300	169.0	225	Circular	87.625	86.200	1.200	87.823	86.003	1.595
4.015	32.945	908.0	600	Circular	87.418	85.853	0.965	87.823	85.817	1.406
14.002	13.040	504.0	375	Circular	87.521	85.887	1.259	87.418	85.861	1.182
4.014	21.547	908.0	600	Circular	87.500	85.877	1.023	87.418	85.853	0.965
4.013	19.264	723.0	500	Circular	87.400	85.904	0.996	87.500	85.877	1.123
13.000	29.498	169.5	225	Circular	87.600	86.175	1.200	87.400	86.001	1.174
4.012	28.941	723.0	500	Circular	87.850	85.944	1.406	87.400	85.904	0.996
4.011	6.084	723.0	500	Circular	87.850	85.952	1.398	87.850	85.944	1.406
4.010	27.773	545.0	400	Circular	87.822	86.003	1.419	87.850	85.952	1.498
10.003	19.085	264.0	225	Circular	87.724	86.099	1.400	87.850	86.027	1.598
10.002	18.982	169.5	225	Circular	87.700	86.294	1.181	87.724	86.182	1.317
12.000	16.776	264.0	225	Circular	87.588	86.163	1.200	87.724	86.099	1.400
11.001	26.210	169.1	225	Circular	87.700	86.449	1.026	87.700	86.294	1.181
10.001	34.125	169.8	225	Circular	87.816	86.665	0.926	87.700	86.464	1.011
10.000	16.252	169.3	225	Circular	87.635	86.761	0.649	87.816	86.665	0.926
11.000	12.853	169.1	225	Circular	87.700	86.525	0.950	87.700	86.449	1.026
4.009	19.118	504.0	375	Circular	87.721	86.041	1.305	87.822	86.003	1.444
8.001	28.505	243.6	300	Circular	87.400	86.120	0.980	87.822	86.003	1.519

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.017	PI 4	1500	Manhole	Adoptable	Outfall 4	1500	Manhole	Adoptable
1.016	1-16	2100	Manhole	Adoptable	PI 4	1500	Manhole	Adoptable
1.015	1-15	1500	Manhole	Adoptable	1-16	2100	Manhole	Adoptable
1.014	1-14	1500	Manhole	Adoptable	1-15	1500	Manhole	Adoptable
1.013	1-13	1500	Manhole	Adoptable	1-14	1500	Manhole	Adoptable
18.004	18-4	1350	Manhole	Adoptable	1-14	1500	Manhole	Adoptable
18.003	18-3	1350	Manhole	Adoptable	18-4	1350	Manhole	Adoptable
18.002	18-2	1350	Manhole	Adoptable	18-3	1350	Manhole	Adoptable
18.001	18-1	1200	Manhole	Adoptable	18-2	1350	Manhole	Adoptable
20.000	20-0	1200	Manhole	Adoptable	18-2	1350	Manhole	Adoptable
18.000	18-0	1200	Manhole	Adoptable	18-1	1200	Manhole	Adoptable
19.001	19-1	1200	Manhole	Adoptable	18-1	1200	Manhole	Adoptable
19.000	19-0	1200	Manhole	Adoptable	19-1	1200	Manhole	Adoptable
1.012	1-12	1350	Manhole	Adoptable	1-13	1500	Manhole	Adoptable
4.016	4-16	1500	Manhole	Adoptable	1-13	1500	Manhole	Adoptable
16.000	16-0	1200	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
17.000	17-0	1200	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
4.015	4-15	1500	Manhole	Adoptable	4-16	1500	Manhole	Adoptable
14.002	14-2	1350	Manhole	Adoptable	4-15	1500	Manhole	Adoptable
4.014	4-14	1500	Manhole	Adoptable	4-15	1500	Manhole	Adoptable
4.013	4-13	1500	Manhole	Adoptable	4-14	1500	Manhole	Adoptable
13.000	13-0	1200	Manhole	Adoptable	4-13	1500	Manhole	Adoptable
4.012	4-12	1500	Manhole	Adoptable	4-13	1500	Manhole	Adoptable
4.011	4-11	1500	Manhole	Adoptable	4-12	1500	Manhole	Adoptable
4.010	4-10	1350	Manhole	Adoptable	4-11	1500	Manhole	Adoptable
10.003	10-3	1200	Manhole	Adoptable	4-11	1500	Manhole	Adoptable
10.002	10-2	1200	Manhole	Adoptable	10-3	1200	Manhole	Adoptable
12.000	12-0	1200	Manhole	Adoptable	10-3	1200	Manhole	Adoptable
11.001	11-1	1200	Manhole	Adoptable	10-2	1200	Manhole	Adoptable
10.001	10-1	1200	Manhole	Adoptable	10-2	1200	Manhole	Adoptable
10.000	10-0	1200	Manhole	Adoptable	10-1	1200	Manhole	Adoptable
11.000	11-0	1200	Manhole	Adoptable	11-1	1200	Manhole	Adoptable
4.009	4-9	1350	Manhole	Adoptable	4-10	1350	Manhole	Adoptable
8.001	8-1	1200	Manhole	Adoptable	4-10	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
8.000	44.945	264.0	225	Circular	87.700	86.290	1.185	87.400	86.120	1.055
9.000	44.809	264.0	225	Circular	87.700	86.399	1.076	87.400	86.229	0.946
4.008	27.328	321.5	375	Circular	87.727	86.126	1.226	87.721	86.041	1.305
7.000	59.885	169.6	225	Circular	88.100	86.575	1.300	87.721	86.222	1.274
6.003	23.535	169.3	225	Circular	87.930	86.265	1.440	87.727	86.126	1.376
4.007	52.234	198.6	255	Circular	87.821	86.389	1.177	87.727	86.126	1.346
4.006	11.653	197.5	255	Circular	88.062	86.448	1.359	87.821	86.389	1.177
4.005	4.463	194.1	255	Circular	88.128	86.471	1.402	88.062	86.448	1.359
4.004	27.740	198.1	255	Circular	88.227	86.611	1.361	88.128	86.471	1.402
5.001	38.057	169.1	225	Circular	88.000	86.962	0.813	88.227	86.737	1.265
4.003	25.937	198.0	255	Circular	88.321	86.742	1.324	88.227	86.611	1.361
4.002	35.740	198.6	255	Circular	88.200	86.922	1.023	88.321	86.742	1.324
4.001	3.729	196.3	255	Circular	88.200	86.941	1.004	88.200	86.922	1.023
4.000	28.651	199.0	255	Circular	88.200	87.085	0.860	88.200	86.941	1.004
5.000	27.560	169.1	225	Circular	88.100	87.125	0.750	88.000	86.962	0.813
6.002	28.382	168.9	225	Circular	88.000	86.433	1.342	87.930	86.265	1.440
6.001	39.265	169.2	225	Circular	88.070	86.665	1.180	88.000	86.433	1.342
6.000	34.964	169.7	225	Circular	87.900	86.871	0.804	88.070	86.665	1.180
14.001	49.191	380.0	300	Circular	87.334	86.016	1.018	87.521	85.887	1.334
15.000	37.380	169.1	225	Circular	88.094	86.269	1.600	87.521	86.048	1.248
14.000	52.189	380.0	300	Circular	88.142	86.153	1.689	87.334	86.016	1.018
1.011	12.131	600.0	400	Circular	88.016	85.921	1.695	88.157	85.901	1.856
3.000	40.242	169.8	225	Circular	88.471	86.791	1.455	88.157	86.554	1.378
1.010	47.904	349.7	400	Circular	88.495	86.058	2.037	88.016	85.921	1.695
1.009	28.263	600.0	400	Circular	88.321	86.105	1.816	88.495	86.058	2.037
1.008	64.345	504.0	375	Circular	88.553	86.233	1.945	88.321	86.105	1.841
1.007	45.197	504.0	375	Circular	88.681	86.323	1.983	88.553	86.233	1.945
1.006	61.852	504.0	375	Circular	88.523	86.446	1.702	88.681	86.323	1.983
1.005	43.656	504.0	375	Circular	88.201	86.533	1.293	88.523	86.446	1.702
2.000	30.803	169.2	225	Circular	88.588	87.163	1.200	88.523	86.981	1.317
1.004	41.714	323.4	375	Circular	88.050	86.662	1.013	88.201	86.533	1.293
1.003	17.750	322.7	375	Circular	88.150	86.717	1.058	88.050	86.662	1.013
1.002	32.342	323.4	375	Circular	88.200	86.817	1.008	88.150	86.717	1.058
1.001	38.395	322.6	375	Circular	88.200	86.936	0.889	88.200	86.817	1.008

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
8.000	8-0	1200	Manhole	Adoptable	8-1	1200	Manhole	Adoptable
9.000	9-0	1200	Manhole	Adoptable	8-1	1200	Manhole	Adoptable
4.008	4-8	1350	Manhole	Adoptable	4-9	1350	Manhole	Adoptable
7.000	7-0	1200	Manhole	Adoptable	4-9	1350	Manhole	Adoptable
6.003	6-3	1200	Manhole	Adoptable	4-8	1350	Manhole	Adoptable
4.007	4-7	1200	Manhole	Adoptable	4-8	1350	Manhole	Adoptable
4.006	4-6	1200	Manhole	Adoptable	4-7	1200	Manhole	Adoptable
4.005	4-5	1200	Manhole	Adoptable	4-6	1200	Manhole	Adoptable
4.004	4-4	1200	Manhole	Adoptable	4-5	1200	Manhole	Adoptable
5.001	5-1	1200	Manhole	Adoptable	4-4	1200	Manhole	Adoptable
4.003	4-3	1200	Manhole	Adoptable	4-4	1200	Manhole	Adoptable
4.002	4-2	1200	Manhole	Adoptable	4-3	1200	Manhole	Adoptable
4.001	4-1	1200	Manhole	Adoptable	4-2	1200	Manhole	Adoptable
4.000	4-0	1200	Manhole	Adoptable	4-1	1200	Manhole	Adoptable
5.000	5-0	1200	Manhole	Adoptable	5-1	1200	Manhole	Adoptable
6.002	6-2	1200	Manhole	Adoptable	6-3	1200	Manhole	Adoptable
6.001	6-1	1200	Manhole	Adoptable	6-2	1200	Manhole	Adoptable
6.000	6-0	1200	Manhole	Adoptable	6-1	1200	Manhole	Adoptable
14.001	14-1	1200	Manhole	Adoptable	14-2	1350	Manhole	Adoptable
15.000	15-0	1200	Manhole	Adoptable	14-2	1350	Manhole	Adoptable
14.000	14-0	1200	Manhole	Adoptable	14-1	1200	Manhole	Adoptable
1.011	1-11	1800	Manhole	Adoptable	1-12	1350	Manhole	Adoptable
3.000	3-0	1200	Manhole	Adoptable	1-12	1350	Manhole	Adoptable
1.010	1-10	1350	Manhole	Adoptable	1-11	1800	Manhole	Adoptable
1.009	1-9	1350	Manhole	Adoptable	1-10	1350	Manhole	Adoptable
1.008	1-8	1350	Manhole	Adoptable	1-9	1350	Manhole	Adoptable
1.007	1-7	1350	Manhole	Adoptable	1-8	1350	Manhole	Adoptable
1.006	1-6	1350	Manhole	Adoptable	1-7	1350	Manhole	Adoptable
1.005	1-5	1350	Manhole	Adoptable	1-6	1350	Manhole	Adoptable
2.000	2-0	1200	Manhole	Adoptable	1-6	1350	Manhole	Adoptable
1.004	1-4	1350	Manhole	Adoptable	1-5	1350	Manhole	Adoptable
1.003	1-3	1350	Manhole	Adoptable	1-4	1350	Manhole	Adoptable
1.002	1-2	1350	Manhole	Adoptable	1-3	1350	Manhole	Adoptable
1.001	1-1	1350	Manhole	Adoptable	1-2	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	20.719	323.7	375	Circular	88.550	87.000	1.175	88.200	86.936	0.889
21.015	34.110	578.1	600	Circular	88.070	85.997	1.473	87.300	85.938	0.762
21.014	3.768	538.3	600	Circular	88.070	86.104	1.366	88.070	86.097	1.373
21.013	35.358	1030.0	600	Circular	88.850	86.138	2.112	88.070	86.104	1.366
21.012	31.554	1030.0	600	Circular	88.730	86.169	1.961	88.850	86.138	2.112
30.002	19.913	168.8	225	Circular	88.800	86.896	1.679	88.850	86.778	1.847
30.001	28.062	169.0	225	Circular	88.700	87.062	1.413	88.800	86.896	1.679
30.000	36.134	137.4	225	Circular	88.750	87.325	1.200	88.700	87.062	1.413
21.011	65.244	1030.0	600	Circular	88.117	86.232	1.285	88.730	86.169	1.961
29.005	35.580	169.4	225	Circular	88.851	86.487	2.139	88.730	86.277	2.228
29.004	32.236	163.6	225	Circular	88.880	86.684	1.971	88.851	86.487	2.139
29.003	16.189	168.6	225	Circular	88.782	86.780	1.777	88.880	86.684	1.971
29.002	52.121	169.2	225	Circular	88.289	87.088	0.976	88.782	86.780	1.777
29.001	12.256	167.9	225	Circular	88.500	87.161	1.114	88.289	87.088	0.976
29.000	37.960	169.5	225	Circular	88.510	87.385	0.900	88.500	87.161	1.114
21.010	23.315	582.9	500	Circular	87.929	86.272	1.157	88.117	86.232	1.385
27.001	43.903	1030.0	600	Circular	87.900	86.275	1.025	88.117	86.232	1.285
28.001	32.739	324.2	375	Circular	87.846	86.333	1.138	88.117	86.232	1.510
28.000	46.846	323.1	375	Circular	88.108	86.478	1.255	87.846	86.333	1.138
27.000	48.356	1030.0	600	Circular	88.114	86.322	1.192	87.900	86.275	1.025
21.009	43.935	578.1	500	Circular	88.083	86.348	1.235	87.929	86.272	1.157
21.008	15.307	566.9	500	Circular	88.218	86.375	1.343	88.083	86.348	1.235
21.007	14.038	561.5	500	Circular	88.161	86.400	1.261	88.218	86.375	1.343
21.006	51.829	462.8	500	Circular	88.369	86.512	1.357	88.161	86.400	1.261
21.005	22.318	348.7	400	Circular	88.456	86.598	1.458	88.369	86.534	1.435
22.007	6.699	394.1	400	Circular	88.500	86.529	1.571	88.369	86.512	1.457
22.006	18.119	402.7	400	Circular	88.890	86.574	1.916	88.500	86.529	1.571
22.005	15.182	399.5	400	Circular	88.931	86.612	1.919	88.890	86.574	1.916
26.001	33.167	169.2	225	Circular	88.550	87.022	1.303	88.890	86.826	1.839
26.000	17.489	169.8	225	Circular	88.550	87.125	1.200	88.550	87.022	1.303
22.004	49.431	350.6	400	Circular	89.151	86.753	1.998	88.931	86.612	1.919
25.001	14.843	168.7	225	Circular	88.700	87.103	1.372	88.931	87.015	1.691
25.000	29.832	169.5	225	Circular	88.704	87.279	1.200	88.700	87.103	1.372
22.003	46.319	350.9	400	Circular	88.563	86.885	1.278	89.151	86.753	1.998

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1-0	1350	Manhole	Adoptable	1-1	1350	Manhole	Adoptable
21.015	PI 3	1500	Manhole	Adoptable	Outfall 3	1500	Manhole	Adoptable
21.014	21-14	1500	Manhole	Adoptable	PI 3	1500	Manhole	Adoptable
21.013	21-13	1500	Manhole	Adoptable	21-14	1500	Manhole	Adoptable
21.012	21-12	1500	Manhole	Adoptable	21-13	1500	Manhole	Adoptable
30.002	30-2	1200	Manhole	Adoptable	21-13	1500	Manhole	Adoptable
30.001	30-1	1200	Manhole	Adoptable	30-2	1200	Manhole	Adoptable
30.000	30-0	1200	Manhole	Adoptable	30-1	1200	Manhole	Adoptable
21.011	21-11	1500	Manhole	Adoptable	21-12	1500	Manhole	Adoptable
29.005	29-5	1200	Manhole	Adoptable	21-12	1500	Manhole	Adoptable
29.004	29-4	1200	Manhole	Adoptable	29-5	1200	Manhole	Adoptable
29.003	29-3	1200	Manhole	Adoptable	29-4	1200	Manhole	Adoptable
29.002	29-2	1200	Manhole	Adoptable	29-3	1200	Manhole	Adoptable
29.001	29-1	1200	Manhole	Adoptable	29-2	1200	Manhole	Adoptable
29.000	29-0	1200	Manhole	Adoptable	29-1	1200	Manhole	Adoptable
21.010	21-10	1500	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
27.001	27-1	1500	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
28.001	28-1	1350	Manhole	Adoptable	21-11	1500	Manhole	Adoptable
28.000	28-0	1350	Manhole	Adoptable	28-1	1350	Manhole	Adoptable
27.000	27-0	1500	Manhole	Adoptable	27-1	1500	Manhole	Adoptable
21.009	21-9	1500	Manhole	Adoptable	21-10	1500	Manhole	Adoptable
21.008	21-8	1500	Manhole	Adoptable	21-9	1500	Manhole	Adoptable
21.007	21-7	1500	Manhole	Adoptable	21-8	1500	Manhole	Adoptable
21.006	21-6	1500	Manhole	Adoptable	21-7	1500	Manhole	Adoptable
21.005	21-5	1350	Manhole	Adoptable	21-6	1500	Manhole	Adoptable
22.007	22-7	1350	Manhole	Adoptable	21-6	1500	Manhole	Adoptable
22.006	22-6	1350	Manhole	Adoptable	22-7	1350	Manhole	Adoptable
22.005	22-5	1350	Manhole	Adoptable	22-6	1350	Manhole	Adoptable
26.001	26-1	1200	Manhole	Adoptable	22-6	1350	Manhole	Adoptable
26.000	26-0	1200	Manhole	Adoptable	26-1	1200	Manhole	Adoptable
22.004	22-4	1350	Manhole	Adoptable	22-5	1350	Manhole	Adoptable
25.001	25-1	1200	Manhole	Adoptable	22-5	1350	Manhole	Adoptable
25.000	25-0	1200	Manhole	Adoptable	25-1	1200	Manhole	Adoptable
22.003	22-3	1350	Manhole	Adoptable	22-4	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
22.002	7.454	338.8	400	Circular	88.564	86.907	1.257	88.563	86.885	1.278
24.000	53.093	351.6	400	Circular	88.655	87.100	1.155	88.563	86.949	1.214
22.001	51.789	349.9	400	Circular	88.298	87.055	0.843	88.564	86.907	1.257
23.000	63.858	324.2	375	Circular	88.357	87.161	0.821	88.564	86.964	1.225
22.000	13.905	347.6	400	Circular	88.245	87.095	0.750	88.298	87.055	0.843
21.004	24.650	347.2	400	Circular	88.367	86.669	1.298	88.456	86.598	1.458
21.003	48.146	323.1	375	Circular	88.691	86.818	1.498	88.367	86.669	1.323
21.002	56.065	324.1	375	Circular	88.405	86.991	1.039	88.691	86.818	1.498
21.001	35.179	322.7	375	Circular	88.225	87.100	0.750	88.405	86.991	1.039
21.000	51.042	323.0	375	Circular	88.540	87.258	0.907	88.225	87.100	0.750
31.017	18.902	1020.0	600	Circular	86.440	84.520	1.320	85.570	84.501	0.469
31.016	5.899	536.2	600	Circular	86.440	84.631	1.209	86.440	84.620	1.220
31.015	11.460	477.5	600	Circular	86.850	84.655	1.595	86.440	84.631	1.209
31.014	20.609	572.5	450	Circular	86.950	84.691	1.809	86.850	84.655	1.745
37.004	26.698	342.3	375	Circular	86.930	84.822	1.733	86.850	84.744	1.731
37.003	49.639	406.9	375	Circular	87.021	84.944	1.702	86.930	84.822	1.733
37.002	64.636	323.2	300	Circular	87.247	85.144	1.803	87.021	84.944	1.777
40.001	74.807	169.6	225	Circular	87.075	85.619	1.231	87.021	85.178	1.618
40.000	26.496	169.8	225	Circular	87.200	85.775	1.200	87.075	85.619	1.231
38.001	67.475	244.5	300	Circular	87.147	85.420	1.427	87.247	85.144	1.803
37.001	73.376	169.9	225	Circular	87.736	86.272	1.239	87.247	85.840	1.182
37.000	51.420	169.7	225	Circular	88.000	86.575	1.200	87.736	86.272	1.239
38.000	43.565	169.5	225	Circular	87.352	85.677	1.450	87.147	85.420	1.502
39.000	6.921	168.8	225	Circular	87.171	86.115	0.831	87.147	86.074	0.848
31.013	14.958	575.3	450	Circular	87.000	84.717	1.833	86.950	84.691	1.809
31.012	33.595	579.2	450	Circular	87.231	84.775	2.006	87.000	84.717	1.833
31.011	55.310	350.1	400	Circular	86.901	84.933	1.568	87.231	84.775	2.056
36.004	42.767	100.0	225	Circular	87.676	86.319	1.132	87.231	85.891	1.115
36.003	14.574	100.0	225	Circular	87.954	86.465	1.264	87.676	86.319	1.132
36.002	11.007	100.0	225	Circular	88.162	86.575	1.362	87.954	86.465	1.264
36.001	14.673	100.0	225	Circular	88.383	86.722	1.436	88.162	86.575	1.362
36.000	30.135	169.3	225	Circular	88.558	86.900	1.433	88.383	86.722	1.436
31.010	29.020	349.6	400	Circular	86.850	85.016	1.434	86.901	84.933	1.568
31.009	19.192	348.9	400	Circular	87.260	85.071	1.789	86.850	85.016	1.434

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
22.002	22-2	1350	Manhole	Adoptable	22-3	1350	Manhole	Adoptable
24.000	24-0	1350	Manhole	Adoptable	22-3	1350	Manhole	Adoptable
22.001	22-1	1350	Manhole	Adoptable	22-2	1350	Manhole	Adoptable
23.000	23-0	1350	Manhole	Adoptable	22-2	1350	Manhole	Adoptable
22.000	22-0	1350	Manhole	Adoptable	22-1	1350	Manhole	Adoptable
21.004	21-4	1350	Manhole	Adoptable	21-5	1350	Manhole	Adoptable
21.003	21-3	1350	Manhole	Adoptable	21-4	1350	Manhole	Adoptable
21.002	21-2	1350	Manhole	Adoptable	21-3	1350	Manhole	Adoptable
21.001	21-1	1350	Manhole	Adoptable	21-2	1350	Manhole	Adoptable
21.000	21-0	1350	Manhole	Adoptable	21-1	1350	Manhole	Adoptable
31.017	PI 1	1500	Manhole	Adoptable	Outfall 1	1500	Manhole	Adoptable
31.016	31-17	2100	Manhole	Adoptable	PI 1	1500	Manhole	Adoptable
31.015	31-16	1500	Manhole	Adoptable	31-17	2100	Manhole	Adoptable
31.014	31-15	1350	Manhole	Adoptable	31-16	1500	Manhole	Adoptable
37.004	37-4	1350	Manhole	Adoptable	31-16	1500	Manhole	Adoptable
37.003	37-3	1350	Manhole	Adoptable	37-4	1350	Manhole	Adoptable
37.002	37-2	1200	Manhole	Adoptable	37-3	1350	Manhole	Adoptable
40.001	40-1	1200	Manhole	Adoptable	37-3	1350	Manhole	Adoptable
40.000	40-0	1200	Manhole	Adoptable	40-1	1200	Manhole	Adoptable
38.001	38-1	1200	Manhole	Adoptable	37-2	1200	Manhole	Adoptable
37.001	37-1	1200	Manhole	Adoptable	37-2	1200	Manhole	Adoptable
37.000	37-0	1200	Manhole	Adoptable	37-1	1200	Manhole	Adoptable
38.000	38-0	1200	Manhole	Adoptable	38-1	1200	Manhole	Adoptable
39.000	39-0	1200	Manhole	Adoptable	38-1	1200	Manhole	Adoptable
31.013	31-14	1350	Manhole	Adoptable	31-15	1350	Manhole	Adoptable
31.012	31-13	1350	Manhole	Adoptable	31-14	1350	Manhole	Adoptable
31.011	31-12	1350	Manhole	Adoptable	31-13	1350	Manhole	Adoptable
36.004	36-4	1200	Manhole	Adoptable	31-13	1350	Manhole	Adoptable
36.003	36-3	1200	Manhole	Adoptable	36-4	1200	Manhole	Adoptable
36.002	36-2	1200	Manhole	Adoptable	36-3	1200	Manhole	Adoptable
36.001	36-1	1200	Manhole	Adoptable	36-2	1200	Manhole	Adoptable
36.000	36-0	1200	Manhole	Adoptable	36-1	1200	Manhole	Adoptable
31.010	31-11	1350	Manhole	Adoptable	31-12	1350	Manhole	Adoptable
31.009	31-10	1800	Manhole	Adoptable	31-11	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
35.000	30.939	169.1	225	Circular	87.091	85.659	1.207	86.850	85.476	1.149
31.008	8.755	350.2	400	Circular	87.385	85.096	1.889	87.260	85.071	1.789
31.007	4.633	308.9	300	Circular	87.387	85.384	1.703	87.385	85.369	1.716
34.000	53.968	169.7	225	Circular	87.400	85.675	1.500	87.385	85.357	1.803
31.006	53.993	244.3	300	Circular	87.894	85.605	1.989	87.387	85.384	1.703
33.002	12.512	169.1	225	Circular	87.322	85.611	1.486	87.387	85.537	1.625
33.001	9.300	169.1	225	Circular	87.366	85.666	1.475	87.322	85.611	1.486
33.000	22.672	169.2	225	Circular	87.225	85.800	1.200	87.366	85.666	1.475
31.005	6.674	166.9	225	Circular	88.000	85.645	2.130	87.894	85.605	2.064
32.001	27.582	169.2	225	Circular	87.750	85.980	1.545	87.894	85.817	1.852
32.000	24.620	169.8	225	Circular	87.750	86.125	1.400	87.750	85.980	1.545
31.004	31.472	100.0	225	Circular	88.350	85.960	2.165	88.000	85.645	2.130
31.003	17.107	80.0	225	Circular	88.412	86.174	2.013	88.350	85.960	2.165
31.002	13.738	80.0	225	Circular	88.375	86.346	1.804	88.412	86.174	2.013
31.001	22.282	80.0	225	Circular	88.460	86.625	1.610	88.375	86.346	1.804
31.000	25.451	169.7	225	Circular	88.586	86.775	1.586	88.460	86.625	1.610
41.014	5.314	312.6	500	Circular	87.350	85.165	1.685	86.400	85.148	0.752
41.013	5.268	526.8	500	Circular	87.350	85.275	1.575	87.350	85.265	1.585
41.012	24.728	343.4	400	Circular	87.450	85.347	1.703	87.350	85.275	1.675
48.000	54.165	100.0	225	Circular	87.450	86.300	0.925	87.350	85.758	1.367
41.011	14.015	368.8	400	Circular	87.390	85.385	1.605	87.450	85.347	1.703
41.010	5.101	340.1	400	Circular	87.430	85.400	1.630	87.390	85.385	1.605
41.009	31.084	323.8	375	Circular	87.480	85.674	1.431	87.430	85.578	1.477
47.001	49.677	169.5	225	Circular	87.550	86.108	1.217	87.430	85.815	1.390
47.000	50.028	120.0	225	Circular	87.950	86.525	1.200	87.550	86.108	1.217
41.008	13.682	318.2	375	Circular	87.523	85.717	1.431	87.480	85.674	1.431
46.000	9.566	167.8	225	Circular	87.430	86.005	1.200	87.480	85.948	1.307
41.007	5.218	248.5	375	Circular	87.523	85.738	1.410	87.523	85.717	1.431
41.006	52.111	323.7	375	Circular	87.897	85.899	1.623	87.523	85.738	1.410
41.005	5.064	241.1	375	Circular	87.879	85.920	1.584	87.897	85.899	1.623
41.004	45.028	323.9	375	Circular	88.226	86.059	1.792	87.879	85.920	1.584
45.000	36.295	169.6	225	Circular	87.573	86.412	0.936	87.879	86.198	1.456
41.003	32.932	243.9	300	Circular	87.500	86.194	1.006	88.226	86.059	1.867
42.002	17.507	243.1	300	Circular	88.148	86.399	1.449	88.226	86.327	1.599

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
35.000	35-0	1200	Manhole	Adoptable	31-11	1350	Manhole	Adoptable
31.008	31-9	1350	Manhole	Adoptable	31-10	1800	Manhole	Adoptable
31.007	31-8	1200	Manhole	Adoptable	31-9	1350	Manhole	Adoptable
34.000	33-0	1200	Manhole	Adoptable	31-9	1350	Manhole	Adoptable
31.006	31-7	1200	Manhole	Adoptable	31-8	1200	Manhole	Adoptable
33.002	34-2	1200	Manhole	Adoptable	31-8	1200	Manhole	Adoptable
33.001	34-1	1200	Manhole	Adoptable	34-2	1200	Manhole	Adoptable
33.000	34-0	1200	Manhole	Adoptable	34-1	1200	Manhole	Adoptable
31.005	31-6	1200	Manhole	Adoptable	31-7	1200	Manhole	Adoptable
32.001	32-1	1200	Manhole	Adoptable	31-7	1200	Manhole	Adoptable
32.000	32-0	1200	Manhole	Adoptable	32-1	1200	Manhole	Adoptable
31.004	31-5	1200	Manhole	Adoptable	31-6	1200	Manhole	Adoptable
31.003	31-4	1200	Manhole	Adoptable	31-5	1200	Manhole	Adoptable
31.002	31-2	1200	Manhole	Adoptable	31-4	1200	Manhole	Adoptable
31.001	31-1	1200	Manhole	Adoptable	31-2	1200	Manhole	Adoptable
31.000	31-0	1200	Manhole	Adoptable	31-1	1200	Manhole	Adoptable
41.014	PI 5	1500	Manhole	Adoptable	Outfall 5	1500	Manhole	Adoptable
41.013	41-13	1800	Manhole	Adoptable	PI 5	1500	Manhole	Adoptable
41.012	41-12	1800	Manhole	Adoptable	41-13	1800	Manhole	Adoptable
48.000	48-0	1200	Manhole	Adoptable	41-13	1800	Manhole	Adoptable
41.011	41-11	1350	Manhole	Adoptable	41-12	1800	Manhole	Adoptable
41.010	41-10	1350	Manhole	Adoptable	41-11	1350	Manhole	Adoptable
41.009	41-9	1350	Manhole	Adoptable	41-10	1350	Manhole	Adoptable
47.001	47-1	1200	Manhole	Adoptable	41-10	1350	Manhole	Adoptable
47.000	47-0	1200	Manhole	Adoptable	47-1	1200	Manhole	Adoptable
41.008	41-8	1350	Manhole	Adoptable	41-9	1350	Manhole	Adoptable
46.000	46-0	1200	Manhole	Adoptable	41-9	1350	Manhole	Adoptable
41.007	41-7	1350	Manhole	Adoptable	41-8	1350	Manhole	Adoptable
41.006	41-6	1350	Manhole	Adoptable	41-7	1350	Manhole	Adoptable
41.005	41-5	1350	Manhole	Adoptable	41-6	1350	Manhole	Adoptable
41.004	41-4	1350	Manhole	Adoptable	41-5	1350	Manhole	Adoptable
45.000	45-0	1200	Manhole	Adoptable	41-5	1350	Manhole	Adoptable
41.003	41-3	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable
42.002	42-2	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
44.000	16.241	169.2	225	Circular	88.248	86.423	1.600	88.226	86.327	1.674
42.001	30.162	243.2	300	Circular	87.996	86.523	1.173	88.148	86.399	1.449
43.000	11.712	169.7	225	Circular	88.018	86.593	1.200	88.148	86.524	1.399
42.000	12.458	244.3	300	Circular	87.868	86.574	0.994	87.996	86.523	1.173
41.002	49.058	244.1	300	Circular	87.800	86.395	1.105	87.500	86.194	1.006
41.001	45.904	244.2	300	Circular	88.250	86.583	1.367	87.800	86.395	1.105
41.000	28.592	244.4	300	Circular	88.250	86.700	1.250	88.250	86.583	1.367
49.006	4.546	454.6	450	Circular	87.100	85.620	1.030	86.501	85.610	0.441
49.005	18.999	327.6	400	Circular	88.100	85.821	1.879	87.100	85.763	0.937
49.004	82.625	456.5	400	Circular	88.427	86.002	2.025	88.100	85.821	1.879
49.003	63.994	323.2	400	Circular	88.831	86.200	2.231	88.427	86.002	2.025
49.002	27.221	80.0	225	Circular	89.346	87.200	1.921	88.831	86.860	1.746
49.001	36.427	80.0	225	Circular	90.205	88.000	1.980	89.346	87.545	1.576
49.000	45.692	80.0	225	Circular	91.041	88.900	1.916	90.205	88.329	1.651
50.006	5.797	263.5	450	Circular	87.889	85.526	1.913	86.490	85.504	0.536
50.005	24.841	460.0	450	Circular	87.899	85.680	1.769	87.889	85.626	1.813
50.004	35.824	720.0	450	Circular	87.734	85.730	1.554	87.899	85.680	1.769
50.003	34.665	500.0	375	Circular	87.547	85.799	1.373	87.734	85.730	1.629
50.002	53.673	500.0	375	Circular	87.245	85.906	0.964	87.547	85.799	1.373
50.001	20.216	320.9	375	Circular	87.191	85.969	0.847	87.245	85.906	0.964
50.000	72.790	323.5	375	Circular	87.806	86.194	1.237	87.191	85.969	0.847

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
44.000	44-0	1200	Manhole	Adoptable	41-4	1350	Manhole	Adoptable
42.001	42-1	1200	Manhole	Adoptable	42-2	1200	Manhole	Adoptable
43.000	43-0	1200	Manhole	Adoptable	42-2	1200	Manhole	Adoptable
42.000	42-0	1200	Manhole	Adoptable	42-1	1200	Manhole	Adoptable
41.002	41-2	1200	Manhole	Adoptable	41-3	1200	Manhole	Adoptable
41.001	41-1	1200	Manhole	Adoptable	41-2	1200	Manhole	Adoptable
41.000	41-0	1200	Manhole	Adoptable	41-1	1200	Manhole	Adoptable
49.006	PI 2	1350	Manhole	Adoptable	Outfall 2	1350	Manhole	Adoptable
49.005	50-5	1350	Manhole	Adoptable	PI 2	1350	Manhole	Adoptable
49.004	50-4	1350	Manhole	Adoptable	50-5	1350	Manhole	Adoptable
49.003	50-3	1350	Manhole	Adoptable	50-4	1350	Manhole	Adoptable
49.002	50-2	1200	Manhole	Adoptable	50-3	1350	Manhole	Adoptable
49.001	50-1	1200	Manhole	Adoptable	50-2	1200	Manhole	Adoptable
49.000	50-0	1200	Manhole	Adoptable	50-1	1200	Manhole	Adoptable
50.006	PI 6	1350	Manhole	Adoptable	Outfall 6	1350	Manhole	Adoptable
50.005	49-5	1350	Manhole	Adoptable	PI 6	1350	Manhole	Adoptable
50.004	49-4	1350	Manhole	Adoptable	49-5	1350	Manhole	Adoptable
50.003	49-3	1350	Manhole	Adoptable	49-4	1350	Manhole	Adoptable
50.002	49-2	1350	Manhole	Adoptable	49-3	1350	Manhole	Adoptable
50.001	49-1	1350	Manhole	Adoptable	49-2	1350	Manhole	Adoptable
50.000	49-0	1350	Manhole	Adoptable	49-1	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-0	681728.297	714559.265	88.550	1.550	1350	0	1.000	87.000	375
1-1	681727.082	714579.948	88.200	1.264	1350	1	1.000	86.936	375
						0	1.001	86.936	375
1-2	681729.935	714618.237	88.200	1.383	1350	1	1.001	86.817	375
						0	1.002	86.817	375
1-3	681724.880	714650.182	88.150	1.433	1350	1	1.002	86.717	375
						0	1.003	86.717	375
1-4	681726.157	714667.886	88.050	1.388	1350	1	1.003	86.662	375
						0	1.004	86.662	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-5	681706.946	714704.913	88.201	1.668	1350	1	1.004	86.533	375
						0	1.005	86.533	375
2-0	681654.345	714711.728	88.588	1.425	1200				
						0	2.000	87.163	225
1-6	681668.442	714684.340	88.523	2.077	1350	1	2.000	86.981	225
							2	1.005	86.446	375
						0	1.006	86.446	375
1-7	681613.809	714655.342	88.681	2.358	1350	1	1.006	86.323	375
						0	1.007	86.323	375
1-8	681573.837	714634.246	88.553	2.320	1350	1	1.007	86.233	375
						0	1.008	86.233	375
1-9	681516.849	714604.369	88.321	2.216	1350	1	1.008	86.105	375
						0	1.009	86.105	400
1-10	681489.411	714611.148	88.495	2.437	1350	1	1.009	86.058	400
						0	1.010	86.058	400
1-11	681465.859	714652.863	88.016	2.095	1800	1	1.010	85.921	400
						0	1.011	85.921	400
3-0	681495.121	714623.928	88.471	1.680	1200				
						0	3.000	86.791	225
1-12	681476.088	714659.384	88.157	2.256	1350	1	3.000	86.554	225
							2	1.011	85.901	400
						0	1.012	85.901	450
4-0	681714.921	714722.862	88.200	1.115	1200				
						0	4.000	87.085	255
4-1	681700.576	714747.663	88.200	1.259	1200	1	4.000	86.941	255
						0	4.001	86.941	255
4-2	681696.983	714746.664	88.200	1.278	1200	1	4.001	86.922	255
						0	4.002	86.922	255
4-3	681679.139	714777.631	88.321	1.579	1200	1	4.002	86.742	255
						0	4.003	86.742	255
5-0	681687.188	714707.538	88.100	0.975	1200				
						0	5.000	87.125	225
5-1	681674.194	714731.842	88.000	1.038	1200	1	5.000	86.962	225
						0	5.001	86.962	225
4-4	681656.262	714765.409	88.227	1.616	1200	1	5.001	86.737	225
							2	4.003	86.611	255
						0	4.004	86.611	255

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
4-5	681631.788	714752.351	88.128	1.657	1200	1	4.004	86.471	255
						0	4.005	86.471	255
4-6	681629.584	714756.232	88.062	1.614	1200	1	4.005	86.448	255
						0	4.006	86.448	255
4-7	681618.718	714752.021	87.821	1.432	1200	1	4.006	86.389	255
						0	4.007	86.389	255
6-0	681651.744	714821.450	87.900	1.029	1200	0	6.000	86.871	225
6-1	681635.217	714852.261	88.070	1.405	1200	1	6.000	86.665	225
						0	6.001	86.665	225
6-2	681600.572	714833.783	88.000	1.567	1200	1	6.001	86.433	225
						0	6.002	86.433	225
6-3	681613.963	714808.759	87.930	1.665	1200	1	6.002	86.265	225
						0	6.003	86.265	225
4-8	681593.233	714797.616	87.727	1.601	1350	1	6.003	86.126	225
						2	4.007	86.126	255
						0	4.008	86.126	375
7-0	681598.010	714732.199	88.100	1.525	1200	0	7.000	86.575	225
4-9	681569.162	714784.678	87.721	1.680	1350	1	7.000	86.222	225
						2	4.008	86.041	375
						0	4.009	86.041	375
8-0	681578.569	714821.954	87.700	1.410	1200	0	8.000	86.290	225
9-0	681499.419	714779.633	87.700	1.301	1200	0	9.000	86.399	225
8-1	681538.921	714800.785	87.400	1.280	1200	1	9.000	86.229	225
						2	8.000	86.120	225
						0	8.001	86.120	300
4-10	681552.322	714775.627	87.822	1.819	1350	1	8.001	86.003	300
						2	4.009	86.003	375
						0	4.010	86.003	400
10-0	681456.887	714742.982	87.635	0.874	1200	0	10.000	86.761	225
10-1	681464.184	714728.460	87.816	1.151	1200	1	10.000	86.665	225
						0	10.001	86.665	225
11-0	681470.270	714761.709	87.700	1.175	1200	0	11.000	86.525	225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
11-1	681481.748	714767.493	87.700	1.251	1200	1	11.000	86.449	225
						0	11.001	86.449	225
10-2	681494.310	714744.490	87.700	1.406	1200	1	11.001	86.294	225
						2	10.001	86.464	225
						0	10.002	86.294	225
12-0	681518.601	714738.418	87.588	1.425	1200				
						0	12.000	86.163	225
10-3	681511.067	714753.407	87.724	1.625	1200	1	12.000	86.099	225
						2	10.002	86.182	225
						0	10.003	86.099	225
4-11	681527.859	714762.478	87.850	1.898	1500	1	10.003	86.027	225
						2	4.010	85.952	400
						0	4.011	85.952	500
4-12	681530.789	714757.146	87.850	1.906	1500	1	4.011	85.944	500
						0	4.012	85.944	500
13-0	681570.228	714744.973	87.600	1.425	1200				
						0	13.000	86.175	225
4-13	681544.032	714731.413	87.400	1.496	1500	1	13.000	86.001	225
						2	4.012	85.904	500
						0	4.013	85.904	500
4-14	681526.924	714722.557	87.500	1.623	1500	1	4.013	85.877	500
						0	4.014	85.877	600
14-0	681632.181	714739.287	88.142	1.989	1200				
						0	14.000	86.153	300
14-1	681586.068	714714.847	87.334	1.318	1200	1	14.000	86.016	300
						0	14.001	86.016	300
15-0	681560.301	714658.807	88.094	1.825	1200				
						0	15.000	86.269	225
14-2	681542.637	714691.750	87.521	1.634	1350	1	15.000	86.048	225
						2	14.001	85.887	300
						0	14.002	85.887	375
4-15	681536.496	714703.253	87.418	1.565	1500	1	14.002	85.861	375
						2	4.014	85.853	600
						0	4.015	85.853	600
16-0	681524.006	714656.720	88.000	1.425	1200				
						0	16.000	86.575	225
17-0	681491.700	714717.223	87.625	1.425	1200				
						0	17.000	86.200	225
4-16	681507.377	714687.844	87.823	2.006	1500	1	17.000	86.003	225
						2	16.000	86.367	225
						3	4.015	85.817	600
						0	4.016	85.817	600

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1-13	681471.112	714668.653	88.078	2.301	1500	1	4.016	85.777	600
						2	1.012	85.884	450
						0	1.013	85.777	600
18-0	681422.878	714707.549	87.800	1.375	1200	0	18.000	86.425	225
19-0	681367.542	714630.246	88.150	1.425	1200	0	19.000	86.725	225
19-1	681380.523	714649.147	87.600	1.010	1200	1	19.000	86.590	225
						0	19.001	86.590	225
18-1	681392.936	714654.934	87.750	1.682	1200	1	19.001	86.509	225
						2	18.000	86.068	225
						0	18.001	86.068	300
20-0	681458.635	714610.046	87.550	1.306	1200	0	20.000	86.244	225
18-2	681419.839	714638.804	87.900	1.961	1350	1	20.000	85.959	225
						2	18.001	85.939	300
						0	18.002	85.939	375
18-3	681442.714	714678.477	87.724	1.927	1350	1	18.002	85.797	375
						0	18.003	85.797	375
18-4	681452.487	714687.900	87.871	2.101	1350	1	18.003	85.770	375
						0	18.004	85.770	375
1-14	681458.950	714691.294	87.871	2.119	1500	1	18.004	85.756	375
						2	1.013	85.752	600
						0	1.014	85.752	600
1-15	681452.167	714703.160	87.781	2.042	1500	1	1.014	85.739	600
						0	1.015	85.739	600
1-16	681431.016	714720.912	87.570	1.858	2100	1	1.015	85.712	600
						0	1.016	85.712	600
PI 4	681413.439	714734.297	87.100	1.516	1500	1	1.016	85.684	600
						0	1.017	85.584	600
Outfall 4	681407.762	714738.679	86.490	0.917	1500	1	1.017	85.573	600
21-0	681732.623	714543.018	88.540	1.282	1350	0	21.000	87.258	375
21-1	681683.674	714528.552	88.225	1.125	1350	1	21.000	87.100	375
						0	21.001	87.100	375
21-2	681649.964	714518.491	88.405	1.414	1350	1	21.001	86.991	375
						0	21.002	86.991	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
21-3	681596.221	714502.522	88.691	1.873	1350	1	21.002	86.818	375
						0	21.003	86.818	375
21-4	681550.069	714488.810	88.367	1.698	1350	1	21.003	86.669	375
						0	21.004	86.669	400
21-5	681538.872	714510.770	88.456	1.858	1350	1	21.004	86.598	400
						0	21.005	86.598	400
22-0	681680.587	714541.754	88.245	1.150	1350				
						0	22.000	87.095	400
22-1	681676.628	714555.083	88.298	1.243	1350	1	22.000	87.055	400
						0	22.001	87.055	400
23-0	681708.590	714630.655	88.357	1.196	1350				
						0	23.000	87.161	375
22-2	681652.175	714600.736	88.564	1.657	1350	1	23.000	86.964	375
						2	22.001	86.907	400
						0	22.002	86.907	400
24-0	681619.602	714645.364	88.655	1.555	1350				
						0	24.000	87.100	400
22-3	681644.994	714598.737	88.563	1.678	1350	1	24.000	86.949	400
						2	22.002	86.885	400
						0	22.003	86.885	400
22-4	681604.492	714576.263	89.151	2.398	1350	1	22.003	86.753	400
						0	22.004	86.753	400
25-0	681578.956	714511.950	88.704	1.425	1200				
						0	25.000	87.279	225
25-1	681570.824	714540.652	88.700	1.597	1200	1	25.000	87.103	225
						0	25.001	87.103	225
22-5	681561.371	714552.096	88.931	2.319	1350	1	25.001	87.015	225
						2	22.004	86.612	400
						0	22.005	86.612	400
26-0	681520.981	714587.351	88.550	1.425	1200				
						0	26.000	87.125	225
26-1	681529.224	714571.926	88.550	1.528	1200	1	26.000	87.022	225
						0	26.001	87.022	225
22-6	681548.127	714544.673	88.890	2.316	1350	1	26.001	86.826	225
						2	22.005	86.574	400
						0	22.006	86.574	400
22-7	681533.514	714533.960	88.500	1.971	1350	1	22.006	86.529	400
						0	22.007	86.529	400

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
21-6	681527.948	714530.232	88.369	1.857	1500	1	22.007	86.512	400
						2	21.005	86.534	400
						0	21.006	86.512	500
21-7	681498.591	714572.945	88.161	1.761	1500	1	21.006	86.400	500
						0	21.007	86.400	500
21-8	681494.806	714586.463	88.218	1.843	1500	1	21.007	86.375	500
						0	21.008	86.375	500
21-9	681479.812	714583.385	88.083	1.735	1500	1	21.008	86.348	500
						0	21.009	86.348	500
21-10	681440.788	714563.200	87.929	1.657	1500	1	21.009	86.272	500
						0	21.010	86.272	500
27-0	681350.118	714601.420	88.114	1.792	1500	0	27.000	86.322	600
27-1	681391.219	714575.945	87.900	1.625	1500	1	27.000	86.275	600
						0	27.001	86.275	600
28-0	681472.874	714484.377	88.108	1.630	1350	0	28.000	86.478	375
28-1	681446.895	714523.359	87.846	1.513	1350	1	28.000	86.333	375
						0	28.001	86.333	375
21-11	681424.130	714546.888	88.117	1.885	1500	1	28.001	86.232	375
						2	27.001	86.232	600
						3	21.010	86.232	500
						0	21.011	86.232	600
29-0	681529.152	714477.102	88.510	1.125	1200	0	29.000	87.385	225
29-1	681493.847	714463.154	88.500	1.339	1200	1	29.000	87.161	225
						0	29.001	87.161	225
29-2	681481.690	714464.705	88.289	1.201	1200	1	29.001	87.088	225
						0	29.002	87.088	225
29-3	681435.452	714440.649	88.782	2.002	1200	1	29.002	86.780	225
						0	29.003	86.780	225
29-4	681420.740	714447.405	88.880	2.196	1200	1	29.003	86.684	225
						0	29.004	86.684	225
29-5	681401.736	714473.443	88.851	2.364	1200	1	29.004	86.487	225
						0	29.005	86.487	225
21-12	681378.428	714500.325	88.730	2.561	1500	1	29.005	86.277	225
						2	21.011	86.169	600
						0	21.012	86.169	600

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
30-0	681336.824	714583.857	88.750	1.425	1200	0	30.000	87.325	225
30-1	681318.656	714552.623	88.700	1.638	1200	1	30.000	87.062	225
						0	30.001	87.062	225
30-2	681338.498	714532.780	88.800	1.904	1200	1	30.001	86.896	225
						0	30.002	86.896	225
21-13	681354.275	714520.630	88.850	2.712	1500	1	30.002	86.778	225
						2	21.012	86.138	600
						0	21.013	86.138	600
21-14	681331.006	714494.008	88.070	1.966	1500	1	21.013	86.104	600
						0	21.014	86.104	600
PI 3	681328.921	714490.869	88.070	2.073	1500	1	21.014	86.097	600
						0	21.015	85.997	600
Outfall 3	681310.005	714462.485	87.300	1.362	1500	1	21.015	85.938	600
31-0	681241.100	714577.004	88.586	1.811	1200	0	31.000	86.775	225
31-1	681266.075	714572.105	88.460	1.835	1200	1	31.000	86.625	225
						0	31.001	86.625	225
31-2	681288.357	714572.144	88.375	2.029	1200	1	31.001	86.346	225
						0	31.002	86.346	225
31-4	681300.880	714577.792	88.412	2.238	1200	1	31.002	86.174	225
						0	31.003	86.174	225
31-5	681310.328	714592.053	88.350	2.390	1200	1	31.003	85.960	225
						0	31.004	85.960	225
31-6	681328.209	714617.952	88.000	2.355	1200	1	31.004	85.645	225
						0	31.005	85.645	225
32-0	681351.362	714665.315	87.750	1.625	1200	0	32.000	86.125	225
32-1	681337.837	714644.743	87.750	1.770	1200	1	32.000	85.980	225
						0	32.001	85.980	225
31-7	681322.684	714621.696	87.894	2.289	1200	1	32.001	85.817	225
						2	31.005	85.605	225
						0	31.006	85.605	300
34-0	681241.403	714640.836	87.225	1.425	1200	0	33.000	85.800	225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
34-1	681263.636	714636.398	87.366	1.700	1200	1	33.000	85.666	225
						0	33.001	85.666	225
34-2	681271.591	714641.215	87.322	1.711	1200	1	33.001	85.611	225
						0	33.002	85.611	225
31-8	681277.979	714651.973	87.387	2.003	1200	1	33.002	85.537	225
						2	31.006	85.384	300
						0	31.007	85.384	300
33-0	681304.110	714699.473	87.400	1.725	1200				
						0	34.000	85.675	225
31-9	681274.152	714654.584	87.385	2.289	1350	1	34.000	85.357	225
						2	31.007	85.369	300
						0	31.008	85.096	400
31-10	681266.162	714658.164	87.260	2.189	1800	1	31.008	85.071	400
						0	31.009	85.071	400
35-0	681280.289	714692.365	87.091	1.432	1200				
						0	35.000	85.659	225
31-11	681255.367	714674.032	86.850	1.834	1350	1	35.000	85.476	225
						2	31.009	85.016	400
						0	31.010	85.016	400
31-12	681230.026	714659.891	86.901	1.968	1350	1	31.010	84.933	400
						0	31.011	84.933	400
36-0	681231.376	714579.073	88.558	1.658	1200				
						0	36.000	86.900	225
36-1	681201.801	714584.854	88.383	1.661	1200	1	36.000	86.722	225
						0	36.001	86.722	225
36-2	681188.714	714591.490	88.162	1.587	1200	1	36.001	86.575	225
						0	36.002	86.575	225
36-3	681182.045	714600.247	87.954	1.489	1200	1	36.002	86.465	225
						0	36.003	86.465	225
36-4	681178.035	714614.258	87.676	1.357	1200	1	36.003	86.319	225
						0	36.004	86.319	225
31-13	681174.797	714656.902	87.231	2.456	1350	1	36.004	85.891	225
						2	31.011	84.775	400
						0	31.012	84.775	450
31-14	681172.134	714690.391	87.000	2.283	1350	1	31.012	84.717	450
						0	31.013	84.717	450
31-15	681178.112	714704.102	86.950	2.259	1350	1	31.013	84.691	450
						0	31.014	84.691	450

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
37-0	681393.391	714716.054	88.000	1.425	1200	0	37.000	86.575	225
37-1	681364.767	714673.338	87.736	1.464	1200	1	37.000	86.272	225
						0	37.001	86.272	225
38-0	681384.526	714741.184	87.352	1.675	1200	0	38.000	85.677	225
39-0	681352.807	714770.696	87.171	1.056	1200	0	39.000	86.115	225
38-1	681348.326	714765.422	87.147	1.727	1200	1	39.000	86.074	225
						2	38.000	85.420	225
						0	38.001	85.420	300
37-2	681304.036	714714.518	87.247	2.103	1200	1	38.001	85.144	300
						2	37.001	85.840	225
						0	37.002	85.144	300
40-0	681328.813	714803.744	87.200	1.425	1200	0	40.000	85.775	225
40-1	681305.668	714816.641	87.075	1.456	1200	1	40.000	85.619	225
						0	40.001	85.619	225
37-3	681257.516	714759.392	87.021	2.077	1350	1	40.001	85.178	225
						2	37.002	84.944	300
						0	37.003	84.944	375
37-4	681218.378	714728.860	86.930	2.108	1350	1	37.003	84.822	375
						0	37.004	84.822	375
31-16	681195.150	714715.697	86.850	2.195	1500	1	37.004	84.744	375
						2	31.014	84.655	450
						0	31.015	84.655	600
31-17	681189.329	714725.568	86.440	1.809	2100	1	31.015	84.631	600
						0	31.016	84.631	600
PI 1	681186.333	714730.649	86.440	1.920	1500	1	31.016	84.620	600
						0	31.017	84.520	600
Outfall 1	681181.220	714748.846	85.570	1.069	1500	1	31.017	84.501	600
41-0	681603.924	714908.556	88.250	1.550	1200	0	41.000	86.700	300
41-1	681618.947	714884.229	88.250	1.667	1200	1	41.000	86.583	300
						0	41.001	86.583	300
41-2	681580.497	714859.153	87.800	1.405	1200	1	41.001	86.395	300
						0	41.002	86.395	300

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
41-3	681539.046	714832.914	87.500	1.306	1200	1	41.002	86.194	300
						0	41.003	86.194	300
42-0	681554.612	714897.046	87.868	1.294	1200	0	42.000	86.574	300
42-1	681561.361	714886.575	87.996	1.473	1200	1	42.000	86.523	300
						0	42.001	86.523	300
43-0	681529.669	714880.070	88.018	1.425	1200	0	43.000	86.593	225
42-2	681536.014	714870.226	88.148	1.749	1200	1	43.000	86.524	225
						2	42.001	86.399	300
						0	42.002	86.399	300
44-0	681512.910	714874.563	88.248	1.825	1200	0	44.000	86.423	225
41-4	681521.339	714860.680	88.226	2.167	1350	1	44.000	86.327	225
						2	42.002	86.327	300
						3	41.003	86.059	300
						0	41.004	86.059	375
45-0	681450.416	714820.912	87.573	1.161	1200	0	45.000	86.412	225
41-5	681482.391	714838.085	87.879	1.959	1350	1	45.000	86.198	225
						2	41.004	85.920	375
						0	41.005	85.920	375
41-6	681480.058	714842.579	87.897	1.998	1350	1	41.005	85.899	375
						0	41.006	85.899	375
41-7	681434.036	714818.133	87.523	1.785	1350	1	41.006	85.738	375
						0	41.007	85.738	375
41-8	681436.400	714813.481	87.523	1.806	1350	1	41.007	85.717	375
						0	41.008	85.717	375
46-0	681419.932	714815.536	87.430	1.425	1200	0	46.000	86.005	225
41-9	681424.329	714807.040	87.480	1.806	1350	1	46.000	85.948	225
						2	41.008	85.674	375
						0	41.009	85.674	375
47-0	681526.464	714826.290	87.950	1.425	1200	0	47.000	86.525	225
47-1	681482.339	714802.714	87.550	1.442	1200	1	47.000	86.108	225
						0	47.001	86.108	225
41-10	681438.489	714779.369	87.430	2.030	1350	1	47.001	85.815	225
						2	41.009	85.578	375
						0	41.010	85.400	400

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
41-11	681441.127	714775.003	87.390	2.005	1350	1	41.010	85.385	400
						0	41.011	85.385	400
41-12	681437.310	714761.518	87.450	2.103	1800	1	41.011	85.347	400
						0	41.012	85.347	400
48-0	681389.971	714797.634	87.450	1.150	1200	0	48.000	86.300	225
41-13	681415.501	714749.863	87.350	2.075	1800	1	48.000	85.758	225
						2	41.012	85.275	400
						0	41.013	85.275	500
PI 5	681410.913	714747.274	87.350	2.185	1500	1	41.013	85.265	500
						0	41.014	85.165	500
Outfall 5	681406.210	714744.800	86.400	1.252	1500	1	41.014	85.148	500
50-0	681272.880	714510.934	91.041	2.141	1200	0	49.000	88.900	225
50-1	681305.334	714543.097	90.205	2.205	1200	1	49.000	88.329	225
						0	49.001	88.000	225
50-2	681326.122	714573.010	89.346	2.146	1200	1	49.001	87.545	225
						0	49.002	87.200	225
50-3	681341.206	714595.670	88.831	2.631	1350	1	49.002	86.860	225
						0	49.003	86.200	400
50-4	681376.057	714649.341	88.427	2.425	1350	1	49.003	86.002	400
						0	49.004	86.002	400
50-5	681423.923	714716.689	88.100	2.279	1350	1	49.004	85.821	400
						0	49.005	85.821	400
PI 2	681408.828	714728.225	87.100	1.480	1350	1	49.005	85.763	400
						0	49.006	85.620	450
Outfall 2	681405.225	714730.997	86.501	0.891	1350	1	49.006	85.610	450
49-0	681617.771	714850.092	87.806	1.612	1350	0	50.000	86.194	375
49-1	681553.609	714815.717	87.191	1.222	1350	1	50.000	85.969	375
						0	50.001	85.969	375
49-2	681537.854	714803.050	87.245	1.339	1350	1	50.001	85.906	375
						0	50.002	85.906	375

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
49-3	681490.130	714778.489	87.547	1.748	1350	1	50.002	85.799	375
						0	50.003	85.799	375
49-4	681460.413	714760.641	87.734	2.004	1350	1	50.003	85.730	375
						0	50.004	85.730	450
49-5	681437.601	714733.019	87.899	2.219	1350	1	50.004	85.680	450
						0	50.005	85.680	450
PI 6	681413.647	714739.599	87.889	2.363	1350	1	50.005	85.626	450
						0	50.006	85.526	450
Outfall 6	681408.322	714741.891	86.490	0.986	1350	1	50.006	85.504	450

Simulation Settings

Rainfall Methodology	FSR	Summer CV	0.750	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Winter CV	0.840	Additional Storage (m³/ha)	20.0
M5-60 (mm)	15.600	Analysis Speed	Normal	Check Discharge Rate(s)	x
Ratio-R	0.286	Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
5	20	0	0

Node 21-14 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	86.104	Product Number	CTL-SHE-0093-4000-1143-4000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.0	Min Node Diameter (mm)	1200

Node 31-17 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	84.631	Product Number	CTL-SHE-0143-9900-1143-9900
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	9.9	Min Node Diameter (mm)	1200

Node 50-5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.821	Product Number	CTL-SHE-0065-2000-1143-2000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 1-11 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.921	Product Number	CTL-SHE-0173-1500-1143-1500
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	15.0	Min Node Diameter (mm)	1500

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Node 41-13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.275	Product Number	CTL-SHE-0193-2100-1661-2100
Design Depth (m)	1.661	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	21.0	Min Node Diameter (mm)	1800

Node 1-16 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	85.712	Product Number	CTL-SHE-0250-3740-1800-3740
Design Depth (m)	1.800	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	37.4	Min Node Diameter (mm)	1800

Node 49-5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	85.680	Product Number	CTL-SHE-0065-2000-1143-2000
Design Depth (m)	1.143	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 21-14 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	86.104
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	2120.0	0.0	1.143	2120.0	0.0	1.144	0.0	0.0

Node 31-17 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	84.631
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	540.0	0.0	1.143	540.0	0.0	1.144	0.0	0.0

Node 41-7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.738
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.89	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	350.0	0.0	1.143	350.0	0.0	1.144	0.0	0.0

Node 31-10 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.071
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.90	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	500.0	0.0	1.143	500.0	0.0	1.144	0.0	0.0

Node 4-12 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.944
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.89	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	680.0	0.0	1.143	680.0	0.0	1.144	0.0	0.0

Node 1-11 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.921
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.91	Time to half empty (mins)	0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	655.0	0.0	1.143	655.0	0.0	1.144	0.0	0.0

Node 49-3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.799
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.87	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	150.0	0.0	1.143	150.0	0.0	1.144	0.0	0.0

Node 50-5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	85.821
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.87	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	183.0	0.0	1.143	183.0	0.0	1.144	0.0	0.0

Node 22-7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	10.0	Invert Level (m)	86.529
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.88	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	360.0	0.0	1.143	360.0	0.0	1.144	0.0	0.0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 86.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1-0	10	87.037	0.037	2.4	0.0586	0.0000	OK
15 minute winter	1-1	11	86.999	0.063	7.3	0.1152	0.0000	OK
15 minute winter	1-2	11	86.902	0.085	13.0	0.1603	0.0000	OK
15 minute winter	1-3	13	86.878	0.161	22.7	0.2860	0.0000	OK
15 minute winter	1-4	13	86.849	0.187	25.7	0.3000	0.0000	OK
15 minute winter	1-5	12	86.880	0.347	33.4	0.6710	0.0000	OK
15 minute winter	2-0	11	87.200	0.037	2.4	0.0475	0.0000	OK
15 minute summer	1-6	12	86.811	0.365	55.3	1.1191	0.0000	OK
15 minute summer	1-7	11	86.820	0.497	72.9	1.4311	0.0000	SURCHARGED
15 minute winter	1-8	11	86.812	0.579	90.6	1.4918	0.0000	SURCHARGED
15 minute winter	1-9	11	86.758	0.653	110.2	2.0066	0.0000	SURCHARGED
15 minute summer	1-10	11	86.672	0.614	111.2	1.1567	0.0000	SURCHARGED
600 minute winter	1-11	465	86.383	0.462	22.3	276.4980	0.0000	SURCHARGED
15 minute winter	3-0	11	86.829	0.038	2.6	0.0486	0.0000	OK
240 minute winter	1-12	176	86.393	0.492	11.3	1.1442	0.0000	SURCHARGED
15 minute summer	4-0	1	87.085	0.000	0.0	0.0000	0.0000	OK
15 minute winter	4-1	11	87.000	0.059	5.5	0.0937	0.0000	OK
15 minute winter	4-2	11	86.977	0.055	5.3	0.0621	0.0000	OK
15 minute winter	4-3	12	86.965	0.223	19.3	0.3334	0.0000	OK
15 minute summer	5-0	1	87.125	0.000	0.0	0.0000	0.0000	OK
15 minute winter	5-1	11	87.031	0.069	8.5	0.1347	0.0000	OK
15 minute winter	4-4	13	86.958	0.347	32.8	0.7183	0.0000	SURCHARGED
15 minute winter	4-5	13	86.920	0.449	34.2	0.7245	0.0000	SURCHARGED
15 minute winter	4-6	13	86.903	0.455	37.1	0.5151	0.0000	SURCHARGED
15 minute winter	4-7	13	86.871	0.482	41.4	0.9902	0.0000	SURCHARGED
15 minute winter	6-0	10	86.918	0.047	4.0	0.0712	0.0000	OK
15 minute winter	6-1	12	86.913	0.248	18.6	0.4222	0.0000	SURCHARGED
15 minute winter	6-2	12	86.877	0.444	18.1	0.6208	0.0000	SURCHARGED
15 minute winter	6-3	12	86.835	0.570	35.6	1.3164	0.0000	SURCHARGED
15 minute winter	4-8	11	86.803	0.677	87.9	2.0862	0.0000	SURCHARGED
15 minute winter	7-0	12	86.756	0.181	16.7	0.2043	0.0000	OK
15 minute winter	4-9	11	86.752	0.711	117.3	2.2884	0.0000	SURCHARGED
15 minute winter	8-0	11	86.809	0.519	19.4	0.5874	0.0000	SURCHARGED
15 minute summer	9-0	11	86.810	0.411	15.8	0.4643	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1-0	1.000	1-1	2.3	0.269	0.021	0.1838	
15 minute winter	1-1	1.001	1-2	7.0	0.458	0.063	0.5907	
15 minute winter	1-2	1.002	1-3	12.7	0.587	0.115	0.9933	
15 minute winter	1-3	1.003	1-4	20.8	0.695	0.188	0.8872	
15 minute winter	1-4	1.004	1-5	30.1	0.594	0.272	3.0266	
15 minute winter	1-5	1.005	1-6	43.0	0.520	0.486	4.5059	
15 minute winter	2-0	2.000	1-6	2.3	0.546	0.057	0.1278	
15 minute summer	1-6	1.006	1-7	62.0	0.645	0.701	6.7936	
15 minute summer	1-7	1.007	1-8	80.4	0.747	0.910	4.9851	
15 minute winter	1-8	1.008	1-9	94.7	0.881	1.072	7.0971	
15 minute winter	1-9	1.009	1-10	109.2	1.009	1.139	3.5382	
15 minute summer	1-10	1.010	1-11	123.6	2.073	0.981	3.0782	
600 minute winter	1-11	Hydro-Brake®	1-12	11.9				
15 minute winter	3-0	3.000	1-12	2.4	0.557	0.061	0.1752	
240 minute winter	1-12	1.012	1-13	11.4	0.270	0.089	1.6668	
15 minute summer	4-0	4.000	4-1	0.0	0.000	0.000	0.1253	
15 minute winter	4-1	4.001	4-2	5.3	0.634	0.103	0.0318	
15 minute winter	4-2	4.002	4-3	5.3	0.497	0.103	0.9811	
15 minute winter	4-3	4.003	4-4	14.1	0.449	0.276	1.2747	
15 minute summer	5-0	5.000	5-1	0.0	0.000	0.000	0.1381	
15 minute winter	5-1	5.001	4-4	8.2	0.771	0.206	0.9081	
15 minute winter	4-4	4.004	4-5	32.1	0.820	0.626	1.4164	
15 minute winter	4-5	4.005	4-6	37.1	0.875	0.718	0.2279	
15 minute winter	4-6	4.006	4-7	38.7	0.820	0.754	0.5950	
15 minute winter	4-7	4.007	4-8	44.0	0.897	0.860	2.6670	
15 minute winter	6-0	6.000	6-1	3.8	0.412	0.096	0.7929	
15 minute winter	6-1	6.001	6-2	16.4	0.751	0.412	1.5616	
15 minute winter	6-2	6.002	6-3	22.3	0.561	0.560	1.1288	
15 minute winter	6-3	6.003	4-8	33.5	0.844	0.842	0.9360	
15 minute winter	4-8	4.008	4-9	92.7	0.841	0.836	3.0142	
15 minute winter	7-0	7.000	4-9	-16.7	-0.475	-0.420	2.2138	
15 minute winter	4-9	4.009	4-10	130.4	1.183	1.476	2.1087	
15 minute winter	8-0	8.000	8-1	-19.4	-0.559	-0.609	1.7875	
15 minute summer	9-0	9.000	8-1	-15.8	-0.494	-0.497	1.7821	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 86.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	8-1	11	86.722	0.602	45.3	1.5745	0.0000	SURCHARGED
15 minute summer	4-10	11	86.693	0.690	154.5	1.3748	0.0000	SURCHARGED
15 minute winter	10-0	13	86.770	0.009	0.8	0.0105	0.0000	OK
15 minute winter	10-1	12	86.778	0.113	7.7	0.2036	0.0000	OK
15 minute winter	11-0	11	86.799	0.274	10.2	0.3101	0.0000	SURCHARGED
15 minute winter	11-1	11	86.795	0.346	18.9	0.5912	0.0000	SURCHARGED
15 minute winter	10-2	11	86.767	0.473	28.5	1.0406	0.0000	SURCHARGED
15 minute winter	12-0	11	86.706	0.543	6.5	0.6143	0.0000	SURCHARGED
15 minute winter	10-3	11	86.701	0.602	48.4	1.4512	0.0000	SURCHARGED
15 minute winter	4-11	10	86.623	0.671	229.4	1.9719	0.0000	SURCHARGED
240 minute winter	4-12	176	86.396	0.452	60.5	274.5162	0.0000	OK
240 minute winter	13-0	176	86.395	0.220	0.5	0.2494	0.0000	OK
240 minute winter	4-13	176	86.395	0.491	28.7	1.1447	0.0000	OK
240 minute winter	4-14	176	86.395	0.518	29.2	1.1639	0.0000	OK
240 minute winter	14-0	176	86.395	0.242	1.2	0.3390	0.0000	OK
240 minute winter	14-1	176	86.395	0.379	7.2	1.2503	0.0000	SURCHARGED
240 minute winter	15-0	176	86.395	0.126	0.5	0.1520	0.0000	OK
240 minute winter	14-2	176	86.395	0.508	15.7	2.1060	0.0000	SURCHARGED
240 minute winter	4-15	176	86.394	0.541	30.8	1.4824	0.0000	OK
15 minute summer	16-0	1	86.575	0.000	0.0	0.0000	0.0000	OK
240 minute winter	17-0	176	86.394	0.194	0.5	0.2192	0.0000	OK
240 minute winter	4-16	176	86.394	0.577	31.7	2.5256	0.0000	OK
240 minute winter	1-13	176	86.393	0.616	34.2	1.5325	0.0000	SURCHARGED
15 minute summer	18-0	1	86.425	0.000	0.0	0.0000	0.0000	OK
15 minute winter	19-0	10	86.778	0.053	5.0	0.0784	0.0000	OK
15 minute winter	19-1	11	86.664	0.074	8.9	0.1133	0.0000	OK
240 minute winter	18-1	176	86.393	0.325	5.4	0.6568	0.0000	SURCHARGED
15 minute winter	20-0	13	86.396	0.152	10.2	0.2285	0.0000	OK
240 minute winter	18-2	176	86.393	0.454	13.4	1.4728	0.0000	SURCHARGED
240 minute winter	18-3	176	86.392	0.595	16.7	1.4824	0.0000	SURCHARGED
240 minute winter	18-4	176	86.392	0.622	17.6	1.0620	0.0000	SURCHARGED
240 minute winter	1-14	176	86.392	0.640	36.3	1.5239	0.0000	SURCHARGED
240 minute winter	1-15	176	86.391	0.652	36.6	1.3573	0.0000	SURCHARGED
240 minute winter	1-16	176	86.390	0.678	37.3	2.7569	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	8-1	8.001	4-10	30.7	0.436	0.433	2.0073	
15 minute summer	4-10	4.010	4-11	157.8	1.261	1.567	3.4769	
15 minute winter	10-0	10.000	10-1	-0.8	-0.099	-0.021	0.1634	
15 minute winter	10-1	10.001	10-2	8.3	0.656	0.209	1.0172	
15 minute winter	11-0	11.000	11-1	-10.2	-0.444	-0.256	0.5112	
15 minute winter	11-1	11.001	10-2	14.2	0.387	0.356	1.0424	
15 minute winter	10-2	10.002	10-3	34.5	0.868	0.867	0.7549	
15 minute winter	12-0	12.000	10-3	-6.5	-0.286	-0.203	0.6672	
15 minute winter	10-3	10.003	4-11	53.1	1.336	1.671	0.7590	
15 minute winter	4-11	4.011	4-12	237.3	2.807	1.510	0.6096	
240 minute winter	4-12	4.012	4-13	28.5	-0.190	0.182	5.5141	
240 minute winter	13-0	13.000	4-13	-0.5	-0.028	-0.011	1.1699	
240 minute winter	4-13	4.013	4-14	29.2	0.166	0.186	3.7610	
240 minute winter	4-14	4.014	4-15	29.7	0.132	0.131	5.6694	
240 minute winter	14-0	14.000	14-1	1.1	0.128	0.019	3.4254	
240 minute winter	14-1	14.001	14-2	5.7	0.236	0.100	3.4640	
240 minute winter	15-0	15.000	14-2	0.3	0.248	0.008	1.1698	
240 minute winter	14-2	14.002	4-15	14.8	0.375	0.167	1.4383	
240 minute winter	4-15	4.015	4-16	31.4	0.266	0.139	8.9913	
15 minute summer	16-0	16.000	4-16	0.0	0.000	0.000	0.0000	
240 minute winter	17-0	17.000	4-16	-0.5	-0.022	-0.013	1.2681	
240 minute winter	4-16	4.016	1-13	32.5	0.286	0.153	11.4848	
240 minute winter	1-13	1.013	1-14	34.8	0.250	0.164	7.2394	
15 minute summer	18-0	18.000	18-1	0.0	0.000	0.000	1.2038	
15 minute winter	19-0	19.000	19-1	4.9	0.535	0.123	0.2109	
15 minute winter	19-1	19.001	18-1	8.7	0.787	0.218	0.1512	
240 minute winter	18-1	18.001	18-2	4.6	0.250	0.065	2.2089	
15 minute winter	20-0	20.000	18-2	7.8	0.233	0.196	1.6516	
240 minute winter	18-2	18.002	18-3	12.1	0.333	0.109	5.0511	
240 minute winter	18-3	18.003	18-4	16.3	0.290	0.185	1.4974	
240 minute winter	18-4	18.004	1-14	17.5	0.205	0.198	0.8052	
240 minute winter	1-14	1.014	1-15	36.3	0.304	0.171	3.8500	
240 minute winter	1-15	1.015	1-16	36.6	0.263	0.173	7.7780	
240 minute winter	1-16	1.016	PI 4	37.2	0.425	0.153	1.9346	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 86.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PI 4	9	85.905	0.321	37.1	0.5675	0.0000	OK
15 minute summer	Outfall 4	1	85.900	0.327	37.2	0.0000	0.0000	OK
15 minute winter	21-0	11	87.281	0.023	1.0	0.0353	0.0000	OK
15 minute winter	21-1	11	87.178	0.078	11.5	0.1875	0.0000	OK
15 minute winter	21-2	11	87.087	0.096	16.9	0.1800	0.0000	OK
10080 minute winter	21-3	10020	87.072	0.254	0.7	0.6525	0.0000	OK
10080 minute winter	21-4	10020	87.072	0.403	0.9	0.8417	0.0000	SURCHARGED
10080 minute winter	21-5	10020	87.072	0.474	1.1	0.9939	0.0000	SURCHARGED
15 minute summer	22-0	12	87.221	0.126	4.7	0.2348	0.0000	OK
15 minute winter	22-1	12	87.220	0.165	14.4	0.3006	0.0000	OK
15 minute winter	23-0	11	87.222	0.061	6.9	0.1230	0.0000	OK
15 minute winter	22-2	11	87.183	0.276	65.1	1.3248	0.0000	OK
15 minute winter	24-0	12	87.187	0.087	8.1	0.1336	0.0000	OK
15 minute winter	22-3	11	87.170	0.285	82.4	0.7646	0.0000	OK
15 minute summer	22-4	10	87.144	0.391	96.5	0.9924	0.0000	OK
15 minute summer	25-0	1	87.279	0.000	0.0	0.0000	0.0000	OK
15 minute winter	25-1	10	87.192	0.089	12.3	0.1689	0.0000	OK
15 minute summer	22-5	10	87.085	0.473	133.1	1.1876	0.0000	SURCHARGED
15 minute summer	26-0	1	87.125	0.000	0.0	0.0000	0.0000	OK
10080 minute winter	26-1	9960	87.072	0.050	0.1	0.0671	0.0000	OK
10080 minute winter	22-6	9960	87.072	0.498	3.2	0.9658	0.0000	SURCHARGED
10080 minute winter	22-7	9960	87.072	0.543	3.2	172.6563	0.0000	SURCHARGED
10080 minute winter	21-6	9960	87.072	0.560	4.5	1.4050	0.0000	SURCHARGED
10080 minute winter	21-7	9960	87.071	0.671	5.0	2.3140	0.0000	SURCHARGED
10080 minute winter	21-8	10320	87.074	0.699	5.1	1.4543	0.0000	SURCHARGED
10080 minute winter	21-9	10200	87.069	0.721	5.0	1.3823	0.0000	SURCHARGED
10080 minute winter	21-10	10140	87.071	0.799	5.2	2.2519	0.0000	SURCHARGED
10080 minute winter	27-0	10200	87.071	0.749	0.3	1.3237	0.0000	SURCHARGED
10080 minute winter	27-1	10140	87.071	0.796	0.9	2.8174	0.0000	SURCHARGED
10080 minute winter	28-0	10320	87.071	0.593	0.3	1.1330	0.0000	SURCHARGED
10080 minute winter	28-1	10080	87.071	0.738	0.7	2.6375	0.0000	SURCHARGED
10080 minute winter	21-11	10200	87.071	0.839	6.8	3.3785	0.0000	SURCHARGED
15 minute winter	29-0	11	87.400	0.015	0.4	0.0180	0.0000	OK
15 minute winter	29-1	11	87.217	0.056	5.5	0.0857	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PI 4	1.017	Outfall 4	38.7	0.252	0.145	1.1134	215.0
15 minute winter	21-0	21.000	21-1	0.9	0.100	0.008	0.4976	
15 minute winter	21-1	21.001	21-2	10.9	0.574	0.099	0.6818	
15 minute winter	21-2	21.002	21-3	16.2	0.539	0.147	1.7161	
10080 minute winter	21-3	21.003	21-4	0.7	0.261	0.006	4.5635	
10080 minute winter	21-4	21.004	21-5	0.9	0.277	0.007	3.0854	
10080 minute winter	21-5	21.005	21-6	1.1	0.308	0.009	2.7940	
15 minute summer	22-0	22.000	22-1	5.7	0.405	0.045	0.5211	
15 minute winter	22-1	22.001	22-2	17.8	0.292	0.141	3.6088	
15 minute winter	23-0	23.000	22-2	6.5	0.283	0.059	2.5043	
15 minute winter	22-2	22.002	22-3	63.8	0.794	0.498	0.6994	
15 minute winter	24-0	24.000	22-3	7.2	0.242	0.057	2.3594	
15 minute winter	22-3	22.003	22-4	87.4	0.870	0.694	4.9502	
15 minute summer	22-4	22.004	22-5	104.4	0.942	0.829	6.1691	
15 minute summer	25-0	25.000	25-1	0.0	0.000	0.000	0.2076	
15 minute winter	25-1	25.001	22-5	11.9	0.858	0.299	0.2071	
15 minute summer	22-5	22.005	22-6	136.8	1.189	1.161	1.9006	
15 minute summer	26-0	26.000	26-1	0.0	0.000	0.000	0.0451	
10080 minute winter	26-1	26.001	22-6	-0.1	0.246	-0.003	0.7669	
10080 minute winter	22-6	22.006	22-7	3.2	0.395	0.027	2.2683	
10080 minute winter	22-7	22.007	21-6	3.1	0.355	0.026	0.8386	
10080 minute winter	21-6	21.006	21-7	4.5	0.369	0.023	10.1382	
10080 minute winter	21-7	21.007	21-8	5.0	0.368	0.028	2.7460	
10080 minute winter	21-8	21.008	21-9	5.0	0.373	0.028	2.9942	
10080 minute winter	21-9	21.009	21-10	4.9	0.328	0.028	8.5941	
10080 minute winter	21-10	21.010	21-11	5.2	0.274	0.029	4.5606	
10080 minute winter	27-0	27.000	27-1	0.4	-0.003	0.002	13.6208	
10080 minute winter	27-1	27.001	21-11	0.9	0.057	0.004	12.3665	
10080 minute winter	28-0	28.000	28-1	0.2	0.103	0.002	5.1670	
10080 minute winter	28-1	28.001	21-11	0.6	0.102	0.006	3.6110	
10080 minute winter	21-11	21.011	21-12	6.6	0.227	0.031	18.3778	
15 minute winter	29-0	29.000	29-1	0.4	0.094	0.009	0.1697	
15 minute winter	29-1	29.001	29-2	5.3	0.587	0.134	0.1122	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 86.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	29-2	11	87.158	0.070	8.6	0.0991	0.0000	OK
10080 minute winter	29-3	10140	87.071	0.291	0.4	0.5008	0.0000	SURCHARGED
10080 minute winter	29-4	10140	87.071	0.387	0.5	0.5259	0.0000	SURCHARGED
10080 minute winter	29-5	10140	87.071	0.584	0.7	0.9573	0.0000	SURCHARGED
10080 minute winter	21-12	10320	87.071	0.902	8.0	2.8620	0.0000	SURCHARGED
15 minute winter	30-0	11	87.357	0.032	2.0	0.0405	0.0000	OK
15 minute winter	30-1	11	87.120	0.058	6.1	0.0805	0.0000	OK
10080 minute winter	30-2	10200	87.071	0.175	0.4	0.2881	0.0000	OK
10080 minute winter	21-13	10320	87.071	0.933	8.5	2.2952	0.0000	SURCHARGED
10080 minute winter	21-14	10320	87.071	0.967	8.4	1867.1510	0.0000	SURCHARGED
10080 minute winter	PI 3	10320	87.071	1.074	0.1	1.8976	0.0000	SURCHARGED
15 minute summer	Outfall 3	1	87.150	1.212	0.0	0.0000	0.0000	OK
15 minute summer	31-0	1	86.775	0.000	0.0	0.0000	0.0000	OK
15 minute winter	31-1	10	86.694	0.069	12.1	0.1239	0.0000	OK
15 minute winter	31-2	10	86.433	0.087	17.1	0.1211	0.0000	OK
15 minute winter	31-4	10	86.271	0.097	21.0	0.1282	0.0000	OK
15 minute winter	31-5	11	86.069	0.109	24.8	0.1424	0.0000	OK
15 minute winter	31-6	11	85.840	0.195	35.3	0.3119	0.0000	OK
15 minute summer	32-0	1	86.125	0.000	0.0	0.0000	0.0000	OK
15 minute winter	32-1	11	86.031	0.051	4.6	0.0709	0.0000	OK
15 minute winter	31-7	10	85.787	0.182	41.7	0.2125	0.0000	OK
15 minute winter	34-0	10	85.854	0.054	5.3	0.0823	0.0000	OK
15 minute winter	34-1	10	85.772	0.106	12.5	0.1661	0.0000	OK
15 minute summer	34-2	10	85.758	0.147	15.8	0.1990	0.0000	OK
15 minute winter	31-8	9	85.731	0.347	86.8	0.8876	0.0000	SURCHARGED
15 minute winter	33-0	10	85.690	0.015	0.7	0.0170	0.0000	OK
15 minute winter	31-9	9	85.703	0.607	98.8	1.1449	0.0000	SURCHARGED
2880 minute winter	31-10	1860	85.515	0.444	7.3	201.1402	0.0000	SURCHARGED
15 minute winter	35-0	11	85.712	0.053	5.0	0.0789	0.0000	OK
2880 minute winter	31-11	1860	85.515	0.499	3.6	1.0578	0.0000	SURCHARGED
2880 minute winter	31-12	1860	85.515	0.582	3.8	1.3011	0.0000	SURCHARGED
15 minute summer	36-0	1	86.900	0.000	0.0	0.0000	0.0000	OK
15 minute winter	36-1	10	86.802	0.080	13.1	0.1532	0.0000	OK
15 minute winter	36-2	10	86.671	0.096	17.2	0.1354	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	29-2	29.002	29-3	8.5	0.539	0.214	0.8297	
10080 minute winter	29-3	29.003	29-4	0.4	0.302	0.011	0.6439	
10080 minute winter	29-4	29.004	29-5	0.5	0.311	0.012	1.2821	
10080 minute winter	29-5	29.005	21-12	0.7	0.270	0.018	1.4151	
10080 minute winter	21-12	21.012	21-13	7.9	0.208	0.037	8.8880	
15 minute winter	30-0	30.000	30-1	1.9	0.347	0.044	0.2080	
15 minute winter	30-1	30.001	30-2	5.9	0.475	0.148	0.3525	
10080 minute winter	30-2	30.002	21-13	0.3	0.307	0.008	0.7260	
10080 minute winter	21-13	21.013	21-14	8.4	0.397	0.039	9.9595	
10080 minute winter	21-14	Hydro-Brake®	PI 3	0.1				
10080 minute winter	PI 3	21.015	Outfall 3	0.0	0.000	0.000	9.6080	0.0
15 minute summer	31-0	31.000	31-1	0.0	0.000	0.000	0.1265	
15 minute winter	31-1	31.001	31-2	11.9	0.970	0.204	0.2732	
15 minute winter	31-2	31.002	31-4	16.8	1.098	0.288	0.2104	
15 minute winter	31-4	31.003	31-5	20.9	1.179	0.359	0.3032	
15 minute winter	31-5	31.004	31-6	25.0	0.891	0.481	0.8756	
15 minute winter	31-6	31.005	31-7	36.6	1.067	0.913	0.2347	
15 minute summer	32-0	32.000	32-1	0.0	0.000	0.000	0.0794	
15 minute winter	32-1	32.001	31-7	4.4	0.660	0.110	0.1833	
15 minute winter	31-7	31.006	31-8	43.7	0.728	0.617	3.1100	
15 minute winter	34-0	33.000	34-1	5.2	0.448	0.130	0.2923	
15 minute winter	34-1	33.001	34-2	12.7	0.705	0.319	0.1910	
15 minute summer	34-2	33.002	31-8	16.4	0.773	0.412	0.3944	
15 minute winter	31-8	31.007	31-9	88.7	1.326	1.411	0.3263	
15 minute winter	33-0	34.000	31-9	-0.7	0.248	-0.019	1.1032	
15 minute winter	31-9	31.008	31-10	121.0	2.284	0.961	0.5612	
2880 minute winter	31-10	31.009	31-11	3.3	0.363	0.027	2.4026	
15 minute winter	35-0	35.000	31-11	4.8	0.679	0.121	0.2195	
2880 minute winter	31-11	31.010	31-12	3.6	0.358	0.029	3.6330	
2880 minute winter	31-12	31.011	31-13	3.8	0.251	0.030	6.9243	
15 minute summer	36-0	36.000	36-1	0.0	0.000	0.000	0.1818	
15 minute winter	36-1	36.001	36-2	12.8	0.891	0.246	0.2107	
15 minute winter	36-2	36.002	36-3	16.9	0.993	0.326	0.1878	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 86.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	36-3	11	86.570	0.105	20.5	0.1435	0.0000	OK
15 minute winter	36-4	11	86.425	0.106	22.5	0.1349	0.0000	OK
2880 minute winter	31-13	1860	85.515	0.740	4.7	2.2534	0.0000	SURCHARGED
2880 minute winter	31-14	1860	85.515	0.798	5.1	1.5062	0.0000	SURCHARGED
2880 minute winter	31-15	1860	85.515	0.824	5.2	1.3252	0.0000	SURCHARGED
15 minute summer	37-0	1	86.575	0.000	0.0	0.0000	0.0000	OK
15 minute winter	37-1	11	86.345	0.073	10.1	0.1330	0.0000	OK
15 minute winter	38-0	12	85.819	0.142	10.7	0.2183	0.0000	OK
15 minute summer	39-0	1	86.115	0.000	0.0	0.0000	0.0000	OK
15 minute summer	38-1	12	85.784	0.364	33.1	0.8793	0.0000	SURCHARGED
15 minute winter	37-2	12	85.793	0.649	81.9	2.4135	0.0000	SURCHARGED
15 minute summer	40-0	1	85.775	0.000	0.0	0.0000	0.0000	OK
15 minute winter	40-1	11	85.671	0.052	5.2	0.0775	0.0000	OK
15 minute winter	37-3	11	85.535	0.591	120.0	2.3940	0.0000	SURCHARGED
2880 minute winter	37-4	1860	85.515	0.693	7.0	1.5709	0.0000	SURCHARGED
2880 minute winter	31-16	1860	85.515	0.860	12.3	2.3033	0.0000	SURCHARGED
2880 minute winter	31-17	1860	85.515	0.884	12.3	437.4695	0.0000	SURCHARGED
2880 minute winter	PI 1	1980	85.309	0.789	15.3	1.3940	0.0000	SURCHARGED
15 minute summer	Outfall 1	1	85.300	0.799	0.0	0.0000	0.0000	OK
15 minute winter	41-0	10	86.775	0.075	10.1	0.1340	0.0000	OK
15 minute winter	41-1	12	86.682	0.099	16.8	0.1530	0.0000	OK
15 minute winter	41-2	12	86.670	0.275	35.5	0.5459	0.0000	OK
15 minute winter	41-3	11	86.652	0.458	51.6	0.8267	0.0000	SURCHARGED
15 minute winter	42-0	11	86.701	0.127	17.2	0.3144	0.0000	OK
15 minute winter	42-1	11	86.694	0.171	40.7	0.4769	0.0000	OK
15 minute winter	43-0	11	86.657	0.064	3.6	0.0887	0.0000	OK
15 minute winter	42-2	12	86.649	0.250	62.0	0.5574	0.0000	OK
15 minute summer	44-0	12	86.596	0.173	3.6	0.2318	0.0000	OK
15 minute winter	41-4	11	86.589	0.530	107.9	1.1939	0.0000	SURCHARGED
15 minute winter	45-0	10	86.492	0.080	11.3	0.1695	0.0000	OK
15 minute winter	41-5	10	86.454	0.534	138.1	1.2393	0.0000	SURCHARGED
15 minute summer	41-6	10	86.416	0.517	131.3	0.7392	0.0000	SURCHARGED
240 minute winter	41-7	172	86.248	0.510	37.6	159.5190	0.0000	SURCHARGED
240 minute winter	41-8	172	86.247	0.530	17.4	0.9172	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	36-3	36.003	36-4	20.6	1.143	0.396	0.2647	
15 minute winter	36-4	36.004	31-13	22.3	1.248	0.430	0.7658	
2880 minute winter	31-13	31.012	31-14	4.7	0.251	0.035	5.3229	
2880 minute winter	31-14	31.013	31-15	5.1	0.255	0.038	2.3700	
2880 minute winter	31-15	31.014	31-16	5.2	0.185	0.039	3.2654	
15 minute summer	37-0	37.000	37-1	0.0	0.000	0.000	0.2735	
15 minute winter	37-1	37.001	37-2	8.9	0.812	0.223	0.8052	
15 minute winter	38-0	38.000	38-1	10.4	0.413	0.261	1.4414	
15 minute summer	39-0	39.000	38-1	0.0	0.000	0.000	0.0000	
15 minute summer	38-1	38.001	37-2	33.5	0.528	0.474	4.7515	
15 minute winter	37-2	37.002	37-3	73.4	1.043	1.196	4.5516	
15 minute summer	40-0	40.000	40-1	0.0	0.000	0.000	0.0885	
15 minute winter	40-1	40.001	37-3	4.7	0.531	0.119	1.7474	
15 minute winter	37-3	37.003	37-4	121.5	1.101	1.233	5.4750	
2880 minute winter	37-4	37.004	31-16	7.0	0.369	0.065	2.9447	
2880 minute winter	31-16	31.015	31-17	12.3	0.546	0.039	3.2280	
2880 minute winter	31-17	31.016	PI 1	15.3	0.261	0.052	1.6616	
2880 minute winter	PI 1	31.017	Outfall 1	10.3	0.037	0.048	5.3243	422.8
15 minute winter	41-0	41.000	41-1	9.9	0.603	0.139	0.4743	
15 minute winter	41-1	41.001	41-2	16.3	0.654	0.231	2.0149	
15 minute winter	41-2	41.002	41-3	34.0	0.740	0.480	3.3865	
15 minute winter	41-3	41.003	41-4	46.8	0.742	0.660	2.3190	
15 minute winter	42-0	42.000	42-1	16.5	0.494	0.233	0.4352	
15 minute winter	42-1	42.001	42-2	39.4	0.799	0.556	1.5674	
15 minute winter	43-0	43.000	42-2	3.5	0.497	0.089	0.1852	
15 minute winter	42-2	42.002	41-4	61.5	1.077	0.866	1.1175	
15 minute summer	44-0	44.000	41-4	15.2	0.587	0.381	0.5873	
15 minute winter	41-4	41.004	41-5	115.1	1.044	1.041	4.9665	
15 minute winter	45-0	45.000	41-5	11.0	0.667	0.276	0.9518	
15 minute winter	41-5	41.005	41-6	140.6	1.275	1.095	0.5585	
15 minute summer	41-6	41.006	41-7	138.3	1.823	1.250	3.6074	
240 minute winter	41-7	41.007	41-8	17.4	0.409	0.138	0.5755	
240 minute winter	41-8	41.008	41-9	17.5	0.411	0.157	1.5091	

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 86.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	46-0	172	86.246	0.241	0.2	0.2727	0.0000	SURCHARGED
240 minute winter	41-9	172	86.246	0.572	17.6	1.0533	0.0000	SURCHARGED
15 minute summer	47-0	1	86.525	0.000	0.0	0.0000	0.0000	OK
240 minute winter	47-1	172	86.244	0.136	2.6	0.2636	0.0000	OK
240 minute winter	41-10	172	86.244	0.844	18.3	2.2309	0.0000	SURCHARGED
240 minute winter	41-11	172	86.243	0.858	18.5	1.4257	0.0000	SURCHARGED
240 minute winter	41-12	172	86.242	0.895	18.7	2.5330	0.0000	SURCHARGED
15 minute summer	48-0	1	86.300	0.000	0.0	0.0000	0.0000	OK
240 minute winter	41-13	172	86.240	0.965	20.6	3.9258	0.0000	SURCHARGED
30 minute summer	PI 5	17	85.902	0.737	11.3	1.3023	0.0000	SURCHARGED
15 minute summer	Outfall 5	1	85.900	0.752	8.0	0.0000	0.0000	OK
15 minute summer	50-0	1	88.900	0.000	0.0	0.0000	0.0000	OK
15 minute winter	50-1	10	88.078	0.078	14.9	0.1415	0.0000	OK
15 minute winter	50-2	11	87.301	0.101	22.9	0.1548	0.0000	OK
960 minute winter	50-3	735	86.368	0.168	2.9	0.2861	0.0000	OK
960 minute winter	50-4	735	86.368	0.366	4.9	0.8523	0.0000	OK
960 minute winter	50-5	735	86.368	0.547	6.6	88.5125	0.0000	SURCHARGED
15 minute winter	PI 2	19	85.901	0.281	1.7	0.4019	0.0000	OK
15 minute summer	Outfall 2	1	85.900	0.290	1.7	0.0000	0.0000	OK
960 minute winter	49-0	720	86.303	0.109	0.2	0.1558	0.0000	OK
960 minute winter	49-1	720	86.303	0.334	2.4	1.1883	0.0000	OK
960 minute winter	49-2	720	86.303	0.397	2.2	0.6687	0.0000	SURCHARGED
960 minute winter	49-3	720	86.303	0.504	3.9	67.0993	0.0000	SURCHARGED
960 minute winter	49-4	720	86.303	0.573	1.8	1.1457	0.0000	SURCHARGED
960 minute winter	49-5	720	86.303	0.623	1.9	1.1778	0.0000	SURCHARGED
30 minute summer	PI 6	20	85.901	0.375	1.6	0.5360	0.0000	OK
15 minute summer	Outfall 6	1	85.900	0.396	1.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	46-0	46.000	41-9	-0.2	-0.036	-0.006	0.3805	
240 minute winter	41-9	41.009	41-10	17.8	0.392	0.161	3.4285	
15 minute summer	47-0	47.000	47-1	0.0	0.000	0.000	0.3045	
240 minute winter	47-1	47.001	41-10	2.6	0.428	0.065	1.6122	
240 minute winter	41-10	41.010	41-11	18.5	0.338	0.145	0.6386	
240 minute winter	41-11	41.011	41-12	18.6	0.352	0.151	1.7545	
240 minute winter	41-12	41.012	41-13	18.8	0.209	0.148	3.0957	
15 minute summer	48-0	48.000	41-13	0.0	0.000	0.000	1.0771	
240 minute winter	41-13	Hydro-Brake®	PI 5	20.5				
30 minute summer	PI 5	41.014	Outfall 5	11.3	0.058	0.047	1.0395	53.2
15 minute summer	50-0	49.000	50-1	0.0	0.000	0.000	0.0000	
15 minute winter	50-1	49.001	50-2	14.4	1.207	0.248	0.4371	
15 minute winter	50-2	49.002	50-3	22.7	1.352	0.391	0.4576	
960 minute winter	50-3	49.003	50-4	2.9	0.310	0.022	5.4354	
960 minute winter	50-4	49.004	50-5	4.1	0.384	0.037	10.1318	
960 minute winter	50-5	Hydro-Brake®	PI 2	1.8				
15 minute winter	PI 2	49.006	Outfall 2	2.9	0.028	0.019	0.4819	16.7
960 minute winter	49-0	50.000	49-1	-0.2	-0.006	-0.002	4.7378	
960 minute winter	49-1	50.001	49-2	1.9	0.284	0.017	2.1628	
960 minute winter	49-2	50.002	49-3	1.9	0.322	0.021	5.9200	
960 minute winter	49-3	50.003	49-4	1.8	0.092	0.020	3.8234	
960 minute winter	49-4	50.004	49-5	1.8	0.067	0.015	5.6761	
960 minute winter	49-5	Hydro-Brake®	PI 6	1.8				
30 minute summer	PI 6	50.006	Outfall 6	1.6	0.011	0.008	0.8370	15.0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Appendix E Foul Water Calculations – Causeway Flow Modelling

Design Settings

Frequency of use (kDU)	0.00	Additional Flow (%)	10	Preferred Cover Depth (m)	1.200
Flow per dwelling per day (l/day)	900	Minimum Velocity (m/s)	0.75	Include Intermediate Ground	✓
Domestic Flow (l/s/ha)	0.0	Connection Type	Level Soffits		
Industrial Flow (l/s/ha)	0.0	Minimum Backdrop Height (m)	0.000		

Nodes

Name	Dwellings	Add Inflow (l/s)	Cover Level (m)	Manhole Type	Easting (m)	Northing (m)	Depth (m)
F1-0	1		88.635	Adoptable	681605.904	714507.116	0.900
F1-1	6		88.440	Adoptable	681643.639	714518.395	1.361
F2-0	1		88.422	Adoptable	681705.935	714537.000	1.322
F1-2	11		88.210	Adoptable	681681.768	714529.791	1.869
F1-3	13		88.330	Adoptable	681674.642	714555.156	2.165
F3-0	1		88.431	Adoptable	681703.061	714625.818	1.277
F1-4	29		88.564	Adoptable	681650.788	714598.067	2.726
F4-0	1		88.704	Adoptable	681582.191	714510.863	0.900
F4-1	5		88.978	Adoptable	681569.307	714553.991	1.924
F4-2	19		89.156	Adoptable	681609.685	714576.614	2.948
F1-5	56		88.564	Adoptable	681647.322	714598.040	2.749
F5-0	1		89.000	Adoptable	681536.138	714558.239	1.350
F5-1	2		88.550	Adoptable	681526.925	714572.301	1.180
F5-2	4		88.316	Adoptable	681515.254	714595.415	1.378
F5-3	4		88.316	Adoptable	681520.512	714603.858	1.544
F5-4	15		88.485	Adoptable	681563.804	714626.666	2.114
F1-6	89		88.684	Adoptable	681617.082	714654.736	3.226
F6-0	1		88.550	Adoptable	681726.249	714560.543	0.900
F6-1	3		88.200	Adoptable	681725.107	714581.547	0.901
F6-2	6		88.200	Adoptable	681728.107	714619.460	1.535
F6-3	7		88.150	Adoptable	681722.615	714651.566	2.028
F6-4	8		88.050	Adoptable	681723.730	714668.118	2.204
F6-5	10		88.198	Adoptable	681705.206	714702.021	2.685
F1-7	114		88.525	Adoptable	681671.450	714684.025	3.410
F1-8	118		88.332	Adoptable	681638.950	714744.328	3.645
F7-0	1		87.800	Adoptable	681490.078	714715.528	1.954
F8-0	2		88.020	Adoptable	681521.402	714656.903	1.220
F7-1	16		87.985	Adoptable	681506.482	714684.820	2.794
F7-2	16		87.408	Adoptable	681536.163	714700.675	2.441
F9-0	1		88.058	Adoptable	681558.286	714659.263	2.088
F7-3	24		87.543	Adoptable	681540.601	714692.368	2.623
F7-4	34		87.333	Adoptable	681586.773	714716.877	2.674
F1-9	160		87.991	Adoptable	681623.827	714736.480	3.594
F10-0	1		88.200	Adoptable	681713.509	714720.549	1.350
F10-1	4		88.200	Adoptable	681700.576	714744.800	1.808
F10-2	4		88.200	Adoptable	681695.873	714742.686	1.894
F10-3	8		88.321	Adoptable	681678.365	714775.602	2.636
F11-0	1		88.220	Adoptable	681688.371	714709.683	1.270
F10-4	16		88.230	Adoptable	681658.788	714765.122	2.693
F1-10	177		88.100	Adoptable	681619.645	714744.287	3.758
F1-11	181		88.100	Adoptable	681607.012	714767.873	3.925
F14-0	1		87.600	Adoptable	681573.282	714744.034	1.550
F14-1	8		87.477	Adoptable	681526.341	714718.957	2.314
F13-0	1		87.700	Adoptable	681465.808	714761.926	1.350
F13-1	4		87.700	Adoptable	681481.785	714770.408	1.651
F12-0	1		87.794	Adoptable	681467.425	714728.011	1.350
F12-1	9		87.674	Adoptable	681496.840	714743.682	2.136
F12-2	27		87.699	Adoptable	681509.560	714750.477	2.849
F15-0	0		88.100	Adoptable	681598.067	714736.123	1.350
F12-3	62		87.699	Adoptable	681572.350	714784.040	3.205
F1-12	251		87.687	Adoptable	681592.328	714794.696	3.703
F1-13	272		87.926	Adoptable	681616.616	714807.658	4.114
F1-14	285		88.000	Adoptable	681600.550	714837.960	4.402
F1-15	285		88.000	Adoptable	681586.729	714830.424	4.650
F1-16	57		87.800	Adoptable	681571.873	714847.882	4.542
F1-17	57		87.221	Adoptable	681541.687	714831.363	4.090
F1-18	14		87.950	Adoptable	681524.354	714827.481	4.885
F19-0	1		87.550	Adoptable	681449.454	714787.470	1.050
F1-19	6		87.550	Adoptable	681481.406	714804.537	4.665
F16-0	5	0.1	87.868	Adoptable	681552.176	714897.692	1.568
F16-1	10	0.5	87.984	Adoptable	681560.903	714884.154	2.087
F16-3	43	0.5	88.191	Adoptable	681524.134	714860.453	3.388
F16-4	28		88.091	Adoptable	681503.825	714847.235	3.530

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Nodes

Name	Dwellings	Add Inflow (l/s)	Cover Level (m)	Manhole Type	Easting (m)	Northing (m)	Depth (m)
F16-5	19		87.537	Adoptable	681450.686	714818.852	3.277
F17-0	1		87.437	Adoptable	681419.260	714812.458	1.350
F16-6	16		87.473	Adoptable	681423.611	714804.389	3.366
F1-20	10		87.394	Adoptable	681436.252	714780.387	4.699
F1-21	9		87.390	Adoptable	681439.149	714773.907	4.721
F1-22	8		87.450	Adoptable	681436.168	714763.355	4.822
F18-0	1		87.450	Adoptable	681392.894	714797.345	0.866
F1-23	8		87.450	Adoptable	681416.521	714752.922	4.904
F1-24	0		87.158	Adoptable	681378.751	714742.826	4.757
F20-0	1		88.726	Adoptable	681439.291	714444.344	1.226
F20-1	3		88.561	Adoptable	681465.939	714458.303	1.562
F20-2	5		88.279	Adoptable	681484.092	714467.811	1.622
F20-3	11		88.000	Adoptable	681469.215	714494.805	1.932
F20-4	20		87.834	Adoptable	681447.197	714525.527	2.018
F21-0	0		89.246	Adoptable	681321.207	714553.285	0.900
F21-1	2		89.030	Adoptable	681341.209	714533.837	1.149
F22-0	1		88.906	Adoptable	681412.481	714461.119	1.350
F22-1	3		88.802	Adoptable	681400.498	714478.287	1.670
F21-2	13		88.686	Adoptable	681381.331	714500.780	2.247
F20-5	37		88.075	Adoptable	681426.659	714547.155	2.717
F20-6	43		87.822	Adoptable	681390.976	714578.100	2.700
F23-0	1		88.900	Adoptable	681332.220	714579.790	1.900
F20-7	54		87.588	Adoptable	681349.719	714603.726	2.709
F20-8	54		88.100	Adoptable	681358.300	714617.873	3.304
F24-0	1		88.510	Adoptable	681526.742	714478.429	1.050
F24-1	2		88.367	Adoptable	681547.942	714488.332	1.492
F24-2	4		88.445	Adoptable	681536.421	714512.184	2.086
F24-3	7		88.308	Adoptable	681522.814	714534.939	2.126
F24-4	12		88.130	Adoptable	681495.671	714572.910	2.259
F24-5	13		88.135	Adoptable	681492.512	714583.791	2.340
F24-6	13		87.942	Adoptable	681478.757	714581.170	2.217
F25-0	3		87.905	Adoptable	681440.096	714560.424	1.027
F24-7	22		87.942	Adoptable	681475.059	714579.186	2.238
F24-8	22		87.539	Adoptable	681460.126	714604.741	1.983
F26-0	1		88.380	Adoptable	681496.301	714626.098	2.380
F26-1	6		87.879	Adoptable	681474.131	714667.516	2.879
F26-2	11		87.720	Adoptable	681459.717	714694.230	2.922
F26-3	12		87.677	Adoptable	681452.414	714690.031	2.935
F26-4	14		87.689	Adoptable	681442.036	714680.474	3.018
F24-9	47		87.351	Adoptable	681417.272	714637.714	2.927
F27-0	1		87.587	Adoptable	681420.559	714707.290	1.050
F27-1	8		87.650	Adoptable	681396.370	714665.633	1.916
F24-10	57		87.600	Adoptable	681386.517	714655.975	3.355
F20-9	114		87.600	Adoptable	681376.792	714647.689	3.460
F28-0	1		88.556	Adoptable	681241.932	714575.312	1.350
F28-1	4		88.417	Adoptable	681268.719	714570.058	1.666
F28-2	5		88.332	Adoptable	681288.354	714570.205	1.908
F28-3	6		88.143	Adoptable	681302.827	714577.426	1.989
F28-4	10		87.215	Adoptable	681330.785	714619.384	1.901
F28-5	10		87.179	Adoptable	681327.278	714625.076	2.051
F20-10	128		87.250	Adoptable	681352.693	714663.072	3.253
F29-0	1		88.000	Adoptable	681392.820	714718.858	1.350
F29-2	4		88.000	Adoptable	681375.025	714691.965	1.887
F20-11	132		87.710	Adoptable	681362.184	714676.885	3.797
F30-0	1		87.229	Adoptable	681241.977	714638.304	1.350
F30-1	3		87.360	Adoptable	681262.902	714634.330	2.013
F30-2	4		87.319	Adoptable	681272.752	714638.737	2.202
F31-0	1		87.286	Adoptable	681306.931	714634.640	1.350
F30-3	10		87.322	Adoptable	681281.103	714652.031	2.542
F30-4	10		87.293	Adoptable	681277.468	714654.479	2.542
F20-12	153		87.326	Adoptable	681314.190	714709.602	3.703
F32-0	1		88.543	Adoptable	681232.207	714577.382	1.350
F32-1	4		88.353	Adoptable	681200.253	714583.628	1.703
F32-2	4		88.119	Adoptable	681186.751	714590.812	1.724
F32-3	6		87.912	Adoptable	681179.482	714600.756	1.722
F32-4	6		87.677	Adoptable	681176.174	714614.144	1.717
F32-5	10		87.218	Adoptable	681173.612	714654.293	2.138
F32-6	15		86.876	Adoptable	681230.561	714657.804	2.276
F32-7	20		86.748	Adoptable	681258.083	714673.091	2.305
F32-8	25		87.071	Adoptable	681283.967	714692.649	2.790

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Nodes

Name	Dwellings	Add Inflow (l/s)	Cover Level (m)	Manhole Type	Easting (m)	Northing (m)	Depth (m)
F33-0	1		87.112	Adoptable	681175.802	714667.406	1.350
F33-1	3		86.998	Adoptable	681174.873	714691.996	1.646
F33-2	4		86.913	Adoptable	681181.559	714704.513	1.798
F33-3	10		86.905	Adoptable	681222.482	714728.838	2.345
F34-0	1		87.200	Adoptable	681329.047	714800.041	0.850
F34-1	3		87.075	Adoptable	681304.981	714813.451	1.184
F33-4	20		86.994	Adoptable	681260.017	714759.534	2.676
F20-13	208		87.260	Adoptable	681307.001	714714.391	3.680
F20-14	224		87.141	Adoptable	681349.491	714762.841	4.946
F20-15	227		87.218	Adoptable	681358.981	714774.201	5.097
F20-16 OUT			87.202	Adoptable	681374.034	714763.264	5.174
ExFMH_1			88.894	Adoptable	681413.756	714450.016	3.624
F36-0			88.906	Adoptable	681397.961	714472.633	3.682
F36-1			88.725	Adoptable	681375.805	714497.797	3.557
F36-2			89.006	Adoptable	681339.022	714527.788	3.917
F36-3			90.084	Adoptable	681309.438	714555.727	5.063
F36-4			89.346	Adoptable	681337.470	714597.780	4.409
F36-5			88.100	Adoptable	681370.964	714653.690	3.272
EX Air Valve			87.785	Adoptable	681210.765	714542.261	1.835
EX 45 Bend			87.300	Adoptable	681308.803	714570.782	1.800
EX DM 1 (IW)/MH 4 (MURPHY)			88.200	Adoptable	681360.686	714661.144	3.697
EX EI 1.00			87.628	Adoptable	681407.527	714717.638	3.270
EX EI 1.01			87.200	Adoptable	681461.913	714782.816	3.010
EX EI 1.02			87.321	Adoptable	681521.417	714814.365	3.266
EX EI 1.03	342		87.167	Adoptable	681580.377	714847.065	3.248

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
F1.000	F1-0	F1-1	39.385	0.150	87.735	87.079	0.656	60.0	150
F1.001	F1-1	F1-2	39.796	0.150	87.079	86.416	0.663	60.0	150
F2.000	F2-0	F1-2	25.219	0.150	87.100	86.680	0.420	60.0	150
F1.002	F1-2	F1-3	26.347	0.150	86.341	86.165	0.176	150.0	225
F1.003	F1-3	F1-4	49.095	0.150	86.165	85.838	0.327	150.0	225
F3.000	F3-0	F1-4	59.183	0.150	87.154	86.168	0.986	60.0	150
F1.004	F1-4	F1-5	3.466	0.150	85.838	85.815	0.023	150.0	225
F4.000	F4-0	F4-1	45.011	0.150	87.804	87.054	0.750	60.0	150
F4.001	F4-1	F4-2	46.284	0.150	87.054	86.283	0.771	60.0	150
F4.002	F4-2	F1-5	43.308	0.150	86.208	85.919	0.289	150.0	225
F1.005	F1-5	F1-6	64.256	0.150	85.815	85.458	0.357	180.0	225
F5.000	F5-0	F5-1	16.811	0.150	87.650	87.370	0.280	60.0	150
F5.001	F5-1	F5-2	25.893	0.150	87.370	86.938	0.432	60.0	150
F5.002	F5-2	F5-3	9.962	0.150	86.938	86.772	0.166	60.0	150
F5.003	F5-3	F5-4	48.933	0.150	86.772	86.446	0.326	150.0	150
F5.004	F5-4	F1-6	60.220	0.150	86.371	86.036	0.335	180.0	225
F1.006	F1-6	F1-7	61.755	0.150	85.458	85.115	0.343	180.0	225
F6.000	F6-0	F6-1	21.035	0.150	87.650	87.299	0.351	60.0	150

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)
F1.000	0.110	1.533	27.1	0.0	0.750	1.211	0.000	1	0.0	0.0	3
F1.001	0.238	1.533	27.1	0.1	1.211	1.644	0.000	7	0.0	0.0	6
F2.000	0.110	1.533	27.1	0.0	1.172	1.380	0.000	1	0.0	0.0	3
F1.002	0.216	1.238	49.2	0.2	1.644	1.940	0.000	19	0.0	0.0	11
F1.003	0.256	1.238	49.2	0.4	1.940	2.501	0.000	32	0.0	0.0	14
F3.000	0.110	1.533	27.1	0.0	1.127	2.246	0.000	1	0.0	0.0	3
F1.004	0.311	1.238	49.2	0.7	2.501	2.524	0.000	62	0.0	0.0	19
F4.000	0.110	1.533	27.1	0.0	0.750	1.774	0.000	1	0.0	0.0	3
F4.001	0.209	1.533	27.1	0.1	1.774	2.723	0.000	6	0.0	0.0	6
F4.002	0.237	1.238	49.2	0.3	2.723	2.420	0.000	25	0.0	0.0	13
F1.005	0.382	1.127	44.8	1.6	2.524	3.001	0.000	143	0.0	0.0	29
F5.000	0.110	1.533	27.1	0.0	1.200	1.030	0.000	1	0.0	0.0	3
F5.001	0.179	1.533	27.1	0.0	1.030	1.228	0.000	3	0.0	0.0	4
F5.002	0.238	1.533	27.1	0.1	1.228	1.394	0.000	7	0.0	0.0	6
F5.003	0.190	0.955	16.9	0.1	1.394	1.889	0.000	11	0.0	0.0	9
F5.004	0.232	1.127	44.8	0.3	1.889	2.423	0.000	26	0.0	0.0	13
F1.006	0.468	1.127	44.8	3.0	3.001	3.185	0.000	258	0.0	0.0	39
F6.000	0.110	1.533	27.1	0.0	0.750	0.751	0.000	1	0.0	0.0	3

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
F6.001	F6-1	F6-2	38.032	0.150	87.299	86.665	0.634	60.0	150
F6.002	F6-2	F6-3	32.572	0.150	86.665	86.122	0.543	60.0	150
F6.003	F6-3	F6-4	16.590	0.150	86.122	85.846	0.276	60.0	150
F6.004	F6-4	F6-5	38.634	0.150	85.846	85.588	0.258	150.0	150
F6.005	F6-5	F1-7	38.253	0.150	85.513	85.300	0.213	180.0	225
F1.007	F1-7	F1-8	68.503	0.150	85.115	84.687	0.428	160.0	225
F1.008	F1-8	F1-9	17.038	0.150	84.687	84.581	0.106	160.0	225
F7.000	F7-0	F7-1	34.815	0.150	85.846	85.266	0.580	60.0	150
F8.000	F8-0	F7-1	31.654	0.150	86.800	86.272	0.528	60.0	150
F7.001	F7-1	F7-2	33.650	0.150	85.191	84.967	0.224	150.0	225
F7.002	F7-2	F7-3	9.418	0.150	84.967	84.920	0.047	200.0	225
F9.000	F9-0	F7-3	37.533	0.150	85.970	85.344	0.626	60.0	150
F7.003	F7-3	F7-4	52.274	0.150	84.920	84.659	0.261	200.0	225
F7.004	F7-4	F1-9	41.920	0.150	84.659	84.397	0.262	160.0	225
F1.009	F1-9	F1-10	8.857	0.150	84.397	84.342	0.055	160.0	225
F10.000	F10-0	F10-1	27.484	0.150	86.850	86.392	0.458	60.0	150
F10.001	F10-1	F10-2	5.156	0.150	86.392	86.306	0.086	60.0	150
F10.002	F10-2	F10-3	37.283	0.150	86.306	85.685	0.621	60.0	150
F10.003	F10-3	F10-4	22.206	0.150	85.685	85.537	0.148	150.0	150
F11.000	F11-0	F10-4	62.839	0.150	86.950	85.903	1.047	60.0	150
F10.004	F10-4	F1-10	44.343	0.150	85.537	85.260	0.277	160.0	150
F1.010	F1-10	F1-11	26.756	0.150	84.342	84.175	0.167	160.0	225
F1.011	F1-11	F1-12	30.579	0.150	84.175	83.984	0.191	160.0	225
F12.000	F14-0	F14-1	53.219	0.150	86.050	85.163	0.887	60.0	150
F12.001	F14-1	F12-2	35.709	0.150	85.163	84.925	0.238	150.0	150
F13.000	F13-0	F13-1	18.089	0.150	86.350	86.049	0.301	60.0	150
F13.001	F13-1	F12-1	30.675	0.150	86.049	85.538	0.511	60.0	150
F14.000	F12-0	F12-1	33.329	0.150	86.444	85.889	0.555	60.0	150
F13.002	F12-1	F12-2	14.421	0.150	85.538	85.298	0.240	60.0	150
F12.002	F12-2	F12-3	71.197	0.150	84.850	84.494	0.356	200.0	225
F15.000	F15-0	F12-3	54.382	0.150	86.750	85.844	0.906	60.0	150
F12.003	F12-3	F1-12	22.642	0.150	84.494	84.268	0.226	100.0	225
F1.012	F1-12	F1-13	27.530	0.150	83.984	83.812	0.172	160.0	225

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)
F6.001	0.179	1.533	27.1	0.0	0.751	1.385	0.000	4	0.0	0.0	5
F6.002	0.264	1.533	27.1	0.1	1.385	1.878	0.000	10	0.0	0.0	7
F6.003	0.314	1.533	27.1	0.2	1.878	2.054	0.000	17	0.0	0.0	9
F6.004	0.258	0.955	16.9	0.3	2.054	2.460	0.000	25	0.0	0.0	14
F6.005	0.249	1.127	44.8	0.4	2.460	3.000	0.000	35	0.0	0.0	15
F1.007	0.556	1.198	47.6	4.7	3.185	3.420	0.000	407	0.0	0.0	47
F1.008	0.599	1.198	47.6	6.0	3.420	3.185	0.000	525	0.0	0.0	54
F7.000	0.110	1.533	27.1	0.0	1.804	2.569	0.000	1	0.0	0.0	3
F8.000	0.146	1.533	27.1	0.0	1.070	1.563	0.000	2	0.0	0.0	3
F7.001	0.216	1.238	49.2	0.2	2.569	2.216	0.000	19	0.0	0.0	11
F7.002	0.235	1.067	42.4	0.4	2.216	2.398	0.000	35	0.0	0.0	15
F9.000	0.110	1.533	27.1	0.0	1.938	2.049	0.000	1	0.0	0.0	3
F7.003	0.281	1.067	42.4	0.7	2.398	2.449	0.000	60	0.0	0.0	20
F7.004	0.349	1.198	47.6	1.1	2.449	3.369	0.000	94	0.0	0.0	23
F1.009	0.678	1.198	47.6	8.9	3.369	3.533	0.000	779	0.0	0.0	65
F10.000	0.110	1.533	27.1	0.0	1.200	1.658	0.000	1	0.0	0.0	3
F10.001	0.209	1.533	27.1	0.1	1.658	1.744	0.000	5	0.0	0.0	5
F10.002	0.264	1.533	27.1	0.1	1.744	2.486	0.000	9	0.0	0.0	7
F10.003	0.218	0.955	16.9	0.2	2.486	2.543	0.000	17	0.0	0.0	11
F11.000	0.110	1.533	27.1	0.0	1.120	2.177	0.000	1	0.0	0.0	3
F10.004	0.273	0.923	16.3	0.4	2.543	2.690	0.000	34	0.0	0.0	16
F1.010	0.724	1.198	47.6	11.3	3.533	3.700	0.000	990	0.0	0.0	74
F1.011	0.759	1.198	47.6	13.4	3.700	3.478	0.000	1171	0.0	0.0	81
F12.000	0.110	1.533	27.1	0.0	1.400	2.164	0.000	1	0.0	0.0	3
F12.001	0.174	0.955	16.9	0.1	2.164	2.624	0.000	9	0.0	0.0	8
F13.000	0.110	1.533	27.1	0.0	1.200	1.501	0.000	1	0.0	0.0	3
F13.001	0.209	1.533	27.1	0.1	1.501	1.986	0.000	5	0.0	0.0	5
F14.000	0.110	1.533	27.1	0.0	1.200	1.635	0.000	1	0.0	0.0	3
F13.002	0.290	1.533	27.1	0.2	1.986	2.251	0.000	15	0.0	0.0	8
F12.002	0.266	1.067	42.4	0.6	2.624	2.980	0.000	51	0.0	0.0	18
F15.000	0.000	1.533	27.1	0.0	1.200	1.705	0.000	0	0.0	0.0	0
F12.003	0.449	1.526	60.7	1.3	2.980	3.194	0.000	113	0.0	0.0	22
F1.012	0.823	1.198	47.6	17.6	3.478	3.889	0.000	1535	0.0	0.0	94

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
F1.013	F1-13	F1-14	34.298	0.150	83.812	83.598	0.214	160.0	225
F1.014	F1-14	F1-15	15.742	0.150	83.598	83.500	0.098	160.0	225
F1.015	F1-15	F1-16	22.923	0.150	83.350	83.258	0.092	250.0	225
F1.016	F1-16	F1-17	34.410	0.150	83.258	83.131	0.127	270.0	225
F1.017	F1-17	F1-18	17.762	0.150	83.131	83.065	0.066	270.0	225
F1.018	F1-18	F1-19	48.692	0.150	83.065	82.885	0.180	270.0	225
F19.000	F19-0	F1-19	36.224	0.150	86.500	85.896	0.604	60.0	150
F1.019	F1-19	F1-20	51.207	0.150	82.885	82.695	0.190	270.0	225
F18.000	F16-0	F16-1	16.107	0.150	86.300	85.897	0.403	40.0	150
F18.001	F16-1	F16-3	43.746	0.150	85.897	84.803	1.094	40.0	150
17.002	F16-3	F16-4	24.232	0.150	84.803	84.561	0.242	100.0	150
17.003	F16-4	F16-5	60.244	0.150	84.561	84.260	0.301	200.0	150
17.004	F16-5	F16-6	30.696	0.150	84.260	84.107	0.153	200.0	150
F17.000	F17-0	F16-6	9.167	0.150	86.087	85.934	0.153	60.0	150
17.005	F16-6	F1-20	27.127	0.150	84.107	83.971	0.136	200.0	150
F1.020	F1-20	F1-21	7.098	0.150	82.695	82.669	0.026	270.0	225
F1.021	F1-21	F1-22	10.965	0.150	82.669	82.628	0.041	270.0	225
F1.022	F1-22	F1-23	22.245	0.150	82.628	82.546	0.082	270.0	225
F16.000	F18-0	F1-23	50.315	0.150	86.584	85.745	0.839	60.0	150
F1.023	F1-23	F1-24	39.096	0.150	82.546	82.401	0.145	270.0	225
F1.024	F1-24	F20-14	35.451	0.150	82.401	82.270	0.131	270.0	225
F20.000	F20-0	F20-1	30.083	0.150	87.500	86.999	0.501	60.0	150
F20.001	F20-1	F20-2	20.492	0.150	86.999	86.657	0.342	60.0	150
F20.002	F20-2	F20-3	30.822	0.150	86.657	86.143	0.514	60.0	150
F20.003	F20-3	F20-4	37.797	0.150	86.068	85.816	0.252	150.0	225
F20.004	F20-4	F20-5	29.826	0.150	85.816	85.617	0.199	150.0	225
F21.000	F21-0	F21-1	27.898	0.150	88.346	87.881	0.465	60.0	150
F21.001	F21-1	F21-2	51.986	0.150	87.881	87.138	0.743	70.0	150
F22.000	F22-0	F22-1	20.936	0.150	87.556	87.207	0.349	60.0	150
F22.001	F22-1	F21-2	29.552	0.150	87.132	86.639	0.493	60.0	225
F21.002	F21-2	F20-5	64.848	0.150	86.439	85.358	1.081	60.0	225
F20.005	F20-5	F20-6	47.232	0.150	85.358	85.122	0.236	200.0	225
F20.006	F20-6	F20-7	48.568	0.150	85.122	84.879	0.243	200.0	225

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)
F1.013	0.861	1.198	47.6	20.7	3.889	4.177	0.000	1807	0.0	0.0	103
F1.014	0.896	1.198	47.6	24.0	4.177	4.275	0.000	2092	0.0	0.0	113
F1.015	0.787	0.951	37.8	27.2	4.425	4.317	0.000	2377	0.0	0.0	142
F1.016	0.769	0.913	36.3	27.9	4.317	3.865	0.000	2434	0.0	0.0	148
F1.017	0.774	0.913	36.3	28.5	3.865	4.660	0.000	2491	0.0	0.0	151
F1.018	0.774	0.913	36.3	28.7	4.660	4.440	0.000	2505	0.0	0.0	152
F19.000	0.110	1.533	27.1	0.0	0.900	1.504	0.000	1	0.0	0.0	3
F1.019	0.774	0.913	36.3	28.8	4.440	4.474	0.000	2512	0.0	0.0	152
F18.000	0.330	1.887	33.3	0.2	1.418	1.937	0.000	5	0.0	0.1	8
F18.001	0.575	1.887	33.3	0.8	1.937	3.238	0.000	15	0.0	0.6	16
17.002	0.531	1.178	20.8	1.9	3.238	3.380	0.000	58	0.0	1.1	30
17.003	0.432	0.822	14.5	2.2	3.380	3.127	0.000	86	0.0	1.1	40
17.004	0.439	0.822	14.5	2.4	3.127	3.216	0.000	105	0.0	1.1	41
F17.000	0.110	1.533	27.1	0.0	1.200	1.389	0.000	1	0.0	0.0	3
17.005	0.453	0.822	14.5	2.6	3.216	3.273	0.000	122	0.0	1.1	43
F1.020	0.795	0.913	36.3	31.5	4.474	4.496	0.000	2644	0.0	1.1	162
F1.021	0.795	0.913	36.3	31.6	4.496	4.597	0.000	2653	0.0	1.1	163
F1.022	0.795	0.913	36.3	31.7	4.597	4.679	0.000	2661	0.0	1.1	163
F16.000	0.110	1.533	27.1	0.0	0.716	1.555	0.000	1	0.0	0.0	3
F1.023	0.795	0.913	36.3	31.8	4.679	4.532	0.000	2670	0.0	1.1	164
F1.024	0.795	0.913	36.3	31.8	4.532	4.646	0.000	2670	0.0	1.1	164
F20.000	0.110	1.533	27.1	0.0	1.076	1.412	0.000	1	0.0	0.0	3
F20.001	0.179	1.533	27.1	0.0	1.412	1.472	0.000	4	0.0	0.0	5
F20.002	0.264	1.533	27.1	0.1	1.472	1.707	0.000	9	0.0	0.0	7
F20.003	0.216	1.238	49.2	0.2	1.707	1.793	0.000	20	0.0	0.0	11
F20.004	0.275	1.238	49.2	0.5	1.793	2.233	0.000	40	0.0	0.0	15
F21.000	0.000	1.533	27.1	0.0	0.750	0.999	0.000	0	0.0	0.0	0
F21.001	0.134	1.416	25.0	0.0	0.999	1.398	0.000	2	0.0	0.0	4
F22.000	0.110	1.533	27.1	0.0	1.200	1.445	0.000	1	0.0	0.0	3
F22.001	0.155	1.982	78.8	0.0	1.445	1.822	0.000	4	0.0	0.0	4
F21.002	0.285	1.982	78.8	0.2	2.022	2.492	0.000	19	0.0	0.0	8
F20.005	0.323	1.067	42.4	1.1	2.492	2.475	0.000	96	0.0	0.0	25
F20.006	0.373	1.067	42.4	1.6	2.475	2.484	0.000	139	0.0	0.0	29

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
F23.000	F23-0	F20-7	29.650	0.150	87.000	86.259	0.741	40.0	150
F20.007	F20-7	F20-8	16.546	0.150	84.879	84.796	0.083	200.0	225
F20.008	F20-8	F20-9	35.085	0.150	84.796	84.621	0.175	200.0	225
F24.000	F24-0	F24-1	23.399	0.150	87.460	86.875	0.585	40.0	150
F24.001	F24-1	F24-2	26.489	0.150	86.875	86.434	0.441	60.0	150
F24.002	F24-2	F24-3	26.513	0.150	86.359	86.182	0.177	150.0	225
F24.003	F24-3	F24-4	46.675	0.150	86.182	85.871	0.311	150.0	225
F24.004	F24-4	F24-5	11.330	0.150	85.871	85.795	0.076	150.0	225
F24.005	F24-5	F24-6	14.002	0.150	85.795	85.725	0.070	200.0	225
F24.006	F24-6	F24-7	4.197	0.150	85.725	85.704	0.021	200.0	225
F25.000	F25-0	F24-7	39.679	0.150	86.878	86.217	0.661	60.0	150
F24.007	F24-7	F24-8	29.598	0.150	85.704	85.556	0.148	200.0	225
F24.008	F24-8	F24-9	54.071	0.150	85.556	85.286	0.270	200.0	225
F26.000	F26-0	F26-1	46.978	0.150	86.000	85.217	0.783	60.0	150
F26.001	F26-1	F26-2	30.355	0.150	85.000	84.798	0.202	150.0	225
F26.002	F26-2	F26-3	8.424	0.150	84.798	84.742	0.056	150.0	225
F26.003	F26-3	F26-4	14.108	0.150	84.742	84.671	0.071	200.0	225
F26.004	F26-4	F24-9	49.413	0.150	84.671	84.424	0.247	200.0	225
F24.009	F24-9	F24-10	35.768	0.150	84.424	84.245	0.179	200.0	225
F27.000	F27-0	F27-1	48.171	0.150	86.537	85.734	0.803	60.0	150
F27.001	F27-1	F24-10	13.797	0.150	85.734	85.504	0.230	60.0	150
F24.010	F24-10	F20-9	12.776	0.150	84.245	84.181	0.064	200.0	225
F20.009	F20-9	F20-10	28.590	0.150	84.140	83.997	0.143	200.0	225
F28.000	F28-0	F28-1	27.297	0.150	87.206	86.751	0.455	60.0	150
F28.001	F28-1	F28-2	19.636	0.150	86.751	86.424	0.327	60.0	150
F28.002	F28-2	F28-3	16.174	0.150	86.424	86.154	0.270	60.0	150
F28.003	F28-3	F28-4	50.419	0.150	86.154	85.314	0.840	60.0	150
F28.004	F28-4	F28-5	6.686	0.150	85.314	85.203	0.111	60.0	150
F28.005	F28-5	F20-10	45.712	0.150	85.128	84.823	0.305	150.0	225
F20.010	F20-10	F20-11	16.759	0.150	83.997	83.913	0.084	200.0	225
F29.000	F29-0	F29-2	32.247	0.150	86.650	86.113	0.537	60.0	150
F29.001	F29-2	F20-11	19.807	0.150	86.113	85.783	0.330	60.0	150
F20.011	F20-11	F20-12	58.085	0.150	83.913	83.623	0.290	200.0	225

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)
F23.000	0.140	1.887	33.3	0.0	1.750	1.179	0.000	1	0.0	0.0	2
F20.007	0.409	1.067	42.4	2.2	2.484	3.079	0.000	194	0.0	0.0	35
F20.008	0.442	1.067	42.4	2.8	3.079	2.754	0.000	248	0.0	0.0	39
F24.000	0.140	1.887	33.3	0.0	0.900	1.342	0.000	1	0.0	0.0	2
F24.001	0.179	1.533	27.1	0.0	1.342	1.861	0.000	3	0.0	0.0	4
F24.002	0.147	1.238	49.2	0.1	1.861	1.901	0.000	7	0.0	0.0	7
F24.003	0.194	1.238	49.2	0.2	1.901	2.034	0.000	14	0.0	0.0	9
F24.004	0.237	1.238	49.2	0.3	2.034	2.115	0.000	26	0.0	0.0	13
F24.005	0.251	1.067	42.4	0.4	2.115	1.992	0.000	39	0.0	0.0	16
F24.006	0.266	1.067	42.4	0.6	1.992	2.013	0.000	52	0.0	0.0	19
F25.000	0.179	1.533	27.1	0.0	0.877	1.575	0.000	3	0.0	0.0	4
F24.007	0.309	1.067	42.4	0.9	2.013	1.758	0.000	77	0.0	0.0	22
F24.008	0.336	1.067	42.4	1.1	1.758	1.840	0.000	99	0.0	0.0	25
F26.000	0.110	1.533	27.1	0.0	2.230	2.512	0.000	1	0.0	0.0	3
F26.001	0.147	1.238	49.2	0.1	2.654	2.697	0.000	7	0.0	0.0	7
F26.002	0.216	1.238	49.2	0.2	2.697	2.710	0.000	18	0.0	0.0	11
F26.003	0.219	1.067	42.4	0.3	2.710	2.793	0.000	30	0.0	0.0	15
F26.004	0.251	1.067	42.4	0.5	2.793	2.702	0.000	44	0.0	0.0	17
F24.009	0.409	1.067	42.4	2.2	2.702	3.130	0.000	190	0.0	0.0	35
F27.000	0.110	1.533	27.1	0.0	0.900	1.766	0.000	1	0.0	0.0	3
F27.001	0.264	1.533	27.1	0.1	1.766	1.946	0.000	9	0.0	0.0	7
F24.010	0.442	1.067	42.4	2.9	3.130	3.194	0.000	256	0.0	0.0	40
F20.009	0.578	1.067	42.4	7.1	3.235	3.028	0.000	618	0.0	0.0	62
F28.000	0.110	1.533	27.1	0.0	1.200	1.516	0.000	1	0.0	0.0	3
F28.001	0.209	1.533	27.1	0.1	1.516	1.758	0.000	5	0.0	0.0	5
F28.002	0.264	1.533	27.1	0.1	1.758	1.839	0.000	10	0.0	0.0	7
F28.003	0.314	1.533	27.1	0.2	1.839	1.751	0.000	16	0.0	0.0	9
F28.004	0.361	1.533	27.1	0.3	1.751	1.826	0.000	26	0.0	0.0	11
F28.005	0.275	1.238	49.2	0.4	1.826	2.202	0.000	36	0.0	0.0	15
F20.010	0.620	1.067	42.4	9.0	3.028	3.572	0.000	782	0.0	0.0	70
F29.000	0.110	1.533	27.1	0.0	1.200	1.737	0.000	1	0.0	0.0	3
F29.001	0.209	1.533	27.1	0.1	1.737	1.777	0.000	5	0.0	0.0	5
F20.011	0.652	1.067	42.4	10.5	3.572	3.478	0.000	919	0.0	0.0	76

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
F30.000	F30-0	F30-1	21.299	0.150	85.879	85.347	0.532	40.0	150
F30.001	F30-1	F30-2	10.791	0.150	85.347	85.167	0.180	60.0	150
F30.002	F30-2	F30-3	15.699	0.150	85.117	84.855	0.262	60.0	150
F31.000	F31-0	F30-3	31.137	0.150	85.936	85.417	0.519	60.0	150
F30.003	F30-3	F30-4	4.382	0.150	84.780	84.751	0.029	150.0	225
F30.004	F30-4	F20-12	66.235	0.150	84.751	84.309	0.442	150.0	225
F20.012	F20-12	F20-13	8.638	0.150	83.623	83.580	0.043	200.0	225
F32.000	F32-0	F32-1	32.559	0.150	87.193	86.650	0.543	60.0	150
F32.001	F32-1	F32-2	15.294	0.150	86.650	86.395	0.255	60.0	150
F32.002	F32-2	F32-3	12.318	0.150	86.395	86.190	0.205	60.0	150
F32.003	F32-3	F32-4	13.791	0.150	86.190	85.960	0.230	60.0	150
F32.004	F32-4	F32-5	40.231	0.150	85.960	85.155	0.805	50.0	150
F32.005	F32-5	F32-6	57.057	0.150	85.080	84.795	0.285	200.0	225
F32.006	F32-6	F32-7	31.483	0.150	84.600	84.443	0.157	200.0	225
F32.007	F32-7	F32-8	32.442	0.150	84.443	84.281	0.162	200.0	225
F32.008	F32-8	F20-13	31.675	0.150	84.281	84.123	0.158	200.0	225
F33.000	F33-0	F33-1	24.608	0.150	85.762	85.352	0.410	60.0	150
F33.001	F33-1	F33-2	14.191	0.150	85.352	85.115	0.237	60.0	150
F33.002	F33-2	F33-3	47.607	0.150	85.115	84.798	0.317	150.0	150
F33.003	F33-3	F33-4	48.488	0.150	84.560	84.318	0.242	200.0	225
F34.000	F34-0	F34-1	27.550	0.150	86.350	85.891	0.459	60.0	150
F34.001	F34-1	F33-4	70.205	0.150	85.891	84.721	1.170	60.0	150
F33.004	F33-4	F20-13	65.157	0.150	84.318	83.992	0.326	200.0	225
F20.013	F20-13	F20-14	64.442	0.150	83.580	83.258	0.322	200.0	225
F20.014	F20-14	F20-15	14.802	0.150	82.195	82.121	0.074	200.0	300
F20.015	F20-15	F20-16 OUT	18.607	0.150	82.121	82.028	0.093	200.0	300
F36.000	ExFMH_1	F36-0	27.586	0.150	85.270	85.224	0.046	600.0	600
F36.001	F36-0	F36-1	33.528	0.150	85.224	85.168	0.056	600.0	600
F36.002	F36-1	F36-2	47.460	0.150	85.168	85.089	0.079	600.0	600
F36.003	F36-2	F36-3	40.692	0.150	85.089	85.021	0.068	600.0	600
F36.004	F36-3	F36-4	50.540	0.150	85.021	84.937	0.084	600.0	600
F36.005	F36-4	F36-5	65.175	0.150	84.937	84.828	0.109	600.0	600
F36.006	F36-5	EX DM 1 (IW)/MH 4 (MURPHY)	12.696	1.500	84.828	84.807	0.021	600.0	600

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)
F30.000	0.140	1.887	33.3	0.0	1.200	1.863	0.000	1	0.0	0.0	2
F30.001	0.179	1.533	27.1	0.0	1.863	2.002	0.000	4	0.0	0.0	5
F30.002	0.238	1.533	27.1	0.1	2.052	2.317	0.000	8	0.0	0.0	6
F31.000	0.110	1.533	27.1	0.0	1.200	1.755	0.000	1	0.0	0.0	3
F30.003	0.216	1.238	49.2	0.2	2.317	2.317	0.000	19	0.0	0.0	11
F30.004	0.256	1.238	49.2	0.3	2.317	2.792	0.000	29	0.0	0.0	14
F20.012	0.690	1.067	42.4	12.6	3.478	3.455	0.000	1101	0.0	0.0	84
F32.000	0.110	1.533	27.1	0.0	1.200	1.553	0.000	1	0.0	0.0	3
F32.001	0.209	1.533	27.1	0.1	1.553	1.574	0.000	5	0.0	0.0	5
F32.002	0.264	1.533	27.1	0.1	1.574	1.572	0.000	9	0.0	0.0	7
F32.003	0.290	1.533	27.1	0.2	1.572	1.567	0.000	15	0.0	0.0	8
F32.004	0.347	1.683	29.7	0.2	1.567	1.913	0.000	21	0.0	0.0	10
F32.005	0.235	1.067	42.4	0.4	1.913	1.856	0.000	31	0.0	0.0	15
F32.006	0.266	1.067	42.4	0.5	2.051	2.080	0.000	46	0.0	0.0	17
F32.007	0.295	1.067	42.4	0.8	2.080	2.565	0.000	66	0.0	0.0	21
F32.008	0.323	1.067	42.4	1.0	2.565	2.912	0.000	91	0.0	0.0	24
F33.000	0.110	1.533	27.1	0.0	1.200	1.496	0.000	1	0.0	0.0	3
F33.001	0.179	1.533	27.1	0.0	1.496	1.648	0.000	4	0.0	0.0	5
F33.002	0.174	0.955	16.9	0.1	1.648	1.957	0.000	8	0.0	0.0	8
F33.003	0.184	1.067	42.4	0.2	2.120	2.451	0.000	18	0.0	0.0	11
F34.000	0.110	1.533	27.1	0.0	0.700	1.034	0.000	1	0.0	0.0	3
F34.001	0.179	1.533	27.1	0.0	1.034	2.123	0.000	4	0.0	0.0	5
F33.004	0.251	1.067	42.4	0.5	2.451	3.043	0.000	42	0.0	0.0	17
F20.013	0.739	1.067	42.4	16.5	3.455	3.658	0.000	1442	0.0	0.0	97
F20.014	0.992	1.281	90.6	50.9	4.646	4.797	0.000	4336	0.0	1.1	161
F20.015	1.006	1.281	90.6	53.5	4.797	4.874	0.000	4563	0.0	1.1	166
F36.000	0.000	1.123	317.6	0.0	3.024	3.082	0.000	0	0.0	0.0	0
F36.001	0.000	1.123	317.6	0.0	3.082	2.957	0.000	0	0.0	0.0	0
F36.002	0.000	1.123	317.6	0.0	2.957	3.317	0.000	0	0.0	0.0	0
F36.003	0.000	1.123	317.6	0.0	3.317	4.463	0.000	0	0.0	0.0	0
F36.004	0.000	1.123	317.6	0.0	4.463	3.809	0.000	0	0.0	0.0	0
F36.005	0.000	1.123	317.6	0.0	3.809	2.672	0.000	0	0.0	0.0	0
F36.006	0.000	0.883	249.6	0.0	2.672	2.793	0.000	0	0.0	0.0	0

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
EX 2.001	EX Air Valve	EX 45 Bend	102.102	1.500	85.950	85.500	0.450	226.9	600
EX 2.002	EX 45 Bend	EX DM 1 (IW)/MH 4 (MURPHY)	104.198	1.500	85.500	84.803	0.697	149.5	600
EX 2.003	EX DM 1 (IW)/MH 4 (MURPHY)	EX EI 1.00	73.387	1.500	84.503	84.358	0.145	506.1	600
EX 2.004	EX EI 1.00	EX EI 1.01	84.888	1.500	84.358	84.190	0.168	505.3	900
EX 2.005	EX EI 1.01	EX EI 1.02	67.350	1.500	84.190	84.055	0.135	498.9	900
EX 2.006	EX EI 1.02	EX EI 1.03	67.421	1.500	84.055	83.919	0.136	495.7	900

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)
EX 2.001	0.000	1.439	406.8	0.0	1.235	1.200	0.000	0	0.0	0.0	0
EX 2.002	0.000	1.774	501.5	0.0	1.200	2.797	0.000	0	0.0	0.0	0
EX 2.003	0.000	0.962	271.9	0.0	3.097	2.670	0.000	0	0.0	0.0	0
EX 2.004	0.000	1.246	792.4	0.0	2.370	2.110	0.000	0	0.0	0.0	0
EX 2.005	0.000	1.254	797.5	0.0	2.110	2.366	0.000	0	0.0	0.0	0
EX 2.006	0.000	1.258	800.0	0.0	2.366	2.348	0.000	0	0.0	0.0	0

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
F1.000	39.385	60.0	150	Circular	88.635	87.735	0.750	88.440	87.079	1.211
F1.001	39.796	60.0	150	Circular	88.440	87.079	1.211	88.210	86.416	1.644
F2.000	25.219	60.0	150	Circular	88.422	87.100	1.172	88.210	86.680	1.380
F1.002	26.347	150.0	225	Circular	88.210	86.341	1.644	88.330	86.165	1.940
F1.003	49.095	150.0	225	Circular	88.330	86.165	1.940	88.564	85.838	2.501
F3.000	59.183	60.0	150	Circular	88.431	87.154	1.127	88.564	86.168	2.246
F1.004	3.466	150.0	225	Circular	88.564	85.838	2.501	88.564	85.815	2.524
F4.000	45.011	60.0	150	Circular	88.704	87.804	0.750	88.978	87.054	1.774
F4.001	46.284	60.0	150	Circular	88.978	87.054	1.774	89.156	86.283	2.723
F4.002	43.308	150.0	225	Circular	89.156	86.208	2.723	88.564	85.919	2.420
F1.005	64.256	180.0	225	Circular	88.564	85.815	2.524	88.684	85.458	3.001
F5.000	16.811	60.0	150	Circular	89.000	87.650	1.200	88.550	87.370	1.030
F5.001	25.893	60.0	150	Circular	88.550	87.370	1.030	88.316	86.938	1.228
F5.002	9.962	60.0	150	Circular	88.316	86.938	1.228	88.316	86.772	1.394
F5.003	48.933	150.0	150	Circular	88.316	86.772	1.394	88.485	86.446	1.889
F5.004	60.220	180.0	225	Circular	88.485	86.371	1.889	88.684	86.036	2.423
F1.006	61.755	180.0	225	Circular	88.684	85.458	3.001	88.525	85.115	3.185
F6.000	21.035	60.0	150	Circular	88.550	87.650	0.750	88.200	87.299	0.751
F6.001	38.032	60.0	150	Circular	88.200	87.299	0.751	88.200	86.665	1.385
F6.002	32.572	60.0	150	Circular	88.200	86.665	1.385	88.150	86.122	1.878
F6.003	16.590	60.0	150	Circular	88.150	86.122	1.878	88.050	85.846	2.054
F6.004	38.634	150.0	150	Circular	88.050	85.846	2.054	88.198	85.588	2.460
F6.005	38.253	180.0	225	Circular	88.198	85.513	2.460	88.525	85.300	3.000

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
F1.000	F1-0	1200	Manhole	Adoptable	F1-1	1200	Manhole	Adoptable
F1.001	F1-1	1200	Manhole	Adoptable	F1-2	1200	Manhole	Adoptable
F2.000	F2-0	1200	Manhole	Adoptable	F1-2	1200	Manhole	Adoptable
F1.002	F1-2	1200	Manhole	Adoptable	F1-3	1200	Manhole	Adoptable
F1.003	F1-3	1200	Manhole	Adoptable	F1-4	1200	Manhole	Adoptable
F3.000	F3-0	1200	Manhole	Adoptable	F1-4	1200	Manhole	Adoptable
F1.004	F1-4	1200	Manhole	Adoptable	F1-5	1200	Manhole	Adoptable
F4.000	F4-0	1200	Manhole	Adoptable	F4-1	1200	Manhole	Adoptable
F4.001	F4-1	1200	Manhole	Adoptable	F4-2	1200	Manhole	Adoptable
F4.002	F4-2	1200	Manhole	Adoptable	F1-5	1200	Manhole	Adoptable
F1.005	F1-5	1200	Manhole	Adoptable	F1-6	1200	Manhole	Adoptable
F5.000	F5-0	1200	Manhole	Adoptable	F5-1	1200	Manhole	Adoptable
F5.001	F5-1	1200	Manhole	Adoptable	F5-2	1200	Manhole	Adoptable
F5.002	F5-2	1200	Manhole	Adoptable	F5-3	1200	Manhole	Adoptable
F5.003	F5-3	1200	Manhole	Adoptable	F5-4	1200	Manhole	Adoptable
F5.004	F5-4	1200	Manhole	Adoptable	F1-6	1200	Manhole	Adoptable
F1.006	F1-6	1200	Manhole	Adoptable	F1-7	1200	Manhole	Adoptable
F6.000	F6-0	1200	Manhole	Adoptable	F6-1	1200	Manhole	Adoptable
F6.001	F6-1	1200	Manhole	Adoptable	F6-2	1200	Manhole	Adoptable
F6.002	F6-2	1200	Manhole	Adoptable	F6-3	1200	Manhole	Adoptable
F6.003	F6-3	1200	Manhole	Adoptable	F6-4	1200	Manhole	Adoptable
F6.004	F6-4	1200	Manhole	Adoptable	F6-5	1200	Manhole	Adoptable
F6.005	F6-5	1200	Manhole	Adoptable	F1-7	1200	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
F1.007	68.503	160.0	225	Circular	88.525	85.115	3.185	88.332	84.687	3.420
F1.008	17.038	160.0	225	Circular	88.332	84.687	3.420	87.991	84.581	3.185
F7.000	34.815	60.0	150	Circular	87.800	85.846	1.804	87.985	85.266	2.569
F8.000	31.654	60.0	150	Circular	88.020	86.800	1.070	87.985	86.272	1.563
F7.001	33.650	150.0	225	Circular	87.985	85.191	2.569	87.408	84.967	2.216
F7.002	9.418	200.0	225	Circular	87.408	84.967	2.216	87.543	84.920	2.398
F9.000	37.533	60.0	150	Circular	88.058	85.970	1.938	87.543	85.344	2.049
F7.003	52.274	200.0	225	Circular	87.543	84.920	2.398	87.333	84.659	2.449
F7.004	41.920	160.0	225	Circular	87.333	84.659	2.449	87.991	84.397	3.369
F1.009	8.857	160.0	225	Circular	87.991	84.397	3.369	88.100	84.342	3.533
F10.000	27.484	60.0	150	Circular	88.200	86.850	1.200	88.200	86.392	1.658
F10.001	5.156	60.0	150	Circular	88.200	86.392	1.658	88.200	86.306	1.744
F10.002	37.283	60.0	150	Circular	88.200	86.306	1.744	88.321	85.685	2.486
F10.003	22.206	150.0	150	Circular	88.321	85.685	2.486	88.230	85.537	2.543
F11.000	62.839	60.0	150	Circular	88.220	86.950	1.120	88.230	85.903	2.177
F10.004	44.343	160.0	150	Circular	88.230	85.537	2.543	88.100	85.260	2.690
F1.010	26.756	160.0	225	Circular	88.100	84.342	3.533	88.100	84.175	3.700
F1.011	30.579	160.0	225	Circular	88.100	84.175	3.700	87.687	83.984	3.478
F12.000	53.219	60.0	150	Circular	87.600	86.050	1.400	87.477	85.163	2.164
F12.001	35.709	150.0	150	Circular	87.477	85.163	2.164	87.699	84.925	2.624
F13.000	18.089	60.0	150	Circular	87.700	86.350	1.200	87.700	86.049	1.501
F13.001	30.675	60.0	150	Circular	87.700	86.049	1.501	87.674	85.538	1.986
F14.000	33.329	60.0	150	Circular	87.794	86.444	1.200	87.674	85.889	1.635
F13.002	14.421	60.0	150	Circular	87.674	85.538	1.986	87.699	85.298	2.251
F12.002	71.197	200.0	225	Circular	87.699	84.850	2.624	87.699	84.494	2.980
F15.000	54.382	60.0	150	Circular	88.100	86.750	1.200	87.699	85.844	1.705
F12.003	22.642	100.0	225	Circular	87.699	84.494	2.980	87.687	84.268	3.194
F1.012	27.530	160.0	225	Circular	87.687	83.984	3.478	87.926	83.812	3.889
F1.013	34.298	160.0	225	Circular	87.926	83.812	3.889	88.000	83.598	4.177
F1.014	15.742	160.0	225	Circular	88.000	83.598	4.177	88.000	83.500	4.275
F1.015	22.923	250.0	225	Circular	88.000	83.350	4.425	87.800	83.258	4.317
F1.016	34.410	270.0	225	Circular	87.800	83.258	4.317	87.221	83.131	3.865
F1.017	17.762	270.0	225	Circular	87.221	83.131	3.865	87.950	83.065	4.660
F1.018	48.692	270.0	225	Circular	87.950	83.065	4.660	87.550	82.885	4.440

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
F1.007	F1-7	1200	Manhole	Adoptable	F1-8	1200	Manhole	Adoptable
F1.008	F1-8	1200	Manhole	Adoptable	F1-9	1200	Manhole	Adoptable
F7.000	F7-0	1200	Manhole	Adoptable	F7-1	1200	Manhole	Adoptable
F8.000	F8-0	1200	Manhole	Adoptable	F7-1	1200	Manhole	Adoptable
F7.001	F7-1	1200	Manhole	Adoptable	F7-2	1200	Manhole	Adoptable
F7.002	F7-2	1200	Manhole	Adoptable	F7-3	1200	Manhole	Adoptable
F9.000	F9-0	1200	Manhole	Adoptable	F7-3	1200	Manhole	Adoptable
F7.003	F7-3	1200	Manhole	Adoptable	F7-4	1200	Manhole	Adoptable
F7.004	F7-4	1200	Manhole	Adoptable	F1-9	1200	Manhole	Adoptable
F1.009	F1-9	1200	Manhole	Adoptable	F1-10	1200	Manhole	Adoptable
F10.000	F10-0	1200	Manhole	Adoptable	F10-1	1200	Manhole	Adoptable
F10.001	F10-1	1200	Manhole	Adoptable	F10-2	1200	Manhole	Adoptable
F10.002	F10-2	1200	Manhole	Adoptable	F10-3	1200	Manhole	Adoptable
F10.003	F10-3	1200	Manhole	Adoptable	F10-4	1200	Manhole	Adoptable
F11.000	F11-0	1200	Manhole	Adoptable	F10-4	1200	Manhole	Adoptable
F10.004	F10-4	1200	Manhole	Adoptable	F1-10	1200	Manhole	Adoptable
F1.010	F1-10	1200	Manhole	Adoptable	F1-11	1200	Manhole	Adoptable
F1.011	F1-11	1200	Manhole	Adoptable	F1-12	1200	Manhole	Adoptable
F12.000	F14-0	1200	Manhole	Adoptable	F14-1	1200	Manhole	Adoptable
F12.001	F14-1	1200	Manhole	Adoptable	F12-2	1200	Manhole	Adoptable
F13.000	F13-0	1200	Manhole	Adoptable	F13-1	1200	Manhole	Adoptable
F13.001	F13-1	1200	Manhole	Adoptable	F12-1	1200	Manhole	Adoptable
F14.000	F12-0	1200	Manhole	Adoptable	F12-1	1200	Manhole	Adoptable
F13.002	F12-1	1200	Manhole	Adoptable	F12-2	1200	Manhole	Adoptable
F12.002	F12-2	1200	Manhole	Adoptable	F12-3	1200	Manhole	Adoptable
F15.000	F15-0	1200	Manhole	Adoptable	F12-3	1200	Manhole	Adoptable
F12.003	F12-3	1200	Manhole	Adoptable	F1-12	1200	Manhole	Adoptable
F1.012	F1-12	1200	Manhole	Adoptable	F1-13	1200	Manhole	Adoptable
F1.013	F1-13	1200	Manhole	Adoptable	F1-14	1200	Manhole	Adoptable
F1.014	F1-14	1200	Manhole	Adoptable	F1-15	1200	Manhole	Adoptable
F1.015	F1-15	1200	Manhole	Adoptable	F1-16	1200	Manhole	Adoptable
F1.016	F1-16	1200	Manhole	Adoptable	F1-17	1200	Manhole	Adoptable
F1.017	F1-17	1200	Manhole	Adoptable	F1-18	1200	Manhole	Adoptable
F1.018	F1-18	1200	Manhole	Adoptable	F1-19	1200	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
F19.000	36.224	60.0	150	Circular	87.550	86.500	0.900	87.550	85.896	1.504
F1.019	51.207	270.0	225	Circular	87.550	82.885	4.440	87.394	82.695	4.474
F18.000	16.107	40.0	150	Circular	87.868	86.300	1.418	87.984	85.897	1.937
F18.001	43.746	40.0	150	Circular	87.984	85.897	1.937	88.191	84.803	3.238
17.002	24.232	100.0	150	Circular	88.191	84.803	3.238	88.091	84.561	3.380
17.003	60.244	200.0	150	Circular	88.091	84.561	3.380	87.537	84.260	3.127
17.004	30.696	200.0	150	Circular	87.537	84.260	3.127	87.473	84.107	3.216
F17.000	9.167	60.0	150	Circular	87.437	86.087	1.200	87.473	85.934	1.389
17.005	27.127	200.0	150	Circular	87.473	84.107	3.216	87.394	83.971	3.273
F1.020	7.098	270.0	225	Circular	87.394	82.695	4.474	87.390	82.669	4.496
F1.021	10.965	270.0	225	Circular	87.390	82.669	4.496	87.450	82.628	4.597
F1.022	22.245	270.0	225	Circular	87.450	82.628	4.597	87.450	82.546	4.679
F16.000	50.315	60.0	150	Circular	87.450	86.584	0.716	87.450	85.745	1.555
F1.023	39.096	270.0	225	Circular	87.450	82.546	4.679	87.158	82.401	4.532
F1.024	35.451	270.0	225	Circular	87.158	82.401	4.532	87.141	82.270	4.646
F20.000	30.083	60.0	150	Circular	88.726	87.500	1.076	88.561	86.999	1.412
F20.001	20.492	60.0	150	Circular	88.561	86.999	1.412	88.279	86.657	1.472
F20.002	30.822	60.0	150	Circular	88.279	86.657	1.472	88.000	86.143	1.707
F20.003	37.797	150.0	225	Circular	88.000	86.068	1.707	87.834	85.816	1.793
F20.004	29.826	150.0	225	Circular	87.834	85.816	1.793	88.075	85.617	2.233
F21.000	27.898	60.0	150	Circular	89.246	88.346	0.750	89.030	87.881	0.999
F21.001	51.986	70.0	150	Circular	89.030	87.881	0.999	88.686	87.138	1.398
F22.000	20.936	60.0	150	Circular	88.906	87.556	1.200	88.802	87.207	1.445
F22.001	29.552	60.0	225	Circular	88.802	87.132	1.445	88.686	86.639	1.822
F21.002	64.848	60.0	225	Circular	88.686	86.439	2.022	88.075	85.358	2.492
F20.005	47.232	200.0	225	Circular	88.075	85.358	2.492	87.822	85.122	2.475
F20.006	48.568	200.0	225	Circular	87.822	85.122	2.475	87.588	84.879	2.484
F23.000	29.650	40.0	150	Circular	88.900	87.000	1.750	87.588	86.259	1.179
F20.007	16.546	200.0	225	Circular	87.588	84.879	2.484	88.100	84.796	3.079
F20.008	35.085	200.0	225	Circular	88.100	84.796	3.079	87.600	84.621	2.754
F24.000	23.399	40.0	150	Circular	88.510	87.460	0.900	88.367	86.875	1.342
F24.001	26.489	60.0	150	Circular	88.367	86.875	1.342	88.445	86.434	1.861
F24.002	26.513	150.0	225	Circular	88.445	86.359	1.861	88.308	86.182	1.901
F24.003	46.675	150.0	225	Circular	88.308	86.182	1.901	88.130	85.871	2.034

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
F19.000	F19-0	1200	Manhole	Adoptable	F1-19	1200	Manhole	Adoptable
F1.019	F1-19	1200	Manhole	Adoptable	F1-20	1200	Manhole	Adoptable
F18.000	F16-0	1200	Manhole	Adoptable	F16-1	1200	Manhole	Adoptable
F18.001	F16-1	1200	Manhole	Adoptable	F16-3	1200	Manhole	Adoptable
17.002	F16-3	1200	Manhole	Adoptable	F16-4	1200	Manhole	Adoptable
17.003	F16-4	1200	Manhole	Adoptable	F16-5	1200	Manhole	Adoptable
17.004	F16-5	1200	Manhole	Adoptable	F16-6	1200	Manhole	Adoptable
F17.000	F17-0	1200	Manhole	Adoptable	F16-6	1200	Manhole	Adoptable
17.005	F16-6	1200	Manhole	Adoptable	F1-20	1200	Manhole	Adoptable
F1.020	F1-20	1200	Manhole	Adoptable	F1-21	1200	Manhole	Adoptable
F1.021	F1-21	1200	Manhole	Adoptable	F1-22	1200	Manhole	Adoptable
F1.022	F1-22	1200	Manhole	Adoptable	F1-23	1200	Manhole	Adoptable
F16.000	F18-0	1200	Manhole	Adoptable	F1-23	1200	Manhole	Adoptable
F1.023	F1-23	1200	Manhole	Adoptable	F1-24	1200	Manhole	Adoptable
F1.024	F1-24	1200	Manhole	Adoptable	F20-14	1200	Manhole	Adoptable
F20.000	F20-0	1200	Manhole	Adoptable	F20-1	1200	Manhole	Adoptable
F20.001	F20-1	1200	Manhole	Adoptable	F20-2	1200	Manhole	Adoptable
F20.002	F20-2	1200	Manhole	Adoptable	F20-3	1200	Manhole	Adoptable
F20.003	F20-3	1200	Manhole	Adoptable	F20-4	1200	Manhole	Adoptable
F20.004	F20-4	1200	Manhole	Adoptable	F20-5	1200	Manhole	Adoptable
F21.000	F21-0	1200	Manhole	Adoptable	F21-1	1200	Manhole	Adoptable
F21.001	F21-1	1200	Manhole	Adoptable	F21-2	1200	Manhole	Adoptable
F22.000	F22-0	1200	Manhole	Adoptable	F22-1	1200	Manhole	Adoptable
F22.001	F22-1	1200	Manhole	Adoptable	F21-2	1200	Manhole	Adoptable
F21.002	F21-2	1200	Manhole	Adoptable	F20-5	1200	Manhole	Adoptable
F20.005	F20-5	1200	Manhole	Adoptable	F20-6	1200	Manhole	Adoptable
F20.006	F20-6	1200	Manhole	Adoptable	F20-7	1200	Manhole	Adoptable
F23.000	F23-0	1200	Manhole	Adoptable	F20-7	1200	Manhole	Adoptable
F20.007	F20-7	1200	Manhole	Adoptable	F20-8	1200	Manhole	Adoptable
F20.008	F20-8	1200	Manhole	Adoptable	F20-9	1200	Manhole	Adoptable
F24.000	F24-0	1200	Manhole	Adoptable	F24-1	1200	Manhole	Adoptable
F24.001	F24-1	1200	Manhole	Adoptable	F24-2	1200	Manhole	Adoptable
F24.002	F24-2	1200	Manhole	Adoptable	F24-3	1200	Manhole	Adoptable
F24.003	F24-3	1200	Manhole	Adoptable	F24-4	1200	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
F24.004	11.330	150.0	225	Circular	88.130	85.871	2.034	88.135	85.795	2.115
F24.005	14.002	200.0	225	Circular	88.135	85.795	2.115	87.942	85.725	1.992
F24.006	4.197	200.0	225	Circular	87.942	85.725	1.992	87.942	85.704	2.013
F25.000	39.679	60.0	150	Circular	87.905	86.878	0.877	87.942	86.217	1.575
F24.007	29.598	200.0	225	Circular	87.942	85.704	2.013	87.539	85.556	1.758
F24.008	54.071	200.0	225	Circular	87.539	85.556	1.758	87.351	85.286	1.840
F26.000	46.978	60.0	150	Circular	88.380	86.000	2.230	87.879	85.217	2.512
F26.001	30.355	150.0	225	Circular	87.879	85.000	2.654	87.720	84.798	2.697
F26.002	8.424	150.0	225	Circular	87.720	84.798	2.697	87.677	84.742	2.710
F26.003	14.108	200.0	225	Circular	87.677	84.742	2.710	87.689	84.671	2.793
F26.004	49.413	200.0	225	Circular	87.689	84.671	2.793	87.351	84.424	2.702
F24.009	35.768	200.0	225	Circular	87.351	84.424	2.702	87.600	84.245	3.130
F27.000	48.171	60.0	150	Circular	87.587	86.537	0.900	87.650	85.734	1.766
F27.001	13.797	60.0	150	Circular	87.650	85.734	1.766	87.600	85.504	1.946
F24.010	12.776	200.0	225	Circular	87.600	84.245	3.130	87.600	84.181	3.194
F20.009	28.590	200.0	225	Circular	87.600	84.140	3.235	87.250	83.997	3.028
F28.000	27.297	60.0	150	Circular	88.556	87.206	1.200	88.417	86.751	1.516
F28.001	19.636	60.0	150	Circular	88.417	86.751	1.516	88.332	86.424	1.758
F28.002	16.174	60.0	150	Circular	88.332	86.424	1.758	88.143	86.154	1.839
F28.003	50.419	60.0	150	Circular	88.143	86.154	1.839	87.215	85.314	1.751
F28.004	6.686	60.0	150	Circular	87.215	85.314	1.751	87.179	85.203	1.826
F28.005	45.712	150.0	225	Circular	87.179	85.128	1.826	87.250	84.823	2.202
F20.010	16.759	200.0	225	Circular	87.250	83.997	3.028	87.710	83.913	3.572
F29.000	32.247	60.0	150	Circular	88.000	86.650	1.200	88.000	86.113	1.737
F29.001	19.807	60.0	150	Circular	88.000	86.113	1.737	87.710	85.783	1.777
F20.011	58.085	200.0	225	Circular	87.710	83.913	3.572	87.326	83.623	3.478
F30.000	21.299	40.0	150	Circular	87.229	85.879	1.200	87.360	85.347	1.863
F30.001	10.791	60.0	150	Circular	87.360	85.347	1.863	87.319	85.167	2.002
F30.002	15.699	60.0	150	Circular	87.319	85.117	2.052	87.322	84.855	2.317
F31.000	31.137	60.0	150	Circular	87.286	85.936	1.200	87.322	85.417	1.755
F30.003	4.382	150.0	225	Circular	87.322	84.780	2.317	87.293	84.751	2.317
F30.004	66.235	150.0	225	Circular	87.293	84.751	2.317	87.326	84.309	2.792
F20.012	8.638	200.0	225	Circular	87.326	83.623	3.478	87.260	83.580	3.455
F32.000	32.559	60.0	150	Circular	88.543	87.193	1.200	88.353	86.650	1.553

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
F24.004	F24-4	1200	Manhole	Adoptable	F24-5	1200	Manhole	Adoptable
F24.005	F24-5	1200	Manhole	Adoptable	F24-6	1200	Manhole	Adoptable
F24.006	F24-6	1200	Manhole	Adoptable	F24-7	1200	Manhole	Adoptable
F25.000	F25-0	1200	Manhole	Adoptable	F24-7	1200	Manhole	Adoptable
F24.007	F24-7	1200	Manhole	Adoptable	F24-8	1200	Manhole	Adoptable
F24.008	F24-8	1200	Manhole	Adoptable	F24-9	1200	Manhole	Adoptable
F26.000	F26-0	1200	Manhole	Adoptable	F26-1	1200	Manhole	Adoptable
F26.001	F26-1	1200	Manhole	Adoptable	F26-2	1200	Manhole	Adoptable
F26.002	F26-2	1200	Manhole	Adoptable	F26-3	1200	Manhole	Adoptable
F26.003	F26-3	1200	Manhole	Adoptable	F26-4	1200	Manhole	Adoptable
F26.004	F26-4	1200	Manhole	Adoptable	F24-9	1200	Manhole	Adoptable
F24.009	F24-9	1200	Manhole	Adoptable	F24-10	1200	Manhole	Adoptable
F27.000	F27-0	1200	Manhole	Adoptable	F27-1	1200	Manhole	Adoptable
F27.001	F27-1	1200	Manhole	Adoptable	F24-10	1200	Manhole	Adoptable
F24.010	F24-10	1200	Manhole	Adoptable	F20-9	1200	Manhole	Adoptable
F20.009	F20-9	1200	Manhole	Adoptable	F20-10	1200	Manhole	Adoptable
F28.000	F28-0	1200	Manhole	Adoptable	F28-1	1200	Manhole	Adoptable
F28.001	F28-1	1200	Manhole	Adoptable	F28-2	1200	Manhole	Adoptable
F28.002	F28-2	1200	Manhole	Adoptable	F28-3	1200	Manhole	Adoptable
F28.003	F28-3	1200	Manhole	Adoptable	F28-4	1200	Manhole	Adoptable
F28.004	F28-4	1200	Manhole	Adoptable	F28-5	1200	Manhole	Adoptable
F28.005	F28-5	1200	Manhole	Adoptable	F20-10	1200	Manhole	Adoptable
F20.010	F20-10	1200	Manhole	Adoptable	F20-11	1200	Manhole	Adoptable
F29.000	F29-0	1200	Manhole	Adoptable	F29-2	1200	Manhole	Adoptable
F29.001	F29-2	1200	Manhole	Adoptable	F20-11	1200	Manhole	Adoptable
F20.011	F20-11	1200	Manhole	Adoptable	F20-12	1200	Manhole	Adoptable
F30.000	F30-0	1200	Manhole	Adoptable	F30-1	1200	Manhole	Adoptable
F30.001	F30-1	1200	Manhole	Adoptable	F30-2	1200	Manhole	Adoptable
F30.002	F30-2	1200	Manhole	Adoptable	F30-3	1200	Manhole	Adoptable
F31.000	F31-0	1200	Manhole	Adoptable	F30-3	1200	Manhole	Adoptable
F30.003	F30-3	1200	Manhole	Adoptable	F30-4	1200	Manhole	Adoptable
F30.004	F30-4	1200	Manhole	Adoptable	F20-12	1200	Manhole	Adoptable
F20.012	F20-12	1200	Manhole	Adoptable	F20-13	1200	Manhole	Adoptable
F32.000	F32-0	1200	Manhole	Adoptable	F32-1	1200	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
F32.001	15.294	60.0	150	Circular	88.353	86.650	1.553	88.119	86.395	1.574
F32.002	12.318	60.0	150	Circular	88.119	86.395	1.574	87.912	86.190	1.572
F32.003	13.791	60.0	150	Circular	87.912	86.190	1.572	87.677	85.960	1.567
F32.004	40.231	50.0	150	Circular	87.677	85.960	1.567	87.218	85.155	1.913
F32.005	57.057	200.0	225	Circular	87.218	85.080	1.913	86.876	84.795	1.856
F32.006	31.483	200.0	225	Circular	86.876	84.600	2.051	86.748	84.443	2.080
F32.007	32.442	200.0	225	Circular	86.748	84.443	2.080	87.071	84.281	2.565
F32.008	31.675	200.0	225	Circular	87.071	84.281	2.565	87.260	84.123	2.912
F33.000	24.608	60.0	150	Circular	87.112	85.762	1.200	86.998	85.352	1.496
F33.001	14.191	60.0	150	Circular	86.998	85.352	1.496	86.913	85.115	1.648
F33.002	47.607	150.0	150	Circular	86.913	85.115	1.648	86.905	84.798	1.957
F33.003	48.488	200.0	225	Circular	86.905	84.560	2.120	86.994	84.318	2.451
F34.000	27.550	60.0	150	Circular	87.200	86.350	0.700	87.075	85.891	1.034
F34.001	70.205	60.0	150	Circular	87.075	85.891	1.034	86.994	84.721	2.123
F33.004	65.157	200.0	225	Circular	86.994	84.318	2.451	87.260	83.992	3.043
F20.013	64.442	200.0	225	Circular	87.260	83.580	3.455	87.141	83.258	3.658
F20.014	14.802	200.0	300	Circular	87.141	82.195	4.646	87.218	82.121	4.797
F20.015	18.607	200.0	300	Circular	87.218	82.121	4.797	87.202	82.028	4.874
F36.000	27.586	600.0	600	Circular	88.894	85.270	3.024	88.906	85.224	3.082
F36.001	33.528	600.0	600	Circular	88.906	85.224	3.082	88.725	85.168	2.957
F36.002	47.460	600.0	600	Circular	88.725	85.168	2.957	89.006	85.089	3.317
F36.003	40.692	600.0	600	Circular	89.006	85.089	3.317	90.084	85.021	4.463
F36.004	50.540	600.0	600	Circular	90.084	85.021	4.463	89.346	84.937	3.809
F36.005	65.175	600.0	600	Circular	89.346	84.937	3.809	88.100	84.828	2.672
F36.006	12.696	600.0	600	Circular	88.100	84.828	2.672	88.200	84.807	2.793
EX 2.001	102.102	226.9	600	Circular	87.785	85.950	1.235	87.300	85.500	1.200
EX 2.002	104.198	149.5	600	Circular	87.300	85.500	1.200	88.200	84.803	2.797
EX 2.003	73.387	506.1	600	Circular	88.200	84.503	3.097	87.628	84.358	2.670
EX 2.004	84.888	505.3	900	Circular	87.628	84.358	2.370	87.200	84.190	2.110
EX 2.005	67.350	498.9	900	Circular	87.200	84.190	2.110	87.321	84.055	2.366
EX 2.006	67.421	495.7	900	Circular	87.321	84.055	2.366	87.167	83.919	2.348

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
F32.001	F32-1	1200	Manhole	Adoptable	F32-2	1200	Manhole	Adoptable
F32.002	F32-2	1200	Manhole	Adoptable	F32-3	1200	Manhole	Adoptable
F32.003	F32-3	1200	Manhole	Adoptable	F32-4	1200	Manhole	Adoptable
F32.004	F32-4	1200	Manhole	Adoptable	F32-5	1200	Manhole	Adoptable
F32.005	F32-5	1200	Manhole	Adoptable	F32-6	1200	Manhole	Adoptable
F32.006	F32-6	1200	Manhole	Adoptable	F32-7	1200	Manhole	Adoptable
F32.007	F32-7	1200	Manhole	Adoptable	F32-8	1200	Manhole	Adoptable
F32.008	F32-8	1200	Manhole	Adoptable	F20-13	1200	Manhole	Adoptable
F33.000	F33-0	1200	Manhole	Adoptable	F33-1	1200	Manhole	Adoptable
F33.001	F33-1	1200	Manhole	Adoptable	F33-2	1200	Manhole	Adoptable
F33.002	F33-2	1200	Manhole	Adoptable	F33-3	1200	Manhole	Adoptable
F33.003	F33-3	1200	Manhole	Adoptable	F33-4	1200	Manhole	Adoptable
F34.000	F34-0	1200	Manhole	Adoptable	F34-1	1200	Manhole	Adoptable
F34.001	F34-1	1200	Manhole	Adoptable	F33-4	1200	Manhole	Adoptable
F33.004	F33-4	1200	Manhole	Adoptable	F20-13	1200	Manhole	Adoptable
F20.013	F20-13	1200	Manhole	Adoptable	F20-14	1200	Manhole	Adoptable
F20.014	F20-14	1200	Manhole	Adoptable	F20-15	1200	Manhole	Adoptable
F20.015	F20-15	1200	Manhole	Adoptable	F20-16 OUT	1200	Manhole	Adoptable
F36.000	ExFMH_1	1500	Manhole	Adoptable	F36-0	1500	Manhole	Adoptable
F36.001	F36-0	1500	Manhole	Adoptable	F36-1	1500	Manhole	Adoptable
F36.002	F36-1	1500	Manhole	Adoptable	F36-2	1500	Manhole	Adoptable
F36.003	F36-2	1500	Manhole	Adoptable	F36-3	1500	Manhole	Adoptable
F36.004	F36-3	1500	Manhole	Adoptable	F36-4	1500	Manhole	Adoptable
F36.005	F36-4	1500	Manhole	Adoptable	F36-5	1500	Manhole	Adoptable
F36.006	F36-5	1500	Manhole	Adoptable	EX DM 1 (IW)/MH 4 (MURPHY)	1500	Manhole	Adoptable
EX 2.001	EX Air Valve	1200	Manhole	Adoptable	EX 45 Bend	1200	Manhole	Adoptable
EX 2.002	EX 45 Bend	1200	Manhole	Adoptable	EX DM 1 (IW)/MH 4 (MURPHY)	1500	Manhole	Adoptable
EX 2.003	EX DM 1 (IW)/MH 4 (MURPHY)	1500	Manhole	Adoptable	EX EI 1.00	1800	Manhole	Adoptable
EX 2.004	EX EI 1.00	1800	Manhole	Adoptable	EX EI 1.01	1800	Manhole	Adoptable
EX 2.005	EX EI 1.01	1800	Manhole	Adoptable	EX EI 1.02	1800	Manhole	Adoptable
EX 2.006	EX EI 1.02	1800	Manhole	Adoptable	EX EI 1.03	1800	Manhole	Adoptable

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F1-0	681605.904	714507.116	88.635	0.900	1200	0	F1.000	87.735	150
F1-1	681643.639	714518.395	88.440	1.361	1200	1 0	F1.000	87.079	150
							F1.001	87.079	150
F2-0	681705.935	714537.000	88.422	1.322	1200	0	F2.000	87.100	150
F1-2	681681.768	714529.791	88.210	1.869	1200	1	F2.000	86.680	150
						2	F1.001	86.416	150
						0	F1.002	86.341	225
F1-3	681674.642	714555.156	88.330	2.165	1200	1	F1.002	86.165	225
						0	F1.003	86.165	225
F3-0	681703.061	714625.818	88.431	1.277	1200	0	F3.000	87.154	150
F1-4	681650.788	714598.067	88.564	2.726	1200	1	F3.000	86.168	150
						2	F1.003	85.838	225
						0	F1.004	85.838	225
F4-0	681582.191	714510.863	88.704	0.900	1200	0	F4.000	87.804	150
F4-1	681569.307	714553.991	88.978	1.924	1200	1 0	F4.000	87.054	150
							F4.001	87.054	150
F4-2	681609.685	714576.614	89.156	2.948	1200	1 0	F4.001	86.283	150
							F4.002	86.208	225
F1-5	681647.322	714598.040	88.564	2.749	1200	1	F4.002	85.919	225
						2	F1.004	85.815	225
						0	F1.005	85.815	225
F5-0	681536.138	714558.239	89.000	1.350	1200	0	F5.000	87.650	150
F5-1	681526.925	714572.301	88.550	1.180	1200	1 0	F5.000	87.370	150
							F5.001	87.370	150
F5-2	681515.254	714595.415	88.316	1.378	1200	1 0	F5.001	86.938	150
							F5.002	86.938	150
F5-3	681520.512	714603.858	88.316	1.544	1200	1 0	F5.002	86.772	150
							F5.003	86.772	150
F5-4	681563.804	714626.666	88.485	2.114	1200	1 0	F5.003	86.446	150
							F5.004	86.371	225
F1-6	681617.082	714654.736	88.684	3.226	1200	1	F5.004	86.036	225
						2	F1.005	85.458	225
						0	F1.006	85.458	225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F6-0	681726.249	714560.543	88.550	0.900	1200				
						0	F6.000	87.650	150
F6-1	681725.107	714581.547	88.200	0.901	1200				
						1	F6.000	87.299	150
						0	F6.001	87.299	150
F6-2	681728.107	714619.460	88.200	1.535	1200				
						1	F6.001	86.665	150
						0	F6.002	86.665	150
F6-3	681722.615	714651.566	88.150	2.028	1200				
						1	F6.002	86.122	150
						0	F6.003	86.122	150
F6-4	681723.730	714668.118	88.050	2.204	1200				
						1	F6.003	85.846	150
						0	F6.004	85.846	150
F6-5	681705.206	714702.021	88.198	2.685	1200				
						1	F6.004	85.588	150
						0	F6.005	85.513	225
F1-7	681671.450	714684.025	88.525	3.410	1200				
						1	F6.005	85.300	225
						2	F1.006	85.115	225
						0	F1.007	85.115	225
F1-8	681638.950	714744.328	88.332	3.645	1200				
						1	F1.007	84.687	225
						0	F1.008	84.687	225
F7-0	681490.078	714715.528	87.800	1.954	1200				
						0	F7.000	85.846	150
F8-0	681521.402	714656.903	88.020	1.220	1200				
						0	F8.000	86.800	150
F7-1	681506.482	714684.820	87.985	2.794	1200				
						1	F8.000	86.272	150
						2	F7.000	85.266	150
						0	F7.001	85.191	225
F7-2	681536.163	714700.675	87.408	2.441	1200				
						1	F7.001	84.967	225
						0	F7.002	84.967	225
F9-0	681558.286	714659.263	88.058	2.088	1200				
						0	F9.000	85.970	150
F7-3	681540.601	714692.368	87.543	2.623	1200				
						1	F9.000	85.344	150
						2	F7.002	84.920	225
						0	F7.003	84.920	225
F7-4	681586.773	714716.877	87.333	2.674	1200				
						1	F7.003	84.659	225
						0	F7.004	84.659	225
F1-9	681623.827	714736.480	87.991	3.594	1200				
						1	F7.004	84.397	225
						2	F1.008	84.581	225
						0	F1.009	84.397	225
F10-0	681713.509	714720.549	88.200	1.350	1200				
						0	F10.000	86.850	150

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F10-1	681700.576	714744.800	88.200	1.808	1200	1	F10.000	86.392	150
						0	F10.001	86.392	150
F10-2	681695.873	714742.686	88.200	1.894	1200	1	F10.001	86.306	150
						0	F10.002	86.306	150
F10-3	681678.365	714775.602	88.321	2.636	1200	1	F10.002	85.685	150
						0	F10.003	85.685	150
F11-0	681688.371	714709.683	88.220	1.270	1200				
						0	F11.000	86.950	150
F10-4	681658.788	714765.122	88.230	2.693	1200	1	F11.000	85.903	150
						2	F10.003	85.537	150
						0	F10.004	85.537	150
F1-10	681619.645	714744.287	88.100	3.758	1200	1	F10.004	85.260	150
						2	F1.009	84.342	225
						0	F1.010	84.342	225
F1-11	681607.012	714767.873	88.100	3.925	1200	1	F1.010	84.175	225
						0	F1.011	84.175	225
F14-0	681573.282	714744.034	87.600	1.550	1200				
						0	F12.000	86.050	150
F14-1	681526.341	714718.957	87.477	2.314	1200	1	F12.000	85.163	150
						0	F12.001	85.163	150
F13-0	681465.808	714761.926	87.700	1.350	1200				
						0	F13.000	86.350	150
F13-1	681481.785	714770.408	87.700	1.651	1200	1	F13.000	86.049	150
						0	F13.001	86.049	150
F12-0	681467.425	714728.011	87.794	1.350	1200				
						0	F14.000	86.444	150
F12-1	681496.840	714743.682	87.674	2.136	1200	1	F14.000	85.889	150
						2	F13.001	85.538	150
						0	F13.002	85.538	150
F12-2	681509.560	714750.477	87.699	2.849	1200	1	F13.002	85.298	150
						2	F12.001	84.925	150
						0	F12.002	84.850	225
F15-0	681598.067	714736.123	88.100	1.350	1200				
						0	F15.000	86.750	150
F12-3	681572.350	714784.040	87.699	3.205	1200	1	F15.000	85.844	150
						2	F12.002	84.494	225
						0	F12.003	84.494	225
F1-12	681592.328	714794.696	87.687	3.703	1200	1	F12.003	84.268	225
						2	F1.011	83.984	225
						0	F1.012	83.984	225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F1-13	681616.616	714807.658	87.926	4.114	1200	1	F1.012	83.812	225
						0	F1.013	83.812	225
F1-14	681600.550	714837.960	88.000	4.402	1200	1	F1.013	83.598	225
						0	F1.014	83.598	225
F1-15	681586.729	714830.424	88.000	4.650	1200	1	F1.014	83.500	225
						0	F1.015	83.350	225
F1-16	681571.873	714847.882	87.800	4.542	1200	1	F1.015	83.258	225
						0	F1.016	83.258	225
F1-17	681541.687	714831.363	87.221	4.090	1200	1	F1.016	83.131	225
						0	F1.017	83.131	225
F1-18	681524.354	714827.481	87.950	4.885	1200	1	F1.017	83.065	225
						0	F1.018	83.065	225
F19-0	681449.454	714787.470	87.550	1.050	1200	0	F19.000	86.500	150
F1-19	681481.406	714804.537	87.550	4.665	1200	1	F19.000	85.896	150
						2	F1.018	82.885	225
						0	F1.019	82.885	225
F16-0	681552.176	714897.692	87.868	1.568	1200	0	F18.000	86.300	150
F16-1	681560.903	714884.154	87.984	2.087	1200	1	F18.000	85.897	150
						0	F18.001	85.897	150
F16-3	681524.134	714860.453	88.191	3.388	1200	1	F18.001	84.803	150
						0	17.002	84.803	150
F16-4	681503.825	714847.235	88.091	3.530	1200	1	17.002	84.561	150
						0	17.003	84.561	150
F16-5	681450.686	714818.852	87.537	3.277	1200	1	17.003	84.260	150
						0	17.004	84.260	150
F17-0	681419.260	714812.458	87.437	1.350	1200	0	F17.000	86.087	150
F16-6	681423.611	714804.389	87.473	3.366	1200	1	F17.000	85.934	150
						2	17.004	84.107	150
						0	17.005	84.107	150
F1-20	681436.252	714780.387	87.394	4.699	1200	1	17.005	83.971	150
						2	F1.019	82.695	225
						0	F1.020	82.695	225
F1-21	681439.149	714773.907	87.390	4.721	1200	1	F1.020	82.669	225
						0	F1.021	82.669	225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F1-22	681436.168	714763.355	87.450	4.822	1200	1	F1.021	82.628	225
						0	F1.022	82.628	225
F18-0	681392.894	714797.345	87.450	0.866	1200	0	F16.000	86.584	150
F1-23	681416.521	714752.922	87.450	4.904	1200	1	F16.000	85.745	150
						2	F1.022	82.546	225
						0	F1.023	82.546	225
F1-24	681378.751	714742.826	87.158	4.757	1200	1	F1.023	82.401	225
						0	F1.024	82.401	225
F20-0	681439.291	714444.344	88.726	1.226	1200	0	F20.000	87.500	150
F20-1	681465.939	714458.303	88.561	1.562	1200	1	F20.000	86.999	150
						0	F20.001	86.999	150
F20-2	681484.092	714467.811	88.279	1.622	1200	1	F20.001	86.657	150
						0	F20.002	86.657	150
F20-3	681469.215	714494.805	88.000	1.932	1200	1	F20.002	86.143	150
						0	F20.003	86.068	225
F20-4	681447.197	714525.527	87.834	2.018	1200	1	F20.003	85.816	225
						0	F20.004	85.816	225
F21-0	681321.207	714553.285	89.246	0.900	1200	0	F21.000	88.346	150
F21-1	681341.209	714533.837	89.030	1.149	1200	1	F21.000	87.881	150
						0	F21.001	87.881	150
F22-0	681412.481	714461.119	88.906	1.350	1200	0	F22.000	87.556	150
F22-1	681400.498	714478.287	88.802	1.670	1200	1	F22.000	87.207	150
						0	F22.001	87.132	225
F21-2	681381.331	714500.780	88.686	2.247	1200	1	F22.001	86.639	225
						2	F21.001	87.138	150
						0	F21.002	86.439	225
F20-5	681426.659	714547.155	88.075	2.717	1200	1	F21.002	85.358	225
						2	F20.004	85.617	225
						0	F20.005	85.358	225
F20-6	681390.976	714578.100	87.822	2.700	1200	1	F20.005	85.122	225
						0	F20.006	85.122	225
F23-0	681332.220	714579.790	88.900	1.900	1200	0	F23.000	87.000	150

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F20-7	681349.719	714603.726	87.588	2.709	1200		1 F23.000 2 F20.006 0 F20.007	86.259 84.879 84.879	150 225 225
F20-8	681358.300	714617.873	88.100	3.304	1200		1 F20.007 0 F20.008	84.796 84.796	225 225
F24-0	681526.742	714478.429	88.510	1.050	1200		0 F24.000	87.460	150
F24-1	681547.942	714488.332	88.367	1.492	1200		1 F24.000 0 F24.001	86.875 86.875	150 150
F24-2	681536.421	714512.184	88.445	2.086	1200		1 F24.001 0 F24.002	86.434 86.359	150 225
F24-3	681522.814	714534.939	88.308	2.126	1200		1 F24.002 0 F24.003	86.182 86.182	225 225
F24-4	681495.671	714572.910	88.130	2.259	1200		1 F24.003 0 F24.004	85.871 85.871	225 225
F24-5	681492.512	714583.791	88.135	2.340	1200		1 F24.004 0 F24.005	85.795 85.795	225 225
F24-6	681478.757	714581.170	87.942	2.217	1200		1 F24.005 0 F24.006	85.725 85.725	225 225
F25-0	681440.096	714560.424	87.905	1.027	1200		0 F25.000	86.878	150
F24-7	681475.059	714579.186	87.942	2.238	1200		1 F25.000 2 F24.006 0 F24.007	86.217 85.704 85.704	150 225 225
F24-8	681460.126	714604.741	87.539	1.983	1200		1 F24.007 0 F24.008	85.556 85.556	225 225
F26-0	681496.301	714626.098	88.380	2.380	1200		0 F26.000	86.000	150
F26-1	681474.131	714667.516	87.879	2.879	1200		1 F26.000 0 F26.001	85.217 85.000	150 225
F26-2	681459.717	714694.230	87.720	2.922	1200		1 F26.001 0 F26.002	84.798 84.798	225 225
F26-3	681452.414	714690.031	87.677	2.935	1200		1 F26.002 0 F26.003	84.742 84.742	225 225
F26-4	681442.036	714680.474	87.689	3.018	1200		1 F26.003 0 F26.004	84.671 84.671	225 225

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F24-9	681417.272	714637.714	87.351	2.927	1200	1	F26.004	84.424	225
						2	F24.008	85.286	225
						0	F24.009	84.424	225
F27-0	681420.559	714707.290	87.587	1.050	1200	0	F27.000	86.537	150
F27-1	681396.370	714665.633	87.650	1.916	1200	1	F27.000	85.734	150
						0	F27.001	85.734	150
F24-10	681386.517	714655.975	87.600	3.355	1200	1	F27.001	85.504	150
						2	F24.009	84.245	225
						0	F24.010	84.245	225
F20-9	681376.792	714647.689	87.600	3.460	1200	1	F24.010	84.181	225
						2	F20.008	84.621	225
						0	F20.009	84.140	225
F28-0	681241.932	714575.312	88.556	1.350	1200	0	F28.000	87.206	150
F28-1	681268.719	714570.058	88.417	1.666	1200	1	F28.000	86.751	150
						0	F28.001	86.751	150
F28-2	681288.354	714570.205	88.332	1.908	1200	1	F28.001	86.424	150
						0	F28.002	86.424	150
F28-3	681302.827	714577.426	88.143	1.989	1200	1	F28.002	86.154	150
						0	F28.003	86.154	150
F28-4	681330.785	714619.384	87.215	1.901	1200	1	F28.003	85.314	150
						0	F28.004	85.314	150
F28-5	681327.278	714625.076	87.179	2.051	1200	1	F28.004	85.203	150
						0	F28.005	85.128	225
F20-10	681352.693	714663.072	87.250	3.253	1200	1	F28.005	84.823	225
						2	F20.009	83.997	225
						0	F20.010	83.997	225
F29-0	681392.820	714718.858	88.000	1.350	1200	0	F29.000	86.650	150
F29-2	681375.025	714691.965	88.000	1.887	1200	1	F29.000	86.113	150
						0	F29.001	86.113	150
F20-11	681362.184	714676.885	87.710	3.797	1200	1	F29.001	85.783	150
						2	F20.010	83.913	225
						0	F20.011	83.913	225
F30-0	681241.977	714638.304	87.229	1.350	1200	0	F30.000	85.879	150
F30-1	681262.902	714634.330	87.360	2.013	1200	1	F30.000	85.347	150
						0	F30.001	85.347	150

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F30-2	681272.752	714638.737	87.319	2.202	1200	1	F30.001	85.167	150
						0	F30.002	85.117	150
F31-0	681306.931	714634.640	87.286	1.350	1200	0	F31.000	85.936	150
F30-3	681281.103	714652.031	87.322	2.542	1200	1	F31.000	85.417	150
						2	F30.002	84.855	150
						0	F30.003	84.780	225
F30-4	681277.468	714654.479	87.293	2.542	1200	1	F30.003	84.751	225
						0	F30.004	84.751	225
F20-12	681314.190	714709.602	87.326	3.703	1200	1	F30.004	84.309	225
						2	F20.011	83.623	225
						0	F20.012	83.623	225
F32-0	681232.207	714577.382	88.543	1.350	1200	0	F32.000	87.193	150
F32-1	681200.253	714583.628	88.353	1.703	1200	1	F32.000	86.650	150
						0	F32.001	86.650	150
F32-2	681186.751	714590.812	88.119	1.724	1200	1	F32.001	86.395	150
						0	F32.002	86.395	150
F32-3	681179.482	714600.756	87.912	1.722	1200	1	F32.002	86.190	150
						0	F32.003	86.190	150
F32-4	681176.174	714614.144	87.677	1.717	1200	1	F32.003	85.960	150
						0	F32.004	85.960	150
F32-5	681173.612	714654.293	87.218	2.138	1200	1	F32.004	85.155	150
						0	F32.005	85.080	225
F32-6	681230.561	714657.804	86.876	2.276	1200	1	F32.005	84.795	225
						0	F32.006	84.600	225
F32-7	681258.083	714673.091	86.748	2.305	1200	1	F32.006	84.443	225
						0	F32.007	84.443	225
F32-8	681283.967	714692.649	87.071	2.790	1200	1	F32.007	84.281	225
						0	F32.008	84.281	225
F33-0	681175.802	714667.406	87.112	1.350	1200	0	F33.000	85.762	150
F33-1	681174.873	714691.996	86.998	1.646	1200	1	F33.000	85.352	150
						0	F33.001	85.352	150
F33-2	681181.559	714704.513	86.913	1.798	1200	1	F33.001	85.115	150
						0	F33.002	85.115	150

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F33-3	681222.482	714728.838	86.905	2.345	1200	1	F33.002	84.798	150
						0	F33.003	84.560	225
F34-0	681329.047	714800.041	87.200	0.850	1200	0	F34.000	86.350	150
F34-1	681304.981	714813.451	87.075	1.184	1200	1	F34.000	85.891	150
						0	F34.001	85.891	150
F33-4	681260.017	714759.534	86.994	2.676	1200	1	F34.001	84.721	150
						2	F33.003	84.318	225
						0	F33.004	84.318	225
F20-13	681307.001	714714.391	87.260	3.680	1200	1	F33.004	83.992	225
						2	F32.008	84.123	225
						3	F20.012	83.580	225
						0	F20.013	83.580	225
F20-14	681349.491	714762.841	87.141	4.946	1200	1	F20.013	83.258	225
						2	F1.024	82.270	225
						0	F20.014	82.195	300
F20-15	681358.981	714774.201	87.218	5.097	1200	1	F20.014	82.121	300
						0	F20.015	82.121	300
F20-16 OUT	681374.034	714763.264	87.202	5.174	1200	1	F20.015	82.028	300
ExFMH_1	681413.756	714450.016	88.894	3.624	1500	0	F36.000	85.270	600
F36-0	681397.961	714472.633	88.906	3.682	1500	1	F36.000	85.224	600
						0	F36.001	85.224	600
F36-1	681375.805	714497.797	88.725	3.557	1500	1	F36.001	85.168	600
						0	F36.002	85.168	600
F36-2	681339.022	714527.788	89.006	3.917	1500	1	F36.002	85.089	600
						0	F36.003	85.089	600
F36-3	681309.438	714555.727	90.084	5.063	1500	1	F36.003	85.021	600
						0	F36.004	85.021	600
F36-4	681337.470	714597.780	89.346	4.409	1500	1	F36.004	84.937	600
						0	F36.005	84.937	600
F36-5	681370.964	714653.690	88.100	3.272	1500	1	F36.005	84.828	600
						0	F36.006	84.828	600
EX Air Valve	681210.765	714542.261	87.785	1.835	1200	0	EX 2.001	85.950	600
EX 45 Bend	681308.803	714570.782	87.300	1.800	1200	1	EX 2.001	85.500	600
						0	EX 2.002	85.500	600

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
EX DM 1 (IW)/MH 4 (MURPHY)	681360.686	714661.144	88.200	3.697	1500		1	EX 2.002	84.803	600
							2	F36.006	84.807	600
							0	EX 2.003	84.503	600
EX EI 1.00	681407.527	714717.638	87.628	3.270	1800		1	EX 2.003	84.358	600
							0	EX 2.004	84.358	900
EX EI 1.01	681461.913	714782.816	87.200	3.010	1800		1	EX 2.004	84.190	900
							0	EX 2.005	84.190	900
EX EI 1.02	681521.417	714814.365	87.321	3.266	1800		1	EX 2.005	84.055	900
							0	EX 2.006	84.055	900
EX EI 1.03	681580.377	714847.065	87.167	3.248	1800		1	EX 2.006	83.919	900

Flow+ v10.2 Copyright © 1988-2022 Causeway Technologies Ltd

Appendix F Irish Water – Confirmation of Feasibility

Damien Egan

Punch Consulting Engineers
97 Henry Street
Co.Limerick
V94YC2H
Ireland

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

28 January 2021

Re: CDS20007443 pre-connection enquiry - Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 620 unit(s) at Greatconnell, Newbridge, Co. Kildare

Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Greatconnell, Newbridge, Co. Kildare (the **Premises**). Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time.

SERVICE	**OUTCOME OF PRE-CONNECTION ENQUIRY** **THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.**
Water Connection	Feasible without infrastructure upgrade by Irish Water
Wastewater Connection	Feasible without infrastructure upgrade by Irish Water
SITE SPECIFIC COMMENTS	
Water Connection	Connection is feasible to the existing 300 mm DI main. New connection main has to be a 200mm ID pipe. Bulk meter to be installed on the connection main, meter to be connected to telemetry online. On site storage for the average day peak week demand rate of the commercial section for 24-hour period. This separate storage is required to supply this demand and will have a re-fill time of 12 hours. This Confirmation of Feasibility to connect to the Irish Water infrastructure also does not extend to your fire flow requirements. Please note that Irish Water can not guarantee a flow rate to meet fire flow requirements and in order to guarantee a flow to meet the Fire Authority requirements, you should provide adequate fire storage capacity within your development.

Stiúrthóirí / Directors: Cathal Marley (Chairman), Niall Gleeson, Eamon Gallen, Yvonne Harris, Brendan Murphy, Maria O'Dwyer
Oifig Chláraithe / Registered Office: Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath 1, D01 NP86 / Colvill House, 24-26 Talbot Street, Dublin 1, D01 NP86
Is cuideachta ghníomhaíochta ainmnithe atá faoi theorainn scaireanna é Uisce Éireann / Irish Water is a designated activity company, limited by shares.
Uimhir Chláraithe in Éirinn / Registered in Ireland No.: 530363
IW-HP-BUS
REV012

Wastewater Connection	Connection must be made to the new 900 mm traversing the proposed site (not shown on GIS map bellow).
Strategic Housing Development	Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. In advance of submitting your full application to An Bord Pleanala for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.
The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.	

The map included below outlines the current Irish Water infrastructure adjacent to your site:

Reproduced from the Ordnance Survey of Ireland by Permission of the Government. License No. 3-3-34

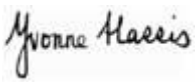
Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

General Notes:

1) The initial assessment referred to above is carried out taking into account water demand and wastewater discharge volumes and infrastructure details on the date of the assessment. **The availability of capacity may change at any date after this assessment.**
2) This feedback does not constitute a contract in whole or in part to provide a connection to any Irish Water infrastructure. All feasibility assessments are subject to the constraints of the Irish Water Capital Investment Plan.
3) The feedback provided is subject to a Connection Agreement/contract being signed at a later date.
4) A Connection Agreement will be required to commencing the connection works associated with the enquiry this can be applied for at https://www.water.ie/connections/get-connected/
5) A Connection Agreement cannot be issued until all statutory approvals are successfully in place.
6) Irish Water Connection Policy/ Charges can be found at https://www.water.ie/connections/information/connection-charges/
7) Please note the Confirmation of Feasibility does not extend to your fire flow requirements.
8) Irish Water is not responsible for the management or disposal of storm water or ground waters. You are advised to contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges
9) To access Irish Water Maps email datarequests@water.ie
10) All works to the Irish Water infrastructure, including works in the Public Space, shall have to be carried out by Irish Water.

If you have any further questions, please contact Marko Komso from the design team on 022 54611 or email mkomso@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,



Yvonne Harris

Head of Customer Operations

Appendix G Irish Water Statement of Design Acceptance

Damien Egan
Punch Consulting Engineers
97 Henry Street
V94YC2H
Co.Limerick
Ireland

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

4 April 2022

Re: Design Submission for Greatconnell, Newbridge, Co. Kildare (the "Development") (the "Design Submission") / Connection Reference No: CDS20007443

Dear Damien Egan,

Many thanks for your recent Design Submission.

We have reviewed your proposal for the connection(s) at the Development. Based on the information provided, which included the documents outlined in Appendix A to this letter, Irish Water has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before you can connect to our network you must sign a connection agreement with Irish Water. This can be applied for by completing the connection application form at www.water.ie/connections. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities (CRU)(https://www.cru.ie/document_group/irish-waters-water-charges-plan-2018/).

You the Customer (including any designers/contractors or other related parties appointed by you) is entirely responsible for the design and construction of all water and/or wastewater infrastructure within the Development which is necessary to facilitate connection(s) from the boundary of the Development to Irish Water's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Irish Water does not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Irish Water representative:
Name: Paul Lowry
Phone:
Email: paullowr@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

- 192229-PUNCH-XX-XX-DR-C-0101 - C02 PROPOSED DRAINAGE LAYOUT
- 192229-PUNCH-XX-XX-DR-C-0102 - C02 PROPOSED DRAINAGE LAYOUT
- 192229-PUNCH-XX-XX-DR-C-0103 - C02 PROPOSED DRAINAGE LAYOUT
- 192229-PUNCH-XX-XX-DR-C-0104 - C02 PROPOSED DRAINAGE LAYOUT
- 192229-PUNCH-XX-XX-DR-C-0175 - C02 PROPOSED FOUL WATER NETWORK LONG SECTIONS
- 192229-PUNCH-XX-XX-DR-C-0176 A0 - PROPOSED FOUL WATER NETWORK LONG SECTIONS
- 192229-PUNCH-XX-XX-DR-C-0177 - C02 PROPOSED FOUL WATER NETWORK LONG SECTIONS
- 192229-PUNCH-XX-XX-DR-C-0178 - C02 PROPOSED FOUL WATER NETWORK LONG SECTIONS
- 192229-PUNCH-XX-XX-DR-C-0179 - C02 PROPOSED FOUL WATER NETWORK LONG SECTIONS
- 192229-PUNCH-XX-XX-DR-C-0180 - C02 PROPOSED FOUL WATER NETWORK LONG SECTIONS
- 192229-PUNCH-XX-XX-DR-C-0181 - C02 PROPOSED FOUL WATER NETWORK LONG SECTIONS
- 192229-PUNCH-XX-XX-DR-C-0182 - C02 PROPOSED FOUL WATER NETWORK LONG SECTIONS
- 192229-PUNCH-XX-XX-DR-C-0183 - C02 PROPOSED FOUL WATER NETWORK LONG SECTIONS
- 192229-PUNCH-XX-XX-DR-C-0184 - C01 PROPOSED FOUL WATER NETWORK LONG SECTIONS

Notes:

- A full detailed design submission for the proposed wastewater pump station(s) shall be submitted at connection application stage and will be subject to detailed design review. The impact of any Irish Water Capital projects will require review and further site design assessment at connection application stage.
- The diversion design for the proposed development shall be design accepted by the diversions@water.ie

*For further information, visit **www.water.ie/connections***

Notwithstanding any matters listed above, the Customer (including any appointed designers/contractors, etc.) is entirely responsible for the design and construction of the Self-Lay Works. Acceptance of the Design Submission by Irish Water will not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

Stiúrthóirí / Directors: Cathal Marley (Chairman), Niall Gleeson, Eamon Gallen, Yvonne Harris, Brendan Murphy, Dawn O'Driscoll, Maria O'Dwyer
Oifig Chláraithe / Registered Office: Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath 1, D01 NP86 / Colvill House, 24-26 Talbot Street, Dublin 1 D01 NP86
Is cuideachta ghníomhaíochta ainmnithe atá faoi theorainn scaireanna é Uisce Éireann / Irish Water is a designated activity company, limited by shares.
Uimhir Chláraithe in Éirinn / Registered in Ireland No.: 530363

Appendix H Irish Water Diversion Confirmation of Feasibility

Aston Limited
C/O Punch Consulting Engineers,
Carnegie House,
Library Road,
Dun Laoghaire,
Co Dublin.
A96 C7W7.

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office
Cork City

www.water.ie

28 March 2022

Dear Ms Fenton,

Re: DIV21230 – Great Connell, Newbridge, Co Kildare

Irish Water has reviewed your enquiry in relation to the diversion of an Irish Water Asset application to the existing sewer at – Great Connell, Newbridge, Co Kildare.

Based upon the details you have provided with your enquiry and as assessed by Irish Water, we wish to advise you that Irish Water have no objection to the application to divert the sewer, subject to below conditions and easement agreement being put in place.

1. The construction shall be in strict accordance with drawings number 192229-PUNCH-XX-XX-DR-C-0130-C04, 192229-PUNCH-XX-XX-DR-C-0131-C04, 192229-PUNCH-XX-XX-DR-C-0184-C02 and 192229-PUNCH-XX-XX-DR-C-0508-C01.
2. A CCTV survey must be submitted for the extent of the existing wastewater sewers to be diverted when applying for the wastewater diversion agreement.
3. You shall enter into a deed of grant of easement with Irish Water and shall provide all necessary maps, drawings, schematics or other document or certificates necessary to complete the grant of deed of easement to the satisfaction of Irish Water and having a protected strip of 9metres in width (8.4m plus the diameter of the sewer). see drawing 192229-PUNCH-XX-XX-DR-C-0130-C04.
4. On receipt of planning permission for the development the applicant shall apply for and enter into a diversion agreement with Irish Water for the diversion of the impacted wastewater sewer.

If you have any further questions, please contact Stephen O'Beirne from the diversions team on 083 087 8334 or email sobeirne@water.ie. For further information, visit **www.water.ie/connections.**

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix I Extracts from IGSL Limited Factual Ground Investigation Report (Report No. 23110, April 2021)

Appendix 5

Infiltration Test Records

Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA03 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	Moderate seepage at 1.20m
0.30	0.70	Firm brown very sandy SILT/CLAY	
0.70	1.20	Grey very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.15)	

Field Data

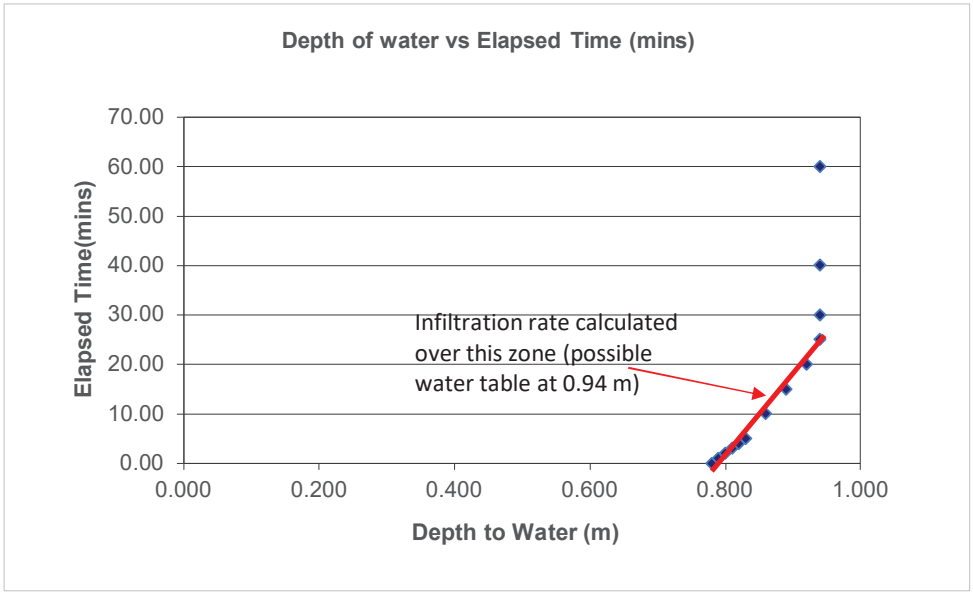
Depth to Water (m)	Elapsed Time (min)	
0.780	0.00	Start of infiltration
0.790	1.00	
0.800	2.00	
0.810	3.00	
0.820	4.00	
0.830	5.00	
0.860	10.00	
0.890	15.00	
0.920	20.00	
0.940	25.00	End of infiltration
0.940	30.00	
0.940	40.00	
0.940	60.00	

Field Test

Depth of Pit (D)	1.20	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.30	m
Initial depth to Water =	0.78	m
Final depth to water =	0.94	m
Elapsed time (mins)=	25.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.65	m2
*Av. side area of permeable stratum over test period=	1.224	m2
Total Exposed area =	1.874	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0022 m/min or 3.69975E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA05 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	
0.30	1.50	Grey very sandy fine to coarse rounded GRAVEL	None observed
		(Note: Slumping of sands and gravels reduced pit depth to 1.41)	

Field Data

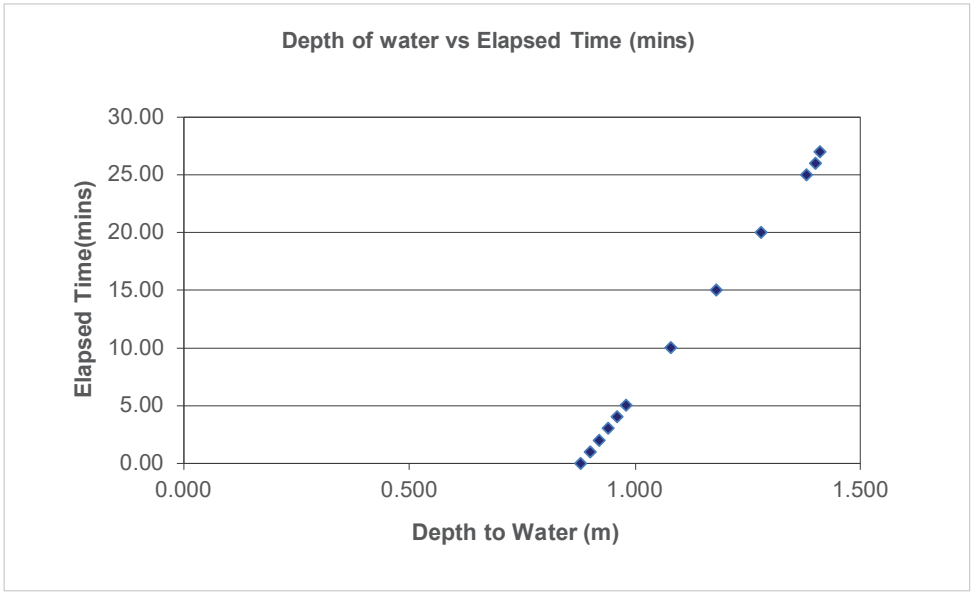
Depth to Water (m)	Elapsed Time (min)
0.880	0.00
0.900	1.00
0.920	2.00
0.940	3.00
0.960	4.00
0.980	5.00
1.080	10.00
1.180	15.00
1.280	20.00
1.380	25.00
1.400	26.00
1.410	27.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.88	m
Final depth to water =	1.41	m
Elapsed time (mins)=	27.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test period=	1.42	m2
Total Exposed area =	2.17	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0068 m/min or 0.000113074 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA05 Cycle 2
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	
0.30	1.50	Grey very sandy fine to coarse rounded GRAVEL	None observed
		(Note: Slumping of sands and gravels reduced pit depth to 1.41)	

Field Data

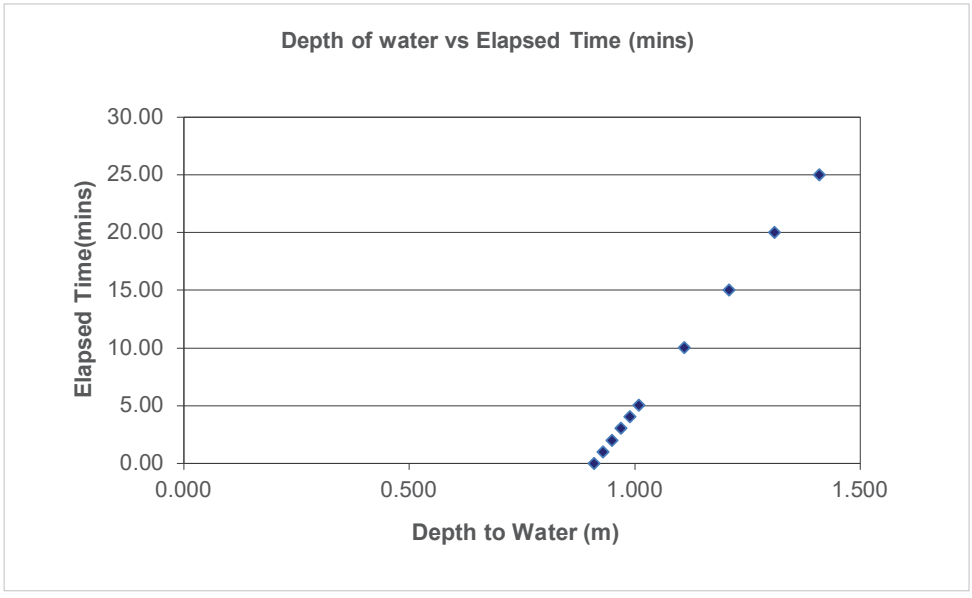
Depth to Water (m)	Elapsed Time (min)
0.910	0.00
0.930	1.00
0.950	2.00
0.970	3.00
0.990	4.00
1.010	5.00
1.110	10.00
1.210	15.00
1.310	20.00
1.410	25.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.91	m
Final depth to water =	1.41	m
Elapsed time (mins)=	25.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test period=	1.36	m2
Total Exposed area =	2.11	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0071 m/min or 0.000118483 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA07 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Brown sandy SILT/CLAY	
0.30	0.70	Brown very silty fine to medium SAND	None Observed
0.70	1.50	Grey silty very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.25)	

Field Data

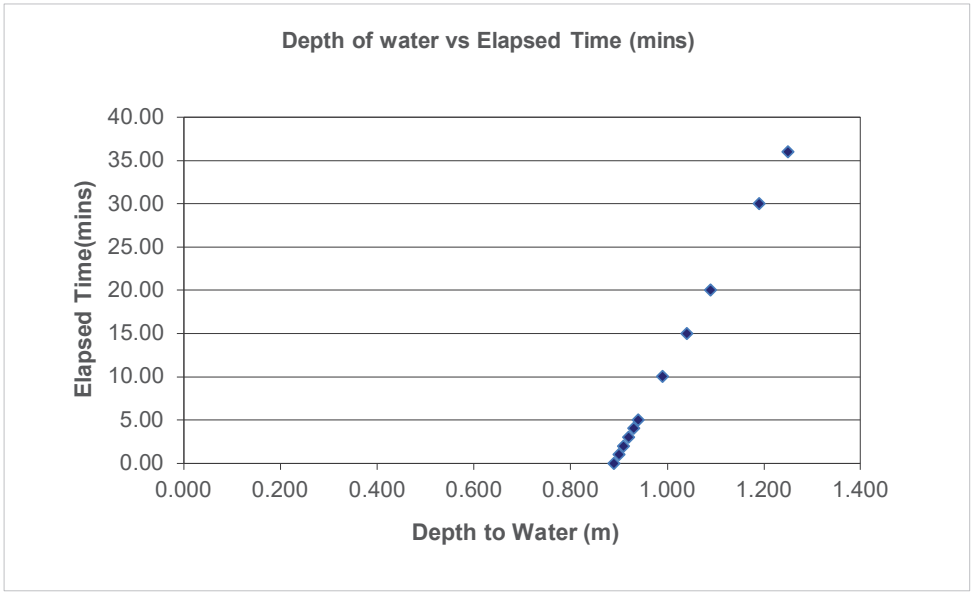
Depth to Water (m)	Elapsed Time (min)
0.890	0.00
0.900	1.00
0.910	2.00
0.920	3.00
0.930	4.00
0.940	5.00
0.990	10.00
1.040	15.00
1.090	20.00
1.190	30.00
1.250	36.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.89	m
Final depth to water =	1.25	m
Elapsed time (mins)=	36.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test period=	1.72	m2
Total Exposed area =	2.47	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.003 m/min or 5.06073E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA07 Cycle 2
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Brown sandy SILT/CLAY	
0.30	0.70	Brown very silty fine to medium SAND	None Observed
0.70	1.50	Grey silty very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.25)	

Field Data

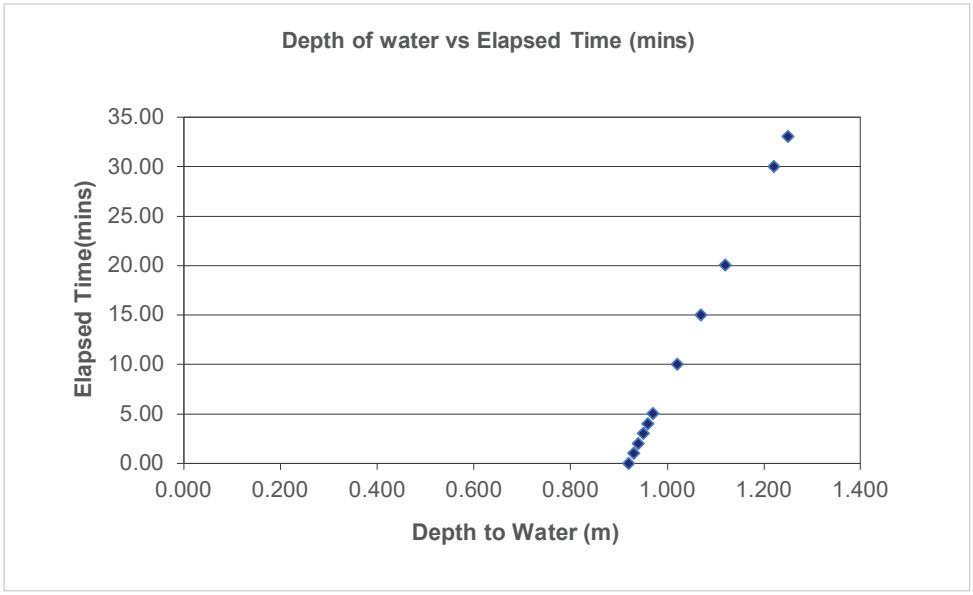
Depth to Water (m)	Elapsed Time (min)
0.920	0.00
0.930	1.00
0.940	2.00
0.950	3.00
0.960	4.00
0.970	5.00
1.020	10.00
1.070	15.00
1.120	20.00
1.220	30.00
1.250	33.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.92	m
Final depth to water =	1.25	m
Elapsed time (mins)=	33.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test period=	1.66	m2
Total Exposed area =	2.41	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0031 m/min or 5.18672E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA11 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Brown slightly gravelly sandy SILT/CLAY	Moderate seepage at 1.20m
0.30	1.30	Grey silty very sandy fine to coarse rounded GRAVEL with cobbles	

Note: Two cycles conducted with results of the first cycle below.

Field Data

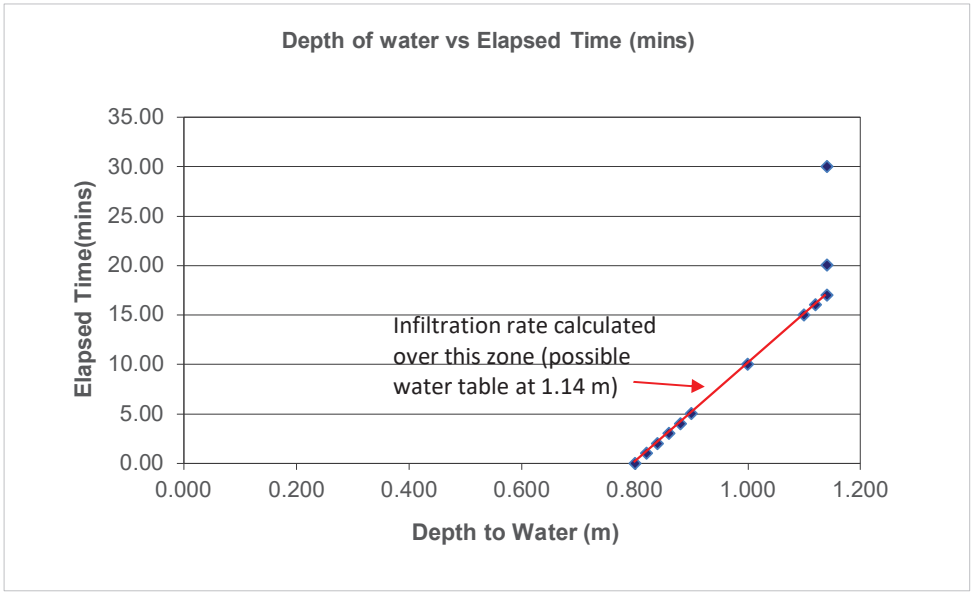
Depth to Water (m)	Elapsed Time (min)
0.800	0.00
0.820	1.00
0.840	2.00
0.860	3.00
0.880	4.00
0.900	5.00
1.000	10.00
1.100	15.00
1.120	16.00
1.140	17.00
1.140	20.00
1.140	30.00

Field Test

Depth of Pit (D)	1.30	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.80	m
Final depth to water =	1.14	m
Elapsed time (mins)=	17.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test pe	1.32	m2
Total Exposed area =	2.07	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0072 m/min or 0.000120773 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA11 Cycle 2
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Brown slightly gravelly sandy SILT/CLAY	Moderate seepage at 1.20m
0.30	1.30	Grey silty very sandy fine to coarse rounded GRAVEL with cobbles	

Note: Two cycles conducted with results of the second cycle below.

Field Data

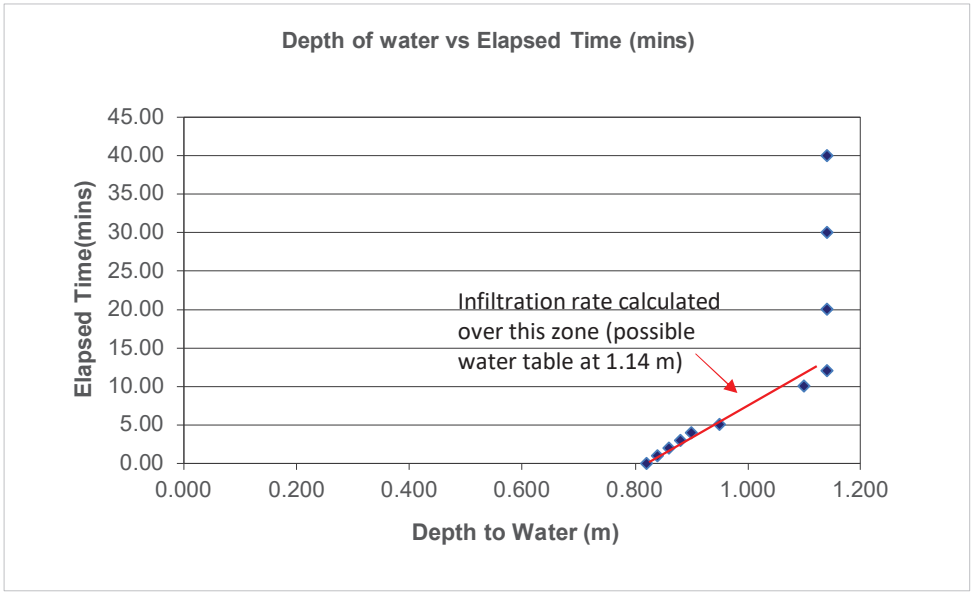
Depth to Water (m)	Elapsed Time (min)
0.820	0.00
0.840	1.00
0.860	2.00
0.880	3.00
0.900	4.00
0.950	5.00
1.100	10.00
1.140	12.00
1.140	20.00
1.140	30.00
1.140	40.00

Field Test

Depth of Pit (D)	1.30	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.82	m
Final depth to water =	1.14	m
Elapsed time (mins)=	12.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test period=	1.28	m2
Total Exposed area =	2.03	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0099 m/min or 0.000164204 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA13 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	Moderate seepage at 1.00m
0.30	1.00	Firm grey-brown very sandy SILT/CLAY	
1.00	1.20	Grey very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.15)	

Field Data

Depth to Water (m)	Elapsed Time (min)
0.750	0.00
0.750	2.00
0.750	4.00
0.750	6.00
0.750	4.00
0.750	5.00
0.740	10.00
0.740	15.00
0.740	20.00
0.740	25.00
0.730	30.00
0.730	40.00
0.730	60.00

Field Test

Depth of Pit (D)	1.20	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.30	m
Initial depth to Water =	0.75	m
Final depth to water =	0.73	m
Elapsed time (mins)=	30.00	
Top of permeable soil		m
Base of permeable soil		m

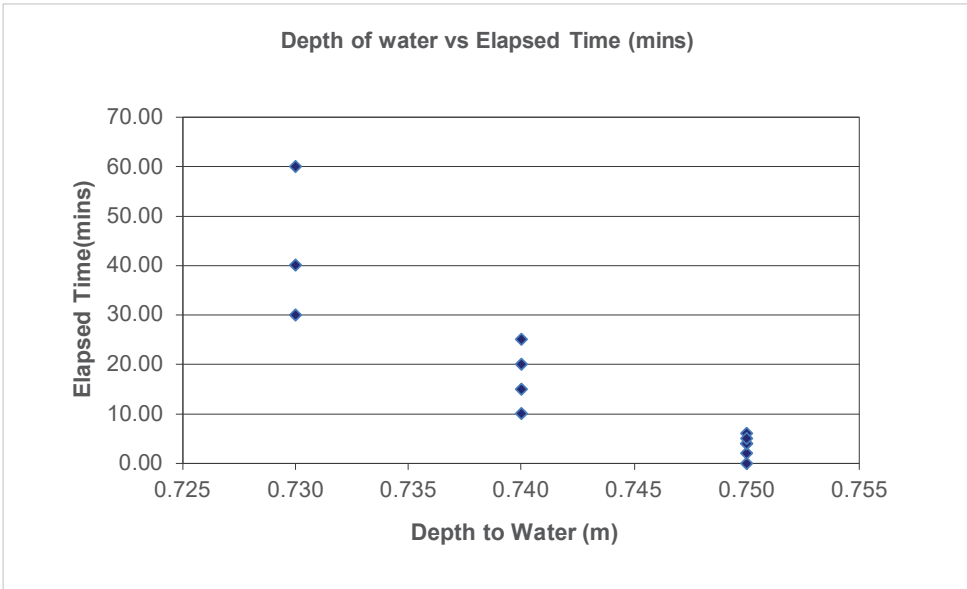
Note: Water level rose due to influx of groundwater

Base area=	0.65	m2
*Av. side area of permeable stratum over test period=	1.656	m2
Total Exposed area =	2.306	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0 m/min or 0 m/sec

Water level rose due to influx of groundwater - test failed



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA16 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	
0.30	1.45	Firm brown very sandy SILT/CLAY	None observed
1.45	2.00	Grey very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.75)	

Field Data

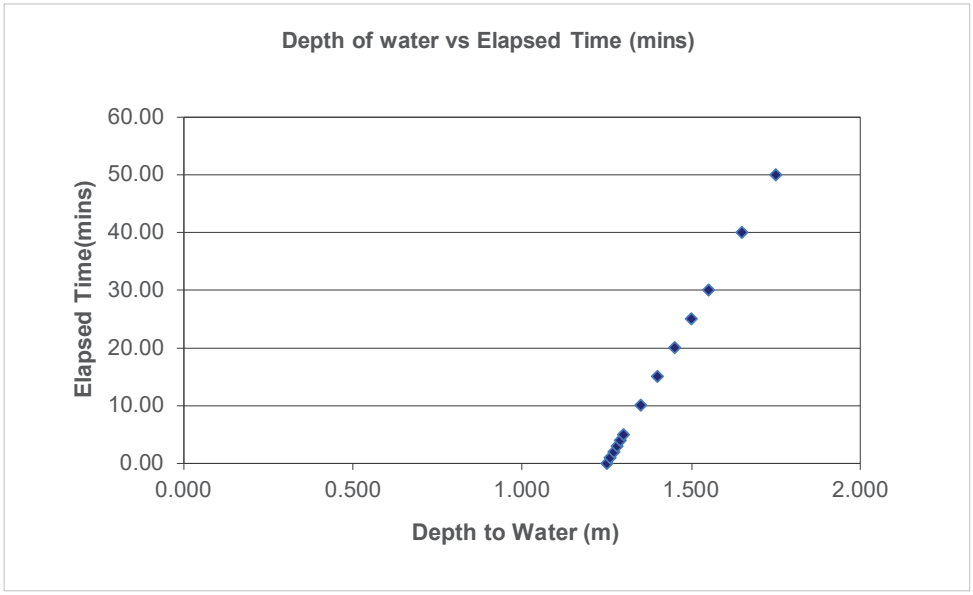
Depth to Water (m)	Elapsed Time (min)
1.250	0.00
1.260	1.00
1.270	2.00
1.280	3.00
1.290	4.00
1.300	5.00
1.350	10.00
1.400	15.00
1.450	20.00
1.500	25.00
1.550	30.00
1.650	40.00
1.750	50.00

Field Test

Depth of Pit (D)	2.00	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.60	m
Initial depth to Water =	1.25	m
Final depth to water =	1.75	m
Elapsed time (mins)=	50.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.8	m2
*Av. side area of permeable stratum over test period=	2.1	m2
Total Exposed area =	2.9	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0028 m/min or 4.5977E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA16 Cycle 2
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	None observed
0.30	1.45	Firm brown very sandy SILT/CLAY	
1.45	2.00	Grey very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.75)	

Field Data

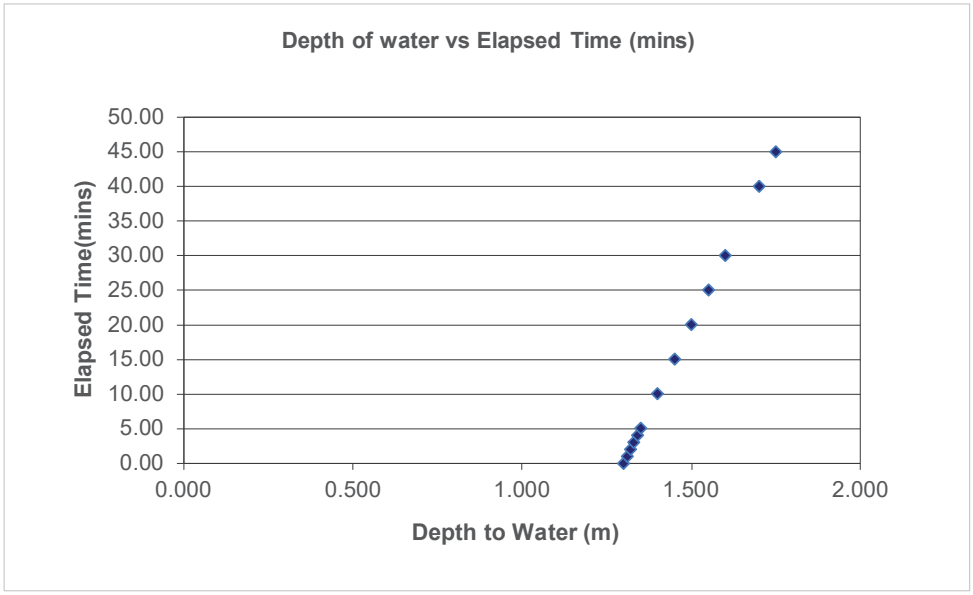
Depth to Water (m)	Elapsed Time (min)
1.300	0.00
1.310	1.00
1.320	2.00
1.330	3.00
1.340	4.00
1.350	5.00
1.400	10.00
1.450	15.00
1.500	20.00
1.550	25.00
1.600	30.00
1.700	40.00
1.750	45.00

Field Test

Depth of Pit (D)	2.00	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.60	m
Initial depth to Water =	1.30	m
Final depth to water =	1.75	m
Elapsed time (mins)=	45.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.8	m2
*Av. side area of permeable stratum over test period=	1.995	m2
Total Exposed area =	2.795	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0029 m/min or 4.77042E-05 m/sec



Appendix 7

Groundwater Monitoring

Groundwater Monitoring

Project No.	23110 - Great Connell, Newbridge
Client	Aston Lands Ltd.
Date	06-Apr-21
Engineer	Byrne Looby
Equipment	Dipmeter / Groundwater Monitor
Time/Weather/Temperature	9.00am-10.30am. 8 Degrees Celsius. Sunny, Dry.
Location ID	**BH02**
Water Level (mbgl)	**1.10m**
Location ID	**BH05**
Water Level (mbgl)	**2.30m**
Location ID	**BH07**
Water Level (mbgl)	**2.15m**
Location ID	**BH09**
Water Level (mbgl)	**1.90m**
Location ID	**BH12**
Water Level (mbgl)	**1.65m**
Location ID	**BH15**
Water Level (mbgl)	**1.70m**
Location ID	**BH17**
Water Level (mbgl)	**1.50m**
Location ID	**BH23**
Water Level (mbgl)	**1.50m**
Location ID	**BH29**
Water Level (mbgl)	**2.35m**
Location ID	**BH30**
Water Level (mbgl)	**1.85m**

Appendix 10

As-Surveyed Site Plans

ExpertGPS

23110 Aston Lands, Great Connell, Newbridge

50 m

MN

2°23'

ExpertGPS

23110 Aston Lands, Great Connell, Newbridge

10 m

MN

2°23'

Appendix J Additional Groundwater Monitoring Records

Table 1: B1747 Greatconnell
Groundwater Monitoring

Borehole ID	Date Standpipe Installed	Ground Level (mAOD)	Total Depth of Standpipe (mBGL)	Bottom of Response Zone (mBGL)	Top of Response Zone (mBGL)	Response Strata (Shallow to deep)	Date	Time	Water Level (mBGL)	Water Level (m AOD)	Comment
BH02	16/03/2021	86.31	5.7	5.7	1	GRAVEL, CLAY, GRAVEL, CLAY	22/04/2021	10:04:00	1.15	**85.16**	Top of steel casing is 0.25m above ground level
							18/05/2021	10:31:00	1.17	**85.14**	
							24/06/2021	11:33	1.25	**85.06**	
							20/07/2021	09:23	1.22	**85.09**	
							03/11/2021	10:40	1.01	**85.3**	
							26/11/2021	10:07	1.15	**85.16**	
							11/01/2022	12:19	0.93	**85.38**	
BH5A	15/02/2021	87.58	5.14	5.14	1	GRAVEL, SAND	22/04/2021	09:48:00	2.175	**85.405**	Top of steel casing is 0.36m above ground level
							18/05/2021	10:25:00	2.33	**85.25**	
							24/06/2021	10:32	2.32	**85.26**	
							20/07/2021	10:38	2.39	**85.19**	
							03/11/2021	10:10	2.28	**85.3**	
							26/11/2021	09:23	2.39	**85.19**	
							11/01/2022	11:40	2.18	**85.4**	
BH7	29/03/2021	87.7	7.98	7.98	4	GRAVEL	22/04/2021	10:13:00	2.24	**85.46**	
							18/05/2021	10:53:00	2.28	**85.42**	
							24/06/2021	NM	NM	**NM**	
							20/07/2021	09:48	2.3	**85.4**	
							03/11/2021	10:47	2.08	**85.62**	
							26/11/2021	09:49	2.23	**85.47**	
							11/01/2022	12:02	2.06	**85.64**	
BH12	12/02/2021	87.38	5.81	5.81	1	GRAVEL, SILT/CLAY, SAND, GRAVEL.	22/04/2021	09:54:00	1.84	**85.54**	Top of steel casing is 0.19m above ground level
							18/05/2021	10:22:00	1.92	**85.46**	
							24/06/2021	10:38	1.91	**85.47**	
							20/07/2021	11:04	2.03	**85.35**	
							03/11/2021	10:15	1.945	**85.435**	
							26/11/2021	09:27	2.02	**85.36**	
							11/01/2022	12:24	1.69	**85.69**	
BH15	02/03/2021	87.57	5.82	5.82	1	GRAVEL, SILT/CLAY, GRAVEL.	22/04/2021	10:46:00	1.77	**85.8**	Top of steel casing is 0.26m above ground level
							18/05/2021	10:57:00	1.82	**85.75**	
							24/06/2021	11:41	1.84	**85.73**	
							20/07/2021	09:58	1.88	**85.69**	
							03/11/2021	10:33	1.68	**85.89**	
							26/11/2021	09:43	1.81	**85.76**	
							11/01/2022	11:57	1.54	**86.03**	
BH17	25/02/2021	88.54	9.41	9.41	1	GRAVEL, SAND, CLAY	22/04/2021	10:54:00	2.64	**85.9**	Top of steel casing is 0.3m above ground level
							18/05/2021	11:00:00	2.745	**85.795**	
							24/06/2021	10:53	2.73	**85.81**	
							20/07/2021	10:06	2.86	**85.68**	
							03/11/2021	10:23	2.92	**85.62**	
							26/11/2021	09:35	2.89	**85.65**	
							11/01/2022	11:50	2.53	**86.01**	
BH19	09/03/2021	NM	NM	NM	NM	GRAVEL	22/04/2021	NM	NM	**NM**	
							18/05/2021	NM	NM	**NM**	
							24/06/2021	13:02	1.6		
							03/11/2021	NM	NM	**NM**	
							26/11/2021	NM	NM	**NM**	
							11/01/2022	NM	NM	**NM**	
BH23	23/02/2021	87.8	7.32	7.32	1	GRAVEL, CLAY, GRAVEL, CLAY	22/04/2021	10:57:00	1.63	**86.17**	Top of steel casing is 0.28m above ground level
							18/05/2021	11:03:00	1.755	**86.045**	
							24/06/2021	10:57	1.81	**85.99**	
							20/07/2021	10:13	1.88	**85.92**	
							03/11/2021	10:27	1.94	**85.86**	
							26/11/2021	09:39	1.92	**85.88**	
							11/01/2022	11:53	1.54	**86.26**	
BH29	25/03/2021	-	13.77	13.77	1	GRAVEL, SILT/CLAY, GRAVEL.	22/04/2021	10:24:00	2.38		Top of steel casing is 0.26m above ground level
							18/05/2021	NM	NM	**NM**	
							24/06/2021	NM	NM	**NM**	
							03/11/2021	11:02	2.15		
							26/11/2021	10:00	2.35		
							11/01/2022	12:10	2.12		
BH30	19/03/2021	87.01	9.15	9.15	1	GRAVEL	22/04/2021	10:20	1.77	**85.24**	Top of steel casing is 0.39m above ground level
							18/05/2021	10:34	1.815	**85.195**	
							24/06/2021	NM	NM	**NM**	
							20/07/2021	09:33	1.84	**85.17**	
							03/11/2021	10:52	1.66	**85.35**	
							26/11/2021	09:52	1.81	**85.2**	
							11/01/2022	12:07	1.63	**85.38**	
Comments											
Weather											
Air Temperature											
Status of instruments											
Site observations											
Site observations 2											
Site observations 3											
Site observations 4											

11/01/2022

NM = Not Measured

APPENDIX 2

RESIDUAL WASTE & RESOURCE MANAGEMENT PLAN

Unit 15
Melbourne Business Park
Model Farm Road
Cork T12 WR89

O'Callaghan Moran & Associates
ENVIRONMENTAL MANAGEMENT FOR BUSINESS

T: 021 434 5366
E: admin@ocallaghanmoran.com
www.ocallaghanmoran.com

RESOURCE & WASTE MANAGEMENT PLAN

GREAT CONNELL SHD

NEWBRIDGE

COUNTY KILDARE

Prepared For: -

Aston Ltd
Great Connell
Newbridge
County Kildare

Prepared By: -

O' Callaghan Moran & Associates
Unit 15
Melbourne Business Park
Model Farm Road
Cork
T12 WR89

April 2022

Project	Preliminary Resource & Waste Management Plan			
Client	Aston Ltd			
Report No.	Date	Status	Prepared By	Reviewed By
211550102	24/03/2022	Initial Draft	Martina Gleeson PhD	Jim O'Callaghan MSc
	01/04/2022	Final		

TABLE OF CONTENTS

PAGE

1. INTRODUCTION 1

1.1 METHODOLOGY 1
1.2 RELEVANT LEGISLATION & GUIDANCE 1
1.3 CIRCULAR ECONOMY 2
1.4 DETAILED RWMP 2

2. SITE DESCRIPTION 3

2.1 SITE LOCATION 3
2.2 SITE LAYOUT 3
2.3 SERVICES 3
2.4 ENVIRONMENTAL SETTING 3
2.4.1 Hydrology 3
2.4.2 Geology & Hydrogeology 4
2.4.3 Biodiversity 4
2.4.4 Archaeology 4
2.5 SURROUNDING LAND USE 4
2.6 ROAD NETWORK 4

3. DEVELOPMENT DESCRIPTION 5

3.1 SERVICES 5
3.2 ROADS/JUNCTIONS 5

4. DETAILED DESIGN STAGE 6

4.1 DESIGN TEAM 6
4.2 APPROACH 6

5. PRELIMINARY CONSTRUCTION PROGRAMME 7

5.1 DEVELOPMENT PHASES 7

6. SITE MANAGEMENT 9

6.1 PRE-DEMOLITION SURVEYS 9
6.2 WASTE TYPES 9
6.3 RESOURCE MANAGER 10
6.3.1 Regulatory Compliance 10
6.3.2 Training 10
6.3.3 Records 10
6.4 ON-SITE WASTE MANAGEMENT 10
6.4.1 Hazardous Waste Management 11
6.4.2 Inspections/Audits 11

APPENDIX 1 DRAWINGS

1. INTRODUCTION

Aston Ltd appointed O'Callaghan Moran & Associates to prepare a preliminary Resource and Waste Management Plan (RWMP) for the proposed Strategic Housing Development (SHD) at Great Connell, Newbridge, County Kildare.

The purpose is to provide information necessary to ensure that the management of construction and demolition (C&D) waste at the site is undertaken in accordance with the current industry standards and waste management regulations.

1.1 Methodology

The approach is based on the Environmental Protection Agency 'Best Practice Guidelines for the Preparation of Resource & Waste Management Plans for Construction and Demolition Projects' (2021) and in line with Aston's environmental and resource and waste management policies.

1.2 Relevant Legislation & Guidance

- Protection of the Environment Act 2003, as amended
- The Waste Management Act 1996, as amended
- The Waste Management (Collection Permit) Regulations 2007, (S.I 821) as amended
- European Communities (Waste Directive) Regulations 2011 (SI 126 of 2011) as amended
- Waste Management (Facility Permit and Registration) Regulations 2007, (S.I No. 821 of 2007) as amended
- Waste Management (Licensing) Regulations 2004 (S.I. No. 395 of 2004) as amended
- Waste Management (Packaging) Regulations 2014 (S.I. 282 of 2014), as amended
- European Union (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014)
- European Union (Batteries and Accumulators) Regulations 2014 (S.I. No. 283 of 2014) as amended
- Waste Management (Food Waste) Regulations 2009 (S.I. 508 of 2009), as amended
- Waste Management (Hazardous Waste) Regulations, 1998 (S.I. No. 163 of 1998) as amended
- Waste Management (Shipments of Waste) Regulations, 2007 (S.I. No .419 of 2007) as amended

- European Communities (Transfrontier Shipment of Waste) Regulations

- Waste Classification List of Waste & Determining if Waste is Hazardous or Non-hazardous (2015)

The RWMP also had regard to the Preliminary Construction Environmental Management Plan, which incorporates an Invasive Species Management Plan prepared for the development.

1.3 Circular Economy

In 2020, the government published its 'Waste Action Plan for a Circular Economy' to inform and direct national and regional waste planning in Ireland over the coming years. It is action focused to embrace the opportunities in becoming a circular economy. While the thrust of the Plan is to prevent waste arising through reuse, its objectives include ensuring that measures support sustainable economic models (for example by supporting the use of recycled over virgin materials).

It is an objective to meet the requirements of the Eastern-Midlands Region Waste Management Plan 2015 – 2021, which in line with the European Union Waste Framework Directive, specifies a mandatory target of 70% of C&D wastes to be prepared for reuse, recycling and material recovery (excluding soil and stones) by 2020.

All of the soil and stone excavated for building foundations and underground services will be retained on-site for reuse. Uncontaminated soil and stone can be notified as a By-Product under the EPA regulated Article 27 Notification System, meaning it is not classed as waste and can be used in other developments where fill is required. Article 27 Notified Soil and Stone may be imported to raise ground to formation levels.

Metal, timber, glass and plasterboard are potentially recyclable. Currently, in the absence of national end of waste criteria for recycled aggregates, opportunities for the recovery and recycling of concrete, bricks and tiles are restricted to use in landfill construction works and at two waste management facilities that have EPA approval to produce End of Waste aggregates; however they have limited capacity.

1.4 Detailed RWMP

This preliminary RWMP will be revised prior to the start of construction to:

- Take consideration of the conditions of the planning permission.

- Identify the members of the Design Team and specify their roles and responsibilities.

- Make provision for the waste prevention and resource recovery measures identified in the detailed design stage.

- Include a post design resource and waste inventory of all residual resources, and

- Identify the roles and responsibilities of the Construction Management Team, including materials procurement.

2. SITE DESCRIPTION

2.1 Site Location

The site is to the east of Newbridge Town Centre. It is accessed from the east off the Great Connell Road, which forms the eastern boundary. It is bounded to the north-east by a residential development (Wellesley Manor) and to the north-west by an open drain that was formerly a meander channel of the River Liffey. A hedgerow forms the southern boundary. The south-western boundary is defined by a buffer zone on the western side of the River Liffey. The western boundary is not defined on the ground.

2.2 Site Layout

The site is 27.64 hectares (ha) and the layout is shown on Drawing PA-0012 in Appendix 1. Most of the site is in agricultural use, currently tillage. An open but overgrown drainage ditch runs along the northern border and in the central area of the site. There are hedgerows along the northern, southern and eastern boundaries and an area of woodland in the southwest, on the eastern bank of the River Liffey.

There is a former residential dwelling (Valencia Lodge) to the east of the agricultural yard. This is a single storey house (136 m^2) with a single storey garage (17.8 m^2) and garden. There is a second former residence (Great Connell) in the north-east corner of the site. This is a two-storey dwelling (332 m^2) with a detached single storey garage and boiler room (48 m^2).

There is a former agricultural yard (8,920m^2) towards the centre of the site containing two single storey sheds (1,440m^2 and 595m^2), a three-sided shed (54 m^2) and a car park to the east.

2.3 Services

There is an Irish Water 300mm watermain running along the Great Connell Road. This supplies the Wellesley Manor via a 100mm uPVC network. There is an existing 1000mm concrete storm water sewer serving Wellesley Manor that flows from northeast to the south-west along the north-eastern boundary and discharges into a small stream that then flows into the Liffey.

A 450mm concrete foul sewer flows north to south through the centre of the site and connects to the foul sewer network serving Wellesley Manor. A 900mm foul sewer, recently installed as part of the upgrade of the Upper Liffey Valley Sewerage Scheme, runs from north-east to south west across the site. There is an overhead 10 kV Medium Voltage electricity line traversing the site which drops underground for a section of its run.

2.4 Environmental Setting

2.4.1 Hydrology

The site is in the catchment of the River Liffey, whose main channel runs through the site close to the south-western boundary. There are two open drainage ditches inside the site boundary that

follow the original alignment of an historic meander on the Liffey.

2.4.2 Geology & Hydrogeology

The subsoils in the western half of the site are Alluvium, with the eastern half underlain Gravels derived from Limestone. The subsoils are between 16.5m and 18m thick and overly limestone bedrock. The sands and gravels are classified as a locally important aquifer. The underlying bedrock is a regionally important karstified (Rkd) aquifer. The water table ranges from 1m to 2,9m below ground level. There is no evidence that previous and current land use has resulted in soil contamination.

2.4.3 Biodiversity

The site is dominated by large fields of arable crops, with two former residences and three former agricultural buildings at the centre of the site towards the eastern boundary. The northern, southern and eastern boundaries include hedgerows with small areas of scrub and treelines. There is an area of mixed broadleaved woodland in the south-west corner of the site and this is the most valuable habitat within the site and will be retained intact. There is an 80m riparian zone either side of the River Liffey. The closest Natura 2000 Site is Pollardstown Fen Special Protection Area, which is 2.6km to the west.

2.4.4 Archaeology

Archaeological field surveys did not identify any significant archaeological features within the site boundary. There are a number of minor features that need to be assessed at the site clearance stage.

2.5 Surrounding Land Use

To the south and south-east are agricultural lands primarily used for tillage. To the east, across the Great Connell Road, are the Murphy Ireland Ltd offices and compound. To the north-east is Wellesley Manor, which has the closest residential dwellings to the development, with the houses in the south of the estate being approximately 10m from the north-eastern development site boundary. A large scale residential development is currently under construction to south west of the site.

2.6 Road Network

The R416 Athgravan Road to the west is a Regional Road linking Newbridge and Athgarvan. It is a single lane two-way carriageway. The Great Connell Road is a Local Primary Road linking the R445 with the L2032 via Bukcley's Cross at the northern end. It is a single lane two-way carriageway.

The Great Connell roundabout provides access to the residential development on the western side of the Great Connell Road, the Murphy International offices and compounds and the Dr. Pepper beverage manufacturing plant.

3. DEVELOPMENT DESCRIPTION

The proposed layout is shown on Drawing PR-002 Proposed Master Site Layout in Appendix 1. The development involves the demolition of two unoccupied private residences and three sheds and the phased construction of 569 residential units comprising a mix of house and apartments with associated car parking (1,008) and bicycle (734) spaces; the construction of a neighbourhood centre and a crèche and the provision of a series of parks (2.6 ha) and open amenity area (8.31 ha) along the River Liffey. Access will be off the Great Connell Road and the development will include the delivery of a 350m section of the Newbridge Southern Outer Orbital Relief Road (NSORR).

3.1 Services

The development will connect to the mains water supply via a 200mm diameter connection from the existing watermain on the Great Connell Road. The surface water drainage system will discharge to the existing drainage ditch and the River Liffey via nine below ground flow attenuation tanks.

The existing 450mm foul sewer that runs across the site from south to north will be diverted and connected to the new 900mm diameter sewer. Due to the site topography there will be two separate foul water networks serving the eastern and western areas of the site respectively. The eastern network will have a gravity flow towards the north-east corner of the site, where it will connect to the 900mm sewer. In the western network, there will be a gravity flow to a new pump station in the north of the site from where it will be pumped to a second connection to the 900mm sewer.

The existing overhead electrical power lines running from the north-east to south-west through the site and along the southern site boundary will be diverted underground.

3.2 Roads/Junctions

The development will deliver a 350m section of the NSOoRR and will involve upgrades to the Great Connell Roundabout and Buckley's Cross. The Great Connell Roundabout will be replaced by a signalised junction.

4. DETAILED DESIGN STAGE

4.1 Design Team

The Design Team will include, but not be limited, to:

- Aston Ltd representative
- Architect
- Civil Engineer
- Quantity Surveyor
- Resource Manager

The roles and responsibilities each team member will be documented.

4.2 Approach

The following elements will be incorporated into the Detailed Design:

Reuse and Recycling Initiatives in accordance with Section 4.3.1 of the EPA Guidance (2021);

Green Procurement Initiatives in accordance with Section 4.3.2 of the EPA Guidance (2021);

Off-Site Construction Initiatives in accordance with Section 4.3.3 of the EPA Guidance (2021);

Materials Optimisation Initiatives in accordance with Section 4.3.4 of the EPA Guidance (2021) and

Flexibility and Deconstruction Initiatives in accordance with Section 4.3.5 of the EPA Guidance (2021).

5. PRELIMINARY CONSTRUCTION PROGRAMME

5.1 Development Phases

The proposed phasing of the works are shown on Drawing PA-008 in Appendix 1.

Phase 1: Northern Area of Site

- Construction of 169 residential units and the neighbourhood centre including the crèche
- Construction of the signalised junction and Great Connell Roundabout.
- Demolition of private residences and removal of trees as per the Arborist requirement.
- Diversion of Athgarvan foul sewer to connected to Upper Liffey Valley Sewerage Scheme
- Undergrounding of overhead power lines.
- Construction of relevant infrastructural works including new foul sewer and pumping station, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.
- Completion of flood compensation storage works within the riparian/zoned amenity lands
- Open Spaces landscaping in Zones 9,10,11,13, A & B.

Phase 2: **South of Phase 2**

- Construction of 103 residential units.
- Construction of relevant infrastructural works including new gravity foul sewer, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.
- Provision of Open Space 2, along with relevant landscape works within the riparian zone.

Phase 3: **South of Phase 3**

- Construction of 99 residential units.
- Construction of relevant infrastructural works including new gravity foul sewer, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.
- Open space landscaping to Areas 3 & F, including treatment works to this section of the Great Connell Road.

Phase 4: **West of Phases 4**

- Construction of 198 residential units.

- Construction of relevant infrastructural works including new gravity foul sewer, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.

- Open space landscaping to areas 1, 4, 5, 6, 7, 8, D & E, including treatment works to the section of the Great Connell Road.

6. SITE MANAGEMENT

6.1 Pre-Demolition Surveys

The buildings to be demolished will be subject to a pre demolition survey in accordance with the EU Guidelines for the waste audits before demolition and renovation works of buildings (May 2018). If asbestos containing materials are identified an asbestos removal plan will be prepared.

6.2 Waste Types

Wastes generated will include broken concrete blocks/tiles/ceramics; surplus bitumen paving; timber and hard plastic off-cuts; metal (aluminium and steel); plasterboard, electrical wire, batteries and damaged equipment; packaging (cardboard, plastic, timber); empty paint tins and adhesive containers; insulation materials; canteen waste from the welfare facilities and waste oil and filters from mobile plant.

The waste types listed in Table 6.1 which also includes the List of Waste (LoW) code (formerly referred to as the European Waste Code or EWC). It should be noted that Table 5.1 is not an exhaustive list and may be revised at the detailed design stage.

Table 6.1

Waste Type	LoW Code
Concrete, bricks, tiles, ceramics	17 01 01-17 01 03 03 & 17 01 07
Wood, glass and plastic	17 02 01-03
Soil and Stone	17 05 03
Bituminous mixtures	17 03 02
Metals (including their alloys)	17 04 01-07
Gypsum-based construction material	17 08 02
Paper and cardboard	20 01 01
Mixed C&D waste	17 09 04
Electrical and electronic components	20 01 35 20 01 36
Batteries and accumulators	20 01 33 20 01 34
Oil	13 01 10, 13 03 05
Chemicals (e.g. solvents, paints, adhesives)	20 01 13 , 20 01 19, 20 01 27
Insulation materials	17 06 04

All clean soil and stone excavated for foundations and services will be retained on site for use in raising ground levels and in landscaping works. Soil and stone impacted by accidental spills of polluting substances e.g. oils will be sent off-site

Pending the completion of the detailed design of the development which will include the selection of materials to 'design out' waste and reuse and recycling initiative and the confirmation of the construction methodologies, it is not possible to estimate with any level of accuracy the quantities of C&D waste that will be generated in each phase of the development. An indication of the likely percentages is shown in Table 6.2

Table 6.2

Waste Types	% By Weight
Mixed C&D	33
Timber	28
Plasterboard	10
Metals	8
Concrete	6
Other	15
Total	**100**

6.3 Resource Manager

Given the scale of the development the Main Contractor will nominate an experienced Resource Manager who shall be responsible for the appropriate segregation and storage of all waste arising in the construction stage, including wastes from the staff welfare facilities.

6.3.1 Regulatory Compliance

The Resource Manager shall ensure that all wastes arising in the construction stage are sent to waste facilities that are authorised under the Waste Management Act 1996, as amended and/or the Environmental Protection Act 1992, as amended and hold up to date permits that approve the acceptance of the specific waste types. These authorisations include:

- Industrial Emissions Licences Waste Licences issued by the EPA
- Waste Facility Permits and Certificates of Registration issued by a local authority.

6.3.2 Training

The Waste Manager shall be responsible for instructing construction staff on the appropriate segregation and storage practices for the different waste types. This may be provided as part of general site training needs such as site induction, health and safety awareness and 'tool box talks'.

6.3.3 Records

The Resource Manager shall be responsible for maintaining the following records of all wastes sent of site

- Details of the waste collector, including the waste collection company name, vehicle registration number and date the wastes were collected,
- Details of the waste management facility to which the waste were sent, including weighbridge records that detail the waste collection company and vehicle registration and the quantity of waste accepted.

6.4 On-Site Waste Management

Appropriately sized skips will be provided by a waste collector who holds an up to date Waste Collection Permit from the National Waste Collection Permit Office (NWCPO) that authorises the collection of the waste types that will arise during the construction stage.

Dedicated skips will be provided for:

- Concrete rubble, bricks and tiles
- Plasterboard
- Hard plastic off-cuts
- Timber off-cuts
- Metal off-cuts and rebar
- Glass
- Cardboard and plastic packaging
- Non-recyclable packaging (e.g. polystyrene)
- Waste Electrical and Electronic Equipment (wiring, batteries)
- Empty paint tins, adhesive containers and oil cans

Separate wheelie bins will be provided for food waste, mixed dry recyclables and residual waste for wastes arising at staff welfare facilities.

The skips will be located at strategic locations around the construction site, as decided by the Resource Manager, in areas that are remote from water course. The wheelie bins shall be stored adjacent to the construction workers welfare facilities.

Signage will be provided that informs the site staff of the waste types that can be placed in each skip.

6.4.1 Hazardous Waste Management

The paint tins, adhesive containers and oil cans will be classified as hazardous waste and shall only be placed in a water tight dedicated skip.

Waste oils arising from routine plant maintenance shall be stored in drums or in an enclosed storage unit in the Contactor's Compound.

6.4.2 Inspections/Audits

The Resource Manager will be responsible for regularly inspecting the skips and bins to

- Ensure they are being used appropriately
- Remove non-conforming wastes, and
- That they are removed from the site as required to prevent spillage.

APPENDIX 3

C E M P

Unit 15
Melbourne Business Park
Model Farm Road
Cork T12 WR89

O'Callaghan Moran & Associates
ENVIRONMENTAL MANAGEMENT FOR BUSINESS

T: 021 434 5366
E: admin@ocallaghanmoran.com
www.ocallaghanmoran.com

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

GREAT CONNELL SHD

NEWBRIDGE

COUNTY KILDARE

Prepared For: -

Aston Ltd
Great Connell
Newbridge
County Kildare

Prepared By: -

O'Callaghan Moran & Associates
Unit 15
Melbourne Business Park
Model Farm Road
Cork
T12 WR89

April 2022

Project	Preliminary Construction Environmental Management Plan			
Client	Aston Ltd			
Report No.	Date	Status	Prepared By	Reviewed By
211550103	24/03/2022	Initial Draft	Austin Hynes BSc MSc	Jim O'Callaghan MSc
	28/03/2022	Draft Rev A		
	01/04/2022	Final		

TABLE OF CONTENTS

PAGE

1. INTRODUCTION 1

1.1 METHODOLOGY 1
1.2 REVISION 1

2. PROJECT DESCRIPTION 2

2.1 SITE LOCATION 2
2.2 SITE LAYOUT 2
2.3 SERVICES 2
2.4 ENVIRONMENTAL SETTING 2
2.4.1 Hydrology 2
2.5 ENVIRONMENTAL SETTING 3
2.5.1 Hydrology 3
2.5.2 Geology & Hydrogeology 3
2.5.3 Biodiversity 3
2.5.4 Archaeology 3
2.6 SURROUNDING LAND USE 4
2.7 ROAD NETWORK 4
2.8 INVASIVE SPECIES 4

3. DEVELOPMENT DESCRIPTION 5

3.1 SERVICES 5
3.2 ROADS/JUNCTIONS 5

4. PRELIMINARY CONSTRUCTION PROGRAMME 6

4.1 DEVELOPMENT PHASES 6

5. METHOD STATEMENT FOR CONSTRUCTION 8

5.1 WORKING HOURS 8
5.2 SITE PREPARATORY WORKS 8
5.3 CONSTRUCTION COMPOUND 8
5.4 EXCAVATION WORKS 9
5.5 CONSTRUCTION OF THE NSOORR 9
5.6 CONCRETE WORKS 9
5.7 SURFACE WATER/DRAINAGE SYSTEM 9
5.8 GROUNDWATER 9
5.9 MATERIALS – SOURCE AND TRANSPORTATION 10
5.10 OILS AND CHEMICAL STORAGE 10
5.11 TRAFFIC MANAGEMENT 10
5.12 HEALTH AND SAFETY 11
5.13 SITE SECURITY 11

6. ENVIRONMENTAL MITIGATION MEASURES 12

6.1 NOISE & VIBRATION 12
6.2 AIR 13

6.2.1 Dust *13*
6.2.2 Engine Exhaust Emissions *14*
6.3 LAND & SOIL 14
6.4 WATER 15
6.5 ARCHAEOLOGY 15
6.6 BIODIVERSITY 16
6.6.1 Lighting *16*
6.6.2 Habitats *16*
6.6.3 Bats *16*
6.7 LANDSCAPE 18
7. INVASIVE SPECIES MANAGEMENT PLAN 19
7.1 INTRODUCTION 19
7.2 HIMALAYAN BALSAM 19
7.3 SURVEY 19
7.4 PROPOSED MANAGEMENT PROGRAMME 19
8. MONITORING 20
8.1 ARCHAEOLOGY 20
8.2 DUST DEPOSITION 20
8.3 NOISE MONITORING 20
8.4 BIODIVERSITY 20
8.5 REPORTING 20

1. INTRODUCTION

Aston Ltd appointed O'Callaghan Moran & Associates to prepare a preliminary Construction Environmental Management Plan (CEMP) for the proposed Strategic Housing Development (SHD) at Great Connell, Newbridge, County Kildare.

The preliminary CEMP defines the measures that will be implemented in the Construction Stage to:

- Effectively mitigate adverse environmental effects, and
- Manage invasive species to achieve their eradication and prevent their spread inside and outside the site boundary.

1.1 Methodology

The preliminary CEMP had regard to the following:

- Construction Industry Research and Information Association (CIRIA) guidance which include 133 Waste Minimisation in Construction (CIRIA 133), and the Control of Water Pollution from Construction Sites, Good Practice Guidelines (CIRIA C532).
- BS 5228 (2009+A1:2014) Code of practice for noise and vibration control on construction and open sites - Noise and Vibration.
- European Communities (Birds and Natural Habitats) Regulations (S.I. No. 477/2011)
- The Construction Stage Prevention & Mitigation Measures in the Environmental Impact Assessment Report.
- Preliminary Resource & Waste Management Plan.
- Provide adequate environmental training and awareness for all project personnel.

1.2 Revision

This preliminary CEMP will be revised following receipt of planning permission to incorporate any additional mitigation measures that may be imposed by the conditions of the planning permission and to update the Invasive Species Management Plan based on new surveys.

2. PROJECT DESCRIPTION

2.1 Site Location

The site is to the east of Newbridge Town Centre. It is accessed from the east off the Great Connell Road, which forms the eastern boundary. It is bounded to the north-east by a residential development (Wellesley Manor) and to the north-west by an open drain that was formerly a meander channel of the River Liffey. A hedgerow forms the southern boundary. The south-western boundary is defined by a buffer zone on the western side of the River Liffey. The western boundary is not defined on the ground.

2.2 Site Layout

The site is 27.64 hectares (ha) and the layout is shown on Drawing PA-0012 in Appendix 1. Most of the site is in agricultural use, currently tillage. An open but overgrown drainage ditch runs along the northern border and in central area of the site. There are hedgerows along the northern, southern and eastern boundaries and an area of woodland in the southwest, on the eastern bank of the River Liffey.

There is a former agricultural yard (8,920m^2) towards the centre of the site containing two single storey sheds (1,440m^2 and 595m^2), and a three-sided shed (54 m^2) and a car park to the east. There is a former residential dwelling (Valencia Lodge) to the east of the agricultural yard. This is a single storey house (136 m^2) with a single storey garage (17.8 m^2) and garden. There is a second former residence (Great Connell) in the north-east corner of the site. This is a two-storey dwelling (332 m^2) with a detached single storey garage and boiler room (48 m^2).

2.3 Services

There is an Irish Water 300mm watermain running along the Great Connell Road. This supplies the Wellesley Manor via a 100mm uPVC network. There is an existing 1000mm concrete storm water sewer serving Wellesley Manor that flows from north-east to the south-west along the north-eastern boundary and discharges into a small stream that then flows into the Liffey.

A 450mm concrete foul sewer flows north to south through the centre of the site and connects to the foul sewer network serving Wellesley Manor. A 900mm foul sewer, recently installed as part of the upgrade of the Upper Liffey Valley Sewerage Scheme, runs from north-east to south-west across the site. There is an overhead 10 kV Medium Voltage electricity line traversing the site which drops underground for a section of its run.

2.4 Environmental Setting

2.4.1 Hydrology

The site is in the catchment of the River Liffey, whose main channel runs through the site close to the south-western boundary. There are two open drainage ditches inside the site boundary that follow the original alignment of an historic meander on the Liffey.

2.5 Environmental Setting

2.5.1 Hydrology

The site is in the catchment of the River Liffey, whose main channel runs through the site close to the south-western boundary. There are two open drainage ditches inside the site boundary that follow the original alignment of an historic meander on the Liffey.

2.5.2 Geology & Hydrogeology

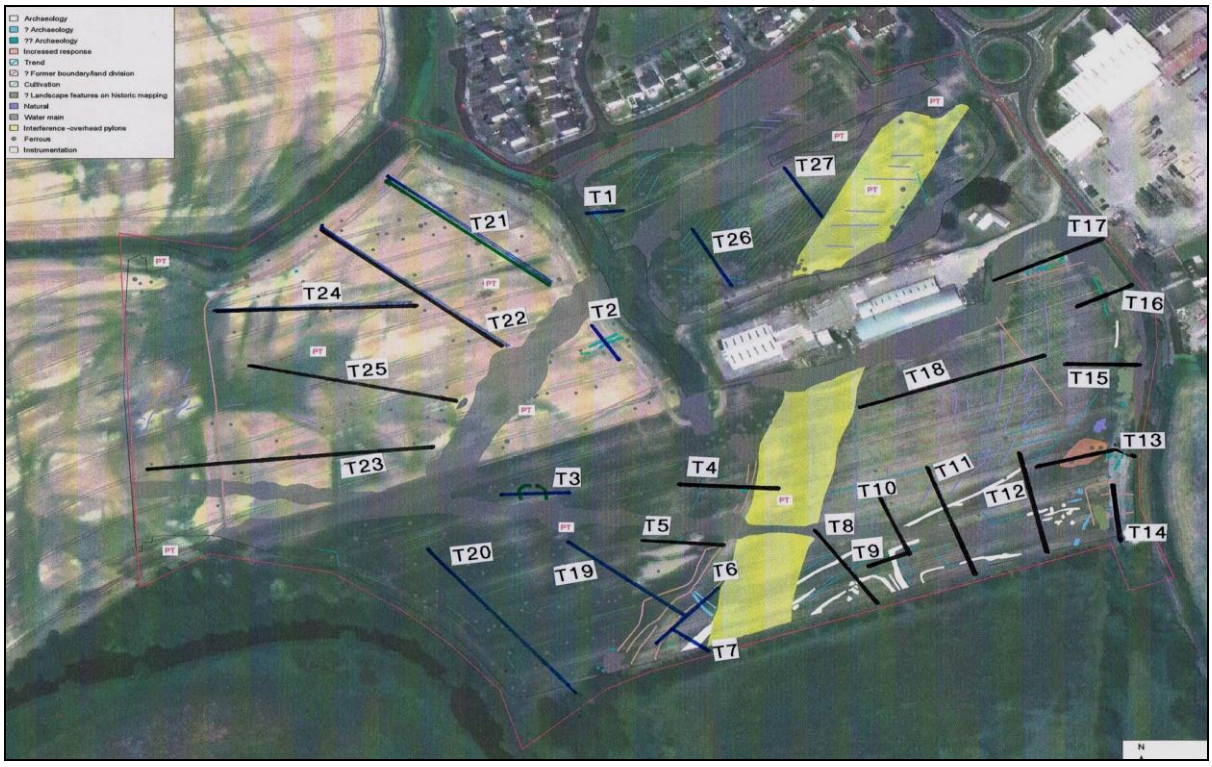
The subsoils in the western half of the site are Alluvium, with the eastern half underlain Gravels derived from Limestone. The subsoils are between 16.5m and 18m thick and overly limestone bedrock. The sands and gravels are classified as a locally important aquifer. The underlying bedrock is a regionally important karstified (Rkd) aquifer. The water table ranges from 1m to 2.9m below ground level.

2.5.3 Biodiversity

The site is dominated by large fields of arable crops, with two former residences and three former agricultural buildings at the centre of the site towards the eastern boundary. The northern, southern and eastern boundaries include hedgerows with small areas of scrub and treelines. There is an area of mixed broadleaved woodland in the south-west corner of the site and this is the most valuable habitat within the site and will be retained intact. There is an 80m riparian zone either side of the River Liffey. The closest Natura 2000 Site is Pollardstown Fen Special Protection Area, which is 2.6km to the west.

2.5.4 Archaeology

Archaeological field surveys did not identify any significant archaeological features within the site boundary. A number of minor features were identified in Test Trench T12 in the south east of the site that need to be assessed at the site clearance stage (Figure 2.1).



2.6 Surrounding Land Use

To the south and south-east are agricultural lands primarily used for tillage. To the east, across the Great Connell Road, are the Murphy Ireland Ltd offices and compound. To the north-east is Wellesley Manor, which has the closest residential dwellings to the development, with the houses in the south of the estate being approximately 10m from the north-eastern development site boundary. A large-scale residential development is currently under construction to south-west of the site.

2.7 Road Network

The R416 Athgravan Road to the west is a Regional Road linking Newbridge and Athgarvan. It is a single lane two-way carriageway. The Great Connell Road is a Local Primary Road linking the R445 with the L2032 via Buckley's Cross at the northern end. It is a single lane two-way carriageway.

The Great Connell roundabout provides access to the residential development on the western side of the Great Connell Road, the Murphy International offices and compounds and the Dr. Pepper beverage manufacturing plant.

The completed section of the N445 'Ballyfarm Road' is expected to be taken in charge by Kildare County Council by Q2 2022. This section of road will then be open to the public.

2.8 Invasive Species

Himalayan Balsam *Impatiens glandulifera,* which is listed in the Third Schedule of SI 477 of 2011 was recorded along the banks of the River Liffey within the proposed development site (Figure 2.4). The locations are in the riparian zone.

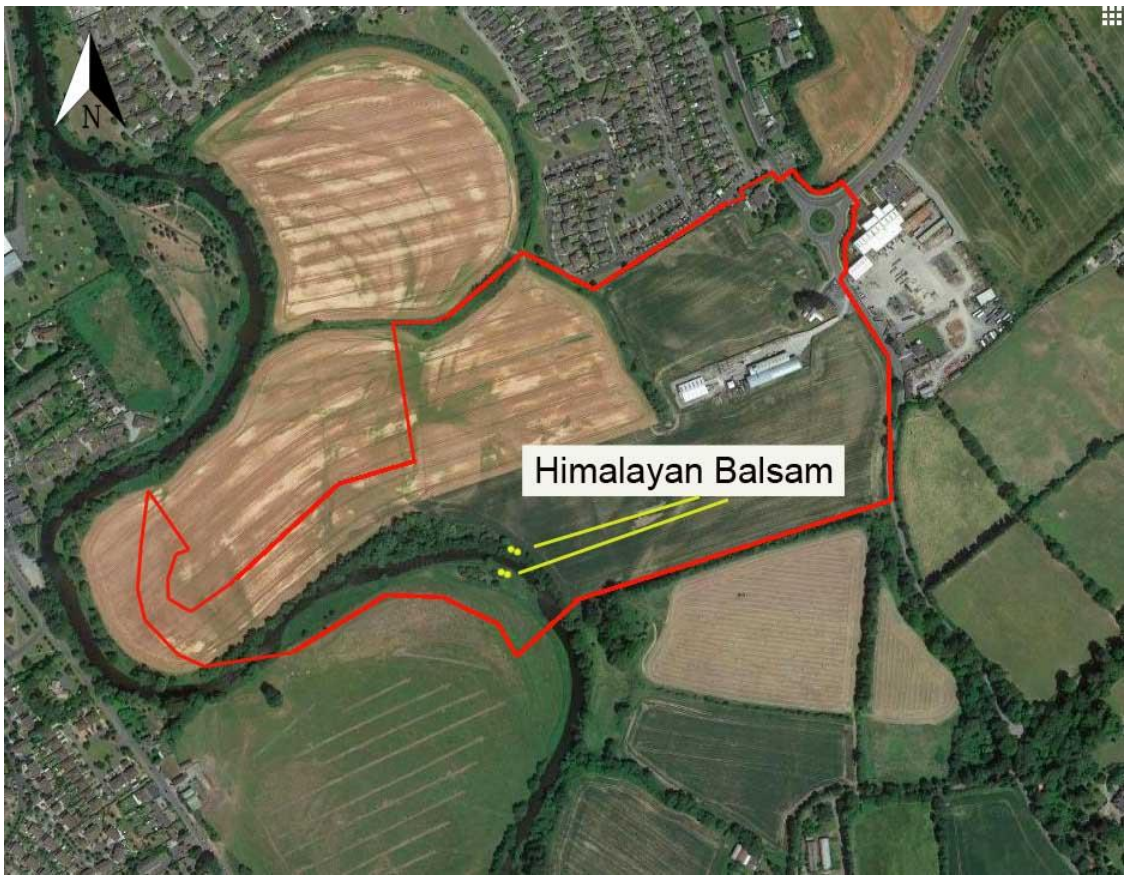


Figure 2.4 Invasive Species

3. DEVELOPMENT DESCRIPTION

The proposed layout is shown on Drawing PR-002 in Appendix 1. The development involves the demolition of two unoccupied private residences and three sheds and the phased construction of 569 residential units comprising a mix of house and apartments with associated car parking (1,008) and bicycle (734) spaces; the construction of a neighbourhood centre and a crèche and the provision of a series of parks (2.6 ha) and open amenity area (8.31 ha) along the River Liffey. Access will be off the Great Connell Road and the development will include the delivery of a 350m section of the Newbridge Southern Outer Orbital Relief Road (NSOORR).

3.1 Services

The development will connect to the mains water supply via a 200mm diameter connection from the existing watermain on the Great Connell Road. The surface water drainage system will discharge to the existing drainage ditch and the River Liffey via nine below ground flow attenuation tanks.

The existing 450mm foul sewer that runs across the site from south to north will be diverted and connected to the new 900mm diameter sewer. There will be a pumped foul water connection to the Upper Liffey Valley Sewerage Scheme

The existing overhead electrical power lines running from the north-east to south-west through the site and along the southern site boundary will be diverted underground.

3.2 Roads/Junctions

The development will deliver a 350m section of the NSOORR and the Great Connell Roundabout will be replaced by a signalised junction

4. PRELIMINARY CONSTRUCTION PROGRAMME

4.1 Development Phases

The proposed phasing of the works is shown on Drawing No PA-008 in Appendix 1

Phase 1: Northern Area of Site

- Construction of 169 residential units and the neighbourhood centre including the crèche
- Construction of the signalised junction and Great Connell Roundabout
- Demolition of private residences and removal of trees as per the Arborist requirement
- Diversion of Athgarvan foul sewer to connected to Upper Liffey Valley Sewerage Scheme
- Undergrounding of overhead power lines.
- Construction of relevant infrastructural works including new foul sewer and pumping station, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.
- Completion of flood compensation storage works within the riparian/zoned amenity lands
- Open Spaces landscaping in Zones 9,10,11,13, A & B.

Phase 2: **South of Phase 2**

- Construction of 103 residential units.
- Construction of relevant infrastructural works including new gravity foul sewer, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.
- Provision of Open Space 2, along with relevant landscape works within the riparian zone.

Phase 3: **South of Phase 3**

- Construction of 99 residential units.
- Construction of relevant infrastructural works including new gravity foul sewer, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.
- Open space landscaping to Areas 3 & F, including treatment works to this section of the Great Connell Road.

Phase 4: **West of Phases 4**

- Construction of 198 residential units.
- Construction of relevant infrastructural works including new gravity foul sewer, surface water drainage including SuDs measures, water mains connections, roads and footpaths and utilities.
- Open space landscaping to areas 1, 4, 5, 6, 7, 8, D & E, including treatment works to the section of the Great Connell Road.

5. METHOD STATEMENT FOR CONSTRUCTION

5.1 Working Hours

The normal working hours shall be 08:00 to 18:00 Monday to Friday (excluding bank holidays) and 08:00 to 16:00 Saturdays, subject to restrictions that may be imposed by the planning permission. Works will not be carried out on Sundays and Public Holidays. Subject to the agreement of the Kildare County Council out of hours activities may be required for certain elements e.g. connections to water mains and municipal foul sewer.

5.2 Site Preparatory Works

Preparatory works involves Site Set Up by the Contractor which will include the following:

- Setting of access control to the development area and the erection of directional signage as specified in the Construction Stage Traffic Management Plan.
- All construction related traffic will access the site via N445 (Ballyfarm Road) only with no construction traffic on the Great Connell Road at any time.
- Provision of secure compound for the storage of all on-site machinery and materials.
- Confirming the buffer distances between site boundaries and sensitive locations.
- Construction of internal site roads.
- Provision of services and utilities, and
- Provision of security fencing and perimeter hoarding.

Prior to the commencement of construction, the Contractor will contact the relevant bodies (e.g. ESB, Gas Networks, Irish Water) check records and drawings to establish the location of existing buried services/utilities. Where it is necessary to disconnect services/utilities during the construction works for a notable period, temporary provisions will be provided.

5.3 Construction Compound

The exact location of the compound will be confirmed in advance of commencement of the works (and agreed with Kildare County Council). The compound may be relocated during the construction phases. All construction traffic and deliveries to the site will be directed to only use the extended section of the N445 (Ballyfarm RD) no other public rad access will be permitted.

The compound will include a site office and welfare facilities, hardstanding for plant and machinery and a designated waste storage area. It will initially be serviced with electrical power from an on-site generator and will include Portaloo toilet facilities until a connection to the municipal foul sewer has been established. The generator will contain a built-in double contained fuel storage tank. All liquid chemicals will be stored in the construction compound in bunded storage areas.

5.4 Excavation Works

Topsoils and subsoils will only be excavated to establish formation level for the buildings, roads and underground services, including the surface water attenuation tanks. A tracked 360-degree excavator will be used to strip the topsoil, and a dumper will be used to move the excavated materials to temporary stockpile locations.

5.5 Construction of the NSOORR

The construction methodology is as follows:

- Soils will be excavated until a competent stratum is reached.
- A layer of geogrid/geotextile may be required at the surface of the competent stratum.
- The competent stratum will be overlain with up to 500mm of granular fill.
- A final hard surface layer will be placed to provide a road profile to accommodate construction traffic.
- Prior to completion of the Phase 1 the finished road surface will be applied.

5.6 Concrete Works

Concrete batching will not be carried out on-site. Excess concrete will be removed from the site and concrete washout will not be permitted on the site. Concrete pouring will be monitored to ensure there is no accidental discharge. Accidental spills will not be hosed down.

5.7 Surface Water/Drainage System

A 5-meter buffer will be maintained along the banks for the drains in the north of the site. The only works carried out inside the 80m strip of riparian area along the Liffey will be the provision of bound gravel bitmac paths. A minimum 10m buffer will be maintained between the riverbank and the operational area when the paths are being laid.

A stretch of the drainage ditch in the north of the site will be infilled. A storm water attenuation system will be installed comprising a range of SuDs measures including underground attenuation. The attenuation system will discharge to the drainage ditch in the north of the site and to the River Liffey via silt traps and oil interceptors. The outfalls will be constructed in accordance with Inland Fisheries Ireland “Guidelines on the Protection of Fisheries during Construction Works In and Adjacent to Waters 2016” .

5.8 Groundwater

The excavation works will not extend to below the water table and dewatering will not be required.

5.9 Materials – Source and Transportation

The selection and specification of construction materials will be informed by the local availability of these materials. Subject to the necessary constraints of performance, durability and cost, construction materials will be sourced from local suppliers and manufacturers, where possible.

5.10 Oils and Chemical Storage

All oils, fuels, paints and other chemicals will be stored in a secure, bunded, hardstand area. The bund capacity of the bulk oil storage tanks will at a minimum be 110% of the tank. For drum storage, a bund capacity of 25% of the maximum volume of material stored is required. The refuelling and servicing of mobile plant and equipment will only be carried out in a designated hardstand area which is at least 50m from any drains.

5.11 Traffic Management

A Traffic Management Plan (TMP) will be prepared prior to the start of the Advance Works. The Plan will take into consideration:

- Department of Transport Traffic Signs Manual 2021
- Department of Transport Guidance for the Control and Management of Traffic at Road Works (2010)
- Relevant conditions of the planning permission, and the
- Site Access

There will be a single entrance to Phases 1 to 4 off the Great Connell Roundabout. All construction and delivery traffic will access the site via the extended section of the R445 “Ballyfarm Rd” which is due to open in Q2 2022. Construction traffic will not access the site from the Great Connell Road.

The traffic will include:

- Private vehicles use by construction site staff
- Construction vehicles (excavators and dump trucks)
- Materials delivery vehicles, typically heavy goods vehicles (HGV)

Many staff members will share transport and will generally arrive before 08:00 and leave after 18.00 thereby avoiding morning and evening peak hour traffic. There will, on average, be 5 HGV movement hourly at the busiest times.

The Plan will address the following

- Provision of Warning/Advanced Warning Signs at appropriate locations.
- Speed limits.
- Designated parking areas.

- Maintaining cleanliness of the public roads on the approaches to the site.
- Maintaining safe pedestrian access on the public roads in the vicinity of the site.

5.12 Health and Safety

As required by the Safety, Health and Welfare at Work (Construction) Regulations 2013, the Contractor appointed to complete the development will prepare a Health and Safety Plan that address site specific health and safety issues from the start to the completion of the construction.

The Contractor will provide 'Site Induction' training for all construction staff and ensure all site staff have current 'Safe Pass' cards. All construction staff will receive a full safety briefing and will be provided with all of the safety equipment required by their assigned tasks.

5.13 Site Security

The Contractor will be responsible for site security, including erecting and maintaining adequate fencing.

6. ENVIRONMENTAL MITIGATION MEASURES

The Construction Stage involves site clearance, building demolition, excavation, the construction of the residential units, neighbourhood centre, crèche and roadways and the provision of the associated wastewater and surface water drainage systems. Heavy goods vehicles will deliver construction materials and the mobile plant will include excavators, lifting equipment, dumper trucks, compressors, and generators.

The construction works have the potential to impact on the environment through the generation of noise and dust and impacts on air quality, surface water, groundwater, and ecology. The Main Contractor shall appoint an experienced Environmental Clerk of Works who will be responsible for ensuring the mitigation measures specified in this Plan are effectively implemented throughout the Construction Stage. This includes the provision of staff induction training and regular 'toolbox' talks.

6.1 Noise & Vibration

The Main Contractor shall be responsible for compliance with the requirements of BS 5228-1:2009+A1:2014 and BS 5228-2:2009+A1:2014 (Code of Practice for Noise and Vibration Control on Construction and Open Sites) and the Safety, Health and Welfare at Work (General Application) Regulations 2007, Part 5 Noise and Vibration.

The noise and vibration assessment carried out as part of the EIA process concluded that the construction phase LAeq 1 h levels at all receptors will be lower than the 65 dB criterion recommended by BS 5228-1:2009. Cumulative levels associated with simultaneous building construction and NSOORR construction will also be lower than the 65 dB criterion, and considerably lower than the 70 dB NRA road construction criterion in the National Roads Authority (NRA) Guidelines for Treatment of Noise and Vibration in National Roads Schemes. No vibration impacts will arise.

Although construction phase noise emissions will be short term, and will not exceed construction phase criteria, the applicant nonetheless proposes to apply the following mitigation measures throughout the construction phase:

- Works will in general be confined to the period Monday-Friday 0800-1800, and Saturday 0800-1600.

- Where it is proposed to operate plant during the period 0700-0800 at locations within 100m of offsite receptors, standard 'beeper' reversing alarms will be replaced with flat spectrum alarms.

- Provision of a barrier along site boundary (e.g. standard 2.4m high construction hoarding) to when construction works are being carried out in proximity to noise sensitive receptors i.e. private residences.

- Hooting will be prohibited onsite. Drivers of plant and vehicles will be instructed to avoiding hooting at all times.

- Plant used on-site will be maintained in a satisfactory condition and in accordance with manufacturer recommendations. In particular, exhaust silencers will be fitted and operating correctly at all times. Defective silencers shall be immediately replaced.

- Queuing of trucks near offsite receptors will be prohibited.

- Plant will only be left running during works and will be switched off at all other times. Plant will not be left idling.

- Where it is proposed to introduce potentially noisy plant to the site, the potential impact of noise emissions will be assessed in advance.

- Where generators or compressors are operated within 100 m of offsite receptors, or previously completed receptors onsite, these will be fitted with manufacturers' acoustic enclosures, or alternatively will be screened by a local acoustic screen or soil stockpile.

- Provision of a barrier along site boundary (e.g. standard 2.4m high construction hoarding) to when construction works are being carried out in proximity to noise sensitive receptors i.e. private residences.

- Selection of quiet plant/location of plant; plant which will have the least impact in term of noise will be selected and will be positioned as far away as practical from noise sensitive receptors.

- All vehicles and mobile plant will have effective exhaust silencers, and these will be subject to regular maintenance to ensure they remain fit for purpose. All diesel fuelled plant will have effective air intake silencers.

- Pneumatic percussive tools (air drills, hammers, rammers etc) will be fitted with the manufacturer's recommended mufflers or silencers.

- Hours of work - all construction related works, other than emergency works and security will be carried out during normal construction working hours.

- The Ecological Clerk of Works will be appointed as a liaison officer with the local community. Where evening or night-time operations are required, local residents will be notified through the liaison officer.

- All noise complaints will be logged in a register and investigated immediately. Details of follow-up action will be included in the register.

6.2 Air

6.2.1 Dust

Dust emissions are likely to arise from earthworks, wind blow from temporary soil stockpiles; construction traffic movements; handling of construction materials and landscaping. The following control measures will be implemented at a minimum:

- The Main Contractor shall prepare a site-specific Dust Management Plan prior to the start of the works.

- Spraying of exposed earthworks, soil stockpiles and site haul roads during dry weather using mobile bowser units.

- Provision of a power wash at the site entrance road to remove dirt from vehicles before they leave the site.

- Paved roads will be regularly swept to remove mud and debris and traffic movements on non-paved areas will be restricted to essential site traffic

- Control of vehicle speeds.

- Material drop heights from plant to plant or from plant to stockpile will be minimised.

- The approach road to the Great Connell Roundabout and the junction itself will be inspected daily for cleanliness and cleaned as required using a mechanical road sweeper.

6.2.2 Engine Exhaust Emissions

The following mitigation measures will be implemented to minimise emissions:

- Construction materials will where possible be sourced locally so as to minimise transport distances.

- Engines will be turned off when machinery is not in use, and

- Regular maintenance of vehicles, plant and equipment.

6.3 Land & Soil

The following management practices will be implemented to minimise the risk of soil contamination:

- Excavation and the stripping of topsoil etc. will only be undertaken when absolutely necessary as this can lead to sediment run off and leaching of nutrients from soils into the groundwater.

- Excavated soils not immediately reused will be stockpiled to minimise the effects of weathering.

- Good housekeeping (daily site clean-ups, use of disposal bins, etc.) on site during construction, and the proper use, storage and disposal of substances and their containers will prevent soil contamination.

- Regular plant maintenance to minimise oil leaks.

- Refuelling of the diesel fuelled plant will only be undertaken by trained personnel in areas where appropriate spill control materials are to hand (spill mats, oil dry). Any spillages will be immediately contained, and the contaminated soil excavated and sent to an appropriately licensed waste management facility.

6.4 Water

The mitigation measures described in Section 6.4 are equally relevant to the protection of surface waters. The following additional measures will be implemented:

- A 10m buffer will be maintained between the existing ditch that will be retained and the construction area.

- The only works carried out inside the 80 m riparian strip along the Liffey will be the provision of bound gravel bitmac paths. A minimum 10 m buffer will be maintained between the riverbank and the operational area when the paths are being laid.

- Pouring of cementitious materials will be carried out where possible in dry periods based on weather forecasts. Plastic covers will be available in case of a sudden rainfall event.

- The concrete pumping will be monitored to ensure no accidental discharge.

- Excess concrete will be removed from the site and concrete washout, with the exception of chute cleaning, will not be permitted on the site

- There will be no hosing into surface water drains of spills of concrete, cement, grout or similar materials

6.5 Archaeology

- Prior to the start of the construction works a suitably qualified and experienced, Archaeologist shall be appointed to undertake all mitigation measures. The Archaeologist shall obtain an Archaeological Excavation Licence from the Department of Housing, Local Government and Housing.

- The Archaeologist shall monitor all topsoil stripping/general ground reduction works onto the surface of the underlying subsoils.

- As part of the initial phase of topsoil stripping, the overall extents of Features F12-1, F12-2 and F12-3, together with the brick-making feature uncovered in T21, identified in the Archaeological Assessment completed as part of the EIA, will be determined (Figure 2.4). These features will be subject to a process of archaeological excavation (preservation by record).

- In the event of additional subsurface features of archaeological interest being uncovered during the monitoring, works in the immediate area of such features shall cease and the Archaeologist will seek the advice of the National Monuments Service, Department of Housing, Local Government and Heritage to determine what additional action should be implemented.

- Should additional archaeological/historical artefactual material be recovered during such works, then the Archaeologist will ensure that the requirements of the National Museum of Ireland with regard to such items should be implemented. This may include specialist archaeological identification and reporting and conservation, if required.

- Following completion of the combined programmes of archaeological excavation and monitoring, and any other possible archaeological interventions/investigations, the Archaeologist shall prepare a full and final report for submission to the Planning Authority and the Department of Housing, Local Government and Housing and National Museum of Ireland.

6.6 Biodiversity

Given the site location there is particular emphasis on the need to protect the valuable habitats adjoining the site i.e. River Liffey and treeline/woodland habitats. To achieve this, it is essential that all construction staff, including all sub-contractors, are fully informed of these habitats and of the control measures that must be implemented to prevent adverse impacts. The Ecological Clerk of Works will be responsible for informing all relevant staff.

6.6.1 Lighting

- Site lighting will be provided with the minimum luminosity necessary for safety and security purposes. Where possible, lighting will be restricted to the working area and using the cowl and angling noted above, will minimise overspill and shadows on sensitive habitats outside the construction area and

- Site lighting will be positioned and directed so that it does not unnecessarily intrude on adjacent ecological receptors. The primary area of concern is the potential impact at the woodland and treelines along the River Liffey. There will be no directional lighting focused towards these areas and cowling and focusing lights downwards will minimise light spillage.

6.6.2 Habitats

- Trees will be protected in accordance with BS: 5837:2012 Trees in relation to design, demolition and construction.

- Where possible trees will be removed outside the period 1st March to 31st August.

- The mitigation measures to protect the trees that will be retained shall comply with Arboriculture Method Statement for works within the root protection area of the tree

- Reinstatement of trees and vegetation will be undertaken by a suitably qualified landscape contractor.

6.6.3 Bats

- Where possible the demolition of buildings will take place between and October March when bats will be hibernating, as they have negligible potential as winter hibernation sites.

- In all cases immediately in advance of demolition a bat specialist will undertake an examination of the building. Emergence surveys will be carried out if buildings are affected during the April to September period. If bats are present at the time of examination it is essential to determine the nature of the roost (i.e. number, species, whether it is a breeding population) as well as its exact location.

- If bats are recorded in the buildings earmarked for demolition, special mitigation measures to will be put in place and a license to derogate from the conservation legislation will be sought from the NPWS.

- The Main Contractor will take all required measures to ensure works do not harm individual bats by altering working methods or timing to avoid bats, if necessary.

- If roosting habitat for bats is removed, replacement habitat will be provided.

- A number of trees will be removed prior to/during construction. The bat specialist will work with the Ecological Clerk of Works to ensure that the loss of trees is minimised, and those trees earmarked for retention are adequately protected.

- Tree-felling will be undertaken in the period September to late October/early November. During this period bats are capable of flight and may avoid the risks of tree-felling if proper measures are undertaken.

- Felled trees will not be mulched immediately. Such trees will be left lying several hours and preferably overnight before any further sawing or mulching. This will allow any bats within the tree to emerge and avoid accidental death. The bat specialist will be on-hand during felling operations to inspect felled trees for bats. If bats are seen or heard in a tree that has been felled, work will cease and the local NPWS Conservation Ranger will be contacted.

- Trees will be retained where possible and no 'tidying up' of dead wood and spilt limbs on tree specimens will be undertaken unless necessary for health and safety.

- Treelines outside the proposed development area but adjacent to it and thus at risk, will be clearly marked by a bat specialist to avoid any inadvertent damage.

- During construction directional lighting will be employed to minimise light spill onto adjacent areas. Where practicable during night-time works, there will be no directional lighting focused towards the River Liffey or boundary habitats and focusing lights downwards will be utilised to minimise light spillage.

- If bats are recorded by the bat specialist within any trees or buildings, no works will proceed without a relevant derogation licence from the NPWS.

- As a biodiversity enhancement measure it is proposed that bat boxes will be put up within the study area. It is proposed that 10 bat boxes will be located within the site (https://www.wildcare.co.uk/vincent-pro-bat-box-10651.html for box proposed or similar). The boxes will be erected by the Ecological Clerk of Works taking into account landscape plans, vehicle movements and lighting.

- As noted above, lighting mitigation measures will follow *Bats & Lighting Guidance Notes for: Planners, engineers, architects and developers* (Bat Conservation Ireland, 2010) and *Guidance note 08/18. Bats and artificial lighting in the UK. Bats and the built environment series* (Bat Conservation Trust 2018).

- All mitigation measures including detailed method statements will be agreed with the NPWS prior to commencement of works, which could affect any bat populations on site.

6.7 Landscape

The mitigation measures will include.

- Erection of 2.4m high construction hoarding around relevant sections of the site boundary e.g. Great Connell Road and the north-eastern boundary with Wellesley Manor.

- Implementing tree protection measures as required (no-dig zones, tree protection fencing and existing hedgerow retention). All trees that will not be removed will remain undisturbed and undamaged

- Tree protection zones will not be used for car parking and the storage of construction materials.

7. INVASIVE SPECIES MANAGEMENT PLAN

7.1 Introduction

This Plan is based on the mitigation measures recommended in the Biodiversity Chapter in the EIAR prepared by Dixon Brosnan Ecologists.

7.2 Himalayan Balsam

Himalayan Balsam is a member of the busy Lizzie family (Balsaminacea) and, as its name suggests, is native to the Himalaya region of Asia. It was introduced as a garden plant in the mid-1800's and rapidly became established along waterways and in other damp places as a result of it prolific seed production.

It is an annual plant forming dense upright stands approximately 1m tall where it effectively out-competes surrounding herbs and grasses. It is tolerant of shade and does very well in the canopy of riparian woodland. In the autumn it dies back leaving the ground bare and vulnerable to erosion.

7.3 Survey

Prior to the commencement of construction works an invasive species survey will be undertaken by an experienced within the proposed development boundary by a competent ecologist to determine if invasive species listed under Part 1 of the Third Schedule of S.I No. 477 of 2011 have established in other areas of the development area in the period between pre-planning and post consent.

7.4 Proposed Management Programme

Given the location and extent of the plants the recommended control measure is hand pulling. The plants will be hand-pulled and bagged prior to the commencement of site works. They will be then placed in a designated area of the site to decay.

The seeds are not particularly robust but may survive for 18 months so a two-year programme of control, which will be within the phased development schedule, will be required. As development works will not be carried out within 50m of the plant stand it is not necessary to wash down machinery leaving the site to prevent seeds from being spread outside the site boundary; however this may change depending on the outcome of the pre-construction survey.

The Contractor will appoint an experienced invasive treatment specialist, who in conjunction with the supervising ecologist, will prepare a detailed management plan prior to the commencement of the works based on up-to-date surveys.

8. MONITORING

An Environmental Monitoring Programme will be implemented for the duration of the works. The scope will be based on the conditions of the planning permission and will be confirmed with Kildare County Council in advance of the works. The preliminary scope is below.

8.1 Archaeology

An experienced Archaeologist will attend on site during the stripping of the topsoil to monitor for archaeological features as specified in Section 6.6.

8.2 Dust Deposition

Dust deposition monitoring will be carried out at locations and frequencies agreed with Kildare County Council. The monitoring will be carried out using Bergerhoff gauges specified in the German Engineering Institute VDI 2119 document entitled 'Measurement of Dustfall Using the Bergerhoff Instrument' (Standard Method).

The gauges will be set up such that the containers were approximately 2m above the ground surface. To inhibit the growth of algae, 10ml of copper sulphate will be added to each jar. The monitoring period shall be between 28 and 32 days. The proposed deposition limit is 350 mg/m2/day

8.3 Noise Monitoring

Noise monitoring will be carried out at noise sensitive locations and frequency agreed with Kildare County Council. The monitoring will be in accordance with International Standard ISO 1996-2:2017 Acoustics – Description, measurement and assessment of environmental noise, Part 2: Determination of environmental noise levels (2017). The noise limits will be as conditioned in the planning permission.

8.4 Biodiversity

A bat specialist will examine the buildings prior to demolition and the mature trees prior to removal to determine the presence/absence of bats.

8.5 Reporting

The results of the monitoring will be submitted to Kildare County Council.

APPENDIX 1

APPENDIX 4

SITE INVESTIGATION REPORT

IGSL Limited

Aston Lands Limited
Byrne Looby Partnership

Residential Development
At
Great Connell
Newbridge
Co. Kildare

Factual Ground Investigation Report

Report No. 23110

April 2021

Report

M7 Business Park
Naas
Co. Kildare
Ireland

T: +353 (45) 846176
E: info @igsl.ie
W: www.igsl.ie

DOCUMENT ISSUE REGISTER

Distribution	Report Status	Revision	Date of Issue	Author
Byrne Looby	Interim Factual Report	0	08/04/2021	D. Green BA BAI CEng MIEI FGS
Byrne Looby	Factual Report	0	14/05/2021	D. Green BA BAI CEng MIEI FGS

TABLE OF CONTENTS

Foreword

1.0 Introduction and Objectives

2.0 Scope of Works

2.1 Cable Percussive Boreholes
2.2 Rotary Coreholes
2.3 Trial Pits
2.4 Dynamic Probes
2.5 Infiltration Tests
2.6 Plate Bearing Tests
2.7 Groundwater Monitoring
2.8 As-Built Survey

3.0 Laboratory Testing

4.0 References

Appendices

Appendix 1 Cable Percussive Boreholes
Appendix 2 Rotary Coreholes
Appendix 3 Trial Pit Records
Appendix 4 Dynamic Probe Records
Appendix 5 Infiltration Test Records
Appendix 6 Plate Bearing Test Records
Appendix 7 Groundwater Monitoring
Appendix 8 Geotechnical Laboratory Testing
Appendix 9 Chemical / Environmental Laboratory Testing
Appendix 10 As-Surveyed Site Plan

FOREWORD

The following conditions and notes on the geotechnical site investigation procedures should be read in conjunction with this report.

Standards

The ground investigation works for this project have been carried out by IGSL in accordance with Eurocode 7 - Part 2: Ground Investigation & Testing (EN 1997-2:2007). This has been used together with complementary documents such as BS 5930:2015 and BS 1377 (Parts 1 to 9) and the following European Norms:

- EN 1997-2 Eurocode 7: 2007 – Geotechnical Design – Part 2: Ground Investigation & Testing
- EN ISO 22475-1:2006 Geotechnical Investigation and Sampling – Sampling Methods & Groundwater Measurements
- EN ISO 14688-1:2018 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 1: Identification and Description
- EN ISO 14688-2:2018 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 2: Classification Principles
- EN ISO 14689-1:2018 Geotechnical Investigation and Testing - Identification & Classification of Rock, Part 1: Identification & Description

Reporting

This report has been prepared for Byrne Looby Partnership and the information should not be used without prior written permission of either party. IGSL Ltd accepts no responsibility or liability for this document being used other than for the purposes for which it was intended. No responsibility can be held by IGSL Ltd for ground conditions between exploratory hole locations.

The engineering logs provide ground profiles and configuration of strata relevant to the investigation depths achieved and caution should be taken when extrapolating between exploratory points. No liability is accepted for ground conditions extraneous to the investigation points. Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction, mining works or karstification below or close to the site.

Boring Procedures

Unless otherwise stated, ‘shell and auger' or cable percussive boring technique has been employed as defined by Section 6.3 of IS EN ISO 22475-1:2006. The boring operations, sampling and in-situ testing complies with the recommendations of IS EN 1997-2:2007 and BS 1377:1990 and EN ISO 22476-3:2005+A1:2011. The shell and auger boring technique allows for continuous sampling in clay and silt above the water table and sand and gravel below the water table (Table 2 of IS EN ISO 22475-1:2006).

It is highlighted that some disturbance and variations is unavoidable in particular ground (e.g. blowing sands, gravel / cobble dominant glacial deposits etc). Attention is drawn to this condition, whenever it is suspected. Where cobbles and boulders are recorded, no conclusion should be drawn concerning the size, presence, lithological nature, or numbers per unit volume of ground.

Rotary Drilling Procedures
Rotary drilling methods are used to recover very heavily over-consolidated glacial till and bedrock samples in line with Section 3.5 of IS EN 1997-2:2007 and IS EN ISO 22475-1. Open hole drilling methods (odex or symmetrix) are utilized to advance the drillholes through granular dominant superficial deposits, with coring in hard ('cemented') fine grained or cohesive glacial deposits and bedrock.

In-Situ Testing
Standard penetration tests are conducted by IGSL strictly in accordance with Section 4.6 of IS EN 1997-2:2007. The SPT equipment (hammer energy test) has been calibrated in accordance with EN ISO 22476-3:2005+A1:2011 and the Energy Ratio (E_r) is defined as the ratio of the actual energy E_{meas} (measured energy during calibration) delivered to the drive weight assembly into the drive rod below the anvil, to the theoretical energy (E_{theor}) as calculated from the drive weight assembly. The measured number of blows (N) reported on the engineering logs are uncorrected. In sands, the energy losses due to rod length and the effect of the overburden pressure should be taken into account (see IS EN ISO 22476-3:2005+A1:2011).

Groundwater
The depth of entry of any influx of groundwater is recorded during the course of boring or drilling operations. However, the normal rate of boring does not usually permit the recording of an equilibrium level for any one water strike. Where possible drilling is suspended for a period of twenty minutes to monitor the subsequent rise in water level. Groundwater conditions observed in the borings or pits are those appertaining to the period of investigation. It should be noted however, that groundwater levels are subject to diurnal, seasonal and climatic variations and can also be affected by drainage conditions, tidal variations etc.

Soil Sampling
Three categories of sampling methods are outlined in EN ISO 22475-1:2006. The categories are referenced A, B and C for any given ground conditions and are shown in Tables 1 and 2 of EN ISO 22475-1:2006. Reference should be made to EN 1997-2:2007 for guidelines on sample class and quality for strength and compressibility testing. Samples of quality classes 1 or 2 can only be obtained by using Category A sampling methods.

Where appropriate Class 1 thin wall undisturbed tube samples (UT100) are obtained in fine grained soils and strictly meet the requirements of EN 1997-2:2007 and EN ISO 22475-1:2006. Soil samples for laboratory tests are divided into five classes with respect to the soil properties that are assumed to remain unchanged during sampling, handling transport and storage. The minimum sample quality required for testing purposes to Eurocode 7 compatibility (EN 1997-2:2007) is shown in Table A.

Table A – Details of Sample Quality Requirements

EN 1997 Clause	Test	Minimum Sample Quality Class
5.5.3	Water Content	3
5.5.4	Bulk Density	2
5.5.5	Particle Density	N/S
5.5.6	Particle Size Analysis	N/S
5.5.7	Consistency Limits	4
5.5.8	Density Index	N/S
5.5.9	Soil Dispersivity	N/S
5.5.10	Frost Susceptibility	N/S
5.6.2	Organic Content	4
5.6.3	Carbonate Content	3
5.6.4	Sulphate Content	3
5.6.5	pH	3
5.6.6	Chloride Content	3
5.7	Strength Index	1
5.8	Strength Tests	1
5.9	Compressibility Tests	1
5.10	Compaction Tests	N/S
5.11	Permeability	2

N/S – not stated. Presume a representative sample of appropriate size.

Samples recovered from trial pits or trenches meet the requirements of IS EN ISO 22475-1. It is highlighted that unforeseen circumstances such as variations in geological strata may lead to lower quality sample classes being obtained.

Engineering Logging

Soil and rock identification is based on the examination of the samples recovered and conforms with IS EN ISO 14688-1:2018 and IS EN ISO 14689-1:2018. Rock weathering classification conforms to IS EN ISO 14689-1:2018 while discontinuities (bedding planes, joints, cleavages, faults etc) are classified in accordance with 4.3.3 of IS EN ISO 14689-1:2018. Rock mechanical indices (TCR, SCR, RQD) are defined in accordance with IS EN ISO 22475-1:2006.

Retention of Samples

After satisfactory completion of all the scheduled laboratory tests on any sample, the remaining material will be discarded. Unless a period of retention of samples is agreed, it is company policy to discard soil samples one month after submission of our final report.

1.0 Introduction and Objectives

It is proposed to construct a residential development at a site at Great Connell, Newbridge, Co. Kildare.

The site is located within the south-eastern outskirts of Newbridge town and the approximate outline of the investigative works is shown on Figure 1.

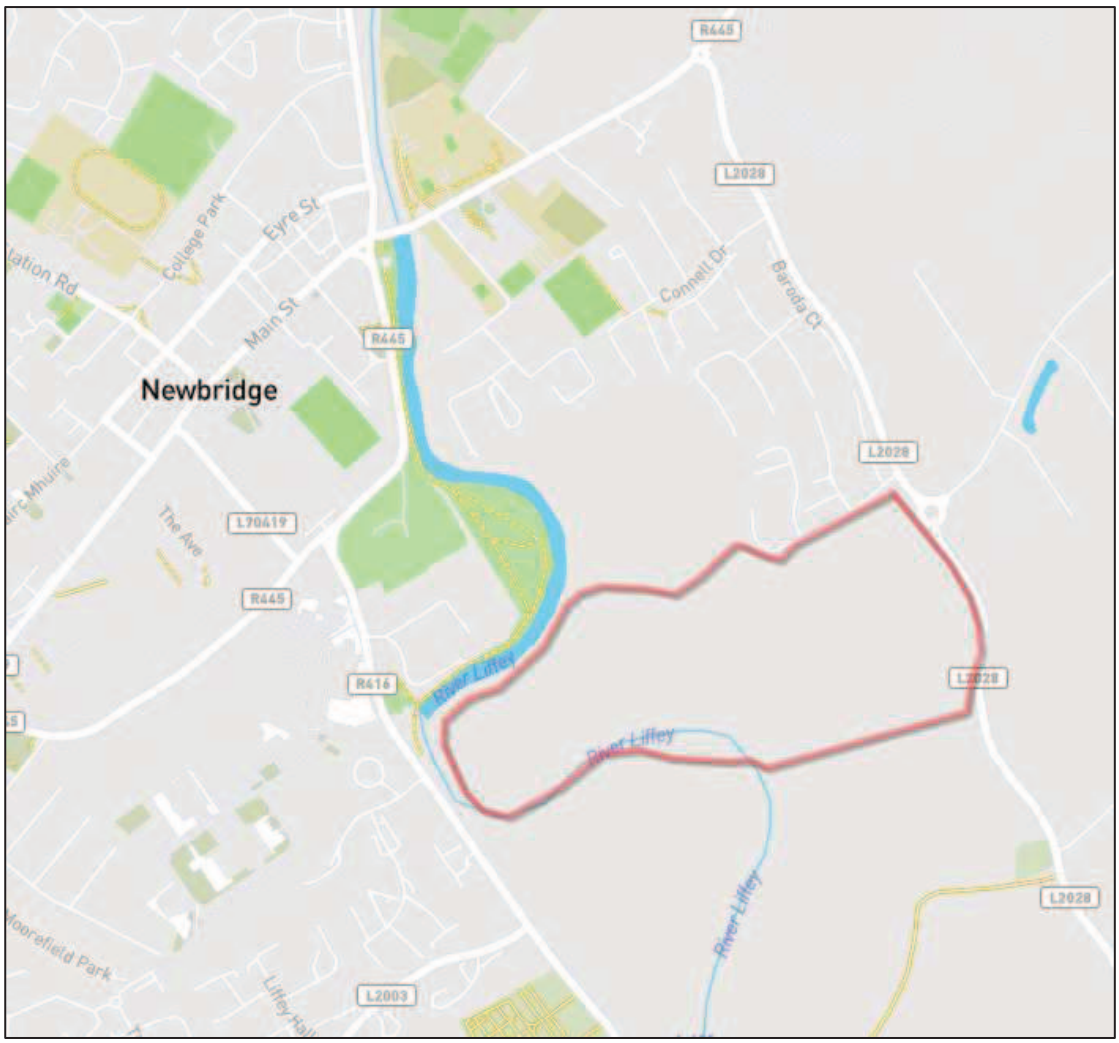


Figure 1 – Site Location (Base Mapping – Google Earth Professional)

IGSL Limited were appointed by Byrne Looby Partnership (BLP) on behalf of Astons Lands Limited to conduct a ground investigation of the site. The objectives of the investigation were to ascertain the ground and groundwater conditions, and to produce a factual report which will assist in the geotechnical design of the new development.

Fieldworks were undertaken during February and March 2021 and laboratory testing of the recovered samples was completed during April / May 2021.

This report presents the factual ground investigation data including fieldwork records and laboratory test results..

2.0 Scope of Works

The programme of exploratory works to date included the following:

- 30 no. cable percussive boreholes (BH01 to BH30)
- 2 no. rotary coreholes (RC13 and RC19)
- 25 no. mechanically excavated trial pits (TP01 to TP25, omitting TP19)
- 17 no. dynamic probes (DP01 to DP17)
- 12 no. infiltration tests in selected trial pits
- 8 no. plate bearing tests in selected trial pits
- Groundwater monitoring of standpipes
- A programme of geotechnical and chemical laboratory testing

The exploratory hole locations are shown on the as-surveyed aerial plans in Appendix 10 of this report.

2.1 Cable Percussive Boreholes

Boreholes were constructed in thirty locations (BH01 to BH30) using a Dando 2000 rig equipped with 200 mm casing. The bored depths ranged from 5.7 to 14.5 metres below existing ground level (m BGL). In one location (BH05), a re-drills (suffixed “A”) was undertaken when a shallow obstruction was encountered during the initial attempt.

A hand dug inspection pit was excavated at each location prior to commencing drilling works and the locations were scanned for services using a CAT detection tool.

During the course of boring, in-situ Standard Penetration Tests (SPT) were undertaken at regular intervals. Samples were also recovered to assist in the visual description of recovered soils and to provide specimens for laboratory testing. In low strength soils, driven tube samples (U100) were attempted.

Instances of groundwater ingress were recorded and monitored for a further 20 minutes to permit the water to rise.

Standpipes were installed in BH02, 05A, 07, 12, 15, 23, 29 and 30 in order to permit long-term monitoring of groundwater levels.

The borehole records are presented in Appendix 1 of this report.

2.2 Rotary Coreholes

Rotary coreholes RC13 and RC19 were drilled adjacent to corresponding cable percussive boreholes to investigate for the presence of bedrock. A tracked GEO 405 rig was used.

Symmetrix “open hole” techniques were used to advance through the upper deposits. It is noted that Symmetrix drilling produces highly pulverised drill returns and therefore, soil descriptions

based on these returns are very approximate. Reference should instead be made to the adjacent cable percussive borehole for detailed soil descriptions.
Standard Penetration Tests (SPTs) were undertaken within the overburden soils and below the depths achieved in the adjacent cable percussive borehole.

Rotary coring of rock was carried out using an air/mist flush and cores of 78 mm diameter were recovered. Cores were placed securely in wooden storage boxes.

On completion of drilling, a standpipe was installed in coreholes RC19 in order to permit long term groundwater monitoring.

The recovered core was inspected by a qualified engineering geologist and logged in detail at IGSL's laboratory. Records detailing the Total Core Recovery (TCR), Solid Core Recovery (SCR) and Rock Quality Designation (RQD) were produced. Core records also include a fracture log (spacing between successive core joints measured from the cores).

All cores were labelled and photographed for inclusion in the report. Photographs are presented digitally for ease of browsing and to permit close examination at high resolution. Corehole records and photographs are included in Appendix 2 of this report.

2.3 Trial Pits

Trial pitting was performed at twenty-five locations (TP01 to TP26, omitting TP19) using an 8-tonne tracked excavator. The trial pits were logged and sampled by an IGSL geotechnical engineer in accordance with BS 5930 (2015).

Pit sidewalls were assessed in terms of their short term stability and any instances of groundwater ingress were recorded. Bulk soil samples were also recovered to provide specimens for laboratory testing.

The samples were placed in heavy duty polyethene bags and sealed before being transported to Naas for laboratory testing.

The trial pits were backfilled with the as-dug arisings and reinstated to the satisfaction of IGSL's site geotechnical engineer. The trial pit logs in Appendix 3 include descriptions of the soils encountered, groundwater conditions and stability of the pit sidewalls.

2.4 Dynamic Probing

Dynamic probing was carried out in seventeen locations (DP01 to DP17) using a tracked Terrier rig.

The dynamic probe utilised by IGSL Ltd complies with the requirements of ISO 22476-2: 2005+A1: 2011 – Geotechnical Investigation and testing – Field testing - Part 2: Dynamic probing. DPH probing comprises a 50 kg drop weight, 500mm drop height and a 43.7mm diameter (90°) cone.

In accordance with the standards, the number of blows required to drive the probe through each 100mm increment of penetration is recorded. Probing is generally terminated when blow

counts, N_{100} values, exceed 25, in order to avoid damage to equipment. Detailed probe records are provided on which the blow counts are recorded both numerically and graphically.

The dynamic probe records are included in Appendix 4.

2.5 Infiltration Tests

Infiltration tests were undertaken in twelve trial pit locations (TP03, 05, 07, 11, 13, 16, 21, 22, 23, 24, 25 and 26) to ascertain the suitability of the sub-soils for soakaway purposes. Testing was performed in accordance with BRE Digest 365 'Soakaway Design'.

To obtain a measure of the infiltration rate of the sub-soils, water is poured into the test pit to ensure total saturation of the sub-soils. This procedure is typically repeated twice more, and records taken of the fall in water level against time.

The results are presented in tabular and graphical format on the infiltration test records in Appendix 5.

2.6 Plate Bearing Tests

Plate bearing tests were performed in eight trial pits (TP04, 05, 06, 07, 08, 09, 12 and 14) to obtain a measure of the moduli of subgrade reaction and equivalent in-situ CBR values. A 450 mm diameter plate was used, and tests were performed at depths of between 0.4 and 0.5 metres below existing ground level. Tests were performed in accordance with BS 1377 Part 9: 1990. "In-situ Tests". The incremental loading test (4.1.6.4.2) was used.

The maximum applied load was estimated on the basis of obtaining an accumulative displacement of at least 1.25 mm. The load was then applied in five approximately equal increments to the design load. To measure recovery the load was removed in three increments. A second phase of loading and unloading was performed to assess the benefits of further compaction.

The settlement under each increment was measured against time until movement had effectively ceased and the results are presented as graphs of applied pressure against settlement. Calculation of Modulus of Sub-grade Reaction (k) and CBR values are in accordance with NRA HD25-26/10 Volume7: Pavement Design and Maintenance.

The plate bearing test records are presented in Appendix 6.

2.7 Groundwater Monitoring

Standpipes were installed to permit long-term monitoring of water levels. The construction comprised a response zone of 50mm slotted HDPE pipe surrounded by a gravel pack.

Response zones were sealed with bentonite grout and un-slotted pipe was used through the sealed section to surface.

The site was revisited post-fieldwork and measurements taken of groundwater levels. The results are presented in Appendix 7.

2.8 As-Built Survey

On completion of fieldworks, the location (x,y) and elevation (z) of each exploratory location was determined by detailed survey using GPS Realtime Kinetic survey instrument.

The National Grid survey co-ordinates and ground levels related to Malin Head Datum are presented on the exploratory hole records and these were used to plot the as-built locations on the Site Plan in Appendix 7 of this report.

3.0 Laboratory Testing

Laboratory test results are segregated and presented as follows:

- Appendix 8 – Geotechnical Laboratory Testing
- Appendix 9 – Chemical and Environmental Testing

Geotechnical testing of soils comprised:

- Moisture Content
- Atterberg Limits (Plasticity Index)
- Particle Size Distribution (PSD)
- Unconsolidated Undrained (UU) Triaxial
- Dry Density / Moisture Content Relationship (Compaction Test)
- Laboratory Shear Vane
- Point Load Index (Rock)
- Unconfined Compressive Strength (UCS) Test (Rock)

Chemical tests were undertaken by Eurofins Chemtest and included:

- Water Soluble Sulphate (WSS)
- pH Analysis
- Organic content
- WAC (RILTA) Test Suite

4.0 References

1. BS 5930:2015 Code of Practice for Site Investigations; British Standards Institute
2. Manual of Contract Documents for Highway Works, Volume 5, Section 3, Ground Investigation, Part 4: Specification
3. BRE Special Digest 1: 2005 – Concrete in aggressive ground
4. EN 1997-3; Eurocode 7: Geotechnical Design – Part 3: Design assisted by field testing; 1997
5. BS1377; British Standard Methods of Test for Soils for Civil Engineering Purposes; British Standards Institute;1990.
6. BRE Digest 365, September 1991, British Research Establishment
7. Manual of Contract Documents for Road Works, Volume 1: Specification for Road Works (March 2007)
8. Manual of Soil Laboratory Testing, Volume 3; K.H. Head
9. ISRM – Suggested Methods for Determining Point Load Strength
10. ISRM – Suggested Methods for Determining the Uniaxial Compressive Strength and Deformability of Rock Materials
11. TRL Report 447- Sulfate specification for structural backfills
12. CIRIA C580
13. Specification for Roadworks Series 600 – Specification for Roadworks

Appendix 1

Cable Percussive Boreholes

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH01
SHEET Sheet 1 of 1

CO-ORDINATES 681,220.59 E, 714,723.17 N
GROUND LEVEL (m AOD) 86.73

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 9.20

DATE COMMENCED 19/03/2021
DATE COMPLETED 20/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		86.53	0.20						
	Soft brown sandy SILT/CLAY with occasional fine gravel		85.73	1.00						
1	Firm grey sandy SILT/CLAY		85.43	1.30	AA140372	B	1.00		N = 14 (1, 2, 2, 2, 4, 6)	
	Medium dense grey fine to coarse silty sandy GRAVEL									
2					AA140373	B	2.00		N = 27 (3, 5, 5, 7, 7, 8)	
			83.93	2.80						
	Firm brown sandy SILT/CLAY with gravel		83.63	3.10	AA140374	B	3.00		N = 19 (1, 1, 3, 4, 5, 7)	
3	Firm brown sandy gravelly CLAY with occasional cobbles									
			82.63	4.10	AA140375	B	4.00		N = 16 (1, 1, 2, 4, 4, 6)	
4	Stiff grey very gravelly SILT/CLAY with cobbles (Possibly claybound Gravel)				Fail	U	4.00			
					AA140376	B	5.00		N = 20 (2, 3, 5, 4, 5, 6)	
5										
					AA140377	B	6.00		N = 21 (1, 2, 4, 4, 6, 7)	
6			80.23	6.50						
	Very stiff dark brown/black sandy gravelly CLAY with some cobbles and occasional boulders									
7					AA140378	B	7.00		N = 30 (3, 6, 7, 7, 8, 8)	
8					AA140379	B	8.00		N = 32 (2, 6, 6, 8, 8, 10)	
9			77.53	9.20	AA140380	B	9.00		N = 50/225 mm (5, 11, 16, 19, 15)	
	Obstruction End of Borehole at 9.20 m									

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
6.8	7	0.5	
8.8	9.2	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.30	2.30	3.10	1.30	20	Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
20-03-21	9.20	Nil	Dry	End of BH

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH02
SHEET Sheet 1 of 1

CO-ORDINATES 681,242.32 E, 714,669.36 N
GROUND LEVEL (m AOD) 86.31

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 5.70

DATE COMMENCED 15/03/2021
DATE COMPLETED 16/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		86.11	0.20						
	Soft grey very sandy SILT/CLAY		85.51	0.80						
1	Loose grey slightly gravelly silty SAND		85.11	1.20	AA140357	B	1.00		N = 28 (1, 1, 3, 7, 8, 10)	
	Loose grey fine to coarse sandy GRAVEL									
2			84.01	2.30	AA140358	B	2.00		N = 11 (2, 3, 2, 3, 3, 3)	
	Firm brown sandy gravelly CLAY with occasional cobbles									
3			83.01	3.30	AA140359	B	3.00		N = 26 (22, 2, 3, 6, 8, 9)	
	Medium dense grey fine to coarse sandy GRAVEL									
4			82.11	4.20	AA140360	B	4.00		N = 25 (4, 5, 5, 5, 7, 8)	
	very stiff dark brown/black sandy gravelly CLAY with some cobbles									
5					AA140361	B	5.00		N = 50/225 mm (9, 16, 18, 20, 12)	
			80.61	5.70	AA140362	B	5.50		N = 50/150 mm (19, 6, 27, 23)	
6	Obstruction End of Borehole at 5.70 m									
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5.2	5.5	1.25	
5.5	5.7	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.50	1.50	2.30	0.90	20	Slow
3.30	3.30	4.20	1.40	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
16-03-21	5.70	1.00	5.70	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
16-03-21	5.70	Nil	Dry	End of BH

REMARKS 4hrs moving rig into BH position .1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . 1hr waiting on standpipe installation instructions.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH03
SHEET Sheet 1 of 1

CO-ORDINATES 681,357.48 E, 714,739.17 N
GROUND LEVEL (m AOD) 87.25

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 7.50

DATE COMMENCED 17/02/2021
DATE COMPLETED 18/02/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	Brown sandy SILT/CLAY with occasional fine gravel		86.75	0.50						
1	Dense grey/brown SAND		86.15	1.10	AA146194	B	1.00		N = 38 (3, 7, 8, 8, 8, 14)	
2	Dense grey/brown fine to coarse very sandy GRAVEL				AA146195	B	2.00		N = 35 (4, 5, 7, 7, 9, 12)	
3			84.15	3.10	AA146196	B	3.00		N = 18 (3, 3, 4, 5, 4, 5)	
	Firm brown sandy SILT/CLAY with occasional gravel		83.35	3.90						
4	Very dense fine to coarse grey/brown sandy silty GRAVEL with occasional cobbles				AA146197	B	4.00		N = 25 (2, 5, 5, 7, 6, 7)	
5					AA146198	B	5.00		N = 50 (7, 10, 11, 12, 15, 12)	
			81.45	5.80						
6	Dense grey fine to coarse clayey GRAVEL with occasional cobbles (Possibly very gravelly clay)				AA146199	B	6.00		N = 50/225 mm (3, 8, 9, 18, 23)	
7					AA146200	B	7.00		N = 50/225 mm (8, 12, 14, 18, 18)	
			79.75	7.50					N = 50/75 mm (25, 31, 50)	
8	Obstruction End of Borehole at 7.50 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
6.8	7	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.30	2.30	3.20	1.50	20	Moderate
3.90	3.90	No	1.40	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
18-02-21	7.80	Nil	1.50	End of BH

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH04
SHEET Sheet 1 of 2

CO-ORDINATES 681,405.32 E, 714,795.97 N
GROUND LEVEL (m AOD) 87.10

RIG TYPE Dando 3000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 10.90

DATE COMMENCED 08/02/2021
DATE COMPLETED 10/02/2011

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY W.Butler
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	Soft brown sandy SILT/CLAY									
			86.10	1.00						
1	Loose grey/brown fine SAND				AA149903	B	1.00		N = 5 (1, 1, 1, 0, 1, 3)	
			85.10	2.00						
2	Medium dense grey/brown fine to coarse very gravelly slightly silty SAND (Possibly very sandy gravel)				AA149904	B	2.00		N = 43 (4, 11, 10, 9, 12, 12)	
3					AA149905	B	3.00		N = 18 (3, 4, 3, 5, 5, 5)	
4					AA149906	B	4.00		N = 29 (3, 9, 8, 8, 7, 6)	
			82.10	5.00						
5	Firm grey SILT/CLAY		81.90	5.20	AA149907	B	5.00		N = 19 (3, 5, 4, 6, 4, 5)	
	Medium dense grey/brown very sandy GRAVEL									
6					AA149908	B	6.00		N = 16 (2, 2, 3, 4, 4, 5)	
			80.10	7.00						
7	Dense grey fine to coarse slightly silty sandy GRAVEL with some cobbles				AA149909	B	7.00		N = 35 (4, 5, 7, 10, 10, 8)	
8					AA149910	B	8.00		N = 40 (4, 4, 5, 9, 11, 15)	
			78.10	9.00						
9	Very stiff to hard very gravelly CLAY with cobbles (Possibly clayey gravel)				AA149911	B	9.00		N = 51/225 mm (4, 11, 15, 23, 13)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
8.7	8.9	0.75	
10.6	10.9	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.00	2.00	2.20	1.60	20	Moderate
4.50	4.50	No	2.50	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
09-02-21			2.00	Start of 2nd day

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. **BH04**
SHEET Sheet 2 of 2

CO-ORDINATES 681,405.32 E, 714,795.97 N
GROUND LEVEL (m AOD) 87.10

RIG TYPE Dando 3000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 10.90

DATE COMMENCED 08/02/2021
DATE COMPLETED 10/02/2011

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY W.Butler
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10	Very stiff to hard very gravelly CLAY with cobbles (Possibly clayey gravel) *(continued)*				AA149912	B	10.00		N = 50/225 mm (5, 6, 18, 20, 12)	
			76.20	10.90						
11	Obstruction End of Borehole at 10.90 m				AA149913	B	10.90		N = 45/150 mm (5, 9, 25, 20)	
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
8.7	8.9	0.75	
10.6	10.9	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
10-02-21	10.90	Nil	2.00	End of BH
19-02-21	14.00	Nil	Nil	End of BH

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH05**
		SHEET	Sheet 1 of 1
CO-ORDINATES	681,492.26 E 714,843.16 N	**RIG TYPE**	Dando 3000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.59	**BOREHOLE DEPTH (m)**	3.00
		DATE COMMENCED	11/02/2021
		DATE COMPLETED	11/02/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	W.Butler
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	Brown sandy SILT/CLAY with occasional fine gravel		86.69	0.90						
1	Loose brown silty SAND with occasional fine gravel		86.09	1.50	AA149915	B	1.00		N = 7 (1, 2, 1, 2, 2, 2)	
2	Dense grey/brown sandy GRAVEL with ocasional cobbles (Possibly gravelly sand)		84.59	3.00	AA149916	B	2.00		N = 42 (2, 5, 9, 14, 10, 9)	
3	Obstruction End of Borehole at 3.00 m				AA149917	B	3.00		N = 60/150 mm (4, 7, 28, 32)	
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.9	3	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Obstruction encountered . Relocated to BH05A and attempted rebore.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH05A**
		SHEET	Sheet 1 of 2
CO-ORDINATES	681,489.37 E 71,842.10 N	**RIG TYPE**	Dando 3000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.58	**BOREHOLE DEPTH (m)**	10.00
		DATE COMMENCED	12/02/2021
		DATE COMPLETED	15/02/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	W.Butler
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	Brown sandy SILT/CLAY with occasional fine gravel		86.68	0.90						
1	Dense grey/brown sandy GRAVEL with ocasional cobbles (Possibly gravelly sand)					B	1.00			
2						B	2.00			
3			84.08	3.50	AA149918	B	3.00			
	Dense grey/brown fine to coarse silty/clayey GRAVEL		83.58	4.00						
4	Medium dense grey/brown fine to coarse SAND with occasional fine gravel				AA149919	B	4.00		N = 33 (2, 3, 5, 9, 10, 9)	
5					AA149920	B	5.00		N = 31 (3, 3, 5, 5, 9, 12)	
			81.58	6.00						
6	Medium dense to dense grey very sandy GRAVEL with some large cobbles				AA149921	B	6.00		N = 25 (3, 2, 2, 5, 9, 9)	
7					AA149922	B	7.00		N = 19 (4, 4, 4, 4, 3, 8)	
8					AA149923	B	8.00		N = 35 (4, 5, 5, 9, 11, 10)	
9					AA149924	B	9.00		N = 43 (5, 6, 9, 9, 11, 14)	
			77.58	10.00						

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.8	5	1.5	Blowing Sands
9.3	9.5	1.5	
9.8	10	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
6.00	6.00	Np	2.00	20	Rapid

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
15-02-21	5.50	1.00	5.50	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH05A**
		SHEET	Sheet 2 of 2
CO-ORDINATES	681,489.37 E 71,842.10 N	**RIG TYPE**	Dando 3000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.58	**BOREHOLE DEPTH (m)**	10.00
		DATE COMMENCED	12/02/2021
		DATE COMPLETED	15/02/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	W.Butler
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10	Obstruction End of Borehole at 10.00 m				AA149925	B	10.00		N = 50/75 mm (25, 34, 50)	
11										
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.8	5	1.5	Blowing Sands
9.3	9.5	1.5	
9.8	10	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
15-02-21	10.30	Nil	2.00	End of BH

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
15-02-21	5.50	1.00	5.50	50mm SP

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. **BH06**
SHEET Sheet 1 of 2

CO-ORDINATES 681,589.10 E, 714,889.20 N
GROUND LEVEL (m AOD) 87.60

RIG TYPE Dando 3000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 14.00

DATE COMMENCED 17/02/2021
DATE COMPLETED 19/02/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY W.Butler
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.50	0.10						
	Brown sandy GRAVEL		87.30	0.30						
	Loose grey/brown very sandy GRAVEL									
1					AA149925	B	1.00		N = 7 (1, 1, 2, 1, 2, 2)	
			86.20	1.40						
	Medium dense grey fine to coarse silty sandy GRAVEL with occasional large cobbles									
2					AA149926	B	2.00		N = 22 (2, 3, 3, 4, 8, 7)	
3					AA149927	B	3.00		N = 28 (5, 6, 6, 7, 7, 8)	
4			83.40	4.20	AA149928	B	4.00		N = 39 (5, 7, 8, 8, 12, 11)	
	Medium dense grey/brown clayey GRAVEL with occasional large cobbles (Possibly very gravelly clay)				AA149929	B	4.50			
5					AA149930	B	5.00		N = 27 (3, 4, 6, 6, 5, 10)	
			81.60	6.00						
6	Firm brown SILT/CLAY with some gravel		81.30	6.30	AA149931	U	6.00	100%rec	N = 17 (3, 4, 3, 4, 5, 5)	
					AA149932	B	6.00			
	Stiff brown gravelly SILT/CLAY with frequent large cobbles									
7					AA149933	B	7.00		N = 26 (6, 8, 7, 8, 6, 5)	
			79.70	7.90						
8	Dense to very denese grey/brown fine to coarse very sandy GRAVEL (Possibly very gravelly sand)				AA149934	B	8.00		N = 41 (6, 5, 7, 9, 11, 14)	
9					AA149935	B	9.00		N = 50 (4, 6, 10, 14, 18, 8)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
7.2	7.5	0.5	
13.8	14	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
3.00	3.00	3.50	2.00	20	Moderate
7.90	7.90	No	4.00	20	Rapid

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
17-02-21			6.00	End of 1st Day
18-02-21			5.00	End of 2nd Day
19-02-21			5.00	End of BH

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. **BH06**
SHEET Sheet 2 of 2

CO-ORDINATES 681,589.10 E, 714,889.20 N
GROUND LEVEL (m AOD) 87.60

RIG TYPE Dando 3000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 14.00

DATE COMMENCED 17/02/2021
DATE COMPLETED 19/02/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY W.Butler
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
10	Dense to very denese grey/brown fine to coarse very sandy GRAVEL (Possibly very gravelly sand) *(continued)*				AA149936	B	10.00		N = 50 (5, 12, 12, 11, 15, 12)	
11					AA149937	B	11.00		N = 50/225 mm (5, 10, 15, 19, 16)	
12					AA149938	B	12.00		N = 50/225 mm (5, 8, 16, 21, 13)	
13					AA149939	B	13.00		N = 50/225 mm (7, 9, 22, 19, 9)	
			73.60	14.00						
14	Very dense grey angular COBBLES and boulders		73.30	14.30	AA149940	B	14.00		N = 50/75 mm (10, 15, 50)	
	Obstruction End of Borehole at 14.00 m									
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
7.2	7.5	0.5	
13.8	14	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH07
SHEET Sheet 1 of 1

CO-ORDINATES 681,207.79 E, 714,585.10 N
GROUND LEVEL (m AOD) 87.70

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 9.70

DATE COMMENCED 25/03/2021
DATE COMPLETED 29/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.50	0.20						
	Brown sandy SILT/CLAY with occasional gravel		87.10	0.60						
1	Medium dense to dense grey fine to coarse very sandy GRAVEL				AA145355	B	1.00		N = 37 (5, 5, 7, 7, 11, 12)	
2					AA145356	B	2.00		N = 29 (3, 5, 6, 6, 7, 10)	
3			84.50	3.20	AA145357	B	3.00		N = 18 (3, 3, 4, 4, 4, 6)	
	Firm to stiff brown sandy SILT/CLAY with gravel		83.50	4.20	AA145358	B	4.00		N = 21 (1, 2, 3, 4, 6, 8)	
4	Medium dense to dense grey fine to coarse (occasionally very sandy) sandy silty GRAVEL (Blowing sands noted)									
5					AA145359	B	5.00		N = 25 (1, 0, 2, 4, 9, 10)	
6					AA145360	B	6.00		N = 37 (2, 6, 8, 9, 9, 11)	
7					AA145361	B	7.00		N = 31 (3, 4, 4, 7, 8, 12)	
8			79.60	8.10	AA145362	B	8.00		N = 35 (2, 4, 6, 8, 9, 12)	
	Hard brown sandy gravelly CLAY with cobbles									
9					AA145363	B	9.00		N = 62 (8, 10, 12, 18, 18, 14)	
			78.00	9.70						
	Obstruction								N = 50/75 mm (25, 50)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.2	8.1	1.5	Blowing Sand
9.1	9.7	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.80	2.80	3.20	No	20	Slow
4.20	4.20	No	1.80	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
29-03-21	9.70	4.00	8.00	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
26-03-21	9.70	Nil	2.60	End of BH

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Blowing bands 4.20-8.10m

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH08
SHEET Sheet 1 of 1

CO-ORDINATES 681,298.36 E, 714,610.51 N
GROUND LEVEL (m AOD) 87.30
RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 7.60
DATE COMMENCED 19/02/2021
DATE COMPLETED 20/02/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby
SPT HAMMER REF. NO.
ENERGY RATIO (%)
BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.10	0.20						
	Brown sandy SILT/CLAY with occasional fine gravel		86.80	0.50						
	Grey/brown SAND		86.60	0.70						
1	Medium dense to dense grey/brown fine to coarse sandy GRAVEL				AA141101	B	1.00		N = 32 (4, 7, 7, 7, 8, 10)	
2					AA141102	B	2.00		N = 15 (3, 5, 3, 4, 4, 4)	
			85.00	2.30						
	Stiff brown sandy gravelly CLAY with occasional cobbles				Fail	U	2.50			
3					AA141103	B	3.00		N = 21 (2, 4, 4, 5, 5, 7)	
			83.50	3.80						
4	Medium dense grey/brown fine to coarse sandy silty GRAVEL				AA141104	B	4.00		N = 21 (2, 2, 2, 5, 6, 8)	
5					AA141105	B	5.00		N = 24 (3, 4, 5, 5, 7, 7)	
			81.80	5.50						
	Stiff grey/brown very gravelly SILT/CLAY									
6					AA141106	B	6.00		N = 18 (5, 6, 3, 3, 5, 7)	
			80.80	6.50						
	Medium dense to dense grey/brown fine to coarse sandy GRAVEL		80.30	7.00						
7	Very stiff dark brown/grey sandy gravelly CLAY with occasional cobbles and boulders				AA141107	B	7.00		N = 50/225 mm (6, 11, 14, 15, 21)	
			79.70	7.60						
	Obstruction End of Borehole at 7.60 m								N = 50/150 mm (8, 16, 25, 25)	
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
7	7.3	1.5	
7.4	7.6	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.80	2.80	No	2.50	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
19-02-21			2.00	End of 1st day
20-02-21	7.80	Nil	1.10	End of BH

REMARKS Tracked machine required to move rig into position due to soft ground.1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH09
SHEET Sheet 1 of 1

CO-ORDINATES 681,440.24 E, 714,704.65 N
GROUND LEVEL (m AOD) 86.48

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 5.80

DATE COMMENCED 16/02/2021
DATE COMPLETED 17/02/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		86.28	0.20						
	Soft grey sandy SILT/CLAY		85.28	1.20	AA146185	U	1.00	40%rec	N = 5 (1, 0, 1, 1, 1, 2)	
1					AA146186	B	1.00			
	Medium dense grey/brown fine to coarse sandy silty GRAVEL		83.88	2.60	AA146187	B	2.00		N = 25 (4, 5, 10, 7, 4, 4)	
2										
	Firm brown SILT/CLAY with some gravel		82.98	3.50	AA146188	B	3.00		N = 12 (2, 2, 3, 3, 2, 4)	
3					Fail	U	3.50			
	Medium dense to dense grey/brown fine to coarse sandy GRAVEL		80.68	5.80	AA146189	B	4.00		N = 21 (5, 8, 8, 4, 4, 5)	
4										
5					AA146190	B	5.00		N = 21 (3, 5, 5, 7, 5, 4)	
	Obstruction End of Borehole at 5.80 m								N = 50/75 mm (25, 50)	
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.3	3.5	1.5	Blowing Sands
5.6	5.8	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.70	1.70	3.50	1.40	20	Slow
4.10	4.10	No	1.50	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
17-02-21	5.80	Nil	1.40	End of BH

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Sands blowing back 3.50m

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. **BH10**
SHEET Sheet 1 of 1

CO-ORDINATES 681,631.68 E, 714,827.27 N
GROUND LEVEL (m AOD) 87.21

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 8.10

DATE COMMENCED 10/02/2021
DATE COMPLETED 11/02/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.01	0.20						
	Brown sandy SILT/CLAY with occasional fine gravel		86.71	0.50						
1	Loose to medium dense brown silty sandy GRAVEL with cobbles (Blowing bands noted)				AA146158	B	1.00		N = 17 (1, 3, 5, 4, 4, 4)	
2					AA146159	B	2.00		N = 11 (1, 1, 1, 2, 2, 6)	
3					AA146160	B	3.00		N = 14 (3, 3, 3, 4, 3, 4)	
4			83.11	4.10	AA146161	B	4.00		N = 19 (2, 3, 4, 5, 5, 5)	
	Firm grey/brown sandy SILT/CLAY with occasional gravel		82.51	4.70						
5	Firm reddish brown very gravelly CLAY		82.01	5.20	AA146162	B	5.00		N = 10 (1, 1, 2, 2, 2, 4)	
6	Dense grey fine to coarse sandy GRAVEL		80.91	6.30	AA146163	B	6.00		N = 31 (4, 4, 5, 7, 9, 10)	
7	Very stiff brown sandy gravelly CLAY with occasional cobbles		80.11	7.10	AA146164	B	7.00		N = 34 (5, 7, 7, 6, 10, 11)	
8	Dense grey/brown coarse clayey GRAVEL with cobbles and boulders (Possibly very gravelly clay)		79.11	8.10	AA146165	B	8.00		N = 50/75 mm (25, 36, 50)	
	Obstruction End of Borehole at 8.10 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.6	2.7	0.25	
4.1	0.5	1.5	Blowing Sand
7.8	8.1	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.10	2.10	2.30	No	20	Slow
2.70	2.70	4.10	2.00	20	Moderate
4.90	4.90	No	2.00	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Blowing sands noted from 3.10m)

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH11
SHEET Sheet 1 of 1

CO-ORDINATES 681,480.05 E, 714,705.44 N
GROUND LEVEL (m AOD) 87.05

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 8.90

DATE COMMENCED 15/02/2021
DATE COMPLETED 16/02/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		86.85	0.20						
	Brown sandy SILT/CLAY with occasional fine gravel		86.55	0.50						
1	Loose brown slightly silty/clayey SAND		85.55	1.50	AA146174	U	1.00	95%rec	N = 3 (1, 0, 1, 0, 1, 1)	
					AA146175	B	1.00			
2	Medium dense grey fine to coarse sandy GRAVEL		83.55	3.50	AA146176	B	2.00		N = 31 (3, 6, 7, 6, 8, 10)	
3					AA146177	B	3.00		N = 26 (4, 8, 8, 7, 8, 3)	
4	Medium dense grey fine to coarse SAND with some fine to medium gravel and occasional cobbles		81.45	5.60	AA146178	B	4.00		N = 6 (1, 0, 1, 1, 2, 2)	
5					AA146179	B	5.00		N = 8 (1, 0, 1, 0, 2, 5)	
6	Medium dense to dense grey fine to coarse slightly silty/clayey GRAVEL with some cobbles and occasional boulders				AA146180	B	6.00		N = 34 (6, 8, 10, 11, 8, 5)	
					Fail	U	6.50			
7			79.85	7.20	AA146181	B	7.00		N = 53 (5, 9, 12, 12, 14, 15)	
8	Very stifft very gravelly CLAY with cobbles		78.15	8.90	AA146182	B	8.00		N = 26 (7, 10, 7, 5, 5, 9)	
9	Obstruction End of Borehole at 8.90 m				AA146183	B	8.90		N = 50/75 mm (25, 30, 50)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.8	5.1	1.5	Blowing Sands
6.2	6.4	1	
8.6	8.9	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
3.00	3.00	No	1.30	20	Moderate

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
16-02-21			1.30	Start of 2nd day

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Sands blowing back 2.50 to 5.00m.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH12**
		SHEET	Sheet 1 of 1
CO-ORDINATES	681,568.79 E 714,740.59 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.38	**BOREHOLE DEPTH (m)**	8.30
		DATE COMMENCED	11/02/2021
		DATE COMPLETED	12/02/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	P.Thomas
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.18	0.20						
	Medium dense to dense grey/brown fine to coarse silty/clayey GRAVEL				AA146166	B	1.00		N = 23 (3, 5, 6, 5, 6, 6)	
1										
					AA146167	B	2.00		N = 14 (2, 3, 2, 2, 3, 7)	
2										
			84.18	3.20	AA146168	B	3.00		N = 33 (4, 5, 7, 8, 8, 10)	
3	Firm grey gravelly SILT/CLAY									
					AA146169	B	4.00		N = 9 (1, 2, 2, 2, 2, 3)	
4			82.98	4.40						
	Soft grey sandy SILT/CLAY		82.68	4.70	Fail	U	4.50			
	Loose grey/brown silty/clayey SAND				AA146170	B	5.00		N = 9 (1, 0, 1, 1, 2, 5)	
5			81.98	5.40						
	Medium dense grey fine to coarse sandy GRAVEL with occasional cobbles and boulders				AA146171	B	6.00		N = 24 (3, 7, 8, 7, 4, 5)	
6			81.08	6.30						
	Very stiff dark brown sandy gravelly CLAY with some cobbles				AA146172	B	7.00		N = 44 (6, 8, 8, 10, 12, 14)	
7										
					AA146173	B	8.00		N = 50/150 mm (10, 14, 29, 21)	
8			79.08	8.30						
	Obstruction End of Borehole at 8.30 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
8	8.3	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.70	2.70	3.50	1.90	20	Slow
4.70	4.70	6.30	2.40	20	Moderate
7.90	7.90	No	1.40	20	Rapid

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
15-02-21	6.00	1.00	6.00	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
12-02-21	8.30	Nil	1.40	End of BH

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Bentonite seal 8.30-6.00m

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH13**
		SHEET	Sheet 1 of 1
CO-ORDINATES	681,252.69 E 714,513.65 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.76	**BOREHOLE DEPTH (m)**	9.10
		DATE COMMENCED	03/03/2021
		DATE COMPLETED	03/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	P.Thomas
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.56	0.20						
	Brown very sandy SILT/CLAY with occasional fine gravel		87.06	0.70						
1	Medium dense to dense grey fine to coarse slightly clayey sandy GRAVEL with occasional cobbles				AA146117	B	1.00		N = 23 (1, 3, 5, 5, 7, 6)	
2					AA146118	B	2.00		N = 30 (3, 5, 5, 7, 8, 10)	
3			84.26	3.50	AA146119	B	3.00		N = 40 (3, 6, 9, 9, 10, 12)	
4	Firm to stiff brown sandy gravelly CLAY with occasional cobbles		83.36	4.40	AA146120	B	4.00		N = 18 (3, 3, 3, 4, 5, 6)	
5	Medium dense to dense grey fine to coarse clayey GRAVEL with cobbles and boulders				AA146121	B	5.00		N = 22 (1, 3, 3, 5, 7, 7)	
6					AA146122	B	6.00		N = 34 (4, 5, 6, 8, 9, 11)	
7					AA146123	B	7.00		N = 49 (7, 10, 10, 11, 14, 14)	
8					AA146124	B	8.00		N = 48 (6, 7, 8, 10, 14, 16)	
9			78.66	9.10	AA146125	B	9.00		N = 50/150 mm (16, 9, 28, 22)	
	Obstruction End of Borehole at 9.10 m									

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
7.4	7.6	0.5	
8.6	9.1	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.40	2.40	3.50	1.50	20	Moderate
4.40	4.40	No	1.30	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
04-03-21	9.10	Nil	1.40	End of BH

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Blowing noted in gravels.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH14**
		SHEET	Sheet 1 of 2
CO-ORDINATES	681,332.22 E 714,516.08 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.86	**BOREHOLE DEPTH (m)**	10.00
		DATE COMMENCED	02/03/2021
		DATE COMPLETED	03/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	P.Thomas
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.66	0.20						
	Brown sandy SILT/CLAY with occasional fine gravel		87.26	0.60						
1	Medium dense grey fine to coarse sandy GRAVEL				AA146107	B	1.00		N = 29 (4, 4, 6, 8, 7, 8)	
2					AA146108	B	2.00		N = 16/225 mm (3, 3, 5, 5, 6)	
3			84.36	3.50	AA146109	B	3.00		N = 19 (2, 4, 5, 4, 5, 5)	
	Firm to stiff brown sandy gravelly CLAY		83.66	4.20	AA146110	B	4.00		N = 20 (2, 2, 3, 4, 6, 7)	
4					Fail	B	4.00			
	Dense grey fine to coarse sandy GRAVEL									
5					AA146111	B	5.00		N = 28 (3, 5, 5, 7, 7, 9)	
6					AA146112	B	6.00		N = 37 (4, 5, 8, 8, 10, 11)	
7			80.76	7.10	AA146113	B	7.00		N = 43 (4, 9, 10, 10, 11, 12)	
	Stiff to very stiff brown very gravelly sandy CLAY with occasional cobbles									
8					AA146114	B	8.00		N = 33 (3, 5, 9, 7, 8, 9)	
9					AA146115	B	9.00		N = 31 (2, 5, 7, 7, 8, 9)	
	End of Borehole		77.86	10.00						

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5.7	5.9	1.5	
7.4	7.6	0.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.90	1.90	3.50	1.20	20	Moderate
4.20	4.20	No	0.50	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
03-03-21	10.00	Nil	1.80	End of BH

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. **BH14**
SHEET Sheet 2 of 2

CO-ORDINATES 681,332.22 E
714,516.08 N
GROUND LEVEL (m AOD) 87.86

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 10.00

DATE COMMENCED 02/03/2021
DATE COMPLETED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10					AA146116	B	10.00		N = 34 (6, 6, 8, 8, 7, 11)	
11										
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5.7	5.9	1.5	
7.4	7.6	0.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH15**
		SHEET	Sheet 1 of 1
CO-ORDINATES	681,434.42 E 714,570.88 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	
GROUND LEVEL (m AOD)	87.57	**BOREHOLE DEPTH (m)**	7.80
		DATE COMMENCED	01/03/2021
		DATE COMPLETED	02/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	P.Thomas
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.37	0.20						
	Brown very sandy SILT/CLAY with occasional fine gravel		87.07	0.50						
	Brown silty/clayey SAND		86.47	1.10	AA141149	B	1.00		N = 35 (3, 6, 6, 7, 10, 12)	
1	Medium dense to dense fine to coarse very sandy siltyGRAVEL									
2					AA141150	B	2.00		N = 40 (5, 6, 8, 8, 8, 16)	
3			83.87	3.70	AA146101	B	3.00		N = 21 (2, 3, 3, 5, 5, 8)	
	Stiff brown sandy SILT/CLAY with some gravel									
4			82.77	4.80	AA146102	B	4.00		N = 26 (3, 5, 7, 6, 6, 7)	
	Medium dense grey fine to coarse very sandy GRAVEL (Possibly very gravelly sand)				AA146103	B	5.00		N = 16 (1, 2, 3, 3, 5, 5)	
5										
6			81.47	6.10	AA146104	B	6.00		N = 42 (2, 3, 6, 9, 10, 17)	
	Very stiff to hard dark grey/brown sandy gravelly CLAY with occasional cobbles									
7					AA146105	B	7.00		N = 50/225 mm (6, 9, 12, 15, 23)	
			79.77	7.80						
	Obstruction				AA146106	B	7.80		N = 50/225 mm (15, 10, 18, 22, 10)	
8	End of Borehole at 7.80 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5.6	2.4	1.5	Blowing Sands
7.1	7.3	1	
7.6	7.8	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.40	2.40	3.70	1.10	20	Slow
4.80	4.80	No	2.40	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
01-03-21	6.00	1.00	6.00	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
02-03-21	4.80	4.80	1.30	Start of 2nd day

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Sands blowing back 5.60 to 2.40m and 5.90 to 3.70m. Redrilled 3.70-5.90m.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH16
SHEET Sheet 1 of 2

CO-ORDINATES 681,509.06 E, 714,585.12 N
GROUND LEVEL (m AOD) 87.77

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 10.40

DATE COMMENCED 25/02/2021
DATE COMPLETED 01/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.57	0.20						
	Brown sandy SILT/CLAY with occasional fine gravel		87.17	0.60						
	Brown SAND		86.97	0.80						
1	Medium dense to dense grey/brown fine to coarse sandy GRAVEL				AA141139	B	1.00		N = 47/150 mm (8, 14, 22, 25)	
2					AA141140	B	2.00		N = 26 (3, 4, 4, 6, 8, 8)	
3			84.27	3.50	AA141141	B	3.00		N = 35 (2, 4, 5, 9, 9, 12)	
	Stiff brown sandy SILT/CLAY with some gravel		82.97	4.80						
4					AA141142	B	4.00		N = 25 (3, 3, 5, 5, 7, 8)	
5	Loose grey/brown fine to coarse very sandy GRAVEL		82.17	5.60	AA141143	B	5.00		N = 11 (1, 1, 2, 2, 2, 5)	
6	Very stiff dark grey/brown sandy gravelly CLAY with occasional grvael		81.27	6.50	AA141144	B	6.00		N = 35 (3, 5, 7, 9, 9, 10)	
	Medium dense grey/brown sandy GRAVEL		80.87	6.90						
7	Firm grey/brown sandy SILT/CLAY with some gravel		80.27	7.50	AA141145	B	7.00		N = 10 (2, 2, 2, 2, 3, 3)	
8	Medium dense grey fine to coarse very clayey sandy GRAVEL (Possibly very gravelly clay)		79.27	8.50	AA141146	B	8.00		N = 12 (1, 2, 2, 2, 3, 5)	
9	Loose to medium dense silty SAND with occasional gravel		78.17	9.60	AA141147	B	9.00		N = 11 (1, 0, 1, 2, 2, 6)	
	Very stiff brown very gravelly sandy CLAY with some cobbles and occasional boulders									

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
1.3	1.5	1	
10	10.2	1	
10.2	10.4	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.00	2.00	No	1.80	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
01-03-21			1.00	Start of 2nd Day

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH16**
		SHEET	Sheet 2 of 2
CO-ORDINATES	681,509.06 E 714,585.12 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.77	**BOREHOLE DEPTH (m)**	10.40
		DATE COMMENCED	25/02/2021
		DATE COMPLETED	01/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	P.Thomas
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10			77.37	10.40	AA141148	B	10.00		N = 50/150 mm (7, 14, 24, 26)	
	Obstruction End of Borehole at 10.40 m									
11										
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
1.3	1.5	1	
10	10.2	1	
10.2	10.4	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH17
SHEET Sheet 1 of 2

CO-ORDINATES 681,631.72 E, 714,618.77 N
GROUND LEVEL (m AOD) 88.54

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 11.50

DATE COMMENCED 24/02/2021
DATE COMPLETED 25/02/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		88.24	0.30						
1	Soft brown very sandy SILT/CLAY		87.34	1.20	AA141126	B	1.00		N = 7 (1, 1, 2, 1, 2, 2)	
	Stiff Firm				AA141127	U	1.50	80%rec		
2			86.54	2.00						
	Medium dense to dense grey fine to coarse sandy GRAVEL				AA141128	B	2.00		N = 22 (3, 3, 3, 5, 6, 8)	
3					AA141129	B	3.00		N = 35 (2, 5, 7, 10, 8, 10)	
4			84.44	4.10	AA141130	B	4.00		N = 9 (3, 4, 3, 3, 2, 1)	
	Firm grey SILT/CLAY with occasional gravel				AA141131	U	4.50	20%rec		
			83.84	4.70						
	Medium dense grey fine to coarse GRAVEL		83.64	4.90						
5	Firm grey sandy SILT/CLAY with some gravel		83.24	5.30	AA141132	B	5.00		N = 12 (1, 1, 1, 2, 4, 5)	
	Loose grey/brown silty SAND (Possibly sandy silt)									
6					AA141133	B	6.00		N = 5 (1, 0, 1, 1, 1, 2)	
7			81.04	7.50	AA141134	B	7.00		N = 11 (1, 1, 2, 2, 3, 4)	
	Stiff brown very sandy gravelly CLAY									
8			79.84	8.70	AA141135	B	8.00		N = 24 (2, 4, 5, 5, 6, 8)	
	Very stiff very gravelly CLAY with cobbles (occasionally becoming claybound gravel)									
9					AA141136	B	9.00		N = 50 (4, 5, 9, 10, 17, 14)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
9.3	9.6	0.75	
11	11.2	1	
11.3	11.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.50	2.50	4.30	2.10	20	Moderate
4.70	4.70	No	2.10	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. **BH17**
SHEET Sheet 2 of 2

CO-ORDINATES 681,631.72 E, 714,618.77 N
GROUND LEVEL (m AOD) 88.54

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 11.50

DATE COMMENCED 24/02/2021
DATE COMPLETED 25/02/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10	Very stiff very gravelly CLAY with cobbles (occasionally becoming claybound gravel) *(continued)*				AA141137	B	10.00		N = 33 (3, 3, 5, 8, 8, 12)	
11					AA141138	B	11.00		N = 50/150 mm (8, 17, 23, 27)	
			77.04	11.50					N = 50/75 mm (25, 32, 50)	
	Obstruction End of Borehole at 11.50 m									
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
9.3	9.6	0.75	
11	11.2	1	
11.3	11.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
25-02-21	11.50	Nil	2.10	End of BH

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH18
SHEET Sheet 1 of 1

CO-ORDINATES 681,708.66 E, 714,655.37 N
GROUND LEVEL (m AOD) 87.81

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 9.60

DATE COMMENCED 23/02/2021
DATE COMPLETED 24/02/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.61	0.20						
	Brown silty/clayey SAND with occasional gravel		86.71	1.10	AA141116	B	1.00		N = 11 (1, 3, 2, 3, 3, 3)	
1	Medium dense fine to coarse sandy GRAVEL with layers of blowing sands									
2					AA141117	B	2.00		N = 14 (1, 2, 2, 2, 4, 6)	
3					AA141118	B	3.00		N = 28 (3, 5, 7, 8, 8, 5)	
4			83.61	4.20	AA141119	B	4.00		N = 50/225 mm (2, 5, 12, 18, 20)	
	Firm brown/grey sandy SILT/CLAY with some gravel		82.61	5.20	AA141120	B	5.00		N = 7 (1, 0, 1, 1, 2, 3)	
5	Loose grey very silty SAND (Possibly very sandy silt)		81.71	6.10	AA141121	B	6.00		N = 16 (1, 1, 2, 4, 4, 6)	
6	Stiff to very stiff grey very sandy very gravelly CLAY									
7					AA141122	B	7.00		N = 25 (3, 4, 4, 5, 7, 9)	
8					AA141123	B	8.00		N = 29 (2, 5, 6, 7, 8, 8)	
9					AA141124	B	9.00		N = 52 (4, 6, 9, 9, 18, 16)	
			78.21	9.60	AA141125	B	9.50		N = 50/150 mm (9, 16, 28, 22)	
	Obstruction End of Borehole at 9.60 m									

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.8	3.9	1	Blowing Sands
9.2	9.4	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.50	2.50	6.30	Yes	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
24-02-21	9.60	Nil	2.20	End of BH

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Blowing fine gravel 4.20-2.30m.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH19**
		SHEET	Sheet 1 of 1
CO-ORDINATES	681,195.57 E 714,444.93 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	86.81	**BOREHOLE DEPTH (m)**	9.30
		DATE COMMENCED	08/03/2021
		DATE COMPLETED	09/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	P.Thomas
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		86.61	0.20						
	Dense to very dense brown fine to coarse very sandy clayey GRAVEL									
1					AA146126	B	1.00		N = 31 (3, 5, 7, 6, 7, 11)	
2					AA146127	B	2.00		N = 38 (4, 5, 8, 8, 10, 12)	
3					AA146128	B	3.00		N = 29 (3, 5, 5, 6, 9, 9)	
4					AA146129	B	4.00		N = 20 (2, 2, 4, 4, 5, 7)	
5					AA146130	B	5.00		N = 50 (5, 9, 10, 12, 14, 14)	
6					AA146131	B	6.00		N = 42 (4, 6, 7, 8, 12, 15)	
7					AA146132	B	7.00		N = 50/225 mm (6, 9, 14, 16, 20)	
8					AA146133	B	8.00		N = 50 (4, 9, 12, 12, 14, 12)	
9					AA146134	B	9.00		N = 50/150 mm (14, 11, 19, 31)	
			77.51	9.30						
	Obstruction End of Borehole at 9.30 m									

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2	3.8	1.5	Blowing Sands
7.3	7.6	0.75	
8.8	9.2	1	
9.2	9.3	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.80	1.80	No	0.70	20	Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
09-03-21	9.30	Nil	0.80	End of BH

REMARKS 2hrs moving rig into position .1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Blowing bands 2.80-7.30m.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. **BH20**
SHEET Sheet 1 of 1

CO-ORDINATES 681,362.53 E
714,426.04 N
GROUND LEVEL (m AOD) 87.72

RIG TYPE Dando 3000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 7.60

DATE COMMENCED 01/03/2021
DATE COMPLETED 02/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY W.Butler
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.52	0.20						
	Very soft brown sandy SILT/CLAY		86.72	1.00						
1	Loose grey/brown silty SAND				AA158177	B	1.00		N = 3 (1, 0, 1, 1, 1, 0)	
2			85.52	2.20	AA158178	B	2.00		N = 5 (1, 1, 2, 1, 1, 1)	
	Medium dense grey fine to coarse silty very sandy GRAVEL (Possibly very gravelly sand)									
3			83.82	3.90	AA158179	B	3.00		N = 19 (2, 5, 4, 4, 5, 6)	
4	Stiff brown gravelly SILT/CLAY		83.52	4.20	AA158180	B	4.00		N = 27 (3, 6, 5, 5, 8, 9)	
	Medium dense grey/brown fine to coarse SAND with occasional fine gravel(Blowing sands noted)									
5			81.92	5.80	AA158181	B	5.00		N = 26 (3, 5, 6, 5, 7, 8)	
6	Medium dense to dense grey fine to coarse sandy GRAVEL with occasional cobbles				AA158182	B	6.00		N = 33 (4, 4, 5, 8, 9, 11)	
7			80.12	7.60	AA158183	B	7.00		N = 50/225 mm (6, 10, 11, 15, 24)	
	Obstruction								N = 50/75 mm (25, 50)	
8	End of Borehole at 7.60 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5.8	4.2	1.5	Blowing Sand
7.3	7.6	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
3.50	3.50	4.50	1.50	20	Moderate
4.50	4.50	No	1.20	20	Rapid

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
02-03-21			1.50	Start of 2nd day

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Blowing sands noted 5.00-4.00m and 6.00-4.00m

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH21**
		SHEET	Sheet 1 of 2
CO-ORDINATES	681,459.88 E 714,464.59 N	**RIG TYPE**	Dando 3000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.97	**BOREHOLE DEPTH (m)**	10.00
		DATE COMMENCED	25/02/2021
		DATE COMPLETED	01/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	W.Butler
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.67	0.30						
1	Firm brown sandy SILT/CLAY with occasional fine gravel		86.67	1.30	AA158166	B	1.00		N = 16 (2, 2, 3, 5, 4, 4)	
2	Loose to medium dense grey/brown fine to coarse gravelly SAND with occasional small cobbles				AA158167	B	2.00		N = 13 (1, 2, 2, 3, 3, 5)	
3					AA158168	B	3.00		N = 11 (2, 4, 4, 2, 2, 3)	
4			83.97	4.00						
	Firm brown SILT/CLAY with some gravel and occasional cobbles		83.47	4.50	AA158169	B	4.00		N = 13 (1, 2, 1, 2, 5, 5)	
	Medium dense grey/brown fine slightly silty SAND				AA158170	B	4.50			
5					AA158171	B	5.00		N = 15 (2, 2, 3, 3, 5, 4)	
6			81.97	6.00						
	Stiff dark brown sandy gravelly CLAY with occasional cobbles		80.97	7.00	AA158172	B	6.00		N = 18 (3, 2, 5, 4, 4, 5)	
7	Dense grey/brown fine to coarse slightly silty sandy GRAVEL with large cobbles				AA158173	B	7.00		N = 24 (9, 8, 5, 4, 6, 9)	
8					AA158174	B	8.00		N = 38 (5, 8, 8, 8, 10, 12)	
9					AA158175	B	9.00		N = 42 (7, 8, 8, 9, 12, 13)	
			77.97	10.00						

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3	2	0.75	Blowing Sands
7	6	0.75	Blowing Sands
9.2	9.4	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.10	2.10	4.00	1.50	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
26-02-21			4.00	Start of 2nd day
01-03-21			3.00	Start of 3rd day

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Blowing sands 3.00-2.00m , 5.00-4.00m , 7.00-6.00m.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH21**
		SHEET	Sheet 2 of 2
CO-ORDINATES	681,459.88 E 714,464.59 N	**RIG TYPE**	Dando 3000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.97	**BOREHOLE DEPTH (m)**	10.00
		DATE COMMENCED	25/02/2021
		DATE COMPLETED	01/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	W.Butler
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10					AA158176	B	10.00		N = 50/150 mm (17, 8, 36, 14)	
11										
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3	2	0.75	Blowing Sands
7	6	0.75	Blowing Sands
9.2	9.4	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Blowing sands 3.00-2.00m , 5.00-4.00m , 7.00-6.00m.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH22**
		SHEET	Sheet 1 of 1
CO-ORDINATES	681,553.51 E 714,494.46 N	**RIG TYPE**	Dando 3000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.76	**BOREHOLE DEPTH (m)**	7.40
		DATE COMMENCED	24/02/2021
		DATE COMPLETED	24/02/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	W.Butler
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.56	0.20						
	Firm brown sandy SILT/CLAY with occasional fine gravel									
1			86.56	1.20	AA158158	B	1.00		N = 5 (1, 2, 1, 1, 2, 1)	
	Loose to medium dense grey/brown fine silty SAND									
			85.76	2.00						
2	Grey/brown fine to coarse very sandy GRAVEL (Possibly very gravelly sand)				AA158159	B	2.00		N = 16 (2, 2, 3, 5, 4, 4)	
3					AA158160	B	3.00		N = 15 (2, 4, 4, 3, 4, 4)	
4					AA158161	B	4.00		N = 29 (3, 4, 3, 9, 8, 9)	
			83.26	4.50						
	Stiff grey very gravelly CLAY (Possibly very clayey gravel)				AA158162 Fail	B U	4.50 4.50			
			82.76	5.00						
5	Medium dense grey/brown fine to coarse sandy GRAVEL with cobbles				AA158163	B	5.00		N = 29 (6, 7, 12, 8, 4, 5)	
6			81.56	6.20	AA158164	B	6.00		N = 28 (9, 6, 5, 6, 7, 10)	
	Stiff to vV									
7					AA158165	B	7.00		N = 50/225 mm (10, 12, 17, 20, 13)	
			80.36	7.40						
	Obstruction End of Borehole at 7.40 m									
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
7.3	7.4	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.80	2.80	3.20	1.00	20	Moderate

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH23**
		SHEET	Sheet 1 of 1
CO-ORDINATES	681,646.84 E 714,529.27 N	**RIG TYPE**	Dando 3000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.80	**BOREHOLE DEPTH (m)**	7.70
		DATE COMMENCED	22/02/2021
		DATE COMPLETED	23/02/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	W.Butler
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.60	0.20						
	Soft SILT/CLAY		87.30	0.50						
1	Loose grey very silty gravelly SAND		86.50	1.30	AA158181	B	1.00		N = 4 (1, 1, 0, 1, 2, 1)	
2	Medium dense grey fine to coarse very sandy GRAVEL (Possibly very gravelly sand)				AA158182	B	2.00		N = 20 (2, 2, 4, 5, 5, 6)	
3					AA158183	B	3.00		N = 15 (2, 1, 4, 4, 3, 4)	
			84.00	3.80						
4	Stiff grey/brown gravelly CLAY with occasional cobbles				AA158184	B	4.00		N = 24 (1, 2, 2, 5, 8, 9)	
			82.90	4.90						
5	Medium dense grey coarse very sandy GRAVEL (Possibly gravelly sand)				AA158185	B	5.00		N = 14 (2, 2, 3, 2, 4, 5)	
			82.30	5.50						
6	Medium dense to dense grey and grey/brown gravelly CLAY with some cobbles				AA158186	B	6.00		N = 20 (1, 2, 3, 4, 6, 7)	
7					AA158187	B	7.00		N = 50/225 mm (6, 10, 16, 22, 12)	
			80.10	7.70						
8	Obstruction End of Borehole at 7.70 m								N = 50/75 mm (15, 10, 50)	
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.5 7.2 7.5	5 7.3 7.7	1.5 1 2	Blowing Sands

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
3.20	3.20	5.50	2.00	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
23-02-21	7.70	1.00	7.70	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
23-02-21	7.90	Nil	7.50	End of BH

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Sands blowing back 2.50 to 5.00m.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH24**
		SHEET	Sheet 1 of 2
CO-ORDINATES	681,270.04 E 714,499.27 N	**RIG TYPE**	Dando 3000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.75	**BOREHOLE DEPTH (m)**	13.00
		DATE COMMENCED	03/03/2021
		DATE COMPLETED	04/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	W.Butler
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.35	0.40						
1	Medium dense grey/brown fine to coarse SAND		85.75	2.00	AA158184	B	1.00		N = 13 (2, 3, 2, 3, 3, 5)	
2	Medium dense grey fine to coarse sandy GRAVEL with occasional cobbles		83.95	3.80	AA158185	B	2.00		N = 27 (2, 4, 4, 6, 9, 8)	
3					AA158186	B	3.00		N = 22 (3, 4, 6, 6, 5, 5)	
4	Stiff to very stiff brown gravelly CLAY with occasional cobbles		83.25	4.50	AA158187	B	4.00		N = 28 (2, 3, 3, 8, 9, 8)	
5	Dense grey fine to coarse GRAVEL with some cobbles				AA158188	B	4.50			
					AA158189	B	5.00		N = 35 (4, 4, 5, 11, 9, 10)	
6					AA158190	B	6.00		N = 33 (5, 4, 7, 9, 8, 9)	
7					AA158191	B	7.00		N = 35 (4, 6, 7, 7, 12, 9)	
8					AA158192	B	8.00		N = 31 (4, 5, 5, 9, 9, 8)	
9	Very stiff black sandy gravelly CLAY with occasional cobbles		78.75	9.00	AA158193	B	9.00		N = 39 (2, 4, 6, 10, 12, 11)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
12.8	13	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
5.00	5.00	No	3.00	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. **BH24**
SHEET Sheet 2 of 2

CO-ORDINATES 681,270.04 E
714,499.27 N
GROUND LEVEL (m AOD) 87.75

RIG TYPE Dando 3000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 13.00

DATE COMMENCED 03/03/2021
DATE COMPLETED 04/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY W.Butler
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
10	Very stiff black sandy gravelly CLAY with occasional cobbles *(continued)*				AA158194	B	10.00		N = 43 (2, 5, 7, 9, 11, 16)	
11			76.45	11.30	AA158195	B	11.00		N = 50 (6, 10, 12, 15, 16, 7)	
	Dense grey fine to coarse GRAVEL with large cobbles				AA158196	B	11.50			
12					AA158197	B	12.00		N = 50/225 mm (8, 11, 15, 15, 20)	
			74.75	13.00						
13	End of Borehole at 13.00 m				AA158198	B	13.00		N = 50/150 mm (10, 15, 26, 24)	
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
12.8	13	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH25
SHEET Sheet 1 of 2

CO-ORDINATES 681,212.85 E, 714,442.50 N
GROUND LEVEL (m AOD) 87.14

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 12.50

DATE COMMENCED 09/03/2021
DATE COMPLETED 11/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		86.94	0.20						
	Medium dense to dense brown fine to coarse very sandy clayey GRAVEL (Sands blowing 2.80-6.30m)									
1					AA146135	B	1.00		N = 23 (3, 4, 5, 5, 6, 7)	
2					AA146136	B	2.00		N = 35 (3, 5, 5, 9, 9, 12)	
3					AA146137	B	3.00		N = 28 (4, 6, 5, 6, 8, 9)	
4					AA146138	B	4.00		N = 28 (1, 3, 3, 5, 8, 12)	
5					AA146139	B	5.00		N = 41 (3, 5, 8, 9, 10, 14)	
6					AA146140	B	6.00		N = 50 (6, 10, 11, 11, 18, 10)	
7					AA146141	B	7.00		N = 50 (9, 10, 10, 14, 16, 10)	
8					AA146142	B	8.00		N = 50 (6, 10, 11, 12, 15, 12)	
9					AA146143	B	9.00		N = 36 (3, 6, 7, 8, 10, 11)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
10.4	10.9	1	
11.9	12.1	0.75	
12.3	12.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.50	1.50	No	0.70	20	Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
10-03-21			0.70	End of 2nd day

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH25**
		SHEET	Sheet 2 of 2
CO-ORDINATES	681,212.85 E 714,442.50 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.14	**BOREHOLE DEPTH (m)**	12.50
		DATE COMMENCED	09/03/2021
		DATE COMPLETED	11/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	P.Thomas
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10			76.94	10.20	AA146144	B	10.00		N = 50 (5, 7, 10, 10, 12, 18)	
	Very stiff black sandy gravelly CLAY with occasional cobbles									
11			76.04	11.10	AA146145	B	11.00		N = 43 (4, 5, 9, 9, 10, 15)	
	Hard brown very gravelly sandy CLAY with some cobbles and boulders									
12					AA146146	B	12.00		N = 50/225 mm (10, 15, 18, 18, 14)	
			74.64	12.50					N = 50/75 mm (25, 50)	
	Obstruction End of Borehole at 12.50 m									
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
10.4	10.9	1	
11.9	12.1	0.75	
12.3	12.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
11-03-21	12.50	Nil	0.60	End of BH

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH26**
		SHEET	Sheet 1 of 2
CO-ORDINATES	681,222.59 E 714,441.53 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.01	**BOREHOLE DEPTH (m)**	10.10
		DATE COMMENCED	09/03/2021
		DATE COMPLETED	10/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	P.Thomas
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		86.81	0.20						
	Medium dense to dense grey/brown fine to coarse very sandy clayey GRAVEL (Blowing back 3.00-8.00m)									
1					AA146147	B	1.00		N = 28 (2, 5, 5, 7, 7, 9)	
2					AA146148	B	2.00		N = 32 (3, 6, 7, 8, 7, 10)	
3					AA146149	B	3.00		N = 29 (3, 8, 5, 7, 8, 9)	
4					AA146150	B	4.00		N = 34 (2, 3, 5, 8, 10, 11)	
5					AA146151	B	5.00		N = 30 (3, 3, 4, 7, 9, 10)	
6					AA146152	B	6.00		N = 46 (5, 7, 8, 10, 12, 16)	
7					AA146153	B	7.00		N = 50 (3, 6, 11, 12, 12, 15)	
			79.01	8.00						
8	Stiff to very stiff brown sandy gravelly CLAY with occasional cobbles				AA146154	B	8.00		N = 35 (2, 9, 7, 9, 9, 10)	
9					AA146155	B	9.00		N = 36 (2, 5, 8, 8, 10, 10)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
7.4	7.6	1	
9.7	9.9	0.75	
10	10.2	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.00	2.00	No	0.70	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. **BH26**
SHEET Sheet 2 of 2

CO-ORDINATES 681,222.59 E, 714,441.53 N
GROUND LEVEL (m AOD) 87.01

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 10.10

DATE COMMENCED 09/03/2021
DATE COMPLETED 10/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10	Obstruction End of Borehole at 10.10 m		76.81	10.20	AA146156	B	10.00		N = 50/150 mm (9, 16, 21, 29)	
11										
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
7.4	7.6	1	
9.7	9.9	0.75	
10	10.2	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
10-03-21	10.20	Nil	0.70	End of BH

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH27
SHEET Sheet 1 of 2

CO-ORDINATES 681,260.52 E, 714,499.49 N
GROUND LEVEL (m AOD) 86.65

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 10.00

DATE COMMENCED 22/03/2021
DATE COMPLETED 23/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		86.45	0.20						
	Firm brown very sandy SILT/CLAY with occasional gravel		85.55	1.10	AA140381	B	1.00		N = 23 (3, 4, 4, 5, 6, 8)	
1	Medium dense grey SAND		85.35	1.30	Fail	U	1.00			
	Medium dense to dense grey fine to coarse sandy slightly silty GRAVEL with occasional cobbles				AA140382	B	2.00		N = 30 (4, 5, 6, 7, 9, 8)	
2										
					AA140383	B	3.00		N = 35 (3, 5, 7, 8, 9, 11)	
3			83.25	3.40						
	Stiff to very stiff brown sandy gravelly SILT/CLAY				AA140384	B	4.00		N = 50/225 mm (14, 11, 20, 22, 8)	
4			82.15	4.50						
	Medium dense to dense grey fine to coarse slightly silty sandy GRAVEL (Blowing back to 2.90m)				AA140385	B	5.00		N = 17 (2, 2, 3, 3, 4, 7)	
5										
					AA140386	B	6.00		N = 44 (5, 9, 10, 10, 12, 12)	
6										
					AA140387	B	7.00		N = 44 (4, 7, 8, 8, 12, 16)	
7										
					AA140388	B	8.00		N = 45 (4, 5, 9, 10, 11, 15)	
8			78.35	8.30						
	Very stiff to hard mottled reddish brown/dark brown/black sandy gravelly CLAY with occasional cobbles				AA140389	B	9.00		N = 50 (5, 9, 10, 10, 14, 16)	
9										
			76.65	10.00						

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.9	4.3	1	
9.5	10	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.50	2.50	3.40	1.90	20	Moderate
4.50	4.50	8.50	1.90	20	Rapid

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Tracked machine used to move rig into position - 2hrs.1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . 1hr waiting for installation instructions.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH27**
		SHEET	Sheet 2 of 2
CO-ORDINATES	681,260.52 E 714,499.49 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	86.65	**BOREHOLE DEPTH (m)**	10.00
		DATE COMMENCED	22/03/2021
		DATE COMPLETED	23/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	P.Thomas
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
10					AA140390	B	10.00		N = 50/225 mm (4, 12, 15, 17, 18)	
11										
12										
13										
14										
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.9	4.3	1	
9.5	10	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Tracked machine used to move rig into position - 2hrs.1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . 1hr waiting for installation instructions.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH28
SHEET Sheet 1 of 1

CO-ORDINATES 681,673.81 E, 714,747.56 N
GROUND LEVEL (m AOD) 88.04

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 8.30

DATE COMMENCED 22/02/2021
DATE COMPLETED 23/02/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.84	0.20						
	Soft SILT/CLAY		87.54	0.50						
1	Loose grey/brown silty SAND		86.74	1.30	AA141108	B	1.00		N = 8 (1, 2, 2, 2, 2, 2)	
2	Medium dense grey fine to coarse very sandy GRAVEL				AA141109	B	2.00		N = 18 (2, 2, 3, 3, 5, 7)	
3					AA141110	B	3.00		N = 29 (3, 5, 5, 7, 7, 10)	
4			83.94	4.10	AA141111	B	4.00		N = 24 (2, 4, 5, 6, 6, 7)	
	Firm to stiff brown and grey sandy gravelly SILT/CLAY with occasional cobbles				Fail	U	4.50			
5					AA141112	B	5.00		N = 10 (2, 2, 2, 2, 3, 3)	
6					AA141113	B	6.00		N = 19 (1, 2, 3, 3, 5, 8)	
					Fail	U	6.50			
7			80.74	7.30	AA141114	B	7.00		N = 50/150 mm (9, 16, 21, 29)	
	Very stiff brown sandy gravelly CLAY with some cobbles									
8			79.74	8.30	AA141115	B	8.00		N = 50/225 mm (4, 10, 12, 22, 16)	
	Obstruction End of Borehole at 8.30 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4	2.5	1.5	Blowing Sands
6.7	7.3	1.5	
7.3	7.4	0.75	
8.1	8.3	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.50	2.50	4.10	1.30	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
23-02-21			2.20	Start of 2nd day

REMARKS Tracked machine need to move rig into position due to soft ground conditions .1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Sands blowing 4.oom

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

BOREHOLE NO. BH29
SHEET Sheet 1 of 2

CO-ORDINATES 680,889.03 E, 714,469.43 N
GROUND LEVEL (m AOD) 87.32

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 14.50

DATE COMMENCED 23/03/2021
DATE COMPLETED 25/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		87.12	0.20						
	Soft brown SILT/CLAY with frequent gravel		86.62	0.70						
1	Medium dense grey fine to coarse silty sandy GRAVEL				AA140391	B	1.00		N = 23 (2, 2, 4, 4, 6, 9)	
2					AA140392	B	2.00		N = 42 (3, 5, 7, 9, 10, 16)	
			84.82	2.50						
	Stiff brown very sandy SILT/CLAY with gravel		84.52	2.80						
3	Medium dense to dense grey fine to coarse sandy GRAVEL with cobbles				AA140393	B	3.00		N = 50 (7, 10, 11, 14, 15, 10)	
4					AA140394	B	4.00		N = 50/225 mm (5, 5, 8, 19, 23)	
5			82.12	5.20	AA140395	B	5.00		N = 20 (6, 6, 4, 4, 5, 7)	
	Stiff brown very gravelly SILT/CLAY (Possibly claybound gravel)									
6					AA140396	B	6.00		N = 15 (2, 3, 3, 3, 4, 5)	
7					AA140397	B	7.00		N = 25 (3, 4, 5, 7, 6, 7)	
			79.82	7.50						
	Dense brown fine to coarse very silty/clayey sandy GRAVEL (Blowing from 13.00m)									
8					AA140398	B	8.00		N = 33 (3, 3, 7, 8, 8, 10)	
9					AA140399	B	9.00		N = 37 (5, 9, 7, 9, 9, 12)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.3	4.7	1	
8.5	8.8	0.5	
14.2	14.5	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.00	2.00	2.50	1.90	20	Slow
2.80	2.80	No	2.00	20	Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
25-03-21	14.50	1.00	14.00	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
23-03-21			2.20	End of 1st day
24-03-21			3.50	End of 2nd day
25-03-21			1.70	Start of 3rd day

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH29**
		SHEET	Sheet 2 of 2
CO-ORDINATES	680,889.03 E 714,469.43 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.32	**BOREHOLE DEPTH (m)**	14.50
		DATE COMMENCED	23/03/2021
		DATE COMPLETED	25/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	P.Thomas
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
10	Dense brown fine to coarse very silty/clayey sandy GRAVEL (Blowing from 13.00m) *(continued)*				AA140400	B	10.00		N = 36 (4, 6, 7, 8, 10, 11)	
11					AA145351	B	11.00		N = 35 (5, 5, 5, 9, 9, 12)	
12					AA145352	B	12.00		N = 44 (4, 4, 9, 11, 10, 14)	
13					AA145353	B	13.00		N = 41 (1, 5, 5, 10, 12, 14)	
14					AA145354	B	14.00		N = 50/225 mm (4, 8, 11, 15, 24)	
			72.82	14.50	AA145355	B	14.50			
	Obstruction End of Borehole at 14.50 m									
15										
16										
17										
18										
19										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.3	4.7	1	
8.5	8.8	0.5	
14.2	14.5	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
25-03-21	14.50	1.00	14.00	50mm SP

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**BOREHOLE NO.**	**BH30**
		SHEET	Sheet 1 of 1
CO-ORDINATES	681,077.10 E 714,609.95 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	87.01	**BOREHOLE DEPTH (m)**	9.40
		DATE COMMENCED	18/03/2021
		DATE COMPLETED	19/03/2021
CLIENT	Aston Lands Ltd	**SPT HAMMER REF. NO.**	
		BORED BY	P.Thomas
ENGINEER	Byrne Looby	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		86.81	0.20						
	Brown sandy SILT/CLAY with frequent gravel		86.61	0.40						
1	Loose grey very sandy GRAVEL (Possibly very gravelly sand)(Blowing bands 4.70-8.20m)				AA140363	B	1.00		N = 17 (2, 3, 4, 4, 4, 5)	
2					AA140364	B	2.00		N = 12 (1, 3, 2, 3, 3, 4)	
			84.31	2.70						
3	Medium dense to dense grey sandy (occasionally very sandy) silty GRAVEL with occasional cobbles (Blowing 8.20-4.70m)				AA140365	B	3.00		N = 37 (3, 7, 8, 8, 10, 11)	
4					AA140366	B	4.00		N = 46 (4, 6, 9, 10, 12, 15)	
5					AA140367	B	5.00		N = 23 (3, 3, 5, 5, 5, 8)	
6					AA140368	B	6.00		N = 34 (2, 5, 6, 9, 9, 10)	
7					AA140369	B	7.00		N = 36 (5, 5, 7, 8, 9, 12)	
8			78.81	8.20	AA140370	B	8.00		N = 50/225 mm (6, 10, 12, 15, 23)	
	Dense grey very sandy silty/clayey GRAVEL with some cobbles and occasional boulders (Possibly very gravelly clay									
9					AA140371	B	9.00		N = 50/225 mm (11, 14, 20, 24, 6)	
			77.61	9.40						
	Obstruction End of Borehole at 9.40 m									

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.7	8.2	1.5	Blowing Sand
9.1	9.4	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.60	2.60	No	1.30	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
19-03-21	8.90	1.00	8.90	50mm SP

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
19-03-21	9.40	Nil	1.50	End of BH

REMARKS 1hr Erecting Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 23110.GPJ IGSL.GDT 8/4/21

Appendix 2

Rotary Corehole Records

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**DRILLHOLE NO**	**RC13**
		SHEET	Sheet 1 of 3
CO-ORDINATES	681,252.69 E 714,513.65 N	**DATE DRILLED**	05/03/2021
GROUND LEVEL (mOD)	87.76	**DATE LOGGED**	05/03/2021
CLIENT	Aston Lands Ltd	**DRILLED BY**	IGSL
ENGINEER	Byrne Looby	**LOGGED BY**	D.O'Shea
RIG TYPE	GEO405		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	78		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as returns of TOPSOIL	0.20	87.56		
								SYMMETRIX DRILLING: No recovery, observed by driller as returns of brown very sandy SILT/CLAY with occasional fine gravel	0.70	87.06		
1								SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey fine to coarse slightly clayey sandy GRAVEL with occasional cobbles				
2												
3									3.50	84.26		
								SYMMETRIX DRILLING: No recovery, observed by driller as returns of brown sandy gravelly CLAY with occasional cobbles				
4									4.40	83.36		
								SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey fine to coarse clayey GRAVEL with cobbles and boulders				
5												
6												
7												
8												
9	9.00	20	0	0				Returns of brown clayey cobbly GRAVEL. Gravel is angular to subrounded fine to coarse of limestone and limestone conglometrate. Cobbles are subrounded of limestone.	9.00	78.76		

REMARKS

Hole cased 0.00-18.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.80	2.80	N/S			Slow

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

DRILLHOLE NO RC13
SHEET Sheet 2 of 3

CO-ORDINATES 681,252.69 E
714,513.65 N
GROUND LEVEL (mOD) 87.76

RIG TYPE GEO405
FLUSH Air/Mist
INCLINATION (deg) -90
CORE DIAMETER (mm) 78

DATE DRILLED 05/03/2021
DATE LOGGED 05/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

DRILLED BY IGSL
LOGGED BY D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.50							Returns of brown clayey cobbly GRAVEL. Gravel is angular to subrounded fine to coarse of limestone and limestone conglometrate. Cobbles are subrounded of limestone. *(continued)*				N = 52 (4, 8, 18, 15, 9, 10)
11		20	0	0								
	12.00											N = 76/220 mm (4, 8, 11, 15, 25, 25)
12		13	0	0								
13	13.50											N = 85 (3, 9, 15, 20, 23, 27)
		20	0	0								
14	15.00											N = 84 (3, 7, 10, 17, 26, 31)
15		20	0	0								
16	16.50											N = 74 (4, 9, 12, 21, 19, 22)
		7	0	0								
17	18.00								18.00	69.76		
18		100	78	57				Very strong to strong, thickly to thinly bedded, grey to locally black, fine to medium-grained, LIMESTONE (locally slightly fossiliferous, localised chert, stylolites present), fresh to very locally slightly weathered. Discontinuities are widely to closely spaced, smooth to locally rough, planar to undulose. Apertures are tight to locally moderately open, locally clay-smeared, locally moderately iron-oxide stained. Dips are subhorizontal & locally 50°				N = 25/10 mm (25, 25)
19	19.50											

REMARKS

Hole cased 0.00-18.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.80	2.80	N/S			Slow

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

DRILLHOLE NO RC13
SHEET Sheet 3 of 3

CO-ORDINATES 681,252.69 E
714,513.65 N
GROUND LEVEL (mOD) 87.76

RIG TYPE GEO405
FLUSH Air/Mist
INCLINATION (deg) -90
CORE DIAMETER (mm) 78

DATE DRILLED 05/03/2021
DATE LOGGED 05/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

DRILLED BY IGSL
LOGGED BY D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
20		100	88	71				Very strong to strong, thickly to thinly bedded, grey to locally black, fine to medium-grained, LIMESTONE (locally slightly fossiliferous, localised chert, stylolites present), fresh to very locally slightly weathered. Discontinuities are widely to closely spaced, smooth to locally rough, planar to undulose. Apertures are tight to locally moderately open, locally clay-smeared, locally moderately iron-oxide stained. Dips are subhorizontal & locally 50° *(continued)*				
21	21.00	100	72	56								
22	22.50	100	96	96								
23	23.20							End of Borehole at 23.20 m	23.20	64.56		
24												
25												
26												
27												
28												
29												

REMARKS

Hole cased 0.00-18.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.80	2.80	N/S			Slow

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
05-03-21	23.20	18.00	1.80	Water level recorded 5 mins after end of drilling.

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC FI 10M 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**DRILLHOLE NO**	**RC19**
		SHEET	Sheet 1 of 3
CO-ORDINATES	681,195.57 E 714,444.93 N	**DATE DRILLED**	10/05/2021
GROUND LEVEL (mOD)	86.81	**DATE LOGGED**	10/05/2021
RIG TYPE	GEO405		
FLUSH	Air/Mist		
CLIENT	Aston Lands Ltd	**DRILLED BY**	IGSL
ENGINEER	Byrne Looby	**LOGGED BY**	D.O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	78		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as returns of TOPSOIL	0.20	86.61		
								SYMMETRIX DRILLING: No recovery, observed by driller as returns of brown fine to coarse very sandy clayey GRAVEL				
1												
2												
3												
4												
5												
6												
7												
8												
9	9.00	20	0	0				Returns of brown clayey cobbly GRAVEL. Gravel is angular to subrounded fine to coarse of limestone and limestone conglometrate. Cobbles are subrounded of limestone.	9.00	77.81		

REMARKS

Hole cased 0.00-18.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.90	2.90	N/S			Slow
11.10	11.10	N/S			Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
10-03-21	10.50	1.00	10.50	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

DRILLHOLE NO RC19
SHEET Sheet 2 of 3

CO-ORDINATES 681,195.57 E
714,444.93 N
GROUND LEVEL (mOD) 86.81

RIG TYPE GEO405
FLUSH Air/Mist
INCLINATION (deg) -90
CORE DIAMETER (mm) 78

DATE DRILLED 10/05/2021
DATE LOGGED 10/05/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

DRILLED BY IGSL
LOGGED BY D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.50							Returns of brown clayey cobbly GRAVEL. Gravel is angular to subrounded fine to coarse of limestone and limestone conglometrate. Cobbles are subrounded of limestone. *(continued)*				
11		20	0	0								
12	12.00	20	0	0								N = 68 (5, 13, 12, 11, 15, 30)
13	13.50	20	0	0								N = 99 (8, 22, 21, 27, 22, 29)
14												
15	15.00	13	0	0								
16	16.50								16.50	70.31		
17	17.20	100	40	16				Very strong to strong, thickly to thinly bedded, grey to locally black, fine to medium-grained, LIMESTONE (locally slightly fossiliferous, localised chert, stylolites present), fresh to very locally slightly weathered.				
18		100	40	24				Discontinuities are widely to closely spaced, smooth to locally rough, planar to undulose. Apertures are tight to locally moderately open, commonly clay-smeared/filled (2-5mm thick), locally moderately iron-oxide stained. Dips are subhorizontal & locally 30°				
19	18.70	100	91	82								

REMARKS

Hole cased 0.00-18.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.90	2.90	N/S			Slow
11.10	11.10	N/S			Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
10-03-21	10.50	1.00	10.50	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 23110.GPJ IGSL.GDT 8/4/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

DRILLHOLE NO RC19
SHEET Sheet 3 of 3

CO-ORDINATES 681,195.57 E
714,444.93 N
GROUND LEVEL (mOD) 86.81

RIG TYPE GEO405
FLUSH Air/Mist
INCLINATION (deg) -90
CORE DIAMETER (mm) 78

DATE DRILLED 10/05/2021
DATE LOGGED 10/05/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

DRILLED BY IGSL
LOGGED BY D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
20	20.20							Very strong to strong, thickly to thinly bedded, grey to locally black, fine to medium-grained, LIMESTONE (locally slightly fossiliferous, localised chert, stylolites present), fresh to very locally slightly weathered. Discontinuities are widely to closely spaced, smooth to locally rough, planar to undulose. Apertures are tight to locally moderately open, commonly clay-smeared/filled (2-5mm thick), locally moderately iron-oxide stained. Dips are subhorizontal & locally 30° *(continued)*				
21	21.20	100	95	95								
22	22.20	100	82	75				End of Borehole at 22.20 m	22.20	64.61		
23												
24												
25												
26												
27												
28												
29												

REMARKS

Hole cased 0.00-18.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.90	2.90	N/S			Slow
11.10	11.10	N/S			Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
10-03-21	10.50	1.00	10.50	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
10-03-21	22.20	16.50	0.90	Water level recorded 5 mins after end of drilling.

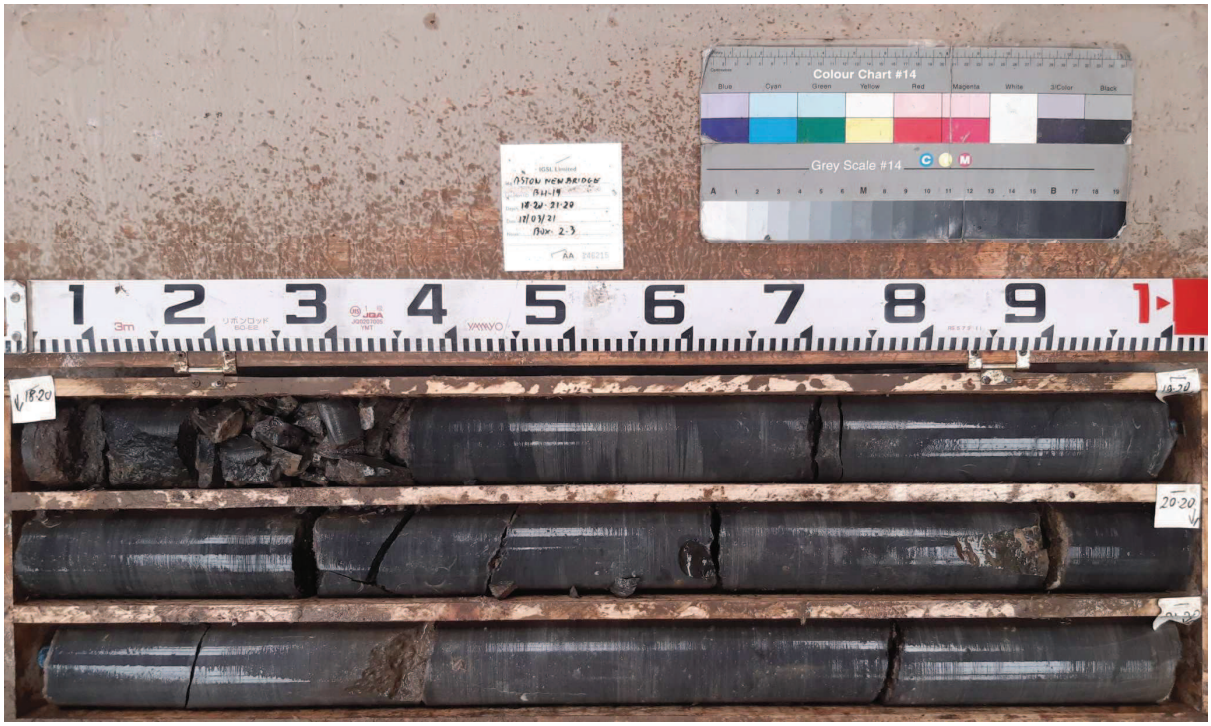
RC13 Box 1 of 3 – 9.00-19.50m

RC13 Box 2 of 3 – 19.50-22.50m

RC13 Box 3 of 3 – 22.50-23.20m

RC19 Box 1 of 3 – 9.00-18.20m

RC19 Box 2 of 3 – 18.20-21.20m



RC19 Box 3 of 3 – 21.20-22.20m

Appendix 3

Trial Pit Records

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP01**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,261.25 E 714,754.42 N
		DATE STARTED	17/02/2021
		DATE COMPLETED	17/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	86.79
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	86.69						
Soft brown sandy SILT/CLAY									
Grey very sandy fine to course rounded GRAVEL		1.10	85.69	1 (Moderate)	AA142227	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.30	85.49		AA142228	B	2.00		
End of Trial Pit at 2.60m		2.60	84.19						

Groundwater Conditions
Groundwater at 1.30m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP02**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,313.25 E 714,759.78 N
		DATE STARTED	17/02/2021
		DATE COMPLETED	17/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.11
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	87.01						
Soft brown sandy SILT/CLAY		0.40	86.71						
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content					AA142225	B	0.60		
				1 (Moderate)	AA142226	B	2.00		
End of Trial Pit at 2.60m		2.60	84.51						

Groundwater Conditions
Groundwater at 2.45m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP03**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,245.02 E 714,638.00 N
		DATE STARTED	18/02/2021
		DATE COMPLETED	18/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	86.99
		EXCAVATION METHOD	8-Ton Excavator
ENGINEER	Byrne Looby		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	86.89						
Soft brown sandy SILT/CLAY					AA142235	B	0.50		
Grey mottled brown very silty fine to medium SAND		0.80	86.19						
				1 (Moderate)	AA142236	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.50	85.49						
					AA142237	B	2.00		
End of Trial Pit at 2.60m		2.60	84.39						

Groundwater Conditions
Groundwater at 1.30m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP04**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,383.31 E 714,663.16 N
		DATE STARTED	19/02/2021
		DATE COMPLETED	19/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.34
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 Soft brown sandy SILT/CLAY									
Grey very sandy fine to course rounded GRAVEL		0.40	86.94						
1.0					AA142257	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.20	86.14						
2.0				1 (Moderate)	AA142258	B	2.00		
End of Trial Pit at 2.40m		2.40	84.94						
3.0									
4.0									

Groundwater Conditions
Groundwater at 2.10m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP05**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,389.79 E 714,641.46 N
		DATE STARTED	19/02/2021
		DATE COMPLETED	19/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.51
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 Soft brown sandy SILT/CLAY									
Grey very sandy fine to course rounded GRAVEL		0.40	87.11						
1.0					AA142259	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.30	86.21						
2.0				1 (Moderate)	AA142260	B	2.00		
End of Trial Pit at 2.60m		2.60	84.91						
3.0									
4.0									

Groundwater Conditions
Groundwater at 2.20m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP06**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,439.72 E 714,742.75 N
		DATE STARTED	19/02/2021
		DATE COMPLETED	19/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	86.66
		EXCAVATION METHOD	8-Ton Excavator
ENGINEER	Byrne Looby		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	86.56						
Soft brown sandy SILT/CLAY		0.50	86.16						
Grey very sandy fine to course rounded GRAVEL					AA142254	B	0.50		
					AA142255	B	1.00		
				1 (Moderate)					
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.80	84.86						
					AA142256	B	2.00		
End of Trial Pit at 2.60m		2.60	84.06						

0.0 1.0 2.0 3.0 4.0

Groundwater Conditions
Groundwater at 1.80m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP07**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,475.07 E 714,767.17 N
		DATE STARTED	17/02/2021
		DATE COMPLETED	17/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.28
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	87.18						
Soft brown sandy SILT/CLAY					AA142231	B	0.60		
Grey very sandy fine to course rounded GRAVEL		0.80	86.48						
				1 (Moderate)	AA142232	B	2.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		2.30	84.98						
End of Trial Pit at 2.60m		2.60	84.68						

Groundwater Conditions
Groundwater at 2.30m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP08**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,541.74 E 714,809.46 N
		DATE STARTED	19/02/2021
		DATE COMPLETED	19/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	86.83
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.10	86.73						
Soft brown sandy SILT/CLAY									
Grey very sandy fine to course rounded GRAVEL		0.60	86.23						
1.0				1 (Moderate)	AA142248	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.30	85.53						
2.0					AA142249	B	2.00		
End of Trial Pit at 2.50m		2.50	84.33						
3.0									
4.0									

Groundwater Conditions
Groundwater at 1.80m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP09**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,591.55 E 714,836.23 N
		DATE STARTED	18/02/2021
		DATE COMPLETED	18/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.03
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	86.93						
Soft brown sandy SILT/CLAY									
Grey very sandy fine to course rounded GRAVEL		0.50	86.53						
					AA142233	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.30	85.73	1 (Moderate)					
					AA142234	B	2.00		
End of Trial Pit at 2.60m		2.60	84.43						

Groundwater Conditions
Groundwater at 2.00m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP10**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,533.36 E 714,733.76 N
		DATE STARTED	17/02/2021
		DATE COMPLETED	17/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.51
		EXCAVATION METHOD	8-Ton Excavator
ENGINEER	Byrne Looby		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.10	87.41						
Soft brown sandy SILT/CLAY		0.50	87.01						
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content					AA142229	B	0.50		
				1 (Moderate)	AA142230	B	2.00		
End of Trial Pit at 2.70m		2.70	84.81						

Groundwater Conditions
Groundwater at 2.20m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP11**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,600.76 E 714,761.55 N
		DATE STARTED	19/02/2021
		DATE COMPLETED	19/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.10
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	87.00						
Soft brown sandy SILT/CLAY		0.50	86.60						
Grey very sandy fine to course rounded GRAVEL		1.00	86.10		AA142250	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content				1 (Moderate)	AA142251	B	2.00		
End of Trial Pit at 2.50m		2.50	84.60						

0.0 1.0 2.0 3.0 4.0

Groundwater Conditions
Groundwater at 1.80m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

IGSL TP LOG 23110.GPJ IGSL.GDT 8/4/21

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP12**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,288.05 E 714,540.43 N
		DATE STARTED	19/02/2021
		DATE COMPLETED	19/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.62
		EXCAVATION METHOD	8-Ton Excavator
ENGINEER	Byrne Looby		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL									
Soft brown sandy SILT/CLAY		0.20	87.42						
Grey very sandy fine to course rounded GRAVEL		0.60	87.02		AA142252	B	0.50		
1.0					AA142253	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.50	86.12	1 (Moderate)					
2.0									
End of Trial Pit at 2.30m		2.30	85.32						
3.0									
4.0									

Groundwater Conditions
Groundwater at 1.50m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP13**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,481.63 E 714,603.64 N
		DATE STARTED	19/02/2021
		DATE COMPLETED	19/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	86.85
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	86.75						
Soft brown sandy SILT/CLAY									
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.10	85.75	1 (Moderate)	AA142261	B	1.00		
					AA142262	B	2.00		
End of Trial Pit at 2.20m		2.20	84.65						

Groundwater Conditions
Groundwater at 1.30m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP14**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,334.37 E 714,594.82 N
		DATE STARTED	19/02/2021
		DATE COMPLETED	19/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.21
		EXCAVATION METHOD	8-Ton Excavator
ENGINEER	Byrne Looby		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	87.11						
Soft brown sandy SILT/CLAY with underlying teram sheet at 0.40m (MADE GROUND)		0.40	86.81						
Brown mottled grey gravelly silty fine to coarse SAND		0.80	86.41						
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content				1 (Moderate)	AA142263	B	1.00		
					AA142264	B	2.00		
End of Trial Pit at 2.30m		2.30	84.91						

Groundwater Conditions
Groundwater at 1.90m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP15**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,572.42 E 714,642.20 N
		DATE STARTED	17/02/2021
		DATE COMPLETED	17/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	88.17
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	88.07						
Soft to firm brown sandy SILT/CLAY					AA142214	B	0.80		50
Grey very sandy fine to course rounded GRAVEL		1.40	86.77	1 (Moderate)	AA142215	B	1.50		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.70	86.47		AA142216	B	2.00		
End of Trial Pit at 2.50m		2.50	85.67						

Groundwater Conditions
Groundwater at 1.70m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP16**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,640.41 E 714,663.09 N
		DATE STARTED	19/02/2021
		DATE COMPLETED	19/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	88.57
		EXCAVATION METHOD	8-Ton Excavator
ENGINEER	Byrne Looby		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
Soft brown sandy SILT/CLAY		0.00							
Grey silty very gravelly fine to coarse SAND		0.40	88.17						
					AA142265	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.50	87.07						
				1 (Moderate)	AA142266	B	2.00		
End of Trial Pit at 2.60m		2.60	85.97						

Groundwater Conditions
Groundwater at 2.40m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP17**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,528.00 E 714,524.24 N
		DATE STARTED	17/02/2021
		DATE COMPLETED	17/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	88.48
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.10	88.38						
Soft brown very sandy SILT/CLAY					AA142220	B	1.00		
Grey very sandy fine to course rounded GRAVEL		1.40	87.08		AA142221	B	1.50		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		2.00	86.48	1 (Moderate)	AA142222	B	2.50		
End of Trial Pit at 2.60m		2.60	85.88						

Groundwater Conditions
Groundwater at 2.00m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP18**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,603.87 E 714,559.58 N
		DATE STARTED	17/02/2021
		DATE COMPLETED	17/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	88.23
		EXCAVATION METHOD	8-Ton Excavator
ENGINEER	Byrne Looby		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	88.13						
Soft brown sandy SILT/CLAY					AA142217	B	1.00		50
Grey very sandy fine to course rounded GRAVEL		1.30	86.93	1 (Moderate)	AA142218	B	1.50		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.80	86.43		AA142219	B	2.00		
End of Trial Pit at 2.50m		2.50	85.73						

0.0 1.0 2.0 3.0 4.0

Groundwater Conditions
Groundwater at 1.85m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP20**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,418.11 E 714,474.88 N
		DATE STARTED	17/02/2021
		DATE COMPLETED	17/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.20
		EXCAVATION METHOD	8-Ton Excavator
ENGINEER	Byrne Looby		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	87.10						
Soft brown sandy SILT/CLAY									40
Soft to firm grey sandy clayey SILT		0.80	86.40						
				1 (Moderate)	AA142223	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.20	86.00						
					AA142224	B	2.00		
End of Trial Pit at 2.50m		2.50	84.70						

Groundwater Conditions
Groundwater at 1.20m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP21**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	680,807.66 E 714,495.63 N
		DATE STARTED	18/02/2021
		DATE COMPLETED	18/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	86.23
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 Soft brown sandy SILT/CLAY									
Grey very sandy fine to course rounded GRAVEL		0.40	85.83						
1.0 Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.10	85.13	(Moderate)	AA142240	B	1.00		
2.0					AA142241	B	2.00		
End of Trial Pit at 2.20m		2.20	84.03						
3.0									
4.0									

Groundwater Conditions
Groundwater at 1.20m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP22**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	680,933.30 E 714,564.85 N
		DATE STARTED	18/02/2021
		DATE COMPLETED	18/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.41
		EXCAVATION METHOD	8-Ton Excavator
ENGINEER	Byrne Looby		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 Soft brown sandy SILT/CLAY		0.40	87.01						
Grey very sandy fine to course rounded GRAVEL					AA142267	B	1.00		
1.0									
2.0				1 (Moderate)	AA142268	B	2.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		2.20	85.21						
End of Trial Pit at 2.70m		2.70	84.71						
3.0									
4.0									

Groundwater Conditions
Groundwater at 2.30m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP23**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,063.96 E 714,683.79 N
		DATE STARTED	18/02/2021
		DATE COMPLETED	18/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.42
		EXCAVATION METHOD	8-Ton Excavator
ENGINEER	Byrne Looby		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.10	87.32						
Soft brown sandy SILT/CLAY		0.50	86.92						
Grey mottled brown very silty fine to medium SAND					AA142238	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.50	85.92	1 (Moderate)	AA142239	B	2.00		
End of Trial Pit at 2.50m		2.50	84.92						

0.0 1.0 2.0 3.0 4.0

Groundwater Conditions
Groundwater at 2.00m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP24**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	680,895.49 E 714,385.12 N
		DATE STARTED	18/02/2021
		DATE COMPLETED	18/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.42
		EXCAVATION METHOD	8-Ton Excavator
ENGINEER	Byrne Looby		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 Soft brown sandy SILT/CLAY		0.20	87.22						
Grey mottled brown very silty fine to medium SAND					AA142242	B	1.00		
				1 (Moderate)					
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.70	85.72		AA142243	B	2.00		
End of Trial Pit at 2.60m		2.60	84.82						

Groundwater Conditions
Groundwater at 1.70m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP25**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,022.07 E 714,455.84 N
		DATE STARTED	18/02/2021
		DATE COMPLETED	18/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.50
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
Soft brown sandy SILT/CLAY		0.00							
Grey mottled brown gravelly very silty fine to medium SAND		0.40	87.10		AA142244	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content		1.30	86.20	1 (Moderate)	AA142245	B	2.00		
End of Trial Pit at 2.70m		2.70	84.80						

Groundwater Conditions
Groundwater at 2.20m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

TRIAL PIT RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**TRIAL PIT NO.**	**TP26**
		SHEET	Sheet 1 of 1
LOGGED BY	L. Daniels	**CO-ORDINATES**	681,111.22 E 714,523.66 N
		DATE STARTED	18/02/2021
		DATE COMPLETED	18/02/2021
CLIENT	Aston Lands Ltd	**GROUND LEVEL (m)**	87.57
ENGINEER	Byrne Looby	**EXCAVATION METHOD**	8-Ton Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
Soft brown sandy SILT/CLAY		0.50	87.07						
Grey mottled brown gravelly very silty fine to medium SAND		1.20	86.37		AA142246	B	1.00		
Grey slightly silty very sandy fine to course rounded GRAVEL with a high cobble content				1 (Moderate)	AA142247	B	2.00		
End of Trial Pit at 2.70m		2.70	84.87						

Groundwater Conditions
Groundwater at 2.10m

Stability
Slumping of sands and gravels resulting in wall collapse

General Remarks
Set up Covid-19 restriction zone. CAT scanned location for services. Pit terminated due to wall collapse and groundwater influx.

Appendix 4

Dynamic Probe Records

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. DP01
SHEET Sheet 1 of 1

CO-ORDINATES 681,287.03 E
714,784.10 N
GROUND LEVEL (mOD) 86.83

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

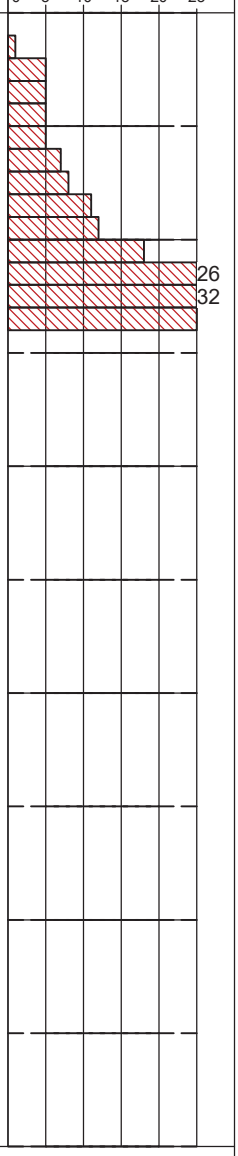
DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	1
						0.20	5
						0.30	5
						0.40	5
						0.50	5
						0.60	7
						0.70	8
						0.80	11
						0.90	12
1.0						1.00	18
						1.10	26
						1.20	32
						1.30	25
	End of Probe at 1.40 m			85.43			
2.0							
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. DP02
SHEET Sheet 1 of 1

CO-ORDINATES 681,466.15 E
714,837.49 N
GROUND LEVEL (mOD) 87.37

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

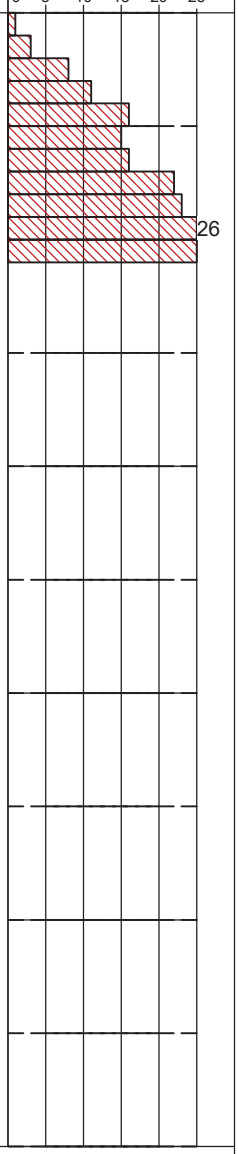
DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	1
						0.10	3
						0.20	8
						0.30	11
						0.40	16
						0.50	15
						0.60	16
						0.70	22
						0.80	23
						0.90	26
1.0						1.00	25
	End of Probe at 1.10 m			86.27			
2.0							
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP03**
SHEET Sheet 1 of 1

CO-ORDINATES 681,536.53 E
714,882.56 N
GROUND LEVEL (mOD) 87.21

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

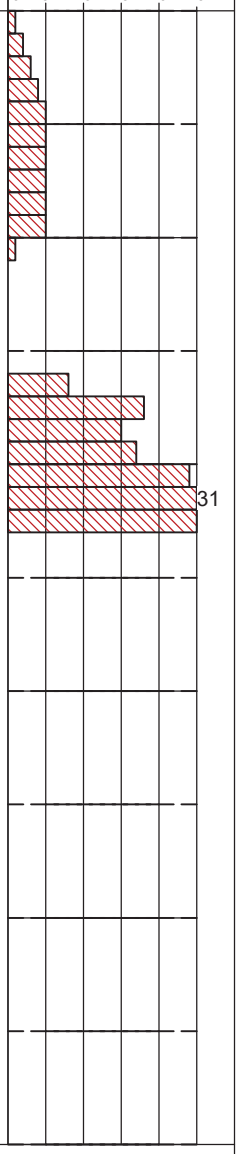
DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	1
						0.10	2
						0.20	3
						0.30	4
						0.40	5
						0.50	5
						0.60	5
						0.70	5
						0.80	5
						0.90	5
1.0						1.00	1
						1.10	0
						1.20	0
						1.30	0
						1.40	0
						1.50	0
						1.60	8
						1.70	18
						1.80	15
						1.90	17
2.0						2.00	24
						2.10	31
						2.20	25
	End of Probe at 2.30 m			84.91			
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP04**
SHEET Sheet 1 of 2

CO-ORDINATES 681,213.29 E
714,648.61 N
GROUND LEVEL (mOD) 86.36

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	1
						0.30	2
						0.40	2
						0.50	2
						0.60	1
						0.70	0
						0.80	0
						0.90	2
1.0						1.00	2
						1.10	0
						1.20	0
						1.30	0
						1.40	1
						1.50	3
						1.60	3
						1.70	4
						1.80	2
						1.90	4
2.0						2.00	8
						2.10	6
						2.20	7
						2.30	12
						2.40	14
						2.50	11
						2.60	10
						2.70	7
						2.80	4
						2.90	2
3.0						3.00	5
						3.10	8
						3.20	8
						3.30	6
						3.40	5
						3.50	5
						3.60	5
						3.70	5
						3.80	5
						3.90	7
4.0						4.00	8
						4.10	10
						4.20	10
						4.30	12
						4.40	11
						4.50	12
						4.60	15
						4.70	13
						4.80	16
						4.90	11

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP04**
SHEET Sheet 2 of 2

CO-ORDINATES 681,213.29 E
714,648.61 N
GROUND LEVEL (mOD) 86.36

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
5.0	. *(continued)*					5.00	14
						5.10	15
						5.20	16
						5.30	16
						5.40	16
						5.50	17
						5.60	22
						5.70	23
						5.80	25
	End of Probe at 5.90 m			80.46			
6.0							
7.0							
8.0							
9.0							

Graphic Probe Record
0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP05**
SHEET Sheet 1 of 1

CO-ORDINATES 681,308.68 E
714,683.09 N
GROUND LEVEL (mOD) 87.08

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	1
						0.20	1
						0.30	4
						0.40	3
						0.50	2
						0.60	4
						0.70	3
						0.80	8
						0.90	12
1.0						1.00	17
						1.10	15
						1.20	27
						1.30	16
						1.40	14
						1.50	15
						1.60	12
						1.70	11
						1.80	10
						1.90	10
2.0						2.00	6
						2.10	3
						2.20	5
						2.30	4
						2.40	6
						2.50	12
						2.60	16
						2.70	22
						2.80	26
						2.90	25
3.0	End of Probe at 3.00 m			84.08			
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP06**
SHEET Sheet 1 of 1

CO-ORDINATES 681,401.57 E
714,723.21 N
GROUND LEVEL (mOD) 87.25

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

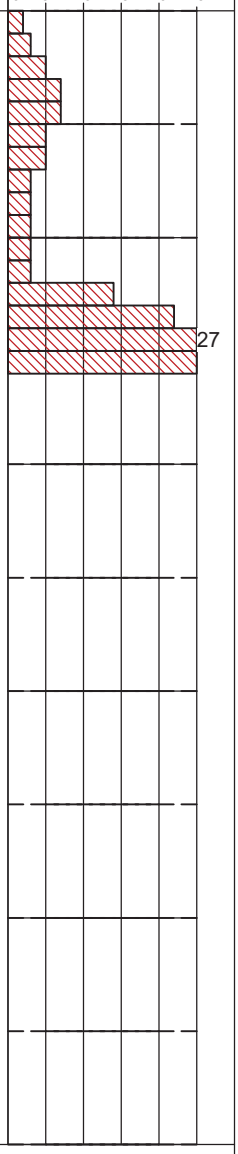
DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	2
						0.10	3
						0.20	5
						0.30	7
						0.40	7
						0.50	5
						0.60	5
						0.70	3
						0.80	3
						0.90	3
1.0						1.00	3
						1.10	3
						1.20	14
						1.30	22
						1.40	27
						1.50	25
	End of Probe at 1.60 m			85.65			
2.0							
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. DP07
SHEET Sheet 1 of 1

CO-ORDINATES 681,499.08 E
714,789.40 N
GROUND LEVEL (mOD) 87.21

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	1
						0.20	2
						0.30	3
						0.40	2
						0.50	1
						0.60	4
						0.70	5
						0.80	5
						0.90	9
1.0						1.00	17
						1.10	17
						1.20	18
						1.30	23
						1.40	25
						1.50	29
						1.60	25
	End of Probe at 1.70 m			85.51			
2.0							
3.0							
4.0							

Graphic Probe Record: 0 5 10 15 20 25; 29

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP08**
SHEET Sheet 1 of 1

CO-ORDINATES 681,587.26 E
714,788.59 N
GROUND LEVEL (mOD) 87.01

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	0
						0.30	3
						0.40	3
						0.50	4
						0.60	6
						0.70	10
						0.80	14
						0.90	13
1.0						1.00	15
						1.10	17
						1.20	17
						1.30	1
						1.40	19
						1.50	22
						1.60	15
						1.70	13
						1.80	14
						1.90	11
2.0						2.00	11
						2.10	9
						2.20	13
						2.30	15
						2.40	19
						2.50	27
						2.60	25
	End of Probe at 2.70 m			84.31			
3.0							
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP09**
SHEET Sheet 1 of 1

CO-ORDINATES 681,235.72 E
714,590.24 N
GROUND LEVEL (mOD) 87.71

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	0
						0.30	5
						0.40	14
						0.50	16
						0.60	16
						0.70	22
						0.80	26
						0.90	24
1.0						1.00	29
						1.10	25
	End of Probe at 1.20 m			86.51			
2.0							
3.0							
4.0							

Graphic Probe Record: 0 5 10 15 20 25 — 26 — 29

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT	Proposed Residential Development at Great Connell , Newbridge	**PROBE NO.**	**DP10**
		SHEET	Sheet 1 of 1
CO-ORDINATES	681,384.95 E 714,570.44 N	**DATE DRILLED**	02/03/2021
GROUND LEVEL (mOD)	87.56	**DATE LOGGED**	03/03/2021
HAMMER MASS (kg)	50		
CLIENT	Aston Lands Ltd	**INCREMENT SIZE (mm)**	100
ENGINEER	Byrne Looby	**FALL HEIGHT (mm)**	500
		PROBE TYPE	DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	2
						0.30	3
						0.40	3
						0.50	2
						0.60	4
						0.70	5
						0.80	11
						0.90	10
1.0						1.00	11
						1.10	9
						1.20	6
						1.30	5
						1.40	3
						1.50	1
						1.60	0
						1.70	0
						1.80	0
						1.90	0
2.0						2.00	6
						2.10	7
						2.20	6
						2.30	5
						2.40	5
						2.50	5
						2.60	6
						2.70	8
						2.80	12
						2.90	14
3.0						3.00	15
						3.10	14
						3.20	12
						3.30	14
						3.40	11
						3.50	12
						3.60	10
						3.70	12
						3.80	26
						3.90	25
4.0	End of Probe at 4.00 m			83.56			

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP11**
SHEET Sheet 1 of 1

CO-ORDINATES 681,435.04 E
714,622.16 N
GROUND LEVEL (mOD) 87.44

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

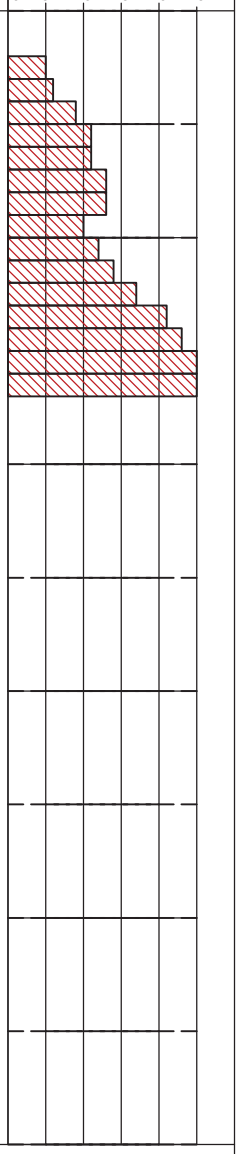
DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	5
						0.30	6
						0.40	9
1.0						0.50	11
						0.60	11
						0.70	13
						0.80	13
						0.90	10
						1.00	12
						1.10	14
						1.20	17
						1.30	21
						1.40	23
						1.50	25
						1.60	25
	End of Probe at 1.70 m			85.74			
2.0							
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP12**
SHEET Sheet 1 of 1

CO-ORDINATES 681,529.06 E
714,655.59 N
GROUND LEVEL (mOD) 87.26

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

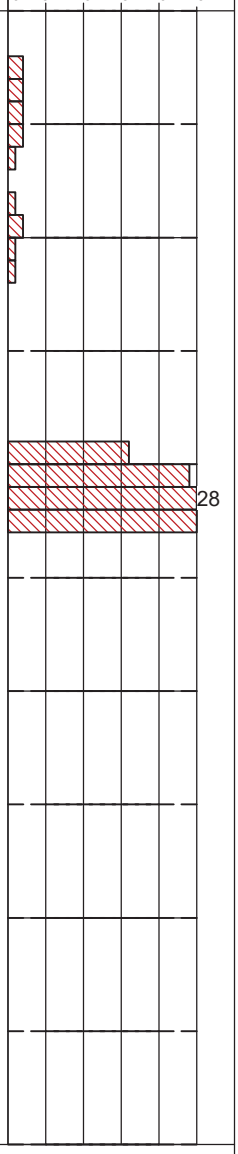
DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	2
						0.30	2
						0.40	2
						0.50	2
						0.60	1
						0.70	0
						0.80	1
						0.90	2
1.0						1.00	1
						1.10	1
						1.20	0
						1.30	0
						1.40	0
						1.50	0
						1.60	0
						1.70	0
						1.80	0
2.0						1.90	16
						2.00	24
						2.10	28
						2.20	25
	End of Probe at 2.30 m			84.96			
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. DP13
SHEET Sheet 1 of 1

CO-ORDINATES 681,622.74 E
714,693.21 N
GROUND LEVEL (mOD) 88.19

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	2
						0.30	4
						0.40	5
						0.50	4
						0.60	4
						0.70	4
						0.80	3
						0.90	2
1.0						1.00	4
						1.10	4
						1.20	5
						1.30	7
						1.40	11
						1.50	12
						1.60	13
						1.70	11
						1.80	11
						1.90	10
2.0						2.00	8
						2.10	9
						2.20	11
						2.30	14
						2.40	19
						2.50	14
						2.60	16
						2.70	22
						2.80	26
						2.90	25
3.0	End of Probe at 3.00 m			85.19			
4.0							

Graphic Probe Record: 0 5 10 15 20 25; 26

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP14**
SHEET Sheet 1 of 1

CO-ORDINATES 681,375.95 E
714,497.21 N
GROUND LEVEL (mOD) 87.91

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	1
						0.30	2
						0.40	3
						0.50	5
						0.60	3
						0.70	4
						0.80	3
						0.90	4
1.0						1.00	4
						1.10	3
						1.20	7
						1.30	12
						1.40	14
						1.50	18
						1.60	15
						1.70	15
						1.80	15
						1.90	12
2.0						2.00	14
						2.10	12
						2.20	15
						2.30	19
						2.40	19
						2.50	22
						2.60	21
						2.70	22
						2.80	24
						2.90	25
3.0	End of Probe at 3.00 m			84.91			
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP15**
SHEET Sheet 1 of 1

CO-ORDINATES 681,469.20 E
714,531.31 N
GROUND LEVEL (mOD) 87.25

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

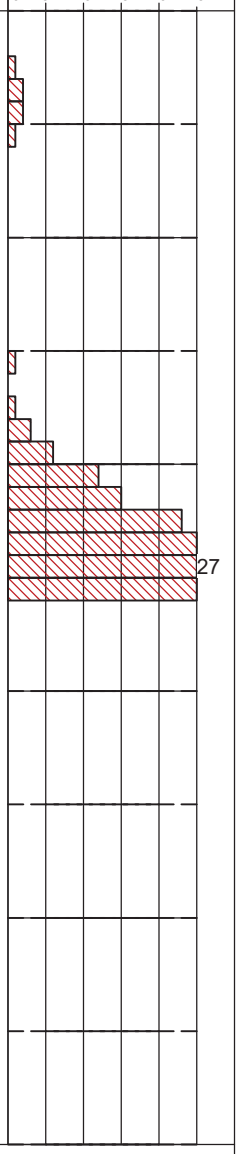
DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	1
						0.30	2
						0.40	2
						0.50	1
						0.60	0
						0.70	0
						0.80	0
						0.90	0
1.0						1.00	0
						1.10	0
						1.20	0
						1.30	0
						1.40	0
						1.50	1
						1.60	0
						1.70	1
						1.80	3
						1.90	6
2.0						2.00	12
						2.10	15
						2.20	23
						2.30	25
						2.40	27
						2.50	25
	End of Probe at 2.60 m			84.65			
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. **DP16**
SHEET Sheet 1 of 1

CO-ORDINATES 681,563.51 E
714,567.64 N
GROUND LEVEL (mOD) 88.59

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	1
						0.20	1
						0.30	2
						0.40	0
						0.50	0
						0.60	1
						0.70	0
						0.80	0
						0.90	0
1.0						1.00	0
						1.10	1
						1.20	1
						1.30	2
						1.40	3
						1.50	5
						1.60	8
						1.70	12
						1.80	13
						1.90	14
2.0						2.00	12
						2.10	12
						2.20	11
						2.30	10
						2.40	10
						2.50	11
						2.60	13
						2.70	14
						2.80	16
						2.90	17
3.0						3.00	19
						3.10	21
						3.20	24
						3.30	25
	End of Probe at 3.40 m			85.19			
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. DP17
SHEET Sheet 1 of 2

CO-ORDINATES 681,658.94 E
714,601.40 N
GROUND LEVEL (mOD) 88.52

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

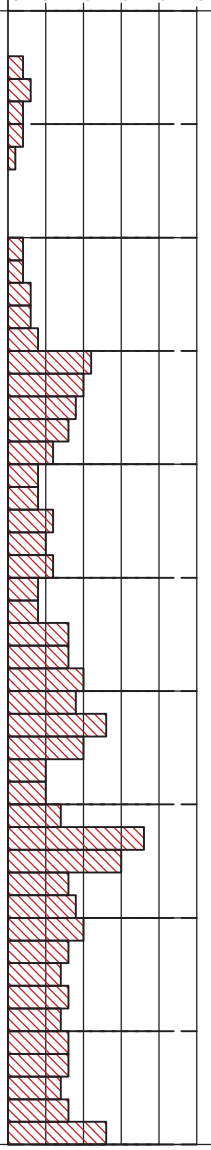
DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	2
						0.30	3
						0.40	2
						0.50	2
						0.60	1
						0.70	0
						0.80	0
						0.90	0
1.0						1.00	2
						1.10	2
						1.20	3
						1.30	3
						1.40	4
						1.50	11
						1.60	10
						1.70	9
						1.80	8
						1.90	6
2.0						2.00	4
						2.10	4
						2.20	6
						2.30	5
						2.40	6
						2.50	4
						2.60	4
						2.70	8
						2.80	8
						2.90	10
3.0						3.00	9
						3.10	13
						3.20	10
						3.30	5
						3.40	5
						3.50	7
						3.60	18
						3.70	15
						3.80	8
						3.90	9
4.0						4.00	10
						4.10	8
						4.20	7
						4.30	8
						4.40	7
						4.50	8
						4.60	8
						4.70	7
						4.80	8
						4.90	13

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

DYNAMIC PROBE RECORD

REPORT NUMBER 23110

CONTRACT Proposed Residential Development at Great Connell , Newbridge

PROBE NO. DP17
SHEET Sheet 2 of 2

CO-ORDINATES 681,658.94 E
714,601.40 N

GROUND LEVEL (mOD) 88.52

HAMMER MASS (kg) 50
INCREMENT SIZE (mm) 100
FALL HEIGHT (mm) 500

DATE DRILLED 02/03/2021
DATE LOGGED 03/03/2021

CLIENT Aston Lands Ltd
ENGINEER Byrne Looby

PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)	Graphic Probe Record
5.0	. *(continued)*					5.00	23	
						5.10	26	26
						5.20	25	
	End of Probe at 5.30 m			83.22				
6.0								
7.0								
8.0								
9.0								

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 23110.GPJ IGSL.GDT 8/4/21

Appendix 5

Infiltration Test Records

Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA03 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	Moderate seepage at 1.20m
0.30	0.70	Firm brown very sandy SILT/CLAY	
0.70	1.20	Grey very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.15)	

Field Data

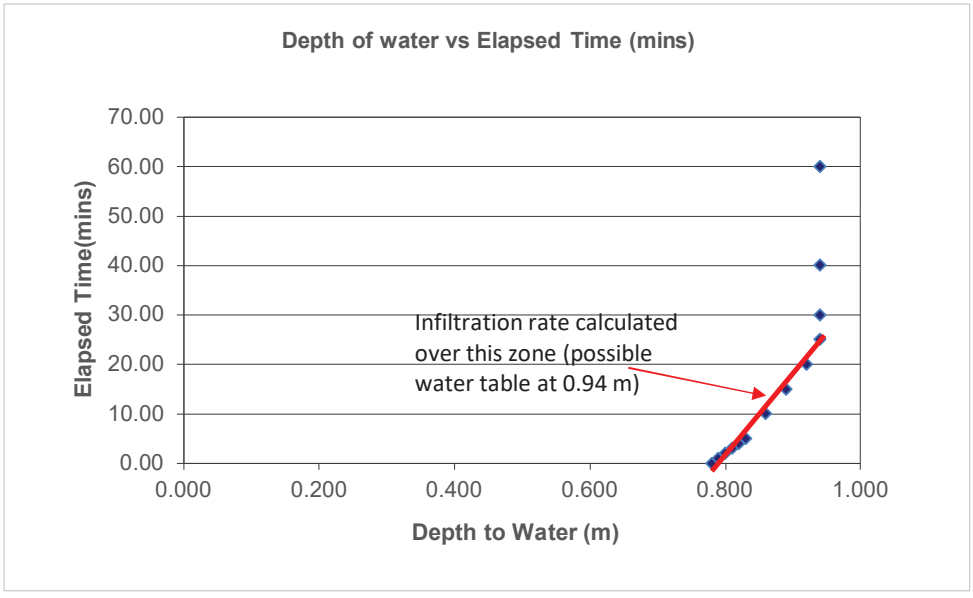
Depth to Water (m)	Elapsed Time (min)	
0.780	0.00	Start of infiltration
0.790	1.00	
0.800	2.00	
0.810	3.00	
0.820	4.00	
0.830	5.00	
0.860	10.00	
0.890	15.00	
0.920	20.00	
0.940	25.00	End of infiltration
0.940	30.00	
0.940	40.00	
0.940	60.00	

Field Test

Depth of Pit (D)	1.20	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.30	m
Initial depth to Water =	0.78	m
Final depth to water =	0.94	m
Elapsed time (mins)=	25.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.65	m2
*Av. side area of permeable stratum over test period=	1.224	m2
Total Exposed area =	1.874	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0022 m/min or 3.69975E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA05 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	
0.30	1.50	Grey very sandy fine to coarse rounded GRAVEL	None observed
		(Note: Slumping of sands and gravels reduced pit depth to 1.41)	

Field Data

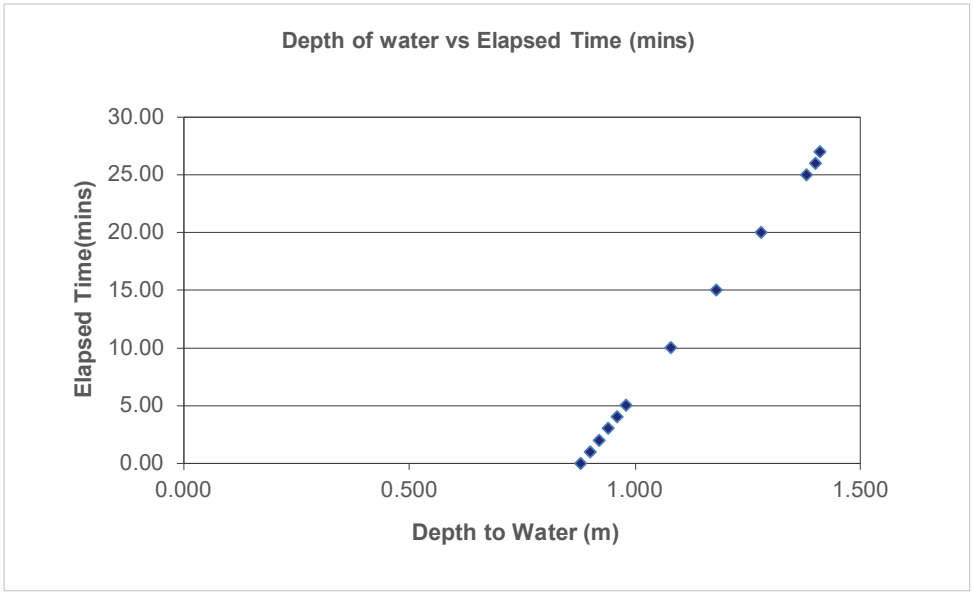
Depth to Water (m)	Elapsed Time (min)
0.880	0.00
0.900	1.00
0.920	2.00
0.940	3.00
0.960	4.00
0.980	5.00
1.080	10.00
1.180	15.00
1.280	20.00
1.380	25.00
1.400	26.00
1.410	27.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.88	m
Final depth to water =	1.41	m
Elapsed time (mins)=	27.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test period=	1.42	m2
Total Exposed area =	2.17	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0068 m/min or 0.000113074 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA05 Cycle 2
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	
0.30	1.50	Grey very sandy fine to coarse rounded GRAVEL	None observed
		(Note: Slumping of sands and gravels reduced pit depth to 1.41)	

Field Data

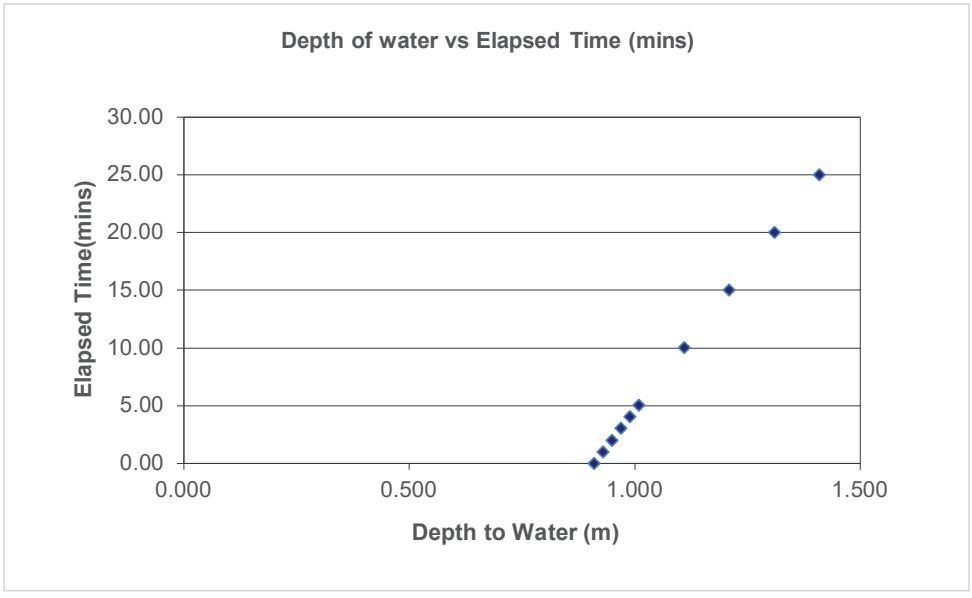
Depth to Water (m)	Elapsed Time (min)
0.910	0.00
0.930	1.00
0.950	2.00
0.970	3.00
0.990	4.00
1.010	5.00
1.110	10.00
1.210	15.00
1.310	20.00
1.410	25.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.91	m
Final depth to water =	1.41	m
Elapsed time (mins)=	25.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test period=	1.36	m2
Total Exposed area =	2.11	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0071 m/min or 0.000118483 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA07 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Brown sandy SILT/CLAY	
0.30	0.70	Brown very silty fine to medium SAND	None Observed
0.70	1.50	Grey silty very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.25)	

Field Data

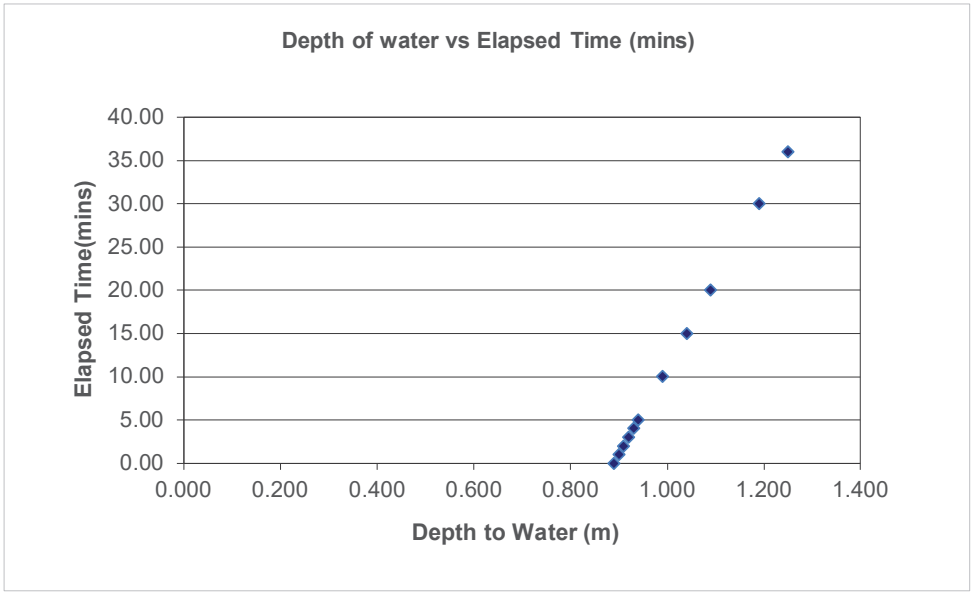
Depth to Water (m)	Elapsed Time (min)
0.890	0.00
0.900	1.00
0.910	2.00
0.920	3.00
0.930	4.00
0.940	5.00
0.990	10.00
1.040	15.00
1.090	20.00
1.190	30.00
1.250	36.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.89	m
Final depth to water =	1.25	m
Elapsed time (mins)=	36.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test period=	1.72	m2
Total Exposed area =	2.47	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.003 m/min or 5.06073E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA07 Cycle 2
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Brown sandy SILT/CLAY	
0.30	0.70	Brown very silty fine to medium SAND	None Observed
0.70	1.50	Grey silty very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.25)	

Field Data

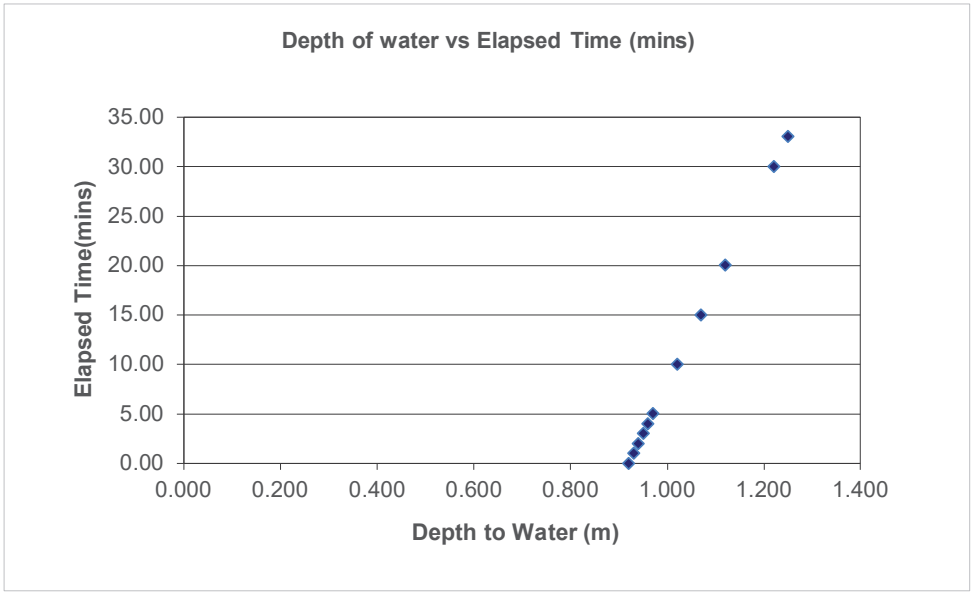
Depth to Water (m)	Elapsed Time (min)
0.920	0.00
0.930	1.00
0.940	2.00
0.950	3.00
0.960	4.00
0.970	5.00
1.020	10.00
1.070	15.00
1.120	20.00
1.220	30.00
1.250	33.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.92	m
Final depth to water =	1.25	m
Elapsed time (mins)=	33.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test period=	1.66	m2
Total Exposed area =	2.41	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0031 m/min or 5.18672E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA11 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Brown slightly gravelly sandy SILT/CLAY	Moderate seepage at 1.20m
0.30	1.30	Grey silty very sandy fine to coarse rounded GRAVEL with cobbles	

Note: Two cycles conducted with results of the first cycle below.

Field Data

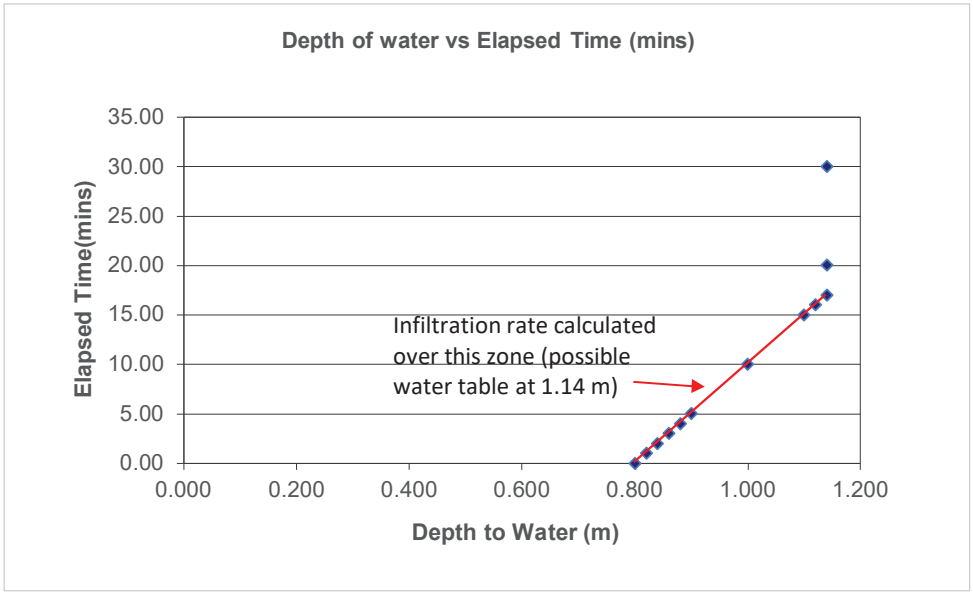
Depth to Water (m)	Elapsed Time (min)
0.800	0.00
0.820	1.00
0.840	2.00
0.860	3.00
0.880	4.00
0.900	5.00
1.000	10.00
1.100	15.00
1.120	16.00
1.140	17.00
1.140	20.00
1.140	30.00

Field Test

Depth of Pit (D)	1.30	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.80	m
Final depth to water =	1.14	m
Elapsed time (mins)=	17.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test pe	1.32	m2
Total Exposed area =	2.07	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0072 m/min or 0.000120773 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA11 Cycle 2
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Brown slightly gravelly sandy SILT/CLAY	Moderate seepage at 1.20m
0.30	1.30	Grey silty very sandy fine to coarse rounded GRAVEL with cobbles	

Note: Two cycles conducted with results of the second cycle below.

Field Data

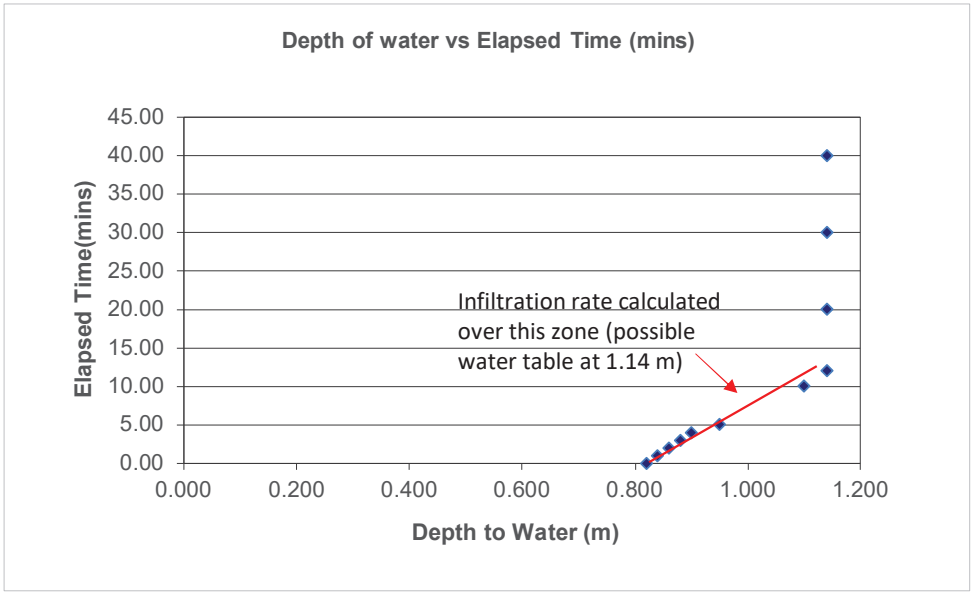
Depth to Water (m)	Elapsed Time (min)
0.820	0.00
0.840	1.00
0.860	2.00
0.880	3.00
0.900	4.00
0.950	5.00
1.100	10.00
1.140	12.00
1.140	20.00
1.140	30.00
1.140	40.00

Field Test

Depth of Pit (D)	1.30	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.50	m
Initial depth to Water =	0.82	m
Final depth to water =	1.14	m
Elapsed time (mins)=	12.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.75	m2
*Av. side area of permeable stratum over test period=	1.28	m2
Total Exposed area =	2.03	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0099 m/min or 0.000164204 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA13 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	Moderate seepage at 1.00m
0.30	1.00	Firm grey-brown very sandy SILT/CLAY	
1.00	1.20	Grey very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.15)	

Field Data

Depth to Water (m)	Elapsed Time (min)
0.750	0.00
0.750	2.00
0.750	4.00
0.750	6.00
0.750	4.00
0.750	5.00
0.740	10.00
0.740	15.00
0.740	20.00
0.740	25.00
0.730	30.00
0.730	40.00
0.730	60.00

Field Test

Depth of Pit (D)	1.20	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.30	m
Initial depth to Water =	0.75	m
Final depth to water =	0.73	m
Elapsed time (mins)=	30.00	
Top of permeable soil		m
Base of permeable soil		m

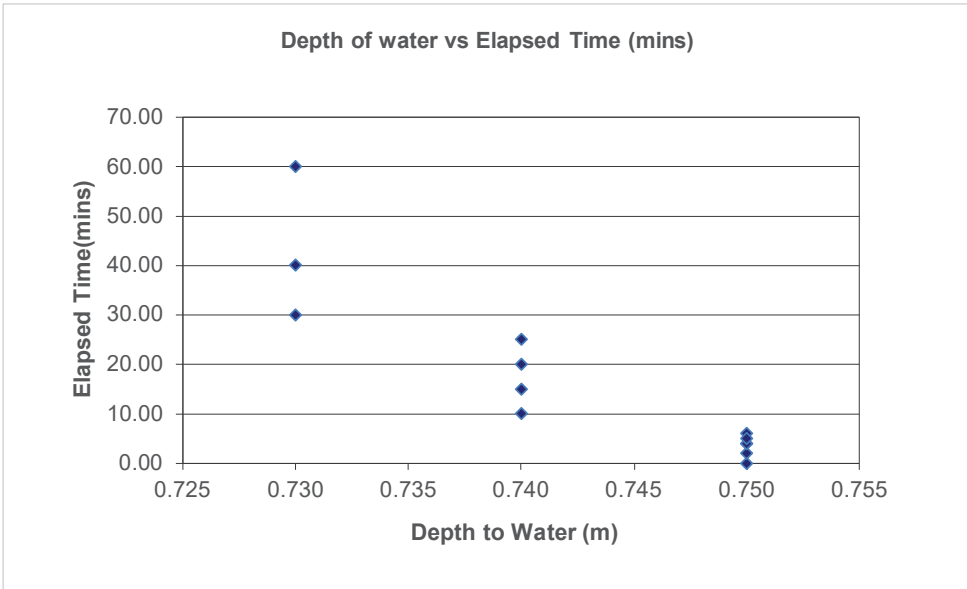
Note: Water level rose due to influx of groundwater

Base area=	0.65	m2
*Av. side area of permeable stratum over test period=	1.656	m2
Total Exposed area =	2.306	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0 m/min or 0 m/sec

Water level rose due to influx of groundwater - test failed



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA16 Cycle 1
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	
0.30	1.45	Firm brown very sandy SILT/CLAY	None observed
1.45	2.00	Grey very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.75)	

Field Data

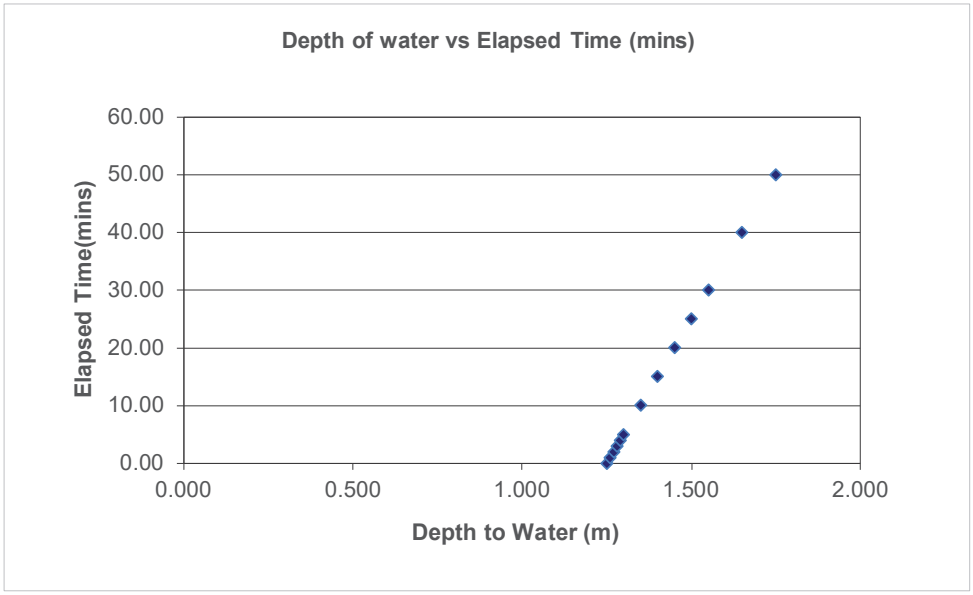
Depth to Water (m)	Elapsed Time (min)
1.250	0.00
1.260	1.00
1.270	2.00
1.280	3.00
1.290	4.00
1.300	5.00
1.350	10.00
1.400	15.00
1.450	20.00
1.500	25.00
1.550	30.00
1.650	40.00
1.750	50.00

Field Test

Depth of Pit (D)	2.00	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.60	m
Initial depth to Water =	1.25	m
Final depth to water =	1.75	m
Elapsed time (mins)=	50.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.8	m2
*Av. side area of permeable stratum over test period=	2.1	m2
Total Exposed area =	2.9	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0028 m/min or 4.5977E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA16 Cycle 2
Engineer: Byrne Looby
Date: 23rd February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	None observed
0.30	1.45	Firm brown very sandy SILT/CLAY	
1.45	2.00	Grey very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.75)	

Field Data

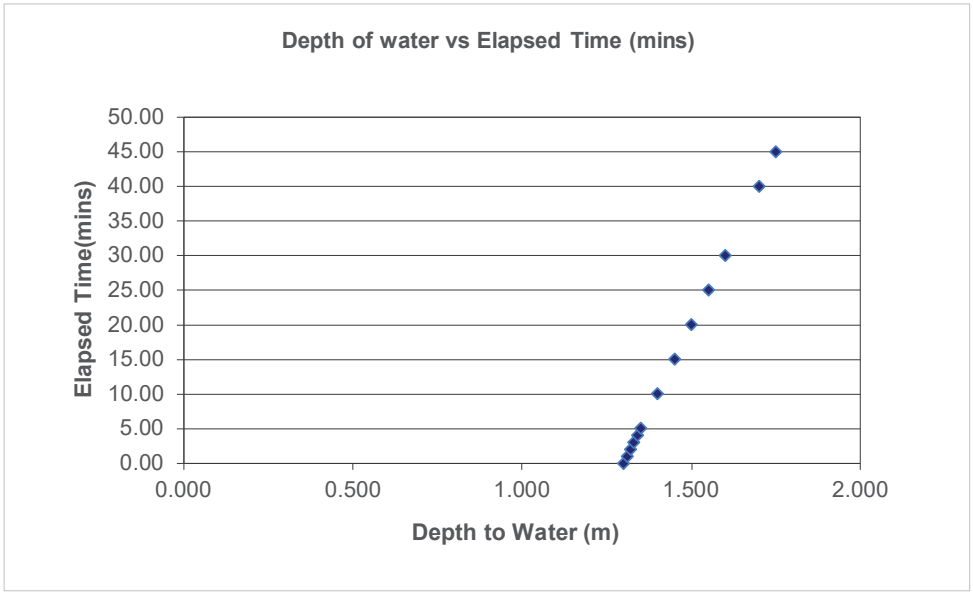
Depth to Water (m)	Elapsed Time (min)
1.300	0.00
1.310	1.00
1.320	2.00
1.330	3.00
1.340	4.00
1.350	5.00
1.400	10.00
1.450	15.00
1.500	20.00
1.550	25.00
1.600	30.00
1.700	40.00
1.750	45.00

Field Test

Depth of Pit (D)	2.00	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.60	m
Initial depth to Water =	1.30	m
Final depth to water =	1.75	m
Elapsed time (mins)=	45.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.8	m2
*Av. side area of permeable stratum over test period=	1.995	m2
Total Exposed area =	2.795	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0029 m/min or 4.77042E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA21 Cycle 1
Engineer: Byrne Looby
Date: 24th February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	Moderate seepage at 0.80m
0.30	1.20	Brown gravelly silty fine to coarse SAND	

Field Data

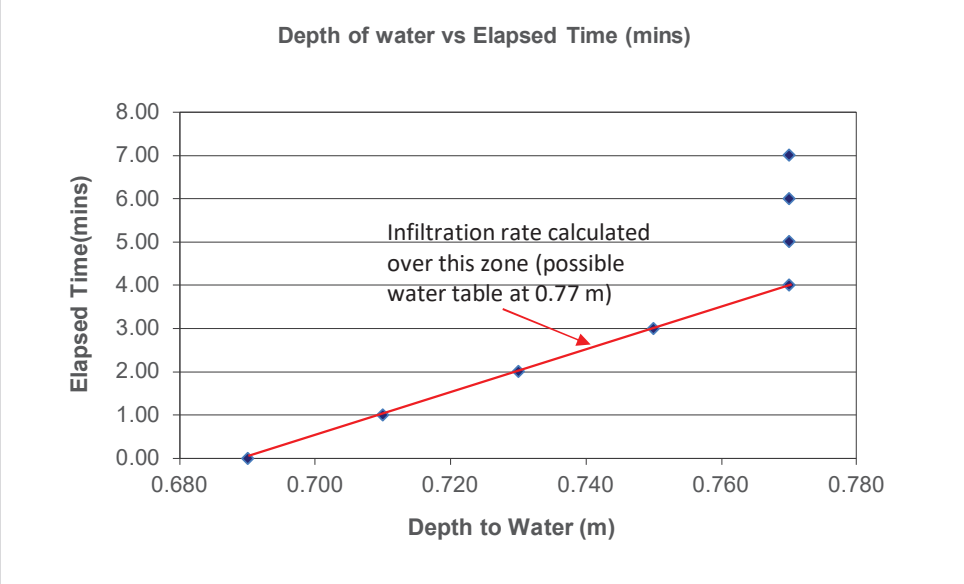
Depth to Water (m)	Elapsed Time (min)
0.690	0.00
0.710	1.00
0.730	2.00
0.750	3.00
0.770	4.00
0.770	5.00
0.770	6.00
0.770	7.00

Field Test

Depth of Pit (D)	1.20	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.00	m
Initial depth to Water =	0.69	m
Final depth to water =	0.77	m
Elapsed time (mins)=	4.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.5	m2
*Av. side area of permeable stratum over test period=	1.41	m2
Total Exposed area =	1.91	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0052 m/min or 8.726E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA22 Cycle 1
Engineer: Byrne Looby
Date: 24th February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.40	Soft brown sandy SILT/CLAY	Moderate seepage at 2.20m
0.40	2.20	Grey very sandy fine to coarse rounded GRAVEL	
2.20	2.50	Grey very sandy fine to coarse rounded GRAVEL with cobbles	
		(Note: Slumping of sands and gravels reduced pit depth to 2.2)	

Field Data

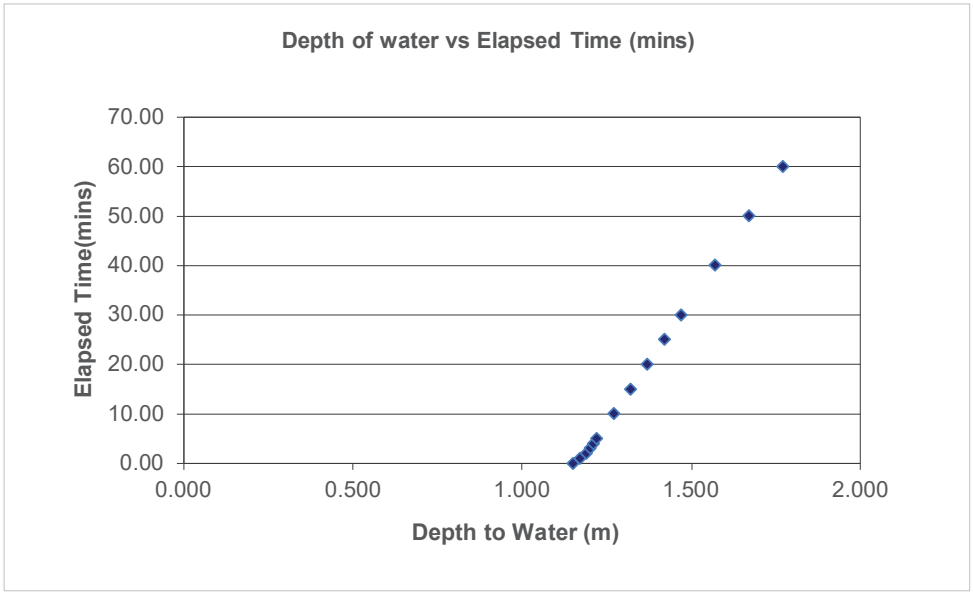
Depth to Water (m)	Elapsed Time (min)
1.150	0.00
1.170	1.00
1.190	2.00
1.200	3.00
1.210	4.00
1.220	5.00
1.270	10.00
1.320	15.00
1.370	20.00
1.420	25.00
1.470	30.00
1.570	40.00
1.670	50.00
1.770	60.00

Field Test

Depth of Pit (D)	2.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.40	m
Initial depth to Water =	1.15	m
Final depth to water =	1.77	m
Elapsed time (mins)=	60.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.7	m2
*Av. side area of permeable stratum over test period=	3.952	m2
Total Exposed area =	4.652	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0016 m/min or 2.59148E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA22 Cycle 2
Engineer: Byrne Looby
Date: 24th February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.40	Soft brown sandy SILT/CLAY	Moderate seepage at 2.20m
0.40	2.20	Grey very sandy fine to coarse rounded GRAVEL	
2.20	2.50	Grey very sandy fine to coarse rounded GRAVEL with cobbles	
		(Note: Slumping of sands and gravels reduced pit depth to 2.2)	

Field Data

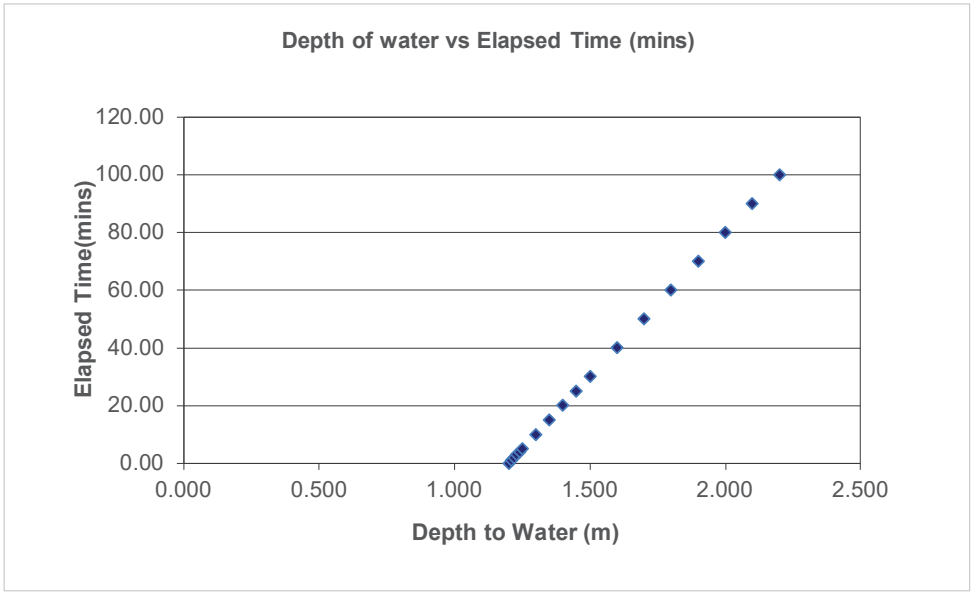
Depth to Water (m)	Elapsed Time (min)
1.200	0.00
1.210	1.00
1.220	2.00
1.230	3.00
1.240	4.00
1.250	5.00
1.300	10.00
1.350	15.00
1.400	20.00
1.450	25.00
1.500	30.00
1.600	40.00
1.700	50.00
1.800	60.00
1.900	70.00
2.000	80.00
2.100	90.00
2.200	100.00

Field Test

Depth of Pit (D)	2.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.40	m
Initial depth to Water =	1.20	m
Final depth to water =	2.20	m
Elapsed time (mins)=	100.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.7	m2
*Av. side area of permeable stratum over test period=	3.04	m2
Total Exposed area =	3.74	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0019 m/min or 3.11943E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA23 Cycle 1
Engineer: Byrne Looby
Date: 24th February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	None observed
0.30	1.20	Firm brown very sandy SILT/CLAY	
1.20	1.50	Grey very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.30)	

Field Data

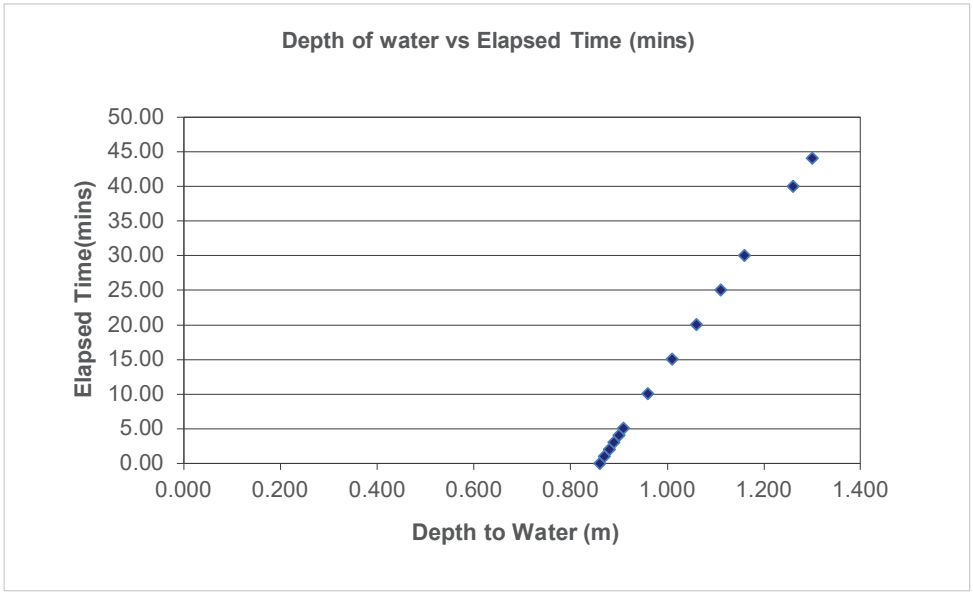
Depth to Water (m)	Elapsed Time (min)
0.860	0.00
0.870	1.00
0.880	2.00
0.890	3.00
0.900	4.00
0.910	5.00
0.960	10.00
1.010	15.00
1.060	20.00
1.110	25.00
1.160	30.00
1.260	40.00
1.300	44.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.10	m
Initial depth to Water =	0.86	m
Final depth to water =	1.30	m
Elapsed time (mins)=	44.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.55	m2
*Av. side area of permeable stratum over test period=	1.344	m2
Total Exposed area =	1.894	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0029 m/min or 4.83985E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA23 Cycle 2
Engineer: Byrne Looby
Date: 24th February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	
0.30	1.20	Firm brown very sandy SILT/CLAY	None observed
1.20	1.50	Grey very sandy fine to coarse rounded GRAVEL	
		(Note: Slumping of sands and gravels reduced pit depth to 1.30)	

Note: Two cycles conducted with results of the second cycle below.

Field Data

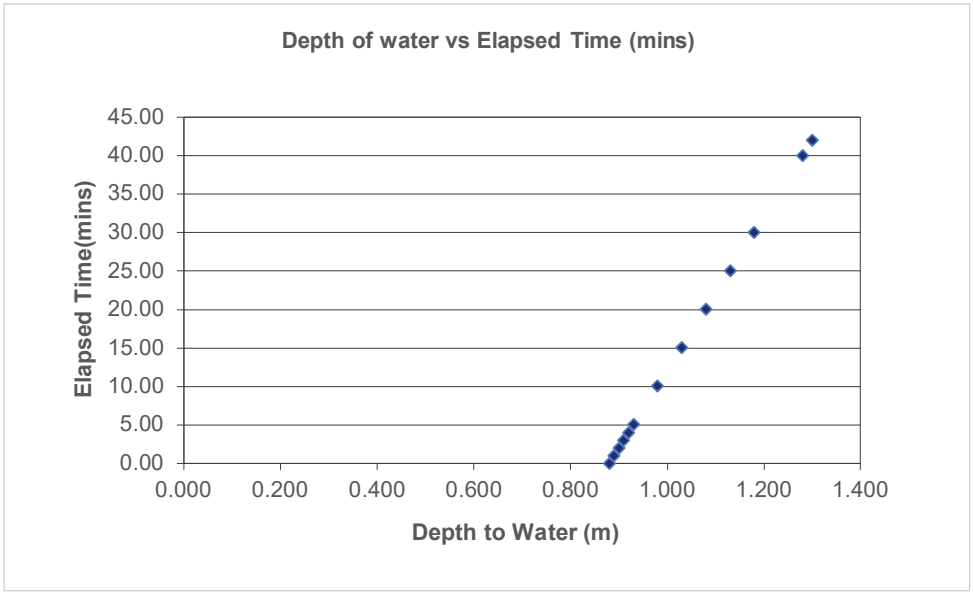
Depth to Water (m)	Elapsed Time (min)
0.880	0.00
0.890	1.00
0.900	2.00
0.910	3.00
0.920	4.00
0.930	5.00
0.980	10.00
1.030	15.00
1.080	20.00
1.130	25.00
1.180	30.00
1.280	40.00
1.300	42.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.10	m
Initial depth to Water =	0.88	m
Final depth to water =	1.30	m
Elapsed time (mins)=	42.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.55	m2
*Av. side area of permeable stratum over test period=	1.312	m2
Total Exposed area =	1.862	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.003 m/min or 4.92302E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA24 Cycle 1
Engineer: Byrne Looby
Date: 24th February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	
0.30	0.95	Brown very silty fine to coarse SAND	None Observed
0.95	1.50	Grey very sandy fine to coarse rounded GRAVEL with cobbles	
		(Note: Slumping of sands and gravels reduced pit depth to 1.25)	

Note: Two cycles conducted with results of the first cycle below.

Field Data

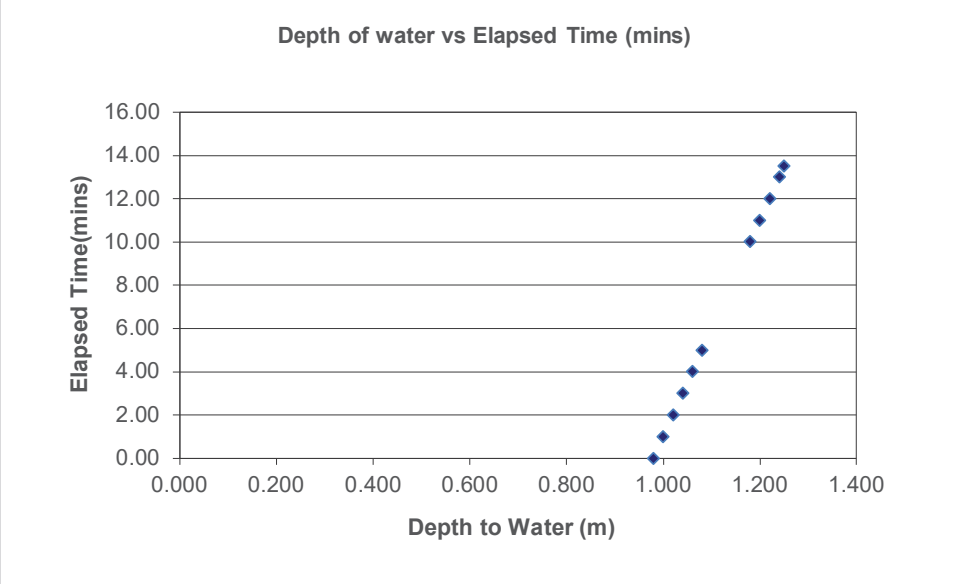
Depth to Water (m)	Elapsed Time (min)
0.980	0.00
1.000	1.00
1.020	2.00
1.040	3.00
1.060	4.00
1.080	5.00
1.180	10.00
1.200	11.00
1.220	12.00
1.240	13.00
1.250	13.50

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.10	m
Initial depth to Water =	0.98	m
Final depth to water =	1.250	m
Elapsed time (mins)=	13.50	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.55	m2
*Av. side area of permeable stratum over test period=	1.232	m2
Total Exposed area =	1.782	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0062 m/min or 0.000102881 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA24 Cycle 2
Engineer: Byrne Looby
Date: 24th February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown sandy SILT/CLAY	
0.30	0.95	Brown very silty fine to coarse SAND	None Observed
0.95	1.50	Grey very sandy fine to coarse rounded GRAVEL with cobbles	
		(Note: Slumping of sands and gravels reduced pit depth to 1.25)	

Field Data

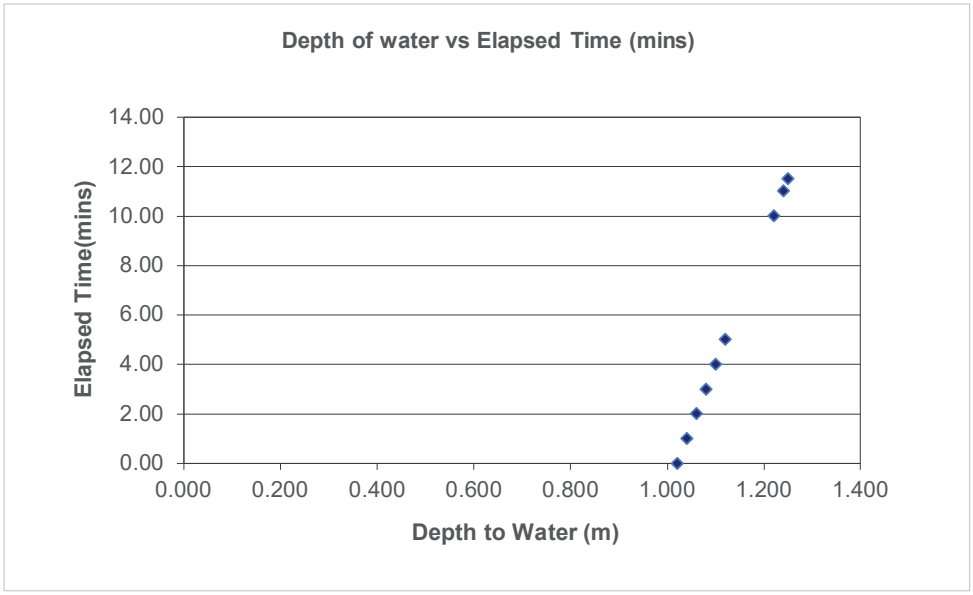
Depth to Water (m)	Elapsed Time (min)
1.020	0.00
1.040	1.00
1.060	2.00
1.080	3.00
1.100	4.00
1.120	5.00
1.220	10.00
1.240	11.00
1.250	11.50

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.10	m
Initial depth to Water =	1.02	m
Final depth to water =	1.25	m
Elapsed time (mins)=	11.50	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.55	m2
*Av. side area of permeable stratum over test period=	1.168	m2
Total Exposed area =	1.718	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0064 m/min or 0.000106713 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA25 Cycle 1
Engineer: Byrne Looby
Date: 24th February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.40	Soft brown sandy SILT/CLAY	None Observed
0.40	0.70	Soft brown very sandy SILT/CLAY	
0.70	1.30	Grey very sandy fine to coarse rounded GRAVEL with cobbles	
		(Note: Slumping of sands and gravels reduced pit depth to 1.10)	

Field Data

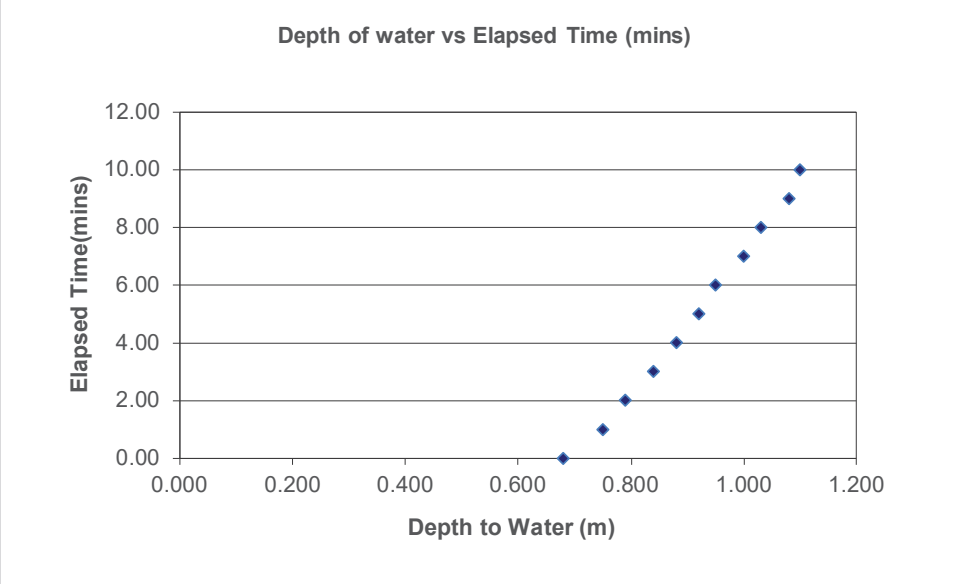
Depth to Water (m)	Elapsed Time (min)
0.680	0.00
0.750	1.00
0.790	2.00
0.840	3.00
0.880	4.00
0.920	5.00
0.950	6.00
1.000	7.00
1.030	8.00
1.080	9.00
1.100	10.00

Field Test

Depth of Pit (D)	1.30	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.00	m
Initial depth to Water =	0.68	m
Final depth to water =	1.10	m
Elapsed time (mins)=	10.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.5	m2
*Av. side area of permeable stratum over test period=	1.23	m2
Total Exposed area =	1.73	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0121 m/min or 0.000202312 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA25 Cycle 2
Engineer: Byrne Looby
Date: 24th February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.40	Soft brown sandy SILT/CLAY	None Observed
0.40	0.70	Soft brown very sandy SILT/CLAY	
0.70	1.30	Grey very sandy fine to coarse rounded GRAVEL with cobbles	
		(Note: Slumping of sands and gravels reduced pit depth to 1.10)	

Note: Two cycles conducted with results of the second cycle below.

Field Data

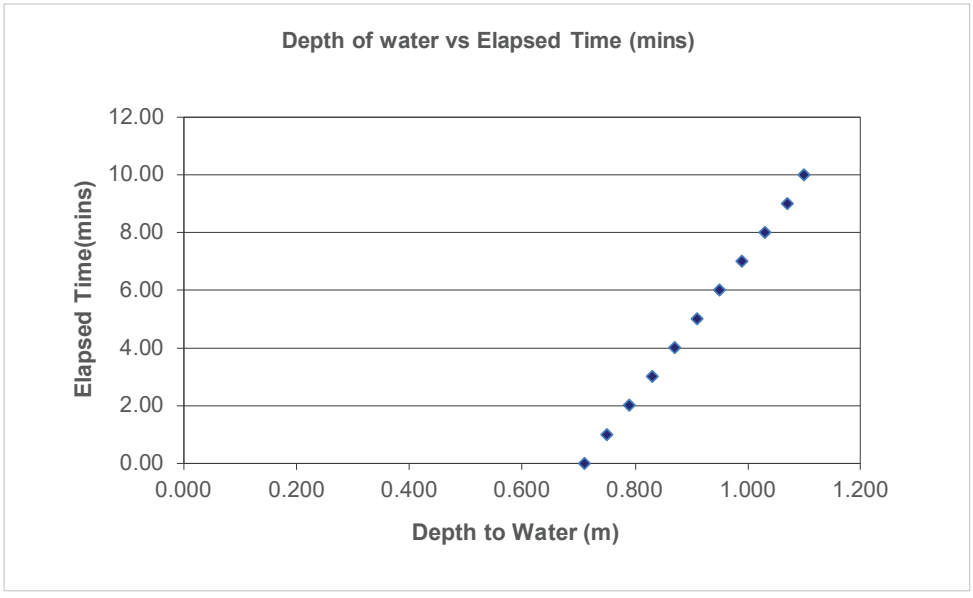
Depth to Water (m)	Elapsed Time (min)
0.710	0.00
0.750	1.00
0.790	2.00
0.830	3.00
0.870	4.00
0.910	5.00
0.950	6.00
0.990	7.00
1.030	8.00
1.070	9.00
1.100	10.00

Field Test

Depth of Pit (D)	1.30	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.00	m
Initial depth to Water =	0.71	m
Final depth to water =	1.10	m
Elapsed time (mins)=	10.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.5	m2
*Av. side area of permeable stratum over test period=	1.185	m2
Total Exposed area =	1.685	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0116 m/min or 0.000192878 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA26 Cycle 1
Engineer: Byrne Looby
Date: 24th February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.80	Soft brown sandy SILT/CLAY	None Observed
0.80	1.20	Soft brown very sandy SILT/CLAY	
1.20	1.70	Grey very sandy fine to coarse rounded GRAVEL with cobbles	
		(Note: Slumping of sands and gravels reduced pit depth to 1.55)	

Field Data

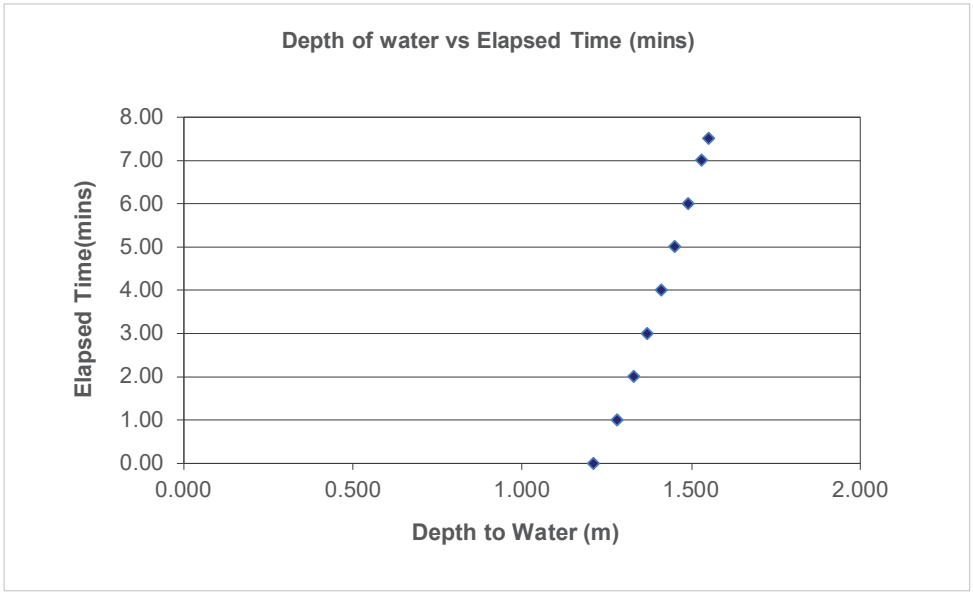
Depth to Water (m)	Elapsed Time (min)
1.210	0.00
1.280	1.00
1.330	2.00
1.370	3.00
1.410	4.00
1.450	5.00
1.490	6.00
1.530	7.00
1.550	7.50

Field Test

Depth of Pit (D)	1.70	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.10	m
Initial depth to Water =	1.21	m
Final depth to water =	1.55	m
Elapsed time (mins)=	7.50	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.55	m2
*Av. side area of permeable stratum over test period=	1.024	m2
Total Exposed area =	1.574	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0158 m/min or 0.000264012 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Aston, Greatconnell, Newbridge Contract No. 23110
Test No. SA26 Cycle 2
Engineer: Byrne Looby
Date: 24th February 2021

Summary of ground conditions

from	to	Description	Ground water
0.00	0.80	Soft brown sandy SILT/CLAY	None Observed
0.80	1.20	Soft brown very sandy SILT/CLAY	
1.20	1.70	Grey very sandy fine to coarse rounded GRAVEL with cobbles	
		(Note: Slumping of sands and gravels reduced pit depth to 1.55)	

Field Data

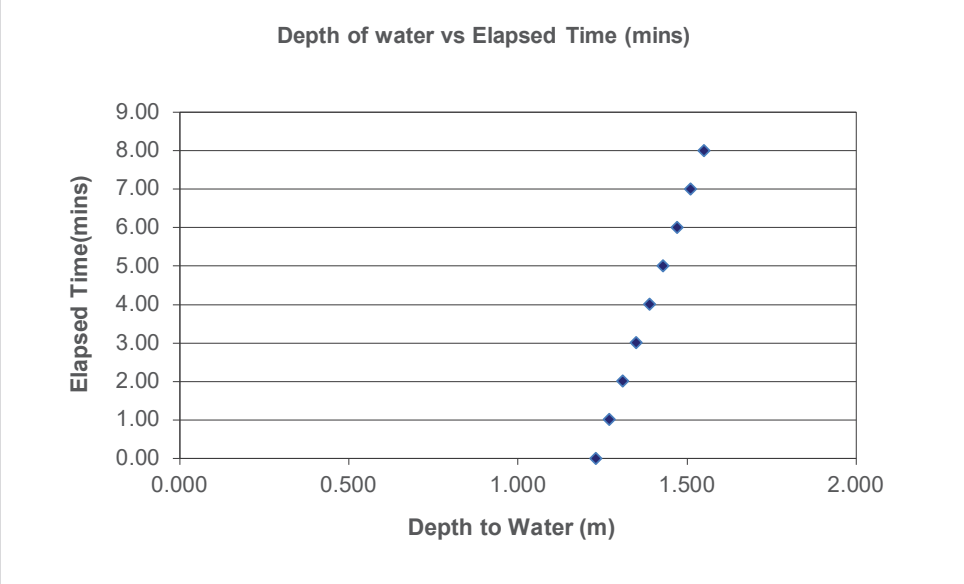
Depth to Water (m)	Elapsed Time (min)
1.230	0.00
1.270	1.00
1.310	2.00
1.350	3.00
1.390	4.00
1.430	5.00
1.470	6.00
1.510	7.00
1.550	8.00

Field Test

Depth of Pit (D)	1.70	m
Width of Pit (B)	0.50	m
Length of Pit (L)	1.10	m
Initial depth to Water =	1.23	m
Final depth to water =	1.55	m
Elapsed time (mins)=	8.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.55	m2
*Av. side area of permeable stratum over test period=	0.992	m2
Total Exposed area =	1.542	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.0143 m/min or 0.000237786 m/sec



Appendix 6

Plate Bearing Test Records

PLATE TEST REPORT SHEET (F3.1)

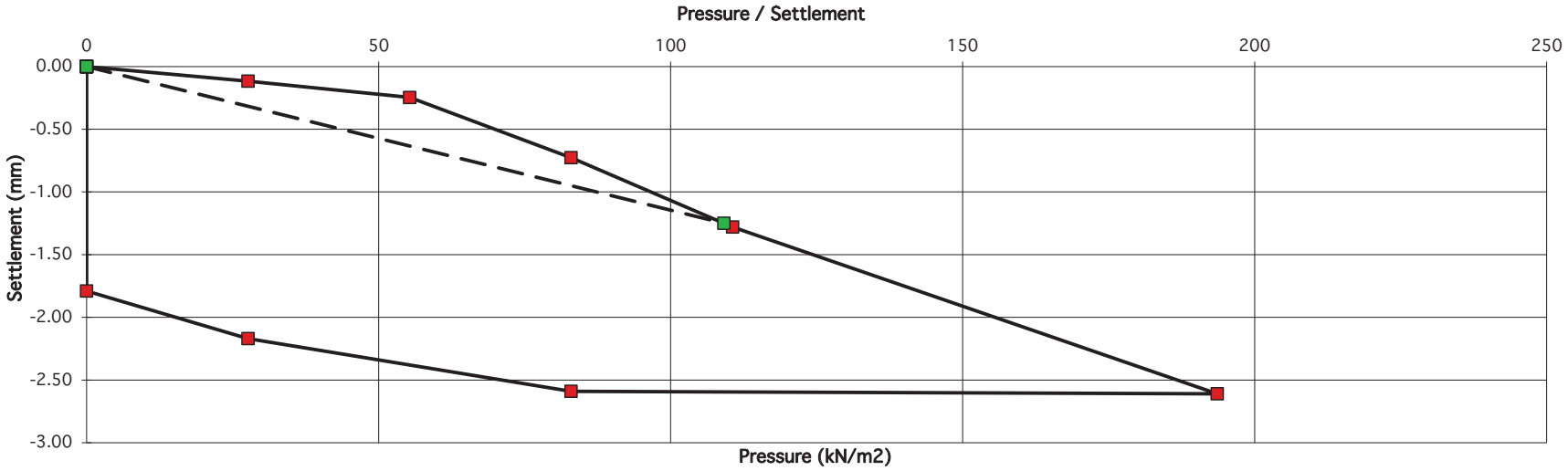
Applied Pressure/Settlement Curve

Reference No.	R120441
Contract	23110 Aston, Newbridge
Test No.	PLT04 Load
Location	See Site Plan
Depth	0.50mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown clayey fine to coarse SAND

Sample Ref No. N/A
Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 87
Modulus of subgrade reaction = 56 MPa/m
Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 10.4 %

PLATE TEST REPORT SHEET (F3.1)

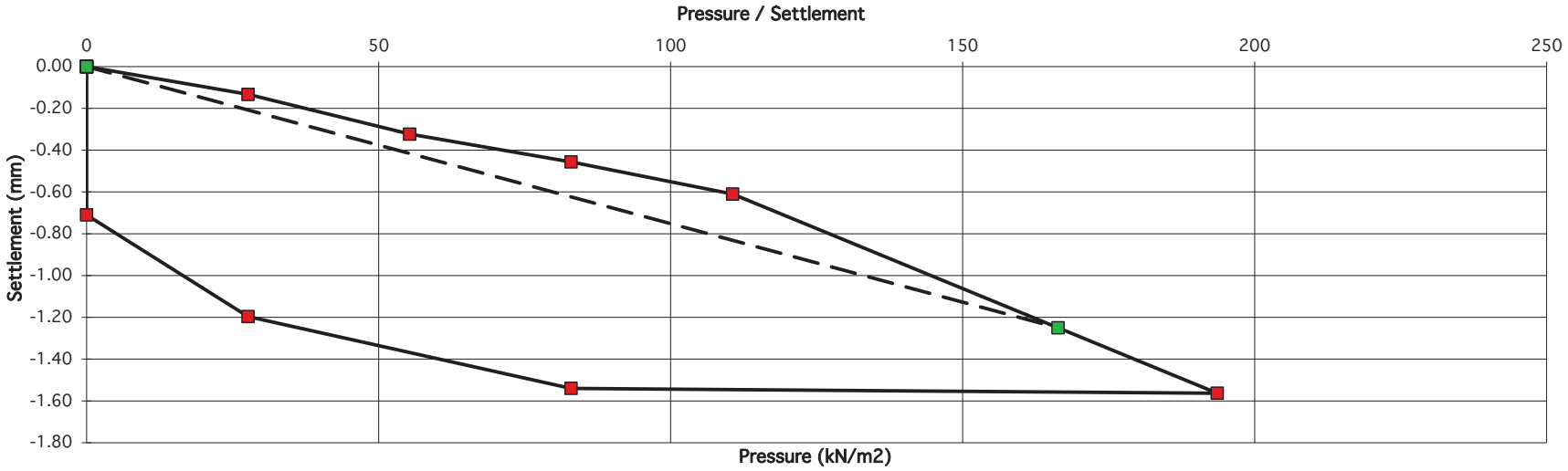
Applied Pressure/Settlement Curve

Reference No.	R120441
Contract	23110 Aston, Newbridge
Test No.	PLT04 Reload
Location	See Site Plan
Depth	0.50mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown clayey fine to coarse SAND

Sample Ref No. N/A
Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 133
Modulus of subgrade reaction = 86 MPa/m
Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 21.5 %

PLATE TEST REPORT SHEET (F3.1)

Applied Pressure/Settlement Curve

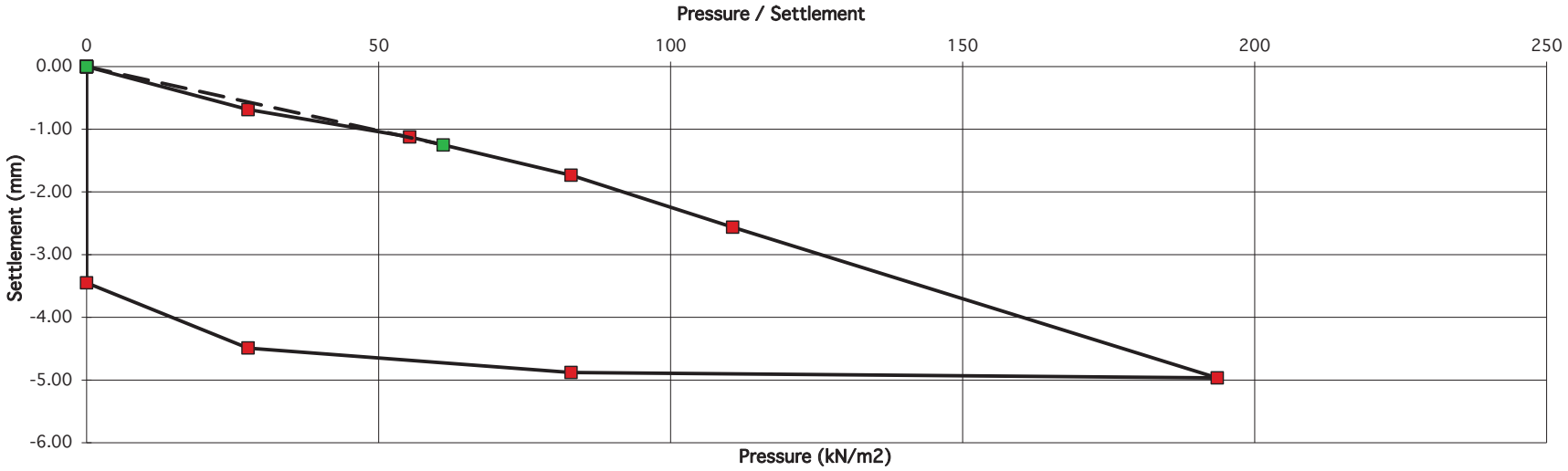
Reference No.	R120441
Contract	23110 Aston, Newbridge
Test No.	PLT.05 Load
Location	See Site Plan
Depth	0.50mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy CLAY

Sample Ref No. N/A

Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 49

Modulus of subgrade reaction = 31 MPa/m

Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 3.8 %

PLATE TEST REPORT SHEET (F3.1)

Applied Pressure/Settlement Curve

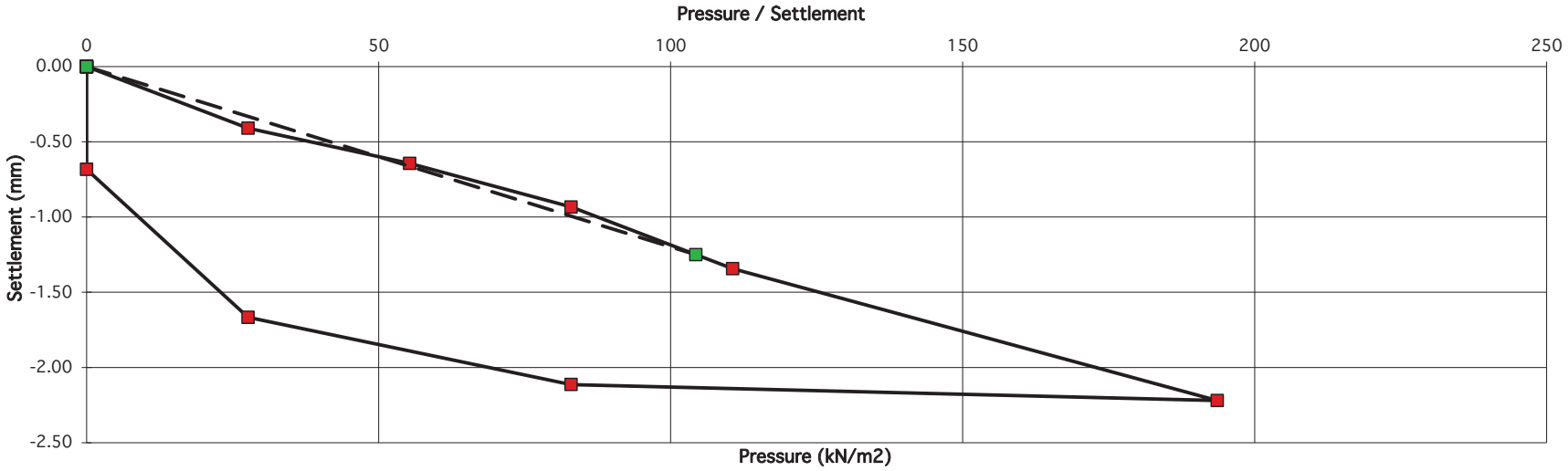
Reference No.	R120441
Contract	23110 Aston, Newbridge
Test No.	PLT.05 Reload
Location	See Site Plan
Depth	0.50mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy CLAY

Sample Ref No. N/A

Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 83

Modulus of subgrade reaction = 54 MPa/m

Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 9.6 %

PLATE TEST REPORT SHEET (F3.1)

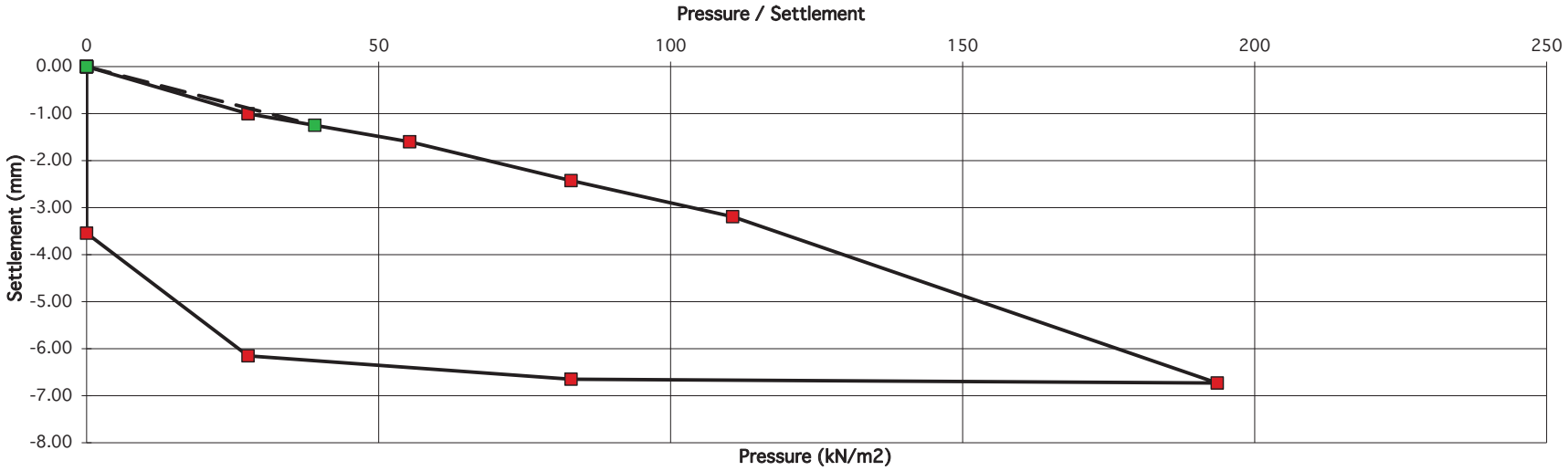
Applied Pressure/Settlement Curve

Reference No.	R120442
Contract	23110 Aston, Newbridge
Test No.	PLT.06 Load
Location	See Site Plan
Depth	0.40mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy SILT/CLAY

Sample Ref No. N/A
Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 31
Modulus of subgrade reaction = 20 MPa/m
Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 1.7 %

PLATE TEST REPORT SHEET (F3.1)

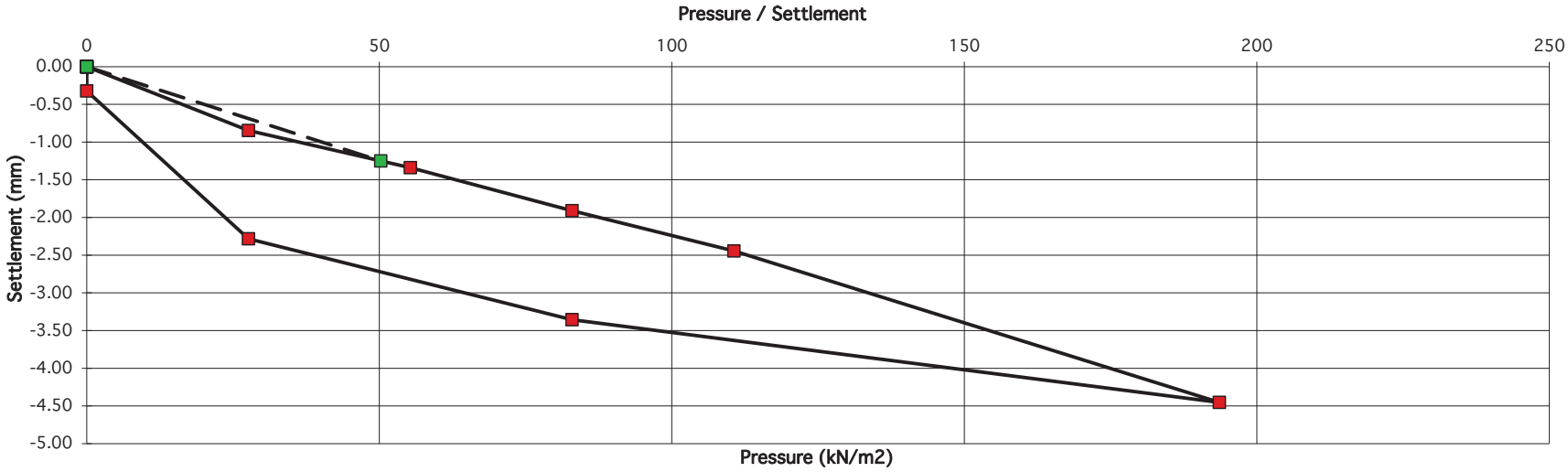
Applied Pressure/Settlement Curve

Reference No.	R120442
Contract	23110 Aston, Newbridge
Test No.	PLT.06 Reload
Location	See Site Plan
Depth	0.40mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy SILT/CLAY

Sample Ref No. N/A
Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 40
Modulus of subgrade reaction = 26 MPa/m
Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 2.7 %

PLATE TEST REPORT SHEET (F3.1)

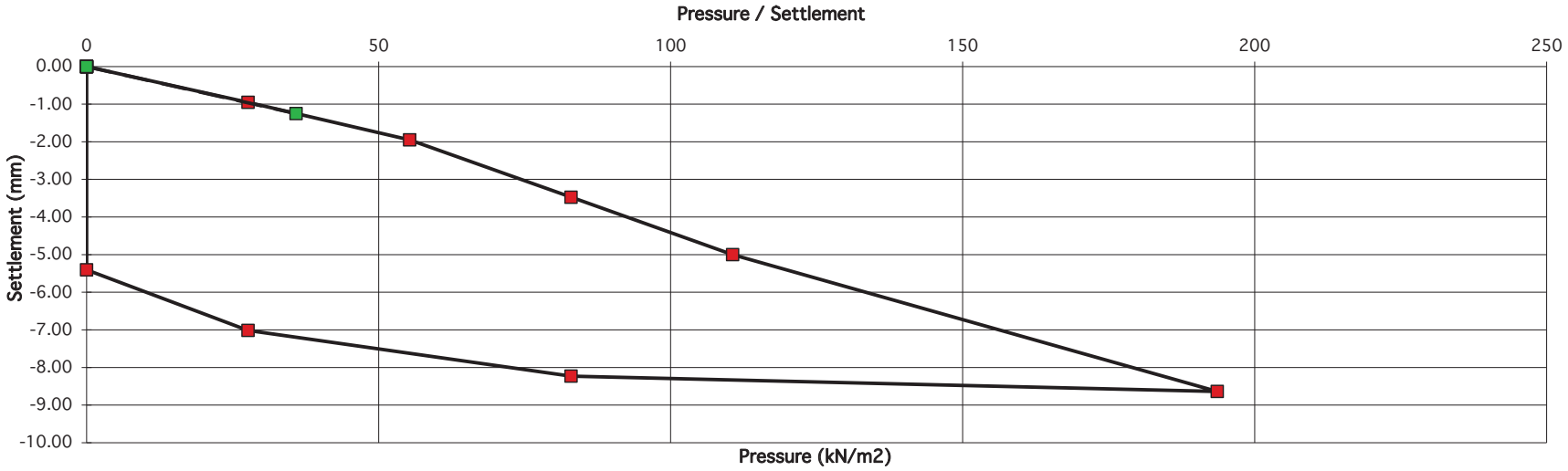
Applied Pressure/Settlement Curve

Reference No.	R120443
Contract	23110 Aston, Newbridge
Test No.	PLT.07 Load
Location	See Site Plan
Depth	0.40mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy SILT/CLAY

Sample Ref No. N/A
Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 29
Modulus of subgrade reaction = 18 MPa/m
Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 1.5 %

PLATE TEST REPORT SHEET (F3.1)

Applied Pressure/Settlement Curve

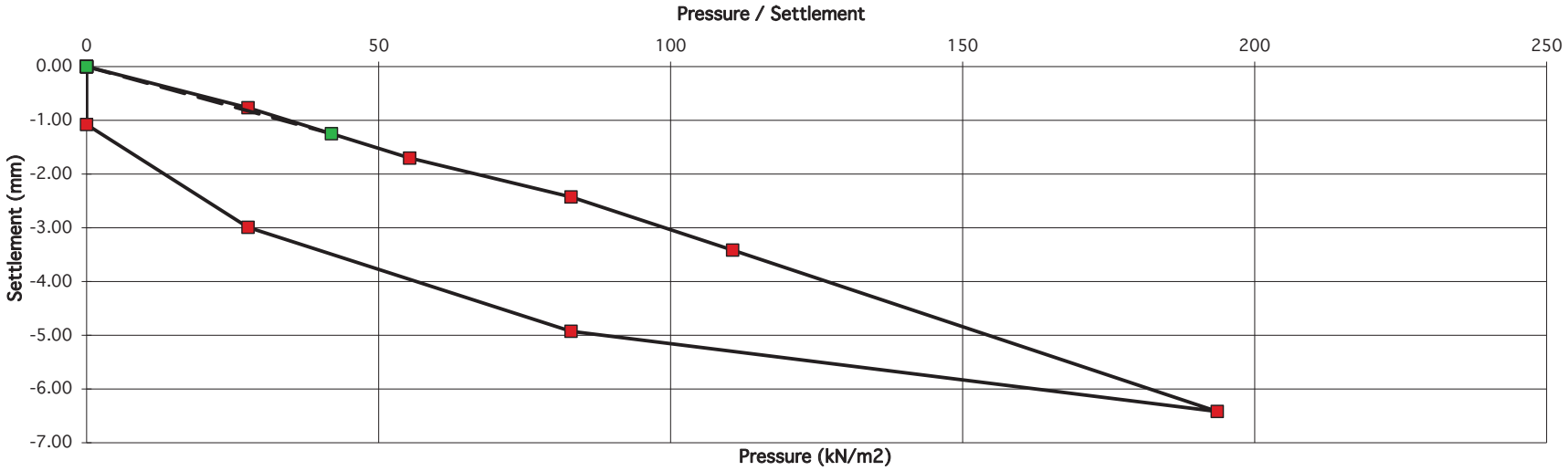
Reference No.	R120443
Contract	23110 Aston, Newbridge
Test No.	PLT.07 Reload
Location	See Site Plan
Depth	0.40mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy SILT/CLAY

Sample Ref No. N/A

Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 34

Modulus of subgrade reaction = 22 MPa/m

Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 2.0 %

PLATE TEST REPORT SHEET (F3.1)

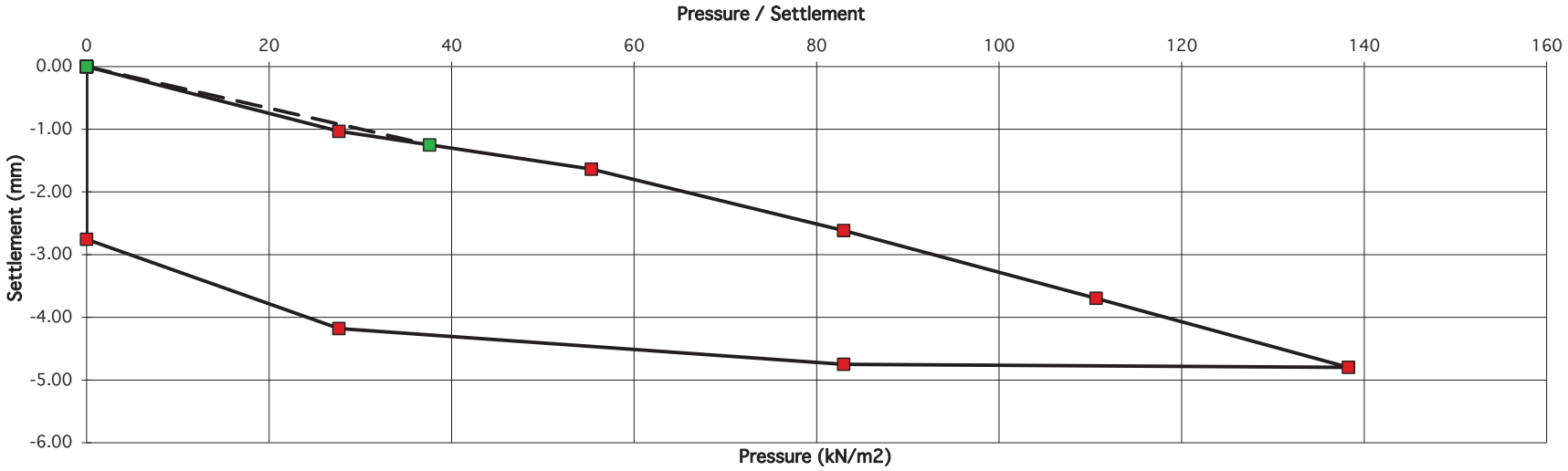
Applied Pressure/Settlement Curve

Reference No.	R120444
Contract	23110 Aston, Newbridge
Test No.	PLT.08 Load
Location	See Site Plan
Depth	0.40mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy SILT/CLAY

Sample Ref No. N/A
Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 30
Modulus of subgrade reaction = 19 MPa/m
Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 1.6 %

PLATE TEST REPORT SHEET (F3.1)

Applied Pressure/Settlement Curve

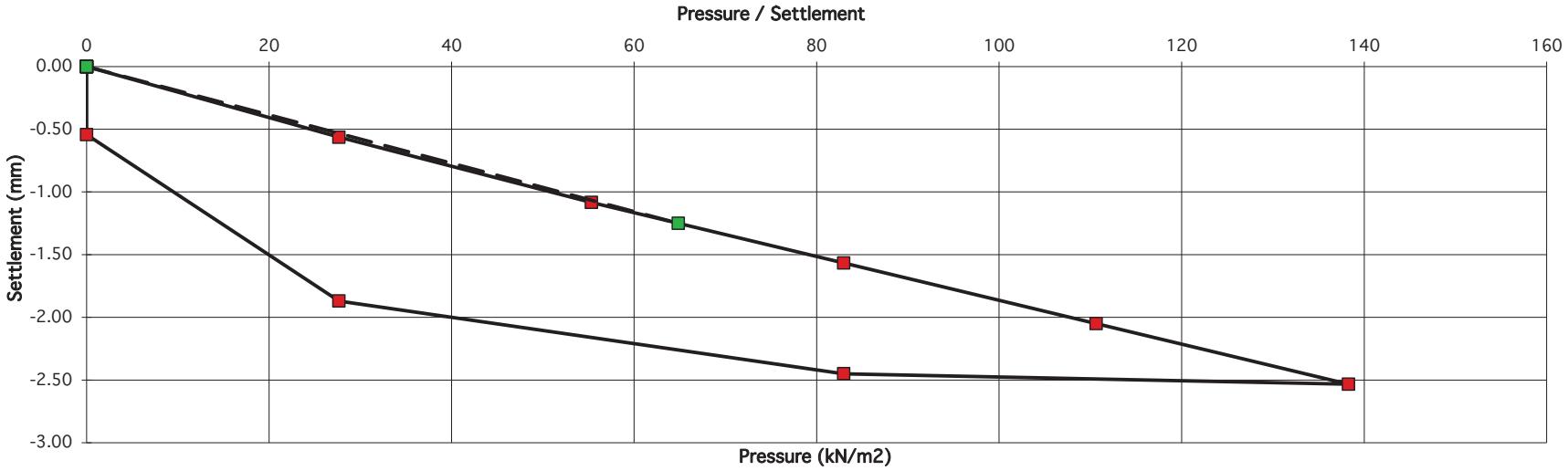
Reference No.	R120444
Contract	23110 Aston, Newbridge
Test No.	PLT.08 Reload
Location	See Site Plan
Depth	0.40mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy SILT/CLAY

Sample Ref No. N/A

Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 52

Modulus of subgrade reaction = 33 MPa/m

Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 4.2 %

PLATE TEST REPORT SHEET (F3.1)

Applied Pressure/Settlement Curve

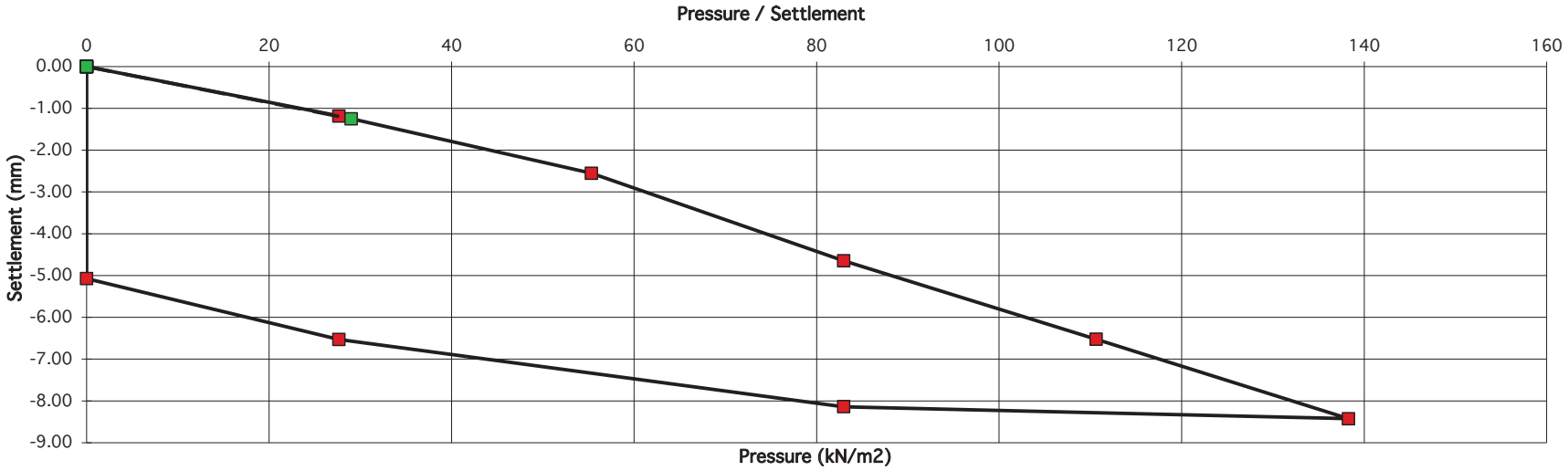
Reference No.	R120445
Contract	23110 Aston, Newbridge
Test No.	PLT.09 Load
Location	See Site Plan
Depth	0.40mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy SILT/CLAY

Sample Ref No. N/A

Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 23

Modulus of subgrade reaction = 15 MPa/m

Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 1.0 %

PLATE TEST REPORT SHEET (F3.1)

Applied Pressure/Settlement Curve

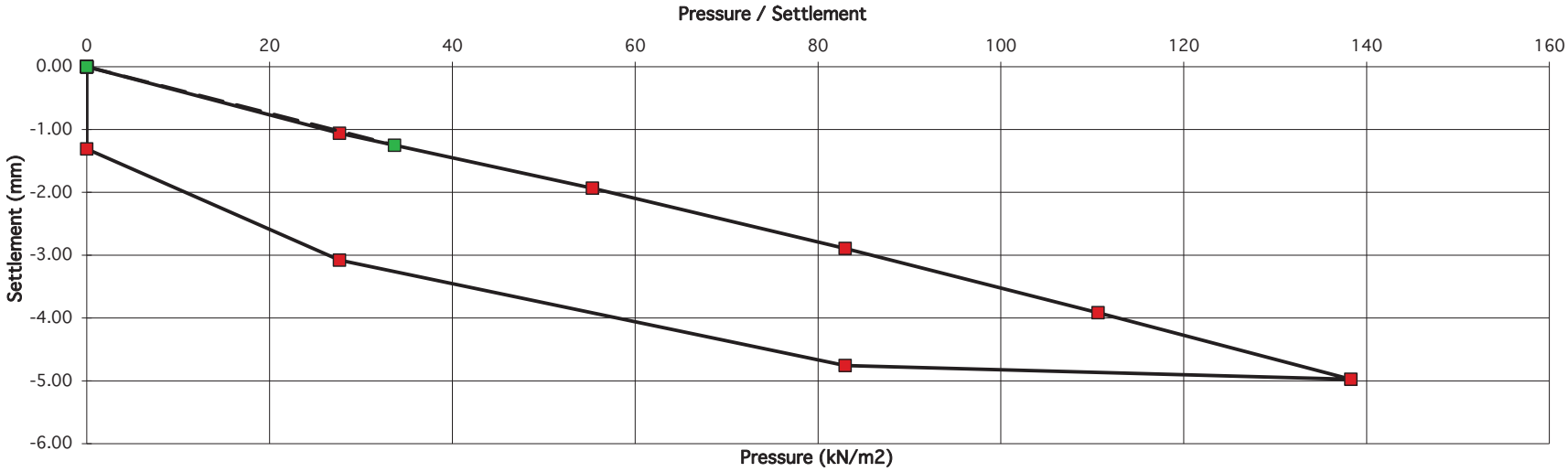
Reference No.	R120445
Contract	23110 Aston, Newbridge
Test No.	PLT.09 Reload
Location	See Site Plan
Depth	0.40mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy SILT/CLAY

Sample Ref No. N/A

Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 27

Modulus of subgrade reaction = 17 MPa/m

Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 1.4 %

PLATE TEST REPORT SHEET (F3.1)

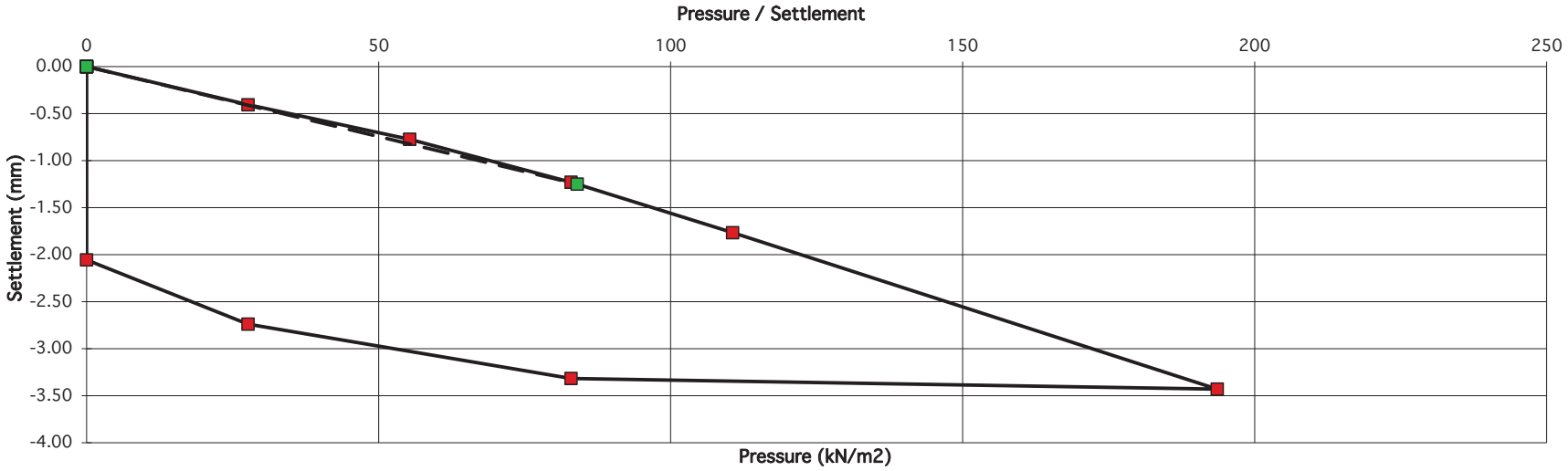
Applied Pressure/Settlement Curve

Reference No.	R120446
Contract	23110 Aston, Newbridge
Test No.	PLT.12 Load
Location	See Site Plan
Depth	0.50mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy CLAY

Sample Ref No. N/A
Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 67
Modulus of subgrade reaction = 43 MPa/m
Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 6.6 %

PLATE TEST REPORT SHEET (F3.1)

Applied Pressure/Settlement Curve

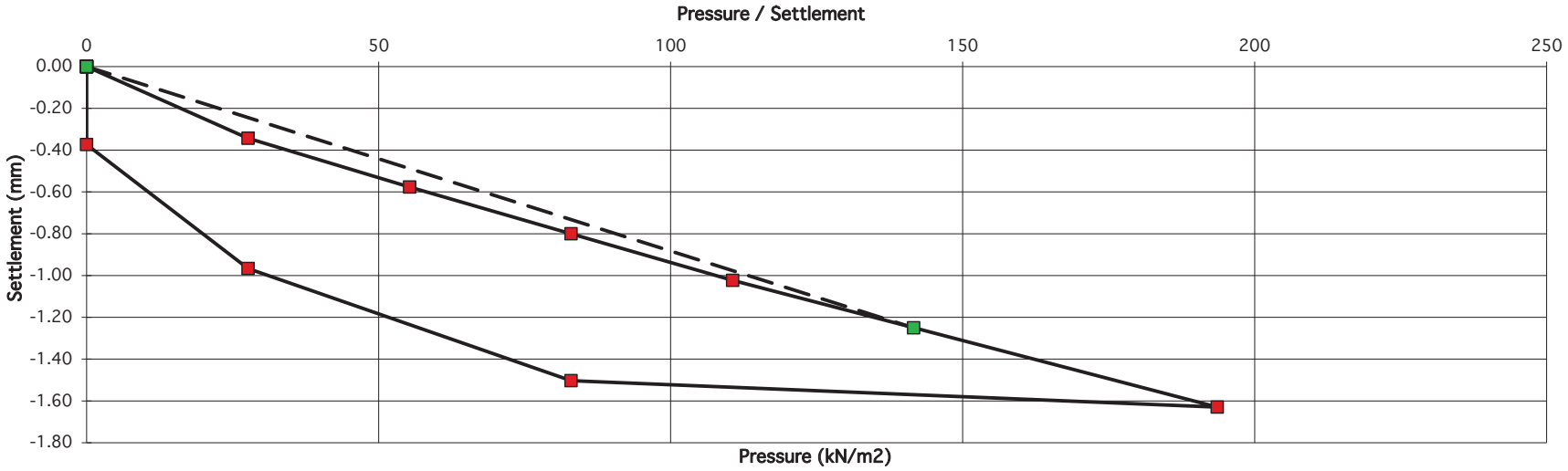
Reference No.	R120446
Contract	23110 Aston, Newbridge
Test No.	PLT.12 Reload
Location	See Site Plan
Depth	0.50mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy CLAY

Sample Ref No. N/A

Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 113

Modulus of subgrade reaction = 73 MPa/m

Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 16.3 %

PLATE TEST REPORT SHEET (F3.1)

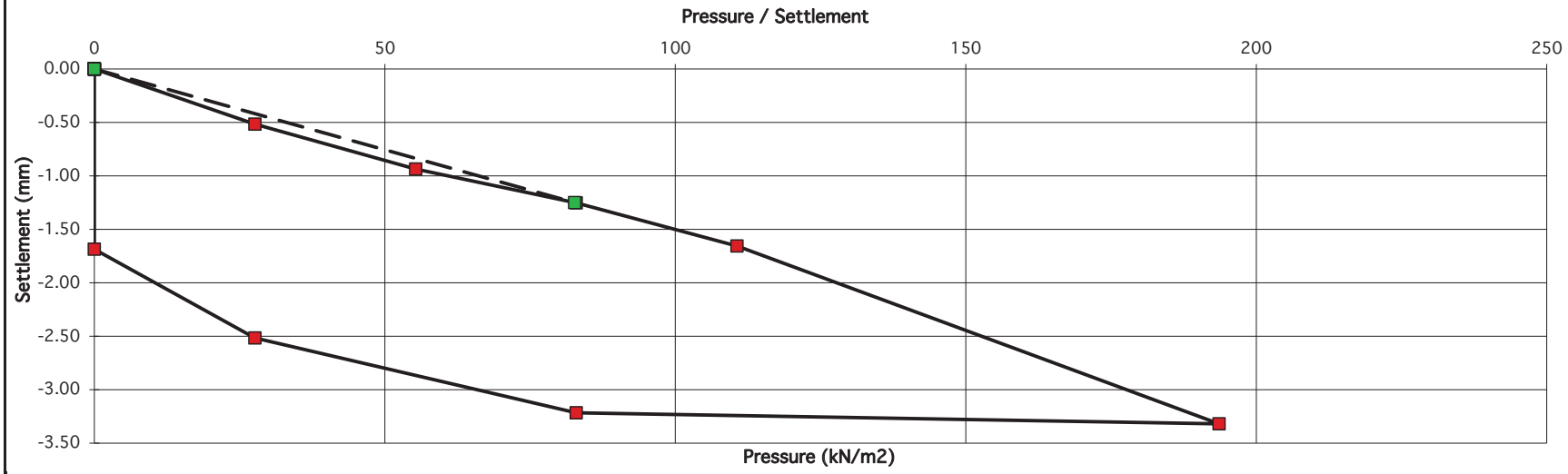
Applied Pressure/Settlement Curve

Reference No.	R120447
Contract	23110 Aston, Newbridge
Test No.	PLT.14 Load
Location	See Site Plan
Depth	0.50mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy CLAY

Sample Ref No. N/A
Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 66
Modulus of subgrade reaction = 43 MPa/m
Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 6.4 %

PLATE TEST REPORT SHEET (F3.1)

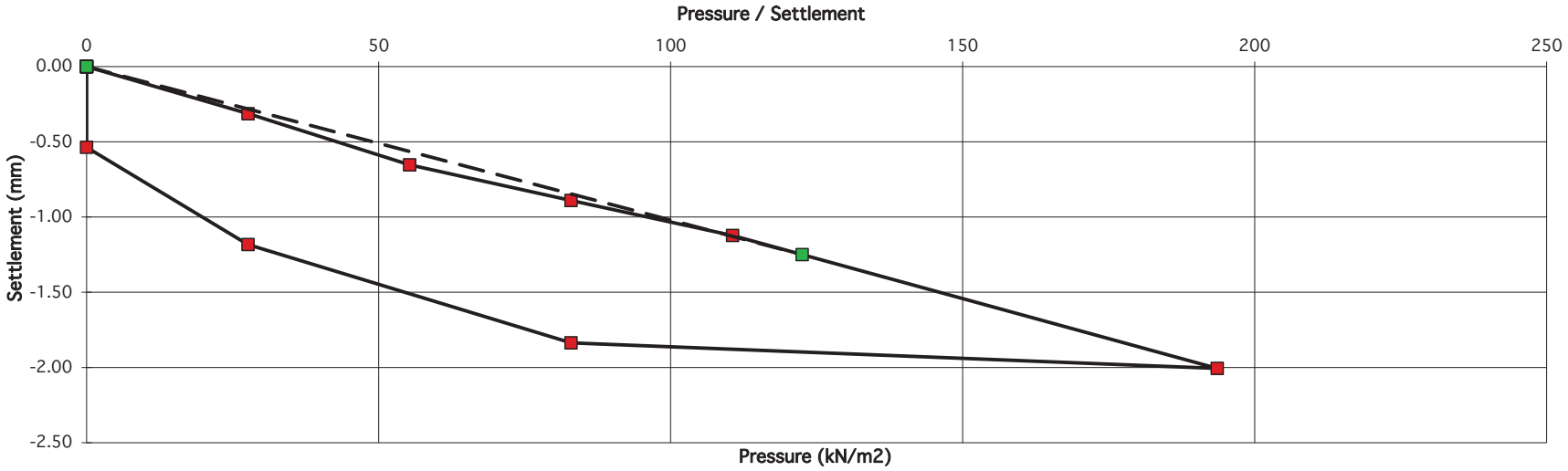
Applied Pressure/Settlement Curve

Reference No.	R120447
Contract	23110 Aston, Newbridge
Test No.	PLT.14 Reload
Location	See Site Plan
Depth	0.50mbgl
Client	Byrne Looby
Plate Diameter:	450 mm
Test Method	BS 1377: Part 9: 1990 Test4 - Incremental Loading Test
Technician	L. Daniels
Authorised by	
Date	22/02/2021

Description of soil under test
(natural soil, placed fill, sub-base)

Brown sandy CLAY

Sample Ref No. N/A
Depth 0.00 m bgl



Gradient at 1.25 mm settlement intersection = 98
Modulus of subgrade reaction = 63 MPa/m
Correction factor applied = 0.64 as per HD 25-26/10

Equivalent CBR value in accordance with NRA HD25-26/10 12.7 %

Appendix 7

Groundwater Monitoring

Groundwater Monitoring

Project No.	23110 - Great Connell, Newbridge
Client	Aston Lands Ltd.
Date	06-Apr-21
Engineer	Byrne Looby
Equipment	Dipmeter / Groundwater Monitor
Time/Weather/Temperature	9.00am-10.30am. 8 Degrees Celsius. Sunny, Dry.
Location ID	**BH02**
Water Level (mbgl)	**1.10m**
Location ID	**BH05**
Water Level (mbgl)	**2.30m**
Location ID	**BH07**
Water Level (mbgl)	**2.15m**
Location ID	**BH09**
Water Level (mbgl)	**1.90m**
Location ID	**BH12**
Water Level (mbgl)	**1.65m**
Location ID	**BH15**
Water Level (mbgl)	**1.70m**
Location ID	**BH17**
Water Level (mbgl)	**1.50m**
Location ID	**BH23**
Water Level (mbgl)	**1.50m**
Location ID	**BH29**
Water Level (mbgl)	**2.35m**
Location ID	**BH30**
Water Level (mbgl)	**1.85m**

Appendix 8

Geotechnical Laboratory Testing

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

Report No. **R120030** Contract No. 23110 Contract Name: Aston Lands - Great Connell , Newbridge Co.Kildare

Customer Murphy International / BLP

Samples Received: 19/03/21 Date Tested: 19/03/21

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
BH04	AA149904	2.0	A21/1141	B	9.3								Brown clayey/silty sandy GRAVEL
BH04	AA149907	5.0	A21/1143	B	18								Brown sandy gravelly SILT/CLAY
BH04	AA149911	9.0	A21/1144	B	7.2	25	NP	NP	26	WS	4.4		Brown silty sandy GRAVEL
BH03	AA146194	1.0	A21/1145	B	12								Brown clayey/silty gravelly SAND
BH05	AA149916	2.0	A21/1146	B	10								Brown clayey/silty, very sandy, GRAVEL
BH05A	AA149922	7.0	A21/1148	B	4.9								Brown sandy gravelly SILT/CLAY
BH06	AA149929	4.5	A21/1150	B	12								Grey/brown sandy gravelly SILT/CLAY
BH06	AA149938	12.0	A21/1152	B	7.5								Brown sandy gravelly SILT/CLAY
BH08	AA141103	3.0	A21/1153	B	9.8	25	14	11	39	WS	4.4	C L	Brown sandy gravel CLAY
BH08	AA141106	6.0	A21/1155	B	5.8								Brown silty/clayey sandy GRAVEL
BH09	AA146187	2.0	A21/1156	B	4								Brown sandy GRAVEL
BH11	AA146181	7.0	A21/1157	B	4.1								Brown sandy GRAVEL
BH12	AA146169	4.0	A21/1158	B	12	19	NP	NP	56	WS	4.4		Brown sandy gravelly SILT
BH12	AA146172	7.0	A21/1159	B	14	31	16	15	66	WS	4.4	C L	Brown sandy gravelly CLAY
BH28	AA141112	5.0	A211161	B	10	22	13	9	46	WS	4.4	C L	Grey/brown sandy gravelly CLAY

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results apply to the sample as received.
NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

Approved by	Date	Page
H Byrne	12/05/21	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

Report No. **R119991** Contract No. 23110 Contract Name: Aston Lands - Great Connell , Newbridge Co.Kildare

Customer Murphy International / BLP

Samples Received: 14/04/21 Date Tested: 14/04/21

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
BH15	AA141150	2.0	A21/1318	B	4.2								Brown sandy, GRAVEL with some cobbles
BH15	AA146102	4.0	A21/1319	B	11	31	21	10	45	WS	4.4	C L	Brown sandy gravelly CLAY
BH15	AA146105	7.0	A21/1320	B	12								Brown sandy gravelly SILT/CLAY
BH16	AA141140	2.0	A21/1321	B	3.7								Brown sandy gravelly SILT/CLAY
BH16	AA141145	7.0	A21/1322	B	15	29	15	14	68	WS	4.4	C L	Brown sandy gravelly CLAY
BH17	AA141127	1.5	A21/1323	U	13	39	NP	NP	57	WS	4.4		Brown sandy gravelly SILT
BH17	AA141131	4.5	A21/1324	U	8.3	27	13	14	62	WS	4.4	C L	Brown sandy gravelly CLAY
BH18	AA141120	5.0	A21/1326	B	12								Brown slightly sandy, slightly gravelly, SILT/CLAY
BH18	AA141122	7.0	A21/1327	B	11	25	15	10	43	WS	4.4	C L	Brown sandy gravelly CLAY
BH21	AA158166	1.0	A21/1328	B	19	32	NP	NP	68	WS	4.4		Brown sandy gravelly SILT
BH21	AA158169	4.0	A21/1329	B	13								Brown sandy gravelly SILT/CLAY
BH22	AA158162	4.5	A21/1333	B	11	27	NP	NP	45	WS	4.4		Brown sandy gravelly SILT
BH13	AA146118	2.0	A21/1334	B	4.3								Brown sandy, GRAVEL
BH13	AA146120	4.0	A21/1335	B	13	24	13	11	65	WS	4.4	C L	Brown sandy gravelly CLAY

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results apply to the sample as received.
NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

Approved by | Date: 12/05/21 | Page: 1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

Report No. **R119992** Contract No. 23110 Contract Name: Aston Lands - Great Connell , Newbridge Co.Kildare

Customer Murphy International / BLP

Samples Received: 14/04/21 Date Tested: 14/04/21

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
BH14	A146107	1.0	A21/1337	B	3.7								Brown sandy GRAVEL
BH14	AA146110	4.0	A21/1338	B	5.1								Brown sandy GRAVEL
BH14	AA146114	8.0	A21/1339	B	8.2								Brown sandy GRAVEL
BH24	AA158184	1.0	A21/1340	B	4.2								Brown sandy, GRAVEL
BH24	AA158187	4.0	A21/1341	B	5.6	18	NP	NP	5	WS	4.4		Brown sandy GRAVEL
BH24	AA158193	9.0	A21/1343	B	4.3	20	NP	NP	8	WS	4.4		Brown sandy GRAVEL

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results apply to the sample as received.
NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

Approved by	Date	Page
H Byrne	12/05/21	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

Report No. **R120291** Contract No. 23110 Contract Name: Aston Lands - Great Connell , Newbridge Co.Kildare

Customer Murphy International / BLP

Samples Received: 16/04/21 Date Tested: 16/04/21

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
BH19	AA146126	1.0	A21/1521	B	13								Brown clayey/silty, very sandy, GRAVEL
BH19	AA146132	7.0	A21/1522	B	2.7								Brown sandy gravelly SILT/CLAY
BH25	AA146136	2.0	A21/1523	B	4.9								Brown sandy gravelly SILT/CLAY
BH25	AA146140	6.0	A21/1524	B	2.5								Brown sandy, GRAVEL with some cobbles
BH26	AA146147	1.0	A21/1525	B	3.4								Brown slightly clayey/silty, sandy, GRAVEL
BH26	AA146153	7.0	A21/1526	B	6.4								Brown sandy gravelly SILT/CLAY
BH01	AA14032	1.0	A21/1528	B	29	37	NP	NP	95	WS	4.4		Brown sandy gravelly SILT
BH01	AA140374	3.0	A21/1529	B	11.2								Brown sandy gravelly SILT/CLAY
BH01	AA140376	5.0	A21/1530	B	4.9	20	NP	NP	11	WS	4.4		Brown silty sandy GRAVEL
BH01	AA140379	8.0	A21/1531	B	15	34	17	17	72	WS	4.4	C L	Brown sandy gravelly CLAY
BH02	AA140357	1.0	A21/1532	B	23								Brown very sandy, slightly gravelly, SILT/CLAY
BH02	AA140361	5.0	A21/1533	B	13	31	15	16	67	WS	4.4	C L	Brown sandy gravelly SILT
BH27	AA140382	2.0	A21/1534	B	4.8								Brown slightly clayey/silty, sandy, GRAVEL with some cobbles
BH27	AA140384	4.0	A21/1535	B	12	23	12	11	42	WS	4.4	C L	Brown sandy gravelly CLAY
BH27	AA140389	9.0	A21/1536	B	12	23	12	11	75	WS	4.4	C L	Brown sandy gravelly CLAY

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results apply to the sample as received.
NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

Approved by | Date: 12/05/21 | Page: 1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

Report No. **R120292** Contract No. 23110 Contract Name: Aston Lands - Great Connell , Newbridge Co.Kildare

Customer Murphy International / BLP

Samples Received: 16/04/21 Date Tested: 16/04/21

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
BH29	AA140391	1.0	A21/1537	B	4.2								Brown sandy GRAVEL
BH29	AA140394	4.0	A21/1538	B	4.0								Brown sandy GRAVEL
BH29	AA140396	6.0	A21/1539	B	13	26	13	13	47	WS	4.4	C L	Brown sandy gravelly CLAY
BH29	AA140397	7.0	A21/1540	B	9.3								Brown sandy gravelly SILT/CLAY
BH29	AA145354	14.0	A21/1543	B	5.5								Brown sandy GRAVEL
BH30	AA140364	2.0	A21/1544	B	14								Brown very sandy GRAVEL
BH07	AA145356	2.0	A21/1545	B	9.8								Brown sandy gravelly SILT/CLAY
BH07	AA145357	3.0	A21/1547	B	5.4	18	NP	NP	9	WS	4.4		Brown sandy GRAVEL
BH07	AA145360	6.0	A21/1548	B	9.7								Brown sandy GRAVEL
BH10	AA146158	1.0	A21/1551	B	8.3								Brown slightly clayey/silty, sandy, GRAVEL
BH10	AA146161	4.0	A21/1552	B	13	25	13	12	56	WS	4.4	C L	Brown sandy gravelly CLAY

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results apply to the sample as received.
NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

Approved by	Date	Page
	12/05/21	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

Report No. **R119988** Contract No. 23110 Contract Name: Aston Lands - Great Connell , Newbridge Co.Kildare

Customer Murphy International / BLP

Samples Received: 23/03/21 Date Tested: 23/03/21

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
TP01	AA142227	1.0	A21/1165	B	5.7								Brown slightly clayey/silty, gravelly, SAND
TP02	AA142226	2.0	A21/1170	B	7.6								Brown clayey/silty sandy GRAVEL
TP03	AA142235	0.5	A21/1171	B	18	36	NP	NP	50	WS	4.4		Brown sandy gravelly SILT
TP03	AA142236	1.0	A21/1172	B	28								Brown very sandy, slightly gravelly, SILT/CLAY
TP04	AA142257	1.0	A21/1173	B	7.9								Brown silty gravelly SAND
TP05	AA142260	2.0	A21/1174	B	8.9								Brown slightly clayey/silty, very sandy, GRAVEL
TP06	AA142256	2.0	A21/1176	B	7.2								Brown clayey/silty sandy GRAVEL
TP07	AA142231	0.6	A21/1177	B	13	37	NP	NP	37	WS	4.4		Brown silty gravelly SAND
TP08	AA142248	1.0	A21/1178	B	9.5								Brown clayey/silty sandy GRAVEL
TP09	AA142233	1.0	A21/1179	B	7.9								Brown clayey/silty sandy GRAVEL
TP10	AA142230	2.0	A21/1181	B	9.2								Brown clayey/silty sandy GRAVEL
TP11	AA142251	2.0	A21/1182	B	7.3								Brown clayey/silty sandy GRAVEL
TP12	AA142253	1.0	A21/1183	B	8.5								Brown slightly clayey/silty, very sandy, GRAVEL
TP14	AA142263	1.0	A21/1174	B	31								Mottled brown sandy SILT/CLAY
TP15	AA142214	0.8	A21/1186	B	18	43	NP	NP	48	WS	4.4		Brown sandy gravelly SILT

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results apply to the sample as received.
NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

Approved by | Date | Page
H Byrne | 12/05/21 | 1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

Report No. **R119988** Contract No. 23110 Contract Name: Aston Lands - Great Connell , Newbridge Co.Kildare

Customer Murphy International / BLP

Samples Received: 23/03/21 Date Tested: 23/03/21

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
TP15	AA142216	2.0	A21/1187	B	8.7								Brown slightly clayey/silty, very sandy, GRAVEL
TP16	AA142266	2.0	A21/1189	B	6.8								Grey clayey/silty sandy GRAVEL
TP17	AA142220	1.0	A21/1190	B	30	41	NP	NP	92	WS	4.4		Brown sandy gravelly SILT/CLAY
TP18	AA142217	1.0	A21/1191	B	21								Brown sandy gravelly SILT/CLAY
TP20	AA142223	1.0	A21/1192	B	31	44	NP	NP	95	WS	4.4		Brown sandy SILT/CLAY
TP25	AA142244	1.0	A21/1195	B	19								Mottled grey/brown clayey/silty gravelly SAND
TP26	AA142247	2.0	A21/1196	B	5.7								Brown slightly clayey/silty, very sandy, GRAVEL

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results apply to the sample as received.
NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

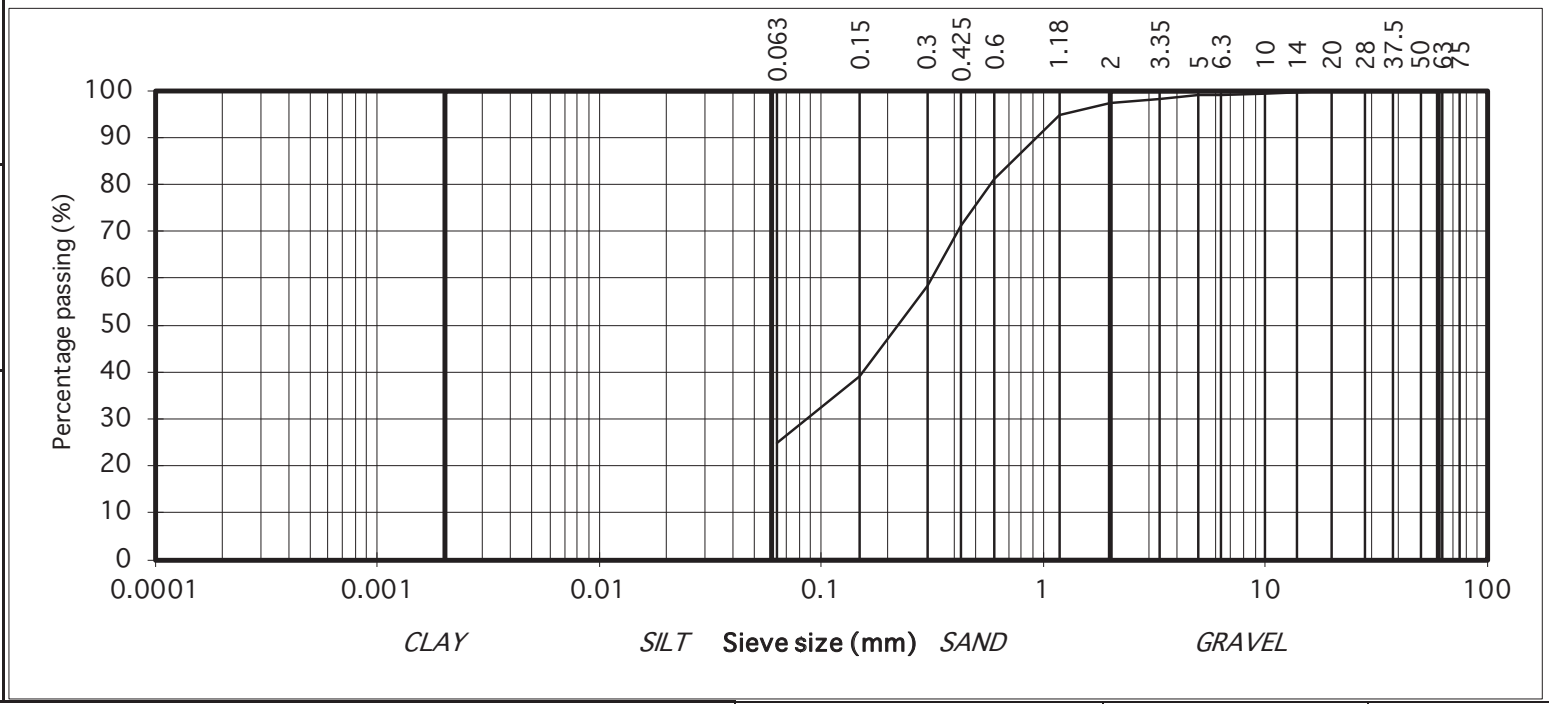
Approved by | Date: 30/03/21 | Page: 1 of 1

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	100	
14	100	
10	99	
6.3	99	
5	99	
3.35	98	
2	97	
1.18	95	SAND
0.6	81	
0.425	71	
0.3	58	
0.15	39	
0.063	25	SILT/CLAY

Contract No.	23110	Report No.	R121039
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH02		
Sample No.	AA140357	Lab. Sample No.	A21/1532
Sample Type:	B		
Depth (m)	1.00	Customer:	Murphy International / BLP
Date Received	16/04/2021	Date Testing started	16/04/2021
Description:	Brown very sandy, slightly gravelly, SILT/CLAY		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

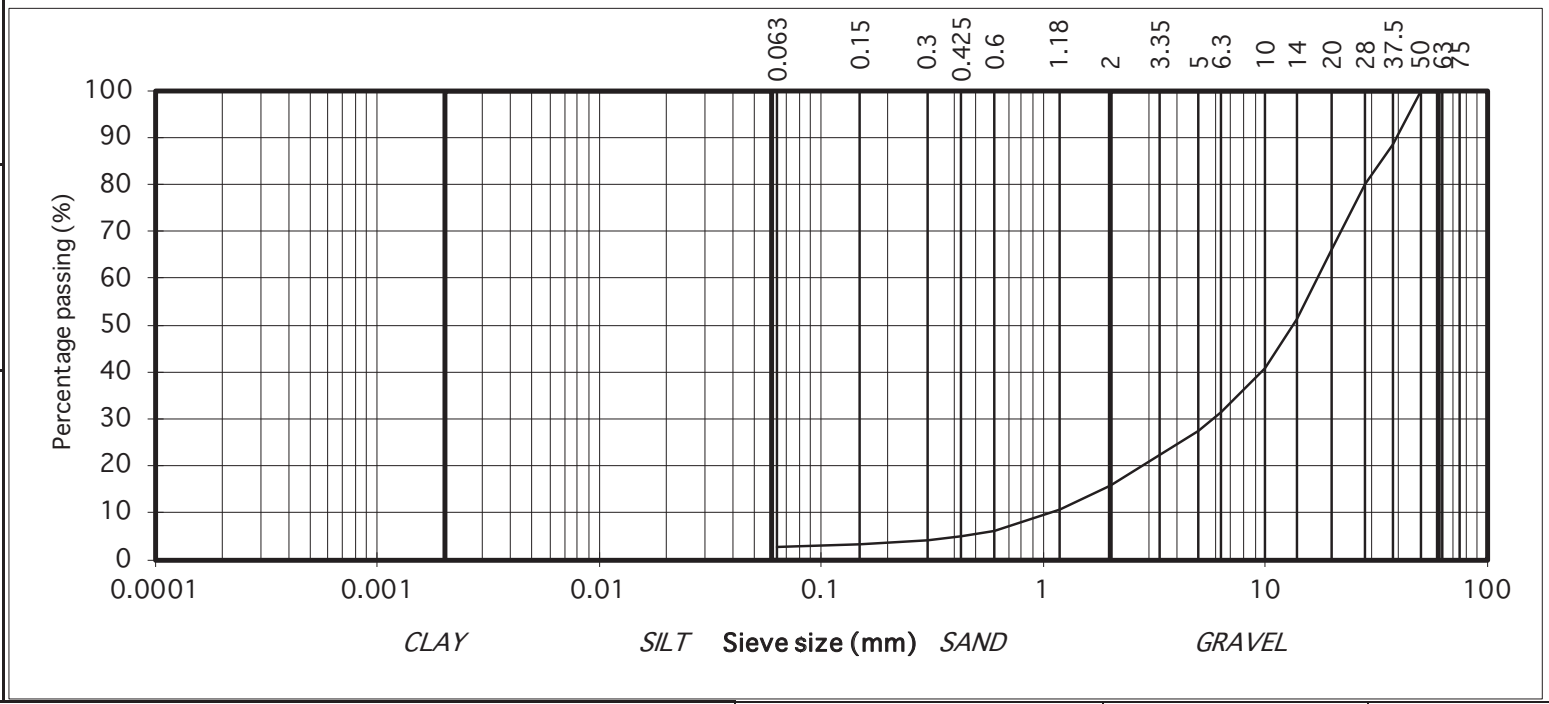
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	89	
28	80	
20	66	
14	51	
10	41	
6.3	31	
5	28	
3.35	22	
2	16	
1.18	11	SAND
0.6	6	
0.425	5	
0.3	4	
0.15	3	
0.063	3	SILT/CLAY

Contract No.	23110	Report No.	R120914
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH04		
Sample No.	AA149905	Lab. Sample No.	A21/1142
Sample Type:	B		
Depth (m)	3.00	Customer:	Murphy International / BLP
Date Received	19/03/2021	Date Testing started	19/03/2021
Description:	Brown slightly clayey/silty, sandy, GRAVEL		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

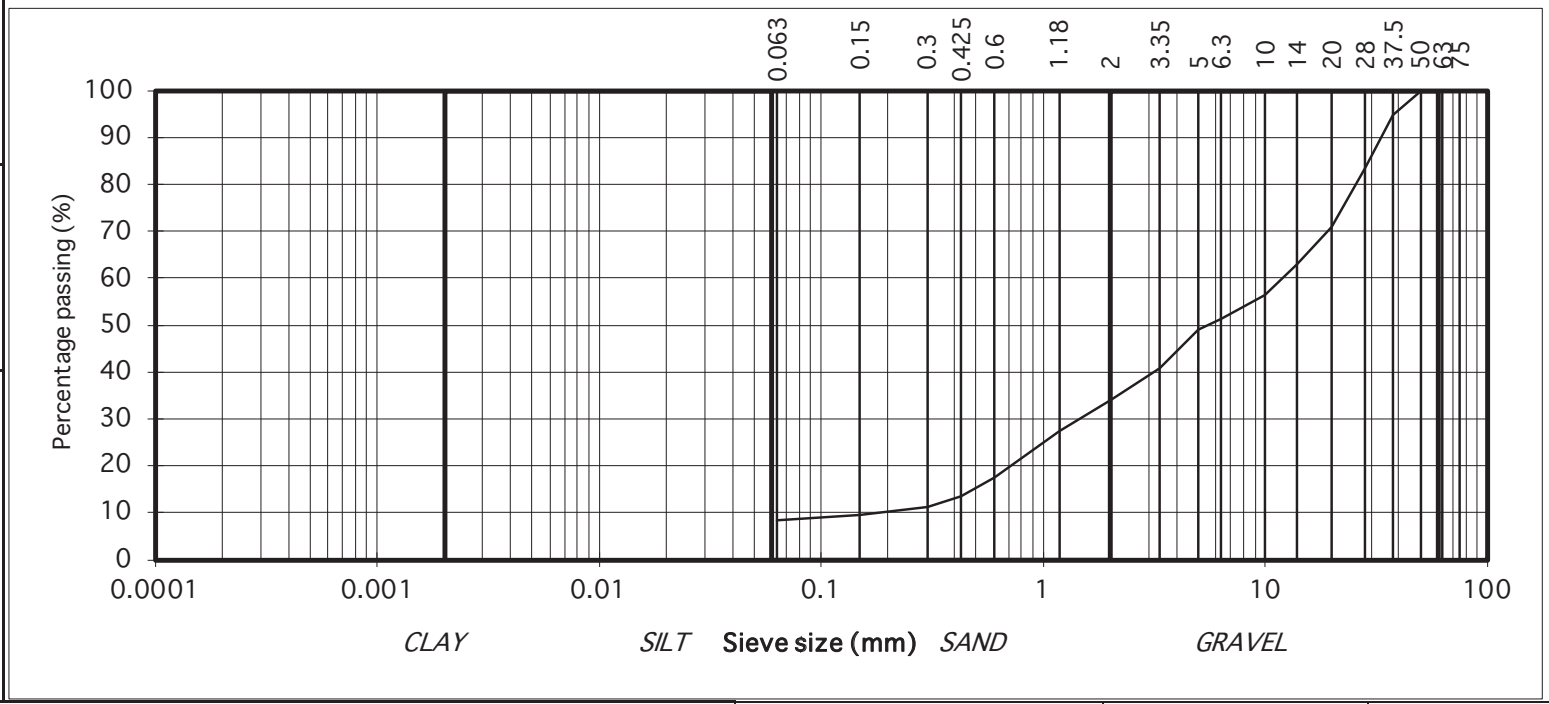
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	95	
28	84	
20	71	
14	63	
10	56	
6.3	51	
5	49	
3.35	41	
2	34	
1.18	27	SAND
0.6	17	
0.425	13	
0.3	11	
0.15	9	
0.063	8	SILT/CLAY

Contract No. 23110 Report No. R120915
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH05
Sample No. AA149916 Lab. Sample No. A21/1146
Sample Type: B
Depth (m) 2.00 Customer: Murphy International / BLP
Date Received 19/03/2021 Date Testing started 19/03/2021
Description: Brown clayey/silty, very sandy, GRAVEL

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

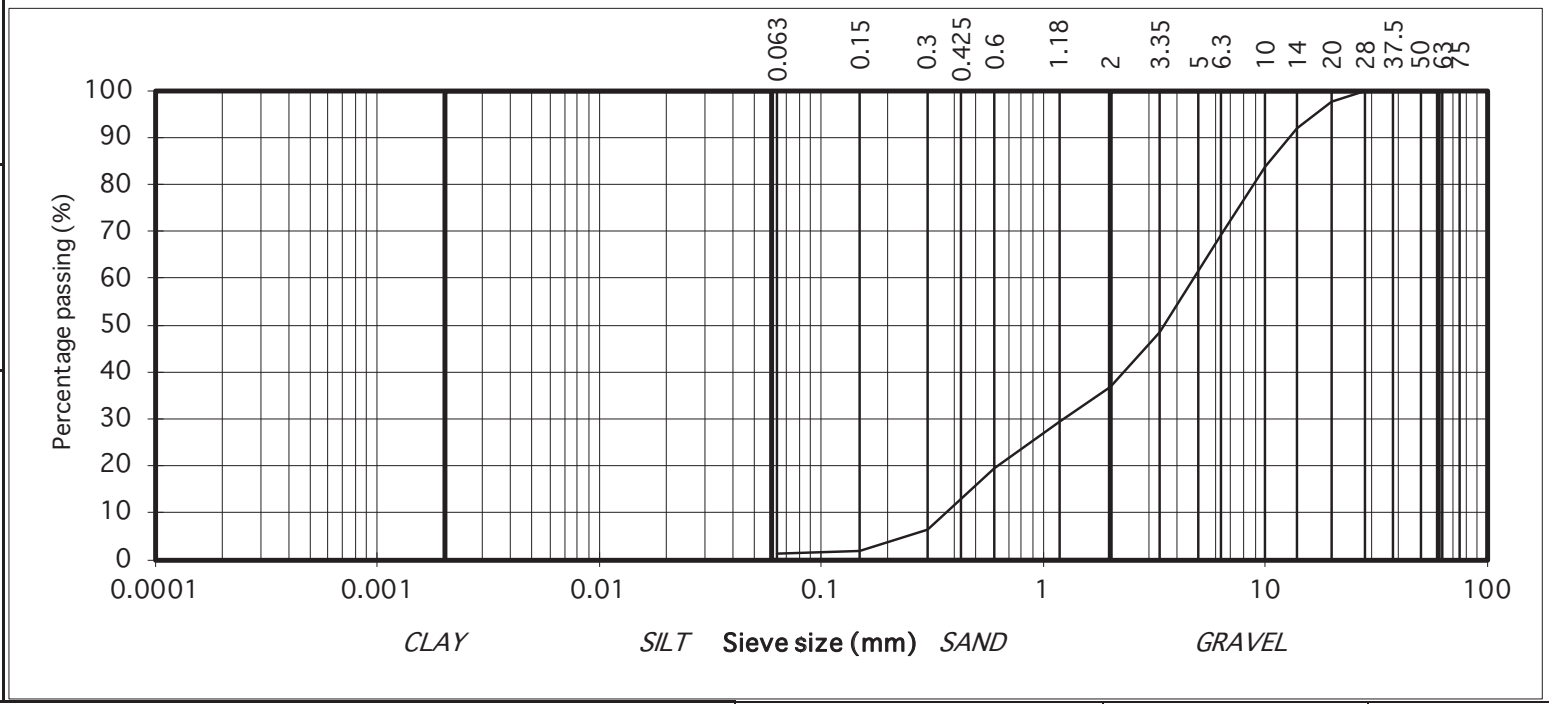
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	98	
14	92	
10	84	
6.3	69	
5	62	
3.35	49	
2	37	
1.18	29	SAND
0.6	19	
0.425	13	
0.3	6	
0.15	2	
0.063	1	SILT/CLAY

Contract No. 23110 Report No. R120916
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH05A
Sample No. AA149920 Lab. Sample No. A21/1147
Sample Type: B
Depth (m) 5.00 Customer: Murphy International / BLP
Date Received 19/03/2021 Date Testing started 19/03/2021
Description: Brown slightly clayey/silty, very sandy, GRAVEL

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

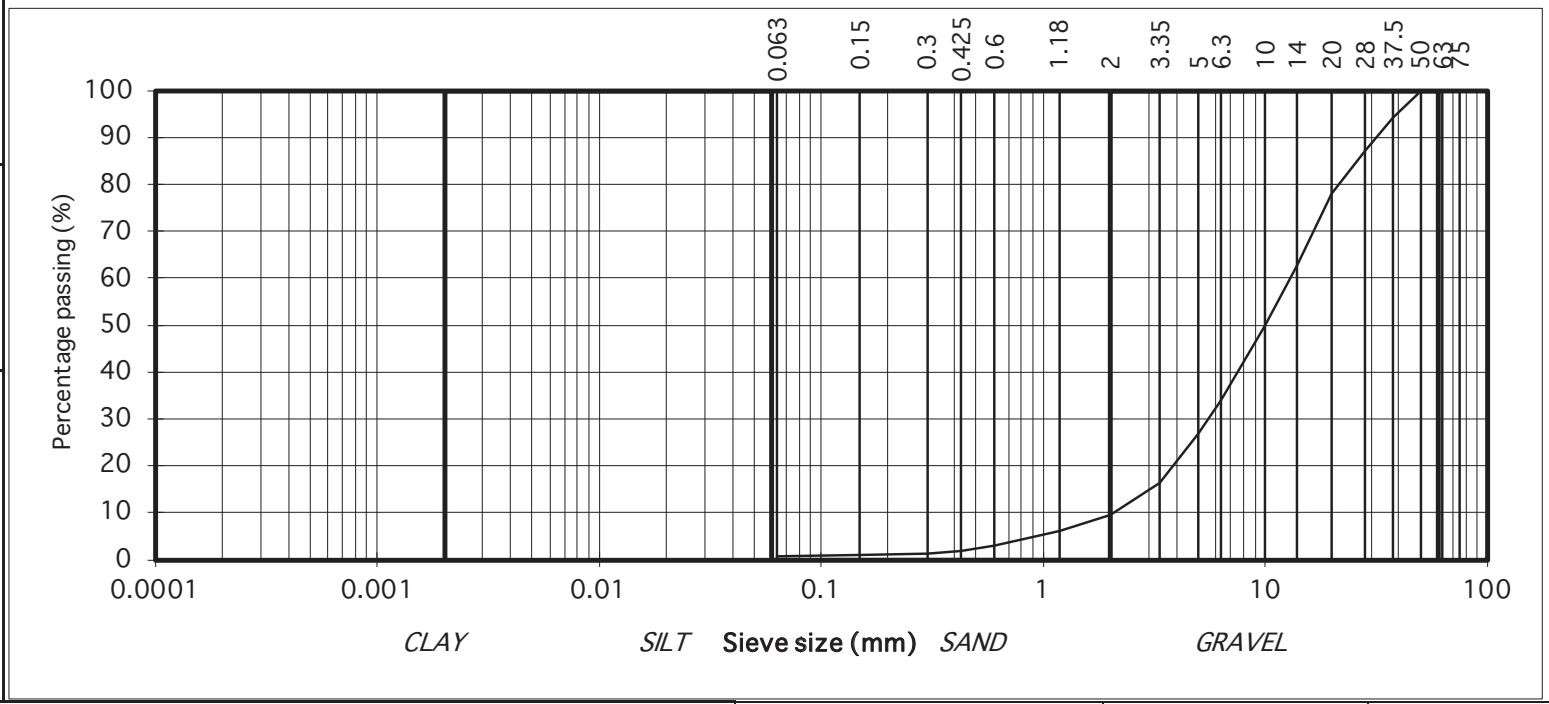
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	94	
28	87	
20	78	
14	63	
10	50	
6.3	34	
5	27	
3.35	16	
2	9	
1.18	6	SAND
0.6	3	
0.425	2	
0.3	1	
0.15	1	
0.063	1	SILT/CLAY

Contract No. 23110 Report No. R120917
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH06
Sample No. AA149927 Lab. Sample No. A21/1149
Sample Type: B
Depth (m) 3.00 Customer: Murphy International / BLP
Date Received 19/03/2021 Date Testing started 19/03/2021
Description: Brown slightly clayey/silty, sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

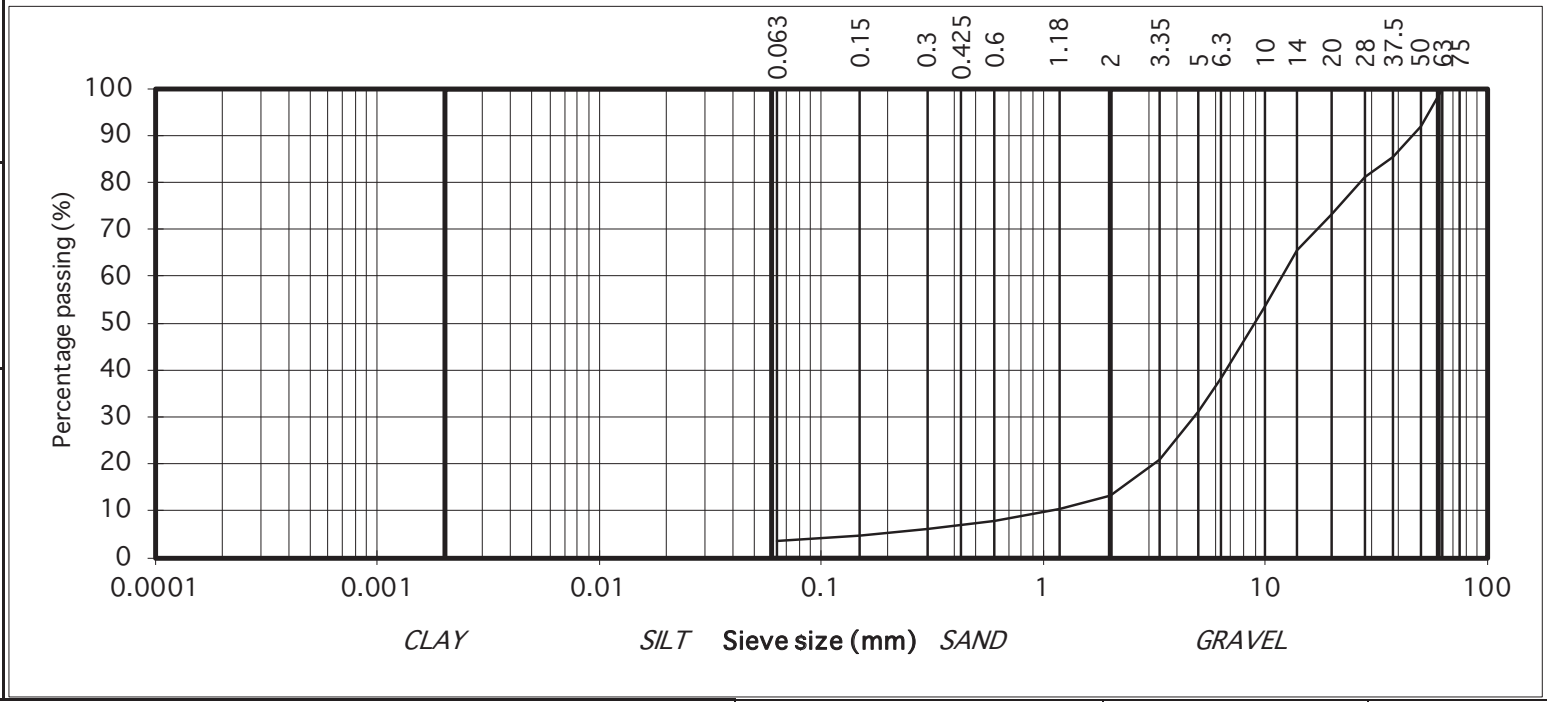
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	92	GRAVEL
37.5	85	
28	81	
20	73	
14	65	
10	54	
6.3	38	
5	31	
3.35	21	
2	13	
1.18	10	SAND
0.6	8	
0.425	7	
0.3	6	
0.15	5	
0.063	4	SILT/CLAY

Contract No.	23110	Report No.	R120918
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH06		
Sample No.	AA149935	Lab. Sample No.	A21/1155
Sample Type:	B		
Depth (m)	9.00	Customer:	Murphy International / BLP
Date Received	19/03/2021	Date Testing started	19/03/2021
Description:	Brown slightly clayey/silty, sandy, GRAVEL		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

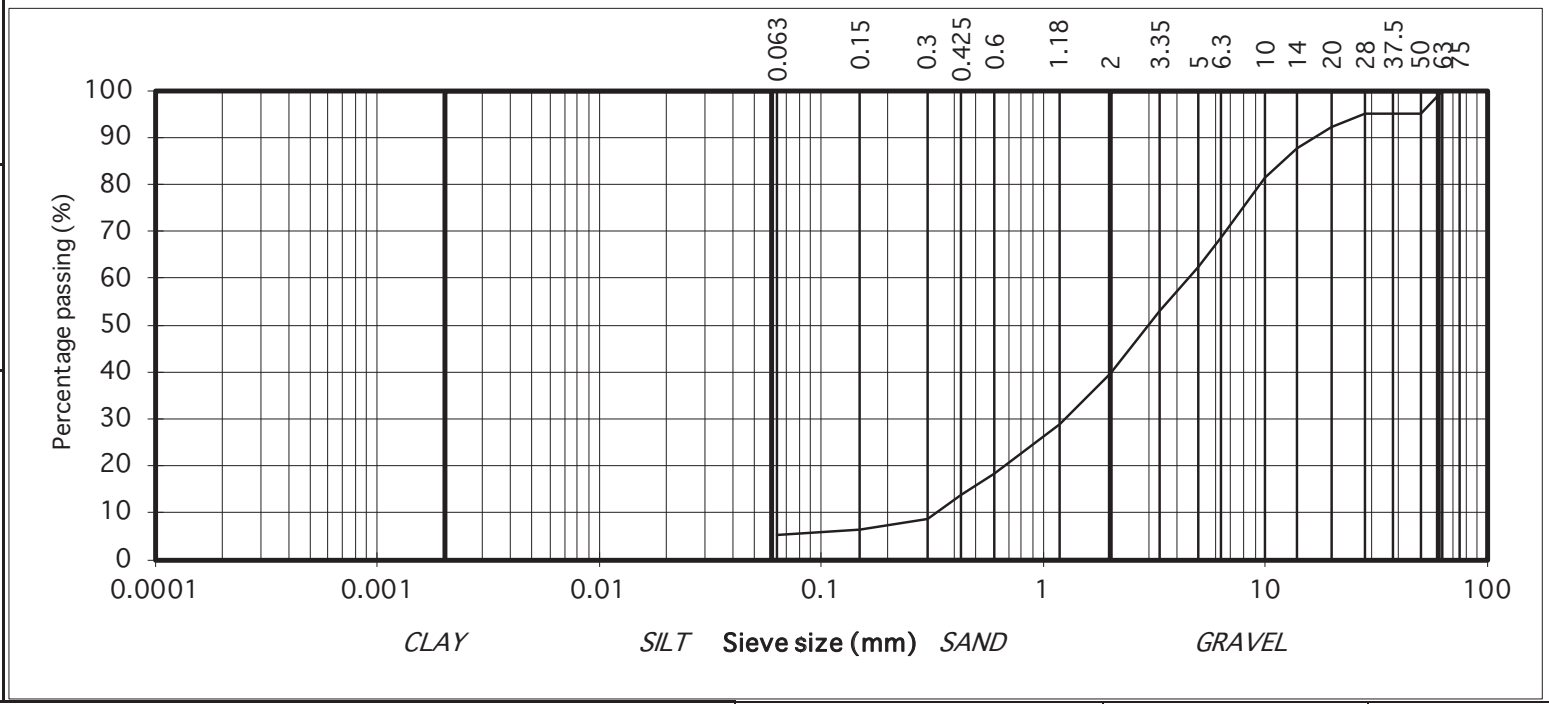
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	95	GRAVEL
37.5	95	
28	95	
20	92	
14	88	
10	81	
6.3	69	
5	62	
3.35	53	
2	40	
1.18	29	SAND
0.6	18	
0.425	14	
0.3	9	
0.15	6	
0.063	5	SILT/CLAY

Contract No. 23110 Report No. R120919
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH08
Sample No. AA141104 Lab. Sample No. A21/1154
Sample Type: B
Depth (m) 4.00 Customer: Murphy International / BLP
Date Received 19/03/2021 Date Testing started 19/03/2021
Description: Brown clayey/silty, very sandy, GRAVEL

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

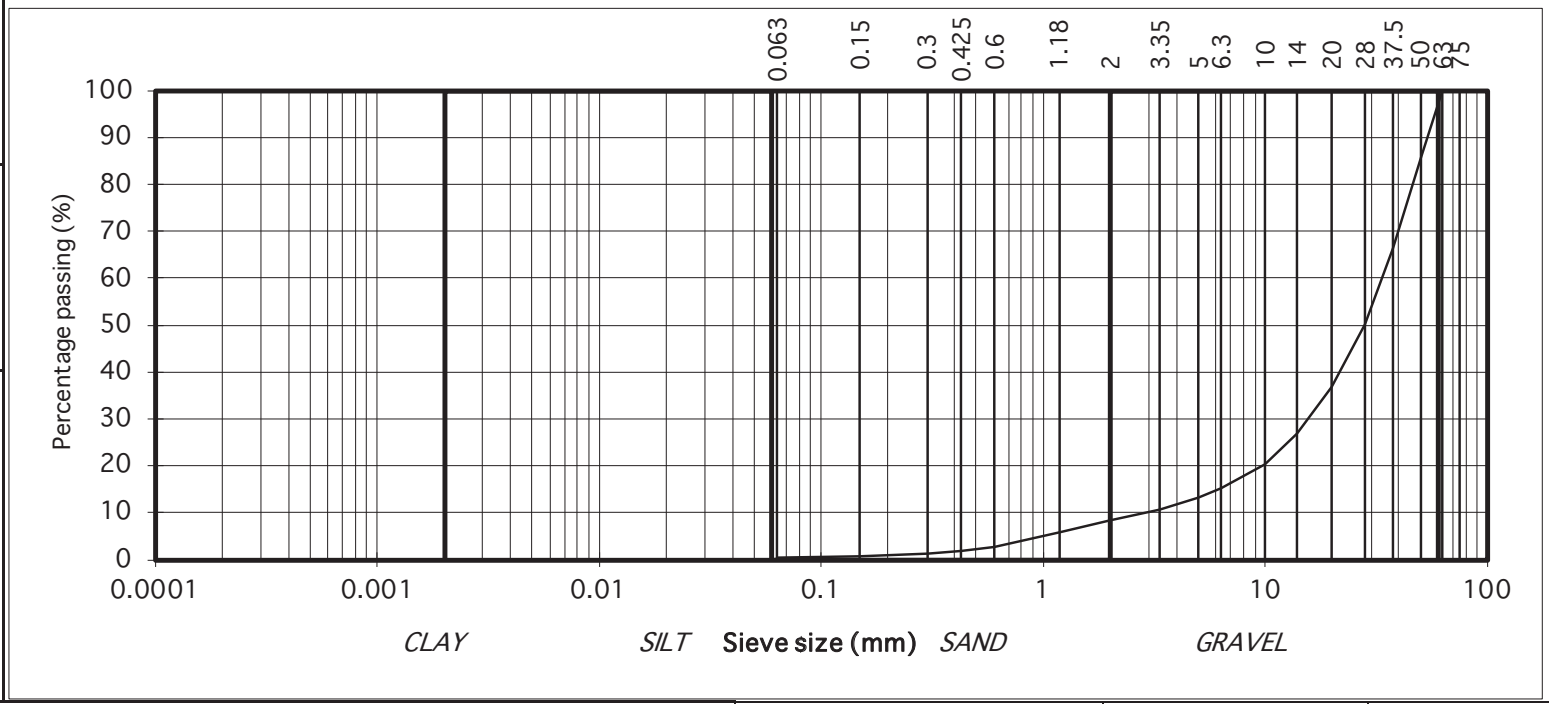
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	86	GRAVEL
37.5	66	
28	50	
20	37	
14	27	
10	20	
6.3	15	
5	13	
3.35	11	
2	8	
1.18	6	SAND
0.6	3	
0.425	2	
0.3	1	
0.15	1	
0.063	1	SILT/CLAY

Contract No.	23110	Report No.	R120937
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH10		
Sample No.	AA146158	Lab. Sample No.	A21/1551
Sample Type:	B		
Depth (m)	1.00	Customer:	Murphy International / BLP
Date Received	16/04/2021	Date Testing started	16/04/2021
Description:	Brown slightly clayey/silty, sandy, GRAVEL		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

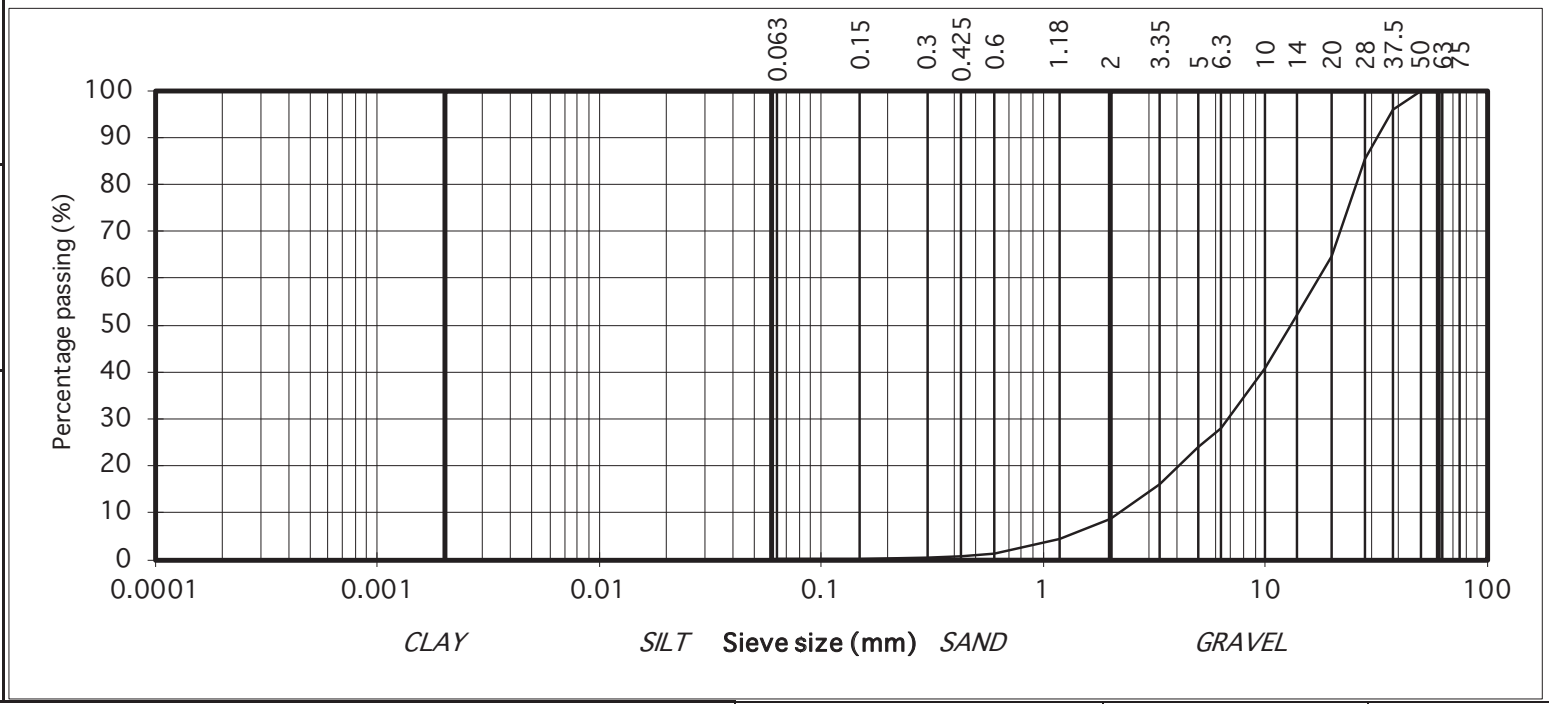
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	96	
28	86	
20	65	
14	52	
10	41	
6.3	28	
5	24	
3.35	16	
2	9	
1.18	4	SAND
0.6	1	
0.425	1	
0.3	0	
0.15	0	
0.063	0	SILT/CLAY

Contract No. 23110 Report No. R120909
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH13
Sample No. AA146118 Lab. Sample No. A21/1334
Sample Type: B
Depth (m) 2.00 Customer: Murphy International / BLP
Date Received 14/04/2021 Date Testing started 14/04/2021
Description: Brown sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

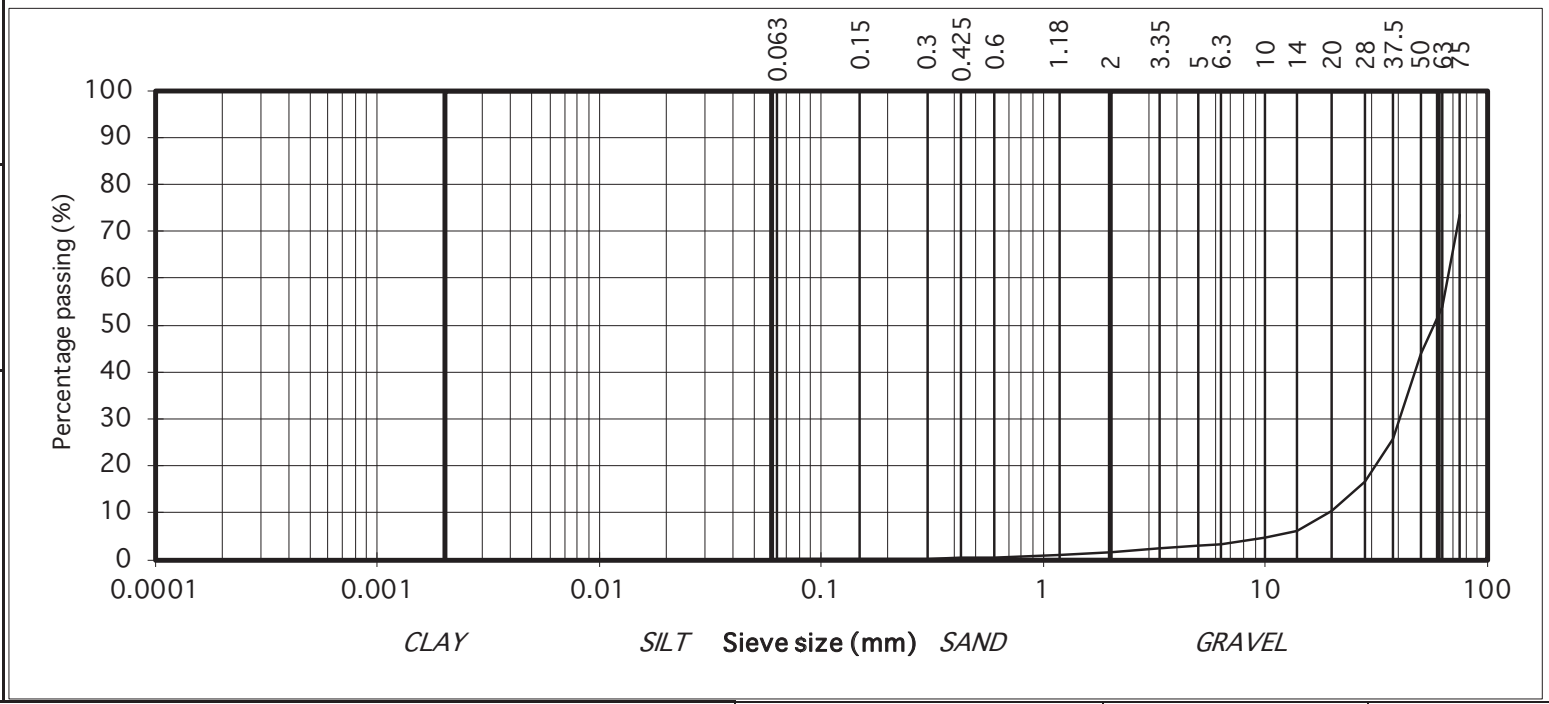
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	74	COBBLES
63	54	
50	44	GRAVEL
37.5	26	
28	16	
20	10	
14	6	
10	5	
6.3	3	
5	3	
3.35	2	
2	2	
1.18	1	SAND
0.6	0	
0.425	0	
0.3	0	
0.15	0	
0.063	0	SILT/CLAY

Contract No.	23110	Report No.	R120910
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH13		
Sample No.	AA146123	Lab. Sample No.	A21/1336
Sample Type:	B		
Depth (m)	7.00	Customer:	Murphy International / BLP
Date Received	14/04/2021	Date Testing started	30/03/2021
Description:	Brown slightly sandy, GRAVEL with many cobbles		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

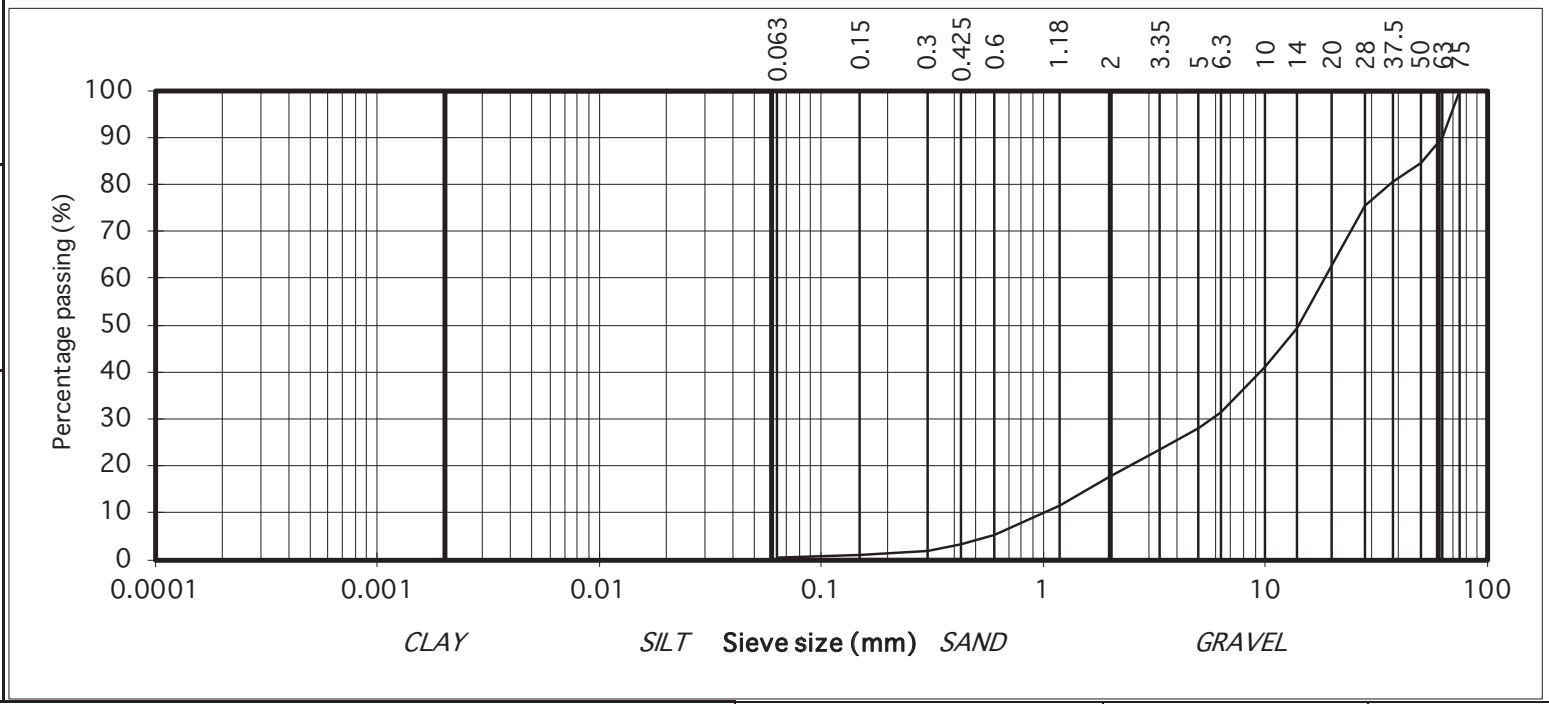
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	90	
50	85	GRAVEL
37.5	81	
28	76	
20	63	
14	49	
10	41	
6.3	31	
5	28	
3.35	23	
2	18	
1.18	12	SAND
0.6	5	
0.425	3	
0.3	2	
0.15	1	
0.063	0	SILT/CLAY

Contract No.	23110	Report No.	R120903
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH15		
Sample No.	AA141150	Lab. Sample No.	A21/1318
Sample Type:	B		
Depth (m)	2.00	Customer:	Murphy International / BLP
Date Received	14/04/2021	Date Testing started	14/04/2021
Description:	Brown sandy, GRAVEL with some cobbles		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

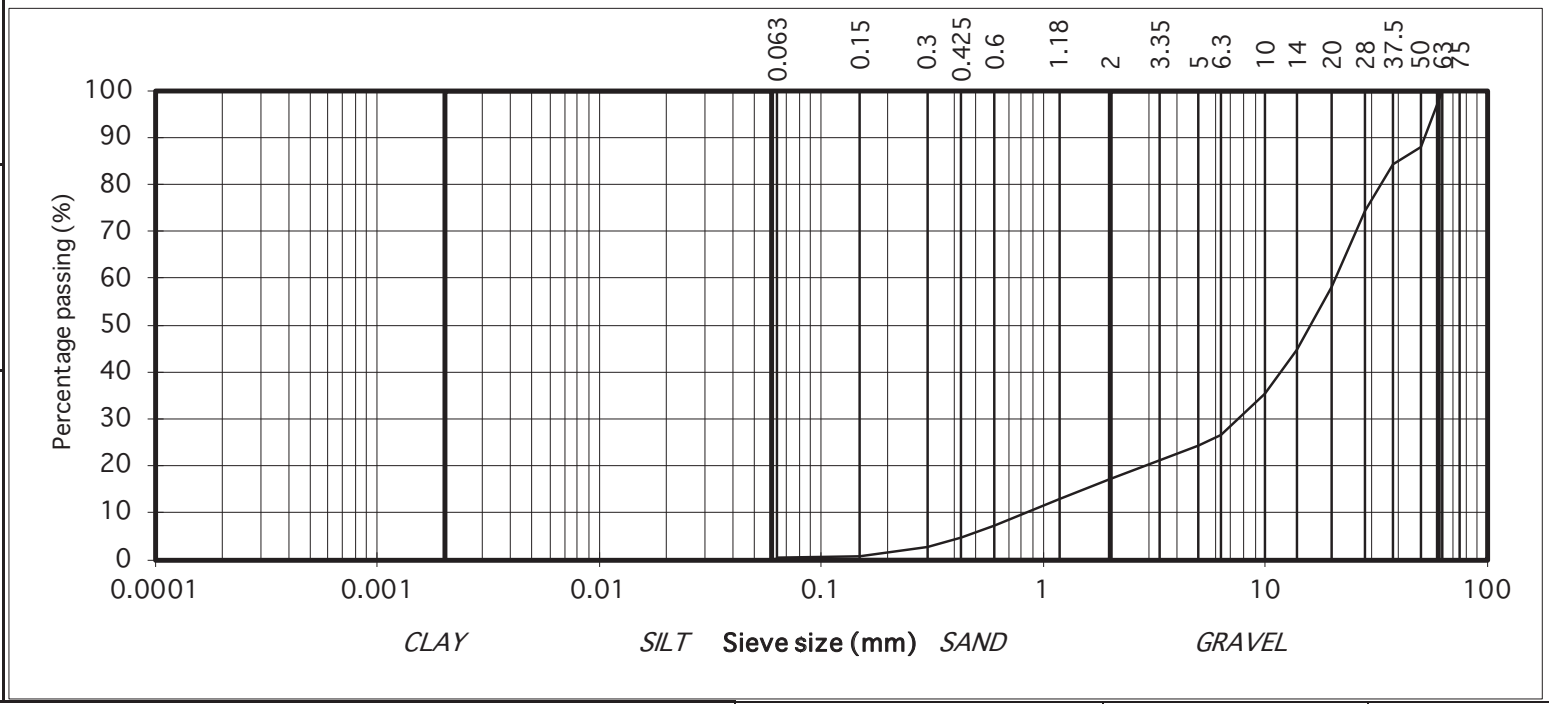
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	88	GRAVEL
37.5	84	
28	74	
20	58	
14	45	
10	35	
6.3	27	
5	24	
3.35	21	
2	17	
1.18	13	SAND
0.6	7	
0.425	5	
0.3	3	
0.15	1	
0.063	0	SILT/CLAY

Contract No.	23110	Report No.	R120904
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH18		
Sample No.	AA141117	Lab. Sample No.	A21/1325
Sample Type:	B		
Depth (m)	2.00	Customer:	Murphy International / BLP
Date Received	14/04/2021	Date Testing started	14/04/2021
Description:	Brown sandy, GRAVEL		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

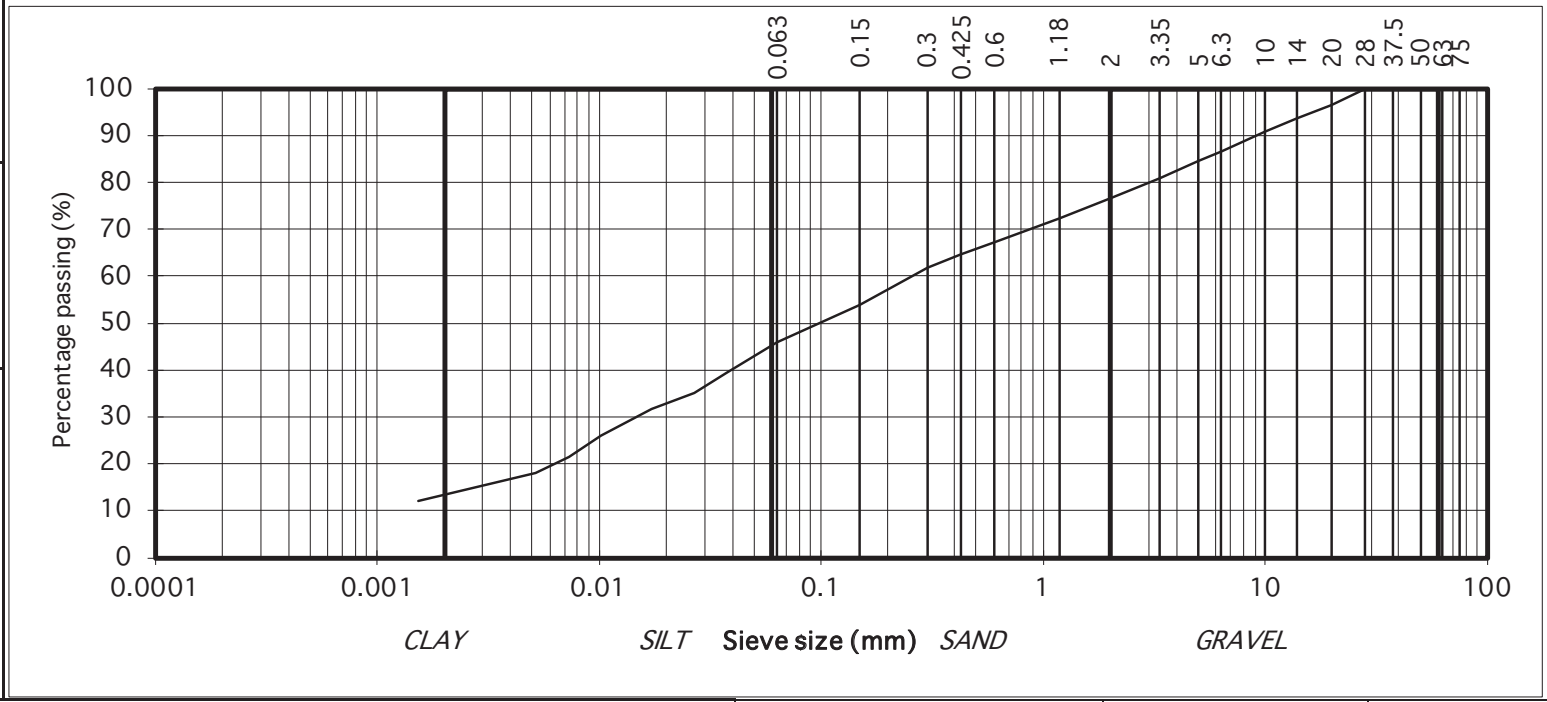
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	97	
14	94	
10	91	
6.3	87	
5	84	
3.35	81	
2	77	
1.18	72	SAND
0.6	67	
0.425	65	
0.3	62	
0.15	54	
0.063	46	SILT/CLAY
0.037	39	
0.027	35	
0.017	32	
0.010	26	
0.007	21	
0.005	18	
0.002	12	

Contract No.	23110	Report No.	R120905
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH18		
Sample No.	AA141120	Lab. Sample No.	A21/1326
Sample Type:	B		
Depth (m)	5.00	Customer:	Murphy International / BLP
Date Received	14/04/2021	Date Testing started	14/04/2021
Description:	Brown slightly sandy, slightly gravelly, SILT/CLAY		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

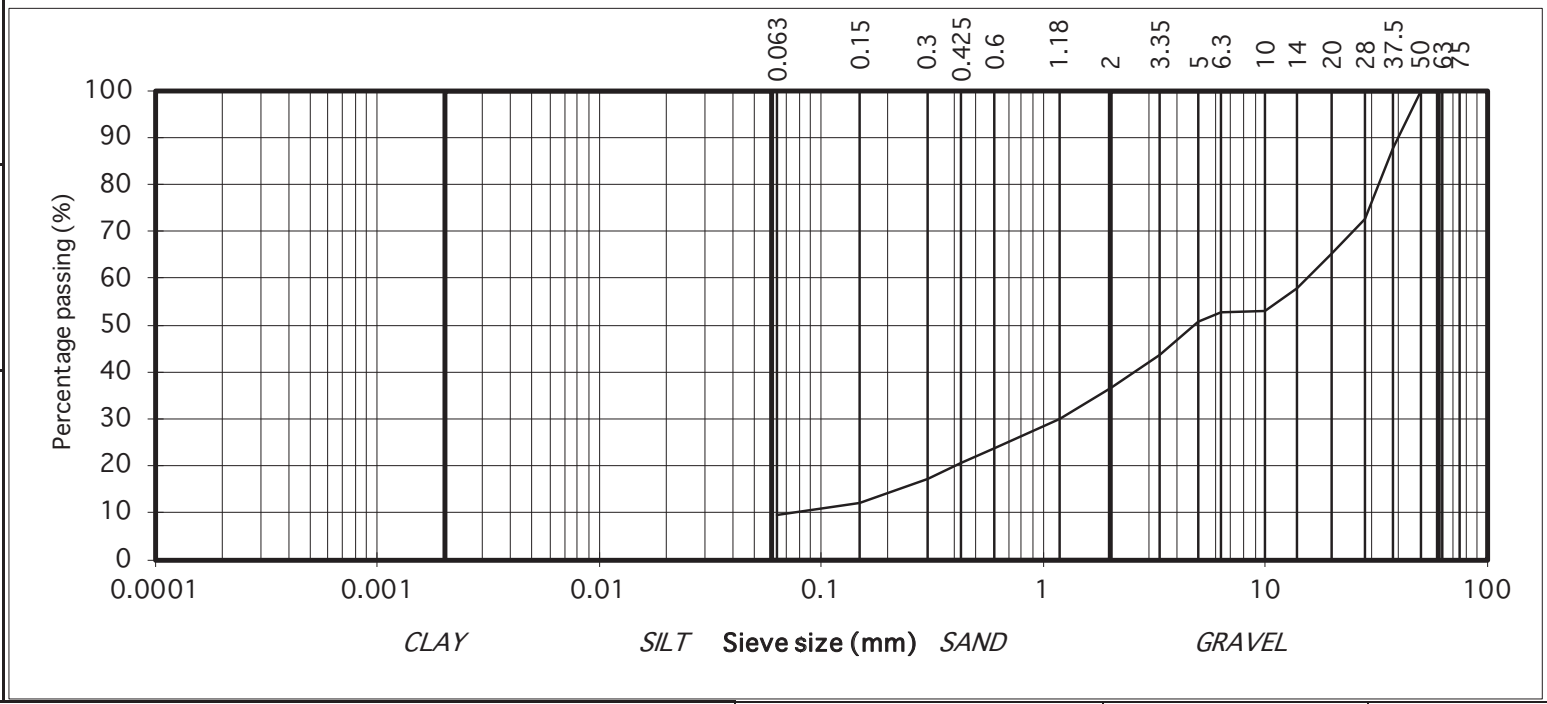
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	88	
28	73	
20	65	
14	58	
10	53	
6.3	53	
5	51	
3.35	43	
2	36	
1.18	30	SAND
0.6	24	
0.425	21	
0.3	17	
0.15	12	
0.063	10	SILT/CLAY

Contract No. 23110 Report No. R121038
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH19
Sample No. AA146126 Lab. Sample No. A21/1521
Sample Type: B
Depth (m) 1.00 Customer: Murphy International / BLP
Date Received 16/04/2021 Date Testing started 16/04/2021
Description: Brown clayey/silty, very sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

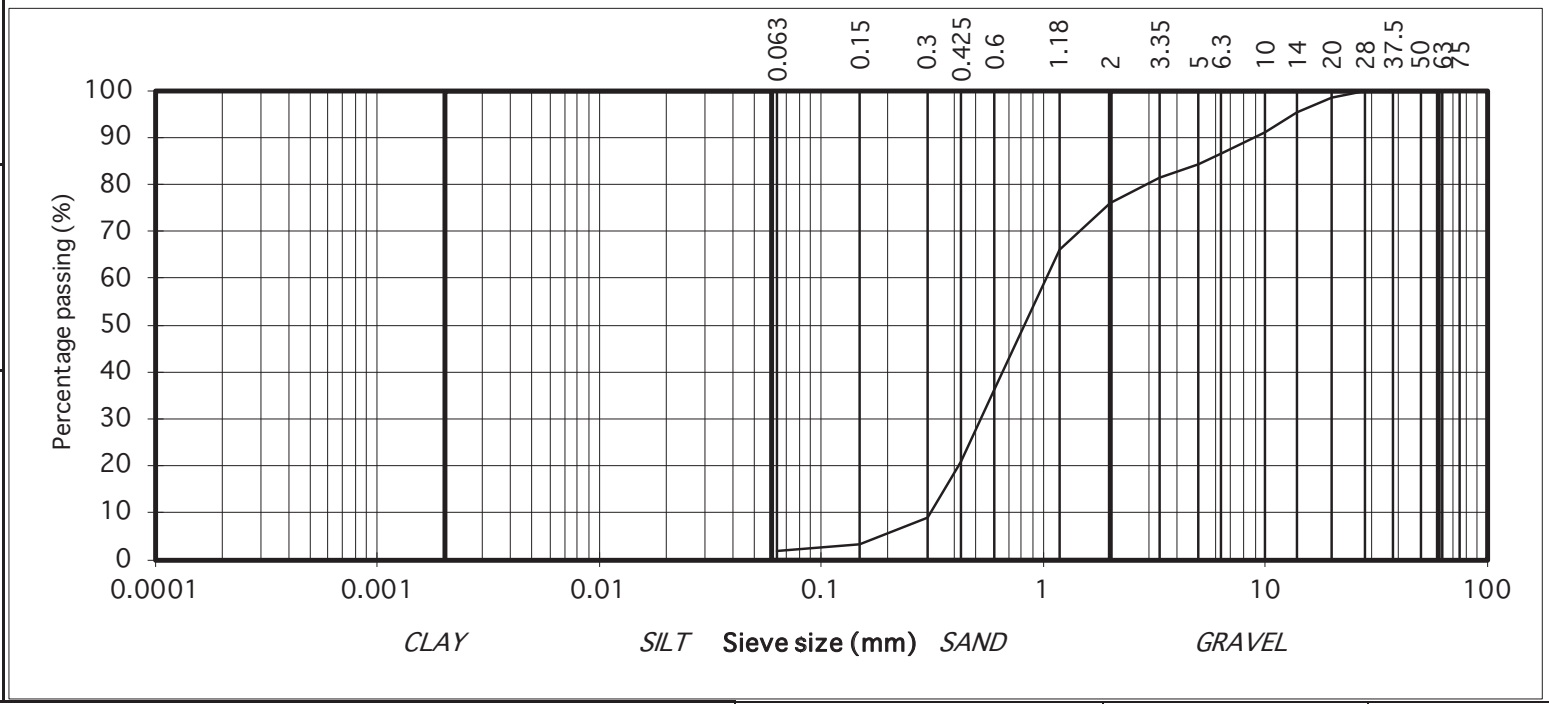
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	98	
14	95	
10	91	
6.3	87	
5	84	
3.35	81	
2	76	
1.18	66	SAND
0.6	36	
0.425	21	
0.3	9	
0.15	3	
0.063	2	SILT/CLAY

Contract No.	23110	Report No.	R120936
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH20		
Sample No.	AA158177	Lab. Sample No.	A21/1549
Sample Type:	B		
Depth (m)	1.00	Customer:	Murphy International / BLP
Date Received	16/04/2021	Date Testing started	16/04/2021
Description:	Brown slightly clayey/silty, very gravelly, SAND		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

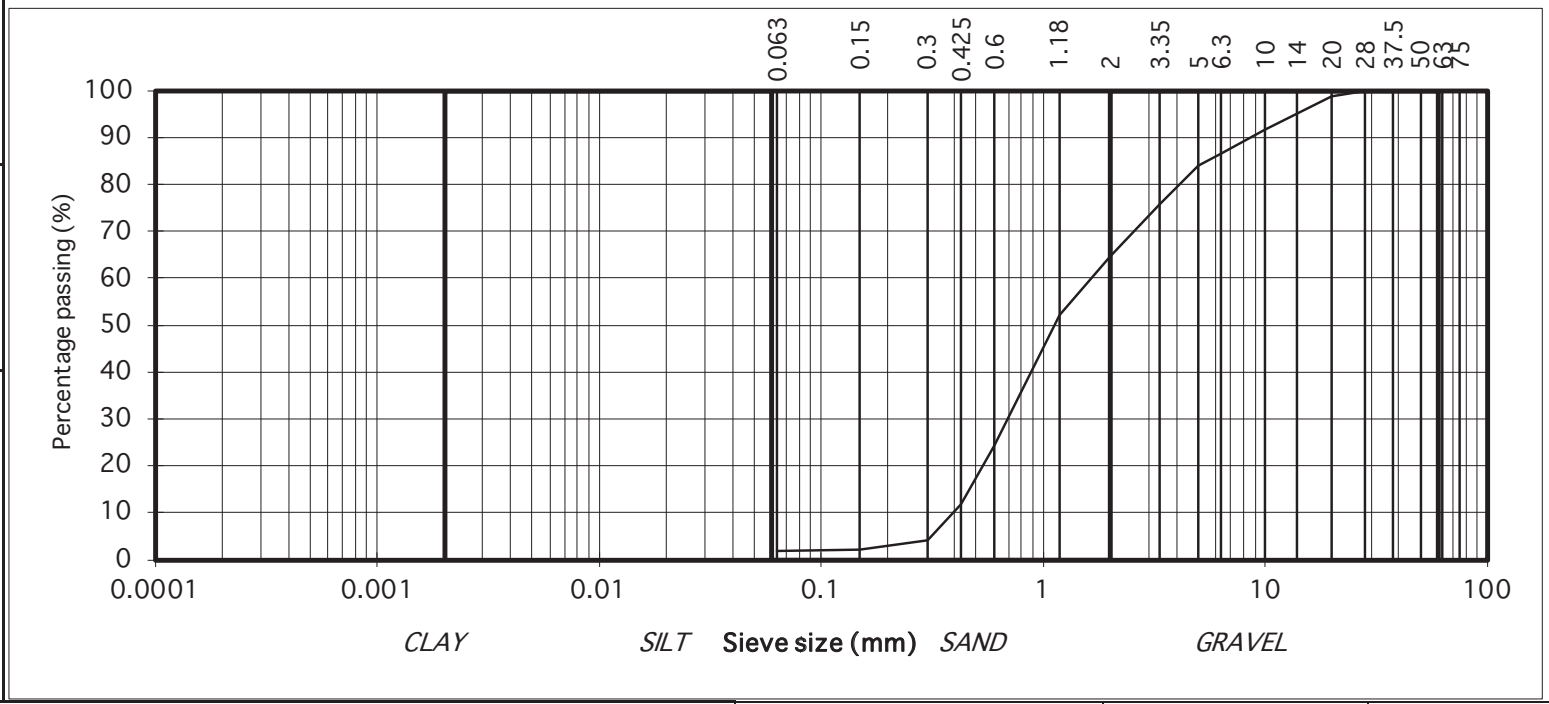
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	99	
14	95	
10	92	
6.3	87	
5	84	
3.35	76	
2	65	
1.18	52	SAND
0.6	24	
0.425	12	
0.3	4	
0.15	2	
0.063	2	SILT/CLAY

Contract No. 23110 Report No. R120937
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH20
Sample No. AA158181 Lab. Sample No. A21/1550
Sample Type: B
Depth (m) 5.00 Customer: Murphy International / BLP
Date Received 16/04/2021 Date Testing started 16/04/2021
Description: Brown slightly clayey/silty, very gravelly, SAND

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

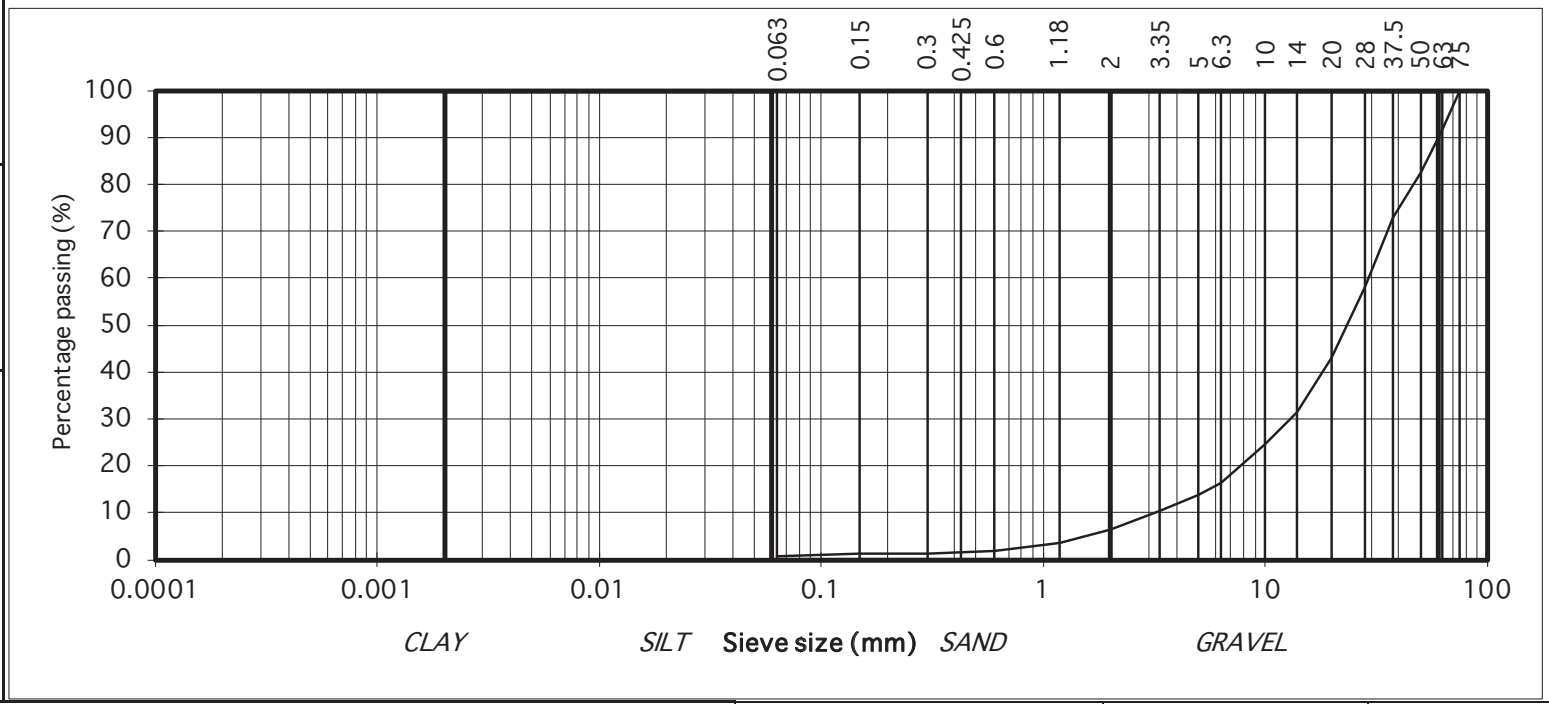
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	92	
50	83	GRAVEL
37.5	73	
28	58	
20	43	
14	31	
10	24	
6.3	16	
5	14	
3.35	10	
2	6	
1.18	4	SAND
0.6	2	
0.425	2	
0.3	1	
0.15	1	
0.063	1	SILT/CLAY

Contract No.	23110	Report No.	R120906
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH21		
Sample No.	AA158174	Lab. Sample No.	A21/1330
Sample Type:	B		
Depth (m)	8.00	Customer:	Murphy International / BLP
Date Received	14/04/2021	Date Testing started	14/04/2021
Description:	Brown slightly clayey/silty, sandy, GRAVEL with some cobbles		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

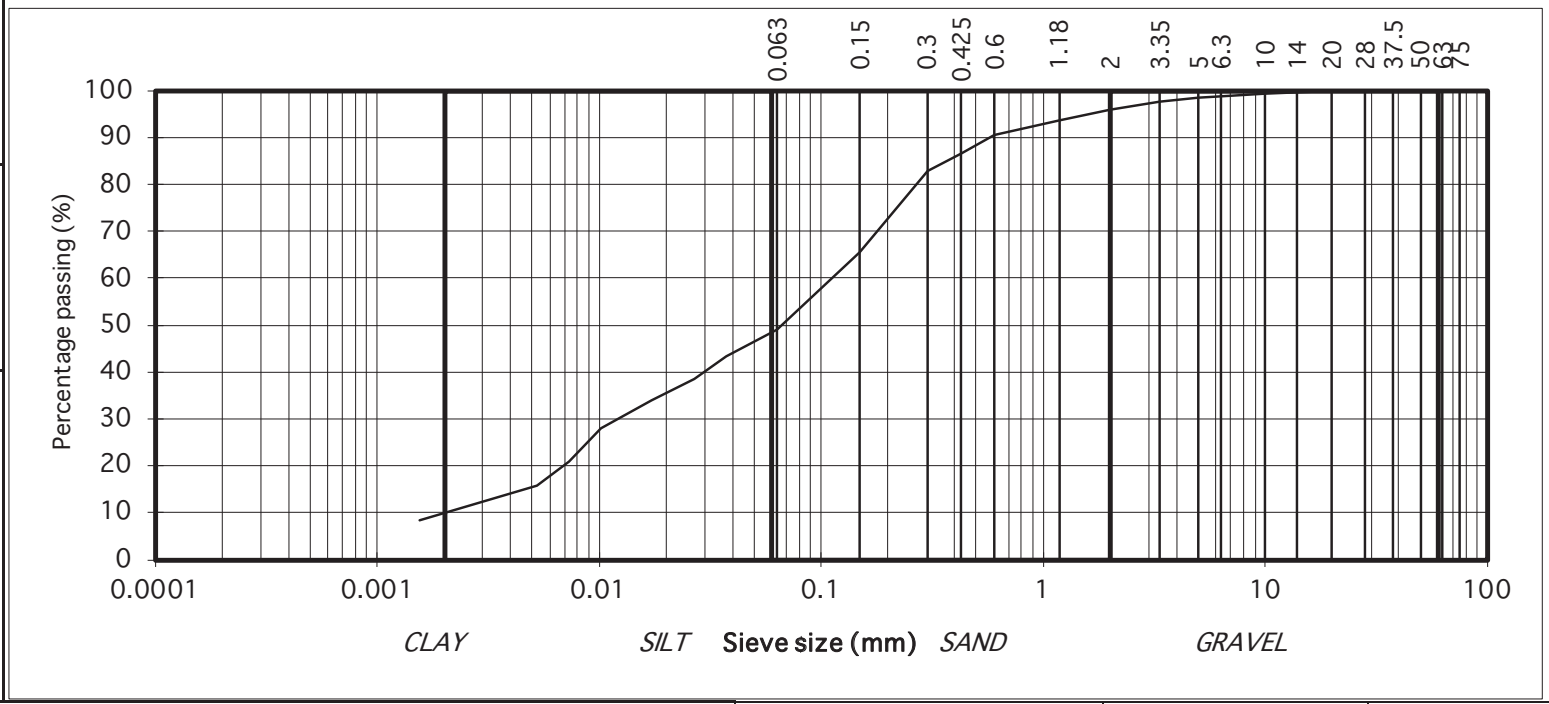
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	100	
14	100	
10	99	
6.3	99	
5	99	
3.35	98	
2	96	
1.18	94	SAND
0.6	91	
0.425	87	
0.3	83	
0.15	66	
0.063	49	SILT/CLAY
0.037	43	
0.027	39	
0.017	34	
0.010	28	
0.007	21	
0.005	16	
0.002	8	

Contract No.	23110	Report No.	R120907
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH22		
Sample No.	AA158158	Lab. Sample No.	A21/1331
Sample Type:	B		
Depth (m)	1.00	Customer:	Murphy International / BLP
Date Received	14/04/2021	Date Testing started	14/04/2021
Description:	Brown sandy, slightly gravelly, SILT/CLAY		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

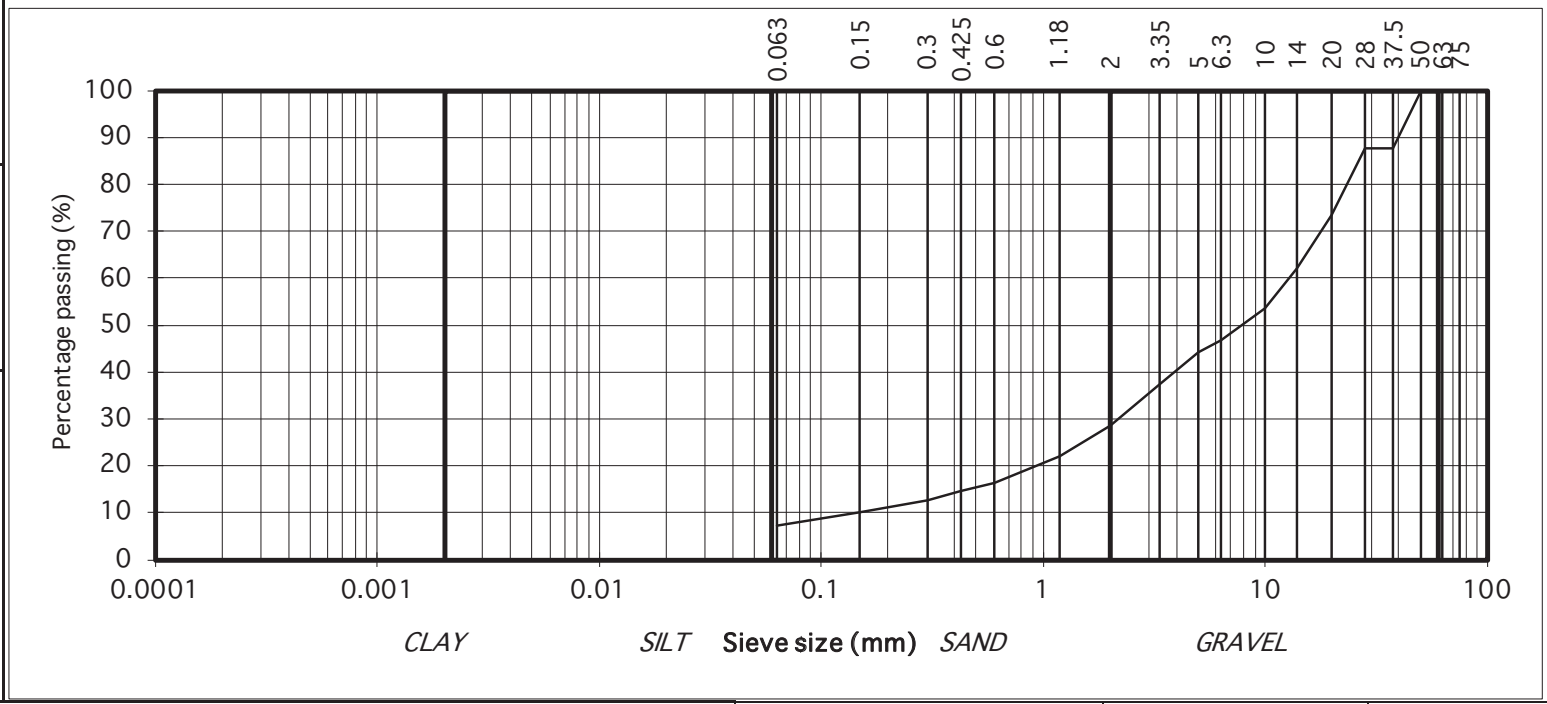
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	88	
28	88	
20	73	
14	62	
10	54	
6.3	47	
5	44	
3.35	37	
2	29	
1.18	22	SAND
0.6	16	
0.425	14	
0.3	13	
0.15	10	
0.063	7	SILT/CLAY

Contract No. 23110 Report No. R120908
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH22
Sample No. AA158159 Lab. Sample No. A21/1332
Sample Type: B
Depth (m) 1.00 Customer: Murphy International / BLP
Date Received 14/04/2021 Date Testing started 14/04/2021
Description: Brown clayey/silty, very sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

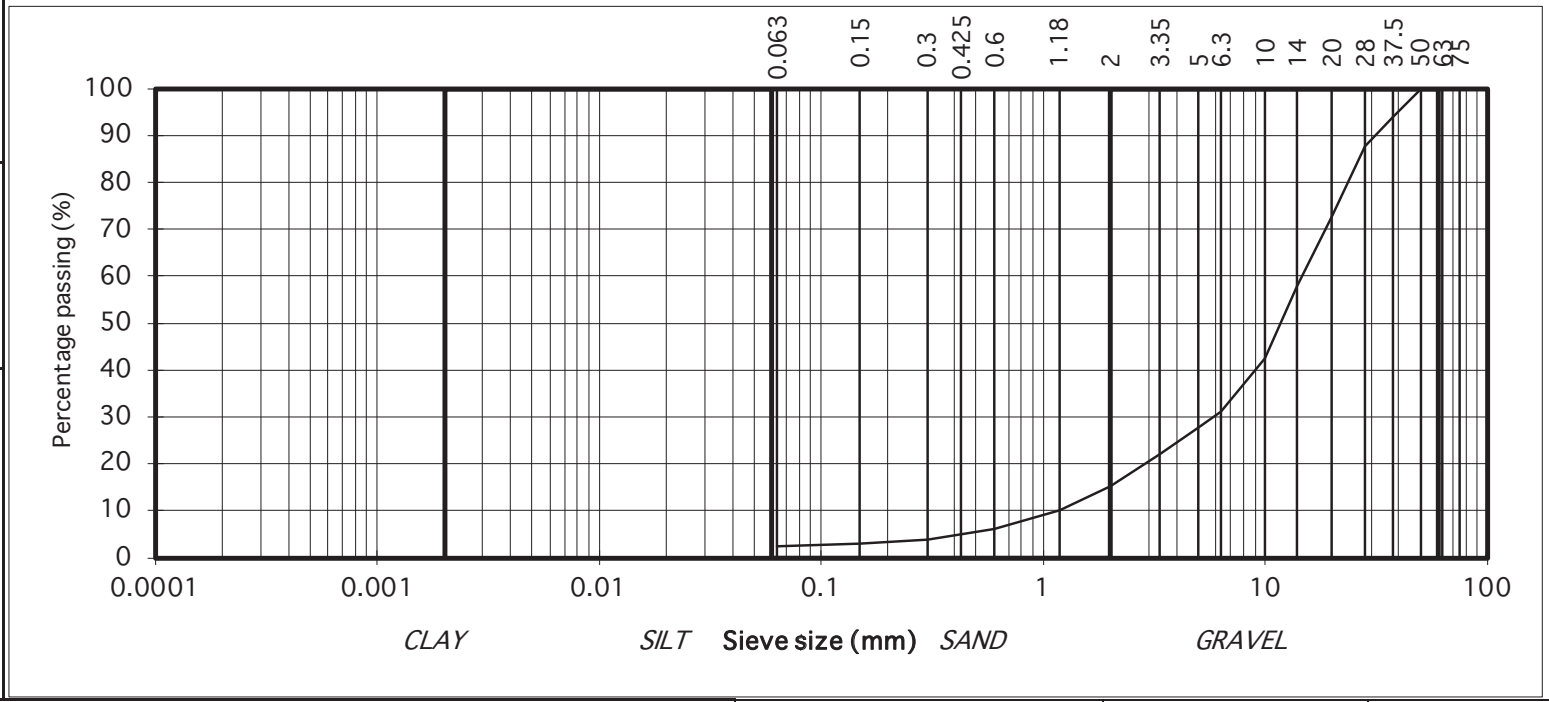
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	94	
28	88	
20	73	
14	58	
10	42	
6.3	31	
5	28	
3.35	22	
2	15	
1.18	10	SAND
0.6	6	
0.425	5	
0.3	4	
0.15	3	
0.063	2	SILT/CLAY

Contract No.	23110	Report No.	R120920
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH23		
Sample No.	AA158182	Lab. Sample No.	A21/1160
Sample Type:	B		
Depth (m)	2.00	Customer:	Murphy International / BLP
Date Received	19/03/2021	Date Testing started	19/03/2021
Description:	Brown slightly clayey/silty, sandy, GRAVEL		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

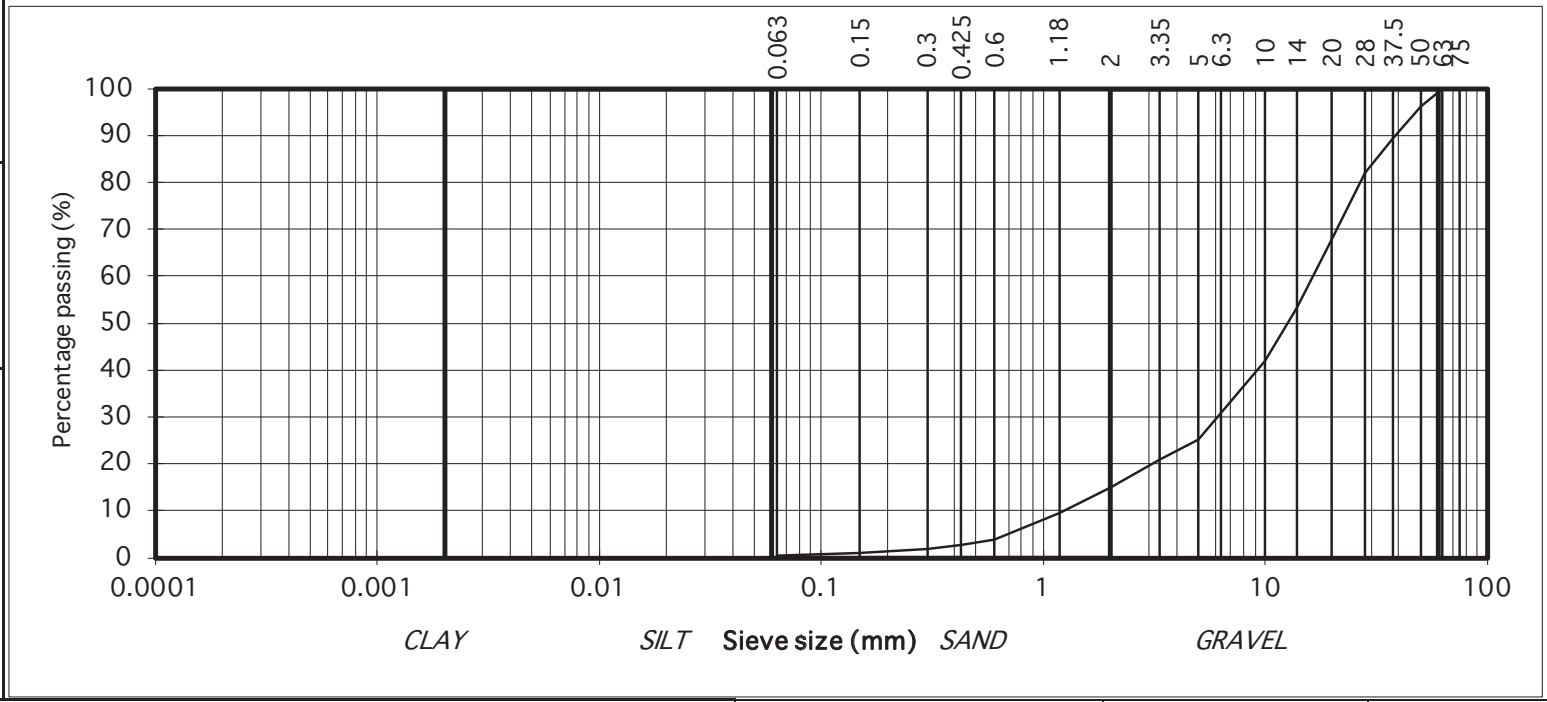
ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	96	GRAVEL
37.5	90	
28	82	
20	68	
14	53	
10	42	
6.3	31	
5	25	
3.35	21	
2	15	
1.18	9	SAND
0.6	4	
0.425	3	
0.3	2	
0.15	1	
0.063	0	SILT/CLAY

Contract No. 23110 Report No. R120911
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH24
Sample No. AA158184 Lab. Sample No. A21/1340
Sample Type: B
Depth (m) 1.00 Customer: Murphy International / BLP
Date Received 14/04/2021 Date Testing started 14/04/2021
Description: Brown sandy, GRAVEL

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

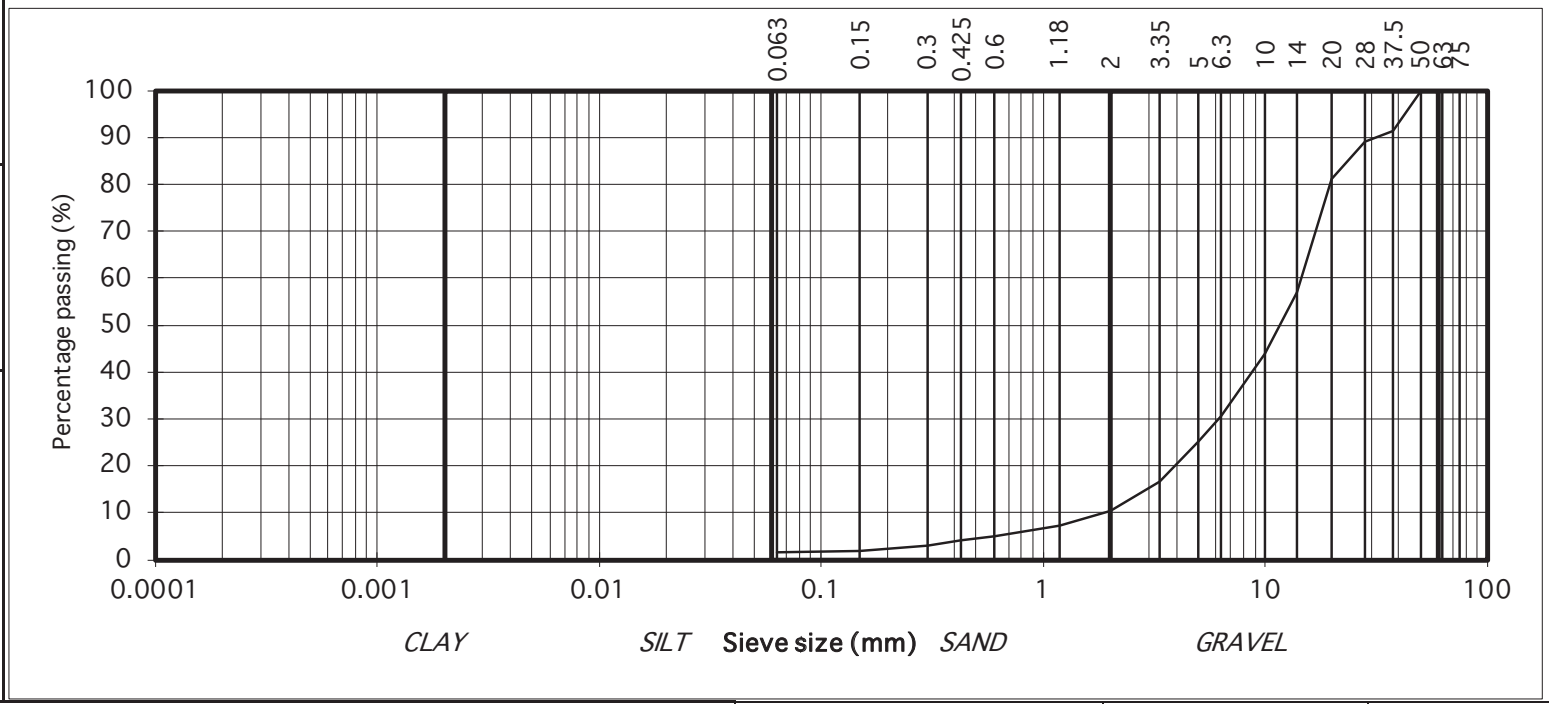
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	91	
28	89	
20	81	
14	57	
10	44	
6.3	31	
5	25	
3.35	17	
2	10	
1.18	7	SAND
0.6	5	
0.425	4	
0.3	3	
0.15	2	
0.063	2	SILT/CLAY

Contract No. 23110 Report No. R120912
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH24
Sample No. AA158190 Lab. Sample No. A21/1342
Sample Type: B
Depth (m) 6.00 Customer: Murphy International / BLP
Date Received 14/04/2021 Date Testing started 14/04/2021
Description: Brown slightly clayey/silty, sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

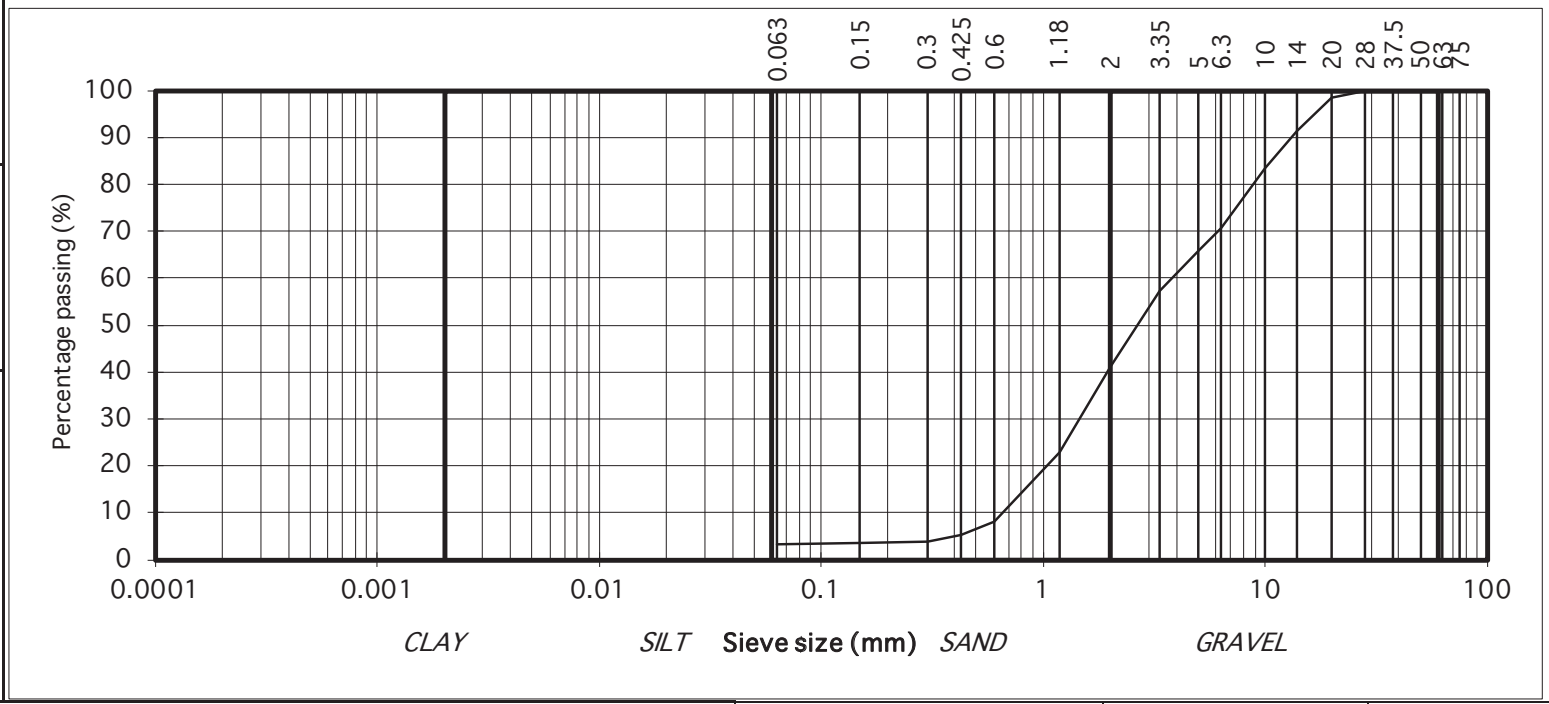
ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 137T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	99	
14	91	
10	84	
6.3	71	
5	66	
3.35	57	
2	41	
1.18	23	SAND
0.6	8	
0.425	5	
0.3	4	
0.15	3	
0.063	3	SILT/CLAY

Contract No.	23110	Report No.	R120913
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH24		
Sample No.	AA158197	Lab. Sample No.	A21/1344
Sample Type:	B		
Depth (m)	12.00	Customer:	Murphy International / BLP
Date Received	14/04/2021	Date Testing started	14/04/2021
Description:	Brown slightly clayey/silty, very sandy, GRAVEL		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

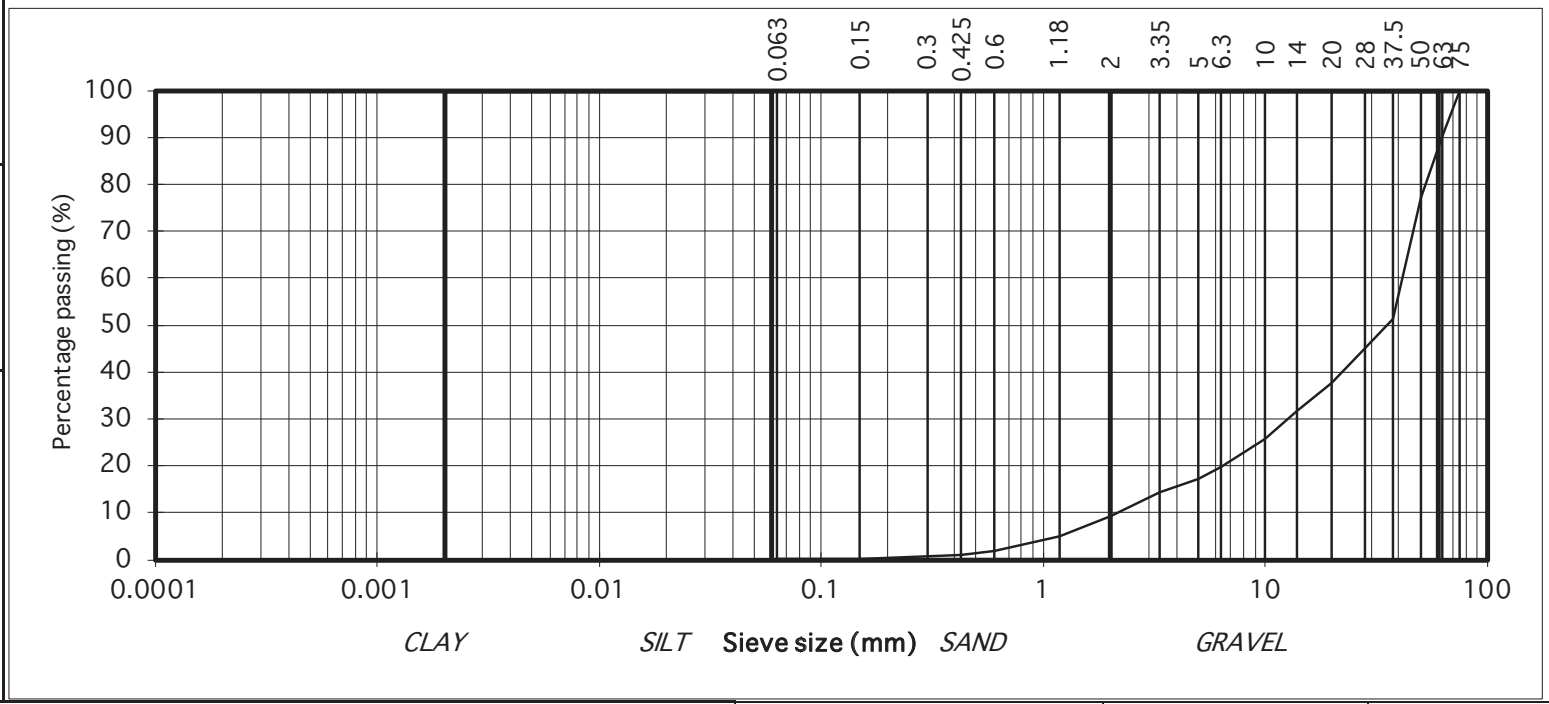
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	90	
50	77	GRAVEL
37.5	51	
28	45	
20	38	
14	32	
10	26	
6.3	20	
5	17	
3.35	14	
2	9	
1.18	5	SAND
0.6	2	
0.425	1	
0.3	1	
0.15	0	
0.063	0	SILT/CLAY

Contract No. 23110 Report No. R120929
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH25
Sample No. AA146140 Lab. Sample No. A21/1524
Sample Type: B
Depth (m) 1.00 Customer: Murphy International / BLP
Date Received 16/04/2021 Date Testing started 16/04/2021
Description: Brown sandy, GRAVEL with some cobbles

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

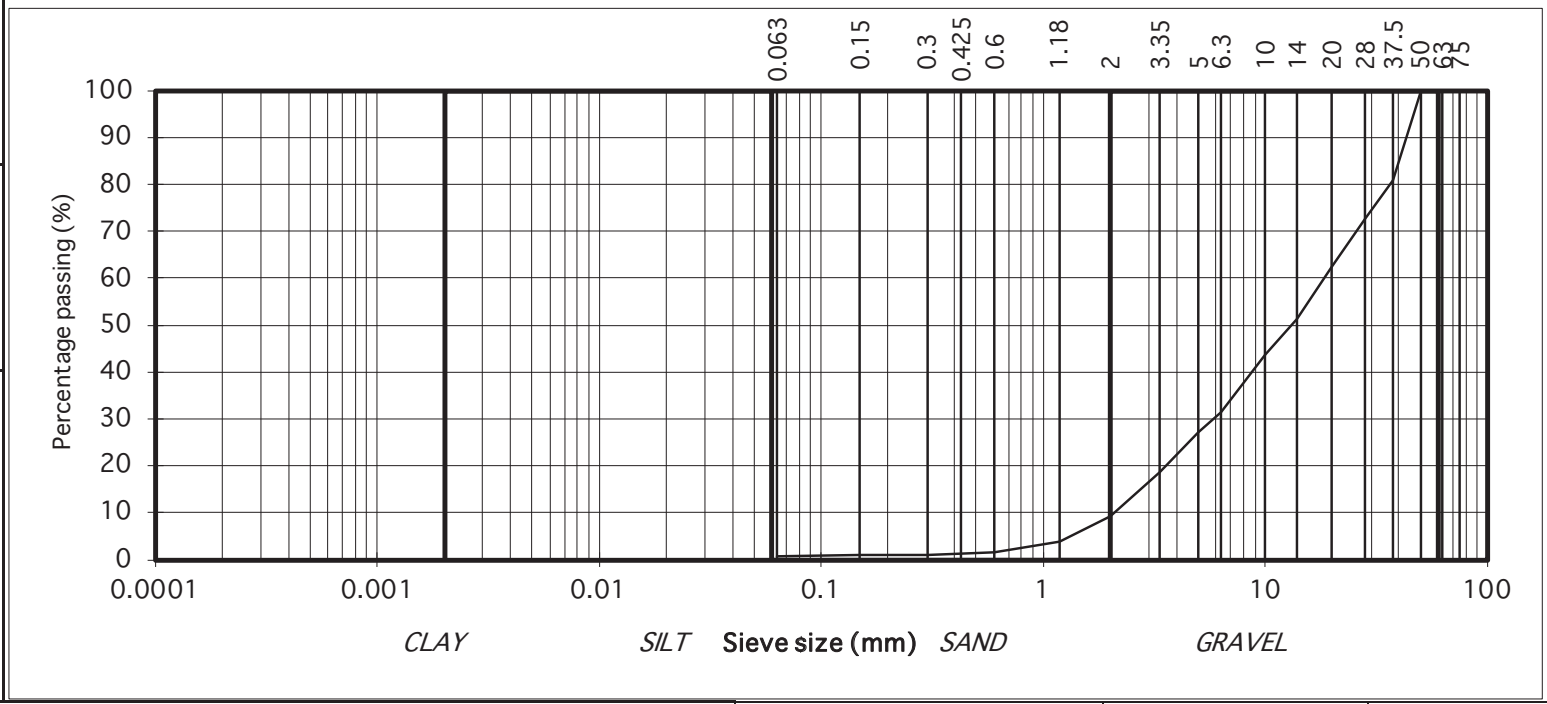
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	81	
28	73	
20	63	
14	51	
10	44	
6.3	32	
5	27	
3.35	19	
2	9	
1.18	4	SAND
0.6	1	
0.425	1	
0.3	1	
0.15	1	
0.063	1	SILT/CLAY

Contract No. 23110 Report No. R120930
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH26
Sample No. AA146147 Lab. Sample No. A21/1525
Sample Type: B
Depth (m) 1.00 Customer: Murphy International / BLP
Date Received 16/04/2021 Date Testing started 15/04/2021
Description: Brown slightly clayey/silty, sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

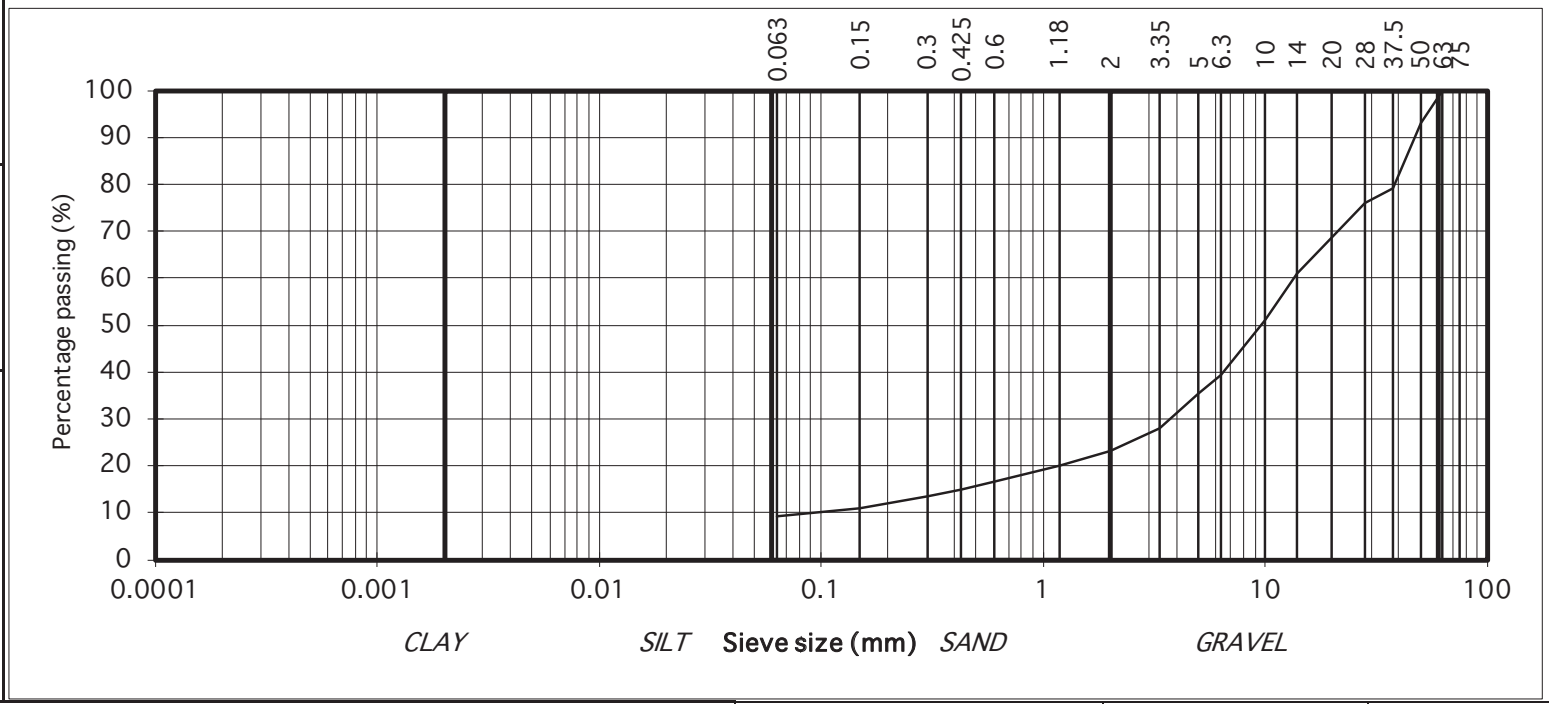
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	93	GRAVEL
37.5	79	
28	76	
20	69	
14	61	
10	51	
6.3	39	
5	35	
3.35	28	
2	23	
1.18	20	SAND
0.6	16	
0.425	15	
0.3	13	
0.15	11	
0.063	9	SILT/CLAY

Contract No. 23110 Report No. R120931
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH26
Sample No. AA146154 Lab. Sample No. A21/1527
Sample Type: B
Depth (m) 8.00 Customer: Murphy International / BLP
Date Received 16/04/2021 Date Testing started 16/04/2021
Description: Brown clayey/silty, sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

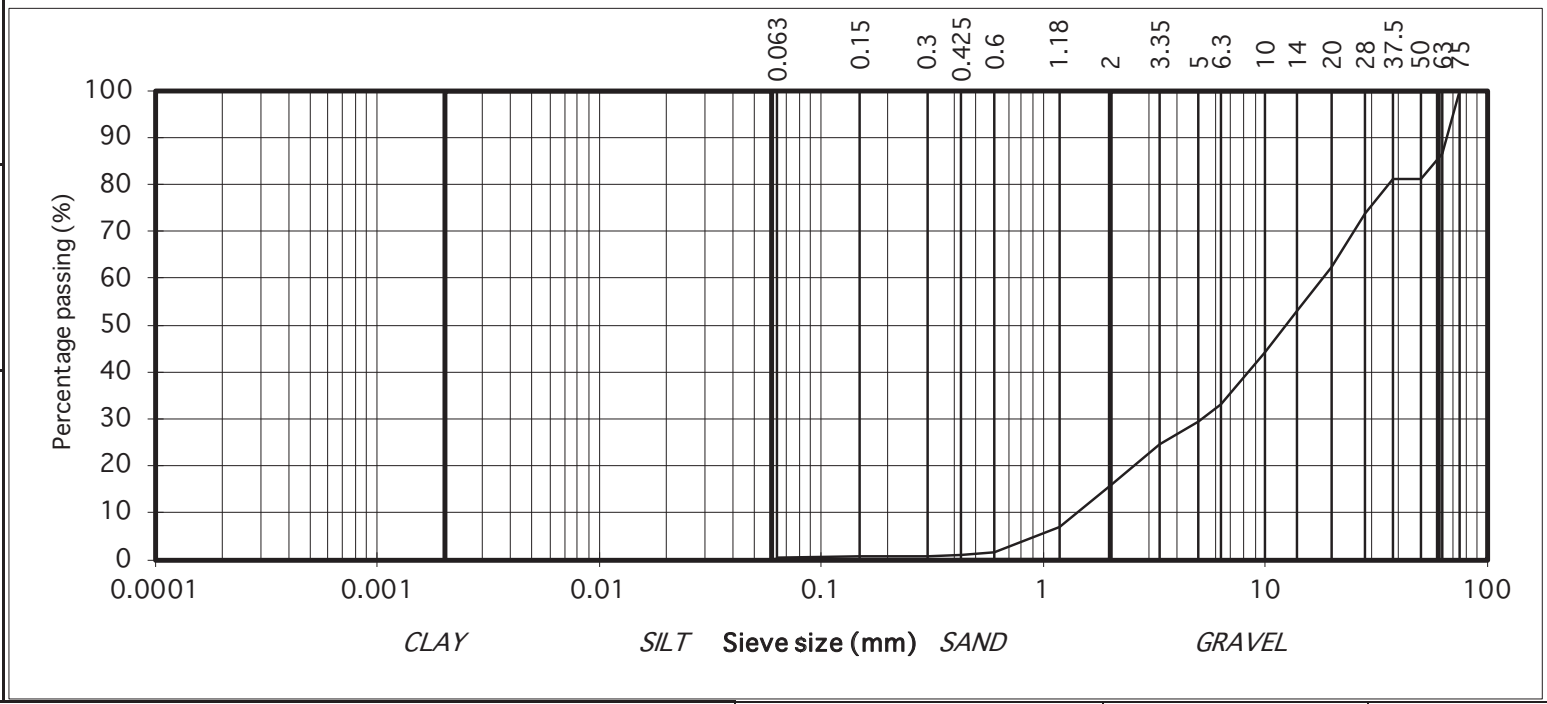
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	87	
50	81	GRAVEL
37.5	81	
28	74	
20	62	
14	53	
10	44	
6.3	33	
5	30	
3.35	25	
2	16	
1.18	7	SAND
0.6	1	
0.425	1	
0.3	1	
0.15	1	
0.063	1	SILT/CLAY

Contract No. 23110 Report No. R120932
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH27
Sample No. AA140382 Lab. Sample No. A21/1534
Sample Type: B
Depth (m) 2.00 Customer: Murphy International / BLP
Date Received 16/04/2021 Date Testing started 16/04/2021
Description: Brown slightly clayey/silty, sandy, GRAVEL with some cobbles

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

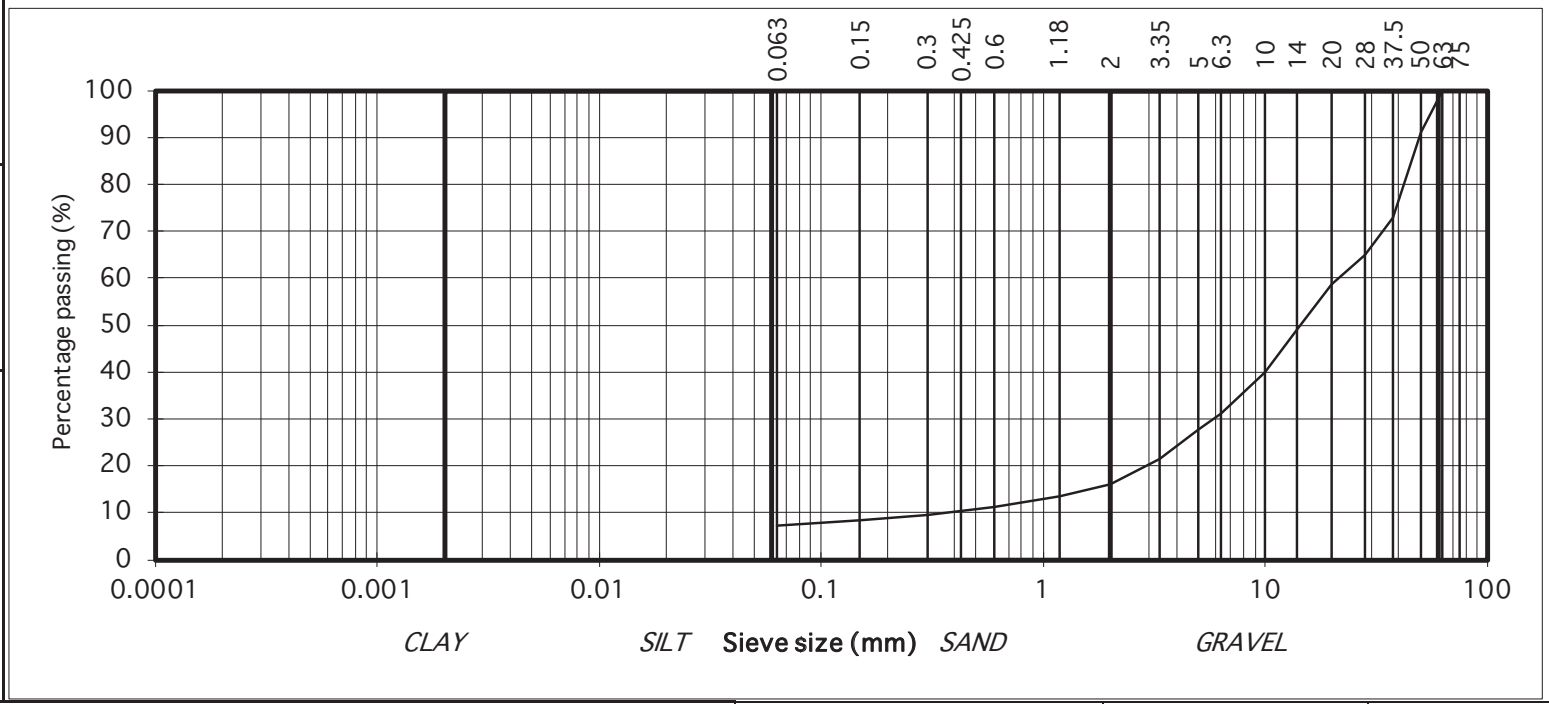
Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	91	GRAVEL
37.5	73	
28	65	
20	59	
14	49	
10	40	
6.3	31	
5	28	
3.35	21	
2	16	
1.18	13	SAND
0.6	11	
0.425	10	
0.3	10	
0.15	8	
0.063	7	SILT/CLAY

Contract No.	23110	Report No.	R120933
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	BH29		
Sample No.	AA140398	Lab. Sample No.	A21/1541
Sample Type:	B		
Depth (m)	8.00	Customer:	Murphy International / BLP
Date Received	16/04/2021	Date Testing started	16/04/2021
Description:	Brown clayey/silty, sandy, GRAVEL		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

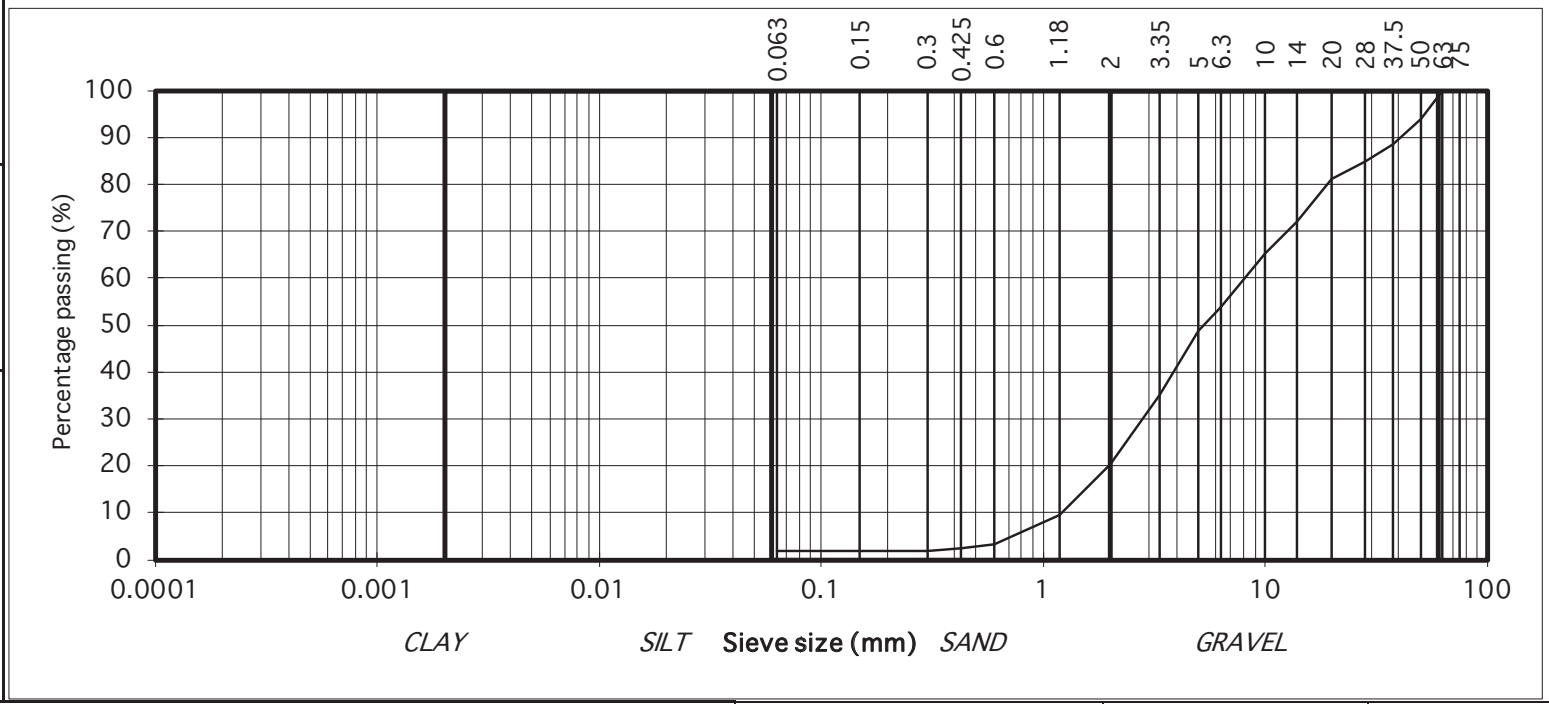
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	94	GRAVEL
37.5	89	
28	85	
20	81	
14	72	
10	65	
6.3	54	
5	49	
3.35	35	
2	20	
1.18	10	SAND
0.6	3	
0.425	2	
0.3	2	
0.15	2	
0.063	2	SILT/CLAY

Contract No. 23110 Report No. R120952
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH29
Sample No. AA145352 Lab. Sample No. A21/1542
Sample Type: B
Depth (m) 12.00 Customer: Murphy International / BLP
Date Received 16/04/2021 Date Testing started 16/04/2021
Description: Brown slightly clayey/silty, sandy, GRAVEL

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

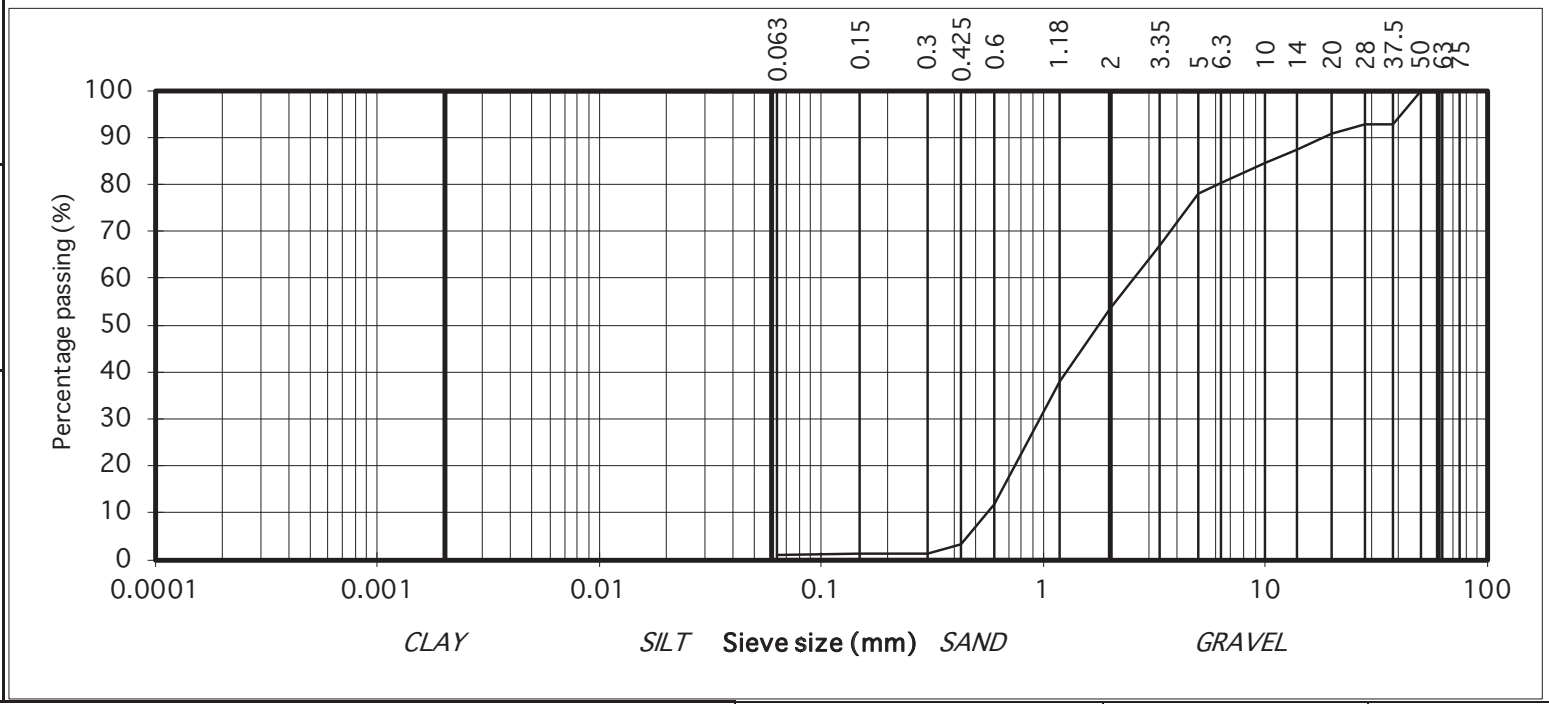
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	93	
28	93	
20	91	
14	88	
10	85	
6.3	80	
5	78	
3.35	67	
2	54	
1.18	38	SAND
0.6	12	
0.425	3	
0.3	1	
0.15	1	
0.063	1	SILT/CLAY

Contract No. 23110 Report No. R120934
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH30
Sample No. AA140364 Lab. Sample No. A21/1544
Sample Type: B
Depth (m) 2.00 Customer: Murphy International / BLP
Date Received 16/04/2021 Date Testing started 16/04/2021
Description: Brown slightly clayey/silty, very gravelly, SAND

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

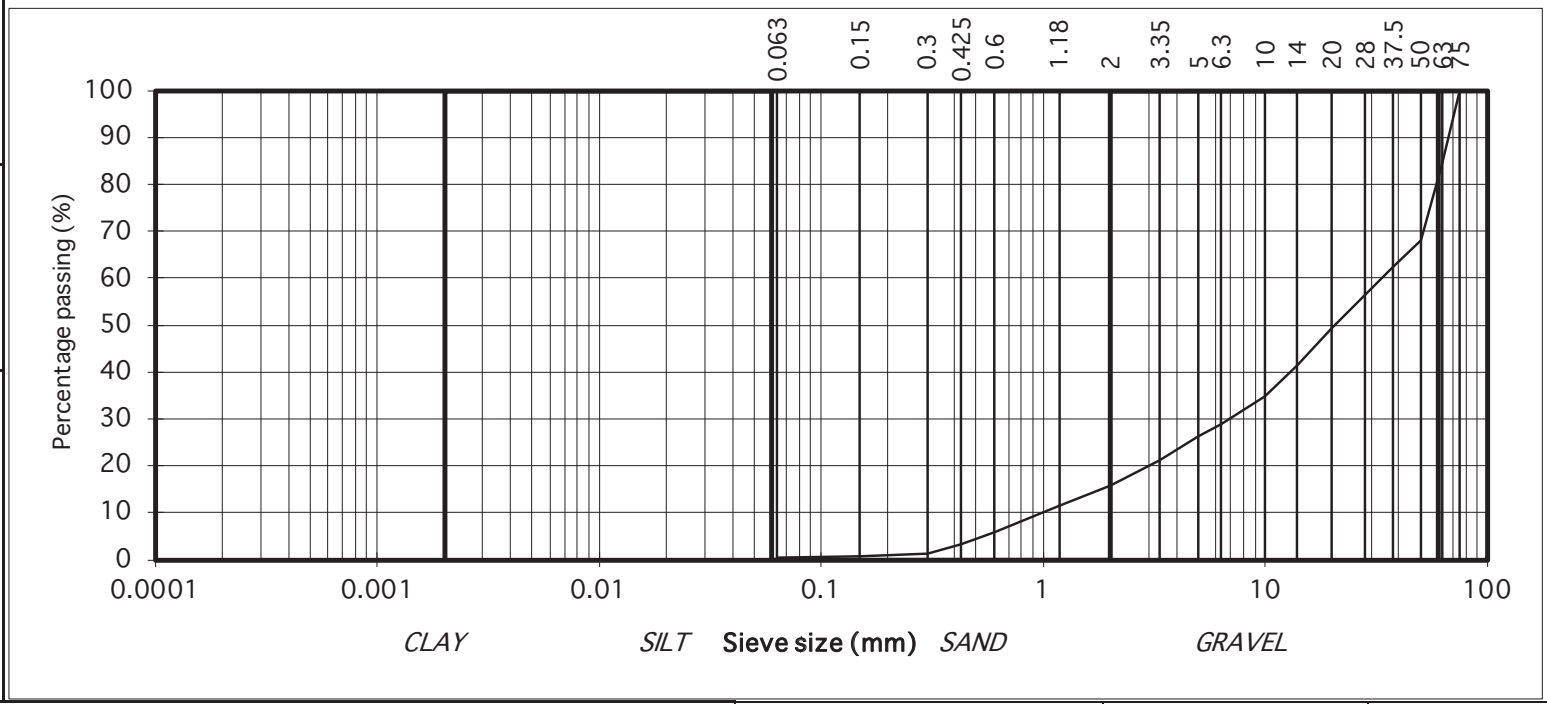
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	85	
50	68	GRAVEL
37.5	62	
28	56	
20	49	
14	41	
10	35	
6.3	29	
5	26	
3.35	21	
2	16	
1.18	12	SAND
0.6	6	
0.425	3	
0.3	1	
0.15	1	
0.063	0	SILT/CLAY

Contract No. 23110 Report No. R120935
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : BH30
Sample No. AA140366 Lab. Sample No. A21/1545
Sample Type: B
Depth (m) 4.00 Customer: Murphy International / BLP
Date Received 16/04/2021 Date Testing started 16/04/2021
Description: Brown sandy, GRAVEL with some cobbles

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

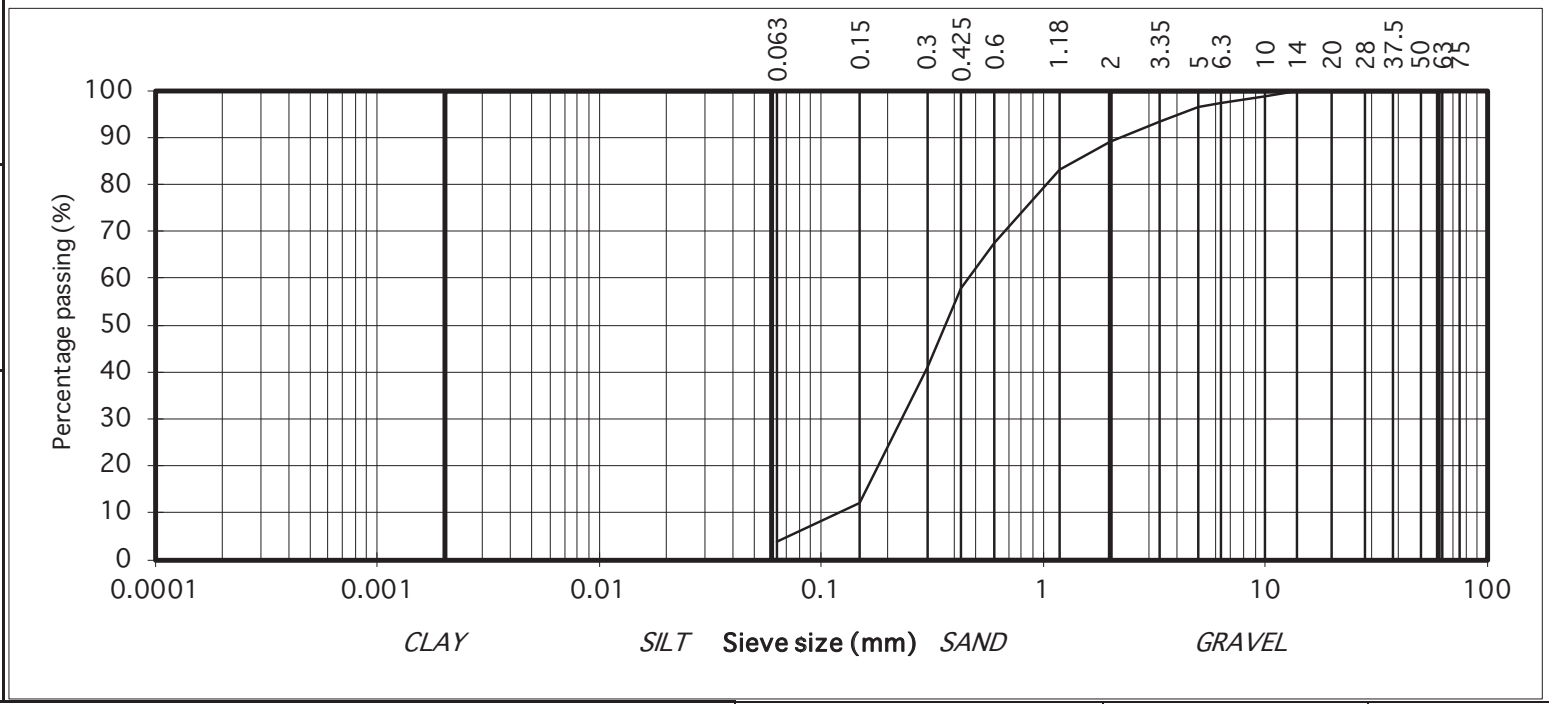
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	100	
14	100	
10	99	
6.3	97	
5	96	
3.35	94	
2	89	SAND
1.18	83	
0.6	68	
0.425	58	
0.3	41	
0.15	12	
0.063	4	SILT/CLAY

Contract No.	23110	Report No.	R120232
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	TP01		
Sample No.	AA142227	Lab. Sample No.	A21/1165
Sample Type:	B		
Depth (m)	1.00	Customer:	Murphys Int/BLP
Date Received	23/03/2021	Date Testing started	23/03/2021
Description:	Brown slightly clayey/silty, gravelly, SAND		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

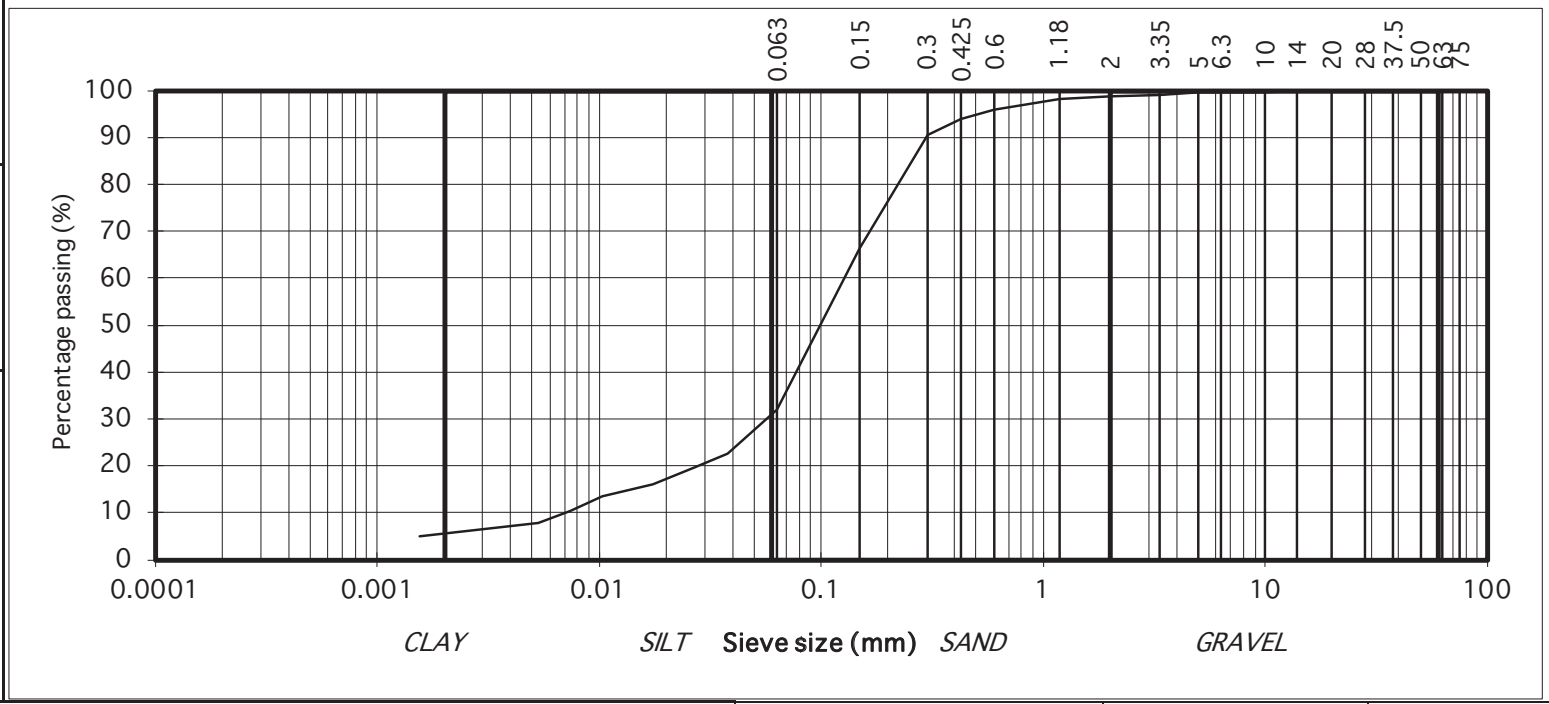
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	100	
14	100	
10	100	
6.3	100	
5	100	
3.35	99	
2	99	
1.18	98	SAND
0.6	96	
0.425	94	
0.3	91	
0.15	66	
0.063	32	SILT/CLAY
0.038	22	
0.027	20	
0.018	16	
0.010	13	
0.007	10	
0.005	8	
0.002	5	

Contract No.	23110	Report No.	R120921
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	TP03		
Sample No.	AA142236	Lab. Sample No.	A21/1172
Sample Type:	B		
Depth (m)	1.00	Customer:	Murphy International / BLP
Date Received	23/03/2021	Date Testing started	23/03/2021
Description:	Brown very sandy, slightly gravelly, SILT/CLAY		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

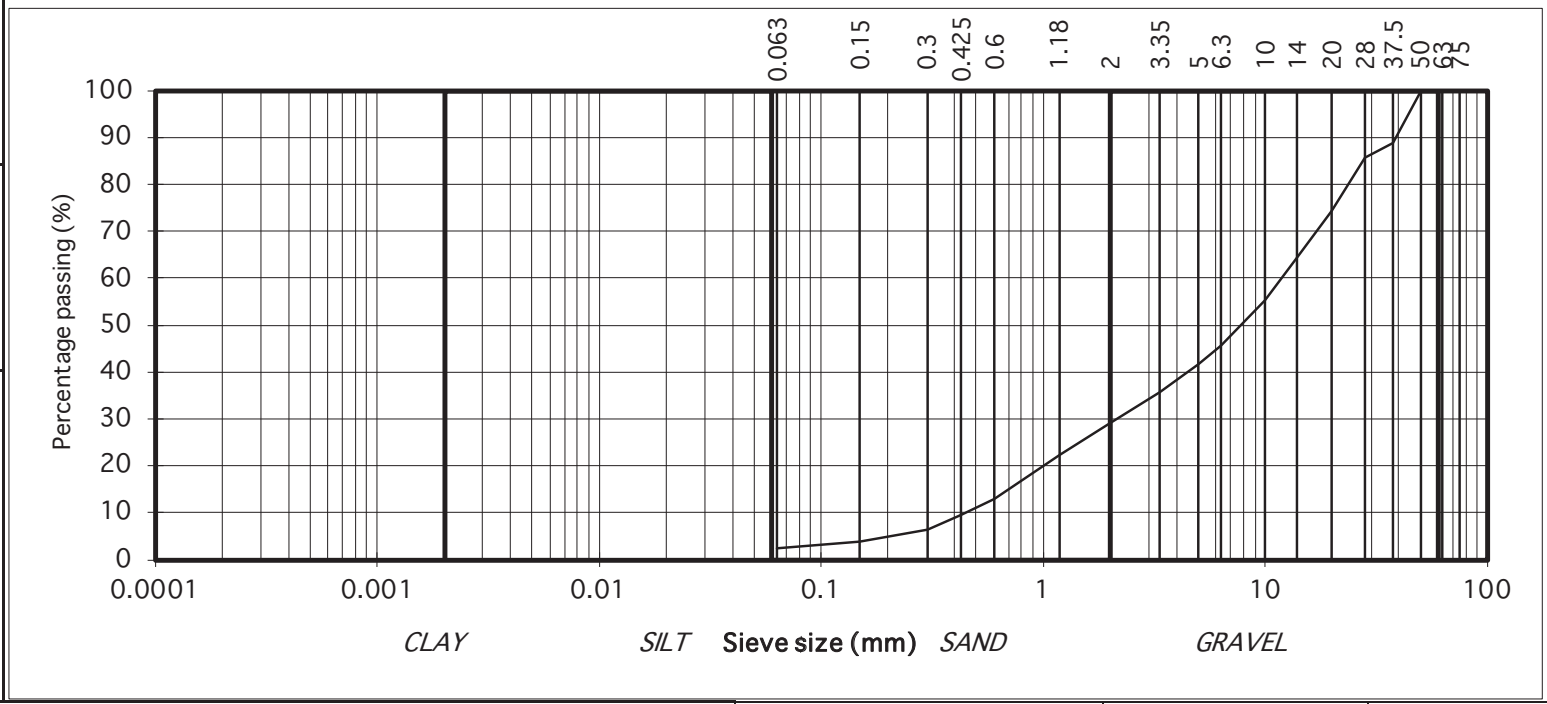
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	89	
28	86	
20	74	
14	64	
10	55	
6.3	46	
5	42	
3.35	36	
2	29	
1.18	22	SAND
0.6	13	
0.425	9	
0.3	6	
0.15	4	
0.063	3	SILT/CLAY

Contract No.	23110	Report No.	R120197
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	TP05		
Sample No.	AA142260	Lab. Sample No.	A21/1174
Sample Type:	B		
Depth (m)	2.00	Customer:	Murphys Int/BLP
Date Received	23/03/2021	Date Testing started	23/03/2021
Description:	Brown slightly clayey/silty, very sandy, GRAVEL		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

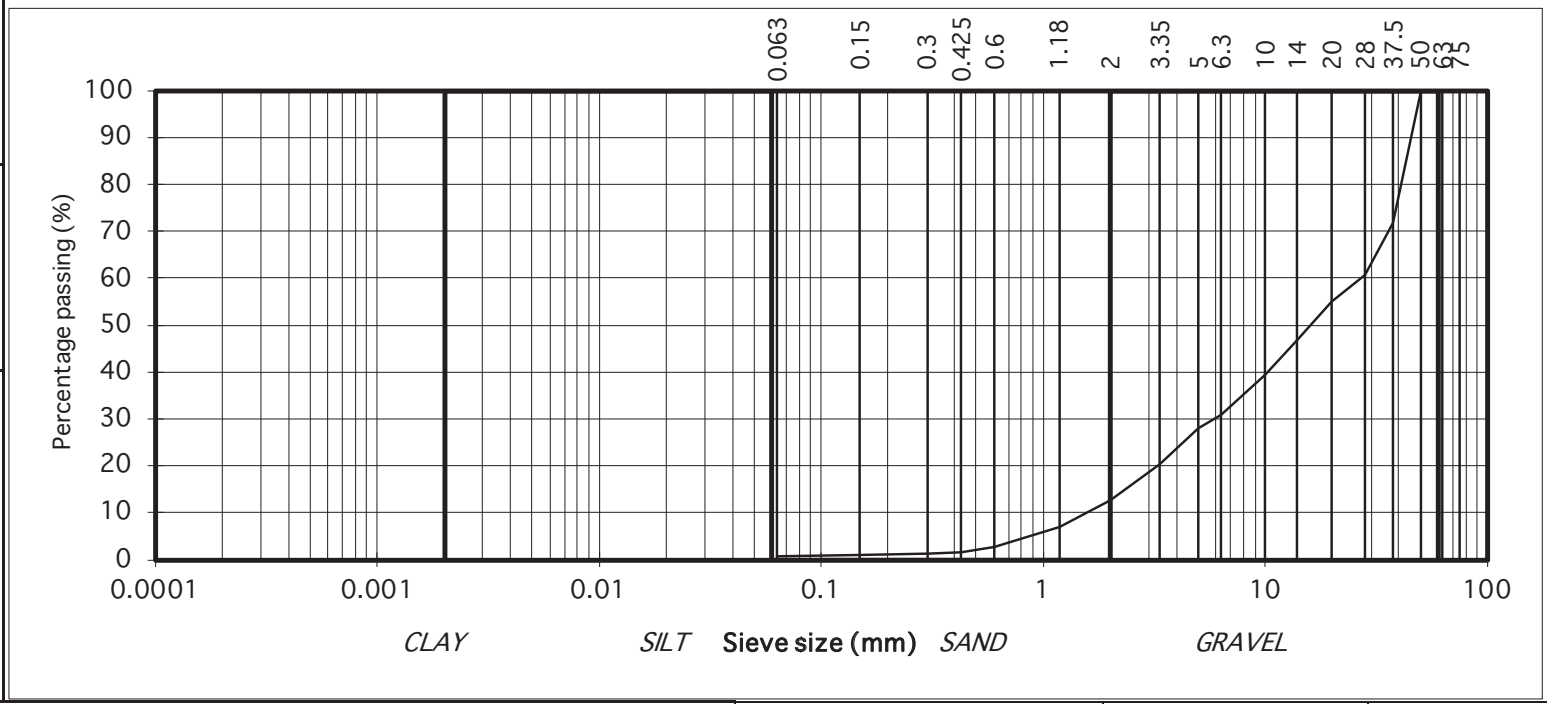
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	72	
28	61	
20	55	
14	47	
10	39	
6.3	31	
5	28	
3.35	20	
2	13	
1.18	7	SAND
0.6	3	
0.425	2	
0.3	1	
0.15	1	
0.063	1	SILT/CLAY

Contract No. 23110 Report No. R120922
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : TP06
Sample No. AA142255 Lab. Sample No. A21/1175
Sample Type: B
Depth (m) 1.00 Customer: Murphy International / BLP
Date Received 23/03/2021 Date Testing started 23/03/2021
Description: Brown slightly clayey/silty, sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

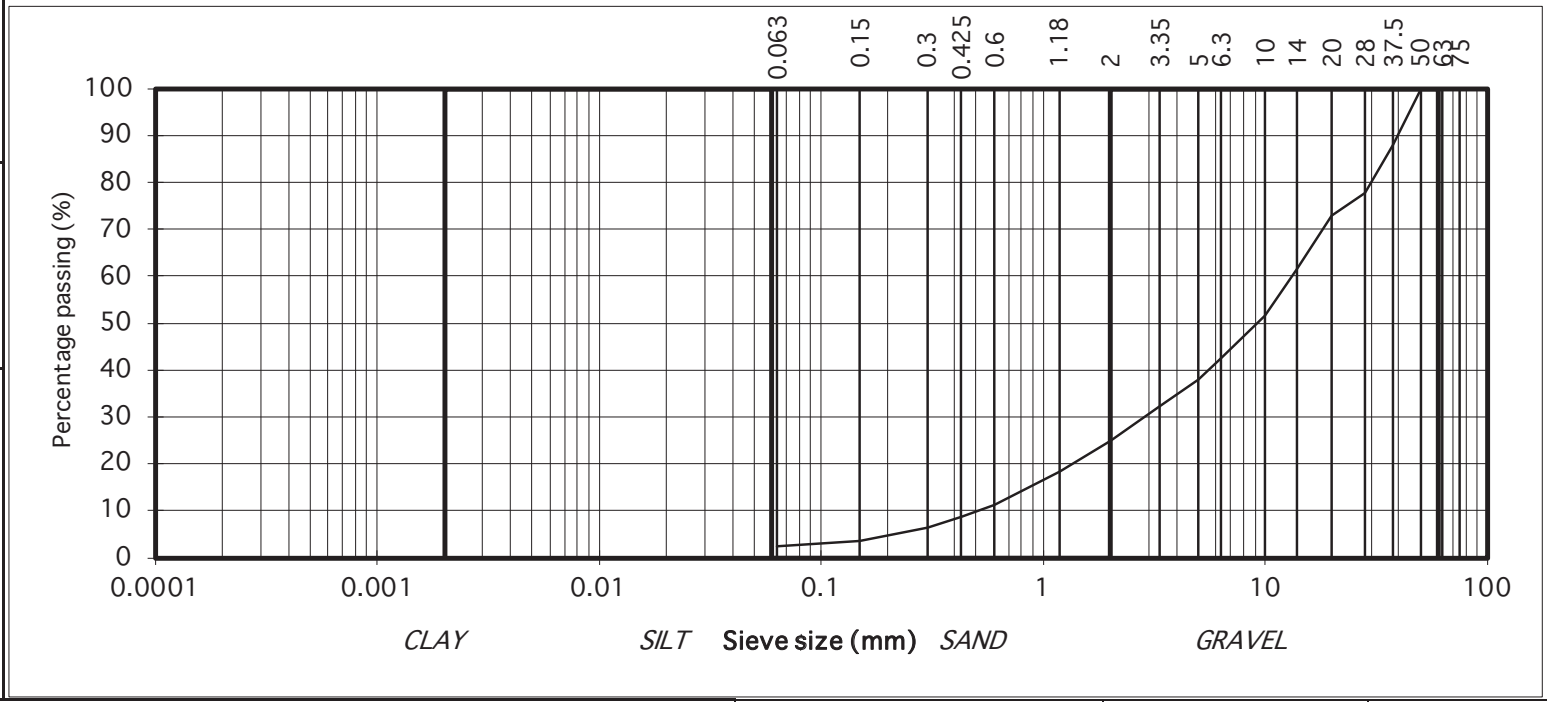
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	88	
28	78	
20	73	
14	62	
10	52	
6.3	42	
5	38	
3.35	32	
2	25	
1.18	18	SAND
0.6	11	
0.425	9	
0.3	6	
0.15	4	
0.063	2	SILT/CLAY

Contract No.	23110	Report No.	R120923
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	TP09		
Sample No.	AA142234	Lab. Sample No.	A21/1180
Sample Type:	B		
Depth (m)	2.00	Customer:	Murphy International / BLP
Date Received	23/03/2021	Date Testing started	23/03/2021
Description:	Brown slightly clayey/silty, very sandy, GRAVEL		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

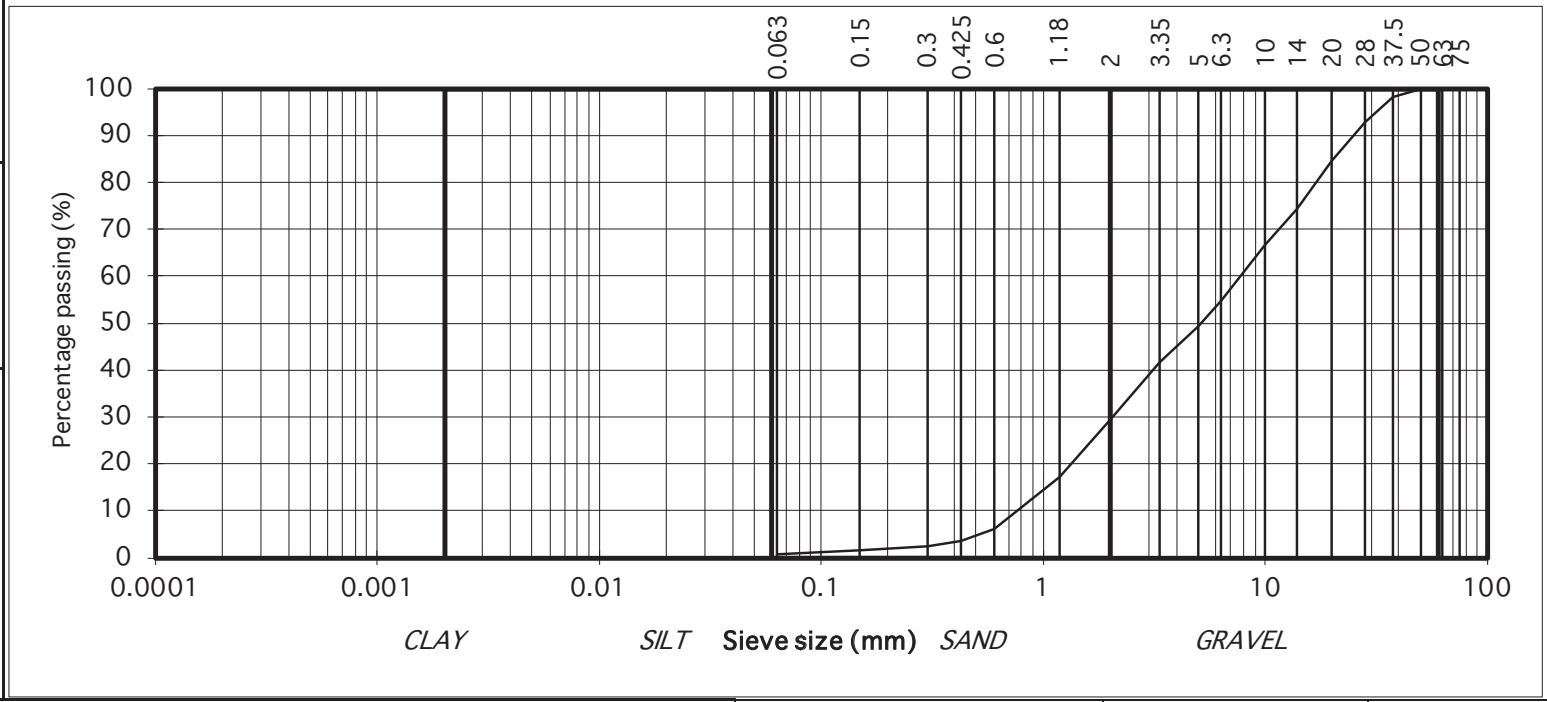
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	98	
28	93	
20	85	
14	74	
10	67	
6.3	55	
5	49	
3.35	42	
2	29	
1.18	17	SAND
0.6	6	
0.425	4	
0.3	2	
0.15	1	
0.063	1	SILT/CLAY

Contract No. 23110 Report No. R120924
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : TP12
Sample No. AA142253 Lab. Sample No. A21/1183
Sample Type: B
Depth (m) 1.00 Customer: Murphy International / BLP
Date Received 23/03/2021 Date Testing started 23/03/2021
Description: Brown slightly clayey/silty, very sandy, GRAVEL

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

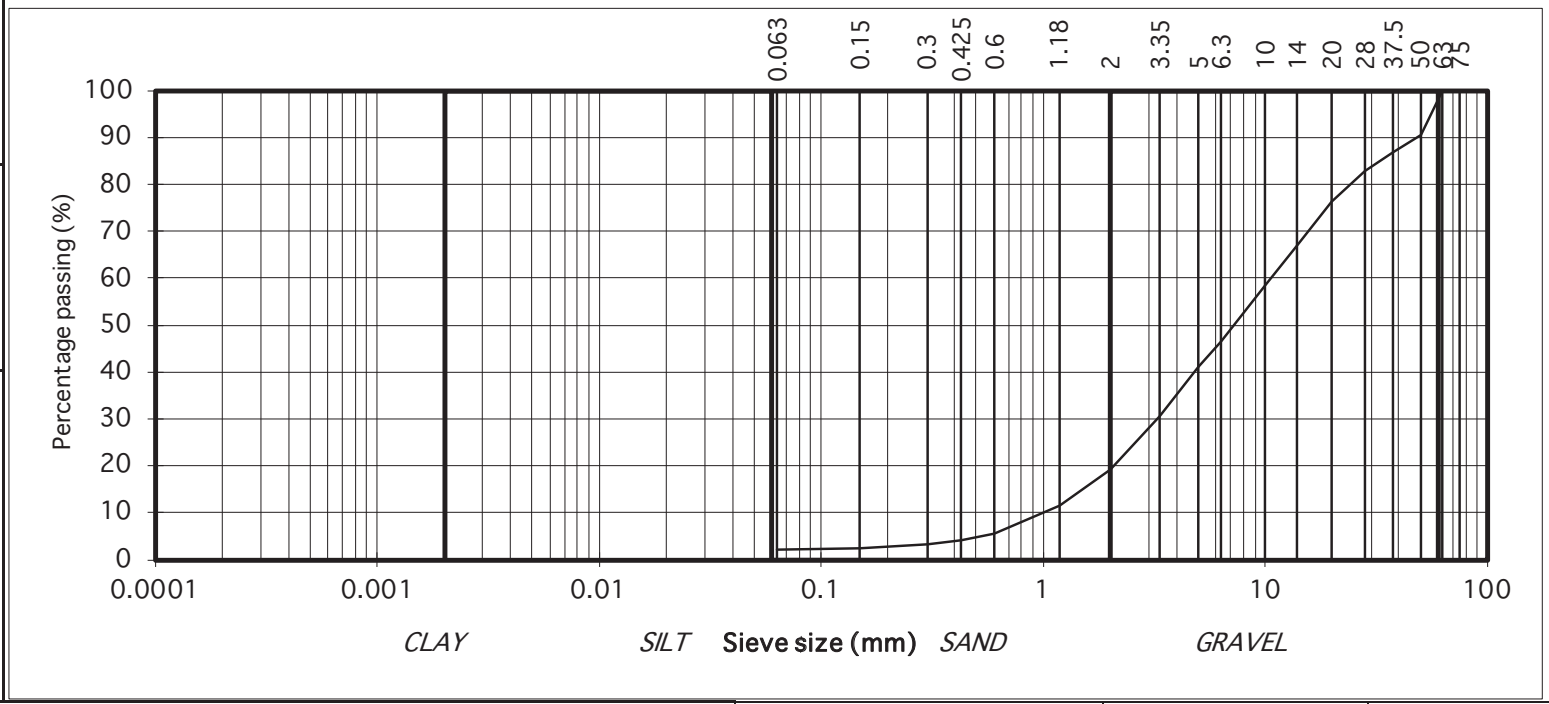
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	91	GRAVEL
37.5	87	
28	83	
20	76	
14	67	
10	58	
6.3	46	
5	41	
3.35	30	
2	19	
1.18	11	SAND
0.6	5	
0.425	4	
0.3	3	
0.15	2	
0.063	2	SILT/CLAY

Contract No. 23110 Report No. R120925
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : TP13
Sample No. AA142262 Lab. Sample No. A21/1184
Sample Type: B
Depth (m) 2.00 Customer: Murphy International / BLP
Date Received 23/03/2021 Date Testing started 24/03/2021
Description: Brown slightly clayey/silty, sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

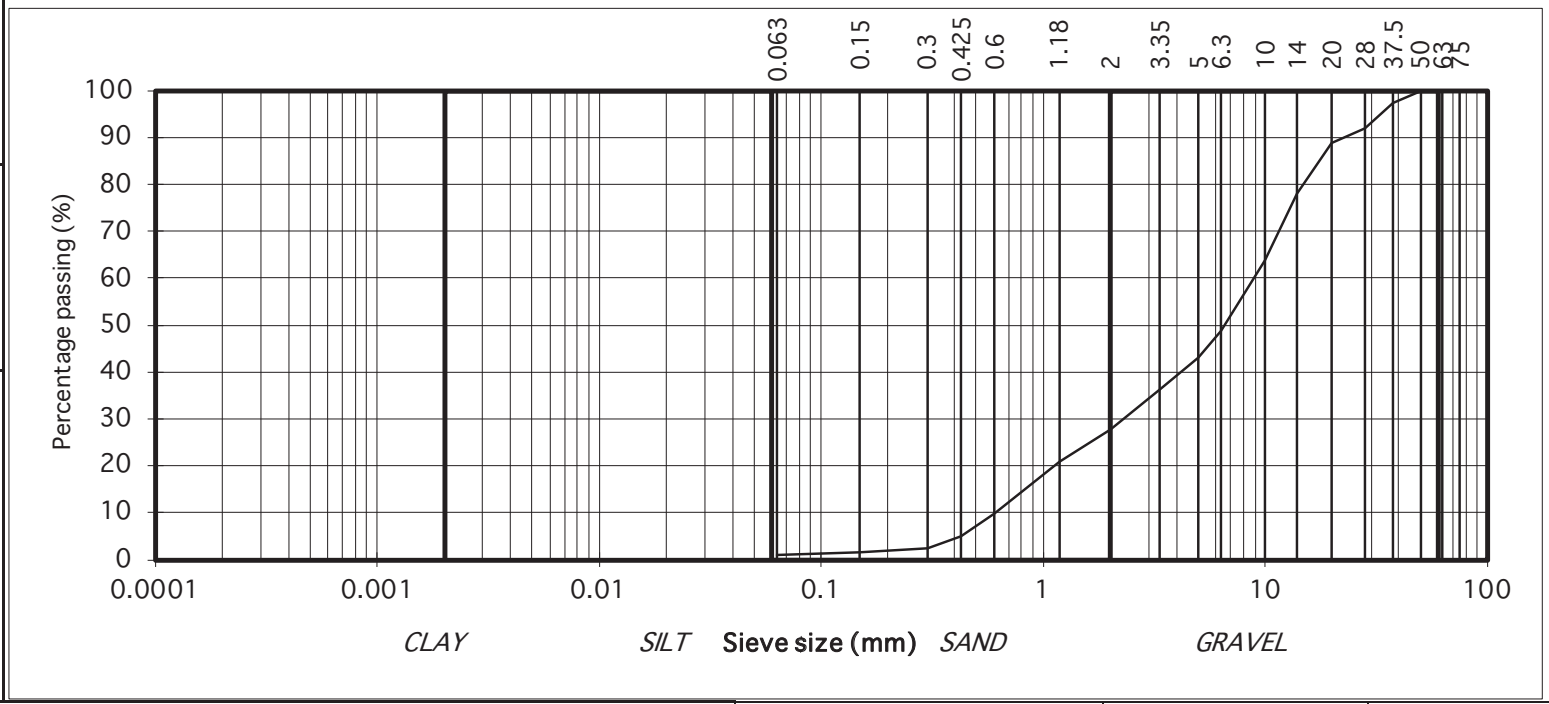
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	97	
28	92	
20	89	
14	78	
10	64	
6.3	49	
5	43	
3.35	36	
2	28	
1.18	21	SAND
0.6	10	
0.425	5	
0.3	2	
0.15	2	
0.063	1	SILT/CLAY

Contract No.	23110	Report No.	R120198
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	TP15		
Sample No.	AA142216	Lab. Sample No.	A21/1187
Sample Type:	B		
Depth (m)	2.00	Customer:	Murphys Int/BLP
Date Received	23/03/2021	Date Testing started	23/03/2021
Description:	Brown slightly clayey/silty, very sandy, GRAVEL		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

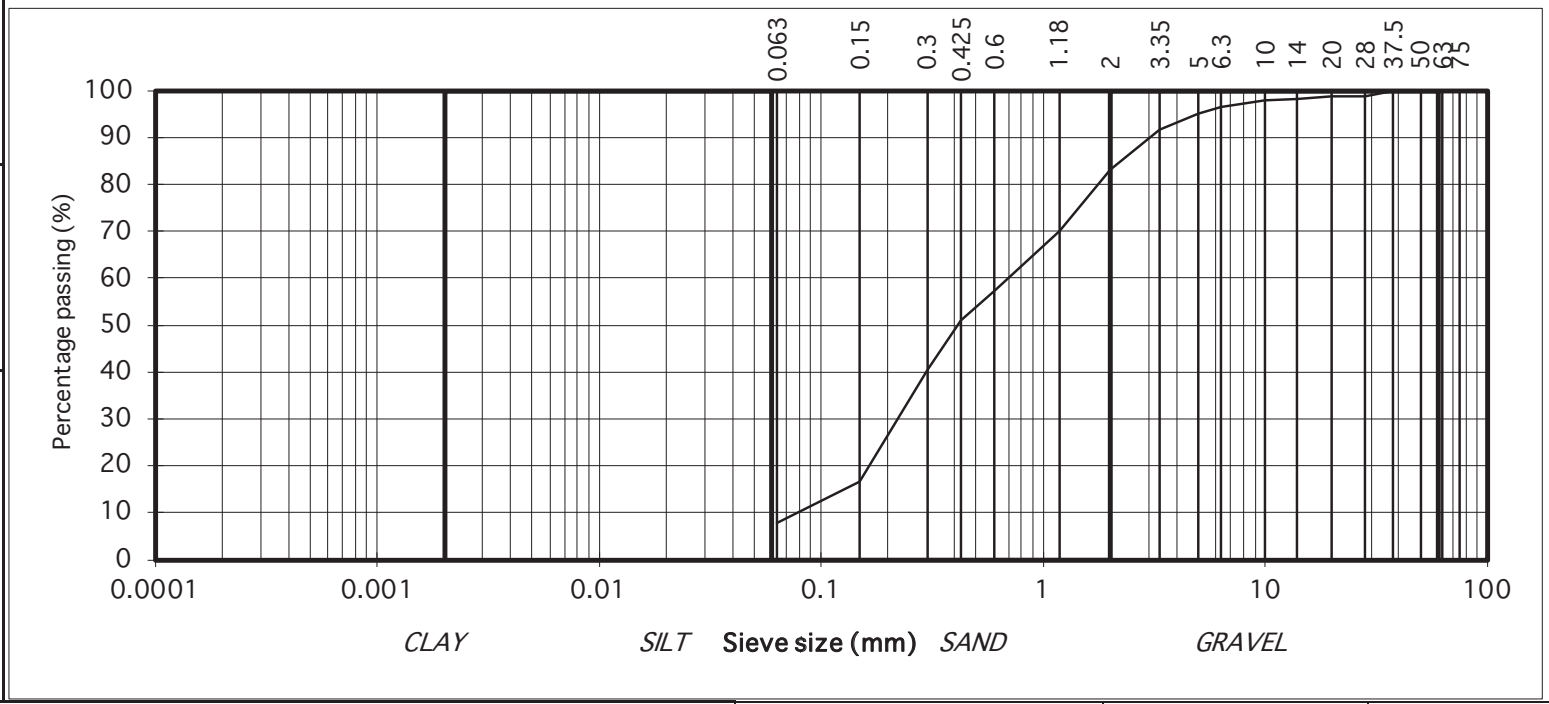
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	99	
20	99	
14	98	
10	98	
6.3	96	
5	95	
3.35	92	
2	83	
1.18	70	SAND
0.6	57	
0.425	51	
0.3	40	
0.15	17	
0.063	8	SILT/CLAY

Contract No.	23110	Report No.	R120926
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	TP16		
Sample No.	AA142265	Lab. Sample No.	A21/1188
Sample Type:	B		
Depth (m)	1.00	Customer:	Murphy International / BLP
Date Received	23/03/2021	Date Testing started	23/03/2021
Description:	Brown clayey/silty, gravelly, SAND		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

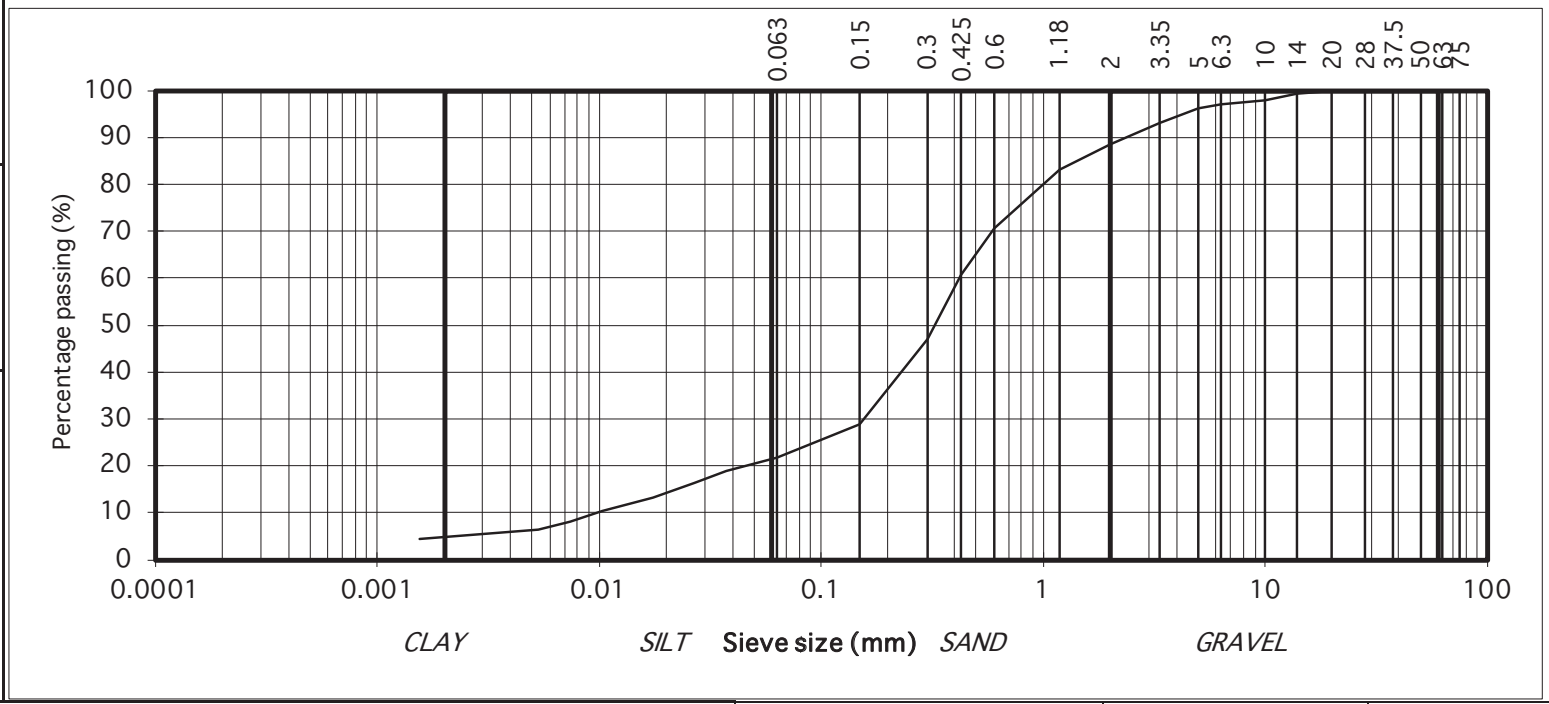
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	100	
14	100	
10	98	
6.3	97	
5	96	
3.35	93	
2	89	
1.18	83	SAND
0.6	71	
0.425	61	
0.3	47	
0.15	29	
0.063	22	SILT/CLAY
0.038	19	
0.027	16	
0.018	13	
0.010	10	
0.007	8	
0.005	6	
0.002	4	

Contract No.	23110	Report No.	R120927
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	TP23		
Sample No.	AA142238	Lab. Sample No.	A21/1193
Sample Type:	B		
Depth (m)	1.00	Customer:	Murphy International / BLP
Date Received	23/03/2021	Date Testing started	23/03/2021
Description:	Brown very sandy, slightly gravelly, SILT/CLAY		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

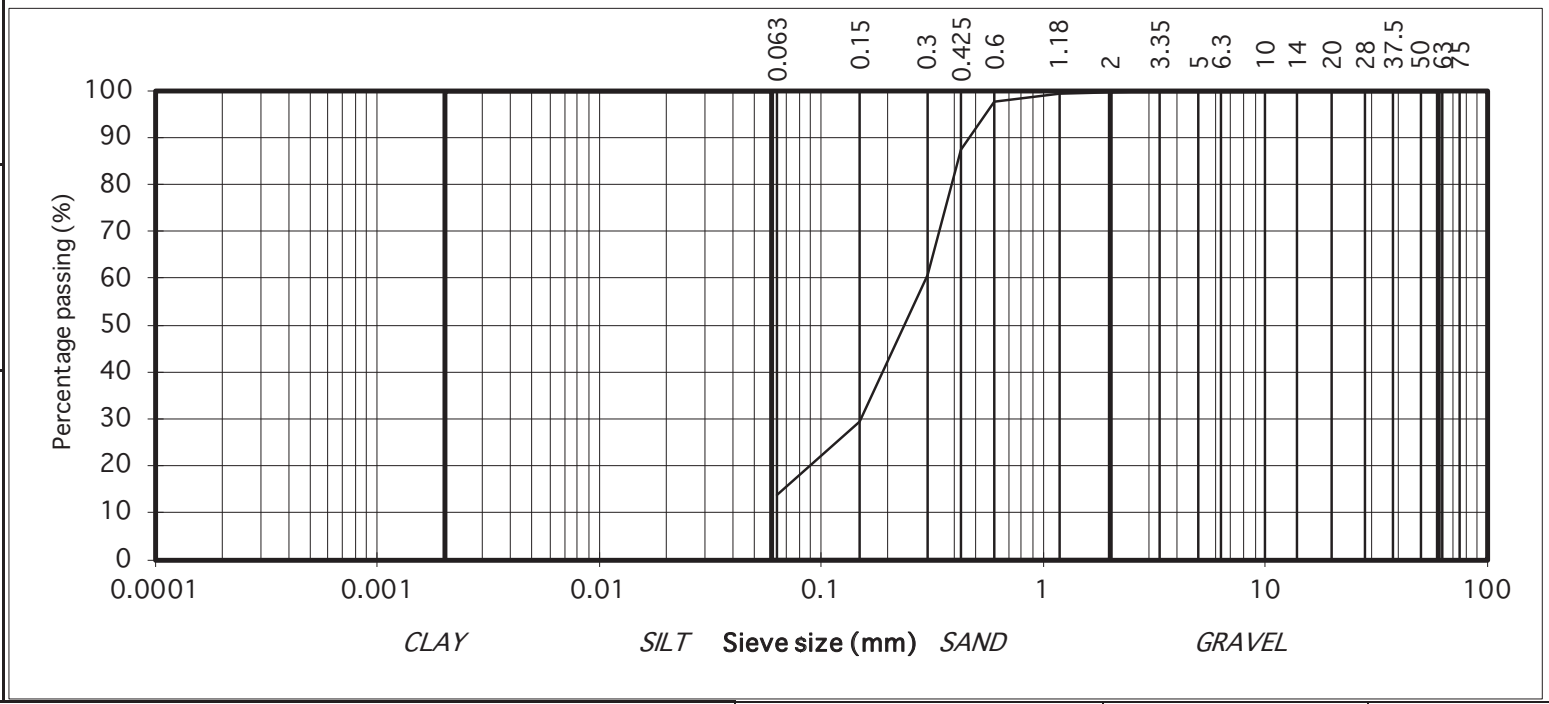
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	100	
14	100	
10	100	
6.3	100	
5	100	
3.35	100	
2	100	
1.18	99	SAND
0.6	98	
0.425	87	
0.3	61	
0.15	30	
0.063	14	SILT/CLAY

Contract No.	23110	Report No.	R120928
Contract Name:	Aston Lands , Great Connell , Newbridge , Co.Kildare		
BH/TP :	TP24		
Sample No.	AA142242	Lab. Sample No.	A21/1194
Sample Type:	B		
Depth (m)	1.00	Customer:	Murphy International / BLP
Date Received	23/03/2021	Date Testing started	24/03/2021
Description:	Brown clayey/silty, SAND		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.		



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

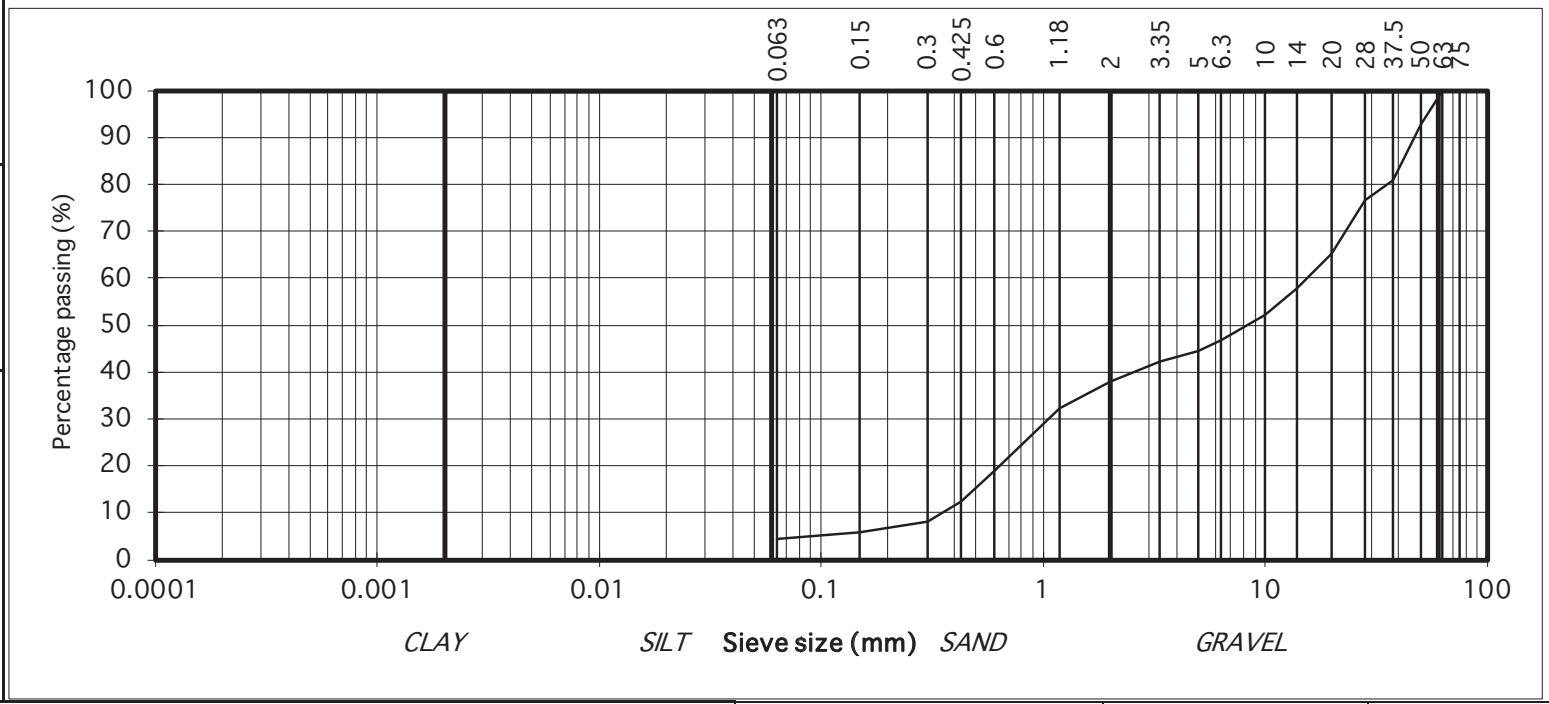
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	93	GRAVEL
37.5	81	
28	77	
20	65	
14	58	
10	52	
6.3	47	
5	44	
3.35	42	
2	38	
1.18	32	SAND
0.6	19	
0.425	12	
0.3	8	
0.15	6	
0.063	5	SILT/CLAY

Contract No. 23110 Report No. R120233
Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare
BH/TP : TP26
Sample No. AA142247 Lab. Sample No. A21/1196
Sample Type: B
Depth (m) 2.00 Customer: Murphys Int/BLP
Date Received 23/03/2021 Date Testing started 24/03/2021
Description: Brown slightly clayey/silty, very sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	12/05/21	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

IGSL Ltd
Materials Laboratory
M7 Business Park
Naas
Co. Kildare

Test Report

Dry Density/Moisture Content Relationship

Tested in accordance with BS1377:Part 4:1990

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No. R121511 Contract No. 23110

Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare

Lab Contract No. Location: TP04

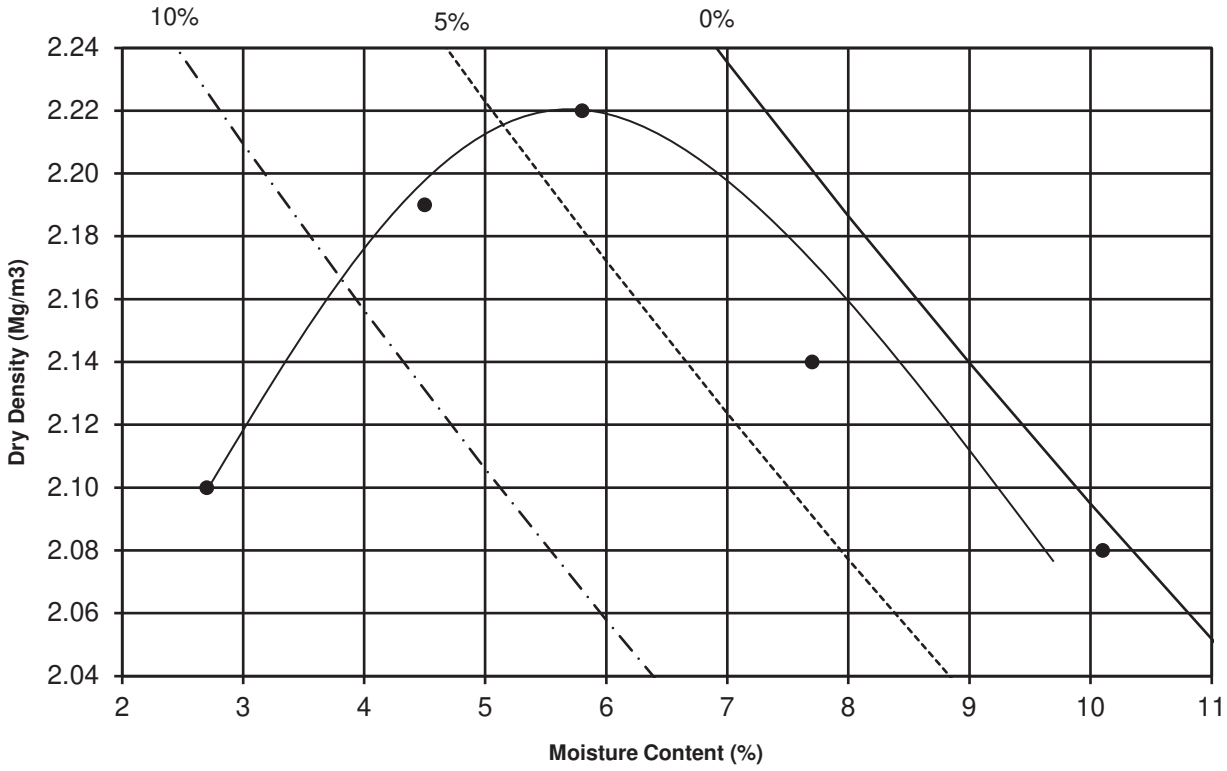
Sample No. AA142257 Depth (m) 1 Material Type B

Lab sample no. A21/1173 Customer: Murphy International / BLP

Date Received: 23/03/2021 Test Method: Vibro Hammer

Date Tested: 23/03/2021 BS1377:Part 4:1990 3.7

Dry Density (Mg/m^3)	2.10	2.19	2.22	2.14	2.08	0.00	
Moisture Content (%)	2.7	4.5	5.8	7.7	10	0	



Maximum Dry Density (Mg/m^3): 2.22 Optimum Moisture Content (%): 6

Description: Brown clayey silty sandy GRAVEL

Sample Preparation: Material passing 37.5mm ~~Single~~ / Separate samples used

Particle Density (Mg/m^3): 2.65 Particle Density: Assumed

% retained on 20/37.5mm sieve: 21

Persons authorised to approve reports
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

The result relates to the specimen tested.
Opinions and interpretations are outside the scope of accreditation

IGSL Materials Laboratory	Approved by	Date	Page
	H Byrne	12/05/21	1 of 1

IGSL Ltd
Materials Laboratory
M7 Business Park
Naas
Co. Kildare

Test Report

Dry Density/Moisture Content Relationship

Tested in accordance with BS1377:Part 4:1990

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No. R121512 Contract No. 23110

Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare

Lab Contract No. Location: TP08

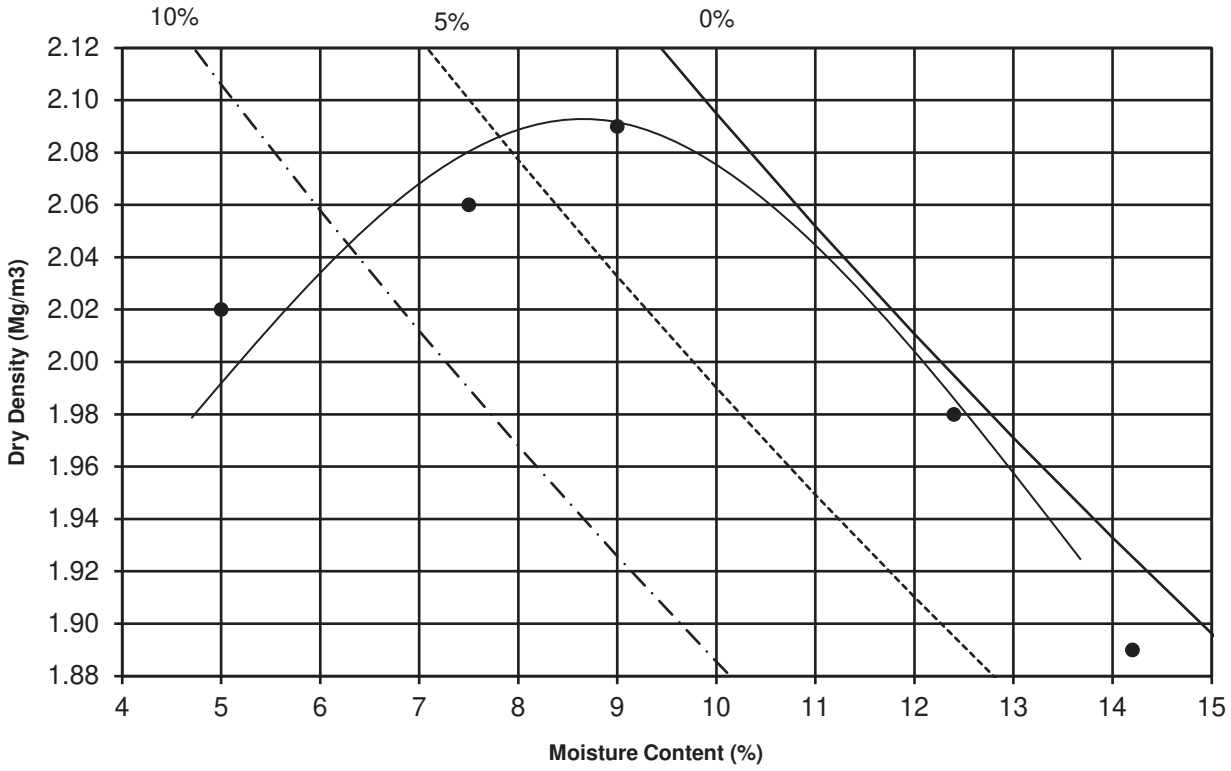
Sample No. AA142248 Depth (m) 1 Material Type B

Lab sample no. A21/1178 Customer: Murphy International / BLP

Date Received: 23/03/2021 Test Method: Vibro Hammer

Date Tested: 23/03/2021 BS1377:Part 4:1990 3.7

Dry Density (Mg/m^3)	2.06	2.09	1.98	2.02	1.89	0.00	
Moisture Content (%)	7.5	9.0	12.4	5.0	14	0	



Maximum Dry Density (Mg/m^3): 2.09 Optimum Moisture Content (%): 9

Description: Brown clayey/silty sandy GRAVEL

Sample Preparation: Material passing 37.5mm ~~Single~~ / Separate samples used

Particle Density (Mg/m^3): 2.65 Particle Density: Assumed

% retained on 20/37.5mm sieve: 19

The result relates to the specimen tested.
Opinions and interpretations are outside the scope of accreditation

Persons authorised to approve reports
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

IGSL Materials Laboratory	Approved by	Date	Page
	H Byrne	12/05/21	1 of 1

IGSL Ltd
Materials Laboratory
M7 Business Park
Naas
Co. Kildare

Test Report

Dry Density/Moisture Content Relationship

Tested in accordance with BS1377:Part 4:1990

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No. R121513 Contract No. 23110

Contract Name: Aston Lands , Great Connell , Newbridge , Co.Kildare

Lab Contract No. Location: TP18

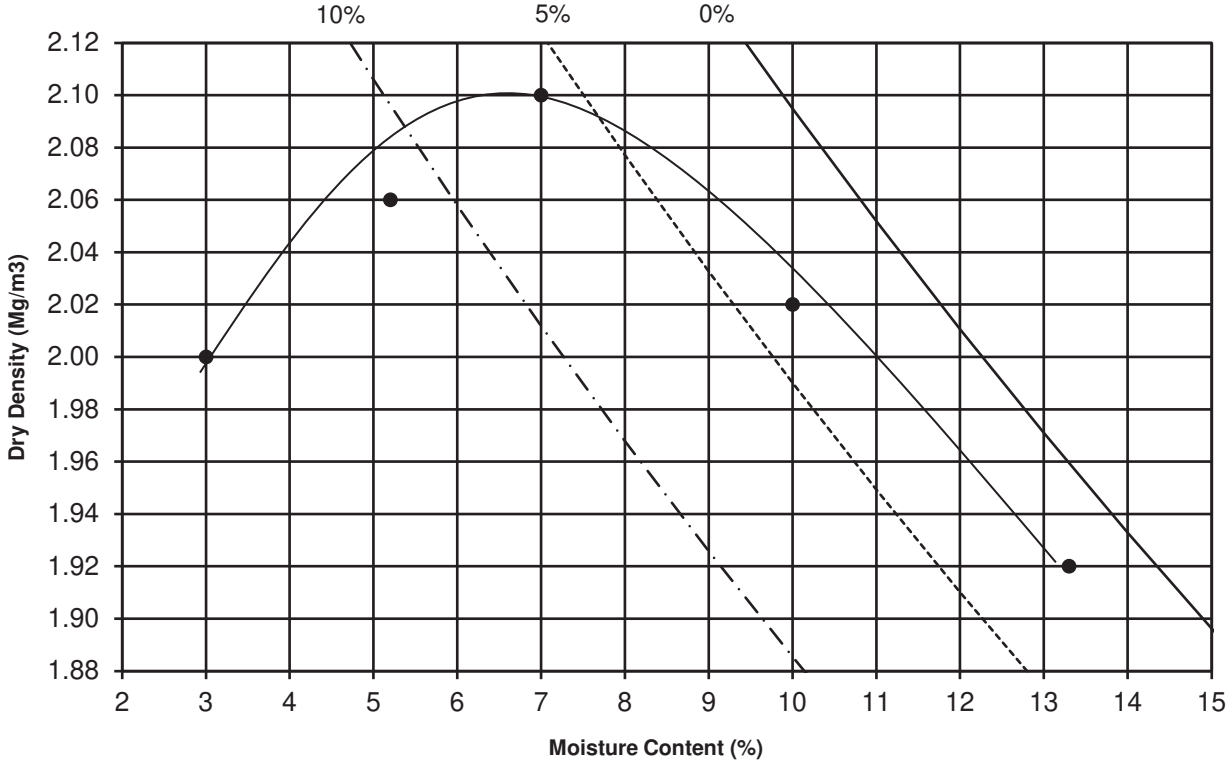
Sample No. AA142217 Depth (m) 1 Material Type B

Lab sample no. A21/1191 Customer: Murphy International / BLP

Date Received: 23/03/2021 Test Method: Vibro Hammer

Date Tested: 23/03/2021 BS1377:Part 4:1990 3.7

Dry Density (Mg/m^3)	2.10	2.02	1.92	2.00	2.06	0.00	
Moisture Content (%)	7.0	10	13	3.0	5.2	0	



Maximum Dry Density (Mg/m^3): 2.10 Optimum Moisture Content (%): 7

Description: Brown clayey/silty sandy GRAVEL

Sample Preparation: Material passing 37.5mm ~~Single~~ / Separate samples used

Particle Density (Mg/m^3): 2.65 Particle Density: Assumed

% retained on 20/37.5mm sieve: 27

Persons authorised to approve reports
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

The result relates to the specimen tested.
Opinions and interpretations are outside the scope of accreditation

IGSL Materials Laboratory	Approved by	Date	Page
	H Byrne	12/05/21	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Shear Strength by the Laboratory Vane Method

Tested in accordance with BS1377:Part 7:1990, clause 3

Report No. **R119555** Contract No. 23110 Contract Name: Aston Lands Great Connell Newbridge

Customer Murphy International / BLP

Samples Received: Date Tested: 30/03/21 Note: samples were tamped into a container before testing

BH	Sample No.	Depth (m)	Specimen Type	Average Shear Strength (kPa)	Average Remoulded Shear Strength (kPa) after 2 revolutions of the vane	Moisture Content % of material tested	Vane Size (mm)	Description
17		1.5	R	22.4	3.2	21	12.7 x 12.7	Brown sandy SILT/CLAY
17		4.5	R	56.0	21.6	12	12.7 x 12.7	Grey slightly sandy slightly gravelly SILT/CLAY with roots

Specimen Types: P - Piston U - U100 tube R - Remoulded specimen

IGSL Ltd Laboratory	Persons authorized to approve reports	Approved by	Date	Page
	J Barrett (Quality Manager)		08/04/21	1 of 1

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Proposed Residential Development at Great Connell, Newbridge
Contract no. 23110

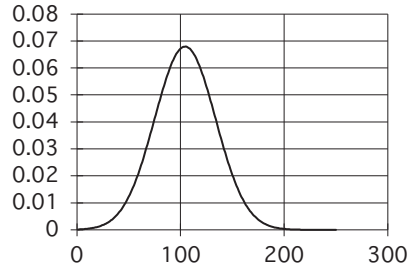
Sample Type: Core
Date of test: 29/04/2021

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC13	18.0	78	38.0	1.222	6.25	7.63	153	d	//
	19.0	78	19.0	1.222	3.12	3.81	76	d	//
	2.5	78	22.0	1.222	3.62	4.42	88	d	//
RC19	6.5	78	24.0	1.222	3.94	4.82	96	d	//
	19.0	78	27.0	1.222	4.44	5.42	108	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	5	5
Minimum	3.81	76
Average	5.22	104
Maximum	7.63	153
Standard Dev.	1.47	29
Upper 95% Confidence Limit	8.10	161.97
Lower 95% Confidence Limit	2.34	46.84

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations	
i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Proposed Residential Development at Great Connell, Newbridge
Job Number:	23110
Hole No:	RC13
Depth (m):	18.50m

Sample Description

Colour:	Light blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

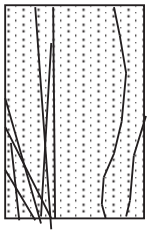
Sample Measurements

Length	202	
Diameter (Ø)	78.1	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	384	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{384000}{4788.19385}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

= 80.16 (Mpa)

Bulk Density = 2.65 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Proposed Residential Development at Great Connell, Newbridge
Job Number:	23110
Hole No:	RC13
Depth (m):	20.00m

Sample Description

Colour:	Light blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

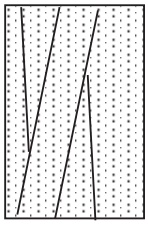
Sample Measurements

Length	204	
Diameter (Ø)	78	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	442	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{442000}{4775.94}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$=$ 92.50 (Mpa)

Bulk Density $=$ 2.65 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Proposed Residential Development at Great Connell, Newbridge
Job Number:	23110
Hole No:	RC19
Depth (m):	18.50m

Sample Description

Colour:	Blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh: Unchanged from original state
II. Slightly weathered: Slight discolouration, slight weakening
III. Moderately weathered: Considerable weakening, penetrative discolouration
IV. Highly weathered: Considerable weakening, penetrative discolouration, breaks in hand

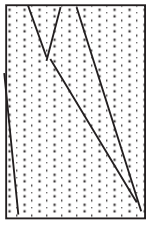
Sample Measurements

Length	198	
Diameter (Ø)	78.1	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	504	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength = $\frac{504000}{4788.19385}$

= $\frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 105.21 (Mpa)

Bulk Density = 2.67 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Proposed Residential Development at Great Connell, Newbridge
Job Number:	23110
Hole No:	RC19
Depth (m):	20.70m

Sample Description

Colour:	Blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh: Unchanged from original state
II. Slightly weathered: Slight discolouration, slight weakening
III. Moderately weathered: Considerable weakening, penetrative discolouration
IV. Highly weathered: Considerable weakening, penetrative discolouration, breaks in hand

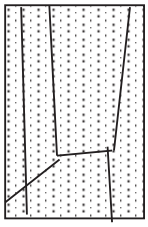
Sample Measurements

Length	200	
Diameter (Ø)	78.1	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	589	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength = $\frac{589000}{4788.19385}$

$= \frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 122.95 (Mpa)

Bulk Density = 2.65 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Proposed Residential Development at Great Connell, Newbridge
Job Number:	23110
Hole No:	RC19
Depth (m):	21.80m

Sample Description

Colour:	Blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

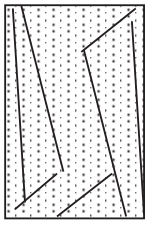
Sample Measurements

Length	201	
Diameter (Ø)	78	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	394	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{394000}{4775.94}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$= 82.46$ (Mpa)

Bulk Density $= 2.66$ (Mg/m^3)

Notes:

Appendix 9

Chemical / Environmental Laboratory Testing (Eurofins Chemtest Laboratory)

eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING
2183

Final Report

Report No.:	21-08094-1
Initial Date of Issue:	23-Mar-2021
Client	IGSL
Client Address:	M7 Business Park Naas County Kildare Ireland
Contact(s):	Darren Keogh
Project	23110
Quotation No.:	Q20-19951
Order No.:	
No. of Samples:	16
Turnaround (Wkdays):	7
Date Approved:	23-Mar-2021
Approved By:	
Details:	Glynn Harvey, Technical Manager

Date Received:	15-Mar-2021
Date Instructed:	15-Mar-2021
Results Due:	23-Mar-2021

Results - Leachate

Project: 23110

Client: IGSL				**Chemtest Job No.:**		21-08094	21-08094	21-08094	21-08094	21-08094	21-08094
Quotation No.: Q20-19951				**Chemtest Sample ID.:**		1159752	1159757	1159759	1159760	1159762	1159764
Order No.:				Client Sample Ref.:		AA142225	AA142229	AA142252	AA142214	AA142220	AA142242
				Sample Location:		TP02	TP10	TP12	TP15	TP17	TP25
				Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):		0.60	0.50	0.50	0.80	1.00	1.00
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**						
pH	U	1010	10:1		N/A	8.8	8.7	8.3	8.2	8.2	8.2
Ammonium	U	1220	10:1	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Ammonium	N	1220	10:1	mg/kg	0.10	0.46	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron (Dissolved)	U	1455	10:1	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo[j]fluoranthene	N	1800	10:1	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010

Results - Soil

Project: 23110

Client: IGSL				**Chemtest Job No.:**	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094
Quotation No.: Q20-19951				**Chemtest Sample ID.:**	1159749	1159750	1159751	1159752	1159753	1159754	1159755	1159756	1159757	1159758
Order No.:				Client Sample Ref.:	AA149926	AA158181	AA141110	AA142225	AA142226	AA142235	AA142254	AA142231	AA142229	AA142250
				Sample Location:	BH06	BH23	BH28	TP02	TP02	TP03	TP06	TP07	TP10	TP11
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	2.00	1.00	3.00	0.60	2.00	0.50	0.50	0.60	0.50	1.00
				Bottom Depth (m):	2.00	1.00	3.00							
				Asbestos Lab:				COVENTRY					COVENTRY	
Determinand	**Accred.**	**SOP**	**Units**	**LOD**										
ACM Type	U	2192		N/A				-					-	
Asbestos Identification	U	2192		N/A				No Asbestos Detected					No Asbestos Detected	
ACM Detection Stage	U	2192		N/A				-					-	
Moisture	N	2030	%	0.020	4.6	7.4	7.7	6.3	7.5	14	16	11	6.4	5.9
pH	U	2010		4.0	[A] 9.2	[A] 9.0	[A] 9.0		[A] 9.0		[A] 8.8			[A] 8.8
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40				[A] < 0.40					[A] < 0.40	
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010			[A] < 0.010
Sulphur (Elemental)	U	2180	mg/kg	1.0				[A] 2.3					[A] 2.4	
Cyanide (Total)	U	2300	mg/kg	0.50				[A] < 0.50					[A] < 0.50	
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50				[A] 2.0					[A] 2.2	
Sulphate (Acid Soluble)	U	2430	%	0.010				[A] 0.014					[A] 0.013	
Arsenic	U	2450	mg/kg	1.0				15					16	
Barium	U	2450	mg/kg	10				34					36	
Cadmium	U	2450	mg/kg	0.10				0.48					0.84	
Chromium	U	2450	mg/kg	1.0				13					14	
Molybdenum	U	2450	mg/kg	2.0				< 2.0					2.3	
Antimony	N	2450	mg/kg	2.0				< 2.0					5.3	
Copper	U	2450	mg/kg	0.50				9.5					11	
Mercury	U	2450	mg/kg	0.10				< 0.10					0.12	
Nickel	U	2450	mg/kg	0.50				16					17	
Lead	U	2450	mg/kg	0.50				17					18	
Selenium	U	2450	mg/kg	0.20				< 0.20					< 0.20	
Zinc	U	2450	mg/kg	0.50				59					56	
Chromium (Trivalent)	N	2490	mg/kg	1.0				13					14	
Chromium (Hexavalent)	N	2490	mg/kg	0.50				< 0.50					< 0.50	
Organic Matter	U	2625	%	0.40						[A] 0.69		[A] 0.48		
Mineral Oil	N	2670	mg/kg	10				< 10					< 10	
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0				[A] < 1.0					[A] < 1.0	
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0				[A] < 1.0					[A] < 1.0	
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0				[A] < 1.0					[A] < 1.0	
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0				[A] < 1.0					[A] < 1.0	
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0				[A] < 1.0					[A] < 1.0	
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0				[A] < 1.0					[A] < 1.0	
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0				[A] < 1.0					[A] < 1.0	
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0				[A] < 1.0					[A] < 1.0	
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0				[A] < 5.0					[A] < 5.0	
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0				[A] < 1.0					[A] < 1.0	

Results - Soil

Project: 23110

Client: IGSL					**Chemtest Job No.:**	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094
Quotation No.: Q20-19951					**Chemtest Sample ID.:**	1159749	1159750	1159751	1159752	1159753	1159754	1159755	1159756	1159757	1159758
Order No.:					Client Sample Ref.:	AA149926	AA158181	AA141110	AA142225	AA142226	AA142235	AA142254	AA142231	AA142229	AA142250
					Sample Location:	BH06	BH23	BH28	TP02	TP02	TP03	TP06	TP07	TP10	TP11
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	2.00	1.00	3.00	0.60	2.00	0.50	0.50	0.60	0.50	1.00
					Bottom Depth (m):	2.00	1.00	3.00							
					Asbestos Lab:				COVENTRY					COVENTRY	
Determinand	**Accred.**	**SOP**	**Units**	**LOD**											
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0				[A] < 1.0						[A] < 1.0	
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0				[A] < 1.0						[A] < 1.0	
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0				[A] < 1.0						[A] < 1.0	
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0				[A] < 1.0						[A] < 1.0	
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0				[A] < 1.0						[A] < 1.0	
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0				[A] < 1.0						[A] < 1.0	
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0				[A] < 1.0						[A] < 1.0	
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0				[A] < 5.0						[A] < 5.0	
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0				[A] < 10						[A] < 10	
Benzene	U	2760	µg/kg	1.0				[A] < 1.0						[A] < 1.0	
Toluene	U	2760	µg/kg	1.0				[A] < 1.0						[A] < 1.0	
Ethylbenzene	U	2760	µg/kg	1.0				[A] < 1.0						[A] < 1.0	
m & p-Xylene	U	2760	µg/kg	1.0				[A] < 1.0						[A] < 1.0	
o-Xylene	U	2760	µg/kg	1.0				[A] < 1.0						[A] < 1.0	
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0				[A] < 1.0						[A] < 1.0	
Naphthalene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Acenaphthylene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Acenaphthene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Fluorene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Phenanthrene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Anthracene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Fluoranthene	N	2800	mg/kg	0.010				[A] 0.062						[A] < 0.010	
Pyrene	N	2800	mg/kg	0.010				[A] 0.053						[A] < 0.010	
Benzo[a]anthracene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Chrysene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Benzo[b]fluoranthene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Benzo[k]fluoranthene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Benzo[a]pyrene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Coronene	N	2800	mg/kg	0.010				[A] < 0.010						[A] < 0.010	
Total Of 17 PAH's	N	2800	mg/kg	0.20				[A] < 0.20						[A] < 0.20	
PCB 28	N	2815	mg/kg	0.0010				[A] < 0.0010						[A] < 0.0010	
PCB 52	N	2815	mg/kg	0.0010				[A] < 0.0010						[A] < 0.0010	
PCB 90+101	N	2815	mg/kg	0.0010				[A] < 0.0010						[A] < 0.0010	
PCB 118	N	2815	mg/kg	0.0010				[A] < 0.0010						[A] < 0.0010	
PCB 153	N	2815	mg/kg	0.0010				[A] < 0.0010						[A] < 0.0010	

Results - Soil

Project: 23110

Client: IGSL					**Chemtest Job No.:**	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094
Quotation No.: Q20-19951					**Chemtest Sample ID.:**	1159749	1159750	1159751	1159752	1159753	1159754	1159755	1159756	1159757	1159758
Order No.:					Client Sample Ref.:	AA149926	AA158181	AA141110	AA142225	AA142226	AA142235	AA142254	AA142231	AA142229	AA142250
					Sample Location:	BH06	BH23	BH28	TP02	TP02	TP03	TP06	TP07	TP10	TP11
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	2.00	1.00	3.00	0.60	2.00	0.50	0.50	0.60	0.50	1.00
					Bottom Depth (m):	2.00	1.00	3.00							
					Asbestos Lab:				COVENTRY					COVENTRY	
Determinand	**Accred.**	**SOP**	**Units**	**LOD**											
PCB 138	N	2815	mg/kg	0.0010					[A] < 0.0010					[A] < 0.0010	
PCB 180	N	2815	mg/kg	0.0010					[A] < 0.0010					[A] < 0.0010	
Total PCBs (7 congeners)	N	2815	mg/kg	0.0010					[A] < 0.0010					[A] < 0.0010	
Total Phenols	U	2920	mg/kg	0.30					< 0.30					< 0.30	

Results - Soil

Project: 23110

Client: IGSL				**Chemtest Job No.:**	21-08094	21-08094	21-08094	21-08094	21-08094	21-08094
Quotation No.: Q20-19951				**Chemtest Sample ID.:**	1159759	1159760	1159761	1159762	1159763	1159764
Order No.:				Client Sample Ref.:	AA142252	AA142214	AA142215	AA142220	AA142242	AA142242
				Sample Location:	TP12	TP15	TP15	TP17	TP24	TP25
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.50	0.80	1.50	1.00	1.00	1.00
				Bottom Depth (m):						
				Asbestos Lab:	COVENTRY	COVENTRY		COVENTRY		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
ACM Type	U	2192		N/A	-	-		-		-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected		No Asbestos Detected		No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-		-		-
Moisture	N	2030	%	0.020	14	23	9.5	22	18	23
pH	U	2010		4.0			[A] 8.7		[A] 8.9	
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	[A] < 0.40	[A] < 0.40		[A] < 0.40		[A] < 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010			[A] < 0.010		[A] < 0.010	
Sulphur (Elemental)	U	2180	mg/kg	1.0	[A] 1.3	[A] 1.4		[A] 1.5		[A] 1.2
Cyanide (Total)	U	2300	mg/kg	0.50	[A] < 0.50	[A] < 0.50		[A] < 0.50		[A] < 0.50
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	[A] 2.8	[A] 1.7		[A] 2.0		[A] 1.9
Sulphate (Acid Soluble)	U	2430	%	0.010	[A] 0.041	[A] < 0.010		[A] 0.023		[A] 0.034
Arsenic	U	2450	mg/kg	1.0	20	5.7		19		21
Barium	U	2450	mg/kg	10	84	23		54		82
Cadmium	U	2450	mg/kg	0.10	1.3	0.52		0.84		1.3
Chromium	U	2450	mg/kg	1.0	21	14		13		20
Molybdenum	U	2450	mg/kg	2.0	< 2.0	< 2.0		< 2.0		< 2.0
Antimony	N	2450	mg/kg	2.0	< 2.0	< 2.0		< 2.0		< 2.0
Copper	U	2450	mg/kg	0.50	17	9.7		9.7		17
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10		< 0.10		< 0.10
Nickel	U	2450	mg/kg	0.50	35	19		17		35
Lead	U	2450	mg/kg	0.50	24	13		16		24
Selenium	U	2450	mg/kg	0.20	0.25	< 0.20		< 0.20		0.33
Zinc	U	2450	mg/kg	0.50	110	57		44		110
Chromium (Trivalent)	N	2490	mg/kg	1.0	21	14		13		20
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50		< 0.50		< 0.50
Organic Matter	U	2625	%	0.40						
Mineral Oil	N	2670	mg/kg	10	< 10	< 10		< 10		< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	[A] < 5.0	[A] < 5.0		[A] < 5.0		[A] < 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0

Results - Soil

Project: 23110

Client: IGSL					**Chemtest Job No.:**	21-08094	21-08094	21-08094	21-08094	21-08094
Quotation No.: Q20-19951					**Chemtest Sample ID.:**	1159759	1159760	1159761	1159762	1159763	1159764
Order No.:					Client Sample Ref.:	AA142252	AA142214	AA142215	AA142220	AA142242	AA142242
					Sample Location:	TP12	TP15	TP15	TP17	TP24	TP25
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	0.50	0.80	1.50	1.00	1.00	1.00
					Bottom Depth (m):						
					Asbestos Lab:	COVENTRY	COVENTRY		COVENTRY		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	[A] < 5.0	[A] < 5.0		[A] < 5.0		[A] < 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	[A] < 10	[A] < 10		[A] < 10		[A] < 10
Benzene	U	2760	µg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Toluene	U	2760	µg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Ethylbenzene	U	2760	µg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
m & p-Xylene	U	2760	µg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
o-Xylene	U	2760	µg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	[A] < 1.0	[A] < 1.0		[A] < 1.0		[A] < 1.0
Naphthalene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] 12
Acenaphthylene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Acenaphthene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Fluorene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Phenanthrene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Anthracene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Fluoranthene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Pyrene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Benzo[a]anthracene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Chrysene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Benzo[b]fluoranthene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Benzo[k]fluoranthene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Benzo[a]pyrene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Coronene	N	2800	mg/kg	0.010	[A] < 0.010	[A] < 0.010		[A] < 0.010		[A] < 0.010
Total Of 17 PAH's	N	2800	mg/kg	0.20	[A] < 0.20	[A] < 0.20		[A] < 0.20		[A] 12
PCB 28	N	2815	mg/kg	0.0010	[A] < 0.0010	[A] < 0.0010		[A] < 0.0010		[A] < 0.0010
PCB 52	N	2815	mg/kg	0.0010	[A] < 0.0010	[A] < 0.0010		[A] < 0.0010		[A] < 0.0010
PCB 90+101	N	2815	mg/kg	0.0010	[A] < 0.0010	[A] < 0.0010		[A] < 0.0010		[A] < 0.0010
PCB 118	N	2815	mg/kg	0.0010	[A] < 0.0010	[A] < 0.0010		[A] < 0.0010		[A] < 0.0010
PCB 153	N	2815	mg/kg	0.0010	[A] < 0.0010	[A] < 0.0010		[A] < 0.0010		[A] < 0.0010

Results - Soil

Project: 23110

Client: IGSL			**Chemtest Job No.:**		21-08094	21-08094	21-08094	21-08094	21-08094	21-08094
Quotation No.: Q20-19951			**Chemtest Sample ID.:**		1159759	1159760	1159761	1159762	1159763	1159764
Order No.:			Client Sample Ref.:		AA142252	AA142214	AA142215	AA142220	AA142242	AA142242
			Sample Location:		TP12	TP15	TP15	TP17	TP24	TP25
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.50	0.80	1.50	1.00	1.00	1.00
			Bottom Depth (m):							
			Asbestos Lab:		COVENTRY	COVENTRY		COVENTRY		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
PCB 138	N	2815	mg/kg	0.0010	[A] < 0.0010	[A] < 0.0010		[A] < 0.0010		[A] < 0.0010
PCB 180	N	2815	mg/kg	0.0010	[A] < 0.0010	[A] < 0.0010		[A] < 0.0010		[A] < 0.0010
Total PCBs (7 congeners)	N	2815	mg/kg	0.0010	[A] < 0.0010	[A] < 0.0010		[A] < 0.0010		[A] < 0.0010
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30		< 0.30		< 0.30

Results - Single Stage WAC

Project: 23110

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	21-08094						
Chemtest Sample ID:	1159752						
Sample Ref:	AA142225						
Sample ID:							
Sample Location:	TP02						
Top Depth(m):	0.60						
Bottom Depth(m):							
Sampling Date:							
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%	[A] 0.20	3	5	6
Loss On Ignition	2610	U	%	0.97	--	--	10
Total BTEX	2760	U	mg/kg	[A] < 0.010	6	--	--
Total PCBs (7 congeners)	2815	N	mg/kg	[A] < 0.0010	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	[A] < 10	500	--	--
Total Of 17 PAH's	2800	N	mg/kg	[A] < 0.20	100	--	--
pH	2010	U		8.9	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.018	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0005	0.0047	0.5	2	25
Barium	1455	U	< 0.005	< 0.0005	20	100	300
Cadmium	1455	U	< 0.00012	< 0.0012	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	< 0.0005	< 0.0005	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0007	0.0072	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0005	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	< 0.0005	< 0.0005	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.003	4	50	200
Chloride	1220	U	1.4	14	800	15000	25000
Fluoride	1220	U	0.13	1.3	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	44	440	4000	60000	100000
Phenol Index	1920	U	0.043	0.43	1	-	-
Dissolved Organic Carbon	1610	U	3.0	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	6.3

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 23110

Chemtest Job No:	21-08094				**Landfill Waste Acceptance Criteria Limits**		
Chemtest Sample ID:	1159757						
Sample Ref:	AA142229						
Sample ID:							
Sample Location:	TP10						
Top Depth(m):	0.50				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Bottom Depth(m):							
Sampling Date:							
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	[A] < 0.20	3	5	6
Loss On Ignition	2610	U	%	0.96	--	--	10
Total BTEX	2760	U	mg/kg	[A] < 0.010	6	--	--
Total PCBs (7 congeners)	2815	N	mg/kg	[A] < 0.0010	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	[A] < 10	500	--	--
Total Of 17 PAH's	2800	N	mg/kg	[A] < 0.20	100	--	--
pH	2010	U		9.1	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.013	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0010	0.0099	0.5	2	25
Barium	1455	U	< 0.005	< 0.0005	20	100	300
Cadmium	1455	U	< 0.00012	< 0.0012	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	0.0005	0.0053	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0008	0.0080	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0005	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	< 0.0005	< 0.0005	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.003	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.18	1.8	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	45	450	4000	60000	100000
Phenol Index	1920	U	0.033	0.33	1	-	-
Dissolved Organic Carbon	1610	U	3.1	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	6.4

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 23110

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	21-08094						
Chemtest Sample ID:	1159759						
Sample Ref:	AA142252				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:							
Sample Location:	TP12						
Top Depth(m):	0.50						
Bottom Depth(m):							
Sampling Date:							
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	[A] 0.40	3	5	6
Loss On Ignition	2610	U	%	2.7	--	--	10
Total BTEX	2760	U	mg/kg	[A] < 0.010	6	--	--
Total PCBs (7 congeners)	2815	N	mg/kg	[A] < 0.0010	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	[A] < 10	500	--	--
Total Of 17 PAH's	2800	N	mg/kg	[A] < 0.20	100	--	--
pH	2010	U		8.1	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.0040	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0007	0.0069	0.5	2	25
Barium	1455	U	< 0.005	< 0.0005	20	100	300
Cadmium	1455	U	< 0.00012	< 0.0012	0.04	1	5
Chromium	1455	U	0.0006	0.0058	0.5	10	70
Copper	1455	U	0.0013	0.013	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0005	0.0048	0.5	10	30
Nickel	1455	U	0.0006	0.0058	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	< 0.0005	< 0.0005	0.1	0.5	7
Zinc	1455	U	0.003	0.030	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.23	2.3	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	57	570	4000	60000	100000
Phenol Index	1920	U	0.036	0.36	1	-	-
Dissolved Organic Carbon	1610	U	5.0	50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	14

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 23110

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	21-08094						
Chemtest Sample ID:	1159760						
Sample Ref:	AA142214						
Sample ID:							
Sample Location:	TP15						
Top Depth(m):	0.80						
Bottom Depth(m):							
Sampling Date:							
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%	[A] < 0.20	3	5	6
Loss On Ignition	2610	U	%	1.1	--	--	10
Total BTEX	2760	U	mg/kg	[A] < 0.010	6	--	--
Total PCBs (7 congeners)	2815	N	mg/kg	[A] < 0.0010	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	[A] < 10	500	--	--
Total Of 17 PAH's	2800	N	mg/kg	[A] < 0.20	100	--	--
pH	2010	U		8.8	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.0090	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0003	0.0030	0.5	2	25
Barium	1455	U	< 0.005	< 0.0005	20	100	300
Cadmium	1455	U	< 0.00012	< 0.0012	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	< 0.0005	< 0.0005	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0003	0.0031	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0005	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	< 0.0005	< 0.0005	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.003	4	50	200
Chloride	1220	U	1.1	11	800	15000	25000
Fluoride	1220	U	0.17	1.7	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	20	190	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	6.4	64	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	23

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 23110

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	21-08094						
Chemtest Sample ID:	1159762						
Sample Ref:	AA142220						
Sample ID:							
Sample Location:	TP17						
Top Depth(m):	1.00						
Bottom Depth(m):							
Sampling Date:							
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%	[A] 0.24	3	5	6
Loss On Ignition	2610	U	%	1.2	--	--	10
Total BTEX	2760	U	mg/kg	[A] < 0.010	6	--	--
Total PCBs (7 congeners)	2815	N	mg/kg	[A] < 0.0010	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	[A] < 10	500	--	--
Total Of 17 PAH's	2800	N	mg/kg	[A] < 0.20	100	--	--
pH	2010	U		8.9	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.025	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	< 0.0002	< 0.0002	0.5	2	25
Barium	1455	U	< 0.005	< 0.0005	20	100	300
Cadmium	1455	U	< 0.00012	< 0.0012	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	< 0.0005	< 0.0005	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0006	0.0059	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0005	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	< 0.0005	< 0.0005	0.1	0.5	7
Zinc	1455	U	0.003	0.032	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.20	2.0	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	53	530	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	6.3	63	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	22

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 23110

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	21-08094						
Chemtest Sample ID:	1159764						
Sample Ref:	AA142242				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:							
Sample Location:	TP25						
Top Depth(m):	1.00						
Bottom Depth(m):							
Sampling Date:							
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	[A] 0.41	3	5	6
Loss On Ignition	2610	U	%	2.8	--	--	10
Total BTEX	2760	U	mg/kg	[A] < 0.010	6	--	--
Total PCBs (7 congeners)	2815	N	mg/kg	[A] < 0.0010	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	[A] < 10	500	--	--
Total Of 17 PAH's	2800	N	mg/kg	[A] 12	100	--	--
pH	2010	U		8.3	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.0030	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0003	0.0027	0.5	2	25
Barium	1455	U	< 0.005	< 0.0005	20	100	300
Cadmium	1455	U	< 0.00012	< 0.0012	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	< 0.0005	< 0.0005	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	< 0.0002	< 0.0002	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0005	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	< 0.0005	< 0.0005	0.1	0.5	7
Zinc	1455	U	0.003	0.031	4	50	200
Chloride	1220	U	1.5	15	800	15000	25000
Fluoride	1220	U	0.17	1.7	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	16	160	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	6.3	63	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	23

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1159749	AA149926		BH06		A	Amber Glass 250ml
1159749	AA149926		BH06		A	Plastic Tub 500g
1159750	AA158181		BH23		A	Amber Glass 250ml
1159750	AA158181		BH23		A	Plastic Tub 500g
1159751	AA141110		BH28		A	Amber Glass 250ml
1159751	AA141110		BH28		A	Plastic Tub 500g
1159752	AA142225		TP02		A	Amber Glass 250ml
1159752	AA142225		TP02		A	Plastic Tub 500g
1159753	AA142226		TP02		A	Amber Glass 250ml
1159753	AA142226		TP02		A	Plastic Tub 500g
1159754	AA142235		TP03		A	Amber Glass 250ml
1159754	AA142235		TP03		A	Plastic Tub 500g
1159755	AA142254		TP06		A	Amber Glass 250ml
1159755	AA142254		TP06		A	Plastic Tub 500g
1159756	AA142231		TP07		A	Amber Glass 250ml
1159756	AA142231		TP07		A	Plastic Tub 500g
1159757	AA142229		TP10		A	Amber Glass 250ml
1159757	AA142229		TP10		A	Plastic Tub 500g
1159758	AA142250		TP11		A	Amber Glass 250ml
1159758	AA142250		TP11		A	Plastic Tub 500g
1159759	AA142252		TP12		A	Amber Glass 250ml
1159759	AA142252		TP12		A	Plastic Tub 500g

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1159760	AA142214		TP15		A	Amber Glass 250ml
1159760	AA142214		TP15		A	Plastic Tub 500g
1159761	AA142215		TP15		A	Amber Glass 250ml
1159761	AA142215		TP15		A	Plastic Tub 500g
1159762	AA142220		TP17		A	Amber Glass 250ml
1159762	AA142220		TP17		A	Plastic Tub 500g
1159763	AA142242		TP24		A	Amber Glass 250ml
1159763	AA142242		TP24		A	Plastic Tub 500g
1159764	AA142242		TP25		A	Amber Glass 250ml
1159764	AA142242		TP25		A	Plastic Tub 500g

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters by GC-MS	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Pentane extraction / GCMS detection
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N–dimethyl-p-phenylenediamine.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

Test Methods

SOP	Title	Parameters included	Method summary
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key	
U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

2183

Final Report

Report No.:	21-09826-1
Initial Date of Issue:	08-Apr-2021
Client	IGSL
Client Address:	M7 Business Park Naas County Kildare Ireland
Contact(s):	Darren Keogh
Project	23110 Aston Lands Great Connell Newbridge

Quotation No.:		**Date Received:**	26-Mar-2021
Order No.:		**Date Instructed:**	26-Mar-2021
No. of Samples:	10		
Turnaround (Wkdays):	7	**Results Due:**	07-Apr-2021
Date Approved:	08-Apr-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: 23110 Aston Lands Great Connell Newbridge

Client: IGSL				**Chemtest Job No.:**	21-09826	21-09826	21-09826	21-09826	21-09826	21-09826	21-09826	21-09826	21-09826	21-09826
Quotation No.:				**Chemtest Sample ID.:**	1167939	1167940	1167941	1167942	1167943	1167944	1167945	1167946	1167947	1167948
Order No.:				Client Sample Ref.:	AA146102	AA141140	AA141142	AA141126	AA141129	AA141130	AA141119	AA146120	AA146107	AA146109
				Sample Location:	BH15	BH16	BH16	BH17	BH17	BH17	BH18	BH13	BH14	BH14
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	4.00	2.00	4.00	1.00	3.00	4.00	4.00	4.00	1.00	3.00
Determinand	**Accred.**	**SOP**	**Units**	**LOD**										
Moisture	N	2030	%	0.020	9.6	4.1	10	17	2.6	2.7	5.4	10	17	3.5
pH	U	2010		4.0		[A] 9.1			[A] 9.0				[A] 8.7	
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010		[A] < 0.010			[A] < 0.010				[A] < 0.010	
Organic Matter	U	2625	%	0.40	[A] < 0.40		[A] < 0.40	[A] 0.64		[A] < 0.40	[A] < 0.40	[A] 0.50		

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1167939	AA146102		BH15		A	Amber Glass 250ml
1167939	AA146102		BH15		A	Plastic Tub 500g
1167940	AA141140		BH16		A	Amber Glass 250ml
1167940	AA141140		BH16		A	Plastic Tub 500g
1167941	AA141142		BH16		A	Amber Glass 250ml
1167941	AA141142		BH16		A	Plastic Tub 500g
1167942	AA141126		BH17		A	Amber Glass 250ml
1167942	AA141126		BH17		A	Plastic Tub 500g
1167943	AA141129		BH17		A	Amber Glass 250ml
1167943	AA141129		BH17		A	Plastic Tub 500g
1167944	AA141130		BH17		A	Amber Glass 250ml
1167944	AA141130		BH17		A	Plastic Tub 500g
1167945	AA141119		BH18		A	Amber Glass 250ml
1167945	AA141119		BH18		A	Plastic Tub 500g
1167946	AA146120		BH13		A	Amber Glass 250ml
1167946	AA146120		BH13		A	Plastic Tub 500g
1167947	AA146107		BH14		A	Amber Glass 250ml

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

2183

Amended Report

Report No.:	21-11956-2		
Initial Date of Issue:	20-Apr-2021	**Date of Re-Issue:**	05-May-2021
Client	IGSL		
Client Address:	M7 Business Park Naas County Kildare Ireland		
Contact(s):	John Clancy		
Project	Aston Lands		
Quotation No.:		**Date Received:**	14-Apr-2021
Order No.:		**Date Instructed:**	14-Apr-2021
No. of Samples:	7		
Turnaround (Wkdays):	5	**Results Due:**	20-Apr-2021
Date Approved:	20-Apr-2021		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Soil

Project: Aston Lands

Client: IGSL				**Chemtest Job No.:**	21-11956	21-11956	21-11956	21-11956	21-11956	21-11956	21-11956
Quotation No.:				**Chemtest Sample ID.:**	1179345	1179346	1179347	1179348	1179349	1179350	1179351
Order No.:				Client Sample Ref.:	AA146127	AA146137	AA146149	AA140373	AA140382	AA140399	AA145356
				Sample Location:	BH19	BH25	BH26	BH01	BH27	BH29	BH07
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	2.00	3.00	3.00	2.00	2.00	9.00	2.00
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Moisture	N	2030	%	0.020	7.8	7.6	7.6	8.2	7.1	7.5	7.0
pH	U	2010		4.0	[A] 8.9	[A] 9.0	[A] 8.9	[A] 8.7	[A] 9.0	[A] 9.0	[A] 8.8
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1179345	AA146127		BH19		A	Amber Glass 250ml
1179345	AA146127		BH19		A	Plastic Tub 500g
1179346	AA146137		BH25		A	Amber Glass 250ml
1179346	AA146137		BH25		A	Plastic Tub 500g
1179347	AA146149		BH26		A	Amber Glass 250ml
1179347	AA146149		BH26		A	Plastic Tub 500g
1179348	AA140373		BH01		A	Amber Glass 250ml
1179348	AA140373		BH01		A	Plastic Tub 500g
1179349	AA140382		BH27		A	Amber Glass 250ml
1179349	AA140382		BH27		A	Plastic Tub 500g
1179350	AA140399		BH29		A	Amber Glass 250ml
1179350	AA140399		BH29		A	Plastic Tub 500g
1179351	AA145356		BH07		A	Amber Glass 250ml
1179351	AA145356		BH07		A	Plastic Tub 500g

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Appendix 10

As-Surveyed Site Plans

ExpertGPS

23110 Aston Lands, Great Connell, Newbridge

50 m

MN

2°23'

ExpertGPS

23110 Aston Lands, Great Connell, Newbridge

10 m

MN

2°23'

APPENDIX 5

JBA FLOOD RISK REPORT

Great Connell SHD, Newbridge Flood Risk Assessment

Technical Report

April 2022

Aston Limited

Great Connell

Newbridge

Co. Kildare

JBA Project Manager

Ross Bryant
24 Grove Island
Corbally
Limerick
Ireland

Revision History

Revision Ref / Date Issued	Amendments	Issued to
S3-P01 / 11 Jun 2021	Initial Issue	Aston Limited
A3-C01 / 08 Sept 2021	Text and site boundary amendments	Aston Limited
A3-C02 / 22 Feb 2022	Text and site boundary amendments	Aston Limited
A3-C03 / 14 Mar 2022	Update bridge and compensatory storage design	Aston Limited
A3-C04 / 22 Mar 2022	Text amendments	Aston Limited
A3-C05 / 25 Mar 2022	Text amendments	Aston Limited
A3-C07 / 06 Apr 2022	Text amendment after peer review	Aston Limited

Contract

This report describes work commissioned by Sinead Fenton, on behalf of Aston Limited , by email dated 19/12/2019. Orla Hannon and Ross Bryant of JBA Consulting carried out this work.

Prepared by ..... Orla Hannon BSc (Hons)
Analyst

Reviewed by ..... Ross Bryant BSc MSc CEnv MCIWEM C.WEM
Principal Analyst

Purpose

This document has been prepared as an FRA for Aston Limited. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to Aston Limited .

Copyright

© JBA Consulting Engineers and Scientists Limited 2022

Carbon Footprint

A printed copy of the main text in this document will result in a carbon footprint of if 100% post-consumer recycled paper is used and if primary-source paper is used. These figures assume the report is printed in black and white on A4 paper and in duplex.

JBA is aiming to reduce its per capita carbon emissions.

Contents

Executive Summary 1

1 Introduction 2

1.1 Terms of Reference and Scope 2
1.2 Flood Risk Assessment; Aims and Objectives 2
1.3 Development Proposal 2
1.4 Report Structure 3

2 Site Background 5

2.1 Location 5
2.2 Watercourses 5
2.3 Site Geology 7
2.4 Site Topography 7
2.5 Newbridge Local Area Plan 2013-2019 7

3 Flood Risk Identification 9

3.1 Flood History 9
3.2 Predicative Flooding 10
3.3 Sources of Flooding 12

4 Flood Risk Assessment 13

4.1 Hydrology Estimation 13
4.2 Hydraulic Model 14
4.3 Model Results - Baseline Scenario 15

5 Site Design / Masterplanning 17

5.1 Design Scenario 1 - Aston SHD Application & Kildare Co. Co. Road and Bridge Application 17
5.2 Design Scenario 2 - Aston SHD Application 21

6 Mitigation Measures 24

6.1 Finished Floor Levels 24
6.2 Compensatory Storage 25
6.3 Access and Egress 27
6.4 Stormwater Design 27
6.5 Bridge Design 28
6.6 Residual Risk 28

7 The Justification Test for Development Management 29

7.1 Strategy 29
7.2 Justification Test: Part 1 29
7.3 Justification Test: Part 2 29

8 Conclusion 31

Appendices I

A Appendix - Understanding Flood Risk I

B Groundwater Monitoring III

C Site Investigation V

D JBA Response the KCC Comments X

E ARUP Peer Review XVI

II

List of Figures

Figure 1-1: Proposed Site Layout 4
Figure 2-1: Site Location in Newbridge 5
Figure 2-2: River Liffey Catchment Overview 6
Figure 2-3: Drain Catchment Overview 6
Figure 2-4: Site Subsoils 7
Figure 2-5: Newbridge LAP Zoning 8
Figure 3-1: Floodinfo.ie 9
Figure 3-2: SFRA Flood Zones 10
Figure 3-3: CFRAM flood extents 11
Figure 4-1: Eastern CFRAM Inflow Hydrograph at Model Upstream during 1% AEP Design Run 14
Figure 4-2: JBA Model Schematisation 15
Figure 4-3: JBA Flood Extents 16
Figure 5-1: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test (Table 3:2 of the Planning Guidelines) 17
Figure 5-2: Post-Development Flood Extents - Scenario 1 SHD & Bridge Development 18
Figure 5-3: 1% AEP Depth Difference Map - Scenario 1 SHD & Bridge Development 19
Figure 5-5: Post-Development Flood Extents - Scenario 2 SHD Development 22
Figure 5-7: 0.1% AEP Depth Difference Map - Scenario 2 SHD Development 23
Figure 6-1: Minimum Recommended FFL 24
Figure 6-2: Compensatory Storage 25
Figure 6-3: Punch Post-Development with Flood Compensation 26
Figure 6-4: Flood Compensation Areas (Extract From 192229-PUNCH-XX-XX-DR-C-0814) 26
Figure 6-5: Punch Post-Development - Including overland flow path 27
Figure 6-6: Overland surface water flow route 28

List of Tables

Table 3-1: CFRAM Fluvial Flood Levels 11
Table 4-2: JBA vs CFRAM Modelled Results 16
Table 5-1: Pre- and Post-SHD & Bridge Development Water Levels 20
Table 5-2: Pre- and Post-SHD Development Water Levels 23

Abbreviations

1D ..... One Dimensional (modelling)
2D ..... Two Dimensional (modelling)
AEP ..... Annual Exceedance Probability
CFRAM ..... Catchment Flood Risk Assessment and Management
DoEHLG ..... Department of the Environment, Heritage and Local Government
FARL ..... FEH index of flood attenuation due to reservoirs and lakes
FB ..... Freeboard
FFL ..... Finish Floor Levels
FRA ..... Flood Risk Assessment
FSR ..... Flood Studies Report
FSU ..... Flood Studies Update
GSI ..... Geological Survey of Ireland
LHB ..... Left Hand Bank
OPW ..... Office of Public Works
PFRA ..... Preliminary Flood Risk Assessment
RFI ..... Request for Further Information
RHB ..... Right Hand Bank
RR ..... Rainfall-Runoff
SAAR ..... Standard Average Annual Rainfall (mm)
SFRA ..... Strategic Flood Risk Assessment
URBEXT ..... FEH index of fractional urban extent
WL ..... Water Level

Executive Summary

Aston Limited intend to apply to An Bord Pleanála for permission for a Strategic Housing Development (SHD) in Great Connell, Newbridge, County Kildare. The subject site comprises the lands surrounding and including the dwellings of 'Greatconnell' and 'Valencia Lodge', Great Connell, Newbridge, Co. Kildare. The development is partly located within lands shown to be at risk of flooding in the OPW CFRAM mapping (floodinfo.ie). As such, a site-specific flood risk assessment (SSFRA) was carried out for the site to confirm the flood risk to the site and ensure the development would not increase the flood risk elsewhere.

The results of this detailed study have demonstrated that the baseline assessment of flooding on the Great Connell lands differ from what was portrayed in the CFRAM mapping. There are additional overland flow routes across the Great Connell lands than what is shown in the CFRAM mapping. The changes in the flood extents relates to a more detailed representation of the site levels using topographic survey as well as acknowledgment of the sensitivity of the water levels/additional overland paths to the roughness assigned to the watercourse and floodplain. For this reason, the model results in this report are more conservative that the CFRAM results.

Two post-development scenarios were tested. The first includes the proposed SHD development and the proposed bridge and the second represents the proposed SHD development without the bridge. Aston Limited are progressing with a separate planning application for the Road and Bridge Ref:4559, which is included as part of this scenario. The second design scenario is the less likely condition where the SHD development is constructed without the bridge. When the land is raised for the proposed development the overland flow routes through the site are removed. Compensatory storage is included as part of the post-development design to account for the loss of the overland flow routes through the site in Flood Zone A. This is done in accordance with the Planning System and Flood Risk Management Guidelines and the Kildare County Development Plan.

The first post-development scenario which included the SHD development and the proposed bridge confirms that the developments do not increase the flood risk to the surrounding area in the 1% AEP event and has minimal impacts in the 0.1% AEP event. There is an additional overland flow path, but this is constrained to the blue lined boundary, which is lands owned by the applicant. Any future change of use to this land from greenfield/open space will be preceded by a flood risk assessment. Outside of the blue line boundary, there are some increases in flood depths in the 0.1% AEP event downstream of the proposed bridge. These increases do not pose an increased flood risk to any properties downstream.

In the second post-development scenario, which does not include the proposed bridge and is the less likely condition to occur, there are some localised increases in flood extents and depths in addition to those noted in Scenario 1. In areas where there is an increase in extent (green fields), there are no receptors, so in both cases the risk has not increased at the 0.1% AEP standard.

The groundwater risk to the site is confirmed to be low from GSI datasets as well as supplementary data such as the site investigation and the groundwater monitoring carried out at the site.

The proposed minimum floor level for the site places the developments above the 0.1% AEP event plus an additional 500mm freeboard. This FFL also protects the development from the 1% plus climate change event.

The Justification Test was applied and passed as the hydraulic modelling confirms the impact on surrounding water levels is not significant and the development can manage the risk to itself in accordance with the Planning Guidelines.

This report was subject to a peer review carried out by ARUP, dated the 05/04/2022, which confirms this FRA was completed "in accordance with requirements of The Planning System and Flood Risk Management Guidelines and in compliance with the Strategic Flood Risk Assessment (SFRA) of the Kildare County Development Plan 2017-2023". As per the review, ARUP "are satisfied that the proposed development will not result in any material increase in flood risk both on and off site and that the residual risk has been managed to acceptable levels". They are also satisfied that the Justification Test for the proposed development passed all criteria.

1 Introduction

Under the Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009) the proposed development must undergo a Flood Risk Assessment to ensure sustainability and effective management of flood risk.

1.1 Terms of Reference and Scope

JBA Consulting was appointed by Aston Limited to prepare a Flood Risk Assessment (FRA) for the proposed development of a site located at Great Connell, Newbridge. The report was prepared as an output from An Bord Pleanála response to the proposed development.

1.2 Flood Risk Assessment; Aims and Objectives

This study is being completed to inform the future development of the site as it relates to flood risk. It aims to identify, quantify and communicate to Planning Authority officials and other stakeholders the risk of flooding to land, property and people and the measures that would be recommended to manage the risk.

The objectives of this FRA are to:

- Identify potential sources of flood risk;
- Confirm the level of flood risk and identify key hydraulic features;
- Assess the impact that the proposed development has on flood risk;
- Develop appropriate flood risk mitigation and management measures which will allow for the long-term development of the site.

Recommendations for development have been provided in the context of the OPW / DECLG planning guidance, "The Planning System and Flood Risk Management". A review of the likely effects of climate change, and the long-term impacts this may have on any development has also been undertaken.

For general information on flooding, the definition of flood risk, flood zones and other terms see 'Understanding Flood Risk' in Appendix A.

1.3 Development Proposal

Aston Limited intend to apply to An Bord Pleanála for permission for a Strategic Housing Development (SHD) at this site at Great Connell, Newbridge, County Kildare. This subject site comprises the lands surrounding and including the dwellings of 'Greatconnell' and 'Valencia Lodge', Great Connell, Newbridge, Co. Kildare. The proposed site layout is shown in Figure 1-1.

The development will consist of the demolition of existing site structures (2,622.3 sqm) and the construction of 569 no. residential units, a neighbourhood centre with 11 no. units (commercial floor area 2,141 sqm) and a childcare facility (886 sqm), a circa 350 metre section of distributor road, and all ancillary and associated works on a site of 27.64 ha. The proposed development comprises:

1. Demolition of existing site structures (total 2,622.3 sqm) comprising; 'Great Connell' a two-storey dwelling of 331.9 sqm with detached single storey garage and outhouses of 48 sqm; 'Valencia Lodge' a single storey dwelling of 135.6 sqm with a single storey garage of 17.8 sqm; two no. single storey sheds of 1,440 sqm and 595 sqm, and a three-sided shed of 54 sqm.
2. Construction of 569 no. new residential dwellings (325 no. houses and 244 no. apartments) comprising:
    a. 64 no. two-bed houses; 173 no. three-bed houses; and 88 no. four-bed houses (ranging in height from 2 to 3 storeys).
    b. Apartment Block A (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
    c. Apartment Block B (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.

d. Apartment Block C (Part 3 and 4 Storeys): 4 no. one-bed apartments; 19 no. two-bed apartments and 4 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 87 sqm.

e. 13 no. apartments above the proposed Neighbourhood Centre comprising; 4 no. own-door two-bed apartments; 3 no. shared-access one-bed apartments; and 6 no. shared-access two-bed apartments. These proposed units have private balconies or terraces.

f. 160 no. own-door apartments in 2- and 3- storey buildings comprising; 16 no. one-bed apartments; 78 no. two-bed apartments, 66 no. three-bed duplex apartments. These units will have private amenity areas in the form of terraces, balconies and/or rear gardens.

3. Provision of Neighbourhood Centre (ranging in height between 2 and 4 storeys) with 11 no. commercial units comprising: a convenience shop of 909 sqm (unit 1); 3 no. doctor/dentist/physio units of 120 sqm, 120 sqm and 90 sqm (units 6, 7, and 8, respectively); a café of 125 sqm (unit 4); a restaurant of 213 sqm (unit 9); and 5 no. shop/convenience services units of 112 sqm, 49 sqm, 171 sqm, 100sqm and 100 sqm (units 2, 3, 5,10 and 11, respectively). The proposed Neighbourhood Centre includes an external roof terrace of 176 sqm.
4. Provision of a childcare facility (886 sqm) within the Neighbourhood Centre with capacity for in the order of 154 no. children.
5. Provision of 1,008 no. car parking spaces comprising 650 no. spaces for the proposed houses; 312 no. spaces for the proposed apartments; and 46 no. spaces to serve the Neighbourhood Centre.
6. Provision of 732 bicycle parking spaces comprising 536 no. secure residential spaces, 134 no. residential visitor spaces, and 62 no. spaces to serve the Neighbourhood Centre.
7. A series of 18 no. public open spaces and pocket parks are proposed throughout the residential development (2.613 ha net area).
8. Provision of a 8.31 ha amenity area adjoining the River Liffey.
9. Vehicular access to the proposed development from Great Connell road via a circa 350 metre section of the Newbridge South Orbital Relief Road (NSOOR), including footpaths and cycle paths. It is proposed to upgrade the existing Great Connell Roundabout to a signalised junction, and provide footpaths and cycle paths within the subject site along the Great Connell Road.
10. Proposed development facilitates future potential pedestrian, cycle and vehicular links to adjoining residential development and undeveloped lands.
11. All enabling and site development works, landscaping, boundary treatments, lighting, services and connections, including connection to permitted wastewater pumping station, waste management, ESB substations, compensatory flood storage and all other ancillary works above and below ground on a site of 27.64 ha.
12. A 7 year permission is sought.

1.4 Report Structure

Section 2 of this report gives an overview of the study location and associated watercourses. Section 3 contains background information and initial assessment of flood risk. An overview of the technical approaches to Flood Risk Assessment (FRA) are included in Section 4 while site-specific mitigation measures are explained in Section 5. Conclusions are provided in Section 6.

Figure 1-1: Proposed Site Layout

2 Site Background

This section describes the proposed development site in Great Connell, including watercourses, geology and wider geographical area.

2.1 Location

The proposed site is a green field site in Newbridge, Co. Kildare. It is located on the right bank of the River Liffey. There are existing buildings within the site boundary which will be demolished as part of the development. The site is bordered to the north and north east by residential estates and green fields to the south. The Murphy International Ltd offices are located to the east of the site. The blue line boundary in the figure below defines the area under the ownership and control of the applicant. A wide, open drain flows through and around the north western section of the site which follows the alignment of a historical meander of the River Liffey. Figure 2-1 below shows the site location and local features.

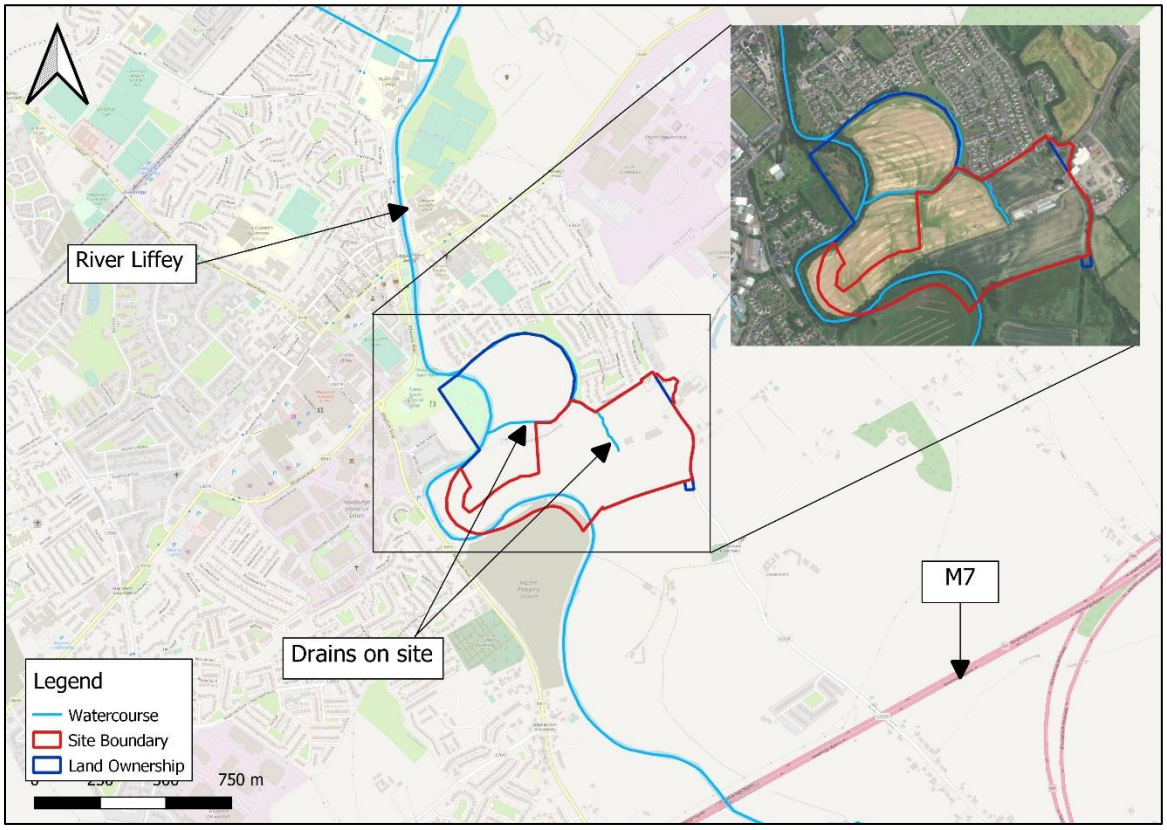


Figure 2-1: Site Location in Newbridge

2.2 Watercourses

The main watercourse in the area is the River Liffey which flows in a northerly direction along the western boundary of the site. It has a total catchment area of 480km². Golden Falls dam is located upstream of Newbridge. The outflow from the dam is controlled and accounts of approx. two thirds of the total catchment area (refer to Figure 2-2).

There are two drains flowing through the Great Connell site which follow the original alignment of the historic meanders on the River Liffey. These drains have a very small catchment area consisting of the green fields in the area and a section of Wellsley Manor housing estate to the north (Figure 2-3).

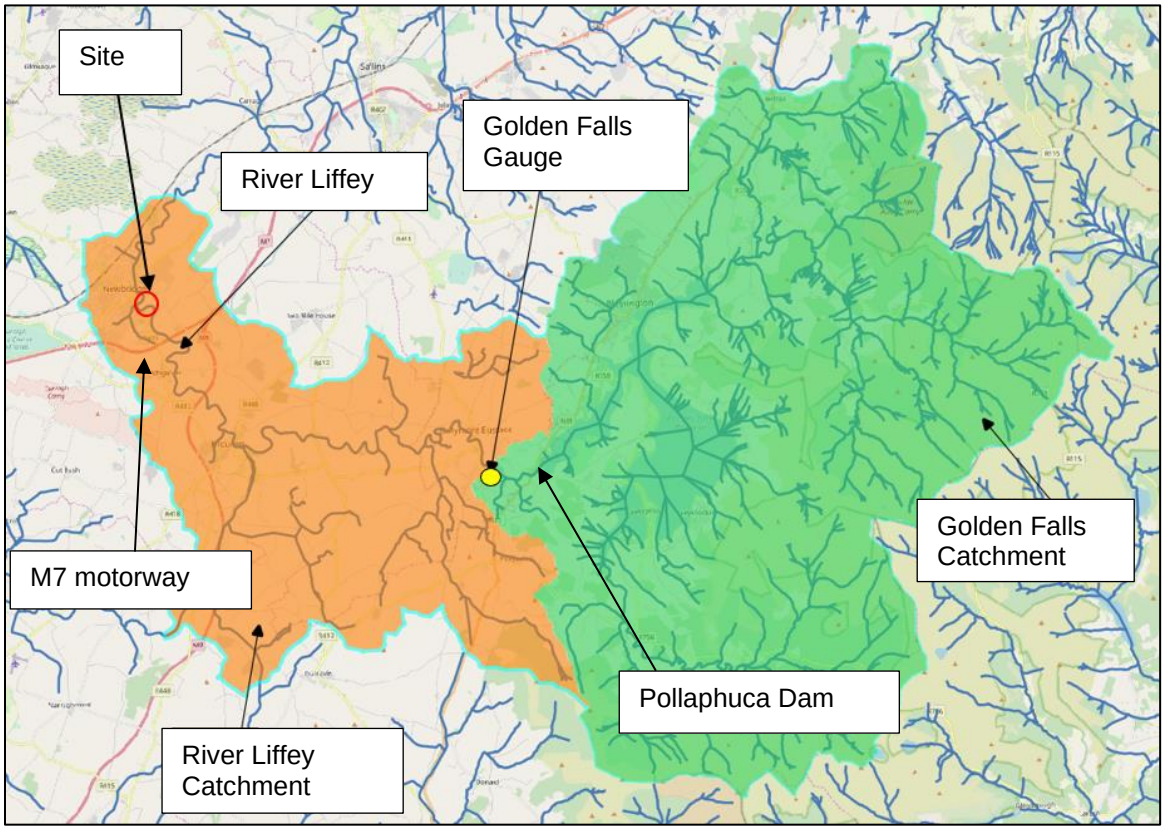


Figure 2-2: River Liffey Catchment Overview

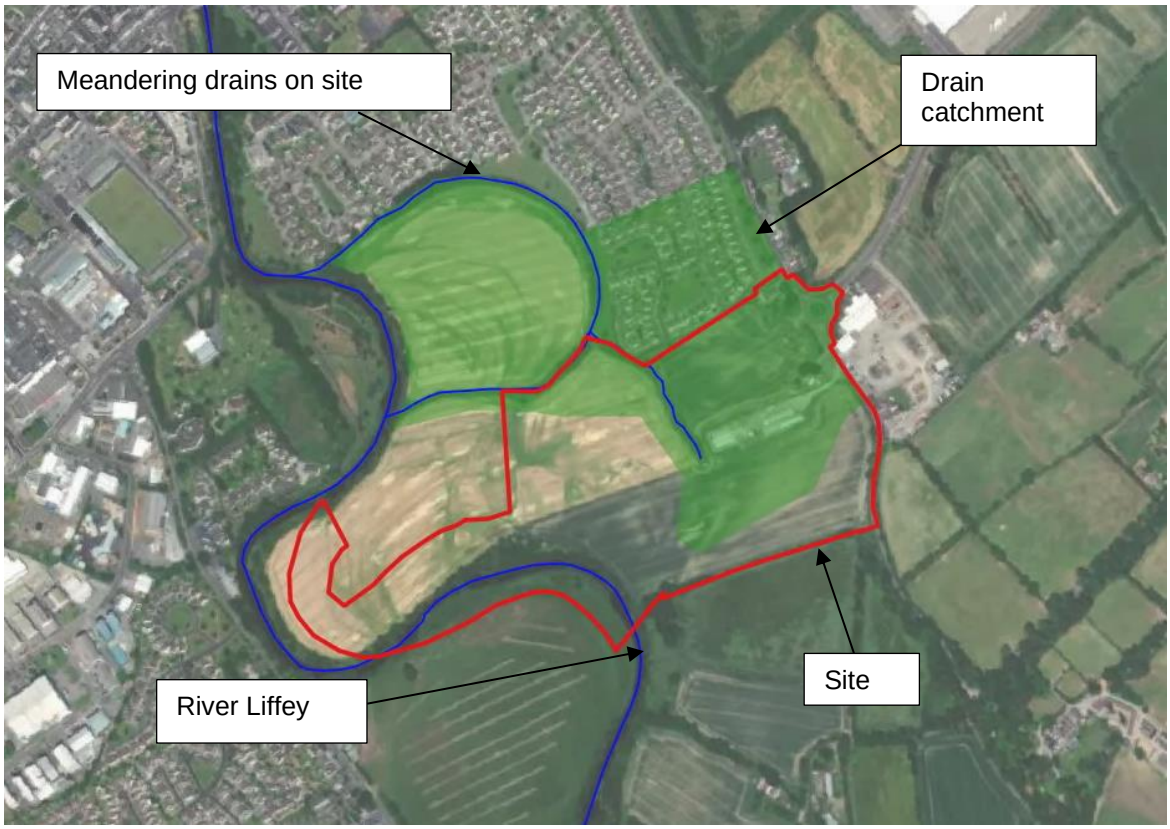


Figure 2-3: Drain Catchment Overview

2.3 Site Geology

The groundwater and geological maps of the site, provided by the Geological Survey of Ireland (GSI), have been studied and an extract of the geological map is presented in Figure 2-4. The subsoil is primarily Alluvium sediments to the western half with Gravels derived from Limestone (GLs) along the eastern half.

Alluvium is river sediment and indicative of previous flooding. This is most likely a historic river terrace, indicative of a period where the position of the meandering river was migrating through the general area. The loop drain to the north is a clear remnant of a historic river meander. Since the construction of the upstream dam the peak flows are controlled, and maximum flood extents reduced. The extent of alluvial soils is no longer likely to correspond with the predicted flood extent. The underlying bedrock is part of the Rickardstown Formation which is described as cherty often dolomitised limestone.

The boreholes completed as part of the groundwater monitoring indicate a groundwater depth of 1m - 2.92m depth across 10No. borehole locations (Appendix B). This was completed over a period of 10 months (April 2021 - January 2022), with an average groundwater depth of 2m. The Site Investigation works carried out for the site indicate a groundwater depth of 2.3m - 2.7m (Appendix C).

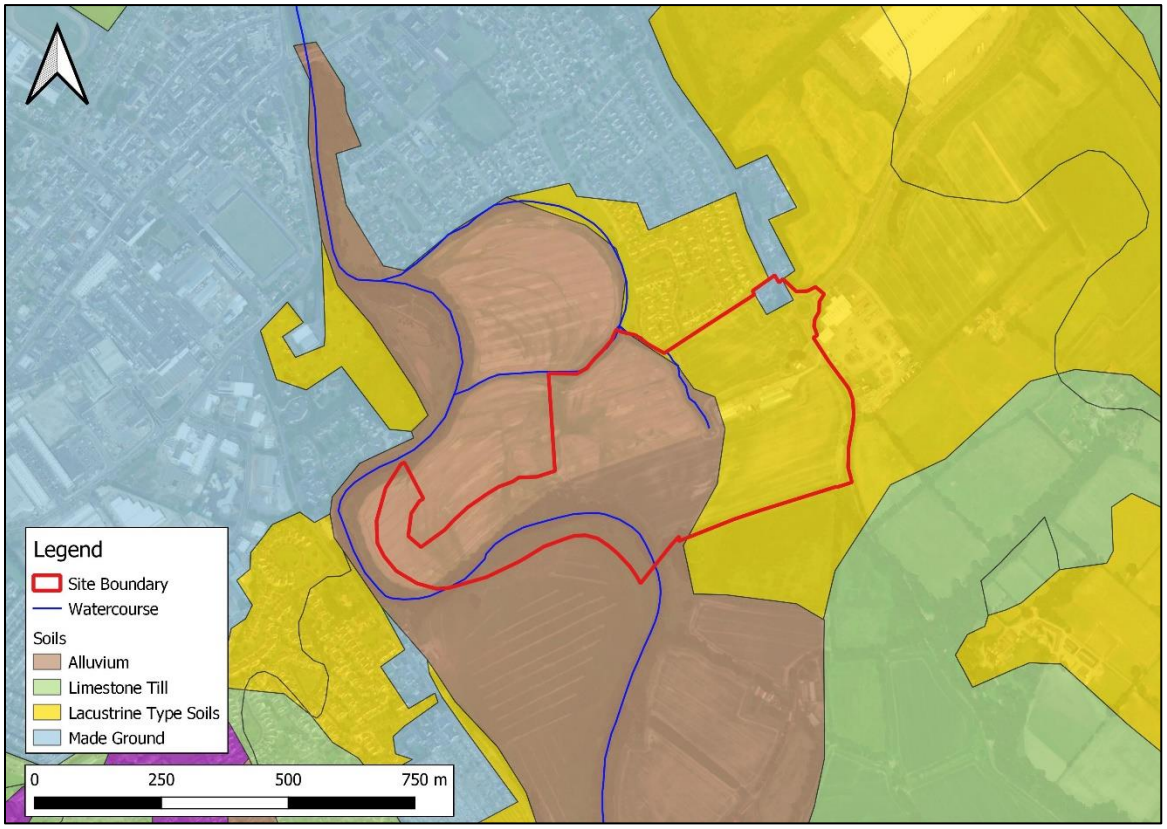


Figure 2-4: Site Subsoils

2.4 Site Topography

The site covers an area of 27.64 ha. The general slope of the site is towards the north west. The highest point of the site is to the south east, 88.6mOD, while the lowest point is in the north west corner, 85.8mOD.

2.5 Newbridge Local Area Plan 2013-2019

The Newbridge LAP shows that the site is in the C zoning (New Residential) and also the F zoning (Open Space and Amenity), Figure 2-5. As indicated in the LAP;

"{The C} zoning provides for new residential development and associated ancillary services. Permission may also be granted for home based economic activity within this zone subject to the preservation of residential amenity and traffic considerations. New residential areas should be

developed in accordance with a comprehensive plan detailing the layout of services, roads, pedestrian and cycle routes and the landscaping of open space.

The aim of {the F} land use zoning objective is to protect recreation, open space and amenity areas, to maintain and improve amenity lands, to preserve private open space and to provide recreational facilities. Existing agricultural uses in open spaces area will continue to be permitted and reasonable development proposals in relation to this issue will be considered on their merits."

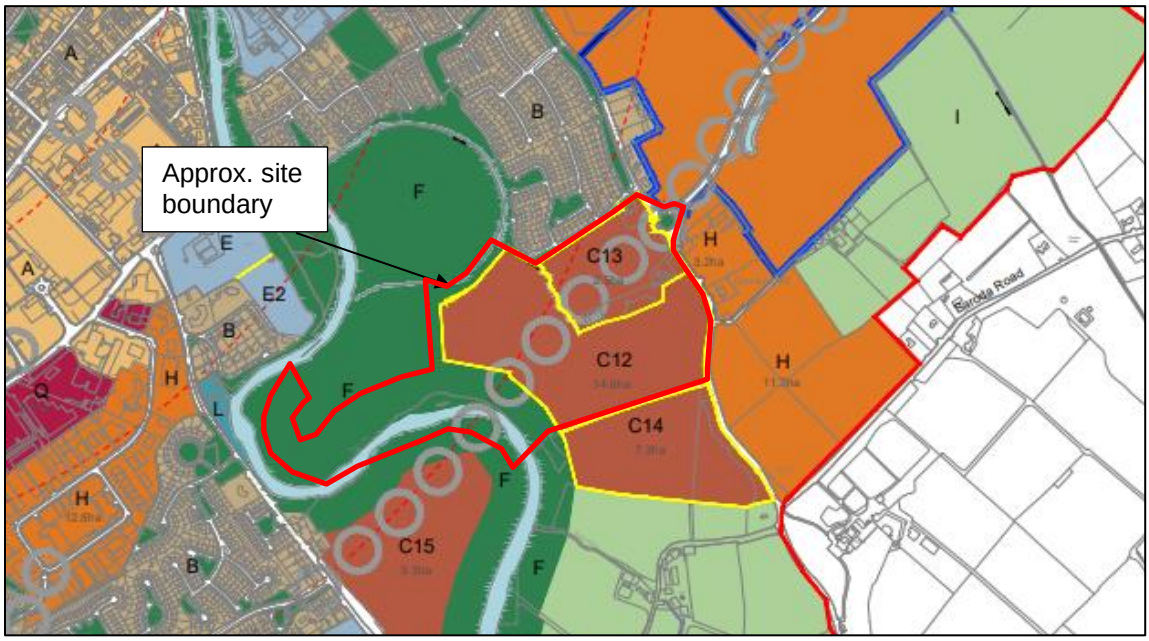


Figure 2-5: Newbridge LAP Zoning

3 Flood Risk Identification

An assessment of the potential for and scale of flood risk at the site is conducted using historical and predictive information. This identifies any sources of potential flood risk to the site and reviews historic flood information. The findings from the flood risk identification stage of the assessment are provided in the following sections.

3.1 Flood History

A number of sources of flood information were reviewed to establish any recorded flood history at, or near the site. This includes the OPW's website, www.floodmaps.ie and general internet searches.

3.1.1 Floodmaps.ie

The OPW host a National Flood Information website, www.floodinfo.ie, which highlights areas at risk of flooding through the collection of recorded data and observed flood events. As can be seen in Figure 3-1 below, two historic flood events have been recorded in the area but none have been recorded at the site. Details of the two recurring flood events, both documented in 2005, are provided below.

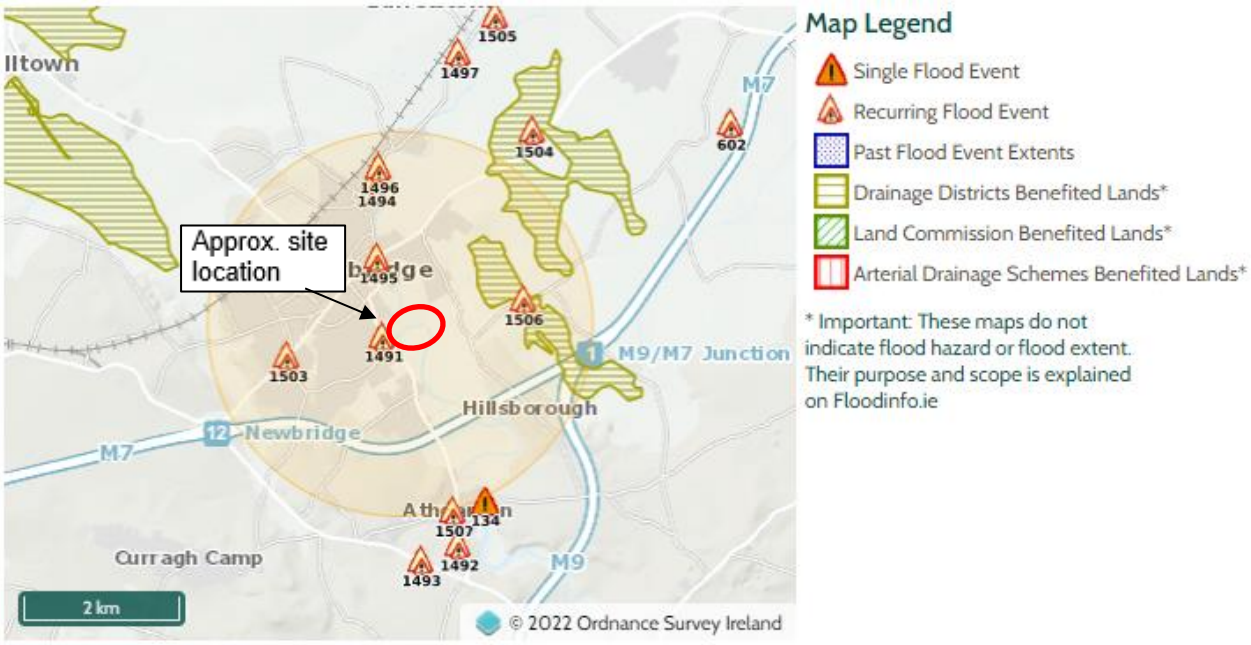


Figure 3-1: Floodinfo.ie

- Ref: 1491 Kilbelin, Newbridge – Area floods after heavy rain. The surface water system not able to cope. Occurs 1 or 2 times per year. This occurs approx. 500m west of the proposed development footprint and the opposite bank of the River Liffey.
- Ref: 1495 Recurring flooding at Newbridge College: Flooding occurs at the junction of the stream in 47 and the Liffey after heavy rain.

3.1.2 Previous FRA for the site

A flood risk assessment review report was carried out for a site within the Great Connell lands in November 2013. It was carried out by Byrne Looby Partners Water Services Ltd to review the KCC SFRA. The study relates to the site directly north of the proposed site, which is surrounded by the historic Liffey meander. According to the study:

'Aston own the land for 42 years and it has never flooded even through Hurricane Charlie rainfalls of the mid-1980's and other serious downpours. Before that the Brennan Family owned the land for many decades and in their time the land never flooded. The Brennan family owned the land before and after the Hydroelectric Scheme of the Liffey in the 1930's.'

3.1.3 GSi Groundwater and Surface Water Flood Mapping

The GSi datasets have been checked and do not indicate any historic surface water or ground water flooding. The GSI dataset indicates a moderate to high groundwater vulnerability.

3.1.4 Internet Searches

An internet search was conducted to gather information about whether the site was previously affected but flooding but no relevant information was found.

3.2 Predicative Flooding

The subject area has been a subject of number of predicative flood mapping or modelling studies and other related studies and plans:

- Newbridge SFRA;
- Eastern Catchment Flood Risk Assessment and Management Study;

The level of detail presented by each method varies according to the quality of the information used and the approaches involved. The Eastern CFRAM is the most detailed assessment of flood extent and supersedes the fluvial flood outlines presented by the Newbridge SFRA.

3.2.1 Newbridge SFRA

The Newbridge SFRA, completed as part of the LAP, was completed in 2013 prior to the publication of the CFRAM maps. Flood maps produced as part of the SFRA are shown in Figure 3-2 below. The site is also identified as being partially within the lands subject to a site-specific Flood Risk Assessment appropriate to the scale of the development being proposed. The SFRA states that such development proposals shall also:

- Indicate and quantify loss of floodplain storage arising from the development proposal;
- Provide compensatory storage within or adjacent to the proposed development;
- Indicate measures to ensure that water-vulnerable elements of the development would not be flooded during the 1000year flood;
- Ensure that existing flow paths for flood water will not be compromised.

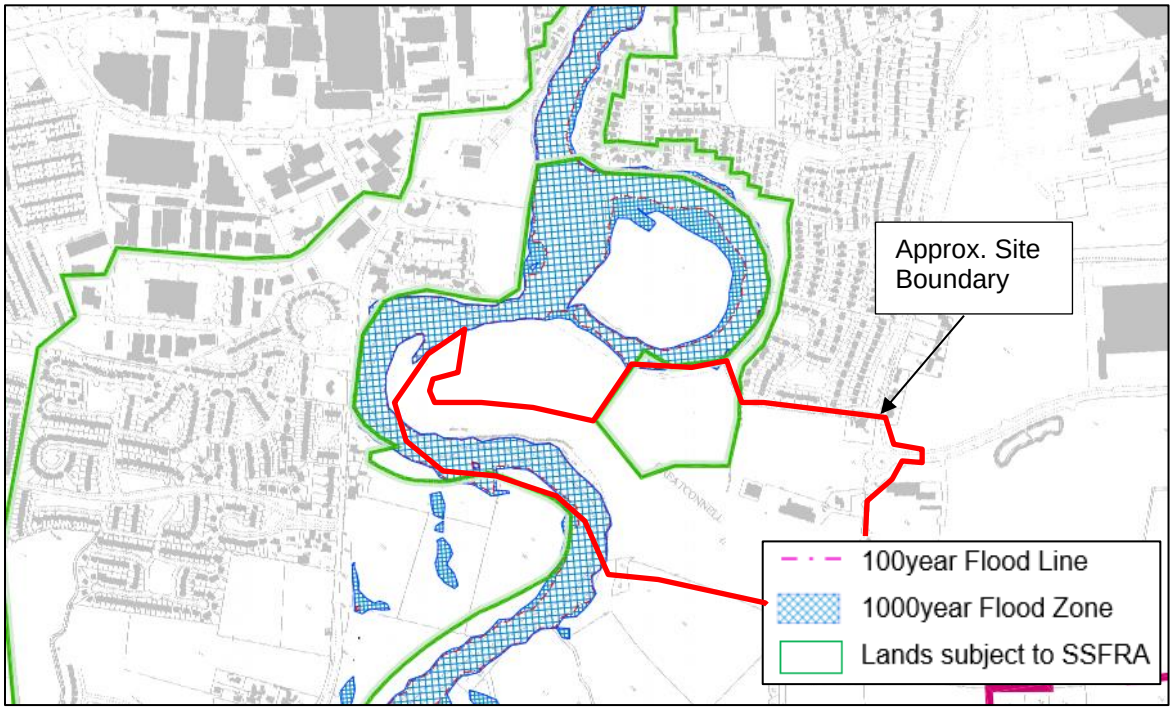


Figure 3-2: SFRA Flood Zones

3.2.2 Eastern CFRAM

The primary source of data with which to identify flood risk to the site is the Eastern CFRAM. The Eastern CFRAM covers approximately 6,300km² and involves detailed hydraulic modelling of rivers and their tributaries along with coastal flooding.

Flood maps are publicly available for 10%, 1% and 0.1% AEP and covers the River Liffey adjacent to the site. Flood maps have been finalised for Newbridge Town and an extract of the flood map covering the site is presented in Figure 3-3. The CFRAM map suggests that there is a potential fluvial overland flow through the centre of the site where the River Liffey overtops its banks and spills across into the drain within the site boundary.

Flood levels for the modelled events are also provided as part of the CFRAM study. Water levels at the nearest nodes to the site are provided in Table 3-1 below.

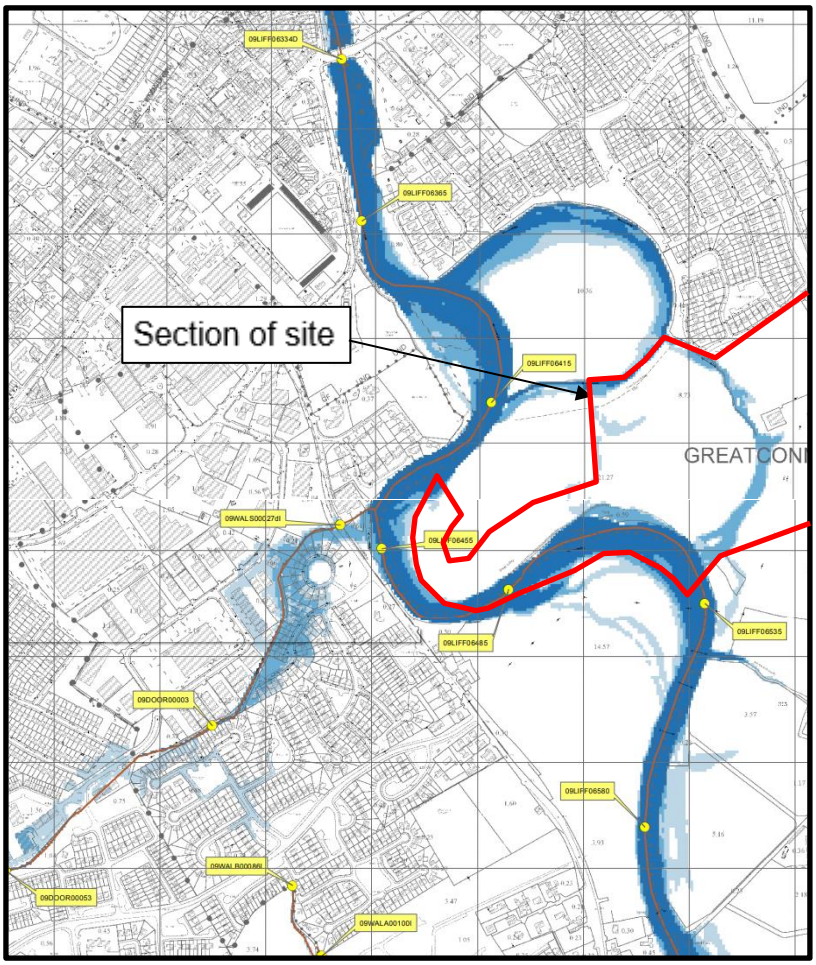


Figure 3-3: CFRAM flood extents

Table 3-1: CFRAM Fluvial Flood Levels

CFRAM Node	1% AEP Water Level (m)	0.1% AEP Water Level (m)
09LIFF06535	87.90	88.06
09LIFF06485	86.90	87.09
09LIFF06415	85.74	85.86

3.3 Sources of Flooding

The initial stage of a Flood Risk Assessment requires the identification and consideration of probable sources of flooding. Following the initial phase of this Flood Risk Assessment, it is possible to summarise the level of potential risk posed by each source of flooding. The flood sources are described below.

3.3.1 Fluvial

Under the CFRAM flood mapping the proposed development is located primarily in Flood Zone C. However, there is an overland flow path from the River Liffey across the south of the site into the drain as part of the 1% and 0.1% AEP event (Flood Zone A & B). This flow path follows the path of the historic meander of the Liffey. As it is proposed to develop within the site boundary, a more detailed model will be required to clarify the baseline flood extents and support the proposed design of the site. This is discussed in detail in Section 4 below.

3.3.2 Tidal

The development site is located inland so tidal flood risk has therefore been screened out at this stage.

3.3.3 Pluvial

Pluvial, or surface water, flooding is the result of rainfall-generated flows that arise before run-off can enter a watercourse or sewer. It is usually associated with high intensity rainfall.

A number of drainage channels are located both through and adjacent to the site, as well as the River Liffey meandering around the site, as discussed in Section 2.2. The site slopes towards the drainage channels to the north and the River Liffey to the south and west. As such surface water entering / falling on the site would flow into these watercourses.

Adequate storm water drainage systems will minimise the pluvial flood risk to the site from these drains. It is also important that increases in surface water runoff as a result of the development, including changes from greenfield to paved area, are managed. Pluvial mitigation is discussed further in Section 6.4.

3.3.4 Groundwater

Groundwater flooding results from high sub-surface water levels that impact upper levels of the soil strata and overland areas that are usually dry. Review of the GSi information on groundwater flood risk does not highlight any historic groundwater flooding on or near the site. The groundwater vulnerability is indicated as moderate to high. However, as mentioned in Section 2.3, the Site Investigation works indicate a groundwater depth of 2.3m - 2.7m. The groundwater monitoring completed over a 10-month period indicates a groundwater depth of 1m - 2.92m depth, with an average depth of 2m across the 10No. borehole locations. This indicates the groundwater flood risk is generally low.

4 Flood Risk Assessment

As outlined in Section 3.3, there is fluvial risk to the site, as indicated by the Eastern CFRAM Study. In order to assess the impacts of the proposed site layout and implement mitigation measures that ensure flood risk to the site is effectively managed, it is necessary to re-model this area. This will also provide clarification of the Flood Zone extents at a site-specific level and allow development scenarios to be tested. The following sections will detail the process of flow estimation, hydraulic modelling and present the results of the flood risk to the site.

A peer review was carried out by ARUP which confirmed the FRA was completed in accordance with The Planning System and Flood Risk Management Guidelines and in compliance with the Strategic Flood Risk Assessment (SFRA) of the Kildare County Development Plan 2017-2023. This involved a review of the proposals, hydrology/modelling approach and mitigation recommendations provided under the FRA. Any comments made by ARUP throughout the review processes were taken on board by JBA and updated according in the model and mitigation process. Refer to Appendix E for the Peer Review.

4.1 Hydrology Estimation

4.1.1 Flow Estimation

Flows and hydrographs have been estimated based on a hydrological analysis of the River Liffey using appropriate methods, such as the FSU method and the FSR Rainfall Runoff method. These have been prepared to check the Final CFRAM flows to ensure the CFRAM flows are suitable for use in the JBA model.

As discussed in Section 2.3 the catchment is sub-divided into the controlled Golden Falls catchment and the natural River Liffey. Using the available information for both catchments, flows were calculated to check and verify the CFRAM flows. The River Liffey flows were calculated using the physical catchment descriptors while the Golden Falls flows were estimated from the gauged flows at the dam. The ESB was contacted in attempt to update the AMAX series from when it was carried out for the CFRAM (Final CFRAM Hydrology Report issued April 2016). Only the average AMAX series was available rather than the peak AMAX series which could not be used as part of the calculations. The calculated flow estimates for both catchments were similar to those used in the CFRAM and so the CFRAM flows were deemed suitable for use in the model.

The 1% AEP and 0.1% AEP fluvial events were modelled using CFRAM calculated flows from node 09LIFF06678E which is at the upstream extent of the model. These estimated flows are outlined in Table 4-1 below.

The CFRAM flow for the Doorfield watercourse, which enters the River Liffey west of the site, were also adopted, Node 09WALS00027dl. This watercourse was not modelled so the flows were applied directly to the River Liffey.

As mentioned in Section 2.2, the local drains on site also had a small catchment area (approx. 0.3km^2), draining local fields and a housing estate. Inflows for this drain were calculated using the IH124 Method plus the 95% Confidence Interval. This method gave a flow of 0.6m3/s for the 1% AEP event and 0.8m^3/s for the 0.1% AEP event. To allow for uncertainties with the inflows of such a small drain, a constant inflow of 1m^3/s was applied in the model for all return periods.

Table 4-1: Fluvial Flows (m^3/s)

Inflow for model	Source	1% AEP (m^3/s)	0.1% AEP (m^3/s)
Upstream Inflow	CFRAM Node 09LIFF06678E	134.15	156.53
Doorfield	CFRAM Node 09WALS00027dl	2.84	4.57
Drain	JBA Estimation	1	1

4.1.2 Inflow Hydrographs

The hydrograph shape was based on the CFRAM hydrograph, where the River Liffey peak flow passes through the site at approx. 30hours and then the Golden Falls Dam peak flow is released at

approx. 96hrs for 24hrs (Figure 4-1). As the River Liffey Peak flow is considerably smaller than the Golden Falls Dam peak, the peak flows in the CFRAM model represent the Dam releases through the site.

For the Doorfield and the Drain inflows, a constant inflow of the flows shown in Table 4-1 were applied to the model.

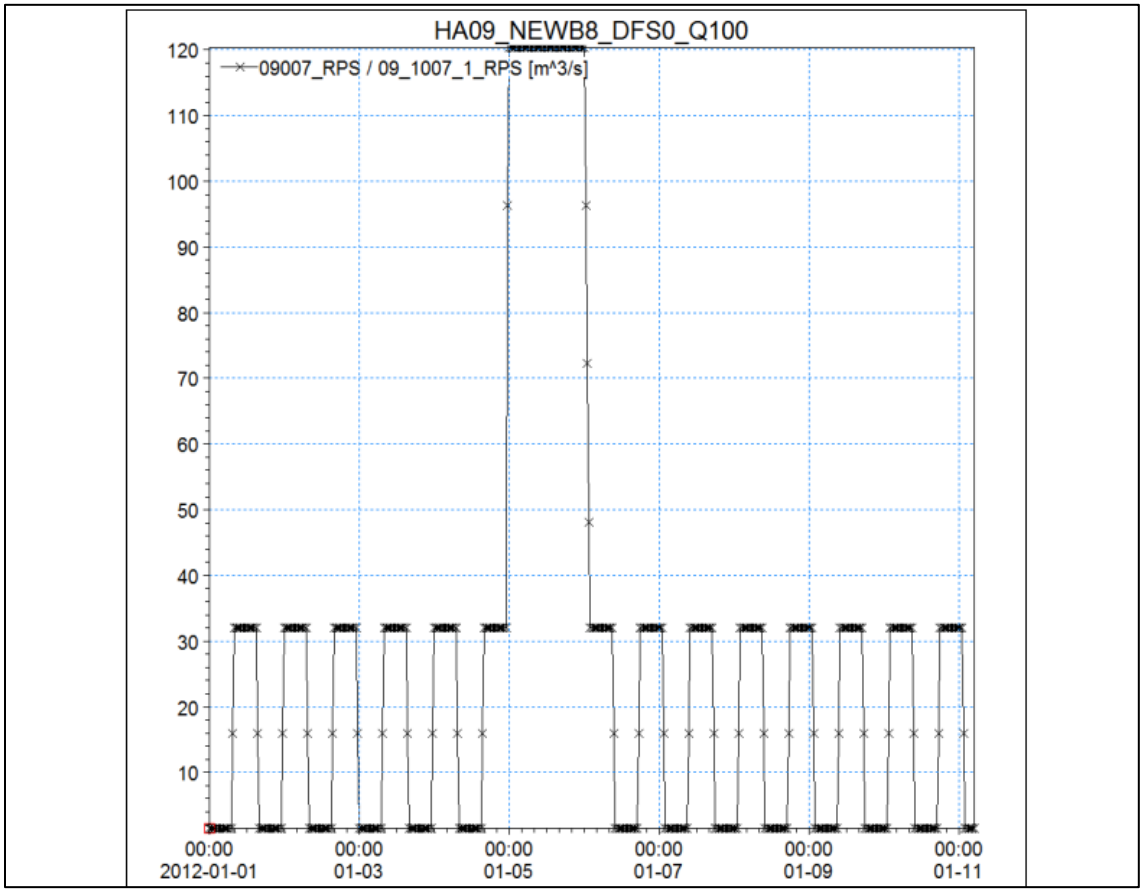


Figure 4-1: Eastern CFRAM Inflow Hydrograph at Model Upstream during 1% AEP Design Run

4.2 Hydraulic Model

The hydraulic modelling for this study was completed using a combination of two software packages: Estry and TUFLOW by BMT-WBM. When both software packages are used in conjunction with each other, they form what is termed a 'linked-model'. A linked-model allows flow in the river channel and structures to be represented using 1D modelling equations (Estry) and allows any out-of-bank volumes to be represented by 2D routing equations (TUFLOW).

The hydraulic modelling was carried out in the following stages:

- A new 1D model of the River Liffey was created using the CFRAM survey data provided by the OPW. A 1D model of the on-site drains was created using topographic survey carried out by Murphy Surveys in January 2020.
- A 2D (TUFLOW) model grid enclosing the study area was created. This was done using LiDAR data covering the area supplemented with site specific ground survey.
- 1D and 2D components were linked along the bank crest lines along with the deactivation of the floodplains from the 1D domain and of the channels from the 2D domain.
- Design simulations were run to derive the existing risk flood extents.

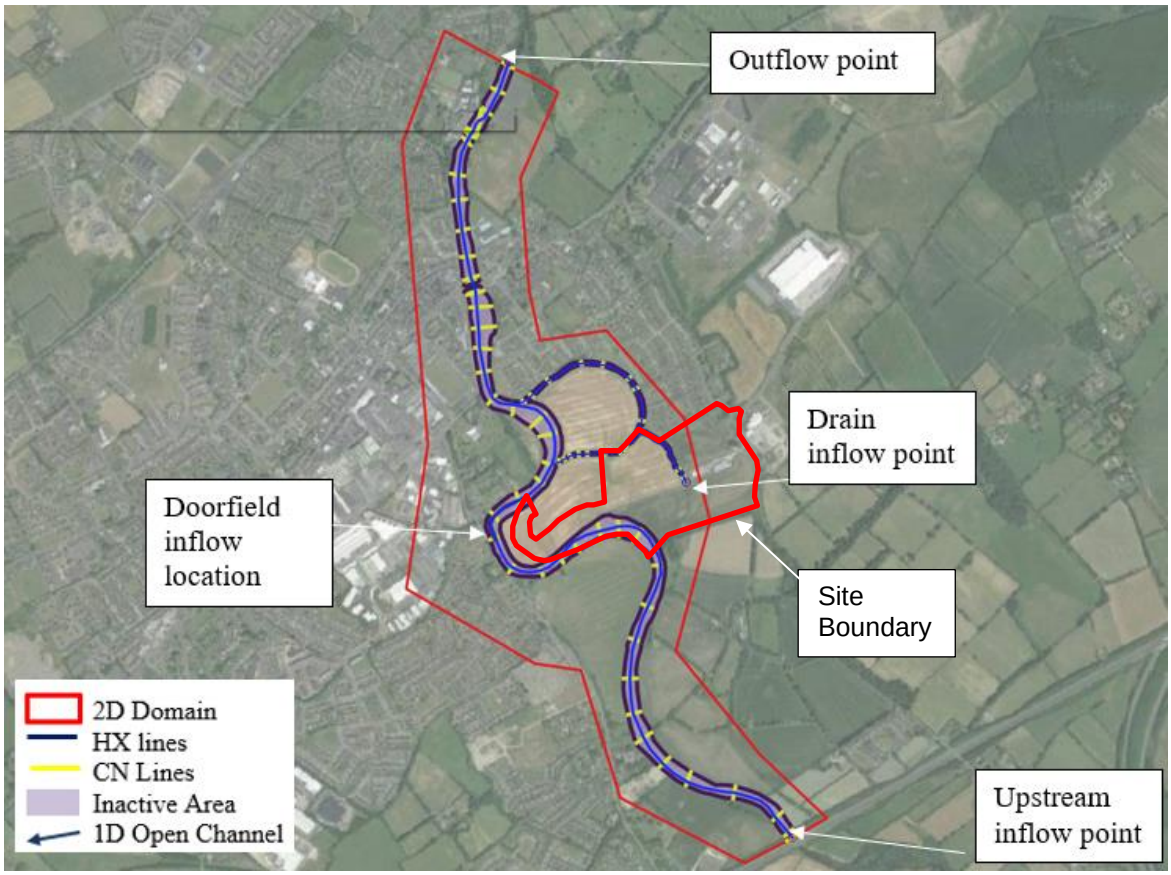


Figure 4-2: JBA Model Schematisation

4.3 Model Results - Baseline Scenario

Model results for the 1% and 0.1% AEP events (Flood Zone A & B) are shown in Figure 4-3 below. The figure also shows the climate change scenario which is a 20% increase in the 1% AEP flows. The site is indicated as being primarily within Flood Zone C. This means the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both rivers and coastal floods). There are two overland flow paths across the site which are within Flood Zone B meaning there is a risk of flooding in this section during the 0.1% AEP event. One of these flow paths is also within Flood Zone A so there is a risk during the 1% AEP event.

The results of the JBA model are shown in Table 4-2. The JBA modelled water levels and flows are compared against the CFRAM modelled water levels and flows at two locations. As seen in the table below JBA water levels results are higher than the CFRAM and so are more conservative. The modelled flows in these locations are lower in the JBA model, despite the inflows for the model being the same (Section 4.1.1). The reason for the increase in water levels and flows moving downstream in the model is discussed below.

JBA carried out a range of sensitivity tests in the model, including roughness sensitivity. The model was shown to be particularly sensitive to a 20% increase in roughness as it gives rise to an additional overland flow path through the site in the 1% AEP event. This flow path is similar to that seen in the CFRAM study. It was therefore decided to adopt the increased roughness values in the model for the final results due to the sensitive nature of the site and this flow path needs to be acknowledged. While the increase in roughness values has increased the water levels across the model, it has also caused a decrease in flow in the model, as evident in the comparison with the CFRAM flows in Table 4-2 below. Without an increase in roughness values the flows and water levels between the two models correlate well, but the increased roughness has changed the flow regime in the model. The increased roughness has slowed the flow through the model which increased water levels and flattens the peak flow curve.

It is also noted that the development on the left bank has been included in the baseline scenario. On 31 October 2018, An Bord Pleanála granted planning permission to Ardstone Homes Limited (An Bord Pleanála Reference 302141-18) for 343 no. units on a site to the west of the current subject

site, identified in yellow on Figure 4.3. This development is currently in the construction phase. It is also a request of Kildare County Council and An Bord Pleanála that this development is included in the baseline scenario.

Figure 4-3: JBA Flood Extents

Table 4-2: JBA vs CFRAM Modelled Results

Node	**CFRAM**		**Model**	
	Water Level	Flow	Water Level	Flow
		Q100		
09LIFF06580	88.50	-	88.82	126.97
09LIFF06535	87.90	-	88.12	130.46
09LIFF06455	86.46	131.97	86.92	130.92
09LIFF06415	85.74	135.10	86.02	121.48
		Q1000		
09LIFF06580	88.69	-	89.00	142.09
09LIFF06535	88.06	-	88.27	149.27
09LIFF06455	86.61	157.76	87.07	144.97
09LIFF06415	85.86	166.03	86.20	132.41

5 Site Design / Masterplanning

Following on from updating the existing flood extents in Section 4, indicative post-development scenarios were modelled. The first scenario involved raising ground levels within the proposed site to represent the proposed residential development and also representing the proposed bridge across the River Liffey. The second scenario included the SHD development only without the proposed bridge. These scenarios are discussed in detail in the sections below.

As discussed in Section 4.3 the site is predominantly in Flood Zone C with an overland flow route through the site in Flood Zone A and B.

Figure 5-1 below identifies the appropriate development types for each flood zone, as per the Planning Guidelines. All development types are appropriate for Flood Zone C. Developments within Flood Zone A are recommended to be water compatible, i.e. car parking and green spaces, while less vulnerable developments such as retail or commercial uses are appropriate within Flood Zone B. Any other developments in these zoning types must apply and pass the Justification Test (JT).

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Figure 5-1: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test (Table 3:2 of the Planning Guidelines)

When the ground levels at the site are raised, the overland flow routes of Flood Zone A/B are cut off, this is discussed in detail in Section 5.1 below. This development strategy means that the JT must be applied and passed. To pass the JT, it must be shown that the impact on surrounding water levels is not significant, and that the development can manage the risk to itself (refer to Section 7 for the JT).

5.1 Design Scenario 1 - Aston SHD Application & Kildare Co. Co. Road and Bridge Application

The post-development scenario which represents the proposed SHD development and the proposed bridge was modelled to assess the impacts of both developments on the surrounding land. Compensatory storage to account for the loss of the overland flow route through the site in Flood Zone A was included in the design (refer to Section 6.2 for more details on the compensatory storage). This was provided at two locations: along the meander of the River Liffey along the site's western boundary and approx. 80m upstream. Figure 5-2 below shows the post-development flood extent map for the 1% and 0.1% AEP events. Ground levels were also lowered between the development footprint and the River Liffey to reinstate an overland flow route within the floodplain, which re-enters the channel approx. 180m downstream. A depth difference map for the 1% AEP event is shown in Figure 5-3. Table 5-1 below compares the pre- and post-development water level at a number of locations (identified in Figure 5-3). As seen in the table, the impacts of removing the overland flow routes are negligible in the 1% AEP event. There is a decrease in flood depths of up to 20mm upstream of the proposed bridge. There is an additional overland flow path on the right bank as a result of the development but this is within the Blue Line boundary, being the area defined as under the ownership and control of the applicant.

A depth difference map for the 0.1% AEP event is shown in Figure 5-4 below. Table 5-1 below compares the pre- and post-development water level at a number of locations (identified in Figure 5-4). The impacts on water levels and extents upstream of the bridge are negligible as a result of the SHD development and the proposed bridge. Downstream of the proposed bridge there is a slight increase in water levels (approx. 16mm). There is no increase in flood extents on the left bank. As the area adjacent to the river is designated green space, there is no increase to flood risk here. Water level increases of up to 10mm are noted in the River Liffey channel directly downstream

of the compensatory storage areas. This increase is as a result of the additional flow passing through the compensatory storage area and entering back in the channel. Properties are located on the left bank of the River Liffey in this location but ground levels are approx. 5m above water levels so there is no increase to risk. As with the 1% AEP event, there is an additional overland flow path through the site as a result of the development, but this is confined to lands owned by the applicant. Any future change of use to this land from greenfield/open space will be preceded by a flood risk assessment.

It must be noted that the bridge design is in accordance with OPW Section 50 design requirements in terms of water level increases/increases in risk elsewhere. The bridge will be subject to an OPW Section 50 consent application. Aston Limited are progressing with a separate application for the extended road and new bridge crossing.

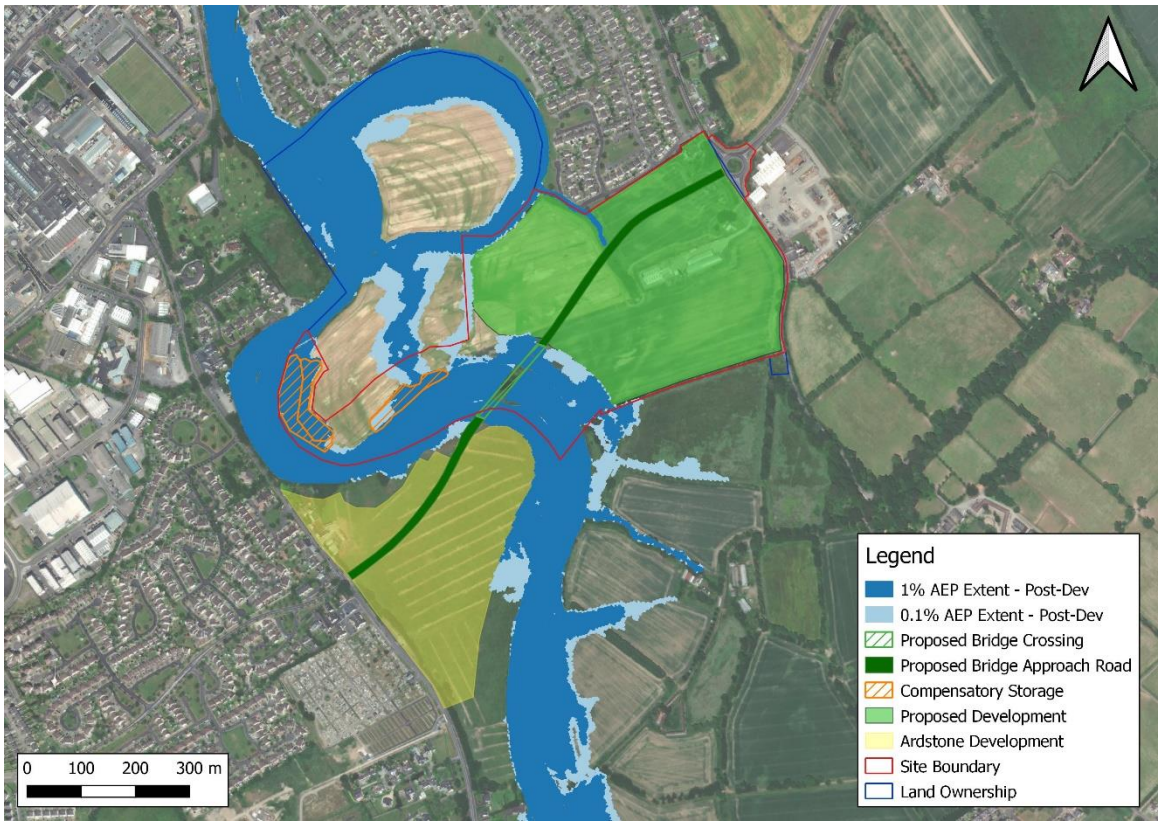


Figure 5-2: Post-Development Flood Extents - Scenario 1 SHD & Bridge Development

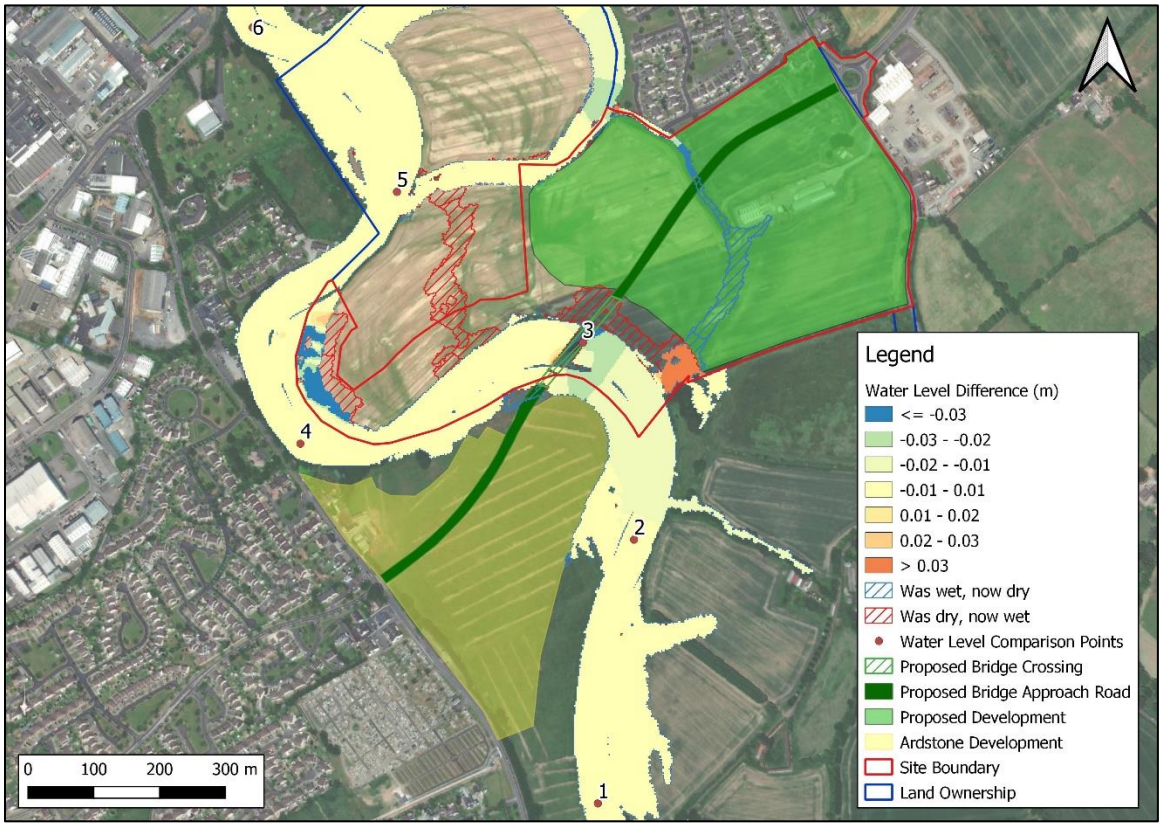


Figure 5-3: 1% AEP Depth Difference Map - Scenario 1 SHD & Bridge Development

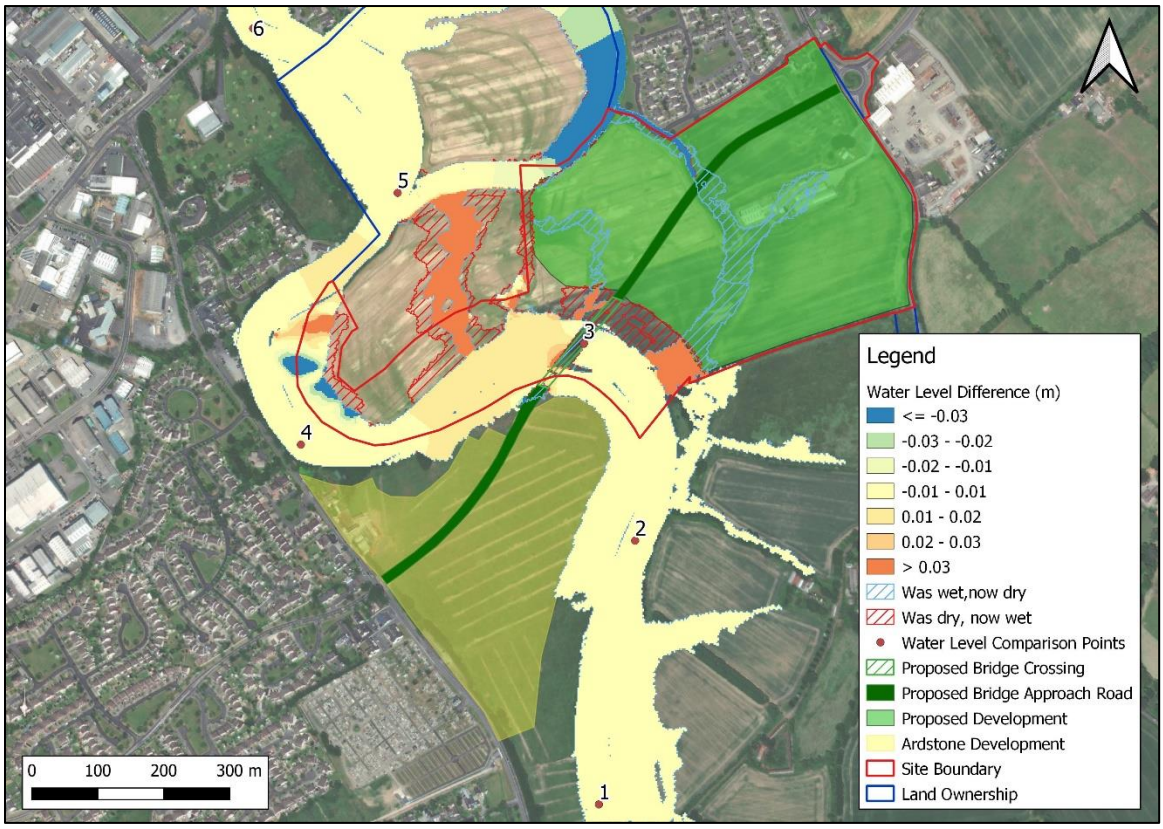


Figure 5-4: 0.1% AEP Depth Difference Map - Scenario 1 SHD & Bridge Development

Table 5-1: Pre- and Post-SHD & Bridge Development Water Levels

Location	1% AEP		0.1% AEP	
	Pre	Post	Pre	Post
1	88.97	88.97	89.15	89.15
2	88.38	88.38	88.55	88.56
3	87.80	87.80	87.93	87.96
4	86.92	86.92	87.07	87.07
5	86.02	86.02	86.20	86.20
6	85.61	85.61	85.86	85.86

5.2 Design Scenario 2 - Aston SHD Application

The post-development scenario which represents the proposed SHD development without the proposed bridge was modelled to assess the impacts of the SHD development alone. **It is noted that this scenario; where the SHD site is constructed without the bridge, is the less likely of the two scenarios as the applicant and Kildare County Council are actively progressing the consenting and funding for the bridge.** Aston Limited are also progressing with the planning application for the Road and Bridge (Ref:4559). As with Design Scenario 1 in the section above, compensatory storage to account for the loss of the overland flow route In Flood Zone A as a result of the SHD development was included in the model as well as the overland flow route in the 1% AEP event being reinstated. Figure 5-2 below shows the post-development flood extent map for the 1% and 0.1% AEP events.

A depth difference map for the 1% AEP event is shown in Figure 5-6 below and compares the pre- and post-development water level at a number of locations (identified in the figure). As seen in the table, the impacts of removing the overland flow routes are negligible in the 1% AEP event. There is an additional overland flow path on the right bank, which is a result of the compensatory storage in this area allowing more flow to enter this area. This additional overland flow path is outside of the development footprint and contained within the Blue Line boundary, being the area defined as under the ownership and control of the applicant.

A depth difference map for the 0.1% AEP event is shown in Figure 5-7 below which compares the pre- and post-development water level at a number of locations (identified in the figure). Similar to the 1% AEP event, there is an additional overland flow path within the blue line boundary as a result of the compensatory storage but this is located away from the development footprint. As with Scenario 1, there is an increase of up to 10mm in the River Liffey channel directly downstream of the compensatory storage areas. Properties are approx. 5m above water levels so there is no increase to risk. There is also an increase in water levels of approx. 15mm adjacent to the proposed development and the northern boundary of the Ardstone development, but there is no increase in flood extents and/or risk as there is still over 1m freeboard between the 0.1% AEP water levels and the finished floor levels of the Ardstone development and all buildings are in Flood Zone C. To the south of the site on the right bank there is an isolated increase in depth and a minor increase in extent, where the water is ponding in a low-lying area. These areas are greenfields within the existing floodplain so again the flood risk is not increased.

While the 0.1% AEP depth difference map does indicate an increase in water levels and extents in the vicinity of the site, there is no increase to flood risk as detailed in the section above and the design scenario with the SHD in place and the bridge unconstructed is the less likely of the two scenarios.

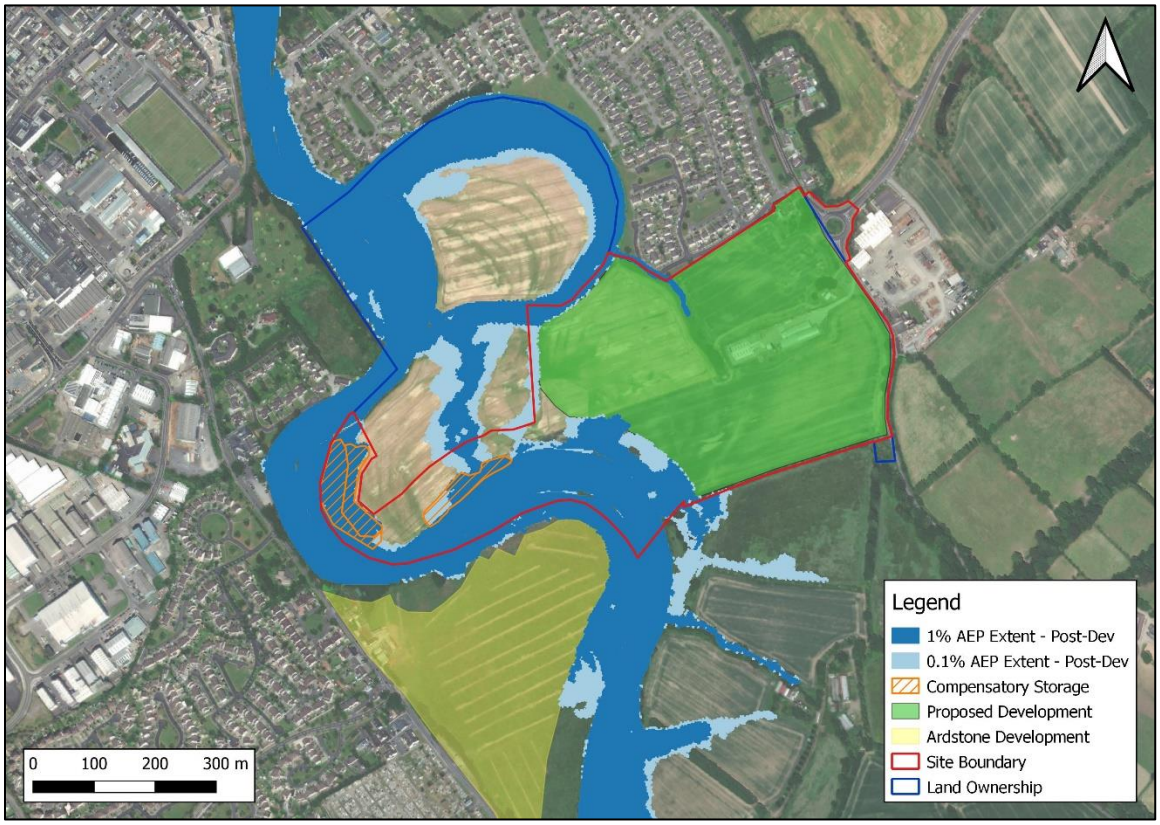


Figure 5-5: Post-Development Flood Extents - Scenario 2 SHD Development

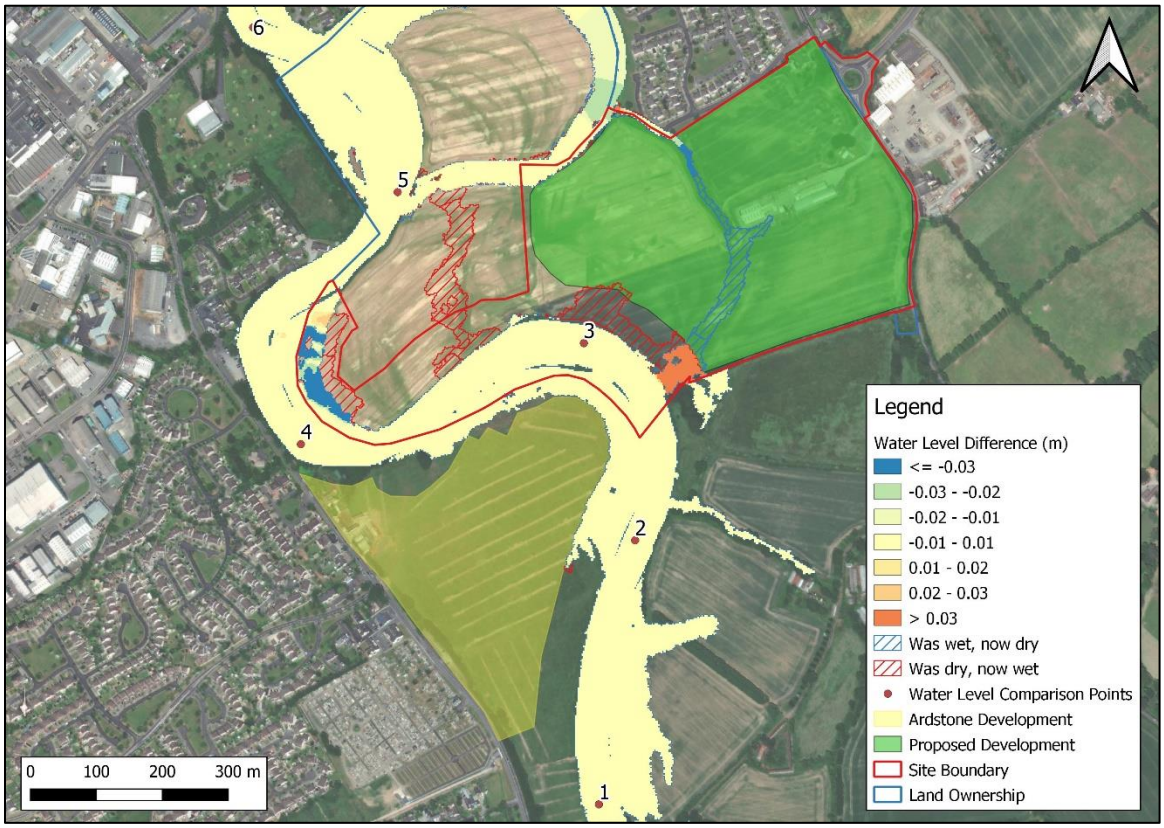


Figure 5-6: 1% AEP Depth Difference Map - Scenario 2 SHD Development

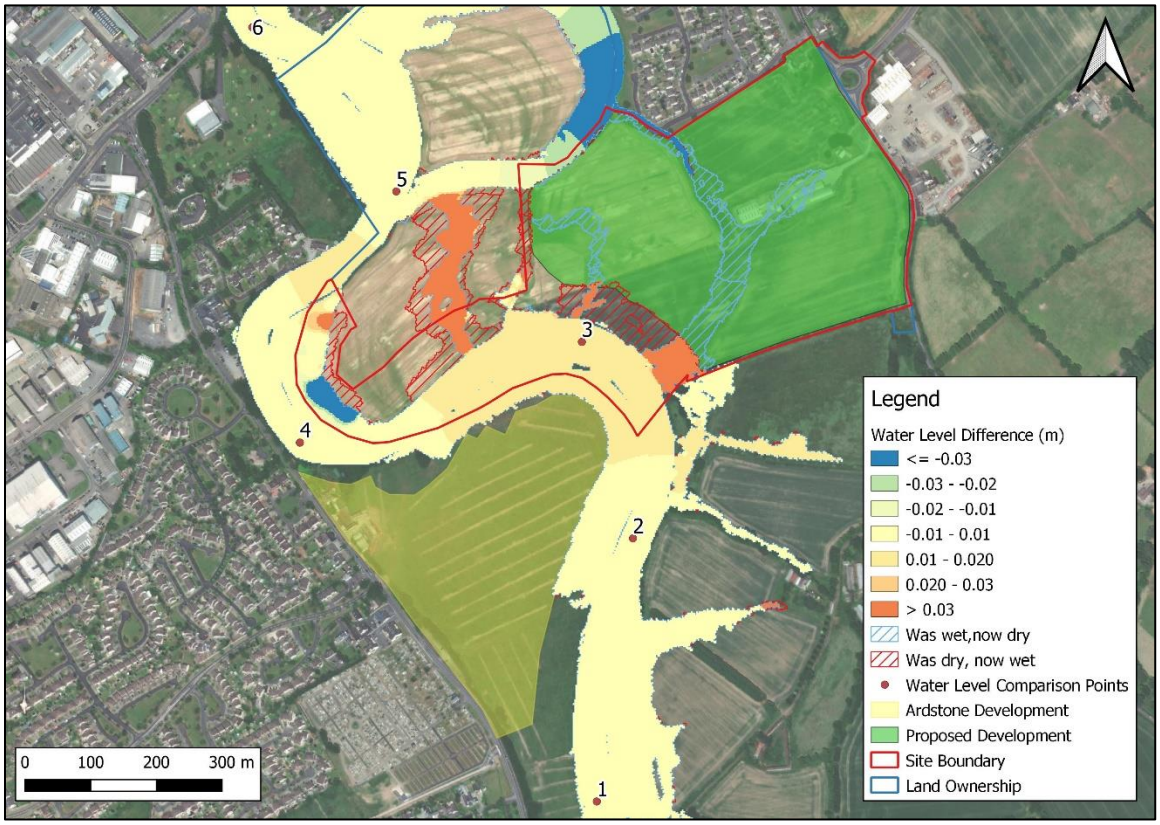


Figure 5-7: 0.1% AEP Depth Difference Map - Scenario 2 SHD Development

Table 5-2: Pre- and Post-SHD Development Water Levels

Location	1% AEP		0.1% AEP	
	Pre	Post	Pre	Post
1	88.97	88.97	89.15	89.15
2	88.38	88.38	88.55	88.56
3	87.80	87.80	87.94	87.95
4	86.92	86.92	87.07	87.07
5	86.02	86.02	86.20	86.20
6	85.61	85.61	85.86	85.86

6 Mitigation Measures

The following section details the necessary mitigation measures required to progress the development strategy.

6.1 Finished Floor Levels

Based on the indicative post-development scenario it is recommended to set the Finished Floor Levels (FFL) above the 0.1% flood level with an additional 500mm freeboard. This is in line with the County Development Plan SFRA[1] recommendations. Refer to Figure 6-1 below for the range of recommended FFL at each block of houses adjacent to the watercourses. Note, these FFL are the recommended FFL, not the proposed FFL. The FFL varies across the length of the site, in accordance with the general downstream slope of the water levels in River Liffey and the drains on site.

The minimum recommended FFL for each block refers to the outer line of each housing block (i.e. adjacent to the river). Once the outer rows are raised to the minimum recommended levels, they will act as a barrier for the inner housing and prevent inundation in the extreme events.

The proposed finished floor level for the site places the developments above the 0.1% AEP event plus a minimum additional freeboard of 500mm. Along the River Liffey the FFL ranges from 89.10mOD at the upstream end to 88.45mOD at the downstream. Similarly, the proposed FFL along the drain to the north ranges from 87.70mOD to 87.05mOD. These proposed FFL are above the minimum recommended FFL as shown in Figure 6-1. These FFL also place the development above the 1% AEP plus climate change event.

It is also recommended to place the FFL 150mm above nearby road levels to prevent surface water inundation during an exceedance event.

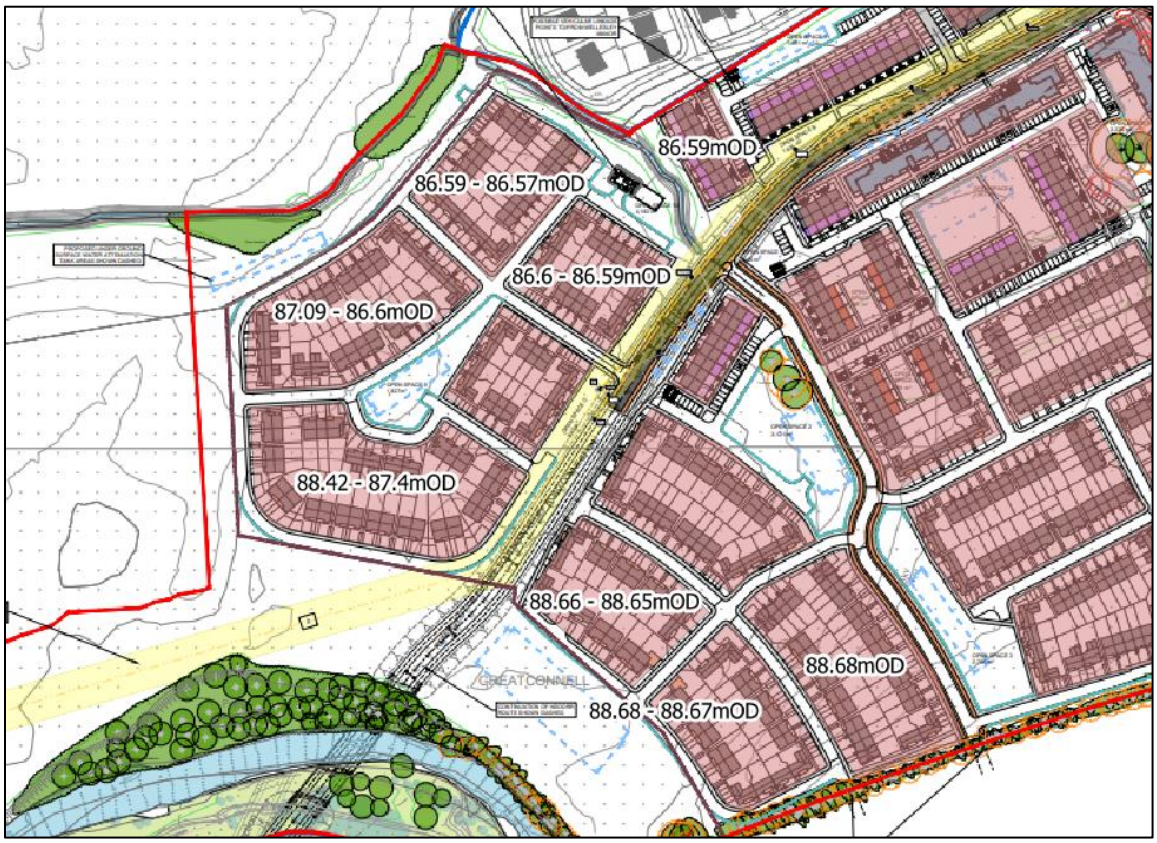


Figure 6-1: Minimum Recommended FFL

1 https://kildare.ie/CountyCouncil/AllServices/Planning/DevelopmentPlans/KildareCountyDevelopmentPlan2017-2023/EnviromentalReports/SFRA%20Report.pdf

6.2 Compensatory Storage

Compensatory storage for the site has been designed in line with the Kildare County Development Plan SFRA whereby compensatory storage is designed for the loss of floodplain within Flood Zone A and is also provided for in lands which do not flood in the 1% AEP event. As per the Planning Guidelines (Appendix A, Section 3.3.1), level for level compensation provides the same surface area at the same elevation before and after development. It is noted that the open space which will be landscaped and used as an amenity area will not be raised. Only the compensatory storage areas will be lowered and the impacts on levels are modelled and discussed below.

Compensatory storage is provided in the pre-development Flood Zone C area. It has been included in the design scenarios in Section 5.1 and 5.2 above. Figure 6-2 below shows the compensatory storage area utilised for the loss volume of Flood Zone A along the western boundary, overlaying the existing flood extents. In addition to this area of compensatory storage for the 1% AEP event, another area of compensatory storage has been provided to reduce impacts in an event exceeding the 1% AEP. This area of compensatory storage has been provided on the right bank of the River Liffey between the proposed bridge crossing and the 1% AEP storage area at the western boundary.

Figure 6-2 confirms the compensatory storage areas are outside of Flood Zone A. The figure also identifies the area of ground requiring regrading to link the flood plain and the compensatory storage. Note the area for regrading is not included in the volumetric calculations for the loss of Flood Zone A. Refer to Figure 5-4 for the post-development flood extents including the compensatory storage area.

Figure 6-3 provides a table of the pre- and post-development volumes for each of the height ranges. The table confirms that, despite a volume shortfall in 5 of the height ranges due to the topography, the overall volume has over 1,200m³ of a gain in the post-development scenario.

For further information on the compensatory storage design refer to the PUNCH engineering drawings submitted as part of the wider planning application (Drawing ref: 192229-Punch-XX-XX-DR-C-0811 - 192229-Punch-XX-XX-DR-C-0815).

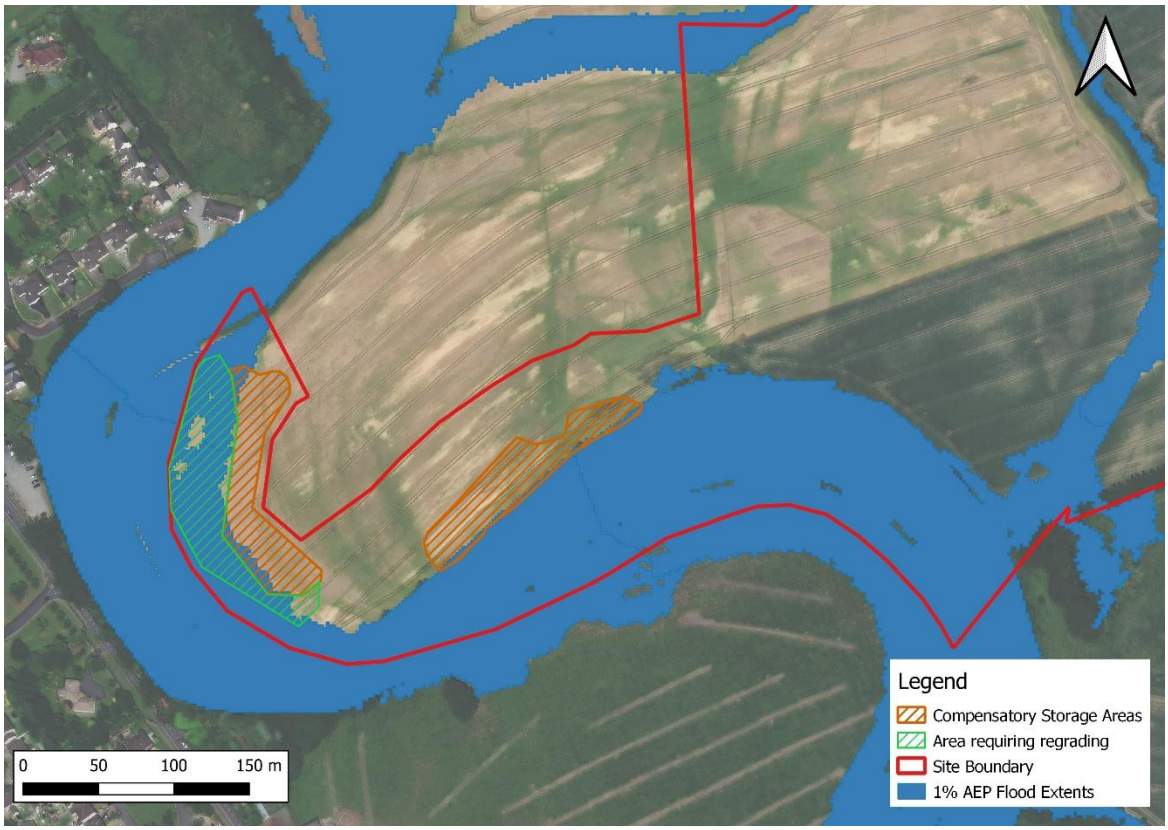


Figure 6-2: Compensatory Storage

FLOOD STORAGE					
Height Range (Below flood plain)		Preworks (Refer to drawing 192229-PUNCH-XX-XX-DR-C-0811)	Post-Works (Refer to drawing 192229-PUNCH-XX-XX-DR-C-0813)	Shortfall	Additional
(m)	(m)	(m3)	(m3)	(m3)	(m3)
0.00	0.20	29127.881	29925.037		797.156
0.20	0.40	23317.669	23922.799		605.130
0.40	0.60	18712.786	18667.366	-45.420	
0.60	0.80	14693.045	14647.683	-45.362	
0.80	1.00	10923.473	10894.683	-28.790	
1.00	1.20	8702.552	8697.846	-4.706	
1.20	1.40	7339.686	7339.677	-0.009	
1.40	1.60	6338.635	6338.635	0.000	
1.60	1.80	5545.515	5545.515	0.000	
1.80	2.00	4841.687	4841.687	0.000	
2.00	2.20	4101.458	4101.458	0.000	
2.20	2.40	2765.708	2765.708	0.000	
2.40	2.60	1452.496	1452.496	0.000	
2.60	2.80	778.381	778.381	0.000	
2.80	3.00	321.364	321.364	0.000	
3.00	3.20	118.410	118.410	0.000	
3.20	3.40	43.792	43.792	0.000	
3.40	3.60	16.866	16.866	0.000	
3.60	3.80	2.391	2.391	0.000	
3.80	4.00	0.133	0.133	0.000	
		139143.928	140421.927	-124.287	1402.286

Figure 6-3: Punch Post-Development with Flood Compensation

In addition to the compensatory storage provided above, additional excavations were introduced to reinstate overland flow paths across the site, as discussed in Section 5.1 as part of the design scenario, refer to Figure 6-4. Figure 6-5 below compares the pre- and post-development floodplain surfaces; with the additional flow path included this time.

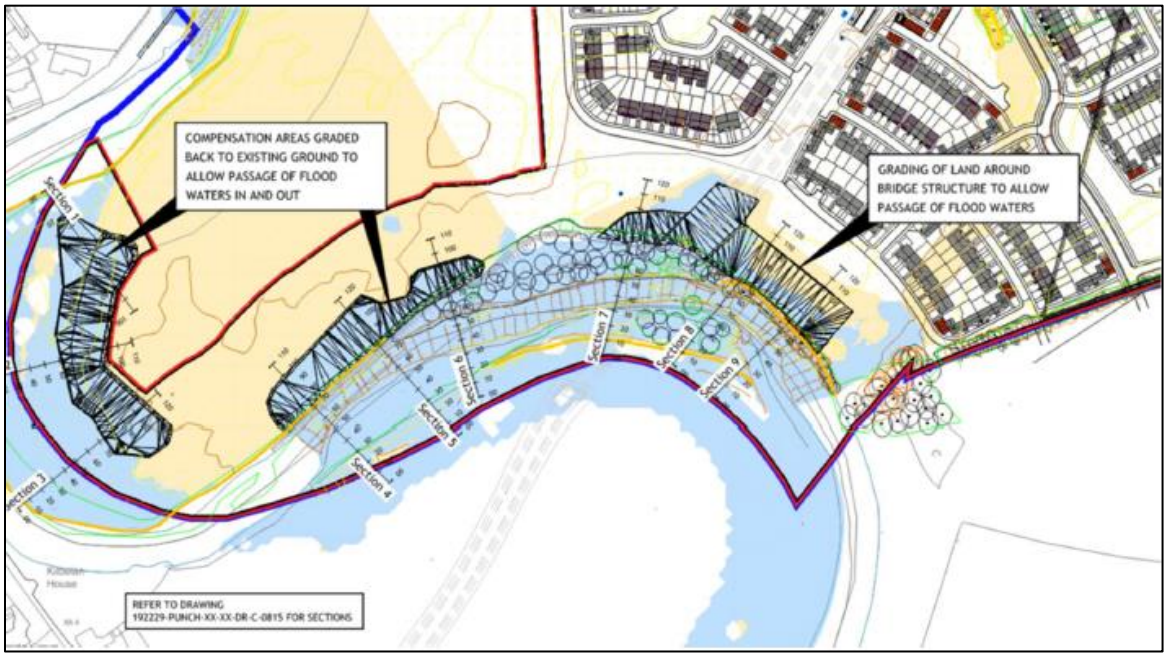


Figure 6-4: Flood Compensation Areas (Extract From 192229-PUNCH-XX-XX-DR-C-0814)

Post-Development (Final) includes flow paths in and out of flood compensation area and around the bridge structure

FLOOD STORAGE

Height Range (Below flood plain)		Preworks (Refer to drawing 192229-PUNCH-XX-XX-DR-C-0811)	Post-Works (Refer to drawing 192229-PUNCH-XX-XX-DR-C-0814)	Shortfall	Additional
(m)	(m)	(m3)	(m3)	(m3)	(m3)
0.00	0.20	29127.881	30657.397		1529.516
0.20	0.40	23317.669	24284.356		966.69
0.40	0.60	18712.786	18670.793	-41.99	
0.60	0.80	14693.045	14647.667	-45.38	
0.80	1.00	10923.473	10894.616	-28.86	
1.00	1.20	8702.552	8697.744	-4.81	
1.20	1.40	7339.686	7339.560	-0.13	
1.40	1.60	6338.635	6338.524	-0.11	
1.60	1.80	5545.515	5545.428	-0.09	
1.80	2.00	4841.687	4841.642	-0.05	
2.00	2.20	4101.458	4101.476		0.02
2.20	2.40	2765.708	2765.720		0.01
2.40	2.60	1452.496	1452.496	0.00	
2.60	2.80	778.381	778.381	0.00	
2.80	3.00	321.364	321.364	0.00	
3.00	3.20	118.410	118.410	0.00	
3.20	3.40	43.792	43.792	0.00	
3.40	3.60	16.866	16.866	0.00	
3.60	3.80	2.391	2.391	0.00	
3.80	4.00	0.133	0.133	0.00	
		139143.928	141518.756	-121.40	2496.23

Figure 6-5: Punch Post-Development - Including overland flow path

Refer to PUNCH drawing 19229-PUNCH-XX-XX-DR-C-0815 for sections indicating the excavations for the flood compensation storage areas and the including flow paths and regrading of the lands back towards the River Liffey.

6.3 Access and Egress

Access and Egress to the site though the main access road is in Flood Zone C.

6.4 Stormwater Design

The attenuation system should be designed to relevant standards, to mitigate against pluvial flooding on the site and the risk of increase due to the changes at the site to a hardstanding area. This should be prepared in accordance with the Kildare County Development Plan, GDSDS and should also include the comprehensive use of a Sustainable Drainage System.

For further information on the stormwater design refer to the PUNCH engineering drawings submitted as part of the wider planning application (Drawing ref: 192229-Punch-XX-XX-DR-C-0101 - 192229-Punch-XX-XX-DR-C-0104, 192229-Punch-XX-XX-DR-C-0160).

Flood risk associated with pre-existing surface water overland flow routes from adjacent lands will not be increased as a result of proposed development. At the Wellesley Manor housing estate to the north of the development, the overland flow route follows the access road within the estate (Figure 6-6). Ground levels suggest overland flow reaches the access road along the southern boundary of the estate and then flows south west along the road into the local drain within the proposed site boundary. No works are proposed for the drain at this location so this overland flow route will not be affected.

Surface water falling on the Great Connell Road along the extent of the site road frontage would enter the existing site along sections of the road. The proposed design will consist of a 2m grass verge/planting along the road and green space within the site adjacent to the road which will allow the surface water from the road to continue drain away and will not impact the flow route.

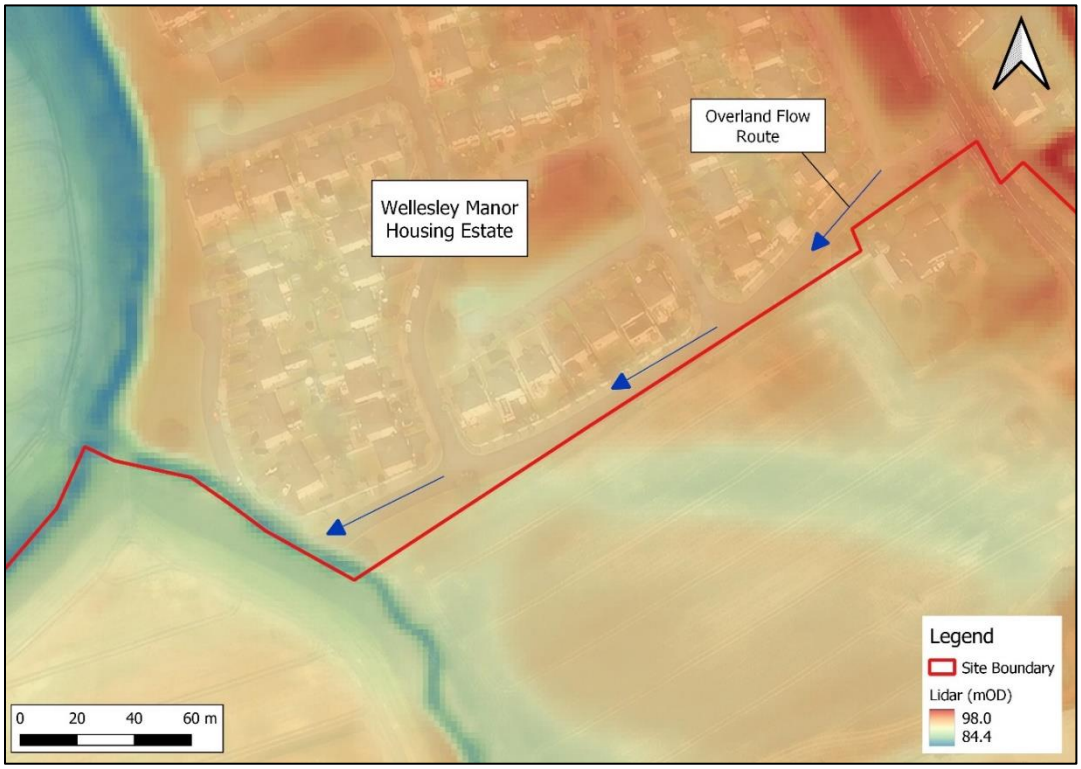


Figure 6-6: Overland surface water flow route

6.5 Bridge Design

As discussed in Section 5.1 it is proposed to construct a bridge across the River Liffey adjacent to the site. Aston Limited are progressing with a separate planning application to construct the extended bridge and bridge crossing. The bridge design has been assessed and is in line with the Section 50 requirements and within the tolerance limits of afflux. The proposed bridge design is therefore appropriate, and it has negligible impacts on water levels and extents at the site and there is no increase in risk to surrounding receptors.

6.6 Residual Risk

Residual risk is defined as risks that remain after all avoidance, substitution and mitigation measures have been taken. The flood risk assessment identified the main sources of residual risk to the development as Structure Blockage and Dam Failure of the ESB infrastructure upstream.

The potential risk of blockage for the proposed bridge adjacent to the site has been considered. The bridge abutments and piers have a minimum span of 24m, which are located outside of the riverbed. These wide spans greatly reduce the potential for blockage and therefore the risk of blockage is considered low.

Failure of the Golden Falls and/or Pollaphuca ESB Dams is identified as the second residual risk. A high flow scenario was tested where the 1% flows were increased by over 60m³/s, this high flow scenario is also above both the 0.1% AEP event and the climate change event. Even with this increase there is still a minimum of 170mm freeboard above the proposed FFL.

7 The Justification Test for Development Management

7.1 Strategy

As the development is partially located in Flood Zone A and B the Justification Test has been undertaken to confirm the site is appropriate for development. The development is a high vulnerability development type and so the JT is required, as indicated in Table 3.1 of The Planning System and Flood Risk Management.

The planning guidance appropriate to this development is, "The Planning System and Flood Risk Management" and sets out a framework within which the planning authority should consider proposals for new development in areas of flood risk. This framework is called the Justification Test for Development Management.

Under the County Development Plan, the part of the site on which residential development is proposed is zoned 'C - New Residential ', with an objective to "*provide for new residential development and associated ancillary services."*

In the following text, each of the criteria within the JT is responded to as they relate to the proposed development. For ease of reading, where the responses are supported by technical detail, which is contained in this report, an appropriate chapter has been referenced.

7.2 Justification Test: Part 1

The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of the planning guidelines.

In line with "The Planning System and Flood Risk Management Guidelines for Planning Authorities (2009)" a Strategic Flood Risk Assessment (SFRA) has been conducted as part of the preparation of the Newbridge Local Area Plan. Under the Newbridge Local Area Plan and the SFRA, the site is zoned 'C - New residential'. As stated above it is considered that the proposed development complies with the land use zoning at the site.

Conclusion: It has been outlined that the proposed residential development complies with the C land use zoning onsite and that the LAP was adopted taking into account The Planning System and Flood Risk Management Guidelines .

7.3 Justification Test: Part 2

The proposal has been subject to an appropriate flood risk assessment that demonstrates:

(i) the development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk

As part of the FRA, the site is identified as being located within Flood Zone A, B and C. A hydraulic model has been constructed to confirm the existing flood risk to the site. Following on from this, the post-development scenario was tested which confirmed the development does not increase the flood risk elsewhere. The 1% AEP flood levels and extents remained unchanged, and in some locations, there is a decrease in flood levels and extents of approx. 20mm. An additional overland flow path is noted within the Blue Line boundary, being the area defined as under the ownership and control of the applicant. As such, the increased overland flows and associated extents are on land owned by the applicant, and no impact on third party lands arises. The 0.1% AEP extent (a residual risk/exceedance event) had minor increases in levels, and extent (only in the condition where the bridge is not constructed in combination with the housing). Risk is defined as the likelihood of flooding multiplied by the consequence of flooding at a receptor (Appendix A). As the likelihood is low and the consequence is low (there is no receptor; such as an existing building), then there is no increase in risk.

Compensatory storage has been designed for the site which compensates for the loss of Flood Zone A and ensures existing water levels and extents are managed appropriately in the area.

Conclusion: A hydraulic model constructed for the site compared pre- and post-development scenarios which confirmed there is no increase in flood risk as a result of the development.

(ii) the development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;

The FFL of the development will be located above the 0.1% AEP flood level plus an additional 500mm freeboard. All access routes are also placed above the 0.1% AEP event.

Conclusion: All developments onsite will be located above the 0.1% AEP flood level with a 500mm freeboard. Therefore, the flood risk to people and property onsite has been minimised.

(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access.

The FFL levels of the proposed developments are placed above the 1% plus climate change event, therefore they are at low risk of flooding from future climate change. The proposed bridge crossing has a minimum span of 24m between the abutments, which are located outside of the riverbed. These wide spans greatly reduce the potential for blockage and therefore the risk of blockage is considered low. As there is also approx. 170mm freeboard above a high flow scenario which exceeds the 0.1% AEP and climate change event, the risk of inundation as a result of dam failure at the ESB Dams is reduced.

Conclusion: The impacts of climate change have been assessed in the hydraulic model and they were confirmed to be low as the FFL are above the 1% AEP+CC level. The wide span of the bridge will also reduce the risk of blockage from debris. Therefore, residual risks have been accounted for within the design.

(iv) The development proposed will address the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

To address Part iv of the JT, please refer to supplementary Planning Report and Statement of Consistency provided as part of the application.

8 Conclusion

JBA Consulting has undertaken a detailed Flood Risk Assessment for the proposed site development located at Great Connell, Newbridge, Co. Kildare. The site is greenfield and it is proposed to construct a residential development within the site boundary.

The site is identified as being partially within Flood Zone A and B in the CFRAM mapping. In order to assess the impacts of the proposed site layout and implement mitigation measures the site and surrounding area has been re-modelled.

The updated baseline model confirms that the site is partially within Flood Zone A and B from overland flow routes of the River Liffey. The model was tested with two design scenarios. The first included the proposed SHD development and the proposed bridge and the second had proposed SHD development without the bridge. The second design scenario is the less likely condition where the SHD development is constructed without the bridge. When the land is raised for the proposed development the overland flow routes through the site are removed.

Compensatory storage is provided to compensate for the loss of Flood Zone A, a standard which is in accordance with the Planning System and Flood Risk Management Guidelines and the Kildare County Development Plan. This has been designed and modelled as part of the post-development scenario and confirms the proposed development does not increase flood levels or extents in the 1% AEP event for which it has been designed.

The resulting flood maps for the post-development Scenario 1 confirms that the proposed SHD development and the bridge do not increase the flood risk to the surrounding area in the 1% AEP event and has minimal impacts in the 0.1% AEP event. There is an additional overland flow path within the Blue Line boundary, being the area defined as under the ownership and control of the applicant. As such, the increased overland flows and associated extents are on land owned by the applicant. Any future change of use to this land from greenfield/open space will be preceded by a flood risk assessment. Outside of the blue line boundary, there are some increases in flood depths in the 0.1% AEP event downstream of the proposed bridge. In areas where the increases in depths are adjacent to properties there is still sufficient freeboard between the water levels and FFL. Aston Limited are progressing with a separate planning application through Kildare Co Co PP Reference 4559. In Scenario 2, which does not include the proposed bridge and is the less likely condition to occur, there are some localised increases in flood extents and depths in addition to the increases noted in Scenario 1. In areas where there is an increase in extent (green fields), there are no receptors, so in both cases the risk has not increased at the 0.1% AEP standard.

The groundwater risk to the site is confirmed to be low from the site investigation and the groundwater monitoring carried out at the site.

The Justification Test was applied and passed as the hydraulic modelling confirms the impact on surrounding water levels is not significant and the development can manage the risk to itself.

The proposed finished floor level for the site places the developments above the 0.1% AEP event plus a minimum additional freeboard of 500mm. The FFL varies across the site, as the water levels slope downstream. Along the River Liffey the FFL ranges from 89.10mOD at the upstream end to 88.45mOD at the downstream. Similarly, the proposed FFL along the drain to the north ranges from 87.70mOD to 87.05mOD. This level also protects the development from the 1% AEP plus climate change event.

In summary the proposed development will be at low risk of flooding and will not increase the flood risk to the surrounding areas.

This report was subject to a peer review carried out by ARUP which confirms this FRA was completed "in accordance with requirements of The Planning System and Flood Risk Management Guidelines and in compliance with the Strategic Flood Risk Assessment (SFRA) of the Kildare County Development Plan 2017-2023". As per the review, ARUP "are satisfied that the proposed development will not result in any material increase in flood risk both on and off site and that the residual risk has been managed to acceptable levels". They are also satisfied that the Justification Test for the proposed development passed all criteria.

This Flood Risk Assessment was undertaken in accordance with 'The Planning System and Flood Risk Management' guidelines and is in agreement with the core principles contained within.

Appendices

A Appendix - Understanding Flood Risk

Flood Risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood Risk can be expressed in terms of the following relationship:

Flood Risk = Probability of Flooding x Consequences of Flooding

A.1 Probability of Flooding

The likelihood or probability of a flood event (whether tidal or fluvial) is classified by its Annual Exceedance Probability (AEP) or return period years, a 1% AEP flood 1 in 100 chance of occurring in any given year. In this report, flood frequency will primarily be expressed in terms of AEP, which is the inverse of the return period, as shown in the table below and explained above. This can helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval and is the terminology which will be used throughout this report.

Table: Conversion between return periods and annual exceedance probabilities

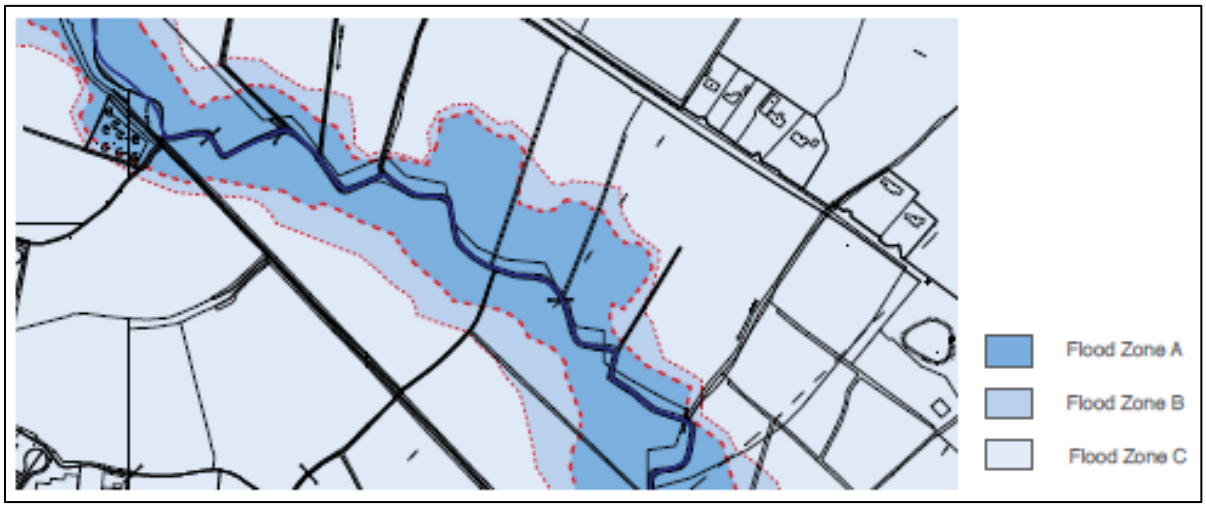
Return period (years)	Annual exceedance probability (%)
2	50
10	10
50	2
100	1
200	0.5
1000	0.1

A.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purpose of the Planning Guidelines, there are 3 types of levels of flood zones, A, B and C.

Zone	Description
Flood Zone A	Where the probability of flooding is highest, greater than 1% (1 in 100) from river flooding or 0.5% (1 in 200) for coastal/ tidal Flooding
Flood Zone B	Moderate probability of flooding, between 1% and 0.1% from rivers and between 0.5% and 0.1% from coastal/ tidal.
Flood Zone C	Lowest probability of flooding, less than 0.1% from both rivers and coastal/ tidal.

It is important to note that the definition of the flood zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences will be maintained in perpetuity.



A.3 Consequences of Flooding

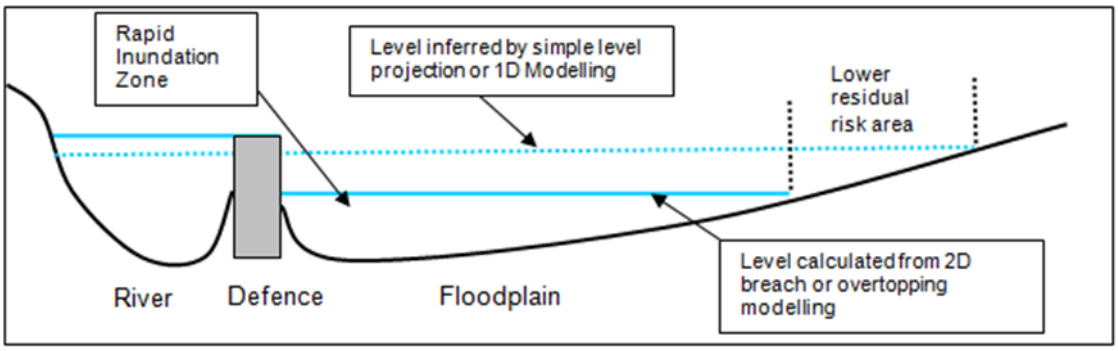
Consequences of flooding depend on the Hazards caused by flooding (depth of water, speed of flow. Rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure of the population, presence and reliability of mitigation measures etc.)

The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on type of development, nature, which are detailed in Table 3.1 of the Guidelines, and are summarised as:

- **Highly vulnerable**, including residential properties, essential infrastructure and emergency service facilities
- **Less vulnerable**, such as retail and commercial and local transport infrastructure, such as changing rooms.
- **Water compatible**, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

A.4 Residual Risk

The presence of flood defences, by their very nature, hinder the movement of flood water across the floodplain and prevent flooding unless river levels rise above the defence crest level or a breach occurs. This known as residual risk:

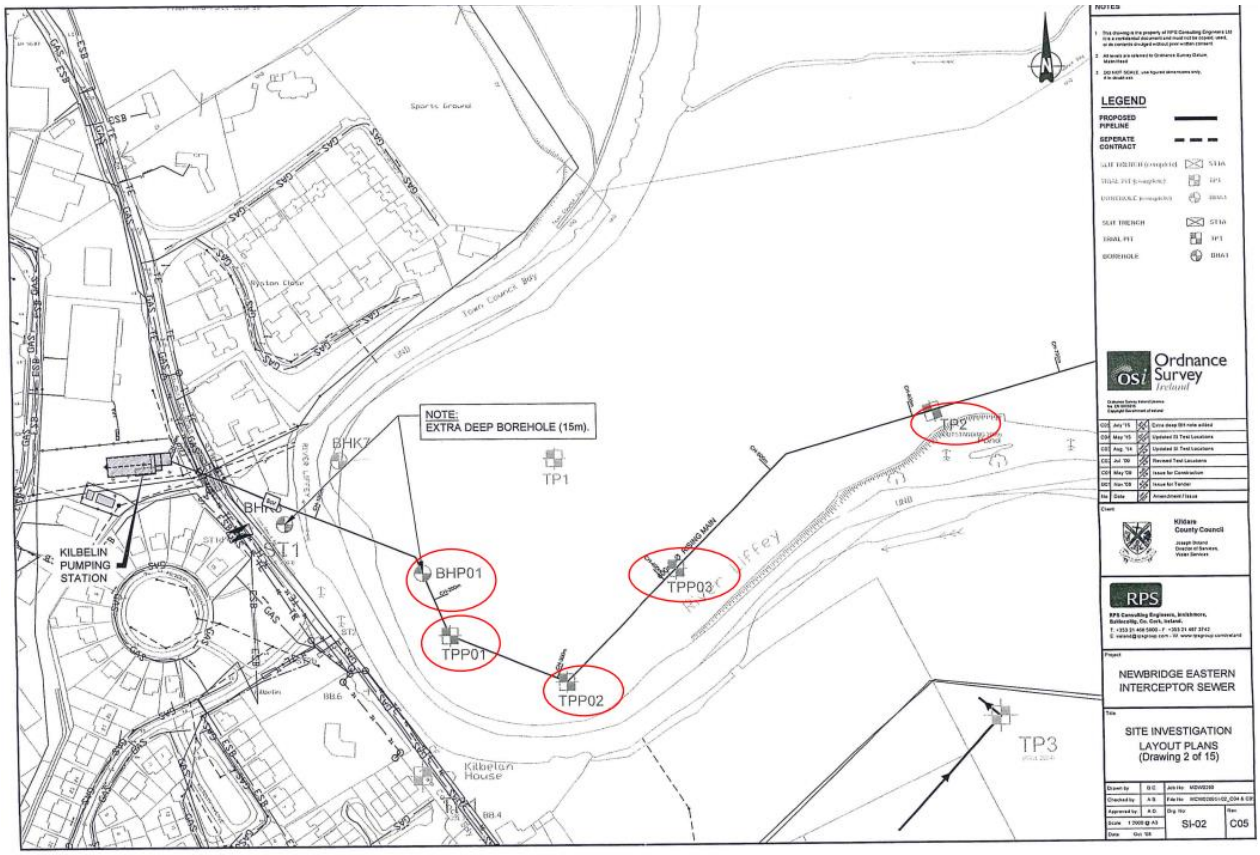


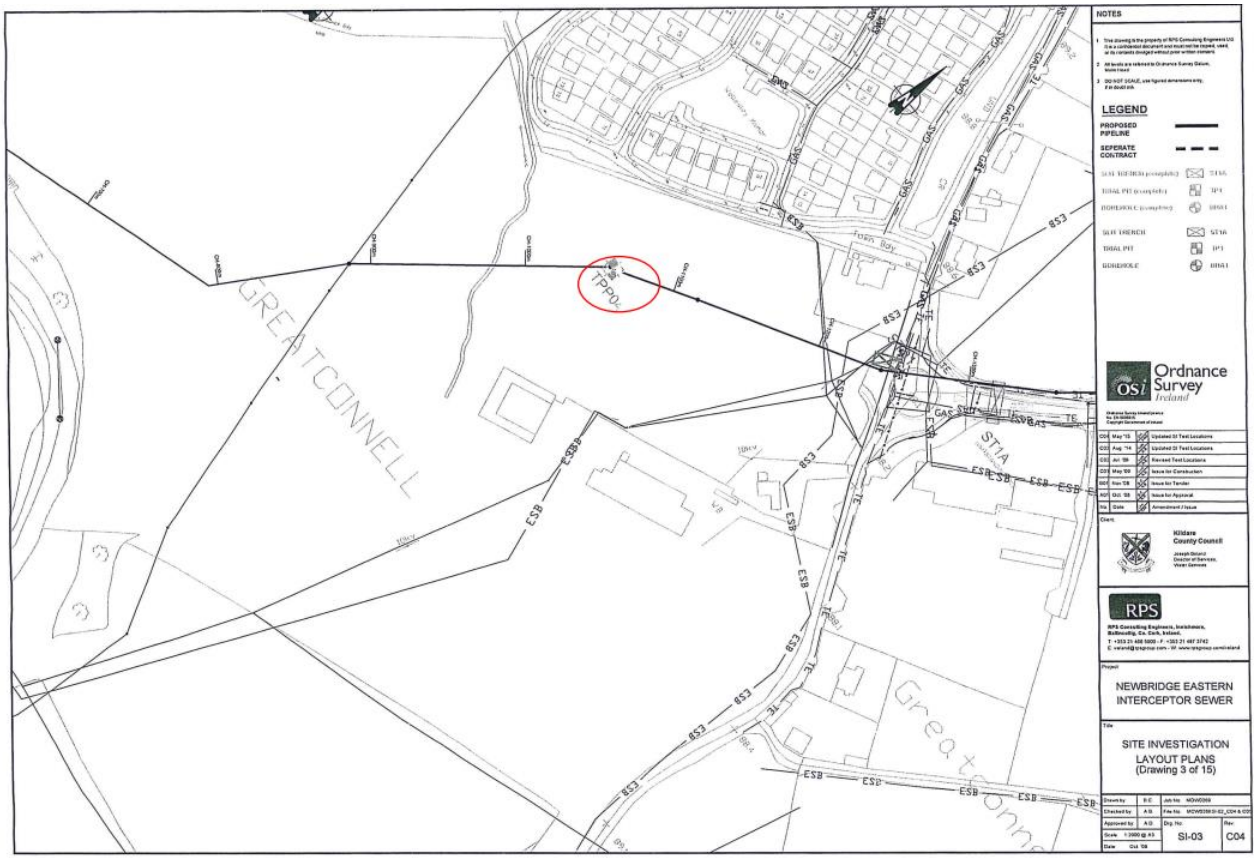
B Groundwater Monitoring

Borehole ID	Date Standpipe Installed	Ground Level (mAOD)	Total Depth of Standpipe (mBGL)	Bottom of Response Zone (mBGL)	Top of Response Zone (mBGL)	Response Strata (Shallow to deep)	Date	Time	Water Level (mBGL)	Water Level (m AOD)	Comment
BH02	16/03/2021	86.31	5.7	5.7	1	GRAVEL, CLAY, GRAVEL, CLAY	22/04/2021	10:04:00	1.15	**85.16**	Top of steel casing is 0.25m above ground level
							18/05/2021	10:31:00	1.17	**85.14**	
							24/06/2021	11:33	1.25	**85.06**	
							20/07/2021	09:23	1.22	**85.09**	
							03/11/2021	10:40	1.01	**85.3**	
							26/11/2021	10:07	1.15	**85.16**	
							11/01/2022	12:19	0.93	**85.38**	
BH5A	15/02/2021	87.58	5.14	5.14	1	GRAVEL, SAND	22/04/2021	09:48:00	2.175	**85.405**	Top of steel casing is 0.36m above ground level
							18/05/2021	10:25:00	2.33	**85.25**	
							24/06/2021	10:32	2.32	**85.26**	
							20/07/2021	10:28	2.39	**85.19**	
							03/11/2021	10:10	2.28	**85.3**	
							26/11/2021	09:23	2.39	**85.19**	
							11/01/2022	11:40	2.18	**85.4**	
BH7	26/03/2021	87.7	7.98	7.98	4	GRAVEL	22/04/2021	10:13:00	2.24	**85.46**	
							18/05/2021	10:53:00	2.28	**85.42**	
							24/06/2021	NM	NM	**NM**	
							20/07/2021	09:48	2.3	**85.4**	
							03/11/2021	10:47	2.08	**85.62**	
							26/11/2021	09:49	2.23	**85.47**	
							11/01/2022	12:02	2.06	**85.64**	
BH12	12/02/2021	87.38	5.81	5.81	1	GRAVEL, SILT/CLAY, SAND, GRAVEL	22/04/2021	09:54:00	1.84	**85.54**	Top of steel casing is 0.19m above ground level
							18/05/2021	10:22:00	1.92	**85.46**	
							24/06/2021	10:28	1.91	**85.47**	
							20/07/2021	11:04	2.03	**85.35**	
							03/11/2021	10:15	1.945	**85.425**	
							26/11/2021	09:27	2.02	**85.36**	
							11/01/2022	12:24	1.69	**85.69**	
BH15	02/03/2021	87.57	5.82	5.82	1	GRAVEL, SILT/CLAY, GRAVEL	22/04/2021	10:46:00	1.77	**85.8**	Top of steel casing is 0.26m above ground level
							18/05/2021	10:57:00	1.82	**85.75**	
							24/06/2021	11:41	1.84	**85.73**	
							20/07/2021	09:58	1.88	**85.69**	
							03/11/2021	10:33	1.68	**85.89**	
							26/11/2021	09:43	1.81	**85.76**	
							11/01/2022	11:57	1.54	**86.03**	
BH17	25/02/2021	88.54	9.41	9.41	1	GRAVEL, SAND, CLAY	22/04/2021	10:54:00	2.64	**85.9**	Top of steel casing is 0.3m above ground level
							18/05/2021	11:00:00	2.745	**85.795**	
							24/06/2021	10:53	2.73	**85.81**	
							20/07/2021	10:06	2.86	**85.68**	
							03/11/2021	10:23	2.92	**85.62**	
							26/11/2021	09:35	2.89	**85.65**	
							11/01/2022	11:50	2.53	**86.01**	
BH19	09/03/2021	NM	NM	NM	NM	GRAVEL	22/04/2021	NM	NM	**NM**	
							18/05/2021	NM	NM	**NM**	
							24/06/2021	13:02	1.6		
							03/11/2021	NM	NM	**NM**	
							26/11/2021	NM	NM	**NM**	
							11/01/2022	NM	NM	**NM**	
BH23	23/02/2021	87.8	7.32	7.32	1	GRAVEL, CLAY, GRAVEL, CLAY	22/04/2021	10:57:00	1.63	**86.17**	Top of steel casing is 0.28m above ground level
							18/05/2021	11:03:00	1.755	**86.045**	
							24/06/2021	10:57	1.81	**85.99**	
							20/07/2021	10:13	1.88	**85.92**	
							03/11/2021	10:27	1.94	**85.86**	
							26/11/2021	09:39	1.92	**85.88**	
							11/01/2022	11:53	1.54	**86.26**	
BH29	25/03/2021	-	13.77	13.77	1	GRAVEL, SILT/CLAY, GRAVEL	22/04/2021	10:24:00	2.38		Top of steel casing is 0.26m above ground level
							18/05/2021	NM	NM	**NM**	
							24/06/2021	NM	NM	**NM**	
							03/11/2021	11:02	2.15		
							26/11/2021	10:00	2.35		
							11/01/2022	12:10	2.12		
BH30	19/03/2021	87.01	9.15	9.15	1	GRAVEL	22/04/2021	10:20	1.77	**85.24**	Top of steel casing is 0.39m above ground level
							18/05/2021	10:34	1.815	**85.195**	
							24/06/2021	NM	NM	**NM**	
							20/07/2021	09:33	1.84	**85.17**	
							03/11/2021	10:52	1.66	**85.35**	
							26/11/2021	09:52	1.81	**85.2**	
							11/01/2022	12:07	1.63	**85.38**	

C Site Investigation

C.1 Locations





C.2 Trial Hole Logs

REPORT NO. 9377	TRIAL PIT RECORD	IGSL Ltd.

CONTRACT:	Newbridge Eastern Interceptor Sewer	Trial Pit No.:	TP2
		Sheet:	Sheet 1 of 1
CLIENT:	Kildare County Council	Excavation Method:	JCB
ENGINEER:	RPS MCOS	Date Started:	14/01/2004
CO-ORDINATES:	E - N -	Date Completed:	14/01/2004
		Ground Level (mOD):	-

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water Strike (m)	Samples: Ref. No.	Samples: Type	Samples: Depth (m)	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0	TOPSOIL									
	Medium dense grey/brown coarse gravelly SAND with occasional cobbles		0.25							
1.0						K8378	B	1.00		
	Medium dense grey/brown coarse very gravelly SAND with cobbles		1.50							
2.0	End of Trial Pit at 2.00 m		2.00			K8379	B	2.00		
3.0										
4.0										

Groundwater Conditions: No water encountered

Stability: Pit sides very unstable during excavation

Remarks: Trial pit stopped at 2.0m due to sides collapsing.

TRIAL PIT RECORD

REPORT NUMBER 18590

CONTRACT	Newbridge Eastern Interceptor Sewer	TRIAL PIT NO.	TPP01
		SHEET	Sheet 1 of 1
LOGGED BY	I.Reder	CO-ORDINATES	680,818.08 E 714,391.69 N
		DATE STARTED	31/08/2015
		DATE COMPLETED	31/08/2015
CLIENT	Kildare County Council	GROUND LEVEL (m)	86.57
ENGINEER	RPS	EXCAVATION METHOD	JCB

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 Gravelly TOPSOIL		0.30	86.27						
Medium dense to dense, brown becoming brownish grey, very sandy fine to coarse GRAVEL with some subrounded to rounded cobbles					AA38353	B	1.00-1.00		
1.0									
Firm, grey, sandy gravelly CLAY with many subrounded cobbles and occasional boulders (<0.3m diameter)		1.80	84.77		AA38354	B	2.00-2.00		
2.0									
Dense, brown/grey, clayey/silty very sandy GRAVEL with many rubrounded to rounded cobbles		2.70	83.87	(Rapid)	AA38355	B	3.00-3.00		
3.0									
End of Trial Pit at 3.50m		3.50	83.07						
4.0									

Groundwater Conditions
Rapid water flow at 2.7m

Stability
TP slightly unstable from G.L. up to 1.8m and from 2.7m to 3.5m

General Remarks

TRIAL PIT RECORD

REPORT NUMBER 18590

CONTRACT	Newbridge Eastern Interceptor Sewer	**TRIAL PIT NO.**	**TPP03**
		SHEET	Sheet 1 of 1
LOGGED BY	I.Reder	**CO-ORDINATES**	680,979.18 E 714,391.21 N
		DATE STARTED	31/08/2015
		DATE COMPLETED	31/08/2015
CLIENT	Kildare County Council	**GROUND LEVEL (m)**	87.60
ENGINEER	RPS	**EXCAVATION METHOD**	JCB

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL									
Soft to firm, brown, very sandy slightly gravelly SILT/CLAY		0.35	87.25		AA38359	B	0.80-0.80		
1.0									
Dense, brown, clayey/silty very sandy fine to coarse GRAVEL with many subrounded to rounded cobbles and occasional boulders		1.70	85.90	1 (Rapid)	AA38360	B	1.80-1.80		
2.0									
					AA38361	B	2.80-2.80		
3.0 End of Trial Pit at 3.00m		3.00	84.60						
4.0									

Groundwater Conditions
Rapid water flow at 2.7m

Stability
TP unstable from 1.7m

General Remarks

TRIAL PIT RECORD

REPORT NUMBER 18590

CONTRACT	Newbridge Eastern Interceptor Sewer	TRIAL PIT NO.	TPP04
		SHEET	Sheet 1 of 1
LOGGED BY	I.Reder	CO-ORDINATES	681,474.97 E 714,765.59 N
		DATE STARTED	31/08/2015
		DATE COMPLETED	31/08/2015
CLIENT	Kildare County Council	GROUND LEVEL (m)	87.28
ENGINEER	RPS	EXCAVATION METHOD	JCB

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL									
		0.40	86.88						
Loose, brown, slightly clayey fine SAND					AA38365	B	0.50-0.50		
		0.70	86.58						
Loose to medium dense, brown, clayey/silty very gravelly fine to coarse SAND									
1.0					AA38366	B	1.10-1.10		
		1.30	85.98						
Dense, brown/grey, sandy fine to coarse GRAVEL with many subrounded to rounded cobbles									
2.0					AA38367	B	1.90-1.90		
		2.30	84.98	1 (Rapid)					
Dense, brown/grey, clayey/silty sandy fine to coarse GRAVEL with many subrounded to rounded cobbles									
					AA38368	B	2.70-2.70		
		2.90	84.38						
TP terminated due to major instability - collapsed End of Trial Pit at 2.90m									
3.0									
4.0									

Groundwater Conditions
Rapid water flow at 2.3m

Stability
TP very unstable - collapsed

General Remarks

D JBA Response the KCC Comments

#	KCC Comment	JBA Response
Pg 14	A revised Site Specific Flood Risk Assessment is required to take account of additional information as well as third party expert scrutiny. The current proposal contravenes the Planning System Flood Risk Management Guidelines as it appears to suggest a relocation of flood water to adjoining property outside the site. It should also be revised following a revised SuDS strategy as recommended.	The Site Specific Flood Risk Assessment (SSFRA) has been revised in light of the comments received from KCC and the OPW, referenced below. The SSFRA has also been updated with new information regarding the updated proposed site development. A third party review of the SSFRA was carried out ARUP, dated the 05/04/2022, which confirms this FRA was completed "in accordance with requirements of The Planning System and Flood Risk Management Guidelines and in compliance with the Strategic Flood Risk Assessment (SFRA) of the Kildare County Development Plan 2017-2023". As per the review, ARUP "are satisfied that the proposed development will not result in any material increase in flood risk both on and off site and that the residual risk has been managed to acceptable levels". They are also satisfied that the Justification Test for the proposed development passed all criteria.
#	Water Services (D Hall comments)	JBA Response
2.32 2.32.1	Site Specific Flood Risk Assessment was submitted with any planning application shall be revised as follows: The historic flood adjacent to the subject site as per submitted SSFRA fig 3.1 shall be assessed and	 The historic flood adjacent to the site at Kilbelin, Newbridge (Ref: 1491) has been assessed. It related to the surface water system in the area not being able to cope after heavy rainfall. This occurs 1 or 2 times a year. It is approx. 500m west of the proposed development footprint and so is not considered a risk to the site. Refer to Section 3.1.1 of the SSFRA.
2.32.2	New fluvial flood mapping on OPW floodinfo website including indicative and CFRAMS fluvial flood extents shall be assessed – see item 2.33 below	The CFRAM fluvial flood extents as shown on the OPW floodinfo website have been assessed as part of the SSFRA. They are discussed in Section 3.2.2 of the report. The National Indicative Fluvial Mapping on the OPW floodinfo website did not have any flood extent mapping available in the Newbridge area. Item 2.33 discussed in relevant section below
2.32.3	The site specific hydrological analysis (river Liffey peak flow estimates) appear to correspond to the OPW CFRAMS values and the new 1D-2D linked hydraulic model (SSFRA sections 3.3.1, 4.1 and 4.2) which was development with additional topographic survey details and its results should be subject to third party independent expert scrutiny including:	A third party review of the SSFRA was carried out ARUP, dated the 05/04/2022, which confirms this FRA was completed "in accordance with requirements of The Planning System and Flood Risk Management Guidelines and in compliance with the Strategic Flood Risk Assessment (SFRA) of the Kildare County Development Plan 2017-2023". As per the review, ARUP "are satisfied that the proposed development will not result in any material increase in flood risk both on and off site and that the residual risk has been managed to acceptable levels". They are also satisfied that the Justification Test for the proposed development passed all criteria.

2.32.3.1	Predicted Q100 and Q1000 flows are lower than OPW CFRAMS values due to increased model roughness values to acknowledge the CFRAMS fluvial overland flow path through the subject site (SSFRA 4.3 and Table 4.2) and	The JBA models used the same flow inputs as the CFRAM model, localised changes in modelled flows along the length of the 1D channel are a result of changes in model parameters (e.g. Mannings roughness) and additional flow routes across the site in the JBA model. Refer to FRA Section 4.1.1 and 4.3.
2.32.3.2	The increase Q100 and Q1000 flood levels compared with OPW CFRAMS fluvial flood mapping for present day scenario <Table 4.2> must lead to increased flood extents which is apparent in figure 4.2 and which contravenes Planning System Flood Risk Management Guidelines (PSFRMG) Justification Test criterion 2i as per submitted SSFRA section 6.3 and	The increase in Q100 and Q1000 flood levels compared with the OPW CFRAMS fluvial flood mapping for present day scenario (Table 4.2) relates to the baseline scenario. This is the pre-development scenario as modelled by JBA. This baseline scenario was used as the compassion for the post-development model to assess impacts. Therefore, Justification Test criterion 2i does not apply to this as the baseline scenario is pre-development. Refer to Section 4.3
2.32.3.3	Minimal increase in Liffey flood water levels for 1% and 0.1% AEP events for the post-development scenario ie raised site ground levels thus removing the predicted overland fluvial flow paths through the subject site and representing the proposed Liffey bridge crossing and should include any bridge embankments and NSORR to be constructed under the proposed development (agreement regarding the proposed bridge constructed as per item 2.2 above shall be reflected in SSFRA to be submitted with any planning application including both SSFRA section 5.3) with the existing site watercourse-drainage channel to the north of the subject site retained and	The design scenario 1 which was modelled represents the raised site ground levels (which remove the predicted overland fluvial flow paths through the subject site), the proposed Liffey bridge crossing, embankments and the NSORR, and includes the drainage channel to the north. The model results confirm that there are no negative impacts as a result of this design in the 1% AEP event and in the 0.1% AEP event any increases in extents are confirmed to within the blue line boundary (land owned by the applicant). Increases in water levels are limited to downstream of the bridge and site, and within the river channel. There is no increase in extents or risk in these areas as the adjacent ground levels are sufficiently above the flood levels. Refer to Section 5.1 of the SSFRA for more information on the post-development model results.
2.32.3.4	The claims at SSFRA section 5.1 that changes to the 0.1% event fluvial flood extents post-development are also minimal and outside the Great Connell lands (ie subject site), there is only a minor increase to extents in the green field across the river (ie ongoing Glenveagh SHD?, see item 2.32.3.8 below) in contravention of PSFRMG Justification Test criterion 2i as per submitted SSFRA section 6.3 These changes are not readily distinguishable from a cursory examination of SSFRA figure 5.2 and in fact, it appears that other flood extents outside the subject site have actually increased which would also be in contravention of the PSFRMG Justification Test criterion 2i as per submitted SSFRA section 6.3 and require mitigation and	The post-development scenario and mitigation measures have since been updated and are reflected in the SSFRA. The Glenveagh SHD is also included in the baseline and post-development scenario. Section 5 of the SSFRA discusses the impacts of the proposed development in detail (depth difference maps and comparison of pre- and post-development water levels). Section 7.3 – Justification Test: Part 2 has been amended in light of the updated proposed development design and it confirms the development will not increase the flood risk elsewhere, amongst the other points in the JT.

2.32.3.5	The recommended finished floor levels (FFLs) as per SSFRA section 5.2.1 shall be justified with additional information and SSFRA figure 5.3 minimum recommended FFLs is at odds with the submitted OFS Master Site Layout Plan drawings no PR-002 Rev. O in terms of scheme layout and sub-minimum recommended FFLS e.g. at house numbers 494-499 etc and	The FFL are justified in Section 6.1 of the report – the minimum recommended FFLs of the development are placed above the 0.1% AEP post-development flood level with an additional 500mm freeboard, which is in line with the County Development Plan SFRA recommendations. Figure 6-1 shows the minimum recommended FFL for each block of houses, which have been calculated as discussed in the paragraph above (0.1% AEP + 500mm FB). The proposed FFLs, which have been designed taking into account the recommended minimum levels, will differ from the recommended levels as shown in Figure 6-1 as in some instance the proposed FFL exceeds the minimum recommended FFL. It is noted that this minimum recommended freeboard refers to the outer row of each housing block (i.e. the housing row closest to the watercourse). Once these housing rows are raised above the minimum recommended FFLs, they will act as a barrier preventing inundation to those houses in the inner sections of each housing block. For that reason, there may be some FFL within a block below the recommended level.
2.32.3.6	SSFRA figure 5.4 appears to indicate that the proposed compensatory storage is located in the post-development predicated 1% AEP event fluvial flood extents in contravention of PSFRMG and	The compensatory storage areas have been updated along with the relevant figures and are in accordance with Section 3.3.1 of Appendix B of the Planning Guidelines. The compensatory storage is located outside of the predicted 1% AEP extent, refer to figure 6-2 for areas of compensatory storage overlaying the baseline predicted 1% AEP extent. The areas of compensation in the figures in Section 5 are shown to be inundated as these are the post-development scenarios when the compensatory storage is being utilised.
2.32.3.7	Submitted Punch CE flood compensation area drawing no C-0804-C01 appears to indicate a provided compensatory storage volume of 71m3 but the required compensatory storage volume shall be calculated with appropriate plan and cross-section drawings through the subject site across the existing fluvial floodplain with 1% AEP plus 20% climate change factor fluvial flood levels, existing and proposed ground levels as per SSFRA section 3.2.1 Newbridge LAP SFRA and	The Newbridge LAP SFRA or Written Statement do not outline the compensatory storage standard with regard to AEP or climate change. The Kildare County Development Plan 2017-2023 only points to compensatory storage for loss of Flood Zone A, it does not mention climate change. The Planning Guidelines Appendix B 3.3.1 does not state a requirement for climate change allowance in the design of compensatory storage, only the 1% AEP event. Compensatory storage has been designed in line with the requirements of both the Planning Guidelines and the KCDP 2017-2023, whereby compensatory storage is provided for the loss of Flood Zone A. However, the provision of compensatory storage goes beyond the required 1% AEP storage volume, with an additional 1,200m³ of storage provided for.

2.32.3.8	If the Ardstone-Glenveagh SHD which is ongoing at present has raised ground level on their site, the SSFRA submitted with any planning application shall clearly demonstrate that the proposed development when constructed does not create a new flood risk or increase an existing flood risk on other properties and roads, upstream and downstream of the subject site which would contravene Planning System Flood Risk Management Guidelines (PSFRMG) Justification Test criterion 2i as per submitted SSFRA section 6.3 and	The hydraulic model has been updated to include the Ardstone-Glenveagh SHD in the baseline model (refer to Section 4.3 of the SSFRA). The design scenarios have demonstrated that the proposed development does not create a new flood risk or increase an existing flood risk on other properties and roads, upstream and downstream of the subject site (refer to Section 5 of the SSFRA).
2.32.3.9	Compliance with PSFRMG JT Part 2 – see SSFRA section 6.3.	The Justification Test was applied and passed as the hydraulic modelling confirms the impact on surrounding water levels is not significant and the development can manage the risk to itself (section 7.3).
2.32.4	Pluvial flood risk assessment in submitted SSFRA section 3.3.3 and 5.2.4, EPR Appendix E shall assess both the drainage and surface water overland flow elements as follows:	Section 3.3.3 and 5.2.4 have been updated to assess the pluvial risk from both the drainage and the surface water overland flows; see below.
2.32.4.1	Assess existing drainage systems including the site watercourses and any existing site open drainage channels-ditches that will be retained and any existing pipework that will be de-culverted.	The pluvial flood risk associated with the existing drains on site is discussed in Section 3.3.3 of the SSFRA. The overall slope of the land was reviewed to confirm that any surface water entering/falling on the site would flow into these channels and away from the subject site.
2.32.4.2	Compliance with GDSDS Stormwater Drainage Criterion 3 Site Flooding Level of Service for the proposed drainage systems based on the revised drainage and SuDS strategies and designs that emerge from the review to be carried out as outlined at section 2 above shall be demonstrated by submission of separate 30 year and 100 ear event plus 20% climate change factor pipe network simulations covering event durations up to 10,080 minutes and FFLs shall have a minimum freeboard of 500mm above the top water level in the drainage systems including pipe network and attenuation storage for the 100 year event plus 20% event.	Punch
2.32.4.3	Where planned overspills occur from the drainage system for storm events greater than the climate change adjusted 30 year event, the flow routing shall be directed towards safe areas eg surface water outfalls and open spaces and away from other adjacent properties and road and the flow outing shall not be obstructed.	Punch

	Where the planned overspills are of such a quantum that minimum FFL freeboard requirement shall be achieved at the open spaces where relevant, and at low points of the completed site where they might congregate and the recommended mitigation measure at SSFRA section 5.2.1 ie to place FFLs at least 150mm above ground levels shall be reviewed and	Punch
2.32.4.4	The pluvial risks from 'additional storage' as item 2.27 above.	Punch
2.32.4.5	The effect of the proposed development on pre-existing surface water overland flows into the subject site shall be assessed particularly the effect of raising site levels at boundaries and replacing permeable boundary treatments with impermeable ones. Where these overland flows are deemed to be of such a quantum so as to constitute a potential pluvial flood risk on adjacent properties and roads where they are obstructed, impeded or otherwise diverted by construction of the proposed development and which would contravene Planning System Flood Risk Management Guidelines (PSFRMG) Justification Test criteria 2i as per submitted SSFRA section 6.3 they shall be addressed and mitigated.	Section 6.4 of the SSFRA responds to this query and confirms the flood risk associated with pre-existing surface water overland flow routes from adjacent lands will not be increased as a result of proposed development. At the Wellesley Manor housing estate, ground levels suggest overland flows route flow towards the south west along the road and into the local drain within the proposed site boundary. No works are proposed for the drain at this location so this overland flow route will not be affected. Surface water falling on the Great Connell Road along the extent of the site road frontage would enter the existing site along sections of the road. The proposed design will consist of a grass verge/planting along the road which will allow the surface water from the road to continue drain away and will not impact the flow route. Refer to Section 6.4 of the SSFRA for more information.
2.32.5	Climate change is not a residual risk as per submitted SSFRA section 5.5 and its future effects on all flood risk types shall be assessed including OPW floodinfo website fluvial flood mapping for medium range future scenario for indicative and CFRAMS fluvial flood extents.	Climate change is no longer classed as a 'residual risk'. Section 4.3 discusses the climate change flood extents in the baseline scenario and the Climate Change flood levels are considered as part of the FFLs, where the FFL are placed above the climate change level (refer to Section 6.1)
2.32.6 2.32.6.1	The pluvial residual risk associated with: Failure or design exceedance events of existing and new drainage systems and any structures thereon including culverts, weirs, bridges and crossings. Flow routing, any potential flood risk and its proper mitigation as item 2.32.4.5 above, the achievement of the minimum FFL freeboard at completed site low points as item 2.32.4.3 above and the drainage maintenance regime to be implemented by the prospective application shall be addressed and	 Failure of the existing Golden Falls and/or Pollaphuca ESB Dams have now been considered as part of the residual risk, whereby a high flow scenario was tested to assess the impacts of additional flow from the Dam(s) being released. This high flow scenario estimated a minimum freeboard of 170mm above the proposed FFL. Refer to Section 6.6 for further information. Punch to confirm detail of surface water and any exceedance within the site.

2.32.6.2	high water levels in the receiving drainage networks including site watercourses and river Liffey with the associated network simulations as per EPR section 2.2.4 included and	Punch to confirm detail of surface water and any exceedance within the site.
2.32.6.3	compliance with PSFRMG JT criterion 2ii shall also be reviewed in light of the above.	Punch to confirm detail of surface water and any exceedance within the site.
2.33	Ground water flood risk as submitted SSFRA section 2.3 and 3.3.4 shall be assessed with respect to GSI groundwater vulnerability mapping, OPW PFRA flood mapping, new OPW floodinfo website groundwater flood mapping and the results of the site groundwater monitoring programme. The claim at SSFRA section 2.3 that the high GSI groundwater vulnerability classification for the subject site indicated a groundwater depth of greater than 3m is both counterintuitive and dispelled by the site investigation and groundwater monitoring results to date and shall be reviewed. As SSFRA section 3.3.4 it is further claimed that lower level of the subject site could potentially be impacted by groundwater flooding ie northwest corner and after periods of heavy rainfall, groundwater levels and levels in the 'drain'? could both rise and impact adjacent lands. The contravention of PSFRMG Justification Test criterion 2i as per submitted SSFRA section 6.3 shall be addressed and mitigated.	The ground water flood risk has now been assessed with respect to GSI groundwater vulnerability mapping (moderate to low). No historic surface water or groundwater flooding is identified in either the GSI datasets or the OPW PFRA or maps on the floodinfo website. Section 2.3 of the report discusses the groundwater monitoring carried out for the site which indicated an average groundwater depth of 2m. Site investigation works were also carried out on the site which indicated a groundwater depth of 2.3-2.7m. As concluded in Section 3.3.4, this information concludes that the groundwater risk to the site is low.
2.34	It is hoped that the minimum setbacks from the IFI guidance on planning for watercourses in the urban environment (ie for watercourses greater than 10m width, no development within 35m; less than 10m width, no development within 20m) which was launched in November 2020 will be included in all of the LAPs and the CDP in the future as this will also help with flood risk management. It is noted that the LAP for Newbridge has been extended to the end of the year, but SSFRA submitted within any planning application should address this issue.	This has been addressed in Section 7.8.2 of the EIAR and also in the Natura Impact Statement.
	Other	

2.35	The prospective application should have regard to pre-planning meeting details, previous planning decisions and Irish Water and KCC WSD reports and conditions on the subject and adjacent sites, including the adjacent Ardstone-Glenveagh SHD.	Noted
2.36	WSD remain available for further technical consultation with the applicant-agent.	Noted

E ARUP Peer Review

ARUP

Aston Limited

Aston SHD, Newbridge, Co. Kildare

Peer Review of Flood Risk Assessment

Reference:

Draft 01 | 5 April 2022

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 286328-00

Ove Arup & Partners Ireland Limited
50 Ringsend Road
Dublin 4
Ireland
arup.com

ARUP

Document Verification

Project title	Aston SHD, Newbridge, Co. Kildare
Document title	Peer Review of Flood Risk Assessment
Job number	286328-00
Document ref	
File reference	286328 Aston SHD, FRA Peer Review

Revision	Date	Filename			
Draft	05/04/2022	**Description**			
			Prepared by	**Checked by**	**Approved by**
		Name	Mesfin Desta	Ken Leahy	Ken Leahy
		Signature			
		Filename			
		Description			
			Prepared by	**Checked by**	**Approved by**
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	**Checked by**	**Approved by**
		Name			
		Signature			

Issue Document Verification with Document ✓

Contents

1.	**Introduction**	**1**
2.	**Objective**	**1**
3.	**Document Reviewed**	**1**
4.	**Reviewer**	**1**
5.	**Methodology**	**2**
6.	**Stage I – Flood Risk Identification**	**2**
6.1	Stage II - Initial Flood Risk Assessment	2
6.2	Stage III - Detailed Flood Risk Assessment	3
7.	**Justification Test**	**7**
8.	**Conclusion and Recommendations**	**8**

Tables

Table 6-1 Design Flows 3

Table 6-2 Comparison of CFRAM and JBA Design Flows and Levels 3

Table 6-3 Pre- and Post-Development Scenario Flood Levels 5

Figures

Figure 6-1 Proposed Compensatory Storage Areas 5

Figure 6-2 Depth Difference Map at Key Instream Locations 6

Figure 6-3 Predicted Flood Level Differences for the 1% and 0.1% AEP Events 7

Drawings

Drawing 1 - Project Site Map 9

1. Introduction

Ove Arup & Partners Ireland Ltd. was commissioned by Aston Limited to complete a peer review of the Flood Risk Assessment (FRA) report prepared by JBA Consulting Engineers for a Strategic Housing Development (SHD) at Great Connell, Newbridge Co. Kildare. The development proposal will consist of the demolition of existing site structures (2,622.3 sqm) and the construction of 569 no. residential units, a neighbourhood centre with 11 no. units (commercial floor area 2,141 sqm) and a childcare facility (886 sqm), a circa 350 metre section of distributor road, and all ancillary and associated works on a site of 27.64 ha (see Drawing 1).

More details of the proposed development are provided in the elsewhere in the Planning Documents.

Kildare Co. Co. made comments on an earlier version of the FRA at a pre-planning meeting in October 2021. JBA subsequently amended the report in consideration of same and upon request by Aston Ltd., issued the report to Arup for peer review on 22/02/2022. Arising from this review, Arup made several recommendations as to how the development proposals could be augmented to further reduce the residual flood risk post the development. Of these, the increase in flood level at the proposed bridge adjacent to Ardstone Development was reduced from 100mm to just 15mm which can be seen as a significant improvement. Other revisions were made accordingly, and JBA amended the FRA which was re-issued to Arup for a final review.

This report sets out the findings and recommendations of our peer review of the flood risk assessment for the development site. The review was based solely on the information presented in the FRA and did not include any independent hydraulic modelling to verify the hydraulic model results contained in the report.

2. Objective

The objective of Arup's review was to confirm if the FRA prepared for the proposed development site at Great Connell, Newbridge, Co. Kildare was in accordance with The Planning System and Flood Risk Management Guidelines, Guidelines for Planning Authorities (DOEHLG & OPW, 2009) (hereafter referred to as "the Guidelines") as well as in compliance with the requirements of the Strategic Flood Risk Assessment (SFRA) prepared for the Kildare County Development Plan 2017-2023.

3. Document Reviewed

The FRA report reviewed is titled, "Great Connell SHD, Newbridge Flood Risk Assessment Revision Ref. A3-C03," as prepared by JBA and issued to Arup on 22 March 2022. This is a later revision of the February 2022 FRA report incorporating updates following on comments given by Arup on review of the earlier revision.

4. Reviewer

The review was completed by Mesfin Desta, PhD FIEI. Mesfin Desta is a Principal Hydrologist with Arup and has over 16 years of experience as a hydrologist. He holds a PhD in Civil Engineering (thesis in hydrology) from UCD and MSc in Engineering Hydrology from NUI Galway. He is a chartered member and Fellow of Engineers Ireland since 2006. He has been responsible for the preparation of Flood Risk Assessment reports for various projects including Strategic Housing Developments, transport infrastructures, wind farms, pumping stations, etc.

The report was reviewed by Ken Leahy, Associate Director at Arup

5. Methodology

The Guidelines require that a site-specific FRA be completed which considers all possible flood risk sources and which incorporates appropriate mitigation measures that will reduce the flood risk to acceptable levels both at the development site itself and off site, both upstream and downstream. The Guidelines recommend a three-staged approach that covers both the likelihood of flooding and the potential consequences. This report outlines the findings at each of these stages:

- Stage I - Flood Risk Identification,
- Stage II – Initial Flood Risk Assessment, and
- Stage III – Detailed Flood Risk Assessment.

Our peer review is completed following the three-staged approach as recommended in the Guidelines.

6. Stage I – Flood Risk Identification

The FRA identified the main source of flooding at the Development Site to be the River Liffey as seen on the relevant CFRAM maps and confirmed in JBA's hydraulic modelling work. The development site is not tidally influenced due to its distance and elevation from the sea and hence the risk of coastal flooding was considered extremely low.

The risk of groundwater flooding was also deemed low. Groundwater monitoring completed for the site indicated that the water table varied between 1.0m and 2.9m below ground. Although the risk of groundwater flooding to the site is low, the relatively shallow water table, likely due to the site's proximity to the River Liffey may require management during construction.

The risk of pluvial flooding was also indicated to be generally low. There had been some historical surface water flooding on the R416 at Kilbelin as seen in the OPW historical flood maps, which was indicated to have been caused by a lack of capacity of the drainage system. This event was recorded in 2005 and has little or no relevance to the proposed development as it is at the opposite side of the river, and no flooding has since been reported.

There is also a risk of flooding due to a breach or mechanical failure of the two upstream reservoirs on the River Liffey (Poulaphouca Reservoir and Golden Falls Dam). This was assessed in the FRA prepared by JBA and was considered low.

6.1 Stage II - Initial Flood Risk Assessment

The proposed development site is situated mainly in Flood Zone C, i.e., at low risk from all identified sources of flooding. However, based on the CFRAMS mapping, it was evident that a portion of the development site lies within Flood Zone A and B because of the overland flow path across the site which becomes active in the 1% AEP event and above.

The SHD is considered "highly vulnerable" development, and hence a Justification Test must be undertaken for any such development located within Flood Zones A and/or B. To address the flood risk aspect of the Justification Test, it was established that a detailed Stage III flood risk assessment was required, including the development of a site-specific hydraulic model.

6.2 Stage III - Detailed Flood Risk Assessment

6.2.1 Hydrology - Design Flows

JBA estimated design flows based on gauged flows (Golden Falls) and physical catchment descriptors (River Liffey Flows) and compared the outputs with the CFRAM flows at the same Hydraulic Estimation Points (HEP). The results compared well with the CFRAM and hence the CFRAM flows were brought forward as inputs to the hydraulic model.

Additional flows were added from two small watercourses (Doorfield - southwest of the site) and a field drain east of the site. The 1% AEP flow from Doorfield was calculated to be 2.84m^3/sec while the field drain contribution was approximated to 1.0m^3/sec. These small watercourses were not included in the original CFRAM analysis.

We are satisfied that the methodologies adopted, and flows utilised were appropriate.

The resulting design flows are listed in Table 6-1 below:

Table 6-1 Design Flows

Source	HEP@	1% AEP (m3/sec)	0.1% AEP (m3/sec)
Upstream inflow (Liffey)	CFRAM Node: 09LIFF06678E	134.15	156.53
Doorfield	CFRAM Node: 09WALS00027dl	2.84	4.57
Field Drain	within the site	1	1

6.2.2 Hydrograph Shape

The hydrograph shape developed as part of the CFRAM Study was adopted for the FRA with the release from Golden Falls Dam generating the peak flow in the model over and above the River Liffey peak. Flows from the two small watercourses were added to the CFRAM flows at their respective locations.

6.2.3 Hydraulic Model

A linked 1D(Estry) and 2D (TUFLOW) model was built to estimate existing flood levels and extents within the proposed site. Table 6-2 below shows a comparison of the CFRAM and JBA Model water levels and flows for the 1% and 0.1% AEP at two selected HEPs

Table 6-2 Comparison of CFRAM and JBA Design Flows and Levels

	CFRAM				JBA Model			
	1% AEP		0.1% AEP		1% AEP		0.1% AEP	
HEP	Level, m OD	Flow, m^3/sec	Level, m OD	Flow, m^3/sec	Level, m OD	Flow, m^3/sec	Level, m OD	Flow, m^3/sec
09LIFF06455	86.46	131.97	86.61	157.76	86.92	130.92	87.07	144.97
09LIFF06415	85.74	135.10	85.86	166.03	86.02	121.48	86.20	132.41

The initial JBA model run calibrated well against the CFRAM model. However, having carried out a sensitivity test on roughness, it became apparent that the overland flow route and river levels were sensitive to roughness,

and therefore, to be conservative, JBA adopted the higher roughness values. Accordingly, as seen in Table 6-2 above, the in-channel flows reduce slightly as a result of greater flow escaping to the floodplain, but levels are higher due to the increased roughness.

We consider this to be a conservative approach given the sensitivity of the model to increase roughness values, and the fact that these higher flood levels will be used to set the FFL for the development. The model developed was, therefore, used to compare the pre- and post-development scenarios.

6.2.4 Design Scenarios

The development proposal has two primary constituent parts, namely, the residential element and a proposed bridge and roadway. It is likely that these elements may be delivered separately, and so it was necessary to consider two design scenarios as follows:

- Scenario 1 – Aston SHD Development plus Bridge over River Liffey, and
- Scenario 2 – Aston SHD Development only.

Both Scenarios involve raising the ground levels at the development site, to remove the overland flow path across the site in the 1% AEP event.

The removal of this conveyance route and storage volume would otherwise result in a localised increase in river levels. To offset the loss of this flow path, improved conveyance and two compensatory storage areas are proposed along the inner meander of the River Liffey to the south and southwest of the site. These elements have been further optimised following recommendations from Arup's review of the earlier version of the FRA report.

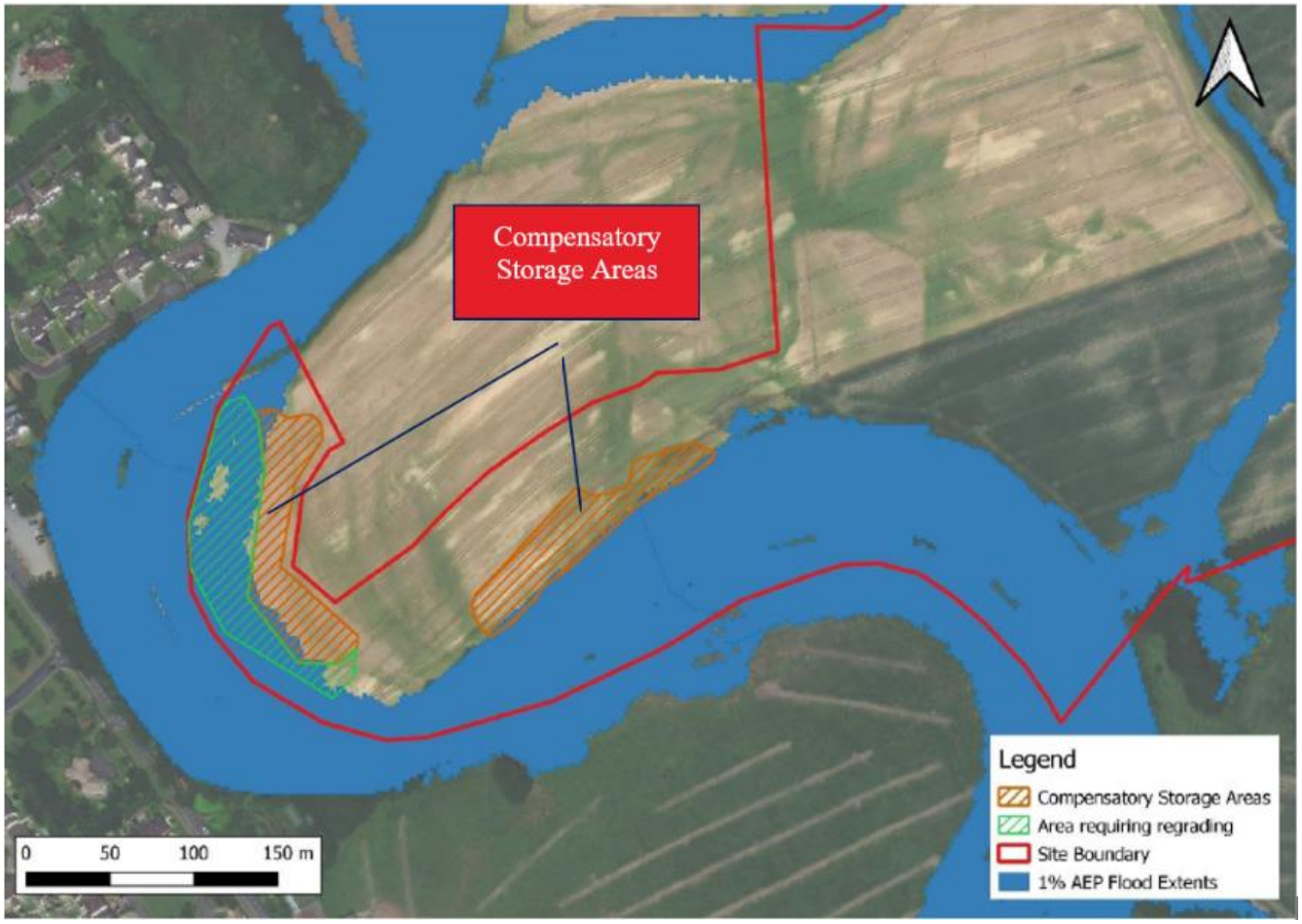


Figure 6-1 Proposed Compensatory Storage Areas

As would be expected, Scenario 1 (i.e., both the SHD and Bridge in place) gives rise to the highest river levels and hence the focus of the peer review was on changes in flood levels pre- and post-development assuming both elements of infrastructure are constructed.

The resulting changes in flood depths/extents for the pre- and post-development conditions under the 1% AEP and 0.1% AEP events for Scenario 1 are presented in Table 6-3 below. Locations 1 to 5 are instream locations shown in Figure 6-2 as used in the FRA Report.

Table 6-3 Pre- and Post-Development Scenario Flood Levels

Location	1% AEP m OD		0.1 AEP m OD	
	Pre	Post	Pre	Post
1	88.97	88.97	89.15	89.15
2	88.38	88.38	88.55	88.56
3	87.80	87.80	87.93	87.96
4	86.92	86.92	87.07	87.07
5	86.02	86.02	86.20	86.20
6	85.61	85.61	85.86	85.86

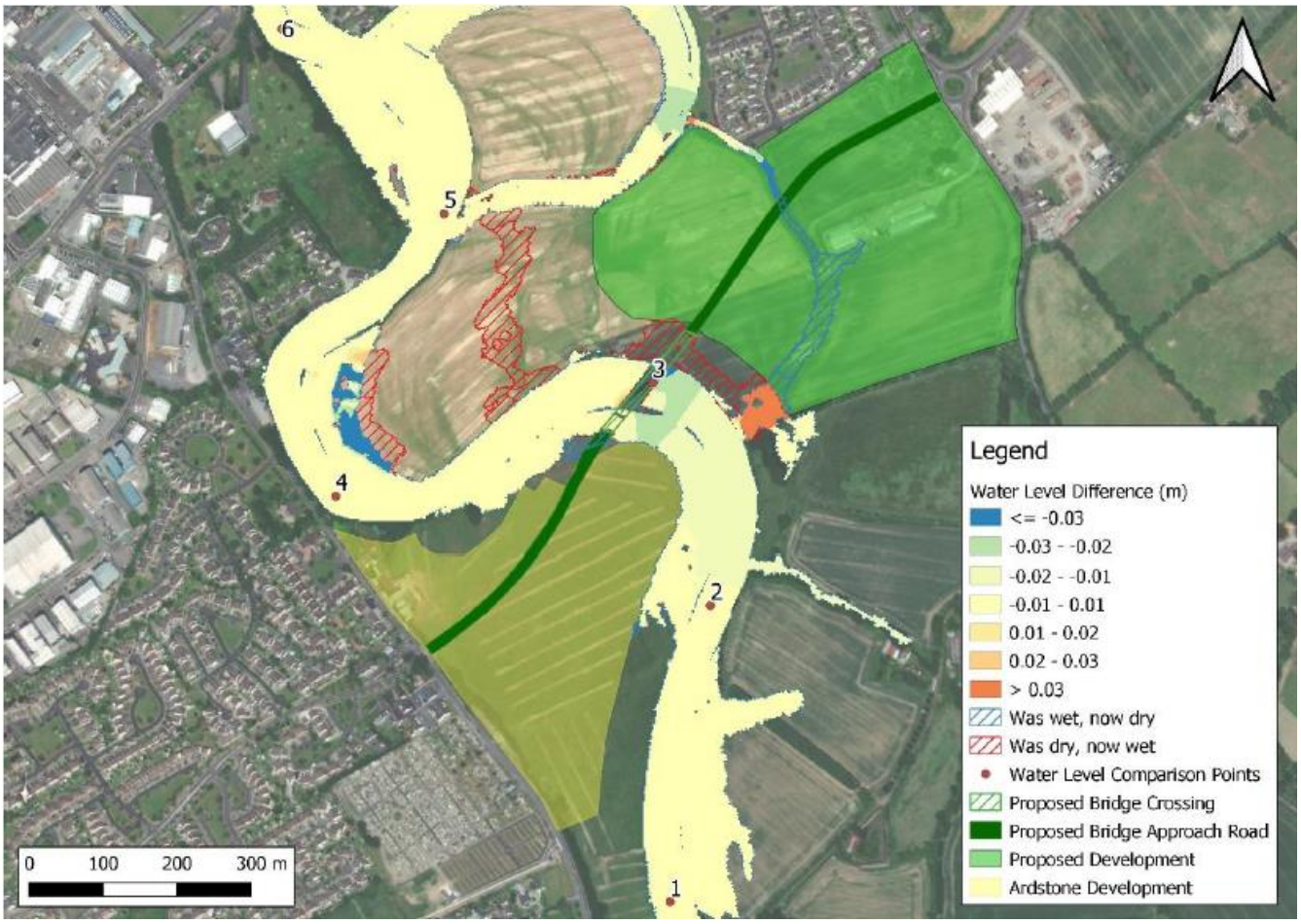


Figure 6-2 Depth Difference Map at Key Instream Locations

The following are the key findings of our review of the pre- and post-development scenarios.

- There is no increase in instream water levels from the pre-development scenario for the 1% AEP event. The 0.1% AEP does show some small-localised increases in instream levels in the order of 0.01m to 0.03m but these are considered negligible in the context of flood risk.
- There were some slight increases in flood levels within the redline boundary (shown in maps), but these are outside of the primary development footprint areas where water compatible development is proposed.
- The main post development change is a small change in flood extents under the 0.1% AEP event (see Figure 6-3 – shown circled). Lands south and southwest of the site are flooded in both the 1% and 0.1% AEP events. Some of these lands are outside the red line boundary. However, these lands are entirely owned by the applicant (Aston Limited) and hence no third party will be impacted by

this.

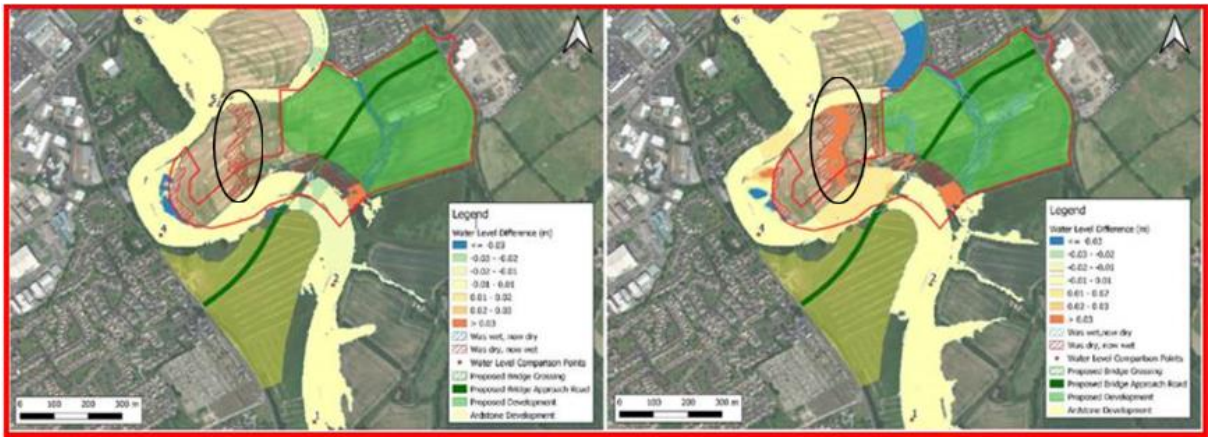


Figure 6-3 Predicted Flood Level Differences for the 1% and 0.1% AEP Events

- The bridge abutments and piers have a minimum span of 24m, which are located outside of the riverbed' to confirm the risk of blockage is low. The span between the centre pier is 40 meters. The 0.1% AEP depth difference map shows a slight local increase in water levels within the channel at the bridge location. It is noted that a separate Section 50 consent will also be required for this bridge.

- On lands not owned by the applicant, no increase in level is observed in the 1% AEP event. A small increase of 15mm depth is reported at the adjacent Ardstone Development. The increase was 100mm in the previous assessment before Arup's recommendations regarding storage and conveyance improvement measure were implemented. The latest run is not expected to result in any discernible increase in the flood extent and over 1m of freeboard is reported to exist between the 0.1% AEP level and the FFL of the Ardstone Development.

7. Justification Test

A Justification Test was prepared by the applicant, and each criterion was deemed to be passed as outlined below:

- Part 1: The Land is zoned for residential development within the LAP for Newbridge.

- Part 2(i): Through the preparation of a detailed FRA including the development of pre- and post-development hydraulic models, it has been shown that the development proposal will not materially alter the risk of flooding either on or off site.

- Part 2(ii): The FFL of the proposed development have been set above the 0.1% AEP fluvial level, plus a minimum freeboard of 500mm to minimise the risk to people, property, and the economy,

- Part 2(iii): The proposal includes compensatory conveyance improvement measures and compensatory storages to mitigate residual risks to acceptable level (i.e., to within the applicant's own land).

- Part 2(iv): The response regarding achievement of the wider planning objectives is addressed elsewhere in the SHD application.

We are satisfied that the Justification Test for the proposed development passed all these criteria.

8. Conclusion and Recommendations

1. Arup completed a peer review of the Flood Risk Assessment (FRA) for Aston SHD as prepared by JBA.

2. The main source of flooding on the proposed Development Site was identified to be the River Liffey. The Development Site is mainly in Flood Zone C. However, the CFRAM flood maps and JBA modelling results showed that there is an overland flow path across the Site for the 1% AEP event, which means that part of the site lies within Flood Zone A and B. Therefore, a detailed flood risk assessment, including a Justification Test, by means of a hydraulic modelling was completed to satisfy the requirements of the Guidelines. We are satisfied that the Justification Test for the proposed development passed all the criteria.

3. The FFL of the proposed development is set above the 0.1% AEP level plus a freeboard of 500mm which we consider appropriate for the class of proposed development.

4. To reduce the residual risk further, a mitigation measure in the form of compensatory conveyance improvements and compensatory storage is proposed on the south and southwestern boundary of the Site. The hydraulic model was used to demonstrate the benefit of these compensatory measures. The compensatory storage areas enabled removal of the flow path from the development footprint without increasing river levels in the 1% AEP event and limiting localised increases to less than 30mm in the 0.1% AEP event. The minor increase in levels results in some minor increase in flood extents in the 0.1%AEP event, but this is generally limited to agricultural lands both within and outside of the redline boundary which are owned by the applicant (Aston Limited) and hence no third party will be impacted.

5. On lands not owned by the applicant, there is a minor increase in flood depth of 15mm in the 0.1%AEP event at an adjacent development (Ardstone Development) but due to the steep bank, there is no discernible increase in flood extent, and it is understood that the FFL of that development provide over 1m of freeboard above the 0.1 % AEP flood level. This is a significant improvement at Ardstone Development (i.e., reduction from 100mm to15mm) in flood levels which was achieved by implementing Arup's comments on the earlier version of the FRA.

6. In addition, by further amending the details of the compensatory measures, to take on board the recommendations from our initial review, we are satisfied that the proposed development will not result in any material increase in flood risk both on and off site and that the residual risk has been managed to acceptable levels.

7. Therefore, following our peer review, Arup considers that the FRA was completed in accordance with the requirements of The Planning System and Flood Risk Management Guidelines, Guidelines for Planning Authorities (DOEHLG & OPW, 2009) and in compliance with the Strategic Flood Risk Assessment (SFRA) of the Kildare County Development Plan 2017-2023.

Drawing 1 - Project Site Map

Offices at
Dublin
Limerick

Registered Office
24 Grove Island
Corbally
Limerick
Ireland

t: +353 (0) 61 345463
e:info@jbaconsulting.ie

JBA Consulting Engineers and Scientists Limited
Registration number 444752

JBA Group Ltd is certified to:
ISO 9001:2015
ISO 14001:2015
OHSAS 18001:2007

New Civil Engineer 100 COMPANIES OF THE YEAR 2016 WINNER
New Civil Engineer 100 COMPANIES OF THE YEAR 2016 2016 RANKED COMPANY
CHAS Accredited Contractor www.chas.gov.uk

Visit our website
www.jbaconsulting.ie

APPENDIX 6

APPROPRIATE ASSESSMENT

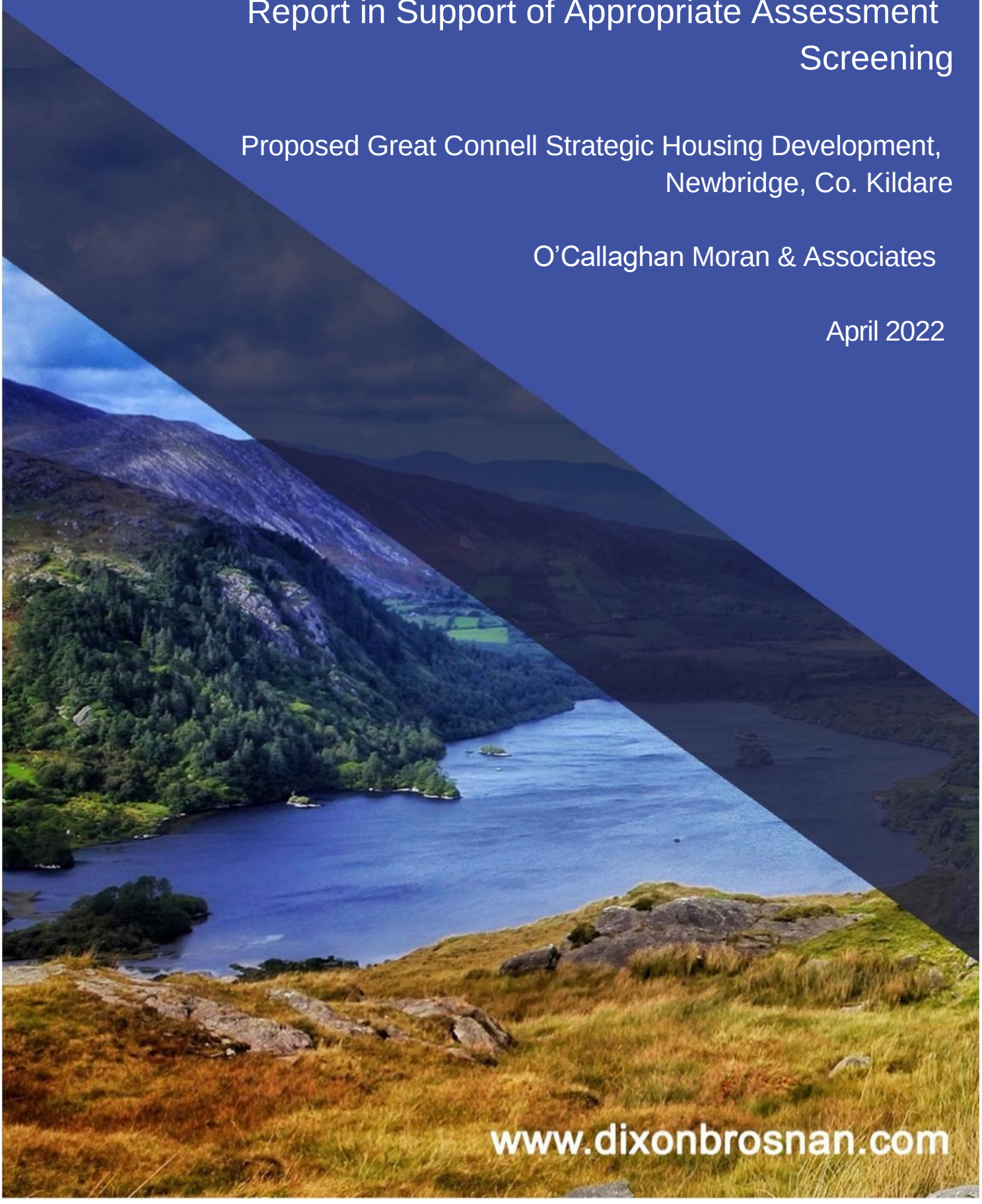
DixonBrosnan
environmental consultants

Report in Support of Appropriate Assessment Screening

Proposed Great Connell Strategic Housing Development, Newbridge, Co. Kildare

O'Callaghan Moran & Associates

April 2022



www.dixonbrosnan.com

Project	Report in Support of Appropriate Assessment Screening for Proposed Great Connell Strategic Housing Development, Newbridge, Co. Kildare	
Client	O'Callaghan, Moran and Associates	
Project Ref.	2179	
Report No.	2179.01	
Client Ref.	-	
Date	**Revision**	**Prepared By**
08/09/21	Draft 1	Carl Dixon BSc MSc
15/02/2022	Draft 2	Sorcha Sheehy BSc PhD
07/04/2022	Issue to client	

DixonBrosnan Lios Ri Na hAoine, 1 Redemption Road, Cork.
Tel 086 851 1437| carl@dixonbrosnan.com | www.dixonbrosnan.com

This report and its contents are copyright of DixonBrosnan. It may not be reproduced without permission. The report is to be used only for its intended purpose. The report is confidential to the client, and is personal and non-assignable. No liability is admitted to third parties.
©DixonBrosnan 2022.

Table of Content

1. Introduction *5*

1.1 Background **5**

1.2 Aim of Report **6**

1.3 Authors of Report **6**

2. Regulatory Context and Appropriate Assessment Procedure *7*

2.1 Regulatory Context **7**

2.2 Appropriate Assessment Procedure **7**

3. Receiving Environment *9*

3.1 Existing Site **9**

3.2 Proposed development Site Description **9**

3.3 Existing Services **9**

3.3.1 Water Supply 9

3.3.2 Surface Water Drainage 9

3.3.3 Foul Water Drainage 13

3.4 Description of Proposed Development **13**

4. Screening *15*

4.1 Introduction **15**

4.2 Study Area and Scope of Appraisal **15**

4.3 Field Study **16**

4.4 Source-Pathway-Receptor Model **16**

4.5 Likely Significant Effect **16**

4.6 Screening Process **17**

4.7 Desktop Review **17**

5. Natura 2000 Sites *18*

5.1 Designated sites within Zone of Influence **18**

5.2 European Sites Descriptions **25**

5.2.1 North Bull Island SAC 25

5.2.2 South Dublin Bay SAC 25

5.2.3 North Bull Island SPA 26

5.2.4 South Dublin Bay and River Tolka Estuary SPA 26

5.2.5 Poulaphuca Reservoir SPA 27

5.3 Natura 2000 sites – Features of interests and conservation objectives **27**

6. Water Quality data *30*

6.1 River Basin Management Plan for Ireland 2015 – 2018 (2nd /3rd Cycle) **30**

6.2 Urban Wastewater Treatment Directive **32**

7. Site Surveys *33*

7.1 Habitat survey **33**

7.2 Birds **39**
7.3 Invasive Species **41**
8. Potential Impacts ***43***
8.1 Potential impacts from loss of habitat **44**
8.2 Potential impacts from noise and disturbance **44**
8.3 Potential Impacts of Surface Water Run-off **45**
8.4 Potential impacts of wastewater discharges **46**
8.5 Spread of Invasive Species **46**
8.6 In-combination Impacts **46**
9. Screening conclusion and statement ***47***
References ***47***
Appendices ***49***

1. Introduction

1.1 Background

The information in this report has been compiled by DixonBrosnan Environmental Consultants, on behalf of the applicant. It provides information on and assesses the potential for a proposed strategic housing development (SHD) at Great Connell, Newbridge, Co. Kildare, to impact on any Natura 2000 sites within its zone of influence. The information in this report should be read in conjunction with the planning application submitted to An Bord Pleanála (ABP) in connection with the proposed development.

The Birds Directive (2009/147/EC) and the Habitats Directive (92/42/EEC) put an obligation on EU Member States to establish the Natura 2000 network of sites of highest biodiversity importance for rare and threatened habitats and species across the EU. In Ireland, the Natura 2000 network of European sites comprises Special Areas of Conservation (SACs, including candidate SACs) and Special Protection Areas (SPAs, including proposed SPAs). SACs are selected for the conservation of Annex I habitats (including priority types which are in danger of disappearance) and Annex II species (other than birds). SPAs are selected for the conservation of Annex I birds and other regularly occurring migratory birds and their habitats. The annexed habitats and species for which each site is selected correspond to the qualifying interests of the sites and from these the conservation objectives of the site are derived. The Birds and Habitats Directives set out various procedures and obligations in relation to nature conservation management in Member States in general, and of the Natura 2000 sites and their habitats and species in particular. A key protection mechanism is the requirement to consider the possible nature conservation implications of any plan or project on the Natura 2000 site network before any decision is made to allow that plan or project to proceed. Not only is every new plan or project captured by this requirement but each plan or project, when being considered for approval at any stage, must take into consideration the possible effects it may have in combination with other plans and projects when going through the process known as Appropriate Assessment (AA).

The obligation to undertake Appropriate Assessment (AA) derives from Article 6(3) and 6(4) of the Habitats Directive, and both involve a number of steps and tests that need to be applied in sequential order. Article 6(3) is concerned with the strict protection of sites, while Article 6(4) is the procedure for allowing derogation from this strict protection in certain restricted circumstances. As set out in Section 177U of the Planning and Development Act 2000 as amended, a screening for appropriate assessment of an application for consent for the proposed development must be carried out by the competent authority to assess, in view of best scientific knowledge, if the proposed development, individually or in combination with another plan or project is likely to have a significant effect on any European site. Each step in the assessment process precedes and provides a basis for other steps. The results at each step must be documented and recorded carefully so there is full traceability and transparency of the decisions made.

1.2 Aim of Report

The purpose of this report is to inform the AA process as required under the Habitats Directive (92/43/EEC) in instances where a plan or project may give rise to significant impacts on a Natura 2000 site. This report aims to inform the Appropriate Assessment process in determining whether the development, both alone and in combination with other plans or projects, are likely to have a significant impact on the Natura 2000 sites in the study area, in the context of their conservation objectives and specifically on the habitats and species for which the sites have been designated.

This report has been prepared with regard to the following guidance documents, where relevant.

- *Managing Natura 2000 Sites: The Provision of Article 6 of the Habitats Directive 92/43/EEC* (European Commission (EC), 2018);
- *Assessment of Plans and Projects Significantly Affecting Natura 2000 sites: Methodical Guidance on the Provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (European Commission (EC), 2001);
- *Guidance Document on Article 6(4) of the Habitats Directive 92/43/EEC* (European Commission, (EC) 2007);
- *Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities* (Department of Environment, Heritage and Local Government, 2010 revision);
- *Appropriate Assessment under Article 6 of the Habitats Directive; Guidance for Planning Authorities. Circular NPW 1/10 and PSSP 2/10* (Department of Environment, Heritage and Local Government, 2010);
- *Guidelines for Good Practice Appropriate Assessment of Plans under Article 6(3) Habitats Directive* (International Workshop on Assessment of Plans under the Habitats Directive, 2011);
- *Communication from the Commission on the precautionary principle. European Commission* (2000) and
- CJEU Case C 164/17 Edel Grace Peter Sweetman v An Bord Pleanála.

1.3 Authors of Report

This report was prepared by Carl Dixon MSc. (Ecological Monitoring), Sorcha Sheehy PhD (Ecology/Ornithology).

Carl Dixon MSc (Ecology) is a senior ecologist who has over 20 years' experience in ecological and water quality assessments with particular expertise in freshwater ecology. He also has experience in mammal surveys, invasive species surveys and ecological supervision of large-scale projects. Projects in recent years include the Waste to Energy Facility Ringaskiddy, Shannon LNG Project, supervision of the Fermoy Flood Relief Scheme, Skibbereen Flood Relief Scheme, Upgrade of Mallow WWTP Scheme, Douglas Flood Relief Scheme, Great Island Gas Pipeline etc. He has carried out ecological surveys and prepared AA/NIS reports for a range of projects.

Sorcha Sheehy PhD (ecology/ornithology) is an experienced ecological consultant with over ten years' experience. She has worked on Screening/NIS's for a range of small and large-scale projects with particular expertise in assessing impacts on birds. Recent projects include bird risk assessments for Dublin and Cork Airports, Waste to Energy Facility Ringaskiddy and Water Storage Schemes for Irish Water.

2. Regulatory Context and Appropriate Assessment Procedure

2.1 Regulatory Context

The Habitats Directive (Council Directive 92/43/EEC on the *Conservation of Natural Habitats and of Wild Fauna and Flora*) aims to maintain or restore the favourable conservation status of habitats and species of community interest across Europe. The requirements of these directives are transposed into Irish law through the European Communities (Birds and Natural Habitats Regulations; S.I. No. 477 of 2011).

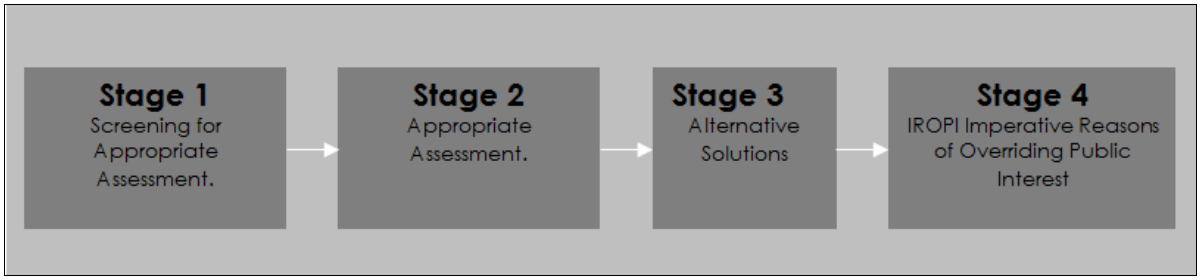
Under the Directive a network of sites of nature conservation importance have been identified by each Member State as containing specified habitats or species requiring to be maintained or returned to favourable conservation status. In Ireland the network consists of SACs and SPAs, and also candidate sites, which form the Natura 2000 network.

Article 6(3) of Council Directive 92/43/EEC of 21 May 1992 on the *Conservation of Natural Habitats and of Wild Fauna and Flora* (as amended) (hereafter 'the Habitats Directive') requires that, any plan or project not directly connected with or necessary to the management of a designated site, but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. A competent authority (e.g. the EPA or Local Authority) can only agree to a plan or project after having determined that it will not adversely affect the integrity of the site concerned.

The possibility of a significant effect on a designated or "European" site has generated the need for an appropriate assessment to be carried out by the competent authority for the purposes of Article 6(3). A Stage Two Appropriate Assessment is required if it cannot be excluded, on the basis of objective information, that the proposed development, individually or in combination with other plans or projects, will have a significant effect on a European site. The first (Screening) Stage for appropriate assessment operates merely to determine whether a (Stage Two) Appropriate Assessment must be undertaken on the implications of the plan or project for the conservation objectives of relevant European sites.

2.2 Appropriate Assessment Procedure

The assessment requirements of Article 6(3) establish a stage-by-stage approach. This assessment follows the stages outlined in the 2001 European Commission publications "Assessment of plans and projects significantly affecting Natura 2000 sites: methodological guidance on the provisions of Articles 6(3) and 6(4) of the Habitats Directive 92/43/EEC" (2001) and Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (Draft) Office for Official Publications of the European Communities, Luxembourg (EC, 2015);



The stages are as follows:

Stage One: Screening — the process which identifies any appreciable impacts upon a Natura 2000 site of a project or plan, either alone or in combination with other projects or plans, and considers whether these impacts are likely to be significant;

Stage Two: Appropriate assessment — the consideration of the impact on the integrity of the Natura 2000 site of the project or plan, either alone or in combination with other projects or plans, with respect to the site's structure and function and its conservation objectives. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts;

Stage Three: Assessment of alternative solutions: The process which examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site. It is confirmed that no reliance is placed by the developer on Stage Three in the context of this application for development consent;

Stage Four: Assessment where no alternative solutions exist and where adverse impacts remain — an assessment of compensatory measures where, in the light of an assessment of imperative reasons of overriding public interest (IROPI), it is deemed that the project or plan should proceed (it is important to note that this guidance does not deal with the assessment of imperative reasons of overriding public interest). Again, for the avoidance of doubt, it is confirmed that no reliance is placed by the developer on Stage Four in the context of this application for development consent.

It is the responsibility of the competent authority, in this instance ABP, to make a decision on whether or not the proposed development should be approved, taking into consideration any potential impact upon any Natura 2000 site within its zone of influence.

3. Receiving Environment

3.1 Existing Site

The site is to the east of Newbridge Town Centre (**Figure 1**). It is accessed from the east from the Great Connell road, which forms the eastern boundary. It is bounded to the north-east by a residential development (Wellesley Manor) and to the north-west by an open drain that was formerly a meander channel of the River Liffey. A hedgerow forms the southern boundary. The south-western boundary is defined by a buffer zone on the western side of the River Liffey. The western boundary is not defined on the ground.

The proposed development is on the eastern outskirts of Newbridge, ca 1km from the Town Centre and main retail area. To the south and south-east are agricultural lands primarily used for tillage. To the east, across the Great Connell Road, are the Murphy Ireland Ltd offices and compound. To the north-east is Wellesley Manor, which has the closest residential dwellings to the development, with the houses in the south of the estate being approximately 10 m from the north-eastern development site boundary.

The Dr Pepper beverage manufacturing plant (formerly Lidl distribution centre) is ca 500m to the north-east. The Pfizer manufacturing complex, which is Europe's largest manufacturers of solid dose pharmaceuticals is ca 800m to the north. To the south-west, across the River Liffey, a 343 unit residential development is currently under construction. The Baroda Stud Farm is ca 500m to the south-east.

3.2 Proposed Development Site Description

The proposed development site covers an area of 27.64ha, most of which is used for tillage. The River Liffey flows through the southwestern corner of the site, with an area of treelines and woodland along its boundary. A drainage ditch at the centre of the site is connected to a drainage ditch on the northern boundary, which ultimately flows into the River Liffey to the west of the proposed development site.

3.3 Existing Services

3.3.1 Water Supply

There is an Irish Water 300mm watermain running along the Great Connell Road to the east of the site. This supplies the Wellesley Manor residential estate via a 100mm uPVC network.

3.3.2 Surface Water Drainage

Due to the topography it is not possible to drain the entire residential development site via one outfall. As such it is proposed to discharge via gravity to four new outlets on the existing ditch which passes through the north of the site as well as two new outlet to the River Liffey to the west.

The proposed section of Newbridge South Outer Orbital Relief Road (NSOORR) that will run through the site will have a separate drainage system. Due to level and vertical clearance constraints imposed by the existing 900mm diameter foul sewer traversing the site two outfalls are required.

Seven underground attenuation tanks with a combined capacity of 5,387m3, will serve the residential development, as shown on Drawing 192229-PUNCH-XX-XX-DR-C-0160. Two underground tanks (combined volume of 320m3) will serve the section of the NSOORR.

All of the tanks will be fitted with flow regulation devices designed to maintain the flow rates to the water courses at pre-development greenfield rates. Class 1 Bypass Hydrocarbon Separators will be located downstream of all of the attenuation tanks. The discharge points to the ditch and the river will be fitted with non-return valves to prevent water from the river surcharging up through the surface water drainage network.

In addition to the underground attenuation tanks, the following Sustainable Urban Drainage Systems (SuDs) are incorporated into the design:

- Permeable paving
- Swales/Bioswales
- Green Roofs
- Soakaways/Soak Pits
- Rainwater Harvesting

The drainage system design takes account effects of coincidental flooding and is in accordance with the Greater Dublin Strategic Drainage Study (GDSDS) Volume 5 Guidance for combination flood events. Futher details on surface water drainage are included in **Appendix 2** drawings.

Figure 1. Proposed development site location | Source OSI

Figure 2. Proposed site layout | Source OFM

3.3.3 Foul Water Drainage

The network was designed using Causeway Flow software in accordance with Irish Water's Code of Practice for Wastewater Infrastructure and the Department of the Environment's Recommendations for Site Development Works for Housing Areas. The foul water loading was calculated in accordance with the Code of Practice for Wastewater Infrastructure, with a 10% allowance for infiltration

The existing 450mm foul sewer that runs across the site from south to north will be diverted to connect to the Upper Liffey Valley Sewerage Scheme (ULVS) existing 900 mm diameter sewer. Due to the site topography it was not feasible to provide a gravity connection to the ULVS sewer.

All foul water will be collected by gravity and brought to a foul water pumping station in the north of the site from where it will be pumped to the ULVS sewer, as shown on Drawing 192229-PUNCH-XX-XX-DR-C-0113 **(**Appendix 2**)**. The foul pumping station will deliver a peak flow to the ULVS sewer of 19.5l/s. It will include a 254m3 capacity emergency storage tank that will retain the foul water in the event of a breakdown.

PUNCH estimate the average daily discharge to the Irish Water foul sewer will be 280,355 litres when the development is complete. To reduce the water demand on the water supplies water conservation measures will be incorporated in the sanitary facilities throughout the development, e.g. dual flush toilets.

A Pre-Connection Enquiry Form was sent to Irish Water in relation to the proposed development, and Irish Water issued a Confirmation of Feasibility. The PUNCH proposed foul network proposals were then submitted to Irish Water for Design Vetting and Irish Water issued a Statement of Design Acceptance.

See **Appendix 2** Drawings for further detail on foul water drainage.

3.4 Description of Proposed Development

The proposed residential development provides for 569 residential dwellings and supporting commercial development in Great Connell, Newbridge. To facilitate the development it is necessary to demolish the existing structures on the site which comprise; 'Great Connell' a two-storey dwelling of 331.9 sqm with detached single storey garage and outhouses of 48 sqm; 'Valencia Lodge' a single storey dwelling of 135.6 sqm with a single storey garage of 17.8 sqm; two no. single storey sheds of 1,440 sqm and 595 sqm, and a three-sided shed of 54 sqm.

The proposed residential development comprises the construction of 569 no. new residential dwellings (325 no. houses and 244 no. apartments). There are 15 no. house types proposed, which in total provide 64 no. two-bed houses; 173 no. three-bed houses; and 88 no. four-bed houses (ranging in height from 2 to 3 storeys).

The 244 no. proposed apartments include 164 no. own-door units and 80 no. shared access apartments and comprise the following;

- Apartment Block A (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
- Apartment Block B (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
- Apartment Block C (Part 3 and 4 Storeys): 4 no. one-bed apartments; 19 no. two-bed apartments and 4 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 87 sqm.
- 13 no. apartments above the proposed Neighbourhood Centre comprising; 4 no. own-door two-bed apartments; 3 no. shared-access one-bed apartments; and 6 no. shared-access two-bed apartments. These proposed units have private balconies or terraces, and access to the communal roof terrace of 176 sqm.
- 160 no. own-door apartments in 2- and 3- storey buildings comprising; 16 no. one-bed apartments; 78 no. two-bed apartments, 66 no. three-bed duplex apartments. These units will have private amenity areas in the form of terraces, balconies and/or rear gardens.

The proposed Neighbourhood Centre has a total commercial floor area of 2,141 sqm and accommodates 11 no. commercial units with a variety of uses comprising:

- Convenience shop of 909 sqm (unit 1)
- 3 no. doctor/dentist/physio units of 120 sqm, 120 sqm and 90 sqm (units 6, 7, and 8, respectively)
- café of 125 sqm (unit 4)
- restaurant of 213 sqm (unit 9)
- 5 no. shop/convenience services units of 112 sqm, 49 sqm, 171 sqm, 100sqm and 100 sqm (units 2, 3, 5,10 and 11, respectively). It is envisaged that these units will be occupied by uses such as butchers, green grocers, hairdressers, pharmacies, or a local post office.

Within the Neighbourhood Centre it is proposed to provide a childcare facility (886 sqm) with capacity for in the order of 154 no. children.

A total of 1,008 no. car parking spaces are proposed to serve the proposed development. 650 no. car parking spaces are proposed to serve the 325 no. houses, 312 no. car parking spaces are proposed to serve the 244 no. apartments, and 46 no. car parking spaces are proposed to serve the neighbourhood centre, including the childcare facility.

A total of 732 no. bicycle parking spaces are proposed to serve the development comprising 536 no. long-stay residential spaces, 134 no. residential visitor spaces, and 62 no. bike spaces to serve the neighbourhood centre including the childcare facility.

4. Screening

4.1 Introduction

This section contains the information required for the competent authority to undertake screening for AA for the proposed development.

The aims of this section are to:

- Determine whether the proposed development is directly connected with, or necessary to, the conservation management of any Natura 2000 Sites;
- Provide information on, and assess the potential for the proposed development to significantly effect on Natura 2000 Sites (also known as European sites); and
- Determine whether the proposed development, alone or in combination with other projects, is likely to have significant effects on Natura 2000 sites in view of their conservation objectives.

The proposed development is not directly connected with, or necessary to the conservation management of any Natura 2000 sites.

4.2 Study Area and Scope of Appraisal

Natura 2000 sites (European sites) are only at risk from significant effects where a source-pathway-receptor link exists between a proposed development and a Natura 2000 site(s). This can take the form of a direct impact (e.g. where the proposed development and/or associated construction works are located within the boundary of the Natura 2000 site(s) or an indirect impact where impacts outside of the Natura 2000 site(s) affect ecological receptors within (e.g. impacts to water quality which can affect riparian habitats at a distance from the impact source).

The Zone of Influence (ZoI) comprises the area within which the proposed development may potentially affect the conservation objectives (or qualifying interests) of a Natura 2000 site. There is no recommended zone of influence, and guidance from the National Parks and Wildlife Service (NPWS) recommends that the distance should be evaluated on a case-by-case basis with reference to the nature, size and location of the project, the sensitivities of the ecological receptors, and the potential for in-combination effects (cumulative).

In ecological and environmental impact assessment, for an effect to occur there must be a risk enabled by having a source (e.g. construction works at a proposed development site), a ‘receptor’ (e.g. SAC or other ecologically sensitive feature), and a pathway between the source and the receptor (e.g. a watercourse which connects the proposed development site to the SAC, *ex situ* foraging habitat for SCI birds). A ‘receptor’ is defined as the Special Conservation Interest (SCI) of SPAs or Qualifying Interest (QI) of SACs for which conservation objectives have been set for the European sites being screened.

Consideration is therefore given to the source-pathway-receptor linkage and associated risks between the proposed development and Natura 2000 sites. For a significant effect to occur there needs to be an identified risk whereby a source (e.g. contaminant or pollutant arising from construction activities) affects a particular receptor (i.e. Natura 2000 site) through a

particular pathway (e.g. a watercourse which connects the proposed development with the Natura 2000 site).

The identification of risk does not automatically mean that an effect will occur, nor that it will be significant. The identification of these risks means that there is a possibility of environmental or ecological damage occurring. The level and significance of the effect depends upon the nature of the consequence, likelihood of the risk and characteristics of the receptor.

The precautionary principle is applied for the purposes of screening to ensure that consideration and pre-emptive action is undertaken where there is a lack of scientific evidence. It is noted that mitigation measures are not taken into account in the AA screening assessment process.

Thus, any appreciable direct, indirect or in-combination impacts which could arise from the proposed development in relation to the designated sites within this zone were considered.

4.3 Field Study

Survey surveys were carried out on the 3rd December 2020, 19th May 2021, 9th September 2021 and 8th March 2022 to identify the habitats, flora and fauna present at the site. The surveys assessed the potential for all Qualifying Interests (QIs)/ Special Conservation Interests (SCIs) of European sites and third schedule invasive species to occur within the proposed site.

4.4 Source-Pathway-Receptor Model

The likely effects of the proposed development on any European site has been assessed using a source-pathway-receptor model, where:

- A ‘source’ is defined as the individual element of the proposed works that has the potential to impact on a European site, its qualifying features and its conservation objectives.
- A ‘pathway’ is defined as the means or route by which a source can affect the ecological receptor.
- A ‘receptor’ is defined as the SCI of SPAs or QI of SACs for which conservation objectives have been set for the European sites being screened.

A source-pathway-receptor model is a standard tool used in environmental assessment. In order for an effect to be likely, all three elements of this mechanism must be in place. The absence or removal of one of the elements of the mechanism results in no likelihood for the effect to occur. The source-pathway-receptor model was used to identify a list of European sites, and their QIs/SCIs, with potential links to European sites. These are termed as ‘relevant’ European sites/QIs/SCIs throughout this report.

4.5 Likely Significant Effect

The threshold for a Likely Significant Effect (LSE) is treated in the screening exercise as being above a de minimis level. The opinion of the Advocate General in CJEU case C-258/11 outlines:

"the requirement that the effect in question be 'significant' exists in order to lay down a de minimis threshold. Plans or projects that have no appreciable effect on a European site are thereby excluded.

If all plans or projects capable of having any effect whatsoever on the site were to be caught by Article 6(3), activities on or near the site would risk being impossible by reason of legislative overkill."

In this report, therefore, 'relevant' European sites are those within the potential ZoI of activities associated with the construction and operation of the proposed development, where LSE pathways to European sites were identified through the source-pathway-receptor model.

4.6 Screening Process

The Screening for Appropriate Assessment will incorporate the following steps:

- Definition of the zone of influence for the proposed works;
- Identification of the European sites that are situated (in their entirety or partially or downstream) within the zone of influence of the proposed works;
- Identification of the most up-to-date QIs and SCIs for each European site within the zone of influence;
- Identification of the environmental conditions that maintain the QIs/SCIs at the desired target of Favourable Conservation Status;
- Identification of the threats/impacts – actual or potential that could negatively impact the environmental conditions of the QIs/SCIs within the European sites;
- Highlighting the activities of the proposed works that could give rise to significant negative impacts; and
- Identification of other plans or projects, for which in-combination impacts would likely have significant effects.

4.7 Desktop Review

A desktop review facilitates the identification of the baseline ecological conditions and key ecological issues relating to Natura 2000 sites and facilitates an evaluation assessment of potential in-combination impacts. Sources of information used for this report include reports prepared for the area and information from statutory and non-statutory bodies. The following sources of information and relevant documentation were utilised:

- National Parks & Wildlife Service (NPWS) - www.npws.ie;
- Environmental Protection Agency (EPA) – www.epa.ie;
- National Biodiversity Data Centre (NBDC) – www.biodiversityireland.ie;
- Invasive Species Ireland - http://www.invasivespeciesireland.com/;
- *Best Practice Guidance for Habitat Survey and Mapping* (Heritage Council, 2011);
- Kildare County Development Plan 2017-2023 (Kildare County Council 2017) and

- Geohive mapping http://map.geohive.ie.

5. Natura 2000 Sites

5.1 Designated sites within Zone of Influence

Natura 2000 sites within the zone of influence of the proposed development site are listed below in **Table 1** and shown in **Figure 3** and **Figure 4**. The proposed development site does not form part of any Natura 2000 site.

The closest Natura 2000 sites are the Pollardstown Fen SAC (site code 000396) and Moud's Bog Fen SAC (site code 002331) located 2.6km northwest and 3.2km north respectively from the proposed development site. Although these SACs are located within the Liffey catchment, they are located upstream of the proposed development site and in separate sub catchments. There is no hydrological or hydrogeological pathway between these Natura 2000 sites and the proposed development site. The invertebrate qualifying species for the Pollardstown Fen SAC do not occur within the zone of influence of the proposed development site. Therefore, no pathway for impact between Pollardstown Fen SAC and Moud's Bog Fen SAC have been identified.

During construction and operation surface water runoff from the site will be diverted to the River Liffey. Wastewater from the proposed development will also ultimately discharge to the River Liffey via the Upper Liffey Valley Sewerage Scheme (License ref. D0002). There are four Natura 2000 sites within Dublin Bay which are hydrologically connected to the River Liffey. These are South Dublin Bay SAC (site code 000210), South Dublin Bay and River Tolka Estuary SPA (site code 004024), North Dublin Bay SAC (site code 000206) and North Bull Island SPA (site code 004006). These are located approximately 59.2-61.8km downstream of the proposed development site. Although unlikely due to the distance involved, given the hydrological connection, surface water run-off during the construction or operational phase as well as wastewater discharges during operation could potentially impact on the South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA.

The Poulaphouca Reservoir SPA (site code 004063) is located 14.7km southeast of the proposed development site. Qualifying species from this SPA i.e. Greylag Goose and Lesser Black-backed Gull, could potentially forage on or near the proposed development site. Therefore, qualifying species could be impacted by disturbance in *ex situ* habitats during the construction or operation phase.

Therefore, a source-pathway-receptor link has been identified between the source (the proposed SHD development) and the receptor (South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA, South Dublin Bay & River Tolka Estuary SPA and Poulaphuca Reservoir SPA) via a potential pathway (discharge of surface water run-off during construction/operation, wastewater discharges during operation, disturbance during construction and operation and the spread of invasive species). Further information on these Natura 2000 is sites provided below. Site synopses for these Natura 2000 are included in **Appendix 1**.

Given the lack of a hydrological or other connection, no potential impact on any other Natura 2000 site has been identified.

Table 1. Natura 2000 sites and their location relative to the proposed development site

Natura 2000 Sites	Site Code	Distance at closest point and potential source-pathway-receptor link	Qualifying interests
Special Area of Conservation (SAC)			
Pollardstown Fen SAC	000396	2.6km west. Northwest.	**Habitats** 7210 Calcareous fens with Cladium mariscus and species of the Caricion davallianae* 7220 Petrifying springs with tufa formation (Cratoneurion)* 7230 Alkaline fens **Species** 1014 Narrow-mouthed Whorl Snail (Vertigo angustior) 1013 Geyer's Whorl Snail (Vertigo geyeri) 1016 Desmoulin's Whorl Snail (Vertigo moulinsiana)
Mouds Bog SAC	002331	3.2km north	**Habitats** 7110 Active raised bogs* 7120 Degraded raised bogs still capable of natural regeneration 7150 Depressions on peat substrates of the Rhynchosporion
Ballynafagh Lake SAC	001387	10.5km north	**Habitats** 7230 Alkaline fens **Species** 1065 Marsh Fritillary (*Euphydryas aurinia*) 1016 Desmoulin's Whorl Snail (*Vertigo moulinsiana*)
Ballynafagh Bog SAC	000391	12.4km north	**Habitats** 7110 Active raised bogs* 7120 Degraded raised bogs still capable of natural regeneration 7150 Depressions on peat substrates of the Rhynchosporion

Natura 2000 Sites	Site Code	Distance at closest point and potential source-pathway-receptor link	Qualifying interests
River Barrow and River Nore SAC	002162	12.9km southwest	**Habitats** 1130 Estuaries 1140 Mudflats and sandflats not covered by seawater at low tide 1170 Reefs 1310 Salicornia and other annuals colonising mud and sand 1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae) 1410 Mediterranean salt meadows (Juncetalia maritimi) 3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation 4030 European dry heaths 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels 7220 Petrifying springs with tufa formation (Cratoneurion)* 91A0 Old sessile oak woods with Ilex and Blechnum in the British Isles 91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)* **Species** 1029 Freshwater Pearl Mussel (*Margaritifera margaritifera*) 1016 Desmoulin's Whorl Snail *(Vertigo moulinsiana*) 1355 Otter (*Lutra lutra*) 1092 White-clawed Crayfish (*Austropotamobius pallipes*) 1106 Salmon (*Salmo salar*)

Natura 2000 Sites	Site Code	Distance at closest point and potential source-pathway-receptor link	Qualifying interests
			1421 Killarney Fern (*Trichomanes speciosum*) 1103 Twaite Shad (*Alosa fallax fallax*) 1990 Nore Pearl Mussel (*Margaritifera durrovensis*) 1095 Sea Lamprey (*Petromyzon marinus*) 1096 Brook Lamprey (*Lampetra planeri*) 1099 River Lamprey (*Lampetra fluviatilis*)
South Dublin Bay SAC	000210	43.6km northeast (59.2km downstream)	**Habitats** 1140 Mudflats and sandflats not covered by seawater at low tide 1210 Annual vegetation of drift lines 1310 Salicornia and other annuals colonising mud and sand 2110 Embryonic shifting dunes
North Dublin Bay SAC	000206	45.4km northeast (61.8km downstream)	**Habitats** 1140 Mudflats and sandflats not covered by seawater at low tide 1210 Annual vegetation of drift lines 1310 Salicornia and other annuals colonising mud and sand 1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae) 1410 Mediterranean salt meadows (Juncetalia maritimi) 2110 Embryonic shifting dunes 2120 Shifting dunes along the shoreline with Ammophila arenaria (white dunes) 2130 Fixed coastal dunes with herbaceous vegetation (grey dunes)* 2190 Humid dune slacks **Species** 1395 Petalwort (*Petalophyllum ralfsii*)

Natura 2000 Sites	Site Code	Distance at closest point and potential source-pathway-receptor link	Qualifying interests
Special Protection Area (SPA)			
Poulaphuca Reservoir SPA	004063	14.7km southeast.	**Birds** A043 Greylag Goose (*Anser anser*) A183 Lesser Black-backed Gull (*Larus fuscus*)
South Dublin Bay and River Tolka Estuary SPA	004024	41.8km northeast (59.2km downstream)	Birds A144 Sanderling (*Calidris alba*) A157 Bar-tailed Godwit (*Limosa lapponica*) A149 Dunlin (*Calidris alpina*) A162 Redshank (Tringa totanus) A179 Black-headed Gull (Chroicocephalus ridibundus) A143 Knot (*Calidris canutus*) A192 Roseate Tern (*Sterna dougallii*) A046 Light-bellied Brent Goose (*Branta bernicla hrota*) A141 Grey Plover (*Pluvialis squatarola*) A130 Oystercatcher (*Haematopus ostralegus)* A194 Arctic Tern (*Sterna paradisaea*) A193 Common Tern (*Sterna hirundo*) A137 Ringed Plover (*Charadrius hiaticula*) **Habitats** Wetlands
North Bull Island SPA	004006	43.0km northeast (61.8km downstream)	**Birds** A160 Curlew (*Numenius arquata*) A149 Dunlin (*Calidris alpina*) A157 Bar-tailed Godwit (*Limosa lapponica*) A162 Redshank (*Tringa totanus)*

Natura 2000 Sites	Site Code	Distance at closest point and potential source-pathway-receptor link	Qualifying interests
			A179 Black-headed Gull (*Chroicocephalus ridibundus)* A144 Sanderling (*Calidris alba*) A156 Black-tailed Godwit (*Limosa limosa*) A143 Knot (*Calidris canutus*) A169 Turnstone (*Arenaria interpres*) A054 Pintail (*Anas acuta)* A046 Light-bellied Brent Goose (*Branta bernicla hrota*) A048 Shelduck (*Tadorna tadorna*) A052 Teal (*Anas crecca*) A141 Grey Plover (*Pluvialis squatarola*) A056 Shoveler (*Anas clypeata*) A130 Oystercatcher (*Haematopus ostralegus*) A140 Golden Plover (*Pluvialis apricaria*) **Habitats** Wetlands

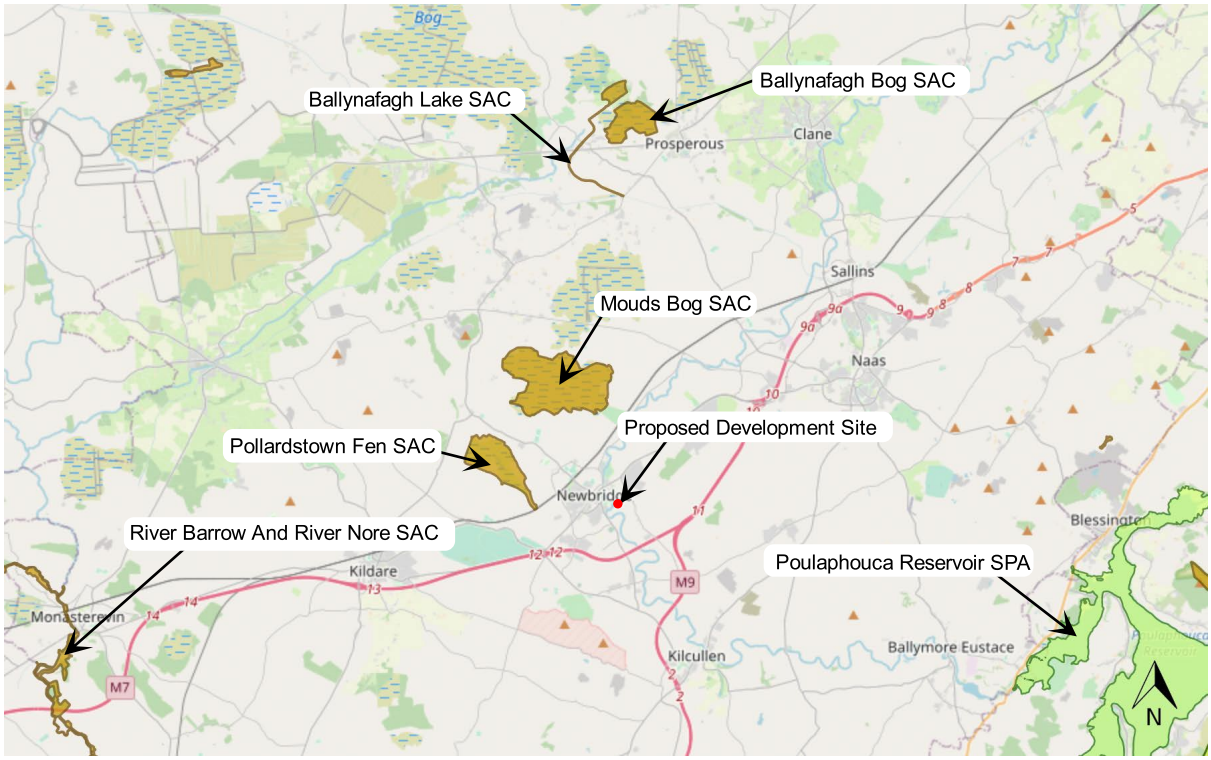


Figure 3. Location of the proposed development site and Natura 2000 sites within Zone of Influence (Zol) (Map 1) | Source: EPA Envision mapping https://gis.epa.ie/EPAMaps/) | Not to scale

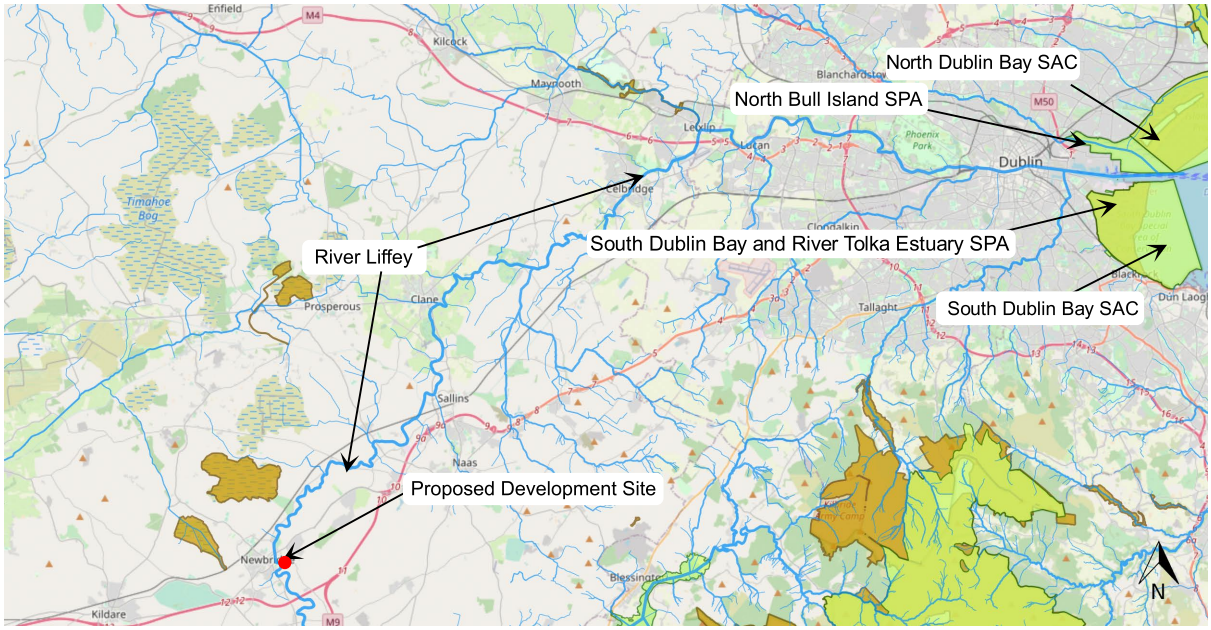


Figure 4. Location of the proposed development site and Natura 2000 sites within Zone of Influence (Zol) (Map 2) | Source: EPA Envision mapping https://gis.epa.ie/EPAMaps/) | Not to scale

5.2 European Sites Descriptions

5.2.1 North Bull Island SAC

The North Bull Island sand spit is a relatively recent depositional feature, formed as a result of improvements to Dublin Port during the 18th and 19th centuries. It is almost five kilometres long and one kilometre wide and runs parallel to the coast between Clontarf and Sutton. The sediment which forms the island is predominantly glacial in origin and siliceous in nature. Between the island and the mainland there occurs two sheltered intertidal areas which are separated by a solid causeway constructed in 1964. The seaward side of the island has a fine sandy beach. A substantial area of shallow marine water is included in the site. The interior of the island is excluded from the site as it has been converted to golf courses. The proximity of the North Bull Island to Dublin City results in it being a very popular recreational area. It is also very important for educational and research purposes. Nature conservation is a main land use within the site.

Site possesses an excellent diversity of coastal habitats. The North Bull Island dune system is one of the most important systems on the east coast and is one of the few in Ireland that is actively accreting. It possesses extensive and mostly good quality examples of embryonic, shifting marram and fixed dunes, as well as excellent examples of humid dune slacks. Both Atlantic and Mediterranean salt marshes are well represented and a particularly good marsh zonation is shown. The salt marshes grade into mudflats and sandflats, some of which are dominated by annual Salicornia species. *Petalophyllum ralfsii* occurs at its only known station away from the western seaboard. The site has five Red Data Book vascular plant species and four Red Data Book bryophyte species. This is one of the most important sites for wintering waterfowl in Ireland, with internationally important populations of *Branta bernicla horta*, *Calidris canutus* and *Limosa lapponica*, plus nationally important numbers of a further 14 species. 20% of the national total of *Pluvialis squatarola* occurs here. Formerly it had important colony of *Sterna albifrons*. North Dublin Bay is nationally important for three insect species. The scientific interests of the site have been well documented and future prospects are good owing to the various designations assigned to site.

5.2.2 South Dublin Bay SAC

This intertidal site extends from the South Wall at Dublin Port to the West Pier at Dun Laoghaire, a distance of approximately 5 km. At their widest, the intertidal flats extend for almost 3 km. The seaward boundary is marked by the low tide mark, while the landward boundary is now almost entirely artificially embanked. Several permanent channels exist, the largest being Cockle Lake. A small sandy beach occurs at Merrion Gates, while some bedrock shore occurs near Dun Laoghaire. A number of small streams and drains flow into the site. The proximity of the site to Dublin City results in it being a very popular recreational area. It is also important for educational and research purposes.

Site possesses a fine and fairly extensive example of intertidal flats. Sediment type is predominantly sand, with muddy sands in the more sheltered areas. A typical macro-invertebrate fauna exists. Has the largest stand of Zostera on the east coast. Supports part of the important wintering waterfowl populations of Dublin Bay. Regularly has an internationally population of *Branta bernicila horta*, plus nationally important numbers of at least a further 6 species, including *Limosa lapponica*. Regular autumn roosting ground for significant numbers

of *Sterna* terns, including *S. dougallii*. The scientific interests of the site have been well documented.

5.2.3 North Bull Island SPA

The North Bull Island sand spit is a relatively recent depositional feature, formed as a result of improvements to Dublin Port during the 18th and 19th centuries. It is almost 5km long and 1km wide and runs parallel to the coast between Clontarf and Sutton. The sediment which forms the island is predominantly glacial in origin and siliceous in nature. A well-developed dune system runs the length of the island, with good examples of embryonic, shifting marram and fixed dunes, as well as excellent examples of humid dune slacks. Extensive salt marshes also occur. Between the island and the mainland occur two sheltered intertidal areas which are separated by a solid causeway constructed in 1964. The seaward side of the island has a fine sandy beach. A substantial area of shallow marine water is included in the site. Part of the interior of the island has been converted to golf courses. The proximity of the North Bull Island to Dublin City results in it being a very popular recreational area. It is also very important for educational and research purposes. Nature conservation is a main land use within the site.

The site is among the top ten sites for wintering waterfowl in the country. It supports internationally important populations of *Branta bernicila hrota* and *Limosa lapponica* and is the top site in the country for both of these species. A further 14 species have populations of national importance, with particular notable numbers of *Tadorna tadorna* (8.5% of national total), *Anas acuta* (11.6% of national total), *Pluvialis squatarola* (6.9% of national total), *Calidris canutus* (10.5% of national total). North Bull Island SPA is a regular site for passage waders such as *Philomachus pugnax, Calidris ferruginea* and *Tringa erythropus*. The site supports *Asio flammeus* in winter. Formerly the site had an important colony of *Sterna albifrons* but breeding has not occurred in recent years. The site provides both feeding and roosting areas for the waterfowl species. Habitat quality for most of the estuarine habitats is very good. The site has a population of the rare *Petalophyllum ralfsii* which is the only known station away from the western seaboard as well as five Red Data Book vascular plant species and four bryophyte species. It is nationally important for three insect species. Wintering bird populations have been monitored more or less continuously since the late 1960s, and the other scientific interests of the site have also been well documented. Future prospects are good owing to various designations assigned to site.

5.2.4 South Dublin Bay and River Tolka Estuary SPA

This site comprises a substantial part of Dublin Bay. It includes virtually all of the intertidal area in the south bay, as well as much of the Tolka Estuary to the north of the River Liffey. A portion of the shallow bay waters is also included. In the south bay, the intertidal flats extend for almost 3 km at their widest. The sediments are predominantly well-aerated sands. The sands support the largest stand of *Zostera noltii* on the East Coast. Several permanent channels exist, the largest being Cockle Lake. A small sandy beach occurs at Merrion Gates, while some bedrock shore occurs near Dun Laoghaire. The landward boundary is now almost entirely artificially embanked. Sediments in the Tolka Estuary vary from soft thixotrophic muds with a high organic content in the inner estuary to exposed, well aerated sands off the Bull Wall. The proximity of the site to Dublin City results in it being a very popular recreational area. It is also important for educational and research purposes.

The site possesses extensive intertidal flats which support wintering waterfowl which are part of the overall Dublin Bay population. It regularly has an internationally important population of *Branta bernicla hrota*, which feeds on *Zostera noltii* in the autumn. It has nationally important numbers of a further 6 species: *Haematopus ostralegus, Charadrius hiaticula, Calidris canutus, Calidris alba, Calidris alpina* and *Limosa lapponica*. It is an important site for wintering gulls, especially *Larus ridibundus* and *Larus canus*. South Dublin Bay is the premier site in Ireland for *Larus melanocephalus*, with up to 20 birds present at times. Is a regular autumn roosting ground for significant numbers of terns, including *Sterna dougallii, S. hirundo* and S*. paradisaea*.

5.2.5 Poulaphuca Reservoir SPA

Poulaphouca Reservoir SPA, located in the western foothills of the Wicklow Mountains, was created in 1944 by damming of the River Liffey for the purpose of generating electricity from hydropower. The reservoir covers an area of approximately 20 square kilometres and is the largest inland water body in the mid- east and south-east regions. The reservoir receives water from two main sources, the River Liffey at the northern end, and the Kings River at the southern end. The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Greylag Goose and Lesser Black-backed Gull.

Poulaphouca Reservoir is of national importance for its Greylag Goose population, which is one of the largest in the country. The site provides the main roost for the birds, with feeding occurring mostly on improved grassland outside of the site. A mean peak of 701 individuals occurred during the five seasons 1995/96 to 1999/2000. The reservoir attracts roosting gulls during winter, most notably a large population of Lesser Black-backed Gull (651), which in Ireland is rare in winter away from the south coast.

The principal interest of the site is the Greylag Goose population, which is of national importance. A range of other wildfowl species also occurs, including Whooper Swan, a species that is listed on Annex I of the E.U. Birds Directive. The site is also notable as a winter roost for gulls, especially Lesser Black-backed Gull. Part of Poulaphouca Reservoir SPA is a Wildfowl Sanctuary.

5.3 Natura 2000 sites – Features of interests and conservation objectives

The EU Habitats Directive contains a list of habitats (Annex I) and species (Annex II) for which SACs must be established by Member States. Similarly, the EU Birds Directive contains lists of important bird species (Annex I) and other migratory bird species for which SPAs must be established. Those that are known to occur at a site are referred to as ‘qualifying interests’ and are listed in the Natura 2000 forms which are lodged with the EU Commission by each Member State. A ‘qualifying interest’ is one of the factors (such as the species or habitat that is present) for which the site merits designation. The National Parks and Wildlife Service (NPWS) are responsible for the designation of SACs and SPAs in Ireland.

The conservation objectives for the site are detailed in:

- NPWS (2013) *Conservation Objectives: North Dublin Bay SAC 000206. Version 1.* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

- NPWS (2013) *Conservation Objectives: South Dublin Bay SAC 000210. Version 1.* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.
- NPWS (2015) *Conservation Objectives: North Bull Island SPA 004006. Version 1.* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.
- NPWS (2015) *Conservation Objectives: South Dublin Bay and River Tolka Estuary SPA 004024. Version 1*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.
- NPWS (2021) *Conservation objectives for Poulaphouca Reservoir SPA [004063]. Generic Version 8.0. Department of Housing, Local Government and Heritage*.

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network. European and national legislation places a collective obligation on Ireland and its citizens to maintain at favourable conservation status sites designated as Special Areas of Conservation and Special Protection Areas. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level. Favourable conservation status of a habitat is achieved when its natural range, and area it covers within that range, is stable or increasing, and the ecological factors that are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when population data on the species concerned indicate that it is maintaining itself, and the natural range of the species is neither being reduced or likely to be reduced for the foreseeable future, and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis. The species and/or habitats listed as features of interests for South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA, South Dublin Bay & River Tolka Estuary SPA and Poulaphuca Reservoir SPA are included in **Tables 2 to 6**.

Table 2. Features of Interest for North Dublin Bay SAC

Habitat/species Code	Habitat /Species	Conservation objective
1140	Mudflats and sandflats not covered by seawater at low tide	Maintain
1210	Annual vegetation of drift lines	Restore
1310	Salicornia and other annuals colonising mud and sand	Restore
1330	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	Maintain
1410	Mediterranean salt meadows (*Juncetalia maritimi*)	Maintain
2110	Embryonic shifting dunes	Restore

Habitat/species Code	Habitat /Species	Conservation objective
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	Restore
2130	Fixed coastal dunes with herbaceous vegetation (grey dunes)	Restore
2190	Humid dune slacks	Restore
1395	Petalwort *Petalophyllum ralfsii*	Maintain

Restore = Restore favourable conservation condition, Maintain = Maintain favourable conservation condition

Table 3. Features of Interest for South Dublin Bay SAC

Habitat/species Code	Habitat /Species	Conservation objective
1140	Mudflats and sandflats not covered by seawater at low tide	Maintain
1210	Annual vegetation of drift lines	Maintain/Restore
1310	Salicornia and other annuals colonising mud and sand	Maintain/Restore
2110	Embryonic shifting dunes	Maintain/Restore

Restore = Restore favourable conservation condition, Maintain = Maintain favourable conservation condition

Table 4: Features of Interest for North Bull Island SPA

Species Code	Species	Scientific name	Conservation objective
A046	Brent Goose	*Branta bernicla hrota*	Maintain
A048	Shelduck	*Tadorna tadorna*	Maintain
A052	Teal	*Anas crecca*	Maintain
A054	Pintail	*Anas acuta*	Maintain
A056	Shoveler	*Anas clypeata*	Maintain
A130	Oystercatcher	*Haematopus ostralegus*	Maintain
A140	Golden Plover	*Pluvialis apricaria*	Maintain
A141	Grey Plover	*Pluvialis squatarola*	Maintain
A143	Knot	*Calidris canutus*	Maintain
A144	Sanderling	*Calidris alba*	Maintain
A149	Dunlin	*Calidris alpina alpina*	Maintain
A156	Black-tailed Godwit	*Limosa limosa*	Maintain
A157	Bar-tailed Godwit	*Limosa lapponica*	Maintain
A160	Curlew	*Numenius arquata*	Maintain
A162	Redshank	*Tringa totanus*	Maintain
A169	Turnstone	*Arenaria interpres*	Maintain
A179	Black-headed Gull	*Chroicocephalus ridibundus*	Maintain
A999	Wetlands & waterbirds		Maintain

Restore = Restore favourable conservation condition, Maintain = Maintain favourable conservation condition

Table 5: Features of Interest for South Dublin Bay & River Tolka Estuary SPA

Species Code	Species	Scientific name	Conservation objective
A046	Brent Goose	*Branta bernicla hrota*	Maintain
A130	Oystercatcher	*Haematopus ostralegus*	Maintain
A137	Ringed Plover	*Charadrius hiaticula*	Maintain
A141	Grey Plover	*Pluvialis squatarola*	Maintain
A143	Knot	*Calidris canutus*	Maintain
A144	Sanderling	*Calidris alba*	Maintain
A149	Dunlin	*Calidris alpina alpina*	Maintain
A157	Bar-tailed Godwit	*Limosa lapponica*	Maintain
A162	Redshank	*Tringa totanus*	Maintain
A179	Black-headed Gull	*Chroicocephalus ridibundus*	Maintain
A192	Roseate Tern	*Sterna dougallii*	Maintain
A193	Common Tern	*Sterna hirundo*	Maintain
A194	Arctic Tern	*Sterna paradisaea*	Maintain
A999	Wetlands & waterbirds		Maintain

Restore = Restore favourable conservation condition, Maintain = Maintain favourable conservation condition

Table 6. Qualifying Species for Poulaphuca Reservoir SPA

Species code	Species		*Conservation objective*
A043	Greylag Goose	*Anser anser*	Maintain/Restore
A183	Lesser Black-backed Gull	*Larus fuscus*	Maintain/Restore

Restore = Restore favourable conservation condition, Maintain = Maintain favourable conservation condition

To acknowledge the importance of Ireland's wetlands to wintering waterbirds, “Wetland and Waterbirds” may be included as a Special Conservation Interest for some SPAs that have been designated for wintering waterbirds and that contain a wetland site of significant importance to one or more of the species of Special Conservation Interest. Thus, a further objective is to maintain or restore the favourable conservation condition of the wetland habitat within the North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA as a resource for the regularly occurring migratory waterbirds that utilise them.

It should be noted that some of the Natura 2000 sites overlap with each other and thus the conservation objectives for these sites should be used in conjunction with those for overlapping and adjacent sites as appropriate.

6. Water Quality data

6.1 River Basin Management Plan for Ireland 2015 – 2018 (2nd /3rd Cycle)

The Water Framework Directive (WFD) sets out the environmental objectives which are required to be met through the process of river basin planning and implementation of those plans. Specific objectives are set out for surface water, groundwater and protected areas. The

challenges that must be overcome in order to achieve those objectives are very significant. Therefore, a key purpose of the River Basin Management Plan (RBMP) is to set out priorities and ensure that implementation is guided by these priorities.

The second-cycle RBMP aims to build on the progress made during the first cycle. Key measures during the first cycle included the licensing of urban waste-water discharges (with an associated investment in urban waste-water treatment) and the implementation of the Nitrates Action Programme (Good Agricultural Practice Regulations). The former measure has resulted in significant progress in terms both of compliance levels and of the impact of urban waste-water on water quality. The latter provides a considerable environmental baseline which all Irish farmers must achieve and has resulted in improving trends in the level of nitrates and phosphates in rivers and groundwater. It is acknowledged, however, that sufficient progress has not been made in developing and implementing supporting measures during the first cycle.

Overall, RBMP assesses the quality of water in Ireland and presents detailed scientific characterisation of our water bodies. The characterisation process also takes into account wider water quality considerations, such as the special water-quality requirements of protected areas. The characterisation process identifies those water bodies that are *At Risk* of not meeting the objectives of the WFD, and the process also identifies the significant pressures causing this risk. Based on an assessment of risk and pressures, a programme of measures has been developed to address the identified pressures and work towards achieving the required objectives for water quality and protected areas. Data relating to the watercourses within the study area is provided in **Table 7** and the location of these shown in **Figure 5.**

Table 7. WFD Status

Catchment: Liffey and Dublin Bay (Code 9) – 2nd Cycle
This catchment includes the area drained by the River Liffey and by all streams entering tidal water between Sea Mount and Sorrento Point, Co. Dublin, draining a total area of 1,616km2. The largest urban centre in the catchment is Dublin City. The other main urban centres are Dun Laoghaire, Lucan, Clonee, Dunboyne, Leixlip, Maynooth, Kilcock, Celbridge, Newcastle, Rathcoole, Clane, Kill, Sallins, Johnstown, Naas, Newbridge, Athgarvan, Kilcullen and Blessington. The total population of the catchment is approximately 1,255,000. The Liffey catchment contains the largest population of any catchment in Ireland and is characterised by a sparsely populated, upland south eastern area and a densely populated, flat, low lying area over the remainder of the catchment basin. The Liffey catchment comprises 17 sub-catchments with 77 river water bodies, six lakes, six transitional and five coastal water bodies, and 16 groundwater bodies The proposed development site is in the Liffey_080 River Water Body. Status Reports have been prepared this Water Body. Status means the condition of the water in a watercourse and is defined by its ecological and chemical conditions, whichever is worse. Water Bodies are ranked in one of five classes,' High', 'Good', 'Moderate', 'Poor' and 'Bad'. The WFD requires measures to ensure waters achieve at least 'Good Status' by 2015 and that their current status does not deteriorate. Where necessary, for example in heavily impacted or modified watercourses, extended deadlines (2021 and 2027) have been set for achieving the following objectives: • Prevent Deterioration • Restore Good Status

- Reduce Chemical Pollution
- Achieve Protected Areas Objectives

The objectives for particular watercourses are based on 'Pressure and Impact Assessments' of human activity, including point and diffuse emissions, land use and morphological conditions on surface waters to identify those water bodies that are 'At Risk' of failing to meet the WFD objectives. The ecological status/potential of the LIFFEY_080 is classified as 'Good' and the river is 'Not at Risk' of meeting its RBMP objectives. The WWTP discharge point is located in the Liffey_SC_060 sub-catchment. This small sub-catchment only contains three waterbodies. Liffey_100 requires further investigative assessment to identify the source of the pressure believed to be the WWTP. Although Liffey_110 is unassigned Kildare CoCo indicated pressure from a pumping station that needs to be considered. In Liffey_120 there is elevated P and NH3. There are known issues with a historic landfill in the waterbody and also urban diffuse pressures from Naas. The status of waterbodies in the vicinity of Dublin Bay are also described below.

Waterbodies relevant to the proposed project (2nd Cycle)

Waterbody	WFD Status	Risk	**Pressure Category** **WFD Status**
Liffey_080	Good	Not at risk	n/a
Liffey_100	Moderate	Review	Urban wastewater
Liffey_120	Good	Not at risk	n/a
Liffey Estuary	Good	At risk	Urban wastewater
Dublin Bay	Good	Not at risk	n/a

Source: EPA envision mapping and www.catchments.ie 22/04/2021

6.2 Urban Wastewater Treatment Directive

The Waste Water Discharge (Authorisation) Regulations 2007 (S.I. 684 of 2007) gives effect to the requirements of the Urban Waste Water Treatment Directive (Directive 91/271/EEC) and the Water Framework Directive (2000/60/EC) in Ireland. The Urban Waste Water Treatment Directive (UWWTD) lays down the requirements for the collection, treatment and discharge of urban waste-water and specifies the quality standards which must be met — based on agglomeration size — before treated waste-water is released into the environment.

The priority objective for this river basin planning cycle is to secure compliance with the Urban Waste Water Treatment Directive and to contribute to the improvement and protection of waters in keeping with the water-quality objectives established by this Plan. Achieving this objective entails addressing waste-water discharges and overflows where protected areas (i.e. designated bathing waters and shellfish waters) or high-status waters are at risk from urban waste-water pressures.

As part of the proposed development wastewater discharging from the proposed development will be conveyed to the Upper Liffey Valley Sewerage Scheme WWTP (D0002) for treatment prior to discharging into the River Liffey.

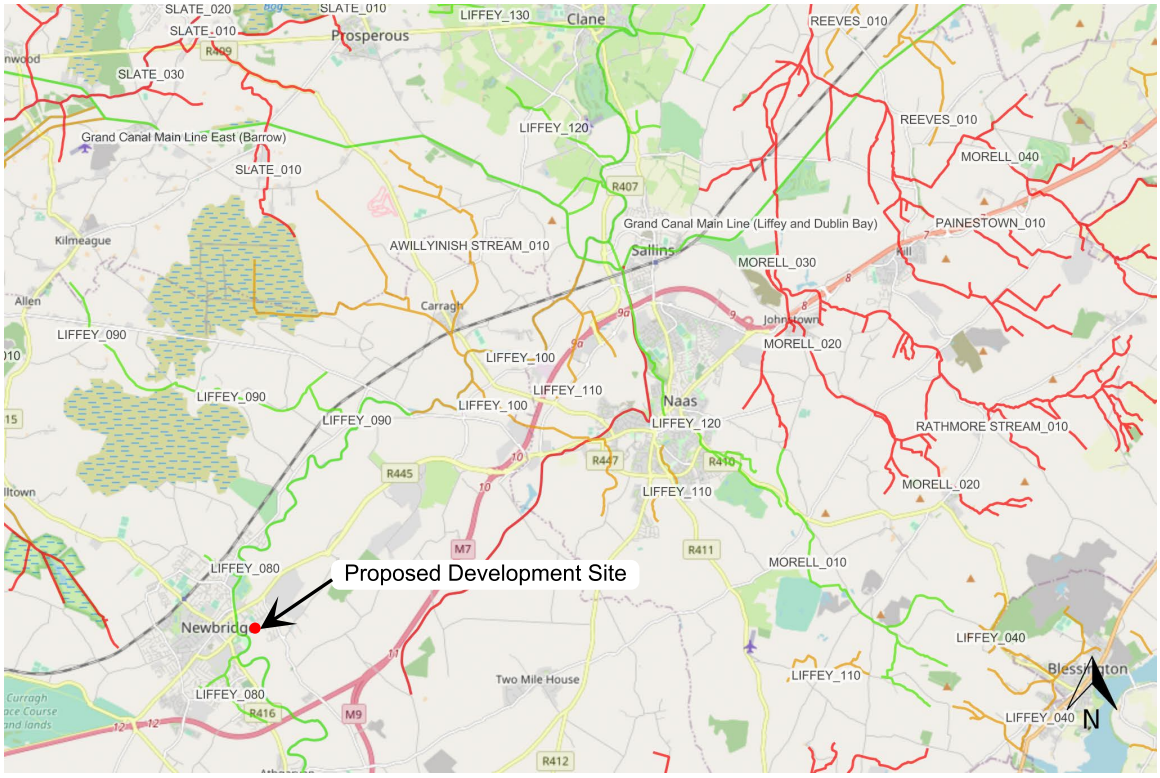


Figure 5. WFD status waterbodies in the vicinity of the proposed development | Source: EPA Envision mapping | not to scale.

7. Site Surveys

7.1 Habitat survey

Survey surveys were carried out on the 3rd December 2020, 19th May 2021, 9th September 2021 and 8th March 2022 to identify the habitats, flora and fauna present at the site. Habitat mapping was carried out in line with the methodology outlined in the Heritage Council Publication, *Best Practice Guidance for Habitat Survey and Mapping* (Heritage Council, 2011). The terrestrial and aquatic habitats within or adjacent to the proposed development site was classified using the classification scheme outlined in the Heritage council publication *A Guide to Habitats in Ireland* (Fossitt, 2000) and cross referenced with Annex I Habitats where required. The survey results are representative of the habitats within the application site and include the dominant and characteristic species of flora.

An overview of habitats recorded within the site is shown in **Figure 6.** The habitats recorded onsite as well as their ecological value is detailed in **Table 8**. Site photographs are also included below. No rare plant species were recorded within the works area during the site survey and given the modified nature of the habitats within the proposed development area are highly unlikely to occur.

Table 8. Habitats recorded within proposed development site boundary

Habitat	Comments
Arable Crops BC1	The primary land use is for arable crops. The most common crop is Spring Barley *Hordeum vulgare*, which has been sown as a monocrop over much of the site area. Fields cultivated for arable crops are characterised by a limited diversity of grasses and herbaceous species. Species noted including Common Poppy *Papaver rhoes* and Common Field-Speedwell *Veronica persica* which are common weed species of this type of agricultural land. This habitat does not have links to Annex I habitat.
Dry meadow and grassy verges GS2	This habitat has developed on a bank between an existing hedgerow and drain. This habitat is dominated by common species including Cocksfoot *Dactylis glomerata*, Common Vetch *Vicia sativa* and Bramble *Rubus fruiticosus*. In absence of active management scrub species are likely to become more dominant (small area not mapped). Dry meadow and grassy verge loosely corresponds to the annexed habitat, 'lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) (6510)'. The dry meadow and grassy verge habitat within the study area is not a valuable example of this habitat type.
Dry meadow and grassy verges GS2/Tall Herb Swamp FS2	The section of the site south of the river is a mosaic of formerly grazed grassland and tall herb swamp vegetation along the riverbank. Currently this habitat is not actively managed or grazed with a preponderance of coarse grasses including False Oat Grass *Arrhenatherum elatius* and Cock's Foot *Dactylus glomerata* are common. Links with Annex I: *Corresponds to the annexed habitat, 'lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) (6510)'.* Areas of this habitat closer to the riverbank have some characteristics of tall herb swamp. These areas are occasionally waterlogged. They are dominated by Fool's Watercress *Apium nodiflorum* and Hemlock Water Droplet *Oenanthe crocata.* Patches of Soft Rush *Juncus effusus* and Common Reed *Phragmites australis* are present but not dominant. Occasional trees, particularly Willow *Salix sp.,* are present with a small copse of Hawthorn *Crataegus monogynus* was also noted. Links with Annex I: Tall-herb swamps can include pockets of the annexed habitat 'hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)'. In Ireland, however, stands of the latter are usually fragmented and poorly developed. This is not a valuable example of this habitat type.
Hedgerows WL1/ Treelines WL2/	The site is generally bordered by hedgerows and treelines. These linear vegetated boundaries are not homogenous. Those along the southern and western boundaries of the site are classified as treelines, with taller trees (5m+). The dominant mature trees include Beech *Fagus sylvatica*, Sycamore *Acer pseudoplatanus* and Scots Pine *Pinus sylvestris*. Poplar *Populus sp.* also occurs. Understorey species include Bramble *Rubus fruticosus*, Elder *Sambucus nigra*, Cleavers *Galium aparine* and Common Vetch. Along the northern and eastern borders, linear vegetation is thinner and generally under 5m in height and these linear features are classified as hedgerows. The occasional, trees recorded include those mentioned above as well as Hawthorn and Sessile Oak *Quercus petraea*. Scrub vegetation is common and dominates in parts. Species noted include Rosebay Willowherb *Chamaenerion angustifolium*,

Habitat	Comments
	Cow Parsley *Anthriscus sylvestris*, Guelder-Rose *Viburnum opulus*, Hedge Mustard *Sisymbrium officinale*, Groundsel *Senecio vulgaris*, Silverweed *Argentina anserine* and Dandelion *Taraxicum* spp. This habitat does not correspond to an Annex I habitat.
Mixed Broadleaved Woodland WD1	Some areas of wider woodland border the river in the southern section of the site. Some conifers are present, however broadleaved species predominate. The tallest and most mature specimens are Beech and Sessile Oak. Some Scots Pine and Sycamore are also present. The understory includes Sycamore, Hawthorn, Bracken *Pteridium aquilinum* and Common Vetch. There is a strong component of willow including Crack Willow *Salix fragilis* and Goat Willow *Salix caprea*. It therefore has elements of Riparian woodland but is unlikely to have significant levels of flooding. This habitat does not correspond to an Annex I habitat.
Drainage Ditch FW4	A drainage ditch runs through the site and along part of the northern site boundary. The channel is approximately 2m wide and flows are limited with isolated pools during low flow conditions. Instream vegetation includes Water Crowfoot *Ranunculus aquatalis* and Blanket Weed *Chlamydomonas* spp. Drier sections of the ditch support Soft Rush *Juncus effusus* and Meadow Grass *Poa annua.* Minnow *Phoxinus phoxinus* were noted in small pools, although this species is unlikely to persist during drier periods when the drain is essentially stagnant or dry. As this species is common in the River Liffey it can readily recolonise the drain when flows increase. Therefore, this habitat is not considered a critical resource for this species. The banks are overgrown with Bramble, Rosebay Willowherb, and Soft Rush. Small areas of riparian Given the limited size of the drain, limited prey availability and frequent dog usage this habitat is unlikely to be of significant value for Otter. No signs of Otter were recorded during site surveys. This habitat does not correspond to an Annex I habitat.
Depositing/Lowland Rivers FW2	A meander of the River Liffey borders the south-western corner of the site. At this location the river is approximately 23m wide and fast-flowing with low, sloping banks. Filamentous algae along the stretch of the river covers a signficiant proportion of the riverbed, greatly reducing the overall value of the sites in terms of spawning and, to a lesser extent, nursery habitat. Bankside vegetation along the site boundary is dense with Bramble forming thickets. Bankside vegetation includes Elder, Beech, Sycamore, Hawthorn and the understory includes Bramble, Bracken, Nettle *Urtica dioica* and Hogweed *Heracleum sphondylium*. Hemlock Water-Dropwort *Oenanthe crocata* is very common at the waters edge. In-stream vegetation includes Water Crowfoot *Ranunculus peltatus*. The River Liffey supports Otter and it is considered probable that otter utlise the river and riparian habitat where the site borders the river. There is dense vegetation between the site and the river with dense bramble and mature trees which limits access. No evidence of Otter including spraints, slides, couches, feeding signs or holts were recorded. However taking a worst case scenario

Habitat	Comments
	approach it is assumted that the Liffey where it adjoins the site is used by otter for foraging. FW2 has links to the Annex I habitat Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260). The River Liffey has not been designated as a Natura 2000 site but is considered a high value habitat at a regional level.
Buildings and Artificial Surfaces BL3	This habitat includes a number of buildings in the easter section of the site. These include the main central barn-shaped warehouse structure, a smaller warehouse structure, a one-storey dwelling, and a two-storey dwelling. Also included within the category are the existing roundabout, paths and yards surrounding these buildings. The warehouse buildings have concrete lower sections, with upper sections and roofs of Kingspan cladding. The residential houses are stone/concrete with tiled roofs and are currently in use. All structures are relatively modern and none have openings accessible to or suitable for bats. The only openings present are ventilator shafts on the large warehouse, but these are modern and well-maintained. This habitat does not have links to Annex I habitat
Riparian Woodland WN5	The section of the drainage ditch which runs parallel to the northern boundary has narrow strips of riparian woodland where periodic flooding occurs. Willows *Salix* spp are dominant with Alder *Alnus glutinosa and Gorse* also present. Wetland species such as Common Reed *Phragmites australis* and Reed Canary Grass *Phalaris arundinacea* are present but do not dominate. Other species noted include Nettle, Hemlock Water-Dropwort and Creeping Buttercup. WN5 has Links with *Annex I. Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0).* This is a small isolated area of habitat which is not of significant ecological value.

Figure 6. Habitat map

Pic 1: Field of arable crops BC1 surrounding the main buildings. Looking west.

Pic 2. Area of Hedgerow WL1 with Treeline WL2 beyond. Souther edge of site.

Pic 3. Mixed Broadleaved Woodland WD1 at the south of the site.

Pic 4. Stagnant area of the central Drainage Ditch FW4.

Pic 5. River FW2 at accessible point, looking across at western bank.

Pic 6. Main large central warehouse structure BL3. Eastern edge of structure.

Pic 7. Smaller warehouse structure, southern edge.

Pic 8. Residential house at northeast of site, southern edge.

7.2 Birds

Bird species listed in Annex I of the Birds Directive are considered a conservation priority. Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland (BOCCI). These are bird species suffering declines in population size. BirdWatch Ireland and the Royal Society for the Protection of Birds have identified and classified these species by the rate of decline into Red and Amber lists. Red List bird species are of high conservation concern and the Amber List species are of medium conservation concern. Green listed species are regularly occurring bird species whose conservation status is currently considered favourable (Gilbert *et al*. 2021).

Bird surveys were carried out in conjunction with habitat surveys on the 3rd December 2020, 19th May 2021, 9th September 2021 and 8th March 2022. During the survey, all birds seen or heard within the development site were recorded. Bird species listed in Annex I of the Birds Directive are considered a conservation priority. Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland (BOCCI). These are bird species suffering declines in population size. BirdWatch Ireland and the Royal Society for the Protection of Birds have identified and classified these species by the rate of decline into Red and Amber lists. Red List bird species are of high conservation concern and the Amber List species are of medium conservation. Green listed species are regularly occurring bird species whose conservation status is currently considered favourable. Birds species listed in Annex I of the Birds Directive (2009/147/EC) are considered a conservation priority. Species recorded within the site are shown in **Table 9**.

Table 9. Bird species recorded within proposed development site

Species		Birds Directive Annex	BOCCI	
		I	Red List	Amber List
Blackbird	*Tardus Turdus merula*			
Blue Tit	*Cyanistes caeruleus*			
Bullfinch	*Pyrrhula pyrrhula*			
Buzzard	*Buteo buteo*			
Chaffinch	*Fringilla coelebs*			
Chiffchaff	*Phylloscopus collybita*			
Collared Dove	*Streptopelia decaocta*			
European Swallow	*Hirundo rustica*			x
Great Tit	*Parus major*			

Species		Birds Directive Annex	BOCCI	
		I	Red List	Amber List
Hooded Crow	*Corvus cornix*			
House Sparrow	*Passer domesticus*			
Jackdaw	*Corvus monedula*			
Mistle Thrush	*Turdus piscivorus*			
Pheasant	*Phasianus colchicus*			
Robin	*Erithacus rubecula.*			
Rook	*Corvus frugiligus*			
Song Thrush	*Turdus philomelos*			
Willow Warbler	*Phylloscopus trochilus*			x
Wood Pigeon	*Columba palumbus*			
Yellowhammer	*Emberiza citrinella*		x	

Overall, the proposed development site is of local value for terrestrial bird species that are relatively common in the Irish countryside. Good quality treelines, woodland and hedgerows at the site provide a range of nesting habitat for common bird species.

No Annex I species were recorded at the site. The River Liffey which runs through the southwestern corner of the site could potentially provide foraging habitat for Kingfisher *Alcedo atthis*. However, no signs of Kingfisher were recorded during site surveys and due to the low sloping river banks at the site there is no suitable nesting habitat within the site or in proximity to the site boundary. No signs of wintering waders or waterfowl were recorded during site surveys. However, Whooper Swans are known to forage on agricultural grassland and cereal stubble in autumn and winter (Robinson et al, 2004). While Whooper Swan could potentially forage at the site during the winter months, given the large areas of arable farming in the region the area within the proposed development site does not provide critical habitat for this species.

One Red List species Yellowhammer *Emberiza citronella* (one singing male) was recorded within the treeline/hedgerow on the southern end of the site. Historically, this species was widespread throughout the country but has suffered declines due to the decrease in cereal crop cultivation in Ireland. Due to this decline, the majority of the Yellowhammer population is confined to the east and south of Ireland. An adult Yellowhammer will mainly feed on the grains produced by grasses and cereals with the young being fed various insect species. In Ireland, the Yellowhammer is strongly associated with cereal cultivation and by extension, is most commonly found in farmland, in close proximity to such crops.

Two Amber List species Swallow *Hirundo rustica* and Willow Warbler *Phylloscopus trochilus* were recorded. Swallow were recorded foraging at the site but no nest sites were recorded. Nesting Willow Warbler were recorded within the woodland habitat on the southern end of the site.

The Red List species Yellowhammer and Amber List species Willow Warbler were recorded within the site boundary but overall the site supports a mixture of terrestrial bird species that are relatively common in the Irish countryside. No Annex I species, were recorded within the proposed development site. Although species more speicalised species such as Grey Heron and Dipper may utilise riverine habitats, no signs of Kingfisher were noted.

7.3 Invasive Species

Non-native plants are defined as those plants which have been introduced outside of their native range by humans and their activities, either purposefully or accidentally. Invasive non-native species are so-called as they typically display one or more of the following characteristics or features: (1) prolific reproduction through seed dispersal and/or re-growth from plant fragments; (2) rapid growth patterns; and, (3) resistance to standard weed control methods.

Where a non-native species displays invasive qualities and is not managed it can potentially: (1) out compete native vegetation, affecting plant community structure and habitat for wildlife; (2) cause damage to infrastructure including road carriageways, footpaths, walls and foundations; and, (3) have an adverse effect on landscape quality. The NBDC lists a number of both aquatic and terrestrial high impact invasive plant species which have been recorded within hectad N81 (**Table 10**). It should be noted that this data relates to the entire 10km^2 area and these species will not necessarily occur within the proposed development site boundary.

Table 10. NBDC records of high impact invasive species from N81

Species Group	Species name
Flatworm (Turbellaria)	Arthurdendyus triangulatus
Flowering plant	Cherry Laurel (*Prunus laurocerasus*)
Flowering plant	Indian Balsam (*Impatiens glandulifera*)
Flowering plant	Japanese Knotweed (*Fallopia japonica*)
Insect - beetle (Coleoptera)	Harlequin Ladybird (*Harmonia axyridis*)
Terrestrial mammal	American Mink (*Mustela vison*)
Terrestrial mammal	Brown Rat (*Rattus norvegicus*)
Terrestrial mammal	Eastern Grey Squirrel (*Sciurus carolinensis*)
Terrestrial mammal	Fallow Deer (*Dama dama*)
Terrestrial mammal	House Mouse (*Mus musculus*)
Terrestrial mammal	Sika Deer (*Cervus nippon*)

Source: NBDC 11/02/22

The control of invasive species in Ireland comes under the Wildlife (Amendment) Act 2000, where it states that

'*Any person who— [...] plants or otherwise causes to grow in a wild state in any place in the State any species of flora, or the flowers, roots, seeds or spores of flora, ['refers only to exotic species thereof']][...] otherwise than under and in accordance with a licence granted in that behalf by the Minister shall be guilty of an offence.'*

The Birds and Natural Habitats Regulations 2011 (SI 477 of 2011), Section 49(2) prohibits the introduction and dispersal of species listed in the Third Schedule, which includes Japanese Knotweed (*Fallopia japonica*), as follows: "any person who plants, disperses, allows or causes to disperse, spreads or otherwise causes to grow [….] shall be guilty of an offence."

The third schedule invasive species Himalayan Balsam *Impatiens glandulifera* was recorded along the banks of the River Liffey the proposed development site (**Figure 7**). Himalayan Balsam is a member of the busy Lizzie family (Balsaminacea) and as its name suggests, is native to the Himalaya region of Asia. It was introduced as a garden plant in the mid-1800's (Royal Horticultural Society 2008a) and quite swiftly became established along waterways and in other damp places by means of its prolific seed production. It is an annual plant forming dense upright stands approximately 1m tall where it effectively out- competes surrounding herbs and grasses. It is tolerant of shade and does very well in the canopy of riparian woodland. In the autumn it dies back leaving the ground bare and vulnerable to erosion.

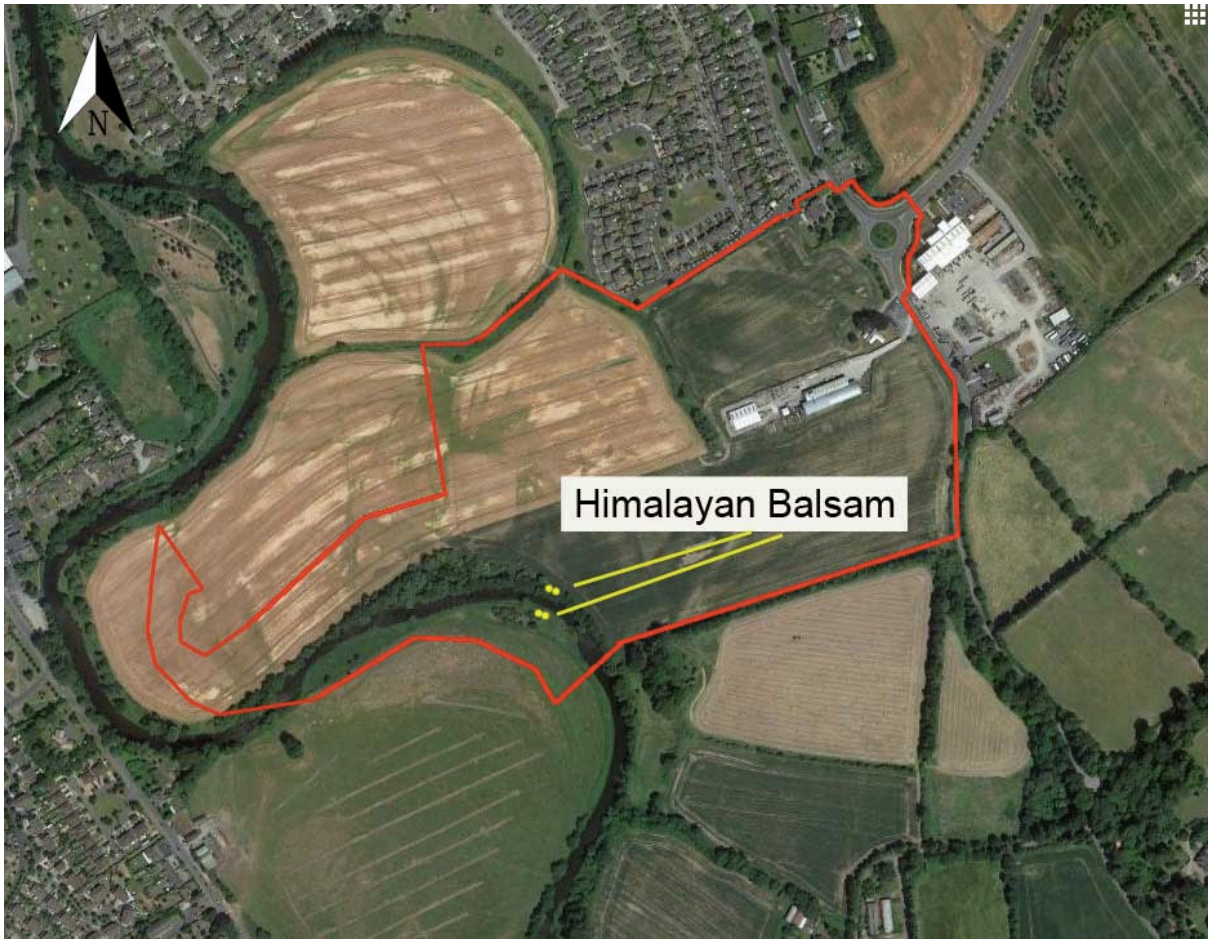


Figure 7. Himalayn Balsam location within proposed development site

8. Potential Impacts

All potential impacts would relate to direct and indirect impacts to relevant habitats and fauna of the South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA, South Dublin Bay & River Tolka Estuary SPA and Poulaphuca Reservoir SPA. Impacts are based on the EC (2018), professional judgement and criteria or standards where available.

The potential impacts associated with the proposed development are discussed in the following section with respect to their likelihood to have significant impacts on Natura 2000 sites. As part of the assessment direct, indirect and in-combination impacts were considered. Direct impacts refer to habitat loss or fragmentation arising from land-take requirements for development. Indirect and secondary impacts do not have a straight-line route between cause and effect, and it is potentially more challenging to ensure that all the possible indirect impacts of the project/plan - in combination with other plans and projects have been established.

As part of the assessment the potential for impacts associated with the development were reviewed as outlined below:

- Potential impacts of loss of habitat
- Potential impacts from noise and disturbance
- Potential impacts of surface water run-off

- Potential impacts of wastewater discharges
- Potential impacts of spread of invasive species
- In-combination Impacts

8.1 Potential impacts from loss of habitat

The proposed development site is not located within a designated site. The habitats recorded within the proposed development site do not correspond to habitats listed on Annex I of the Habitats Directive or to qualifying habitats for the South Dublin Bay SAC and North Dublin Bay SAC.

The arable lands within the proposed development site may provide occasional foraging grounds for SCI species of North Bull Island SPA, South Dublin Bay & River Tolka Estuary SPA and Poulaphuca Reservoir SPA. However, these are common habitats in the vicinity and given the transient use and/or lack of site fidelity any birds which use this site will readily forage at alternative sites nearby. Therefore, the proposed development will not result in any significant deterioration in habitat quality or loss of *ex situ* habitat for SCI species of North Bull Island SPA, South Dublin Bay & River Tolka Estuary SPA and Poulaphuca Reservoir SPA.

The proposed development will not result in any loss of habitat within Natura 2000 sites. The habitats onsite are considered of low value at a local level and are common in the surrounding landscape. No potential for habitat fragmentation has been identified. Thus, no effects on the qualifying interests and conservation of objectives of Natura 2000 site due to habitat loss will occur.

8.2 Potential impacts from noise and disturbance

Potentially increased noise and disturbance associated with the site works could cause disturbance/displacement of fauna. If of sufficient severity, there could be impacts on reproductive success.

The potential effects and impacts of disturbance have been widely recognised in wildlife conservation legislation, as has the need to develop conservation measures for birds whilst taking human activities into account. Article 4.4 of the Bird's Directive (79/409/EEC) requires member states to "*take appropriate steps to avoid… any disturbances affecting the birds, in so far as these would be significant having regard to the objectives of this Article*". This specifically relates to conservation measures concerning Annex I species.

The wintering birds listed as qualifying interests for the North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA are strongly associated with estuarine shoreline areas or wetlands. However, as resources within the SPAs becomes depleted later in the winter, a some of bird species, most notably Light-bellied Brent Goose (*Branta bernicla hrota*) but also terrestrial foraging waders such as Curlew (*Numenius arquata*), switch from inter-tidal foraging to inland feeding on amenity grassland. However, given the distance of the proposed development site from the North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA (>40km) the agricultural lands within or in the vicinity of the proposed development site will not provide a critical resource for SCI species and no impact in predicted to occur.

Greylag Goose and Lesser Black-backed Gull, SCI species for the Poulaphuca Reservoir SPA, could also forage or arable lands on or in the vicinity of the site. The Greylag Goose wintering at Poulaphouca Reservoir mainly use fields at Threecastles to the northeast of Blessington Bridge and roost on the adjacent section of the reservoir, while they may also use fields at Mountseskin in Co. Dublin around 8 km to the north-east, and formerly roosted near Ballymore Eustace, around 5 km to the south-west (Boland and Crowe, 2008). The Greylag Goose wintering at the North Wicklow Coastal Marshes mainly use fields between Newcastle and Killoughter, and also use other areas along the coastal strip, including fields near Leabeg (around 4km to the north) and Broad Lough (around 5km to the south), while they also occasionally roost at Vartry Reservoir around 10km to the west (Boland and Crowe, 2008). Greylag Goose are known to occur within N81, the 10km grid square which overlaps with the proposed development site and may travel between foraging grounds at Poulaphuca Reservoir and the Lower River Suir to the southwest of the proposed development site. However, while Greylag Goose may feed on stubble fields within the proposed development site, given the widespread nature of arable and grassland farming in this area and the distance from known roosting and foraging grounds, the proposed development site does not provide critical foraging habitat for this species.

Lesser Black-backed Gull are transient visitors to arable lands following harvesting. They are generalist, omnivorous species which will readily forage in a range of habitats and the proposed development site does not provide critical foraging habitat for this species.

Given the common nature of habitats onsite and the distance from known foraging grounds for SCI species no effect on bird populations listed as qualifying interests for relevant SPAs is predicted to occur. No impact on any Natura 2000 sites is predicted to occur due to noise and disturbance.

8.3 Potential Impacts of Surface Water Run-off

Potential impacts on aquatic habitats which can arise from this type of development during construction and operation include increased silt levels in surface water run-off and inadvertent spillages of hydrocarbons from fuel and hydraulic fluid.

High levels of silt in surface water run-off from the storage areas, can impact in particular on fish species, in particular salmonids. If of sufficient severity, adult fish could theoretically be affected by increased silt levels as gills may become damaged by exposure to elevated suspended solids levels. If of sufficient severity, aquatic invertebrates may be smothered by excessive deposits of silt from suspended solids. In areas of stony substrate, silt deposits may result in a change in the macro-invertebrate species composition, favouring less diverse assemblages and impacting on sensitive species. Aquatic plant communities may also be affected by increased siltation. Submerged plants may be stunted and photosynthesis may be reduced. Impacts on plant and invertebrate communities also has the potential to impact of prey availability for SCI birds.

Elevated silt levels could theoretically, if of sufficient magnitude, result in changes in the ecology of receiving waters. Given the location of the works, the distance of the proposed development from the estuarine environment (>59km downstream), the robust nature of qualifying habitats (e.g. Mudflats and sandflats not covered by seawater at low tide [1140], Salicornia and other annuals colonising mud and sand [1310], Atlantic salt meadows (*Glauco-*

Puccinellietalia maritimae) [1330], Mediterranean salt meadows) and the dilution provided in the estuarine/marine environment, impacts on water quality within European sites due to elevated silt levels during construction are highly unlikely to occur.

Inadvertent spillages of hydrocarbons, silt or other chemicals during construction and operation could introduce toxic chemicals into the aquatic environment via surface water run-off and have a direct toxicological impact on habitats and fauna. However, the distance from estuarine/marine environment, the robust nature of qualifying habitats and the dilution provided in the estuarine/marine environment impacts of Natura 2000 sites downstream are highly unlikely.

However, given the proximity of the River Liffey to the proposed development site and the hydrological connection to the South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA, using an abundance of caution and applying the precautionary principle, potential impacts from surface water discharges and possible contamination by hydrocarbons and other chemicals during construction and operation have been screened in for further investigation.

8.4 Potential impacts of wastewater discharges

Once constructed surface and wastewater from the proposed development will be conveyed for treatment to the Upper Liffey Valley Sewerage Scheme WWTP (D0002), which is located approximately 12km downstream of the proposed development site.

Given the hydrological connection to the South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA, using an abundance of caution and applying the precautionary principle, potential impacts from wastewater discharges during operation have been screened in for further investigation.

8.5 Spread of Invasive Species

The third schedule species Himalayan Balsam was recorded within the proposed development site. During construction, best practice measures will be followed to remove this species and prevent its spread within the proposed development site. However, even in the absence of removal and considering the distance upstream, the invasive species recorded within the proposed development site cannot colonise the estuarine/marine habitats for which the South Dublin Bay and North Dublin Bay SACs are designated. Therefore, no potential impacts from invasive species on Natura 2000 sites will occur.

8.6 In-combination Impacts

In-combination impacts refer to a series of individually impacts that may, in combination, produce a significant impact. The underlying intention of this in combination provision is to take account of in-combination impacts from existing or proposed plans and projects and these will often only occur over time.

High negative threats, pressures and activities identified for the South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA include roads and motorways, bridges, shipping, urbanised areas, industrial or commercial development, walking, horse-riding, golf courses, land reclamation and accumulation of organic material.

Potential in-combination impacts on the sites may arise owing to an alteration to water quality or quantity. Deterioration in water quality can occur as an indirect consequence of point source or diffuse pollution, which in turn changes the aquatic environment and reduces its capacity to support certain plants and animals. This leads to potential negative consequences for the qualifying interests that rely on the maintenance of water quality within the Natura 2000 site.

The area surrounding the proposed development is also heavily populated with a mixture of residential properties, commercial units and roads. Wastewater is also discharged from local settlements and industry. This in combination with the proposed development could potentially lead to in-combination impacts within the South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA. Applying an abundance of caution further investigation is also required to determine if increased surface water and wastewater discharges will have an in-combination impact on the South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA.

9. Screening conclusion and statement

This AA screening report has been prepared to assess whether the proposed development, individually or in-combination with other plans or projects, and in view of best scientific knowledge, is likely to have a significant effect on any European site(s).

The screening exercise was completed in compliance with the relevant European Commission guidance, national guidance, and case law. The potential impacts of the proposed development have been considered in the context of the European sites potentially affected, their qualifying interests or special conservation interests, and their conservation objectives.

Through an assessment of the source-pathway-receptor model, which considered the ZoI of effects from the proposed development and the potential in-combination effects with other plans or projects, the following findings were reported:

Although the likelihood of effects on the South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA is low, using an abundance of caution potential impact pathways have been identified and a NIS is being prepared for the proposed development.

References

Boland, H. & Crowe, O. (2008). An Assessment of the Distribution and Range of Greylag (Icelandic-Breeding and Feral Populations) in Ireland. Report to the National Parks and Wildlife Service and the Northern Ireland Environment Agency. BirdWatch Ireland, Newtown Mountkennedy.

Environmental Protection Agency Ireland (http://www.epa.ie/): Accessed 07/09/21

Fossitt, J. A. (2000). A Guide to Habitats in Ireland. The Heritage Council of Ireland Series

Geohive mapping http://map.geohive.ie ; Accessed 07/09/21

Invasive Species Ireland (http://invasivespeciesireland.com/): Accessed 07/09/21

Leslie, A.D. (2005) The ecology and biodiversity value of Sycamore (Acer pseudoplatanus) with particular reference to Great Britain. Scottish Forestry. Vol 59 No 3. p19 -26.

Morecroft, M. D., Stokes, V. J., Taylor, M. E., & Morison, J. I. (2008). Effects of climate and management history on the distribution and growth of sycamore (Acer pseudoplatanus L.) in a southern British woodland in comparison to native competitors. Forestry, 81(1), 59-74.

National Biodiversity Data Centre (http://www.biodiversityireland.ie/): Accessed 07/09/21

National Parks and Wildlife Service website (www.npws.ie) : Accessed 07/09/21

NPWS (2013a) Conservation Objectives: North Dublin Bay SAC 000206. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013b) Conservation Objectives: South Dublin Bay SAC 000210. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2015a) Conservation Objectives: North Bull Island SPA 004006. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2015b) Conservation Objectives: South Dublin Bay and River Tolka Estuary SPA 004024. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Waters, T. L., & Savill, P. S. (1992). Ash and sycamore regeneration and the phenomenon of their alternation. Forestry, 65(4), 417-433.

Appendices

Appendix 1. Natura 2000 Site Synopses

Site Name: North Dublin Bay SAC

Site Code: 000206

This site covers the inner part of north Dublin Bay, the seaward boundary extending from the Bull Wall lighthouse across to the Martello Tower at Howth Head. The North Bull Island is the focal point of this site.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

- [1140] Tidal Mudflats and Sandflats
- [1210] Annual Vegetation of Drift Lines
- [1310] Salicornia Mud
- [1330] Atlantic Salt Meadows
- [1410] Mediterranean Salt Meadows
- [2110] Embryonic Shifting Dunes
- [2120] Marram Dunes (White Dunes)
- [2130] Fixed Dunes (Grey Dunes)*
- [2190] Humid Dune Slacks
- [1395] Petalwort (Petalophyllum ralfsii)

North Bull Island is a sandy spit which formed after the building of the South Wall and Bull Wall in the 18th and 19th centuries. It now extends for about 5 km in length and is up to 1 km wide in places. A well-developed and dynamic dune system stretches along the seaward side of the island. Various types of dunes occur, from fixed dune grassland to pioneer communities on foredunes. Marram Grass (Ammophila arenaria) is dominant on the outer dune ridges, with Lyme-grass (Leymus arenarius) and Sand Couch (Elymus farctus) on the foredunes. Behind the first dune ridge, plant diversity increases with the appearance of such species as Wild Pansy (Viola tricolor), Kidney Vetch (Anthyllis vulneraria), Common Bird's-foot-trefoil (Lotus corniculatus), Common Restharrow (Ononis repens), Yellow-rattle (Rhinanthus minor) and Pyramidal Orchid (Anacamptis pyramidalis). In these grassy areas and slacks, the scarce Bee Orchid (Ophrys apifera) occurs.

About 1 km from the tip of the island, a large dune slack with a rich flora occurs, usually referred to as the 'Alder Marsh' because of the presence of Alder trees (Alnus glutinosa). The water table is very near the surface and is only slightly brackish. Saltmarsh Rush (Juncus maritimus) is the dominant species, with Meadowsweet (Filipendula ulmaria) and Devil's-bit Scabious (Succisa pratensis) being frequent. The orchid flora is notable and includes Marsh Helleborine (Epipactis palustris), Common Twayblade (Listera ovata), Autumn Lady's-tresses (Spiranthes spiralis) and Marsh Orchids (Dactylorhiza spp.).

Saltmarsh extends along the length of the landward side of the island. The edge of the marsh is marked by an eroding edge which varies from 20 cm to 60 cm high. The marsh can be zoned into different levels according to the vegetation types present. On the lower marsh, Glasswort (Salicornia europaea), Common Saltmarsh-grass (Puccinellia maritima), Annual Sea-blite (Suaeda maritima) and Greater Sea-spurrey (Spergularia media) are the main species. Higher up in the middle marsh Sea Plantain (Plantago maritima), Sea Aster (Aster tripolium), Sea Arrowgrass (Triglochin maritima) and Thrift (Armeria maritima) appear. Above the mark of the normal high tide, species such as Common Scurvygrass (Cochlearia officinalis) and Sea Milkwort (Glaux maritima) are found, while on the extreme upper marsh, the rushes Juncus maritimus and J. gerardi are dominant. Towards the tip of the island, the saltmarsh grades naturally into fixed dune vegetation.

The habitat ‘annual vegetation of drift lines’ is found in places, along the length of Dollymount Strand, with species such as Sea Rocket (Cakile maritima), Oraches (Atriplex spp.) and Prickly Saltwort (Salsola kali).

The island shelters two intertidal lagoons which are divided by a solid causeway. The sediments of the lagoons are mainly sands with a small and varying mixture of silt and clay. The north lagoon has an area known as the "Salicornia flat", which is dominated by Salicornia dolichostachya, a pioneer glasswort species, and covers about 25 ha. Beaked Tasselweed (Ruppia maritima) occurs in this area, along with some Narrow-leaved Eelgrass (Zostera angustifolia). Dwarf Eelgrass (Z. noltii) also occurs in Sutton Creek. Common Cordgrass (Spartina anglica) occurs in places but its growth is controlled by management. Green algal mats (Enteromorpha spp., Ulva lactuca) cover large areas of the flats during summer. These sediments have a rich macrofauna, with high densities of Lugworms (Arenicola marina) in parts of the north lagoon. Mussels (Mytilus edulis) occur in places, along with bivalves such as Cerastoderma edule, Macoma balthica and Scrobicularia plana. The small gastropod Hydrobia ulvae occurs in high densities in places, while the crustaceans Corophium volutator and Carcinus maenas are common. The sediments on the seaward side of North Bull Island are mostly sands. The site extends below the low spring tide mark to include an area of the sublittoral zone.

Three rare plant species which are legally protected under the Flora (Protection) Order, 1999 have been recorded on the North Bull Island. These are Lesser Centaury (Centaurium pulchellum), Red Hemp-nettle (Galeopsis angustifolia) and Meadow Saxifrage (Saxifraga granulata). Two further species listed as threatened in the Red Data Book, Wild Clary/Sage (Salvia verbenaca) and Spring Vetch (Vicia lathyroides), have also been recorded. A rare liverwort, Petalophyllum ralfsii, was first recorded from the North Bull Island in 1874 and has recently been confirmed as still present. This species is of high conservation value as it is listed on Annex II of the E.U. Habitats Directive. The North Bull is the only known extant site for the species in Ireland away from the western seaboard.

North Dublin Bay is of international importance for waterfowl. During the 1994/95 to 1996/97 period the following species occurred in internationally important numbers (figures are average maxima): Brent Goose 2,333; Knot 4,423; Bar-tailed Godwit 1,586. A further 14 species occurred in nationally important concentrations - Shelduck 1505; Wigeon 1,166; Teal 1,512; Pintail 334; Shoveler 239; Oystercatcher 2,190; Ringed Plover 346; Grey Plover 816; Sanderling 357; Dunlin 6,238; Black-tailed Godwit 156; Curlew 1,193; Turnstone 197 and Redshank 1,175. Some of these species frequent South Dublin Bay and the River Tolka Estuary for feeding and/or roosting purposes (mostly Brent Goose, Oystercatcher, Ringed Plover, Sanderling and Dunlin).

The tip of the North Bull Island is a traditional nesting site for Little Tern. A high total of 88 pairs nested in 1987. However, nesting attempts have not been successful since the early 1990s. Ringed Plover, Shelduck, Mallard, Skylark, Meadow Pipit and Stonechat also nest. A well-known population of Irish Hare is resident on the island.

The invertebrates of the North Bull Island have been studied and the island has been shown to contain at least seven species of regional or national importance in Ireland (from the Orders Diptera, Hymenoptera and Hemiptera).

The main land uses of this site are amenity activities and nature conservation. The North Bull Island is the main recreational beach in Co. Dublin and is used throughout the year. Much of the land surface of the island is taken up by two golf courses. Two separate Statutory Nature Reserves cover much of the island east of the Bull Wall and the surrrounding intertidal flats. The site is used regularly for educational purposes. North Bull Island has been designated a Special Protection Area under the E.U. Birds Directive and it is also a statutory Wildfowl Sanctuary, a Ramsar Convention site, a Biogenetic Reserve, a Biosphere Reserve and a Special Area Amenity Order site.

This site is an excellent example of a coastal site with all the main habitats represented. The site holds good examples of nine habitats that are listed on Annex I of the E.U. Habitats Directive; one of these is listed with priority status. Several of the wintering bird species have populations of international importance, while some of the invertebrates are of national importance. The site contains a numbers of rare and scarce plants including some which are legally protected. Its proximity to the capital city makes North Dublin Bay an excellent site for educational studies and research.

Site Name: South Dublin Bay SAC

Site Code: 000210

This site lies south of the River Liffey in Co. Dublin, and extends from the South Wall to the west pier at Dun Laoghaire. It is an intertidal site with extensive areas of sand and mudflats. The sediments are predominantly sands but grade to sandy muds near the shore at Merrion Gates. The main channel which drains the area is Cockle Lake.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

- [1140] Tidal Mudflats and Sandflats
- [1210] Annual vegetation of drift lines
- [1310] Salicornia and other annuals colonising mud and sand
- [2110] Embryonic shifting dunes

The bed of Dward Eelgrass (Zostera noltii) found below Merrion Gates is the largest stand on the east coast. Green algae (Enteromorpha spp. and Ulva lactuca) are distributed throughout the area at a low density. Fucoid algae occur on the rocky shore in the Maretimo to Dún Laoghaire area. Species include Fucus spiralis, F. vesiculosus, F. serratus, Ascophyllum nodosum and Pelvetia canaliculata.

Several small, sandy beaches with incipient dune formation occur in the northern and western sectors of the site, notably at Poolbeg, Irishtown and Merrion/ Booterstown. The formation at Booterstown is very recent. Drift line vegetation occurs in association with the embryonic and incipient fore dunes. Typically drift lines occur in a band approximately 5 m wide, though at Booterstown this zone is wider in places. The habitat occurs just above the High Water Mark and below the area of embryonic dune. Species present are Sea Rocket (Cakile maritima), Frosted Orache (Atriplex laciniata), Spear-leaved Orache (A. prostrata), Prickly Saltwort (Salsola kali) and Fat Hen (Chenopodium album). Also occurring is Sea Sandwort (Honkenya peploides), Sea Beet (Beta vulgaris subsp. maritima) and Annual Sea-blite (Suaeda maritima). A small area of pioneer saltmarsh now occurs in the lee of an embryonic sand dune just north of Booterstown Station. This early stage of saltmarsh development is here characterised by the presence of pioneer stands of glassworts (Salicornia spp.) occurring below an area of drift line vegetation. As this is of very recent origin, it covers a small area but ample areas of substrate and shelter are available for the further development of this habitat.

Lugworm (Arenicola marina), Cockles (Cerastoderma edule) and annelids and other bivalves are frequent throughout the site. The small gastropod Hydrobia ulvae occurs on the muddy sands off Merrion Gates.

South Dublin Bay is an important site for waterfowl. Although birds regularly commute between the south bay and the north bay, recent studies have shown that certain populations which occur in the south bay spend most of their time there. The principal species are Oystercatcher (1215), Ringed Plover (120), Sanderling (344), Dunlin (2628) and Redshank (356) (average winter peaks 1996/97 and 1997/98). Up to 100 Turnstones are usual in the south bay during winter. Brent Goose regularly occur in numbers of international importance (average peak 299). Bar-tailed Godwit (565), a species listed on Annex I of the E.U. Birds Directive, also occur.

Large numbers of gulls roost in South Dublin Bay, e.g. 4,500 Black-headed Gulls in February 1990; 500 Common Gulls in February 1991. It is also an important tern roost in the autumn, regularly holding 2000-3000 terns including Roseate Terns, a species listed on Annex I of the E.U. Birds Directive. South Dublin Bay is largely protected as a Special Protection Area.

At low tide the inner parts of the south bay are used for amenity purposes. Baitdigging is a regular activity on the sandy flats. At high tide some areas have windsurfing and jet-skiing.

This site is a fine example of a coastal system, with extensive sand and mudflats, and incipient dune formations. South Dublin Bay is also an internationally important bird site.

Site Name: South Dublin Bay and River Tolka Estuary SPA

Site Code: 004024

The South Dublin Bay and River Tolka Estuary SPA comprises a substantial part of Dublin Bay. It includes the intertidal area between the River Liffey and Dun Laoghaire, and the estuary of the River Tolka to the north of the River Liffey, as well as Booterstown Marsh. A portion of the shallow marine waters of the bay is also included.

In the south bay, the intertidal flats extend for almost 3 km at their widest. The sediments are predominantly well-aerated sands. Several permanent channels exist, the largest being Cockle Lake. A small sandy beach occurs at Merrion Gates, while some bedrock shore occurs near Dun Laoghaire. The landward boundary is now almost entirely artificially embanked. There is a bed of Dwarf Eelgrass (Zostera noltii) below Merrion Gates which is the largest stand on the east coast. Green algae (Ulva spp.) are distributed throughout the area at a low density. The macroinvertebrate fauna is well-developed, and is characterised by annelids such as Lugworm (Arenicola marina), Nephthys spp. and Sand Mason (Lanice conchilega), and bivalves, especially Cockle (Cerastoderma edule) and Baltic Tellin (Macoma balthica). The small gastropod Spire Shell (Hydrobia ulvae) occurs on the muddy sands off Merrion Gates, along with the crustacean Corophium volutator. Sediments in the Tolka Estuary vary from soft thixotrophic muds with a high organic content in the inner estuary to exposed, well-aerated sands off the Bull Wall. The site includes Booterstown Marsh, an enclosed area of saltmarsh and muds that is cut off from the sea by the Dublin/Wexford railway line, being linked only by a channel to the east, the Nutley stream. Sea water incursions into the marsh occur along this stream at high tide. An area of grassland at Poolbeg, north of Irishtown Nature Park, is also included in the site.

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Light-bellied Brent Goose, Oystercatcher, Ringed Plover, Grey Plover, Knot, Sanderling, Dunlin, Bar-tailed Godwit, Redshank, Black-headed Gull, Roseate Tern, Common Tern and Arctic Tern. The E.U. Birds Directive pays particular attention to wetlands, and as these form part of the SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

The site is an important site for wintering waterfowl, being an integral part of the internationally important Dublin Bay complex – all counts for wintering waterbirds are five year mean peaks for the period 1995/96 to 1999/2000. Although birds regularly commute between the south bay and the north bay, recent studies have shown that certain populations which occur in the south bay spend most of their time there. An internationally important population of Light-bellied Brent Goose (368) occurs regularly and newly arrived birds in the autumn feed on the Eelgrass bed at Merrion. At the time of designation the site supported nationally important numbers of a further nine species: Oystercatcher (1,145), Ringed Plover (161), Grey Plover (45), Knot (548), Sanderling (321), Dunlin (1,923), Bar-tailed Godwit (766), Redshank (260) and Black-headed Gull (3,040). Other species occurring in smaller numbers include Great Crested Grebe (21), Curlew (127) and Turnstone (52). Little Egret, a species which has recently colonised Ireland, also occurs at this site.

South Dublin Bay is a significant site for wintering gulls, with a nationally important population of Black-headed Gull, but also Common Gull (330) and Herring Gull (348). Mediterranean Gull is also recorded from here, occurring through much of the year, but especially in late winter/spring and again in late summer into winter.

Both Common Tern and Arctic Tern breed in Dublin Docks, on a man-made mooring structure known as the E.S.B. dolphin – this is included within the site. Small numbers of Common Tern and Arctic Tern were recorded nesting on this dolphin in the 1980s. A survey in 1995 recorded nationally important numbers of Common Tern nesting here (52 pairs). The breeding population of Common Tern at this site has increased, with 216 pairs recorded in 2000. This increase was largely due to the ongoing management of the site for breeding terns. More recent data highlights this site as one of the most important Common Tern sites in the country with over 400 pairs recorded here in 2007.

South Dublin Bay is an important staging/passage site for a number of tern species in the autumn (mostly late July to September). The origin of many of the birds is likely to be the Dublin breeding sites (Rockabill and the Dublin

Docks) though numbers suggest that the site is also used by birds from other sites, perhaps outside the state. This site is selected for designation for its autumn tern populations: Roseate Tern (2,000 in 1999), Common Tern (5,000 in 1999) and Arctic Tern (20,000 in 1996).

The South Dublin Bay and River Tolka Estuary SPA is of ornithological importance as it supports an internationally important population of Light-bellied Brent Goose and nationally important populations of a further nine wintering species. Furthermore, the site supports a nationally important colony of breeding Common Tern and is an internationally important passage/staging site for three tern species. It is of note that four of the species that regularly occur at this site are listed on Annex I of the E.U. Birds Directive, i.e. Bar-tailed Godwit, Common Tern, Arctic Tern and Roseate Tern. Sandymount Strand/Tolka Estuary is also a Ramsar Convention site.

Site Name: North Bull Island SPA

Site Code: 004006

This site covers all of the inner part of north Dublin Bay, with the seaward boundary extending from the Bull Wall lighthouse across to Drumleck Point at Howth Head. The North Bull Island sand spit is a relatively recent depositional feature, formed as a result of improvements to Dublin Port during the 18th and 19th centuries. It is almost 5 km long and 1 km wide and runs parallel to the coast between Clontarf and Sutton. Part of the interior of the island has been converted to golf courses.

Saltmarsh extends along the length of the landward side of the island and provides the main roost site for wintering birds in Dublin Bay. The island shelters two intertidal lagoons which are divided by a solid causeway. These lagoons provide the main feeding grounds for the wintering waterfowl. The sediments of the lagoons are mainly sands with a small and varying mixture of silt and clay. Green algal mats (Ulva spp.) are a feature of the flats during summer. These sediments have a rich macro-invertebrate fauna, with high densities of Lugworm (Arenicola marina) and Ragworm (Hediste diversicolor).

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Light-bellied Brent Goose, Shelduck, Teal, Pintail, Shoveler, Oystercatcher, Golden Plover, Grey Plover, Knot, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Turnstone and Black-headed Gull. The site is also of special conservation interest for holding an assemblage of over 20,000 wintering waterbirds. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

The North Bull Island SPA is of international importance for waterfowl on the basis that it regularly supports in excess of 20,000 waterfowl. The site supports internationally important populations of three species, Light-bellied Brent Goose (1,548), Black-tailed Godwit (367) and Bar-tailed Godwit (1,529) - all figures are mean peaks for the five winters between 1995/96 and 1999/2000. The site is one of the most important in the country for Light-bellied Brent Goose. A further 14 species have populations of national importance – Shelduck (1,259), Teal (953), Pintail (233), Shoveler (141), Oystercatcher (1,784), Grey Plover (517), Golden Plover (2,033), Knot (2,837), Sanderling (141), Dunlin (4,146), Curlew (937), Redshank (1,431), Turnstone (157) and Black-headed Gull (2,196). The populations of Pintail and Knot are of particular note as they comprise 14% and 10% respectively of the all-Ireland population totals. Other species that occur regularly in winter include Grey Heron, Little Egret, Cormorant, Wigeon, Goldeneye, Red-breasted Merganser, Ringed Plover and Greenshank. Gulls are a feature of the site during winter and, along with the nationally important population of Black-headed Gull (2,196), other species that occur include Common Gull (332) and Herring Gull (331). While some of the birds also frequent South Dublin Bay and the River Tolka Estuary for feeding and/or roosting purposes, the majority remain within the site for much of the winter. The wintering bird populations have been monitored more or less continuously since the late 1960s and the site is now surveyed each winter as part of the larger Dublin Bay complex.

The North Bull Island SPA is a regular site for passage waders, especially Ruff, Curlew Sandpiper and Spotted Redshank. These are mostly observed in single figures in autumn but occasionally in spring or winter.

The site formerly had an important colony of Little Tern but breeding has not occurred in recent years. Several pairs of Ringed Plover breed, along with Shelduck in some years. Breeding passerines include Skylark, Meadow Pipit, Stonechat and Reed Bunting. The island is a regular wintering site for Short-eared Owl, with up to 5 present in some winters.

The North Bull Island SPA is an excellent example of an estuarine complex and is one of the top sites in Ireland for wintering waterfowl. It is of international importance on account of both the total number of waterfowl and the individual populations of Light-bellied Brent Goose, Black-tailed Godwit and Bar-tailed Godwit that use it. Also of significance is the regular presence of several species that are listed on Annex I of the E.U. Birds Directive, notably Golden Plover and Bar-tailed Godwit, but also Ruff and Short-eared Owl. North Bull Island is a Ramsar Convention site, and part of the North Bull Island SPA is a Statutory Nature Reserve and a Wildfowl Sanctuary.

SITE NAME: POULAPHOUCA RESERVOIR SPA SITE CODE: 004063

Poulaphouca Reservoir SPA, located in the western foothills of the Wicklow Mountains, was created in 1944 by damming of the River Liffey for the purpose of generating electricity from hydropower. The reservoir covers an area of approximately 20 square kilometres and is the largest inland water body in the mid- east and south-east regions. The reservoir receives water from two main sources, the River Liffey at the northern end, and the Kings River at the southern end. The exit is into the River Liffey gorge at the western end. Underlying the reservoir are sands and gravels deposited during the last glaciation. The shores of the lake are mostly sandy. When water levels are low the exposed lake muds are colonised by an ephemeral flora of annual plant species. Wet grassland areas occur in sheltered bays around the lake but especially in the northern part. Reed Canary-grass (Phalaris arundinacea) is the main grass species present, but other plant species characteristic of wet grasslands occur, including Creeping Bent (Agrostis stolonifera), Meadowsweet (Filipendula ulmaria), Yellow Iris (Iris pseudacorus) and Water Mint (Mentha aquatica). Sedges (Carex spp.) are locally common, while Rusty Willow (Salix cinerea subsp. oleifolia) scrub is often found associated with the wet grassland. In some places the water washes against grassy banks which are generally less than a metre high, and in a few places there are steep sand and clay cliffs, up to 15 m high - these are remnants of the old River Liffey channel. In many places the banks are actively eroding, and a strip of conifers has been planted around much of the perimeter of the reservoir in an attempt to stabilize the banks.

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Greylag Goose and Lesser Black- backed Gull.

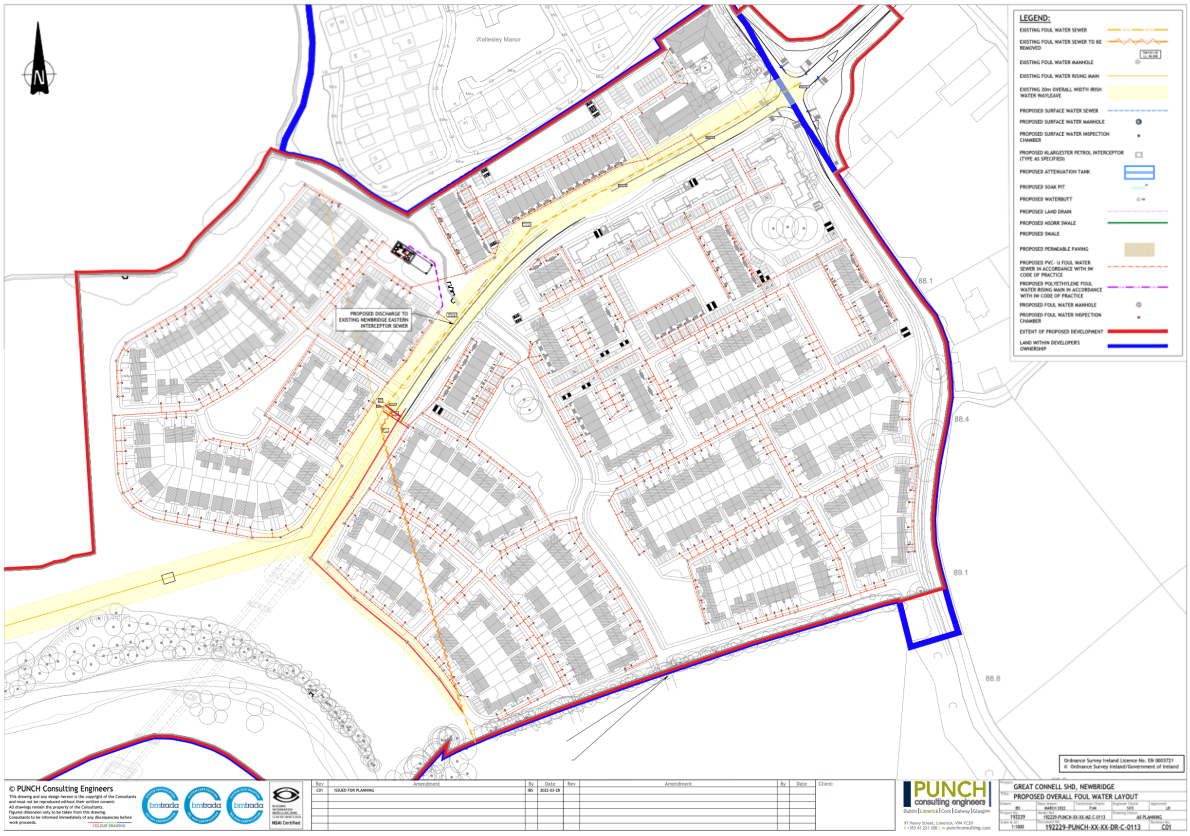
Poulaphouca Reservoir is of national importance for its Greylag Goose population, which is one of the largest in the country. The site provides the main roost for the birds, with feeding occurring mostly on improved grassland outside of the site. A mean peak of 701 individuals occurred during the five seasons 1995/96 to 1999/2000. Other waterfowl species occur in relatively low numbers, including Whooper Swan (22), Wigeon (180), Teal (107), Mallard (186), Goldeneye (22), Cormorant (11), Great Crested Grebe (8), Curlew (86) and Mute Swan (11). The site is also used by Grey Heron (6).

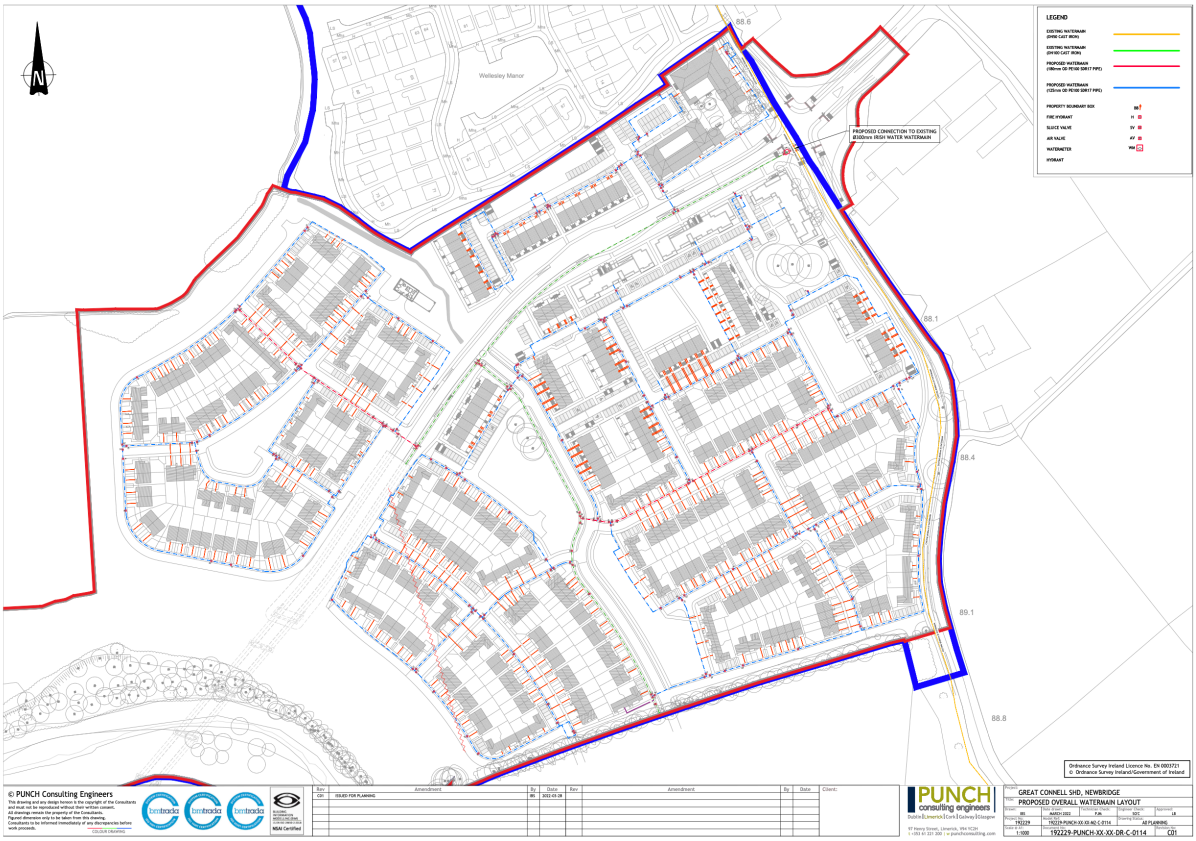
The reservoir attracts roosting gulls during winter, most notably a large population of Lesser Black-backed Gull (651), which in Ireland is rare in winter away from the south coast. Black-headed Gull (915) and Common Gull (183) also occur.

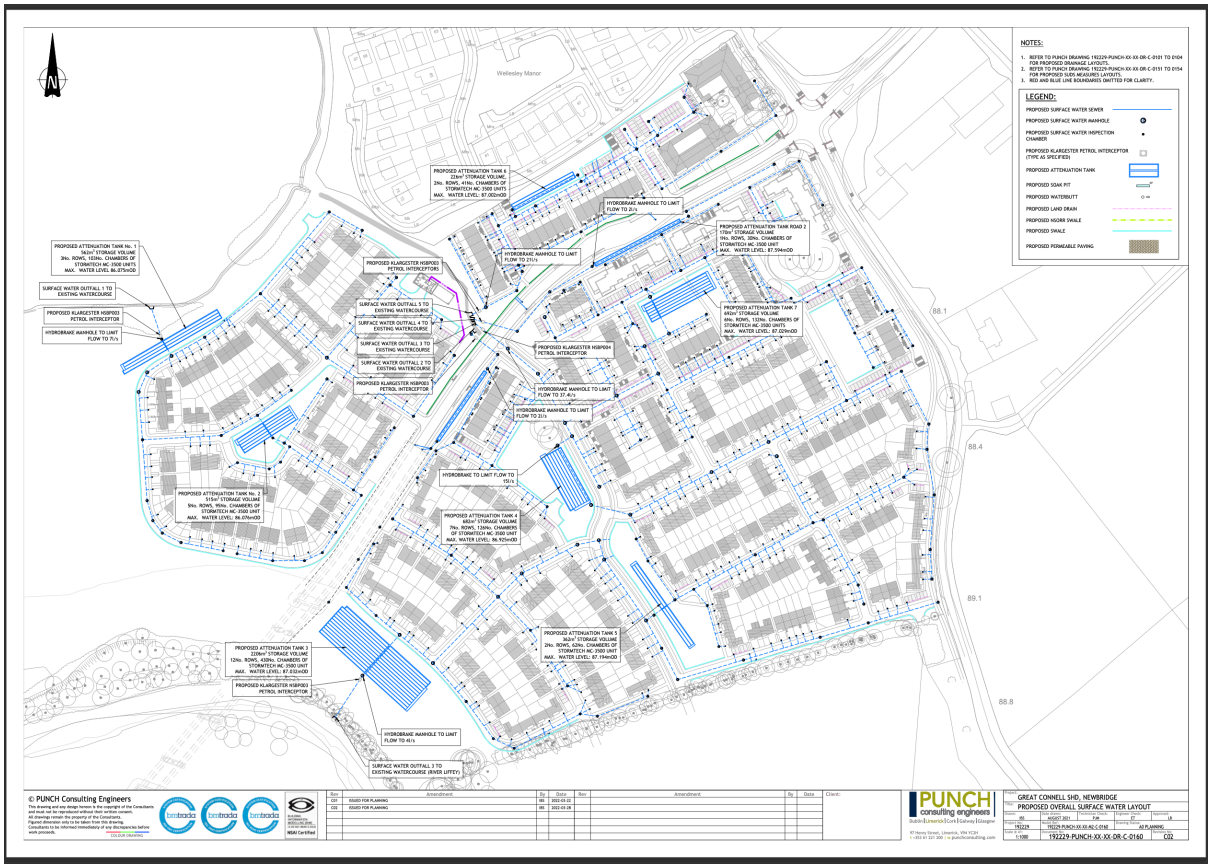
Breeding birds at the site include Great Crested Grebe (several pairs), which is localised in its distribution in eastern Ireland, as well as Snipe and Lapwing.

The principal interest of the site is the Greylag Goose population, which is of national importance. A range of other wildfowl species also occurs, including Whooper Swan, a species that is listed on Annex I of the E.U. Birds Directive. The site is also notable as a winter roost for gulls, especially Lesser Black-backed Gull. Part of Poulaphouca Reservoir SPA is a Wildfowl Sanctuary.

Appendix 2. Drawings






NOTES:
1. REFER TO PUNCH DRAWING 192229-PUNCH-XX-XX-DR-C-0101 TO 0104 FOR PROPOSED DRAINAGE LAYOUTS.
2. REFER TO PUNCH DRAWING 192229-PUNCH-XX-XX-DR-C-0151 TO 0154 FOR PROPOSED SUDS MEASURES LAYOUTS.
3. RED AND BLUE LINE BOUNDARIES OMITTED FOR CLARITY.
LEGEND:
PROPOSED SURFACE WATER SEWER
PROPOSED SURFACE WATER MANHOLE
PROPOSED SURFACE WATER INSPECTION CHAMBER
PROPOSED KLARGESTER PETROL INTERCEPTOR (TYPE AS SPECIFIED)
PROPOSED ATTENUATION TANK
PROPOSED SOAK PIT
PROPOSED WATERBUTT
PROPOSED LAND DRAIN
PROPOSED HIGRIB SWALE
PROPOSED SWALE
PROPOSED PERMEABLE PAVING
Wellesley Manor
PROPOSED ATTENUATION TANK 6
PROPOSED ATTENUATION TANK ROAD 2
PROPOSED ATTENUATION TANK 7
PROPOSED ATTENUATION TANK 4
PROPOSED ATTENUATION TANK 5
PROPOSED ATTENUATION TANK 3
PROPOSED ATTENUATION TANK No. 1
PROPOSED ATTENUATION TANK No. 2
HYDROBRAKE MANHOLE TO LIMIT FLOW TO 2l/s
HYDROBRAKE MANHOLE TO LIMIT FLOW TO 37.4l/s
HYDROBRAKE TO LIMIT FLOW TO 151/s
HYDROBRAKE MANHOLE TO LIMIT FLOW TO 4l/s
PROPOSED KLARGESTER HSBP003 PETROL INTERCEPTOR
PROPOSED KLARGESTER HSBP004 PETROL INTERCEPTOR
SURFACE WATER OUTFALL 1 TO EXISTING WATERCOURSE
SURFACE WATER OUTFALL 2 TO EXISTING WATERCOURSE
SURFACE WATER OUTFALL 3 TO EXISTING WATERCOURSE
SURFACE WATER OUTFALL 4 TO EXISTING WATERCOURSE
SURFACE WATER OUTFALL 5 TO EXISTING WATERCOURSE
SURFACE WATER OUTFALL 3 TO EXISTING WATERCOURSE (RIVER LIFFEY)
88.1
88.4
89.1
88.8
© PUNCH Consulting Engineers
This drawing and any design herein is the copyright of the Consultants. Unauthorised use of this drawing in whole or in part is prohibited. All drawings remain the property of the Consultants. Figured dimension only to be taken from this drawing. Contractors to be informed immediately of any discrepancies before work proceeds.
COLOUR DRAWING
Bus | Amendment | By | Date
GIS | ISSUED FOR PLANNING | MB | 2022-03-30
GIS | ISSUED FOR PLANNING | MB | 2022-03-28
Client:
PUNCH consulting engineers
Dublin | Limerick | Cork | Galway | Glasgow
57 Henry Street, Limerick, V94 YC2X
t: +353 61 327 300 | e: punchconsulting.com
PROJECT: GREAT CONNELL SHD, NEWBRIDGE
TITLE: PROPOSED OVERALL SURFACE WATER LAYOUT
Scale @ A1: 1:500
Drawn: AUGUST 2021
Checked: PW
Approved: EC
Rev: A
Project No.: 192229
Originator: PUNCH
Zone: XX
Level: XX
Type: DR
Role: C
Number: 0160
Status: AA PLANNING
Scale @ A3: 1:1000
Revision No.: C02

APPENDIX 7

NATURA IMPACT ASSESSMENT

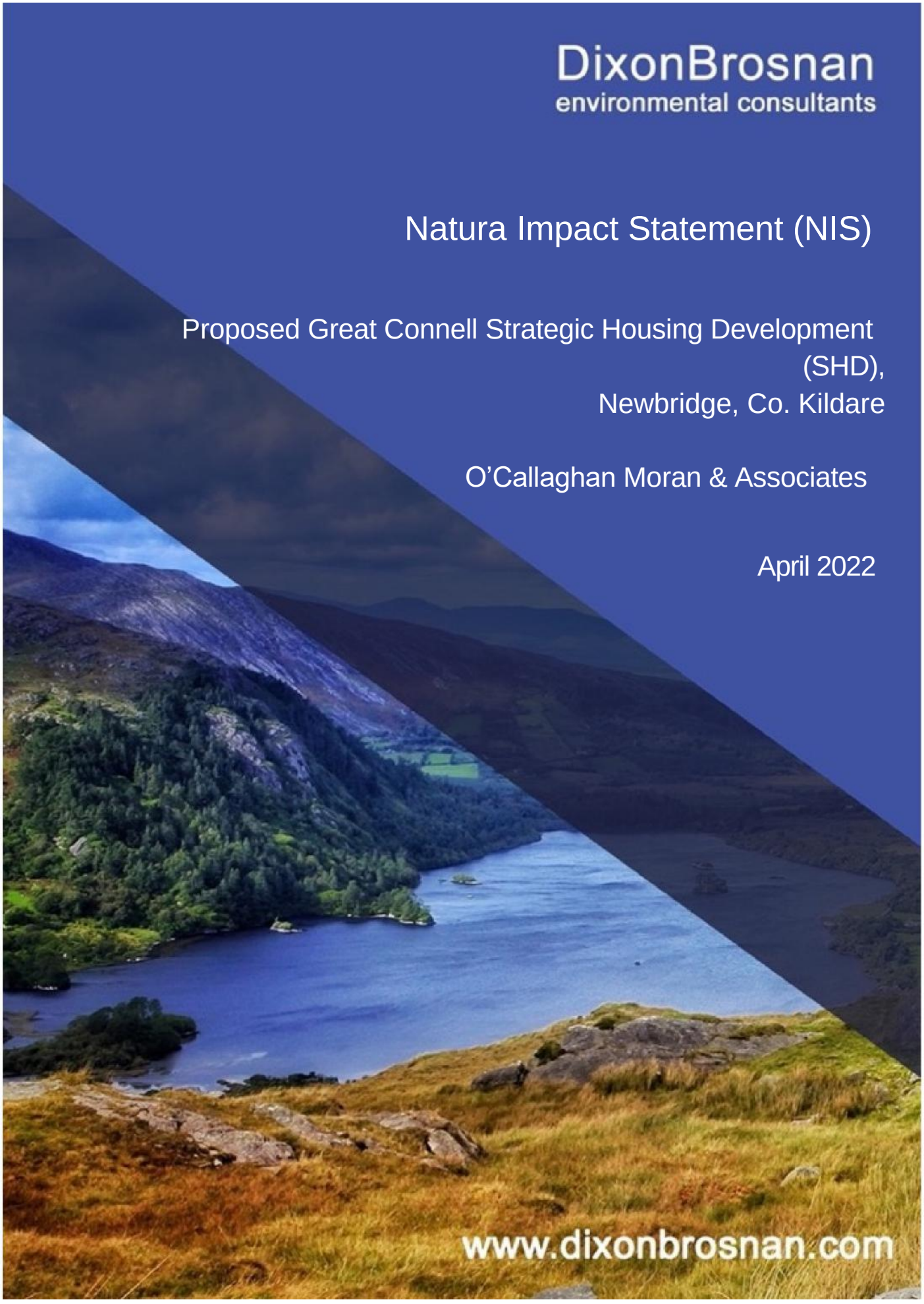
DixonBrosnan
environmental consultants

Natura Impact Statement (NIS)

Proposed Great Connell Strategic Housing Development (SHD),
Newbridge, Co. Kildare

O'Callaghan Moran & Associates

April 2022



Project	Natura Impact Statement (NIS) for Proposed Great Connell Strategic Housing Development, Newbridge, Co. Kildare	
Client	O'Callaghan, Moran and Associates	
Project Ref.	2179	
Report No.	2179.02	
Client Ref.	-	
Date	Revision	Prepared By
22/02/2022	First Draft	Sorcha Sheehy PhD
04/04/2022	Issue to Client	Carl Dixon MSc

DixonBrosnan Lios Ri Na hAoine, 1 Redemption Road, Cork.

Tel 086 851 1437| carl@dixonbrosnan.com | www.dixonbrosnan.com

This report and its contents are copyright of DixonBrosnan. It may not be reproduced without permission. The report is to be used only for its intended purpose. The report is confidential to the client, and is personal and non-assignable. No liability is admitted to third parties.
©DixonBrosnan 2022.

Table of Contents

1. Introduction 5

1.1 Background 5

1.2 Aim of this Report 5

1.3 Authors of the Report 7

2. Regulatory Context and Appropriate Assessment Procedure 7

2.1 Regulatory Context 7

2.2 Appropriate Assessment Procedure 8

2.3 Appropriate Assessment Screening Determination 9

3. Description of Project 9

3.1 Existing Site 9

3.2 Proposed Development Site Description 10

3.3 Existing Services 10

3.3.1 Water Supply 10

3.3.2 Surface Water Drainage 10

3.3.3 Foul Water Drainage 14

3.4 Description of Proposed Development 14

4. Natura 2000 Sites 16

4.1 Zone of Influence (ZoI) 16

4.2 Natura 2000 Sites 16

4.3 European Sites Descriptions 17

4.3.1 North Dublin Bay SAC 17

4.3.2 South Dublin Bay SAC 18

4.3.3 North Bull Island SPA 18

4.3.4 South Dublin Bay and River Tolka Estuary SPA 19

4.4 Natura 2000 sites – Features of interests and conservation objectives. 20

4.5 Baseline Data 23

4.5.1 Habitats 23

4.5.2 Birds 28

4.5.3 Invasive Species 30

4.5.4 River Basin Management Plan for Ireland 2015 – 2018 (2nd Cycle) 32

4.5.5 Urban Wastewater Treatment Directive 34

5. Impact Assessment 35

5.1 Introduction 35

5.2 Status of Qualifying Interests in North Dublin SAC and South Dublin Bay SAC 35

5.2.1 Mudflats and sandflats not covered by seawater at low tide (1140), Salicornia and other annuals colonising mud and sand (1310), salt meadows (Glauco-Puccinellietalia maritimae) (ASM) (1330) and Mediterranean salt meadows (*Juncetalia maritimi*) (MSM) (1410) 35

5.2.2 Annual vegetation of drift lines [1210], Embryonic shifting dunes [2110], Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120], Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130], Humid dune slacks [2190] 36

5.2.3 *Petalophyllum ralfsii* (Petalwort) [1395] 37

5.3 Status of Special Conservation Interests (SCIs) for North Bull Island SPA 41

5.4 Status of Special Conservation Interests (SCIs) for South Dublin Bay and River Tolka SPA....44

5.5 Assessment of Potential Impacts.....47

5.5.1 Impacts on surface water quality during construction..... 47

5.5.2 Impacts from Surface Water During Operation 49

5.5.3 Impact from Wastewater Discharges During Operation 49

5.5.4 In combination Impacts..... 53

6. Mitigation 57

6.1 General Mitigation Measures.....57

6.2 Land & Soil.....57

6.3 Water.....58

6.4 Oils and Chemical Storage 58

7. NIS conclusion and statement 59

References..... 59

Appendices..... 61

1. Introduction

1.1 Background

DixonBrosnan Environmental Consultants has been commissioned by O'Callaghan, Moran and Associates to prepare a Natura Impact Statement (NIS) to support the planning application for a proposed development at the Newbridge, Co. Kildare. The information in this report forms part of and should be read in conjunction with other planning application consultation documentation included an Appropriate Assessment (AA) Screening report.

The Birds Directive (2009/147/EC) and the Habitats Directive (92/42/EEC) put an obligation on EU Member States to establish the Natura 2000 network of sites of highest biodiversity importance for rare and threatened habitats and species across the EU. In Ireland, the Natura 2000 network of European sites includes Special Areas of Conservation (SACs, including candidate SACs) and Special Protection Areas (SPAs, including proposed SPAs). SACs are selected for the conservation of Annex I habitats (including priority types which are in danger of disappearance) and Annex II species (other than birds). SPAs are selected for the conservation of Annex I birds and other regularly occurring migratory birds and their habitats. The annexed habitats and species for which each site is selected correspond to the qualifying interests of the sites and from these the conservation objectives of the site are derived. The Birds and Habitats Directives set out various procedures and obligations in relation to nature conservation management in Member States in general, and of the Natura 2000 sites and their habitats and species in particular. A key protection mechanism is the requirement to consider the possible nature conservation implications of any plan or project on the Natura 2000 site network before any decision is made to allow that plan or project to proceed. Not only is every new plan or project captured by this requirement but each plan or project, when being considered for approval at any stage, must take into consideration the possible effects it may have in combination with other plans and projects when going through the process known as Appropriate Assessment (AA).

The obligation to undertake Appropriate Assessment (AA) derives from Article 6(3) and 6(4) of the Habitats Directive, and both involve a number of steps and tests that need to be applied in sequential order. Article 6(3) is concerned with the strict protection of sites, while Article 6(4) is the procedure for allowing derogation from this strict protection in certain restricted circumstances. As set out in Section 177U of the Planning and Development Act 2000 as amended, a screening for appropriate assessment of an application for consent for the project must be carried out by the competent authority to assess, in view of best scientific knowledge, if the project, individually or in combination with another plan or project is likely to have a significant effect on any European site. Each step in the assessment process precedes and provides a basis for other steps. The results at each step must be documented and recorded carefully so there is full traceability and transparency of the decisions made.

1.2 Aim of this Report

The application site is potentially hydrologically connected to four Natura 2000 sites i.e. South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA. The application site is not directly connected with or necessary to the management of these or any other European site and hence the requirements of Article 6(3) of the Habitats Directive and Part XAB of the Planning and Development Act 2000, apply.

Section 177U(1) of the Planning and Development Act 2000 requires that a screening for an appropriate assessment of, inter alia, an application for consent for a project be carried out by a competent authority to assess, in light of best scientific knowledge, whether the project, individually or in combination with another plan or project is likely to have a significant effect on a European site. A report in support of Appropriate Assessment (AA) screening was completed by DixonBrosnan on behalf of O'Callaghan, Moran and Associates. This report concluded that although the likelihood of effects on the South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA is low, applying the precautionary principle, potential impact pathways have been identified and a NIS should be prepared for the proposed development. No significant impacts were identified for any other Natura 2000 sites.

Accordingly, this NIS has been prepared to inform the Appropriate Assessment of the project's potential to result in likely significant effects to the South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA as a result of surface water and wastewater emissions. The purpose of this report is to inform the AA process as required under the Habitats Directive (92/43/EEC) in instances where a plan or project may give rise to adverse effects on the integrity of Natura 2000 sites. This report aims to inform the Appropriate Assessment process in determining whether the development, both alone and in combination with other plans or projects, are likely to have an adverse effect on the integrity of Natura 2000 sites in the study area, in the context of their conservation objectives and specifically on the habitats and species for which the sites have been designated.

Documentation/guidelines of relevance to this NIS include the following:

- *Managing Natura 2000 Sites: The Provision of Article 6 of the Habitats Directive 92/43/EEC* (European Commission (EC), 2018),
- *Assessment of Plans and Projects Significantly Affecting Natura 2000 sites: Methodical Guidance on the Provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (European Commission (EC), 2001),
- *Guidance Document on Article 6(4) of the Habitats Directive 92/43/EEC* (European Commission, (EC) 2007);
- *Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities* (Department of Environment, Heritage and Local Government, 2010 revision),
- *Appropriate Assessment under Article 6 of the Habitats Directive; Guidance for Planning Authorities. Circular NPW 1/10 and PSSP 2/10* (Department of Environment, Heritage and Local Government, 2010),
- *Guidelines for Good Practice Appropriate Assessment of Plans under Article 6(3) Habitats Directive* (International Workshop on Assessment of Plans under the Habitats Directive, 2011,
- *Practice Note PN01 Appropriate Assessment Screening for Development* Management Office of the Planning Regulator (2021),

- *Assessment of plans & projects in relation to N2K sites – Methodological Guidance* (EC 2021),
- *Guidance document on the strict protection of animal species of Community interest under the Habitats Directive* (EC 2021) and
- *Communication from the Commission on the precautionary principle. European Commission* (2000).

1.3 Authors of the Report

This report was prepared by Carl Dixon MSc (Ecological Monitoring) and Dr. Sorcha Sheehy PhD (Ecology/ornithology).

Carl Dixon MSc (Ecology) is a senior ecologist who has over 20 years' experience in ecological and water quality assessments. He also has experience in mammal surveys, invasive species surveys and ecological supervision of large-scale projects. Projects in recent years include the Waste to Energy Facility Ringaskiddy, Shannon LNG Project, supervision of the Fermoy Flood Relief Scheme, Skibbereen Flood Relief Scheme, Upgrade of Mallow WWTP Scheme, Douglas Flood Relief Scheme, Great Island Gas Pipeline etc.

Sorcha Sheehy PhD (ecology/ornithology) is an experienced ecological consultant with over twelve years' experience. She has worked on Screening/NIS's for a range of small and large-scale projects with particular expertise in assessing impacts on birds. Sorcha has carried out Hen Harrier surveys for several windfarm applications. Recent projects include bird risk assessments for Dublin and Cork Airports as well as contributions to the Arklow Wind Bank Park NIS/EIAR and Mallow Town Park NIS.

2. Regulatory Context and Appropriate Assessment Procedure

2.1 Regulatory Context

The Habitats Directive (Council Directive 92/43/EEC on the *Conservation of Natural Habitats and of Wild Fauna and Flora*) aims to maintain or restore the favourable conservation status of habitats and species of community interest across Europe. The requirements of these directives are transposed into Irish law through the European Communities (Birds and Natural Habitats Regulations; S.I. No. 477 of 2011).

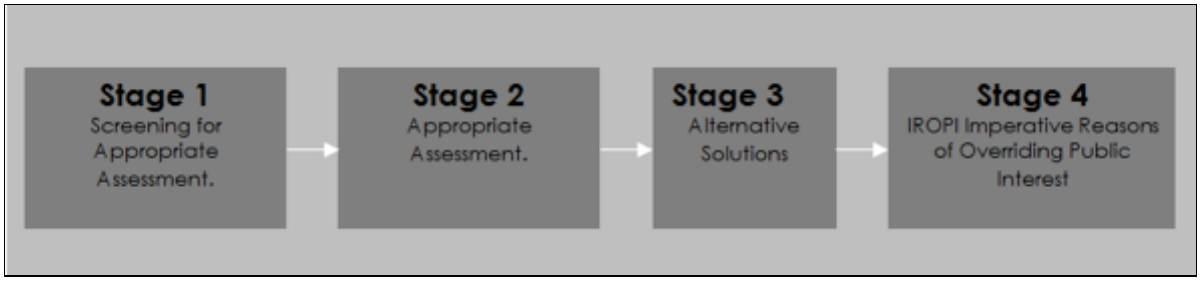
Under the Directive a network of sites of nature conservation importance have been identified by each Member State as containing specified habitats or species requiring to be maintained or returned to favourable conservation status. In Ireland the network consists of SACs and SPAs, and also candidate sites, which form the Natura 2000 network.

Article 6(3) of Council Directive 92/43/EEC of 21 May 1992 on the *Conservation of Natural Habitats and of Wild Fauna and Flora* (as amended) (hereafter 'the Habitats Directive') requires that, any plan or project not directly connected with or necessary to the management of a designated site, but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. A competent authority (e.g. the EPA or Local Authority) can only agree to a plan or project after having determined that it will not adversely affect the integrity of the site concerned.

The possibility of a significant effect on a designated or "European" site has generated the need for an appropriate assessment to be carried out by the competent authority for the purposes of Article 6(3). A Stage Two Appropriate Assessment is required if it cannot be excluded, on the basis of objective information, that the project, individually or in combination with other plans or projects, will have a significant effect on a European site. The first (Screening) Stage for appropriate assessment operates merely to determine whether a (Stage Two) Appropriate Assessment must be undertaken on the implications of the plan or project for the conservation objectives of relevant European sites.

2.2 Appropriate Assessment Procedure

The assessment requirements of Article 6(3) establish a stage-by-stage approach. This assessment follows the stages outlined in the 2001 European Commission publications "Assessment of plans and projects significantly affecting Natura 2000 sites: methodological guidance on the provisions of Articles 6(3) and 6(4) of the Habitats Directive 92/43/EEC" (2001) and Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (Draft) Office for Official Publications of the European Communities, Luxembourg (EC, 2015);



The stages are as follows:

Stage One: Screening — the process which identifies any appreciable impacts upon a Natura 2000 site of a project or plan, either alone or in combination with other projects or plans, and considers whether these impacts are likely to be significant;

Stage Two: Appropriate assessment — the consideration of the impact on the integrity of the Natura 2000 site of the project or plan, either alone or in combination with other projects or plans, with respect to the site's structure and function and its conservation objectives. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts;

Stage Three: Assessment of alternative solutions: The process which examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site. It is confirmed that no reliance is placed by the developer on Stage Three in the context of this application for development consent;

Stage Four: Assessment where no alternative solutions exist and where adverse impacts remain — an assessment of compensatory measures where, in the light of an assessment of imperative reasons of overriding public interest (IROPI), it is deemed that the project or plan should proceed (it is important to note that this guidance does not deal with the assessment of imperative reasons of overriding public interest). Again, for the avoidance of doubt, it is

confirmed that no reliance is placed by the developer on Stage Four in the context of this application for development consent.

It is the responsibility of the competent authority, in this instance An Bord Pleanála, to make a decision on whether or not the project should be approved, taking into consideration any potential impact upon any Natura 2000 site within its zone of influence.

2.3 Appropriate Assessment Screening Determination

In accordance with Regulation 42(1) of the European Communities (Birds and Natural Habitats) Regulations 2011 as amended, DixonBrosnan carried out a report in support of AA screening to determine, in view of best scientific knowledge and the conservation objectives of the site, if the proposed development, individually or in combination with other plans or projects is likely to have a significant effect on European Sites. In this context, particular attention was paid to South Dublin Bay SAC (site code 000210), North Dublin Bay SAC (site code 000206), North Bull Island SPA (site code 004006) and the South Dublin Bay & River Tolka Estuary SPA (site code 004063).

The report in support of AA Screening concluded the following:

This AA screening report has been prepared to assess whether the proposed development, individually or in-combination with other plans or projects, and in view of best scientific knowledge, is likely to have a significant effect on any European site(s).

The screening exercise was completed in compliance with the relevant European Commission guidance, national guidance, and case law. The potential impacts of the proposed development have been considered in the context of the European sites potentially affected, their qualifying interests or special conservation interests, and their conservation objectives.

Through an assessment of the source-pathway-receptor model, which considered the ZoI of effects from the proposed development and the potential in-combination effects with other plans or projects, the following findings were reported:

Although the likelihood of effects on the South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA is low, using an abundance of caution potential impact pathways have been identified and a NIS is being prepared for the proposed development.

As noted above, it is the responsibility of the competent authority, in this instance An Bord Pleanála, to make a decision on whether or not the project should be approved, taking into consideration any potential impact upon any Natura 2000 site within its zone of influence.

3. Description of Project

3.1 Existing Site

The site is to the east of Newbridge Town Centre (**Figure 1**). It is accessed from the east from the Great Connell road, which forms the eastern boundary. It is bounded to the north-east by a residential development (Wellesley Manor) and to the north-west by an open drain that was formerly a meander channel of the River Liffey. A hedgerow forms the southern boundary.

The south-western boundary is defined by a buffer zone on the western side of the River Liffey. The western boundary is not defined on the ground.

The proposed development is on the eastern outskirts of Newbridge, ca 1km from the Town Centre and main retail area. To the south and south-east are agricultural lands primarily used for tillage. To the east, across the Great Connell Road, are the Murphy Ireland Ltd offices and compound. To the north-east is Wellesley Manor, which has the closest residential dwellings to the development, with the houses in the south of the estate being approximately 10 m from the north-eastern development site boundary.

The Dr Pepper beverage manufacturing plant (formerly Lidl distribution centre) is ca 500m to the north-east. The Pfizer manufacturing complex, which is Europe's largest manufacturers of solid dose pharmaceuticals is ca 800m to the north. To the south-west, across the River Liffey, a 343 unit residential development is currently under construction. The Baroda Stud Farm is ca 500m to the south-east.

3.2 Proposed Development Site Description

The proposed development site covers an area of 27.64ha, most of which is used for tillage. The River Liffey flows through the southwestern corner of the site, with an area of treelines and woodland along its boundary. A drainage ditch at the centre of the site is connected to a drainage ditch on the northern boundary, which ultimately flows into the River Liffey to the west of the proposed development site.

3.3 Existing Services

3.3.1 Water Supply

There is an Irish Water 300mm watermain running along the Great Connell Road to the east of the site. This supplies the Wellesley Manor residential estate via a 100mm uPVC network.

3.3.2 Surface Water Drainage

Due to the topography it is not possible to drain the entire residential development site via one outfall. As such it is proposed to discharge via gravity to four new outlets on the existing ditch which passes through the north of the site as well as two new outlet to the River Liffey to the west.

The proposed section of Newbridge South Outer Orbital Relief Road (NSOORR) that will run through the site will have a separate drainage system. Due to level and vertical clearance constraints imposed by the existing 900mm diameter foul sewer traversing the site two outfalls are required.

Seven underground attenuation tanks with a combined capacity of 5,387m3, will serve the residential development, as shown on Drawing 192229-PUNCH-XX-XX-DR-C-0160. Two underground tanks (combined volume of 320m3) will serve the section of the NSOORR.

All of the tanks will be fitted with flow regulation devices designed to maintain the flow rates to the water courses at pre-development greenfield rates. Class 1 Bypass Hydrocarbon Separators will be located downstream of all of the attenuation tanks. The discharge points

to the ditch and the river will be fitted with non-return valves to prevent water from the river surcharging up through the surface water drainage network.

In addition to the underground attenuation tanks, the following Sustainable Urban Drainage Systems (SuDs) are incorporated into the design:

- Permeable paving
- Swales/Bioswales
- Green Roofs
- Soakaways/Soak Pits
- Rainwater Harvesting

The drainage system design takes account effects of coincidental flooding and is in accordance with the Greater Dublin Strategic Drainage Study (GDSDS) Volume 5 Guidance for combination flood events. Futher details on surface water drainage are included in **Appendix 2** drawings.

Figure 1. Proposed development site location | Source OSI

Figure 2. Proposed site layout | Source OFM

3.3.3 Foul Water Drainage

The network was designed using Causeway Flow software in accordance with Irish Water's Code of Practice for Wastewater Infrastructure and the Department of the Environment's Recommendations for Site Development Works for Housing Areas. The foul water loading was calculated in accordance with the Code of Practice for Wastewater Infrastructure, with a 10% allowance for infiltration

The existing 450mm foul sewer that runs across the site from south to north will be diverted to connect to the Upper Liffey Valley Sewerage Scheme (ULVS) existing 900 mm diameter sewer. Due to the site topography it was not feasible to provide a gravity connection to the ULVS sewer.

All foul water will be collected by gravity and brought to a foul water pumping station in the north of the site from where it will be pumped to the ULVS sewer, as shown on Drawing 192229-PUNCH-XX-XX-DR-C-0113 **(**Appendix 2**)**. The foul pumping station will deliver a peak flow to the ULVS sewer of 19.5l/s. It will include a 254m3 capacity emergency storage tank that will retain the foul water in the event of a breakdown.

PUNCH estimate the average daily discharge to the Irish Water foul sewer will be 280,355 litres when the development is complete. To reduce the water demand on the water supplies water conservation measures will be incorporated in the sanitary facilities throughout the development, e.g. dual flush toilets.

A Pre-Connection Enquiry Form was sent to Irish Water in relation to the proposed development, and Irish Water issued a Confirmation of Feasibility (**Appendix 3**). The PUNCH proposed foul network proposals were then submitted to Irish Water for Design Vetting and Irish Water issued a Statement of Design Acceptance.

See **Appendix 2** Drawings for further detail on foul water drainage.

3.4 Description of Proposed Development

The proposed residential development provides for 569 residential dwellings and supporting commercial development in Great Connell, Newbridge. To facilitate the development it is necessary to demolish the existing structures on the site which comprise; 'Great Connell' a two-storey dwelling of 331.9 sqm with detached single storey garage and outhouses of 48 sqm; 'Valencia Lodge' a single storey dwelling of 135.6 sqm with a single storey garage of 17.8 sqm; two no. single storey sheds of 1,440 sqm and 595 sqm, and a three-sided shed of 54 sqm.

The proposed residential development comprises the construction of 569 no. new residential dwellings (325 no. houses and 244 no. apartments). There are 15 no. house types proposed, which in total provide 64 no. two-bed houses; 173 no. three-bed houses; and 88 no. four-bed houses (ranging in height from 2 to 3 storeys).

The 244 no. proposed apartments include 164 no. own-door units and 80 no. shared access apartments and comprise the following;

- Apartment Block A (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
- Apartment Block B (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
- Apartment Block C (Part 3 and 4 Storeys): 4 no. one-bed apartments; 19 no. two-bed apartments and 4 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 87 sqm.
- 13 no. apartments above the proposed Neighbourhood Centre comprising; 4 no. own-door two-bed apartments; 3 no. shared-access one-bed apartments; and 6 no. shared-access two-bed apartments. These proposed units have private balconies or terraces, and access to the communal roof terrace of 176 sqm.
- 160 no. own-door apartments in 2- and 3- storey buildings comprising; 16 no. one-bed apartments; 78 no. two-bed apartments, 66 no. three-bed duplex apartments. These units will have private amenity areas in the form of terraces, balconies and/or rear gardens.

The proposed Neighbourhood Centre has a total commercial floor area of 2,141 sqm and accommodates 11 no. commercial units with a variety of uses comprising:

- Convenience shop of 909 sqm (unit 1)
- 3 no. doctor/dentist/physio units of 120 sqm, 120 sqm and 90 sqm (units 6, 7, and 8, respectively)
- café of 125 sqm (unit 4)
- restaurant of 213 sqm (unit 9)
- 5 no. shop/convenience services units of 112 sqm, 49 sqm, 171 sqm, 100sqm and 100 sqm (units 2, 3, 5,10 and 11, respectively). It is envisaged that these units will be occupied by uses such as butchers, green grocers, hairdressers, pharmacies, or a local post office.

Within the Neighbourhood Centre it is proposed to provide a childcare facility (886 sqm) with capacity for in the order of 154 no. children.

A total of 1,008 no. car parking spaces are proposed to serve the proposed development. 650 no. car parking spaces are proposed to serve the 325 no. houses,

312 no. car parking spaces are proposed to serve the 244 no. apartments, and 46 no. car parking spaces are proposed to serve the neighbourhood centre, including the childcare facility.

A total of 732 no. bicycle parking spaces are proposed to serve the development comprising 536 no. long-stay residential spaces, 134 no. residential visitor spaces, and 62 no. bike spaces to serve the neighbourhood centre including the childcare facility.

4. Natura 2000 Sites

4.1 Zone of Influence (ZoI)

The Zone of Influence (ZoI) comprises the area within which the proposed project may potentially affect the conservation objectives or qualifying interests (QI) of a Natura 2000 site. There is no recommended zone of influence, and guidance from the National Parks and Wildlife Service (NPWS) recommends that the distance should be evaluated on a case-by-case basis with reference to the nature, size and location of the project, the sensitivities of the ecological receptors, and the potential for in-combination effects (cumulative).

In ecological and environmental impact assessment, for an effect to occur there must be a risk enabled by having a source (e.g. construction works at a project site), a 'receptor' (e.g. SAC or other ecologically sensitive feature), and a pathway between the source and the receptor (e.g. a watercourse which connects the project site to the SAC). A 'receptor' is defined as the Special Conservation Interest (SCI) of SPAs or Qualifying Interest (QI) of SACs for which conservation objectives have been set for the European sites being screened.

Consideration is therefore given to the source-pathway-receptor linkage and associated risks between the project and Natura 2000 sites. For a significant effect to occur there needs to be an identified risk whereby a source (e.g. contaminant or pollutant arising from construction activities) affects a particular receptor (i.e. Natura 2000 site) through a particular pathway (e.g. a watercourse which connects the project with the Natura 2000 site).

The identification of risk does not automatically mean that an effect will occur, nor that it will be significant. The identification of these risks means that there is a possibility of environmental or ecological damage occurring. The level and significance of the effect depends upon the nature of the consequence, likelihood of the risk and characteristics of the receptor.

The precautionary principle is applied for the purposes of screening to ensure that consideration and pre-emptive action is undertaken where there is a lack of scientific evidence. It is noted that mitigation measures are not taken into account in the AA screening assessment process.

4.2 Natura 2000 Sites

As outlined in **Section 2.3**, the AA screening for the proposed development determined that the potential impact pathways have been identified between the proposed development and South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin

Bay & River Tolka Estuary SPA from surface water discharges and wastewater discharges as well as potential in-combination impacts.

During construction and operation surface water runoff from the site will be diverted to the River Liffey. Wastewater discharges from the proposed development will also ultimately discharge to the River Liffey via the Upper Liffey Valley Sewerage Scheme (License ref. D0002). There are four Natura 2000 sites within Dublin Bay which are hydrologically connected to the River Liffey. These are South Dublin Bay SAC (site code 000210), South Dublin Bay and River Tolka Estuary SPA (site code 004024), North Dublin Bay SAC (site code 000206) and North Bull Island SPA (site code 004006). These are located approximately 59.2-61.8km downstream of the proposed development site (**Figure 3**). Although unlikely due to the distance involved, given the hydrological connection, surface water run-off during the construction or operational phase as well as wastewater discharges during operation could potentially impact on the South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA.

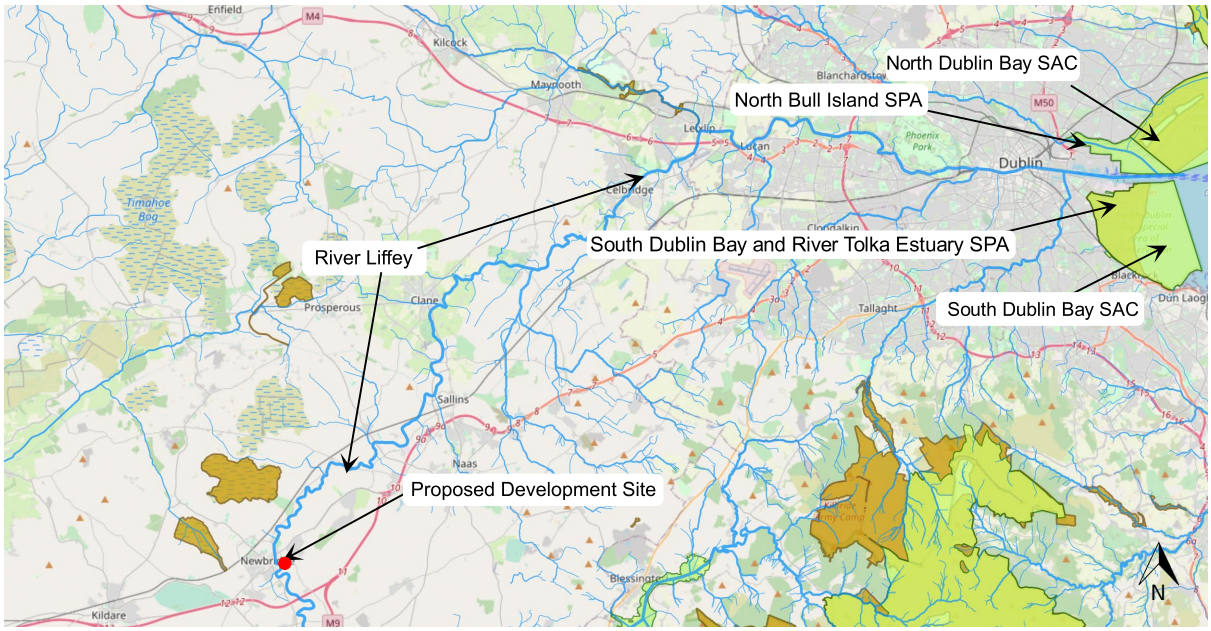


Figure 3. Location of the proposed development site and Natura 2000 sites screened into NIS | Source: EPA Envision mapping https://gis.epa.ie/EPAMaps/) | Not to scale

4.3 European Sites Descriptions

4.3.1 North Dublin Bay SAC

The North Dublin Bay SAC sand spit is a relatively recent depositional feature, formed as a result of improvements to Dublin Port during the 18th and 19th centuries. It is almost five kilometres long and one kilometre wide and runs parallel to the coast between Clontarf and Sutton. The sediment which forms the island is predominantly glacial in origin and siliceous in nature. Between the island and the mainland there occurs two sheltered intertidal areas which are separated by a solid causeway constructed in 1964. The seaward side of the island has a fine sandy beach. A substantial area of shallow marine water is included in the site. The interior of the island is excluded from the site as it has been converted to golf courses. The proximity of the North Bull Island to Dublin City results in it being a very popular recreational area. It is

also very important for educational and research purposes. Nature conservation is a main land use within the site.

The SAC possesses an excellent diversity of coastal habitats. The North Bull Island dune system is one of the most important systems on the east coast and is one of the few in Ireland that is actively accreting. It possesses extensive and mostly good quality examples of embryonic, shifting marram and fixed dunes, as well as excellent examples of humid dune slacks. Both Atlantic and Mediterranean salt marshes are well represented and a particularly good marsh zonation is shown. The salt marshes grade into mudflats and sandflats, some of which are dominated by annual Salicornia species. *Petalophyllum ralfsii* occurs at its only known station away from the western seaboard. The site has five Red Data Book vascular plant species and four Red Data Book bryophyte species. This is one of the most important sites for wintering waterfowl in Ireland, with internationally important populations of *Branta bernicla horta*, *Calidris canutus* and *Limosa lapponica*, plus nationally important numbers of a further 14 species. 20% of the national total of *Pluvialis squatarola* occurs here. Formerly it had important colony of *Sterna albifrons*. North Dublin Bay is nationally important for three insect species. The scientific interests of the site have been well documented and future prospects are good owing to the various designations assigned to site. A full site synopsis for this site is included in **Appendix 1** of this NIS.

4.3.2 South Dublin Bay SAC

The South Dublin Bay SAC extends from the South Wall at Dublin Port to the West Pier at Dun Laoghaire, a distance of approximately 5 km. At their widest, the intertidal flats extend for almost 3 km. The seaward boundary is marked by the low tide mark, while the landward boundary is now almost entirely artificially embanked. Several permanent channels exist, the largest being Cockle Lake. A small sandy beach occurs at Merrion Gates, while some bedrock shore occurs near Dun Laoghaire. A number of small streams and drains flow into the site. The proximity of the site to Dublin City results in it being a very popular recreational area. It is also important for educational and research purposes.

Site possesses a fine and fairly extensive example of intertidal flats. Sediment type is predominantly sand, with muddy sands in the more sheltered areas. A typical macro-invertebrate fauna exists. Has the largest stand of Zostera on the east coast. Supports part of the important wintering waterfowl populations of Dublin Bay. Regularly has an internationally population of *Branta bernicila horta*, plus nationally important numbers of at least a further 6 species, including *Limosa lapponica*. Regular autumn roosting ground for significant numbers of *Sterna* terns, including *S. dougallii*. The scientific interests of the site have been well documented. A full site synopsis for this site is included in **Appendix 1** of this NIS.

4.3.3 North Bull Island SPA

The North Bull Island SPA sand spit is a relatively recent depositional feature, formed as a result of improvements to Dublin Port during the 18th and 19th centuries. It is almost 5km long and 1km wide and runs parallel to the coast between Clontarf and Sutton. The sediment which forms the island is predominantly glacial in origin and siliceous in nature. A well-developed dune system runs the length of the island, with good examples of embryonic, shifting marram and fixed dunes, as well as excellent examples of humid dune slacks. Extensive salt marshes also occur. Between the island and the mainland occur two sheltered intertidal areas which

are separated by a solid causeway constructed in 1964. The seaward side of the island has a fine sandy beach. A substantial area of shallow marine water is included in the site. Part of the interior of the island has been converted to golf courses. The proximity of the North Bull Island to Dublin City results in it being a very popular recreational area. It is also very important for educational and research purposes. Nature conservation is a main land use within the site.

The site is among the top ten sites for wintering waterfowl in the country. It supports internationally important populations of Branta bernicila hrota and Limosa lapponica and is the top site in the country for both of these species. A further 14 species have populations of national importance, with particular notable numbers of Tadorna tadorna (8.5% of national total), Anas acuta (11.6% of national total), Pluvialis squatarola (6.9% of national total), Calidris canutus (10.5% of national total). North Bull Island SPA is a regular site for passage waders such as Philomachus pugnax, Calidris ferruginea and Tringa erythropus. The site supports Asio flammeus in winter. Formerly the site had an important colony of Sterna albifrons but breeding has not occurred in recent years. The site provides both feeding and roosting areas for the waterfowl species. Habitat quality for most of the estuarine habitats is very good. The site has a population of the rare Petalophyllum ralfsii which is the only known station away from the western seaboard as well as five Red Data Book vascular plant species and four bryophyte species. It is nationally important for three insect species. Wintering bird populations have been monitored more or less continuously since the late 1960s, and the other scientific interests of the site have also been well documented. Future prospects are good owing to various designations assigned to site. A full site synopsis for this site is included in **Appendix 1** of this NIS.

4.3.4 South Dublin Bay and River Tolka Estuary SPA

This South Dublin Bay and River Tolka Estuary SPA comprises a substantial part of Dublin Bay. It includes virtually all of the intertidal area in the south bay, as well as much of the Tolka Estuary to the north of the River Liffey. A portion of the shallow bay waters is also included. In the south bay, the intertidal flats extend for almost 3 km at their widest. The sediments are predominantly well-aerated sands. The sands support the largest stand of Zostera noltii on the East Coast. Several permanent channels exist, the largest being Cockle Lake. A small sandy beach occurs at Merrion Gates, while some bedrock shore occurs near Dun Laoghaire. The landward boundary is now almost entirely artificially embanked. Sediments in the Tolka Estuary vary from soft thixotrophic muds with a high organic content in the inner estuary to exposed, well aerated sands off the Bull Wall. The proximity of the site to Dublin City results in it being a very popular recreational area. It is also important for educational and research purposes.

The site possesses extensive intertidal flats which support wintering waterfowl which are part of the overall Dublin Bay population. It regularly has an internationally important population of Branta bernicla hrota, which feeds on Zostera noltii in the autumn. It has nationally important numbers of a further 6 species: Haematopus ostralegus, Charadrius hiaticula, Calidris canutus, Calidris alba, Calidris alpina and Limosa lapponica. It is an important site for wintering gulls, especially Larus ridibundus and Larus canus. South Dublin Bay is the premier site in Ireland for Larus melanocephalus, with up to 20 birds present at times. Is a regular autumn roosting ground for significant numbers of terns, including *Sterna dougallii, S. hirundo* and *S. paradisaea*. A full site synopsis for this site is included in **Appendix 1** of this NIS.

4.4 Natura 2000 sites – Features of interests and conservation objectives.

The EU Habitats Directive contains a list of habitats (Annex I) and species (Annex II) for which SACs must be established by Member States. Similarly, the EU Birds Directive contains lists of important bird species (Annex I) and other migratory bird species for which SPAs must be established. Those that are known to occur at a site are referred to as 'qualifying interests' and are listed in the Natura 2000 forms which are lodged with the EU Commission by each Member State. A 'qualifying interest' is one of the factors (such as the species or habitat that is present) for which the site merits designation. The National Parks and Wildlife Service (NPWS) are responsible for the designation of SACs and SPAs in Ireland.

The conservation objectives for South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA are detailed in:

NPWS (2013) *Conservation Objectives: North Dublin Bay SAC 000206. Version 1.* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013) *Conservation Objectives: South Dublin Bay SAC 000210. Version 1.* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2015) *Conservation Objectives: North Bull Island SPA 004006. Version 1.* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2015) *Conservation Objectives: South Dublin Bay and River Tolka Estuary SPA 004024. Version 1*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network. European and national legislation places a collective obligation on Ireland and its citizens to maintain at favourable conservation status sites designated as Special Areas of Conservation and Special Protection Areas. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level. Favourable conservation status of a habitat is achieved when its natural range, and area it covers within that range, is stable or increasing, and the ecological factors that are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when population data on the species concerned indicate that it is maintaining itself, and the natural range of the species is neither being reduced or likely to be reduced for the foreseeable future, and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis. The species and/or habitats listed as features of interests for South Dublin Bay SAC,

North Dublin Bay SAC, North Bull Island SPA and South Dublin Bay & River Tolka Estuary SPA are included in **Tables 1 to 4**.

Table 1. Qualifying Interests for North Dublin Bay SAC

Habitat/species Code	Habitat /Species	Conservation objective
1140	Mudflats and sandflats not covered by seawater at low tide	Maintain
1210	Annual vegetation of drift lines	Restore
1310	Salicornia and other annuals colonising mud and sand	Restore
1330	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	Maintain
1410	Mediterranean salt meadows (*Juncetalia maritimi*)	Maintain
2110	Embryonic shifting dunes	Restore
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	Restore
2130	Fixed coastal dunes with herbaceous vegetation (grey dunes)	Restore
2190	Humid dune slacks	Restore
1395	Petalwort *Petalophyllum ralfsii*	Maintain

Restore = Restore favourable conservation condition, Maintain = Maintain favourable conservation condition

Table 2. Qualifying Interests for South Dublin Bay SAC

Habitat/species Code	Habitat /Species	Conservation objective
1140	Mudflats and sandflats not covered by seawater at low tide	Maintain
1210	Annual vegetation of drift lines	Maintain/Restore
1310	Salicornia and other annuals colonising mud and sand	Maintain/Restore
2110	Embryonic shifting dunes	Maintain/Restore

Restore = Restore favourable conservation condition, Maintain = Maintain favourable conservation condition

Table 3. Special Conservation Interests for North Bull Island SPA

Species Code	Species	Scientific name	Conservation objective
A046	Brent Goose	*Branta bernicla hrota*	Maintain
A048	Shelduck	*Tadorna tadorna*	Maintain
A052	Teal	*Anas crecca*	Maintain
A054	Pintail	*Anas acuta*	Maintain
A056	Shoveler	*Anas clypeata*	Maintain
A130	Oystercatcher	*Haematopus ostralegus*	Maintain
A140	Golden Plover	*Pluvialis apricaria*	Maintain
A141	Grey Plover	*Pluvialis squatarola*	Maintain
A143	Knot	*Calidris canutus*	Maintain
A144	Sanderling	*Calidris alba*	Maintain

Species Code	Species	Scientific name	Conservation objective
A149	Dunlin	*Calidris alpina alpina*	Maintain
A156	Black-tailed Godwit	*Limosa limosa*	Maintain
A157	Bar-tailed Godwit	*Limosa lapponica*	Maintain
A160	Curlew	*Numenius arquata*	Maintain
A162	Redshank	*Tringa totanus*	Maintain
A169	Turnstone	*Arenaria interpres*	Maintain
A179	Black-headed Gull	*Chroicocephalus ridibundus*	Maintain
A999	Wetlands & waterbirds		Maintain

Restore = Restore favourable conservation condition, Maintain = Maintain favourable conservation condition

Table 4. Special Conservation Interests for South Dublin Bay & River Tolka Estuary SPA

Species Code	Species	Scientific name	Conservation objective
A046	Brent Goose	*Branta bernicla hrota*	Maintain
A130	Oystercatcher	*Haematopus ostralegus*	Maintain
A137	Ringed Plover	*Charadrius hiaticula*	Maintain
A141	Grey Plover	*Pluvialis squatarola*	Maintain
A143	Knot	*Calidris canutus*	Maintain
A144	Sanderling	*Calidris alba*	Maintain
A149	Dunlin	*Calidris alpina alpina*	Maintain
A157	Bar-tailed Godwit	*Limosa lapponica*	Maintain
A162	Redshank	*Tringa totanus*	Maintain
A179	Black-headed Gull	*Chroicocephalus ridibundus*	Maintain
A192	Roseate Tern	*Sterna dougallii*	Maintain
A193	Common Tern	*Sterna hirundo*	Maintain
A194	Arctic Tern	*Sterna paradisaea*	Maintain
A999	Wetlands & waterbirds		Maintain

Restore = Restore favourable conservation condition, Maintain = Maintain favourable conservation condition

To acknowledge the importance of Ireland's wetlands to wintering waterbirds, “Wetland and Waterbirds” may be included as a Special Conservation Interest for some SPAs that have been designated for wintering waterbirds and that contain a wetland site of significant importance to one or more of the species of Special Conservation Interest. Thus, a further objective is to maintain or restore the favourable conservation condition of the wetland habitat within the North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA as a resource for the regularly occurring migratory waterbirds that utilise them.

It should be noted that some of the Natura 2000 sites overlap with each other and thus the conservation objectives for these sites should be used in conjunction with those for overlapping and adjacent sites as appropriate.

4.5 Baseline Data

4.5.1 Habitats

Survey surveys were carried out on the 3rd December 2020, 19th May 2021, 9th September 2021 and 8th March 2022 to identify the habitats, flora and fauna present at the site. Habitat mapping was carried out in line with the methodology outlined in the Heritage Council Publication, *Best Practice Guidance for Habitat Survey and Mapping* (Heritage Council, 2011). The terrestrial and aquatic habitats within or adjacent to the proposed development site was classified using the classification scheme outlined in the Heritage council publication *A Guide to Habitats in Ireland* (Fossitt, 2000) and cross referenced with Annex I Habitats where required. The survey results are representative of the habitats within the application site and include the dominant and characteristic species of flora.

An overview of habitats recorded within the site is shown in **Figure 4.** The habitats recorded onsite as well as their ecological value is detailed in **Table 5**. Site photographs are also included below. No rare plant species were recorded within the works area during the site survey and given the modified nature of the habitats within the proposed development area are highly unlikely to occur.

Table 5. Habitats recorded within proposed development site boundary

Habitat	Comments
Arable Crops BC1	The primary land use is for arable crops. The most common crop is Spring Barley *Hordeum vulgare*, which has been sown as a monocrop over much of the site area. Fields cultivated for arable crops are characterised by a limited diversity of grasses and herbaceous species. Species noted including Common Poppy *Papaver rhoes* and Common Field-Speedwell *Veronica persica* which are common weed species of this type of agricultural land. This habitat does not have links to Annex I habitat.
Dry meadow and grassy verges GS2	This habitat has developed on a bank between an existing hedgerow and drain. This habitat is dominated by common species including Cocksfoot *Dactylis glomerata*, Common Vetch *Vicia sativa* and Bramble *Rubus fruiticosus*. In absence of active management scrub species are likely to become more dominant (small area not mapped). Dry meadow and grassy verge loosely corresponds to the annexed habitat, 'lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) (6510)'. The dry meadow and grassy verge habitat within the study area is not a valuable example of this habitat type.
Dry meadow and grassy verges GS2/Tall Herb Swamp FS2	The section of the site south of the river is a mosaic of formerly grazed grassland and tall herb swamp vegetation along the riverbank. Currently this habitat is not actively managed or grazed with a preponderance of coarse grasses including False Oat Grass *Arrhenatherum elatius* and Cock's Foot *Dactylus glomerata* are common. Links with Annex I: *Corresponds to the annexed habitat, 'lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) (6510)'.* Areas of this habitat closer to the riverbank have some characteristics of tall herb swamp. These areas are occasionally waterlogged. They are dominated by Fool's Watercress *Apium nodiflorum* and Hemlock Water Droplet *Oenanthe crocata.* Patches of Soft Rush *Juncus effusus* and Common Reed *Phragmites australis* are

Habitat	Comments
	present but not dominant. Occasional trees, particularly Willow *Salix sp.,* are present with a small copse of Hawthorn *Crataegus monogynus* was also noted. Links with Annex I: Tall-herb swamps can include pockets of the annexed habitat 'hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)'. In Ireland, however, stands of the latter are usually fragmented and poorly developed. This is not a valuable example of this habitat type.
Hedgerows WL1/ Treelines WL2/	The site is generally bordered by hedgerows and treelines. These linear vegetated boundaries are not homogenous. Those along the southern and western boundaries of the site are classified as treelines, with taller trees (5m+). The dominant mature trees include Beech *Fagus sylvatica*, Sycamore *Acer pseudoplatanus* and Scots Pine *Pinus sylvestris*. Poplar *Populus sp.* also occurs. Understorey species include Bramble *Rubus fruticosus*, Elder *Sambucus nigra*, Cleavers *Galium aparine* and Common Vetch. Along the northern and eastern borders, linear vegetation is thinner and generally under 5m in height and these linear features are classified as hedgerows. The occasional, trees recorded include those mentioned above as well as Hawthorn and Sessile Oak *Quercus petraea*. Scrub vegetation is common and dominates in parts. Species noted include Rosebay Willowherb *Chamaenerion angustifolium*, Cow Parsley *Anthriscus sylvestris*, Guelder-Rose *Viburnum opulus*, Hedge Mustard *Sisymbrium officinale*, Groundsel *Senecio vulgaris*, Silverweed *Argentina anserine* and Dandelion *Taraxicum* spp. This habitat does not correspond to an Annex I habitat.
Mixed Broadleaved Woodland WD1	Some areas of wider woodland border the river in the southern section of the site. Some conifers are present, however broadleaved species predominate. The tallest and most mature specimens are Beech and Sessile Oak. Some Scots Pine and Sycamore are also present. The understory includes Sycamore, Hawthorn, Bracken *Pteridium aquilinum* and Common Vetch. There is a strong component of willow including Crack Willow *Salix fragilis* and Goat Willow *Salix caprea*. It therefore has elements of Riparian woodland but is unlikely to have significant levels of flooding. This habitat does not correspond to an Annex I habitat.
Drainage Ditch FW4	A drainage ditch runs through the site and along part of the northern site boundary. The channel is approximately 2m wide and flows are limited with isolated pools during low flow conditions. Instream vegetation includes Water Crowfoot *Ranunculus aquatalis* and Blanket Weed *Chlamydomonas* spp. Drier sections of the ditch support Soft Rush *Juncus effusus* and Meadow Grass *Poa annua.* Minnow *Phoxinus phoxinus* were noted in small pools, although this species is unlikely to persist during drier periods when the drain is essentially stagnant or dry. As this species is common in the River Liffey it can readily recolonise the drain when flows increase. Therefore, this habitat is not considered a critical resource for this species. The banks are overgrown with Bramble, Rosebay Willowherb, and Soft Rush. Small areas of riparian Given the limited size of the drain, limited prey availability and frequent dog usage this habitat is unlikely to be of significant value for Otter. No signs of Otter were recorded during site surveys. This habitat does not correspond to an Annex I habitat.

Habitat	Comments
Depositing/Lowland Rivers FW2	A meander of the River Liffey borders the south-western corner of the site. At this location the river is approximately 23m wide and fast-flowing with low, sloping banks. Filamentous algae along the stretch of the river covers a signficiant proportion of the riverbed, greatly reducing the overall value of the sites in terms of spawning and, to a lesser extent, nursery habitat. Bankside vegetation along the site boundary is dense with Bramble forming thickets. Bankside vegetation includes Elder, Beech, Sycamore, Hawthorn and the understory includes Bramble, Bracken, Nettle *Urtica dioica* and Hogweed *Heracleum sphondylium*. Hemlock Water-Dropwort *Oenanthe crocata* is very common at the waters edge. In-stream vegetation includes Water Crowfoot *Ranunculus peltatus*. The River Liffey supports Otter and it is considered probable that otter utlise the river and riparian habitat where the site borders the river. There is dense vegetation between the site and the river with dense bramble and mature trees which limits access. No evidence of Otter including spraints, slides, couches, feeding signs or holts were recorded. However taking a worst case scenario approach it is assumted that the Liffey where it adjoins the site is used by otter for foraging. FW2 has links to the Annex I habitat Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260). The River Liffey has not been designated as a Natura 2000 site but is considered a high value habitat at a regional level.
Buildings and Artificial Surfaces BL3	This habitat includes a number of buildings in the easter section of the site. These include the main central barn-shaped warehouse structure, a smaller warehouse structure, a one-storey dwelling, and a two-storey dwelling. Also included within the category are the existing roundabout, paths and yards surrounding these buildings. The warehouse buildings have concrete lower sections, with upper sections and roofs of Kingspan cladding. The residential houses are stone/concrete with tiled roofs and are currently in use. All structures are relatively modern and none have openings accessible to or suitable for bats. The only openings present are ventilator shafts on the large warehouse, but these are modern and well-maintained. This habitat does not have links to Annex I habitat
Riparian Woodland WN5	The section of the drainage ditch which runs parallel to the northern boundary has narrow strips of riparian woodland where periodic flooding occurs. Willows *Salix* spp are dominant with Alder *Alnus glutinosa and Gorse* also present. Wetland species such as Common Reed *Phragmites australis* and Reed Canary Grass *Phalaris arundinacea* are present but do not dominate. Other species noted include Nettle, Hemlock Water-Dropwort and Creeping Buttercup. WN5 has Links with *Annex I. Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0).* This is a small isolated area of habitat which is not of significant ecological value.

Figure 4. Habitat map

Photograph 1: Field of arable crops BC1 surrounding the main buildings. Looking west.

Photograph 2. Area of Hedgerow WL1 with Treeline WL2 beyond. Souther edge of site.

Photograph 3. Mixed Broadleaved Woodland WD1 at the south of the site.

Photograph 4. Stagnant area of the central Drainage Ditch FW4.

Photograph 5. River FW2 at accessible point, looking across at western bank.

Photograph 6. Main large central warehouse structure BL3. Eastern edge of structure.

Photograph 7. Smaller warehouse structure, southern edge.

Photograph 8. Residential house at northeast of site, southern edge.

4.5.2 Birds

Bird species listed in Annex I of the Birds Directive are considered a conservation priority. Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland (BOCCI). These are bird species suffering declines in population size. BirdWatch Ireland and the Royal Society for the Protection of Birds have identified and classified these species by the rate of decline into Red and Amber lists. Red List bird species are of high conservation concern and the Amber List species are of medium conservation concern. Green listed species are regularly occurring bird species whose conservation status is currently considered favourable (Gilbert et al. 2021).

Bird surveys were carried out in conjunction with habitat surveys on the 3rd December 2020, 19th May 2021, 9th September 2021 and 8th March 2022. During the survey, all birds seen or heard within the development site were recorded. Bird species listed in Annex I of the Birds Directive are considered a conservation priority. Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland (BOCCI). These are bird species suffering declines in population size. BirdWatch Ireland and the Royal Society for the Protection of Birds have identified and classified these species by the rate of decline into Red and Amber lists. Red List bird species are of high conservation concern and the Amber List species are of medium conservation. Green listed species are regularly occurring bird species whose conservation status is currently considered favourable. Birds species listed in Annex I of the Birds Directive (2009/147/EC) are considered a conservation priority. Species recorded within the site are shown in **Table 6**.

Table 6. Bird species recorded within proposed development site

Species		Birds Directive Annex	BOCCI	
		I	Red List	Amber List
Blackbird	*Tardus Turdus merula*			
Blue Tit	*Cyanistes caeruleus*			
Bullfinch	*Pyrrhula pyrrhula*			
Buzzard	*Buteo buteo*			
Chaffinch	*Fringilla coelebs*			
Chiffchaff	*Phylloscopus collybita*			
Collared Dove	*Streptopelia decaocta*			
European Swallow	*Hirundo rustica*			x
Great Tit	*Parus major*			
Hooded Crow	*Corvus cornix*			

Species		Birds Directive Annex	BOCCI	
		I	Red List	Amber List
House Sparrow	*Passer domesticus*			
Jackdaw	*Corvus monedula*			
Mistle Thrush	*Turdus piscivorus*			
Pheasant	*Phasianus colchicus*			
Robin	*Erithacus rubecula.*			
Rook	*Corvus frugiligus*			
Song Thrush	*Turdus philomelos*			
Willow Warbler	*Phylloscopus trochilus*			x
Wood Pigeon	*Columba palumbus*			
Yellowhammer	*Emberiza citrinella*		x	

Overall, the proposed development site is of local value for terrestrial bird species that are relatively common in the Irish countryside. Good quality treelines, woodland and hedgerows at the site provide a range of nesting habitat for common bird species.

No Annex I species were recorded at the site. The River Liffey which runs through the southwestern corner of the site could potentially provide foraging habitat for Kingfisher *Alcedo atthis*. However, no signs of Kingfisher were recorded during site surveys and due to the low sloping river banks at the site there is no suitable nesting habitat within the site or in proximity to the site boundary. No signs of wintering waders or waterfowl were recorded during site surveys. However, Whooper Swans are known to forage on agricultural grassland and cereal stubble in autumn and winter (Robinson et al, 2004). While Whooper Swan could potentially forage at the site during the winter months, given the large areas of arable farming in the region the area within the proposed development site does not provide critical habitat for this species.

One Red List species Yellowhammer *Emberiza citronella* (one singing male) was recorded within the treeline/hedgerow on the southern end of the site. Historically, this species was widespread throughout the country but has suffered declines due to the decrease in cereal crop cultivation in Ireland. Due to this decline, the majority of the Yellowhammer population is confined to the east and south of Ireland. An adult Yellowhammer will mainly feed on the grains produced by grasses and cereals with the young being fed various insect species. In Ireland, the Yellowhammer is strongly associated with cereal cultivation and by extension, is most commonly found in farmland, in close proximity to such crops.

Two Amber List species Swallow *Hirundo rustica* and Willow Warbler *Phylloscopus trochilus* were recorded. Swallow were recorded foraging at the site but no nest sites were recorded. Nesting Willow Warbler were recorded within the woodland habitat on the southern end of the site.

The Red List species Yellowhammer and Amber List species Willow Warbler were recorded within the site boundary but overall the site supports a mixture of terrestrial bird species that are relatively common in the Irish countryside. No Annex I species, were recorded within the proposed development site. Although species more speicalised species such as Grey Heron and Dipper may utilise riverine habitats, no signs of Kingfisher were noted.

4.5.3 Invasive Species

Non-native plants are defined as those plants which have been introduced outside of their native range by humans and their activities, either purposefully or accidentally. Invasive non-native species are so-called as they typically display one or more of the following characteristics or features: (1) prolific reproduction through seed dispersal and/or re-growth from plant fragments; (2) rapid growth patterns; and, (3) resistance to standard weed control methods.

Where a non-native species displays invasive qualities and is not managed it can potentially: (1) out compete native vegetation, affecting plant community structure and habitat for wildlife; (2) cause damage to infrastructure including road carriageways, footpaths, walls and foundations; and, (3) have an adverse effect on landscape quality. The NBDC lists a number of both aquatic and terrestrial high impact invasive plant species which have been recorded within hectad N81 (**Table 7**). It should be noted that this data relates to the entire 10km^2 area and these species will not necessarily occur within the proposed development site boundary.

Table 7. NBDC records of high impact invasive species from N81

Species Group	Species name
Flatworm (Turbellaria)	Arthurdendyus triangulatus
Flowering plant	Cherry Laurel (*Prunus laurocerasus*)
Flowering plant	Indian Balsam (*Impatiens glandulifera*)
Flowering plant	Japanese Knotweed (*Fallopia japonica*)
Insect - beetle (Coleoptera)	Harlequin Ladybird (*Harmonia axyridis*)
Terrestrial mammal	American Mink (*Mustela vison*)
Terrestrial mammal	Brown Rat (*Rattus norvegicus*)
Terrestrial mammal	Eastern Grey Squirrel (*Sciurus carolinensis*)
Terrestrial mammal	Fallow Deer (*Dama dama*)
Terrestrial mammal	House Mouse (*Mus musculus*)
Terrestrial mammal	Sika Deer (*Cervus nippon*)

Source: NBDC 11/02/22

The control of invasive species in Ireland comes under the Wildlife (Amendment) Act 2000, where it states that

'*Any person who— [...] plants or otherwise causes to grow in a wild state in any place in the State any species of flora, or the flowers, roots, seeds or spores of flora, ['refers only to exotic species thereof']*[...] *otherwise than under and in accordance with a licence granted in that behalf by the Minister shall be guilty of an offence.'*

The Birds and Natural Habitats Regulations 2011 (SI 477 of 2011), Section 49(2) prohibits the introduction and dispersal of species listed in the Third Schedule, which includes Japanese Knotweed (*Fallopia japonica*), as follows: "any person who plants, disperses, allows or causes to disperse, spreads or otherwise causes to grow [….] shall be guilty of an offence."

The third schedule invasive species Himalayan Balsam *Impatiens glandulifera* was recorded along the banks of the River Liffey the proposed development site (**Figure 5**). Himalayan Balsam is a member of the busy Lizzie family (Balsaminacea) and as its name suggests, is native to the Himalaya region of Asia. It was introduced as a garden plant in the mid-1800's (Royal Horticultural Society 2008a) and quite swiftly became established along waterways and in other damp places by means of its prolific seed production. It is an annual plant forming dense upright stands approximately 1m tall where it effectively out- competes surrounding herbs and grasses. It is tolerant of shade and does very well in the canopy of riparian woodland. In the autumn it dies back leaving the ground bare and vulnerable to erosion.

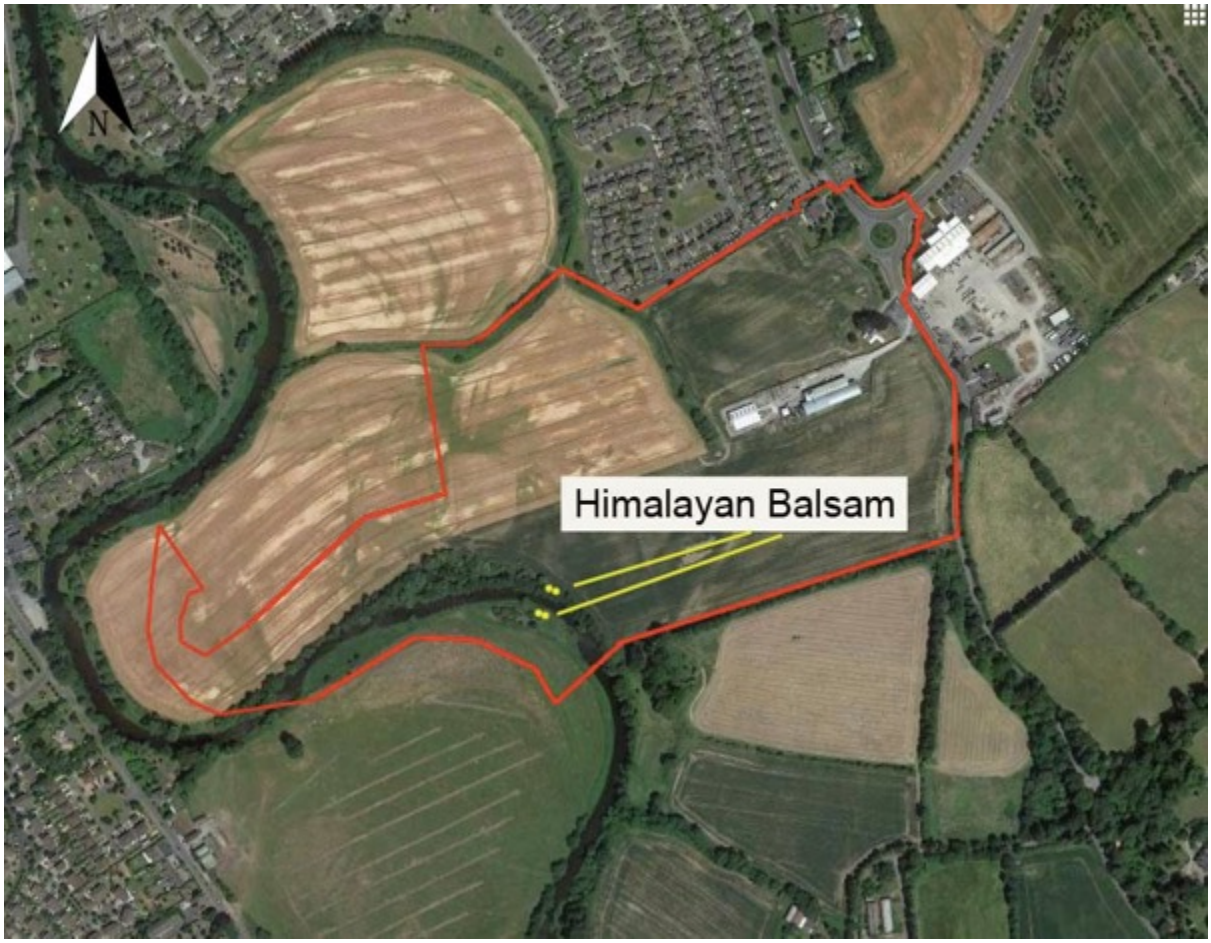


Figure 5. Himalayan Balsam location within proposed development site

4.5.4 River Basin Management Plan for Ireland 2015 – 2018 (2nd Cycle)

The Water Framework Directive (WFD) sets out the environmental objectives which are required to be met through the process of river basin planning and implementation of those plans. Specific objectives are set out for surface water, groundwater and protected areas. The challenges that must be overcome in order to achieve those objectives are very significant. Therefore, a key purpose of the River Basin Management Plan (RBMP) is to set out priorities and ensure that implementation is guided by these priorities.

The second-cycle RBMP aims to build on the progress made during the first cycle. Key measures during the first cycle included the licensing of urban waste-water discharges (with an associated investment in urban waste-water treatment) and the implementation of the Nitrates Action Programme (Good Agricultural Practice Regulations). The former measure has resulted in significant progress in terms both of compliance levels and of the impact of urban waste-water on water quality. The latter provides a considerable environmental baseline which all Irish farmers must achieve and has resulted in improving trends in the level of nitrates and phosphates in rivers and groundwater. It is acknowledged, however, that sufficient progress has not been made in developing and implementing supporting measures during the first cycle.

Overall, RBMP assesses the quality of water in Ireland and presents detailed scientific characterisation of our water bodies. The characterisation process also takes into account wider water quality considerations, such as the special water-quality requirements of protected areas. The characterisation process identifies those water bodies that are *At Risk* of not meeting the objectives of the WFD, and the process also identifies the significant pressures causing this risk. Based on an assessment of risk and pressures, a programme of measures has been developed to address the identified pressures and work towards achieving the required objectives for water quality and protected areas. Data relating to the watercourses within the study area is provided in **Table 8** and the location of these shown in **Figure 6.**

Treated wastewater from the proposed development site will ultimately be discharged to the Upper River Liffey via a primary discharge point from the Upper Liffey Valley Sewerage Scheme Wastewater Treatment Plant (WWTP). Results from the 2nd cycle of the WFD for waterbodies near the proposed development site and WWTP discharge point are discussed **Table 8**.

Table 8. WFD Status

Catchment: Liffey and Dublin Bay (Code 9) – 2nd Cycle
This catchment includes the area drained by the River Liffey and by all streams entering tidal water between Sea Mount and Sorrento Point, Co. Dublin, draining a total area of 1,616km2. The largest urban centre in the catchment is Dublin City. The other main urban centres are Dun Laoghaire, Lucan, Clonee, Dunboyne, Leixlip, Maynooth, Kilcock, Celbridge, Newcastle, Rathcoole, Clane, Kill, Sallins, Johnstown, Naas, Newbridge, Athgarvan, Kilcullen and Blessington. The total population of the catchment is approximately 1,255,000. **The Liffey catchment contains the largest population of any catchment in Ireland and is characterised by a sparsely populated, upland south eastern area and a densely populated, flat, low lying area over the remainder of the catchment basin.** **The Liffey catchment comprises 17 sub-catchments with 77 river water bodies, six lakes, six transitional and five coastal water bodies, and 16 groundwater bodies** **The proposed development site is in the Liffey_080 River Water Body. Status Reports have been prepared this Water Body. Status means the condition of the water in a watercourse and is defined by its ecological and chemical conditions, whichever is worse. Water Bodies are ranked in one of five classes,' High', 'Good', 'Moderate', 'Poor' and 'Bad'.** **The WFD requires measures to ensure waters achieve at least 'Good Status' by 2015 and that their current status does not deteriorate. Where necessary, for example in heavily impacted or modified watercourses, extended deadlines (2021 and 2027) have been set for achieving the following objectives:** **• Prevent Deterioration** **• Restore Good Status** **• Reduce Chemical Pollution** **• Achieve Protected Areas Objectives** **The objectives for particular watercourses are based on 'Pressure and Impact Assessments' of human activity, including point and diffuse emissions, land use and morphological conditions on surface waters to identify those water bodies that are 'At Risk' of failing to meet the WFD objectives. The ecological status/potential of the LIFFEY_080 is classified as 'Good' and the river is 'Not at Risk' of meeting its RBMP objectives. The WWTP discharge point is located in the Liffey_SC_060 sub-catchment. This small sub-catchment only contains three waterbodies. Liffey_100 requires further investigative assessment to identify the source of the pressure believed to be the WWTP. Although Liffey_110 is unassigned Kildare**

Catchment: Liffey and Dublin Bay (Code 9) – 2nd Cycle			
CoCo indicated pressure from a pumping station that needs to be considered. In Liffey_120 there is elevated P and NH3. There are known issues with a historic landfill in the waterbody and also urban diffuse pressures from Naas. The status of waterbodies in the vicinity of Dublin Bay are also described below.			
Waterbodies relevant to the proposed project (2nd Cycle)			
Waterbody	WFD Status	Risk	**Pressure Category** **WFD Status**
Liffey_080	Good	Not at risk	n/a
Liffey_100	Moderate	Review	Urban wastewater
Liffey_120	Good	Not at risk	n/a
Liffey Estuary	Good	At risk	Urban wastewater
Dublin Bay	Good	Not at risk	n/a

Source: EPA envision mapping and www.catchments.ie 22/04/2021

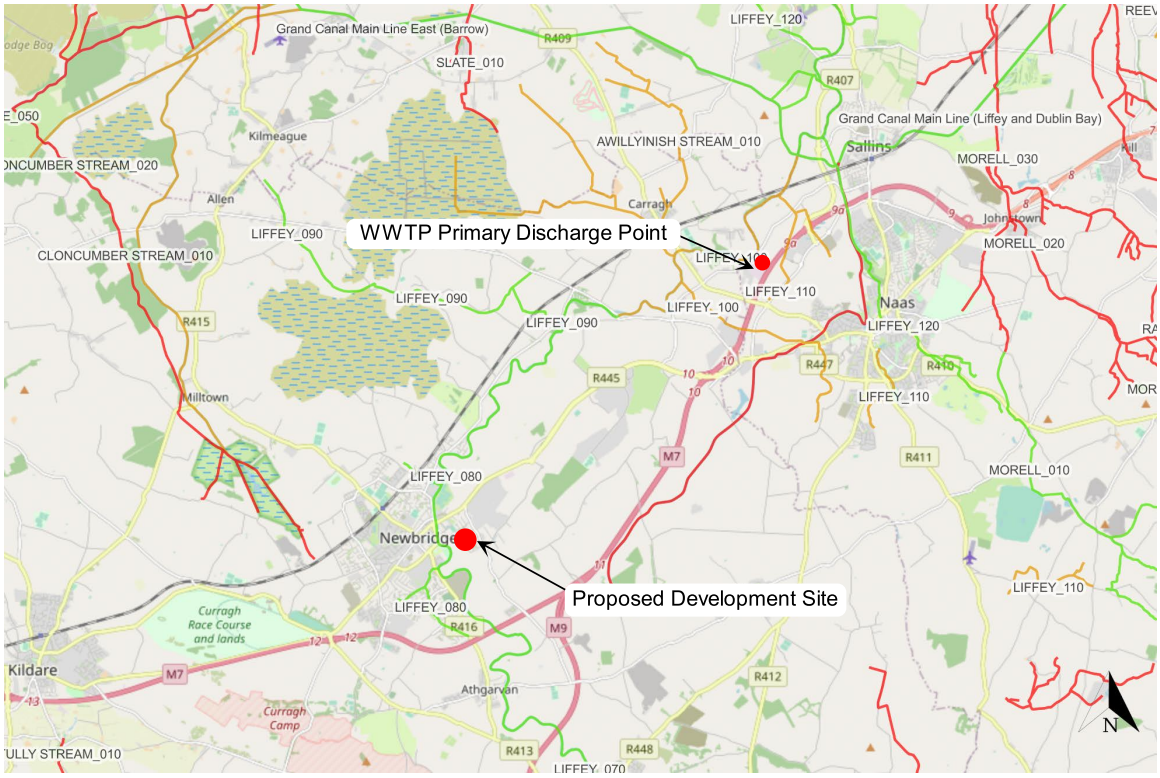


Figure 5. WFD 2nd cycle - waterbodies in the vicinity of the proposed development | Source: EPA Envision mapping | not to scale. Red lines 'At Risk'.

4.5.5 Urban Wastewater Treatment Directive

The Waste Water Discharge (Authorisation) Regulations 2007 (S.I. 684 of 2007) gives effect to the requirements of the Urban Waste Water Treatment Directive (Directive 91/271/EEC) and the Water Framework Directive (2000/60/EC) in Ireland. The Urban Waste Water Treatment Directive (UWWTD) lays down the requirements for the collection, treatment and

discharge of urban waste-water and specifies the quality standards which must be met — based on agglomeration size — before treated waste-water is released into the environment.

The priority objective for this river basin planning cycle is to secure compliance with the Urban Waste Water Treatment Directive and to contribute to the improvement and protection of waters in keeping with the water-quality objectives established by this Plan. Achieving this objective entails addressing waste-water discharges and overflows where protected areas (i.e. designated bathing waters and shellfish waters) or high-status waters are at risk from urban waste-water pressures.

As part of the proposed development wastewater discharging from the proposed development will be conveyed to the Upper Liffey Sewerage Scheme WWTP (D0002-01) for treatment prior to discharging into the River Liffey.

5. Impact Assessment

5.1 Introduction

The AA screening report, accompanying this application, identified potential significant effects on the South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA. **Sections 3 and 4** of this report are relevant to informing the Natura Impact Statement (NIS) in that the proposed development and receiving environment is described in sufficient detail. This NIS now examines and analyses, in light of the best scientific knowledge, with respect to this Natura 2000 site within the zone of influence of the proposed development, the potential effect sources and pathways, how these could impact on the qualifying habitats and SCI species and whether the predicted effects would adversely affect the integrity of the South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA.

Mitigation measures are set out within the NIS and ensure that any effects on the conservation objectives of South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA will be avoided during the proposed development such that there will be no risk of adverse effects on South Dublin Bay SAC, North Dublin Bay SAC, North Bull Island SPA and the South Dublin Bay & River Tolka Estuary SPA.

5.2 Status of Qualifying Interests in North Dublin SAC and South Dublin Bay SAC

5.2.1 Mudflats and sandflats not covered by seawater at low tide (1140), Salicornia and other annuals colonising mud and sand (1310), salt meadows (Glauco-Puccinellietalia maritimae) (ASM) (1330) and Mediterranean salt meadows (J*uncetalia maritimi*) (MSM) (1410)

Mudflats and sandflats not covered by seawater at low tide (1140), Salicornia and other annuals colonising mud and sand (1310), salt meadows (Glauco-Puccinellietalia maritimae) (ASM) (1330) and Mediterranean salt meadows (*Juncetalia maritimi*) (MSM) (1410) are qualifying habitats for the North Dublin Bay SAC. Mudflats and sandflats not covered by seawater at low tide [1140] and Salicornia and other annuals colonising mud and sand [1310] are qualifying habitats for the South Dublin Bay SAC.

Saltmarshes are stands of vegetation that occur along sheltered coasts, mainly on mud or sand, and are flooded periodically by the sea. They are restricted to the area between mid-neap tide level and high-water spring tide level. The three qualifying habitats are listed under Annex I of the EU Habitats Directive (92/43/EEC):

Within North Dublin Bay SAC the areas of Salicornia habitat are situated in a large area on the mudflats, north of the causeway called the Salicornia bank. This area developed soon after the construction of the causeway in 1964 so this section of habitat is relatively young. This area also contains frequent clumps of common cordgrass (*Spartina anglica*) which can be quite dense in places (McCorry, 2007).

The main area of saltmarsh is dominated by ASM with several areas supporting MSM as indicated by clumps of sea rush (*Juncus maritimus*) at the back of the saltmarsh (McCorry, 2007).

Human communities and industries often discharge wastewaters into estuaries, influencing their organic and pollutant loading, benthic community and trophic structure. The deleterious effects of excessive nutrient enrichment include increases in the frequency and duration of phytoplankton blooms (in some cases of nuisance and toxin emitting species), depletion of dissolved oxygen resulting in the mortality of marine organisms, and changes to the structure and functioning of marine food webs. In addition, nutrient enriched waters may experience excessive growth and stranding's of macroalgae that typically produce very strong odours and visual impact as they degrade on beaches and shorelines (EPA, 2008).

The position of estuaries at the foot of the watershed and their open connection to the sea makes them subject to almost continuous input of nutrients (Neilson & Cronin, 1981). Although estuaries cycle large quantities of nutrients, these same nutrients if put in excessive amounts can be highly detrimental to estuarine and coastal ecosystems (Neilson & Cronin, 1981).

The overall objective for these habitats in North Dublin Bay Complex SAC is to 'restore the favourable conservation condition'. The specific conservation targets for this SAC are listed in **Table 9**.

The overall objective for these habitats in South Dublin Bay SAC is to 'restore the favourable conservation condition'. The specific conservation targets for this SAC are listed in **Table 10**.

5.2.2 Annual vegetation of drift lines [1210], Embryonic shifting dunes [2110], Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120], Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130], Humid dune slacks [2190]

Annual vegetation of drift lines [1210], Embryonic shifting dunes [2110], Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120], Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130] and Humid dune slacks [2190] are qualifying habitats for North Dublin Bay SAC.

Annual vegetation of drift lines [1210] and Embryonic shifting dunes [2110] are qualifying habitats for South Dublin Bay SAC.

These are terrestrial habitats with no pathway for impact via surface water discharges. Given the distance from the proposed development site, and the terrestrial nature of these habitats

no potential effects on these habitats will occur. Therefore they are not addressed further in this NIS.

5.2.3 *Petalophyllum ralfsii* (Petalwort) [1395]

Petalwort is a qualyfing interest for the North Dublin Bay SAC. This species occurs on terrestrial habitat and there is no pathway for impact via surface water discharges. Therefore this species is not addressed further in this NIS.

Table 9. QI habitats in North Dublin Bay SAC for which a potential impact has been identified – specific targets

Habitats	Attribute	Measure	Target
Mudflats and sandflats not covered by seawater at low tide	Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes
	Community distribution	Hectares	Conserve the following community type in a natural condition: Mixed sediment to sandy mud with polychaetes and oligochaetes community complex
	Community structure: Mytilus edulis density	Individuals/m2	Conserve the high quality of the Mytilus edulis- dominated community, subject to natural processes
	Community distribution	Hectares	Conserve the following community types in a natural condition: Fine sand to sandy mud with Pygospio elegans and Crangon crangon community complex; Fine sand with Spio martinensis community complex
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: North Bull Island - 81.84ha.
	Habitat distribution	Occurrence	No decline or change in habitat distribution, subject to natural processes.
	Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain/restore natural circulation of sediments and organic matter, without any physical obstructions
	Physical structure: creeks and pans	Occurrence	Maintain/restore creek and pan structure, subject to natural processes, including erosion and succession
	Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime
	Vegetation structure: zonation	Occurrence	Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession
	Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward
	Vegetation structure: vegetation cover	Percentage cover at a representative number of monitoring stops	Maintain more than 90% area outside creeks vegetated

Habitats	Attribute	Measure	Target
	Vegetation composition: typical species and subcommunities	Percentage cover at a representative number of monitoring stops	Maintain range of subcommunities with typical species listed in SMP (McCorry and Ryle, 2009)
	Vegetation structure: negative indicator species - *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is known to occur
Salicornia and other annuals colonising mud and sand	Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: North Bull Island - 29.10ha
	Habitat distribution	Occurrence	No decline or change in habitat distribution, subject to natural processes.
	Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain/restore natural circulation of sediments and organic matter, without any physical obstructions
	Physical structure: creeks and pans	Occurrence	Maintain/restore creek and pan structure, subject to natural processes, including erosion and succession
	Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime
	Vegetation structure: zonation	Occurrence	Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession
	Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward
	Vegetation structure: vegetation cover	Percentage cover at a representative number of monitoring stops	Maintain more than 90% area outside creeks vegetated
	Vegetation composition: typical species and subcommunities	Percentage cover at a representative number of monitoring stops	Maintain range of subcommunities with typical species listed in SMP (McCorry and Ryle, 2009)
	Vegetation structure: negative indicator species - *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is known to occur
Mediterranean salt meadows (*Juncetalia maritimi*)	Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: North Bull Island - 7.98ha.
	Habitat distribution	Occurrence	No decline or change in habitat distribution, subject to natural processes.
	Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain/restore natural circulation of sediments and organic matter, without any physical obstructions
	Physical structure: creeks and pans	Occurrence	Maintain/restore creek and pan structure, subject to natural processes, including erosion and succession
	Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime
	Vegetation structure: zonation	Occurrence	Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession

Habitats	Attribute	Measure	Target
	Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward
	Vegetation structure: vegetation cover	Percentage cover at a representative number of monitoring stops	Maintain more than 90% area outside creeks vegetated
	Vegetation composition: typical species and subcommunities	Percentage cover at a representative number of monitoring stops	Maintain range of subcommunities with typical species listed in SMP (McCorry and Ryle, 2009)
	Vegetation structure: negative indicator species - *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is known to occur

Table 10. QI habitats in South Dublin Bay SAC for which a potential impact has been identified – specific targets

Habitats	Attribute	Measure	Target
Mudflats and sandflats not covered by seawater at low tide	Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes
	Community distribution	Hectares	Conserve the following community type in a natural condition: Mixed sediment to sandy mud with polychaetes and oligochaetes community complex
	Community structure: Mytilus edulis density	Individuals/m2	Conserve the high quality of the Mytilus edulis- dominated community, subject to natural processes
	Community distribution	Hectares	Conserve the following community types in a natural condition: Fine sand to sandy mud with Pygospio elegans and Crangon crangon community complex; Fine sand with Spio martinensis community complex
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: North Bull Island - 81.84ha.
	Habitat distribution	Occurrence	No decline or change in habitat distribution, subject to natural processes.
	Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain/restore natural circulation of sediments and organic matter, without any physical obstructions
	Physical structure: creeks and pans	Occurrence	Maintain/restore creek and pan structure, subject to natural processes, including erosion and succession
	Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime
	Vegetation structure: zonation	Occurrence	Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession

Habitats	Attribute	Measure	Target
	Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward
	Vegetation structure: vegetation cover	Percentage cover at a representative number of monitoring stops	Maintain more than 90% area outside creeks vegetated
	Vegetation composition: typical species and subcommunities	Percentage cover at a representative number of monitoring stops	Maintain range of subcommunities with typical species listed in SMP (McCorry and Ryle, 2009)
	Vegetation structure: negative indicator species - *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is known to occur
Salicornia and other annuals colonising mud and sand	Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: North Bull Island - 29.10ha
	Habitat distribution	Occurrence	No decline or change in habitat distribution, subject to natural processes.
	Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain/restore natural circulation of sediments and organic matter, without any physical obstructions
	Physical structure: creeks and pans	Occurrence	Maintain/restore creek and pan structure, subject to natural processes, including erosion and succession
	Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime
	Vegetation structure: zonation	Occurrence	Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession
	Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward
	Vegetation structure: vegetation cover	Percentage cover at a representative number of monitoring stops	Maintain more than 90% area outside creeks vegetated
	Vegetation composition: typical species and subcommunities	Percentage cover at a representative number of monitoring stops	Maintain range of subcommunities with typical species listed in SMP (McCorry and Ryle, 2009)
	Vegetation structure: negative indicator species - *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is known to occur
Mediterranean salt meadows (*Juncetalia maritimi)*	Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: North Bull Island - 7.98ha.
	Habitat distribution	Occurrence	No decline or change in habitat distribution, subject to natural processes.
	Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain/restore natural circulation of sediments and organic matter, without any physical obstructions
	Physical structure: creeks and pans	Occurrence	Maintain/restore creek and pan structure, subject to natural processes, including erosion and succession
	Physical structure:	Hectares flooded;	Maintain natural tidal

Habitats	Attribute	Measure	Target
	flooding regime	frequency	regime
	Vegetation structure: zonation	Occurrence	Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession
	Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward
	Vegetation structure: vegetation cover	Percentage cover at a representative number of monitoring stops	Maintain more than 90% area outside creeks vegetated
	Vegetation composition: typical species and subcommunities	Percentage cover at a representative number of monitoring stops	Maintain range of subcommunities with typical species listed in SMP (McCorry and Ryle, 2009)
	Vegetation structure: negative indicator species - *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is known to occur

5.3 Status of Special Conservation Interests (SCIs) for North Bull Island SPA

North Bull Island lies roughly parallel to the shore and is a low-lying sandy spit, about 4.85 km long and 0.70 km wide (McCorry & Ryle, 2009a). It is a relatively recent geomorphological feature having emerged as a result of the build-up of sediment overt the last 200 years following the construction of the South and North Bull walls during the 18 and 19 centuries. The North Bull Wall marks the southern boundary of the island and is connected to the mainland by a wooden bridge. The island is actively accreting (Ryle *et a*l. 2009). A sandy beach, Dollymount Strand, occurs on the seaward side of the island and intertidal mudflats occur on the inner (mainland side) fringed by saltmarsh. A causeway built in 1965 provides the main access to the island and divides the intertidal flats into two areas known as the North and South Bull lagoons. Both of these are covered completely by most tides and are drained by permanent channels; the southern lagoon fills and empties beneath Bull Bridge, while water in the northern lagoon is channelled in and out through Sutton Creek (Harris, 1977). These lagoons provide the main feeding grounds for the wintering waterfowl while the fringing saltmarsh provides the main roost site for wintering birds in Dublin Bay. Macroalgal mats of filamentous Ulva spp. (formerly Enteromorpha spp.)1 are prevalent.

North Bull Island is one of the finest sand dune systems in Ireland and is internationally important in terms of conservation value (McCorry & Ryle, 2009a). It has several high quality examples of rare and threatened coastal habitats and a wealth of biodiversity, which includes several habitats and species listed in Annexes I and II of the EU Habitats Directive. As a consequence, North Bull Island is afforded several other nature conservation designations alongside its status as a Special Protection Area. It was designated as an official bird sanctuary under the Wild Bird Protection Act, 1931, the first bird sanctuary in Ireland (McCorry & Ryle, 2009a), and was established as a National Nature Reserve in 1988 (two parts covered by S.I. 231 and S. I. 232 of 1988). The site has been designated as part of a Special Area of Conservation (North Dublin Bay SAC - NPWS site code 000206). North Bull Island is also a Biogenetic Reserve (Council of Europe) and a UNESCO World Biosphere Reserve.

The specific conservation objectives for species listed as conservation interests for the North Bull Island SPA (**Table 11**) are to maintain a favourable conservation condition of the non-breeding waterbirds and to maintain the favourable conservation condition of the wetland habitat at the SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.

These species are listed as SCIs for the North Bull Island SPA for the following reasons:

During winter the site regularly supports 1% or more of the biogeographic population of Light-bellied Brent Geese.

During winter the site regularly supports 1% or more of the all-Ireland population of each of the following species: Shelduck, Teal, Pintail, Shoveler, Oystercatcher, Golden Plover, Grey Plover, Knot, Sanderling, Dunlin, Bar-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank and Turnstone.

During winter the mean peak number of wintering Black-headed Gull within the site during the baseline period exceeds the selection threshold set for this species.

The wetland habitats contained within North Bull Island SPA are identified of conservation importance for non-breeding (wintering) migratory waterbirds. Therefore, the wetland habitats are considered to be an additional Special Conservation Interest.

The conservation targets for these species with North Bull Island SPA are listed in **Table 11**.

Table 11. SCI species of North Bull Island SPA for which a potential impact has been identified – specific targets

Species/Habitats	Attribute	Measure	Target
Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] **Shelduck (*Tadorna tadorna)* [A048]**	Population trend	Percentage change	Long term population trend stable or increasing
Teal (*Anas crecca)* [A052] **Pintail (*Anas acuta*) [A054]** **Shoveler (*Anas clypeata*) [A056]**	Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by each species, other than that occurring from natural patterns of variation

Oystercatcher (*Haematopus ostralegus*) [A130] **Golden Plover (*Pluvialis apricaria*) [A140]** **Grey Plover (*Pluvialis squatarola*) [A141]** **Knot (*Calidris canutus*) [A143]** **Sanderling (*Calidris alba*) [A144]** **Dunlin (*Calidris alpina*) [A149]** **Black-tailed Godwit (*Limosa limosa)* [A156]** **Bar-tailed Godwit (*Limosa lapponica*) [A157]** **Curlew (*Numenius arquata*) [A160]** **Redshank (*Tringa totanus*) [A162]**			

Turnstone (*Arenaria interpres*) [A169] **Black-headed Gull (*Chroicocephalus ridibundus*) [A179]**			
Wetlands	Habitat area	Hectares	The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 1,713 hectares, other than that occurring from natural patterns of variation

5.4 Status of Special Conservation Interests (SCIs) for South Dublin Bay and River Tolka SPA

The South Dublin Bay and River Tolka Estuary SPA comprises a substantial part of Dublin Bay. It includes the expanse of intertidal habitat between the River Liffey and Dún Laoghaire plus the estuary of the River Tolka to the north of the River Liffey. A portion of the shallow marine waters of the bay is also included. The site also includes a small (c.4ha) brackish marsh called Booterstown Marsh.

In the south bay, the intertidal flats extend for almost 3 km at their widest. The sediments are predominantly well-aerated sands with Sandymount Strand dominating the narrower Merrion Strand further south. Sediments in the Tolka Estuary vary from soft muds with a high organic content in the inner estuary to exposed, well-aerated sands off the Bull Wall. Some bedrock shore occurs near Dún Laoghaire. The landward boundary is now almost entirely artificially embanked and bordered by road or railway.

A bed of Dwarf Eelgrass (Zostera noltii) occurs near Merrion Gates and is the largest known stand on the east coast. Green macroalgal mats occur at low densities. A sand bar has developed between Merrion Gates and Booterstown Railway Station. Sand bars are used as roosts by waders, gulls and terns as the tide floods and ebbs in the south bay. Embryonic dune, strandline vegetation and some marram dune also occur.

Booterstown Marsh lies approximately 3 miles south of Dublin City. The marsh is brackish in nature and developed during the 19th century after being separated from Merrion Strand by the building of an embankment which carries the Dublin/Wexford railway line. It is bounded to the west by the Dublin to Blackrock road. The marsh drains by a series of sluices and one main outflow (Williamstown Creek) to the south-east of the railway (DART) station. Primarily a brackish marsh, some fragmented saltmarsh occurs along its fringes. This is the only remaining area of saltmarsh in South Dublin Bay although this habitat would have fringed a large section of this area in the past (Dún Laoghaire-Rathdown County Council, 2009). Large parts of the marsh are unvegetated with bare intertidal mudflats. Salinity levels fluctuate on a regular basis due to the combination of freshwater inputs from two streams and tidal influence.

These species are listed as SCIs for the South Dublin Bay and River Tolka SPA for the following reasons:

- During winter the site regularly supports 1% or more of the biogeographic population of Light-bellied Brent Geese.
- During winter the site regularly supports 1% or more of the all-Ireland population of each of the following species: Oystercatcher, Knot, Sanderling, Dunlin, Bar-tailed Godwit, Redshank and Ringed Plover

The winter mean peak number of Black-headed Gull within the site during the baseline period exceeds the selection threshold set for this species.

During the breeding season this site supports a colony of Common Tern which exceeds the All-Ireland 1% threshold for this Annex I species.

This site is selected as an important passage area for three migratory waterbird species based on significant concentrations recorded, as follows: Common Tern, Arctic Tern and Roseate Tern.

The conservation targets for these species with South Dublin Bay and River Tolka Estuary SPA are listed in **Table 12**.

Table 12. SCI species of South Dublin Bay and River Tolka SPA for which a potential impact has been identified – specific targets

Species/Habitats	Attribute	Measure	Target
Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] **Oystercatcher (*Haematopus ostralegus*) [A130]**	Population trend	Percentage change	Long term population trend stable or increasing
Ringed Plover (*Charadrius hiaticula)* [A137] **Knot (*Calidris canutus*) [A143]** **Sanderling (*Calidris alba*) [A144]** **Dunlin (*Calidris alpina*) [A149]**	Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by each species, other than that occurring from natural patterns of variation

Bar-tailed Godwit (*Limosa lapponica*) [A157] **Redshank (*Tringa totanus)* [A162]** **Black-headed Gull (*Chroicocephalus ridibundus*) [A179]**			
Common Tern (*Sterna hirundo*) [A193]	Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline
	Productivity rate: fledged young per breeding pair	Mean number	No significant decline
	Passage population individuals	Number	No significant decline
	Distribution: breeding colonies	Number; location; area (hectares)	No significant decline
	Prey biomass available	Kilogrammes	No significant decline
	Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase
	Disturbance at the breeding site	Level of impact	Human activities should occur at levels that do not adversely affect the breeding common tern population
	Disturbance at roosting sites	Level of impact	Human activities should occur at levels that do not adversely affect the numbers of common tern among the post-breeding aggregation of terns

Roseate Tern (*Sterna dougallii*) [A192] **Arctic Tern (*Sterna paradisaea)* [A194]**	Passage population individuals	Number	No significant decline
	Prey biomass available	Kilogrammes	No significant decline
	Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase
	Distribution of roosting site	Number; location; shape; area (hectares)	No significant increase
	Disturbance at roosting sites	Level of impact	Human activities should occur at levels that do not adversely affect the numbers of common tern among the post-breeding aggregation of terns
Wetlands	Habitat area	Hectares	The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 2,192 hectares, other than that occurring from natural patterns of variation

5.5 Assessment of Potential Impacts

All potential impacts would relate to direct and indirect impacts to relevant habitats and fauna of South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA. The assessment of impacts is based on the EC (2018) *Managing Natura 2000 Sites: The Provision of Article 6 of the Habitats Directive 92/43/EEC*, professional judgement and criteria or standards where available.

The potential impacts associated with the development are discussed in the following section with respect to their likelihood to have had or to have significant impacts on Natura 2000 sites. As part of the assessment direct, indirect and cumulative impacts were considered. Direct impacts refer to habitat loss or fragmentation arising from land-take requirements for development. Indirect and secondary impacts do not have a straight-line route between cause and effect, and it is potentially more challenging to ensure that all the possible indirect impacts of the project/plan – in combination with other plans and projects have been established.

As part of the assessment the potential for impacts associated with the proposed development were reviewed as outlined below:

- Impacts from surface water runoff during construction
- Impacts from surface water runoff during operation
- Impacts from wastewater discharges during construction
- In-combination impacts

5.5.1 Impacts on surface water quality during construction

Potential impacts on aquatic habitats which can arise from surface water emissions associated with the construction phase of the proposed development include increased silt levels in surface water run-off and inadvertent spillages of hydrocarbons from fuel and hydraulic fluid.

High levels of silt can impact on fish species, in particular salmonids. If of sufficient severity, adult fish could theoretically be affected by increased silt levels as gills may become damaged by exposure to elevated suspended solids levels. If of sufficient severity, aquatic invertebrates may be smothered by excessive deposits of silt from suspended solids. In areas of stony substrate, silt deposits may result in a change in the macro-invertebrate species composition, favouring less diverse assemblages and impacting on sensitive species. Cement can also affect fish, plant life and macroinvertebrates by altering pH levels of the water. Aquatic plant communities may also be affected by increased siltation. Submerged plants may be stunted and photosynthesis may be reduced. Such run-off if severe could potentially impact on water quality and thus could impact on aquatic species.

Inadvertent spillages of hydrocarbon and/or other chemical substances could introduce toxic chemicals into the aquatic environment via direct means, surface water run-off or groundwater contamination. Some hydrocarbons exhibit an affinity for sediments and thus become entrapped in deposits from which they are only released by vigorous erosion or turbulence. Oil products may contain various highly toxic substances, such as benzene, toluene, naphthenic acids and xylene which are to some extent soluble in water; these penetrate into the fish and can have a direct toxic effect. The lighter oil fractions (including kerosene, petrol, benzene, toluene and xylene) are much more toxic to fish than the heavy fractions (heavy paraffins and tars). In the case of turbulent waters, the oil becomes dispersed as droplets into the water. In such cases, the gills of fish can become mechanically contaminated and their respiratory capacity reduced (Svobodova *et al.* 1993). Aquatic plant communities may also be affected by increased siltation. Submerged plants may be stunted and photosynthesis may be reduced. Significant impacts on fish stocks or invertebrate prey could potentially impact on piscivorous species including Common Tern, Roseate Tern and Arctic Tern or wading birds such as Golden Plover and Black-tailed Godwit due to a reduction in prey availability.

During the construction phase, the scale of the works will be small and there is no potential for significant hydrocarbon spills. Therefore, in the unlikely event of a minor hydrocarbon spill and in the context of the available dilution in the River Liffey, impacts are highly unlikely to occur. However, given the hydrological connection of the proposed development to Dublin Bay, the precautionary principle has been applied and mitigation measures to prevent hydrocarbon (and other chemical) runoff during the construction phase have been outlined in **Section 6** of this report. These measures include a 80m riparian strip along the River Liffey where no constructing works will take place.

Although unlikely given the distance from South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA and the dilution available with the River Liffey, there is potential for contamination arising during construction works. Therefore, in order to prevent any risk of impacts from siltation a range of standard water protection measures have been included in **Section 6** of this report, to ensure there is no impact on the South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA from surface water runoff during the construction phase. Therefore, the proposed development will have no impact on the integrity of these Natura 2000 sites due to surface water runoff during the construction phase.

5.5.2 Impacts from Surface Water During Operation

A new surface water sewer network shall be provided for the proposed development. The proposed surface water drainage network will serve the developed section of the site. Due to the topography across the site, it is not possible to drain the entire site via one outfall. As such it is proposed to discharge via four outlets to the existing ditch which passes through the mid-northern portion of the site and two outlets to the River Liffey to the west.

All surface water drainage within the site will fall via gravity to the various surface water outfalls. Flows from the development will be limited to greenfield runoff rates and appropriate attenuation will be provided. Therefore, total discharge will be limited to the greenfield runoff rate of 76.31 l/s.

The proposed link road which will traverse the site is to be drained separately to the development drainage. A dedicated surface water drainage line will be provided for the road which will discharge to a dedicated attenuation system. As an additional treatment measure, the surface water will be routed through petrol interceptors prior to discharge to the River Liffey.

The flow from the road will also be limited to greenfield rates and will connect to the proposed development drainage downstream of the hydrobrake. It is proposed that all surface water run-off from trafficked areas will outfall via Class 1 Bypass Separator located downstream of the proposed attenuation tanks. These devices will remove hydrocarbons and fine sediment particles from the site runoff and lower the risk of downstream contamination following an oil spillage on site. In addition to the underground attenuation tanks, the following Sustainable Urban Drainage Systems (SuDs) are incorporated into the design including permeable paving, swales/bioswales, green roofs, soakaways/soak pits and rainwater harvesting.

Updated baseline modelling carried out by JBA Consulting as part of the Flood Risk Assessment (RFA) confirms that the site is partially within Flood Zone A and B from overland flow routes of the River Liffey. The proposed development provides compensatory storage compensate for the loss of Flood Zone A. Overall the proposed development will be at low risk of flooding and will not increase the flood risk to the surrounding areas. It is noted that an independent peer review was complete on the flood strategy for the proposed development was carried out by Arup and the results of this confirms the proposed flood risk assessment.

Given the operational design measures and the lack of changes in flows/flood risk to surrounding area, the proposed development will have no impact on the integrity of these Natura 2000 sites due to surface water runoff during the operational phase.

5.5.3 Impact from Wastewater Discharges During Operation

Wastewater from the proposed development will be conveyed for treatment to the Upper Liffey Valley Sewerage Scheme WWTP. Treated effluent from the proposed development will ultimately discharge into the waters of the River Liffey 47km-50km upstream of Dublin Bay.

Although highly unlikely given the distance upstream and dilution available, the proposed development could potentially impact on South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA. The proposed development could potentially result in an increase in nutrients discharging to Dublin Bay via

the River Liffey discharge for the Upper Liffey Valley Sewerage Scheme WWTP. Increased nutrients can potentially impact on estuarine habitats by changing baseline ecological conditions and increasing algal growth, which in turn could impact on qualifying habitats for South Dublin Bay SAC and North Dublin Bay SAC as well as on and feeding success for birds listed as SCIs South Dublin Bay and River Tolka Estuary SPA and North Bull Island SPA.

This area of County Kildare is served by the Upper Liffey Valley Sewerage Scheme WWTP wastewater treatment plant with a Plant Capacity Population Equivalent (P.E.) of 130,000. The WWTP has one primary discharge point which discharges to the River Liffey approximately 12km downstream of the proposed development site. The WWTP obtained a discharge licence (Reg: D0002-01) from the Environmental Protection Agency and has assigned emission limit values (ELVs) for a range of parameters to ensure a high degree of protection to the River Liffey and connecting waters. The discharge licence assigns ELVs for biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), Total Nitrogen (Total N), Total Oxidised Nitrogen, Total Ammonia, Total Phosphorous, Orthophosphate, pH and total coliforms. The ELVs are set based on the full design capacity (P.E 130,000) and are aimed at providing a high degree of protection to the receiving water body and to ensure the receiving waterbody is capable of accommodating the proposed discharge without causing or exacerbating a breach in the relevant standards.

The 2020 Annual Environmental Report for the Upper Liffey Sewerage Scheme WWTP (D0002-01) was reviewed. **Table 13** provides a summary of the current operating conditions for the WWTP from the main effluent discharge obtained from the most recent Environmental Protection Agency Annual Environment Report 2020 (EPA 2021).

The AER notes that the final effluent from the Primary Discharge Point was compliant with the Emission Limit Values in 2020 and noted there were no exceedances during the monitoring period.

Overall, the discharge from the WWTP does not have an observable negative impact on receiving water quality nor a negative impact on the Water Framework Directive Status. However ambient monitoring results do not meet the required EQS upstream or downstream of the WWTP for ammonia. The AER concluded the following:

- The WWTP discharge was compliant with the ELV’s set in the wastewater discharge licence .
- The ambient monitoring results do not meet the required EQS upstream or downstream of the WWTPs for ammonia. The EQS relates to the Oxygenation and Nutrient Conditions set out in the Surface Water Regulations 2009.
- Based on ambient monitoring results a deterioration in Ortho-P (RS09L011200 & RS09L011300) and Ammonia (RS09L011200) concentrations downstream of the effluent discharge is noted.
- A minor deterioration in water quality has been identified, however it is not known if it or is not caused by the WWTP.

- Other causes of deterioration in water quality in the area are unknown. The discharge from the wastewater treatment plant does not have an observable negative impact on the Water Framework Directive status.

The Upper Liffey WWTP, with a design capacity of 130,000 currently operates an agglomeration PE of 97,150 PE (based on EPA 2020 data). Given the residual capacity at the WWPT, there will be sufficient capacity within to cater for the additional loading and no impact on local water quality is predicted to occur.

The addition of the effluent discharge from the proposed development to the Upper Liffey Sewerage Scheme WWTP is well within its design capacity and will not comprise the operational capability of the WWTP to treat effluent to comply with emission limit values. Therefore, the impacts from the proposed development will be negligible given the current operating conditions at the WWTP. The proposed development will not have a significant impact on the conservation objectives of listed as qualifying interests or the conservation objectives of South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA. Similarly, there will be no impact on estuarine habitats within these Natura 2000 sites.

Table 13. Effluent Monitoring

Effluent Monitoring Summary	BOD (mg/l)	COD (mg/l)	TSS (mg/l)	Orthophosphate (mg/l)	Total P (mg/l)	Ammonia Total (as N) (mg/l)	Total Oxidised Nitrogen (mg/l)	Fats Oils and Greases (mg/l)	pH
WWDL ELV (Schedule A)	19	100	35.0	0.5	0.9	0.9	20	15	6-9
ELV with Condition 2 Interpretation included	20	200	87.5	0.6	1.08	1.08	24	18	6-9
No. of Sample results	50	50	50	50	50	50	50	9	50
Number of exceedances	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Number of sample results above ELV with condition 2 interpretation	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Annual Mean (parameters where a mean ELV applies are shaded)	1.36	22.12	2.65	0.09	0.23	0.11	8.45	3.45	7.5
Overall Compliance (Pass/Fail)	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**

5.5.4 In combination Impacts

In-combination impacts refer to a series of individually modest impacts that may in combination produce a significant impact. The underlying intention of this in combination provision is to take account of in-combination impacts from existing or proposed plans and projects and these will often only occur over time. Other developments near site and potential in-combination impacts are identified in **Table 14**. In the absence of any significant impacts on qualifying interests or conservation objectives associated with this project no significant in-combination impacts have been identified.

Table 14. Other developments near site and potential cumulative impacts

Plans and Projects	Key Policies/Issues/Objectives Directly Related to the Conservation of the Natura 2000 Network	Impact
River Basin Management Plan 2018-2021	The project should comply with the environmental objectives of the Irish RBMP which are to be achieved generally by 2021. • Ensure full compliance with relevant EU legislation • Prevent deterioration • Meeting the objectives for designated protected areas • Protect high status waters • Implement targeted actions and pilot schemes in focus sub-catchments aimed at: targeting water bodies close to meeting their objective and addressing more complex issues which will build knowledge for the third cycle.	The implementation and compliance with key environmental policies, issues and objectives of this management plan will result in positive in-combination effects to European sites. The implementation of this plan will have a positive impact for the biodiversity. It will not contribute to in-combination or cumulative impacts with the proposed development.
Inland Fisheries Ireland Corporate Plan 2016 - 2020	To ensure that Ireland's fish populations are managed and protected to ensure their conservation status remains favourable. That they provide a basis for a sustainable world class recreational angling product, and that pristine aquatic habitats are also enjoyed for other recreational uses. To develop and improve fish habitats and ensure that the conditions required for fish populations to thrive are sustained and protected. To grow the number of anglers and ensure the needs of IFI's other key stakeholders are being met in a sustainable conservation focused manner. EU (Quality of Salmonid Waters) Regulations 1988. All works during development and operation of the project must aim to conserve fish and other species of fauna and flora habitat; biodiversity of inland fisheries and ecosystems and protect spawning salmon and trout.	The implementation and compliance with key environmental issues and objectives of this corporate plan will result in positive on-combination effects to European sites. The implementation of this corporate plan will have a positive impact for biodiversity of inland fisheries and ecosystems. It will not contribute to in-combination or cumulative impacts with the proposed works.

Plans and Projects	Key Policies/Issues/Objectives Directly Related to the Conservation of the Natura 2000 Network	Impact
Irish Water Capital Investment Plan 2014-2016	Proposals to upgrade and secure water services and water treatment services countrywide.	Likely net positive impact due to water conservation and more effective treatment of water.
Water Services Strategic Plan (WSSP, 2015)	Irish Water has prepared a Water Services Strategic Plan (WSSP, 2015), under Section 33 of the Water Service No. 2 Act of 2013 to address the delivery of strategic objectives which will contribute towards improved water quality and biodiversity requirements through reducing: • Habitat loss and disturbance from new / upgraded infrastructure; • Species disturbance; • Changes to water quality or quantity; and Nutrient enrichment /eutrophication.	The WSSP forms the highest tier of asset management plans (Tier 1) which Irish Water prepare and it sets the overarching framework for subsequent detailed implementation plans (Tier 2) and water services projects (Tier 3). The WSSP also sets out the strategic objectives against which the Irish Water Capital Investment Programme is developed. The current version of the CAP outlines the proposals for capital expenditure in terms of upgrades and new builds within the Irish Water owned assets. Therefore, no adverse significant in-combination effects are envisaged.
NPWS Conservation Management Plans	Conservation Management Plans have not been fully prepared for the European sites being assessed. However, conservation objectives along with supporting documents for the South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA	The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site. The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation

Plans and Projects	Key Policies/Issues/Objectives Directly Related to the Conservation of the Natura 2000 Network	Impact
		status of those habitats and species at a national level. The resultant effects of conservation objectives are a net positive and there is no potential for in combination effects on European sites.
WWTP discharges	Ringsend WWTP, Lower Liffey Valley Sewerage Scheme WWTP, Balllymore Eustace WWTP	Discharges from municipal WWTPs are required to meet water quality standards. Irish Water Capital Investment Plan proposes to upgrade water treatment services countrywide (see above). The long-term cumulative impact is predicted to be negligible.
Other developments	In November 2021 planning permission (Planning Ref No 211248) was granted to Barola Capital DAC for a Distribution Warehouse, Ancillary Office Accommodation and Ancillary Buildings on a 15.42 ha site to the north-east of the proposed development. The site enabling works for the main contract due to start in May 2022. The works to the Ballyfarm Road including upgraded bus stops and resurfacing of footpaths are scheduled for completion in June 2022. Given the progress to date, the Distribution Centre will be operational before the construction of Phase 1 of the proposed development begins. In December 2021, Murphy Ireland International Ltd. lodged an application (Ref No 21780) for two manufacturing buildings at their compound to the east of the proposed development. The pipe repair and testing operation in the centre of the development area will be relocated to these buildings. If the construction of the buildings overlaps with Phase I of the proposed development there is the potential for cumulative effects on air quality.	A worst-case scenario would occur if the construction of these projects were to run concurrently with proposed developments. In the event of this there is potential for in-combination disturbance effects, as the sites are located in proximity to each other. Should this situation arise, construction activities will be planned and phased, in consultation with construction management teams. A worst-case scenario is of construction for both projects running concurrently. Given the dilution provided in the River Liffey and implementation mitigation measures, no significant effect on water quality or in-combination effects will occur in the

Plans and Projects	Key Policies/Issues/Objectives Directly Related to the Conservation of the Natura 2000 Network	Impact
		event that the projects run concurrently. No cumulative impacts are predicted to occur within the Natura 2000 sites as a result of these proposed and permitted projects.
Other plans	The completion of the section of the NSORR between Great Connell Roundabout and the Athgarvan Road requires the extension of the roadway and the construction of a bridge over the Liffey to tie into the section of the NSORR being delivered as part of the residential development currently under construction to the south west of the propose development site. This will be the subject of a separate planning application and will be subject of EIA. At the time of the preparation of this EIAR the alignment and design of the bridge are indicative only.	A worst-case scenario would occur if the construction of these projects were to run concurrently with proposed developments. In the event of this there is potential for in-combination disturbance effects, as the sites are located in proximity to each other. Should this situation arise, construction activities will be planned and phased, in consultation with construction management teams. A worst-case scenario is of construction for both projects running concurrently. Given the dilution provided in the River Liffey and implementation mitigation measures, no significant effect on water quality or in-combination effects will occur in the event that the projects run concurrently. No cumulative impacts are predicted to occur within the Natura 2000 sites as a result of these proposed and permitted projects.

The area surrounding the proposed development is also heavily populated with a mixture light industrial, commercial and residential developments. Wastewater is also discharged from other settlements along the River Liffey and Dublin Bay (e.g. Lower Liffey and Dublin City)

and local industry. However, in the absence of any significant impact associated with this project no cumulative impacts on water quality have been identified. Similarly, no significant cumulative impacts in relation to noise and disturbance have been identified.

6. Mitigation

6.1 General Mitigation Measures

The mitigation measures have been drawn up in line with current best practice and include an avoidance of sensitive habitats at the design stage and mitigation measures will function effectively in preventing significant ecological impacts. A Preliminary Construction Environmental Management Plan (CEMP) has been prepared. The CEMP contains the construction mitigation measures, which are set out in this report.

Mitigation measures (of relevance in respect of any potential ecological effects) will be implemented throughout the project, including the preparation and implementation of detailed method statements. The works will incorporate the relevant elements of the guidelines outlined below:

- *Control of water pollution from construction sites. Guidance for consultants and contractors (*C532). CIRIA. H. Masters-Williams et al (2001)
- *Control of water pollution from linear construction projects. Technical guidance (C648).* CIRIA. E. Murnane, A. Heap and A. Swain. (2006)

All personnel involved with the proposed development will receive an on-site induction relating to construction and operations, and the environmentally sensitive nature of the River Liffey and to re-emphasise the precautions that are required as well as the control measures to be implemented. Site managers, foremen and workforce, including all subcontractors, will be suitably trained in risks and preventative measures.

The construction works have the potential to impact on the environment through the generation of noise and dust and impacts on air quality, surface water, groundwater and ecology. The Main Contractor shall appoint an experienced Ecological Clerk of Works (ECoW) who will be responsible for ensuring the mitigation measures specified in this Plan are effectively implemented throughout the Construction Stage. This includes the provision of staff induction training and regular ‘tool box’ talks.

6.2 Land & Soil

The following management practices will be implemented to minimise the risk of soil contamination:

- Excavation and the stripping of topsoil etc. will only be undertaken when absolutely necessary as this can lead to sediment run off and leaching of nutrients from soils into the groundwater.
- Excavated soils not immediately reused will be stockpiled to minimise the effects of weathering.

- Good housekeeping (daily site clean-ups, use of disposal bins, etc.) on site during construction, and the proper use, storage and disposal of substances and their containers will Regular plant maintenance to minimise oil leaks.

- Refuelling of the diesel fuelled plant will only be undertaken by trained personnel in areas where appropriate spill control materials are to hand (spill mats, oil dry). Any spillages should be immediately contained and the contaminated soil excavated and sent to an appropriately licensed waste management facility.

6.3 Water

The mitigation measures described in **Section 6.2** are equally relevant to the protection of surface waters. The following additional measures will be implemented:

- A 10m buffer will be maintained between the existing ditch that will be retained and the construction area.

- The only works carried out inside the 80 m riparian strip along the Liffey will be the provision of bound gravel bitmac paths. A minimum 10 m buffer will be maintained between the river bank and the operational area when the paths are being laid.

- Pouring of cementitious materials will be carried out where possible in the dry and pumped concrete will be monitored to ensure no accidental discharge

- Excess concrete will be removed from the site and concrete washout will not be permitted on the site

- There will be no hosing into surface water drains of spills of concrete, cement, grout or similar materials

- A 5 meter buffer will be maintained along the banks for the drains in the north of the site.

A stretch of the drainage ditch in the north of the site will be infilled. A storm water attenuation system will be installed comprising a range of SuDs measures including underground attenuation. The attenuation system will discharge to the drainage ditch in the north of the site and to the River Liffey via silt traps and oil interceptors. The outfalls will be constructed in accordance with Inland Fisheries Ireland “Guidelines on the Protection of Fisheries during Construction Works In and Adjacent to Waters 2016”

6.4 Oils and Chemical Storage

All oils, fuels, paints and other chemicals will be stored in a secure, bunded, hardstand area. The bund capacity of the bulk oil storage tanks will at a minimum be 110% of the tank. For drum storage, a bund capacity of 25% of the maximum volume of material stored is required. The refuelling and servicing of mobile plant and equipment will only be carried out in a designated hardstand area which is at least 50m from any drains.

7. NIS conclusion and statement

The AA screening concluded, on the basis of objective information and in view of best scientific knowledge, the possibility of significant effects from the proposed project on European sites could not be ruled out and therefore an Appropriate Assessment was required. The AA screening concluded that there was potential for the proposed development to significantly impact South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA via surface water runoff during construction and operation and the wastewater discharges during operation.

The NIS has been prepared to inform and assist An Bord Pleanála to assess, in view of best scientific knowledge, if the proposed development, individually or in combination with another plan or project is likely to have a significant effect on the European sites, South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA.

This NIS has examined and analysed, in light of the best scientific knowledge, with respect to South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA within the potential zone of influence of the proposed development, the potential effect pathways, how these could impact on SCI species and habitats and whether the predicted effects would adversely affect the integrity of South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA.

Mitigation measures are set out in **Section 6** of the NIS and they ensure that any effects on the conservation objectives of South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA, North Dublin Bay SAC and North Bull Island SPA will be avoided during the proposed development such that there will be no risk of adverse effects on the integrity of these European sites.

It has been objectively concluded following an examination, analysis and evaluation of the relevant information, including in particular the nature of the predicted effects from the proposed development and with the implementation of the mitigation measures proposed, that the construction and operation of the proposed development will not adversely affect (either directly or indirectly) the integrity of any European site, either alone or in combination with other plans or projects. There is no reasonable scientific doubt in relation to this conclusion. The competent authority will make the final determination in this regard.

References

Department of Environment, Heritage and Local Government, (2010 revision) Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities

Department of Environment, Heritage and Local Government, (2010). Appropriate Assessment under Article 6 of the Habitats Directive; Guidance for Planning Authorities. Circular NPW 1/10 and PSSP 2/10

EC (2000). Communication from the Commission on the precautionary principle.

EC (2007) Guidance Document on Article 6(4) of the Habitats Directive 92/43/EEC (European Commission,

EC (2021). Assessment of plans & projects in relation to N2K sites – Methodological Guidance

EC (2021). Guidance document on the strict protection of animal species of Community interest under the Habitats Directive

Environmental Protection Agency Ireland (http://www.epa.ie/). Accessed 08/12/21

European Commission (EC), 2001. Assessment of Plans and Projects Significantly Affecting Natura 2000 sites: Methodical Guidance on the Provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC

European Commission (EC), 2018. Managing Natura 2000 Sites: The Provision of Article 6 of the Habitats Directive 92/43/EEC

Fossitt, J. A. (2000). *A Guide to Habitats in Ireland*. The Heritage Council of Ireland Series

Masters-Williams et al (2001) Control of water pollution from construction sites. Guidance for consultants and contractors (C532). CIRIA

Murnane, A. Heap and A. Swain. (2006). Control of water pollution from linear construction projects. Technical guidance (C648). CIRIA.

National Biodiversity Data Centre (http://www.biodiversityireland.ie/). Accessed 21/02/22

National Parks and Wildlife Service website (www.npws.ie). Accessed 21/02/22

Appendices

Appendix 1. Natura 2000 Site Synopses

Site Name: North Dublin Bay SAC

Site Code: 000206

This site covers the inner part of north Dublin Bay, the seaward boundary extending from the Bull Wall lighthouse across to the Martello Tower at Howth Head. The North Bull Island is the focal point of this site.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

- [1140] Tidal Mudflats and Sandflats
- [1210] Annual Vegetation of Drift Lines
- [1310] Salicornia Mud
- [1330] Atlantic Salt Meadows
- [1410] Mediterranean Salt Meadows
- [2110] Embryonic Shifting Dunes
- [2120] Marram Dunes (White Dunes)
- [2130] Fixed Dunes (Grey Dunes)*
- [2190] Humid Dune Slacks
- [1395] Petalwort (Petalophyllum ralfsii)

North Bull Island is a sandy spit which formed after the building of the South Wall and Bull Wall in the 18th and 19th centuries. It now extends for about 5 km in length and is up to 1 km wide in places. A well-developed and dynamic dune system stretches along the seaward side of the island. Various types of dunes occur, from fixed dune grassland to pioneer communities on foredunes. Marram Grass (Ammophila arenaria) is dominant on the outer dune ridges, with Lyme-grass (Leymus arenarius) and Sand Couch (Elymus farctus) on the foredunes. Behind the first dune ridge, plant diversity increases with the appearance of such species as Wild Pansy (Viola tricolor), Kidney Vetch (Anthyllis vulneraria), Common Bird's-foot-trefoil (Lotus corniculatus), Common Restharrow (Ononis repens), Yellow-rattle (Rhinanthus minor) and Pyramidal Orchid (Anacamptis pyramidalis). In these grassy areas and slacks, the scarce Bee Orchid (Ophrys apifera) occurs.

About 1 km from the tip of the island, a large dune slack with a rich flora occurs, usually referred to as the 'Alder Marsh' because of the presence of Alder trees (Alnus glutinosa). The water table is very near the surface and is only slightly brackish. Saltmarsh Rush (Juncus maritimus) is the dominant species, with Meadowsweet (Filipendula ulmaria) and Devil's-bit Scabious (Succisa pratensis) being frequent. The orchid flora is notable and includes Marsh Helleborine (Epipactis palustris), Common Twayblade (Listera ovata), Autumn Lady's-tresses (Spiranthes spiralis) and Marsh Orchids (Dactylorhiza spp.).

Saltmarsh extends along the length of the landward side of the island. The edge of the marsh is marked by an eroding edge which varies from 20 cm to 60 cm high. The marsh can be zoned into different levels according to the vegetation types present. On the lower marsh, Glasswort (Salicornia europaea), Common Saltmarsh-grass (Puccinellia maritima), Annual Sea-blite (Suaeda maritima) and Greater Sea-spurrey (Spergularia media) are the main species. Higher up in the middle marsh Sea Plantain (Plantago maritima), Sea Aster (Aster tripolium), Sea Arrowgrass (Triglochin maritima) and Thrift (Armeria maritima) appear. Above the mark of the normal high tide, species such as Common Scurvygrass (Cochlearia officinalis) and Sea Milkwort (Glaux maritima) are found, while on the extreme upper marsh, the rushes Juncus maritimus and J. gerardi are dominant. Towards the tip of the island, the saltmarsh grades naturally into fixed dune vegetation.

The habitat ‘annual vegetation of drift lines’ is found in places, along the length of Dollymount Strand, with species such as Sea Rocket (Cakile maritima), Oraches (Atriplex spp.) and Prickly Saltwort (Salsola kali).

The island shelters two intertidal lagoons which are divided by a solid causeway. The sediments of the lagoons are mainly sands with a small and varying mixture of silt and clay. The north lagoon has an area known as the "Salicornia flat", which is dominated by Salicornia dolichostachya, a pioneer glasswort species, and covers about 25 ha. Beaked Tasselweed (Ruppia maritima) occurs in this area, along with some Narrow-leaved Eelgrass (Zostera angustifolia). Dwarf Eelgrass (Z. noltii) also occurs in Sutton Creek. Common Cordgrass (Spartina anglica) occurs in places but its growth is controlled by management. Green algal mats (Enteromorpha spp., Ulva lactuca) cover large areas of the flats during summer. These sediments have a rich macrofauna, with high densities of Lugworms (Arenicola marina) in parts of the north lagoon. Mussels (Mytilus edulis) occur in places, along with bivalves such as Cerastoderma edule, Macoma balthica and Scrobicularia plana. The small gastropod Hydrobia ulvae occurs in high densities in places, while the crustaceans Corophium volutator and Carcinus maenas are common. The sediments on the seaward side of North Bull Island are mostly sands. The site extends below the low spring tide mark to include an area of the sublittoral zone.

Three rare plant species which are legally protected under the Flora (Protection) Order, 1999 have been recorded on the North Bull Island. These are Lesser Centaury (Centaurium pulchellum), Red Hemp-nettle (Galeopsis angustifolia) and Meadow Saxifrage (Saxifraga granulata). Two further species listed as threatened in the Red Data Book, Wild Clary/Sage (Salvia verbenaca) and Spring Vetch (Vicia lathyroides), have also been recorded. A rare liverwort, Petalophyllum ralfsii, was first recorded from the North Bull Island in 1874 and has recently been confirmed as still present. This species is of high conservation value as it is listed on Annex II of the E.U. Habitats Directive. The North Bull is the only known extant site for the species in Ireland away from the western seaboard.

North Dublin Bay is of international importance for waterfowl. During the 1994/95 to 1996/97 period the following species occurred in internationally important numbers (figures are average maxima): Brent Goose 2,333; Knot 4,423; Bar-tailed Godwit 1,586. A further 14 species occurred in nationally important concentrations - Shelduck 1505; Wigeon 1,166; Teal 1,512; Pintail 334; Shoveler 239; Oystercatcher 2,190; Ringed Plover 346; Grey Plover 816; Sanderling 357; Dunlin 6,238; Black-tailed Godwit 156; Curlew 1,193; Turnstone 197 and Redshank 1,175. Some of these species frequent South Dublin Bay and the River Tolka Estuary for feeding and/or roosting purposes (mostly Brent Goose, Oystercatcher, Ringed Plover, Sanderling and Dunlin).

The tip of the North Bull Island is a traditional nesting site for Little Tern. A high total of 88 pairs nested in 1987. However, nesting attempts have not been successful since the early 1990s. Ringed Plover, Shelduck, Mallard, Skylark, Meadow Pipit and Stonechat also nest. A well-known population of Irish Hare is resident on the island.

The invertebrates of the North Bull Island have been studied and the island has been shown to contain at least seven species of regional or national importance in Ireland (from the Orders Diptera, Hymenoptera and Hemiptera).

The main land uses of this site are amenity activities and nature conservation. The North Bull Island is the main recreational beach in Co. Dublin and is used throughout the year. Much of the land surface of the island is taken up by two golf courses. Two separate Statutory Nature Reserves cover much of the island east of the Bull Wall and the surrrounding intertidal flats. The site is used regularly for educational purposes. North Bull Island has been designated a Special Protection Area under the E.U. Birds Directive and it is also a statutory Wildfowl Sanctuary, a Ramsar Convention site, a Biogenetic Reserve, a Biosphere Reserve and a Special Area Amenity Order site.

This site is an excellent example of a coastal site with all the main habitats represented. The site holds good examples of nine habitats that are listed on Annex I of the E.U. Habitats Directive; one of these is listed with priority status. Several of the wintering bird species have populations of international importance, while some of the invertebrates are of national importance. The site contains a numbers of rare and scarce plants including some which are legally protected. Its proximity to the capital city makes North Dublin Bay an excellent site for educational studies and research.

Site Name: South Dublin Bay SAC

Site Code: 000210

This site lies south of the River Liffey in Co. Dublin, and extends from the South Wall to the west pier at Dun Laoghaire. It is an intertidal site with extensive areas of sand and mudflats. The sediments are predominantly sands but grade to sandy muds near the shore at Merrion Gates. The main channel which drains the area is Cockle Lake.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

- [1140] Tidal Mudflats and Sandflats
- [1210] Annual vegetation of drift lines
- [1310] Salicornia and other annuals colonising mud and sand
- [2110] Embryonic shifting dunes

The bed of Dward Eelgrass (Zostera noltii) found below Merrion Gates is the largest stand on the east coast. Green algae (Enteromorpha spp. and Ulva lactuca) are distributed throughout the area at a low density. Fucoid algae occur on the rocky shore in the Maretimo to Dún Laoghaire area. Species include Fucus spiralis, F. vesiculosus, F. serratus, Ascophyllum nodosum and Pelvetia canaliculata.

Several small, sandy beaches with incipient dune formation occur in the northern and western sectors of the site, notably at Poolbeg, Irishtown and Merrion/ Booterstown. The formation at Booterstown is very recent. Drift line vegetation occurs in association with the embryonic and incipient fore dunes. Typically drift lines occur in a band approximately 5 m wide, though at Booterstown this zone is wider in places. The habitat occurs just above the High Water Mark and below the area of embryonic dune. Species present are Sea Rocket (Cakile maritima), Frosted Orache (Atriplex laciniata), Spear-leaved Orache (A. prostrata), Prickly Saltwort (Salsola kali) and Fat Hen (Chenopodium album). Also occurring is Sea Sandwort (Honkenya peploides), Sea Beet (Beta vulgaris subsp. maritima) and Annual Sea-blite (Suaeda maritima). A small area of pioneer saltmarsh now occurs in the lee of an embryonic sand dune just north of Booterstown Station. This early stage of saltmarsh development is here characterised by the presence of pioneer stands of glassworts (Salicornia spp.) occurring below an area of drift line vegetation. As this is of very recent origin, it covers a small area but ample areas of substrate and shelter are available for the further development of this habitat.

Lugworm (Arenicola marina), Cockles (Cerastoderma edule) and annelids and other bivalves are frequent throughout the site. The small gastropod Hydrobia ulvae occurs on the muddy sands off Merrion Gates.

South Dublin Bay is an important site for waterfowl. Although birds regularly commute between the south bay and the north bay, recent studies have shown that certain populations which occur in the south bay spend most of their time there. The principal species are Oystercatcher (1215), Ringed Plover (120), Sanderling (344), Dunlin (2628) and Redshank (356) (average winter peaks 1996/97 and 1997/98). Up to 100 Turnstones are usual in the south bay during winter. Brent Goose regularly occur in numbers of international importance (average peak 299). Bar-tailed Godwit (565), a species listed on Annex I of the E.U. Birds Directive, also occur.

Large numbers of gulls roost in South Dublin Bay, e.g. 4,500 Black-headed Gulls in February 1990; 500 Common Gulls in February 1991. It is also an important tern roost in the autumn, regularly holding 2000-3000 terns including Roseate Terns, a species listed on Annex I of the E.U. Birds Directive. South Dublin Bay is largely protected as a Special Protection Area.

At low tide the inner parts of the south bay are used for amenity purposes. Baitdigging is a regular activity on the sandy flats. At high tide some areas have windsurfing and jet-skiing.

This site is a fine example of a coastal system, with extensive sand and mudflats, and incipient dune formations. South Dublin Bay is also an internationally important bird site.

Site Name: South Dublin Bay and River Tolka Estuary SPA

Site Code: 004024

The South Dublin Bay and River Tolka Estuary SPA comprises a substantial part of Dublin Bay. It includes the intertidal area between the River Liffey and Dun Laoghaire, and the estuary of the River Tolka to the north of the River Liffey, as well as Booterstown Marsh. A portion of the shallow marine waters of the bay is also included.

In the south bay, the intertidal flats extend for almost 3 km at their widest. The sediments are predominantly well-aerated sands. Several permanent channels exist, the largest being Cockle Lake. A small sandy beach occurs at Merrion Gates, while some bedrock shore occurs near Dun Laoghaire. The landward boundary is now almost entirely artificially embanked. There is a bed of Dwarf Eelgrass (Zostera noltii) below Merrion Gates which is the largest stand on the east coast. Green algae (Ulva spp.) are distributed throughout the area at a low density. The macroinvertebrate fauna is well-developed, and is characterised by annelids such as Lugworm (Arenicola marina), Nephthys spp. and Sand Mason (Lanice conchilega), and bivalves, especially Cockle (Cerastoderma edule) and Baltic Tellin (Macoma balthica). The small gastropod Spire Shell (Hydrobia ulvae) occurs on the muddy sands off Merrion Gates, along with the crustacean Corophium volutator. Sediments in the Tolka Estuary vary from soft thixotrophic muds with a high organic content in the inner estuary to exposed, well-aerated sands off the Bull Wall. The site includes Booterstown Marsh, an enclosed area of saltmarsh and muds that is cut off from the sea by the Dublin/Wexford railway line, being linked only by a channel to the east, the Nutley stream. Sea water incursions into the marsh occur along this stream at high tide. An area of grassland at Poolbeg, north of Irishtown Nature Park, is also included in the site.

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Light-bellied Brent Goose, Oystercatcher, Ringed Plover, Grey Plover, Knot, Sanderling, Dunlin, Bar-tailed Godwit, Redshank, Black-headed Gull, Roseate Tern, Common Tern and Arctic Tern. The E.U. Birds Directive pays particular attention to wetlands, and as these form part of the SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

The site is an important site for wintering waterfowl, being an integral part of the internationally important Dublin Bay complex – all counts for wintering waterbirds are five year mean peaks for the period 1995/96 to 1999/2000. Although birds regularly commute between the south bay and the north bay, recent studies have shown that certain populations which occur in the south bay spend most of their time there. An internationally important population of Light-bellied Brent Goose (368) occurs regularly and newly arrived birds in the autumn feed on the Eelgrass bed at Merrion. At the time of designation the site supported nationally important numbers of a further nine species: Oystercatcher (1,145), Ringed Plover (161), Grey Plover (45), Knot (548), Sanderling (321), Dunlin (1,923), Bar-tailed Godwit (766), Redshank (260) and Black-headed Gull (3,040). Other species occurring in smaller numbers include Great Crested Grebe (21), Curlew (127) and Turnstone (52). Little Egret, a species which has recently colonised Ireland, also occurs at this site.

South Dublin Bay is a significant site for wintering gulls, with a nationally important population of Black-headed Gull, but also Common Gull (330) and Herring Gull (348). Mediterranean Gull is also recorded from here, occurring through much of the year, but especially in late winter/spring and again in late summer into winter.

Both Common Tern and Arctic Tern breed in Dublin Docks, on a man-made mooring structure known as the E.S.B. dolphin – this is included within the site. Small numbers of Common Tern and Arctic Tern were recorded nesting on this dolphin in the 1980s. A survey in 1995 recorded nationally important numbers of Common Tern nesting here (52 pairs). The breeding population of Common Tern at this site has increased, with 216 pairs recorded in 2000. This increase was largely due to the ongoing management of the site for breeding terns. More recent data highlights this site as one of the most important Common Tern sites in the country with over 400 pairs recorded here in 2007.

South Dublin Bay is an important staging/passage site for a number of tern species in the autumn (mostly late July to September). The origin of many of the birds is likely to be the Dublin breeding sites (Rockabill and the Dublin Docks) though numbers suggest that the site is also used by birds from other sites, perhaps outside the state. This site is selected for designation for its autumn tern populations: Roseate Tern (2,000 in 1999), Common Tern (5,000 in 1999) and Arctic Tern (20,000 in 1996).

The South Dublin Bay and River Tolka Estuary SPA is of ornithological importance as it supports an internationally important population of Light-bellied Brent Goose and nationally important populations of a further nine wintering species. Furthermore, the site supports a nationally important colony of breeding Common Tern and is an internationally important passage/staging site for three tern species. It is of note that four of the species that regularly occur at this site are listed on Annex I of the E.U. Birds Directive, i.e. Bar-tailed Godwit, Common Tern, Arctic Tern and Roseate Tern. Sandymount Strand/Tolka Estuary is also a Ramsar Convention site.

Site Name: North Bull Island SPA

Site Code: 004006

This site covers all of the inner part of north Dublin Bay, with the seaward boundary extending from the Bull Wall lighthouse across to Drumleck Point at Howth Head. The North Bull Island sand spit is a relatively recent depositional feature, formed as a result of improvements to Dublin Port during the 18th and 19th centuries. It is almost 5 km long and 1 km wide and runs parallel to the coast between Clontarf and Sutton. Part of the interior of the island has been converted to golf courses.

Saltmarsh extends along the length of the landward side of the island and provides the main roost site for wintering birds in Dublin Bay. The island shelters two intertidal lagoons which are divided by a solid causeway. These lagoons provide the main feeding grounds for the wintering waterfowl. The sediments of the lagoons are mainly sands with a small and varying mixture of silt and clay. Green algal mats (Ulva spp.) are a feature of the flats during summer. These sediments have a rich macro-invertebrate fauna, with high densities of Lugworm (Arenicola marina) and Ragworm (Hediste diversicolor).

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Light-bellied Brent Goose, Shelduck, Teal, Pintail, Shoveler, Oystercatcher, Golden Plover, Grey Plover, Knot, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Turnstone and Black-headed Gull. The site is also of special conservation interest for holding an assemblage of over 20,000 wintering waterbirds. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

The North Bull Island SPA is of international importance for waterfowl on the basis that it regularly supports in excess of 20,000 waterfowl. The site supports internationally important populations of three species, Light-bellied Brent Goose (1,548), Black-tailed Godwit (367) and Bar-tailed Godwit (1,529) - all figures are mean peaks for the five winters between 1995/96 and 1999/2000. The site is one of the most important in the country for Light-bellied Brent Goose. A further 14 species have populations of national importance – Shelduck (1,259), Teal (953), Pintail (233), Shoveler (141), Oystercatcher (1,784), Grey Plover (517), Golden Plover (2,033), Knot (2,837), Sanderling (141), Dunlin (4,146), Curlew (937), Redshank (1,431), Turnstone (157) and Black-headed Gull (2,196). The populations of Pintail and Knot are of particular note as they comprise 14% and 10% respectively of the all-Ireland population totals. Other species that occur regularly in winter include Grey Heron, Little Egret, Cormorant, Wigeon, Goldeneye, Red-breasted Merganser, Ringed Plover and Greenshank. Gulls are a feature of the site during winter and, along with the nationally important population of Black-headed Gull (2,196), other species that occur include Common Gull (332) and Herring Gull (331). While some of the birds also frequent South Dublin Bay and the River Tolka Estuary for feeding and/or roosting purposes, the majority remain within the site for much of the winter. The wintering bird populations have been monitored more or less continuously since the late 1960s and the site is now surveyed each winter as part of the larger Dublin Bay complex.

The North Bull Island SPA is a regular site for passage waders, especially Ruff, Curlew Sandpiper and Spotted Redshank. These are mostly observed in single figures in autumn but occasionally in spring or winter.

The site formerly had an important colony of Little Tern but breeding has not occurred in recent years. Several pairs of Ringed Plover breed, along with Shelduck in some years. Breeding passerines include Skylark, Meadow Pipit, Stonechat and Reed Bunting. The island is a regular wintering site for Short-eared Owl, with up to 5 present in some winters.

The North Bull Island SPA is an excellent example of an estuarine complex and is one of the top sites in Ireland for wintering waterfowl. It is of international importance on account of both the total number of waterfowl and the individual populations of Light-bellied Brent Goose, Black-tailed Godwit and Bar-tailed Godwit that use it. Also of significance is the regular presence of several species that are listed on Annex I of the E.U. Birds Directive, notably Golden Plover and Bar-tailed Godwit, but also Ruff and Short-eared Owl. North Bull Island is a Ramsar Convention site, and part of the North Bull Island SPA is a Statutory Nature Reserve and a Wildfowl Sanctuary.

SITE NAME: POULAPHOUCA RESERVOIR SPA SITE CODE: 004063

Poulaphouca Reservoir SPA, located in the western foothills of the Wicklow Mountains, was created in 1944 by damming of the River Liffey for the purpose of generating electricity from hydropower. The reservoir covers an area of approximately 20 square kilometres and is the largest inland water body in the mid- east and south-east regions. The reservoir receives water from two main sources, the River Liffey at the northern end, and the Kings River at the southern end. The exit is into the River Liffey gorge at the western end. Underlying the reservoir are sands and gravels deposited during the last glaciation. The shores of the lake are mostly sandy. When water levels are low the exposed lake muds are colonised by an ephemeral flora of annual plant species. Wet grassland areas occur in sheltered bays around the lake but especially in the northern part. Reed Canary-grass (Phalaris arundinacea) is the main grass species present, but other plant species characteristic of wet grasslands occur, including Creeping Bent (Agrostis stolonifera), Meadowsweet (Filipendula ulmaria), Yellow Iris (Iris pseudacorus) and Water Mint (Mentha aquatica). Sedges (Carex spp.) are locally common, while Rusty Willow (Salix cinerea subsp. oleifolia) scrub is often found associated with the wet grassland. In some places the water washes against grassy banks which are generally less than a metre high, and in a few places there are steep sand and clay cliffs, up to 15 m high - these are remnants of the old River Liffey channel. In many places the banks are actively eroding, and a strip of conifers has been planted around much of the perimeter of the reservoir in an attempt to stabilize the banks.

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Greylag Goose and Lesser Black- backed Gull.

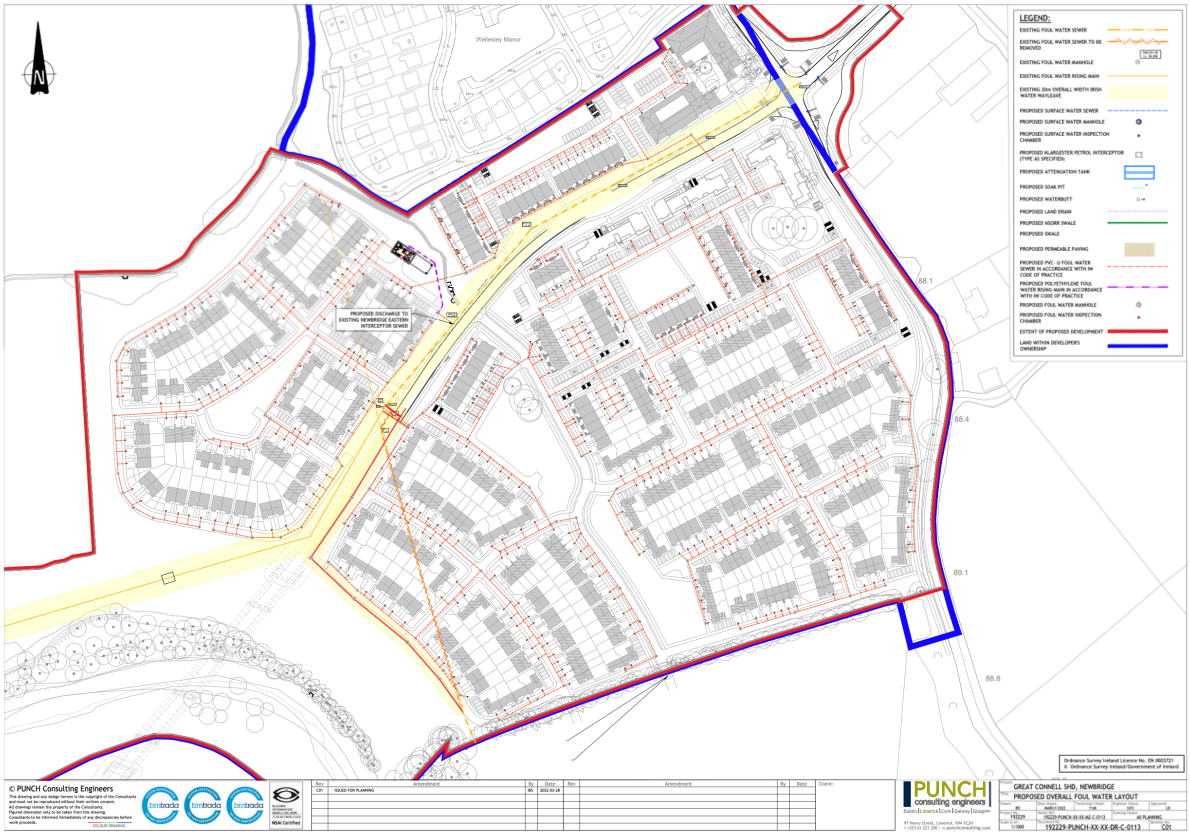
Poulaphouca Reservoir is of national importance for its Greylag Goose population, which is one of the largest in the country. The site provides the main roost for the birds, with feeding occurring mostly on improved grassland outside of the site. A mean peak of 701 individuals occurred during the five seasons 1995/96 to 1999/2000. Other waterfowl species occur in relatively low numbers, including Whooper Swan (22), Wigeon (180), Teal (107), Mallard (186), Goldeneye (22), Cormorant (11), Great Crested Grebe (8), Curlew (86) and Mute Swan (11). The site is also used by Grey Heron (6).

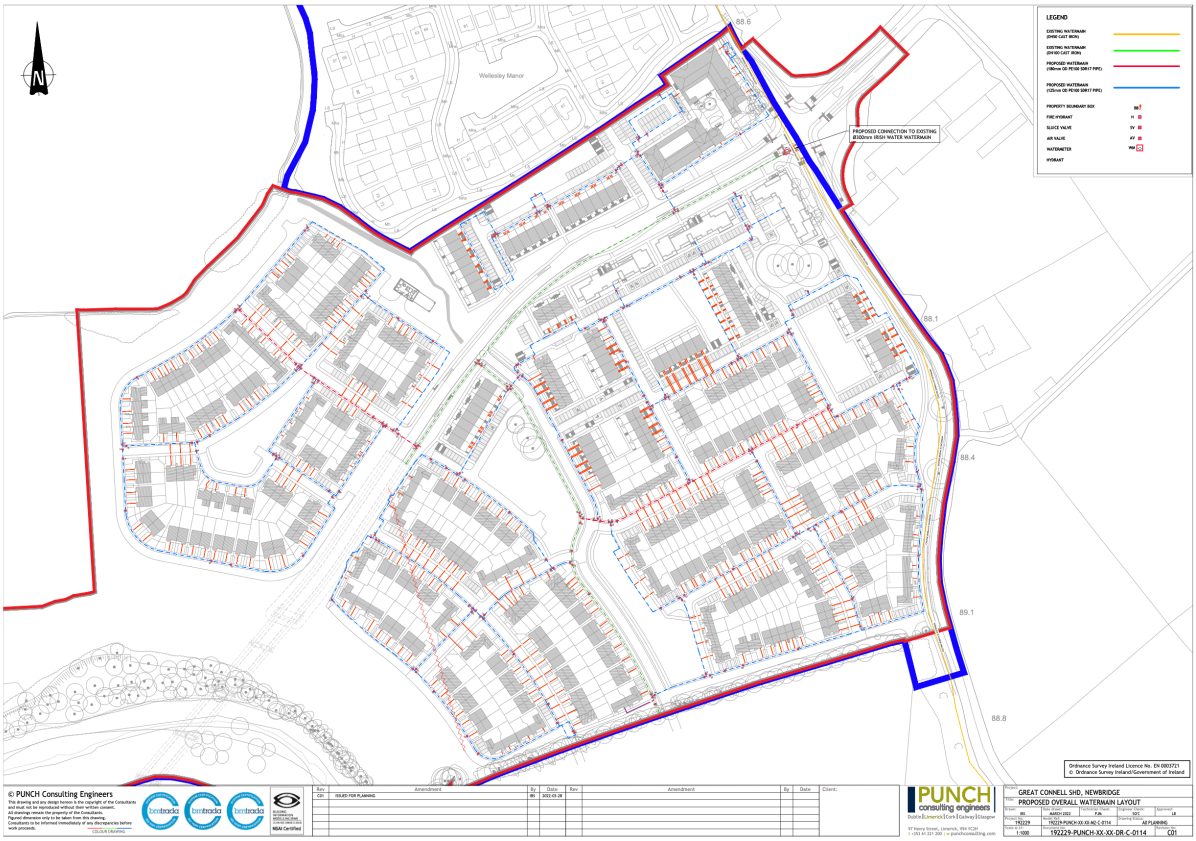
The reservoir attracts roosting gulls during winter, most notably a large population of Lesser Black-backed Gull (651), which in Ireland is rare in winter away from the south coast. Black-headed Gull (915) and Common Gull (183) also occur.

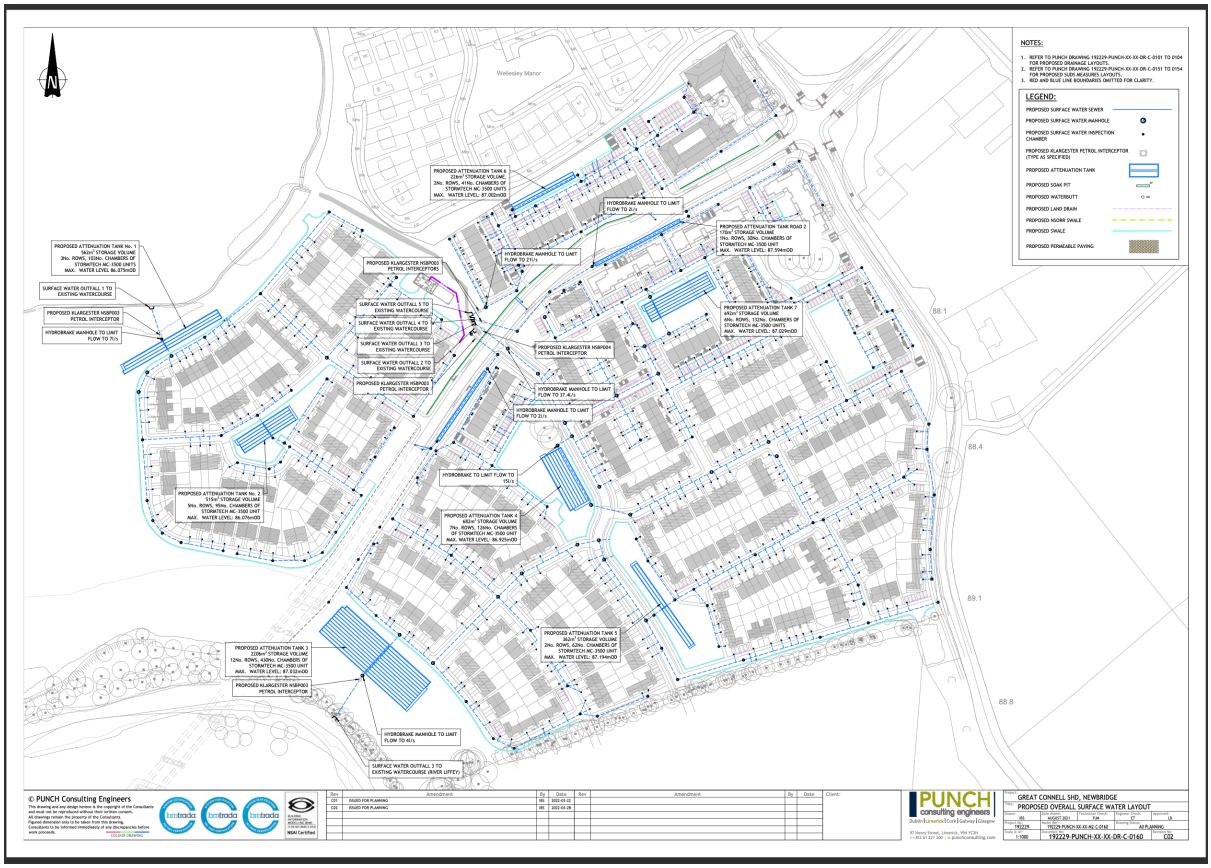
Breeding birds at the site include Great Crested Grebe (several pairs), which is localised in its distribution in eastern Ireland, as well as Snipe and Lapwing.

The principal interest of the site is the Greylag Goose population, which is of national importance. A range of other wildfowl species also occurs, including Whooper Swan, a species that is listed on Annex I of the E.U. Birds Directive. The site is also notable as a winter roost for gulls, especially Lesser Black-backed Gull. Part of Poulaphouca Reservoir SPA is a Wildfowl Sanctuary.

Appendix 2. Drawings






NOTES:
1. REFER TO PUNCH DRAWING 192229-PUNCH-XX-XX-DR-C-0101 TO 0104 FOR PROPOSED DRAINAGE LAYOUTS.
2. REFER TO PUNCH DRAWING 192229-PUNCH-XX-XX-DR-C-0151 TO 0154 FOR PROPOSED SUDS MEASURES LAYOUT).
3. RED AND BLUE LINE BOUNDARIES OMITTED FOR CLARITY.
LEGEND:
PROPOSED SURFACE WATER SEWER
PROPOSED SURFACE WATER MANHOLE
PROPOSED SURFACE WATER INSPECTION CHAMBER
PROPOSED KLARGESTER PETROL INTERCEPTOR (TYPE AS SPECIFIED)
PROPOSED ATTENUATION TANK
PROPOSED SOAK PIT
PROPOSED WATERBUTT
PROPOSED LAND DRAIN
PROPOSED HIGRB SWALE
PROPOSED SWALE
PROPOSED PERMEABLE PAVING
PROPOSED ATTENUATION TANK No. 1
1636m³ STORAGE VOLUME
3No. ROWS, 153No. CHAMBERS OF STORMTECH MC-3500 UNITS
MAX. WATER LEVEL 86.075mOD
SURFACE WATER OUTFALL 1 TO EXISTING WATERCOURSE
PROPOSED KLARGESTER HSBP003 PETROL INTERCEPTOR
HYDROBRAKE MANHOLE TO LIMIT FLOW TO 7l/s
PROPOSED ATTENUATION TANK No. 2
515m³ STORAGE VOLUME
5No. ROWS, 80No. CHAMBERS OF STORMTECH MC-3500 UNIT
MAX. WATER LEVEL 86.076mOD
PROPOSED ATTENUATION TANK 3
2206m³ STORAGE VOLUME
12No. ROWS, 552No. CHAMBERS OF STORMTECH MC-3500 UNIT
MAX. WATER LEVEL: 87.032mOD
PROPOSED KLARGESTER HSBP003 PETROL INTERCEPTOR
HYDROBRAKE MANHOLE TO LIMIT FLOW TO 4l/s
SURFACE WATER OUTFALL 3 TO EXISTING WATERCOURSE (RIVER LIFFEY)
PROPOSED ATTENUATION TANK 4
640m³ STORAGE VOLUME
7No. ROWS, 126No. CHAMBERS OF STORMTECH MC-3500 UNIT
MAX. WATER LEVEL: 86.925mOD
HYDROBRAKE TO LIMIT FLOW TO 17l/s
PROPOSED ATTENUATION TANK 5
3632m³ STORAGE VOLUME
29No. ROWS, 1288No. CHAMBERS OF STORMTECH MC-3500 UNIT
MAX. WATER LEVEL: 87.194mOD
HYDROBRAKE MANHOLE TO LIMIT FLOW TO 37.4l/s
HYDROBRAKE MANHOLE TO LIMIT FLOW TO 22l/s
PROPOSED KLARGESTER HSBP004 PETROL INTERCEPTOR
SURFACE WATER OUTFALL 2 TO EXISTING WATERCOURSE
SURFACE WATER OUTFALL 4 TO EXISTING WATERCOURSE
SURFACE WATER OUTFALL 5 TO EXISTING WATERCOURSE
PROPOSED KLARGESTER HSBP005 PETROL INTERCEPTORS
HYDROBRAKE MANHOLE TO LIMIT FLOW TO 27l/s
PROPOSED ATTENUATION TANK 6
1264m³ STORAGE VOLUME
2No. ROWS, 41No. CHAMBERS OF STORMTECH MC-3500 UNITS
MAX. WATER LEVEL: 87.002mOD
HYDROBRAKE MANHOLE TO LIMIT FLOW TO 2l/s
PROPOSED ATTENUATION TANK ROAD 2
1706m³ STORAGE VOLUME
9No. ROWS, 369No. CHAMBERS OF STORMTECH MC-3500 UNIT
MAX. WATER LEVEL: 87.594mOD
PROPOSED ATTENUATION TANK 7
692m³ STORAGE VOLUME
6No. ROWS, 132No. CHAMBERS OF STORMTECH MC-3500 UNITS
MAX. WATER LEVEL: 87.020mOD
Wellesley Manor
88.1
88.4
89.1
88.8
© PUNCH Consulting Engineers
This drawing and any design herein is the copyright of the Consultants. Figured dimension only to be taken from this drawing. Contractors to be informed immediately of any discrepancies before work proceeds.
COLOUR DRAWING
Rev Amendment By Date
01 ISSUED FOR PLANNING MB 2022-03-30
02 ISSUED FOR PLANNING MB 2022-05-18
Client:
PUNCH consulting engineers
Dublin | Limerick | Cork | Galway | Glasgow
57 Henry Street, Limerick, V94 YC2X
t: +353 61 327 300 | e: punchconsulting.com
Project: GREAT CONNELL SHD, NEWBRIDGE
Drawing Title: PROPOSED OVERALL SURFACE WATER LAYOUT
Drawn: AS
Checked: MB
Approved: EC
Date: AUGUST 2021
Scale @ A1: 1:500
Scale @ A3: 1:1000
Project No.: 192229
Drawing No.: 192229-PUNCH-XX-XX-DR-C-0160
Status: FW
Revision: C02
Purpose of Issue: AS PLANNING

Appendix 3. Correspondence with Irish Water

Damien Egan

Punch Consulting Engineers
97 Henry Street
Co.Limerick
V94YC2H
Ireland

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

28 January 2021

Re: CDS20007443 pre-connection enquiry - Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 620 unit(s) at Greatconnell, Newbridge, Co. Kildare

Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Greatconnell, Newbridge, Co. Kildare (the **Premises**). Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time.

SERVICE	OUTCOME OF PRE-CONNECTION ENQUIRY THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.
Water Connection	Feasible without infrastructure upgrade by Irish Water
Wastewater Connection	Feasible without infrastructure upgrade by Irish Water
SITE SPECIFIC COMMENTS	
Water Connection	Connection is feasible to the existing 300 mm DI main. New connection main has to be a 200mm ID pipe. Bulk meter to be installed on the connection main, meter to be connected to telemetry online. On site storage for the average day peak week demand rate of the commercial section for 24-hour period. This separate storage is required to supply this demand and will have a re-fill time of 12 hours. This Confirmation of Feasibility to connect to the Irish Water infrastructure also does not extend to your fire flow requirements. Please note that Irish Water can not guarantee a flow rate to meet fire flow requirements and in order to guarantee a flow to meet the Fire Authority requirements, you should provide adequate fire storage capacity within your development.

Stiúrthóirí / Directors: Cathal Marley (Chairman), Niall Gleeson, Eamon Gallen, Yvonne Harris, Brendan Murphy, Maria O'Dwyer
Oifig Chláraithe / Registered Office: Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath 1, D01 NP86 / Colvill House, 24-26 Talbot Street, Dublin 1, D01 NP86
Is cuideachta ghníomhaíochta ainmnithe atá faoi theorainn scaireanna é Uisce Éireann / Irish Water is a designated activity company, limited by shares.
Uimhir Chláraithe in Éirinn / Registered in Ireland No.: 530363

Wastewater Connection	Connection must be made to the new 900 mm traversing the proposed site (not shown on GIS map bellow).
Strategic Housing Development	Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. In advance of submitting your full application to An Bord Pleanala for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.
The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.	

The map included below outlines the current Irish Water infrastructure adjacent to your site:

Reproduced from the Ordnance Survey of Ireland by Permission of the Government. License No. 3-3-34

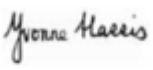
Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

General Notes:

1) The initial assessment referred to above is carried out taking into account water demand and wastewater discharge volumes and infrastructure details on the date of the assessment. **The availability of capacity may change at any date after this assessment.**
2) This feedback does not constitute a contract in whole or in part to provide a connection to any Irish Water infrastructure. All feasibility assessments are subject to the constraints of the Irish Water Capital Investment Plan.
3) The feedback provided is subject to a Connection Agreement/contract being signed at a later date.
4) A Connection Agreement will be required to commencing the connection works associated with the enquiry this can be applied for at https://www.water.ie/connections/get-connected/
5) A Connection Agreement cannot be issued until all statutory approvals are successfully in place.
6) Irish Water Connection Policy/ Charges can be found at https://www.water.ie/connections/information/connection-charges/
7) Please note the Confirmation of Feasibility does not extend to your fire flow requirements.
8) Irish Water is not responsible for the management or disposal of storm water or ground waters. You are advised to contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges
9) To access Irish Water Maps email datarequests@water.ie
10) All works to the Irish Water infrastructure, including works in the Public Space, shall have to be carried out by Irish Water.

If you have any further questions, please contact Marko Komso from the design team on 022 54611 or email mkomso@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,



Yvonne Harris

Head of Customer Operations

APPENDIX 8

ECOLOGICAL IMPACT ASSESSMENT

Appendix 8. NRA 2009 Guidelines

Examples of valuation at different geographical scales

Ecological valuation: Examples

International Importance:

- **'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation and Proposed Special Protection Area (pSPA).**
- **Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended).**
- **Features essential to maintaining the coherence of the Natura 2000 Network.[1]**
- **Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive.**
- **Resident or regularly occurring populations (assessed to be important at the national level) [2] of the following:**
  - **Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or**
  - **Species of animal and plants listed in Annex II and/or IV of the Habitats Directive.**
- **Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971).**
- **World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972).**
- **Biosphere Reserve (UNESCO Man & The Biosphere Programme).**
- **Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979).**
- **Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979).**
- **Biogenetic Reserve under the Council of Europe.**
- **European Diploma Site under the Council of Europe.**
- **Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).[3]**

National Importance:

- **Site designated or proposed as a Natural Heritage Area (NHA).**
- **Statutory Nature Reserve.**
- **Refuge for Fauna and Flora protected under the Wildlife Acts.**
- **National Park.**
- **Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park.**
- **Resident or regularly occurring populations (assessed to be important at the national level)[4] of the following:**
  - **Species protected under the Wildlife Acts; and/or**
  - **Species listed on the relevant Red Data list.**
- **Site containing 'viable areas'[5] of the habitat types listed in Annex I of the Habitats Directive.**

County Importance:

- **Area of Special Amenity.**[6]
- **Area subject to a Tree Preservation Order.**
- **Area of High Amenity, or equivalent, designated under the County Development Plan.**
- **Resident or regularly occurring populations (assessed to be important at the County level)**[7] **of the following:**
  - **Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;**
  - **Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;**
  - **Species protected under the Wildlife Acts; and/or**
  - **Species listed on the relevant Red Data list.**
- **Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance.**
- **County important populations of species, or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP,** [8] **if this has been prepared.**
- **Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county.**
- **Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.**

Local Importance (higher value):

- **Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared;**
- **Resident or regularly occurring populations (assessed to be important at the Local level)**[9]**of the following:**
  - **Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;**
  - **Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;**
  - **Species protected under the Wildlife Acts; and/or**
  - **Species listed on the relevant Red Data list.**
- **Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality;**
- **Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.**

Local Importance (lower value):

- **Sites containing small areas of semi-natural habitat that are of some local importance for wildlife;**
- **Sites or features containing non-native species that are of some importance in maintaining habitat links.**

1 See Articles 3 and 10 of the Habitats Directive.

2 It is suggested that, in general, 1% of the national population of such species qualifies as an internationally important population. However, a smaller population may qualify as internationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

3 Note that such waters are designated based on these waters' capabilities of supporting salmon (*Salmo salar*), trout (*Salmo trutta*), char (*Salvelinus*) and whitefish (*Coregonus*).

4 It is suggested that, in general, 1% of the national population of such species qualifies as a nationally important population. However, a smaller population may qualify as nationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

5 A ‘viable area’ is defined as an area of a habitat that, given the particular characteristics of that habitat, was of a sufficient size and shape, such that its integrity (in terms of species composition, and ecological processes and function) would be maintained in the face of stochastic change (for example, as a result of climatic variation).

6 It should be noted that whilst areas such as Areas of Special Amenity, areas subject to a Tree Preservation Order and Areas of High Amenity are often designated on the basis of their ecological value, they may also be designated for other reasons, such as their amenity or recreational value. Therefore, it should not be automatically assumed that such sites are of County importance from an ecological perspective.

7 It is suggested that, in general, 1% of the County population of such species qualifies as a County important population. However, a smaller population may qualify as County important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

8 BAP: Biodiversity Action Plan

9 It is suggested that, in general, 1%of the local population of such species qualifies as a locally important population. However, a smaller population may qualify as locally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle

Appendix 10.2. Site Photographs

Photograph 1: Field of arable crops BC1 surrounding the agricultural buildings. Looking west.

Photograph 2. Area of Hedgerow WL1 with Treeline WL2 beyond on the southern boundary of the site

Photograph 3. Mixed Broadleaved Woodland WD1 at the south of the site.

Photograph 4. Stagnant waters of the central Drainage Ditch FW4.

Photograph 5. River FW2 at accessible point, looking across at western bank.	**Photograph 6. Main large central warehouse structure BL3. Eastern edge of structure.**
Photograph 7. Smaller warehouse structure, southern edge.	**Photograph 8. Residential house at northeast of site, southern edge.**
Photograph 9. Arable grassland with woodland visible in background.	**Photograph 10. Grassy verges south of the river.**

APPENDIX 9

KPMG SOCIAL INFRASTRUCTURE

Social Infrastructure Audit

To Support a Planning Application for a Proposed Strategic Housing Development at Great Connell, Newbridge, Co. Kildare

On behalf of Aston Limited

March 2022

Document Control Sheet

Project		Aston Limited SHD Application Great Connell, Newbridge, Co Kildare					
Project No.		2-1219					
Document Title		Social Infrastructure Audit					
Rev	**Distribution**	**Author**	**Checked**	**Approved**	**Day**	**Month**	**Year**
1		ZC & SS	MR		24	02	22
2		ZC & SS	MR	MR	28	02	22
3		ZC, SS, MR	SMP	SMP	07	03	22
4		ZC. SS, MR	AC	AC	25	03	22
5							

Contents

1.0 Introduction 1
1.1 Social Infrastructure 1
1.2 Report Structure 2
2.0 Subject Development 3
2.1 Subject Site and Study Area 3
2.1.2 Planning History 3
2.1.3 Transport Access 3
2.2 Proposed Development 4
3.0 Demographic Profile 7
3.1 Population Trends 8
3.2 Age Profile 8
3.3 Educational Attainment 9
3.4 Economic Status 10
3.5 Population Projections 10
4.0 Policy Context 13
4.1 National Planning Framework 13
4.2 Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas 14
4.3 Regional Spatial and Economic Strategy for the Eastern and Midland Region 14
4.4 Sustainable Urban Housing: Design Standards for New Apartments 14
4.5 Childcare Facilities: Guidelines for Planning Authorities 15
4.6 Kildare County Development Plan 2017-2023 15
4.7 Draft Kildare County Development Plan 2023-2029 16
4.8 Newbridge Local Area Plan 2013 – 2019 17
4.9 Policy Summary 17
5.0 Facilities Audit 18
5.1 Health 20
5.2 Childcare 21
5.3 Education and Training 23
5.3.1 Primary Schools 23
5.3.2 Post-Primary Schools 24
5.3.3 Website Review and Phone Survey of School Facilities 24
5.3.4 Historic Enrolments and Trends 26
5.3.5 Future Growth Projections 27
5.3.6 Potential Impact on the Study Area 29
5.3.7 Potential Demand Generated by Scheme 30

5.3.8 Planned Facilities Network 31
5.3.9 Existing School Facilities Planning Permissions 31
5.3.10 New & Future School Provision 32
5.3.11 Schools Summary 32
5.4 Social and Community 33
5.5 Open Space, Sports and Recreation 33
5.6 Faith 34
5.7 Arts and Culture 35
5.8 Other Facilities Including Neighbourhood Centres 36
5.9 Facilities Audit Summary 37
6.0 Childcare Facilities Audit 39
6.1 Existing Network 39
6.2 Potential Demand Generated by Scheme 40
6.3 Estimated Childcare Generate (QNHS) 41
6.4 Summary of Childcare Assessment 42
7.0 Conclusion 43
Appendix A Schools Demand Assessment 44
Appendix B Childcare Demand Assessment 46

1.0 Introduction

This Social Infrastructure Audit has been prepared by KPMG Future Analytics, 1 Stokes Place, St. Stephen's Green, Dublin 2 (Chartered Town Planning and Development Consultants), on behalf of Aston Limited, in support of a planning application for a proposed Strategic Housing Development on lands at Great Connell, Newbridge, Co. Kildare. This report provides a detailed review of the statutory, strategic and policy context that relates to the provision of social infrastructure with the aim to:

- Outline the existing range of social infrastructure within the vicinity of the subject site;
- Determine if the existing social infrastructure provision supports the needs of the existing population; and
- Offer insights into the likelihood of the capacity of the existing services and facilities to support future residents.

A large number of public and private geospatial datasets were used in the course of the survey, including but not limited to:

- 2016 and 2011 Census Boundaries and Statistics;
- 2021 OSi and ESRI Ireland Basemaps;
- 2022 Google Places Dataset;
- 2021 OSM Ireland POI Datasets – Ireland and Northern Ireland;
- 2012-2021 Department of Education and Skills - Irish Schools;
- 2021 QQI Register of Private Higher Education Institutions in Ireland;
- 2022 Tusla Early Years Inspectorate Reports – Registered Childcare Facilities; and
- 2022 HSE Records – 'Find Your Local Health Service'.

1.1 Social Infrastructure

Social infrastructure includes a wide range of services and facilities that contribute to quality of life. It is a key part of the fabric of an area, not just in terms of wellbeing, but also in terms of sense of place, a part of the local identity.

For the purpose of this report, the array of services and facilities defined as social infrastructure have been categorised into the following typologies:

Table 1.1: *Community Infrastructure categories applied to Audit.*

Category	Facility Type
Health	Health Centres, General Practitioner (GP) Practices, Dental Practices, Physiotherapist, Pharmacies, Nursing Homes and Specialist Services
Childcare	Registered Childcare Facilities incl. Full Day, Part-Time and Sessional services
Education and Training	Primary Schools, Post-Primary Schools, Further Education and Training Facilities
Social and Community	Credit Unions, Post Offices, Community Facilities, Emergency Services, Garda Stations, Fire Stations and Libraries
Open Space, Sports and Recreation	Parks, Playgrounds, Dedicated Public Open Space and Amenity Areas, Sports Centres and Formal Club Facilities, Green Corridors, Natural / Semi Natural Green Spaces and Other Open Spaces
Faith	Churches/Places of Worship, Cemeteries

Arts and Culture	Theatre, Museum, Performance and outdoor events spaces, Music, Speech / Drama and Dance
Other Facilities Including Neighbourhood Centres	District, town, neighbourhood, and local centres

1.2 Report Structure

This report will comprise a further six sections.

- **Section 2** provides site context, a description of the Study Area and details relating to the proposed development.
- **Section 3** presents the changing demographic profile of the Study Area.
- **Section 4** reviews national, regional, and local level planning policy relating to social infrastructure.
- **Section 5** provides a detailed assessment of the capacity of the existing social infrastructure to support the needs of the current population and the likelihood of the capacity of the existing services and facilities to support future residents.
- **Section 6** presents a detailed Childcare Facilities Audit.
- **Section 7** provides an overview of the analysis of social infrastructure provision.

2.0 Subject Development

2.1 Subject Site and Study Area

The development site is a greenfield site located at Great Connell to the north east of Newbridge, Co. Kildare on the land's surround and including the dwellings of 'Greatconnell' and 'Valencia Lodge'. Covering c. 27.64 ha in area, the site bounds River Liffey to the south and is accessible through the Great Connell Road which connects to the R445 with the distance of c. 7km from Junction 10 onto the M7. The existing suburb housing estate Wellesley Manor is located to the immediate north of the site. There are existing structures within the site of two agricultural sheds on the east and a commercial premise along the east front. The site is irregular in shape and the location of the subject site in the context of the wider surrounds is illustrated in Figure 2.1 below.

Figure 2.1: *Site Location with the extent of the site outlined in red.*

2.1.2 Planning History

A review of the Strategic Housing Development (SHD) applications through the An Bord Pleanála online planning application register reveals the SHD planning history of the subject area, as set out below:

Planning permission was granted to the south of the subject site on the opposite side of the River Liffey under SHD ABP 302141-18 for 343 no. residential units (283 no. houses, 60 no. apartments) with childcare facilities.

Planning permission was granted in Ballymany, Newbridge under SHD ABP-311040-21 for 204 no. residential units (98 no. houses, 106 no. duplexes/apartments) with provision of a creche.

2.1.3 Transport Access

In terms of public transport, the Newbridge Train Station is located to the north west of the subject site and is of approximately 40 minutes walking distance. The train station provides easy access to locations along the railway including Dublin, Galway, and Waterford. The Newbridge Train Station is also the

terminal station for Phoenix Park Tunnel Service which provides commuter train services to Grand Canal Dock with commuting time of less than an hour.

In addition to the train station, there are a number of bus services within 25 minutes walking distance from the subject site mainly along the R445 including bus routes 120B, 126 and 726 that connect to major terminals in Dublin such as Dublin Airport, Connolly Station and Grand Canal Dock.

2.2 Proposed Development

Aston Limited intend to deliver a strategic housing development on the 27.64 ha development site. The development will consist of 569 no. residential units (325 no. houses, 244 no. apartments) with a neighbourhood centre (11 no. commercial units) and a creche (capacity of 154 no. children). 18 no. open space areas are proposed within the development and cover 2.613 ha in total. The proposed scheme will also include a portion of the Newbridge Southern Outer Orbital Relief Road (NSOORR) which will connect to vehicular access at the exiting roundabout at Great Connell Road. The residential development is deemed to be a strategic housing development (SHD). As such, it is eligible for consideration under the provisions of the Planning and Development (Housing) and Residential Tenancies Act, 2016 (as amended) and Planning and Development (Strategic Housing Development) Regulations, 2017.

For clarity and reference, Table 2.1 below provides a breakdown of residential unit mix, and Figure 2.2 below indicates the proposed layout of the scheme.

***Table 2.1**: Residential Unit Mix.*

Unit Type	Number of Units	Mix %
1-bed	33	5.8%
2-bed	199	35.0%
3-bed	249	44.1%
4-bed	88	15.1%
Total	**569**	**100%**

A full description of the development proposed is as follows:

"*The development will consist of the demolition of existing site structures (2,622.3 sqm) and the construction of 569 no. residential units, a neighbourhood centre with 11 no. units (commercial floor area 2,141 sqm) and a childcare facility (886 sqm), a circa 350 metre section of distributor road, and all ancillary and associated works on a site of 27.64 ha. The proposed development comprises:*

1. *Demolition of existing site structures (total 2,622.3 sqm) comprising; 'Great Connell' a two-storey dwelling of 331.9 sqm with detached single storey garage and outhouses of 48 sqm; 'Valencia Lodge' a single storey dwelling of 135.6 sqm with a single storey garage of 17.8 sqm; two no. single storey sheds of 1,440 sqm and 595 sqm, and a three-sided shed of 54 sqm.*
2. *Construction of 569 no. new residential dwellings (325 no. houses and 244 no. apartments) comprising:*
    - *64 no. two-bed houses; 173 no. three-bed houses; and 88 no. four-bed houses (ranging in height from 2 to 3 storeys).*
    - *Apartment Block A (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.*

- *Apartment Block B (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.*
- *Apartment Block C (Part 3 and 4 Storeys): 4 no. one-bed apartments; 19 no. two-bed apartments and 4 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 87 sqm.*
- *13 no. apartments above the proposed Neighbourhood Centre comprising; 4 no. own-door two-bed apartments; 3 no. shared-access one-bed apartments; and 6 no. shared-access two-bed apartments. These proposed units have private balconies or terraces.*
- *160 no. own-door apartments in 2- and 3- storey buildings comprising; 16 no. one-bed apartments; 78 no. two-bed apartments, 66 no. three-bed duplex apartments. These units will have private amenity areas in the form of terraces, balconies and/or rear gardens.*

3. *Provision of Neighbourhood Centre (ranging in height between 2 and 4 storeys) with 11 no. commercial units comprising: a convenience shop of 909 sqm (unit 1); 3 no. doctor/dentist/physio units of 120 sqm, 120 sqm and 90 sqm (units 6, 7, and 8, respectively); a café of 125 sqm (unit 4); a restaurant of 213 sqm (unit 9); and 5 no. shop/convenience services units of 112 sqm, 49 sqm, 171 sqm, 100sqm and 100 sqm (units 2, 3, 5,10 and 11, respectively). The proposed Neighbourhood Centre includes an external roof terrace of 176 sqm.*
4. *Provision of a childcare facility (886 sqm) within the Neighbourhood Centre with capacity for in the order of 154 no. children.*
5. *Provision of 1,008 no. car parking spaces comprising 650 no. spaces for the proposed houses; 312 no. spaces for the proposed apartments; and 46 no. spaces to serve the Neighbourhood Centre.*
6. *Provision of 732 bicycle parking spaces comprising 536 no. secure residential spaces, 134 no. residential visitor spaces, and 62 no. spaces to serve the Neighbourhood Centre.*
7. *A series of 18 no. public open spaces and pocket parks are proposed throughout the residential development (2.613 ha net area).*
8. *Provision of a 8.31 ha amenity area adjoining the River Liffey.*
9. *Vehicular access to the proposed development from Great Connell road via a circa 350 metre section of the Newbridge South Orbital Relief Road (NSOOR), including footpaths and cycle paths. It is proposed to upgrade the existing Great Connell Roundabout to a signalised junction, and provide footpaths and cycle paths within the subject site along the Great Connell Road.*
10. *Proposed development facilitates future potential pedestrian, cycle and vehicular links to adjoining residential development and undeveloped lands.*
11. *All enabling and site development works, landscaping, boundary treatments, lighting, services and connections, including connection to permitted wastewater pumping station, waste management, ESB substations, compensatory flood storage and all other ancillary works above and below ground on a site of 27.64 ha.*
12. *A 7 year permission is sought."*

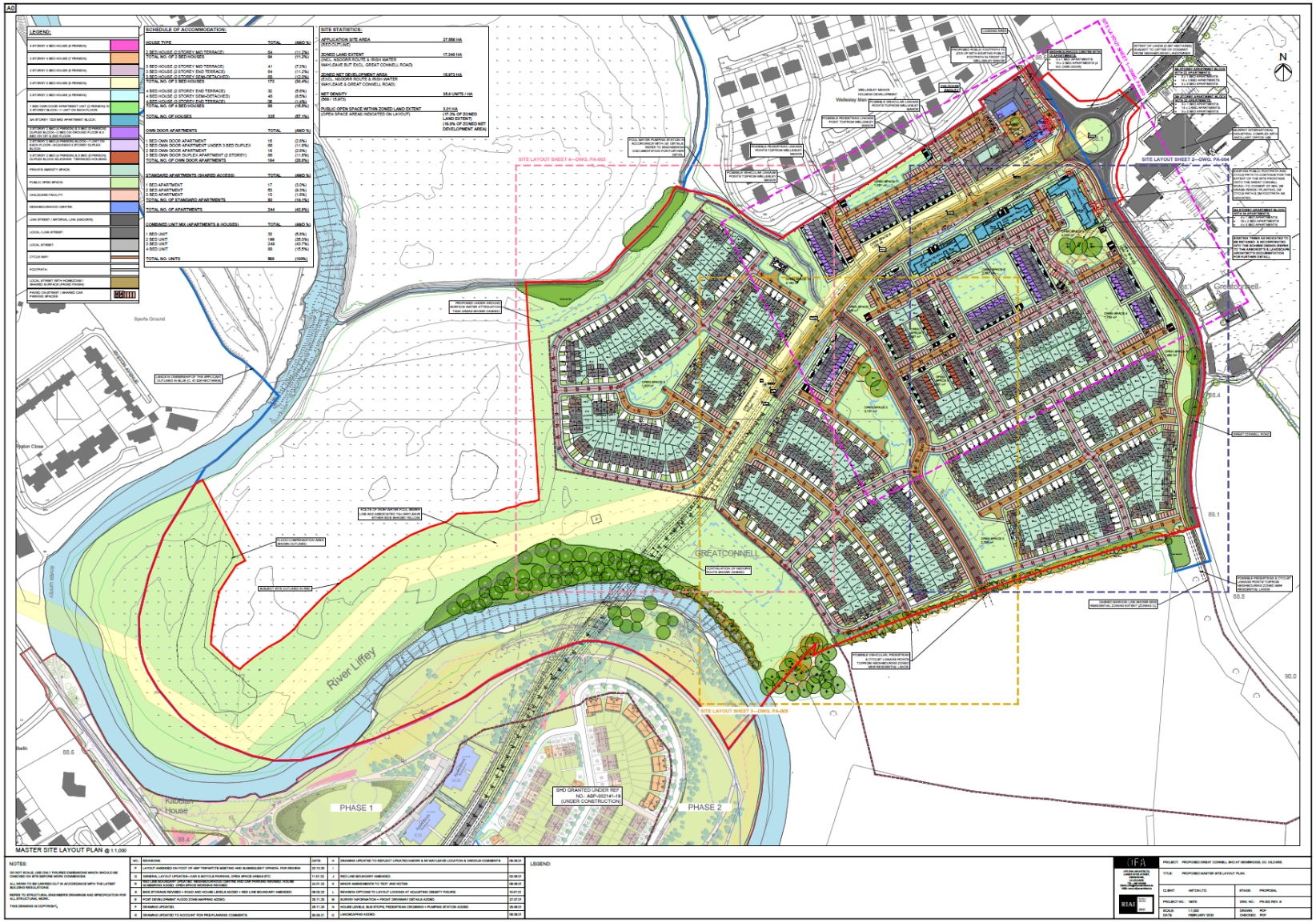


Figure 2.2: Proposed Master Site Layout Plan. Source: O'Flynn Architects.

3.0 Demographic Profile

This section presents socio-economic profile of the study area with respect to the population trends and projections, age profile, educational attainment, and economic status of the local population, to better understand the needs of the area with respect to social infrastructure services and facilities.

The study area for the purposes of the demographic analysis consists of 75 no. CSO Small Area Boundaries which intersect a c. 2km radius from the subject site, as indicated in Figure 3.1 below, and provide insight into the character of the local population with respect to demographic trends. This local Study Area is compared to larger trends within County Kildare in Sections 3.1-3.4 to follow. The defined c. 2 km radius of the subject site, equivalent to a c. 15 to 25-minute walking distance is illustrated in Figure 3.2 below.

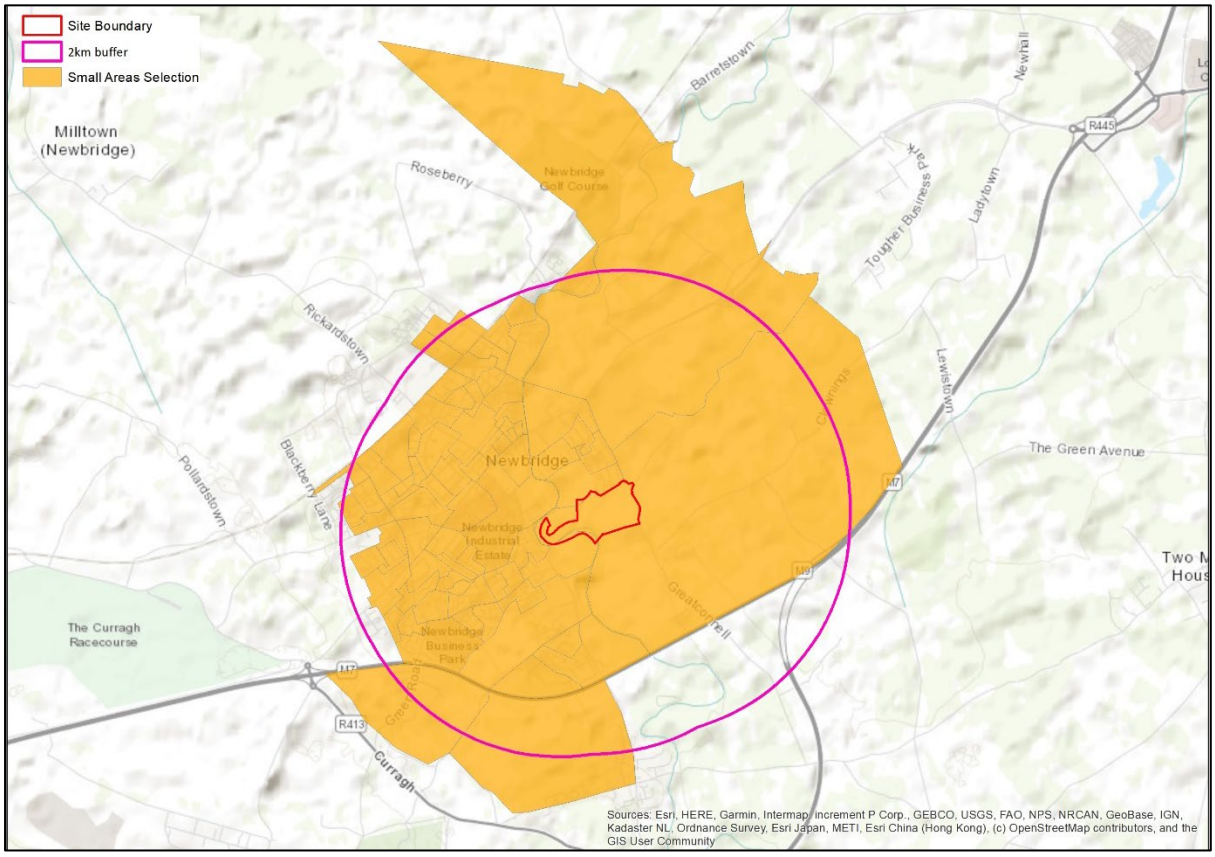


Figure 3.1: *Extent of Demographic Study Area (shown in orange).*

Figure 3.2: Aerial View of Study Area.

3.1 Population Trends

Table 3.1 outlines the population of the Study Area and County Kildare as recorded during the Census 2011 and 2016, as well as the percentage change in population during this period to highlight overall residential patterns.

Table 3.1: Population Change 2011-2016.

Area	2011 Population	2016 Population	2011-2016 Change (#)	2011-2016 Change (%)
Study Area	20,282	21,015	+733	+4%
Kildare	210,312	222,504	+12,192	+6%

As illustrated in Table 3.1, the Study Area experienced a population increase between 2011 and 2016. Over the five-year period, the population of the Study Area rose from 20,282 to 21,015 by 733 persons, representative of an increase of 4% which is at a lower rate than the entirety of County Kildare (+6% increase).

3.2 Age Profile

Tables 3.2 and 3.3 provide a breakdown of the recorded population, categorised by age to allow a more detailed overview of the specific cohorts that have experienced the greatest change. Different age cohorts of a population have different requirements, with young families in need of childcare and educational facilities, a strong working age population requiring employment opportunities, and those of retirement age in need of care and health services. Thus, it is imperative to gain an understanding of

the specific age cohorts that are experiencing the most significant change to ensure that there is an adequate provision of services and facilities.

Table 3.2: Population of the Study Area by Age 2011.

Age Group	Study Area 2011	% Total	Kildare 2011	% Total
0-14	5,073	25%	51,568	25%
15-64	13,495	67%	142,088	68%
65+	1,714	8%	16,656	8%
Total	**20,282**	**100%**	**210,312**	**100%**

Table 3.3: Population of the Study Area by Age 2016.

Age Group	Study Area 2016	% Total	Kildare 2016	% Total
0-14	5,011	24%	53,560	24%
15-64	13,910	66%	146,930	66%
65+	2,094	10%	22,014	10%
Total	**21,015**	**100%**	**222,504**	**100%**

As illustrated in Table 3.2 above, the Study Area had a predominantly working age structure with families in 2011, with 67% of its population aged between 15 and 64 year, and 25% of the population in the age cohort of 0-14, with a minority of a 65+ population recorded at 8%. This is similar to the overall trends occurring within County Kildare in 2011, with a maximum of 1% differences in each age cohort.

As highlighted in Table 3.3 above, the Study Area similarly had a predominantly working age structure in 2016. Noticeably, the number of people within the young age cohort of 0-14 years has decreased between 2011 and 2016, with the working age cohort of 15-64 years and the old age cohort of 65 years and over increased between 2011 and 2016. The young age cohort decreased by 62 persons at a percentage of -1.2%. The working age cohort of 15-64 increased by 415 persons at a percentage of 3%. Most significantly, the +65-age cohort increased by 380 persons at a percentage of 22%. The overall trends occurring with age profiles are similar within County Kildare as whole.

3.3 Educational Attainment

There is a considerably lower amount of third level attainment within the study area (44%) compared to the county (51%), at both level 6+ and level 7+. Table 3.4 reflect the education attainment within the study area and Kildare in 2016.

Table 3.4: Population age 15+ years by highest education completed in 2016.

Education Level	Study Area 2016	% Total	Kildare 2016	% Total
No Formal Education	236	1%	2,018	1%
Primary Education	1,504	9%	11,700	6%
Secondary Education	6,122	35%	59,513	30%
Third Level Education (Level 6+)	4,639	26%	58,716	30%
Third Level Education (Level 7+)	3,238	18%	42,272	21%

Postgraduate Education or Higher	1,049	6%	14,672	8%
Not Stated	865	5%	6,714	3%
Total	**17,653**	**100%**	**195,605**	**100%**

3.4 Economic Status

The economic profile of the Study Area has similar themes to County Kildare, with the majority of the population categorised under 'At Work' in 2016. Table 3.5 provides an overall illustration of the economic status. Within the Study Area, there is a lower percentage (55%) of people at work compared to the county level (57%), with the level of unemployment being higher (8%) within the study area compared to Kildare (6%). Within Kildare, there is a higher percentage of students (12%) than the study area (10%), but the study area marginally contains more 'Retired' persons (12%) than the wider county level (11%).

***Table 3.5**: Economic Status of Study Area and Kildare in 2016.*

Principal Economic Status	*Study Area 2016*	*% Total*	*Kildare 2016*	*% Total*
At Work	8,857	55%	95,947	57%
Looking for First Regular Job	173	1%	1,395	1%
Unemployed	1,281	8%	10,902	6%
Student	1,676	10%	20,559	12%
Looking After Home/Family	1,355	8%	14,478	9%
Retired	1,912	12%	18,890	11%
Unable to Work	698	4%	6,255	4%
Other	52	0.3%	518	0.3%
Total	**15,209**	**100%**	**168,944**	**100%**

3.5 Population Projections

KPMG Future Analytics undertook a custom population projection exercise in order to understand what can be expected in terms of population change for this area.[1] This projection scenario has been developed using the Cohort Component Method.

The scenario only represents a likely trajectory of growth should the input assumptions on migration, mortality and fertility develop as anticipated. The scenario assumptions reflect consensus reached by the CSO expert group on population and have been modified to reflect recent assumed impacts due to COVID-19. Furthermore, a distributional matrix has been developed to resolve Electoral Division scale intra-regional migration.

The study area for the purposes of the population projection consists of 4 no. CSO Electoral Division Boundaries which intersect a c. 2km radius from the subject site, as indicated in Figure 3.3 below. The existing urban areas are mostly concentrated within the intersections of the c. 2km radius from the subject site and the 4 no. Electoral Division Boundaries, therefore, the selection of the study area for population projection is appropriate. The electoral division of Newbridge Urban is highlighted as a stand-alone projection to present the future population trends of the urban area.

[1] A custom population scenario has been examined by using international best practice in demographic projection (the Cohort Component Method) to reflect the assumed impact of COVID-19.

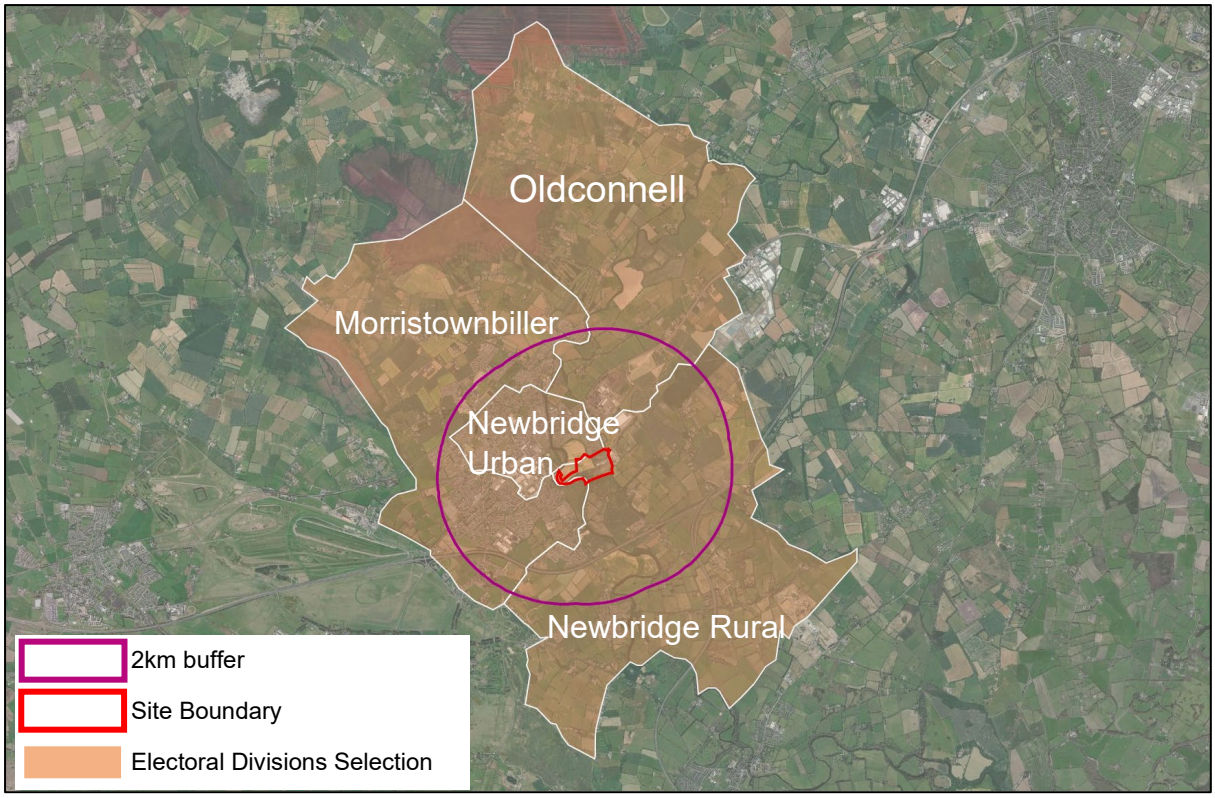


Figure 3.3: *Extent of Population Projection Study Area (shown in light orange).*

As detailed in Table 3.6 below, the Study Area saw a significant increase in its population between 2006 and 2016. However, the population in Newbridge Urban area decreased slightly from 2006 to 2016. A more modest increase is projected between 2016 and 2031 for the study area with the population increase of more than 2,100 per 5 years. Similar population increase is also projected for Newbridge Urban area up until 2031. In 2031, the study area is projected to reach a population of 32,721 and the Newbridge Urban area is likely to reach a population of 9,532.

The *Draft Kildare County Development Plan 2023-2029* is currently undergoing a period of public consultation stage until 24th May 2022. An estimated population of 24,059 was indicated for Newbridge Town in 2021 in Table 2.8 of the Draft Plan, which also sets out a population target of 2,917 no. persons and a housing target of 1,061 no. units for Newbridge to Q4 2028. As the population projection conducted in this report was based on 4 no. Electoral Division Boundaries which cover a larger area than Newbridge Town, it is considered that the population estimation projected below and the targets in the Draft Plan are of a similar level. In addition, it can be concluded that that the proposed development would positively contribute towards helping to achieve both population and housing targets in both.

Table 3.6*: Population Projections for 2031.*

	Study Area EDs			Newbridge Urban ED		
Year	**Population**	**Difference**	**Difference %**	**Population**	**Difference**	**Difference %**
2006	21,727	-		7,888	-	
2016	26,258	4,531	20.8%	7,762	-126	-1.6%
2021	28,424	2,166	8.2%	8,355	593	7.6%
2026	30,609	2,185	7.7%	8,967	612	7.3%
2031	32,721	2,112	6.9%	9,532	565	6.3%

Note: Projections are shaded in light green.

As detailed in Table 3.7, it is projected that the age profile of the Study Area in 2031 will be dominated by those that are of 'working age' (c.68.8%), with a smaller number of younger people (c.17.1%) and older people (c.14.1%). The age profile of the Newbridge Urban area in 2031 will also witness a large number of 'working age' population, however, with a smaller proportion (c. 65.3%) compared with the whole study area. Age groups of younger and older people are also projected to be of higher proportion compared with the whole study area which indicates higher dependency ratio in Newbridge Urban.

***Table 3.7**: Projected Population (age cohorts) for 2031.*

Study Area EDs 2031			Newbridge Urban ED 2031		
Cohort Data	**Population**	**%**	**Cohort Data**	**Population**	**%**
0-14	5,607	17.1%	0-14	1,713	18.0%
15-64	22,492	68.8%	15-64	6,222	65.3%
65+	4,622	14.1%	65+	1,597	16.7%
Total	**32,721**	**100%**	**Total**	**9,532**	**100%**

4.0 Policy Context

A range of national, regional, and local level planning policy relating to social infrastructure have been reviewed. The key points relating to this study, as derived from each policy document, will be highlighted in this section.

4.1 National Planning Framework

The *National Planning Framework* (NPF), under Project Ireland 2040, forms the overarching framework for the spatial development of Ireland to 2040. A key focus of the NPF is on sustainable and compact development within pre-existing urban areas and the provision of accessible services and facilities for all communities.

Given its focus on sustainable development, the NPF includes a number of points related to social infrastructure inclusive of 'National Strategic Outcome 10: Access to Quality Childcare, Education and Health Services' which seeks to provide good accessibility to quality health services and childcare and education facilities, supported by compact growth in urban areas.

Furthermore, Chapter 6 of the NPF states that the *"ability to access services and amenities, such as education and healthcare, shops and parks, the leisure and social interactions available to us and the prospect of securing employment"* is intrinsic to providing a good quality of life for new and existing communities. Chapter 6 additionally includes a Hierarchy of Settlements and Related Infrastructure that indicates the services and facilities necessary within settlements of different size to serve their populations (Figure 4.1).

***Figure 4.1**: Hierarchy of Settlements and Related Infrastructure.*

4.2 Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas

The *Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas (2009)* outline the key principles which should be considered in the establishment of new residential developments. They recognise the significance of social infrastructure to quality of life and state that new development should take into consideration the social infrastructural needs of the community and the existing provision of same.

The Guidelines specify that 1 no. childcare facility (equivalent to a minimum of 20 no. child places) should be provided for every 75 no. units. However, it further elaborates that the threshold for such provision should be established having regard to the existing geographical distribution of childcare facilities and the emerging demographic profile of the area, in consultation with the Childcare Committee. The Guidelines additionally outline that an assessment of existing schools within the vicinity of the subject site to cater for such demand should accompany applications for substantial residential development (200+ no. units). Furthermore, they detail that the provision of health and community facilities should be determined according to the particular circumstances of the area.

The Guidelines notably stipulate the significance of a local assessment of the need to provide social infrastructure in the provision of such services and facilities.

4.3 Regional Spatial and Economic Strategy for the Eastern and Midland Region

The *Regional Spatial and Economic Strategy for the Eastern and Midland Region* (RSES) sets out a 12-year strategic development framework for the Eastern and Midland Region. Supportive of the implementation of the NPF, the RSES reflects its focus on the provision of accessible services and facilities for communities within the Eastern and Midland Region.

Section 9.1 of the RSES details that the availability of, and access to, services and facilities, inclusive of healthcare services, education facilities and community/recreational facilities is key to creating healthier places. This is supported by Regional Policy Objective 9.14 which calls for Local Authorities to *"support the planned provision of easily accessible social, community, cultural and recreational facilities and ensure that all communities have access to a range of facilities that meet the needs of the communities they serve"*.

In addition, Newbridge falls within the Core Region category of the RSES, in which the RSES emphasises the need to provide accessible services, facilities and supports for Core Region towns through *"promote continued growth at more sustainable rates, while providing for increased employment and improved local economies, services and functions to allow towns become more self-sustaining and to create the quality of life to attract investment."*.

4.4 Sustainable Urban Housing: Design Standards for New Apartments

The recently revised *Sustainable Urban Housing: Design Standards for New Apartments* (2020) specifies the provision of 1 no. childcare facility (equivalent to a minimum of 20 no. child places) for every 75 no. proposed residential units, albeit informed by the demographic profile of the area and the existing capacity of childcare facilities, as follows:

> *"Notwithstanding the Planning Guidelines for Childcare Facilities (2001), in respect of which a review is to be progressed, and which recommend the provision of one child-care facility (equivalent to a minimum of 20 child places) for every 75 dwelling units, the threshold for provision of any such facilities in apartment schemes should be established* ***having regard to the scale and unit mix of the proposed development and the***

> ***existing geographical distribution of childcare facilities and the emerging demographic profile of the area.*** *One-bedroom or studio type units should not generally be considered to contribute to a requirement for any childcare provision and subject to location, this may also apply in part or whole, to units with two or more bedrooms."* ***[emphasis added]***
>
> *Source: Sustainable Urban Housing: Design Standards for New Apartments (2020)*
>
> *Section 4.7, pg. 20-21.*

This provides an element of flexibility in the provision of childcare facilities, provided a sufficient demographic and/or geographical justification can be provided. It also states that studio and one-bedroom units do not need to be included in any count that estimates the number of minors in a development and this may also apply to a portion of units with 2 no. or more bedrooms.

4.5 Childcare Facilities: Guidelines for Planning Authorities

The *Childcare Facilities: Guidelines for Planning Authorities (2001)* state that 1 no. childcare facility should be provided for new large-scale housing developments unless there are significant reasons to the contrary:

> *"Planning authorities should require the provision of at least one childcare facility for new housing areas* ***unless there are significant reasons to the contrary*** *for example, development consisting of single bed apartments or* ***where there are adequate childcare facilities in adjoining developments****. For new housing areas, an average of one childcare facility for each 75 dwellings would be appropriate.* ***The threshold for provision should be established having regard to the existing geographical distribution of childcare facilities and the emerging demographic profile of areas.*** *Authorities could consider requiring the provision of larger units catering for up to 30/40 children in areas of major residential development on the basis that such a large facility might be able to offer a variety of services – sessional/drop in/after-school, etc."* ***[emphasis added]***

Source: Childcare Facilities: Guidelines for Planning Authorities (2001) Section 2.4, pg. 5-6.

The provision of childcare facilities is further elaborated in Section 3.3.1 of the Guidelines which states that *"a standard of one childcare facility providing for a minimum 20 childcare places per approximately 75 dwellings may be appropriate''* for new residential developments. However, they continue by clarifying that such Guidelines are exactly that – **guidelines and not a strict prescription or requirement** – and the provision of childcare facilities will depend on the particular circumstances of each individual site and development.

4.6 Kildare County Development Plan 2017-2023

The *Kildare County Development Plan 2017-2023* (KCDP) provides the overarching planning policy that applies to the area. Chapter 11 of the KCDP notes that a key priority for development within Kildare is the creation of sustainable communities, with a range of household types and tenures located in close proximity to community facilities and services. Section 11.4 recognises that the efficient use of available and sufficiently zoned land will be necessary to ensure the provision of necessary facilities and services within reasonable distance of residents within the area, and that significant development should only take place where sufficient schools, parks and other resources are already in place or are proposed for development. As further detailed in Section 11.4, the provision of community infrastructure is required to be produced in tandem with new residential developments.

Given the aforementioned key priority of the Council to create sustainable neighbourhoods, the KCDP includes a suite of policies relating to the provision of social infrastructure:

SR1: *Support sustainable residential development in established urban areas at appropriate locations, to support the ongoing viability of social and physical infrastructure and services, and to meet the future housing needs of the county. Standards in relation to residential development in established urban areas are set out under Chapter 17 of this Plan*

C3: *Assess the suitable provision of nursing homes, crèches and other commercially run community facilities and amenities at appropriate locations, during the preparation of Local Area Plans and Village Plans.*

CPFO2: *Facilitate and encourage the provision of childcare facilities, including community crèche facilities, of an appropriate type and scale, at appropriate locations throughout the county.*

CS11: *Seek the delivery of physical and community infrastructure including strategic open space and recreational areas in conjunction with high quality residential developments to create quality living environments.*

4.7 Draft Kildare County Development Plan 2023-2029

As outlined above, the *Draft Kildare County Development Plan 2023-2029* was released for public viewing on the 14th of March to the 24th of May 2022 and is currently open for public submissions. It will take effect in Q1 of 2023 and provides the intended overarching planning policy applicable to the area. Chapter 2 of the Draft Plan outlines the Core Strategy for Kildare, in which Newbridge is stated as a '*Self-Sustaining Growth Town'* within the settlement hierarchy proposed. Within section 2.10 of the Draft Plan, Newbridge has an estimated population target of 2,917 persons between 2023 to 2028, with a housing target of 1,061 units between 2023 and 2028 also.

Chapter 10 of the Draft Plan notes the importance of social infrastructure, community facilities and community development being vital to the creation of sustainable communities. It highlights the importance of social infrastructure being appropriately located within town/villages in order to provide and optimize accessibility. As further outlined within section 10.4, the Draft Plan also recognizes the importance of providing "*community services and facilities in tandem with and during the early phases of new housing developments*", particularly when creating sustainable communities through social infrastructure provision.

Given the key priority of the Council to create sustainable communities through the provision and facilitation of social infrastructure, the Draft Plan provides a list of policies relating to the provision of social infrastructure:

SC P2: *Require the delivery of a range of universally accessible and well-connected social, community, cultural, and recreational facilities, close to the communities they serve through the designation and safeguarding of specific land uses at appropriate strategic and optimised locations in settlement plans and mandatory Local Area Plans in County Kildare.*

SC P10: *Develop and improve the physical infrastructure of arts and cultural facilities throughout the county particularly in areas where there is a deficiency in such provision.*

SC P12: *Continue to work with the Department of Education and other education authorities to promote and support the provision of primary, post-primary, and further education facilities in the County to reflect the diverse educational needs of communities.*

SC P13: *Support and facilitate the provision of good quality and accessible childcare facilities at suitable locations within the County in consultation with the Kildare County Childcare Committee.*

SC P14: *Support the Health Service Executive (HSE) and other statutory and voluntary agencies in the provision of appropriate healthcare facilities, including the system of hospital care and the provision of community based primary care facilities appropriate to the size and scale of each settlement.*

SC P16: *Support and facilitate the development of places of worship, multi-faith facilities, burial grounds, columbarium walls, and crematoria to cater for the needs of the county.*

4.8 Newbridge Local Area Plan 2013 – 2019

The *Newbridge Local Area Plan (NLAP) 2013 – 2019* provides an overarching planning and sustainable development strategy of Newbridge and was set out in accordance with the Kildare County Development Plan 2011 to 2017 and the Regional Planning Guidelines for the Greater Dublin Area 2011 to 2021. It outlines the social, economic, and planning context for the town, providing the strategic context approach of the policy and objectives in relation to land zoning and planning. It was extended for a further two years until December 2021 as a statutory policy document. The LAP recognizes the importance of community and social infrastructure within chapter 7.10 in contributing to a high quality of life and should be produced in tandem with housing development projects.

To guide sustainable development within Newbridge, the NLAP includes a suite of policies that guide the provision of new residential developments and social infrastructure:

HL5: *To require applications for residential developments over 20 units, to demonstrate the provision of an appropriate mix of dwelling types having regard to the following: • The nature of the existing housing stock and existing social mix in the area; • The desirability of providing for mixed communities; • The provision of a range of housing types and tenures; • The need to provide a choice of housing, suitable for all age groups and persons at different stages of the life cycle; • The need to cater for special needs groups*

HL7: *To facilitate and co-operate in the provision of community facilities in tandem with residential development including, in particular, local services, schools, creches and other education and childcare facilities, including youth facilities.*

HL8: *To require applications for residential developments over 25 units, to demonstrate how the proposed increase in population will be accommodated in terms of education provision.*

CF3: *To facilitate the development of health centres, local clinics, nursing homes and residential home care units in or in proximity to the established town centre in Newbridge.*

4.9 Policy Summary

The proposed development is in compliance with the sustainable development objectives and suite of policies that have been reviewed through planning policy documents that apply to the study area. It will also contribute to allocating extra social infrastructure through the provision of open spaces, healthcare facilities and a childcare facility.

5.0 Facilities Audit

The Infrastructural Study Area for this assessment is defined by a c. 2 km radius of the subject site, equivalent to a c. 15 to 25-minute walking distance. Given that the subject site is located at the edge of Newbridge town adjacent to an existing residential area and in close proximity to the town centre, with future provision of the Newbridge Southern Outer Orbital Relief Road (NSOORR), this catchment forms a logical spatial area for this Social Infrastructure Assessment.

A total of 8 no. categories of facilities that align with the policies set out in the Kildare County Development Plan, were utilised for this audit. More than 130 no. social infrastructure facilities and services were identified within and immediately bordering the Study Area. The summary of all the social infrastructure facilities identified in this audit is provided in Figure 5.1.

Table 5.1: *Social Infrastructure Categories applied to Audit.*

Category	Facility Type
Health	Health Centres, General Practitioner (GP) Practices, Dental Practices, Physiotherapist, Pharmacies, Nursing Homes and Specialist Services
Childcare	Registered Childcare Facilities incl. Full Day, Part-Time and Sessional services
Education and Training	Primary Schools, Post-Primary Schools, Further Education and Training Facilities
Social and Community	Credit Unions, Post Offices, Community Facilities, Emergency Services, Garda Stations, Fire Stations and Libraries
Open Space, Sports and Recreation	Parks, Playgrounds, Dedicated Public Open Space and Amenity Areas, Sports Centres and Formal Club Facilities, Green Corridors, Natural / Semi Natural Green Spaces and Other Open Spaces
Faith	Churches/Places of Worship, Cemeteries
Arts and Culture	Theatre, Museum, Performance and outdoor events spaces, Music, Speech / Drama and Dance, Tourism Amenities
Other Facilities Including Neighbourhood Centres	District, town, neighbourhood, and local centres

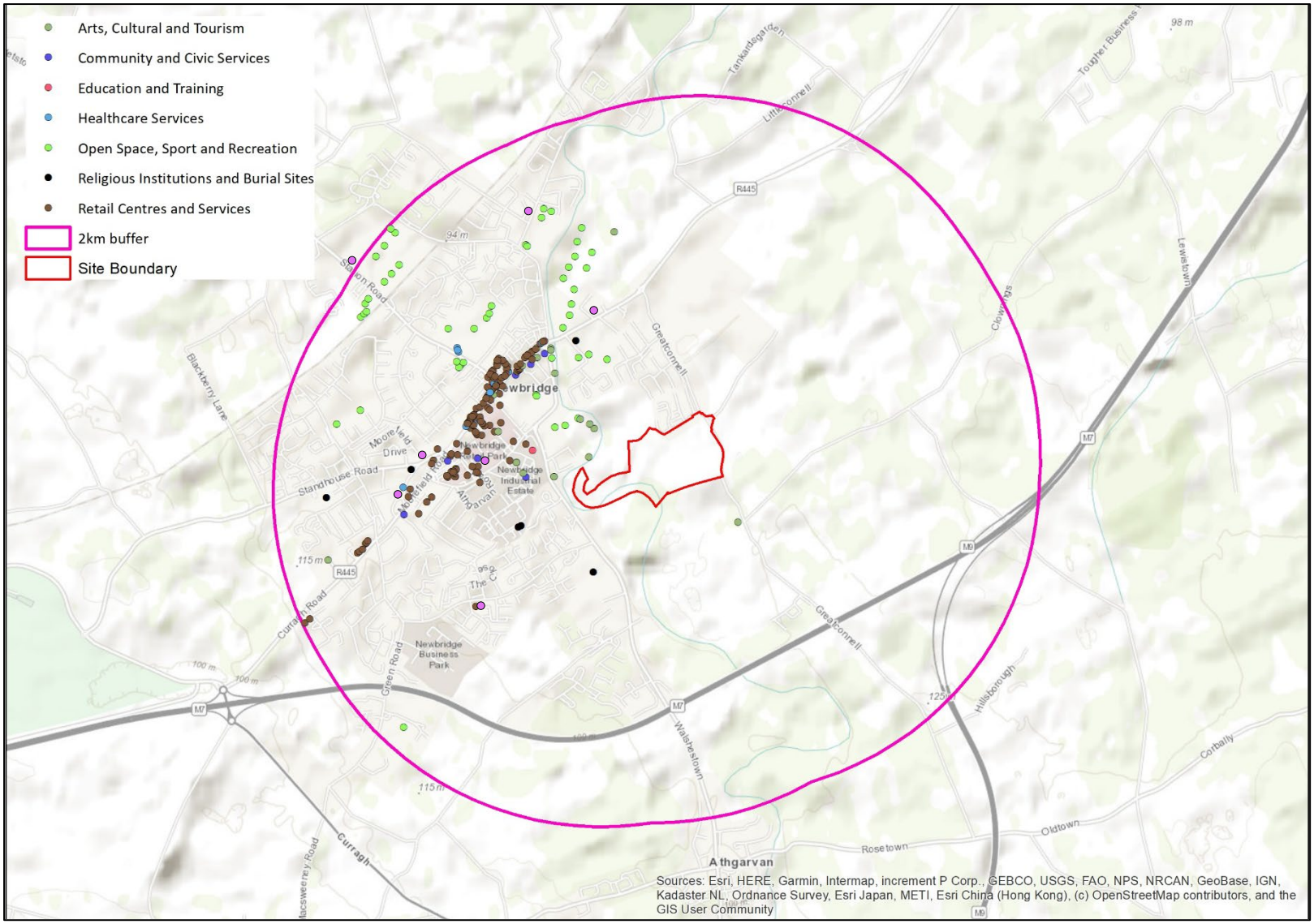


Figure 5.1: *Existing Social Infrastructure within the Study Area.*

5.1 Health

The availability of, and access to, quality health services and facilities is a key element to creating sustainable neighbourhoods. A total of **22 no. health services and facilities**, comprising 10 no. GP practices, 2 no. dental practices, 8 no. pharmacies, and 2 no. opticians were identified within and bordering the Study Area during the baseline survey. There is currently a provision of c. 0.48 GPs per 1,000 population, which is slightly lower than the national average of c. 0.69 GPs per 1,000 population. In relation to the proposed development, it is noted that the proposals include the provision of 3 no. doctor/dentist/physio units which will benefit both existing and future residents in the area.

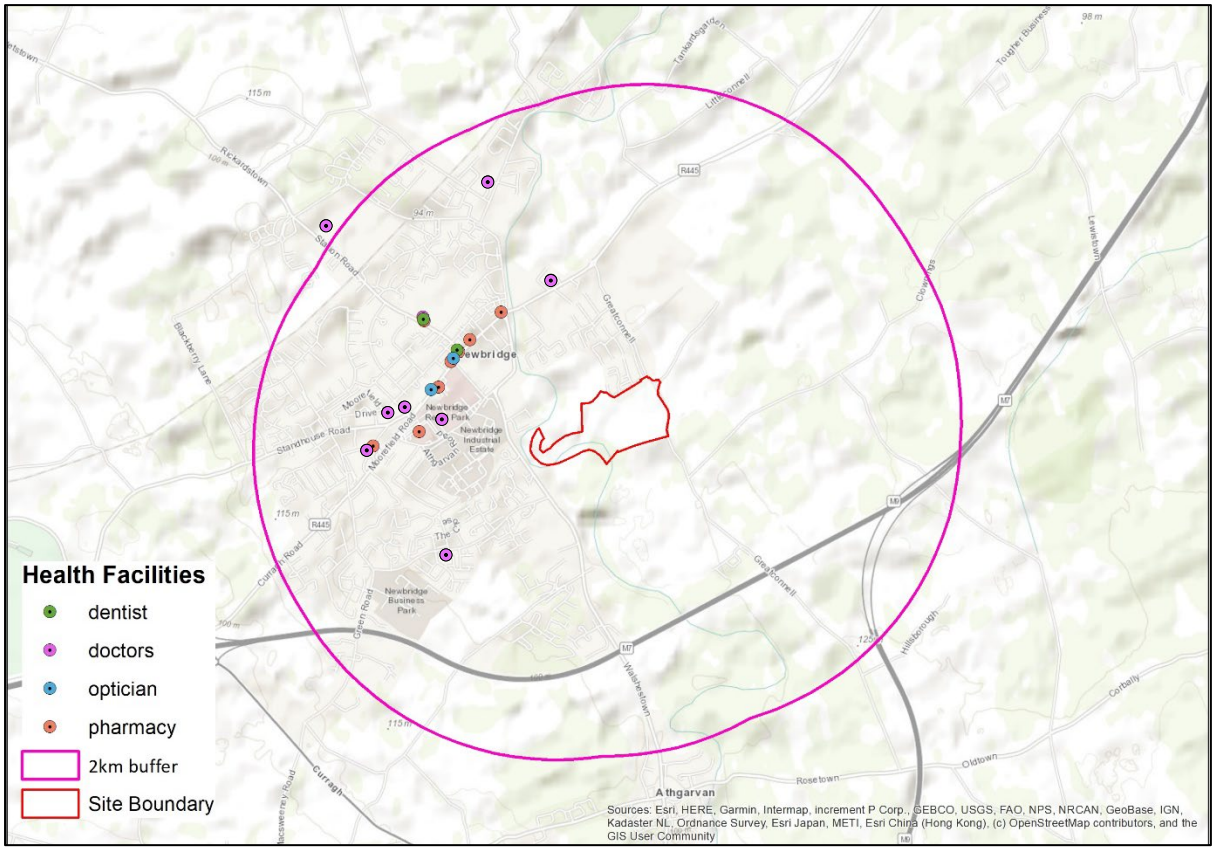


Figure 5.2: Existing Health Services and Facilities within and bordering the Study Area.

Table 5.2 Health Services and Facilities within and bordering the Study Area.

Type	Facilities
GP Practices (10)	Newbridge Family Practice, Newbridge Medical Centre, The Bridge Medical Centre, Moorefield Medical Centre, Curragh Grange Family Practice, Newbridge Womens Health & Family Planning Clinic, Roseberry Clinic, Doctor Hishrim Ramadan, Newbridge Medical & Dental, Defence Forces – Military Medical Facility
Dental Practices (2)	Newbridge Medical & Dental, The Clinic Newbridge
Opticians (2)	Specsavers, and Kellys Opticians.
Pharmacies (8)	Young's Pharmacy, Cosgrove's Pharmacy, Unicarepharmacy, Hickey's Pharmacy, Bergins Pharmacy, Your Local Pharmacy, Mangans Pharmacy, Moorefield Pharmacy

5.2 Childcare

A **total of 15 no. childcare facilities were identified in the Study Area** using the latest Tusla Early Years Inspectorate data[2] which could be accessed within a c.2 km radius of the site (See Section 6.0 for a detailed Childcare Facilities Audit).

Figure 5.3 illustrates the distance of each facility from the subject site and Table 5.3 lists all the childcare facilities within the study area in 2km radius. The closest facilities to the subject site include, Ti-r na Nog, Giggles Playschool and Sonya Keating.

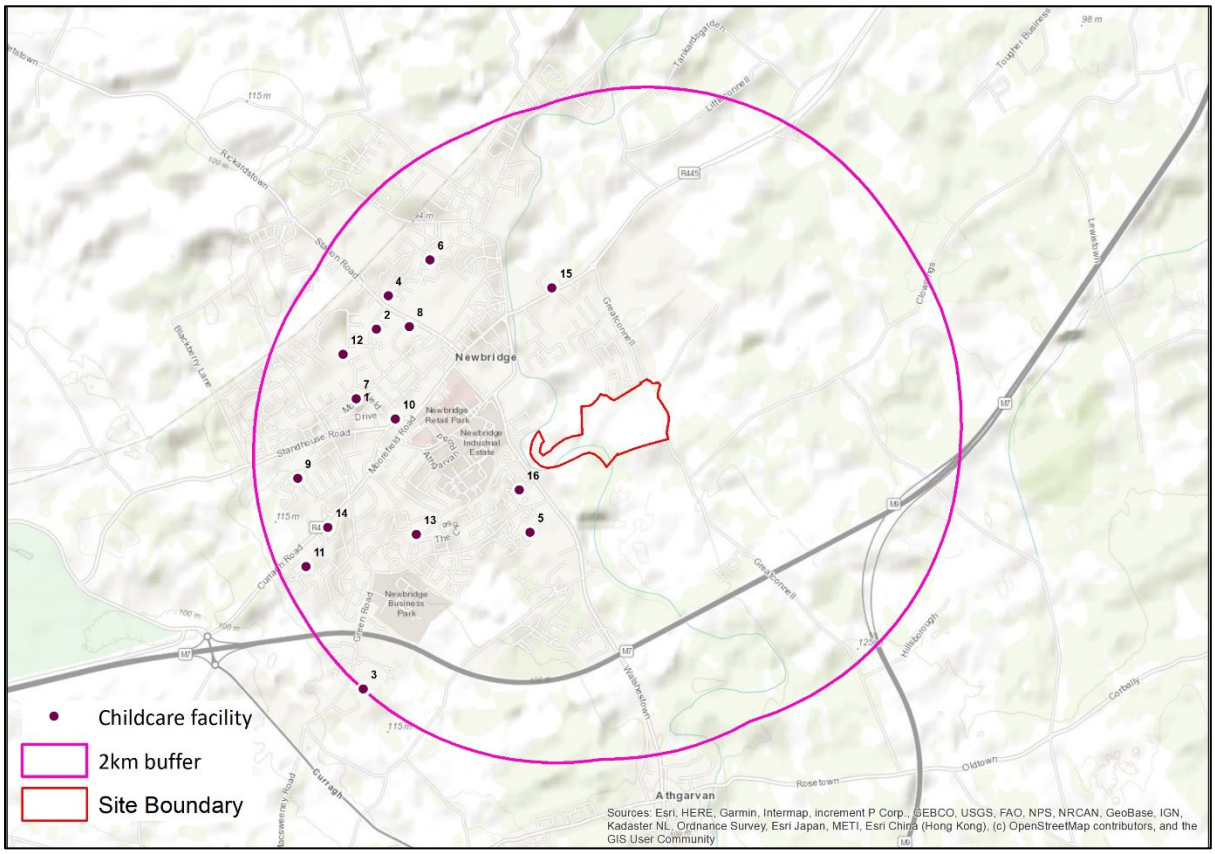


***Figure 5.3**: Existing Childcare Facilities within and bordering the Study Area.*

***Table 5.3**: Childcare Facilities within and bordering the Study Area.*

Type	Facilities
Facilities within 2km	Amanda's Playschool, Rainbow Brite, Montessori, KARE Pre-School, Tots Creche & Daycare Nursery Limited, Giggles Playschool, Klever Kidz Preschool, Hickorys, Judy's Playschool, Mags Childminding, Tots Creche & Daycare Nursery Limited, Teeny Weenys, Family Resource Center (Childcare), Child's Play, Stepping Stones, Ti-r na Nog, Sonya Keating

[2] The Tusla Early Years Inspectorate carries out inspections of Early Years Services under Section 58(J) of the Child Care Act 1991 (as inserted by Section 92 of the Child and Family Agency Act 2013). Inspection Reports for active facilities are available online for public inspection and are updated at regular intervals by the service. Visit the Tusla website for more detail: https://www.tusla.ie/services/preschool-services/creche-inspection-reports/

A note regarding the Childcare Facilities

KPMG Future Analytics carried out a Childcare Facilities Audit (which has further been detailed in Section 6.0 of this report) within a 2km catchment of the proposed development.

The results of this Audit, as detailed comprehensively in Section 6.0, demonstrate how there is adequate capacity within the existing facilities to accommodate the future demand for childcare places arising from the proposed development, which will also include a creche as part of the Strategic Housing Development to further enhance the childcare capacity of the study area.

Notwithstanding same, it is noted that the childcare capacity survey conducted confirms a greater level of capacity is available within those facilities in the catchment on which our Childcare Facilities Audit is based. As such, this latest available insight, independently conducted to the applicant or Design Team, is demonstrative of the level of capacity available in childcare facilities within the area of the proposed development.

5.3 Education and Training

A total of 10 no. education and training facilities were identified within or just outside the Study Area. **Within the Study Area, 6 no. primary schools and 4 no. post-primary schools were recorded**. Figure 5.4 illustrates the distance of each facility from the subject site and Table 5.4 lists all the education and training facilities identified within or just outside the study area.

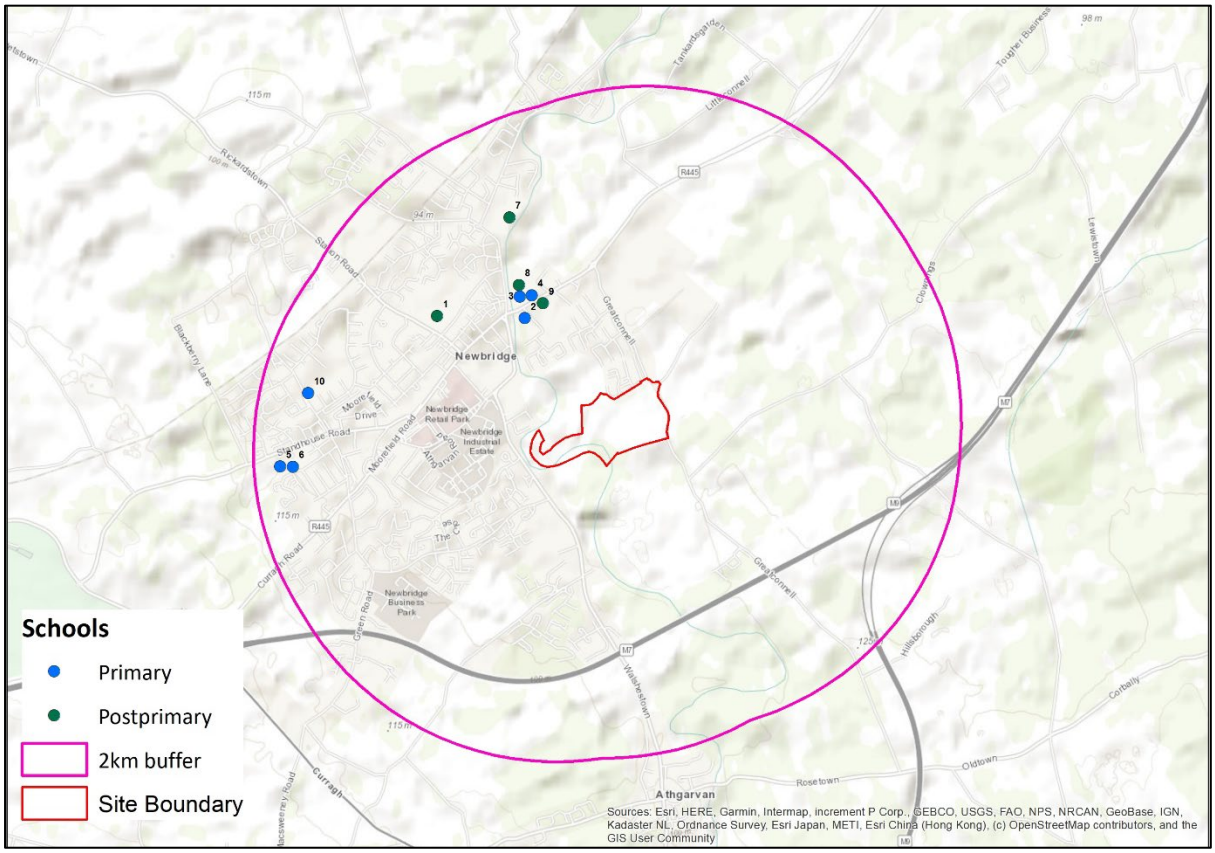


***Figure 5.4**: Existing Education and Training Facilities within and bordering the Study Area.*

***Table 5.4**: Education and Training Facilities within and bordering the Study Area.*

Type	*Facilities*
Primary (6)	*St Patricks National School, Scoil Chonnla Phadraig, St. Conleths and Marys National School, S N Connlaodh Naofa N., Scoil Mhuire, Ballymany Junior National School.*
Post-Primary (4)	*Patricians Secondary School, Holy Familys Secondary School, St Conleth's Community College, Newbridge College*

5.3.1 Primary Schools

A total of 6 no. primary schools were identified within the 2km boundary of the site. These schools held a combined provisional enrolment of 2,009 no. students during the 2020/2021 school year as per Department of Education and Skills (DES) records. We note that of this cohort, all schools within the study area were co-educational (mixed). Table 5.5 (a) below provides detail of the primary schools and their enrolment in 2020/21.

Table 5.5(a): Recorded Enrolments for Primary.

No.	Roll No.	School Name	Females	Males	2020/2021 Enrolment
1	13328I	St Patricks National School	86	106	192
2	15870O	Scoil Chonnla Phadraig	167	175	342
3	17872F	St. Conleths and Marys National School	168	183	351
4	17873H	S N Connlaodh Naofa N	159	172	331
5	19452Q	Scoil Mhuire	201	212	413
6	19550Q	Ballymany Junior National School	174	206	380
Total			**955**	**1,054**	**2,009**

5.3.2 Post-Primary Schools

The Study Area is served by 4 no. post-primary school which recorded a combined enrolment of 3,112 no. students during the 2020/2021 school year as per Department of Educate and Skills (DES) records. We note that, of this cohort, 1no. school was an all-boys school and 1no. of the schools was an all-girls school, while the remaining 8 no. schools were co-educational (mixed). Table 5.5 (b) below provides detail of the post primary schools and their enrolment in 2020/21.

Table 5.5(b): Recorded Enrolments for Post-Primary Schools.

No.	Roll No.	School Name	Females	Males	2020/2021 Enrolment
7	61680T	Newbridge College	440	460	900
8	61681V	Patrician Secondary School	0	903	903
9	61682A	Holy Family Secondary School	721	0	721
10	70680U	St Conleth's Community College	332	256	588
Total			**1,493**	**1,619**	**3,112**

Given the increased mobility of post-primary school students, a larger area of 15 minutes driving distance from the subject site is also examined to assess the potential additional post-primary schools that could serve the proposed development. A further 7 no. post-primary schools are identified to be located within such area but outside the c. 2km radius boundary of the site. 3 no. schools are in Naas and 1 no. school in Kildare Town. 2 no. post-primary schools are considered to be in the close proximity to the subject site. The enrolment of these two additional post-primary schools is presented in Table 5.5 (c).

Table 5.5(c): Recorded Enrolments for Additional Post-Primary Schools.

No.	Roll No.	School Name	Females	Males	2020/2021 Enrolment
1	70660O	Curragh Post-Primary School	64	81	145
2	61690W	Cross and Passion College	427	411	838
Total			**491**	**492**	**983**

5.3.3 Website Review and Phone Survey of School Facilities

A review of the schools' website was carried out in March 2022 by KPMG Future Analytics to ensure that available spaces in classes are captured in this school facilities assessment. This review helped determine the trend in schools for admitting students into the classes each year. The admission notices

for almost all the schools (Primary and Post Primary) indicated the 2022-2023 school term spaces available with for example, a total of 270 no. places for Junior Infants in Primary Schools, and 586 no. places available for first year students in Post Primary Schools. The two additional post-primary schools presented 192 no. places for first year students. It is noted that a total of 168 no. places are available for other years students in Curragh Post-Primary School. Where schools have not provided sufficient information on their intake for the next academic year, these have been assumed as 0.

In addition, a phone survey was carried out in March 2022 by KPMG Future Analytics to determine the available capacity in the schools within the study area. 67% response rate was achieved for primary school survey which informed the availability of 109 no. places; however, the results of the post-primary school survey were not considered the be comprehensive as only 1 no. response (25%) received with incomplete information. The result of this survey can be found in Appendix A.

A brief table on the results from the website review and phone survey can be found in Table 5.6 (a, b and c) below.

***Table 5.6 (a)**: Enrolment and Capacity from Website Review and Phone Survey – Primary Schools.*

Roll No.	School Name	2020/21 Enrolment	Website Review 2022/23 Academic Year Available Capacity		Phone Survey 04/03/2022		
			Junior Infants	Other Years	Enrolment	Maximum Capacity	Availability
13328I	St Patricks National School	192	25	0	197	223	26
15870O	Scoil Chonnla Phadraig	342	0	76**	309	370	61
17872F	St. Conleths and Marys National School	351	0	50**+6*	368	370	2
17873H	S N Connlaodh Naofa N	331	145	5*	330	350	20
19452Q	Scoil Mhuire	413	0	104***+3*	No Information Provided	413 (2020/2021 Enrolment)	No Information Provided
19550Q	Ballymany Junior National School	380	100	3*	No Information Provided	380 (2020/2021 Enrolment)	No Information Provided
		2,009	**270**	**247**		**2,106**	**109**

** Special class*
*** 2nd Class*
**** 3rd Class*

***Table 5.6 (b)**: Enrolment and Capacity from Website Review and Phone Survey – Post-Primary Schools.*

Roll No.	School Name	2020/21 Enrolment	Website Review 2022/23 Academic Year Available Capacity		Phone Survey 04/03/2022		
			First Year	Other Years	Enrolment	Maximum Capacity	Availability
61680T	Newbridge College	900	146	0	No Information Provided	900 (2020/2021 Enrolment)	No Information Provided
61681V	Patrician Secondary School	903	168	0	No Information Provided	903 (2020/2021 Enrolment)	No Information Provided

61682A	Holy Family Secondary School	721	132	0	No Information Provided	721 (2020/2021 Enrolment)	No Information Provided
70680U	St Conleth's Community College	588	140	0	680	680	No Information Provided
		3,112	**586**	**0**		**3,204**	

***Table 5.6 (c)**: Enrolment and Capacity from Website Review and Phone Survey – Additional Post-Primary Schools.*

Roll No.	School Name	2020/21 Enrolment	Website Review 2022/23 Academic Year Available Capacity		Phone Survey 04/03/2022		
			First Year	Other Years	Enrolment	Maximum Capacity	Availability
70660O	Curragh Post-Primary School	145	48	168	No Information Provided	145 (2020/2021 Enrolment)	No Information Provided
61690W	Cross and Passion College	838	144	1	No Information Provided	838 (2020/2021 Enrolment)	No Information Provided
		983	**192**	**169**		**983**	

The website review for the schools for Enrolment years 2022/23 determine that there is availability of spaces for children starting Primary and Post-Primary Schools and though limited, some availability of spaces for children joining (or transferring to) other classes.

5.3.4 Historic Enrolments and Trends

Historical enrolment trends for the Study Area indicate significant decline at primary level for the historic 5-year interval, with a decrease of 180 students within the cohort from 2015/2016 to 2020/2021. A similar trend occurred over the historic 10-year interval, with an overall decrease of 218 students within the cohort from 2010/11 to 2020/2021.

***Table 5.7:** Historic Change in Enrolment (Primary)*

Newbridge Study Area			Enrolment Year			Historic Change	
No.	Roll No.	School Name	10/11	15/16	20/21	5-year	10-year
1.	13328I	St Patricks National School	205	214	192	-22	-13
2.	15870O	Scoil Chonnla Phadraig	361	344	342	-2	-19
3.	17872F	St. Conleths and Marys National School	351	366	351	-15	0
4.	17873H	S N Connlaodh Naofa N	439	430	331	-99	-108
5.	19452Q	Scoil Mhuire	440	412	413	+1	-27
6.	19550Q	Ballymany Junior National School	431	423	380	-43	-51
		Total	**2,227**	**2,189**	**2,009**	**-180**	**-218**

Historical enrolment trends indicate moderate increase at post-primary level for the historic 5-year interval, with an increase of 74 students within the cohort from 2015/2016 to 2020/2021. Significant increases occurred over the historic 10-year interval, with an overall increase of 468 students within the cohort from 2010/11 to 2020/2021.

Table 5.8: *Historic Change in Enrolment (Post-Primary)*

Newbridge Study Area			Enrolment Year			Historic Change	
No.	**Roll No.**	**School Name**	**10/11**	**15/16**	**20/21**	**5-year**	**10-year**
1.	61680T	Newbridge College	834	869	900	+31	+66
2.	61681V	Patrician Secondary School	752	886	903	+17	+151
3.	61682A	Holy Family Secondary School	711	711	721	+10	+10
4.	70680U	St Conleth's Community College	347	572	588	+16	+241
		Total	**2,644**	**3,038**	**3,112**	**+74**	**+468**

5.3.5 Future Growth Projections

The Department of Education and Skills (DES) reported in November 2021[3] that enrolment figures for primary schools in Ireland were likely to have reached peak levels 2018 and are now projected to gradually decline in all population scenarios, with the preferred M1F2 scenario[4] suggesting a low point of c. 440,000 pupils by 2033. This projection then anticipates an increase over the next 4 years (2034-2038) of c. 21,000 primary pupils, in line with revised migration and fertility assumptions for the country (see Figure 5.5). The latest statistical release by the DES in this respect states:

> *"Enrolments in primary schools in Ireland in 2020 stood at 561,411 down by almost 6,000 on 2019 (567,716). Enrolments are now projected to fall over the coming years under all scenarios, and under the M1F2 scenario will reach a low point of 440,551 by 2033. This is 120,860 lower than today's figure. Enrolments will rise again thereafter and are projected to stand at 474,888 by 2040, a rise of some 34,300 over the seven years 2033 to 2040."*
>
> *[DES Enrolment Projections (November 2021), p. 6]*

[3] Source: *Projections of Full-Time Enrolment: Primary and Second Level, 2021-2040 (DES, Nov. 2021).*
[4] Given the strong inward migration in recent years, combined with falling fertility, the projected females used in the CSO report are taken from the M1F2 CSO scenario of population projections. M1 indicates net inward migration of 30,000 persons per year, while F2 indicates falling fertility (from 1.8 to 1.6).

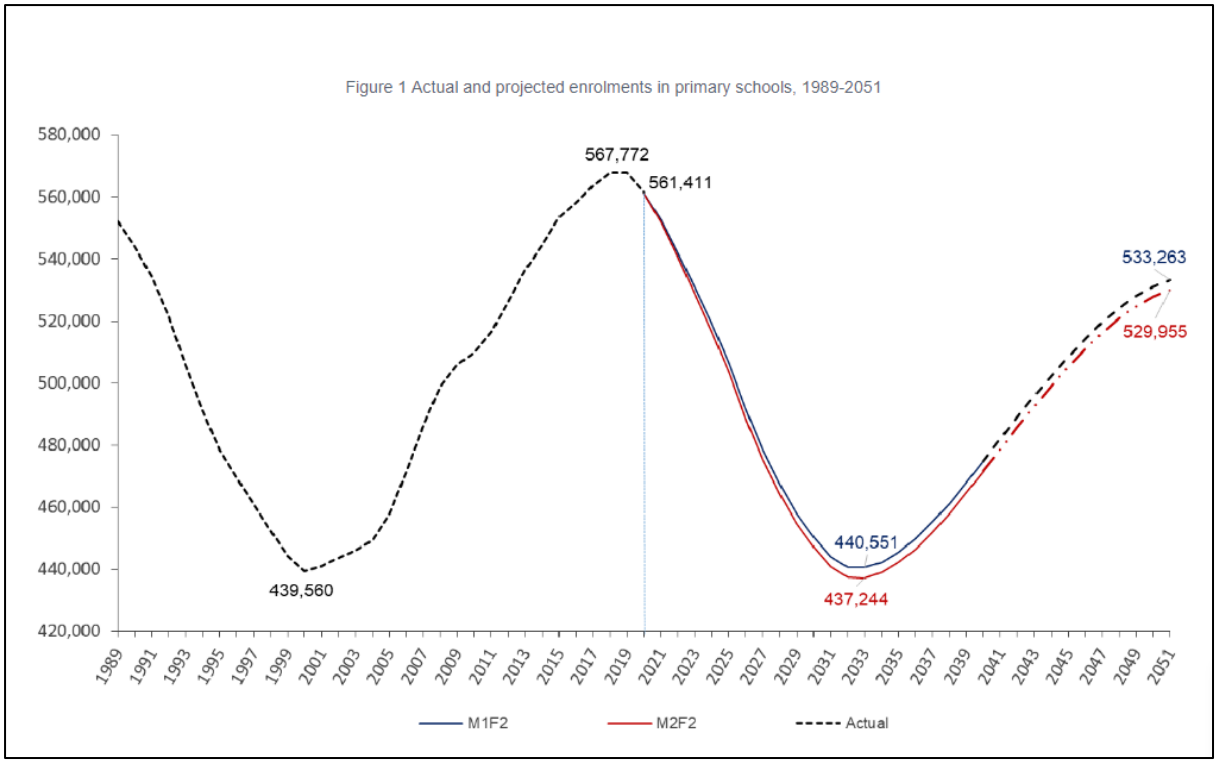


***Figure 5.5**: Projections of Enrolments at Primary Level 2021-2040, organized by projection scenarios created by the CSO (Source: DES, Nov. 2021).*

It is anticipated that post-primary enrolments, however, will continue to rise in the short-term and will likely reach record levels in 2024, with a peak of c. 410,000 pupils, before falling gradually to c. 320,000 pupils in 2038 (see Figure 5.6 overleaf). The DES report states:

> *"**Enrolments in post-primary schools have risen by 26,923 (8%) over the past five years and are projected to continue rising over the short term. Under M1F2 they are projected to peak in 2024 with 408,794 pupils, some 29,610 higher than in 2020.***
>
> Under the M2F2 scenario (whereby inflows are set at a current rate) enrolments will peak with in 2024 with 401,584 pupils, 7,210 less pupils than under the high migrati*on scenario. This difference between the high and medium migration scenarios in post-primary illustrates the importance of migration in the model."*
>
> *[DES Enrolment Projections (November 2021), p. 11]*

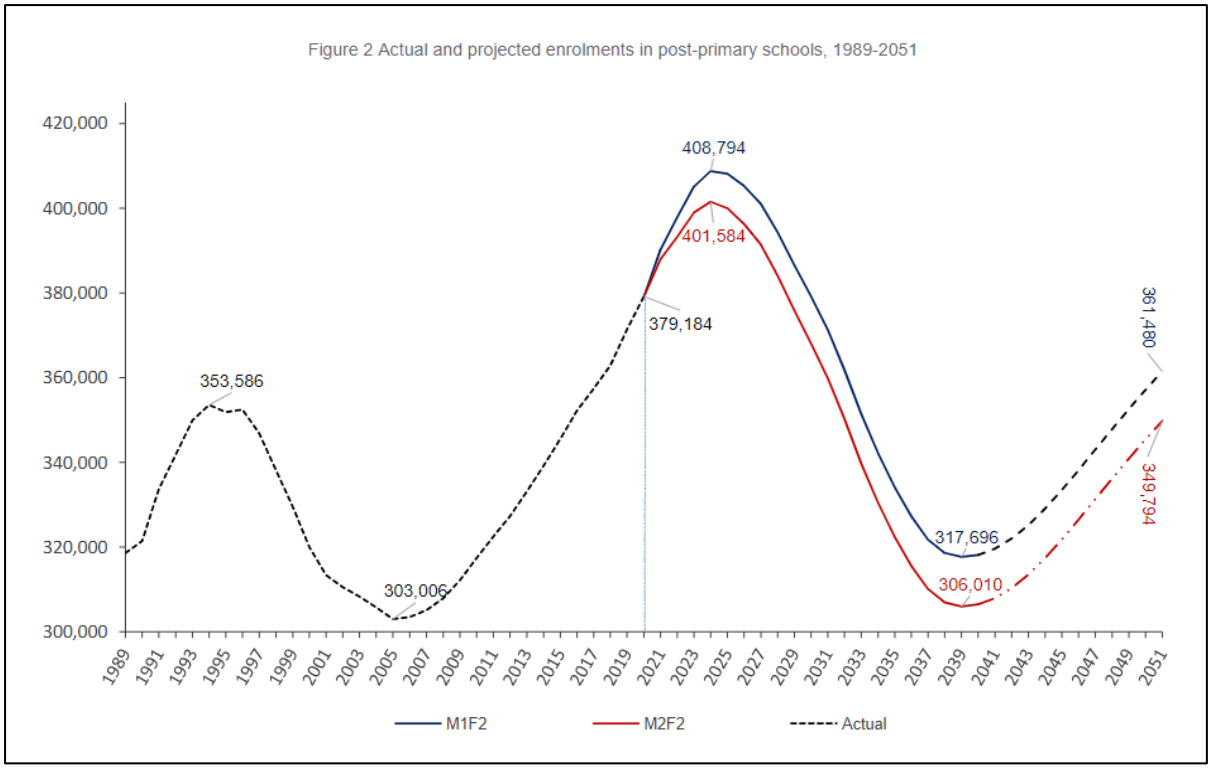


Figure 5.6: *Projections of Enrolments at Post-Primary Level 2021-2040, organized by projection scenarios created by the CSO (Source: DES, Nov. 2021).*

5.3.6 Potential Impact on the Study Area

Using the projected enrolment figures produced within the Department of Education for Regional Projections of Full-time Enrolments Primary and Secondary Level, 2021-2036, we were able to establish an estimate of the future enrolment for the 2025-2026 academic year for the Study Area. The report states that within the Mid-East region that the primary level enrolments are to reduce by c. 9% between 2020/2021 to 2025/2026[5]. Applying this projection to current enrolment figures within the Study Area it is estimated that the enrolments in 6 no. primary schools identified in the assessment are set to reduce by 180 spaces by the 2025/2026 academic year.

At the post-primary level, the regional report projects the enrolment figures are to increase by c. 8.5% between the enrolment year 2020/2021 to 2025/2026[6]. Applying this projection to current enrolment figures within the Study Area it is estimated that the enrolments in 4 no. post-primary schools identified in the assessment are to increase by 265 spaces by the 2025/2026 academic year.

Table 5.9*: Projected Enrolment Trends, 2020 - 2025.*

SHD Study Area	Enrolment Year		Future Trends	
	20/21	25/26[7]	% Change	Est. Change
Primary Schools (6)	2,009	1,829	-9%	-180
Post Primary Schools (4)	3,112	3,377	8.5%	+265

[5] Figure estimated using the Department of Education Regional Projections of Full-Time enrolments Primary and Secondary Level, 2021-2036 projected decrease of 9% between 2020 and 2025 as per M1F2 scenario (November 2021)
[6] Figure estimated using the Department of Education Regional Projections of Full-Time enrolments Primary and Secondary Level, 2021-2036 projected decrease of 8.5% between 2020 and 2025 as per M1F2 scenario. (November 2021)
[7] Figure estimated using the projected decrease of c. 9.0% at primary level and increase of c. 7.5% at post- primary level from 2020 to 2025 as per M1F2 scenario.

5.3.7 Potential Demand Generated by Scheme

The 0-18 years age cohort is selected within the local population, as it comprises the standard age range for pre-school and school age children. The age cohort is then divided into age groups of Pre-school children, Primary school children and Post primary school children. The school demand assessment is conducted based on the school age groups of Primary school children and Post primary school children. We note that the number of school age children increased slightly within the Study Area between 2011 and 2016, from 4,132 children in 2011 (20.4% of total population) to 4,647 children in 2016 (22.1% of total population – see Table 5.6). Having ascertained the overall demographic trends as relevant to the age cohort pertaining to childcare provision, the impact of the proposed development in this context will now be examined.

***Table 5.10**: Breakdown of 0-18 Year Age Cohort for Study Area, 2011-2016.*

Age Group	2011 Population	% Total (0-85+ years)	2016 Population	% Total (0-85+ years)
Pre-school children (0-4)	1,946	9.6%	1,531	7.3%
Primary school children (5-12)	2,553	12.6%	2,845	13.5%
Post primary school children (13-18)	1,579	7.8%	1,802	8.6%
School age children	**4,132**	**20.4%**	**4,647**	**22.1%**

The proposed development will comprise a maximum of 569 no. units of various typologies. As highlighted in previous Section 4.0, studio and one-bedroom units can be excluded in estimations of minors within a development and this may also apply in part or whole, to units with two or more bedrooms. As such, all one-bedroom units have been excluded in the estimation of school age residents, leaving a total of 536 no. units.

To estimate the number of 0–18-year-old residents in the proposed development, the proposed unit mix and form of the development, as well as the following indicators, have been used:

- Persons per unit proposed (determined by the proposed development and the average household size within the Study Area, which is established as 2.96 persons per unit[8] using the Census 2016); and

- Proportion of the Study Area's population within the school age cohort (identified as 13.5% as Primary school children and 8.6% as Post primary school children, 22.1% in total as School age children in 2016 – see Table 5.6).

Analysis of these factors allows for a determination of the total number of school age children in the proposed development. As highlighted in Table 5.7, it is estimated that 351 no. children would be considered school age (including 214 no. primary school children and 137 no. post primary school children) in the proposed development. However, it is submitted that this potential demand generated by the proposed scheme would be an absolute maximum and that a certain proportion of the two-bedroom or more bedrooms units would not be occupied by school going children. In this regard it is considered that the development would likely house less than the projected number of children.

[8] CSO statistics record a total of 21,015 no. residents in 7,112 no. private households.

***Table 5.11**: Methodology for Estimating the Number of School Age Children in the Proposed Development.*

Total Units*	Average Household Size	Residents (Number)	Primary school children (% of Total Population)	Primary school children (Number)	Secondary school children (% of Total Population)	Secondary school children (Number)
536	2.96	1587	13.5%	214	8.6%	137

5.3.8 Planned Facilities Network

The *Kildare County Development Plan (KCDP) 2017 - 2023* provides an overview assessment of educational needs, under the Social, Community & Cultural Development chapter within the plan. It has regards to the requirements of *The Provision of Schools and the Planning System, a Code of Practice for Planning Authorities (DES & DEHLG, 2008)* and *Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas in 2009* in its identification of school sites through the local authority. In regard to the development of school sites, the KCDP states:

> *"Kildare County Council will work with the Department of Education and Skills, under the nationally agreed Memorandum of Understanding on the provision of school sites, to support the Department's Schools Building programme and to **proactively identify and acquire sites for new primary and post primary schools where the Department has identified a need or evidence of demonstrable need is presented by the local community**."*
>
> *[Section 11.12, KCDP – **Our emphasis**.]*

Relevant policies for the development of primary and post-primary schools are set out in Ch. 11.12 of the KCDP, as shown in Table 5.12.

***Table 5.12**: Selected Policies for Social, Community & Cultural Development: Educational Facilities.*

Policy	Description
Policy EF1 Educational Facilities	***Work in conjunction with the relevant education authorities to promote and support the provision of primary and post-primary schools in the county and to support the Department of Education and Skills School Building Programme by planning for future schools based on forecast need.***
Policy EF2 Educational Facilities	*Promote, in conjunction with the relevant authorities, the provision of improved third level facilities within the county.*

5.3.9 Existing School Facilities Planning Permissions

There are a series of planning permissions that have been granted by Kildare County Council for the expansion of the current school facilities within the study area. A no. of 2 primary schools have received planning permission to expand on current school infrastructure in 2021 onwards. Table 5.12 illustrates the summary of planning applications and permission granted for extension of infrastructure and facilities within the schools.

Table 5.13: Schools with current planning applications.

Roll No.	School Name	Planning Application	Status
13328I	St Patricks National School	Single storey extension with 1 no. SEN classroom, 2 no. SET Rooms, Library Resource Room & Boiler Room.	Application Finalised, Permission Granted 06/09/2021
17872F	St. Conleths Infant Primary School and St. Conleth & Marys National School	Additional storey extension to previous approved single story with provision of 1 no. Special Needs Classroom.	Application Finalised, Permission Granted 09/08/2021

5.3.10 New & Future School Provision

Within the Study Area, there is no current plans for new school provision. However, there is expected to be future provision of 2 no. post-primary schools in the surrounding catchment area of Newbridge at a distance approximately 15 minutes' drive, in which it has been recently announced in December 2021 that a post-primary school will be constructed within Kildare Town with a capacity of c. 1,000 places on the Magee Barracks and should be ready for enrolments by 2023 but not confirmed to open that year[9]. A post-primary school recently opened in Naas, which has the capacity of c. 1,000 places in 2021.

Table 5.14: Recent and future schools to open within surrounding catchment of Newbridge area.

School Development Area	Status	Capacity
Naas Community College, Co. Kildare.	Completed, opened in 2021 for enrolments.	1,000.
Kildare Town, Magee Barracks, Co. Kildare.	Announced December 2021, expected to commence enrolments in year 2023 onward.	1,000.

5.3.11 Schools Summary

There are 6 no. existing primary schools and 4 no. existing post primary schools currently operating in the Study Area. These facilities cater to a student population of 2,009 no. primary school students and 3,112 no. post primary school students. 2 no. additional post-primary schools that cater a further 983 no. students are selected which could potentially serve the proposed development.

A website and phone survey assessment completed by KPMG Future Analytics indicated that at a primary school level, a capacity of 517 spaces is available for enrolment for the year 2022/2023. At a post-primary level, a capacity of 947 spaces is available for enrolment for the year 2022/23, indicating that there is capacity for intake of new admissions at both primary and post-primary level.

In regard to future enrolments, we note that a c. 9% decrease in enrolments in primary school level and a c. 8.5% increase in post-primary level is anticipated for the Mid-East region which includes Kildare for the period 2020/2021 to 2025/2026, with respect to the most recent regional enrolment projections published by the Department of Education and Skills.

The projected population of school age children generated by the proposed scheme indicated a potential future demand for 351 no. places including 214 no. primary and 137 no. post primary school children.

Therefore, it is considered that the future demand generated by the proposed development (i.e. 351 No. places – including 214 no. primary and 137 no. post-primary school children) can be accommodated within the existing surplus capacity in the existing schools network, and the existing and future post-primary development identified in the surrounding towns and hinterland area outside of the Study Area.

[9] Source: https://kildare-nationalist.ie/2021/12/13/new-secondary-school-announced-for-magee-barracks/

5.4 Social and Community

Access to quality community services and facilities can have a significant bearing on the quality of life, health and well-being of a community, by encouraging social interaction, promoting learning, and providing support services for those living, working, and visiting an area. The baseline study **identified 7 no. community services and facilities** in and bordering the Study Area. These comprise of 3 recycling glass stations, 1 no. library, 2 no. Emergency Services and 1 no. Town Hall.

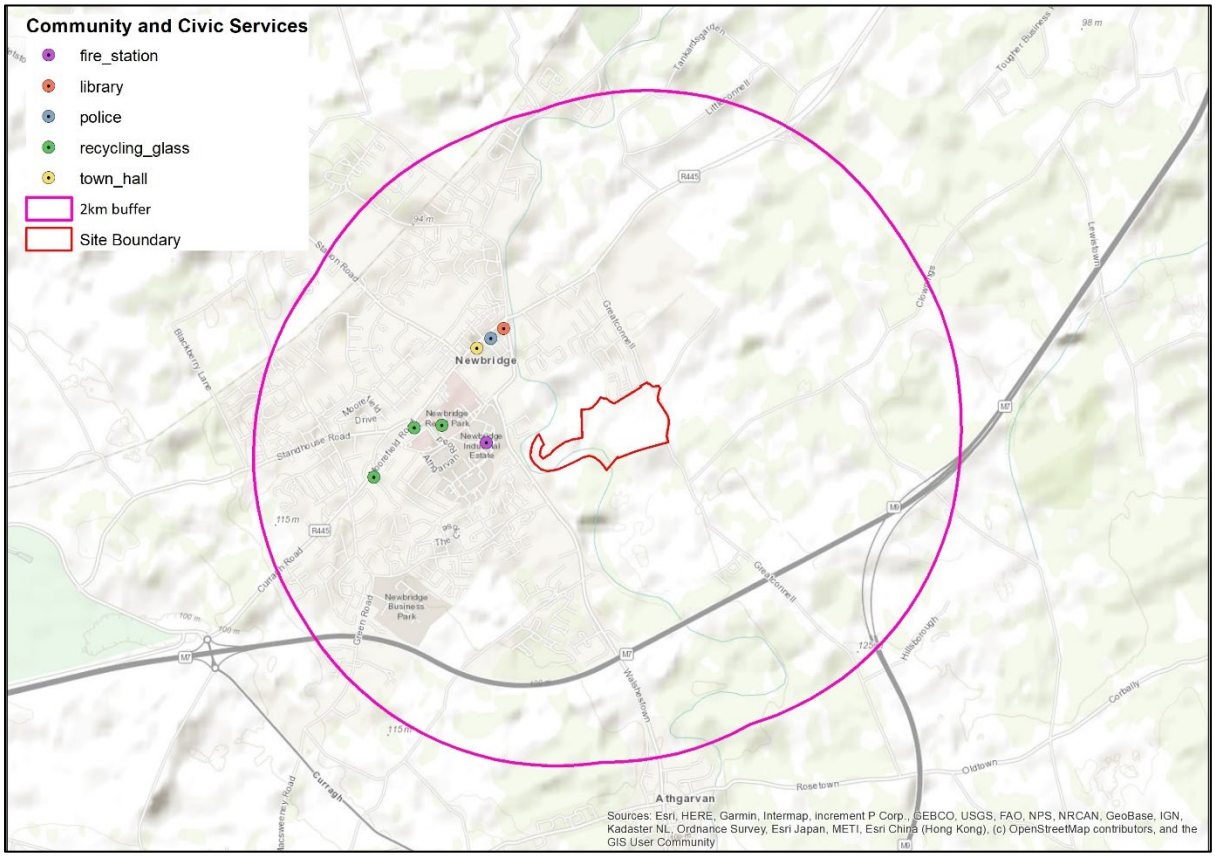


Figure 5.7: *Existing Community Facilities within and bordering the Study Area.*

Table 5.15*: Community Facilities within and bordering the Study Area.*

Type	Facilities
Glass Recycling (3)	AES Waste management Services, Dolly Recycling, Bottle Bank
Libraries (1)	Newbridge Library
Emergency Services (2)	Newbridge Garda Station, County Kildare Central Fire Station
Civic Offices (1)	Newbridge Town Hall

5.5 Open Space, Sports and Recreation

The availability of, and access to, open spaces, affordable sports and recreation facilities that are within easy reach by walking, cycling and public transport is of considerable importance. There are a broad range of facilities for open spaces, sports, and recreation in the Study Area. These include pitches, golf courses, parks, picnic sites, playgrounds, tracks, sports centres and stadiums. A full list of these facilities can be found in Table 5.16 below. Figure 5.8 illustrates the distance of each facility from the subject site. The subject site is well served by numerous open, sports and recreational spaces, most of

which are located to the northwest of the site. The scheme will also benefit from the residential open space and amenity areas along the River Liffey as part of the proposed development.

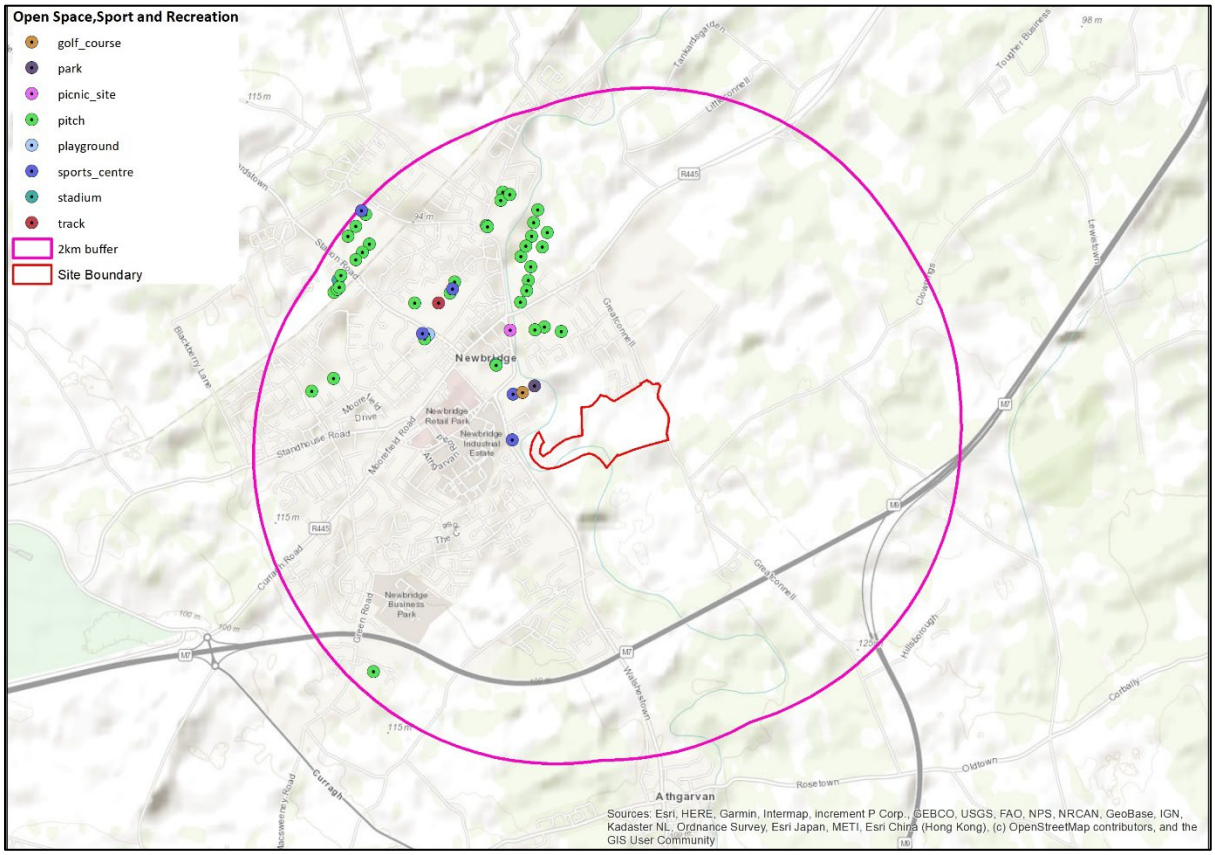


Figure 5.8: *Existing Open Spaces, Sports, and Recreation Facilities within and bordering the Study Area.*

Table 5.16: *Open Spaces, Sports, and Recreation Facilities within and bordering the Study Area.*

Type	Facilities
Park, Picnic Site and Playground	Newbridge Town Park, Ryan Fields Playground
Pitch, Golf Course and Track	Ryston Sports & Social Club, Newbridge Athletic Track, Chapel Lane pitch, Holi Family Catholic Secondary School pitch, Newbridge College pitch, Patrician Catholic Secondary School pitch, St. Conleths and Marys National School pitch, Patrician Sports Field, Newbridge Town Football Club pitches, Sarsfield GAA pitches
Sports Centre and Stadium	Newbridge Sports & Leisure Centre, Ryston Sports & Social Club, The Gables Guest House & Leisure Centre, Newbridge Hotspurs Football Club, St. Conleth's Park, Newbridge Town Football Club

5.6 Faith

The timely provision of faith facilities is of considerable importance to ensuring the religious needs of the existing and future population is met. **A total of 5 no. churches/places of worship and 1 no. burial grounds** were identified in and bordering the Study Area during the baseline survey.

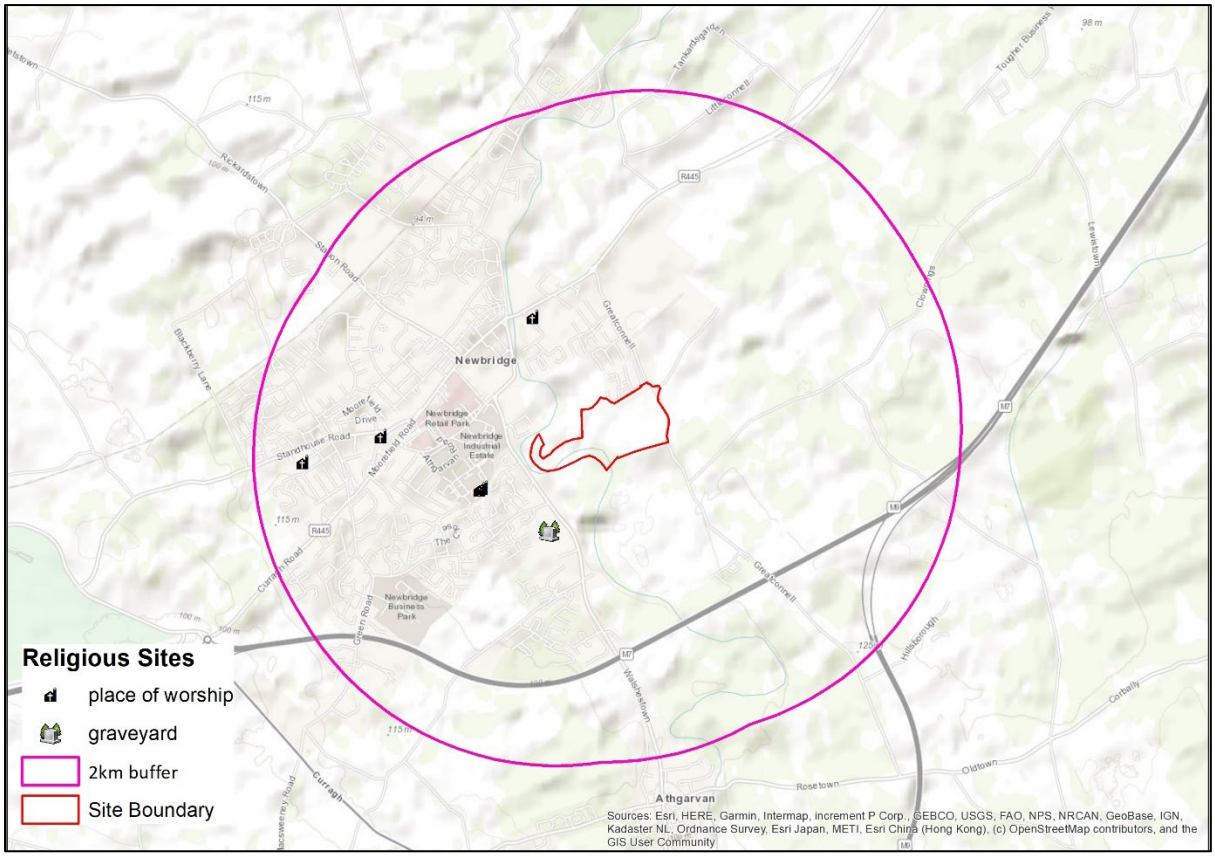


Figure 5.9: Existing Faith Facilities within and bordering the Study Area.

Table 5.17: Faith Facilities within and bordering the Study Area.

Type	Facilities
Faith Facilities (5)	St Patricks Church, Saint Conleth's Church, Cill Mhuire Church, Open Arms Church, Mountain of Fire & Miracles Ministries.
Burial Grounds (1)	Saint Conleth's Burial Grounds

5.7 Arts and Culture

The provision of arts and culture, and tourism facilities are of considerable importance in ensuring for a diverse portfolio of social activities to partake within, and to accommodate tourists. **In total 3 no. arts and cultural facilities and no. 5 tourism facilities were identified in and bordering the Study Area** during the baseline survey, which consists of total no. 1 museum, no. 1 cinema, no. 1 theatre, no. 3 tourism amenities and no. 3 hotels.

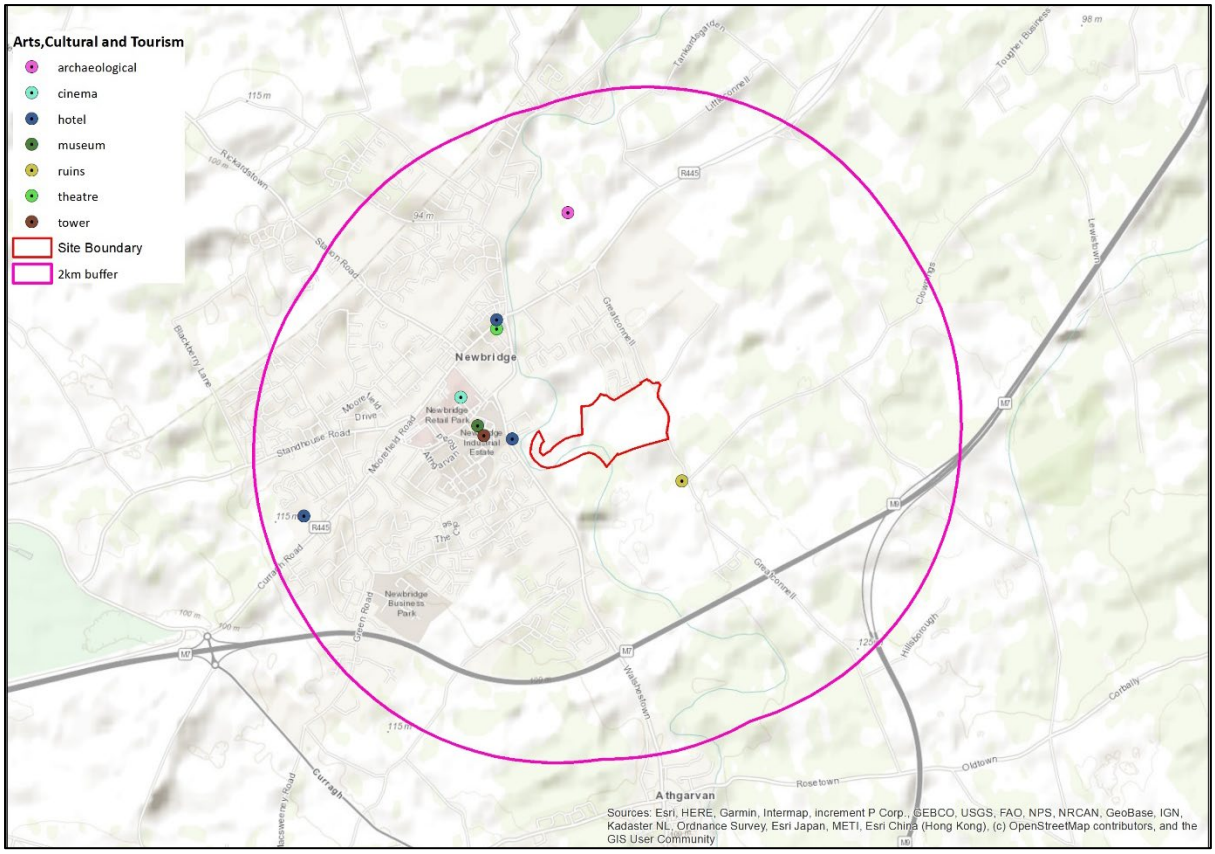


***Figure 5.10**: Existing Arts and Culture facilities bordering and within the Study Area.*

***Table 5.18**: Arts and Culture Facilities bordering and within the Study Area.*

Type	Facilities
Arts & Cultural Facilities (3)	Newbridge Silverware, Riverbank Arts Centre, Odeon Cinema.
Tourism Facilities (6)	The Gables Guest House & Leisure Centre, Eyre Powell Hotel, Keadeen Hotel, Great Connell Church Ruins, Archaelogical Ruins, Tower.

5.8 Other Facilities Including Neighbourhood Centres

Neighbourhood centres generally comprise a small group of shops, typically a newsagent, small supermarket/general grocery store, sub-post office and other small shops of a local nature serving a small, localised neighbourhood catchment population.

A review of the Neighbourhood Centres within a c. 2km radius of the subject site **identified 5 no. definable neighbourhood centres in the town**. As the study area consists of Newbridge Town Centre, which is the main commercial area, it is included in this. 3 no. neighbourhood centres are established, while 2 no. are future designated neighbourhood centres. Newbridge Town Centre including the Whitewater Shopping Centre is the major retail destination of the area and is also closest in terms of distance to the subject site. The site is served by retail services that include Dunnes Stores, Lidl, Aldi, Supervalu, Penneys, TK Maxx, DID and a number of independent speciality retailers in the Town Centre. A full list of these facilities can be found in Figure 5.11 and Table 5.19 below illustrates the distance of the facilities from the subject site.

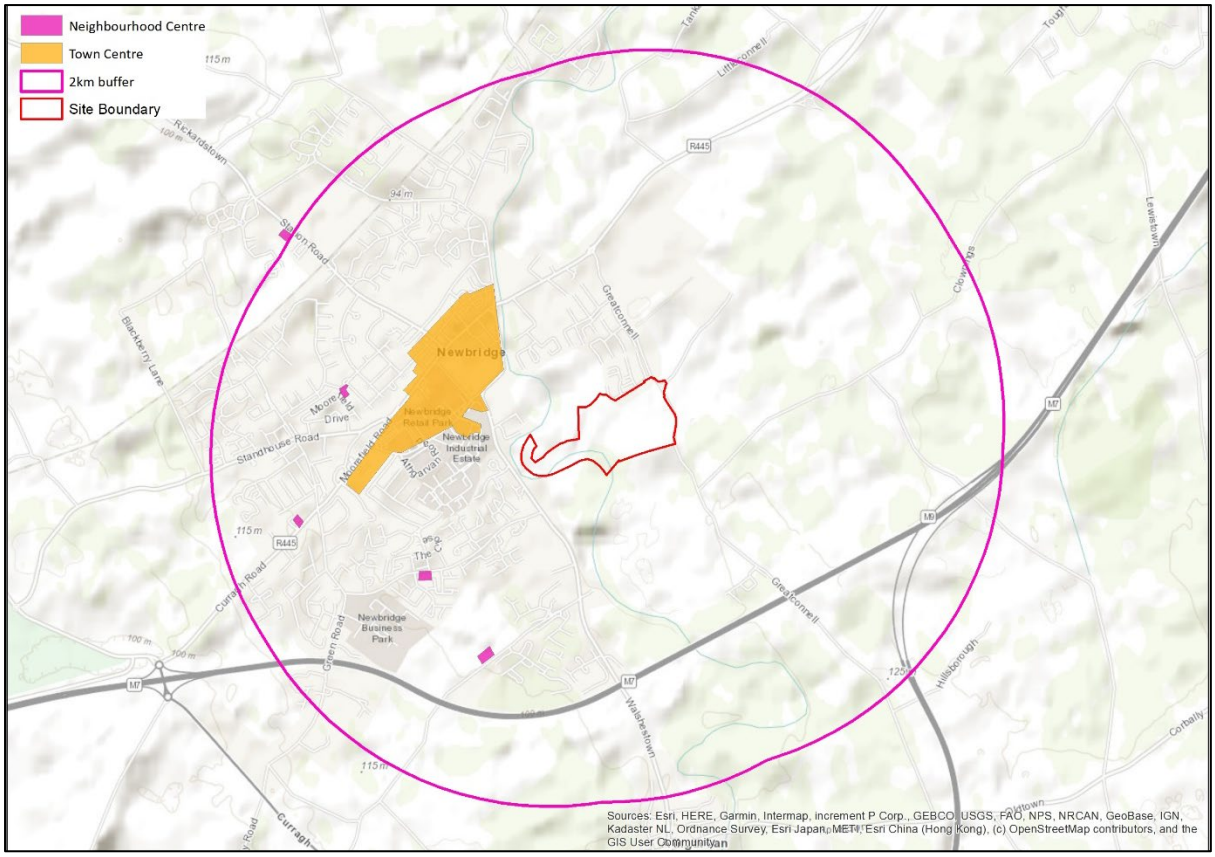


Figure 5.11: *Existing Neighbourhood Centres and Town Centre bordering and within the Study Area.*

Table 5.19: *Neighbourhood Centres and Town Centre bordering and within the Study Area.*

Type	Name / Location	Description / Facilities/ Services
Town Centre	Newbridge Main Street & Edward Street	Whitewater Shopping Centre; Aldi, Lidl, Supervalu, Dunnes Stores and other convenient retails; TK Maxx, DID, Penneys and other comparison retails; Eddie Rocket's, McDonnell's and other hospitality services; Odeon Cinema and other leisure facilities.
Neighbourhood Centre	Moorefield Shopping Centre	Spar, pharmacy and butcher.
Neighbourhood Centre	Ballymany Shopping Centre	Spar, home décor shops, pharmacy and restaurant.
Neighbourhood Centre	Curragh Grange Shopping Centre	Centra, pharmacy and beauty salon.

5.9 Facilities Audit Summary

The Social Infrastructure Audit has identified and established the level of existing social infrastructure provision within and bordering the 2km study area to support the needs of the existing population and to offer insight into the likelihood of the capacity of the existing services and facilities to support the future residents the housing development will bring. The baseline survey undertaken has identified 130 no. facilities, which contribute to the quality of life for local residents being in close proximity to social infrastructure facilities and services.

On the basis of this audit, the proposed development site is supported by an existing network of schools and childcare facilities and has access to a range of other health, community, cultural, religious, recreational, and commercial facilities within the identified c. 2km radius. We also note that the proposal

includes the provision of a neighbourhood centre with 11 no. commercial units including 3 no. health service units, a creche with the capacity of 154 no. children and 18 no. open space areas, all of which will positively contribute to the social infrastructure of the resident population once completed.

6.0 Childcare Facilities Audit

6.1 Existing Network

A total of 15 no. childcare facilities were identified in the Study Area (including the ones that are located just outside the 2km radius) of the site.

The Childcare Facilities Audit was conducted based on the Tusla Early Years Inspectorate Reports[10] for each childcare facility identified, most of which are reported in 2021. These facilities were reported as having a combined capacity of 302 no. childcare places.

Table 6.1 sets out each of the facilities listed by name. The total enrolment numbers for each provider and the maximum capacity figures are also listed, according to Tusla data. Further, to demonstrate the level of childcare facilities available within the area, Appendix B covers a complete list of childcare facilities within the 2km radius of the subject site.

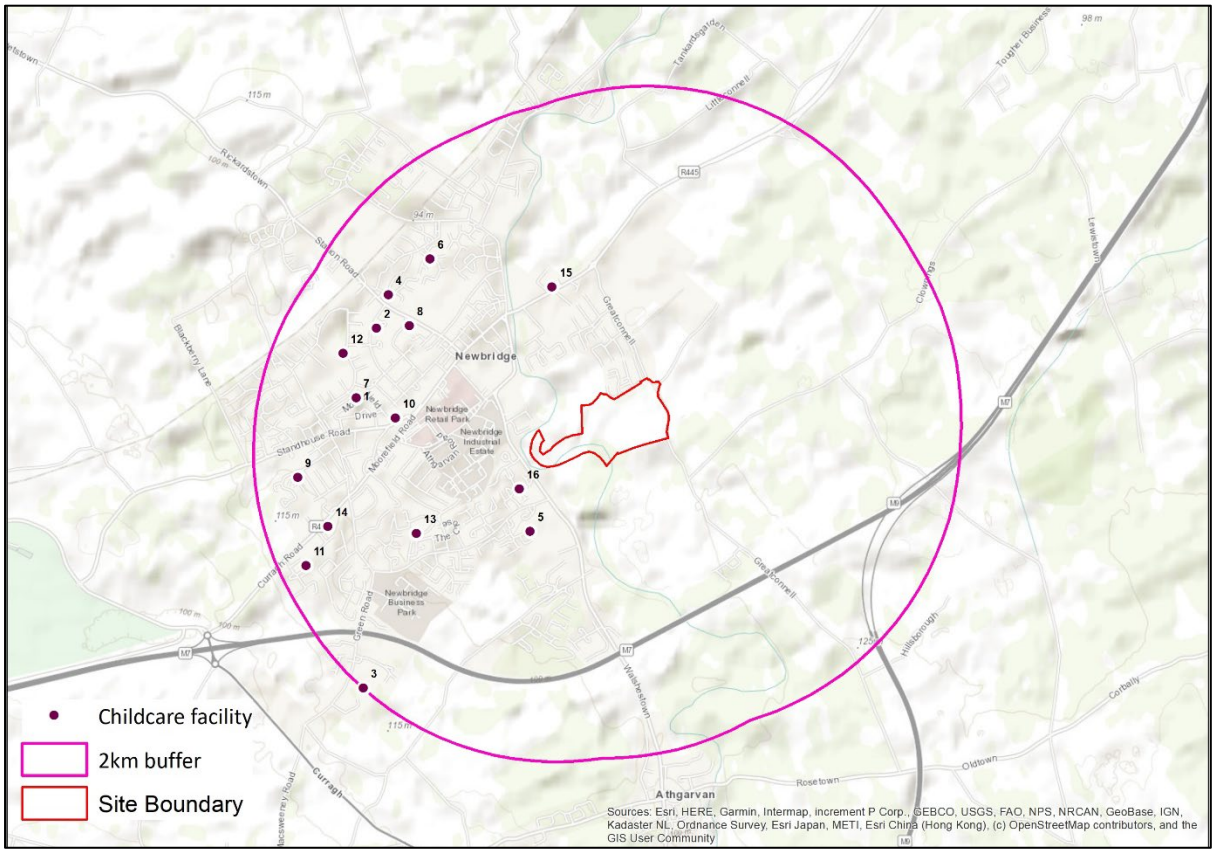


***Figure 6.1**: Location of Existing Childcare Facilities within and bordering the Study Area.*

[10] The Tusla Early Years Inspectorate carries out inspections of Early Years Services under Section 58(J) of the Child Care Act 1991 (as inserted by Section 92 of the Child and Family Agency Act 2013). Inspection Reports for active facilities are available online for public inspection and are updated at regular intervals by the service. Visit the Tusla website for more detail: https://www.tusla.ie/services/preschool-services/creche-inspection-reports/

Table 6.1: Current Capacity of Existing Childcare Facilities in and bordering the Study Area.

No.	Childcare Facility	Service Type	Enrolment	Maximum Capacity	Available Capacity
1	Rainbow Brite Montessori	Sessional	31	54	23
2	KARE Pre-School	Sessional	9	16	7
3	Tots Creche & Daycare Nursery Limited	Full Day Part Time Sessional	16	50	34
4	Giggles Playschool	Sessional	16	20	4
5	Klever Kidz Preschool	Sessional	17	22	5
6	Hickorys	Sessional	8	11	3
7	Judy's Playschool	Sessional	7	11	4
8	Mags Childminding	Childminder	5	5	0
9	Tots Creche & Daycare Nursery Limited	Full Day Part Time Sessional	27	90	63
10	Teeny Weenys	Sessional	11	11	0
11	Family Resource Center (Childcare)	Sessional	26	68	42
12	Child's Play	Full Day	6	80	74
13	Stepping Stones	Full Day	31	33	2
14	Ti-r na Nog	Full Day	82	120	38
15	Sonya Keating	Sessional	14	17	3
			306	**608**	**302**

Note: Childcare services are provided and inspected by Tusla in Am - morning hours and PM – afternoon hours. Am – morning hours services are reviewed above for consistency.

6.2 Potential Demand Generated by Scheme

Given the focus of this childcare assessment, specific regard will be paid to the 0-6 years age cohort within the local population, as it comprises the standard age range for childcare facilities. We note that the number of children within 0-6 years age cohort decreased slightly within the Study Area between 2011 and 2016, from 2,633 children in 2011 (13.0% of total population) to 2,321 children in 2016 (11.0% of total population – see Table 6.2). Having ascertained the overall demographic trends as relevant to the age cohort pertaining to childcare provision, the impact of the proposed development in this context will now be examined.

Table 6.2: Number and Percentage of Population Aged 0-6 with Respect to Total Population, 2011-2016.

Age	2011 Population (0-6 years)	% Total (0-85+ years)	2016 Population (0-6 years)	% Total (0-85+ years)
0	428	2.1%	280	1.3%
1	390	1.9%	301	1.4%

2	389	1.9%	324	1.5%
3	394	2.0%	300	1.4%
4	345	1.7%	326	1.6%
5	358	1.8%	416	2.0%
6	329	1.6%	374	1.8%
Total	**2,633**	**13.0%**	**2,321**	**11.0%**

As highlighted in previous Section 4.0, studio and one-bedroom units can be excluded in estimations of minors within a development and this may also apply in part or whole, to units with two or more bedrooms. As such, all one-bedroom units have been excluded in the estimation of 0–6-year-old residents, leaving a total of 536 no. units.

In arriving at the estimated number of 0–6-year-old residents in the proposed development, the proposed unit mix and form of the development, as well as the following indicators, have been used:

- Persons per unit proposed (determined by the proposed development and the average household size within the Study Area, which is established as 2.96 persons per unit[11] using the Census 2016); and
- Proportion of the Study Area's population within the 0–6 years age cohort (identified as 11.0% in 2016 – see Table 6.2).

Analysis of these factors allows for a determination of the total number of 0–6-year-old residents in the proposed development. As highlighted in Table 6.3, it is estimated that 186 no. children aged 0–6 years may reside in the proposed development. However, it should be noted that simply being resident at the development does not equate to a demand for childcare services.

***Table 6.3**: Methodology for Estimating the Number of Children Aged 0-6 Years in the Proposed Development.*

Total Units*	Average Household Size	Residents (Number)	0-6 Years (% of Total Population)	0-6 Years (Number)
536	2.96	1587	11.0	175

6.3 Estimated Childcare Generate (QNHS)

The CSO's Quarterly National Household Survey (QNHS) provides a study specifically on childcare take-up for Q3 of 2016[12]. This release is especially relevant for the purposes of this assessment as it indicates the extent to which childcare facilities are utilised by the general population. Table 6.4 shows the range of methods parents use for the purposes of childcare for their pre-school children in the Mid-East region compared to the larger State, with respect to QNHS figures.

***Table 6.4**: Type of Childcare Utilised by Parents of Pre-School Children.*

Type of Childcare	Mid-East	State
Parent/Partner	65%	62%
Unpaid Relative/Friend	16%	17%

[11] CSO statistics record a total of 21,015 no. residents in 7,112 no. private households.

[12] The QNHS is released by the CSO each quarter and surveys a random sample of the population. Percentage totals may amount to over 100% due to some respondents providing multiple answers. This is the most recent QNHS study on childcare take-up: https://pdf.cso.ie/www/pdf/20170706100048_QNHS_Childcare_Quarter_3_2016_full.pdf

Paid Relative/Friend	5%	3%
Childminder/Au-Pair/Nanny	13%	13%
Childcare Facility	14%	19%
Other	0%	1%

Source: QNHS, 2016

The majority of pre-school children in Mid-East region are cared for by their parents or partners of their parents (65%), with 14% of pre-school children attending a childcare. While it is reasonable to assume that the CSO's QNHS is an accurate and representative measure of the population, it is acknowledged that this figure may be considered to be conservative and as such a scenario where 30% of pre-school children attend a childcare facility is also considered herein. Table 6.5 applies both the QNHS's 14% figure and a 30% figure to the estimated number of residents aged 0–6-year-old, as determined under the quantitative demographic analysis above.

***Table 6.5**: Number of Pre-School Children Requiring Access to Childcare Facilities.*

Total Units*	0-6 Years (Number)	0-6 Years Total at 14%	0-6 Years Total at 30%
536	175	25	53

*Excluding All One-Bed Units

6.4 Summary of Childcare Assessment

In order to determine the current levels of childcare provision, a review of current provision within the Study Area was undertaken. A total of 15 no. childcare facilities were identified in the area using the latest Tusla Early Years Inspectorate data[13] and it was determined that there is combined capacity for 302 no. additional children in these facilities.

In addition to these findings, a calculation was made to estimate that the proposed development could generate 175 no. 0–6-year-old children (that could potentially require a space in the childcare facility). However, per the QNHS (see previous section 6.3), children in the Mid-East region are cared for by their parents or partners of their parents (65%), with 14% of pre-school children attending a childcare facility compared to 19% nationally. This would mean that from the potential 175 no. 0-6-year-olds resident at the proposed development, 25 no. children would attend a childcare facility. It is acknowledged that this percentage is conservative and hence the potential capacity of 53 no. children was used, which is 30% of the total children expected to reside within the proposed development.

It is therefore considered that the demand created by the proposed development can be absorbed by the existing provision. It is also noted that the development will provide a creche with the capacity of 154 no. children which will further enrich the provision of childcare facilities in the area and facilitate future population growth of the area which was projected in section 3.5.

[13] The Tusla Early Years Inspectorate carries out inspections of Early Years Services under Section 58(J) of the Child Care Act 1991 (as inserted by Section 92 of the Child and Family Agency Act 2013). Inspection Reports for active facilities are available online for public inspection and are updated at regular intervals by the service. Visit the Tusla website for more detail: https://www.tusla.ie/services/preschool-services/creche-inspection-reports/

7.0 Conclusion

The proposed development is a strategic housing development scheme at Great Connell in Newbridge of 569 no. residential units (325 no. houses, 244 no. apartments) with a neighbourhood centre (11 no. commercial units) and a creche (capacity of 154 no. children). The proposed development will consist of 33 no. 1-bed, 199 no. 2-bed, 249 no. 3-bed and 88 no. 4-bed.

This Social Infrastructure Audit has identified a significant range of services (more than 130 no. facilities located in close proximity to the subject site) available locally which will contribute to quality of life for local residents, with

On the basis of this audit, the proposed development site is supported by an existing network of schools and childcare facilities and has access to a range of other health, community, cultural, religious, recreational and commercial facilities within the identified c. 2km radius. We also note that the proposal includes the provision of a neighbourhood centre with 11 no. commercial units including 3 no. health facilities, a creche with the capacity of 154 no. children and 18 no. open space areas, all of which will positively contribute to the amenity of the resident population once completed.

In conclusion, the existing social infrastructure provision identified within the c. 2km study area, in conjunction with the neighbourhood centre, creche and open space areas proposed with the subject application will be capable of serving the existing population and potential demand generated by the proposed development scheme, with no significant gaps in the existing services network identified.

Appendix A Schools Demand Assessment

Table A-1: Phone Survey for the Primary Schools within the Study Area

Roll Number	School name	DES Records			Phone Survey 04/03/2022			
		Females	Males	2020/21 Enrolment	Comments	Enrolment	Max. Capacity[14]	Availability
13328I	St Patricks National School	86	106	192		197	223	26
15870O	Scoil Chonnla Phadraig	167	175	342		309	370	61
17872F	St. Conleths and Marys National School	168	183	351		368	370	2
17873H	S N Connlaodh Naofa N	159	172	331		330	350	20
19452Q	Scoil Mhuire	201	212	413	Required Email Survey	No Information Provided	413 (2020/2021 Enrolment)	No Information Provided
19550Q	Ballymany Junior National School	174	206	380	Need to check and will reach back due to GDPR	No Information Provided	380 (2020/2021 Enrolment)	No Information Provided
Total		**955**	**1,054**	**2,009**			**2,106**	**109**

[14] Maximum Capacity is the potential total enrolment figure that the schools quote during the phone call. If there is no information provided by the schools, the Enrolment figure is assumed as the Max. Capacity figure.

Table A-2: Phone Survey for the Post-Primary Schools within the Study Area

Roll Number	School name	DES Records			Phone Survey 04/03/2022			
		Females	Males	2020/21 Enrolment	Comments	Enrolment	Max. Capacity[15]	Availability
61680T	Newbridge College	440	460	900	Call Back Next Week	No Information Provided	900 (2020/2021 Enrolment)	No Information Provided
61681V	Patrician Secondary School	0	903	903	Required Email Survey	No Information Provided	903 (2020/2021 Enrolment)	No Information Provided
61682A	Holy Family Secondary School	721	0	721	Call Back Next Week	No Information Provided	721 (2020/2021 Enrolment)	No Information Provided
70680U	St Conleth's Community College	332	256	588		680	680	No Information Provided
Total		**1,493**	**1,619**	**3,112**			**3,204**	

Table A-2: Phone Survey for the Post-Primary Schools within the Study Area

Roll Number	School name	DES Records			Phone Survey 04/03/2022			
		Females	Males	2020/21 Enrolment	Comments	Enrolment	Max. Capacity[16]	Availability
70660O	Curragh Post-Primary School	64	81	145	Voicemail	No Information Provided	145 (2020/2021 Enrolment)	No Information Provided
61690W	Cross and Passion College	427	411	838	Required Email Survey	No Information Provided	838 (2020/2021 Enrolment)	No Information Provided
Total		**491**	**492**	**983**			**983**	

[15] Maximum Capacity is the potential total enrolment figure that the schools quote during the phone call. If there is no information provided by the schools, the Enrolment figure is assumed as the Max. Capacity figure.

[16] Maximum Capacity is the potential total enrolment figure that the schools quote during the phone call. If there is no information provided by the schools, the Enrolment figure is assumed as the Max. Capacity figure.

Appendix B Childcare Demand Assessment

B.1 Childcare Facilities Summary

Childcare Facilities - Information					*TULSA Inspection*			
No.	**TUSLA Ref.**	**Facility Name**	**Eircode**	**Service Type**	**Insp. Date**	**Insp. Pop**	**Max Capacity**	**Available Spaces***
1	TU2015KE078	Rainbow Brite Montessori	n/a	Sessional	12/10/2021	AM - 31	54	23
2	TU2018KE513	KARE Pre-School	R56F886	Sessional	19/04/2021	AM - 9	16	7
3	TU2015KE031	Tots Creche & Daycare Nursery Limited	W12AT27	Full Day Part Time Sessional	21/07/2021	AM - 16 PM - 13	50	AM - 34 PM - 37
4	TU2015KE046	Giggles Playschool	W12C584	Sessional	16/09/2021	AM - 16	20	4
5	TU2015KE203	Klever Kidz Preschool	W12DN44	Sessional	10/03/2021	AM – 17	22	5
6	TU2015KE040	Hickorys	W12F290	Sessional	14/09/2021	AM - 8	11	3
7	TU2015KE112	Judy's Playschool	W12KP86	Sessional	16/12/2020	AM - 7	11	4
8	TU2015KE198	Mags Childminding	W12KR26	Childminder	08/09/2021	AM - 5 PM - 5	5	0

9	TU2015KE177	Tots Creche & Daycare Nursery Limited	W12KT93	Full Day Part Time Sessional	28/07/2021	AM - 27	90	63
10	TU2015KE015	Teeny Weenys	W12PN26	Sessional	01/04/2019	AM - 11	11	0
11	TU2015KE062	Family Resource Center (Childcare)	W12PX65	Sessional	24/11/2020	AM - 26	68	42
12	TU2015KE117	Child's Play	W12VK16	Full Day	03/02/2021	AM - 6 PM - 6	80	74
13	TU2015KE153	Stepping Stones	W12W310	Full Day	14/12/2021	AM - 31 PM - 23	33	AM - 2 PM - 10
14	TU2015KE083	Ti-r na Nog	W12WY49	Full Day	23/08/2021	AM - 82 PM - 33	120	AM - 38 PM - 87
15	TU2015KE163	Sonya Keating	W12Y163	Sessional	04/10/2018	AM - 14	17	3
								AM – 302 PM – 208

Note: Childcare services are provided and inspected by Tusla in AM – morning hours and PM – afternoon hours.

APPENDIX 10

NOISE SURVEY

Appendix 13.1 Baseline Survey Details

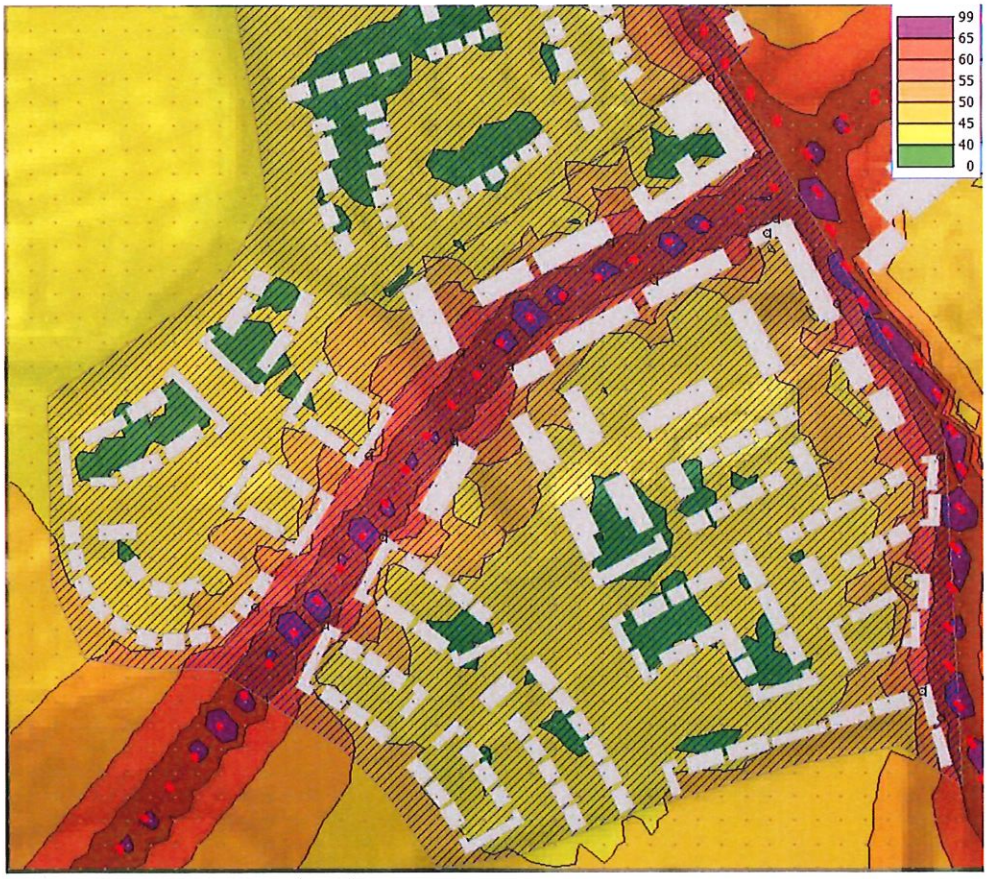
Weather	
Cloud cover	50 % through afternoon, rising to 100 % through evening and thereafter
Precipitation	0 mm
Temperature	8 °C at set up, rising to 12 °C in afternoon, falling to 8 °C overnight, rising to 10 °C Fri
Wind direction	NW throughout
Wind speed	0-3 m/s at set up, increasing to 2-5 m/s during afternoon, falling to 0-2 m/s in evening and overnight, returning to 1-5 m/s Fri morning
WS measurement	Anemo anemometer 2 m above ground level at each station

Field details	
DB2 calibration	Station N1 21.10.21 0952 @ 43.0 mV/Pa
DB4 calibration	Station N3 21.10.21 1007 @ 41.5 mV/Pa
DB5 calibration	Station N2 21.10.21 1055 @ 43.1 mV/Pa
Acoustic field	Free field
Microphone height	4 m above ground level at N1 & N2, 1.5 m above ground level at N3
Standard	ISO 1996 (2016 & 2017)
Survey operator	Damian Brosnan BSc MSc MIOA MIEI

Instruments	
Calibrator	Bruel & Kjaer Type 4231 Serial 2342544 Verification 14.02.20
SLM DB2	NTi Audio XL2 Serial A2A-14337-E0 Microphone A14972 Verification 13.05.21
SLM DB4	NTi Audio XL2 Serial A2A-15429-E0 Microphone A16329 Verification 14.02.20
SLM DB5	NTi Audio XL2 Serial A2A-17932-E0 Microphone A18747 Verification 24.07.20
Certificates	Available on request

Appendix 13.2 Predicted noise contours

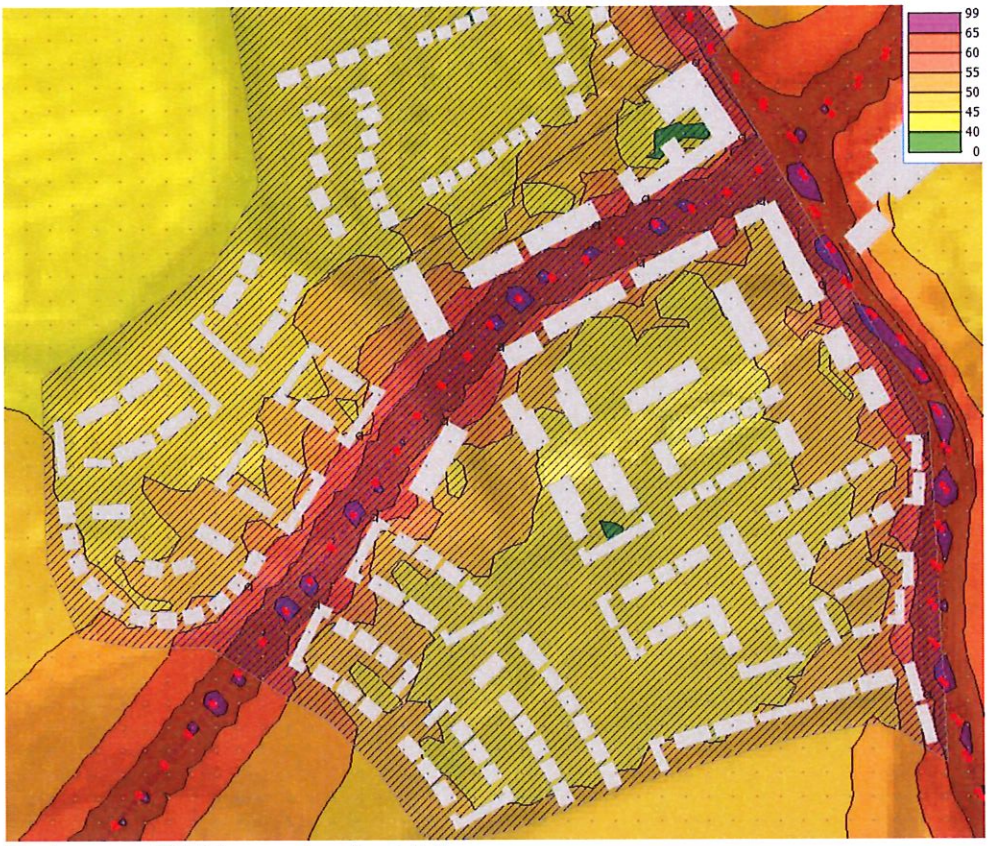
Design year 2039 L_{den} levels at 1.5 m



Design year 2039 $L_{Aeq16\,h}$ levels at 1.5 m

Design year 2039 L_{night} levels at 1.5 m

Design year 2039 L_{den} levels at 4.4 m



Design year 2039 $L_{Aeq16\,h}$ levels at 4.4 m

Design year 2039 L_{night} levels at 4.4 m

Design year 2039 L_{den} levels at 5.1 m

Design year 2039 $L_{Aeq\ 16\ h}$ levels at 5.1 m

Design year 2039 L_{night} levels at 5.1 m

Design year 2039 L_{den} levels at 7.4 m

Design year 2039 $L_{Aeq\ 16\ h}$ levels at 7.4 m

Design year 2039 L_{night} levels at 7.4 m

Design year 2039 L_{den} levels at 7.9 m

Design year 2039 $L_{Aeq\ 16\ h}$ levels at 7.9 m

Design year 2039 L_{night} levels at 7.9 m

Design year 2039 L_{den} levels at 10.3 m

Design year 2039 $L_{Aeq\ 16\ h}$ levels at 10.3 m

Design year 2039 L_{night} levels at 10.3 m

Design year 2039 L_{den} levels at 11 m

Design year 2039 $L_{Aeq\ 16\ h}$ levels at 11 m

Design year 2039 L_{night} levels at 11 m

APPENDIX 11

LANDSCAPE DEVELOPMENT

Great Connell SHD, Newbridge

APRIL 2022

Issue 8

Landscape Development Report

TBS

Contents

1.0 SITE ANALYSIS

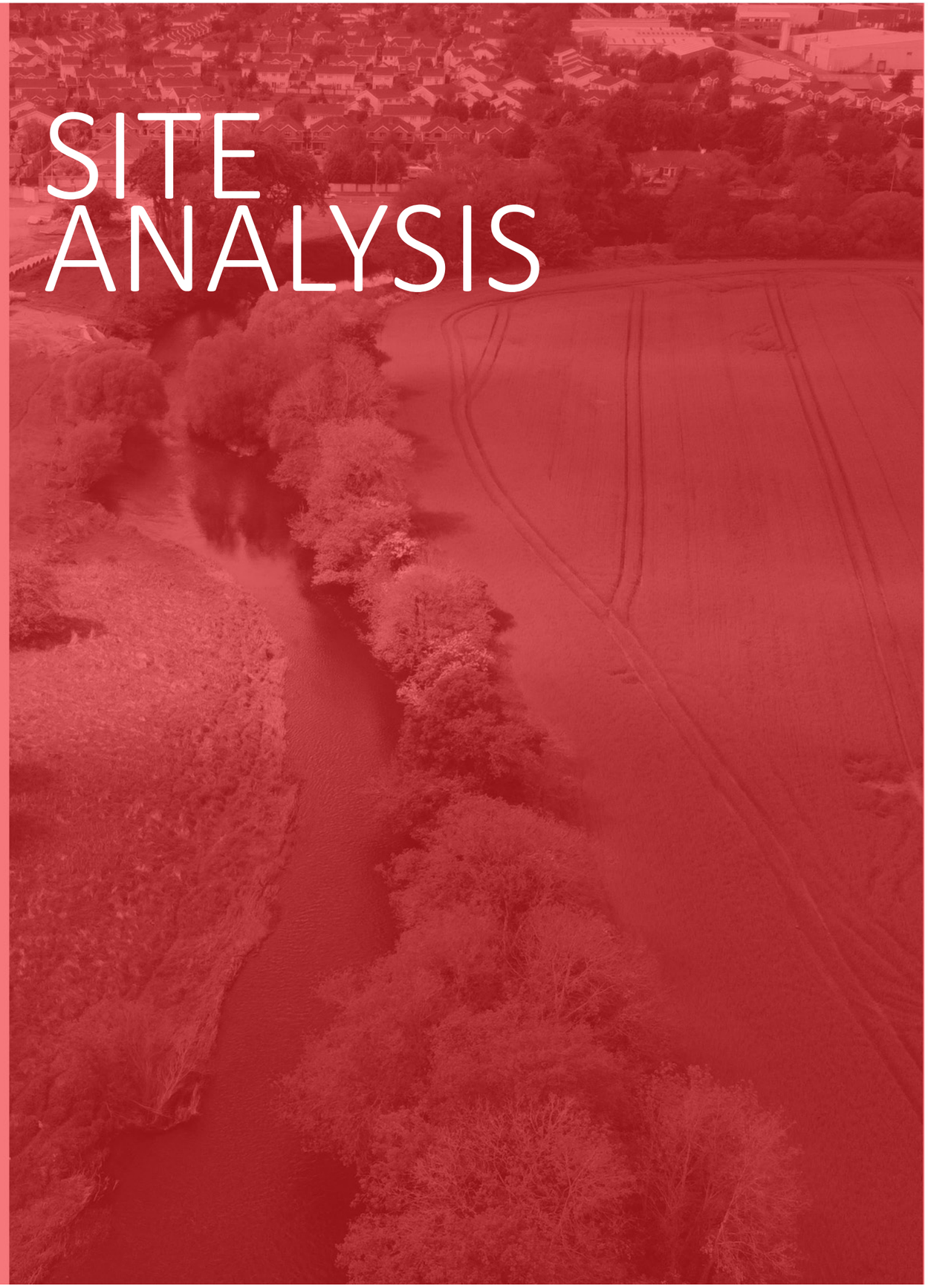
1.1	EXISTING SITE CONDITIONS	4
1.2	SITE IMAGES	5
1.3	OPEN SPACE TYPOLOGIES & SITE BOUNDARIES	6 7
1.4	ACCESS + CIRCULATION	8
1.5	CONCEPT DESIGN & ACTIVITIES	

2.0 DESIGN STRATEGY

2.1	LANDSCAPE DESIGN STRATEGY	10
2.2	PROPOSED MATERIAL	18
2.3	PLANTING SCHEDULE	19
2.4	NATURAL PLAY & EXERCISE EQUIPMENT	21

3.0 LANDSCAPE SPECIFICATION

01 SITE ANALYSIS



01.1 EXISTING SITE CONDITIONS

SITE LOCATION

This subject site comprises the lands surrounding and including the dwellings of 'Greatconnell' and 'Valencia Lodge', Great Connell, Newbridge, Co. Kildare, Eircodes: W12 TW29 and W12 V382.

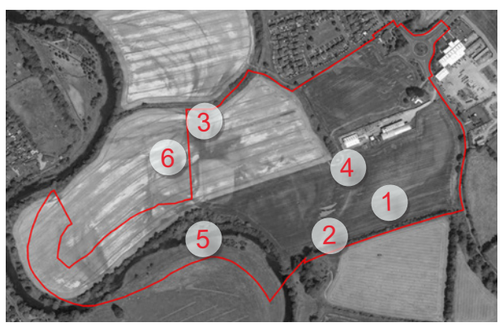
SITE DESCRIPTION

The subject site is irregular in shape and currently comprises of agricultural lands 2 dwellings and former agricultural buildings surrounded by fields with existing hedgerows as boundaries. It is accessed from the east from Great Connell Road. The development is bound to the north-east by a residential development and Great Connell Road along the eastern boundary. To the south-west the site is bound by the River Liffey. The topography of the lands varies with a fall northwards of approx. 1.9m (+86.18m to +88.05m). The site includes existing trees and hedgerows along existing field boundaries.

LEGEND

- SITE BOUNDARY
- WAYLEAVE TO ENG. DWG
- GREAT CONNELL ROAD
- EXISTING HEDGEROWS/ TREES
- RIVER LIFFEY
- SUN PATH

01.2 SITE PHOTOGRAPHS



1 view looking north-east from southern boundary; **2** view looking south-west towards the River Liffey from centre of site; **3** view looking west to Wellesley Manor ; **4** view looking south-east; **5** View looking west along southern boundary; **6** view looking east along the River Liffey from western boundary.

1	2	3
4	5	6

01.3 OPEN SPACE TYPOLOGIES & EXISTING SITE BOUNDARIES

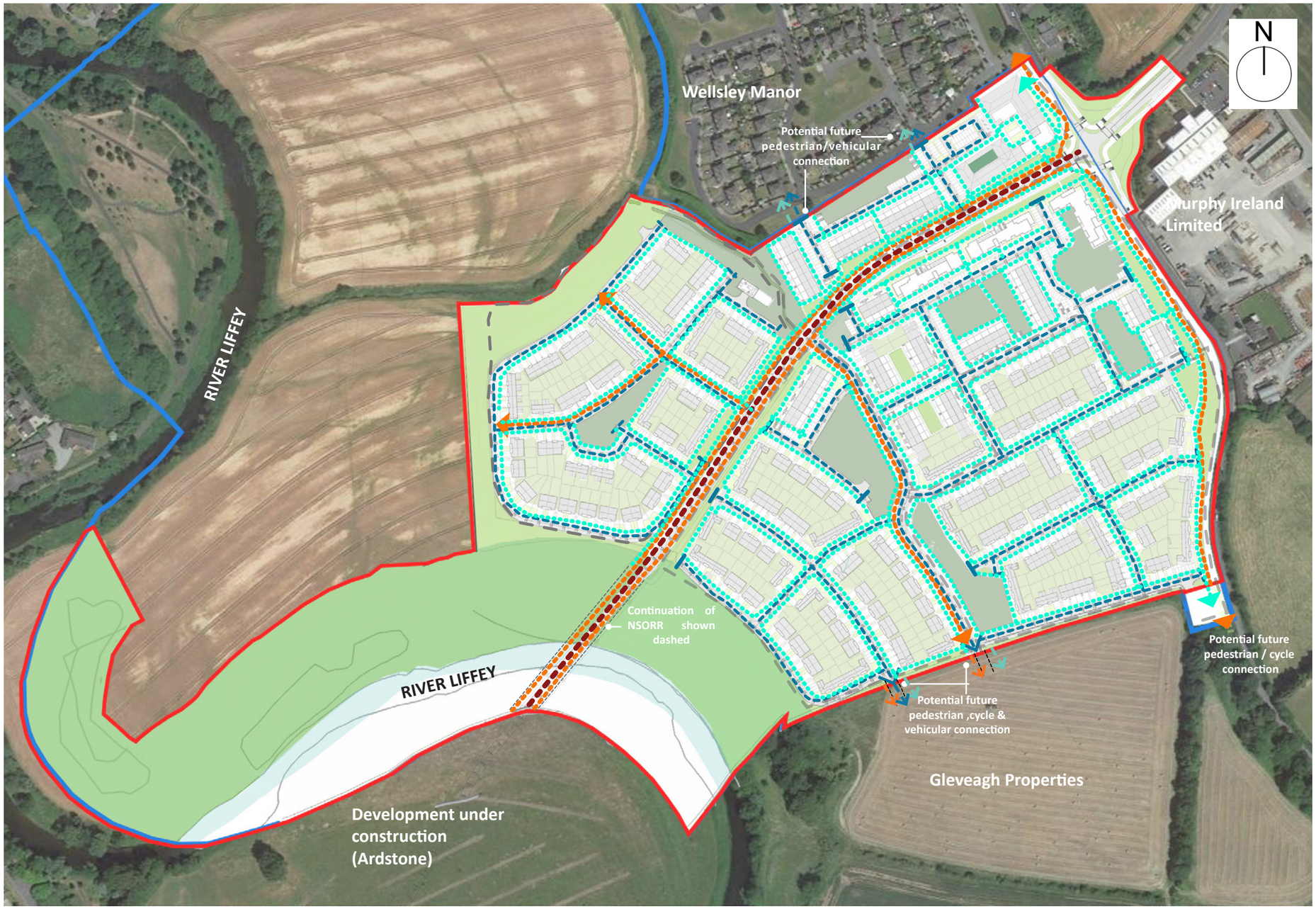
OPEN SPACE TYPOLOGIES LEGEND

- PUBLIC OPEN SPACES
- AMENITY SPACE
- PRIVATE SPACE
- SEMI PRIVATE SPACE
- RIVER PARK

EXISTING BOUNDARIES LEGEND

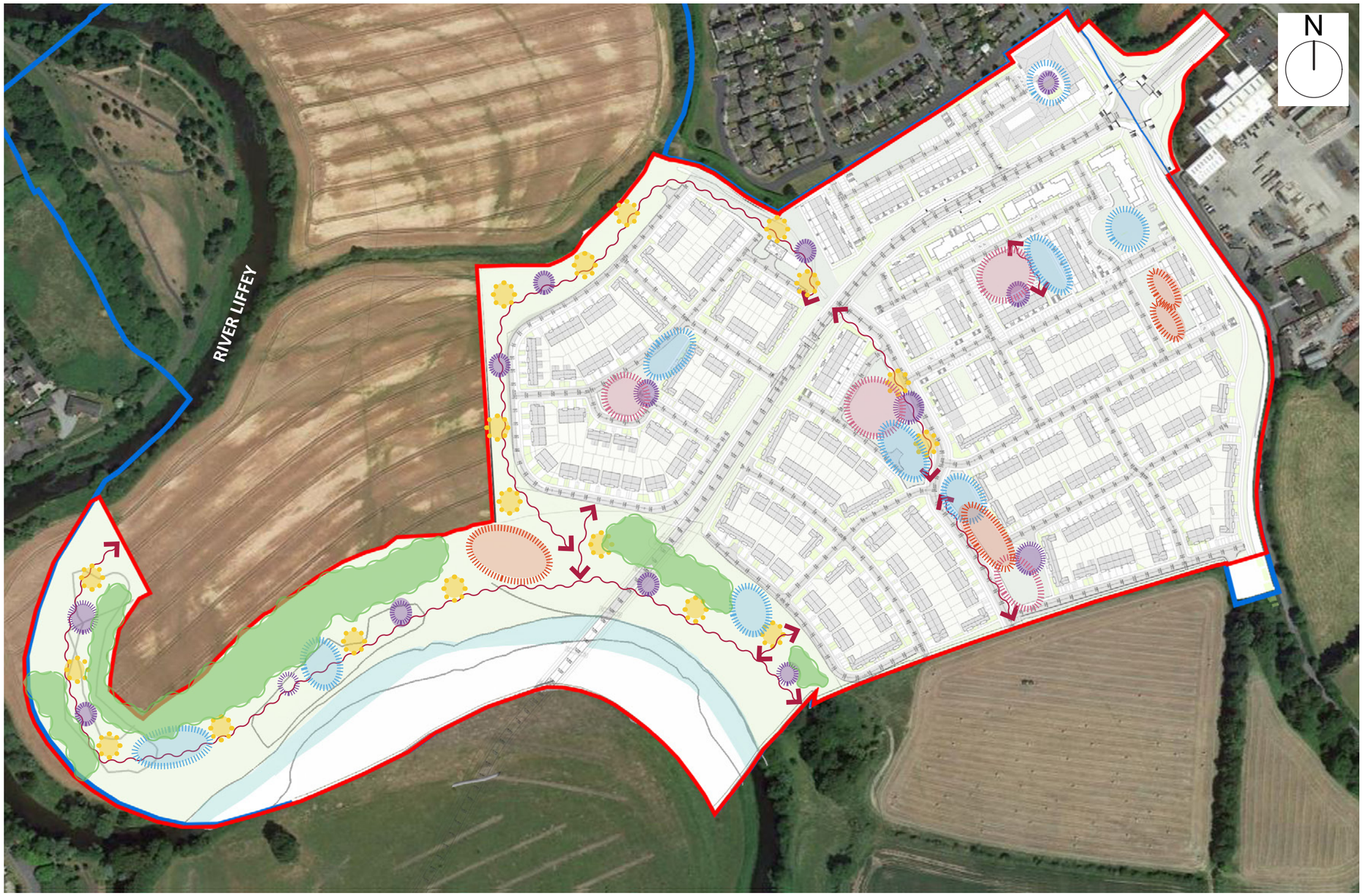
- EXISTING BLOCK WALL
- EXISTING TIMBER POST & RAIL FENCE WITH HEDGE
- EXISTING TREES/ HEDGEROWS
- LOW LEVEL HEDGE

01.4 ACCESS AND CIRCULATION



Future connections to the surrounding lands are considered which include: connections along the north western boundary to Wellesley Manor (pedestrian and vehicular connection) and along the south- eastern boundary into the neighbouring lands (pedestrian, vehicular & cycle connections). Please refer to engineer's report for further information.

01.5 CONCEPT DESIGN & ACTIVITES



The public spaces are designed to incorporate allow for the following components which allow for a spectrum of uses and age groups as follows:

- Informal play spaces (suitable for unstructured play activities and social interaction)
- Kick-about area and informal kick-about area (active and structure play)
- Seating areas located to appeal to the sunny aspect and desired views (for sedentary activity)
- Natural play (for active play with age inclusive equipment 1-13 yrs. & +13 yrs.)
- Proposed native trees, maintained lawn and wildflower planting (nature activities)
- Ground modelling
- Existing trees and hedgerows retained (nature activities)
- Woodland Planting (nature activities)
- High quality paving materials and street furniture
- Walking, running and cycling trails
- Exercise stations (intended for age +13)
- Attenuation features

LEGEND

NATURAL PLAY

ACTIVE PLAY IN KICK-ABOUT AREA / INFORMAL KICK-ABOUT AREA

EXERCISE

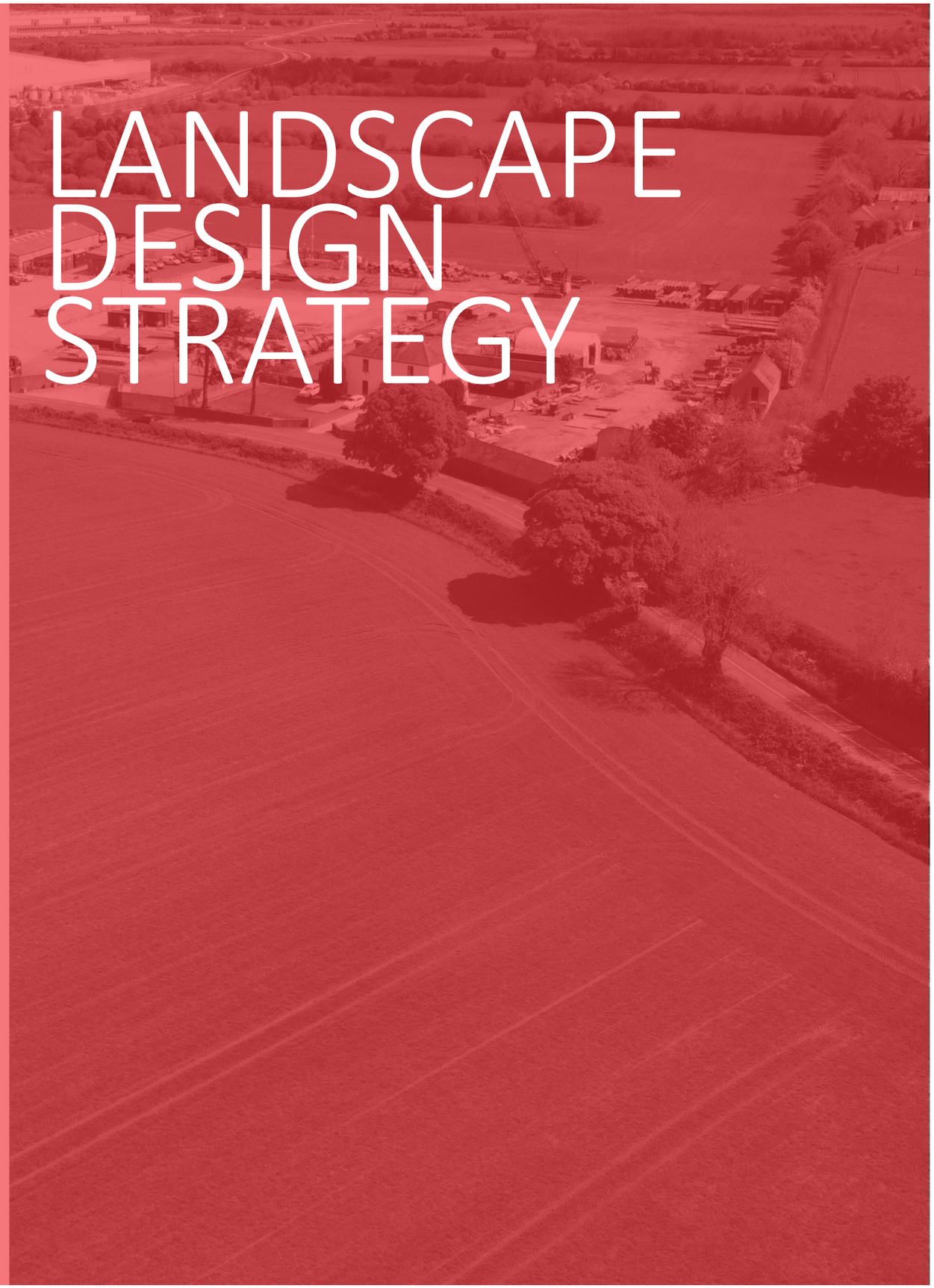
PASSIVE RECREATION (WALKING, STROLLING & RUNNING) & CYCLING

SEDENTARY ZONE (SITTING AND RESTING)

UNSTRUCTURED PLAY AND SOCIAL INTERACTIONS

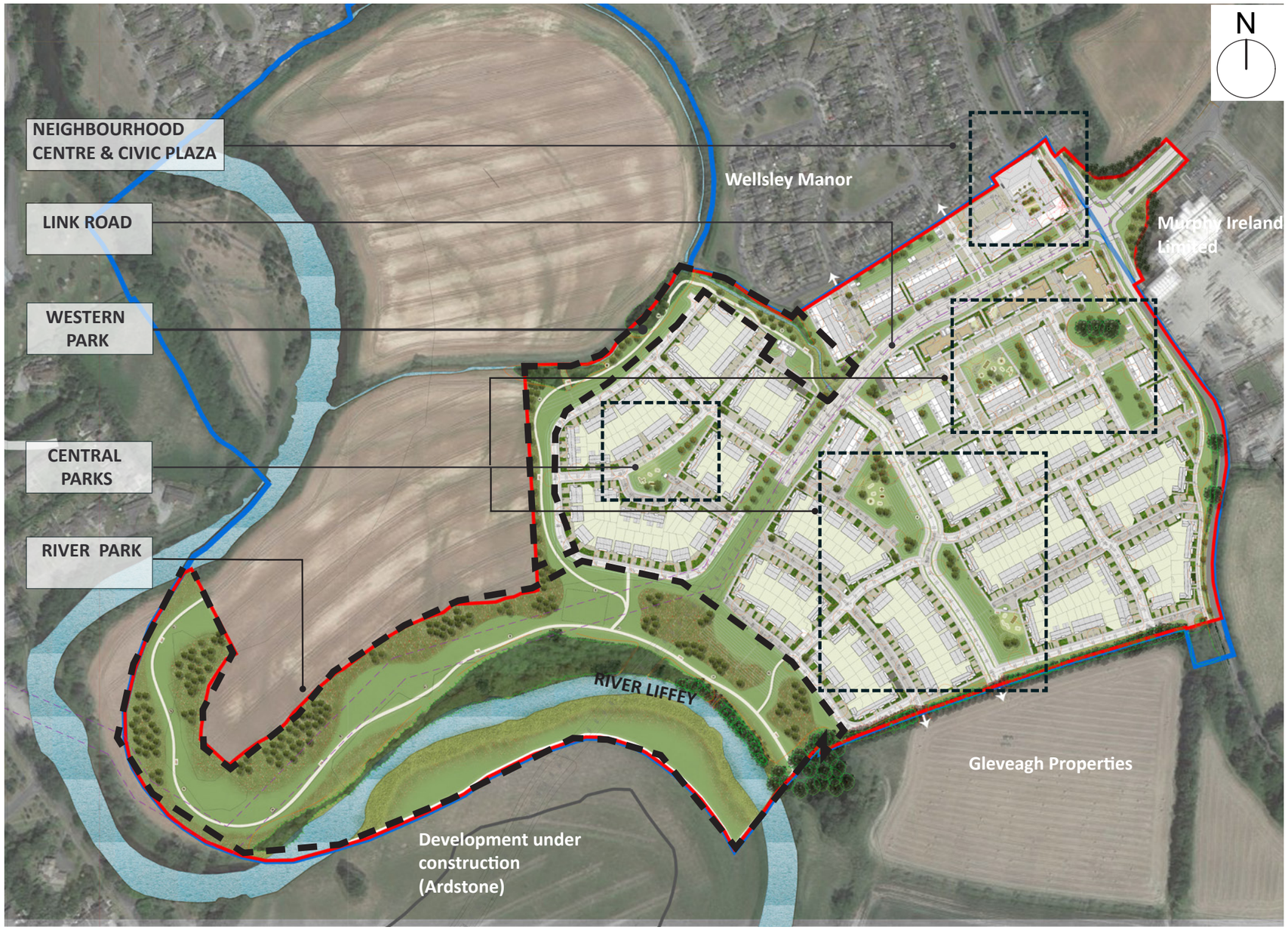
NATURE ACTIVITIES

02 LANDSCAPE DESIGN STRATEGY



02.1 LANDSCAPE DESIGN STRATEGY

PROPOSED LANDSCAPE ELEMENTS /GREEN INFRASTRUCTURE



The landscape incorporating Green Infrastructure (GI) is an important aspect of the character of the lands, which informed the urban structure of the plan. The design approach to the public realm within the subject lands is to produce a coherent and well considered design theme with a strong identity and distinctive sense of place that fosters a connection and attachment between existing and new residents and their surrounding environment. This will be achieved by creating a legible environment for people to live within and move through by using a hierarchy of spaces which include:

- Central Parks
- Western Park
- Local square/ Civic plaza
- River Park

LEGEND

- RED LINE BOUNDARY
- 10M WAYLEAVE (To Architect's DWG)
- SITE PLAN TO ARCHITECT'S LAYOUT
- BITMAC SURFACE TO ACCESS ROAD TO ENG. SPEC.
- PROPOSED CONCRETE FOOTPATH
- PROPOSED HOME ZONE PERMEABLE PAVING TO ENG. SPEC.
- PROPOSED PERMEABLE PAVING TO ENG. SPEC.
- PROPOSED BICYCLE TRACK
- PROPOSED BOUND GRAVEL / BITMAC PATH
- PROPOSED FRONT GARDENS
- PROPOSED LAWN AREA
- PROPOSED SHRUB/ WILDFLOWER AREA
- PROPOSED REAR GARDENS
- PROPOSED SAFA GRASS
- RIVER LIFFEY
- RIVER LIFFEY
- PROPOSED TREES/ MULTISTEM
- PROPOSED TREES WITH ROOT BARRIER
- EXISTING TREES RETAINED TO ARB. DRAWING
- ROOT PROTECTION AREA TO ARB. DRAWING
- EXISTING TREES REMOVED TO ARB. DRAWING
- EXISTING HEDGE RETAINED TO ARB. DRAWING
- EXISTING HEDGE REMOVED TO ARB. DRAWING
- PROPOSED HEDGE
- PROPOSED GROUND MODELLING
- PROPOSED NATURAL PLAY / EXERCISE EQUIPMENT
- PROPOSED SEATING AREA
- PROPOSED ATTENUATION TO ENG. DRAWING
- PROPOSED SWALE TO ENG. DRAWING
- PROPOSED PUBLIC LIGHTING TO ENGINEER'S LAYOUT

02.1 LANDSCAPE DESIGN STRATEGY

CENTRAL PARKS

The masterplan identifies several centrally located public spaces enclosed by residential blocks and human scale streets that relate strongly to the urban layout. The design philosophy of the public realm was to provide bold, contemporary but above all else robust public spaces that have the potential to provide a main focus both within the development as well as the immediate surrounding area.

The central spaces have been designed specifically for flexible use with a spectrum of age inclusive activities. Level changes were also a major consideration in the design of the spaces. The design successfully creates usable spaces while accommodating the surrounding road levels (for further information refer to Dwg 301 & 302). It was considered “optimum landscape” to incorporate:

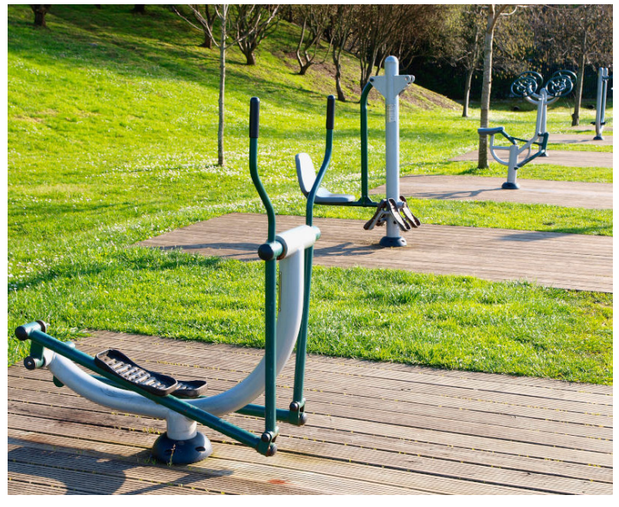
- Informal play spaces (suitable for unstructured play activities and social interaction)
- Informal kick-about area (active and structure play)
- Seating areas located to appeal to the sunny aspect and desired views (for sedentary activity)
- Natural play (for active play with age inclusive equipment 1-13 yrs. & +13 yrs.)
- Proposed native trees
- Ground modelling
- Existing trees and hedgerows retained (nature activities)
- Walking, running and cycling trails
- Exercise stations (intended for age +13)
- Underground Attenuation.

02.1 LANDSCAPE DESIGN STRATEGY

WESTERN PARK

This park is developed along the western boundary of the lands. Existing hedgerows along the boundaries of this area will be retained, where achievable, ensuring the long-term integrity and character of same (Refer to Arborist Drawing). The design provides for a meandering pedestrian/cycle route with new tree planting and wildflower meadow to enhance biodiversity. Exercise equipment and seating areas will also be incorporated along the trail to direct users through the space (for further information refer to Dwg 303). This park will allow for:

- Informal play spaces (suitable for unstructured play activities and social interaction)
- Seating areas located to appeal to the sunny aspect and desired views (for sedentary activity)
- Existing trees and hedgerows retained (nature activities)
- Walking, running and cycling trails
- Exercise stations (intended for age +13)
- Proposed native trees, maintained lawn and wildflower planting (nature activities)
- Underground attenuation.



02.1 LANDSCAPE DESIGN STRATEGY

RIVER PARK

This park will provide a strategic new multi-functional recreational amenity incorporating GI, which will also provide a setting for biodiversity and water management (for further information refer to Dwg 303). The key components of the park includes:

- A pedestrian/cycle route connecting the plan lands with the existing/proposed public space network along the River Liffey,
- Provide the opportunity for passive recreation uses (walking, running and strolling),
- Enhancement of existing hedgerows with the provision of new areas of native urban forestry (suitable for nature activities),
- Kick- about Area for active and structure play,
- Seating areas (for sedentary activity)
- Exercise stations placed strategically along path.
- Incorporation of SuDs measures including flood compensation storage to engineer's design details.

02.1 LANDSCAPE DESIGN STRATEGY

EXERCISE TRAIL

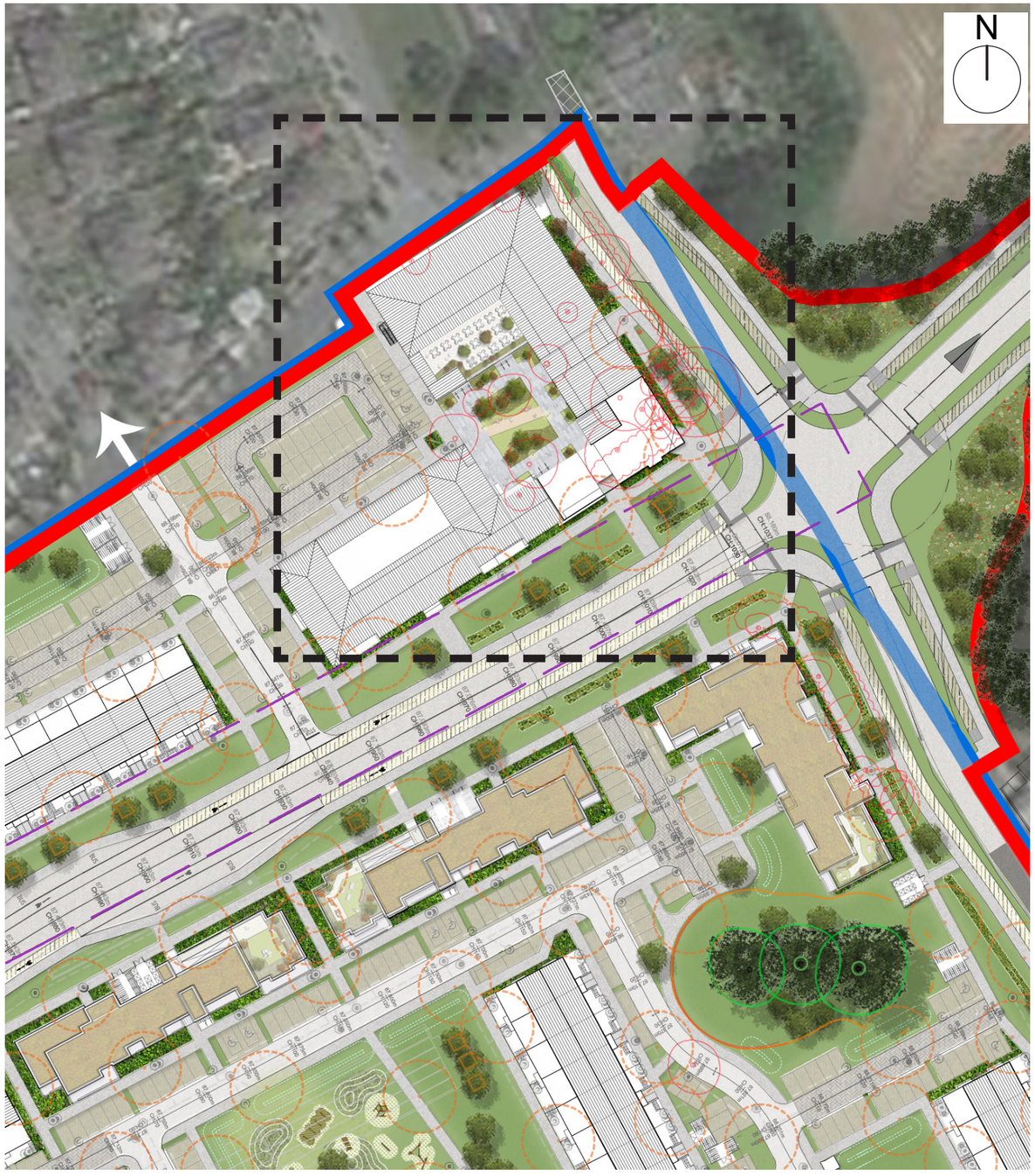
The exercise trail connects the Western Park, River Park and the Central Park. The trail includes 19 no. exercise stations (See section 2.4 for schedule), seating areas , walking path and woodland planting.

LEGEND

- Proposed exercise trail
- Proposed exercise stations
- Proposed seating areas

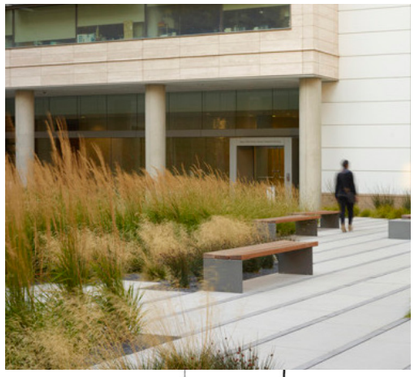
02.1 LANDSCAPE DESIGN STRATEGY

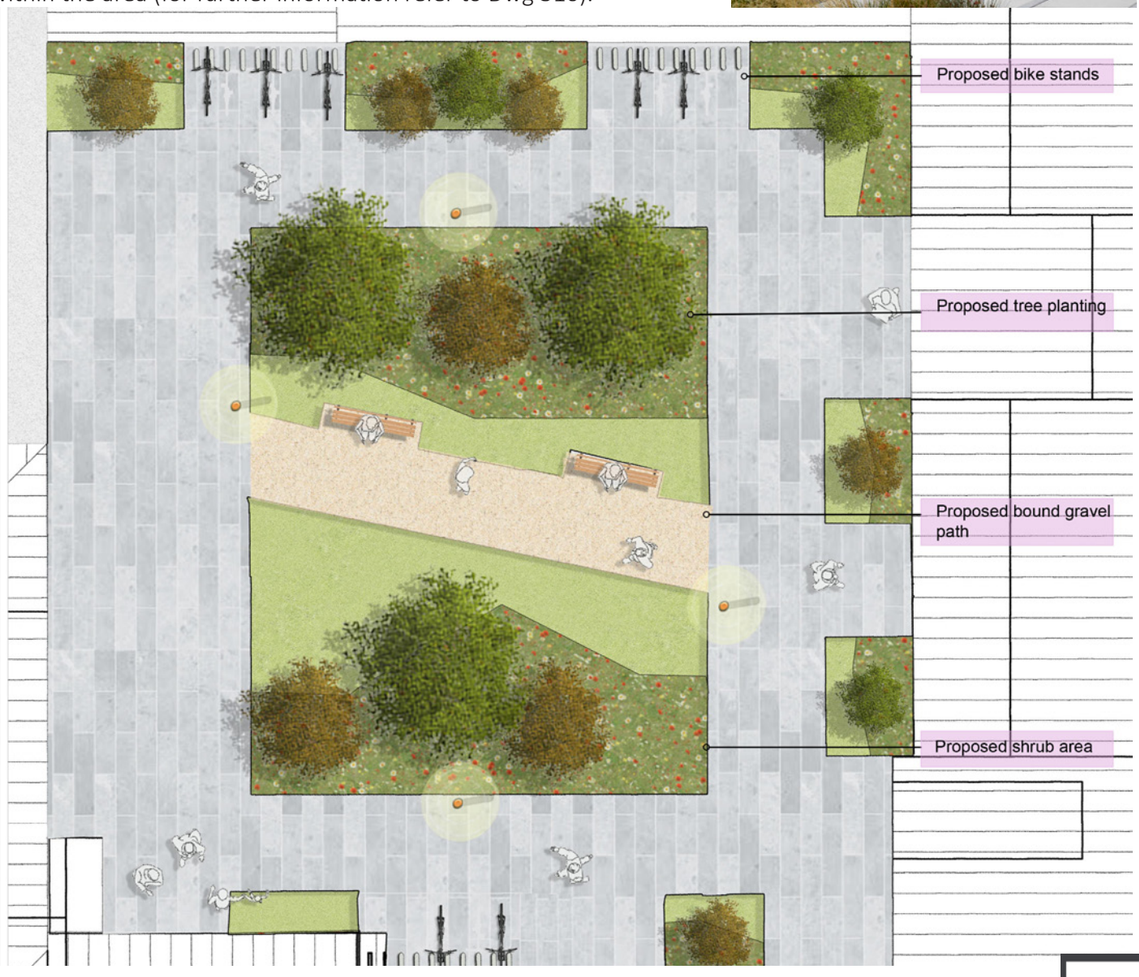
CIVIC PLAZA



The neighbourhood centre is strategically located along the northern boundary of the plan lands. The civic plaza is located immediately adjacent to the proposed local centre and forms the main space and focus at the entrance to the plan lands. The proposed civic plaza provides a strong identity and distinctive sense of place at the entrance to the plan lands, as well as providing a flexible use space incorporating high quality materials. The civic plaza design provides for the following uses:

- Meeting place with seating areas in sheltered sunny locations
- Opportunity for weekend market/special local events
- Quality lighting to ensure safe night time environment
- Connectivity to neighbouring residential & commercial premises within the area (for further information refer to Dwg 310).

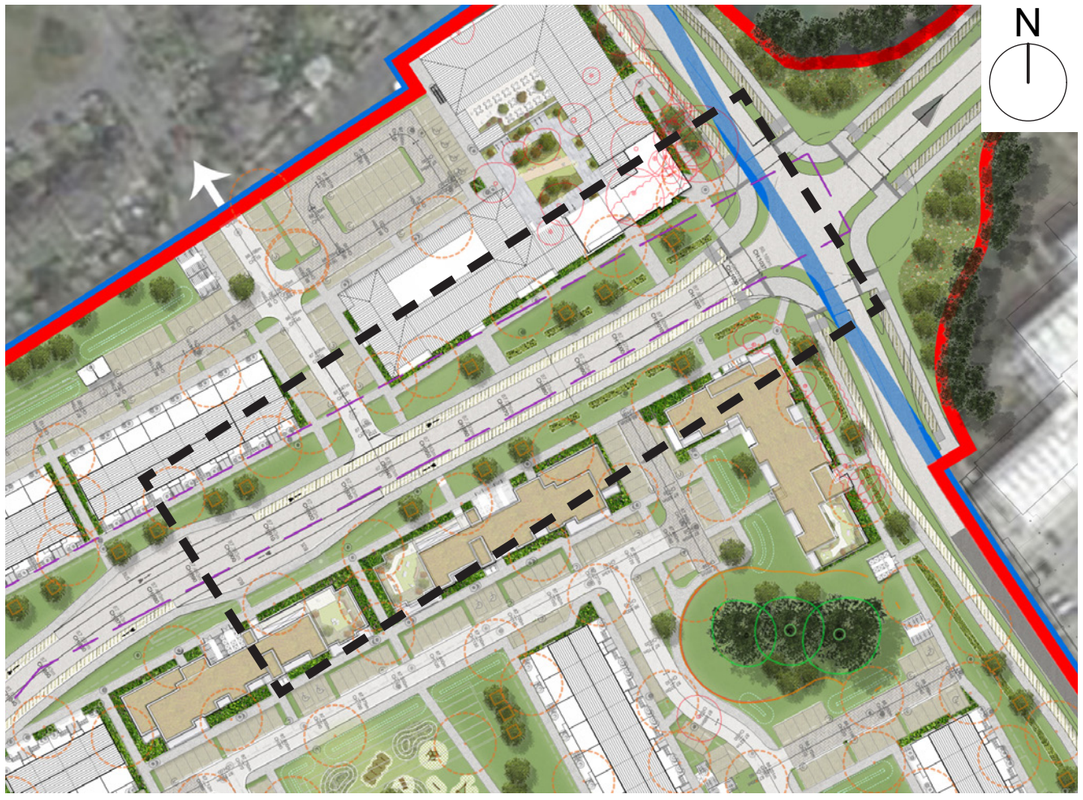


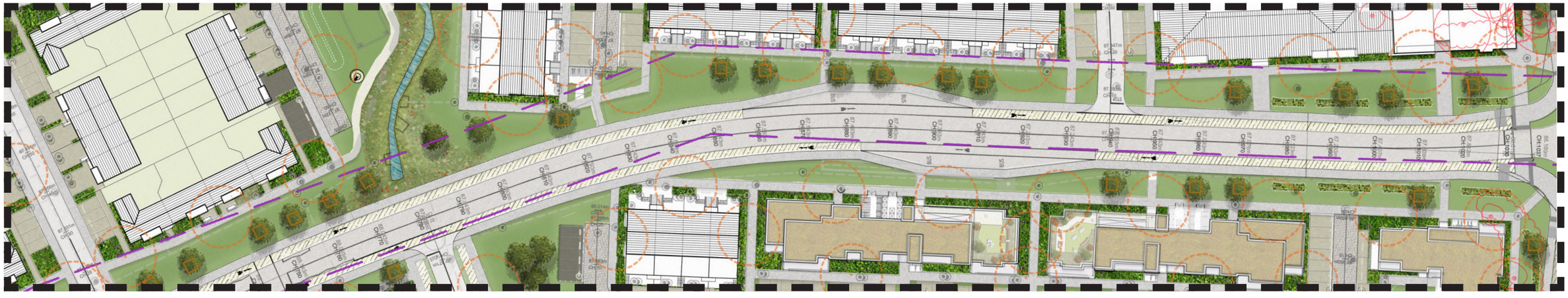


02.1 LANDSCAPE DESIGN STRATEGY

PROPOSED LINK ROAD

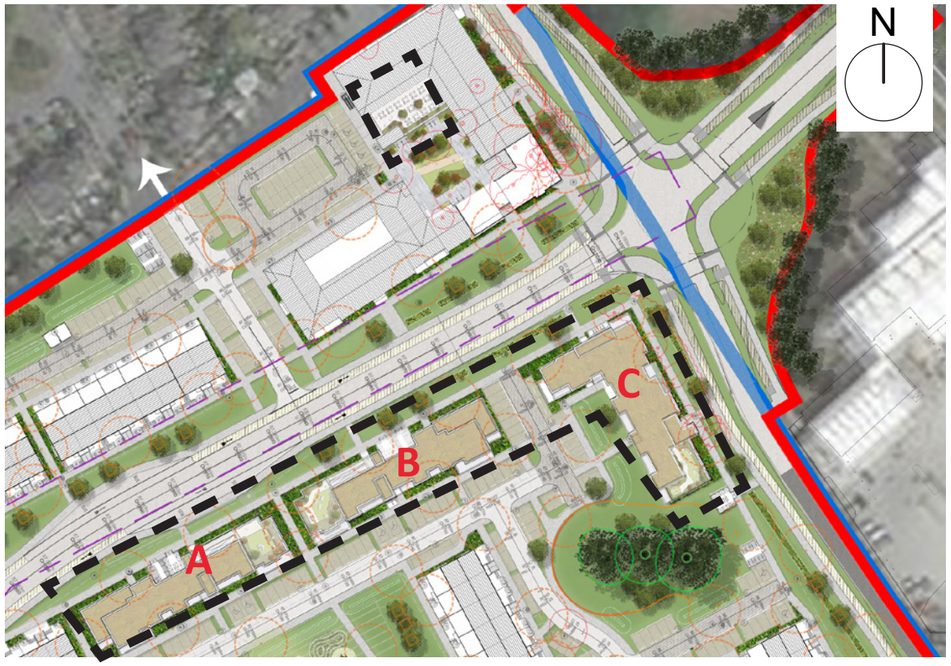
Street tree planting, lawn areas, hedge planting and high-quality lighting are proposed along the Link Road to provide visual interest and complement the overall landscape strategy. Root barriers are proposed for trees in proximity to services (for further information refer to ***Dwg 308***).

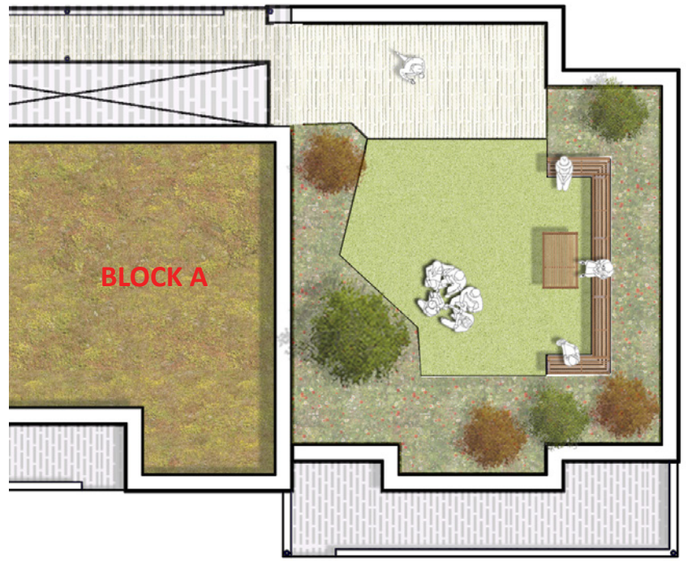




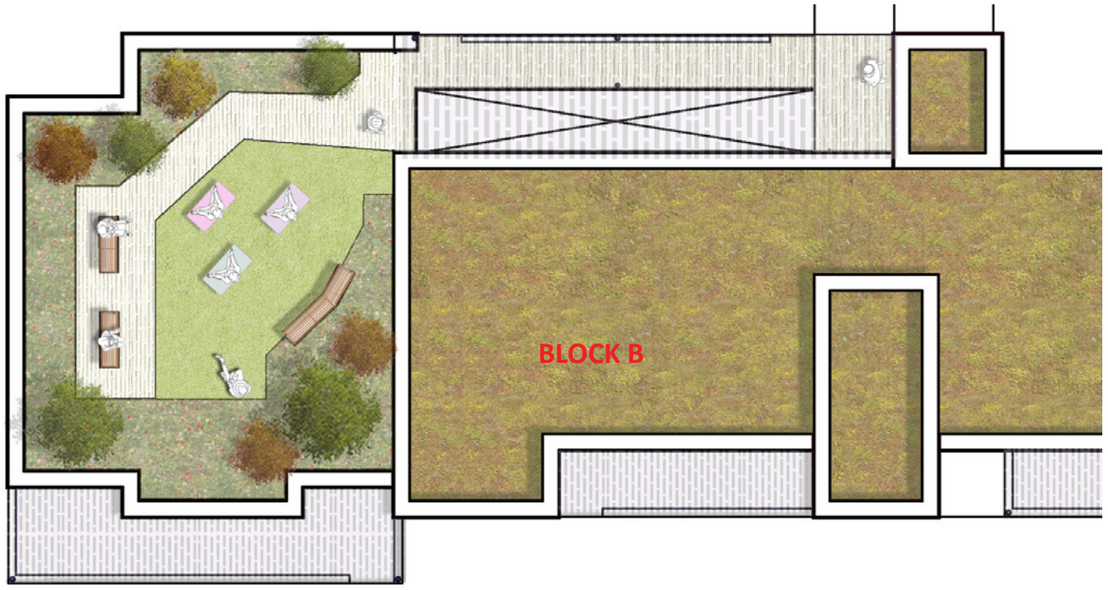
02.1 LANDSCAPE DESIGN STRATEGY

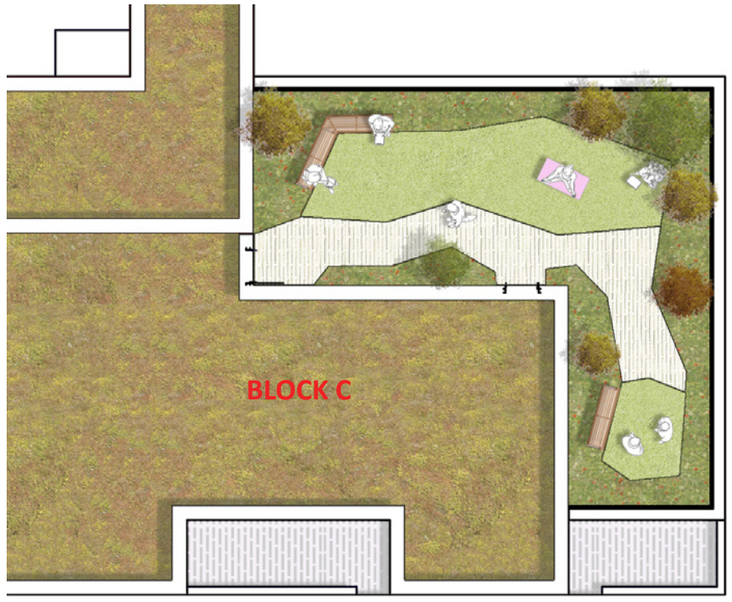
COMMUNAL TERRACES





In addition to the public open spaces, a series of communal terraces are situated throughout the site on:Block A, Block B, Block C and the Neighborhood Center. The communal terraces provide an outdoor space for passive recreation and exercise as it includes synthetic grass area , seating areas and multistem and shrub planting areas (for further information refer to Dwg 310 & 311).





02.2 PROPOSED MATERIALS

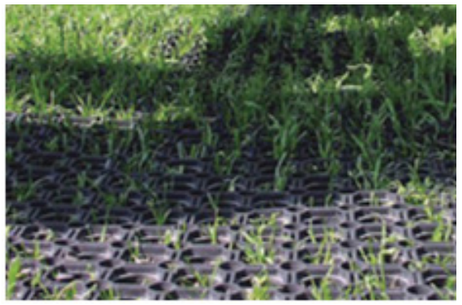
One of the primary aims of the design of the public spaces within the proposed development is to provide a scheme with a strong identity and distinctive sense of place, that fosters a connection and attachment between people and their surrounding environment. This will be achieved by creating a legible environment for people to live within and move through by using a hierarchy of materials (paving and street furniture) and planting to create different character areas and provide visual cues to how people may move through or use these spaces. While different paving materials and textures will be used to demarcate changes to levels, verges, paths and to guide the visually impaired, it is proposed that materials (e.g. paving, lighting, street furniture and tree planting) will be chosen from a limited palette to encourage visual cohesion within the scheme.

1- Proposed bound gravel finish to paths

2- Proposed brushed concrete finish to footpaths

3- Proposed lighting columns to roads and public spaces to engineer's spec.

3- Proposed blister paving flags to pedestrian crossings

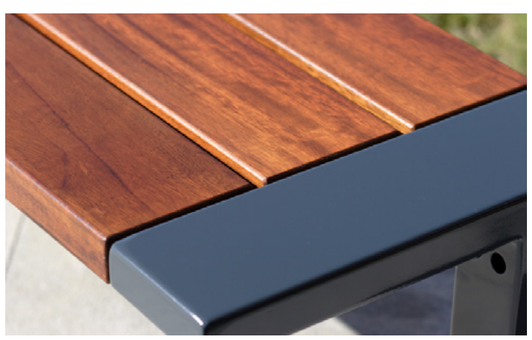


4- Proposed Safa grass to natural play elements

5- Proposed permeable paving to car parking spaces to eng. specification

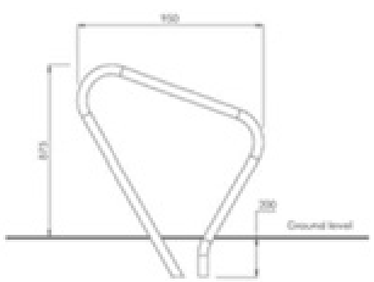
6- Proposed courduroy hazard warning paving flags to pedestrian crossovers

7- Proposed litter bins



7- Proposed bench seating : S64 Bench, Omos or similar approved

8- Proposed bicycle stands



9- Proposed coloured bitmac to cycle route to engineer's spec.

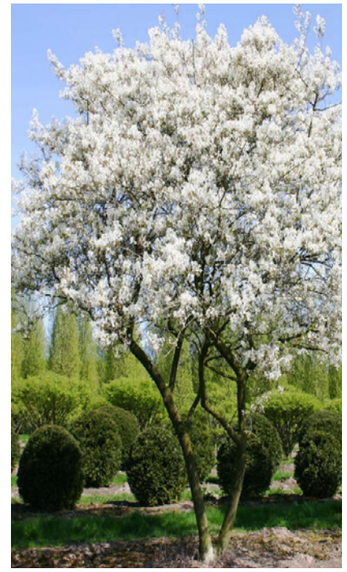
02.3 PLANTING SCHEDULE

Public & Communal Spaces

1554_ Indicative Planting Schedule to Communal and Public Spaces		
Name	**Specification**	**Size**
Supply and protect the following:		
All plant material to Landscape Architects approval		
Street Tree Planting		
Ac- Acer campestre ' Elsrijk'	RB	16-18 cm
Qp- Quercus petraea (where space allows)	RB	16-18 cm
Tree Planting to Open Space Areas		
Extra Heavy Standard Tree Planting		
Ac- Acer campestre	RB	14-16 cm
Bp- Betula pubescens	RB	14-16 cm
Pa- Prunus avium	RB	14-16 cm
Qb- Quercus robur	RB	14-16 cm
Qp- Quercus petraea	RB	14-16cm
large Conifer Planting		
Pn- Pinus nigra	RB	2-2.5m
Ps- Pinus sylvestris	RB	2-2.5m
Bp- Betula pendula	RB	14-16cm
Multi Stems		
Al- Amelanchier lamarckii	RB,fthd	MS 2-2.50 m high
Ap - Acer palmatum	RB,fthd	MS 2-2.50 m high
Betula utilis jacquemontil 'Snow Queen'	RB,fthd	MS 2-2.50 m high
Proposed Hedge to site boundary (where applicable)		
Ac- Acer campestre	5/l.m	BR, fthd,120-150cm
Cm- Crataegus monogyna	5/l.m	BR, fthd,120-150cm
Ia- Ilex aquifolium	5/l.m	BR, fthd,120-150cm
Woodland Tree Planting		
Standard Tree Planting (@ 1.0m c/c)		
Ac- Acer campestre	1.0/sq.m	2xtr, BR, 8-10 cm girth
Ah- Aesculus hippocastanum	1.0/sq.m	2xtr, BR, 8-10 cm girth
Fs- Fagus sylvatica	1.0/sq.m	2xtr, BR, 8-10 cm girth
Pa- Prunus avium	1.0/sq.m	2xtr, BR, 8-10 cm girth
Qr- Quercus robur	1.0/sq.m	2xtr, BR, 8-10 cm girth
Whips/Transplants Planting (@ 1.25m c/c)		
Ac- Acer campestre	1.25/sq.m	BR,fthd, 150-180cm high
Ah- Aesculus hippocastanum	1.25/sq.m	BR,fthd, 150-180cm high
Cm- Crataegus monogyna	1.25/sq.m	BR,fthd, 90-120cm high
Fs- Fagus sylvatica	1.25/sq.m	BR,fthd, 150-180cm high
Ia- Ilex aquifolium	1.25/sq.m	RB,fthd, 60-90cm high
Ps- Pinus sylvestris	1.25/sq.m	RB,fthd, 60-90cm high
Pa- Prunus avium	1.25/sq.m	BR,fthd, 150-180cm high
Qr- Quercus robur	1.25/sq.m	BR,fthd,150-180cm high

Shrub and Herbaceous Planting		
Alchemilla alpina		2lt; C
Anemone 'Honorine Jobert'		2lt; C
Asplenium scol. 'Angustifolia'		2lt; C
Calamagrostis 'Karl Foerster'		3lt; C
Cornus alba 'Wintersun'		60-80cm; BR
Crocosmia ' Lucifer '		3lt; C
Digitalis grandiflora 'Carillon'		3lt; C
Echinacea purpurea 'White Swan'		3lt; C
Helleborus or. 'Montsegur'		3lt; C
Helleborus orientalis (white)		3lt; C
Libertia grandiflora		3lt; C
Liriope muscari 'Monroe White'		3lt; C
Luzula nivea		3lt; C
Miscanthus sinensis 'Gracillimus'		3lt; C
Panicum virgatum 'Heavy Metal'		3lt; C
Pennisetum alopecuroides 'Hameln'		3lt; C
Perovskia atriplicifolia 'Blue Spire'		3lt; C
Persicaria amp. 'Fat Domino'		3lt; C
Polystichum set. 'Herrenhausen'		3lt; C
Rosa 'Flower Carpet' (whilte)		3lt; C
Rudbeckia f. v. sul. 'Goldsturm'		3lt; C
Salvia nem. 'Caradonna'		3lt; C
Salvia nem. 'Schneehugel'		3lt; C
Tiarella cordifolia		3lt; C
Verbena bonariensis 'Lollipop'		3lt; C
Stipa tenuissima 'Ponytails'		3lt; C
Amenity grass areas (to future specification)		25 g/sq.m.
Wildflowe Mix (to future specification)		

Quercus petraea


Amenlanchier lamarckii

The inception of the approach to the scheme is to retain existing trees and hedgerows where possible (refer to Arborist report) and supplement them where necessary. It is proposed to use native tree planting including Oak, Acer, and Prunus. In addition, smaller specimen trees /multi-stem shrubs will also be used along with wildflower and herbaceous planting which benefit pollinators and reinforce the biodiversity within the development (refer to planting schedule & DWG 308).

Acer campestre

Prunus avium

Echinacea purpurea

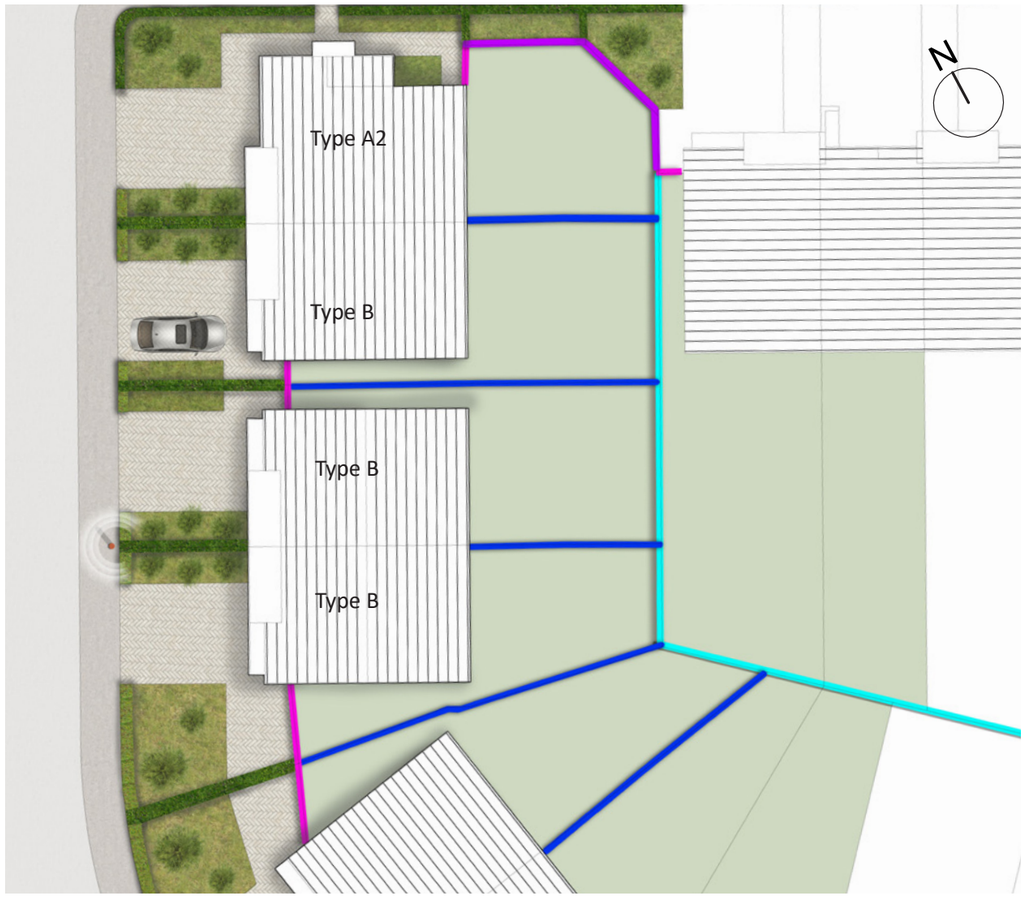
Salvia nem.

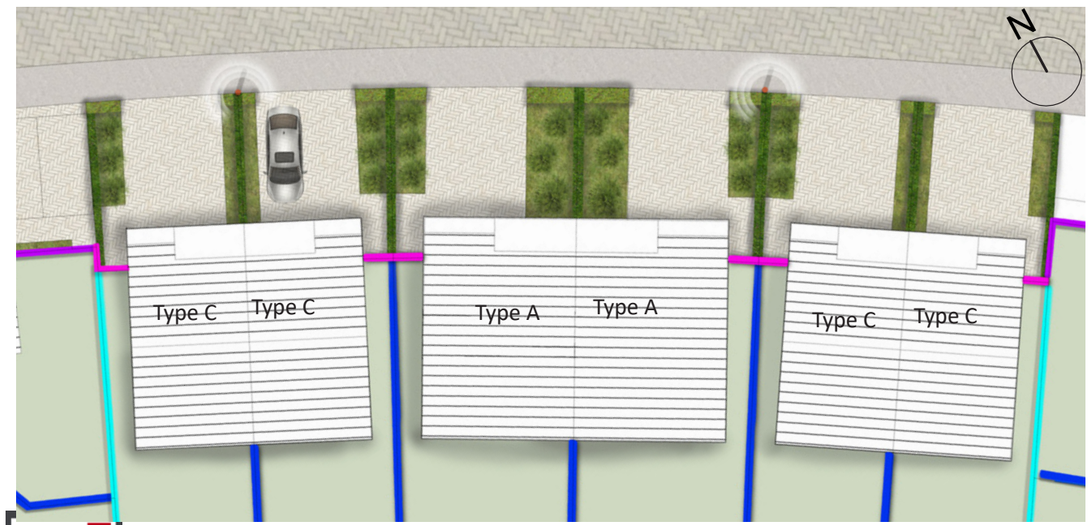
Wild flower planting

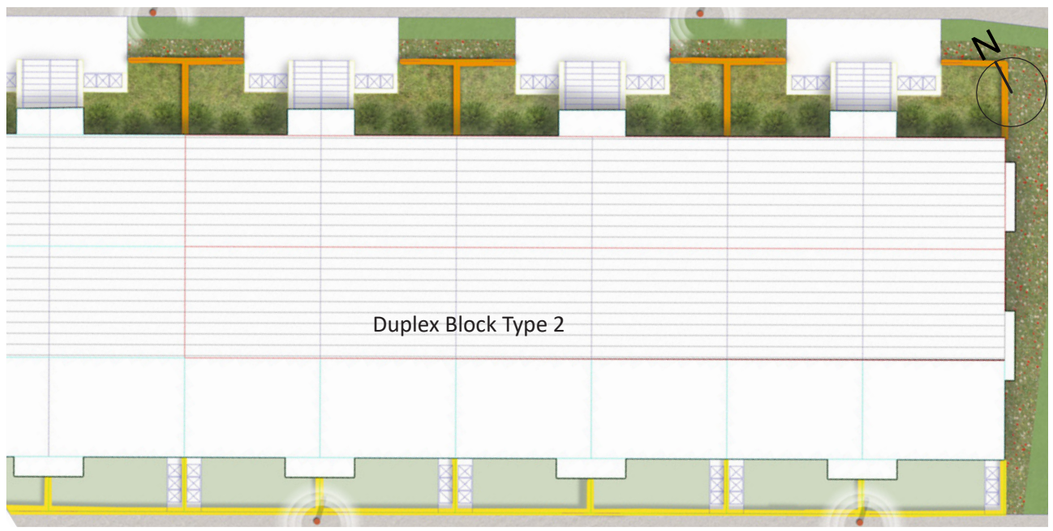
02.3 PLANTING SCHEDULE

Private Areas

1554_Front Garden _Planting Schedule				
Ref.	Qty.	Name	Density	Size
Supply and Protect the following trees (Rootballed unless specified)				
All Plant materials to Landscape Architects approval				
Specimen Shrubs				
SS01		Arbutus unedo	as shown	20 ltr.cg
SS02		Nandina domestica	as shown	20 ltr.cg
SS03		Cistus x hybridus	as shown	5 ltr.cg
SS04		Abelia x grandiflora	as shown	5 ltr.cg
SS05		Fuchsia 'Mrs Popple'	as shown	5 ltr.cg
SS06		Hydrangea paniculata 'Limelight'	as shown	5 ltr.cg
Clipped Shrub (Single row, 500 mm centers)				
CS01		Buxus sempervirens	2/l.m.	5 ltr.cg
Hedges (Doubel Staggered Row)				
H01		Prunus lusitanica	5/l.m	RB,120-150mm
Grasses				
G01		Chionocloa falvicans	5/sq.m.	2 ltr.cg
Perennials				
Option A (sunny aspect)				
P01		Achillea moonshine	5/sq.m.	2 ltr.cg
P02		Anthemmis buxtons variety	5/sq.m.	2 ltr.cg
P03		Campanula glomerata 'Superba'	5/sq.m.	2 ltr.cg
P04		Hellenium 'The Bishop'	5/sq.m.	2 ltr.cg
Option B (shaded aspect)				
P05		Anemone x hybrida c.vars	5/sq.m.	2 ltr.cg
P06		Anthemmis buxtons variety	5/sq.m.	2 ltr.cg
P07		Digitalis purpurea 'Dalmation white'	5/sq.m.	2 ltr.cg
P08		Astrantia 'Buckland'	5/sq.m.	2 ltr.cg
Note:				
All tree material must be accompanied by an Irish Provenance Certification				







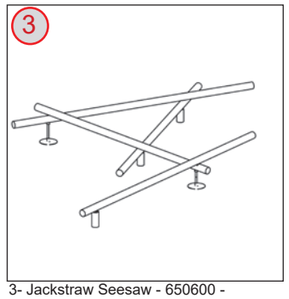
02.4 PROPOSED NATURAL PLAY & EXERCISE EQUIPMENT

Natural play equipment and exercise stations are proposed within the public spaces. These elements are situated strategically to assure passive surveillance from the surrounding housing units. The section below outlines play and exercise equipment which may included the following :

Proposed natural play equipment

1- Balance Bean - 8061276 - 3-12 yrs - HAGS

2- Balancing Wooden Posts - 8061278 - 3-12 yrs - HAGS


3- Jackstraw Seesaw - 650600 - 5+ yrs - Richter Spielgerate

4- Double Overhead Ladder Robinia - FRO213 - 13+ yrs - Kompan

5- Parallel Bars - FSW201 - 13+ yrs - Kompan

6- Strech Station - FSW223 - 13+ yrs - Kompan

7- Riara - 8038418 - 3-12 yrs - HAGS

8- Kion - 8066335 - 3-12 yrs - HAGS

9- Stilts - NRO806 - 3+ yrs - Kompan

10- Triple Balance Beam - NRO804 - 3-12 yrs - Kompan

11- Over under - FSW214 - 13+ yrs - Kompan

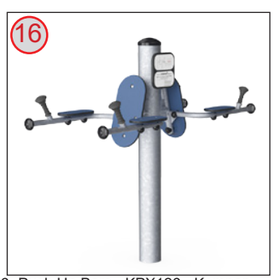
12- Slide - 363300 - 1-3 yrs - Kompan

Proposed exercise equipment (suitable for +13 yrs.)

13- Chest Press - FST10400 - Kompan

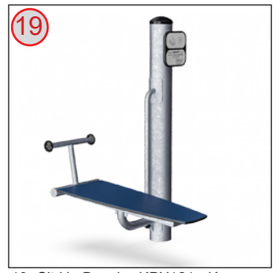
14- Flex Wheel - FSW226 - Kompan

15- Hand Bike - KPX130 - Kompan


16- Push Up Bars - KPX126 - Kompan

17- Upright Row & Press Down - FST10500 - Kompan

18- Cross Trainer - KPX125 - Kompan


19- Sit Up Bench - KPX121 - Kompan

20- Free Runner - KPX120 - Kompan

21- Power Bike - KPX129 - Kompan

22- Double Chest Press - KPX131 - Kompan

23- Triple Bars - KPX132 - Kompan

24- Body Flexer & Upperbody Trainer - KPX224 - Kompan

25- Balance Station - FSW227- Kompan

26- Leg Lift & Pull Up - FSW238 - Kompan

		1554_ Play elements and Exercise stations Schedule		
#	QUA.	Play element & exercise equipment	Supplier	Code
1	2	Balance Beam	HAGS	8061276
2	4	Balancing Wooden Posts	HAGS	8061278
3	2	Jackstraw Seesaw	Richter	650600
4	1	Double Overhead Ladder Robinia	Kompan	FRO213
5	2	Parallel Bars	Kompan	FSW201
6	2	Stretch Station	Kompan	FSW223
7	2	Riara	HAGS	8038418
8	1	Kion	HAGS	8066335
9	1	Stilts	Kompan	NRO806
10	1	Triple Balance Beam	Kompan	NRO804
11	2	Over Under	Kompan	FSW214
12	1	Slide	Richter	363300
		Exercise station along trail		
13	1	Chest Press	Kompan	FST10400
14	2	Flex Wheel	Kompan	FSW226
15	1	Hand Bike	Kompan	KPX130
16	1	Push Up Bars	Kompan	KPX126
17	2	Upright Row & Press Down	Kompan	FST10500
18	1	Cross Trainer	Kompan	KPX125
19	2	Sit Up Bench	Kompan	KPX121
20	1	Free Runner	Kompan	KPX120
21	2	Power Bike	Kompan	KPX129
22	1	Double Chest Press	Kompan	KPX131
23	2	Triple Bars	Kompan	KPX132
24	1	Body Flexer & Upperbody Trainer	Kompan	KPX224
25	1	Balance Station	Kompan	FSW227
26	1	Leg Lift & Pull Up	Kompan	FSW238

Landscape Specification: OUTLINE OF OPERATIONS

Ground preparation will precede planting and will include weed clearance and amelioration where necessary. Intensive landscape aftercare for each area will run for 12 months from the practical completion date using contact herbicides and hand weeding. There will be a period of 12 months defects liability on all planting with plant failures being replaced in the following planting season.
Herbicide and Pesticide usage must be carried out in accordance with:
S.I. 155 of 2012 - European Communities (Sustainable Use of Pesticides) Regulations 2012
S.I. 159 of 2012 - European Communities (Plant Protection Products) Regulations 2012

PLANTING

Materials

All plant material shall be good quality nursery stock, free from fungal, bacterial or viral infection. Aphis, Red Spider or other insect pest, and physical damage. It shall comply with the requirements of the following sections of B.S. 3936, Specification for Nursery Stock, where applicable:

Part 1 - 1992:	Specification for trees and shrubs
Part 2 – 1990:	Specification for roses
Part 4 – 2007:	Specification for forest trees, poplars and willows
Part 7 - 1989:	Specification for bedding plants
Part 9 - 1998:	Specification for bulbs, corms and tubers
Part 10 - 1990:	Specification for ground cover plants

All plants shall have been nursery grown in accordance with good practice and shall be supplied through the normal channels of the wholesale nursery trade. They shall have the habit of growth that is normal for the species.

Except for any cultivated varieties or exotic species which do not set viable seed in Ireland, all plants shall have been grown from seed.

The Contractor will be deemed to have advised his suppliers of the relevant sections of this specification, including all protection required, at the time of enquiry and shall in all cases be liable to replace materials brought on site which are not in accordance with this specification.

Species

All plants supplied shall be exactly true to name as shown in the plant schedules. Unless stipulated, varieties with variegated or otherwise coloured leaves will not be accepted, and any plant found to be of this type upon leafing out shall be replaced by the Contractor at his own expense.

Bundles of plants shall be marked in conformity with the relevant part of B.S. 3936. The contractor shall replace any plants that are found not to conform to the labels. An inspection of plants shall be undertaken prior to planting to ensure quality control.

Extra Heavy Standard and Standard Trees

Extra Heavy Standard trees shall have a total height of 4.0 to 4.5 metres and a girth of 14-16 cm at 1m above ground level. Standard trees shall have a clear stem 1.70 m to 1.85 m in height from ground level to the lowest branch, a minimum girth of 8 cm measured at 1m above ground level and a total height of 2.5 to 3.0 metres.

Trees shall have a sturdy, reasonably straight stem, a well defined and upright central leader, with branches growing out of the stem with reasonable symmetry, or a well balanced branching head according to the Schedule. The crown and root systems shall be well formed and in keeping with the nature of the species. Roots shall be in reasonable balance with the crown and shall be conducive to successful transplantation.

Trees shall be supplied bare rooted unless otherwise specified. They shall have been regularly undercut or transplanted. They shall have been lifted carefully to avoid tearing of major roots and to preserve a substantial proportion of smaller and fibrous roots. Trees shall have been grown on their own roots. Budded or grafted trees will be rejected.

Transplants

Transplants shall not be less than three years old, and shall have been transplanted at least once. Trees of species not listed in B.S. 3936: Part 4: 1984 shall be sturdy, with a balanced root and shoot development. Sizes shall range from 600-900 and 900-1200 mm.

Trees shall be well furnished with lateral and fibrous roots, and shall be lifted without severance of major roots. Roots shall be of the habit normal for the species.

Salix shall have been stumped and transplanted at the end of the first year in the nursery.

Shrubs

Shrubs shall be of the minimum size specified in the schedules, with several stems originating from or near ground level and of reasonable bushiness, healthy, well grown, and with a good root system. Pots or containers shall be as scheduled. Plants shall not be pot bound, nor with roots deformed or restricted. Bare root material will only be accepted where specified.

TBS
landscape architecture
urbanism + landscape planning

Herbicides

Chemical use such as herbicides, pesticides and fertilizers will need require prior approval by the project ecologist and landscape architect. Where species is deep rooted and cannot be removed manually or is persistent it should be treated with localised and spot application of hormone weed killers.

Weedkiller Application

All weedkiller handling and application should be carried out in accordance with the manufacturer's instructions, COSHH Regulations, using the necessary PPE and by trained personnel only.

Bulky Organic Manure/ Mushroom Compost

Bulky organic manure shall consist either of spent peat compost, mushroom compost, as described above, spent hops, or of well rotted farm manure. Farm manure shall consist of predominantly of faecal matter and shall be free of loose, dry straw and of undigested hay. Manure shall be free of surplus liquid effluent. This shall be used on mounds only. Well spent mushroom compost shall be used in all ornamental planting areas.

Fertilisers

Controlled release fertiliser N:P:K 15:9:11 plus trace elements - Osmocote plus or similar approved applied at specified rates.

Fertiliser shall be supplied in sealed bags or containers bearing the manufacturer's name, the net weight and analysis.

Stakes for Standard Trees

Stakes shall be of peeled larch, pine or Douglas fir, preserved with water-borne copper-chrome-arsenic to I.S. 131, to a net dry salt retention of 5.3 kg. per cubic metre of timber. Stakes shall be turned, and painted one end. Sizes shall be as follows:-

for extra heavy standard trees: 2700 x 75 mm dia.
for standard trees: 2700 x 75 mm dia.

Set stakes vertically in the pit, to the western side of the tree station, and drive before planting. Drive stake with a drive-all, wooden maul or cast-iron headed mell, not with a sledge hammer.

Tree Ties

Tree ties shall be of rubber, P.V.C. or proprietary fabric laminate composition, and shall be strong and durable enough to hold the tree securely in all weather conditions for a period of three years. They shall be flexible enough to allow proper tightening of the tie.
Ties shall be min. 40 min. wide for standard trees. Provide a simple collar, free of rough or serrated edges, to prevent chafing. Provide for subsequent adjustment of the tie either by means of a buckle (nail tie to stake immediately behind it) or by leaving heads of securing nails slightly proud, to permit easy extraction and repositioning. All nails shall be galvanised.

Protection

The interval between the lifting of stock at the nursery and planting on site is to be kept to an absolute minimum. Plants shall be protected from drying out and from damage in transport. All stock awaiting planting on site shall be stored in a sheltered place protected from wind and frost, from drying out and from pilfering. Bare rooted plants not immediately required shall be heeled-in in a prepared trench, the bundles of plants first having being opened, the plants separated and each group separately heeled-in and clearly labelled. The roots shall be covered with moist peat or soil and shall be kept moist until planted. Pots shall not be removed until plants have been carried to their planting station. Plants packed in polythene must be stored in shade.

All forest transplants and bare root shrubs shall be wrapped in polythene from the time of lifting to conserve moisture. Except when heeled-in, they shall be protected in polythene at all times until planted into their final position on site.

Plants shall be handled with care at all times, including lifting in and despatch from the nursery. Plants or bundles of plants shall not be tossed, dropped of subjected to any stress likely to break fine roots.

Damage

Any roots damaged during lifting or transport shall be pruned to sound growth before planting. On completion of planting any broken branches shall be pruned.

Vine Weevil

Any plants infected with Vine weevil will be rejected

TBS
landscape architecture
urbanism + landscape planning

Setting Out

Setting out shall be from figured dimensions where indicated, and otherwise by scaling.

Transplants shall be planted at the spacings indicated, in staggered rows.

Transplants in mixtures shall be planted at the spacings indicated, in staggered rows or at random according to instructions on the contract drawings. Species shall be planted in groups in each area. Set out groups avoiding obvious repetition, regularity, and single lines of one species.

Shrubs and ground covers planted in mass shall be at the spacing indicated on the drawings. Shrubs shall not generally be planted closer to a kerb or to the edge of a planting area than a distance equal to half the spacing indicated for that species.

Ripping

Rip all disturbed ground a minimum of 600 mm deep with a subsoiler approved by the Landscape Architect in two transverse directions.

Topsoiling

Excavate for shrub beds and hedge trenches to 400 mm below finished levels. Dispose of material to tip off site or to areas of filling on site as directed by the Landscape Architect. Break up base of beds and trenches min. 150 mm deep. Remove topsoil from areas to be sown with wild-flower mix.

Decompact base of planting bed to allow drainage.

Load and carry topsoil from stockpiles on site, and backfill beds/trenches in layers each not more than 150 mm deep, lightly consolidating each as the work proceeds. Leave area slightly mounded, to allow for settlement.

Incorporate ameliorant and fertiliser, as specified.

Site Preparation

Weedkilling for the below areas – herbicide selection and usage will need to be approved by the project ecologist and landscape architect. prior to works taking place onsite.

Preliminary Weedkilling

Transplants: Weedkill full ground area. Apply a first treatment before 15th July, and a second not later than 15th September to kill regrowth.

Hedge Trench: Weedkill. Excavate trench 600 x 400 mm. Add ameliorants as follows, incorporate evenly into excavated material, and backfill:-

Organic Manure	:	75 mm deep
Osmocote plus	:	70 gm/m

Shrub Planting: Weedkill. Spread over all planting areas:-

Organic Manure	:	50 mm deep
Osmocote plus	:	75 gm/msq

Standard and Selected Standard Tree Planting

Excavate tree pits to 0.5 cubic metres volume (1.0 m diameter x 60 cm deep). The base of the pit shall be broken up to a depth of 15 cm and glazed sides roughened. Remove subsoil, stones and rubbish to tip on site as directed by the Architect/Engineer. Supply and drive the stake.

For planting in areas of made up ground, load and carry topsoil from stockpile on site. In undisturbed ground, backfill with excavated material. Mix the following ameliorants evenly throughout the topsoil while it is stacked beside the pit. (Quantities are calculated for a pit of the specified dimensions):-

Organic Manure:	0.047 cubic m (equivalent to manure 6 cm deep over 1 m dia of tree pit).
Osmocote plus:	250 gm

Trees shall be planted at the same depth as in nursery, as indicated by the soil mark on the stem of the trees. They shall be centred in the planting pit and planting upright. The roots shall be spread to take up their normal disposition. Fit tie. Clean a neat circle 1000 mm dia. of all grass.

Planting of Shrubs and C.G. Transplants

Remove all plastic and non-degradable wrappings and containers before planting. Make four vertical cuts with a sharp knife on the quadrants through the edge of C.G. rootballs to sever girdling roots. Excavate hole to min. 10 cm greater diameter than the root spread, and to a depth to allow planting to same depth as in the nursery. Spread out roots of bare root species. Backfill in layers of not more than 10 cm, firming each layer and on completion.

LTBS
landscape architecture
urbanism + landscape planning

Replacements

The planting will be inspected in September following planting. Any tree or shrub found to have died from any cause except as provided below or the work of other contractors shall be replaced by the contractor at his own expense. Replacement planting shall conform in all respects with this Specification, including all specified excavation, provision and incorporation of all fertilisers and ameliorants, and weedkiller treatments.

Failures will not be charged to the Contractor in the following cases:-
- Damage by hares or rabbits, where not protected by fencing or shelters.
- Failure solely due to prolonged dry weather, except in where the contractor will be responsible for watering.
- Losses due to theft, vandalism or disturbance by other contractors.

Persistence of weed in planted areas will be regarded as a contributory cause of failure due to drought. Prolonged dry weather will not exonerate the Contractor if the scheduled aftercare operations have not been carried out as programmed.

GRASS SEEDING

Native Grass/ wildflower Mix (50mm depth topsoil)

Seed mix selection
It is important that the correct plant species are selected that are adapted to the local site conditions and resemble the semi-natural plant communities of the local area. The plant species must be matched to soil type (pH), fertility, hydrology and topography. The Contractor shall provide the Landscape Architect with a list of the proposed native grass/ wildflower mix along with the proposed supplier for approval, a minimum of 2 weeks prior to seeding.

Ground preparation
The soil must be prepared for seed sowing to create open areas for the seed to germinate. When creating a native meadow from scratch the aim is to produce a firm weed-free tilth, through soil cultivation, to promote healthy germination.

To remove docks and thistles, nettles and weed grasses, the site shall be treated with approved herbicide (following the manufacturers instructions) prior to seed bed cultivation. Several applications may be required after further cultivation and to remove weed flushes.

Post Emergence Weedkiller

'Actrilawn 10' by May and Baker Ltd., used in accordance with the manufacturer's instructions.

Apply 'Actrilawn' when grasses have reached the two-leaf stage or beyond and when seedlings have emerged and have reached cotyledon or two-leaf stage (approx. 4 weeks after sowing). Do not mow within 7 days of treatment. Do not apply during drought. Apply on a fine, still, warm day.

Machinery

All machinery shall be in good and serviceable condition. Harrows and cultivators shall have their full complement of tines, which shall be sharp, effective, and set to give the specified depth of cultivation. Mowers shall be sharp and evenly set to the specified height, and shall in use avoid pulling or laying the sward.

Tractors for use in ripping shall be four-wheel drive or tracked. All tractors shall be fitted with position control to ensure even cultivation, at the minimum specified depth.

Weather

All work to soil shall be carried out in dry weather and when the soil can be reduced to a friable condition, avoiding smearing or panning, and rutting and compaction by tractors.

Seeding shall be carried out in the fine, still weather. Seed shall not be permitted to fall onto hard surfaces or into planting areas. Any grass germinating there shall immediately be treated with a total weedkiller at the Contractor's expense.

Weedkilling

Application: Killing existing grass pre-seeding, and killing weeds germinating in re-spread topsoil. (For seeding from mid-August onwards, apply not later than 31st July).

Cultivations

Cultivate in transverse directions by disc or tine harrows and/or rotary cultivators, to the minimum depth specified in the operations schedule. Remove weeds and roots, metal items and rubbish. Produce a tilth as follows; Reinstatement areas 50mm and quality areas/verges 50mm and pick off stones and debris over that size.

If rotary cultivators are used, the ratio of tractor speed to tine speed shall be sufficient to avoid smearing at the base of the cultivation.

TBS
landscape architecture
urbanism + landscape planning

Final Grading

During cultivations, grade with a blade, lute or grader, to produce even, flowing surfaces, free from local humps and depressions.

Finishes

Topsoil shall stand 30 mm proud of manholes, paths and kerbs after cultivation and firming.

Sowing
Providing a good tilth can be prepared the optimal time for seed sowing is in late summer/early autumn, which means the seeds are not exposed to rising soil temperatures but will be exposed to cold moist temperatures over winter, which can help break dormancy of some species. If sown too late in autumn seedlings may be killed off by frosts. The months of March/April can also be suitable for sowing in areas of land that are prone to winter flooding.
a. Mix seed - regularly mix to ensure even species distribution
b. Surface broadcast – with a fertilizer spreader
c. Rate – 3-4g/m2, 10-20kg/ha 80:20 grasses: wildflowers, 0.5 - 1.Og/m2/2.5-10kg/ha pure wildflower mixtures. Seeding rates depend on soil fertility and wildflower specification.
d. Sand - bulk up small seeding rates with sand or sawdust
f. Ring Roller - use Cambridge Roller to firm seed bed or use cattle to tread in seed

Summary of ground preparation
a. Treat existing vegetation with herbicide (as above)
b. Shallow cultivate site with a rotovator and roll to consolidate ground to keep in moisture
c. Harrow or treat weed re-growth
d. Power harrow to create fine surface tilth
e. Final spray with approved herbicide, if required
f. Surface sow the seed and roll

Amenity grass (150mm depth topsoil)

Seed Mixture

An appropriate seed mix will be specified for the type of sward and level of maintenance

Fertiliser

10:10:20, N:P:K - supplied in bags bearing the names of the manufacturer, the analysis of the contents and the net weight. The contractor shall produce to the Landscape Architect the original delivery docket or invoice stating the quantity supplied for these works.

Pre-Seeding Weedkiller

Herbicide selection and usage will need to be approved by the project ecologist and landscape architect prior to works taking place onsite.

Non-selective herbicide: Do not apply when rain is forecast within six hours. Do not apply when wind is likely to cause spray drift (over 24 kph/15 mph). Allow leaf symptoms to develop before carrying out any cultivations (at least 7 days).

Post Emergence Weedkiller

Apply selective weedkiller when grasses have reached the two-leaf stage or beyond, and when seedlings have emerged and have reached cotyledon or two-leaf stage (approx. 4 weeks after sowing). Do not mow within 7 days of treatment. Do not apply during drought. Apply on a fine, still, warm day.

Machinery

All machinery shall be in good and serviceable condition. Harrows and cultivators shall have their full complement of tines, which shall be sharp, effective, and set to give the specified depth of cultivation. Mowers shall be sharp and evenly set to the specified height, and shall in use avoid pulling or laying the sward.

Tractors for use in ripping shall be four-wheel drive or tracked. All tractors shall be fitted with position control to ensure even cultivation, at the minimum specified depth.

Weather

All work to soil shall be carried out in dry weather, and when the soil can be reduced to a friable condition, avoiding smearing or panning, and rutting and compaction by tractors.

Seeding shall be carried out in the fine, still weather. Seed shall not be permitted to fall onto hard surfaces or into planting areas. Any grass germinating there shall immediately be treated with a total weedkiller at the Contractor's expense.

Weedkilling

Application: Killing existing grass pre-seeding, and killing weeds germinating in re-spread topsoil. Apply non-selective weedkiller (For seeding from mid-August onwards, apply not later than 31st July).

LTBS
landscape architecture
urbanism + landscape planning

If germinating weed grasses are less than 100 mm high and broad leafed weeds have not produced full-sized leaves, do not apply non-selective weedkiller. Apply non-selective herbicide @ 3.0 litres/hectare in water @ 200-300 litres/hectare 4 to 7 days before cultivating.

Ripping

Rip with a subsoiler approved by the Landscape Architect in two transverse directions. The first pass shall be across the maximum fall of the land and the second at right angles to this. Rip at 600 mm maximum centres, at a constant depth of 400 mm. Do not mix subsoil and topsoil layers during ripping.

Cultivations

Cultivate in transverse directions by disc or tine harrows and/or rotary cultivators, to the minimum depth specified in the operations schedule. Remove weeds and roots, metal items and rubbish. Produce a tilth as follows; Reinstatement areas 75mm and quality areas/verges 50mm and pick off stones and debris over that size.

If rotary cultivators are used, the ratio of tractor speed to tine speed shall be sufficient to avoid smearing at the base of the cultivation.

Final Grading

During cultivations, grade with a blade, lute or grader, to produce even, flowing surfaces, free from local humps and depressions.

Finishes

Topsoil shall stand 30 mm proud of manholes, paths and kerbs after cultivation and firming.

Fertiliser

During last stages of cultivation, apply fertiliser evenly over the full area of seeding in two equal passes in transverse directions, and incorporate into the seed bed up to 30 mm deep.

First Cut

Before cutting, pick off stones above the maximum diameter specified on the operations schedule. Roll if specified on the operations schedule to firm sod. The time for cutting and the height of the cut shall be as specified in the operations schedule.

Quality

The quality of the grass sward shall be even throughout with a constant sward and colour. The contractor shall make good any areas not of this quality. Make up and seed over any depressions which develop after seeding. Re cultivate and re-seed any areas which fail to germinate or which die off.

Bulb planting

When the term “bulb” is used in the general rather than in the botanical sense, it should be taken as applying to both corms and bulbs.

All bulbs and corms shall comply with BS 3936:Part 9. They shall be true to name, size, condition and description. Bulbs shall be dry, frost-free and free from infection by disease or fungi. They shall be kept in a warm store prior to planting and shall not be brought onto the site until twenty four hours prior to planting.

All bulbs should be planted in the appropriate season with a suitable planting tool of appropriate pattern and at the correct depth. The hole formed should be of sufficient diameter to accommodate the bulb which should have the base on contact with the soil at the bottom. A plug of turf should be neatly removed and replaced after planting. Bulbs for naturalising should not be planted in rows, but should be scattered by hand over the area allocated to them and planted where they fall.

AFTERCARE

The operations are grouped under the following headings;
Newly planted trees
Shrub beds
Groundcover
General litter clearance

GRASS AREAS

Amenity Grass Areas

Maintenance Objective

To provide an even stand of vegetation of uniform height and colour comprising predominantly grass species, although a small percentage of dichotyledenous plants - no more than 5 per cent - will be accepted.

TBS
landscape architecture
urbanism + landscape planning

Maintenance Operations

a) Mowing shall be carried out using a cylinder mower to maintain the vegetation length within the limits of 30 mm and 75 mm during April to August inclusive and between 50 mm and 90 mm during the rest of the year. (This will normally require mowing at up to once a week in the peak of the season and up to, 20 times per year).

b) The arisings shall be let fly but must be distributed evenly over the surface and at no time shall the layer of clippings be of such a depth that will affect the growth of vegetation. At no stage must arisings come to rest on paved or planted areas.

Additional Operations

a) All edges of grass areas, against buildings, footpaths, roadways, trees, posts and any other obstruction shall be kept neat, trimmed and tidy.

b) Mowing strips against fences, etc. shall be 100 mm wide and may be maintained by the use of an appropriate approved herbicide.

<u>Native Grass Areas / Wildflower Areas</u>

Maintenance Operations

Grass Cutting:
- First Year: Cut by the end of July. Cut again to height of 10cm (and remove if possible) if grass regrows to a height of 25cm in the first year.
- Second and third years: require two cuts, one in Spring and the Second in July or August, the meadow can again be cut in September if the grasses are still growing strong.
- Fourth year: if the grass is still vigorous - cut in spring and in August of. I the perennials are growing strong there will be no need to cut until July, August or September depending on soil conditions.
- When Established: It will require one cut, mid-end of summer.

The arisings shall be let fly but must be distributed evenly over the surface and at no time shall the layer of clippings be of such a depth that will affect the growth of vegetation. At no stage must arisings come to rest on paved or planted areas.

Care of Newly Planted Trees - General

Young trees will need regular attention to ensure establishment. The most important operation is to keep the soil around the base of the tree free from weeds or grass and to ensure secure and correct staking.

Maintenance Objective

Establish a stable and healthily growing tree with a well-shaped framework for future growth.

Maintenance Operations

a) Maintain a 1m. diameter circle of plant-free soil around the base of each isolated tree by hoeing or the use of approved herbicide other than a residual.

Allow for hoeing up of soil once every 4 weeks in the growing season (5 times per year). Allow for herbicide treatment once in the winter or spring and 3 additional treatments.

Note: In some areas this operation may be replaced by the application of bark mulch as ground cover.

b) Cut back any tall vegetation that is threatening to shade or smother the young tree (i.e. taller vegetation growing from outside the 1 m weed free area). Allow for cutting back regularly (3/4 times a year).

c) Provisional item: Water the newly planted trees throughout the summer months (May to August) as required after any period of 4 weeks without significant rainfall (less than 5 mm). Apply sufficient water to thoroughly wet the top 150 mm of soil around the tree roots. This will normally require approximately 10 litres for a seedling or whip and 20 litres for a standard tree, include transport of water to the site.

d) Check stakes and ties for firmness and support and adjust as necessary. Allow for checking twice a year, preferably in late spring and late summer.

e) Firm the soil around the roots to ensure that the plant is securely planted in the ground and upright. Allow for firming once in the spring after planting.

f) Formative prune to remove any dead, diseased or damaged shoots and create a balanced form for future growth. Allow for pruning once in the season after planting.

<u>Shrub Beds - General</u>

The borders must be kept weed free, particularly of perennial weeds, to allow planting to give early cover. However, the plants may be required to be thinned so that the shrubs that are retained are

able to achieve an attractive form. This may involve removing the intermediate plants soon after shoots are touching.

Maintenance Objective

Maintain shrub growth to cover as much as possible of the bed area and allowing the individual plants to achieve as nearly as possible their natural form. Maintain the borders free of visible weeds and shape and prune the shrubs to avoid obstructing pathways or blocking light to, or adhering to windows.

Maintenance Operations

a) After planting, if appropriate and in season for the species involved, prune shrubs to develop their desirable ornamental characteristics. At the same time remove intermediate plants that are restricting the natural and attractive development of their neighbours. Remove all arisings from site.

b) Lightly cultivate the surface soil, to a depth of approximately 50 mm, remove or bury all annual weed or natural litter and break any surface capping. Take special care to avoid unnecessary damage to the shrub plants and ensure that all the shrubs are firmly bedded in the soil. Leave the surface with a fine and even tilth with soil crumbs of less than 50 mm in diameter. Once a year operation in early winter.

Note: This operation is only essential where the soil is compacted or as a means of incorporating mulch. Not required where the areas are mulched.

c) Maintain the soil surface substantially free of weeds (less than 10 per cent weed cover) by hand removal and spot treating with Glyphosate, or approved equivalent. Spot treatment at approximately four-weekly intervals in the main growing season, to a total of five times per season.
Note: As an alternative the beds can be regularly hand-hoed at up to two-weekly intervals in the main growing season, to 6 times per year. This procedure is recommended for the first year after planting when the plants may be more sensitive to contact herbicide damage and residual herbicides may not be used.

Ground Cover – General
Described as dense, low-growing plants, which cover the ground and smother any weeds. Ground-cover needs careful establishment, to ensure that any perennial weeds are eliminated.

Maintenance Objective

Maintain a dense, weed free cover of healthy growth, clipped or pruned as necessary to give a neat and tidy finish and contained within the planted area.
Maintenance Operations

a) Maintain the area substantially free of weeds (less than 10 per cent of weed cover at maximum) by hand removal or spot treating any emergent weeds during the growing season with Glyphosate, or approved equivalent. Spot treatment or weed removal at approximately four-weekly intervals in the main growing season, to 5 times per year in total. Frequency of sprays to drop, as the plants establish.

b) Trim and tidy the plants once a year in the winter months, to remove dead vegetation or overgrowing branches. Remove all arisings from site. The amount of work will vary according to the species.

Litter Clearance - General
Maintenance Objective
Collect and remove from the site, all extraneous litter and rubbish on a regular within landscape basis so that its presence is not detrimental to the appearance of the site. (This means that the landscape should be free from litter after each visit to site).

Maintenance Operations

a) Collect and remove to the contractor's tip all extraneous rubbish, not arising from maintenance works, which is detrimental to the appearance of the site. This rubbish to include stones (over 50mm dia. which may be buried), bricks, debris, paper, confectionery and other wrappings, bottles, cans and plastic containers.

Allow for this operation to be carried out at regular intervals based in conjunction with other maintenance visits and operations.

Herbicide and Pesticide usage must be carried out in accordance with:
Plant protection products (PPPs) are regulated by Regulation (EU) No. 1107/2009.
Regulation (EC) No. 1107/2009 of the European Parliament and of the Council concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC
The main Irish legislation concerning the control, marketing and use of plant protection products (PPPs) are:
S.I. 155 of 2012 - European Communities (Sustainable Use of Pesticides) Regulations 2012
S.I. 159 of 2012 - European Communities (Plant Protection Products) Regulations 2012

TBS
landscape architecture
urbanism + landscape planning

TBS

landscape architecture
urbanism + landscape planning

APPENDIX 12

ARCHAEOLOGICAL SURVEY

GREATCONNELL
NEWBRIDGE
Co. KILDARE

ARCHAEOLOGICAL TESTING REPORT (PART A)

DCHG LICENCE No: 21E0106

MARTIN E. BYRNE, MA, Dip. EIA Mgmt., MIAI.

APRIL 2021

BYRNE MULLINS & ASSOCIATES
ARCHAEOLOGICAL & HISTORICAL HERITAGE CONSULTANTS

7 CNOC NA GREINE SQUARE,
KILCULLEN,
Co. KILDARE.
PHONE 045 480688 FAX 045 442505
e-mail:byrnemullins@eircom.net

TABLE OF CONTENTS

1.Introduction 4
1.1 Background to Investigations 4
2. Site Location and Description 4
3. Relevant Archaeological Inventory 5
3.1 Statutory Protection 6
3.1.1 National Monuments Acts 6
3.1.2 Kildare County Development Plan 2017-2023 6
3.2 Relevant Archaeological Inventory 6
3.3 Results of Previous Archaeological Investigations 12
3.4 Archaeological Artefacts 13
4. Results of Geophysical Survey 13
4.1 General Overview 15
4.2 M1 16
4.3 M2 16
4.4 Conclusions 17
5. Results of Archaeological Testing 20
6. Recovered Artefacts 37
7. Summary Discussion 38

Appendix 1 – Documentary Sources 41
Appendix 2 – Specialist Pottery Report (Clare McCutcheon) 43

List of Figures

1. Site Location 4
2. Locations of previously identified monuments in the site and within 500m of the site boundaries 7
3. LiDar Survey - with portion of subject lands outlined in red 11
4. Interpretative Plan of Combined Geophysical Surveys for 2006 & 2012 12
5. Geophysical Survey: Grey-Scale Plot 14
6. Geophysical Interpretative Plot-1 1
7. Geophysical Interpretative Plot-2 19
8. Locations of Archaeological Test Trenches 20
9. T12: F12-1, F12-2 & F12-3 28
10. T14: F14-1 (Section) 31

List of Plates

1. Aerial Photograph of Site 5
2. KD023-027: Aerial Photographic Image 8
3. KD023-126: Aerial Photographic Image 8
4. KD023-016003 & KD023-016005: Aerial Photographic Image 9
5. KD023-016: Extant Remains of Lady Chapel 10
6. KD023-016001: Entrance to Graveyard 10
7. T1: Discrete areas of burning/charcoal (W area) 21
8. T2 from south 22
9. T3 from east 22
10. T4 from west 23
11. T5 from west 23
12. T6 – from NE 24
13. T6 – SW end 24
14. T7 – from NW 24
15. T8: Iron-panning associated with Geophysical Anomalies 2/3 25
16. T8: possible furrow features 25
17. T9 – from west 26
18. T10 – from south 26
19. T11 – from north 27
20. T12 – from north 27
21. T12: F12-1 from west 28
22. T12: F12-2 from west 28
23. T12: F12-3 from north 29
24. T13: from west 30
25. T14: F14-1 (from east) 30
26. T15: soil staining at eastern end 31
27. T15: Fill of shallow-cut feature in central area 31
28. T16 – from west 32
29. T17: modern disturbance at E end 32
30. T17: modern disturbance in central area 32
31. T18 - from west 33
32. T19 - from NW 33
33. T20 – from NW 34
34. T21: Remains of un-fired brick clamp 34
35. T22 – from NW 35
36. T23 – from E 35
37. T24 – from ESE 36
38. T25 – from ESE 36
39. T26 – from north 36
40. T27 – from south 36

All plans are reproduced under OSI Licence No.: EN0074512

GREATCONNELL
NEWBRIDGE, Co. KILDARE

ARCHAEOLOGICAL TESTING REPORT
(PART A)

DCHG LICENCE No: 21E0106

Martin E. Byrne, MA, Dip. EIA Mgmt, MIAI.
BYRNE MULLINS & ASSOCIATES – ARCHAEOLOGICAL CONSULTANTS

1. INTRODUCTION

This report describes the results of a Programme of Archaeological Testing undertaken with respect to proposed development of lands in the townland of Greatconnell, Newbridge, Co. Kildare

It includes the results of programmes of Geophysical Survey and Archaeological Testing, undertaken under licence nos. 20R0242 and 21E0106, respectively, from the Department of Housing, Local Government & Heritage.

1.1. Background to Archaeological Investigations

It is the intention of the landowners to seek permission for a residential development under the SHD Process.

2. SITE LOCATION & DESCRIPTION

The subject development lands are located in the eastern suburban extent of Newbridge, in the townland of Greatconnell and on the eastern side of the River Liffey and to the south of the Naas-Newbridge Road – Figure 1.

Figure 1 Site Location

The overall site is bounded by a local road to the east and forms part of a much larger agricultural landholding; There is an existing residential development located immediately outside the eastern section of the northern boundary; the south-western boundary is formed by the River Liffey, with the western section formed by an overgrown stream; the southern boundary is formed by a planted earth-and-stone field division, to the south of which are agricultural lands under pasture. All other boundaries have to be formally established. There is an existing commercial plot within the central area of the site accessed from the east. In addition, a new pipeline was constructed through the northern half of the site in 2018/2019 and the site is crossed by a number of electrical OHLs. Prior to the commencement of the Geophysical Survey and subsequent programme of Archaeological Testing the subject lands were fallow and largely covered in cereal stalks, having been harvested in autumn 2020. Some alluvial channels are also indicated by a LiDar survey, including some within the subject lands (Figure 3).

Plate 1 Aerial View of Site

3. ARCHAEOLOGICAL HERITAGE

Archaeology is the study of past societies through their material remains and the landscapes they lived in. The archaeological heritage consists of such material remains (whether in the form of sites and monuments or artefacts in the sense of moveable objects) and environmental evidence (DoAHG 1999, p9).

Archaeological heritage comprises all material remains of past societies, with the potential to enhance our understanding of such societies. It includes the remains of features such as settlements, burials, ships and boats and portable objects of all kinds, from the everyday to the very special. It also includes evidence of the environment in which those societies lived. The terms “site” or “monument” are used generally to refer to fixed structures or areas of activity, as opposed to particular moveable objects. Historic wrecks are also part of the archaeological heritage (DHLG&H, 2021, 3).

3.1 Statutory Protection

The statutory and administrative framework of development control in zone of archaeological potential or in proximity to recorded monuments has two main elements:

a) Archaeological preservation and licensing under the National Monuments Acts and
b) Development plans and planning applications under the Planning Acts.

3.1.1 National Monuments Acts

Section 12 (1) of the National Monuments (Amendment) Act, 1994 provides that the Minister for the Environment, Heritage and Local Government shall establish and maintain a record of monuments and places where the Minister believes there are monuments, such record to be comprised of a list of monuments and relevant places and a map or maps showing each monument and relevant place in respect to each county of the State. This is referred to as the 'Record of Monuments and Places' (RMP), and monuments entered into it are referred to as 'Recorded Monuments'.

Section 12(3) of the National Monuments (Amendment) Act 1994 provides for the protection of monuments and places in the record, stating that *"When the owner or occupier (not being the Minister) of a monument or place which has been recorded under subsection (1) of this section or any person proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such monument or place, he shall give notice in writing of his proposal to carry out the work to the Minister and shall not, except in the case of urgent necessity and with the consent of the Minister, commence work for a period of two months after having given the notice".*

3.1.2 Kildare County Development Plan 2017 - 2023

The following relevant Archaeological Heritage Objectives are set out in Section 12.9.1 of the Plan:

AH1	Manage development in a manner that protects and conserves the archaeological heritage of the county, avoids adverse impacts on sites, monuments, features or objects of significant historical or archaeological interest and secures the preservation in-situ or by record of all sites and features of historical and archaeological interest. The Council will favour preservation in – situ in accordance with the recommendation of the Framework and Principals for the Protection of Archaeological Heritage (1999) or any superseding national policy.
AH2	Have regard to the Record of Monuments and Places (RMP), the Urban Archaeological Survey and archaeological sites identified subsequent to the publication of the RMP when assessing planning applications for development. No development shall be permitted in the vicinity of a recorded feature, where it detracts from the setting of the feature or which is injurious to its cultural or educational value.
AH3	Secure the preservation (in-situ or by record) of all sites, monuments and features of significant historical or archaeological interest, included in the Record of Monuments and Places and their settings, in accordance with the recommendations of the Framework and Principles for the Protection of Archaeological Heritage, DAHG (1999), or any superseding national policy document
AH4	Ensure that development in the vicinity of a site of archaeological interest is not detrimental to the character of the archaeological site or its setting by reason of its location, scale, bulk or detailing and to ensure that such proposed developments are subject to an archaeological assessment. Such an assessment will seek to ensure that the development can be sited and designed in such a way as to avoid impacting on archaeological heritage that is of significant interest including previously unknown sites, features and objects.

Note: The Record of Monuments and Places (RMP) for County Kildare was published in 1996. Consequently, all monuments discovered since the publication are not RMP Sites but are subject to protection under Objective AH2 of the Kildare Development Plan 2017-2023, as set out above.

3.2 Relevant Archaeological Inventory

There are no previously identified monuments located within, or in the immediate environs of, the subject development lands and no surface traces of archaeological potential were noted by a review of historic cartographic or aerial photographic sources or by a surface reconnaissance survey.

The subject lands are located between 70 – 250m outside the northern extent of the Zone of Archaeological Potential/Notification established for Greatconnell Ecclesiastical and Secular Settlement Complex, as illustrated below in Figure 2. This is associated with the Augustinian Friary of Great Connell and associated (secular) settlement site. It includes a number of individual monument/features, as follows:

1	KD023-016007	Ford
2	KD023-127	Enclosure
3	KD023-126	Enclosure
4	KD023-016005	Town Defences
5	KD023-016006	Watermill – unclassified
6	KD023-016003	Dovecote
7	KD023-016 KD023-016001 KD023-016002	Religious House Graveyard Sheela-na-Gig
8	KD023-016004	Deserted Settlement - medieval

Figure 2 Locations of previously identified monuments in the site and within 500m of the site boundaries

The individual monuments are described as follows:

SITE 1 KD023-016007 – Ford

A constituent element of the Augustinian Abbey/Priory (KD023-016) founded in 1202 by Meyler Fitzhenry. Annotated 'Connell Ford' on the 1837 ed. OS 6-inch map. The present disused roadway which runs immediately north of the monastery and then turns southwest towards the river probably follows the line of a medieval routeway which traversed the River Liffey at 'Connell Ford'. The terrier of the 17th century Down Survey map for the barony of Great Connell recorded the presence of 'Connell Foords' over the River Liffey.

SITE 2 KD023-127 – Enclosure

Cropmark of circular shaped enclosure (approx. diam. 37m) with possible field system visible on Google Earth imagery taken 28/06/2018.

Plate 2 KD023-027: Aerial Photographic Image

SITE 3 KD023-126 – Enclosure

Cropmark of circular shaped enclosure (approx. diam. 37m) with possible field system visible on Google Earth imagery taken 28/06/2018.

Plate 3 KD023-126: Aerial Photographic Image

SITE 4 KD023-016005 – Town Defences

The Augustinian Abbey/Priory (KD023-016), founded in 1202 by Meyler Fitzhenry and dedicated to the Blessed Virgin Mary and St David (Gwynn and Hadcock 1970, 154, 177) was suppressed on the 24th of November 1540 and the monastic estate including a medieval settlement with town walls were described as following; 'Robert Wesley (presumably the last prior) was granted a pension of over £13, five other canons smaller amounts; the jurors found that all the buildings were standing as at the time of dissolution; the body of the church had been the parish ch[urch] from time immemorial, the chancel and the chapel of B.M. [Blessed Mary] to the north of it could be demolished, but the belfry could be converted into a castle or

fortilage to defend the town (KD023-016004) and district by the farmer who would need all other buildings, etc., on the 4-acre site; there was a dovecote (KD023-016003) on the town walls, the demesne being 131 acres, and the possessions included over 1,260 acres, a mill (KD023-016006-), five castles, many messuages and cottages' (White 1943, 157; Gwynn and Hadcock 1970, 177). The monastic estate was granted to Edward Randolfe and in reversion to Sir Edw. Butler, and re-granted in 1560 to Sir Nicholas White: and to Sir Edmond Butler in 1566' (Gwynn and Hadcock 1970, 177).

The E gable of the Lady Chapel of the Augustinian abbey was incorporated into the E and S walls of a post-1700 graveyard (KD023-016001).

In 2006, an archaeological geophysical survey (Bonsall and Gimson 2006) revealed and mapped extensive (7 hectares) sub-surface remains associated with the priory including a possible deserted settlement. Features identified included levelled masonry remains, probable burials, a possible trivallate enclosure, a street pattern and burgage plots together with areas of plough furrows on multiple alignments. Google Earth aerial imagery taken 28/06/2018 shows extensive cropmarks belonging to the monastery of Great Connell in the fields to the S, SW and W of the abbey graveyard. A linear cropmark running roughly E-W in the field 140m to the S of the abbey (KD023-016) and which is clearly visible on Digital Globe aerial photography may be the remains of the town defences/walls described in the 1540 survey. This linear cropmark (Plate 4) runs across the fields to the S of the abbey and intersects the circular cropmark which may have been the remains of a medieval dovecote (KD023-016003).

Plate 4 KD023-016003 & KD023-016005: Aerial Photographic Image

SITE 5 KD023-016006 – Watermill (unclassified)

The Augustinian Abbey/Priory of Greatconnell included a mill within its estate; this is listed in the suppression documents of 1540. The remains of a former 'Flour Mill' is located on a mill-race 240m to the SW of the abbey graveyard and may have been built on the site of the medieval mill; it may also have reused the medieval mill-race still visible in the fields to the S and SW of the abbey. One of two mills (KD023-016010-) in the townland of Greatconnell listed in the 1654-56 Civil Survey of Co. Kildare (Simington 1952, 129).

SITE 6 KD023-016003 – Dovecote

A small circular-shaped cropmark (approx. diam. 7m) visible on Google Earth aerial imagery taken 28/06/2018 (Plate 4) may possibly represent the remains of the medieval dovecote which was mentioned in the 1540 suppression documents as standing 'on the town walls' of the Augustinian monastery of Great Connell. A linear cropmark running out from the circular shaped cropmark may represent the remains of these town walls (KD023-016005).

SITE 7 KD023-016 – Religious House (Augustinian); KD023-016001 – Graveyard; KD023-016002 – Sheela-na-Gig

In level pasture at the W foot of a low rise, some 300m E of the River Liffey. Augustinian Abbey/Priory founded in 1202 by Meyler Fitzhenry and dedicated to the Blessed Virgin Mary and St David (Gwynn and Hadcock 1970, 154, 177). It housed regular canons from the Monastery of Llanthony, in Monmouthshire, Wales. In 1458, the 'rectory and towns of Morristown and Ladytown' were granted to the Prior (Fitzgerald 1896-9, 305, 313). The monastery as suppressed on the 24th of November 1540 and the monastic estate was described as following; 'Robert Wesley (presumably the last prior) was granted a pension of over £13, five other canons smaller amounts; the jurors found that all the buildings were standing as at the time of dissolution; the body of the church had been the parish ch[urch] from time immemorial, the chancel and the chapel of B.M. [Blessed Mary] to the north of it could be demolished, but the belfry could be converted into a castle or fortilage to defend the town (KD023-016004) and district by the farmer who would need all other buildings, etc., on the 4-acre site; there was a dovecote (KD023-016003-) on the town walls (KD023-016005), the demesne being 131 acres, and the possessions included over 1,260 acres, a mill (KD023-016006), five castles, many messuages and cottages' (White 1943, 157; Gwynn and Hadcock 1970, 177). The monastic estate was granted to Edward Randolfe and in reversion to Sir Edw. Butler, and re-granted in 1560 to Sir Nicholas White: and to Sir Edmond Butler in 1566' (Gwynn and Hadcock 1970, 177).

In 1781, the extant ruins of Greatconnell Abbey were sketched by Austin Cooper who recorded that; 'one part which I suppose to be both nave and choir, but between which no distinct separation can be made, measures about 200 feet long (c. 61m) and 25 feet broad (c. 7.6m), in part where of are two entire Gothic windows ... very extensive ruins adjoining, in which are some pillars, with curious capitals. In the choir ... the remains of some stalls ... among the ruins ... the tomb of bishop ... Wellesley' (Fitzgerald ibid, 313). Cooper's drawing shows the S wall of the nave with a doorway to the cloister garth, the ruins of which are also partially shown, the ruins of an arch indicating a N aisle, and the lower courses of the E window of the Lady Chapel (pers. comm. Mr. Conleth Manning, 2005). This E window of the Lady Chapel is the only portion that remains upstanding and has been incorporated into the boundary of the post-1700 graveyard (NLI Coo 2122 TX (1) 3).

Most of the abbey buildings were demolished at the beginning of the 19th century and the material was used for the erection of military barracks at Newbridge (Fitzgerald ibid, 313). The E gable of the Lady Chapel was incorporated into the E and S walls of a post-1700 graveyard (KD023-016001) which occupies the E end of the chapel, including the lower courses of a buttressed E gable wall containing the base of a large window, and a projecting NE angle with a battered base faced with finely dressed granite ashlar. Incorporated in the S wall of the graveyard is a length of arcading, now missing any dressed stone. The Urban Survey of Kildare (Bradley et. al. 1986 vol. 3, 228-9 Fig. 104) recorded that Bishop Walter Wellesley's effigial tomb (KD023-016002) was removed from Greatconnell Abbey to its present location (KD022-029034) in St. Brigid's Cathedral, Kildare (KD022-029005).

In 2006, an archaeological geophysical survey (Bonsall and Gimson 2006) revealed and mapped extensive (7 hectares) sub-surface remains associated with the priory including a possible deserted settlement (KD023-016004). Features identified included levelled masonry remains, probable burials, a possible trivallate enclosure, a street pattern and burgage plots together with areas of plough furrows on multiple alignments. Google Earth aerial imagery taken 28/06/2018 shows extensive cropmarks belonging to the monastery of Great Connell in the fields to the S, SW and W of the abbey graveyard. (Fitzgerald 1891-95, 149; 1903-5, 297; 1912-14, 257, 267, 269; Leask 1935-45, 273-4; Killanin and Duignan 1967, 206; Healy 1984, 2)

Plate 5 KD023-016: Extant Remains of Lady Chapel

A post-1700 graveyard was built inside the E end of the Lady Chapel of the 13th century Augustinian Abbey (KD023-016). In 1781 a drawing of the E gable of Lady Chapel and the Augustinian abbey shows that at this time the area was not being used as a graveyard by the local people (NLI Coo 2122 TX (1) 3). The E gable of the chapel forms the E boundary of the post-1700 graveyard. The N wall of the abbey forms the N boundary of the graveyard while the S wall of the abbey represents the S boundary of the burial ground. The N face of the S wall of the graveyard has evidence of vaulted arcading belonging to the 13th century abbey. The W wall of the graveyard with its round-arched gateway appears to be the only section of post-1700 boundary wall. The graveyard consists of a small rectangular-shaped area (c. 27m E-W; c. 17m N-S) enclosed by a stone wall entered through a post-1700 round-headed gateway in the W wall. The enclosed area is higher than surrounding ground level. Table tombs, graveslab and headstones date from the 18th century onwards.

Plate 6 KD023-016001: Entrance to Graveyard

A Sheela-na-gig carved on the underside of a capital on the tomb of Bishop Wellesley (d. 1539) (KD022-029034) which was originally located at Great Connell Priory (KD023-016), and has since been re-erected in Kildare Cathedral (KD022-029005; Freitag 2004, 134). This Sheela-na-gig was described by Freitag (op. cit.) as being 'carved on slab; head cut off; arms splayed out with hands joining over pudenda; legs widely splayed, knees bent'.

SITE 8 **KD023-016004 – Deserted Settlement (medieval)**

In 2006, an archaeological geophysical survey (Bonsall and Gimson 2006) revealed and mapped extensive (7 hectares) sub-surface remains associated with the priory including a possible deserted settlement to the north and northwest. Features identified included levelled masonry remains, probable burials, a possible trivallate enclosure, a street pattern and burgage plots together with areas of plough furrows on multiple alignments. Google Earth aerial imagery taken 28/06/2018 shows extensive cropmarks belonging to the monastery of

Great Connell in the fields to the S, SW and W of the abbey graveyard.

Further geophysical survey was undertaken in 2012 and 2013 (Gimson 2012; Bonsall & Gimson, 2014)) as part of the Great Connell Exploration Project (Bonsall & Loughlin, 2014) and such surveys were supplemented by LiDar information (Figure 3). An interpretation plan of the geophysical surveys undertaken in 2006 and 2012 is illustrated below in Figure 4.

The combined geophysical and LiDAR datasets suggest the presence of a large, possibly double-ditch enclosure which may mark the boundary of the Great Connell Settlement; within this enclosure there appear to be a number of smaller enclosure boundaries. These are located within the confines of the main enclosure ditch and therefore may be contemporary or predate the main settlement. Also present are a number of possible walls which may act as further enclosure boundaries. The main focus of these appears to be adjacent to the extant graveyard, suggesting the presence of extensive remains associated with the church and graveyard. Within this area a number of potential pits were also detected. The three larger pits may be associated with archaeological or structural remains, while the collection of smaller pits may be archaeological or associated with potential burials. Further archaeological evidence was revealed by the presence of a large number of internal ditches which divide the settlement area. It can be seen that a large number of these are parallel and potentially double indicating an organised formation, possibly a gridded street layout, with further sub-divisions present. Other internal ditches appear to have an oval or rectangular formation which might be associated with enclosures or structures. A number of other features were also detected outside the main enclosure and these are of unknown archaeological significance, whilst a potential relatively modern pipe trench was detected truncating the enclosure and settlement (Gimson, 2012, 11). In addition, a number of probable geological alluvial channels are indicated in the LiDar, including within the subject proposed development lands.

Figure 3 LiDar Survey - with portion of subject lands outlined in red

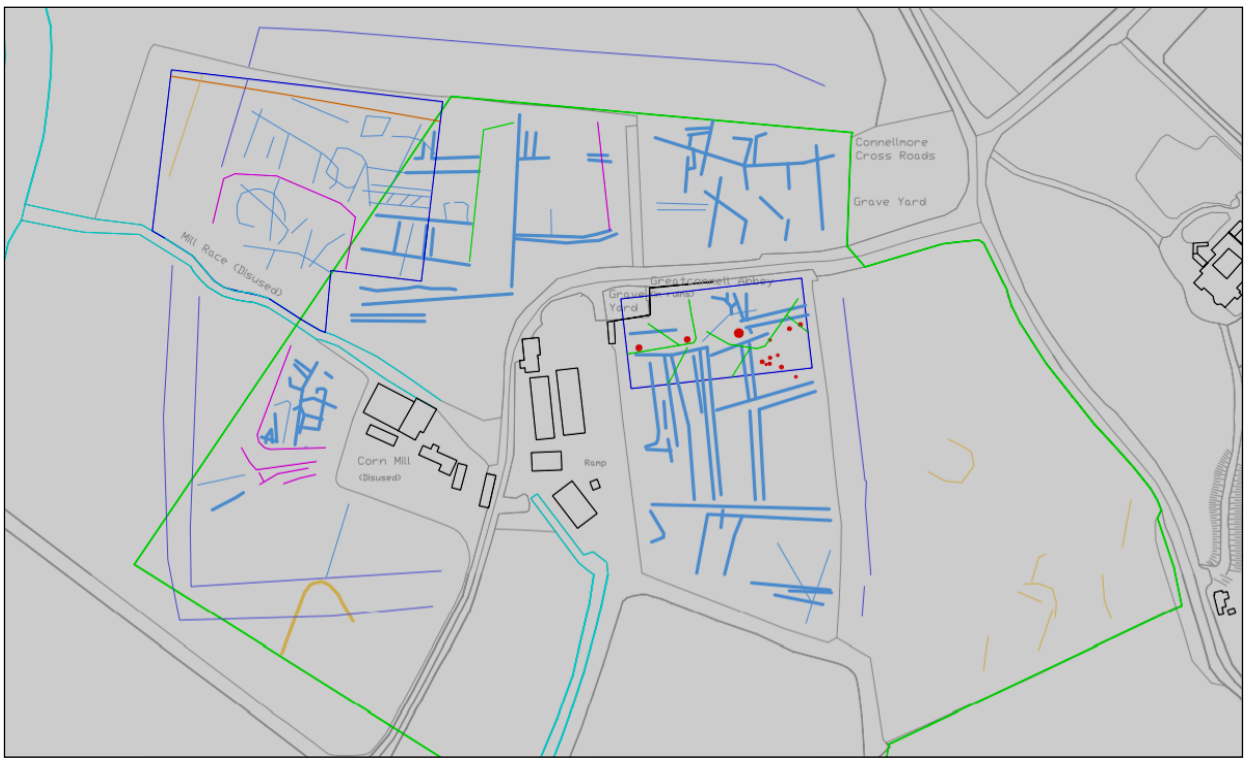


Figure 4 Interpretative Plan of Combined Geophysical Surveys for 2006 & 2012 (From Gimson, 2012, Figure 14)

3.3 Results of Previous Relevant Archaeological Investigations

A search undertaken of the annual Archaeological Excavations Bulletin (www.excavations.ie) indicates that a no previous licenced archaeological investigations have been undertaken within subject lands; a number of investigations have been undertaken within the defined study area, as follows:

Greatconnell (Excavations.ie Ref: 2000:0508)
Martin Byrne, Byrne Mullins & Associates – Licence No: 00E0702

A programme of Archaeological Monitoring of topsoil-stripping associated with the infrastructural development of Great Connell Business Park and the construction of a section of the Newbridge Relief Road and a distribution centre development (former Lidl) was undertaken in September-October 2000. Such works were undertaken within lands to the immediate north of the subject site. The work was carried out in compliance with conditions contained in the grants of planning with respect to the developments, following the submission of an EIS. All topsoil-stripping was carried out using mechanical excavators fitted with toothless buckets. No features, structures or finds of archaeological or historical interest were revealed during the course of the work.

This site is located across the road to the east of the subject lands.

Newhall & Greatconnell (Excavations.ie Ref: 2016:335
Paul Duffy, IAC Ltd – Licence No: 16E0418

A programme of test trenching was carried out in two phases in greenfield areas within the proposed Upper Liffey Valley Sewerage Scheme Contract 2A (Network) pipeline footprint, located to the south and east of Newbridge, Co. Kildare. This first phase of testing was undertaken in response to planning conditions attached to the proposed development (Planning Ref.: Part VIII). It follows a desktop assessment report which recommended testing in greenfield and in the vicinity of five Areas of Archaeological Potential. Phase 1 testing was undertaken between 1 and 11 November and comprised the excavation of 67 trenches, measuring 4,461.5 linear metres, in the townlands of Newhall and Greatconnell. The test areas (Fields 1-5) were located in arable land on the banks of the River Liffey. No features or deposits of archaeological potential were identified in these areas.

Kilbelin (Excavations.ie Ref: 2017:673)
Liam Coen, Archer Heritage – Licence No: 17E0606
This site is located across the river to the west of the subject lands.
The site, on the west bank of the River Liffey, has an area of c. 20.5ha (50.8 acres), 650m of which faces on to the R416 Kilcullen Road. It is irregular in shape, flat and is currently in use as grazing land. A total of 26 trenches (3514 linear metres) were excavated across the site. The trenches were targeted to assess the general potential of the location of the proposed development with two trenches, 6 & 26, located to investigate potential archaeological features identified through a geophysical survey (Detection licence no. 17R0199).

Excavation proceeded in level spits no greater than 0.2m. A series of sand, silt and gravel horizons deposited by river action underlay the topsoil. Glacially deposited boulder clay was not encountered and the trenches were only excavated to a depth of 1.2m for safety purposes. There were extensive post-medieval and modern finds throughout the upper soil levels including pottery sherds, clay pipe fragments and ferrous artefacts. Occasional animal bone fragments were present in the lower deposits. No archaeological features were identified in any of the trenches.

Greatconnell
Aidan O'Connell, Archer Heritage – Licence No: 20E0099
A programme of archaeological testing was undertaken following a geophysical survey of lands located along the southern edge of the main access road through Great Connell Business Park, to other east of the subject lands. A total of 38 trenches were excavated and nothing of archaeological interest was uncovered.

3.4 Artefactual Discoveries
A search of the Topographical Files of the National Museum of Ireland determined that two 'stray' objects have been reported from within the defined study area. Both of these were discovered within the extent of Great Connell Abbey and are described as follows:

- *NMI Reg. No. 1937:2778*. – Fragment of a tile "found in the abbey of Connell More of Great Connell, Co. Kildare on 1st March 1936. It was lying amidst dead leaves and other rubbish". (NMI habitat: C14: 7)
- *NMI Reg. 1943:5*. "Medieval flooring tile from Great Connell Abbey, Co. Kildare. The tile was found in the summer of 1942, during digging operations for a drain immediately south of the graveyard at Great Connell Abbey". (NMI habitat: B3: 1). It is of pale red brick; glazed measuring 3 3/4 inches square and is 1 1/8 inches thick, it has a lion with an elaborate tail framed within a border. It is similar to a type found in western England near Chester from the Fourteenth Century.

4. RESULTS OF GEOPHYSICAL SURVEY
A high resolution magnetic gradiometer survey was undertaken by Target Archaeological Geophysics (Licence No: 20R0242) in December 2020. A grey-scale plot of the results is illustrated in Figure 5, with the interpretative plots illustrated in Figure 6 & 7.

Figure 5 Geophysical Survey: Grey-Scale Plot

4.1 General overview

4.1.1 The results from magnetometer survey in M1-M2 display effects from recent land use in the form of abundant small and large-scale ferrous, responses from buried services and overhead power lines, former boundaries and cultivation, punctuated by weaker soil/geological variations to the E and W. Excluding responses associated with recent land use as described above, background soil magnetism on site is generally within a range of +/-1.5nT.

4.1.2 Buried archaeological remains have been recorded within the proposed development boundary. These are located along the southern/south-eastern edge of M2, and include the partial remains of a potentially large settlement, probably mediaeval in origin. These remains are characterized by a series interconnecting subrectangular enclosures, discrete positives, and trends, with a possible former road or trackway extending to the NE. Combined these remains extend NE-SW along the southern and eastern perimeter of M2 for a distance of c.350m.

4.1.3 Further responses of uncertain origin have been recorded within M1-M2. These are mostly small in scale, and poorly defined. The most notable of these anomalies include a group of magnetically strong positives to the W-NW in M1; magnetically weak curvilinear trends W-SW of survey centre in M2; poorly defined linear response N-NW of survey centre in M2; discrete positives at survey centre in M2; and weakly positive parallel linear responses at the north-eastern boundary of M2 with M1. Weakly magnetic and poorly defined responses such as these are frequently apparent in magnetometer data. Where no clear archaeological context is visible in the results, and unless otherwise stated in this report, the majority of these responses are expected to derive from recent land use, modern ferrous debris and/or natural soil/geological variation.

3.1.4 Significant/potentially significant responses highlighted from the geophysical survey in M1-M2 are discussed below in Sections 4.2 - 4.3.

4.2 M1

4.2.1 The most notable anomalies recorded from geophysical survey in M1 are discussed in the following table:

Geophysical survey area		Figure(s)	Hectares	Terrain & landuse
M1		3-4 & 6-7	2.86	Sub-rectangular stubble field facing housing estate to the N-NW, fabrication plant to the S and Great Connell Road to the E.
Response(s)	**Location from survey centre**	**Interpretation**	**Description**	
1	W-NW	?? Archaeology	Group of strongly magnetic small-scale positives of uncertain origin. The potential that these anomalies may represent pit type features or burnt/fired material such as a fulacht fiadh/burnt mound should not be ignored. Given their proximity to an existing field drain, responses 1 are expected to represent a concentration of modern ferrous debris.	

4.3 M2

4.3.1 The most notable anomalies recorded from geophysical survey in M2 are discussed in the following table:

Geophysical survey area		Figure(s)	Hectares	Terrain & landuse
M2		3-4 & 6-7	14.41	Level stubble field, irregular in shape, located immediately W of Great Connell Road, S & W of fabrication plant.
Response(s)	**Location from survey centre**	**Interpretation**	**Description**	
2-5	S-NE	Archaeology Trend	Curving ditch type responses suggesting probable northern limits of archaeological settlement. Responses 2-5 extend for c.350m in length, and may in part represent part of an earlier road or trackway.	
6-9	S-SE	Archaeology Trend	Network of sub-rectangular enclosures, discrete positives and linear responses highlighting settlement remains which extend beyond southern limit of the proposed development. Responses 8-9 may, in part, be associated with former property divisions depicted on historic mapping to the SE in M4.	
10	S-SW	? Archaeology	Parallel linear responses in proximity to former boundaries and enclosure remains. These responses may be of archaeological interest or alternatively represent relics of more recent landuse.	
11, 12	E-SE	?? Archaeology Increased response	Poorly defined responses in proximity to former land divisions, property boundaries and other features evident on historic mapping. An archaeological interpretation for these anomalies is highly tentative.	
13-14	Survey centre to S	?? Archaeology	Strongly magnetic discrete positives adjacent to/in proximity to former land divisions and trees depicted on historic mapping. An archaeological interpretation for these anomalies remains highly tentative.	
15	W of survey centre	Trend	Curvilinear trends of potential note. Interpretation remains uncertain and a recent landuse and/or a natural soil/geological origin for anomalies 15 should be considered.	

4.4 Conclusions

4.4.1 Geophysical survey within the boundary of the proposed development has been successful in recording a network of enclosure features extending along the southern/south-eastern portion of the site, in geophysics area M2. These remains extend for a distance of c.0.35km S-NE in M2, and represent the northern limit of areas of archaeological potential recorded by another recent geophysical survey in 2020, completed in connection with a separate proposed development located beyond the southern limits of this site, in proximity to KD023-016004.

4.**4.2** Poorly defined linear responses and discrete positives of uncertain origin are also apparent in the results from this survey, the majority of which are expected to relate to more recent land use. Interpretation of the results has been made difficult due to large-scale modern ferrous and interference throughout the results, in particular disturbance from probable landscaping in M1 to the NW-N; ferrous responses emanating from the existing fabrication plant to the E; as well as buried services extending E-W and NE-SW across the proposed development, and interference from overhead power lines. The potential that subtle responses associated with buried archaeological remains have been masked by the range of modern disturbance on site should not be dismissed.

4.4.3 The results from survey within the proposed development boundary also highlight remains of former cultivation, and natural soil/geological variations.

Figure 6 Geophysical Interpretative Plot-1

Figure 7 Geophysical Interpretative Plot-2

5. RESULTS OF ARCHAEOLOGICAL TESTING

A total of 17 test trenches were excavated within the overall extent of the subject lands, the centre-lines of which are illustrated in Figure 8. The locations of the trenches are largely based on the results of the geophysical survey, proposed layout and topographical nature of the site.

Figure 8 Locations of Archaeological Test Trenches

All trenches were excavated by machine fitted with a toothless ditching bucket (Width 1.8m) and all resultant spoil was 'raked through', in an effort to increase the chances of artefact recovery. The trenches were excavated in spits of approx. 10cm depth, with the surface of each spit examined before excavation of the next spit. In addition, the trenches terminated at the surface of the underlying archaeologically sterile subsoils.

Where subsurface features of archaeological potential are uncovered, then the surfaces of such were cleaned by hand and recorded in plan.

The results of the testing are as follows:

T1

This trench was orientated east-west and was 20m in length; it was positioned to primarily investigate Anomaly 1 (cluster of strongly magnetic small-scale positive geophysical responses).

The topsoil/ploughsoil comprised moderately loose, orange/brown silty sandy clay with pebbles and small-medium cobbles dispersed randomly throughout. This overlay firm grey/brown sandy clay subsoil with inclusions of small, discrete clusters of charcoal throughout, particularly in the western area of the trench; the nature of this inclusions (Plate 7) are indicative of the in-situ burning of stubble and considered to be of relatively modern date. Two sherds of 19th century stoneware (Refs: 21E0106:29 – 30) were recovered from the surface of the subsoil (see Section 6 below & Appendix 2)

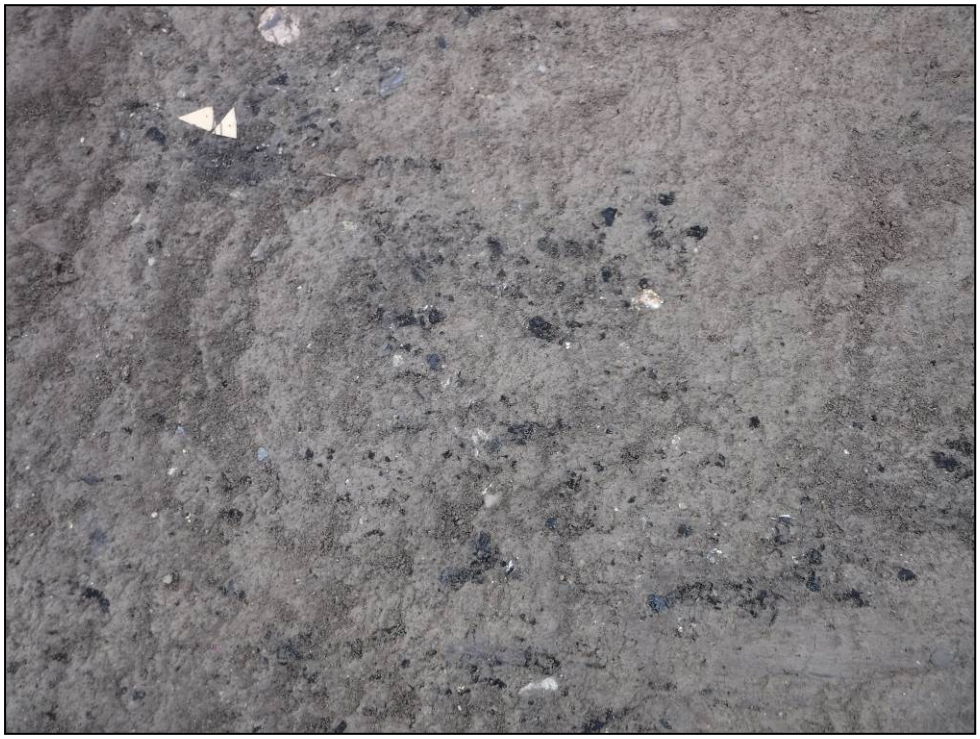


Plate 7 T1: Discrete areas of burning/charcoal (W area)

T2

This trench measures 20m in length and was orientated in a general north-south direction; it was positioned to further investigate some weakly magnetic linear geophysical anomalies extending west from a stream.

Removal of the ploughsoil, which was up to 360mm in depth, revealed the surfaces of firm subsoils, comprising grey/brown or light orange/brown sandy clays with some bands of gravel.

No evidence for disturbance to, or truncation of, the subsoils was noted.

Plate 8 T2 from south

T3

This trench measured 40m in length and was orientated east-west; it was positioned to primarily investigate Anomaly 15 (curvilinear trends).

Removal of the ploughsoil, which was up to 370mm in depth, revealed the surfaces of firm subsoils; these comprised grey/brown or light orange/brown sandy clays, with a noticeably stonier soil matrix at the eastern end

No evidence for disturbance to, or truncation of, the subsoils was noted.

Plate 9 T3 from east

T4

This was generally orientated east-west and was 60m in length; it was positioned to primarily investigate Anomaly 13 (strongly magnetic discrete positive geophysical responses).

Removal of the ploughsoil, which was up to 350mm in depth, revealed the surfaces of firm subsoils; these comprised grey/brown or light orange/brown sandy clays, with a noticeably more clayey matrix at the western end.

No evidence for disturbance to, or truncation of, the subsoils was noted.

Plate 10 T4 from west

T5

This was generally orientated east-west and was 40m in length; it was positioned to primarily investigate Anomaly 14 (strongly magnetic discrete positive geophysical responses).

Removal of the ploughsoil, which was up to 350mm in depth, revealed the surfaces of firm subsoils; these comprised grey/brown or light orange/brown sandy clays, with a noticeably more clayey matrix at the western end.

No evidence for disturbance to, or truncation of, the subsoils was noted.

Plate 11 T5 from west

T6

This was orientated NE-SW and measured 60m in length; it was positioned to primarily investigate Anomaly 10 (parallel linear geophysical responses) and much of the trench was within the extent of a former alluvial channel (Figure 3 above).

Removal of the ploughsoil, which was up to 350mm in depth, revealed the surfaces of firm subsoils; these comprised grey/brown or light orange/brown sandy clays, with a noticeably more clayey matrix at the north-eastern end (Plate 12); the subsoils at the south-western end were much stonier and comprised mid-orange/brown sandy clay bands, some of which appear to be wide, shallow former hand-dug furrows of indeterminable date (Plate 13).

The possible furrow features may be indicative of the geophysical responses in this area.

Plate 12 T6 – from NE

Plate 13 T6 – SW end

T7

This extended in a SE direction for a length of 20m from the SW end of T6; it was positioned to primarily investigate western extent of Anomaly 2 (possible ditch, road/trackway) and within the extent of a former alluvial channel (Figure 3 above).

Removal of the ploughsoil, which was up to 350mm in depth, revealed the surfaces of firm subsoils; these comprised grey/brown or light orange/brown gravelly sandy clays.

The subsoil in the central area comprised slightly stony creamy/grey marl; this may be associated with the former alluvial channel and indicative of the geophysical response.

Plate 14 T7 – from NW

T8

This trench measures 60m in length and was generally orientated north-south; it was primarily positioned to investigate Anomalies 2, 3 & 6 (possible ditch/road/trackway and possible agricultural enclosure features) within the extent of a former alluvial channel (Figure 3 above).

Removal of the ploughsoil, which was up to 350mm in depth, revealed bands of gravel and clay, the edges of which incorporated iron-panning (Plate 14), in the central northern area of the trench; such natural/geological features were coincident with Anomalies 2/3 detected by the geophysical survey.

Two sherds of medieval pottery (21E0106:6: Dublin-type ware & 21E0106:7: Leinster Cooking Ware) were recovered from the ploughsoil (see Section 6 below & Appendix 2).

Plate 15 T8: Iron-panning associated with Geophysical Anomalies 2/3

Some possible narrow ditch or furrow features were uncovered in the southern area of the trench (Plate 16); the southern feature was up to 460mm wide and extended for a distance of 520mm from the eastern trench edge while the northern feature was up to 300mm wide and extended across the entire width of the trench. Both were filled with orange/red silty sand clay, possibly dumps of burnt material.

Plate 16 T8: possible furrow features

T9

This was 20m long and orientated east-west; it was primarily positioned to further investigate Anomaly 7 (possible narrow ditch features associated with potential small sub-rectangular field enclosures) and within the extent of a former alluvial channel (Figure 3 above).

Removal of the ploughsoil, which was up to 350mm in depth, revealed the surfaces of firm subsoils; these comprised light orange/brown sandy clay or grey/brown clay marl.

The marly subsoil may be associated with the former alluvial channel and indicative of the geophysical response.

A single sherd of late 12th/early 13th century 'Dublin-type coking ware' was recovered from the trench surface, with a sherd of 13th/early 14th century 'Kildare-type' ware recovered from the ploughsoil (see Section 6 below & Appendix 2).

Plate 17 T9 – from west

T10

This was 40m long and orientated north-south; it was primarily positioned to further investigate Anomaly 7 (possible narrow ditch features associated with potential small sub-rectangular field enclosures); the central and southernmost sections were located within the extent of a former alluvial channel (Figure 3 above).

Removal of the ploughsoil, which was up to 350mm in depth, revealed the surfaces of firm subsoils; these comprised light orange/brown sandy clay, particularly to the south and north, which was a little stonier to the north; the central area comprised creamy/brown, light or dark grey clay marl.

The marly subsoil may be associated with the former alluvial channel and indicative of the geophysical response.

A single sherd of 19th century stoneware pottery was recovered from the topsoil (see Section 6 below & Appendix 2).

Plate 18 T10 – from south

T11

This was 80m long and orientated north-south; it was primarily positioned to further investigate Anomaly 7 (possible narrow ditch features associated with potential small sub-rectangular field enclosures), as well as Anomaly 4 (possible ditch or road/trackway); the central and southernmost sections were located within the extent of a former alluvial channel (Figure 3 above).

Removal of the ploughsoil, which was up to 350mm in depth, revealed the surfaces of firm subsoils; these comprised light orange/brown sandy clay, particularly to the south, where a number of bands of grey gravelly bands were also noted; the subsoil in the northern-central section comprised creamy/brown, clay marl.

No evidence for Anomaly 4 was encountered, although the gravel banks in the southern area may be responsible for this geophysical response; likewise, the marly subsoil may be associated with the former alluvial channel and indicative of Anomaly 7.

A single sherd of late-19th/early 20th-century 'green-glazed white ware' (21E0106:14) was recovered from the topsoil (see Section 6 below & Appendix 2).

Plate 19 T11 – from north

T12

This trench measured 80m in length and orientated in a general north-south manner; it was primarily positioned to investigate Anomalies 4 & 5 (possible ditch of road/trackway and Anomaly 7 (possible narrow ditch features associated with potential small sub-rectangular field enclosures). The central and southernmost sections were located within the extent of a former alluvial channel (Figure 3 above).

Removal of the ploughsoil, which was up to 380mm in depth, revealed the surfaces of firm subsoils; these comprised light orange/brown sandy clay, particularly to the south, where a number of bands of grey gravelly bands were also noted; the subsoil in the northern-central section comprised creamy/brown, clay marl.

It is considered that the marl subsoil may be associated with the former alluvial channel and indicative of Anomaly 4.

Plate 20 T12 – from north

A series of three 'cut-features' – F12-1, F12-2 & F12-3 – were uncovered in the southern area of the trench, commencing at approximately 11m from the southern trench end. A plan of these features in illustrated in Figure 9. The eastern extents of all three features extended under the eastern edge of the trench.

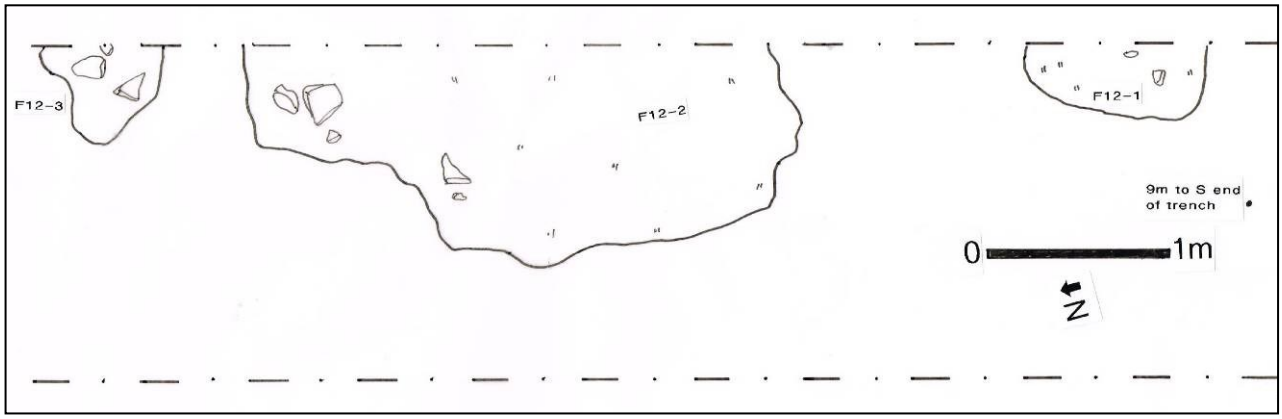


Figure 9 T12: F12-1, F12-2 & F12-3

F12-1 measured 988mm (N-S) and extended a maximum of 400mm to the west from the eastern edge of the trench. The exposed fill comprised moderately loose/soft reddish-brown or grey-brown silty clays, with inclusions of charcoal flecks and small cobbles – Plate 21. A single sherd of medieval pottery (21E0106:4) was recovered from the surface of the fill; this was identified as Dublin-type ware of 13th century date (see Section 6 below & Appendix 2).

Plate 21 T12: F12-1 from west

F12-2 measured up to 2.94m (N-S) and extended a maximum of 1.2m from the eastern edge of the trench. The exposed fill comprised moderately loose/soft reddish-brown silty clay with inclusions of charcoal and some large cobbles – Plate 22; in addition some very small fragments of animal bone were recovered during initial cleaning of the feature. Two sherds of Leinster Cooking Ware (21E0106:8 & 21E0196:11) of late 13th/early 14th century date, together with two sherds of Dublin-type ware (21E0106:9 – 10) of 13th century date, were recovered during initial cleaning of the feature (see Section 6 below & Appendix 2).

Plate 22 T12: F12-2 from west

F12-3 measured up to 680mm (N-S) and extended up to 540mm from the eastern edge of the trench. The fill comprises moderately loose/soft mid-grey/brown silty clay with inclusions of small-medium cobbles and charcoal flecks (Plate 23). A sherd of Dublin-type ware (21E106:5), of 13th century date, was recovered by initial cleaning of the feature (see Section 6 below & Appendix 2).

Plate 23 T12: F12-3 from north

T13

This dog-leg trench was 60m in length and was generally orientated east-west; it was primarily positioned to investigate Anomalies 11 & 12 (poorly defined geophysical responses). The ploughsoil/topsoil was up to 650mm in places, indicating that the area originally included a possible dip in the ground surface that was subsequently filled to create a more level surface. The subsoil largely comprised bands firm grey or mid-brown sandy clays at the eastern end, with occasional bands of grey, gravely-sand to the west.

Plate 24 T13: from west

T14

This was 40m long and orientated north-south; it was primarily positioned to investigate some linear geophysical anomalies which were described as possible former land divisions. A single linear feature (F14-1), measuring 1.48m wide, was uncovered extending across the central area of the trench; it comprised dark grey/brown silty clay on the surface.

Plate 25 T14: F14-1 (from east)

Limited investigation of the feature indicated that it comprises a broad U-shaped cut, with acute slopes from the surface and an acute slope from the south, with slightly gentler from the north, to a broad-rounded base (Figure 10). The fill largely comprised mottled grey-silty clay with some silty-sand at the base. Two sherds of stoneware pottery (21E0106:29 – 30) were recovered from the fill; these fragments of yellow-glazed bowl are of 19th century date (see Section 6 below & Appendix 2).

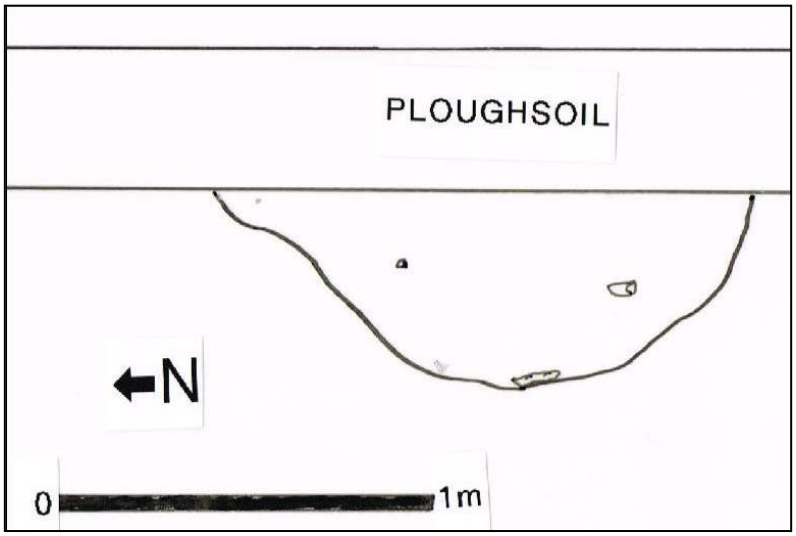


Figure 10 T14: F14-1 (Section)

T15

This trench was generally ENE-WSW in orientation and 40m in length; it was positioned to primarily investigate the potential for an extension to Anomaly 5 (possible road or track). Removal of the ploughsoil, which was up to 340mm in depth, revealed two bands of dark grey/blue staining at the eastern end (Plate 26), probably associated with modern agricultural/drainage activities or locations of former trees. An area of loose, grey/brown, gravelly, sandy/clay (Plate 27) was encountered in the central area of the trench, measuring up to 2m (E-W) x 1.6m (N-S) and likely to be associated with the removal of trees in this area of the site.

Plate 26 T15: soil staining at eastern end

Plate 27 T15: Fill of shallow-cut feature in central area

T16

This trench was orientated generally east-west and was 40m in length; it was positioned to primarily investigate the potential for an extension to Anomaly 5 (a section of possible road or track).

Removal of the ploughsoil, which was up to 350mm in depth, revealed firm, slightly orange/brown sandy clay for much of the western length, with some bands of grey sandy gravel in the eastern area.

Plate 28 T16 – from west

T17

This trench was orientated east-west and was 60m in length; it was positioned to primarily investigate Anomaly 17 (discrete magnetic anomalies) and general disturbance in this area of the site. Removal of the ploughsoil, which was 300-420mm in depth revealed an area of modern disturbance at the western end, including red brick, stone and rubble debris in a reddish sandy matrix extending over an area of approximately 1.8m (Plate 29); this may be associated with former brick making in the area. Further modern disturbance was encountered in the central area, comprising a matrix of loose brick and mortar fragments, together with some concrete fragments and extending over an area of approximately 5m (Plate 30). Elsewhere, the subsoil was undisturbed and comprised bands of gravelly sand and firm orange/brown clays.

Plate 29 T17: modern disturbance at E end

Plate 30 T17: modern disturbance in central area

T18

This trench was 120m long and generally orientated east-west; it was positioned to undertake general investigations in this area of the site.

Removal of the ploughsoil, which was 320-350mm in depth, revealed to surfaces of alternating bands of subsoil, comprising grey sandy gravels and firm mid-brown sandy clays.

Plate 31 T18 - from west

T19

This extended for a distance of 80m in a NW direction from T6; it was positioned to generally investigate the subsurface nature of this area of the site.

Removal of the ploughsoil, which was 300-400mm in depth, revealed variable bands of subsoils, comprising light/mid-brown and grey/brown clays and sands, togher with light-grey gravelly sands.

No features of archaeological interest/potential were uncovered.

Plate 32 T19 – from NW

T20

This was 120m long and generally orientated NW-SE; it was positioned to principally investigate the subsurface nature of this area of the site.

Removal of the ploughsoil, which was 300-400mm in depth, revealed variable bands of subsoils, comprising light/mid-brown and grey/brown clays and sands, togher with light-grey gravelly sands.

No features of archaeological interest/potential were uncovered.

Plate 33 T20 from NW

T21

This was 120m long and generally orientated NW-SE; it was positioned to generally investigate the subsurface nature of this area of the site, where no subsurface geophysical anomalies were detected.

Removal of the ploughsoil, which was 300-400mm in depth, revealed variable bands of subsoils, comprising light/mid-brown and grey/brown clays and sands, togher with light-grey gravelly sands.

A narrow (300mm) trench of red-clay material, representing an un-fired brick-making clamp, was uncovered in the central northern area of the trench; this extended diagonally across the trench (Plate 34) and extended outside the excavated limits. The brick-clay was not very firm and there was no evidence for burning along the edges of the clamp or between the bricks; instead, these areas were filled with a dark grey/light black organic soils, possibly representing decayed/desiccated wood

Plate 34 T21: Remains of un-fired brick clamp

T22 – T25

These trenches were positioned to generally investigate the subsurface nature of this area of the site, where no subsurface geophysical anomalies were detected; the trenches were orientated NW-SE or broadly E-W (T23) or broadly ENE-WSW (T24 & T25), with lengths of 120m (T22, T24 & T25) to 160m (T23).

Removal of the topsoil revealed light orange/brown-, mid-brown- or grey- clays, gravelly clays or gravelly sands, with evidence for modern furrows n all trenches.

No subsurface features of archaeological interest/potential were uncovered and the only artefact of interest was a single sherd of late-17th/19th 'glazed-red earthenware' recovered from T23 (21E0106:17).

Plate 35 T22 – from NW

Plate 36 T23 – from E

Plate 37 T24 – from ESE

Plate 38 T25 – from ESE

T26 & T27

Both of these trenches, measuring 40m in length and orientated in a general N-S fashion, were positioned to generally investigate the subsurface nature of this area of the site, where no subsurface geophysical anomalies were detected.

Removal of the ploughsoil, which was up to 320mm in depth, revealed frim subsoils of mid-brown and grey-brown clays, as well as bands of grey gravelly sand, with some discrete evidence for modern plough furrows. A backfilled service trench was uncovered in the central area of T26.

No subsurface features of archaeological interest/potential were uncovered and no artefacts of interest were recovered.

Plate 39 T26 – from north

Plate 40 T27 – from south

6. RECOVERED ARTEFACTS

A total of 30 sherds of pottery were recovered during the testing process, as follows:

Trench No	Feature No	Find number	Simple Name	Full Name	Material	Dimensions
	Field surface	12	Pottery	Dublin-type cooking ware	Ceramic	Body
	Field surface	13	Pottery	Dublin-type cooking ware	Ceramic	Body
01		29	Pottery	Stoneware	Ceramic	Rim
01		30	Pottery	Stoneware	Ceramic	Body
08	Topsoil	6	Pottery	Dublin-type ware	Ceramic	Body
08	Topsoil	7	Pottery	Leinster Cooking Ware	Ceramic	Body
09		16	Pottery	Kildare-type ware	Ceramic	Body
10		15	Pottery	Stoneware	Ceramic	Body
11		14	Pottery	Whiteware: green glazed	Ceramic	Body
12	Topsoil	1	Pottery	Dublin-type ware	Ceramic	Body
12	Topsoil	2	Pottery	Dublin-type ware	Ceramic	Body
12	Topsoil	3	Pottery	Dublin-type ware	Ceramic	Body
12	1	4	Pottery	Dublin-type fineware	Ceramic	Body
12	3	5	Pottery	Dublin-type ware	Ceramic	Base
12	2	8	Pottery	Leinster Cooking Ware	Ceramic	Body
12	2	9	Pottery	Dublin-type ware	Ceramic	Rim
12	2	10	Pottery	Dublin-type ware	Ceramic	Body
12	2	11	Pottery	Leinster Cooking Ware	Ceramic	Rim
14	1	18	Pottery	Whiteware	Ceramic	Handle
14	1	19	Pottery	Whiteware	Ceramic	Base
14	1	20	Pottery	Whiteware	Ceramic	Rim/Base
14	1	21	Pottery	Spongeware	Ceramic	Body
14	1	22	Pottery	Whiteware	Ceramic	Body
14	1	23	Pottery	Whiteware	Ceramic	Body
14	1	24	Pottery	Shell-edged ware	Ceramic	Rim
14	1	25	Pottery	Stoneware	Ceramic	Body
14	1	26	Pottery	Whiteware	Ceramic	Base
14	1	27	Pottery	Whiteware	Ceramic	Body
14	1	28	Pottery	Stoneware	Ceramic	Body
23		17	Pottery	Glazed red earthenware	Ceramic	Body

These were cleaned and numbered, as per the requirements of the National Museum of Ireland, and submitted to Ms Clare McCutcheon MA, MIAI for specialist analysis (Appendix 2).

In summary, 14 sherds were identified as being of medieval date, with the remainder from the post-medieval period.

Fabric	Sherds	MNV	MVR	Form	Date
Leinster Cooking Ware	3	-	1	Cooking jar	L12th-M14th
Dublin-type cooking ware	1	-	1	Cooking jar	L12th-13th
Dublin-type ware	8	-	1	Jug, storage jar	13th
Dublin-type fineware	1	-	1	Jug	L13th-E14th
Kildare-type ware	1	-	1	Jug	13th-E 14th
Total medieval	**14**	**-**	**5**		
Glazed red earthenware	1	-	1	Bowl	L17th-19th
Shell-edged ware	1	-	1	Plate	18th
Spongeware	1	-	1	Cup/plate?	19th
Whiteware	8	-	3	Cup, 2 plates	L19th-20th
Stoneware	5	-	4	Bowl, ink, conserve jar, beer bottle	19th
Total post-medieval	**16**	**-**	**10**		

7. SUMMARY DISCUSSION

A Programme of Archaeological Testing undertaken with respect to the proposed development of lands in the townland of Greatconnell, Newbridge, Co. Kildare. It is the intention of the landowners to seek permission for a residential development under the SHD Process. Given the scale of the proposed development lands, its location to the north of the ecclesiastical and secular settlement associated with Great Connell Abbey (Ref:KD023-016) and the preliminary results of a geophysical survey of lands to the immediate south, it was considered that the lands should be subject to a Geophysical Survey and Archaeological Testing.

A high resolution magnetic gradiometer survey was undertaken by Target Archaeological Geophysics (Licence No: 20R0242) in December 2020. The results of the Geophysical Survey are presented and discussed above in Section 4 and are summarised as follows:

- Geophysical survey within the boundary of the proposed development has been successful in recording a network of enclosure features extending along the southern/south-eastern portion of the site, in geophysics area M2. These remains extend for a distance of c.0.35km S-NE in M2, and represent the northern limit of areas of archaeological potential recorded by another recent geophysical survey in 2020, completed in connection with a separate proposed development located beyond the southern limits of this site, in proximity to KD023-016004.
- Poorly defined linear responses and discrete positives of uncertain origin are also apparent in the results from this survey, the majority of which are expected to relate to more recent land use. Interpretation of the results has been made difficult due to large-scale modern ferrous and interference throughout the results, in particular disturbance from probable landscaping in M1 to the NW-N; ferrous responses emanating from the existing fabrication plant to the E; as well as buried services extending E-W and NE-SW across the proposed development, and interference from overhead power lines. The potential that subtle responses associated with buried archaeological remains have been masked by the range of modern disturbance on site should not be dismissed.

- The results from survey within the proposed development boundary also highlight remains of former cultivation, and natural soil/geological variations.

The overall lands were subsequently subjected to a programme of Archaeological Testing (Licence No: 21E0106), the primary purpose of which was to determine the archaeological nature and validity of the detected geophysical anomalies. A total of 17 test trenches were excavated within the overall extent of the subject lands, the results of which are described above in Section 5.

Many of the geophysical anomalies were determined to be of geological derivation, associated with natural variations in the subsoil, including iron-panning or associated with modern disturbance or recent agricultural practices, including ploughing and the burning of cereal stubble. In one case (**T14**), evidence of a former land division (ditch), detected by the geophysical survey, proved to be a shallow ditch (drain?) feature; the fill contained 19th century pottery and it's possible that this was associated with a former residential plot in the south-easternmost area of the site.

A possible ditch or road/trackway feature, detected by the geophysical survey, was proved to be associated a former alluvial channel (Figure 4 above), the base of which was largely formed by clay marl in contrast to the immediate surrounding gravels and sands.

Some possible narrow ditch or furrow features were uncovered in the southern area of **T8**; both were filled with orange/red silty sand clay, possibly dumps of burnt material. There were detected by the geophysical survey (Anomaly 6) but no artefactual material was recovered that might aid in the dating of the features.

A series of three 'cut-features' – F12-1, F12-2 & F12-3 – were uncovered in the southern area of **T12**, commencing at approximately 11m from the southern trench end; these appear to be evidence for Anomaly 7 (possible narrow ditch features associated with potential small sub-rectangular field

enclosures); however, limited investigation indicated that, although the features are of probable medieval date, based on artefactual material recovered from the surface areas of the respective fills, the features appear to represent a series of pits rather than ditches. All three features extended under the eastern edge of the trench and, consequently, their full extents were not determined.

A narrow (300mm) trench of red-clay material, representing an un-fired brick-making clamp, was uncovered in the central northern area of **T21**; this extended diagonally across the trench (and extended outside the excavated limits. The brick-clay was not very firm and there was no evidence for burning along the edges of the clamp or between the bricks; instead, these areas were filled with a dark grey/light black organic soils, possibly representing decayed/desiccated wood.

No other features of archaeological interest/potential were noted by the testing, which included areas where no geophysical anomalies were detected.

A total of 30 sherds of pottery were recovered during the testing process; specialist analysis by Clare McCutcheon indicated that 14 were of medieval date and included sherds of Leinster Cooking Ware, Dublin-type cooking ware, Dublin-type ware, Dublin-type fineware and Kildare-type ware, dating from the late-12th to early 14th centuries. The only medieval pottery associated with subsurface features related to the probable pits uncovered in T21. The remaining post-medieval pottery, dating from the late-17th to later-19th/early 20th centuries, comprised Glazed red earthenware, Shell-edged ware, Spongeware Whiteware and Stoneware; the only subsurface feature which produced post-medieval pottery was the possible drain in T14.

The results of the Testing, together with the Geophysical Report, will be incorporated into future Archaeological Impact Assessment Reports that will be prepared to accompany forthcoming planning applications to development the subject lands. Given the nature of the features uncovered, it is likely that it will be recommended that these can be 'preserved by record' and that some areas of topsoil stripping within the site be subject to a programme of monitoring.

.

APPENDIX 1
Consulted Documentary Sources

Aalen, F.H.A, Whelan, K & Stout, M. 1997. *Atlas of the Irish Rural Landscape.* Cork University Press.
2011. *Atlas of the Irish Rural Landscape (Revised & Expanded Second Edition), Cork University Press.*

Archdall, M. 1786. *Monasticon Hibernicum or A history of the Abbies Priories and Other Religious Houses in Ireland,* Luke White Press Dublin.

Bonsall, J & Gimson, H. 2006. *Great Connell Abbey, Newbridge, Co. Kildare: Archaeological Geophysics report.* Unpublished report prepared for Byrne Mullins & Associates – Archaeological & Historical Heritage Consultants (detection licence: 06R0098). Earthsound Archaeological Geophysics
2014. *Land to the south of Great Connell Abbey, Great Connell, Newbridge, Co. Kildare: Archaeological Geophysical Survey.* Unpublished Report prepared as part of the Great Connell Abbey Exploration Project (Year 2) – detection licence: 13R0096. Earthsound Archaeological Geophysics

Bonsall, J & Loughlin, T. 2014. 'Reduce, recycle, reconstruct: resurrecting the architecture and landscape of Great Connell Priory, Newbridge, Co. Kildare'. Unpublished paper presented to *Irish Conference of Medievalists,* UCD, 2nd July 2014.

Barry, T.B. 1987. *The Archaeology of Medieval Ireland.* Routeledge, London.

Byrne, J. 2004. *Byrne's Dictionary of Irish Local History – from earliest times to c. 1900.* Mercier Press, Cork.

Clancy, P. 2006. 'The Curragh, Co. Kildare: the archaeology of an ancient grassland'. *Archaeology Ireland Heritage Guide, No. 31.* Wordwell, Bray.

Connolly, M. 2001. *from Connell to Droichead Nua – Aspects of the History of Newbridge, Co. Kildare.* Leinster Leader, Naas.

Comerford, M. Rev. 1884. *Collections relating to the Diocese of Kildare and Leighlin, II,* pp. 256-268. Dublin

Costello, C. 1991. *Guide to Kildare and West Wicklow.* Leinster Leader, Naas.

Department of Arts, Heritage, Gaeltacht and the Islands. 1999. *Framework and Principles for the Protection of the Archaeological Heritage*. Stationery Office, Dublin.

Department of Housing, Local Government & Heritage. 2021. *Archaeology in the Planning Process.* Office of Planning Regulations.

Harbison, P. 1992. Guide to the National and Historic Monuments of Ireland. Gill & Macmillan.
2000. *Cooper's Ireland. Drawings and Notes from an Eighteenth-Century Gentleman.* O'Brien Press, Dublin.

Halpin, A. & Newman, C. 2006. *Ireland: An Oxford Archaeological Guide to Sites from earliest times to AD 1600.* Oxford University Press.

Healy, P. 1976. *Buildings of Architectural Interest in County Kildare*, An Foras Forbartha, Dublin

Herity, M (ed). 2002. *Ordnance Survey Letters Kildare – Letters Containing Information Relative to the Antiquities of the County of Kildare Collected During The Progress Of The Ordnance Survey In 1837, 1838 and 1839.* Four Masters Press, Dublin.

Hogg, W.E. 1998. *The Millers & The Mills of Ireland of about 1850.* Millbrook Printing, Dublin

Hutchinson, S. 2003. *Towers, Spires and Pinnacles – A history of the cathedrals and churches of the Church of Ireland.* Wordwell, Bray

Gimson, H. 2012. *Lands surrounding Great Connell Abbey, Great Connell, Newbridge, Co. Kildare: Archaeological Geophysical Survey.* Unpublished Report prepared as part of the Great Connell Abbey Exploration Project – detection licence: 12R0126. Earthsound Archaeological Geophysics

Gwynn, A. & Hadcock, R.N. 1970. *Medieval Religious Houses: Ireland.* Dublin.

Killanin, Lord. & Duignan, M.V. 1989. *The Shell Guide to Ireland*. McGraw-Hill Ryerston, Montreal (Revised & Updated edition by P. Harbison).

Lewis, S. 1837. *A Topographical Dictionary of Ireland.* 2 Vols. London.

Lyons, MA. 2000. *Church and Society in County Kildare, c. 1470 – 1547.* Four Courts Press, Dublin.

MacLysaght, E. 1969. *Irish life in the seventeenth century.* Shannon

Moriarty, C. 2018. *The River Liffey: History and Heritage.* The Collins Press, Cork

Murphy, M & Potterton, M. 2010. *The Dublin Region in the Middle Ages. Settlement, Land-Use and Economy.* Four Courts Press/The Discovery Programme.

Nolan, W & McGrath, T (eds). 2006. *Kildare History and Society – Interdisciplinary essays on the history of an Irish County.* Geography Publications, Dublin.

O'Farrell, P. 2003. *A History of County Kildare.* Gill & Macmillan, Dublin.

O'Grady, J.S. 1905. 'Capella de Ballymany' in *J.K.A.S.,* IV, pp. 376-7.

O'Keeffe, T. 2000. *Medieval Ireland – Archaeology.* Tempus Publishing Ltd, Stroud

Ó Ríordáin, S.P. 1979. *Antiquities of the Irish Countryside*. Lilliput Press.

Price, L. (ed). 1942. *An Eighteenth Century Antiquary, The Sketches and Diaries of Austin Cooper*, Falconer Press, Dublin

Rynne, C. 2006. 2006. *Industrial Ireland, 1750-1930. An Archaeology*. Collins Press, Cork.

Sherlock, Archdeacon. 1910. 'Some notes on the Fords and Bridges over the River Liffey', *J.K.A.S. VI,* **4**, pp. 293-305.

Simmington, R.C. (ed). 1954. *The Civil Survey – Co. Kildare, 1654-56.* Irish Manuscripts Commission, Dublin.

Swift, M. 1999. *Historical Maps of Ireland.* Parkgate Books, London.

Taylor & Skinner. 1783. *Maps of the Roads of Ireland*. 2nd edition, Dublin.

Thomas, A. 1992. *The Walled Towns of Ireland.* Vol. 2. pp. 228-9. Irish Academic Press, Dublin.

Valkenburg, A. 1970. 'Walter Wellesley, Bishop of Kildare', in *J.K.A.S.* xiv, pp. 518-43.

White, N. D. 1943. *The Extents of Irish Monastic Possessions 1540-41*. Government Publications, Dublin

APPENDIX 2

The pottery from Greatconnell townland, Newbridge, Co. Kildare (21E0106)

Clare McCutcheon MA MIAI

Introduction:
A total of 30 sherds of pottery were presented for study of which fourteen (46.75%) are medieval in date.

Methodology:
The material has been identified visually and the detailed information is presented in Table 1. This shows the number of sherds in each fabric type, the minimum number of vessels (MNV) present and the minimum vessels represented by the sherds (MVR). The form of the vessels represented is also shown with the known date range of the material. The pottery in each context is listed in Table 2.

Fabric	Sherds	MNV	MVR	Form	Date
Leinster Cooking Ware	3	-	1	Cooking jar	L12th-M14th
Dublin-type cooking ware	1	-	1	Cooking jar	L12th-13th
Dublin-type ware	8	-	1	Jug, storage jar	13th
Dublin-type fineware	1	-	1	Jug	L13th-E14th
Kildare-type ware	1	-	1	Jug	13th-E 14th
Total medieval	**14**	**-**	**5**		
Glazed red earthenware	1	-	1	Bowl	L17th-19th
Shell-edged ware	1	-	1	Plate	18th
Spongeware	1	-	1	Cup/plate?	19th
Whiteware	8	-	3	Cup, 2 plates	L19th-20th
Stoneware	5	-	4	Bowl, ink, conserve jar, beer bottle	19th
Total post-medieval	**16**	**-**	**10**		

Table 1: Pottery identification, Greatconnell, Newbridge, Co. Kildare, Dublin (21E0106)

Leinster Cooking Ware:
This micaceous, hand built ware 'is the single most widespread medieval pottery type in Leinster' (Ó Floinn 1988, 340). It has been found in varying quantities on both urban and rural sites from Dungarvan to Dublin and further north. The fabric contains large plates of mica, quartz grits and other inclusions such as decomposed feldspar (*ibid* 327) and the vessels are unglazed. While similar clay can be found in Dublin-type cooking ware and other locally-made unglazed wares of the period, the method of construction and firing leaves the Leinster Cooking Ware vessels with an easily recognisable sand-pitted base.

The most typical vessel represented is a cooking jar, the standard medieval form with everted rim, ovoid body and sand-gritted base. Two body sherds (7, 8) and a rim (11) represent a cooking jar with a rim diameter of 26mm.

Dublin-type wares:
The designation of a fabric with the suffix *-type* is recommended pottery practice to indicate that a ware has been consistently found in a particular area while evidence for a production centre or kiln which has not yet been discovered (Blake & Davey 1983, 39-40). The general term London-type, for example, has been adopted to describe wares that share general traditions and clay sources (Pearce *et al* 1985, 2). A fuller discussion of the names of the Dublin-type wares has been detailed elsewhere (McCutcheon 2000, 120-23; 2006) and only a general outline is included in this report. The relative dating of the Dublin-type wares has been developed as a result of consistent recovery in the stratigraphic levels of the Dublin excavations, and the absolute dating is developing by the association of imported wares, and the dating information from coins and dendrochronology.

Dublin-type cooking ware: The most distinctive difference between the cooking ware and the largely contemporary Leinster Cooking Ware is the method of construction of the base. Dublin-type cooking ware bases are smooth rather than sand-gritted and the fabric tends to be less coarse. A single small body sherd (13) was recovered.

Dublin-type ware: Eight of the sherds from this site are Dublin-type dating generally to the 13th century, including five bodies (1-3, 6 & 10), a rim (9) and two bases (5 & 12). The rim has external beading, typical of 13th century jugs in Ireland, based on the prototype of Bristol wares. A large body sherd is from a storage jar, with some external glazing and sooting where the vessel has been placed near the fire.

Dublin-type fineware: A body sherd (4) in Dublin-type fineware, dates to the later 13th to 14th century. The piece is low fired and often the glaze was not continued down below the belly or widest point of the jug.

Kildare-type ware:
A single sherd (16) of this low-fired, creamy, sandy ware with patchy glaze was recovered. Similar pottery has been found and analysed from Castledermot, just 20 miles (33km) south of Newbridge (McCutcheon forthcoming).

Glazed red earthenware:
The fabric is generally sandy earthenware, usually oxidised buff to light orange through to brown. The clear lead glaze takes its colour from the fabric with variations due to firing conditions (Jennings 1981, 157). These are also known as brownwares and were made widely in England and Ireland in the later 17th and 18th centuries (Dunlevy 1988, 24-5).

A single very worn sherd (17) was recovered, with very degraded dark brown glaze on both surfaces.

Shell-edged ware:
This is a term used for the decorative motif of a moulded border on some plates. The technique was first used on creamware but was principally associated with pearlware and was popular at Wedgwood and other Staffordshire potteries *c.*1779-1830 (Savage & Newman 1985, 262). Blue and green brush strokes were used to highlight the grooved modelling on the edge of the plate (*ibid*.). The same decoration occasionally appears on the bodies of hollow wares such as jugs and teapots.

The sherd from this site (24) is decorated in blue and represents a dinner plate.

Sponge ware
This is a Staffordshire pottery, 'made for the cheapest market, and decorated with crude painting and by dabbing the ware with a sponge impregnated with colour' (*ibid*. 270). A single body sherd (21) is decorated in a grey floral pattern.

Whiteware:

This term covers a wide range of items from the 19th and 20th centuries in white clay, often more industrial wares and the successor of the more clearly identifiable pearlware with its blue tint in the glaze. Five of the sherds (18, 22, 23, 26 & 27) represent a cup with a splayed base and a strap handle. A further sherd (14) is decorated with green glaze inside and out, over an exterior design of horizontal lines and zig-zags.

Stoneware

The term is used here to cover all English stonewares, made of a clay and fusible stone, which can be fired to partial vitrification, not then requiring a glaze to make it impervious to liquids (*ibid*. 275). Some vessels are further decorated with a glaze, however, and many have transfer printed label or impressed makers' or merchants' names.

A yellow glazed bowl (29, 30) has two parallel horizontal brown lines below the rim on the exterior. An undecorated white glazed sherd (25) may be from a preserve jar, which were made in their millions in the 19th century. Two further fragments represent a beer bottle (15) and an inkwell (28).

Trench	Feature	Pottery
1		Stoneware x2
8	Topsoil	Leinster Cooking Ware x1; Dublin-type ware x1
9		Kildare-type ware x1
10		Stoneware x1
11		Whiteware: green glazed x1
12	1	Dublin-type fineware x1
12	2	Leinster Cooking Ware x2; Dublin-type ware x2
12	3	Dublin-type ware x1
12	Topsoil	Dublin-type ware x3
14	1	Shell-edged ware x1; Stoneware x2; Spongeware x1; Whiteware x7
23		Glazed red earthenware x1
	Field surface	Dublin-type cooking ware x1; Dublin-type ware x1

Table 2: Pottery by trench, Greatconnell townland, Newbridge, Co. Kildare (21E0106)

Bibliography:

Blake, H. & Davey, P. (eds) 1983 *Guidelines for the processing and publication of medieval pottery from excavations*. London.

Dunlevy, M. 1988 *Ceramics in Ireland.* Dublin.

Jennings, S. 1981 *Eighteen centuries of pottery at Norwich*. Norwich.

McCorry, M. forthcoming 'Appendix 1: Petrological report on three sherds from Castledermot', in E. O'Donovan, *Excavations in Main Street, Castledermot, Co. Kildare (96E0265).*

McCutcheon, C. 2000 'Medieval pottery in Dublin: new names and some dates', in S. Duffy (ed.), *Medieval Dublin I: Proceedings of the Friends of Medieval Dublin Symposium 1999*. 117-25. Dublin.

McCutcheon, C. 2006 *Medieval pottery from Wood Quay, Dublin: The 1974-76 waterfront excavations.*. Dublin.

McCutcheon, C. forthcoming 'The pottery' in E. O'Donovan, *Excavations in Main Street, Castledermot, Co. Kildare (96E0265)*.

Ó Floinn, R. 1988 'Handmade medieval pottery in S E Ireland-'Leinster Cooking Ware' in G. Mac Niocaill & P. Wallace (eds), *Keimelia* 325-49. Galway

Pearce, J.E., Vince, A.G. & Jenner, M.A. 1985 *A dated type series of London medieval pottery part 2: London-type ware.* London.

Savage, G. & Newman, H. 1985 *An illustrated dictionary of ceramics*. London. Reprint 2000.

APPENDEIX 13

METEC ESB INFRASTRUCTURE REPORT

ESB INFRASTRUCTURE REPORT

for the

THE STRATEGIC HOUSING DEVELOPMENT

at

GREAT CONNELL,
NEWBRIDGE,
CO. KILDARE.

for

ASTON LIMITED

La Vallee House
Upper Dargle Road
Bray, Co. Wicklow
A98 W2H9
Ireland

p: 00 353 (0)1 204 0005
e: info@metec.ie
w: www.metec.ie

issue no.	issue date	pages	issued for	by	approvals checked	approved
01	31/01/2022	9	Planning	EP	DL	KM

Table of Contents

Introduction 4
1.0 Executive Summary 4
2.0 ESB Infrastructure 7

Introduction

This Report was compiled by METEC Consulting Engineers in March 2022 on behalf of our client, Aston Limited, as part of the proposed strategic housing development at Great Connell, Newbridge, Co. Kildare. The report summarises the existing Engineering Services Infrastructure to the proposed development and the proposed rediversion of existing overhead lines subject to final approval by ESB.

1.0 Executive Summary

The development will consist of the demolition of existing site structures (2,622.3 sqm) and the construction of 569 no. residential units, a neighbourhood centre with 11 no. units (commercial floor area 2,141 sqm) and a childcare facility (886 sqm), a circa 350 metre section of distributor road, and all ancillary and associated works on a site of 27.64 ha. The proposed development comprises:

1. Demolition of existing site structures (total 2,622.3 sqm) comprising; 'Great Connell' a two-storey dwelling of 331.9 sqm with detached single storey garage and outhouses of 48 sqm; 'Valencia Lodge' a single storey dwelling of 135.6 sqm with a single storey garage of 17.8 sqm; two no. single storey sheds of 1,440 sqm and 595 sqm, and a three-sided shed of 54 sqm.
2. Construction of 569 no. new residential dwellings (325 no. houses and 244 no. apartments) comprising:

- 64 no. two-bed houses; 173 no. three-bed houses; and 88 no. four-bed houses (ranging in height from 2 to 3 storeys).
- Apartment Block A (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
- Apartment Block B (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
- Apartment Block C (Part 3 and 4 Storeys): 4 no. one-bed apartments; 19 no. two-bed apartments and 4 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 87 sqm.
- 13 no. apartments above the proposed Neighbourhood Centre comprising; 4 no. own-door two-bed apartments; 3 no. shared-access one-bed apartments; and 6 no. shared-access two-bed apartments. These proposed units have private balconies or terraces.
- 160 no. own-door apartments in 2- and 3- storey buildings comprising; 16 no. one-bed apartments; 78 no. two-bed apartments, 66 no. three-bed duplex apartments. These

units will have private amenity areas in the form of terraces, balconies and/or rear gardens.

3. Provision of Neighbourhood Centre (ranging in height between 2 and 4 storeys) with 11 no. commercial units comprising: a convenience shop of 909 sqm (unit 1); 3 no. doctor/dentist/physio units of 120 sqm, 120 sqm and 90 sqm (units 6, 7, and 8, respectively); a café of 125 sqm (unit 4); a restaurant of 213 sqm (unit 9); and 5 no. shop/convenience services units of 112 sqm, 49 sqm, 171 sqm, 100sqm and 100 sqm (units 2, 3, 5,10 and 11, respectively). The proposed Neighbourhood Centre includes an external roof terrace of 176 sqm.
4. Provision of a childcare facility (886 sqm) within the Neighbourhood Centre with capacity for in the order of 154 no. children.
5. Provision of 1,008 no. car parking spaces comprising 650 no. spaces for the proposed houses; 312 no. spaces for the proposed apartments; and 46 no. spaces to serve the Neighbourhood Centre.
6. Provision of 732 bicycle parking spaces comprising 536 no. secure residential spaces, 134 no. residential visitor spaces, and 62 no. spaces to serve the Neighbourhood Centre.
7. A series of 18 no. public open spaces and pocket parks are proposed throughout the residential development (2.613 ha net area).
8. Provision of a 8.31 ha amenity area adjoining the River Liffey.
9. Vehicular access to the proposed development from Great Connell road via a circa 350 metre section of the Newbridge South Orbital Relief Road (NSOOR), including footpaths and cycle paths. It is proposed to upgrade the existing Great Connell Roundabout to a signalised junction, and provide footpaths and cycle paths within the subject site along the Great Connell Road.
10. Proposed development facilitates future potential pedestrian, cycle and vehicular links to adjoining residential development and undeveloped lands.
11. All enabling and site development works, landscaping, boundary treatments, lighting, services and connections, including connection to permitted wastewater pumping station, waste management, ESB substations, compensatory flood storage and all other ancillary works above and below ground on a site of 27.64 ha.
12. A 7 year permission is sought.

The site location plan layout is shown in *Figures 1.1* below.

Figure 1.1 Site Location Plan

2.0 ESB Infrastructure

The existing infrastructure connections have been identified. These connections will each be isolated and removed/altered prior to the commencement of site construction. New infrastructure connections have been considered in the design of the proposed development and there are no known issues with local infrastructure to supply the new development at this time. A new ESB sub-station and Unit sub-stations are proposed within the footprint of the development. Talks have commenced with the ESB in this regard. The ESB will process the proposal and will be the final arbiters of the electrical configuration within the site.

The ESB Networks drawing in *figure 2.1* below indicates the existing network distribution around the proposed development.

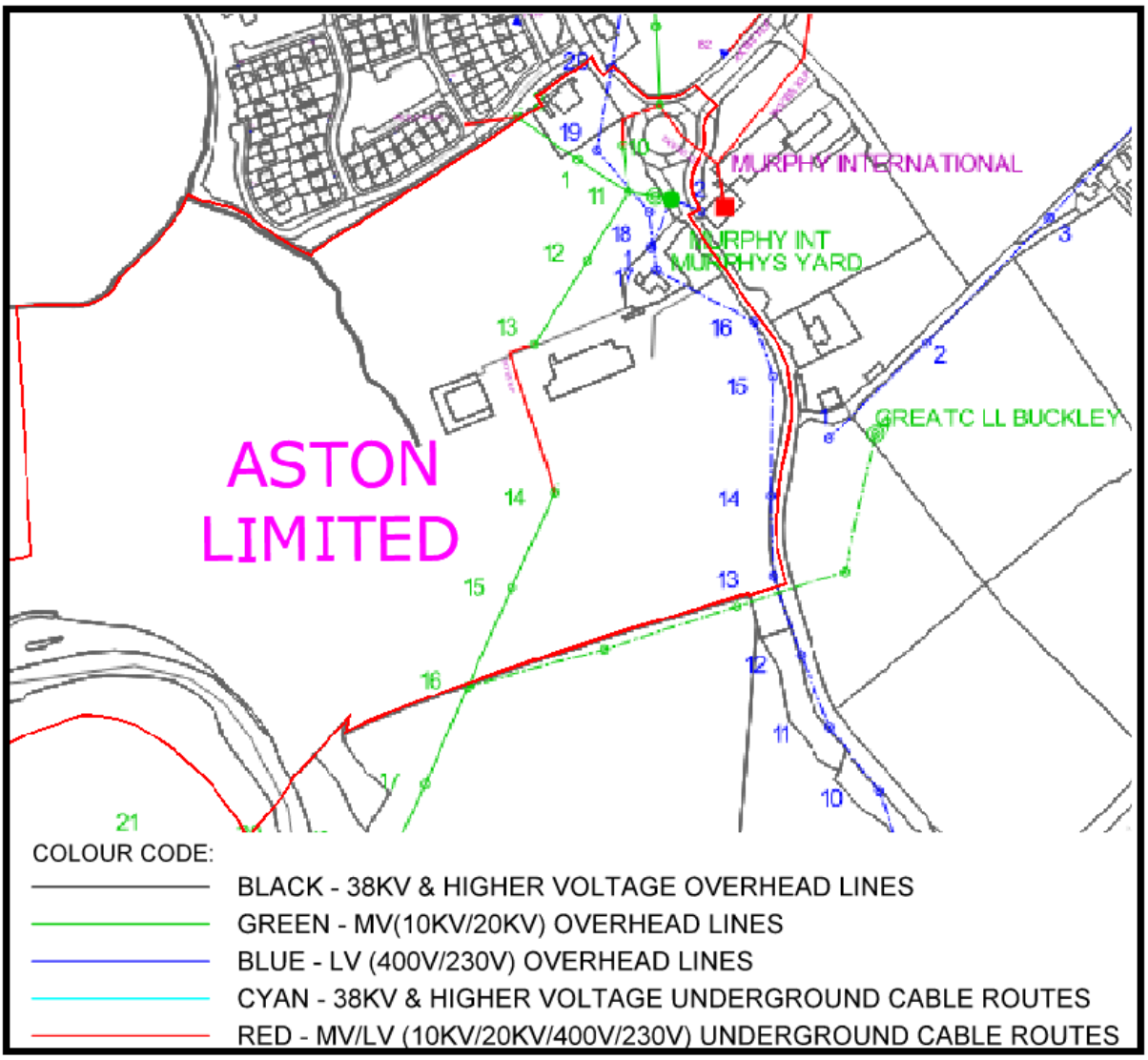


Figure 2.1 ESB Networks Map of surrounding area

The drawing in *figure 3.1* below indicates the optimal underground route of the diverted ESB MV(10KV) overhead lines through the proposed site.

Figure 3.1 Optimal underground cable route

The existing ESB network maps indicate an existing 10 kV Medium Voltage overhead electricity line traversing the proposed site which drops to underground for a section of its run. The ESB Utility maps do not indicate any other underground or overhead cables traversing the site. This overhead line needs to be rediverted for the development. The ESB planners will review the capacity of the existing electrical infrastructure and advise the extent of upgrade works to comply with their infrastructural requirements.

Main cable ducting shall comply with the requirements of the ESB Networks Housing Schemes Guidebook for ESB Networks Standards for Electrical Services. ESB Networks will specify the route, size and purpose of all ducts on the site layout plan. For all ducting which lies within the housing scheme/development, the trench cross-section and ducting requirements set out in the guidebook shall apply.

A prospective load of 3 MVA has been calculated for the development based on ESB electrical loading guidelines for Houses and Apartments. We are proposing that a Freestanding MV/LV Substation with adjoining Switch room is built in the location indicated below within the Open Space 11 area. The Freestanding MV/LV Substation will provide the MV ring main to the 630kVA Unit sub-stations subject to ESB approval.

The 3 No. Apartment Blocks, Creche & neighbourhood centre/apartments shall be fed from the Freestanding MV/LV Substation. The 630kVA Unit Substations (8No.) will be dispersed throughout the site in locations that are optimal for efficient cable distribution.

The drawing in *figure 4.1* below indicates the proposed ESB Sub-station locations.

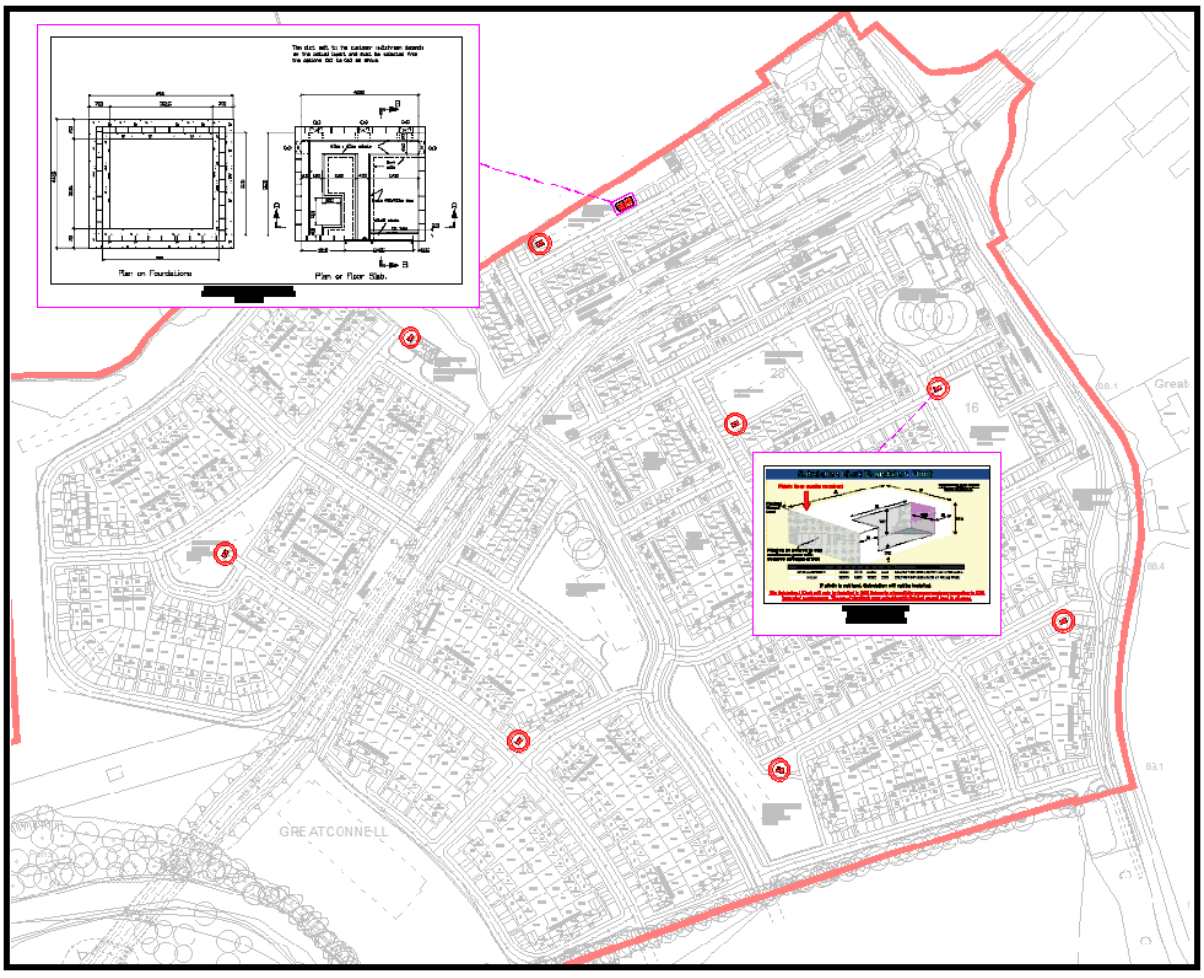


Figure 4.1 Proposed ESB Sub-station Layout (indicative site boundary)

The drawing in *figure 5.1* below indicates the proposed ESB MV Sub-station Layout.

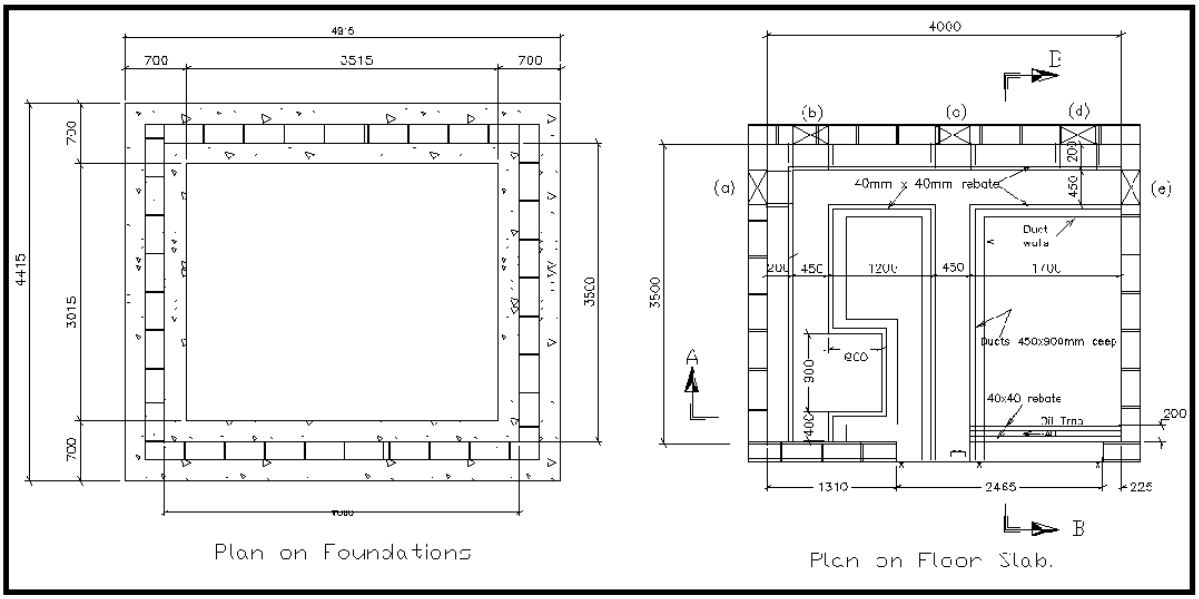


Figure 5.1 MV Substation Building Floor & Foundation Detail

The drawing in *figure 6.1* below indicates the proposed ESB Sub-station Kiosk Plinth details.

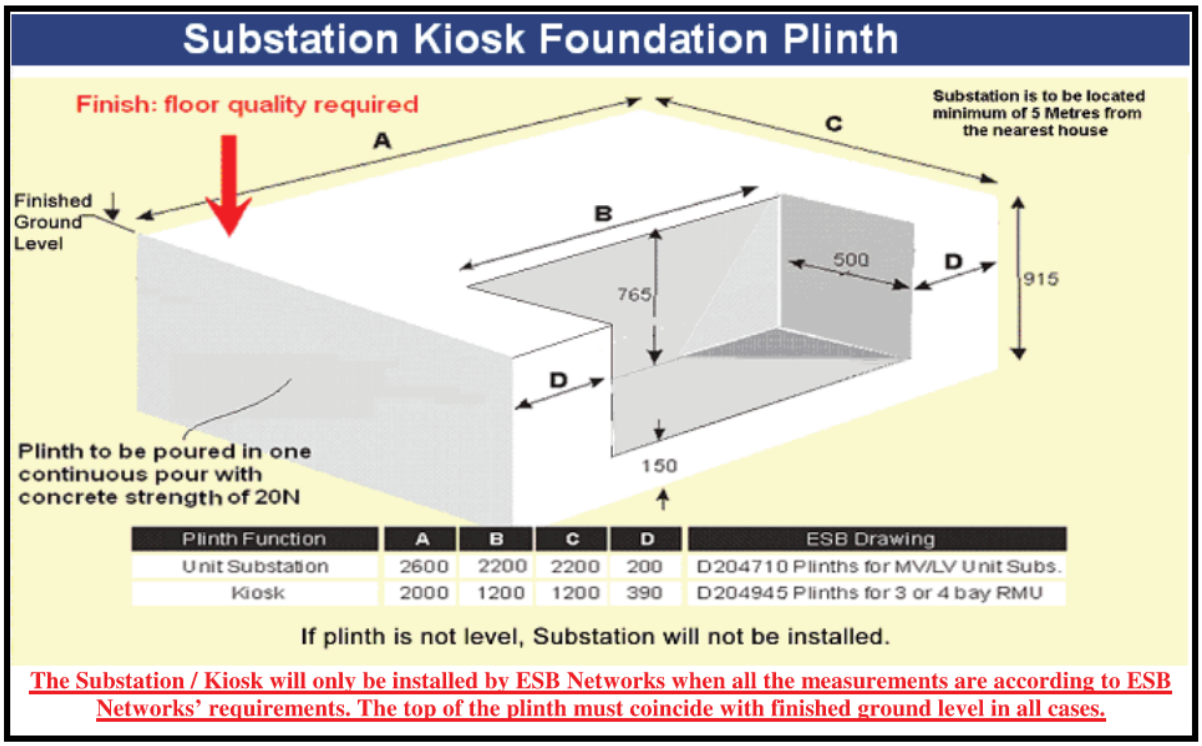


Figure 6.1 Substation Kiosk Floor & Foundation Detail

APPENDIX 14

TRAFFIC & TRANSPORT

PUNCH
consulting engineers

Great Connell SHD, Newbridge

Traffic and Transportation Assessment
192229-PUNCH-XX-XX-RP-C-0004

April 2022

Document Control

Document Number: 192229-PUNCH-XX-XX-RP-C-0004

Status	Revision	Description	Date	Prepared	Checked	Approved
A0	C01	SHD Stage 1	09/09/2021	K. Mullins	S. O'Coileir	J. Tiernan
A0	C02	SHD Stage 3	05/04/2022	S. O'Coileir	J. Tiernan	L. Brennan

Table of Contents

Document Control i
Table of Contents ii
1 Executive Summary 4
2 Introduction 5
2.1 Scoping 5
3 Existing Conditions 6
3.1 Site Location 6
3.2 Existing Road Network 7
3.2.1 Great Connell Road (L2028) 8
3.2.2 Ballyfarm Road 8
3.2.3 R416 Athgarvan Road 9
3.2.4 The Hall (L2003) 9
3.3 Existing Traffic Flows 10
3.4 Future Transport Proposals 12
3.4.1 Newbridge Local Area Plan (2013-2019 as *extended*) 12
3.4.2 Kildare County Council Development Plan (2017-2023) 12
3.5 Coordination with Other Projects 13
4 Proposed Development 14
5 Vehicle Trip Generation 17
6 Trip Assignment and Distribution 18
7 Traffic Forecasting 19
8 Assessment and Road Impact 20
8.1 Junction Analysis 23
8.1.1 Analysis Assumptions 24
8.1.2 Great Connell Roundabout 25
8.1.3 Lidl Distributor Roundabout 28
8.1.4 The Hall Signalised Junction 29
8.1.5 St. Conleth Bridge Signalised Junction 30
8.1.6 Buckley's Cross 32
8.1.7 Analysis Summary 36
9 Road Safety 38
10 Internal Layout 39
10.1 DMURS 39
10.2 Site Access Layout 39

10.2.1 Primary Site Access 39
10.2.2 Secondary Site Access 39
10.3 Newbridge South Orbital Relief Road (NSORR) 39
10.4 Internal Street Layout 39
10.5 Visibility Splays 39
10.6 Vehicle Manoeuvring 40
11 Parking 41
11.1 Car Parking 41
11.2 Cycle Parking 44
12 Summary and Conclusion 46
Appendix A Tri Partite Meeting Comments & PUNCH Responses ..... A-I
Appendix B Traffic Survey Data ..... B-II
Appendix C TRICS Data ..... C-I
Appendix D Development Traffic Flow Diagrams ..... D-I
Appendix E Great Connell Roundabout Junctions 9 Results Output ..... E-I
Appendix F Great Connell Signalised Junction Layout ..... F-II
Appendix G Great Connell Signalised Junction Linsig Results Output ..... G-III
Appendix H Lidl Distributor Roundabout Junctions 9 Results Output ..... H-I
Appendix I The Hall Signalised Junction Linsig Results Output ..... I-I
Appendix J St. Conleth's Bridge Signalised Junction Linsig Results Output ..... J-I
Appendix K Buckley's Cross Roundabout Junction 9 Results Output ..... K-I
Appendix L Buckley's Cross Signalised Junction Layout ..... L-I
Appendix M Buckley's Cross Signalised Junction Linsig Results Output ..... M-II

1 Executive Summary

1. The proposed development is a residential scheme comprising of 569 no. residential units, including a mix of apartments and houses, in addition to a proposed childcare facility/creche and neighbourhood centre/commercial building.

2. This assessment has been carried out in accordance with TII's Traffic and Transport Assessment Guidelines PE-PDV-02045 (May 2014) and makes reference to the Design Manual for Urban Roads & Streets (DMURS).

3. It is proposed to access the proposed residential development from the existing Great Connell Roundabout which will be signalised as part of this development in order to improve the safety of vulnerable road users in the area.

4. The proposed development will deliver a section of the Newbridge Southern Outer Orbital Relief Road (NSORR) from Great Connell Road to the furthest access point within the development site along the new road. The remainder of the NSORR delivery is being progressed by Aston Ltd as part of a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559). Aston Ltd has taken on this element in order to expedite the approval process and ensure that the connection can be made in a shorter timeframe than if Kildare County Council were to progress under public procurement. These two elements together will enable the completion of the NSORR objective identified in the Newbridge LAP.

5. The Ballyfarm Road will be taken in charge by Kildare County Council in Q2 2022.

6. Capacity analysis was carried out on a number of surrounding existing junctions for a number of different scenarios relating to the delivery of the NSORR. In summary, all of the junctions assessed function within capacity without the full delivery of the NSORR (with the exception of St Conleth's Bridge and Buckley's Cross which are already operating above design thresholds). The maximum impact of the proposed development is +6% at all junctions assessed without the full NSORR in place. The proposed development is therefore considered not to be reliant on the delivery of the full NSORR. The delivery of the full NSOORR improves the already congested junctions and reduces the proposed development impact to only +2% in the worst case design year 2039 at both of those already congested junctions.

7. An option to provide a signalised junction in place of Buckley Cross Roundabout has been presented. These works will be progressed by Kildare County Council (with contributions to be agreed with Aston Ltd).

2 Introduction

PUNCH Consulting Engineers were commissioned by Aston Ltd to carry out a Traffic and Transportation Assessment (TTA) for a proposed residential development/strategic housing development (SHD) in Newbridge Co. Kildare.

The assessment has been carried out in accordance with TII's Traffic and Transport Assessment Guidelines PE-PDV-02045 (May 2014) and makes reference to the Design Manual for Urban Roads & Streets (DMURS). Sections from the Newbridge Local Area Plan (2013-2019) and the Kildare County Council Development Plan (2017-2023) have been used to help describe the development location and its local context.

The purpose of the TTA report is to assess the potential impact of the proposed development on the existing local transport network and to ensure that the proposed site access will have adequate capacity to carry the development traffic and the future growth in existing road traffic to the design year and beyond. An assessment of the accessibility of the site for cyclists, pedestrians and public transport users has also been made.

2.1 Scoping

A tripartite meeting occurred online on 22nd October 2021. This section of the report addresses items that were specifically raised following the Tri Partite meeting in relation to traffic and transportation. Below is the text extract from ABP's opinion report relating to traffic and transport:

1. *Traffic and Transport*
   Further consideration and/or justification of the documents as they relate to the traffic and transport provision. The submitted documentation should address the requirements of the Newbridge Local Area Plan 2013-2019 (as extended) for the delivery of the Newbridge Southern Outer Orbital Relief Road (NSOORR) and Compliance with Objective SRO5a. Regards should be given to the submission of a Traffic and Transport Assessment, including inter alia, potential scenarios with and without the bridge, capacity of the surrounding junction and the impact of the proposed development on the surrounding road network. Plans and particulars should clearly indicate compliance with the required upgrades stated in the Transport Section Report, including any third –party consents required for the works, the need for signalised junctions in the vicinity of the site and the DMURS standards for the internal network.

Consultation was undertaken with Kildare County Council Roads, Transportation & Public Safety Department on numerous occasions throughout 2021 via meetings (see main meeting dates below) and email correspondence to allow them to express their views/comments regarding the proposed development prior to the submission of the planning application.

1. 23 March 2021 –Preplanning Meeting - Kildare County Council Consultation Reference: PP5026
2. 15th April 2021- Kildare County Council Roads, Transportation & Public Safety Department
3. 22nd October 2021 – SHD Pre-Application 311390 – Tripartite Meeting
4. 1st March 2022 – Pre-Planning meeting for road and bridge application for remainder of NSORR - Section 247 Kildare County Council Consultation Reference: PP2559

Refer to Appendix A for detailed responses to ABP and KCC Tripartite meeting comments.

This TTA reflects the comments received from Kildare County Council throughout the design development of this SHD project.

3 Existing Conditions

3.1 Site Location

The application site is part brownfield/ part greenfield site with 3 no. existing buildings on the eastern side, and the majority of the existing land used for agriculture. The proposed development is located to the east of Newbridge town centre on the eastern side of the River Liffey. The site is within the Newbridge Local Area Plan. Refer to Figure 3-1 below.

There are three existing accesses onto the site from Great Connell Road to the east.

The proposed site is bounded by the existing Wellesley Manor residential developments to the north-east, Great Connell Road to the east and existing farmland to the south. The River Liffey and existing farmland are located to the west. Ardstone Homes Limited were granted planning for 343 residential units on the site located on the western side of the River Liffey under planning approval grant ABP-302141-18. This development is now under construction.

Figure 3-1: Site Location Plan
(Ref: https://viewer.myplan.ie/)

3.2 Existing Road Network

The site location in relation to the wider road network is detailed in Figure 3-2 below.

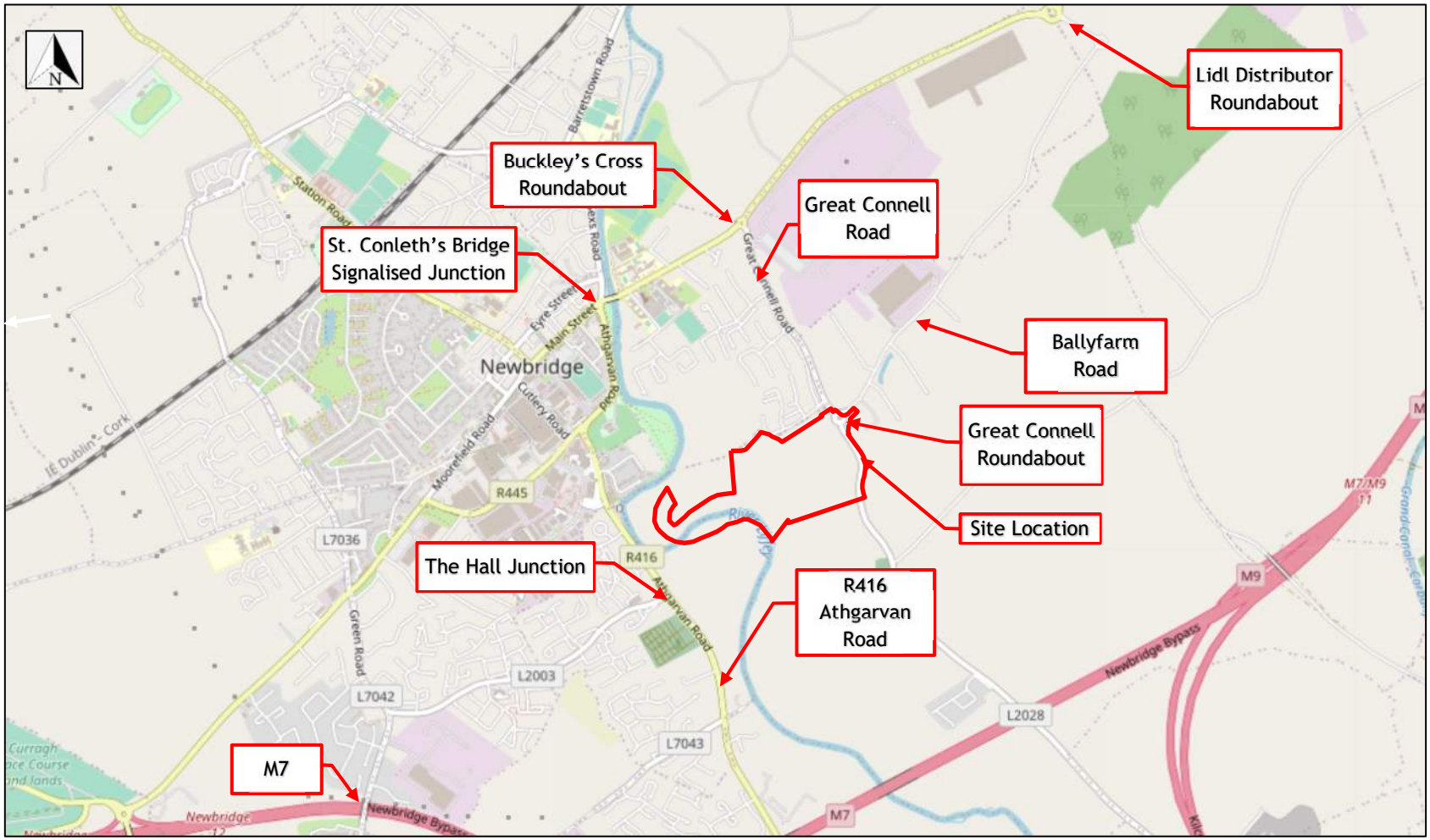


Figure 3-2: Site location and surrounding road network (Ref: https://www.openstreetmap.org/#map=14/53.2652/-6.1863)

A brief description of the local road network and the major road junctions is provided below:

3.2.1 Great Connell Road (L2028)

The Great Connell Road is a Local Primary Road linking the R445 at Buckley's Cross with the L2032 in the south. Great Connell Road is a single lane two-way carriageway with a footpath generally only on the western side of the road, heading south from the R445 junction to the Great Connell Roundabout. North of the roundabout the road provides access to a number of residential estates, and east of the roundabout provides access to the Lidl Distribution Centre and Murphy International Limited headquarters/offices via the Ballyfarm Road. Refer to Figure 3-3.

Figure 3-3: Great Connell Road (Looking south-east) © Google Maps

3.2.2 Ballyfarm Road

The Ballyfarm Road connects the Great Connell Roundabout to the Lidl Distributor Roundabout. It forms part of the NSORR and is fully constructed 6m wide carriageway with verges, footpaths and cycle paths on either side. The road will be taken in charge by Kildare County Council in Q2 2022.

Figure 3-4: Ballyfarm Road at connection to Great Connell Roundabout © Google Maps

3.2.3 R416 Athgarvan Road

The R416 Athgravan road is a Regional Road linking Newbridge town and Athgarvan town. Athgarvan road is a single lane two-way carriageway with some footpaths on both side of the carriageway mainly along developed areas. It has no existing designated cycle lanes. Refer to Figure 3-5.

Figure 3-5: R416 Athgarvan Road (Looking north-west) © Google Maps

3.2.4 The Hall (L2003)

The Hall is part of the existing section of the Newbridge Southern Orbital Relief Road (NSORR) which continues onto Curragh Grange and links Green Road with Athgarvan road. The Hall is a single lane two-way carriageway with wide footpaths on both sides of the carriageway and no existing cycle lanes. The road provides access to a number of residential estates.

Figure 3-6: The Hall (Looking east towards Athgarvan Junction) © Google Maps

3.3 Existing Traffic Flows

A classified turning count traffic survey of the below listed junctions was completed by IDASO on behalf of the client on Wednesday the 10th of November 2021.

1. Great Connell Roundabout
2. Lidl Distributor Roundabout
3. The Hall / R416 Athgarvan Road / New NSORR (East) Signalised Junction.
4. St. Conleth's Bridge Signalised Junction
5. Buckley's Cross Roundabout

The November 2021 surveys were undertaken at a time when schools were fully open and the government was not advising work from home during the Covid-19 pandemic. While it could be argued that an increased proportion of individuals would have continued to work from home during this time period in comparison with pre-covid, it is expected this change in behaviour will become the norm in future years and it is therefore deemed the traffic survey results are appropriate for future analysis.

The November 2021 traffic survey locations and traffic survey results for the peak hours are included in Appendix B.

The November 2021 traffic surveys undertaken found that the mean morning peak hour traffic flows at the existing junctions surrounding the development generally occurred between 08:00 and 09:00 (AM). The evening peak hour flow was found to generally occur between 17:00 and 18:00 (PM). See Figure 3-8 and Figure 3-7 below.

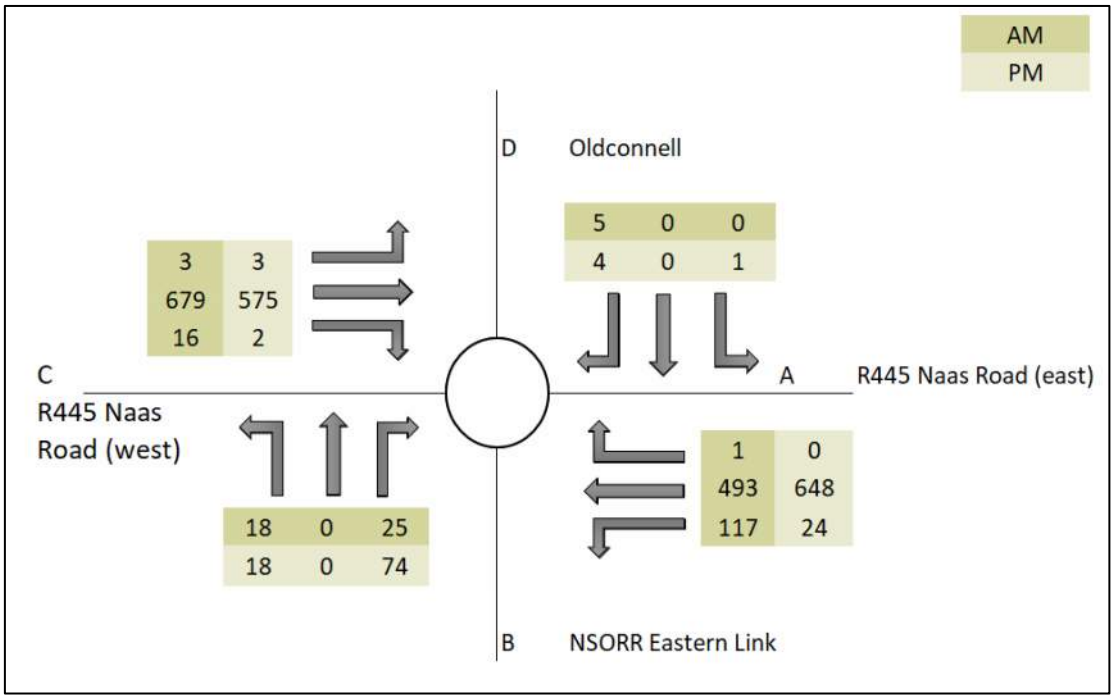


Figure 3-7: November 2021 Lidl Distributor Roundabout Peak Hour Traffic Survey Results (PCUs)

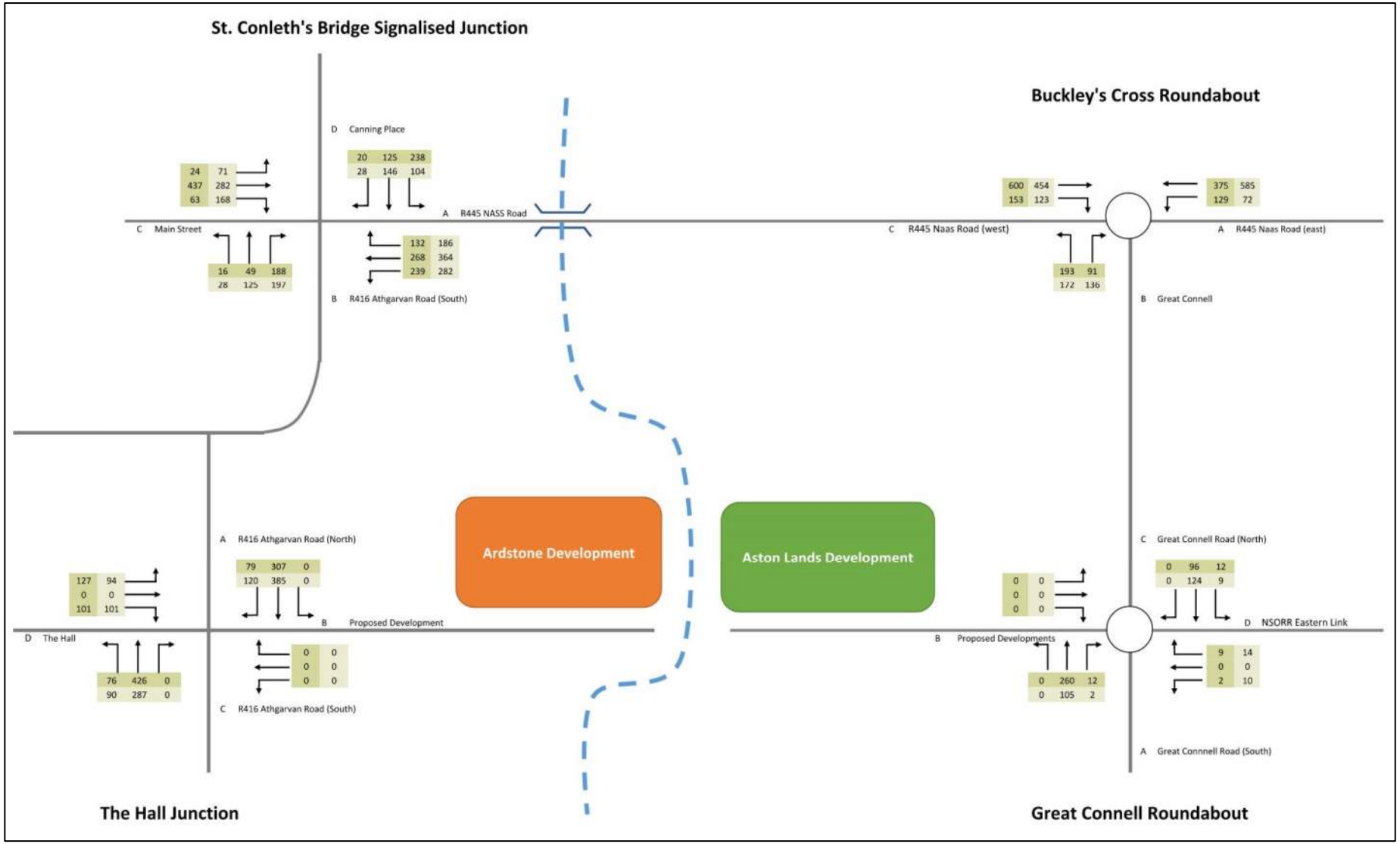


Figure 3-8: November 2021 Peak Hour Traffic Survey Results (PCUs)

3.4 Future Transport Proposals

3.4.1 Newbridge Local Area Plan (2013-2019 as *extended*)

The proposed development is located within the Newbridge Local Area Plan and is mostly zoned as 'C New Residential' and part of the site is also zoned 'F Open Space & Amenity'.

Some of the relevant local area plan transportation objectives are:

- SR0 5a: To construct the NSORR road including a new crossing over the River Liffey.
- SRO 10: To implement safety and/or capacity improvements as necessary at (*relative to this site*):
  g) R415 Athgarvan Road/Kilbelin junction (The Hall Junction), pending the completion of the Southern Relief Road
  h) The R445 Naas Road/Great Connell junction (Buckley's Cross Junction)

Refer to Figure 3-9 below which identifies the Movement objectives within the Newbridge Local Area Plan:

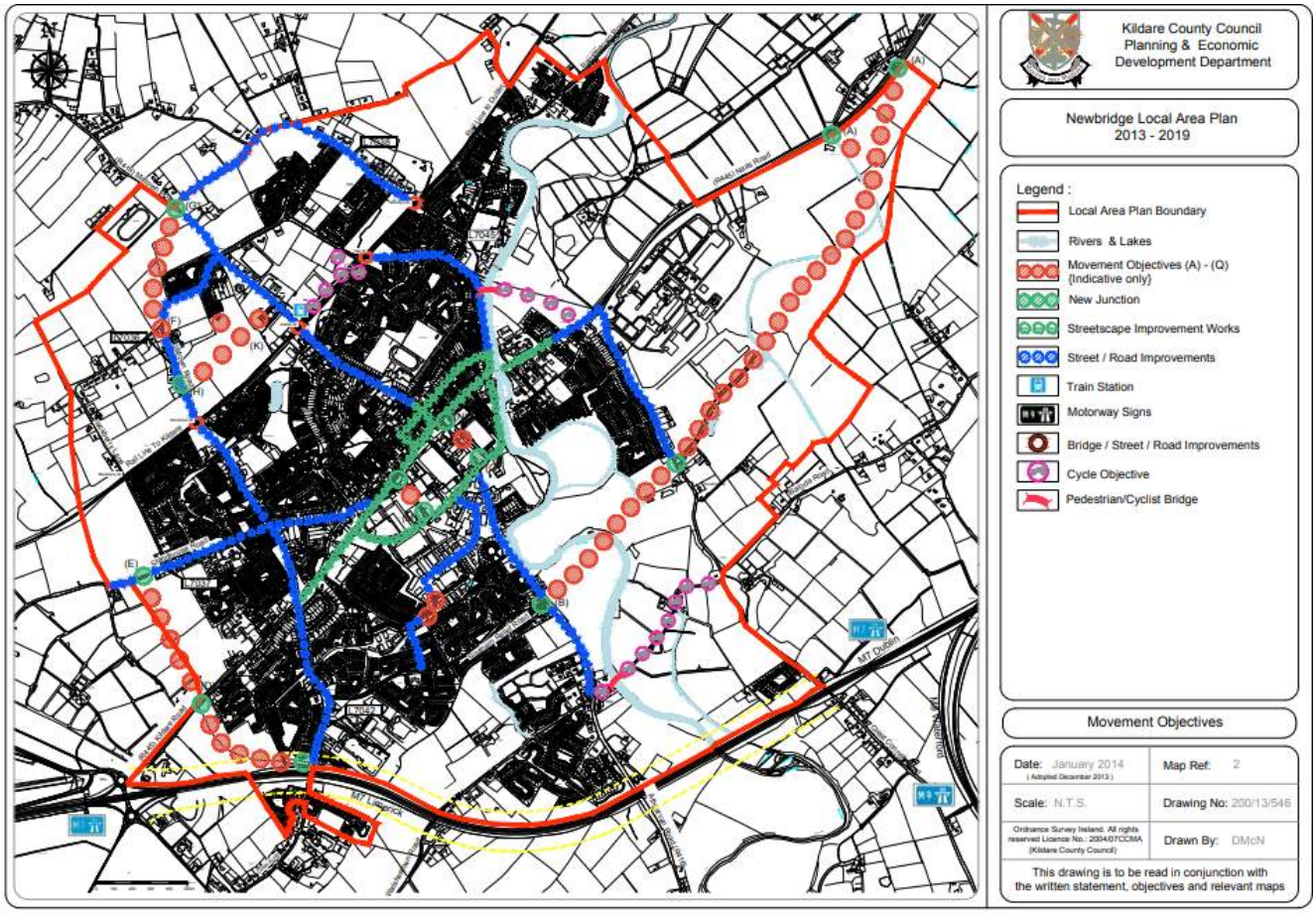


Figure 3-10: Map 2 Movement Objectives - Newbridge Local Area Plan

As discussed later in this report it is proposed as part of this development to contribute significantly to both objectives (SRO5a & SRO10h) noted above.

3.4.2 Kildare County Council Development Plan (2017-2023)

General proposals and objectives as noted in the Development Plan are to reduce car dependency and increase the use of sustainable means of transport such as walking, cycling and the use of public transport.

3.5 Coordination with Other Projects

There are a number of relevant granted planning permissions in the area relating to traffic generation.

1. The adjacent Ardstone Homes Limited residential development located opposite the River Liffey to the south-west of the proposed site (Planning Reference: ABP-302141-18).
2. The proposed Distribution Warehouse located on the NSORR Barola DAC (Planning Reference: 211/248).
3. The change of use of the (distribution) warehouse element to beverage manufacturing use located on the NSORR (Planning Reference: 20/259).

The TTA reports from each of the above applications were reviewed and the development traffic predicted in each report has been included in this submission's 'Do Nothing' 'without development' traffic calculations.

Traffic flows in all cases presented in this report include the surveyed 2021 background traffic with a growth factor applied plus the predicted development traffic.

4 Proposed Development

Aston Limited intend to apply to An Bord Pleanála for permission for a strategic housing development at this site at Great Connell, Newbridge, County Kildare. This subject site comprises the lands surrounding and including the dwellings of 'Greatconnell' and 'Valencia Lodge', Great Connell, Newbridge, Co. Kildare, Eircodes: W12 TW29 and W12 V382.

The development will consist of the demolition of existing site structures (2,622.3 sqm) and the construction of 569 no. residential units, a neighbourhood centre with 11 no. units (commercial floor area 2,141 sqm) and a childcare facility (886 sqm), a circa 350 metre section of distributor road, and all ancillary and associated works on a site of 27.64 ha. The proposed development comprises:

1. Demolition of existing site structures (total 2,622.3 sqm) comprising; 'Great Connell' a two-storey dwelling of 331.9 sqm with detached single storey garage and outhouses of 48 sqm; 'Valencia Lodge' a single storey dwelling of 135.6 sqm with a single storey garage of 17.8 sqm; two no. single storey sheds of 1,440 sqm and 595 sqm, and a three-sided shed of 54 sqm.
2. Construction of 569 no. new residential dwellings (325 no. houses and 244 no. apartments) comprising:
   - 64 no. two-bed houses; 173 no. three-bed houses; and 88 no. four-bed houses (ranging in height from 2 to 3 storeys).
   - Apartment Block A (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
   - Apartment Block B (Part 3 and 4 Storeys): 5 no. one-bed apartments; 14 no. two-bed apartments; and 3 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 112.4 sqm.
   - Apartment Block C (Part 3 and 4 Storeys): 4 no. one-bed apartments; 19 no. two-bed apartments and 4 no. three-bed apartments. These proposed units have private balconies or terraces, and access to a community roof terrace of 87 sqm.
   - 13 no. apartments above the proposed Neighbourhood Centre comprising; 4 no. own-door two-bed apartments; 3 no. shared-access one-bed apartments; and 6 no. shared-access two-bed apartments. These proposed units have private balconies or terraces.
   - 160 no. own-door apartments in 2- and 3- storey buildings comprising; 16 no. one-bed apartments; 78 no. two-bed apartments, 66 no. three-bed duplex apartments. These units will have private amenity areas in the form of terraces, balconies and/or rear gardens.
3. Provision of Neighbourhood Centre (ranging in height between 2 and 4 storeys) with 11 no. commercial units comprising: a convenience shop of 909 sqm (unit 1); 3 no. doctor/dentist/physio units of 120 sqm, 120 sqm and 90 sqm (units 6, 7, and 8, respectively); a café of 125 sqm (unit 4); a restaurant of 213 sqm (unit 9); and 5 no. shop/convenience services units of 112 sqm, 49 sqm, 171 sqm, 100sqm and 100 sqm (units 2, 3, 5,10 and 11, respectively). The proposed Neighbourhood Centre includes an external roof terrace of 176 sqm.
4. Provision of a childcare facility (886 sqm) within the Neighbourhood Centre with capacity for in the order of 154 no. children.
5. Provision of 1,008 no. car parking spaces comprising 650 no. spaces for the proposed houses; 312 no. spaces for the proposed apartments; and 46 no. spaces to serve the Neighbourhood Centre.
6. Provision of 732 bicycle parking spaces comprising 536 no. secure residential spaces, 134 no. residential visitor spaces, and 62 no. spaces to serve the Neighbourhood Centre.
7. A series of 18 no. public open spaces and pocket parks are proposed throughout the residential development (2.613 ha net area).
8. Provision of an 8.31 ha amenity area adjoining the River Liffey.
9. Vehicular access to the proposed development from Great Connell Road via a circa 350 metre section of the Newbridge South Orbital Relief Road (NSORR), including footpaths and cycle paths.

It is proposed to upgrade the existing Great Connell Roundabout to a signalised junction and provide footpaths and cycle paths within the subject site along the Great Connell Road.

10. Proposed development facilitates future potential pedestrian, cycle and vehicular links to adjoining residential development and undeveloped lands.
11. All enabling and site development works, landscaping, boundary treatments, lighting, services and connections, including connection to permitted wastewater pumping station, waste management, ESB substations, compensatory flood storage and all other ancillary works above and below ground on a site of 27.64 ha.
12. A 7 year permission is sought.

The proposed development will deliver approx. 350m of the Newbridge Southern Outer Orbital Relief Road (NSORR) from Great Connell Roundabout to the furthest access point within the development site along the new road. The NSORR splits the proposed development into two distinct sections, north and south.

A bridge over the River Liffey is required to complete the NSORR delivery in accordance with the requirements of the Newbridge Local Area Plan which will eventually tie in with the section of the NSORR to be delivered under Planning Reference: ABP-302141-18, on the western side of the River Liffey. Aston Ltd has commenced the planning process with Kildare County Council to deliver this final road and bridge connection of the NSORR under a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559). Aston Ltd has taken on this element in order to expedite the approval process and ensure that the connection can be made in a shorter timeframe than if Kildare County Council were to progress under public procurement.

The impact of the full delivery of the NSORR is discussed further in Section 7 of this report.

The proposed layout for the development is detailed in the series of drawings by OFA Architects accompanying this report and an extract is included in Figure 4-1.

Figure 4-1: Proposed Site Layout

5 Vehicle Trip Generation

Given the proposed development is primarily residential, peak flows generated by the proposed development will typically occur on weekdays between 07:00 am and 09:00 am in the mornings and between 16:00 pm and 18:00 pm in the evenings. This range corresponds to the findings of the November 2021 surveys completed on the surrounding road network. The worst-case peak hour times are used in all analysis in this report.

The purpose of this section is to determine the overall number of trips that will be generated by the proposed development. The proposed development includes Apartments, Houses and a neighbourhood centre incorporating a creche and commercial units.

In order to estimate the likely volumes of traffic that will be generated by the residential units within the proposed development, trip rates approved by Kildare County Council in the Ardstone Homes Ltd neighbouring residential development's TTA (Planning Reference: ABP-302141-18) were used and applied pro-rata to the relevant number of houses, apartments and the creche within the development. The rates used were similar to those generated using current TRICS data, the higher values have been utilised for a worst-case scenario presentation.

Trip rates recommended by TRICS (Trip Rate Information Computer System) were extracted from the database and applied pro-rata to the proposed commercial floor space within the neighbourhood centre.

Full details of the TRICS analysis are reproduced in Appendix C.

Table 5-1: Estimated AM and PM peak hour traffic (PCUs) generated by proposed using TRICS

Land Use	Calculation Factor		Trip rate				Additional Number of Trips			
			AM Peak		PM Peak		AM Peak		PM Peak	
	GFA m2/100	No. of Units / Children	AM Arriv	AM Depart	PM Arriv	PM Depart	AM Arriv	AM Depart	PM Arriv	PM Depart
Apartments	-	244	0.055	0.147	0.158	0.077	13	36	39	19
Houses	-	325	0.138	0.276	0.28	0.194	45	90	91	63
Creche (per child)	-	154	0.198	0.166	0.061	0.094	31	26	9	15
Commercial	21.4	-	1.579	1.507	1.981	2.117	34	32	42	45
Total							**123**	**184**	**181**	**142**

6 Trip Assignment and Distribution

There will be an increase in traffic generated by the proposed development. All traffic entering and exiting the proposed development will be obliged to obey all road traffic regulatory requirements.

The proposed development traffic will be apportioned during the analysis in accordance with the directional flow of the 2021 surveyed traffic for Scenario A (Existing scenario).

In Scenario B (Ballyfarm Road open) assumptions have been made as to the distribution of development and background traffic based on the origin destination findings of the November 2021 traffic survey. Refer to Appendix B for November 2021 traffic flow diagrams showing background distribution flows applied in this scenario.

In Scenario C (NSORR fully open) the predicted traffic routing assumed by DBFL TTA report completed for Planning Reference: ABP-302141-18 adjacent to the site was used. The DBFL report, predicted that if the NSORR is completed, including the new bridge over the River Liffey, a number of existing users will use the new crossing, bypassing the existing river crossing at St. Conleth's Bridge.

Refer to Appendix D for predicted distribution of proposed development traffic for all Scenarios explored.

7 Traffic Forecasting

In the absence of any specific local traffic growth information, it was assumed that baseline traffic will continue to grow at the levels recommended by the TII in the Project Appraisal Guidelines (PAG) – Unit 5.3 - Travel Demand Projections publication by the TII (October 2021). The Project Appraisal Guidelines describe three levels of transport model functionality. The static model, which reflects traffic volumes on the basis of link flows, is best suited to the proposed development. Such models do not attempt any route assignment, and hence are applicable for networks where no change in traffic flows will result from a proposed scheme. We have used figures from Table 6.1 'Link-Based Growth Rates' for the Kildare County annual growth rates.

The year of opening of the scheme was assumed to be 2024. A 15-year analysis period for the scheme would give a design year of 2039. The central growth factors from the Project Appraisal Guidelines – Unit 5.3 publication are appropriate and are detailed below:

- TII Link Based Growth Rates: Annual Growth Factor for 2016-2030 = 1.0197 (LVs) & 1.0378 (HVs);
- TII Link Based Growth Rates: Annual Growth Factor for 2030-2040 = 1.0062 (LVs) & 1.0155 (HVs).
- TII Link Based Growth Rates: Annual Growth Factor for 2040-2050 = 1.0053 (LVs) & 1.0187 (HVs).

With regards to the volume of traffic using the network, generally the passenger car is adopted as the standard unit and other vehicles are assessed in terms of PCU's. Cars and Light Goods Vehicles are grouped together as Light Vehicles (LV). All other Goods Vehicles, Buses and Coaches are defined as Heavy Vehicles (HV).

Estimated future baseline traffic flows on the road network in the vicinity of the proposed development were calculated by applying these factors to the 2021 surveyed flows.

8 Assessment and Road Impact

The impact on the local external road network has been assessed in this TTA. During detailed scoping discussions with Kildare County Council Roads, Transportation & Public Safety Department the relevant junction locations for assessment were agreed as shown in Figure 8-1.

1. Great Connell Roundabout
2. Lidl Distributor Roundabout
3. The Hall / R416 Athgarvan Road / New NSORR (East) Signalised Junction.
4. St. Conleth's Bridge Signalised Junction
5. Buckley's Cross Roundabout

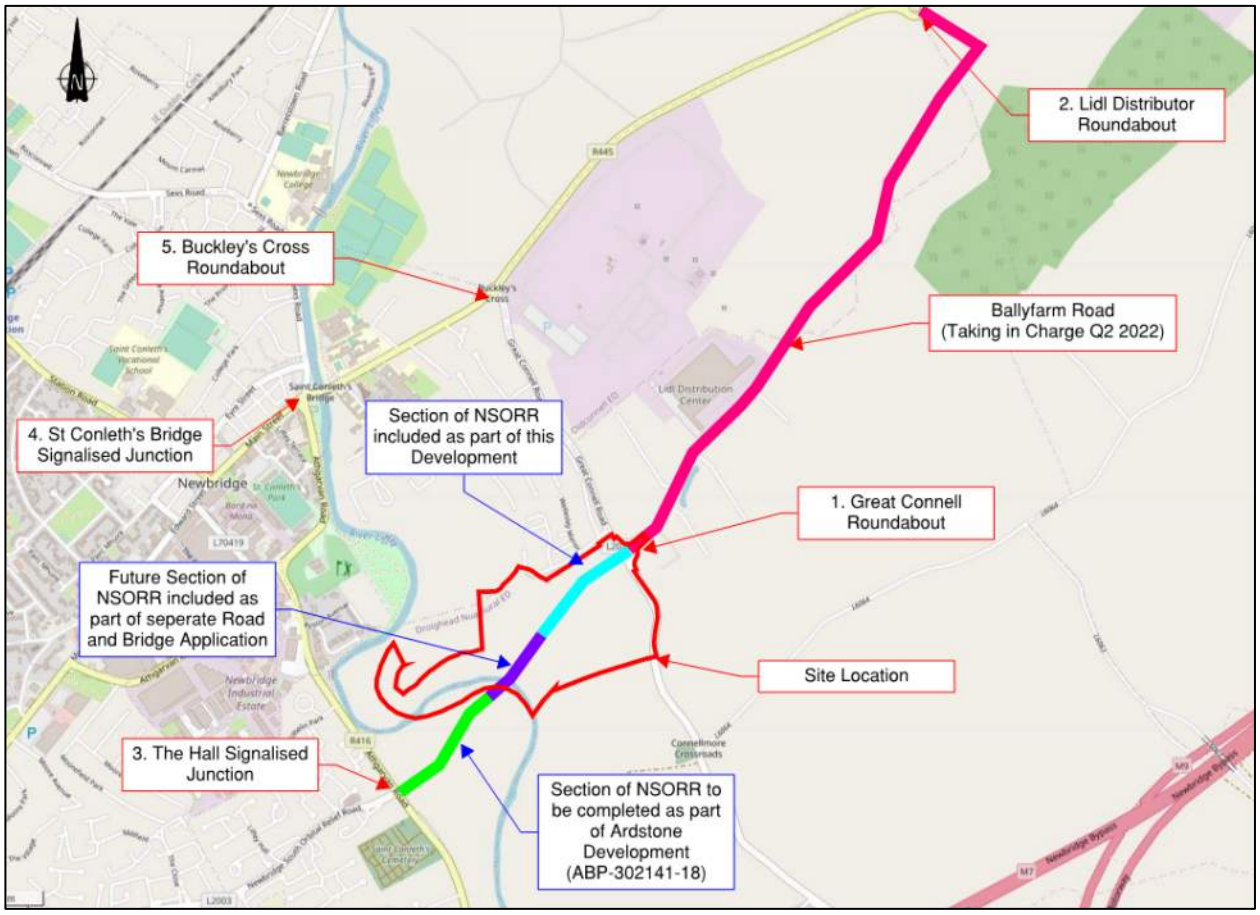


Figure 8-1: Junctions Assessment locations

The delivery of the full NSORR is an objective of the Newbridge Local Area Plan. The completion of the road will have an impact on the existing traffic conditions in the town of Newbridge. Existing and proposed sections of the NSORR are under different ownership/control (Refer to Figures 8-2 & 8-3) for a breakdown.

The Ballyfarm Road (Sections 5-7 on Figures 8-2 & 8-3) will be taken in charge by Kildare County Council in Q2 2022.

The proposed development will deliver approximately 350m of the NSORR from Great Connell Roundabout to the furthest access point within the development site along the new road (Section 4 on Figures 8-2 & 8-3).

Ardstone Ltd has started construction of the western end of the NSORR (Section 1 on Figures 8-2 & 8-3) granted permission under Planning Reference: ABP-302141-18.

A bridge over the River Liffey is required to complete the NSORR (Section 2-3 on Figures 8-2 & 8-3). Aston Ltd has commenced the planning process with Kildare County Council to deliver this road and bridge connection of the NSORR under a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559). Aston Ltd has taken on this element in order to expedite the approval process and ensure that the connection can be made in a shorter timeframe than if Kildare County Council were to progress under public procurement.

Given the above, it is highly likely that the completion of the NSORR can be delivered within a suitable timeframe for the proposed development. However, the scenarios of with and without the bridge connection were assessed to review the impact on the surrounding junction capacities in the area. Section 8-1 describes the analysis completed.

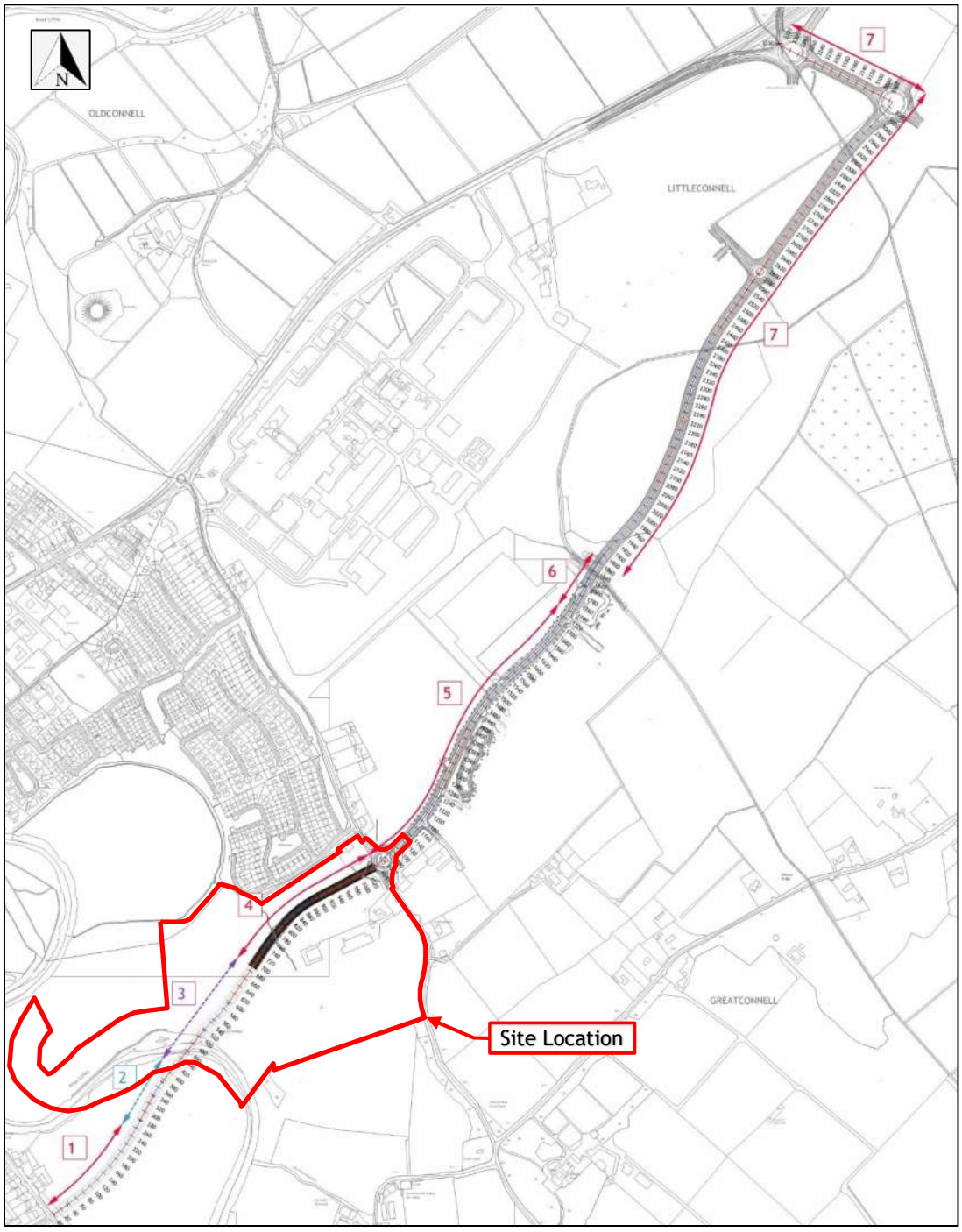


Figure 8-2: NSORR Ownership Details (refer to Figure 8-3 for ownership)

No	Road Section	Planning Reference	Land Ownership	Development Status	Current status of Newbridge Southern Orbital Relief Road (NSORR) section
1	Ch. 0 to Ch. 245	Planning Reference: 18302141	Glenveagh Properties PLC.	Development under construction	Works under construction, road section (245m) be constructed under this application.
2	Ch. 245 to Ch. 410	NA	Glenveagh Properties PLC.	Part of PP5299. Glenveagh agreed for Aston Limited to submit planning application for Road and Bridge. Subject to funding application to government by Kildare Co. Co. (KCC).	This section of road will form part of PP5299.
3	Ch. 410 to Ch. 690	NA	Aston Limited	Part of PP5299 Application with Aston Limited. Development subject of funding application to government by KCC.	Road section (280m), includes 170m long five span bridge across the River Liffey. This section of road will form part of PP5299.
4	Ch. 690 to Ch. 1040	SHD Planning Application ABP-311390-21	Aston Limited	Part of PP5299 and Aston Ltd SHD, as part of its development to form part of the NSOORR.	Road section (350m). Planned road construction works also incorporated into Aston Limited SHD Application planned for Q3 2021. Road design and layout in line with NSOORR requirements.
5	Ch. 1040 to Ch. 1740	Reference No: 99/1828	Ballyfarm Limited & Cox Property Limited	Taking in Charge agreed with Kildare Co Co for Q2 2022. To be opened to the public	Road section (700m) complete to TIC standard.
6	Ch. 1740 to Ch. 1870	Reference No: 17/564	Ballyfarm Limited & Cox Property Limited	Taking in charge agreed with KCC for Q2 2022.	Road section (130 m) complete to TIC standard. Partially funded by Kildare Co Co through a development agreement with Lidl GmbH. Awaiting taking in charge by KCC. Planned Q2-2022
7	Ch. 1870 to Ch. 3330.	Reference No: 17/563	Oakgale Limited	Taking in charge anticipated to be Q2 2022 in line with Ballyfarm Road.	Road section (1460m) complete to TIC standard. Partially funded by Kildare Co Co. through a development agreement with Lidl GmbH. Awaiting taking in charge by KCC. Planned Q2-2022

Figure 8-3: NSORR Ownership Details (refer to Figure 8-2 for locations)

8.1 Junction Analysis

The junctions, as detailed above, were each assessed for the proportion of generated development traffic in the scenarios which has the greatest impact on the junction against the existing background traffic. Where the generated development traffic accounted for less than 5% (TII threshold for traffic congested areas) of the existing background traffic, it was determined that junction capacity modelling of that junction was not required as the development trips generated are deemed to have very little impact on that existing junction capacity. See Table 8-1 below for the calculated percentage of development trips against the existing traffic.

Table 8-1: Development Traffic Percentage of Background Traffic

Junction	Junction	Worst Case Development Trips Generated		DN 2024 Background Traffic	Percentage	Modelling Required
1	Great Connell Roundabout	AM	306	476	64.2%	✓
		PM	323	457	70.6%	
2	Lidl Distributor Roundabout	AM	103	1618	6.3%	✓
		PM	164	1600	10.1%	
3	The Hall / R416 Athgarvan Road	AM	98	1243	7.9%	✓
		PM	103	1189	8.6%	
4	St. Conleth's Bridge	AM	94	1955	4.7%	✗
		PM	100	2137	4.7%	
5	Buckley's Cross	AM	274	1713	16.0%	✓
		PM	290	1707	17.0%	

Based on the information in Table 8-1 above all of the junctions other than St. Conleth's Bridge Signalised Junction exceeded the 5% trigger and were brought forward for further analysis. However following further consultation with KCC St. Conleth's Bridge were also brought forward for further analysis.

Capacity analysis was carried out for the junctions listed below:

1. Great Connell Roundabout (Roundabout/Signalised solutions)
2. Lidl Distributor Roundabout
3. The Hall / R416 Athgarvan Road / New NSORR (East) Signalised Junction.
4. St. Conleth's Bridge Signalised Junction
5. Buckley's Cross (Roundabout/Signalised solutions)

The following scenarios for the surrounding road network were analysed:

A. No section of the NSORR open – current day scenario – These results remain in the report for historical reasons but given the Ballyfarm Road will be delivered before the development is operational (Q2 2022), they are to be viewed for information only and to prove the impacts of the proposals put forward for the proposed development.
B. Only Ballyfarm Road section of NSORR open (delivery Q2 2022)
C. NSORR fully complete

The following development scenarios were analysed for each of the above scenarios with and without development for all junctions:

1. Opening year: 2024
2. Design year: opening year + 5 years: 2029
3. Design year: opening year + 15 years: 2039

The analysis involved examining the projected traffic flows on the local road network both 'with' and 'without' the proposed development in place. The morning peak period and the evening peak period have been examined in order to assess the busiest case in terms of local traffic on the road network and traffic generated by the proposed development.

LinSig software was used for the analysis of the signalised junctions. Junctions 9 ARCADY software was used for analysis of the roundabouts.

8.1.1 Analysis Assumptions

1. For NSORR open Scenarios the results shown assume that the connections are complete in the Opening Year 2024
2. Aston Lands Phasing assumptions:
    a. Phase 1 (north of NSORR) Opening Year 2024 – 169 units & Commercial & Creche
    b. Phases 2-4 (south of NSORR) from Design Year 2029 – 400 units
3. Traffic generation from the permitted developments noted in Section 3.5 above are included in the 'Without Development' scenario results.

LinSig: Analysis Note:

Junction capacities shown below are only one theoretical interpretation of the phase/stage setup for the existing junction. The results should be viewed more for a comparative assessment of with and without proposed development for the various scenarios.

ARCADY Analysis Note:

The ratio of flow to capacity (RFC) is an indicator of the likely performance of a junction under design year loading. Due to site to site variation, there may be a standard error of prediction of the entry capacity by the formulae of + or - 15% for any site. Thus, queuing should not occur in the various turning movements in the chosen design year peak hour in 5 out of 6 peak hour periods or sites if a maximum RFC of about 85% is used. Once the RFC is at 1.0 the Junctions 9 modelling software produces results regarding queues and delays that is unrepresentative of the actual or likely effects. The results should be viewed more for a comparative assessment of with and without proposed development for the various scenarios.

8.1.2 Great Connell Roundabout

Table 8-2: Summary of Junctions 9 Analysis Results for Great Connell Roundabout (refer to Appendix E for full results output)

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Yes Ballyfarm Road		Scenario C - NSORR Fully Complete	
	Without Development	With Proposed Development	Without Development	With Proposed Development	Without Development	With Proposed Development
Peak Hour Flow	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC
AM 2024 Opening Year	20%	20%	20%	20%	23%	23%
AM 2029 Design Year	22%	23%	21%	23%	25%	26%
AM 2039 Design Year	24%	24%	23%	24%	29%	30%
PM 2024 Opening Year	11%	17%	11%	13%	23%	26%
PM 2029 Design Year	12%	24%	13%	17%	26%	34%
PM 2039 Design Year	13%	24%	13%	18%	30%	36%

The Great Connell Roundabout is large enough to be considered well within the design threshold of RFC<85% in any of the above scenarios explored. It can be seen from the above scenarios that the opening of the NSORR moves traffic onto this roundabout, which it has ample capacity to receive. The relative impact of the proposed development is also improved with the opening of the NSORR.

The above analysis predicts that by the Design Year 2039 the existing roundabout would be operating well within the design threshold with the full development in operation during both the AM and PM peak hours for all scenarios.

Kildare County Council have requested that the Great Connell Roundabout is signalised for safety reasons rather than capacity reasons. It is proposed to provide a new signalised junction to replace the existing large roundabout as per Figure 8-4 below and Appendix F. The junction will include for toucan crossings on all arms for enhanced safety of vulnerable road users. These works will be delivered as part of the proposed development.

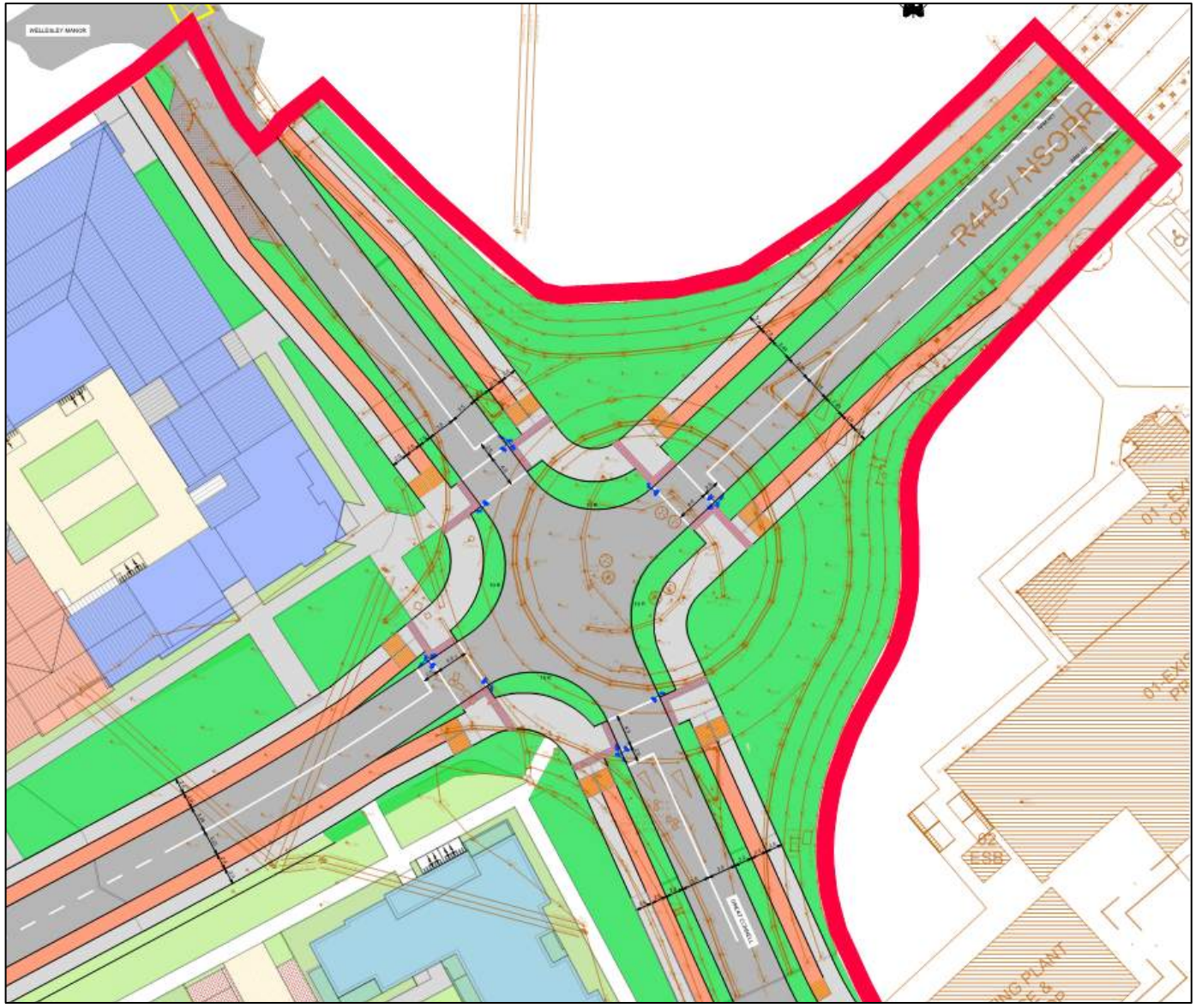


Figure 8-4: Great Connell Roundabout converted to a Signalised Junction (Extract from drawing 192229-PUNCH-XX-XX-DR-C-0431)

For this analysis a Cycle Time of 90 Seconds was used with pedestrians called every cycle. Only Scenarios B & C for the proposed development have been considered as the junction will only be signalised when the development is operational in 2024 when the Ballyfarm Road will be open to the public.

Table 8-3: Summary of Linsig Analysis Results for Great Connell Signalised Junction (refer to Appendix G for full results output)

	Scenario B - No Bridge/ Yes Ballyfarm Road	Scenario C - NSORR Fully Complete
	With Proposed Development	With Proposed Development
Peak Hour Flow	Maximum DOS	Maximum DOS
AM 2024 Opening Year	30%	57%
AM 2029 Design Year	40%	66%
AM 2039 Design Year	42%	71%
PM 2024 Opening Year	21%	48%
PM 2029 Design Year	31%	59%
PM 2039 Design Year	32%	63%

The above analysis predicts that by the Design Year 2039 the proposed signalised junction would be operating within the design threshold (<90% DOS) with the full development in operation during both the AM and PM peak hours for all scenarios. It is proposed to deliver this signalised junction in place of the existing Great Connell Roundabout as part of the proposed development. The detailed design of the signal controls are to be agreed with KCC.

8.1.3 Lidl Distributor Roundabout

Table 8-4 Summary of Junctions 9 Analysis Results for Lidl Distributor Roundabout (refer to Appendix H for full results output)

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Yes Ballyfarm Road		Scenario C - NSORR Fully Complete	
	Without Development	With Proposed Development	Without Development	With Proposed Development	Without Development	With Proposed Development
Peak Hour Flow	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC
AM 2024 Opening Year	48%	52%	44%	45%	41%	44%
AM 2029 Design Year	56%	62%	51%	54%	49%	51%
AM 2039 Design Year	60%	66%	55%	58%	52%	55%
PM 2024 Opening Year	41%	44%	38%	39%	35%	37%
PM 2029 Design Year	47%	52%	44%	46%	40%	44%
PM 2039 Design Year	50%	56%	47%	49%	43%	47%

The Lidl Distributor Roundabout is large enough to be well within the design threshold of RFC<85% in all of the above scenarios explored. The relative impact of the proposed development is also improved with the opening of the NSORR.

The existing roundabout was constructed in 2020 in accordance with current design standards and includes segregated cycle and pedestrian lanes on all existing arms for safe crossing of vulnerable road users, cyclists do not have to join the roundabout carriageway to cross the junction.

8.1.4 The Hall Signalised Junction

It must be noted that the Hall Signalised Junction is operated under a MOVA system which reacts to traffic as it approaches the junction. Existing signal phase/stage information was received from Kildare County Council and inputted into the LinSig model. For this analysis a Cycle Time of 120 Seconds was used with pedestrians called every cycle as per the existing stage/phase timings received from Kildare County Council.

Table 8-5: Summary of LinSig Analysis Results for The Hall Signalised Junction (refer to Appendix I for full results output)

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Yes Ballyfarm Road		Scenario C - NSORR Fully Complete	
	Without Development	With Proposed Development	Without Development	With Proposed Development	Without Development	With Proposed Development
Peak Hour Flow	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS
AM 2024 Opening Year	55%	55%	55%	55%	70%	73%
AM 2029 Design Year	62%	63%	62%	63%	78%	85%
AM 2039 Design Year	67%	67%	67%	67%	87%	95%
PM 2024 Opening Year	50%	50%	50%	50%	61%	65%
PM 2029 Design Year	61%	61%	61%	61%	68%	80%
PM 2039 Design Year	65%	65%	65%	65%	78%	85%

The opening of the Ballyfarm Road section of the NSORR has no impact on the existing signalised junction capacity as development traffic cannot connect to this junction over the River Liffey.
The opening of the Bridge section of the NSORR moves traffic onto this signalised junction due to traffic rerouting from the NSORR. The delivery and opening of the full NSORR is an objective of the Newbridge LAP and Aston Ltd is progressing the remainder of the NSORR delivery as part of this proposed development as well as under a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559). With the full NSORR in place and the full proposed development in place in 2039 the AM DOS is 95% and PM is 85% (90% is the desired capacity for a signalised junction). This level of service for a signalised junction is considered acceptable in an urban environment. There are always opportunities available for signalised junction improvements in the future on the ground by altering the cycle time to respond to actual traffic loading or by providing on-crossing detectors to improve pedestrian impact on the junction capacity.

8.1.5 St. Conleth Bridge Signalised Junction

As noted in Section 8.1 the proportion of generated development traffic against the existing background traffic at St. Conleth Bridge Signalised Junction is below 5% in both the AM & PM peaks. However, Kildare County Council requested that the junction undergo further capacity modelling to confirm the predicted impact of the proposed development on the junction.

It must be noted that the St. Conleth Bridge Signalised Junction is operated under a SCOOT system which reacts to traffic as it approaches the junction. Existing signal phase/stage information was received from Kildare County Council and inputted into the LinSig model. For this analysis a Cycle Time of 144 Seconds was used with pedestrians called every cycle as per the existing stage/phase timings received from Kildare County Council.

Table 8-6: Summary of LinSig Analysis Results for St. Conleth Bridge Signalised Junction (refer to Appendix J for full results output)

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Yes Ballyfarm Road		Scenario C - NSORR Fully Complete	
	Without Development	With Proposed Development	Without Development	With Proposed Development	Without Development	With Proposed Development
Peak Hour Flow	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS	Maximum DOS
AM 2024 Opening Year	144%	148%	144%	148%	114%	116%
AM 2029 Design Year	160%	167%	160%	167%	127%	129%
AM 2039 Design Year	173%	179%	173%	179%	137%	139%
PM 2024 Opening Year	129%	132%	129%	132%	96%	99%
PM 2029 Design Year	148%	153%	148%	153%	107%	111%
PM 2039 Design Year	159%	164%	159%	164%	115%	119%

St. Conleth's Bridge signalised junction with the current stage/phase timings is already operating above design capacity in the AM and PM Peaks Opening Year without the proposed development traffic. The opening of the Ballyfarm Road section of the NSORR has no impact on the existing signalised junction as the traffic rerouting from the NSORR does not occur in this scenario.

With the addition of the Phase 1 traffic the DOS increases by a maximum of only 4% in the opening year Scenario B and 3% in Scenario C. With the full development traffic in 2039 the DOS increases by a maximum of only 6% in Scenario B and 4% in Scenario C.

The opening of the bridge section of the NSORR improves the DOS such that it would not reach the existing level of DOS by 2039, even with the full the development traffic added. The relative impact of the proposed development on the existing junction is also improved with the full opening of the NSORR.

As noted previously Aston Ltd is progressing the remainder of the NSORR delivery as part of this proposed development as well as under a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559) which will expedite the delivery of the full NSORR. Therefore, it is highly likely that the Scenario C results are the improvements that the junction will achieve.

8.1.6 Buckley's Cross

It must be noted that during the below analysis we simulated the queuing at the existing roundabout based on the assumption that the existing roundabout is at theoretical capacity in the current scenario. The modelled queuing is assumed the same for Scenarios A-C even though some improvements with queuing should be experienced with the opening of the NSORR (Scenario C). The results should be viewed more for a comparative assessment of with and without proposed development for the various scenarios.

Table 8-7: Summary of Junctions 9 Analysis Results for Existing Buckley's Cross Roundabout Modelled with Queuing (refer to Appendix K for full results output)

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Yes Ballyfarm Road		Scenario C - NSORR Fully Complete	
	Without Development	With Proposed Development	Without Development	With Proposed Development	Without Development	With Proposed Development
Peak Hour Flow	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC	Max RFC
AM 2024 Opening Year	103%	111%	99%	103%	80%	81%
AM 2029 Design Year	120%	135%	115%	121%	89%	90%
AM 2039 Design Year	129%	144%	123%	129%	96%	98%
PM 2024 Opening Year	80%	88%	77%	81%	57%	59%
PM 2029 Design Year	94%	107%	88%	97%	65%	66%
PM 2039 Design Year	101%	114%	96%	104%	70%	71%

Buckley's Cross Roundabout is above design capacity (>85%RFC) in the Opening Year in the current scenario without any development is place.

With the addition of the Phase 1 traffic the DOS increases by a maximum of only 4% in the opening year Scenario B and 2% in Scenario C. With the full development traffic in 2039 the DOS increases by a maximum of only 8% in Scenario B and 2% in Scenario C.

The opening of Ballyfarm Road improves the existing scenario and the taking in charge of this road is to be furnished by Q2 2022 however the AM Peak is still above the design threshold in the opening year (with Phase 1 development). This level of congestion with Phase 1 development (167 units plus Commercial and Creche) would be considered acceptable in the norms of an urban environment.

When the full NSORR is operational, the capacity of Buckley's Cross Roundabout will be improved, and it will be below the design threshold for roundabout capacity in the PM Peak up to the design Year 2039 and in approximately 2027 (with full development) in the AM Peak. This level of congestion would be considered acceptable in the norms of an urban environment. The relative impact of the proposed development is also improved with partial or full opening of the NSORR. As noted previously Aston Ltd is progressing the delivery of an additional section of the NSORR as part of this proposed development as well as progressing a separate planning application for a section of the NSORR (Section 247 Kildare County Council Consultation Reference: PP2559) which will expedite the delivery of the full NSORR. Therefore, it is highly likely that the Scenario C results are the improvements that the junction will achieve.

It is planned by Kildare County Council to signalise Buckley's Cross in the future therefore we have considered the impact in relation to the proposed development. Figure 8-5 and Appendix L show an indicative layout of a proposed signalised junction design at Buckley's Cross. It should be noted that the design presented below is based on topographical survey from December 2021, and allowances for cycle lanes have been made as the R445 is identified as a primary route in the Strategic Cycle Network Plan for County Kildare. For the analysis of the signal controlled junction, a Cycle Time of 120 Seconds was used with pedestrians called every second cycle. Only Scenarios B & C for the proposed development have been considered as the Ballyfarm Road will be open to the public in Q2 2022.

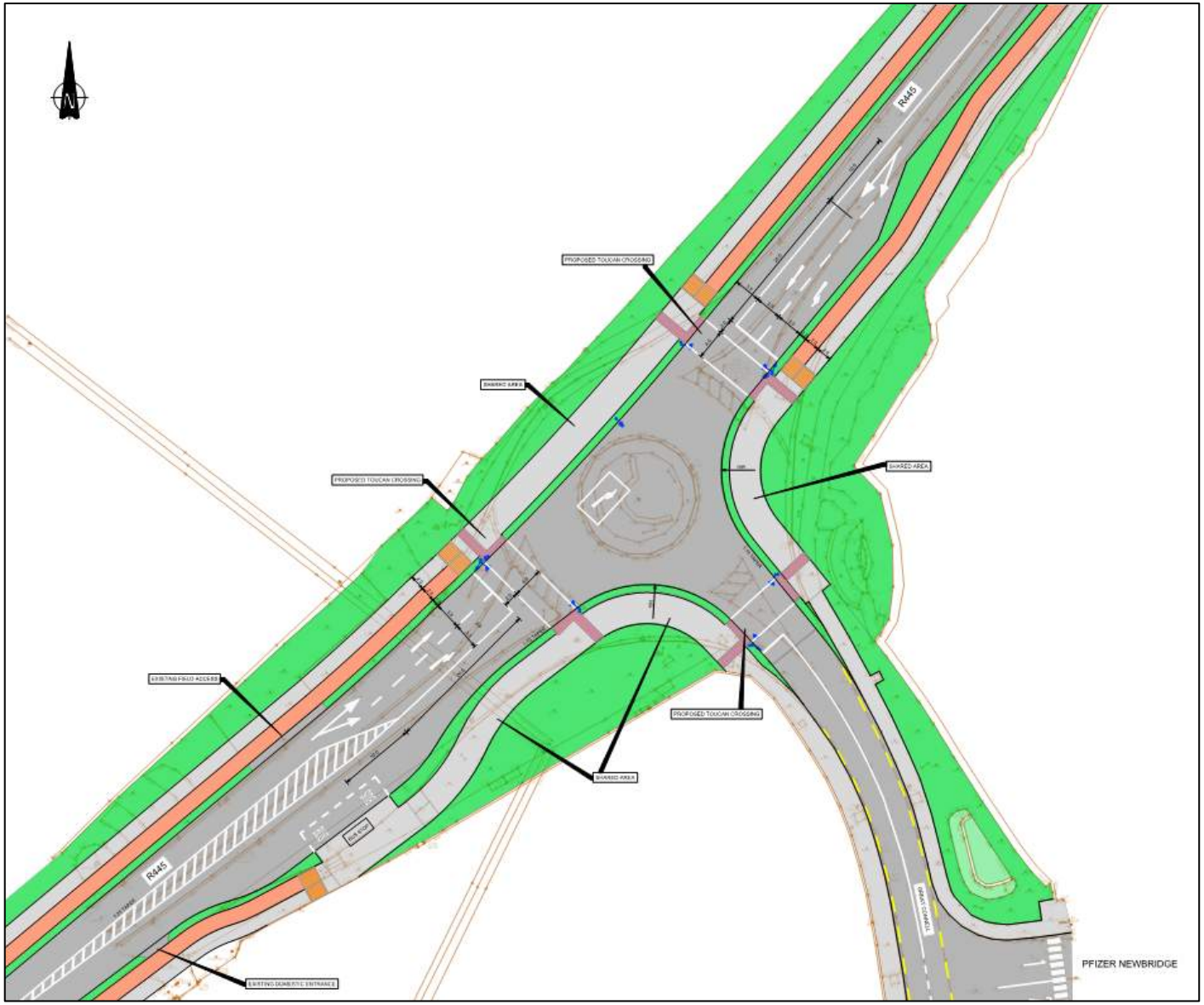


Figure 8-5: Buckley's Cross Indicative Layout of Proposed Signalised Junction (Extract from drawing 192229-PUNCH-XX-XX-DR-C-0432)

Table 8-8: Summary of LinSig Analysis Results for proposed Buckley's Cross Signalised Junction (refer to Appendix M for full results output)

	Scenario B - No Bridge/ Yes Ballyfarm Road	Scenario C - NSORR Fully Complete
	With Proposed Development	With Proposed Development
Peak Hour Flow	Maximum DOS	Maximum DOS
AM 2024 Opening Year	74%	56%
AM 2029 Design Year	87%	62%
AM 2039 Design Year	93%	67%
PM 2024 Opening Year	70%	41%
PM 2029 Design Year	85%	46%
PM 2039 Design Year	93%	49%

It is possible to provide a signalised junction of Buckley's Cross that would be at design capacity for both design scenarios up to the Design Year 2039 with the existing levels of traffic accounted for. With the addition of the full Aston Lands development traffic the design capacity is within the norms of urban development.

When the full NSORR is operational, the capacity of Buckley's Cross Signalised Junction would be improved, and it would be well below the design threshold for junction capacity (max DOS in the design year 2039 of 67%). As noted previously Aston Ltd is progressing the delivery of an additional section of the NSORR as part of this proposed development as well as progressing a separate planning application for a section of the NSORR (Section 247 Kildare County Council Consultation Reference: PP2559) which will expedite the delivery of the full NSORR. Therefore, it is highly likely that the Scenario C results are the improvements that the junction will achieve if signalised.

It is proposed that Kildare County Council would complete a detailed design and deliver this signalised junction if the progression of the River Liffey Bridge Crossing via the NSORR cannot be fulfilled following Phase 1 (167 units plus Commercial and Creche) operation. Contributions will be sought by Kildare County Council and agreed with Aston Ltd. for the implementation of this signalised junction.

8.1.7 Analysis Summary

1. Ballyfarm Road will be taken in charge by Kildare County Council in Q2 2022. Scenario A (where Ballyfarm Road is not open) is only included in the results above to prove the impact of the partial/full opening of the NSORR.

2. As noted previously Aston Ltd is progressing the delivery of an additional section of the NSORR as part of this proposed development as well as progressing a separate planning application for a section of the NSORR (Section 247 Kildare County Council Consultation Reference: PP2559) which will expedite the delivery of the full NSORR. Therefore, it is highly likely that the Scenario C results for each junction are the most appropriate results for the entire network analysis.

3. The Great Connell Roundabout and Lidl Distributor Roundabout are large enough to cater for the proposed development traffic into the design year of 2039 and are well within the design threshold of RFC<85% for all of the scenarios considered.

4. The Lidl Distributor Roundabout existing design has segregated cycle and pedestrian lanes on all arms for safe crossing of vulnerable road users, cyclists do not have to join the roundabout carriageway. No improvements are proposed.

5. It is proposed to alter the Great Connell junction from a roundabout to a signalised junction in order to improve the safety for vulnerable road users. Aston Ltd will deliver this upgrade as part of the proposed development.

6. Whilst the capacity of Buckley's Cross Roundabout is above the design standards at completion of Phase 1 (167 units plus Commercial and Creche) when the Ballyfarm Road is operational, the level of congestion is commensurate with that to be generally expected in urban areas. The opening of the proposed bridge section of the NSORR further improves the capacity of the roundabout. Aston Ltd have commenced the proposed planning application for the extended road and bridge through Kildare County Council. Kildare County Council are actively seeking funding for the bridge construction, and it is reasonable to assume that the bridge could be open within the Design Year 2029. An alternative signalised junction design of Buckley's Cross has been provided which improves capacity for all scenarios if the bridge cannot be progressed. The works to signalise this junction will be completed by Kildare County Council with an agreement for appropriate contributions to be made with Aston Ltd.

7. The Hall signalised junction works harder once the bridge section of the NSORR is opened but it is still considered an acceptable design capacity and within the norms of an urban environment for all of the scenarios considered.

8. The St. Conleth Bridge signalised junction is already operating above design capacity without the proposed development traffic. With the addition of the Phase 1 traffic the DOS increases by a maximum of only 4% in the opening year and 6% in the 2039 design year with the full development traffic. The opening of the Ballyfarm Road section of the NSORR has no impact on the existing signalised junction as the traffic rerouting from the NSORR does not occur in this scenario. The opening of the bridge section of the NSORR improves the DOS such that it would not reach the existing level of DOS by 2039, even with the full the development traffic added.

9. It is considered that in urban areas a certain level of congestion is to be expected during peak times.

10. The results should be viewed more for a comparative assessment of with and without the proposed Aston Lands development which is deemed to be low in all scenarios.

11. The assessment is consistent with the submissions of Kildare County Council and the determination of An Bord Pleanála on the Vacant Site appeal under ABP Reference: Inspectors Report ABP-303069-18 where ABP noted that the existing road network is adequate to support housing on the site and that the delivery of the NSORR would not prevent or delay the provision of housing on the site.

Table 8-9: Worst Case Summary 2039 Results all Surrounding Junctions

	Scenario A - No Bridge/No Ballyfarm Road		Scenario B - No Bridge/ Ballyfarm Road		Scenario C - NSORR Fully Complete	
Junction	2039 Without Development RFC/DOS	2039 With Development RFC/DOS	2039 Without Development RFC/DOS	2039 With Development RFC/DOS	2039 Without Development RFC/DOS	2039 With Development RFC/DOS
Great Connell Roundabout	24%	24%	23%	24%	29%	30%
Great Connell Signalised (Proposed 90 second cycle time)	-	-	-	42%	-	71%
Lidl Distributor Roundabout	60%	66%	55%	58%	52%	55%
The Hall Signalised Junction (Existing 120 second cycle time)	67%	67%	67%	67%	87%	95%
Conleth Bridge Signalised Junction (Existing 144 second cycle time)	173%	179%	173%	179%	137%	139%
Buckley's Cross Roundabout	129%	144%	123%	129%	96%	98%
Buckley's Cross Proposed Signalised Junction (Proposed 120 second cycle time)	-	-	-	93%	-	67%

In summary, all of the junctions assessed function within capacity without the full delivery of the NSORR (with the exception of St Conleth's Bridge and Buckley's Cross which are already operating above design thresholds). The maximum impact of the proposed development is +6% at all junctions assessed without the full NSORR in place. The proposed development is therefore considered not to be reliant on the delivery of the full NSORR.

The delivery of the full NSOORR improves the already congested junctions and reduces the proposed development impact to only +2% at both of those junctions. Aston Ltd is progressing the remainder of the NSORR delivery as part of this proposed development as well as under a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559) which will expedite the delivery of the full NSORR. Therefore, it is highly likely that the Scenario C results for each junction are the most appropriate results for the entire network analysis.

9 Road Safety

A Road Safety Audit for the development will be undertaken and supplied as a separate report. The Road Safety Authority provides collision statistics online for Irish roads.

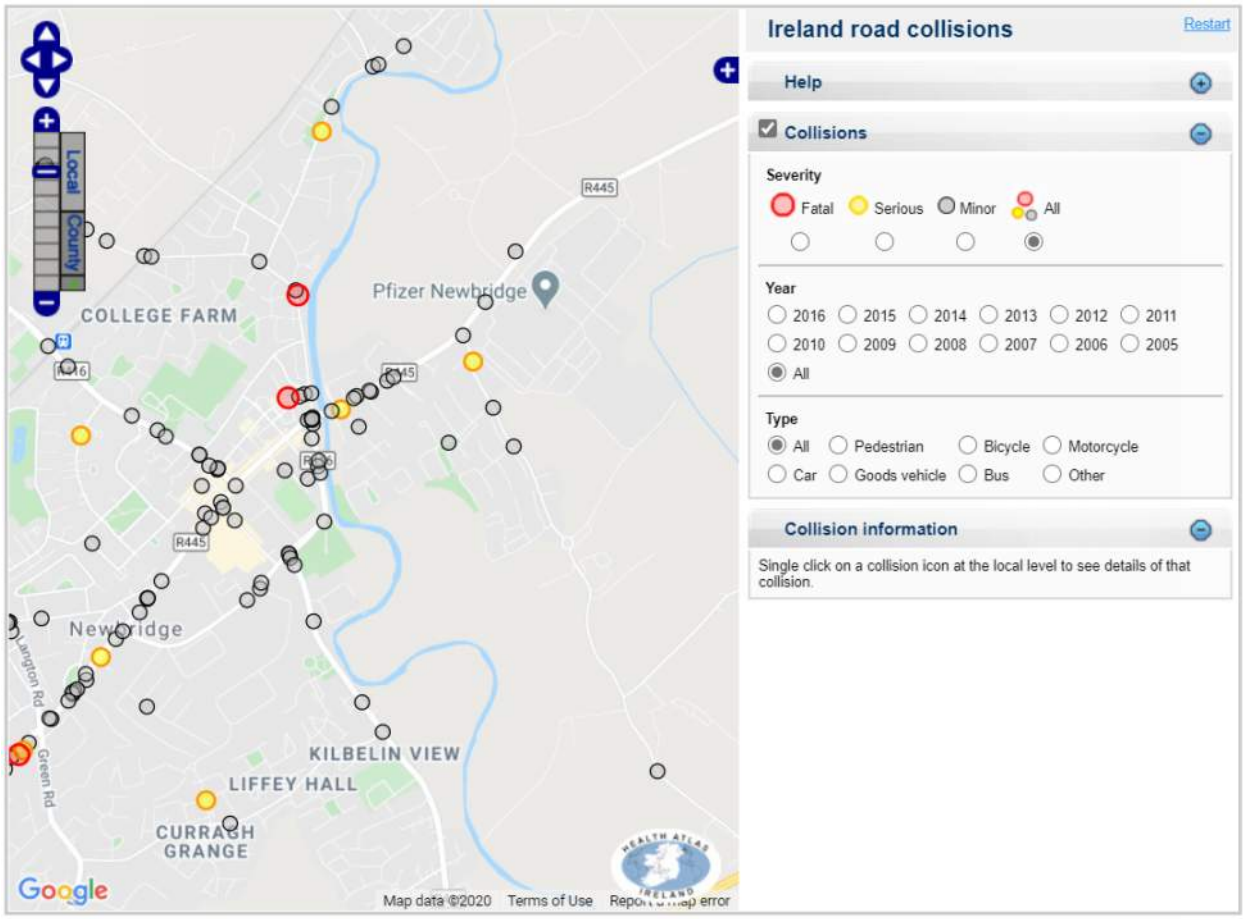


Figure 9-1 Road Safety Statistics adjacent to the development site available at: https://www.rsa.ie/en/RSA/Road-Safety/RSA-Statistics/Collision-Statistics/Ireland-Road-Collisions/

10 Internal Layout

The layout of the proposed development is detailed in the architect and landscape architect's drawings submitted as part of this application. Connectivity of pedestrians and cyclist to adjacent lands is prominent on the site layout. Refer to PUNCH Mobility Management Plan (192229-PUNCH-XX-XX-RP-C-0006) included in the planning documentation which shows the site connectivity with the surrounding land and town centre.

10.1 DMURS

The roads layout together with pedestrian and cycle facilities for the site have been developed considering the design principles set out in the Design Manual for Roads and Streets (2019). A DMURS Compliance Statement (192229-PUNCH-XX-XX-RP-C-0005) for the proposed development is included in the planning documentation.

10.2 Site Access Layout

10.2.1 Primary Site Access

As noted previously, it is proposed to access the site primarily via the western arm off the Great Connell Roundabout which will be upgraded to a signalised junction in order to improve safety for vulnerable road users. A portion of the NSORR is to be constructed in conjunction with the upgrading of the Great Connell Roundabout to a signalised junction.

With the completion of the remainder of the NSORR Road and Bridge, to be submitted separate to this application, access will also be provided via the Hall Signalised Junction to the east.

10.2.2 Secondary Site Access

A secondary access point is also proposed via linkages to the Wellesley Manor Development to the north of the site. This access is principally intended to facilitate pedestrian and cyclist permeability between the proposed development and the Wellesley Manor Development.

10.3 Newbridge South Orbital Relief Road (NSORR)

The proposed development includes 350m of the NSORR. The carriageway width is to be 6.5m along the section of the NSORR with 2m wide cycleways and 2m wide footways either side.

10.4 Internal Street Layout

The proposed development internal street layout is to comprise of main access roads and local roads. This includes for 6m carriageway on the main access roads along with 2m wide footpaths either side, and 5.5m wide carriageway on the local roads along with 2m wide footpaths either side.

10.5 Visibility Splays

The site layout has been developed to provide adequate turning provision and fire tender access. Forward visibility and visibility splays have been provided on the basis of the requirements of Sections

4.4.4 and 4.4.5 of the DMURS manual. Compliance with the requirements is set out on PUNCH drawings 192229-PUNCH-XX-XX-DR-C-0625-629.

10.6 Vehicle Manoeuvring

Autotrack analysis has been undertaken to ensure there are no issues with swept paths and manoeuvrability of fire appliances, refuse vehicles, buses and other heavy goods vehicles on the proposed development site layout. Compliance with the requirements is set out on PUNCH drawings 192229-PUNCH-XX-XX-DR-C-0600-0613.

11 Parking

11.1 Car Parking

Car parking serving the apartments in the development is provided in accordance with the guidance for *Peripheral and/or Less Accessible Urban Locations* in the Design Standards for New Apartments (2018) section 4.22. Car parking serving the houses, creche and neighbourhood/commercial centre are provided in accordance with the Kildare County Council Development Plan (2021) 'Table 17.9'

The applicable car parking standards are noted in Table 11-1 to below:

Table 11-1: Design Standards for New Apartments: *Peripheral and/or Less Accessible Urban Locations* Car Parking Requirement

Development type	GFA m2	No. of Units	Requirement	Total	Total Provided
Apartment	-	244	1 space per unit + 1 visitor space per 4 units	305	312
Total				**305**	**312**

Table 11-2: Kildare County Council Development Plan Car Parking Requirement for Residential

Development type	GFA m2	No. of Units	Requirement	Total	Total Provided
House	-	325	2 spaces per unit	650	650

Table 11-3: Kildare County Council Development Plan Car Parking Maximum for Neighbourhood Centre

Neighbourhood Centre	GFA m2	No. of Units / Children	Maximum Provision	Total Maximum	Total Provided
Creche	-	10 staff 154 children	0.5 per staff member plus 1 per 4 children	43	46
Convenience (unit 1)	909	-	1 space per 20 sq.m gross floor area	45	
Convenience (units 2,3,5,10,11)	532	-	1 space per 20 sq.m gross floor area	27	
Clinic / Group Medical Practices (Doctor/Dentist/Physio units 6,7,8)	330	5 consulting rooms	2 spaces per consulting room	10	
Café & Restaurant (units 4 & 9)	338	-	1 space per 10 sq.m	34	
Total				**159**	**46**

Table 11-4: Summary Car Parking Provision for Proposed Development

Development type	Total Provided
Residential	962
Commercial	46
Total	1,008

It is proposed to provide 1,008 car parking spaces on the development site, which is slightly lower than the combined max requirements of the above tables of 1,114 spaces. The full designation of residential car parking will be provided for each house/apartment.

The Kildare County Council development plan allows for a maximum 159 no. spaces at the neighbourhood centre. The 46 no. proposed spaces satisfy 29% of the maximum requirement which is in accordance with the Development Plan guidance stating that this maximum should not be a target figure.

This car parking provision is aimed at reducing the additional traffic loading in the area and is deemed appropriate at the neighbourhood centre for the following reasons:

1. The variety of sustainable travel options available for the local residents; such as walking or cycling within and surrounding the development.
2. The nature of the uses of the site and likely durations of stays.
3. The proximity to both the proposed and existing housing in the locality and the nearby industrial and warehousing zoning within walking / cycling distance.
4. The abundant pedestrian and cyclist linkages to the proposed and existing developments.

The car parking area around the neighbourhood centre will have a number of shared spaces for each use. The breakdown of car parking allocation is displayed on architectural drawing PA-011.

The 'standard' parking spaces will be demarcated with white lines. All car parking spaces will be 2.5m by 5m, with disabled spaces providing an additional width and length of 1.2m.

A number of "non-standard" spaces are provided at the neighbourhood centre as shown below in Figure 11-1.

- 1 no. space will be allocated for car sharing such as GoCar to facilitate short term and or occasional car users. Refer to Section 3.7 for further information.
- 5% of the total number non-residential spaces will be designated disabled user car-parking spaces. The disabled spaces are to be demarcated with yellow lines, a protected hatched area and appropriate road markings to identify these spaces. The proposed location of the disabled parking spaces will be in close proximity to the building entrances. 4 no. disabled spaces shall be provided.
- Electric Vehicle Charging Points (EVCP) will be provided for as per the Kildare County Council Development Plan standards i.e.10%. through the provision of 5no. spaces. All houses shall be provided with electric vehicle charging points.

Figure 11-1: Extract from architectural site layout showing non-standard parking provision neighbourhood centre

11.2 Cycle Parking

Cycling is to be significantly encouraged as part of the development. Cycle parking serving the proposed development is provided in accordance with the Kildare County Council Development Plan 'Table 17.10. The applicable cycle parking standards are noted in Table 11-5 below:

Table 11-5: Kildare County Council Cycle Parking Space Requirements

Neighbourhood Centre	GFA m2	No. of Units / Children	Minimum Provision	Total Minimum
Creche	-	10 staff 154 children	1 space per 5 staff + 1 space per 10 children	17
Convenience (unit 1)	909	-	1 space per 100 sq.m gross floor area	9
Convenience (units 2,3,5,10,11)	532	-	1 space per 2 car spaces	14
Clinic / Group Medical Practices (Doctor/Dentist/Physio units 6,7,8)	330	5 consulting rooms	1 per 5 staff + 0.5 per consulting room	5
Café & Restaurant (units 4 & 9)	338	-	1 space per 30 sq.m public floor space	7
Total				**52**

Cycle parking serving the apartments in the development is provided in accordance with the Design Standards for New Apartments (2018) section 4.17.

Table 11-6: Design Standards for New Apartments: Peripheral and/or Less Accessible Urban Locations

Car Parking Requirement

Unit type	Residential requirement per bedroom	Visitor requirement per unit	No of units	No of bedrooms	Residential requirement	Visitor requirement
1 bed Apartment	1	0.5	17	17	17	9
2 bed Apartment	1	0.5	135	270	270	68
3 bed Apartment	1	0.5	76	228	228	38
Totals			**228**	**505**	**515**	**115**
					Total Apartment Requirement	**630**

Table 11-7: Summary Cycle Parking Provision for Proposed Development

Development type	Long Stay Provided	Short Stay Provided	Total Provided	Total Required
Apartments	536	134	**670**	630
Commercial			**40**	35
Creche			**22**	17
Total			**732**	682

Refer to the PUNCH Outline Mobility Management Plan (192229-PUNCH-XX-XX-RP-C-0006) included in the planning documentation for further information on provisions for cyclists within the proposed development.

12 Summary and Conclusion

1. The proposed development is a residential scheme comprising of 569 no. residential units, including a mix of apartments and houses, in addition to a proposed childcare facility/creche and neighbourhood centre/commercial building.

2. Traffic surveys of the requested relevant junctions for analysis were completed in November 2021.

3. For the purposes of our assessment, the adjacent residential trip rates (Planning Reference: 18302141) were used for the proposed residential development traffic and the TRICS database was consulted to provide an equivalent trip rate for the proposed commercial development site.

4. It is proposed to access the proposed residential development from the existing Great Connell Roundabout which will be signalised as part of this development in order to improve the safety of vulnerable road users in the area.

5. The Ballyfarm Road will be taken in charge by Kildare County Council in Q2 2022.

6. The proposed development will deliver a section of the Newbridge Southern Outer Orbital Relief Road (NSORR) from Great Connell Road to the furthest access point within the development site along the new road. The remainder of the NSORR delivery is being progressed by Aston Ltd as part of a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559). Aston Ltd has taken on this element in order to expedite the approval process and ensure that the connection can be made in a shorter timeframe than if Kildare County Council were to progress under public procurement. These two elements together will enable the completion of the NSORR objective identified in the Newbridge LAP.

7. Capacity analysis was carried out on a number of surrounding existing junctions for a number of different scenarios relating to the delivery of the NSORR. In summary, all of the junctions assessed function within capacity without the full delivery of the NSORR (with the exception of St Conleth's Bridge and Buckley's Cross which are already operating above design thresholds). The maximum impact of the proposed development is +6% at all junctions assessed without the full NSORR in place. The proposed development is therefore considered not to be reliant on the delivery of the full NSORR. The delivery of the full NSOORR improves the already congested junctions and reduces the proposed development impact to only +2% in the worst case design year 2039 at both of those already congested junctions.

8. An option to provide a signalised junction in place of Buckley Cross Roundabout has been presented. These works will be progressed by Kildare County Council (with contributions to be agreed with Aston Ltd) if the delivery of the NSORR cannot be progressed following the Phase 1 development of this SHD.

9. Car and cycle parking spaces for the proposed development have been provided to meet the requirements set out in the Kildare County Council Development Plan and Design Standards for New Apartments Guidelines for Planning Authorities.

Appendix A Tri Partite Meeting Comments & PUNCH Responses

Tri Partite Meeting Comments

This section of the report addresses the Traffic and Transportation Items raised in the ABP Notice of Pre-Application Consultation Opinion issued following the ABP Tri Partite meeting which took place online on 22nd October 2021.

An Bord Pleanála Notice of Pre-Application Consultation Opinion – Item 1

1. *Traffic and Transport*

   Further consideration and/or justification of the documents as they relate to the traffic and transport provision. The submitted documentation should address the requirements of the Newbridge Local Area Plan 2013-2019 (as extended) for the delivery of the Newbridge Southern Outer Orbital Relief Road (NSOORR) and Compliance with Objective SRO5a. Regards should be given to the submission of a Traffic and Transport Assessment, including inter alia, potential scenarios with and without the bridge, capacity of the surrounding junction and the impact of the proposed development on the surrounding road network. Plans and particulars should clearly indicate compliance with the required upgrades stated in the Transport Section Report, including any third –party consents required for the works, the need for signalised junctions in the vicinity of the site and the DMURS standards for the internal network.

PUNCH Response

Consultation was undertaken with Kildare County Council Roads, Transportation & Public Safety Department on numerous occasions throughout 2021 via meetings (see main meeting dates below) and email correspondence to allow them to express their views/comments regarding the proposed development prior to the submission of the planning application.

1. 23 March 2021 –Preplanning Meeting - Kildare County Council Consultation Reference: PP5026
2. 15th April 2021- Kildare County Council Roads, Transportation & Public Safety Department
3. 22nd October 2021 – SHD Pre-Application 311390 – Tripartite Meeting
4. 1st March 2022 – Pre-Planning meeting for road and bridge application for remainder of NSORR - Section 247 Kildare County Council Consultation Reference: PP2559

The finalised TTA has taken due account of the comments received from Kildare County Council throughout the design development of this SHD project and we note in particular:

1. The TTA has been carried out in accordance with TII's Traffic and Transport Assessment Guidelines PE-PDV-02045 (May 2014) and adheres to the recommendations of the Design Manual for Urban Roads & Streets (DMURS).

2. Access to the proposed residential development will be from the existing Great Connell Roundabout. This junction will be upgraded to a signalised junction as part of this SHD development in order to improve the safety of vulnerable road users in the area.

3. The proposed development will deliver a 350m section of the Newbridge Southern Orbital Relief Road (NSORR) from Great Connell Road to the furthest access point within the

development site along the new road. The remainder of the NSORR delivery is being progressed by Aston Ltd as part of a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559). Aston Ltd has taken on this element in order to expedite the approval process and ensure that the connection can be made in a shorter timeframe than if Kildare County Council were to progress under public procurement. These two elements together will enable the completion of the NSORR objective (SRO5a) identified in the Newbridge LAP.

4. The Ballyfarm Road will be taken in charge by Kildare County Council in Q2 2022.

5. Capacity analysis was carried out on a number of surrounding existing junctions for a number of different scenarios relating to the delivery of the NSORR. In summary, all of the junctions assessed operate within capacity without the full delivery of the NSORR (with the exception of St Conleth's Bridge and Buckley's Cross which are already operating above design thresholds). The maximum impact of the proposed development is +6% at all junctions assessed without the full NSORR in place. The proposed development is therefore considered not to be reliant on the delivery of the full NSORR. The delivery of the full NSORR improves the already congested junctions and reduces the proposed development impact to only +2% at both of those junctions.

6. An option to provide a signalised junction in place of Buckley Cross Roundabout has been presented. These works will be progressed by Kildare County Council (with contributions to be agreed with Aston Ltd).

Kildare County Council SHD Stage 2 Opinion (SHD202105)

Transport Section Report Recommendations

The KCC Roads, Transportation & Public Safety Department has examined the information it received in relation to the proposed Strategic Housing Development and requires further details to provide a complete technical assessment and accordingly has the following comments:

Kildare County Council Transport Recommendation

1. The applicant is to note it is the view of the Kildare County Council that it is an absolute necessity the completed section of the Newbridge South Orbital Relief Road (NSORR) to the east of the development site is fully opened prior to the construction phase should this Strategic Housing Development receive a grant of planning permission. This is to minimize traffic disruption and congestion on the existing public road network allowing traffic to access the R445 Regional Road and M7 Motorway east of Newbridge during the construction phase and once the development is completed and occupied. The applicant is requested to confirm the opening date of this section of the NSORR.

PUNCH Response

Noted. The Applicant can confirm that the completed section of the NSORR, known as Ballyfarm Road, will be taken in charge by Kildare County Council in Q2 2022 prior to the construction phase should this Strategic Housing Development receive a grant of planning permission.

Kildare County Council Transport Recommendation

2. The applicant is to note it is the view of the Kildare County Council that it is an absolute necessity to provide the full length of the Road Objective within the red line of the development site and a bridge crossing over the River Liffey in order to prevent traffic disruption on the public road network east of the River Liffey in order to avoid excessive traffic disruption and congestion in this area due to the development's quantity of 606 no. residential units and commercial neighbourhood centre.

PUNCH Response

Noted. The proposed development will deliver a 350m section of the Newbridge Southern Orbital Relief Road (NSORR) from Great Connell Road to the furthest access point within the development site along the new road. The remainder of the NSORR delivery is being progressed by Aston Ltd as part of a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559). Aston Ltd has taken on this element in order to expedite the approval process and ensure that the connection can be made in a shorter timeframe than if Kildare County Council were to progress under public procurement. These two elements together will enable the completion of the NSORR objective (SRO5a) identified in the Newbridge LAP.

The completed section of the NSORR, known as Ballyfarm Road, will be taken in charge by Kildare County Council in Q2 2022 prior to the construction phase should this Strategic Housing Development receive a grant of planning permission.

Capacity analysis was carried out on a number of surrounding existing junctions for a number of different scenarios relating to the delivery of the NSORR. In summary, all of the junctions assessed operate within capacity without the full delivery of the NSORR (with the exception of St Conleth's Bridge and Buckley's Cross which are already operating above design thresholds). The maximum impact of the proposed development is +6% at all junctions assessed without the full NSORR in place. The proposed development is therefore considered not to be reliant on the delivery of the full NSORR. The delivery of the full NSOORR improves the already congested junctions and reduces the proposed development impact to only +2% in the worst case design year 2039 at both of those already congested junctions.

An option to provide a signalised junction in place of Buckley Cross Roundabout has been presented. These works will be progressed by Kildare County Council (with contributions to be agreed with Aston Ltd).

Kildare County Council Transport Recommendation

a. The applicant is requested to provide a detailed design that is to indicate lines of sight and corner radii at junctions, longitudinal gradients / vertical and horizontal curvature for the Road Objective SR05 (a) to be in accordance with the Design Manual for Urban Roads and Streets (DMURS) 2019. All manhole covers and frames shall not be located in the wheel track of the main carriageway of the Road Objective. E600 manhole covers and frames with a 150mm deep frame shall be used for both foul and surface water manholes located on the main carriageway of the Road Objective. This is having consideration to the projected high volumes of traffic that will use the fully opened Road Objective in order to avoid rocking of manhole covers from vehicular traffic.

PUNCH Response

Noted. The proposed development will deliver a 350m section of the Newbridge Southern Orbital Relief Road (NSORR) from Great Connell Road to the furthest access point within the development site along the new road. Junction radii, longitudinal gradients and vertical/horizontal curvature meet the requirements set out in the Design Manual for Urban Roads and Streets (DMURS) 2019 and are included on the drawings supporting this planning application. E600 manhole cover and frame are included on the standard detail drawings supporting the planning application. The alignment of foul and surface water sewers along the NSORR has been optimised to avoid, as far as practicable, locating manholes in the wheel tracks on the main carriageway.

A Stage 1 Road Safety Audit, appropriate for Planning Stage of Design, has been carried out in accordance with the requirements of TII Publication Number GE-STY-01024 (Dec 2017) by Bruton Consulting Engineers and is included in support of this SHD planning submission. The road safety measures recommended have been adopted and will be implemented at detailed design stage.

Kildare County Council Transport Recommendation

b. The surface water runoff collection, attenuation and disposal system for the Road Objective is to be completely separate to that serving the proposed residential development. This shall be in accordance with the Greater Dublin Strategic Drainage Study (GDSDS) and the recommendations pertaining to Sustainable Urban Drainage Systems (SUDs). The locations of lockable gullies are to be indicated as part of the design. This design shall also demonstrate the manner in which surface water runoff is collected and prevented from being discharged onto the Road Objective from the roads to serve the proposed residential development.

PUNCH Response

Noted. A separate surface water run-off collection, attenuation and disposal system has been provided for the NSORR. The surface water design is in accordance with GDSDS and The SuDS Manual (CIRIA 753). Lockable Gully locations are indicated on the drawings supporting this planning application. The roads serving the Residential Scheme are drained entirely separately to the NSORR. The roads generally have 125mm high kerbs which will prevent run-off from any roads adjoining the NSORR discharging surface water run-off onto the NSORR.

Kildare County Council Transport Recommendation

c. The Road Objective embankment is to be constructed using Class 1 or Class 2C fill with a design CRB >= 2.5%. This would permit the use of a 150mm subbase over a minimum of 600mm of capping layer.

PUNCH Response

Noted. Refer to drawing 192229-PUNCH-XX-XX-DR-0553 for NSORR Road Cross-Section indicating earthworks build-ups.

Kildare County Council Transport Recommendation

d. Finished road levels are to be indicated in the design for the full length of the overall Road Objective providing existing road levels on the L-2028 local road, a detailed design for the bridge crossing the River Liffey and the horizontal and vertical alignment with the section of the Road Objective under construction under construction at Kilbelin by Ardstone Homes Ltd / Glenveagh Properties PLC pursuant to the planning permission register reference: 18/302141. The applicant is requested to liaise with Ardstone Homes Ltd/ Glenveagh Properties PLC in respect of this.

PUNCH Response

Noted. The proposed development will deliver a 350m section of the Newbridge Southern Orbital Relief Road (NSORR) from Great Connell Road to the furthest access point within the development site along the new road. The finished road levels for this section of the NSORR are indicated on drawings 192229-PUNCH-XX-XX-DR-0411 and 192229-PUNCH-XX-XX-DR-0414.

The remainder of the NSORR delivery is being progressed by Aston Ltd as part of a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559). Aston Ltd has taken on this element in order to expedite the approval process and ensure that the connection can

be made in a shorter timeframe than if Kildare County Council were to progress under public procurement. These two elements together will enable the completion of the NSORR objective (SRO5a) identified in the Newbridge LAP.

Kildare County Council Transport Recommendation

e. The cycle tracks on the Road Objective SR05 (a) are to be in accordance National Transport Authority's National Cycling Manual pertaining to widths and signage, the location of lighting standards and signs, the avoidance of obstructions and the re-establishment of a cyclist's position on-road

PUNCH Response

Noted. The cycle tracks provided on the NSORR for planning stage are in accordance with the National Transport Authority's National Cycling Manual. At detailed design stage, the developed design and drawings will ensure that the cycle tracks widths and signage, the location of lighting standards and signs, the avoidance of obstructions and the re-establishment of a cyclist's position on-road fully meet the requirements of the National Transport Authority's National Cycling Manual.

Kildare County Council Transport Recommendation

f. Mitigation measures in order to prevent speeding on the Road Objective

PUNCH Response

Noted. The horizontal and vertical curvature along the NSORR has been designed in accordance with DMURS for a design speed of 60kph which is compatible with the proposed speed limit of 50kph. In Section 4.1.2 'Self-Regulating Streets' of DMURS research has shown how the provision of relatively tight vertical and horizontal curvature, together with the street characteristics of close proximity of buildings, active ground floor use and pedestrian activity will have a self-regulating impact on drivers resulting in lower speeds.

Kildare County Council Transport Recommendation

g. Permeability links from the Road Objective to the Liffey Linear Park.

PUNCH Response

Noted. Permeability links are provided from the NSORR to the Liffey Linear Park. Refer to Architect and Landscape drawings for further details.

Kildare County Council Transport Recommendation

h. The design of the Road Objective is to have full consideration to the "Guidelines for the Treatment of Noise and Vibration in National Road Schemes" 2004 and the "Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes" March 2014 in meeting a day-evening-night sound level of 60 dB Lden (free-field residential façade criterion) for the Road Objective having a speed limit of 50 km/h.

PUNCH Response

Noted. An Environmental Impact Assessment Report (EIAR) has been prepared in support of this SHD Planning Application. The EIAR has assessed the noise impact of the proposed development on the surrounding environment. Noise mitigation measures such as noise barriers will be introduced into the detailed design stage of the NSORR road scheme where appropriate.

Kildare County Council Transport Recommendation

i. The design of the Road Objective shall ensure proposed residential development, crèche and neighbourhood centre shall not be exposed to Lden noise levels in excess of 70 dB (A) and Lnight noise levels in excess of 57 dB (A) as the Road Objective incorporating a bridge crossing the River Liffey will qualify as a "Major Road" pursuant to the European Communities Environmental Noise Regulations 2018, S.I. No. 549/2018 once fully operational. The detailed design is to incorporate noise amelioration/mitigation measures and the omission/ relocation of development set back from the Road Objective in achieving this.

PUNCH Response

Noted. An Environmental Impact Assessment Report (EIAR) has been prepared in support of this SHD Planning Application. The EIAR has assessed the noise impact of the proposed development on the surrounding environment. Noise amelioration/mitigation measures such as noise barriers will be introduced into the detailed design stage of the NSORR road scheme where appropriate.

Kildare County Council Transport Recommendation

3. In conjunction with item 2 d and 2 e. set out in the foregoing, the applicant is requested to submit an Acoustic Design Statement for the Road Objective having 3 million vehicle passages + per annum as it will qualify as a "Major Road" pursuant to the European Communities Environmental Noise Regulations 2018 S.J. No. 549 / 2018 once the Road Objective is fully open and operational. This Acoustic Design Statement is to contain noise amelioration / mitigation measures (as required) and demonstrate the following:

a. The predicted post mitigation Lden noise levels at 1.5 metres above ground level and 1.5 metres above all floor levels are below the 70 dB (A) L.den threshold of the Kildare County Council Third Noise Action Plan 2019-2023 so as not to negatively impact on the useability of open space (both public and private) and the ability of future residents to have patio doors / Windows open during the summer months. Predicted noise level contours are to be indicated on Site Layout Plan drawings at scales of 1:500.

b. The predicted post mitigation Light noise levels at 1.5 metres above all floor levels are below the 57 dB (A) Lnight threshold of the Kildare County Council Third Noise Action Plan 2019-2023. Predicted noise level contours are to be indicated on Site Layout Plan drawings at scales of 1:500.

c. The predicted internal noise levels of the proposed residential units to be in accordance with the recommended indoor arnbient noise levels for a dwelling as prescribed under the British Standards BS 8233:2014. This is also to have an assessment with regard to opening

windows at night (in summer months) and the impact on internal ambient noise levels. This assessment shall also provide an estimate the approximate number of LaFmax events from 11 pm to 7.00 am having regard to potential sleep disturbance.

d. The statement is to incorporate noise amelioration / mitigation measures and the omission / relocation of development set back from the Road Objective in achieving compliance with the Lden and Lnight thresholds. Noise amelioration / mitigation measures and the omission / relocation of development set back from the Road Objective are to be indicated on Site Layout Plan drawings at scales of 1:500.

e. A concluding statement for the overall development indicating full compliance with the Kildare County Council Third Noise Action Plan 2019-2023 and the British Standards BS 8233:2014.

PUNCH Response Item 3a to 3e

Noted. An Acoustic Design Statement has been prepared by the Environmental Consultant and is included with the EIAR in support of this SHD Planning Application.

Kildare County Council Transport Recommendation

4. The applicant is requested to submit a detailed design for the proposed Toucan Crossing on Road Objective in accordance with current standards. The Toucan Crossing is to be in accordance with Kildare County Council's required specifications including:

a. Details of traffic signals.

b. The controller to have ELV and LED signals.

c. The Installation of CCTV camera and pole at the junction to assist monitor relief of traffic flows.

d. Road markings and signs to be in accordance with the Department of Transport, Tourism and Sport (DTTAS) Traffic Signs Manual.

e. The Toucan Crossing is not to be ramped on the Road Objective.

The applicant is requested liaise with the Traffic Management Section of Kildare County Council in regard to this.

PUNCH Response Item 4a to 4e

Noted. A signalised Toucan Crossing is proposed at Ch 745 on the NSORR incorporating the requirements set out by Kildare County Council. Refer to drawing 192229-PUNCH-XX-XX-DR-0560 for details

Kildare County Council Transport Recommendation

5. The applicant is requested to liaise with the National Transport Authority and obtain its written agreement with regard to the design for the two proposed bus stops on the Road Objective.

PUNCH Response

Noted.

Kildare County Council Transport Recommendation

6. The applicant is requested to submit a revised Traffic and Transportation Assessment addressing the concerns of Kildare County Council regarding the following items identified in the "Analysis Summary" of the Punch Consulting Engineers' Traffic and Transportation Assessment dated September 2021 and prepare designs for the following:

> a. Lidl Distributor Roundabout - This junction is on the Strategic Cycle Network Plan for County Kildare and the revised linkages for cyclists (onto the Lidl Distributor Road) are required to be incorporated into Site Layout Plans at scales of 1.250.

PUNCH Response Item 6a

Noted. The Lidl Distributor Roundabout is outside the red and blue line boundaries of this application and thus it is not feasible to include the Strategic Cycle Network Plan linkages (onto the Lidl Distributor Road) on the site layout plans. The Mobility Management Plan makes reference to the Strategic Cycle Network Plan.

The existing roundabout was constructed in 2020 in accordance with current design standards and includes segregated cycle and pedestrian lanes on all existing arms for safe crossing of vulnerable road users, cyclists do not have to join the roundabout carriageway to cross the junction.

Kildare County Council Transport Recommendation

> b. Great Connell Roundabout - It is noted that the roundabout is predicted to operate within capacity. However, large roundabouts can be a hostile environment for vulnerable road users. The applicant is therefore requested to complete a design and assessment for signalising this junction on Site Layout Plan drawing at a scale of 1:250 to include Vulnerable Road User facilities. This design is to be in accordance with the Design Manual for Urban Roads and Streets (DMURS) 2019. This design is to review existing public lighting arrangements and provide upgraded lighting arrangements as deemed required.
>
> The Wellesley Manor junction is located approximately 70m from the existing Great Connell Roundabout. The applicant is requested to assess the impact of the proposed development and the effects it would have on the operation of the Wesley Manor junction with the current configuration of the roundabout and that of a signalised junction. Public lighting arrangements at this location are to be reviewed and the provision of upgraded lighting arrangements as deemed required.

PUNCH Response Item 6b

Noted. It is now proposed to upgrade Great Connell Roundabout to a Signalised Junction as part of this SHD proposal to protect vulnerable road users e.g. pedestrians and cyclists. The Signalised Junction has been designed in compliance with the appropriate design standard TII document DN-GEO-03044-02 Signal Controlled Junctions and Roundabouts. Kildare County Council Roads Planning has reviewed and commented on the design seeking minor adjustments that can be facilitated within

the public available lands. It is proposed to further engage with Kildare County Council Roads Planning Department to reach an agreed layout for the Junction post planning.

Refer to drawings 192229-PUNCH-XX-XX-DR-0431 and 192229-PUNCH-XX-XX-DR-0604.

The analysis has shown that the capacity of the Great Connell junction (roundabout or signalised) is sufficient such that it does not and will not impact Wellesley Manor junction. No queuing is experienced on the northern arm during the peak hours in any of the scenarios explored. The quantum of traffic at the Wellesley Manor junction does not warrant capacity assessment of the impact of the proposed development. As an added precaution a yellow box is noted on Great Connell Road at the existing junction to Wellesley Manor.

Kildare County Council Transport Recommendation

> C. Buckley's Cross Roundabout - It is of concern that the applicant has qualified their analysis by not including existing queuing on the R445 Regional Road in their calculations. To compound this, it is stated that "in urban areas a certain level of congestion is to be expected during peak times". The applicant is requested to provide a design and assessment for a signalised junction including a topographical survey on a Site Layout Plan at a scale of 1:250 to incorporate vulnerable road user facilities including cycle lanes. This design is to be in accordance with the Design Manual for Urban Roads and Streets (DMURS) 2019. This design is to review existing public lighting arrangements and provide upgraded lighting arrangements as deemed required.

PUNCH Response Item 6c

Noted. The roundabout analysis of Buckley's Cross now includes for queuing in the model.

The final TTA now includes a design and a drawing for a potential signalised junction at Buckley's Cross. The signalised junction at Buckley's Cross does not form part of the SHD Planning Submission. The drawing is provided to demonstrate that a Signalised Junction compliant with the requirements of "TII document DN-GEO-03044-02 Signal Controlled Junctions and Roundabouts" can be delivered by Kildare County Council within publicly available lands.

Kildare County Council Transport Recommendation

> d. The Hall Signalised Junction - It is claimed that "there are opportunities available for signalised junction improvements in the future by altering the cycle time". However, the analysis shows the junction being over capacity in 2029. The applicant is requested to provide proposals to increase vehicular capacity having priority for vulnerable road users.

PUNCH Response Item 6d

The analysis of The Hall Signalised junction has since been updated based on November 2021 surveys.

The opening of the Ballyfarm Road section of the NSORR has no impact on the existing signalised junction capacity as development traffic cannot connect to this junction over the River Liffey.

The opening of the Bridge section of the NSORR moves traffic onto this signalised junction due to traffic rerouting from the NSORR. The delivery and opening of the full NSORR is an objective of the

Newbridge LAP and Aston Ltd is progressing the remainder of the NSORR delivery as part of this proposed development as well as under a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559). With the full NSORR in place and the full proposed development in place in 2039 the AM DOS is 95% and PM is 85% (90% is the desired capacity for a signalised junction). This level of service for a signalised junction is considered acceptable in an urban environment and therefore no mitigation measures at this junction are proposed.

Kildare County Council Transport Recommendation

> e. Existing Liffey Bridge Junction - The analysis shows that the development has a negative impact on the performance of the junction without the bridge being constructed. The text that there is a "negligible impact on the existing signalised junction" appears misleading as the junction is shown to be significantly over capacity. Any increase in impact on the capacity of the junction cannot be considered to be unimportant, especially in the context of improving sustainable movement and accessibility in Newbridge Town.

PUNCH Response Item 6e

The analysis of St. Conleth's Bridge Signalised junction has since been updated based on November 2021 surveys.

St. Conleth's Bridge signalised junction with the current stage/phase timings is already operating above design capacity in the AM and PM Peaks Opening Year without the proposed development traffic. The opening of the Ballyfarm Road section of the NSORR has no impact on the existing signalised junction as the traffic rerouting from the NSORR does not occur in this scenario.

With the addition of the Phase 1 traffic the DOS increases by a maximum of only 4% in the opening year Scenario B and 3% in Scenario C. With the full development traffic in 2039 the DOS increases by a maximum of only 6% in Scenario B and 4% in Scenario C.

The opening of the bridge section of the NSORR improves the DOS such that it would not reach the existing level of DOS by 2039, even with the full the development traffic added. The relative impact of the proposed development on the existing junction is also improved with the full opening of the NSORR. Aston Ltd is progressing the remainder of the NSORR delivery as part of this proposed development as well as under a separate planning application (Section 247 Kildare County Council Consultation Reference: PP2559) which will expedite the delivery of the full NSORR. Therefore, it is highly likely that the Scenario C results are the improvements that the junction will achieve.

Kildare County Council Transport Recommendation

7. The applicant is requested to have consideration to the parking assessment of this report to submit revised Site Layout Plans at scales of 1:500 indicating the following:

> a. Revised parking standard for the duplex / apartment units of 1.75 spaces per unit in accordance with Table 17.9 of Chapter 17 of the Kildare County Development Plan 2017-2023 or a revised parking standard of 1.33 spaces per unit (due to its less accessible urban location) in accordance with Section 4.22 of the of the DHPLG "Design Standards for New Apartments March 2018 in conjunction with a Mobility Management Plan providing a robust justification

for this reduced parking standard and the manner in which unauthorised parking of vehicles shall be prevented within the development. The drawings shall indicate off street parking spaces to serve the duplex and apartment development in accordance with Section 4.4.9 of the Design Manual for Urban Roads and Streets (DMURS) 2019.

b. The applicant is requested to consider the parking assessment of this report and address the inadequate vehicular parking proposals of 6 no. spaces for Duplex Block Type 1 numbered 293-300.

c. Vehicular parking spaces for the crèche and neighbourhood centre development to be in accordance with Table 17.9 of Chapter 17 of the Kildare County Development Plan 2017 - 2023.

PUNCH Response Item 7a to 7c

Noted. Revised carparking provisions have been adopted as follows: Car parking serving the apartments in the development is provided in accordance with the guidance for *Peripheral and/or Less Accessible Urban Locations* in the Design Standards for New Apartments (2018) section 4.22.

Car parking serving the houses, creche and neighbourhood/commercial centre are provided in accordance with the Kildare County Council Development Plan (2021) 'Table 17.9'

Kildare County Council Transport Recommendation

d. Lines of sight at all junctions within the application site to be in accordance with the Design Manual for Urban Roads and Streets (DMURS) 2019 having a setback distance "X' of 2.4 metres.

e. Corner radii at all junctions within the application site to be in accordance with the Design Manual for Urban Roads and Streets (DMURS) 2019.

f. Longitudinal gradients / vertical sag curvature for the roads of the residential development to be in accordance with the Design Manual for Urban Roads and Streets (DMURS) 2019.

g. Concrete footpaths to be 2 metres in width with an applicable kerb upstand of 125 mm. The location of pedestrian crossing points indicating dished kerbs incorporating tactile paving.

PUNCH Response Item 7d to 7g

Noted. Refer to DMURS Compliance Statement (192229-PUNCH-XX-XX-RP-C-0005) for the proposed development is included in the planning documentation.

Kildare County Council Transport Recommendation

h. Mitigation measures in order to prevent speeding on the Road Objective.

PUNCH Response Item 7h

Noted. The horizontal and vertical curvature along the NSORR has been designed in accordance with DMURS for a design speed of 60kph which is compatible with the proposed speed limit of 50kph. In Section 4.1.2 'Self-Regulating Streets' of DMURS research has shown how the provision of relatively tight vertical and horizontal curvature, together with the street characteristics of close proximity of

buildings, active ground floor use and pedestrian activity will have a self-regulating impact on drivers resulting in lower speeds.

Kildare County Council Transport Recommendation

i. Perpendicular on street vehicular parking spaces within the residential development to be marked in 2.5 metre x 5.0 metre bays in 100 mm wide white lines with a durable permanent material.

j. Parallel vehicular parking spaces within the residential development to be marked in 2.5 metre x 6.0 metre bays in 100 mm wide white lines with a durable permanent material.

k. 2 no. within curtilage parking spaces for all house units in order to facilitate item m. set out below.

I. 2 no. parking spaces each for the house units numbered, 127 to 132 and 211 to 212.

m. Dual electrical charge points to be provided at the within curtilage spaces for the house units to allow for the night-time charging of Electric Vehicles (EVs). linked to the individual domestic electricity meter. The EV Charger should be compatible with the Sustainable Energy Authority of Ireland's Triple E Register. Elevation details to be indicated at scales of 1:25.

n. Electric car charge points / arrangements to serve the duplex and apartment development. The EV Charger should be compatible with the Sustainable Energy Authority of Ireland's Triple E Register. Consideration to be had to minimizing trip hazards. Elevation details to be indicated at scales of 1:25. Electric car charge points to be located in areas that will not be taken in charge by Kildare County Council. Areas that could be taken in charge by Kildare County Council in the future are to be indicated on these drawings.

o. Electric car charge points / arrangements to serve the crèche and neighbourhood centre development. The EV Charger should be compatible with the Sustainable Energy Authority of Ireland's Triple E Register. Consideration shall be had to minimizing trip hazards. Elevation details to be indicated at scales of 1:25.

PUNCH Response Item 7i-o

Noted. 2 No parking spaces are facilitated within each driveway.

Refer to architectural drawings included in the planning documentation for parking information.

Kildare County Council Transport Recommendation

p. The locations of 30 km/h Slow Zone signs in accordance with the Department of Transport, Tourism and Sport's traffic signs advice note TSAN-2016-02.

PUNCH Response Item 7p

Noted. Refer to PUNCH drawings 192229-PUNCH-XX-XX-DR-0441 to 192229-PUNCH-XX-XX-DR-0444.

Kildare County Council Transport Recommendation

q. Surface wearing course of all roads within residential development to be Stone Mastic Asphalt, SMA 14 surf PMB 65/105-60 des 45mm thick, in compliance with clause 942 of NRANTII specification.

PUNCH Response Item 6q

Noted. Refer to PUNCH drawings 192229-PUNCH-XX-XX-DR-0441 to 192229-PUNCH-XX-XX-DR-0444. (Plans) and 192229-PUNCH-XX-XX-DR-0551 (details)

Kildare County Council Transport Recommendation

r. All signs and road markings shall be in accordance with the Department of Transport, Tourism and Sport (DTTAS) Traffic Signs Manual.

s. The cycle tracks on the Road Objective SR05 (a) are to be in accordance National Transport Authority's National Cycling Manual pertaining to widths and signage, the location of lighting standards and signs, the avoidance of obstructions and the re-establishment of a cyclist's position on-road.

PUNCH Response Item 6r-s

Noted.

Kildare County Council Transport Recommendation

t. Permeability and vehicular links with the road and footpath network of Wellesley Manor Residential Development. This is to demonstrate the permeability link is well lit with public lighting and having passive surveillance. The applicant is requested to liaise with the residents of Wellesley Manor in respect of this.

PUNCH Response Item 6t

Noted. Permeability links are provided from the SHD development to Wellesley Manor and to the Linear Park and onto Newbridge Town. The proposals are described in detail in the Mobility Management Plan. Refer also to the Architect and Landscape drawings.

Kildare County Council Transport Recommendation

u. A suitable boundary condition between the Road Objective with a speed limit of 50 km/h and the residential development, crèche, neighbourhood centre and associated designated public open space in keeping with the guiding principles of the Guidelines for Setting and Managing Speed Limits in Ireland (March 2015) to reduce the incident severity and enhance quality of life in residential areas. The developer shall have consideration to the John Devoy Road, Naas, Co. Kildare and the link road at Rathbride Demesne and L-70050-1 local road in Kildare Town and its respective boundary conditions. (Please see Fig 1.2, Fig1.3, Fig 1.4 and Fig 1.5.).

PUNCH Response Item 6u

Noted. Refer to Architect drawings for fence and boundary details

Kildare County Council Transport Recommendation

8. The applicant is requested to submit a Mobility Management Plan (in conjunction with Item 7.a set out in the foregoing) to Kildare County Council that is to contain:

a. The manner in which the unauthorised parking of vehicles shall be prevented within the development site having regard to the reduced parking standard of 1.33 spaces per unit for duplex and apartment development.

b. Full details and the promotion of all existing public transport links and timetables serving Newbridge. This is also to list all public transport links to prominent employment centres.

c. Future potential bus routes accessing the proposed two bus stops on the Road Objective.

d. Walking and cycling routes in Newbridge.

e. The manner in which future residents of the duplex and apartment units will be informed of the reduced parking standard and vehicular parking spaces available prior to the occupation of these units.

PUNCH Response 8a-e

Noted. An Outline Mobility Management Plan (192229-PUNCH-XX-XX-RP-C-0006) has been provided.

Kildare County Council Transport Recommendation

9. In conjunction with item 7 set out in the foregoing, the applicant is requested to submit cross section and elevation details drawing at scales of 1:50 and 1:20 respectively indicating cross section and construction details of the roads within the residential development, its concrete footpaths, cycle tracks, grass verges, vehicular parking spaces, and kerb upstands of 125 mm / 25mm within the residential development. Surface wearing course of all roads within residential development to be Stone Mastic Asphalt, SMA 14 surf PMB 65/105-60 des 45mm thick, in compliance with clause 942 of NRA/TII specification The cycle track on the Road Objective SR05b shall be in accordance National Transport Authority's National Cycling Manual pertaining to widths and signage, the location of lighting standards, the avoidance of obstructions and the re-establishment of a cyclist's position on-road.

PUNCH Response 9

Noted. Refer to drawing 192229-PUNCH-XX-XX-DR-0551 and 192229-PUNCH-XX-XX-DR-0553 for details of pavement build-ups and road cross-sections. Refer to drawing 192229-PUNCH-XX-XX-DR-0560 for details of cycle paths in accordance with the National Cycling Manual.

Kildare County Council Transport Recommendation

10. The applicant is requested to submit a critical swept path analysis on Site Layout Plans at scales of 1.500 indicating the manner a fire tender and a 3 axle refuse vehicle 9.86m by 2.50m in dimension will access, egress and manoeuvre on the entire site.

PUNCH Response 10

Noted. Refer to drawings 192229-PUNCH-XX-XX-DR-0600 to 192229-PUNCH-XX-XX-DR-0603 for Fire Tender and drawings 192229-PUNCH-XX-XX-DR-0610 to 192229-PUNCH-XX-XX-DR-0613.

Kildare County Council Transport Recommendation

11. The applicant is requested to submit a draft Construction Management Plan that is to contain:

a. A Construction Traffic Management Plan indicating all haul routes to and from the site on Regional and National Routes only via the Newbridge South Orbital Relief Road (NSORR) to the R445 Regional Road. Delivery times for plant and materials and waste collection shall have consideration to morning and evening peak school times in the area and peak traffic periods. Construction related

traffic is not permitted to travel through Newbridge Town Centre. This plan is also to contain mitigation measures to minimize the effects the proposed development would have on the immediate public road network and existing traffic movements.

b. Wheelwash arrangements and locations for the construction phase.

c. Location of the construction compound, use of cranes, parking and storage areas durelief the construction phase. (This is in the interest of the residential amenity of properties in the area).

d. Relevant construction site warning signs shall be in accordance with the Department of Transport, Tourism and Sport (DTTAS) Traffic Signs Manual for the overall development having particular consideration to the construction of the junction on the R445 Regional Road.

e. A Construction and Demolition Waste Management Plan.

f. Details of the method of construction of the proposed junction on the R445 Regional Road in minimizing traffic disruption.

g. Hours of operation during the construction phase to be 08.00 hours to 18.00 hours Monday to Friday and 0.800 hours to 14.00 hours Saturday. No work permitted on the Sundays and public holidays. (This is in the interest of the existing residential amenity of properties in the area).

PUNCH Response 11a-g

Noted. Refer to Environmental Consultant for Draft Construction Management Plan

Kildare County Council Transport Recommendation

12. The applicant is requested to submit a stage 1 and 2 Road Safety Audit / Assessment (RSA) for each of the respective Phases 1, 2A, 2B and 2C by an independent approved and certified auditor. The RSAs are to assess:

a. The internal areas of the application site.

b. At the proposed interface L-2028 local road. (Consideration to be had to the request made in Item 6. set out in the foregoing).

c. At the pedestrian permeability and vehicular links with Wellesley Manor Residential Development.

d. At the pedestrian permeability links with the Liffey Linear Park.

e. At the pedestrian permeability links with the Liffey Linear Park and the Road Objective

The applicant is requested to make the necessary changes to the design proposals following the stage 1 and 2 RSAs. The applicant is to note that if the application is subsequently granted, then the applicant will be required to carry out a stage 3 Road Safety Audits for the respective phases.

PUNCH Response 12 a-e

Noted. A Stage 1 Road Safety Audit, appropriate for Planning Stage of Design, has been carried out in accordance with the requirements of TII Publication Number GE-STY-01024 (Dec 2017) by Bruton Consulting Engineers and is included in support of this SHD planning submission. The road safety measures recommended have been adopted and will be implemented at detailed design stage

Kildare County Council Transport Recommendation

13. The applicant is requested to submit a Site Layout Plan drawings at scales of 1:500 indicating the proposed lighting arrangements for the development accompanied by a site lighting report. These are to be in accordance with the Kildare County Council Lighting Policy Street Lighting Technical Specification June 2019. The applicant is requested to demonstrate the proposed lighting scheme will not be a source of light pollution affecting adjacent lands and properties and the public road network. The applicant is requested to review the existing lighting on the public road network at the L-2028 local road and Wellesley Manor providing access to the application site and to submit proposals to provide for additional public lighting at these locations as deemed required. These details shall also contain the following:

a. The side elevation and height of lighting standards / columns to be indicated on the drawing.

b. The types of light fittings to be indicated on this drawing.

c. Impact upon Vehicular / Vulnerable road users within the development, on the access route from L-2028 local road (having consideration to item 6. set out in the foregoing), at the pedestrian permeability and vehicular links with Wellesley Manor Residential Development and at the permeability links from the Road Objective to the Liffey Linear Park.

d. Passive surveillance at the pedestrian permeability and vehicular links with Wellesley Manor Residential Development.

e. Passive surveillance and lighting at the pedestrian permeability links with the Liffey Linear Park

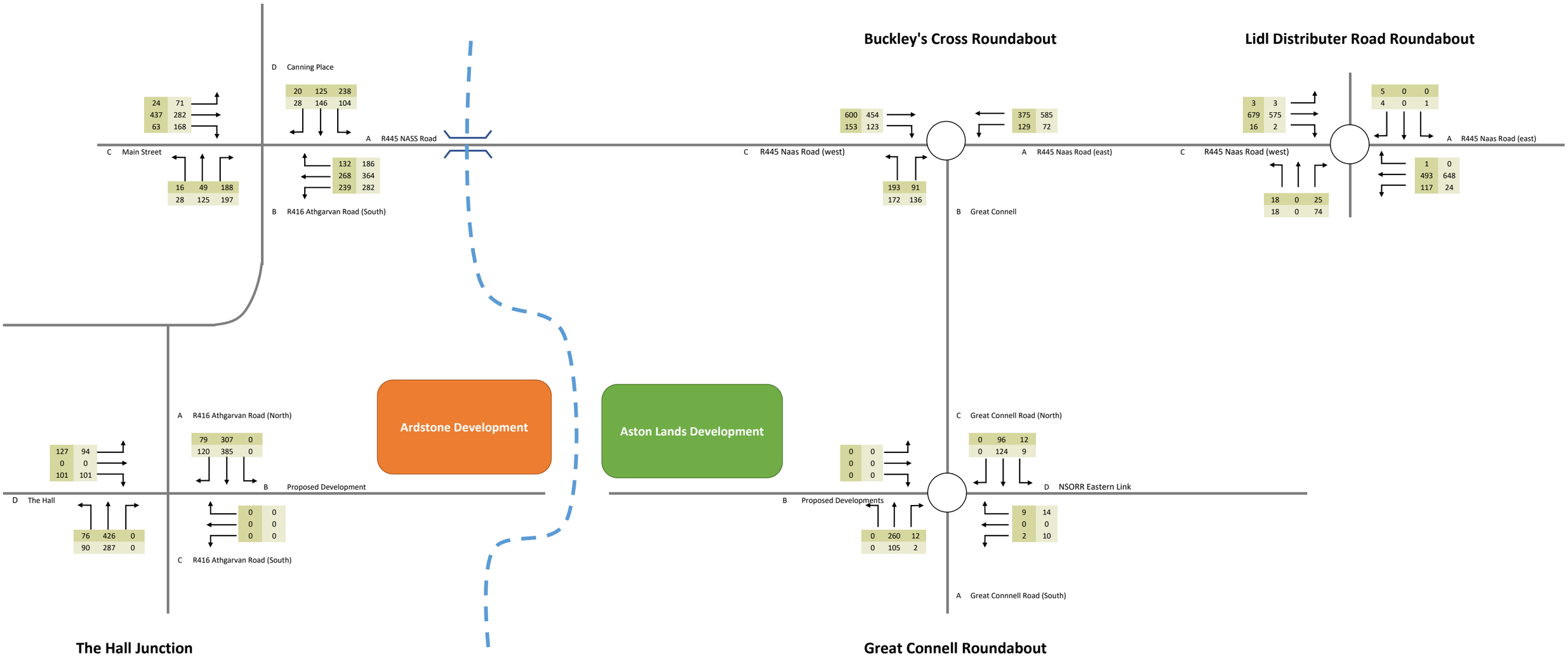
f. Passive surveillance and lighting at the permeability links from the Road Objective to the Liffey Linear Park.

PUNCH Response 13 a-f

Noted. The scheme lighting layout has been developed by Metec Consulting Engineers and is included in support of this SHD planning submission.

Appendix B Traffic Survey Data

Surveyed Traffic Flows 2021



The Hall Junction

Great Connell Roundabout

Appendix C TRICS Data

TRIP RATE for Land Use 01 - RETAIL/O - CONVENIENCE STORE
TOTAL VEHICLES
Calculation factor: 100 sqm
BOLD print indicates peak (busiest) period

	ARRIVALS			DEPARTURES			TOTALS		
Time Range	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate
00:00 - 01:00	1	370	0.000	1	370	1.081	1	370	1.081
01:00 - 02:00									
02:00 - 03:00									
03:00 - 04:00									
04:00 - 05:00									
05:00 - 06:00	3	325	0.616	3	325	0.103	3	325	0.719
06:00 - 07:00	9	313	4.368	9	313	3.729	9	313	8.097
07:00 - 08:00	26	449	4.173	26	449	3.634	26	449	7.807
08:00 - 09:00	26	449	5.013	26	449	4.688	26	449	9.701
09:00 - 10:00	26	449	4.345	26	449	4.302	26	449	8.647
10:00 - 11:00	26	449	3.908	26	449	3.651	26	449	7.559
11:00 - 12:00	26	449	4.585	26	449	4.465	26	449	9.050
12:00 - 13:00	26	449	5.519	26	449	5.228	26	449	10.747
13:00 - 14:00	26	449	4.465	26	449	4.336	26	449	8.801
14:00 - 15:00	26	449	5.030	26	449	5.048	26	449	10.078
15:00 - 16:00	26	449	5.236	26	449	5.193	26	449	10.429
16:00 - 17:00	26	449	5.442	26	449	5.108	26	449	10.550
17:00 - 18:00	26	449	5.947	26	449	6.153	26	449	12.100
18:00 - 19:00	26	449	5.742	26	449	6.402	26	449	12.144
19:00 - 20:00	26	449	4.559	26	449	4.688	26	449	9.247
20:00 - 21:00	24	471	2.697	24	471	3.210	24	471	5.907
21:00 - 22:00	23	482	1.885	23	482	2.201	23	482	4.086
22:00 - 23:00	4	361	3.534	4	361	3.812	4	361	7.346
23:00 - 24:00	3	325	2.875	3	325	2.772	3	325	5.647
Total Rates:			79.939			79.804			159.743

This section displays the trip rate results based on the selected set of surveys and the selected count type (shown just above the table). It is split by three main columns, representing arrivals trips, departures trips, and total trips (arrivals plus departures). Within each of these main columns are three sub-columns. These display the number of survey days where count data is included (per time period), the average value of the selected trip rate calculation parameter (per time period), and the trip rate result (per time period). Total trip rates (the sum of the column) are also displayed at the foot of the table.

*To obtain a trip rate, the average (mean) trip rate parameter value (TRP) is first calculated for all selected survey days that have count data available for the stated time period. The average (mean) number of arrivals, departures or totals (whichever applies) is also calculated (COUNT) for all selected survey days that have count data available for the stated time period. Then, the average count is divided by the average trip rate parameter value, and multiplied by the stated calculation factor (shown just above the table and abbreviated here as FACT). So, the method is: COUNT/TRP*FACT. Trip rates are then rounded to 3 decimal places.*

The survey data, graphs and all associated supporting information, contained within the TRICS Database are published by TRICS Consortium Limited ("the Company") and the Company claims copyright and database rights in this published work. The Company authorises those who possess a current TRICS licence to access the TRICS Database and copy the data contained within the TRICS Database for the licence holders' use only. Any resulting copy must retain all copyrights and other proprietary notices, and any disclaimer contained thereon.

The Company accepts no responsibility for loss which may arise from reliance on data contained in the TRICS Database. [No warranty of any kind, express or implied, is made as to the data contained in the TRICS Database.]

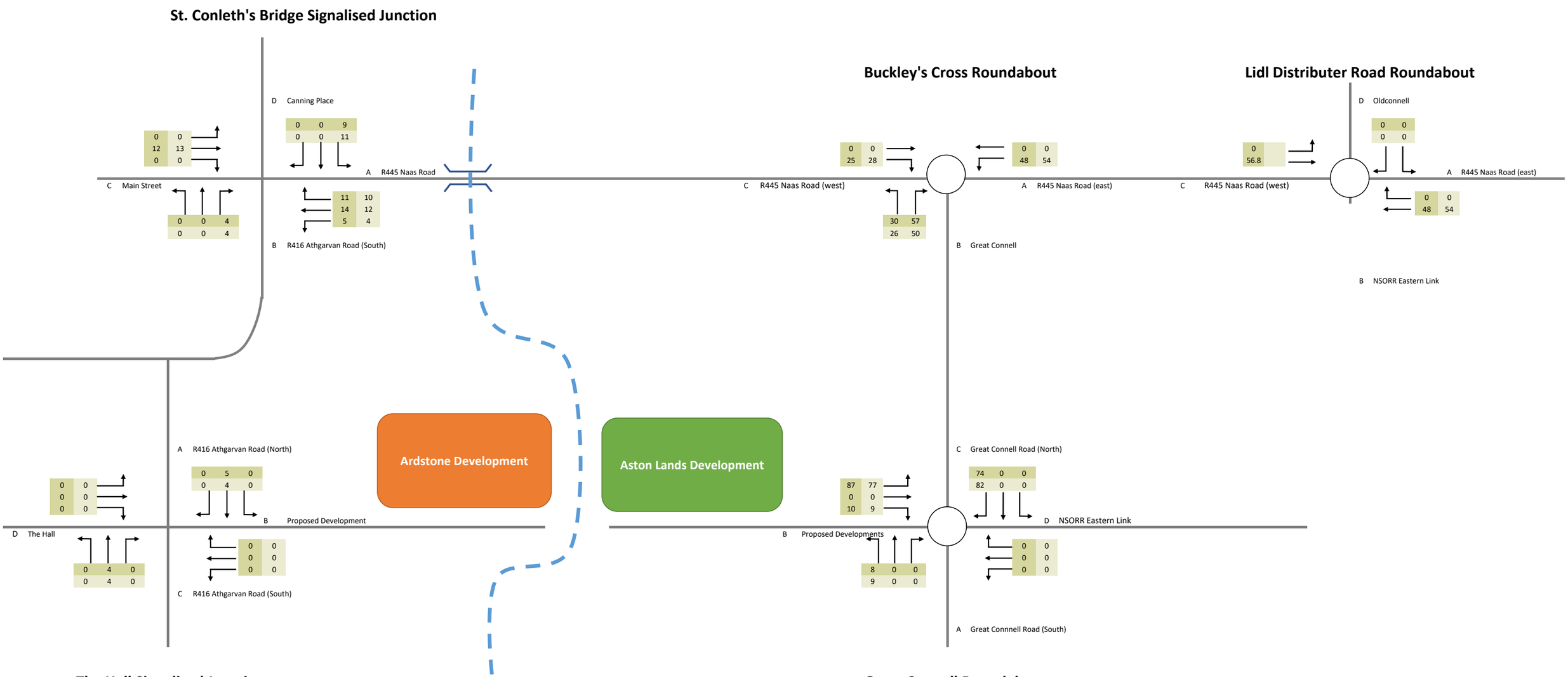
Parameter summary

Trip rate parameter range selected:	70 - 1500 (units: sqm)
Survey date date range:	01/01/12 - 25/09/19
Number of weekdays (Monday-Friday):	26
Number of Saturdays:	0
Number of Sundays:	0
Surveys automatically removed from selection:	0
Surveys manually removed from selection:	0

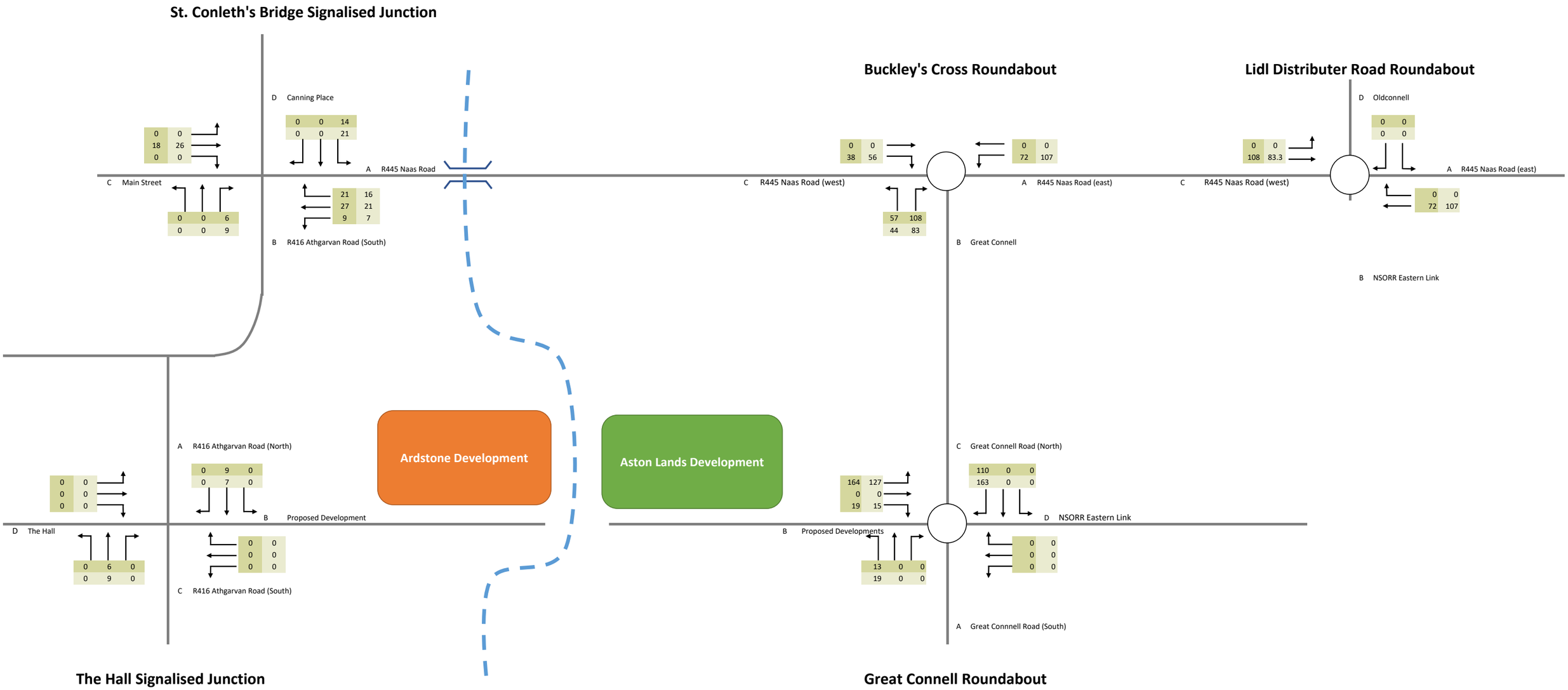
This section displays a quick summary of some of the data filtering selections made by the TRICS® user. The trip rate calculation parameter range of all selected surveys is displayed first, followed by the range of minimum and maximum survey dates selected by the user. Then, the total number of selected weekdays and weekend days in the selected set of surveys are show. Finally, the number of survey days that have been manually removed from the selected set outside of the standard filtering procedure are displayed.

Appendix D Development Traffic Flow Diagrams

Scenario A - Phase 1 - Proposed Development Flows



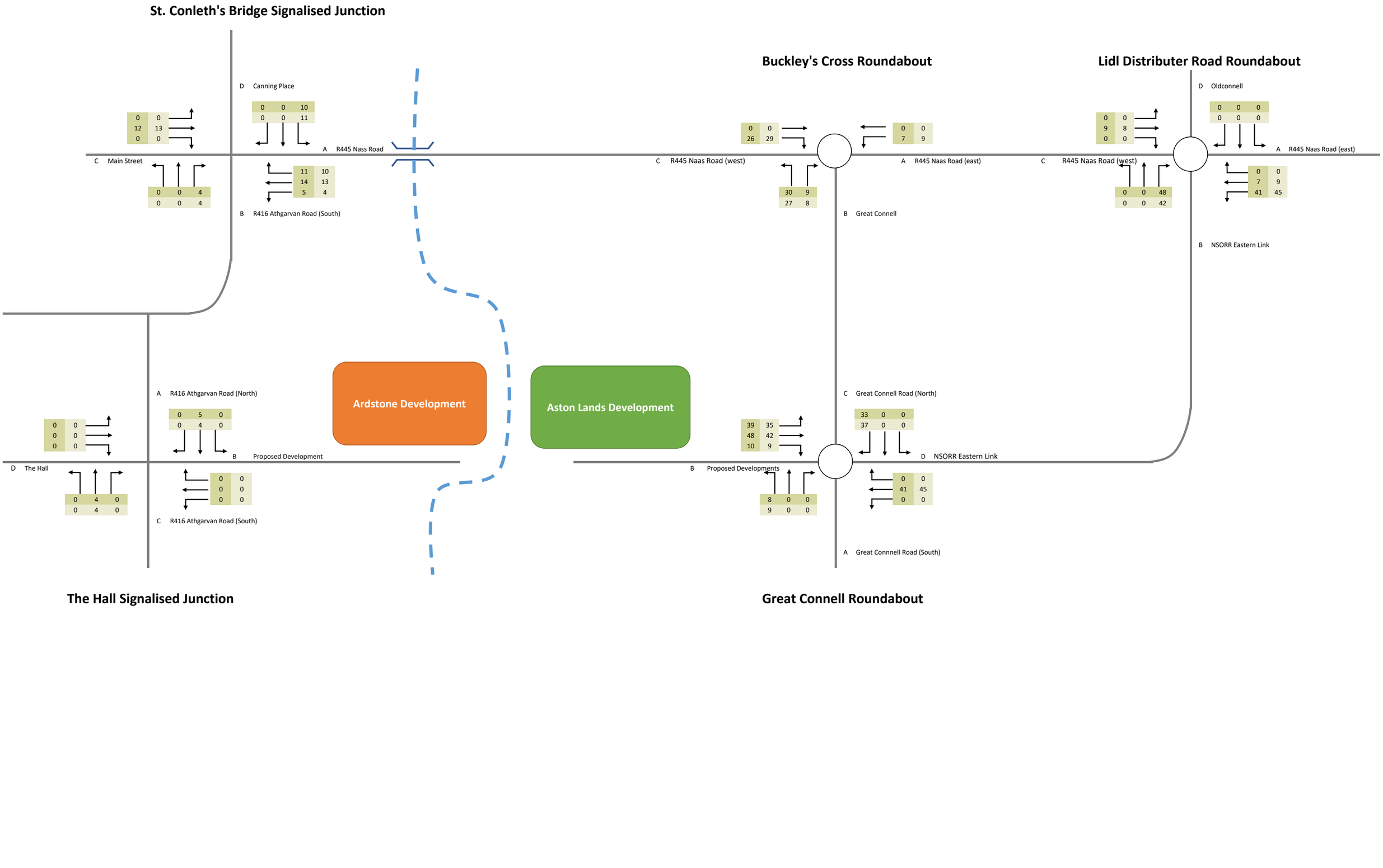
Scenario A - Phase 2 - Proposed Development Flows



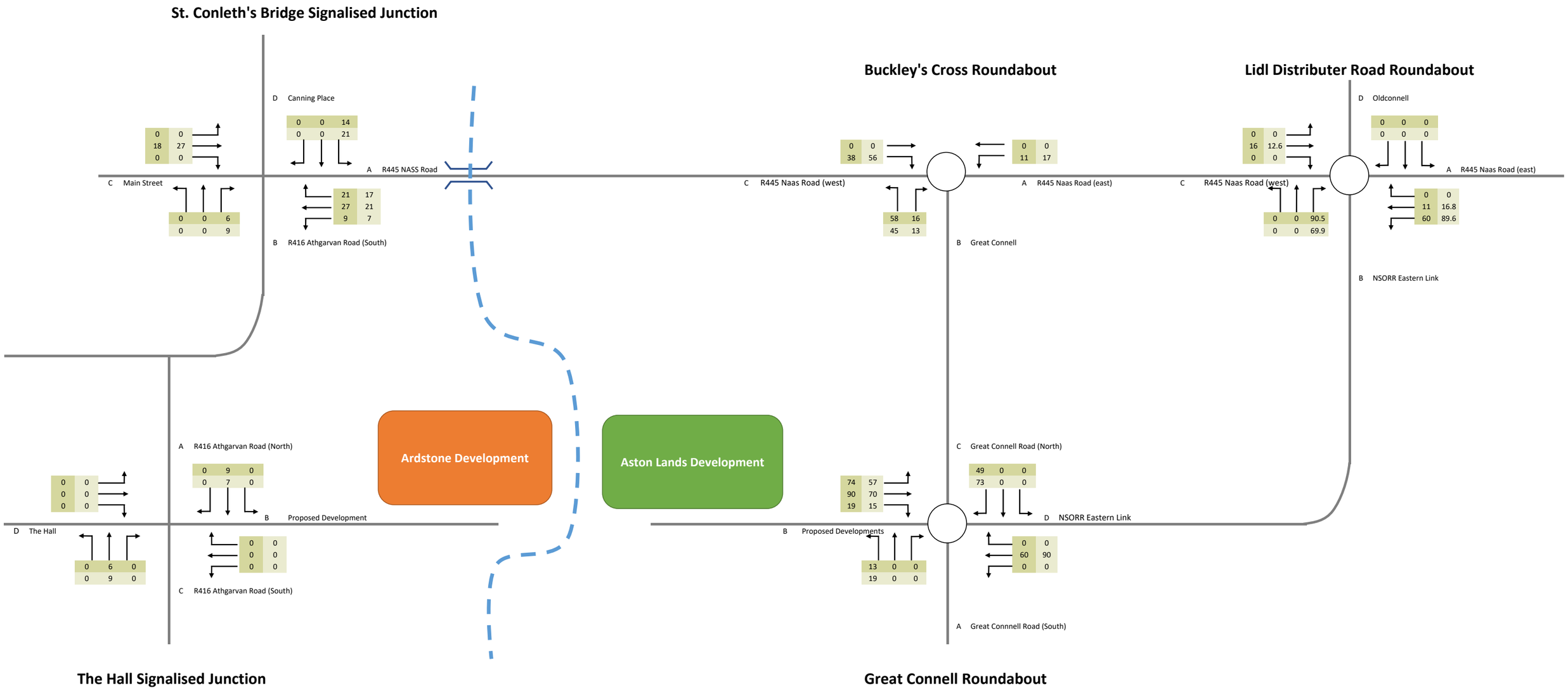
The Hall Signalised Junction

Great Connell Roundabout

Scenario B - Phase 1 - Proposed Development Flows



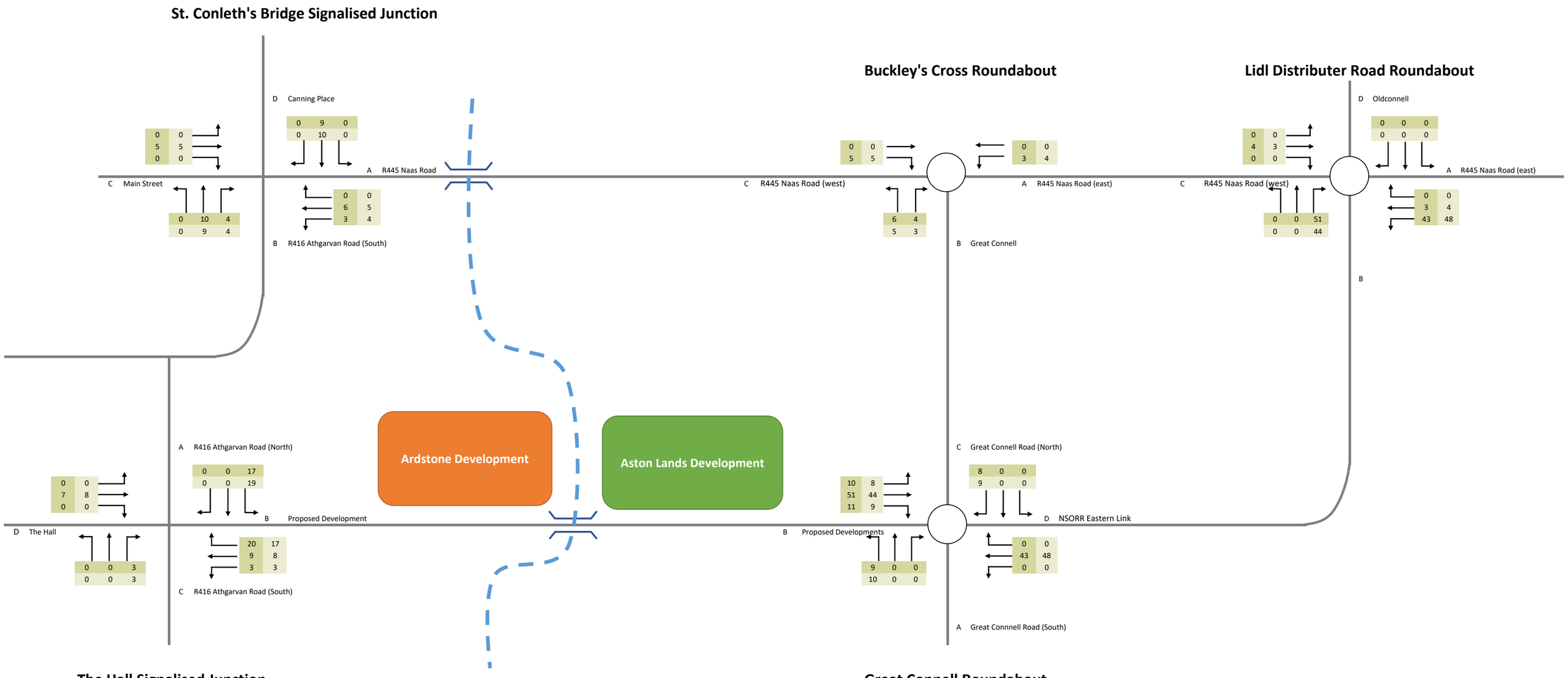
Scenario B - Phase 2 -Proposed Development Flows



The Hall Signalised Junction

Great Connell Roundabout

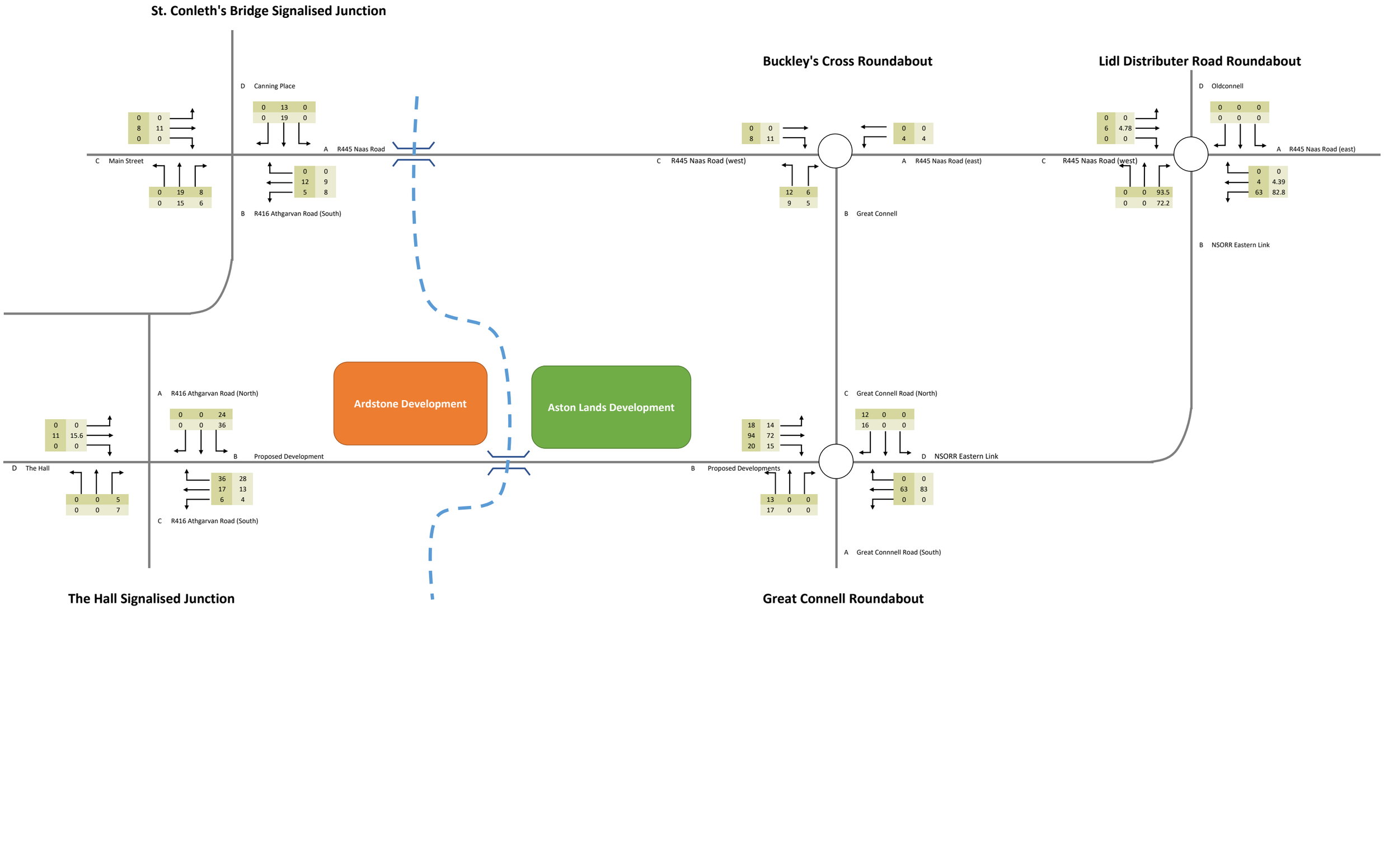
Scenario C - Phase 1 - Proposed Development Flows



The Hall Signalised Junction

Great Connell Roundabout

Scenario C - Phase 2 - Proposed Development Flows



Appendix E Great Connell Roundabout Junctions 9 Results Output

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Great Connell Roundabout - Scenario A (2021 Flows).j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario A - Exisitng
Report generation date: 15/03/2022 15:16:09

»2024 Do Nothing, AM
»2024 Do Nothing, PM
»2029 Do Nothing , AM
»2029 Do Nothing, PM
»2039 Do Nothing, AM
»2039 Do Nothing, PM
»2024 Scenario A Opening Year, AM
»2024 Scenario A Opening Year, PM
»2029 Scenario A Design 5 Years, AM
»2029 Scenario A Design 5 Years, PM
»2039 Scenario A Design 15 Years, AM
»2039 Scenario A Design 15 Years, PM

Summary of junction performance

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	2024 Do Nothing							
A - Great Connell Road (South)	0.2	2.68	0.20	A	0.1	2.35	0.08	A
B - Proposed Development Site	0.0	0.00	0.00	A	0.0	0.00	0.00	A
C - Great Connell Road (North)	0.1	2.65	0.11	A	0.1	2.63	0.11	A
D - NSOOR Eastern Link	0.0	1.98	0.02	A	0.0	2.05	0.04	A
	2029 Do Nothing							
A - Great Connell Road (South)	0.3	2.74	0.22	A	0.1	2.38	0.09	A
B - Proposed Development Site	0.0	0.00	0.00	A	0.0	0.00	0.00	A
C - Great Connell Road (North)	0.1	2.67	0.11	A	0.1	2.67	0.12	A
D - NSOOR Eastern Link	0.0	1.99	0.02	A	0.0	2.06	0.04	A
	2039 Do Nothing							
A - Great Connell Road (South)	0.3	2.80	0.24	A	0.1	2.39	0.09	A
B - Proposed Development Site	0.0	0.00	0.00	A	0.0	0.00	0.00	A
C - Great Connell Road (North)	0.1	2.70	0.12	A	0.1	2.69	0.13	A
D - NSOOR Eastern Link	0.0	2.00	0.02	A	0.0	2.08	0.04	A
	2024 Scenario A Opening Year							
A - Great Connell Road (South)	0.3	2.76	0.20	A	0.1	2.44	0.08	A
B - Proposed Development Site	0.1	2.76	0.08	A	0.1	2.54	0.06	A
C - Great Connell Road (North)	0.2	2.81	0.16	A	0.2	2.82	0.17	A
D - NSOOR Eastern Link	0.0	2.05	0.02	A	0.0	2.13	0.04	A
	2029 Scenario A Design 5 Years							
A - Great Connell Road (South)	0.3	2.90	0.23	A	0.1	2.58	0.10	A
B - Proposed Development Site	0.2	3.02	0.14	A	0.1	2.67	0.10	A
C - Great Connell Road (North)	0.2	2.94	0.19	A	0.3	3.09	0.24	A
D - NSOOR Eastern Link	0.0	2.10	0.02	A	0.0	2.23	0.04	A
	2039 Scenario A Design 15 Years							
A - Great Connell Road (South)	0.3	2.96	0.24	A	0.1	2.61	0.11	A
B - Proposed Development Site	0.2	3.07	0.15	A	0.1	2.69	0.10	A
C - Great Connell Road (North)	0.3	2.97	0.20	A	0.3	3.12	0.24	A
D - NSOOR Eastern Link	0.0	2.11	0.02	A	0.0	2.24	0.04	A

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

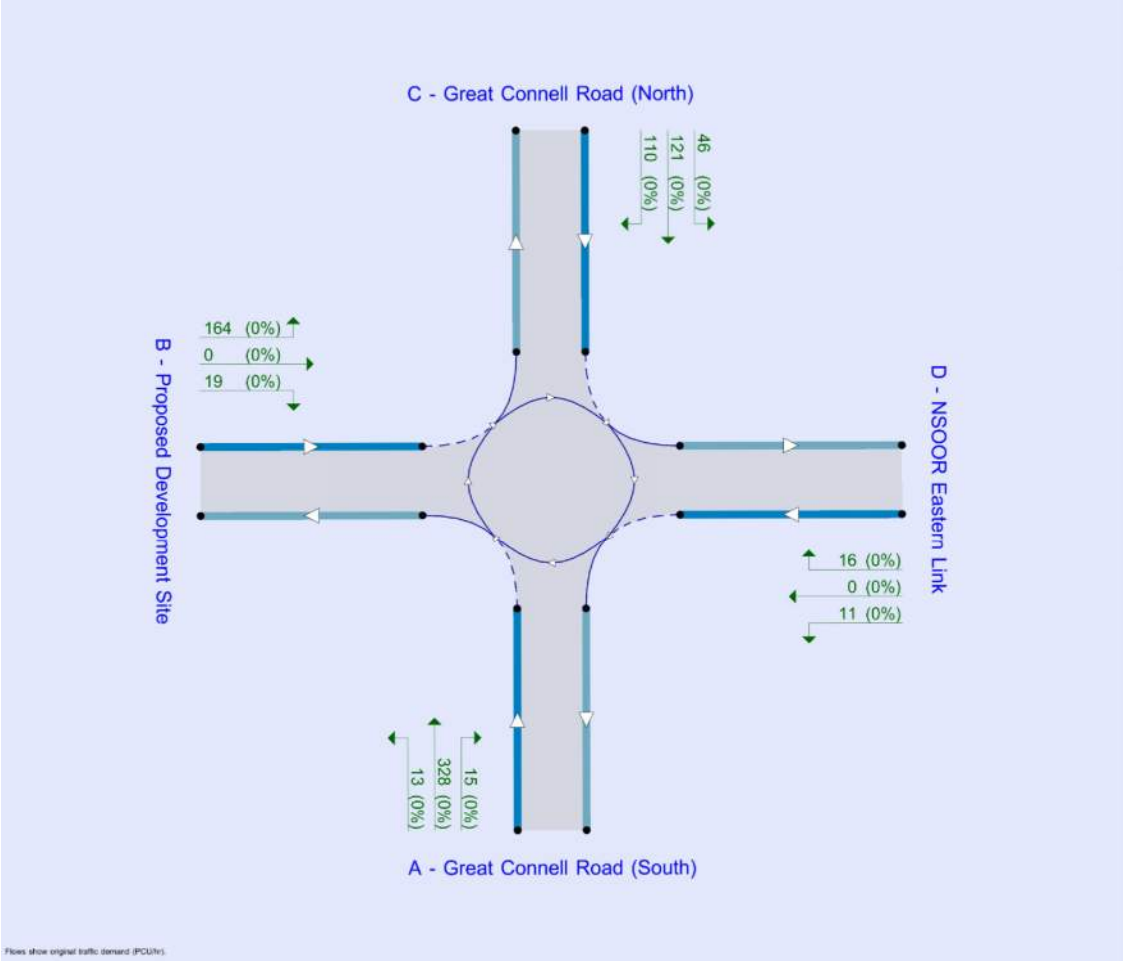
File Description

Title	
Location	
Site number	

Date	29/04/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	07:15	08:45	15
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D3	2029 Do Nothing	AM	ONE HOUR	07:15	08:45	15
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D5	2039 Do Nothing	AM	ONE HOUR	07:15	08:45	15
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D7	2024 Scenario A Opening Year	AM	ONE HOUR	07:15	08:45	15
D8	2024 Scenario A Opening Year	PM	ONE HOUR	17:30	19:00	15
D9	2029 Scenario A Design 5 Years	AM	ONE HOUR	07:15	08:45	15
D10	2029 Scenario A Design 5 Years	PM	ONE HOUR	17:30	19:00	15
D11	2039 Scenario A Design 15 Years	AM	ONE HOUR	07:15	08:45	15
D12	2039 Scenario A Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2024 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.63	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	Great Connell Road (South)	
B	Proposed Development Site	
C	Great Connell Road (North)	
D	NSOOR Eastern Link	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - Great Connell Road (South)	3.60	7.00	15.6	17.4	48.4	29.1	
B - Proposed Development Site	3.50	7.00	10.2	33.5	48.4	26.5	
C - Great Connell Road (North)	3.50	7.00	10.6	38.0	48.4	43.7	
D - NSOOR Eastern Link	4.50	7.00	17.4	18.9	48.4	23.7	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - Great Connell Road (South)	0.612	1691
B - Proposed Development Site	0.608	1616
C - Great Connell Road (North)	0.577	1538
D - NSOOR Eastern Link	0.663	1918

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	305	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	146	100.000
D - NSOOR Eastern Link		✓	26	100.000

Origin-Destination Data

Demand (PCU/hr)

	To				
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link

From	A - Great Connell Road (South)	0	0	276	29
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	102	0	0	44
	D - NSOOR Eastern Link	11	0	15	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.20	2.68	0.2	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.11	2.65	0.1	A
D - NSOOR Eastern Link	0.02	1.98	0.0	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	230	11	1684	0.136	229	0.2	2.473	A
B - Proposed Development Site	0	240	1470	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	110	22	1525	0.072	110	0.1	2.543	A
D - NSOOR Eastern Link	20	77	1867	0.010	20	0.0	1.947	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	274	13	1682	0.163	274	0.2	2.556	A
B - Proposed Development Site	0	288	1441	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	131	26	1523	0.086	131	0.1	2.586	A
D - NSOOR Eastern Link	23	92	1857	0.013	23	0.0	1.962	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	336	17	1681	0.200	336	0.2	2.676	A
B - Proposed Development Site	0	352	1402	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	161	32	1519	0.106	161	0.1	2.649	A
D - NSOOR Eastern Link	29	112	1844	0.016	29	0.0	1.982	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	336	17	1681	0.200	336	0.2	2.676	A
B - Proposed Development Site	0	352	1401	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	161	32	1519	0.106	161	0.1	2.649	A
D - NSOOR Eastern Link	29	112	1844	0.016	29	0.0	1.983	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	274	13	1682	0.163	274	0.2	2.558	A
B - Proposed Development Site	0	288	1441	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	131	26	1523	0.086	131	0.1	2.587	A
D - NSOOR Eastern Link	23	92	1857	0.013	23	0.0	1.962	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	230	11	1684	0.136	230	0.2	2.475	A

B - Proposed Development Site	0	241	1469	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	110	22	1525	0.072	110	0.1	2.545	A
D - NSOOR Eastern Link	20	77	1867	0.010	20	0.0	1.949	A

2024 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.43	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	121	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	150	100.000
D - NSOOR Eastern Link		✓	60	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	111	10
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	131	0	0	19
	D - NSOOR Eastern Link	18	0	42	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.08	2.35	0.1	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.11	2.63	0.1	A
D - NSOOR Eastern Link	0.04	2.05	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	91	32	1671	0.055	91	0.1	2.277	A
B - Proposed Development Site	0	122	1541	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	113	8	1533	0.074	113	0.1	2.533	A
D - NSOOR Eastern Link	45	98	1853	0.024	45	0.0	1.991	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	109	38	1668	0.065	109	0.1	2.309	A
B - Proposed Development Site	0	146	1527	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	135	9	1533	0.088	135	0.1	2.575	A
D - NSOOR Eastern Link	54	118	1840	0.029	54	0.0	2.015	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	133	46	1662	0.080	133	0.1	2.353	A
B - Proposed Development Site	0	179	1507	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	165	11	1531	0.108	165	0.1	2.634	A
D - NSOOR Eastern Link	66	144	1823	0.036	66	0.0	2.049	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	133	46	1662	0.080	133	0.1	2.353	A
B - Proposed Development Site	0	179	1507	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	165	11	1531	0.108	165	0.1	2.634	A
D - NSOOR Eastern Link	66	144	1823	0.036	66	0.0	2.049	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	109	38	1667	0.065	109	0.1	2.309	A
B - Proposed Development Site	0	147	1527	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	135	9	1533	0.088	135	0.1	2.577	A
D - NSOOR Eastern Link	54	118	1840	0.029	54	0.0	2.016	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	91	32	1671	0.055	91	0.1	2.279	A
B - Proposed Development Site	0	123	1541	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	113	8	1533	0.074	113	0.1	2.534	A
D - NSOOR Eastern Link	45	99	1853	0.024	45	0.0	1.991	A

2029 Do Nothing , AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.68	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	2029 Do Nothing	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	334	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	157	100.000
D - NSOOR Eastern Link		✓	27	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	304	30
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	112	0	0	45
	D - NSOOR Eastern Link	11	0	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.22	2.74	0.3	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.11	2.67	0.1	A
D - NSOOR Eastern Link	0.02	1.99	0.0	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	251	12	1683	0.149	251	0.2	2.511	A
B - Proposed Development Site	0	263	1456	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	118	23	1525	0.078	118	0.1	2.558	A
D - NSOOR Eastern Link	20	84	1863	0.011	20	0.0	1.953	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	300	14	1682	0.179	300	0.2	2.605	A
B - Proposed Development Site	0	314	1425	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	141	27	1522	0.093	141	0.1	2.606	A
D - NSOOR Eastern Link	24	101	1852	0.013	24	0.0	1.969	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	368	18	1680	0.219	367	0.3	2.743	A
B - Proposed Development Site	0	385	1382	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	173	33	1519	0.114	173	0.1	2.674	A
D - NSOOR Eastern Link	30	123	1837	0.016	30	0.0	1.992	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	368	18	1680	0.219	368	0.3	2.743	A
B - Proposed Development Site	0	385	1381	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	173	33	1519	0.114	173	0.1	2.674	A
D - NSOOR Eastern Link	30	123	1837	0.016	30	0.0	1.992	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	300	14	1682	0.179	301	0.2	2.608	A
B - Proposed Development Site	0	315	1424	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	141	27	1522	0.093	141	0.1	2.608	A
D - NSOOR Eastern Link	24	101	1851	0.013	24	0.0	1.970	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	251	12	1683	0.149	252	0.2	2.514	A
B - Proposed Development Site	0	264	1455	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	118	23	1525	0.078	118	0.1	2.561	A
D - NSOOR Eastern Link	20	84	1862	0.011	20	0.0	1.954	A

2029 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.45	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	133	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	165	100.000
D - NSOOR Eastern Link		✓	62	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	123	10
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	145	0	0	20
	D - NSOOR Eastern Link	19	0	43	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.09	2.38	0.1	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.12	2.67	0.1	A
D - NSOOR Eastern Link	0.04	2.06	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	100	32	1671	0.060	100	0.1	2.291	A
B - Proposed Development Site	0	132	1535	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	124	8	1533	0.081	124	0.1	2.554	A
D - NSOOR Eastern Link	47	109	1846	0.025	47	0.0	2.000	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	120	39	1667	0.072	120	0.1	2.326	A
B - Proposed Development Site	0	158	1520	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	148	9	1533	0.097	148	0.1	2.600	A
D - NSOOR Eastern Link	56	130	1832	0.030	56	0.0	2.026	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	146	47	1662	0.088	146	0.1	2.375	A
B - Proposed Development Site	0	194	1498	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	182	11	1531	0.119	182	0.1	2.666	A
D - NSOOR Eastern Link	68	160	1812	0.038	68	0.0	2.063	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	146	47	1662	0.088	146	0.1	2.375	A
B - Proposed Development Site	0	194	1498	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	182	11	1531	0.119	182	0.1	2.666	A
D - NSOOR Eastern Link	68	160	1812	0.038	68	0.0	2.063	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	120	39	1667	0.072	120	0.1	2.328	A
B - Proposed Development Site	0	158	1520	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	148	9	1533	0.097	148	0.1	2.602	A
D - NSOOR Eastern Link	56	130	1832	0.030	56	0.0	2.026	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	100	32	1671	0.060	100	0.1	2.293	A
B - Proposed Development Site	0	133	1535	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	124	8	1533	0.081	124	0.1	2.554	A
D - NSOOR Eastern Link	47	109	1846	0.025	47	0.0	2.002	A

2039 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.73	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D5	2039 Do Nothing	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	360	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	167	100.000
D - NSOOR Eastern Link		✓	27	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	328	32
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	121	0	0	46
	D - NSOOR Eastern Link	11	0	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.24	2.80	0.3	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.12	2.70	0.1	A
D - NSOOR Eastern Link	0.02	2.00	0.0	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	271	12	1683	0.161	270	0.2	2.546	A
B - Proposed Development Site	0	282	1444	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	126	24	1524	0.083	125	0.1	2.574	A
D - NSOOR Eastern Link	20	91	1858	0.011	20	0.0	1.958	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	324	14	1682	0.192	323	0.2	2.650	A
B - Proposed Development Site	0	338	1410	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	150	29	1521	0.099	150	0.1	2.625	A
D - NSOOR Eastern Link	24	109	1846	0.013	24	0.0	1.975	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	396	18	1680	0.236	396	0.3	2.804	A
B - Proposed Development Site	0	414	1364	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	184	35	1517	0.121	184	0.1	2.699	A
D - NSOOR Eastern Link	30	133	1830	0.016	30	0.0	1.999	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	396	18	1680	0.236	396	0.3	2.804	A
B - Proposed Development Site	0	414	1364	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	184	35	1517	0.121	184	0.1	2.699	A
D - NSOOR Eastern Link	30	133	1830	0.016	30	0.0	1.999	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	324	14	1682	0.192	324	0.2	2.651	A
B - Proposed Development Site	0	338	1410	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	150	29	1521	0.099	150	0.1	2.627	A
D - NSOOR Eastern Link	24	109	1846	0.013	24	0.0	1.977	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	271	12	1683	0.161	271	0.2	2.551	A
B - Proposed Development Site	0	283	1444	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	126	24	1524	0.083	126	0.1	2.576	A
D - NSOOR Eastern Link	20	91	1858	0.011	20	0.0	1.958	A

2039 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.48	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	143	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	176	100.000
D - NSOOR Eastern Link		✓	64	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	132	11
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	156	0	0	20
	D - NSOOR Eastern Link	19	0	45	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.09	2.39	0.1	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.13	2.69	0.1	A
D - NSOOR Eastern Link	0.04	2.08	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	108	34	1670	0.064	107	0.1	2.303	A
B - Proposed Development Site	0	141	1530	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	133	8	1533	0.086	132	0.1	2.570	A
D - NSOOR Eastern Link	48	117	1841	0.026	48	0.0	2.008	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	129	40	1666	0.077	128	0.1	2.341	A
B - Proposed Development Site	0	169	1513	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	158	10	1532	0.103	158	0.1	2.619	A
D - NSOOR Eastern Link	58	140	1825	0.032	58	0.0	2.036	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	157	50	1660	0.095	157	0.1	2.395	A
B - Proposed Development Site	0	207	1490	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	194	12	1531	0.127	194	0.1	2.692	A
D - NSOOR Eastern Link	70	172	1804	0.039	70	0.0	2.075	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	157	50	1660	0.095	157	0.1	2.395	A
B - Proposed Development Site	0	207	1490	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	194	12	1531	0.127	194	0.1	2.692	A
D - NSOOR Eastern Link	70	172	1804	0.039	70	0.0	2.075	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	129	40	1666	0.077	129	0.1	2.341	A
B - Proposed Development Site	0	169	1513	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	158	10	1532	0.103	158	0.1	2.620	A
D - NSOOR Eastern Link	58	140	1825	0.032	58	0.0	2.036	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	108	34	1670	0.064	108	0.1	2.304	A
B - Proposed Development Site	0	142	1530	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	133	8	1533	0.086	133	0.1	2.570	A
D - NSOOR Eastern Link	48	118	1840	0.026	48	0.0	2.008	A

2024 Scenario A Opening Year, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.75	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D7	2024 Scenario A Opening Year	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	297	100.000
B - Proposed Development Site		✓	97	100.000
C - Great Connell Road (North)		✓	220	100.000
D - NSOOR Eastern Link		✓	26	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	8	276	13
	B - Proposed Development Site	10	0	87	0
	C - Great Connell Road (North)	102	74	0	44
	D - NSOOR Eastern Link	11	0	15	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.20	2.76	0.3	A
B - Proposed Development Site	0.08	2.76	0.1	A
C - Great Connell Road (North)	0.16	2.81	0.2	A
D - NSOOR Eastern Link	0.02	2.05	0.0	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	224	67	1650	0.136	223	0.2	2.521	A
B - Proposed Development Site	73	228	1477	0.049	73	0.1	2.563	A
C - Great Connell Road (North)	166	17	1528	0.108	165	0.1	2.642	A
D - NSOOR Eastern Link	20	140	1826	0.011	20	0.0	1.992	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	267	80	1642	0.163	267	0.2	2.618	A
B - Proposed Development Site	87	273	1450	0.060	87	0.1	2.641	A
C - Great Connell Road (North)	198	21	1526	0.130	198	0.1	2.710	A
D - NSOOR Eastern Link	23	167	1807	0.013	23	0.0	2.017	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	327	98	1631	0.201	327	0.2	2.760	A
B - Proposed Development Site	107	334	1412	0.076	107	0.1	2.756	A
C - Great Connell Road (North)	242	25	1523	0.159	242	0.2	2.809	A
D - NSOOR Eastern Link	29	205	1783	0.016	29	0.0	2.052	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	327	98	1631	0.201	327	0.3	2.760	A
B - Proposed Development Site	107	335	1412	0.076	107	0.1	2.757	A
C - Great Connell Road (North)	242	25	1523	0.159	242	0.2	2.809	A
D - NSOOR Eastern Link	29	205	1783	0.016	29	0.0	2.052	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	267	80	1642	0.163	267	0.2	2.621	A
B - Proposed Development Site	87	274	1449	0.060	87	0.1	2.642	A
C - Great Connell Road (North)	198	21	1526	0.130	198	0.1	2.710	A
D - NSOOR Eastern Link	23	167	1807	0.013	23	0.0	2.019	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	224	67	1650	0.136	224	0.2	2.526	A
B - Proposed Development Site	73	229	1477	0.049	73	0.1	2.566	A
C - Great Connell Road (North)	166	17	1528	0.108	166	0.1	2.644	A
D - NSOOR Eastern Link	20	140	1825	0.011	20	0.0	1.994	A

2024 Scenario A Opening Year, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.60	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D8	2024 Scenario A Opening Year	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	122	100.000
B - Proposed Development Site		✓	86	100.000
C - Great Connell Road (North)		✓	232	100.000
D - NSOOR Eastern Link		✓	60	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	9	111	2
	B - Proposed Development Site	9	0	77	0
	C - Great Connell Road (North)	131	82	0	19
	D - NSOOR Eastern Link	18	0	42	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.08	2.44	0.1	A
B - Proposed Development Site	0.06	2.54	0.1	A
C - Great Connell Road (North)	0.17	2.82	0.2	A
D - NSOOR Eastern Link	0.04	2.13	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	92	93	1634	0.056	92	0.1	2.334	A
B - Proposed Development Site	65	116	1545	0.042	65	0.0	2.431	A
C - Great Connell Road (North)	175	8	1533	0.114	174	0.1	2.649	A
D - NSOOR Eastern Link	45	167	1808	0.025	45	0.0	2.042	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	110	111	1622	0.068	110	0.1	2.379	A
B - Proposed Development Site	77	139	1531	0.050	77	0.1	2.475	A
C - Great Connell Road (North)	209	10	1532	0.136	208	0.2	2.719	A
D - NSOOR Eastern Link	54	199	1786	0.030	54	0.0	2.078	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	134	136	1607	0.084	134	0.1	2.443	A
B - Proposed Development Site	95	171	1512	0.063	95	0.1	2.539	A
C - Great Connell Road (North)	255	12	1531	0.167	255	0.2	2.822	A
D - NSOOR Eastern Link	66	244	1756	0.038	66	0.0	2.129	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	134	137	1607	0.084	134	0.1	2.444	A
B - Proposed Development Site	95	171	1512	0.063	95	0.1	2.539	A
C - Great Connell Road (North)	255	12	1531	0.167	255	0.2	2.822	A
D - NSOOR Eastern Link	66	244	1756	0.038	66	0.0	2.129	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	110	112	1622	0.068	110	0.1	2.381	A
B - Proposed Development Site	77	139	1531	0.051	77	0.1	2.478	A
C - Great Connell Road (North)	209	10	1532	0.136	209	0.2	2.722	A
D - NSOOR Eastern Link	54	200	1786	0.030	54	0.0	2.078	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	92	93	1633	0.056	92	0.1	2.336	A
B - Proposed Development Site	65	117	1545	0.042	65	0.0	2.433	A
C - Great Connell Road (North)	175	8	1533	0.114	175	0.1	2.652	A
D - NSOOR Eastern Link	45	167	1807	0.025	45	0.0	2.044	A

2029 Scenario A Design 5 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.91	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D9	2029 Scenario A Design 5 Years	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	331	100.000
B - Proposed Development Site		✓	183	100.000
C - Great Connell Road (North)		✓	267	100.000
D - NSOOR Eastern Link		✓	27	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	13	304	14
	B - Proposed Development Site	19	0	164	0
	C - Great Connell Road (North)	112	110	0	45
	D - NSOOR Eastern Link	11	0	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.23	2.90	0.3	A
B - Proposed Development Site	0.14	3.02	0.2	A
C - Great Connell Road (North)	0.19	2.94	0.2	A
D - NSOOR Eastern Link	0.02	2.10	0.0	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	249	95	1633	0.153	248	0.2	2.599	A
B - Proposed Development Site	138	251	1463	0.094	137	0.1	2.715	A
C - Great Connell Road (North)	201	25	1523	0.132	200	0.2	2.719	A
D - NSOOR Eastern Link	20	181	1798	0.011	20	0.0	2.024	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	298	113	1621	0.184	297	0.2	2.719	A
B - Proposed Development Site	165	300	1433	0.115	164	0.1	2.836	A
C - Great Connell Road (North)	240	30	1521	0.158	240	0.2	2.810	A
D - NSOOR Eastern Link	24	217	1775	0.014	24	0.0	2.056	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	364	139	1606	0.227	364	0.3	2.899	A
B - Proposed Development Site	201	367	1392	0.145	201	0.2	3.022	A
C - Great Connell Road (North)	294	36	1517	0.194	294	0.2	2.943	A
D - NSOOR Eastern Link	30	265	1743	0.017	30	0.0	2.101	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	364	139	1606	0.227	364	0.3	2.899	A
B - Proposed Development Site	201	368	1392	0.145	201	0.2	3.022	A
C - Great Connell Road (North)	294	36	1517	0.194	294	0.2	2.943	A
D - NSOOR Eastern Link	30	265	1742	0.017	30	0.0	2.101	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	298	113	1621	0.184	298	0.2	2.720	A
B - Proposed Development Site	165	301	1433	0.115	165	0.1	2.838	A
C - Great Connell Road (North)	240	30	1521	0.158	240	0.2	2.813	A
D - NSOOR Eastern Link	24	217	1775	0.014	24	0.0	2.056	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	249	95	1632	0.153	249	0.2	2.604	A
B - Proposed Development Site	138	252	1463	0.094	138	0.1	2.719	A
C - Great Connell Road (North)	201	25	1523	0.132	201	0.2	2.722	A
D - NSOOR Eastern Link	20	182	1798	0.011	20	0.0	2.024	A

2029 Scenario A Design 5 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.81	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D10	2029 Scenario A Design 5 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	144	100.000
B - Proposed Development Site		✓	142	100.000
C - Great Connell Road (North)		✓	328	100.000
D - NSOOR Eastern Link		✓	62	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	19	123	2
	B - Proposed Development Site	15	0	127	0
	C - Great Connell Road (North)	145	163	0	20
	D - NSOOR Eastern Link	19	0	43	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.10	2.58	0.1	A
B - Proposed Development Site	0.10	2.67	0.1	A
C - Great Connell Road (North)	0.24	3.09	0.3	A
D - NSOOR Eastern Link	0.04	2.23	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	108	155	1596	0.068	108	0.1	2.419	A
B - Proposed Development Site	107	126	1539	0.069	107	0.1	2.513	A
C - Great Connell Road (North)	247	13	1530	0.161	246	0.2	2.802	A
D - NSOOR Eastern Link	47	242	1758	0.027	47	0.0	2.103	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	129	185	1577	0.082	129	0.1	2.485	A
B - Proposed Development Site	128	151	1524	0.084	128	0.1	2.577	A
C - Great Connell Road (North)	295	15	1529	0.193	295	0.2	2.916	A
D - NSOOR Eastern Link	56	290	1726	0.032	56	0.0	2.155	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	159	227	1552	0.102	158	0.1	2.583	A
B - Proposed Development Site	156	185	1503	0.104	156	0.1	2.672	A
C - Great Connell Road (North)	361	19	1527	0.237	361	0.3	3.087	A
D - NSOOR Eastern Link	68	355	1683	0.041	68	0.0	2.229	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	159	227	1552	0.102	159	0.1	2.583	A
B - Proposed Development Site	156	185	1503	0.104	156	0.1	2.672	A
C - Great Connell Road (North)	361	19	1527	0.237	361	0.3	3.087	A
D - NSOOR Eastern Link	68	356	1683	0.041	68	0.0	2.229	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	129	185	1577	0.082	130	0.1	2.488	A
B - Proposed Development Site	128	151	1524	0.084	128	0.1	2.580	A
C - Great Connell Road (North)	295	15	1529	0.193	295	0.2	2.920	A
D - NSOOR Eastern Link	56	291	1726	0.032	56	0.0	2.155	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	108	155	1596	0.068	108	0.1	2.420	A
B - Proposed Development Site	107	127	1539	0.069	107	0.1	2.515	A
C - Great Connell Road (North)	247	13	1530	0.161	247	0.2	2.807	A
D - NSOOR Eastern Link	47	243	1757	0.027	47	0.0	2.104	A

2039 Scenario A Design 15 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.96	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D11	2039 Scenario A Design 15 Years	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	356	100.000
B - Proposed Development Site		✓	183	100.000
C - Great Connell Road (North)		✓	277	100.000
D - NSOOR Eastern Link		✓	27	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	13	328	15
	B - Proposed Development Site	19	0	164	0
	C - Great Connell Road (North)	121	110	0	46
	D - NSOOR Eastern Link	11	0	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.24	2.96	0.3	A
B - Proposed Development Site	0.15	3.07	0.2	A
C - Great Connell Road (North)	0.20	2.97	0.3	A
D - NSOOR Eastern Link	0.02	2.11	0.0	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	268	95	1633	0.164	267	0.2	2.635	A
B - Proposed Development Site	138	269	1452	0.095	137	0.1	2.738	A
C - Great Connell Road (North)	209	26	1523	0.137	208	0.2	2.736	A
D - NSOOR Eastern Link	20	188	1794	0.011	20	0.0	2.029	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	320	113	1621	0.197	320	0.2	2.765	A
B - Proposed Development Site	165	323	1420	0.116	164	0.1	2.867	A
C - Great Connell Road (North)	249	31	1520	0.164	249	0.2	2.831	A
D - NSOOR Eastern Link	24	225	1769	0.014	24	0.0	2.062	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	392	139	1606	0.244	392	0.3	2.965	A
B - Proposed Development Site	201	395	1376	0.146	201	0.2	3.065	A
C - Great Connell Road (North)	305	37	1516	0.201	305	0.3	2.971	A
D - NSOOR Eastern Link	30	275	1736	0.017	30	0.0	2.109	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	392	139	1606	0.244	392	0.3	2.965	A
B - Proposed Development Site	201	395	1375	0.147	201	0.2	3.066	A
C - Great Connell Road (North)	305	37	1516	0.201	305	0.3	2.971	A
D - NSOOR Eastern Link	30	275	1736	0.017	30	0.0	2.109	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	320	113	1621	0.197	320	0.2	2.767	A
B - Proposed Development Site	165	323	1419	0.116	165	0.1	2.869	A
C - Great Connell Road (North)	249	31	1520	0.164	249	0.2	2.832	A
D - NSOOR Eastern Link	24	225	1769	0.014	24	0.0	2.064	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	268	95	1632	0.164	268	0.2	2.638	A
B - Proposed Development Site	138	270	1451	0.095	138	0.1	2.740	A
C - Great Connell Road (North)	209	26	1523	0.137	209	0.2	2.741	A
D - NSOOR Eastern Link	20	188	1793	0.011	20	0.0	2.030	A

2039 Scenario A Design 15 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.84	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D12	2039 Scenario A Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	154	100.000
B - Proposed Development Site		✓	142	100.000
C - Great Connell Road (North)		✓	339	100.000
D - NSOOR Eastern Link		✓	64	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	19	132	3
	B - Proposed Development Site	15	0	127	0
	C - Great Connell Road (North)	156	163	0	20
	D - NSOOR Eastern Link	19	0	45	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.11	2.61	0.1	A
B - Proposed Development Site	0.10	2.69	0.1	A
C - Great Connell Road (North)	0.24	3.12	0.3	A
D - NSOOR Eastern Link	0.04	2.24	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	116	156	1595	0.073	116	0.1	2.433	A
B - Proposed Development Site	107	135	1534	0.070	107	0.1	2.522	A
C - Great Connell Road (North)	255	14	1530	0.167	254	0.2	2.821	A
D - NSOOR Eastern Link	48	251	1752	0.028	48	0.0	2.112	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	138	187	1576	0.088	138	0.1	2.503	A
B - Proposed Development Site	128	162	1517	0.084	128	0.1	2.589	A
C - Great Connell Road (North)	305	16	1528	0.199	305	0.2	2.941	A
D - NSOOR Eastern Link	58	300	1719	0.033	58	0.0	2.165	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	170	229	1550	0.109	169	0.1	2.606	A
B - Proposed Development Site	156	198	1495	0.105	156	0.1	2.688	A
C - Great Connell Road (North)	373	20	1526	0.245	373	0.3	3.121	A
D - NSOOR Eastern Link	70	367	1675	0.042	70	0.0	2.243	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	170	229	1550	0.109	170	0.1	2.606	A
B - Proposed Development Site	156	198	1495	0.105	156	0.1	2.688	A
C - Great Connell Road (North)	373	20	1526	0.245	373	0.3	3.121	A
D - NSOOR Eastern Link	70	368	1675	0.042	70	0.0	2.243	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	138	187	1576	0.088	139	0.1	2.506	A
B - Proposed Development Site	128	162	1517	0.084	128	0.1	2.590	A
C - Great Connell Road (North)	305	16	1528	0.199	305	0.3	2.945	A
D - NSOOR Eastern Link	58	301	1719	0.033	58	0.0	2.168	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	116	157	1595	0.073	116	0.1	2.434	A
B - Proposed Development Site	107	136	1533	0.070	107	0.1	2.525	A
C - Great Connell Road (North)	255	14	1530	0.167	255	0.2	2.824	A
D - NSOOR Eastern Link	48	252	1751	0.028	48	0.0	2.114	A

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Great Connell Roundabout - Scenario B.j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario B - Lidl Rd open
Report generation date: 15/03/2022 15:25:52

»2024 Do Nothing, AM
»2024 Do Nothing, PM
»2029 Do Nothing , AM
»2029 Do Nothing, PM
»2039 Do Nothing, AM
»2039 Do Nothing, PM
»2024 Scenario B Opening Year, AM
»2024 Scenario B Opening Year, PM
»2029 Scenario B Design 5 Years, AM
»2029 Scenario B Design 5 Years, PM
»2039 Scenario B Design 15 Years, AM
»2039 Scenario B Design 15 Years, PM

Summary of junction performance

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	2024 Do Nothing							
A - Great Connell Road (South)	0.2	2.67	0.20	A	0.1	2.36	0.08	A
B - Proposed Development Site	0.0	0.00	0.00	A	0.0	0.00	0.00	A
C - Great Connell Road (North)	0.1	2.70	0.11	A	0.1	2.65	0.11	A
D - NSOOR Eastern Link	0.0	1.98	0.02	A	0.0	2.05	0.04	A
	2029 Do Nothing							
A - Great Connell Road (South)	0.3	2.70	0.21	A	0.1	2.33	0.08	A
B - Proposed Development Site	0.0	0.00	0.00	A	0.0	0.00	0.00	A
C - Great Connell Road (North)	0.1	2.64	0.09	A	0.1	2.66	0.11	A
D - NSOOR Eastern Link	0.0	1.97	0.01	A	0.0	2.02	0.02	A
	2039 Do Nothing							
A - Great Connell Road (South)	0.3	2.80	0.23	A	0.1	2.39	0.09	A
B - Proposed Development Site	0.0	0.00	0.00	A	0.0	0.00	0.00	A
C - Great Connell Road (North)	0.1	2.76	0.12	A	0.1	2.72	0.13	A
D - NSOOR Eastern Link	0.0	2.00	0.02	A	0.0	2.08	0.04	A
	2024 Scenario B Opening Year							
A - Great Connell Road (South)	0.2	2.75	0.20	A	0.1	2.42	0.08	A
B - Proposed Development Site	0.1	2.75	0.08	A	0.1	2.51	0.06	A
C - Great Connell Road (North)	0.1	2.76	0.11	A	0.2	2.77	0.13	A
D - NSOOR Eastern Link	0.0	2.05	0.03	A	0.0	2.10	0.04	A
	2029 Scenario B Design 5 Years							
A - Great Connell Road (South)	0.3	2.90	0.23	A	0.1	2.58	0.10	A
B - Proposed Development Site	0.2	3.02	0.14	A	0.1	2.67	0.10	A
C - Great Connell Road (North)	0.2	2.91	0.13	A	0.2	2.95	0.17	A
D - NSOOR Eastern Link	0.1	2.13	0.05	A	0.1	2.28	0.10	A
	2039 Scenario B Design 15 Years							
A - Great Connell Road (South)	0.3	2.96	0.24	A	0.1	2.60	0.11	A
B - Proposed Development Site	0.2	3.06	0.15	A	0.1	2.69	0.10	A
C - Great Connell Road (North)	0.2	2.94	0.14	A	0.2	2.99	0.18	A
D - NSOOR Eastern Link	0.1	2.14	0.05	A	0.1	2.29	0.10	A

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

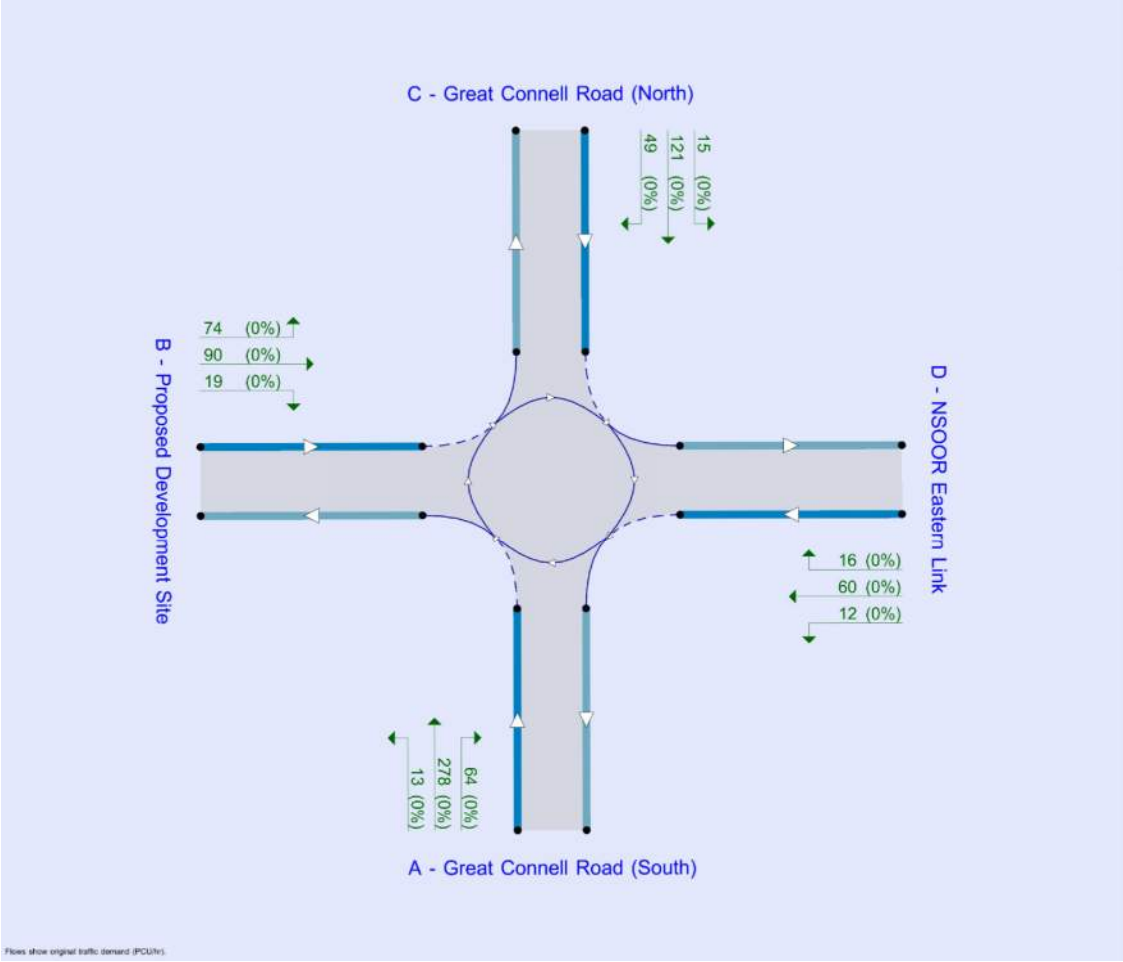
File Description

Title	
Location	
Site number	

Date	29/04/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	07:15	08:45	15
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D3	2029 Do Nothing	AM	ONE HOUR	07:15	08:45	15
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D5	2039 Do Nothing	AM	ONE HOUR	07:15	08:45	15
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D7	2024 Scenario B Opening Year	AM	ONE HOUR	07:15	08:45	15
D8	2024 Scenario B Opening Year	PM	ONE HOUR	17:30	19:00	15
D9	2029 Scenario B Design 5 Years	AM	ONE HOUR	07:15	08:45	15
D10	2029 Scenario B Design 5 Years	PM	ONE HOUR	17:30	19:00	15
D11	2039 Scenario B Design 15 Years	AM	ONE HOUR	07:15	08:45	15
D12	2039 Scenario B Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2024 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.64	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	Great Connell Road (South)	
B	Proposed Development Site	
C	Great Connell Road (North)	
D	NSOOR Eastern Link	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - Great Connell Road (South)	3.60	7.00	15.6	17.4	48.4	29.1	
B - Proposed Development Site	3.50	7.00	10.2	33.5	48.4	26.5	
C - Great Connell Road (North)	3.50	7.00	10.6	38.0	48.4	43.7	
D - NSOOR Eastern Link	4.50	7.00	17.4	18.9	48.4	23.7	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - Great Connell Road (South)	0.612	1691
B - Proposed Development Site	0.608	1616
C - Great Connell Road (North)	0.577	1538
D - NSOOR Eastern Link	0.663	1918

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	304	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	146	100.000
D - NSOOR Eastern Link		✓	26	100.000

Origin-Destination Data

Demand (PCU/hr)

	To				
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link

From	A - Great Connell Road (South)	0	0	234	70
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	102	0	0	44
	D - NSOOR Eastern Link	11	0	15	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.20	2.67	0.2	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.11	2.70	0.1	A
D - NSOOR Eastern Link	0.02	1.98	0.0	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	229	11	1684	0.136	228	0.2	2.472	A
B - Proposed Development Site	0	240	1470	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	110	53	1507	0.073	110	0.1	2.575	A
D - NSOOR Eastern Link	20	77	1867	0.010	20	0.0	1.947	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	273	13	1682	0.162	273	0.2	2.554	A
B - Proposed Development Site	0	287	1441	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	131	63	1501	0.087	131	0.1	2.626	A
D - NSOOR Eastern Link	23	92	1857	0.013	23	0.0	1.962	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	335	17	1681	0.199	334	0.2	2.674	A
B - Proposed Development Site	0	351	1402	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	161	77	1493	0.108	161	0.1	2.701	A
D - NSOOR Eastern Link	29	112	1844	0.016	29	0.0	1.982	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	335	17	1681	0.199	335	0.2	2.674	A
B - Proposed Development Site	0	351	1402	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	161	77	1493	0.108	161	0.1	2.701	A
D - NSOOR Eastern Link	29	112	1844	0.016	29	0.0	1.983	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	273	13	1682	0.162	274	0.2	2.555	A
B - Proposed Development Site	0	287	1441	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	131	63	1501	0.087	131	0.1	2.627	A
D - NSOOR Eastern Link	23	92	1857	0.013	23	0.0	1.964	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	229	11	1684	0.136	229	0.2	2.474	A

B - Proposed Development Site	0	240	1470	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	110	53	1507	0.073	110	0.1	2.578	A
D - NSOOR Eastern Link	20	77	1867	0.010	20	0.0	1.949	A

2024 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.44	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	122	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	150	100.000
D - NSOOR Eastern Link		✓	60	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	95	27
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	131	0	0	19
	D - NSOOR Eastern Link	18	0	42	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.08	2.36	0.1	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.11	2.65	0.1	A
D - NSOOR Eastern Link	0.04	2.05	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	92	32	1671	0.055	92	0.1	2.278	A
B - Proposed Development Site	0	123	1541	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	113	20	1526	0.074	113	0.1	2.547	A
D - NSOOR Eastern Link	45	98	1853	0.024	45	0.0	1.991	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	110	38	1668	0.066	110	0.1	2.310	A
B - Proposed Development Site	0	147	1526	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	135	24	1524	0.089	135	0.1	2.591	A
D - NSOOR Eastern Link	54	118	1840	0.029	54	0.0	2.015	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	134	46	1662	0.081	134	0.1	2.355	A
B - Proposed Development Site	0	180	1506	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	165	30	1521	0.109	165	0.1	2.655	A
D - NSOOR Eastern Link	66	144	1823	0.036	66	0.0	2.049	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	134	46	1662	0.081	134	0.1	2.355	A
B - Proposed Development Site	0	181	1506	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	165	30	1521	0.109	165	0.1	2.655	A
D - NSOOR Eastern Link	66	144	1823	0.036	66	0.0	2.049	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	110	38	1667	0.066	110	0.1	2.312	A
B - Proposed Development Site	0	148	1526	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	135	24	1524	0.089	135	0.1	2.591	A
D - NSOOR Eastern Link	54	118	1840	0.029	54	0.0	2.015	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	92	32	1671	0.055	92	0.1	2.280	A
B - Proposed Development Site	0	124	1541	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	113	20	1526	0.074	113	0.1	2.547	A
D - NSOOR Eastern Link	45	99	1853	0.024	45	0.0	1.991	A

2029 Do Nothing , AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.66	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	2029 Do Nothing	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	318	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	126	100.000
D - NSOOR Eastern Link		✓	13	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	258	60
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	112	0	0	14
	D - NSOOR Eastern Link	2	0	11	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.21	2.70	0.3	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.09	2.64	0.1	A
D - NSOOR Eastern Link	0.01	1.97	0.0	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	239	8	1686	0.142	239	0.2	2.486	A
B - Proposed Development Site	0	247	1466	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	95	45	1512	0.063	95	0.1	2.540	A
D - NSOOR Eastern Link	10	84	1863	0.005	10	0.0	1.942	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	286	10	1685	0.170	286	0.2	2.573	A
B - Proposed Development Site	0	296	1436	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	113	54	1507	0.075	113	0.1	2.583	A
D - NSOOR Eastern Link	12	101	1852	0.006	12	0.0	1.956	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	350	12	1683	0.208	350	0.3	2.699	A
B - Proposed Development Site	0	362	1396	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	139	66	1500	0.093	139	0.1	2.644	A
D - NSOOR Eastern Link	14	123	1837	0.008	14	0.0	1.975	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	350	12	1683	0.208	350	0.3	2.699	A
B - Proposed Development Site	0	362	1395	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	139	66	1500	0.093	139	0.1	2.644	A
D - NSOOR Eastern Link	14	123	1837	0.008	14	0.0	1.975	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	286	10	1685	0.170	286	0.2	2.576	A
B - Proposed Development Site	0	296	1436	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	113	54	1507	0.075	113	0.1	2.583	A
D - NSOOR Eastern Link	12	101	1851	0.006	12	0.0	1.958	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	239	8	1686	0.142	240	0.2	2.491	A
B - Proposed Development Site	0	248	1465	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	95	45	1512	0.063	95	0.1	2.542	A
D - NSOOR Eastern Link	10	84	1862	0.005	10	0.0	1.944	A

2029 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.47	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	125	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	156	100.000
D - NSOOR Eastern Link		✓	28	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	104	21
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	145	0	0	11
	D - NSOOR Eastern Link	12	0	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.08	2.33	0.1	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.11	2.66	0.1	A
D - NSOOR Eastern Link	0.02	2.02	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	94	12	1683	0.056	94	0.1	2.264	A
B - Proposed Development Site	0	106	1551	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	117	16	1529	0.077	117	0.1	2.550	A
D - NSOOR Eastern Link	21	109	1846	0.011	21	0.0	1.972	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	112	14	1682	0.067	112	0.1	2.293	A
B - Proposed Development Site	0	127	1539	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	140	19	1527	0.092	140	0.1	2.595	A
D - NSOOR Eastern Link	25	130	1832	0.014	25	0.0	1.992	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	138	18	1680	0.082	138	0.1	2.333	A
B - Proposed Development Site	0	155	1521	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	172	23	1524	0.113	172	0.1	2.660	A
D - NSOOR Eastern Link	31	160	1812	0.017	31	0.0	2.020	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	138	18	1680	0.082	138	0.1	2.333	A
B - Proposed Development Site	0	155	1521	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	172	23	1524	0.113	172	0.1	2.660	A
D - NSOOR Eastern Link	31	160	1812	0.017	31	0.0	2.020	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	112	14	1682	0.067	112	0.1	2.293	A
B - Proposed Development Site	0	127	1539	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	140	19	1527	0.092	140	0.1	2.598	A
D - NSOOR Eastern Link	25	130	1832	0.014	25	0.0	1.992	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	94	12	1683	0.056	94	0.1	2.266	A
B - Proposed Development Site	0	106	1551	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	117	16	1529	0.077	118	0.1	2.552	A
D - NSOOR Eastern Link	21	109	1846	0.011	21	0.0	1.974	A

2039 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.75	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D5	2039 Do Nothing	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	358	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	167	100.000
D - NSOOR Eastern Link		✓	28	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	278	80
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	121	0	0	46
	D - NSOOR Eastern Link	12	0	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.23	2.80	0.3	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.12	2.76	0.1	A
D - NSOOR Eastern Link	0.02	2.00	0.0	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	270	12	1683	0.160	269	0.2	2.543	A
B - Proposed Development Site	0	281	1445	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	126	60	1503	0.084	125	0.1	2.613	A
D - NSOOR Eastern Link	21	91	1858	0.011	21	0.0	1.959	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	322	14	1682	0.191	322	0.2	2.646	A
B - Proposed Development Site	0	336	1411	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	150	72	1496	0.100	150	0.1	2.673	A
D - NSOOR Eastern Link	25	109	1846	0.014	25	0.0	1.976	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	394	18	1680	0.235	394	0.3	2.799	A
B - Proposed Development Site	0	411	1365	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	184	88	1487	0.124	184	0.1	2.762	A
D - NSOOR Eastern Link	31	133	1830	0.017	31	0.0	2.000	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	394	18	1680	0.235	394	0.3	2.799	A
B - Proposed Development Site	0	412	1365	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	184	88	1487	0.124	184	0.1	2.762	A
D - NSOOR Eastern Link	31	133	1830	0.017	31	0.0	2.000	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	322	14	1682	0.191	322	0.2	2.647	A
B - Proposed Development Site	0	336	1411	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	150	72	1496	0.100	150	0.1	2.674	A
D - NSOOR Eastern Link	25	109	1846	0.014	25	0.0	1.976	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	270	12	1683	0.160	270	0.2	2.548	A
B - Proposed Development Site	0	282	1444	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	126	60	1503	0.084	126	0.1	2.615	A
D - NSOOR Eastern Link	21	91	1858	0.011	21	0.0	1.959	A

2039 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.49	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	142	100.000
B - Proposed Development Site		✓	0	100.000
C - Great Connell Road (North)		✓	176	100.000
D - NSOOR Eastern Link		✓	65	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	112	30
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	156	0	0	20
	D - NSOOR Eastern Link	20	0	45	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.09	2.39	0.1	A
B - Proposed Development Site	0.00	0.00	0.0	A
C - Great Connell Road (North)	0.13	2.72	0.1	A
D - NSOOR Eastern Link	0.04	2.08	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	107	34	1670	0.064	107	0.1	2.302	A
B - Proposed Development Site	0	140	1530	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	133	23	1525	0.087	132	0.1	2.585	A
D - NSOOR Eastern Link	49	117	1841	0.027	49	0.0	2.009	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	128	40	1666	0.077	128	0.1	2.339	A
B - Proposed Development Site	0	168	1514	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	158	27	1522	0.104	158	0.1	2.638	A
D - NSOOR Eastern Link	58	140	1825	0.032	58	0.0	2.037	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	156	50	1660	0.094	156	0.1	2.393	A
B - Proposed Development Site	0	206	1491	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	194	33	1519	0.128	194	0.1	2.716	A
D - NSOOR Eastern Link	72	172	1804	0.040	72	0.0	2.077	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	156	50	1660	0.094	156	0.1	2.393	A
B - Proposed Development Site	0	206	1491	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	194	33	1519	0.128	194	0.1	2.716	A
D - NSOOR Eastern Link	72	172	1804	0.040	72	0.0	2.077	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	128	40	1666	0.077	128	0.1	2.342	A
B - Proposed Development Site	0	168	1514	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	158	27	1522	0.104	158	0.1	2.639	A
D - NSOOR Eastern Link	58	140	1825	0.032	58	0.0	2.037	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	107	34	1670	0.064	107	0.1	2.304	A
B - Proposed Development Site	0	141	1530	0.000	0	0.0	0.000	A
C - Great Connell Road (North)	133	23	1525	0.087	133	0.1	2.587	A
D - NSOOR Eastern Link	49	118	1840	0.027	49	0.0	2.009	A

2024 Scenario B Opening Year, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.69	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D7	2024 Scenario B Opening Year	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	296	100.000
B - Proposed Development Site		✓	97	100.000
C - Great Connell Road (North)		✓	148	100.000
D - NSOOR Eastern Link		✓	53	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	8	234	54
	B - Proposed Development Site	10	0	39	48
	C - Great Connell Road (North)	102	33	0	13
	D - NSOOR Eastern Link	2	41	10	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.20	2.75	0.2	A
B - Proposed Development Site	0.08	2.75	0.1	A
C - Great Connell Road (North)	0.11	2.76	0.1	A
D - NSOOR Eastern Link	0.03	2.05	0.0	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	223	63	1652	0.135	222	0.2	2.516	A
B - Proposed Development Site	73	224	1480	0.049	73	0.1	2.558	A
C - Great Connell Road (North)	111	84	1489	0.075	111	0.1	2.612	A
D - NSOOR Eastern Link	40	109	1846	0.022	40	0.0	1.992	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	266	75	1644	0.162	266	0.2	2.611	A
B - Proposed Development Site	87	268	1453	0.060	87	0.1	2.635	A
C - Great Connell Road (North)	133	101	1480	0.090	133	0.1	2.672	A
D - NSOOR Eastern Link	48	130	1832	0.026	48	0.0	2.017	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	326	92	1634	0.199	326	0.2	2.751	A
B - Proposed Development Site	107	328	1416	0.075	107	0.1	2.748	A
C - Great Connell Road (North)	163	123	1467	0.111	163	0.1	2.760	A
D - NSOOR Eastern Link	58	160	1813	0.032	58	0.0	2.051	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	326	92	1634	0.199	326	0.2	2.751	A
B - Proposed Development Site	107	328	1416	0.075	107	0.1	2.748	A
C - Great Connell Road (North)	163	123	1467	0.111	163	0.1	2.760	A
D - NSOOR Eastern Link	58	160	1812	0.032	58	0.0	2.052	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	266	76	1644	0.162	266	0.2	2.612	A
B - Proposed Development Site	87	268	1453	0.060	87	0.1	2.636	A
C - Great Connell Road (North)	133	101	1480	0.090	133	0.1	2.675	A
D - NSOOR Eastern Link	48	130	1832	0.026	48	0.0	2.019	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	223	63	1652	0.135	223	0.2	2.519	A
B - Proposed Development Site	73	224	1479	0.049	73	0.1	2.559	A
C - Great Connell Road (North)	111	84	1489	0.075	111	0.1	2.612	A
D - NSOOR Eastern Link	40	109	1846	0.022	40	0.0	1.994	A

2024 Scenario B Opening Year, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.52	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D8	2024 Scenario B Opening Year	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	123	100.000
B - Proposed Development Site		✓	86	100.000
C - Great Connell Road (North)		✓	178	100.000
D - NSOOR Eastern Link		✓	71	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	9	95	19
	B - Proposed Development Site	9	0	35	42
	C - Great Connell Road (North)	131	37	0	10
	D - NSOOR Eastern Link	11	45	15	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.08	2.42	0.1	A
B - Proposed Development Site	0.06	2.51	0.1	A
C - Great Connell Road (North)	0.13	2.77	0.2	A
D - NSOOR Eastern Link	0.04	2.10	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	93	73	1646	0.056	92	0.1	2.317	A
B - Proposed Development Site	65	97	1557	0.042	65	0.0	2.412	A
C - Great Connell Road (North)	134	53	1507	0.089	134	0.1	2.620	A
D - NSOOR Eastern Link	53	133	1830	0.029	53	0.0	2.025	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	111	87	1637	0.068	111	0.1	2.357	A
B - Proposed Development Site	77	116	1545	0.050	77	0.1	2.451	A
C - Great Connell Road (North)	160	63	1501	0.107	160	0.1	2.683	A
D - NSOOR Eastern Link	64	159	1813	0.035	64	0.0	2.058	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	135	107	1625	0.083	135	0.1	2.415	A
B - Proposed Development Site	95	142	1529	0.062	95	0.1	2.508	A
C - Great Connell Road (North)	196	77	1493	0.131	196	0.2	2.774	A
D - NSOOR Eastern Link	78	195	1789	0.044	78	0.0	2.103	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	135	107	1625	0.083	135	0.1	2.415	A
B - Proposed Development Site	95	142	1529	0.062	95	0.1	2.508	A
C - Great Connell Road (North)	196	77	1493	0.131	196	0.2	2.774	A
D - NSOOR Eastern Link	78	195	1789	0.044	78	0.0	2.103	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	111	87	1637	0.068	111	0.1	2.359	A
B - Proposed Development Site	77	116	1545	0.050	77	0.1	2.454	A
C - Great Connell Road (North)	160	63	1501	0.107	160	0.1	2.683	A
D - NSOOR Eastern Link	64	159	1813	0.035	64	0.0	2.058	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	93	73	1646	0.056	93	0.1	2.317	A
B - Proposed Development Site	65	97	1557	0.042	65	0.0	2.414	A
C - Great Connell Road (North)	134	53	1507	0.089	134	0.1	2.621	A
D - NSOOR Eastern Link	53	133	1830	0.029	53	0.0	2.027	A

2029 Scenario B Design 5 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.84	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D9	2029 Scenario B Design 5 Years	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	331	100.000
B - Proposed Development Site		✓	183	100.000
C - Great Connell Road (North)		✓	175	100.000
D - NSOOR Eastern Link		✓	87	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	13	258	60
	B - Proposed Development Site	19	0	74	90
	C - Great Connell Road (North)	112	49	0	14
	D - NSOOR Eastern Link	11	60	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.23	2.90	0.3	A
B - Proposed Development Site	0.14	3.02	0.2	A
C - Great Connell Road (North)	0.13	2.91	0.2	A
D - NSOOR Eastern Link	0.05	2.13	0.1	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	249	94	1633	0.153	248	0.2	2.598	A
B - Proposed Development Site	138	251	1463	0.094	137	0.1	2.715	A
C - Great Connell Road (North)	132	127	1465	0.090	131	0.1	2.700	A
D - NSOOR Eastern Link	65	135	1829	0.036	65	0.0	2.041	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	298	112	1622	0.183	297	0.2	2.717	A
B - Proposed Development Site	165	300	1433	0.115	164	0.1	2.836	A
C - Great Connell Road (North)	157	152	1450	0.108	157	0.1	2.784	A
D - NSOOR Eastern Link	78	162	1811	0.043	78	0.0	2.077	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	364	138	1606	0.227	364	0.3	2.898	A
B - Proposed Development Site	201	367	1392	0.145	201	0.2	3.022	A
C - Great Connell Road (North)	193	186	1430	0.135	193	0.2	2.907	A
D - NSOOR Eastern Link	96	198	1787	0.054	96	0.1	2.128	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	364	138	1606	0.227	364	0.3	2.898	A
B - Proposed Development Site	201	368	1392	0.145	201	0.2	3.022	A
C - Great Connell Road (North)	193	186	1430	0.135	193	0.2	2.908	A
D - NSOOR Eastern Link	96	198	1787	0.054	96	0.1	2.128	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	298	112	1622	0.183	298	0.2	2.721	A
B - Proposed Development Site	165	301	1433	0.115	165	0.1	2.838	A
C - Great Connell Road (North)	157	152	1450	0.109	157	0.1	2.784	A
D - NSOOR Eastern Link	78	162	1811	0.043	78	0.0	2.079	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	249	94	1633	0.153	249	0.2	2.601	A
B - Proposed Development Site	138	252	1463	0.094	138	0.1	2.716	A
C - Great Connell Road (North)	132	127	1464	0.090	132	0.1	2.701	A
D - NSOOR Eastern Link	65	136	1828	0.036	66	0.0	2.041	A

2029 Scenario B Design 5 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.66	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D10	2029 Scenario B Design 5 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	144	100.000
B - Proposed Development Site		✓	142	100.000
C - Great Connell Road (North)		✓	229	100.000
D - NSOOR Eastern Link		✓	152	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	19	104	21
	B - Proposed Development Site	15	0	57	70
	C - Great Connell Road (North)	145	73	0	11
	D - NSOOR Eastern Link	19	90	43	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.10	2.58	0.1	A
B - Proposed Development Site	0.10	2.67	0.1	A
C - Great Connell Road (North)	0.17	2.95	0.2	A
D - NSOOR Eastern Link	0.10	2.28	0.1	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	108	155	1596	0.068	108	0.1	2.419	A
B - Proposed Development Site	107	126	1539	0.069	107	0.1	2.513	A
C - Great Connell Road (North)	172	80	1492	0.116	172	0.1	2.725	A
D - NSOOR Eastern Link	114	175	1802	0.063	114	0.1	2.132	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	129	185	1577	0.082	129	0.1	2.486	A
B - Proposed Development Site	128	151	1524	0.084	128	0.1	2.577	A
C - Great Connell Road (North)	206	95	1483	0.139	206	0.2	2.818	A
D - NSOOR Eastern Link	137	209	1780	0.077	137	0.1	2.190	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	159	227	1552	0.102	158	0.1	2.583	A
B - Proposed Development Site	156	185	1503	0.104	156	0.1	2.672	A
C - Great Connell Road (North)	252	117	1470	0.171	252	0.2	2.954	A
D - NSOOR Eastern Link	167	256	1748	0.096	167	0.1	2.276	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	159	227	1552	0.102	159	0.1	2.583	A
B - Proposed Development Site	156	185	1503	0.104	156	0.1	2.672	A
C - Great Connell Road (North)	252	117	1470	0.171	252	0.2	2.954	A
D - NSOOR Eastern Link	167	257	1748	0.096	167	0.1	2.276	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	129	185	1577	0.082	130	0.1	2.486	A
B - Proposed Development Site	128	151	1524	0.084	128	0.1	2.580	A
C - Great Connell Road (North)	206	95	1483	0.139	206	0.2	2.819	A
D - NSOOR Eastern Link	137	210	1779	0.077	137	0.1	2.193	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	108	155	1596	0.068	108	0.1	2.420	A
B - Proposed Development Site	107	127	1539	0.069	107	0.1	2.513	A
C - Great Connell Road (North)	172	80	1492	0.116	173	0.1	2.730	A
D - NSOOR Eastern Link	114	176	1802	0.064	114	0.1	2.133	A

2039 Scenario B Design 15 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.89	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D11	2039 Scenario B Design 15 Years	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	355	100.000
B - Proposed Development Site		✓	183	100.000
C - Great Connell Road (North)		✓	185	100.000
D - NSOOR Eastern Link		✓	88	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	13	278	64
	B - Proposed Development Site	19	0	74	90
	C - Great Connell Road (North)	121	49	0	15
	D - NSOOR Eastern Link	12	60	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.24	2.96	0.3	A
B - Proposed Development Site	0.15	3.06	0.2	A
C - Great Connell Road (North)	0.14	2.94	0.2	A
D - NSOOR Eastern Link	0.05	2.14	0.1	A

Main Results for each time segment

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	267	94	1633	0.164	266	0.2	2.633	A
B - Proposed Development Site	138	269	1452	0.095	137	0.1	2.737	A
C - Great Connell Road (North)	139	130	1463	0.095	139	0.1	2.719	A
D - NSOOR Eastern Link	66	142	1824	0.036	66	0.0	2.047	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	319	112	1622	0.197	319	0.2	2.762	A
B - Proposed Development Site	165	322	1420	0.116	164	0.1	2.866	A
C - Great Connell Road (North)	166	155	1448	0.115	166	0.1	2.808	A
D - NSOOR Eastern Link	79	170	1806	0.044	79	0.0	2.084	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	391	138	1606	0.243	391	0.3	2.961	A
B - Proposed Development Site	201	394	1376	0.146	201	0.2	3.063	A
C - Great Connell Road (North)	204	190	1428	0.143	204	0.2	2.940	A
D - NSOOR Eastern Link	97	208	1780	0.054	97	0.1	2.138	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	391	138	1606	0.243	391	0.3	2.961	A
B - Proposed Development Site	201	394	1376	0.146	201	0.2	3.064	A
C - Great Connell Road (North)	204	190	1428	0.143	204	0.2	2.940	A
D - NSOOR Eastern Link	97	208	1780	0.054	97	0.1	2.138	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	319	112	1622	0.197	319	0.2	2.766	A
B - Proposed Development Site	165	322	1420	0.116	165	0.1	2.867	A
C - Great Connell Road (North)	166	156	1448	0.115	166	0.1	2.811	A
D - NSOOR Eastern Link	79	170	1806	0.044	79	0.0	2.085	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	267	94	1633	0.164	267	0.2	2.638	A
B - Proposed Development Site	138	270	1452	0.095	138	0.1	2.741	A
C - Great Connell Road (North)	139	130	1463	0.095	139	0.1	2.720	A
D - NSOOR Eastern Link	66	142	1824	0.036	66	0.0	2.049	A

2039 Scenario B Design 15 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.68	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D12	2039 Scenario B Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	153	100.000
B - Proposed Development Site		✓	142	100.000
C - Great Connell Road (North)		✓	240	100.000
D - NSOOR Eastern Link		✓	155	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	19	112	22
	B - Proposed Development Site	15	0	57	70
	C - Great Connell Road (North)	156	73	0	11
	D - NSOOR Eastern Link	20	90	45	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.11	2.60	0.1	A
B - Proposed Development Site	0.10	2.69	0.1	A
C - Great Connell Road (North)	0.18	2.99	0.2	A
D - NSOOR Eastern Link	0.10	2.29	0.1	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	115	156	1595	0.072	115	0.1	2.432	A
B - Proposed Development Site	107	134	1534	0.070	107	0.1	2.521	A
C - Great Connell Road (North)	181	80	1491	0.121	180	0.1	2.743	A
D - NSOOR Eastern Link	117	183	1797	0.065	116	0.1	2.142	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	138	187	1576	0.087	137	0.1	2.501	A
B - Proposed Development Site	128	161	1518	0.084	128	0.1	2.588	A
C - Great Connell Road (North)	216	96	1482	0.146	216	0.2	2.841	A
D - NSOOR Eastern Link	139	219	1773	0.079	139	0.1	2.203	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	168	229	1550	0.109	168	0.1	2.604	A
B - Proposed Development Site	156	197	1496	0.105	156	0.1	2.686	A
C - Great Connell Road (North)	264	118	1470	0.180	264	0.2	2.985	A
D - NSOOR Eastern Link	171	268	1740	0.098	171	0.1	2.293	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	168	229	1550	0.109	168	0.1	2.604	A
B - Proposed Development Site	156	197	1496	0.105	156	0.1	2.686	A
C - Great Connell Road (North)	264	118	1470	0.180	264	0.2	2.985	A
D - NSOOR Eastern Link	171	269	1740	0.098	171	0.1	2.293	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	138	187	1576	0.087	138	0.1	2.504	A
B - Proposed Development Site	128	161	1518	0.084	128	0.1	2.591	A
C - Great Connell Road (North)	216	96	1482	0.146	216	0.2	2.842	A
D - NSOOR Eastern Link	139	220	1773	0.079	139	0.1	2.205	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - Great Connell Road (South)	115	157	1595	0.072	115	0.1	2.434	A
B - Proposed Development Site	107	135	1534	0.070	107	0.1	2.524	A
C - Great Connell Road (North)	181	81	1491	0.121	181	0.1	2.746	A
D - NSOOR Eastern Link	117	184	1796	0.065	117	0.1	2.143	A

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Great Connell Roundabout - Scenario C.j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario C- NSOOR open
Report generation date: 15/03/2022 15:36:40

»2024 Do Nothing, AM
»2024 Do Nothing, PM
»2029 Do Nothing , AM
»2029 Do Nothing, PM
»2039 Do Nothing, AM
»2039 Do Nothing, PM
»2024 Scenario C Opening Year, AM
»2024 Scenario C Opening Year, PM
»2029 Scenario C Design 5 Years, AM
»2029 Scenario C Design 5 Years, PM
»2039 Scenario C Design 15 Years, AM
»2039 Scenario C Design 15 Years, PM

Summary of junction performance

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
2024 Do Nothing								
A - Great Connell Road (South)	0.3	3.29	0.23	A	0.1	2.78	0.09	A
B - Proposed Development Site	0.2	2.99	0.18	A	0.1	2.70	0.13	A
C - Great Connell Road (North)	0.2	3.03	0.14	A	0.2	2.92	0.14	A
D - NSOOR Eastern Link	0.3	2.55	0.23	A	0.3	2.65	0.23	A
2029 Do Nothing								
A - Great Connell Road (South)	0.3	3.45	0.25	A	0.1	2.87	0.10	A
B - Proposed Development Site	0.3	3.19	0.23	A	0.2	2.77	0.16	A
C - Great Connell Road (North)	0.1	3.06	0.13	A	0.2	3.02	0.15	A
D - NSOOR Eastern Link	0.3	2.65	0.25	A	0.3	2.77	0.26	A
2039 Do Nothing								
A - Great Connell Road (South)	0.4	3.70	0.29	A	0.1	3.01	0.12	A
B - Proposed Development Site	0.3	3.33	0.24	A	0.2	2.87	0.17	A
C - Great Connell Road (North)	0.2	3.25	0.17	A	0.2	3.12	0.17	A
D - NSOOR Eastern Link	0.4	2.77	0.28	A	0.4	2.96	0.30	A
2024 Scenario C Opening Year								
A - Great Connell Road (South)	0.3	3.43	0.25	A	0.1	2.89	0.10	A
B - Proposed Development Site	0.3	3.20	0.23	A	0.2	2.84	0.17	A
C - Great Connell Road (North)	0.2	3.16	0.15	A	0.2	3.03	0.15	A
D - NSOOR Eastern Link	0.3	2.66	0.25	A	0.4	2.78	0.26	A
2029 Scenario C Design 5 Years								
A - Great Connell Road (South)	0.4	3.76	0.29	A	0.1	3.15	0.13	A
B - Proposed Development Site	0.5	3.71	0.33	A	0.3	3.09	0.24	A
C - Great Connell Road (North)	0.2	3.44	0.17	A	0.2	3.26	0.18	A
D - NSOOR Eastern Link	0.4	2.88	0.30	A	0.5	3.14	0.34	A
2039 Scenario C Design 15 Years								
A - Great Connell Road (South)	0.5	3.96	0.31	A	0.2	3.24	0.14	A
B - Proposed Development Site	0.5	3.84	0.34	A	0.3	3.15	0.25	A
C - Great Connell Road (North)	0.2	3.53	0.19	A	0.2	3.33	0.19	A
D - NSOOR Eastern Link	0.5	2.98	0.32	A	0.6	3.26	0.36	A

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

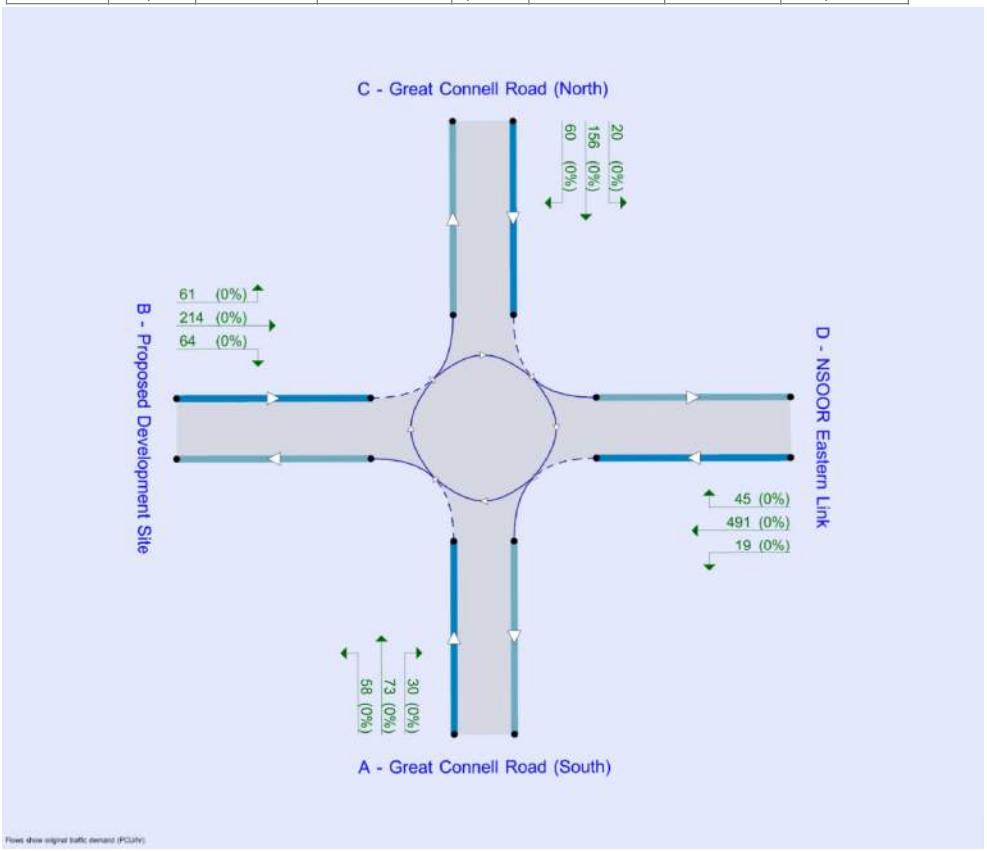
File Description

Title	
Location	
Site number	
Date	29/04/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units

m	kph	PCU	PCU	perHour	s	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	07:15	08:45	15
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D3	2029 Do Nothing	AM	ONE HOUR	07:15	08:45	15
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D5	2039 Do Nothing	AM	ONE HOUR	07:15	08:45	15
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D13	2024 Scenario C Opening Year	AM	ONE HOUR	07:15	08:45	15
D14	2024 Scenario C Opening Year	PM	ONE HOUR	17:30	19:00	15
D15	2029 Scenario C Design 5 Years	AM	ONE HOUR	07:15	08:45	15
D16	2029 Scenario C Design 5 Years	PM	ONE HOUR	17:30	19:00	15
D17	2039 Scenario C Design 15 Years	AM	ONE HOUR	07:15	08:45	15
D18	2039 Scenario C Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2024 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.93	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	Great Connell Road (South)	
B	Proposed Development Site	
C	Great Connell Road (North)	
D	NSOOR Eastern Link	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - Great Connell Road (South)	3.60	7.00	15.6	17.4	48.4	29.1	
B - Proposed Development Site	3.50	7.00	10.2	33.5	48.4	26.5	
C - Great Connell Road (North)	3.50	7.00	10.6	38.0	48.4	43.7	
D - NSOOR Eastern Link	4.50	7.00	17.4	18.9	48.4	23.7	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - Great Connell Road (South)	0.612	1691
B - Proposed Development Site	0.608	1616
C - Great Connell Road (North)	0.577	1538
D - NSOOR Eastern Link	0.663	1918

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	305	100.000
B - Proposed Development Site		✓	232	100.000
C - Great Connell Road (North)		✓	170	100.000
D - NSOOR Eastern Link		✓	373	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	83	152	70
	B - Proposed Development Site	5	0	46	181
	C - Great Connell Road (North)	102	24	0	44
	D - NSOOR Eastern Link	11	347	15	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
	A - Great Connell Road (South)	0	0	0	0

From	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.23	3.29	0.3	A
B - Proposed Development Site	0.18	2.99	0.2	A
C - Great Connell Road (North)	0.14	3.03	0.2	A
D - NSOOR Eastern Link	0.23	2.55	0.3	A

2024 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.73	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	122	100.000
B - Proposed Development Site		✓	176	100.000
C - Great Connell Road (North)		✓	180	100.000
D - NSOOR Eastern Link		✓	374	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	34	61	27
	B - Proposed Development Site	41	0	35	100
	C - Great Connell Road (North)	131	30	0	19
	D - NSOOR Eastern Link	18	314	42	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.09	2.78	0.1	A
B - Proposed Development Site	0.13	2.70	0.1	A
C - Great Connell Road (North)	0.14	2.92	0.2	A
D - NSOOR Eastern Link	0.23	2.65	0.3	A

2029 Do Nothing , AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	3.06	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	2029 Do Nothing	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	319	100.000
B - Proposed Development Site		✓	299	100.000
C - Great Connell Road (North)		✓	156	100.000
D - NSOOR Eastern Link		✓	412	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	92	167	60
	B - Proposed Development Site	6	0	60	233
	C - Great Connell Road (North)	112	30	0	14
	D - NSOOR Eastern Link	2	399	11	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.25	3.45	0.3	A
B - Proposed Development Site	0.23	3.19	0.3	A
C - Great Connell Road (North)	0.13	3.06	0.1	A
D - NSOOR Eastern Link	0.25	2.65	0.3	A

2029 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.84	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	127	100.000
B - Proposed Development Site		✓	225	100.000
C - Great Connell Road (North)		✓	198	100.000
D - NSOOR Eastern Link		✓	410	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	38	68	21
	B - Proposed Development Site	46	0	45	134
	C - Great Connell Road (North)	145	42	0	11
	D - NSOOR Eastern Link	12	382	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.10	2.87	0.1	A
B - Proposed Development Site	0.16	2.77	0.2	A
C - Great Connell Road (North)	0.15	3.02	0.2	A
D - NSOOR Eastern Link	0.26	2.77	0.3	A

2039 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	3.22	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D5	2039 Do Nothing	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	360	100.000
B - Proposed Development Site		✓	317	100.000
C - Great Connell Road (North)		✓	199	100.000
D - NSOOR Eastern Link		✓	455	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	99	180	81
	B - Proposed Development Site	6	0	64	247
	C - Great Connell Road (North)	121	32	0	46
	D - NSOOR Eastern Link	11	428	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.29	3.70	0.4	A
B - Proposed Development Site	0.24	3.33	0.3	A
C - Great Connell Road (North)	0.17	3.25	0.2	A
D - NSOOR Eastern Link	0.28	2.77	0.4	A

2039 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.98	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	144	100.000
B - Proposed Development Site		✓	239	100.000
C - Great Connell Road (North)		✓	220	100.000
D - NSOOR Eastern Link		✓	472	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	41	73	30
	B - Proposed Development Site	49	0	48	142
	C - Great Connell Road (North)	156	44	0	20
	D - NSOOR Eastern Link	19	408	45	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.12	3.01	0.1	A
B - Proposed Development Site	0.17	2.87	0.2	A
C - Great Connell Road (North)	0.17	3.12	0.2	A
D - NSOOR Eastern Link	0.30	2.96	0.4	A

2024 Scenario C Opening Year, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	3.07	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D13	2024 Scenario C Opening Year	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	314	100.000
B - Proposed Development Site		✓	303	100.000
C - Great Connell Road (North)		✓	178	100.000
D - NSOOR Eastern Link		✓	416	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	92	152	70
	B - Proposed Development Site	15	0	56	232
	C - Great Connell Road (North)	102	32	0	44
	D - NSOOR Eastern Link	11	390	15	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.25	3.43	0.3	A
B - Proposed Development Site	0.23	3.20	0.3	A
C - Great Connell Road (North)	0.15	3.16	0.2	A
D - NSOOR Eastern Link	0.25	2.66	0.3	A

2024 Scenario C Opening Year, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	2.86	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D14	2024 Scenario C Opening Year	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	132	100.000
B - Proposed Development Site		✓	238	100.000
C - Great Connell Road (North)		✓	189	100.000
D - NSOOR Eastern Link		✓	422	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	44	61	27
	B - Proposed Development Site	50	0	44	144
	C - Great Connell Road (North)	131	39	0	19
	D - NSOOR Eastern Link	18	362	42	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.10	2.89	0.1	A
B - Proposed Development Site	0.17	2.84	0.2	A
C - Great Connell Road (North)	0.15	3.03	0.2	A
D - NSOOR Eastern Link	0.26	2.78	0.4	A

2029 Scenario C Design 5 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	3.41	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D15	2029 Scenario C Design 5 Years	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	348	100.000
B - Proposed Development Site		✓	430	100.000
C - Great Connell Road (North)		✓	199	100.000
D - NSOOR Eastern Link		✓	489	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	105	167	76
	B - Proposed Development Site	25	0	78	327
	C - Great Connell Road (North)	112	42	0	45
	D - NSOOR Eastern Link	11	462	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.29	3.76	0.4	A
B - Proposed Development Site	0.33	3.71	0.5	A
C - Great Connell Road (North)	0.17	3.44	0.2	A
D - NSOOR Eastern Link	0.30	2.88	0.4	A

2029 Scenario C Design 5 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	3.15	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D16	2029 Scenario C Design 5 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	152	100.000
B - Proposed Development Site		✓	325	100.000
C - Great Connell Road (North)		✓	223	100.000
D - NSOOR Eastern Link		✓	527	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	55	68	29
	B - Proposed Development Site	61	0	58	206
	C - Great Connell Road (North)	145	58	0	20
	D - NSOOR Eastern Link	19	465	43	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.13	3.15	0.1	A
B - Proposed Development Site	0.24	3.09	0.3	A
C - Great Connell Road (North)	0.18	3.26	0.2	A
D - NSOOR Eastern Link	0.34	3.14	0.5	A

2039 Scenario C Design 15 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	3.54	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D17	2039 Scenario C Design 15 Years	AM	ONE HOUR	07:15	08:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	373	100.000
B - Proposed Development Site		✓	448	100.000
C - Great Connell Road (North)		✓	211	100.000
D - NSOOR Eastern Link		✓	518	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	112	180	81
	B - Proposed Development Site	26	0	81	341
	C - Great Connell Road (North)	121	44	0	46
	D - NSOOR Eastern Link	11	491	16	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.31	3.96	0.5	A
B - Proposed Development Site	0.34	3.84	0.5	A
C - Great Connell Road (North)	0.19	3.53	0.2	A
D - NSOOR Eastern Link	0.32	2.98	0.5	A

2039 Scenario C Design 15 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Great Connell Roundabout	Standard Roundabout		A, B, C, D	3.24	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D18	2039 Scenario C Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - Great Connell Road (South)		✓	161	100.000
B - Proposed Development Site		✓	339	100.000
C - Great Connell Road (North)		✓	236	100.000
D - NSOOR Eastern Link		✓	555	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	58	73	30
	B - Proposed Development Site	64	0	61	214
	C - Great Connell Road (North)	156	60	0	20
	D - NSOOR Eastern Link	19	491	45	0

Vehicle Mix

Heavy Vehicle Percentages

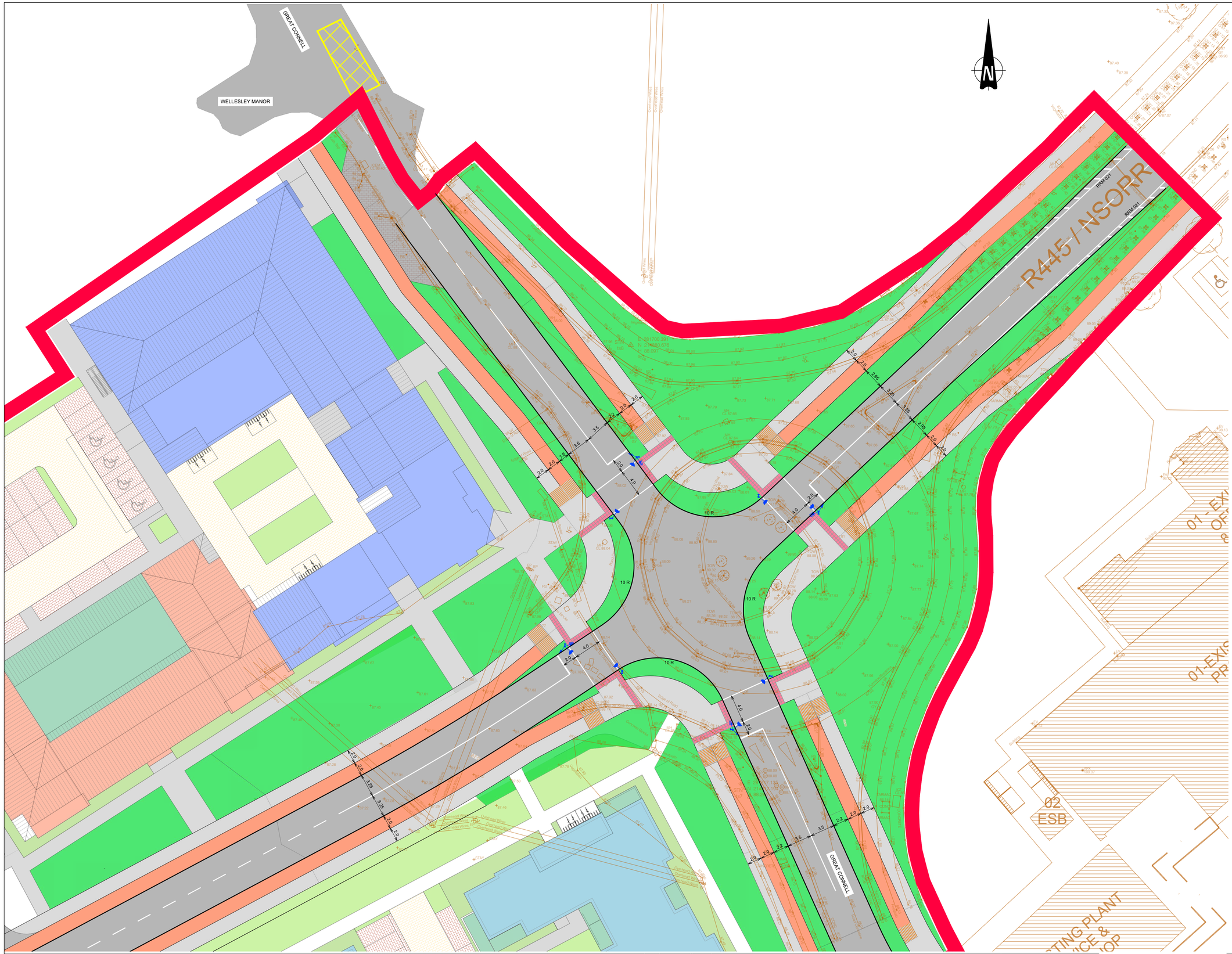
		To			
		A - Great Connell Road (South)	B - Proposed Development Site	C - Great Connell Road (North)	D - NSOOR Eastern Link
From	A - Great Connell Road (South)	0	0	0	0
	B - Proposed Development Site	0	0	0	0
	C - Great Connell Road (North)	0	0	0	0
	D - NSOOR Eastern Link	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - Great Connell Road (South)	0.14	3.24	0.2	A
B - Proposed Development Site	0.25	3.15	0.3	A
C - Great Connell Road (North)	0.19	3.33	0.2	A
D - NSOOR Eastern Link	0.36	3.26	0.6	A

Appendix F Great Connell Signalised Junction Layout



LEGEND:

- CARRIAGEWAY
- CYCLE LANE TRACK
- FOOTPATH
- GRASSED AREA
- TACTILE PAVING (RED)
- CORDUROY HAZARD WARNING PAVING
- SITE BOUNDARY

Ordnance Survey Ireland Licence No. CYAL50252568
© Ordnance Survey Ireland/Government of Ireland

© PUNCH Consulting Engineers
This drawing and any design hereon is the copyright of the Consultants and must not be reproduced without their written consent.
All drawings remain the property of the Consultants.
Figured dimension only to be taken from this drawing.
Consultants to be informed immediately of any discrepancies before work proceeds.
COLOUR DRAWING

BUILDING INFORMATION MODELLING (BIM)
I.S. EN ISO 19650-2:2018
NSAI Certified

Rev	Amendment	By	Date
C01	ISSUED FOR PLANNING	IBS	2022-03-23
C02	ISSUED FOR PLANNING	SB	2022-03-31

Client:

PUNCH consulting engineers
Dublin | Limerick | Cork | Galway | Glasgow
Carnegie House Library Road,
Dun Laoghaire, Co. Dublin, A96 C7W7
t +353 1 271 2200 | w punchconsulting.com

Project: ASTON ROAD & BRIDGE, GREAT CONNELL, NEWBRIDGE CO. KILDARE
Title: GREAT CONNELL - SIGNALISED JUNCTION

Drawn:	Date drawn:	Technician Check:	Engineer Check:	Approved:
S Buckley	February 2022	S Buckley	J Tiernan	J Tiernan

Project No:	Model Ref:	Drawing Status:
192229	192229-PUNCH-XX-XX-M2-C-0431	A0 PLANNING

Scale @ A1:	Document No:	Revision No:
1:250	192229-PUNCH-XX-XX-DR-C-0431	C02

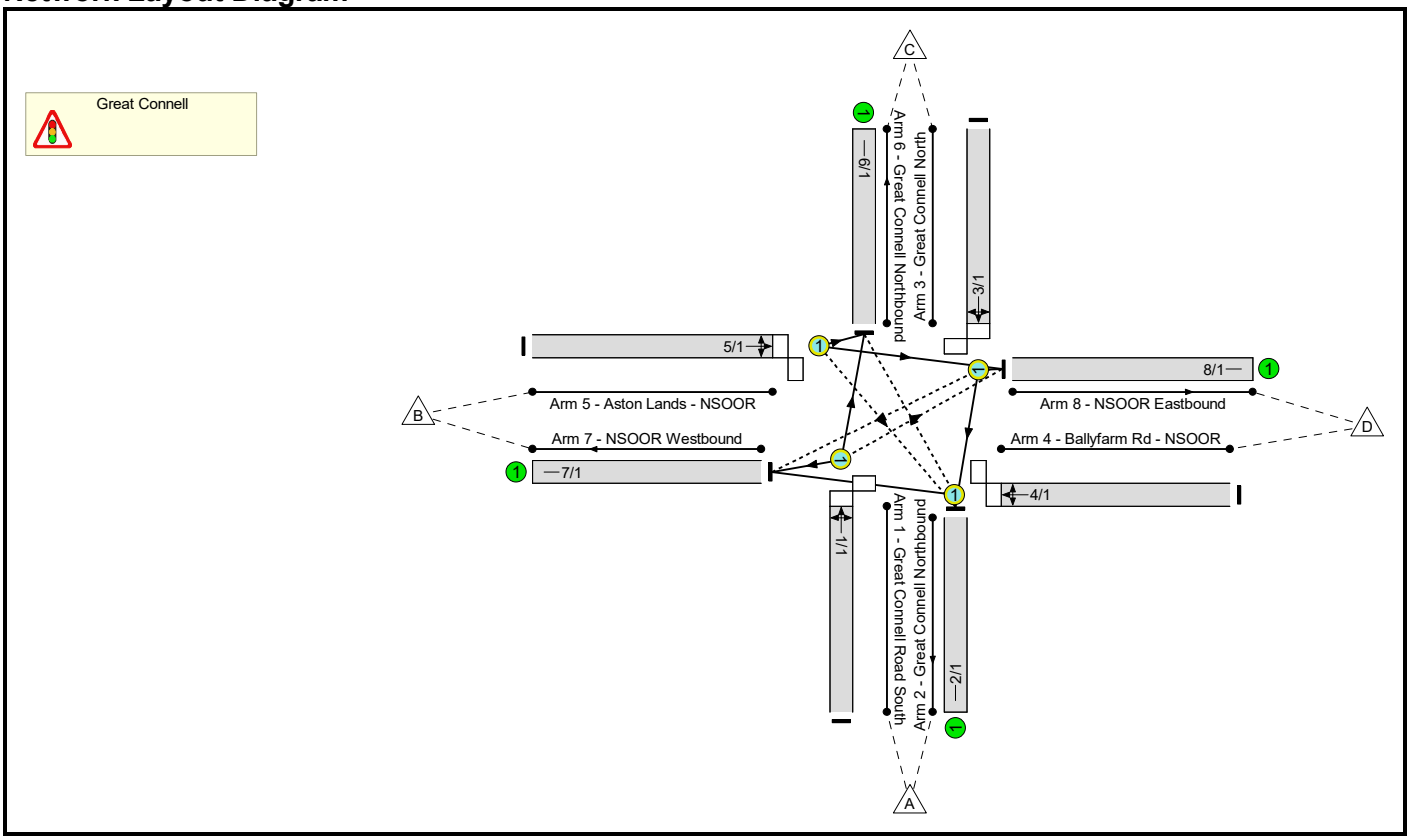
Appendix G Great Connell Signalised Junction Linsig Results Output

Full Input Data And Results

User and Project Details

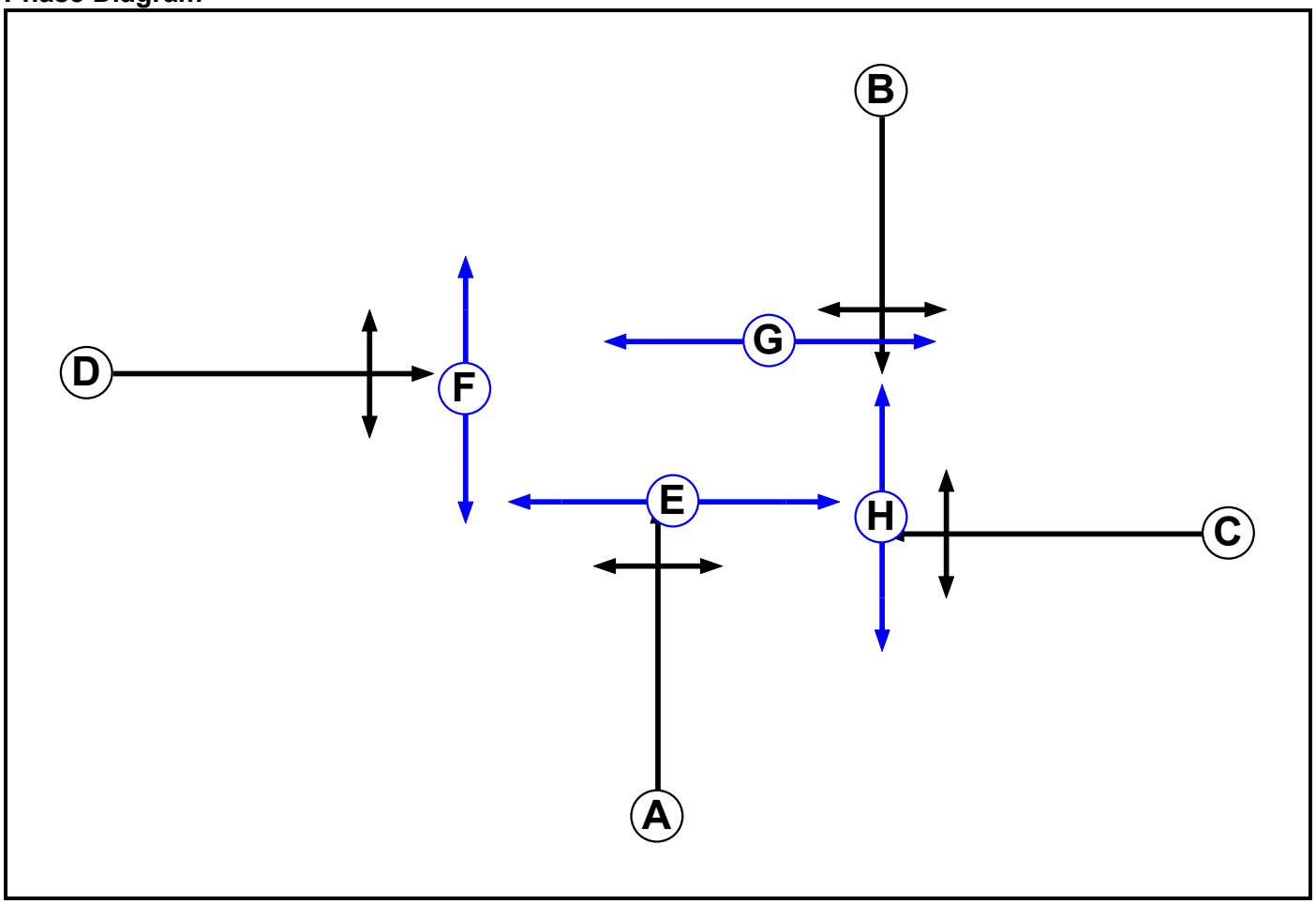
Project:	**Newbridge SHD**
Title:	**Aston Lands**
Location:	Newbridge
Client:	Aston
Checked By:	J Tiernan
Additional detail:	
File name:	192229 - Great Connell Signalised Junction.lsg3x
Author:	J Tiernan
Company:	PUNCH
Address:	97 Henry St Limerick

Network Layout Diagram



Full Input Data And Results

Phase Diagram



Phase Input Data

Phase Name	Phase Type	Assoc. Phase	Street Min	Cont Min
A	Traffic		7	7
B	Traffic		7	7
C	Traffic		7	7
D	Traffic		7	7
E	Pedestrian		7	7
F	Pedestrian		7	7
G	Pedestrian		7	7
H	Pedestrian		7	7

Full Input Data And Results

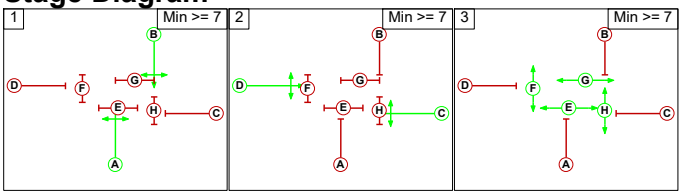
Phase Intergreens Matrix

Terminating Phase \ Starting Phase	A	B	C	D	E	F	G	H
A		-	6	5	5	7	8	9
B	-		5	6	9	8	5	8
C	5	6		-	8	-	8	5
D	5	6	-		8	5	8	9
E	8	8	8	8		-	-	-
F	8	8	-	8	-		-	-
G	8	8	8	8	-	-		-
H	8	8	8	8	-	-	-	

Phases in Stage

Stage No.	Phases in Stage
1	A B
2	C D
3	E F G H

Stage Diagram



Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
There are no Phase Delays defined					

Prohibited Stage Change

From Stage \ To Stage	1	2	3
1		6	9
2	6		9
3	8	8	

Full Input Data And Results

Give-Way Lane Input Data

Junction: Great Connell											
Lane	**Movement**	**Max Flow when Giving Way (PCU/Hr)**	**Min Flow when Giving Way (PCU/Hr)**	**Opposing Lane**	**Opp. Lane Coeff.**	**Opp. Mvmnts.**	**Right Turn Storage (PCU)**	**Non-Blocking Storage (PCU)**	**RTF**	**Right Turn Move up (s)**	**Max Turns in Intergreen (PCU)**
1/1 (Great Connell Road South)	8/1 (Right)	1439	0	3/1	1.09	All	2.00	1.00	0.50	2	2.00
3/1 (Great Connell North)	7/1 (Right)	1439	0	1/1	1.09	All	2.00	1.00	0.50	2	2.00
4/1 (Ballyfarm Rd - NSOOR)	6/1 (Right)	1439	0	5/1	1.09	All	2.00	1.00	0.50	2	2.00
5/1 (Aston Lands - NSOOR)	2/1 (Right)	1439	0	4/1	1.09	All	2.00	1.00	0.50	2	2.00

Full Input Data And Results

Lane Input Data

Junction: Great Connell

Lane	Lane Type	Phases	Start Disp.	End Disp.	Physical Length (PCU)	Sat Flow Type	Def User Saturation Flow (PCU/Hr)	Lane Width (m)	Gradient	Nearside Lane	Turns	Turning Radius (m)
1/1 (Great Connell Road South)	O	A	2	3	60.0	Geom	-	3.50	0.00	Y	Arm 6 Ahead	Inf
											Arm 7 Left	10.00
											Arm 8 Right	10.00
2/1 (Great Connell Northbound)	U		2	3	60.0	Inf	-	-	-	-	-	-
3/1 (Great Connell North)	O	B	2	3	60.0	Geom	-	3.50	0.00	Y	Arm 2 Ahead	Inf
											Arm 7 Right	10.00
											Arm 8 Left	10.00
4/1 (Ballyfarm Rd - NSOOR)	O	C	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 2 Left	10.00
											Arm 6 Right	10.00
											Arm 7 Ahead	Inf
5/1 (Aston Lands - NSOOR)	O	D	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 2 Right	10.00
											Arm 6 Left	10.00
											Arm 8 Ahead	Inf
6/1 (Great Connell Northbound)	U		2	3	60.0	Inf	-	-	-	-	-	-
7/1 (NSOOR Westbound)	U		2	3	60.0	Inf	-	-	-	-	-	-
8/1 (NSOOR Eastbound)	U		2	3	60.0	Inf	-	-	-	-	-	-

Full Input Data And Results

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: 'Scenario B 2024 AM DS'	08:00	09:00	01:00	
2: 'Scenario B 2024 PM DS'	16:15	17:15	01:00	
3: 'Scenario B 2029 AM DS'	08:00	09:00	01:00	
4: 'Scenario B 2029 PM DS'	16:15	17:15	01:00	
5: 'Scenario B 2039 AM DS'	08:00	09:00	01:00	
6: 'Scenario B 2039 PM DS'	16:15	17:15	01:00	
7: 'Scenario C 2024 AM DS'	08:00	09:00	01:00	
8: 'Scenario C 2024 PM DS'	16:15	17:15	01:00	
9: 'Scenario C 2029 AM DS'	08:00	09:00	01:00	
10: 'Scenario C 2029 PM DS'	16:15	17:15	01:00	
11: 'Scenario C 2039 AM DS'	08:00	09:00	01:00	
12: 'Scenario C 2039 PM DS'	16:15	17:15	01:00	

Traffic Flows, Desired

Scenario 1: 'Scenario B 2024 AM DS' (FG1: 'Scenario B 2024 AM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	8	234	54	296
	B	10	0	39	48	97
	C	102	33	0	13	148
	D	2	41	10	0	53
	Tot.	114	82	283	115	594

Scenario 2: 'Scenario B 2024 PM DS' (FG2: 'Scenario B 2024 PM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	9	95	19	123
	B	9	0	35	42	86
	C	131	37	0	10	178
	D	11	45	15	0	71
	Tot.	151	91	145	71	458

Scenario 3: 'Scenario B 2029 AM DS' (FG3: 'Scenario B 2029 AM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	13	258	60	331
	B	19	0	74	90	183
	C	112	49	0	14	175
	D	11	60	16	0	87
	Tot.	142	122	348	164	776

Full Input Data And Results

Scenario 4: 'Scenario B 2029 PM DS' (FG4: 'Scenario B 2029 PM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	19	104	21	144
	B	15	0	57	70	142
	C	145	73	0	11	229
	D	19	90	43	0	152
	Tot.	179	182	204	102	667

Scenario 5: 'Scenario B 2039 AM DS' (FG5: 'Scenario B 2039 AM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	13	278	64	355
	B	19	0	74	90	183
	C	121	49	0	15	185
	D	12	60	16	0	88
	Tot.	152	122	368	169	811

Scenario 6: 'Scenario B 2039 PM DS' (FG6: 'Scenario B 2039 PM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	19	112	22	153
	B	15	0	57	70	142
	C	156	73	0	11	240
	D	20	90	45	0	155
	Tot.	191	182	214	103	690

Scenario 7: 'Scenario C 2024 AM DS' (FG7: 'Scenario C 2024 AM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	92	152	70	314
	B	15	0	56	232	303
	C	102	32	0	44	178
	D	11	390	15	0	416
	Tot.	128	514	223	346	1211

Scenario 8: 'Scenario C 2024 PM DS' (FG8: 'Scenario C 2024 PM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	44	61	27	132
	B	50	0	44	144	238
	C	131	39	0	19	189
	D	18	362	42	0	422
	Tot.	199	445	147	190	981

Full Input Data And Results

Scenario 9: 'Scenario C 2029 AM DS' (FG9: 'Scenario C 2029 AM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	105	167	76	348
	B	25	0	78	327	430
	C	112	42	0	45	199
	D	11	462	16	0	489
	Tot.	148	609	261	448	1466

Scenario 10: 'Scenario C 2029 PM DS' (FG10: 'Scenario C 2029 PM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	55	68	29	152
	B	61	0	58	206	325
	C	145	58	0	20	223
	D	19	465	43	0	527
	Tot.	225	578	169	255	1227

Scenario 11: 'Scenario C 2039 AM DS' (FG11: 'Scenario C 2039 AM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	112	180	81	373
	B	26	0	81	341	448
	C	121	44	0	46	211
	D	11	491	16	0	518
	Tot.	158	647	277	468	1550

Scenario 12: 'Scenario C 2039 PM DS' (FG12: 'Scenario C 2039 PM DS', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	58	73	30	161
	B	64	0	61	214	339
	C	156	60	0	20	236
	D	19	491	45	0	555
	Tot.	239	609	179	264	1291

Full Input Data And Results

Network Results

Scenario 1: 'Scenario B 2024 AM DS' (FG1: 'Scenario B 2024 AM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**30.4%**
Great Connell	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**30.4%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	45	-	296	1905	974	30.4%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	114	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	45	-	148	1877	928	15.9%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	15	-	53	1876	334	15.9%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	15	-	97	1803	321	30.3%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	283	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	82	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	115	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**106**	**0**	**1**	**2.9**	**0.6**	**0.0**	**3.5**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**106**	**0**	**1**	**2.9**	**0.6**	**0.0**	**3.5**	**-**	**-**	**-**	**-**
1/1	296	296	53	0	1	1.0	0.2	0.0	1.3	15.5	4.3	0.2	4.5
2/1	114	114	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	148	148	33	0	0	0.5	0.1	0.0	0.6	14.6	1.9	0.1	2.0
4/1	53	53	10	0	0	0.5	0.1	0.0	0.6	38.1	1.1	0.1	1.2
5/1	97	97	10	0	0	0.9	0.2	0.0	1.1	40.3	2.1	0.2	2.3
6/1	283	283	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	82	82	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	115	115	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 196.0 Total Delay for Signalled Lanes (pcuHr): 3.52 Cycle Time (s): 90
PRC Over All Lanes (%): 196.0 Total Delay Over All Lanes(pcuHr): 3.52

Full Input Data And Results

Scenario 2: 'Scenario B 2024 PM DS' (FG2: 'Scenario B 2024 PM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**20.7%**
Great Connell	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**20.7%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	40	-	123	1900	862	14.3%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	151	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	40	-	178	1890	861	20.7%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	20	-	71	1839	429	16.5%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	20	-	86	1802	420	20.5%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	145	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	91	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	71	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**79**	**0**	**1**	**2.4**	**0.4**	**0.0**	**2.9**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**79**	**0**	**1**	**2.4**	**0.4**	**0.0**	**2.9**	**-**	**-**	**-**	**-**
1/1	123	123	19	0	0	0.5	0.1	0.0	0.6	17.0	1.8	0.1	1.9
2/1	151	151	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	178	178	37	0	0	0.7	0.1	0.0	0.9	17.6	2.7	0.1	2.8
4/1	71	71	15	0	0	0.5	0.1	0.0	0.6	32.9	1.4	0.1	1.5
5/1	86	86	9	0	0	0.7	0.1	0.0	0.8	33.3	1.7	0.1	1.8
6/1	145	145	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	91	91	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	71	71	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 335.3 Total Delay for Signalled Lanes (pcuHr): 2.89 Cycle Time (s): 90
PRC Over All Lanes (%): 335.3 Total Delay Over All Lanes(pcuHr): 2.89

Full Input Data And Results

Scenario 3: 'Scenario B 2029 AM DS' (FG3: 'Scenario B 2029 AM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**40.3%**
Great Connell	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**40.3%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	38	-	331	1902	820	40.3%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	142	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	38	-	175	1864	693	25.3%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	22	-	87	1854	452	19.3%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	22	-	183	1803	461	39.7%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	348	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	122	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	164	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**142**	**0**	**2**	**4.4**	**1.0**	**0.1**	**5.5**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**142**	**0**	**2**	**4.4**	**1.0**	**0.1**	**5.5**	**-**	**-**	**-**	**-**
1/1	331	331	59	0	1	1.6	0.3	0.0	2.0	21.4	5.6	0.3	5.9
2/1	142	142	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	175	175	48	0	1	0.8	0.2	0.1	1.0	20.8	2.7	0.2	2.9
4/1	87	87	16	0	0	0.6	0.1	0.0	0.8	31.9	1.7	0.1	1.8
5/1	183	183	19	0	0	1.4	0.3	0.0	1.7	34.3	3.8	0.3	4.1
6/1	348	348	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	122	122	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	164	164	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 123.1 Total Delay for Signalled Lanes (pcuHr): 5.49 Cycle Time (s): 90
PRC Over All Lanes (%): 123.1 Total Delay Over All Lanes(pcuHr): 5.49

Full Input Data And Results

Scenario 4: 'Scenario B 2029 PM DS' (FG4: 'Scenario B 2029 PM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	-	-	**N/A**	-	-		-	-	-	-	-	-	**31.0%**
Great Connell	-	-	**N/A**	-	-		-	-	-	-	-	-	**31.0%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	35	-	144	1886	751	19.2%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	179	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	35	-	229	1863	738	31.0%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	25	-	152	1828	509	29.8%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	25	-	142	1803	521	27.3%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	204	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	182	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	102	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**150**	**0**	**2**	**3.9**	**0.7**	**0.1**	**4.7**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**150**	**0**	**2**	**3.9**	**0.7**	**0.1**	**4.7**	**-**	**-**	**-**	**-**
1/1	144	144	21	0	0	0.7	0.1	0.0	0.8	20.7	2.3	0.1	2.4
2/1	179	179	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	229	229	72	0	1	1.2	0.2	0.0	1.4	22.7	3.9	0.2	4.1
4/1	152	152	43	0	0	1.0	0.2	0.0	1.3	30.6	2.9	0.2	3.1
5/1	142	142	15	0	0	1.0	0.2	0.0	1.2	29.7	2.7	0.2	2.9
6/1	204	204	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	182	182	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	102	102	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 190.0 Total Delay for Signalled Lanes (pcuHr): 4.74 Cycle Time (s): 90
PRC Over All Lanes (%): 190.0 Total Delay Over All Lanes(pcuHr): 4.74

Full Input Data And Results

Scenario 5: 'Scenario B 2039 AM DS' (FG5: 'Scenario B 2039 AM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**42.2%**
Great Connell	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**42.2%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	39	-	355	1903	842	42.2%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	152	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	39	-	185	1868	704	26.3%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	21	-	88	1852	432	20.4%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	21	-	183	1803	441	41.5%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	368	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	122	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	169	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**146**	**0**	**2**	**4.6**	**1.0**	**0.1**	**5.7**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**146**	**0**	**2**	**4.6**	**1.0**	**0.1**	**5.7**	**-**	**-**	**-**	**-**
1/1	355	355	63	0	1	1.7	0.4	0.0	2.1	21.0	6.0	0.4	6.4
2/1	152	152	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	185	185	48	0	1	0.8	0.2	0.1	1.0	20.3	2.8	0.2	3.0
4/1	88	88	16	0	0	0.7	0.1	0.0	0.8	33.0	1.7	0.1	1.9
5/1	183	183	19	0	0	1.5	0.4	0.0	1.8	35.6	3.8	0.4	4.2
6/1	368	368	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	122	122	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	169	169	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 113.4 Total Delay for Signalled Lanes (pcuHr): 5.73 Cycle Time (s): 90

PRC Over All Lanes (%): 113.4 Total Delay Over All Lanes(pcuHr): 5.73

Full Input Data And Results

Scenario 6: 'Scenario B 2039 PM DS' (FG6: 'Scenario B 2039 PM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	-	-	**N/A**	-	-		-	-	-	-	-	-	**32.3%**
Great Connell	-	-	**N/A**	-	-		-	-	-	-	-	-	**32.3%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	36	-	153	1889	773	19.8%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	191	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	36	-	240	1867	743	32.3%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	24	-	155	1825	487	31.9%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	24	-	142	1803	501	28.4%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	214	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	182	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	103	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**153**	**0**	**2**	**4.0**	**0.8**	**0.1**	**4.9**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**153**	**0**	**2**	**4.0**	**0.8**	**0.1**	**4.9**	**-**	**-**	**-**	**-**
1/1	153	153	22	0	0	0.7	0.1	0.0	0.9	20.2	2.4	0.1	2.5
2/1	191	191	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	240	240	72	0	1	1.2	0.2	0.0	1.5	22.1	4.0	0.2	4.2
4/1	155	155	45	0	1	1.1	0.2	0.0	1.4	31.9	3.1	0.2	3.3
5/1	142	142	15	0	0	1.0	0.2	0.0	1.2	30.7	2.8	0.2	3.0
6/1	214	214	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	182	182	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	103	103	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 178.5 Total Delay for Signalled Lanes (pcuHr): 4.92 Cycle Time (s): 90

PRC Over All Lanes (%): 178.5 Total Delay Over All Lanes(pcuHr): 4.92

Full Input Data And Results

Scenario 7: 'Scenario C 2024 AM DS' (FG7: 'Scenario C 2024 AM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**57.3%**
Great Connell	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**57.3%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	27	-	314	1824	556	56.4%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	128	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	27	-	178	1847	502	35.5%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	33	-	416	1922	726	57.3%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	33	-	303	1874	708	42.8%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	223	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	514	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	346	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**131**	**0**	**1**	**7.7**	**2.0**	**0.1**	**9.8**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**131**	**0**	**1**	**7.7**	**2.0**	**0.1**	**9.8**	**-**	**-**	**-**	**-**
1/1	314	314	69	0	1	2.3	0.6	0.0	2.9	33.8	6.5	0.6	7.2
2/1	128	128	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	178	178	32	0	0	1.2	0.3	0.1	1.5	30.5	3.4	0.3	3.6
4/1	416	416	15	0	0	2.6	0.7	0.0	3.2	28.1	8.2	0.7	8.9
5/1	303	303	15	0	0	1.7	0.4	0.0	2.1	25.5	5.6	0.4	5.9
6/1	223	223	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	514	514	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	346	346	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 57.1 Total Delay for Signalled Lanes (pcuHr): 9.85 Cycle Time (s): 90
PRC Over All Lanes (%): 57.1 Total Delay Over All Lanes(pcuHr): 9.85

Full Input Data And Results

Scenario 8: 'Scenario C 2024 PM DS' (FG8: 'Scenario C 2024 PM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	-	-	**N/A**	-	-		-	-	-	-	-	-	**47.6%**
Great Connell	-	-	**N/A**	-	-		-	-	-	-	-	-	**47.6%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	19	-	132	1818	361	36.5%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	199	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	19	-	189	1879	412	45.9%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	41	-	422	1899	886	47.6%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	41	-	238	1831	736	32.3%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	147	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	445	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	190	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**156**	**0**	**2**	**5.6**	**1.4**	**0.2**	**7.1**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**156**	**0**	**2**	**5.6**	**1.4**	**0.2**	**7.1**	**-**	**-**	**-**	**-**
1/1	132	132	27	0	0	1.1	0.3	0.0	1.4	38.4	2.7	0.3	3.0
2/1	199	199	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	189	189	39	0	0	1.6	0.4	0.0	2.0	38.9	4.0	0.4	4.5
4/1	422	422	42	0	0	1.9	0.5	0.0	2.4	20.5	7.2	0.5	7.6
5/1	238	238	49	0	1	1.0	0.2	0.1	1.3	19.7	3.6	0.2	3.9
6/1	147	147	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	445	445	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	190	190	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 89.0 Total Delay for Signalled Lanes (pcuHr): 7.15 Cycle Time (s): 90
PRC Over All Lanes (%): 89.0 Total Delay Over All Lanes(pcuHr): 7.15

Full Input Data And Results

Scenario 9: 'Scenario C 2029 AM DS' (FG9: 'Scenario C 2029 AM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	-	-	**N/A**	-	-		-	-	-	-	-	-	**65.9%**
Great Connell	-	-	**N/A**	-	-		-	-	-	-	-	-	**65.9%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	26	-	348	1823	528	65.9%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	148	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	26	-	199	1844	395	50.4%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	34	-	489	1924	748	65.4%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	34	-	430	1873	725	59.3%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	261	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	609	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	448	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**157**	**0**	**2**	**9.7**	**3.1**	**0.2**	**13.0**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**157**	**0**	**2**	**9.7**	**3.1**	**0.2**	**13.0**	**-**	**-**	**-**	**-**
1/1	348	348	75	0	1	2.7	1.0	0.1	3.7	37.9	7.6	1.0	8.6
2/1	148	148	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	199	199	42	0	0	1.4	0.5	0.1	2.0	35.8	3.9	0.5	4.4
4/1	489	489	16	0	0	3.1	0.9	0.0	4.0	29.6	9.9	0.9	10.9
5/1	430	430	25	0	0	2.6	0.7	0.0	3.4	28.3	8.5	0.7	9.2
6/1	261	261	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	609	609	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	448	448	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 36.6 Total Delay for Signalled Lanes (pcuHr): 13.04 Cycle Time (s): 90
PRC Over All Lanes (%): 36.6 Total Delay Over All Lanes(pcuHr): 13.04

Full Input Data And Results

Scenario 10: 'Scenario C 2029 PM DS' (FG10: 'Scenario C 2029 PM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	-	-	**N/A**	-	-		-	-	-	-	-	-	**59.4%**
Great Connell	-	-	**N/A**	-	-		-	-	-	-	-	-	**59.4%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	19	-	152	1815	368	41.3%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	225	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	19	-	223	1867	387	57.6%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	41	-	527	1906	888	59.4%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	41	-	325	1839	668	48.7%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	169	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	578	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	255	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**189**	**0**	**2**	**7.2**	**2.2**	**0.3**	**9.7**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**189**	**0**	**2**	**7.2**	**2.2**	**0.3**	**9.7**	**-**	**-**	**-**	**-**
1/1	152	152	29	0	0	1.3	0.4	0.0	1.7	39.1	3.2	0.4	3.6
2/1	225	225	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	223	223	57	0	1	1.9	0.7	0.1	2.6	42.6	4.9	0.7	5.6
4/1	527	527	43	0	0	2.6	0.7	0.0	3.3	22.9	9.7	0.7	10.4
5/1	325	325	60	0	1	1.4	0.5	0.2	2.0	22.5	5.2	0.5	5.7
6/1	169	169	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	578	578	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	255	255	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 51.6 Total Delay for Signalled Lanes (pcuHr): 9.67 Cycle Time (s): 90
PRC Over All Lanes (%): 51.6 Total Delay Over All Lanes(pcuHr): 9.67

Full Input Data And Results

Scenario 11: 'Scenario C 2039 AM DS' (FG11: 'Scenario C 2039 AM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	-	-	**N/A**	-	-		-	-	-	-	-	-	**71.2%**
Great Connell	-	-	**N/A**	-	-		-	-	-	-	-	-	**71.2%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	27	-	373	1823	540	69.1%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	158	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	27	-	211	1847	386	54.7%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	33	-	518	1925	727	71.2%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	33	-	448	1873	703	63.7%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	277	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	647	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	468	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**165**	**0**	**2**	**10.5**	**3.8**	**0.3**	**14.6**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**165**	**0**	**2**	**10.5**	**3.8**	**0.3**	**14.6**	**-**	**-**	**-**	**-**
1/1	373	373	80	0	1	2.8	1.1	0.1	4.0	38.4	8.2	1.1	9.3
2/1	158	158	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	211	211	44	0	0	1.4	0.6	0.1	2.1	36.4	4.0	0.6	4.6
4/1	518	518	16	0	0	3.4	1.2	0.0	4.7	32.5	10.9	1.2	12.2
5/1	448	448	26	0	0	2.9	0.9	0.1	3.8	30.4	9.1	0.9	10.0
6/1	277	277	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	647	647	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	468	468	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 26.4 Total Delay for Signalled Lanes (pcuHr): 14.57 Cycle Time (s): 90

PRC Over All Lanes (%): 26.4 Total Delay Over All Lanes(pcuHr): 14.57

Full Input Data And Results

Scenario 12: 'Scenario C 2039 PM DS' (FG12: 'Scenario C 2039 PM DS', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Aston Lands	-	-	**N/A**	-	-		-	-	-	-	-	-	**62.5%**
Great Connell	-	-	**N/A**	-	-		-	-	-	-	-	-	**62.5%**
1/1	Great Connell Road South Ahead Left Right	O	N/A	N/A	A		1	19	-	161	1816	377	42.7%
2/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	239	Inf	Inf	0.0%
3/1	Great Connell North Ahead Right Left	O	N/A	N/A	B		1	19	-	236	1870	377	62.5%
4/1	Ballyfarm Rd - NSOOR Left Right Ahead	O	N/A	N/A	C		1	41	-	555	1907	888	62.5%
5/1	Aston Lands - NSOOR Right Left Ahead	O	N/A	N/A	D		1	41	-	339	1838	647	52.4%
6/1	Great Connell Northbound	U	N/A	N/A	-		-	-	-	179	Inf	Inf	0.0%
7/1	NSOOR Westbound	U	N/A	N/A	-		-	-	-	609	Inf	Inf	0.0%
8/1	NSOOR Eastbound	U	N/A	N/A	-		-	-	-	264	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Aston Lands	**-**	**-**	**197**	**0**	**2**	**7.6**	**2.6**	**0.3**	**10.5**	**-**	**-**	**-**	**-**
Great Connell	**-**	**-**	**197**	**0**	**2**	**7.6**	**2.6**	**0.3**	**10.5**	**-**	**-**	**-**	**-**
1/1	161	161	30	0	0	1.3	0.4	0.0	1.8	39.2	3.4	0.4	3.8
2/1	239	239	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
3/1	236	236	59	0	1	2.0	0.8	0.1	2.9	44.6	5.2	0.8	6.1
4/1	555	555	45	0	1	2.8	0.8	0.0	3.6	23.7	10.3	0.8	11.2
5/1	339	339	63	0	1	1.5	0.5	0.2	2.2	23.4	5.5	0.5	6.0
6/1	179	179	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	609	609	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	264	264	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 43.9 Total Delay for Signalled Lanes (pcuHr): 10.53 Cycle Time (s): 90
PRC Over All Lanes (%): 43.9 Total Delay Over All Lanes(pcuHr): 10.53

Appendix H Lidl Distributor Roundabout Junctions 9 Results Output

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Lidl Distributer Roundabout - Scenario A (2021 Flows).j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario A - Exisitng
Report generation date: 15/03/2022 15:20:52

»2024 Do Nothing, AM
»2024 Do Nothing, PM
»2029 Do Nothing , AM
»2029 Do Nothing, PM
»2039 Do Nothing, AM
»2039 Do Nothing, PM
»2024 Scenario A Opening Year, AM
»2024 Scenario A Opening Year, PM
»2029 Scenario A Design 5 Years, AM
»2029 Scenario A Design 5 Years, PM
»2039 Scenario A Design 15 Years, AM
»2039 Scenario A Design 15 Years, PM

Summary of junction performance

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	2024 Do Nothing							
A - R445 Naas Road (east)	0.5	2.24	0.34	A	0.5	2.26	0.35	A
B - NSOOR Eastern Link	0.1	2.49	0.07	A	0.2	2.99	0.15	A
C - R445 Naas Road (West)	0.9	3.94	0.48	A	0.7	3.56	0.41	A
D - Oldconnell	0.0	2.66	0.00	A	0.0	2.57	0.00	A
	2029 Do Nothing							
A - R445 Naas Road (east)	0.6	2.39	0.38	A	0.7	2.45	0.40	A
B - NSOOR Eastern Link	0.1	2.61	0.07	A	0.2	3.27	0.16	A
C - R445 Naas Road (West)	1.2	4.61	0.56	A	0.9	3.98	0.47	A
D - Oldconnell	0.0	2.86	0.01	A	0.0	2.72	0.00	A
	2039 Do Nothing							
A - R445 Naas Road (east)	0.7	2.49	0.40	A	0.8	2.58	0.43	A
B - NSOOR Eastern Link	0.1	2.69	0.08	A	0.2	3.47	0.18	A
C - R445 Naas Road (West)	1.5	5.07	0.60	A	1.0	4.28	0.50	A
D - Oldconnell	0.0	2.98	0.01	A	0.0	2.81	0.00	A
	2024 Scenario A Opening Year							
A - R445 Naas Road (east)	0.6	2.32	0.36	A	0.6	2.34	0.37	A
B - NSOOR Eastern Link	0.1	2.56	0.07	A	0.2	3.09	0.15	A
C - R445 Naas Road (West)	1.1	4.24	0.52	A	0.8	3.76	0.44	A
D - Oldconnell	0.0	2.75	0.01	A	0.0	0.00	0.00	A
	2029 Scenario A Design 5 Years							
A - R445 Naas Road (east)	0.7	2.52	0.41	A	0.8	2.66	0.45	A
B - NSOOR Eastern Link	0.1	2.73	0.07	A	0.2	3.56	0.18	A
C - R445 Naas Road (West)	1.6	5.43	0.62	A	1.1	4.43	0.52	A
D - Oldconnell	0.0	3.06	0.01	A	0.0	2.85	0.00	A
	2039 Scenario A Design 15 Years							
A - R445 Naas Road (east)	0.8	2.64	0.44	A	0.9	2.82	0.48	A
B - NSOOR Eastern Link	0.1	2.82	0.08	A	0.2	3.79	0.19	A
C - R445 Naas Road (West)	2.0	6.07	0.66	A	1.3	4.80	0.56	A
D - Oldconnell	0.0	3.19	0.01	A	0.0	2.96	0.00	A

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

File Description

Title	
Location	
Site number	

Date	29/04/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D7	2024 Scenario A Opening Year	AM	ONE HOUR	08:15	09:45	15
D8	2024 Scenario A Opening Year	PM	ONE HOUR	17:30	19:00	15
D9	2029 Scenario A Design 5 Years	AM	ONE HOUR	08:15	09:45	15
D10	2029 Scenario A Design 5 Years	PM	ONE HOUR	17:30	19:00	15
D11	2039 Scenario A Design 15 Years	AM	ONE HOUR	08:15	09:45	15
D12	2039 Scenario A Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2024 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.07	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	R445 Naas Road (east)	
B	NSOOR Eastern Link	
C	R445 Naas Road (West)	
D	Oldconnell	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - R445 Naas Road (east)	7.00	7.30	2.0	36.3	50.0	0.0	
B - NSOOR Eastern Link	4.60	7.00	10.0	24.0	13.0	0.0	
C - R445 Naas Road (West)	3.00	7.80	15.0	26.0	50.0	0.0	
D - Oldconnell	6.00	6.00	0.0	18.0	50.0	0.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - R445 Naas Road (east)	0.788	2458
B - NSOOR Eastern Link	0.766	2008
C - R445 Naas Road (West)	0.663	1815
D - Oldconnell	0.693	1997

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	745	100.000
B - NSOOR Eastern Link		✓	92	100.000
C - R445 Naas Road (West)		✓	775	100.000
D - Oldconnell		✓	5	100.000

Origin-Destination Data

Demand (PCU/hr)

	To				
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell

From	A - R445 Naas Road (east)	0	206	538	1
	B - NSOOR Eastern Link	67	0	25	0
	C - R445 Naas Road (West)	740	32	0	3
	D - Oldconnell	0	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.34	2.24	0.5	A
B - NSOOR Eastern Link	0.07	2.49	0.1	A
C - R445 Naas Road (West)	0.48	3.94	0.9	A
D - Oldconnell	0.00	2.66	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	561	28	2436	0.230	560	0.3	1.918	A
B - NSOOR Eastern Link	69	409	1695	0.041	69	0.0	2.214	A
C - R445 Naas Road (West)	583	51	1781	0.328	582	0.5	2.994	A
D - Oldconnell	4	630	1561	0.002	4	0.0	2.311	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	670	33	2431	0.275	669	0.4	2.043	A
B - NSOOR Eastern Link	83	489	1634	0.051	83	0.1	2.320	A
C - R445 Naas Road (West)	697	61	1775	0.393	696	0.6	3.335	A
D - Oldconnell	4	754	1475	0.003	4	0.0	2.447	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	820	41	2425	0.338	820	0.5	2.242	A
B - NSOOR Eastern Link	101	599	1550	0.065	101	0.1	2.485	A
C - R445 Naas Road (West)	853	75	1766	0.483	852	0.9	3.935	A
D - Oldconnell	6	923	1358	0.004	6	0.0	2.661	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	820	41	2425	0.338	820	0.5	2.242	A
B - NSOOR Eastern Link	101	599	1549	0.065	101	0.1	2.485	A
C - R445 Naas Road (West)	853	75	1766	0.483	853	0.9	3.945	A
D - Oldconnell	6	924	1357	0.004	6	0.0	2.662	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	670	33	2431	0.275	670	0.4	2.046	A
B - NSOOR Eastern Link	83	489	1633	0.051	83	0.1	2.321	A
C - R445 Naas Road (West)	697	61	1775	0.393	698	0.7	3.345	A
D - Oldconnell	4	755	1474	0.003	4	0.0	2.449	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	561	28	2436	0.230	561	0.3	1.920	A
B - NSOOR Eastern Link	69	410	1694	0.041	69	0.0	2.217	A

C - R445 Naas Road (West)	583	51	1781	0.328	584	0.5	3.010	A
D - Oldconnell	4	632	1559	0.002	4	0.0	2.314	A

2024 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.86	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	774	100.000
B - NSOOR Eastern Link		✓	187	100.000
C - R445 Naas Road (West)		✓	633	100.000
D - Oldconnell		✓	5	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	70	703	1
	B - NSOOR Eastern Link	146	0	40	1
	C - R445 Naas Road (West)	622	8	0	3
	D - Oldconnell	1	0	4	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.35	2.26	0.5	A
B - NSOOR Eastern Link	0.15	2.99	0.2	A
C - R445 Naas Road (West)	0.41	3.56	0.7	A
D - Oldconnell	0.00	2.57	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	583	9	2450	0.238	581	0.3	1.925	A
B - NSOOR Eastern Link	141	532	1601	0.088	140	0.1	2.465	A
C - R445 Naas Road (West)	477	111	1742	0.274	475	0.4	2.838	A
D - Oldconnell	4	582	1594	0.002	4	0.0	2.263	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	696	11	2449	0.284	695	0.4	2.053	A
B - NSOOR Eastern Link	168	636	1521	0.111	168	0.1	2.660	A
C - R445 Naas Road (West)	569	133	1727	0.329	569	0.5	3.105	A
D - Oldconnell	4	697	1514	0.003	4	0.0	2.384	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	852	13	2447	0.348	852	0.5	2.256	A
B - NSOOR Eastern Link	206	779	1411	0.146	206	0.2	2.985	A
C - R445 Naas Road (West)	697	163	1707	0.408	696	0.7	3.555	A
D - Oldconnell	6	853	1406	0.004	6	0.0	2.570	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	852	13	2447	0.348	852	0.5	2.256	A
B - NSOOR Eastern Link	206	780	1411	0.146	206	0.2	2.986	A
C - R445 Naas Road (West)	697	163	1707	0.408	697	0.7	3.562	A
D - Oldconnell	6	854	1405	0.004	6	0.0	2.571	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	696	11	2449	0.284	696	0.4	2.055	A
B - NSOOR Eastern Link	168	637	1520	0.111	168	0.1	2.664	A
C - R445 Naas Road (West)	569	133	1727	0.330	570	0.5	3.112	A
D - Oldconnell	4	699	1513	0.003	4	0.0	2.387	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	583	9	2450	0.238	583	0.3	1.927	A
B - NSOOR Eastern Link	141	533	1599	0.088	141	0.1	2.469	A
C - R445 Naas Road (West)	477	112	1741	0.274	477	0.4	2.849	A
D - Oldconnell	4	585	1592	0.002	4	0.0	2.266	A

2029 Do Nothing , AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.48	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	831	100.000
B - NSOOR Eastern Link		✓	97	100.000
C - R445 Naas Road (West)		✓	892	100.000
D - Oldconnell		✓	7	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	219	611	1
	B - NSOOR Eastern Link	70	0	27	0
	C - R445 Naas Road (West)	854	34	0	4
	D - Oldconnell	1	0	6	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.38	2.39	0.6	A
B - NSOOR Eastern Link	0.07	2.61	0.1	A
C - R445 Naas Road (West)	0.56	4.61	1.2	A
D - Oldconnell	0.01	2.86	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	626	30	2434	0.257	624	0.3	1.989	A
B - NSOOR Eastern Link	73	464	1652	0.044	73	0.0	2.279	A
C - R445 Naas Road (West)	672	53	1780	0.377	669	0.6	3.234	A
D - Oldconnell	5	719	1499	0.004	5	0.0	2.409	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	747	36	2429	0.308	747	0.4	2.139	A
B - NSOOR Eastern Link	87	555	1583	0.055	87	0.1	2.406	A
C - R445 Naas Road (West)	802	64	1773	0.452	801	0.8	3.700	A
D - Oldconnell	6	860	1401	0.004	6	0.0	2.580	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	915	44	2423	0.378	914	0.6	2.385	A
B - NSOOR Eastern Link	107	680	1487	0.072	107	0.1	2.607	A
C - R445 Naas Road (West)	982	78	1764	0.557	980	1.2	4.586	A
D - Oldconnell	8	1053	1267	0.006	8	0.0	2.857	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	915	44	2423	0.378	915	0.6	2.387	A
B - NSOOR Eastern Link	107	680	1487	0.072	107	0.1	2.608	A
C - R445 Naas Road (West)	982	78	1764	0.557	982	1.2	4.606	A
D - Oldconnell	8	1055	1266	0.006	8	0.0	2.859	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	747	36	2429	0.308	748	0.4	2.143	A
B - NSOOR Eastern Link	87	556	1582	0.055	87	0.1	2.408	A
C - R445 Naas Road (West)	802	64	1773	0.452	804	0.8	3.721	A
D - Oldconnell	6	863	1399	0.005	6	0.0	2.583	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	626	30	2434	0.257	626	0.3	1.991	A
B - NSOOR Eastern Link	73	466	1651	0.044	73	0.0	2.280	A
C - R445 Naas Road (West)	672	53	1780	0.377	672	0.6	3.252	A
D - Oldconnell	5	722	1497	0.004	5	0.0	2.413	A

2029 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.15	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	887	100.000
B - NSOOR Eastern Link		✓	197	100.000
C - R445 Naas Road (West)		✓	725	100.000
D - Oldconnell		✓	5	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	73	814	0
	B - NSOOR Eastern Link	154	0	42	1
	C - R445 Naas Road (West)	712	9	0	4
	D - Oldconnell	0	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.40	2.45	0.7	A
B - NSOOR Eastern Link	0.16	3.27	0.2	A
C - R445 Naas Road (West)	0.47	3.98	0.9	A
D - Oldconnell	0.00	2.72	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	668	11	2449	0.273	666	0.4	2.017	A
B - NSOOR Eastern Link	148	615	1537	0.097	148	0.1	2.592	A
C - R445 Naas Road (West)	546	116	1738	0.314	544	0.5	3.011	A
D - Oldconnell	4	657	1542	0.002	4	0.0	2.339	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	797	13	2448	0.326	797	0.5	2.181	A
B - NSOOR Eastern Link	177	736	1444	0.123	177	0.1	2.840	A
C - R445 Naas Road (West)	652	139	1723	0.378	651	0.6	3.357	A
D - Oldconnell	4	786	1453	0.003	4	0.0	2.485	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	977	15	2445	0.399	976	0.7	2.448	A
B - NSOOR Eastern Link	217	901	1318	0.165	217	0.2	3.268	A
C - R445 Naas Road (West)	798	170	1702	0.469	797	0.9	3.972	A
D - Oldconnell	6	962	1330	0.004	6	0.0	2.716	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	977	15	2445	0.399	977	0.7	2.450	A
B - NSOOR Eastern Link	217	902	1317	0.165	217	0.2	3.270	A
C - R445 Naas Road (West)	798	171	1702	0.469	798	0.9	3.982	A
D - Oldconnell	6	963	1330	0.004	6	0.0	2.718	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	797	13	2448	0.326	798	0.5	2.184	A
B - NSOOR Eastern Link	177	737	1444	0.123	177	0.1	2.845	A
C - R445 Naas Road (West)	652	140	1723	0.378	653	0.6	3.369	A
D - Oldconnell	4	788	1451	0.003	4	0.0	2.489	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	668	11	2449	0.273	668	0.4	2.023	A
B - NSOOR Eastern Link	148	617	1535	0.097	148	0.1	2.597	A
C - R445 Naas Road (West)	546	117	1738	0.314	546	0.5	3.022	A
D - Oldconnell	4	659	1540	0.002	4	0.0	2.344	A

2039 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.76	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	888	100.000
B - NSOOR Eastern Link		✓	101	100.000
C - R445 Naas Road (West)		✓	955	100.000
D - Oldconnell		✓	7	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	231	656	1
	B - NSOOR Eastern Link	72	0	29	0
	C - R445 Naas Road (West)	916	35	0	4
	D - Oldconnell	1	0	6	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.40	2.49	0.7	A
B - NSOOR Eastern Link	0.08	2.69	0.1	A
C - R445 Naas Road (West)	0.60	5.07	1.5	A
D - Oldconnell	0.01	2.98	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	669	31	2433	0.275	667	0.4	2.036	A
B - NSOOR Eastern Link	76	498	1627	0.047	76	0.0	2.321	A
C - R445 Naas Road (West)	719	55	1779	0.404	716	0.7	3.379	A
D - Oldconnell	5	767	1466	0.004	5	0.0	2.464	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	798	37	2429	0.329	798	0.5	2.207	A
B - NSOOR Eastern Link	91	596	1552	0.059	91	0.1	2.463	A
C - R445 Naas Road (West)	859	66	1772	0.485	857	0.9	3.933	A
D - Oldconnell	6	919	1361	0.005	6	0.0	2.657	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	978	45	2422	0.404	977	0.7	2.490	A
B - NSOOR Eastern Link	111	729	1449	0.077	111	0.1	2.689	A
C - R445 Naas Road (West)	1051	80	1762	0.597	1049	1.5	5.035	A
D - Oldconnell	8	1124	1218	0.006	8	0.0	2.973	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	978	45	2422	0.404	978	0.7	2.492	A
B - NSOOR Eastern Link	111	730	1449	0.077	111	0.1	2.690	A
C - R445 Naas Road (West)	1051	80	1762	0.597	1051	1.5	5.065	A
D - Oldconnell	8	1126	1217	0.006	8	0.0	2.976	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	798	37	2428	0.329	799	0.5	2.211	A
B - NSOOR Eastern Link	91	597	1551	0.059	91	0.1	2.467	A
C - R445 Naas Road (West)	859	66	1772	0.485	861	0.9	3.959	A
D - Oldconnell	6	922	1358	0.005	6	0.0	2.663	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	669	31	2433	0.275	669	0.4	2.042	A
B - NSOOR Eastern Link	76	499	1625	0.047	76	0.0	2.325	A
C - R445 Naas Road (West)	719	55	1779	0.404	720	0.7	3.405	A
D - Oldconnell	5	771	1463	0.004	5	0.0	2.471	A

2039 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.35	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	954	100.000
B - NSOOR Eastern Link		✓	204	100.000
C - R445 Naas Road (West)		✓	778	100.000
D - Oldconnell		✓	5	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	75	879	0
	B - NSOOR Eastern Link	160	0	44	0
	C - R445 Naas Road (West)	765	9	0	4
	D - Oldconnell	0	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.43	2.58	0.8	A
B - NSOOR Eastern Link	0.18	3.47	0.2	A
C - R445 Naas Road (West)	0.50	4.28	1.0	A
D - Oldconnell	0.00	2.81	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	718	11	2449	0.293	717	0.4	2.076	A
B - NSOOR Eastern Link	154	664	1499	0.102	153	0.1	2.674	A
C - R445 Naas Road (West)	586	120	1736	0.337	584	0.5	3.120	A
D - Oldconnell	4	701	1512	0.002	4	0.0	2.387	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	858	13	2448	0.350	857	0.5	2.263	A
B - NSOOR Eastern Link	183	794	1400	0.131	183	0.2	2.959	A
C - R445 Naas Road (West)	699	144	1720	0.407	699	0.7	3.523	A
D - Oldconnell	4	839	1416	0.003	4	0.0	2.550	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1050	15	2445	0.430	1050	0.7	2.578	A
B - NSOOR Eastern Link	225	973	1263	0.178	224	0.2	3.465	A
C - R445 Naas Road (West)	857	176	1699	0.504	855	1.0	4.255	A
D - Oldconnell	6	1027	1286	0.004	6	0.0	2.811	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1050	15	2445	0.430	1050	0.8	2.580	A
B - NSOOR Eastern Link	225	973	1263	0.178	225	0.2	3.467	A
C - R445 Naas Road (West)	857	176	1698	0.504	857	1.0	4.275	A
D - Oldconnell	6	1028	1285	0.004	6	0.0	2.813	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	858	13	2448	0.350	858	0.5	2.267	A
B - NSOOR Eastern Link	183	795	1399	0.131	184	0.2	2.962	A
C - R445 Naas Road (West)	699	144	1720	0.407	701	0.7	3.536	A
D - Oldconnell	4	841	1414	0.003	4	0.0	2.552	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	718	11	2449	0.293	719	0.4	2.082	A
B - NSOOR Eastern Link	154	666	1498	0.103	154	0.1	2.677	A
C - R445 Naas Road (West)	586	121	1735	0.338	586	0.5	3.134	A
D - Oldconnell	4	704	1509	0.002	4	0.0	2.390	A

2024 Scenario A Opening Year, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.26	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D7	2024 Scenario A Opening Year	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	793	100.000
B - NSOOR Eastern Link		✓	92	100.000
C - R445 Naas Road (West)		✓	832	100.000
D - Oldconnell		✓	6	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	206	586	1
	B - NSOOR Eastern Link	67	0	25	0
	C - R445 Naas Road (West)	797	32	0	3
	D - Oldconnell	1	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.36	2.32	0.6	A
B - NSOOR Eastern Link	0.07	2.56	0.1	A
C - R445 Naas Road (West)	0.52	4.24	1.1	A
D - Oldconnell	0.01	2.75	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	597	28	2436	0.245	596	0.3	1.956	A
B - NSOOR Eastern Link	69	445	1667	0.042	69	0.0	2.252	A
C - R445 Naas Road (West)	626	51	1781	0.352	624	0.5	3.106	A
D - Oldconnell	5	672	1531	0.003	5	0.0	2.357	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	713	33	2431	0.293	713	0.4	2.094	A
B - NSOOR Eastern Link	83	532	1601	0.052	83	0.1	2.371	A
C - R445 Naas Road (West)	748	61	1775	0.421	747	0.7	3.502	A
D - Oldconnell	5	805	1440	0.004	5	0.0	2.509	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	873	41	2425	0.360	873	0.6	2.318	A
B - NSOOR Eastern Link	101	651	1509	0.067	101	0.1	2.556	A
C - R445 Naas Road (West)	916	75	1766	0.519	915	1.1	4.223	A
D - Oldconnell	7	985	1315	0.005	7	0.0	2.751	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	873	41	2425	0.360	873	0.6	2.318	A
B - NSOOR Eastern Link	101	652	1509	0.067	101	0.1	2.557	A
C - R445 Naas Road (West)	916	75	1766	0.519	916	1.1	4.236	A
D - Oldconnell	7	986	1314	0.005	7	0.0	2.753	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	713	33	2431	0.293	713	0.4	2.097	A
B - NSOOR Eastern Link	83	533	1600	0.052	83	0.1	2.374	A
C - R445 Naas Road (West)	748	61	1775	0.421	749	0.7	3.517	A
D - Oldconnell	5	807	1438	0.004	5	0.0	2.514	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	597	28	2436	0.245	597	0.3	1.958	A
B - NSOOR Eastern Link	69	446	1666	0.042	69	0.0	2.253	A
C - R445 Naas Road (West)	626	51	1781	0.352	627	0.5	3.120	A
D - Oldconnell	5	675	1529	0.003	5	0.0	2.362	A

2024 Scenario A Opening Year, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.99	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D8	2024 Scenario A Opening Year	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	827	100.000
B - NSOOR Eastern Link		✓	187	100.000
C - R445 Naas Road (West)		✓	683	100.000
D - Oldconnell		✓	4	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	70	757	0
	B - NSOOR Eastern Link	146	0	40	1
	C - R445 Naas Road (West)	672	8	0	3
	D - Oldconnell	0	0	4	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.37	2.34	0.6	A
B - NSOOR Eastern Link	0.15	3.09	0.2	A
C - R445 Naas Road (West)	0.44	3.76	0.8	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	623	6	2453	0.254	621	0.3	1.965	A
B - NSOOR Eastern Link	141	569	1572	0.090	140	0.1	2.514	A
C - R445 Naas Road (West)	514	110	1742	0.295	513	0.4	2.924	A
D - Oldconnell	0	620	1568	0.000	0	0.0	0.000	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	743	7	2452	0.303	743	0.4	2.106	A
B - NSOOR Eastern Link	168	680	1487	0.113	168	0.1	2.728	A
C - R445 Naas Road (West)	614	132	1728	0.355	613	0.5	3.229	A
D - Oldconnell	0	742	1483	0.000	0	0.0	0.000	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	911	9	2451	0.372	910	0.6	2.335	A
B - NSOOR Eastern Link	206	833	1370	0.150	206	0.2	3.091	A
C - R445 Naas Road (West)	752	162	1708	0.440	751	0.8	3.758	A
D - Oldconnell	0	908	1368	0.000	0	0.0	0.000	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	911	9	2451	0.372	911	0.6	2.337	A
B - NSOOR Eastern Link	206	833	1370	0.150	206	0.2	3.092	A
C - R445 Naas Road (West)	752	162	1708	0.440	752	0.8	3.764	A
D - Oldconnell	0	909	1367	0.000	0	0.0	0.000	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	743	7	2452	0.303	744	0.4	2.108	A
B - NSOOR Eastern Link	168	681	1486	0.113	168	0.1	2.733	A
C - R445 Naas Road (West)	614	132	1728	0.355	615	0.6	3.239	A
D - Oldconnell	0	744	1482	0.000	0	0.0	0.000	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	623	6	2453	0.254	623	0.3	1.967	A
B - NSOOR Eastern Link	141	570	1571	0.090	141	0.1	2.518	A
C - R445 Naas Road (West)	514	111	1742	0.295	515	0.4	2.936	A
D - Oldconnell	0	622	1566	0.000	0	0.0	0.000	A

2029 Scenario A Design 5 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.98	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D9	2029 Scenario A Design 5 Years	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	903	100.000
B - NSOOR Eastern Link		✓	97	100.000
C - R445 Naas Road (West)		✓	1000	100.000
D - Oldconnell		✓	7	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	219	683	1
	B - NSOOR Eastern Link	70	0	27	0
	C - R445 Naas Road (West)	962	34	0	4
	D - Oldconnell	1	0	6	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.41	2.52	0.7	A
B - NSOOR Eastern Link	0.07	2.73	0.1	A
C - R445 Naas Road (West)	0.62	5.43	1.6	A
D - Oldconnell	0.01	3.06	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	680	30	2434	0.279	678	0.4	2.048	A
B - NSOOR Eastern Link	73	518	1611	0.045	73	0.0	2.340	A
C - R445 Naas Road (West)	753	53	1780	0.423	750	0.7	3.484	A
D - Oldconnell	5	800	1443	0.004	5	0.0	2.503	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	812	36	2429	0.334	811	0.5	2.225	A
B - NSOOR Eastern Link	87	620	1533	0.057	87	0.1	2.489	A
C - R445 Naas Road (West)	899	64	1773	0.507	898	1.0	4.108	A
D - Oldconnell	6	957	1334	0.005	6	0.0	2.710	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	994	44	2423	0.410	993	0.7	2.517	A
B - NSOOR Eastern Link	107	759	1427	0.075	107	0.1	2.727	A
C - R445 Naas Road (West)	1101	78	1764	0.624	1099	1.6	5.392	A
D - Oldconnell	8	1171	1186	0.007	8	0.0	3.055	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	994	44	2423	0.410	994	0.7	2.519	A
B - NSOOR Eastern Link	107	760	1426	0.075	107	0.1	2.727	A
C - R445 Naas Road (West)	1101	78	1764	0.624	1101	1.6	5.433	A
D - Oldconnell	8	1174	1184	0.007	8	0.0	3.060	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	812	36	2429	0.334	813	0.5	2.229	A
B - NSOOR Eastern Link	87	621	1532	0.057	87	0.1	2.492	A
C - R445 Naas Road (West)	899	64	1773	0.507	901	1.0	4.143	A
D - Oldconnell	6	961	1331	0.005	6	0.0	2.718	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	680	30	2434	0.279	680	0.4	2.053	A
B - NSOOR Eastern Link	73	520	1610	0.045	73	0.0	2.342	A
C - R445 Naas Road (West)	753	53	1780	0.423	754	0.7	3.515	A
D - Oldconnell	5	804	1440	0.004	5	0.0	2.508	A

2029 Scenario A Design 5 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.46	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D10	2029 Scenario A Design 5 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	994	100.000
B - NSOOR Eastern Link		✓	197	100.000
C - R445 Naas Road (West)		✓	808	100.000
D - Oldconnell		✓	5	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	73	921	0
	B - NSOOR Eastern Link	154	0	42	1
	C - R445 Naas Road (West)	795	9	0	4
	D - Oldconnell	0	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.45	2.66	0.8	A
B - NSOOR Eastern Link	0.18	3.56	0.2	A
C - R445 Naas Road (West)	0.52	4.43	1.1	A
D - Oldconnell	0.00	2.85	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	748	11	2449	0.306	747	0.4	2.112	A
B - NSOOR Eastern Link	148	696	1475	0.101	148	0.1	2.712	A
C - R445 Naas Road (West)	608	116	1738	0.350	606	0.5	3.175	A
D - Oldconnell	4	719	1499	0.003	4	0.0	2.406	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	894	13	2448	0.365	893	0.6	2.316	A
B - NSOOR Eastern Link	177	832	1371	0.129	177	0.1	3.014	A
C - R445 Naas Road (West)	726	139	1723	0.422	726	0.7	3.608	A
D - Oldconnell	4	860	1401	0.003	4	0.0	2.577	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1094	15	2445	0.448	1093	0.8	2.662	A
B - NSOOR Eastern Link	217	1019	1228	0.177	217	0.2	3.559	A
C - R445 Naas Road (West)	890	170	1702	0.523	888	1.1	4.413	A
D - Oldconnell	6	1053	1267	0.004	6	0.0	2.852	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1094	15	2445	0.448	1094	0.8	2.664	A
B - NSOOR Eastern Link	217	1020	1227	0.177	217	0.2	3.562	A
C - R445 Naas Road (West)	890	171	1702	0.523	890	1.1	4.430	A
D - Oldconnell	6	1055	1266	0.004	6	0.0	2.854	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	894	13	2448	0.365	895	0.6	2.320	A
B - NSOOR Eastern Link	177	833	1370	0.129	177	0.1	3.021	A
C - R445 Naas Road (West)	726	140	1723	0.422	728	0.7	3.625	A
D - Oldconnell	4	863	1399	0.003	4	0.0	2.580	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	748	11	2449	0.306	749	0.4	2.117	A
B - NSOOR Eastern Link	148	698	1474	0.101	148	0.1	2.716	A
C - R445 Naas Road (West)	608	117	1738	0.350	609	0.5	3.190	A
D - Oldconnell	4	722	1497	0.003	4	0.0	2.412	A

2039 Scenario A Design 15 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	4.36	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D11	2039 Scenario A Design 15 Years	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	960	100.000
B - NSOOR Eastern Link		✓	101	100.000
C - R445 Naas Road (West)		✓	1062	100.000
D - Oldconnell		✓	7	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	231	728	1
	B - NSOOR Eastern Link	72	0	29	0
	C - R445 Naas Road (West)	1023	35	0	4
	D - Oldconnell	1	0	6	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.44	2.64	0.8	A
B - NSOOR Eastern Link	0.08	2.82	0.1	A
C - R445 Naas Road (West)	0.66	6.07	2.0	A
D - Oldconnell	0.01	3.19	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	723	31	2433	0.297	721	0.4	2.100	A
B - NSOOR Eastern Link	76	552	1585	0.048	76	0.1	2.385	A
C - R445 Naas Road (West)	800	55	1779	0.449	796	0.8	3.651	A
D - Oldconnell	5	847	1410	0.004	5	0.0	2.562	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	863	37	2429	0.355	863	0.5	2.299	A
B - NSOOR Eastern Link	91	660	1502	0.060	91	0.1	2.550	A
C - R445 Naas Road (West)	955	66	1772	0.539	953	1.2	4.391	A
D - Oldconnell	6	1014	1294	0.005	6	0.0	2.794	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1057	45	2422	0.436	1056	0.8	2.634	A
B - NSOOR Eastern Link	111	809	1389	0.080	111	0.1	2.817	A
C - R445 Naas Road (West)	1169	80	1762	0.664	1166	1.9	6.010	A
D - Oldconnell	8	1241	1137	0.007	8	0.0	3.186	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1057	45	2422	0.436	1057	0.8	2.636	A
B - NSOOR Eastern Link	111	809	1388	0.080	111	0.1	2.818	A
C - R445 Naas Road (West)	1169	80	1762	0.664	1169	2.0	6.070	A
D - Oldconnell	8	1244	1135	0.007	8	0.0	3.192	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	863	37	2428	0.355	864	0.6	2.303	A
B - NSOOR Eastern Link	91	661	1501	0.060	91	0.1	2.553	A
C - R445 Naas Road (West)	955	66	1772	0.539	958	1.2	4.438	A
D - Oldconnell	6	1019	1291	0.005	6	0.0	2.801	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	723	31	2433	0.297	723	0.4	2.105	A
B - NSOOR Eastern Link	76	554	1584	0.048	76	0.1	2.389	A
C - R445 Naas Road (West)	800	55	1779	0.449	801	0.8	3.688	A
D - Oldconnell	5	852	1407	0.004	5	0.0	2.568	A

2039 Scenario A Design 15 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.71	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D12	2039 Scenario A Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	1060	100.000
B - NSOOR Eastern Link		✓	204	100.000
C - R445 Naas Road (West)		✓	861	100.000
D - Oldconnell		✓	5	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	75	985	0
	B - NSOOR Eastern Link	160	0	44	0
	C - R445 Naas Road (West)	848	9	0	4
	D - Oldconnell	0	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.48	2.82	0.9	A
B - NSOOR Eastern Link	0.19	3.79	0.2	A
C - R445 Naas Road (West)	0.56	4.80	1.3	A
D - Oldconnell	0.00	2.96	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	798	11	2449	0.326	796	0.5	2.176	A
B - NSOOR Eastern Link	154	744	1439	0.107	153	0.1	2.800	A
C - R445 Naas Road (West)	648	120	1736	0.373	646	0.6	3.296	A
D - Oldconnell	4	763	1469	0.003	4	0.0	2.457	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	953	13	2448	0.389	952	0.6	2.406	A
B - NSOOR Eastern Link	183	889	1327	0.138	183	0.2	3.147	A
C - R445 Naas Road (West)	774	144	1720	0.450	773	0.8	3.798	A
D - Oldconnell	4	913	1364	0.003	4	0.0	2.646	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1167	15	2445	0.477	1166	0.9	2.811	A
B - NSOOR Eastern Link	225	1089	1174	0.191	224	0.2	3.790	A
C - R445 Naas Road (West)	948	176	1699	0.558	946	1.2	4.774	A
D - Oldconnell	6	1118	1223	0.005	6	0.0	2.957	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1167	15	2445	0.477	1167	0.9	2.815	A
B - NSOOR Eastern Link	225	1090	1173	0.191	225	0.2	3.793	A
C - R445 Naas Road (West)	948	176	1698	0.558	948	1.3	4.796	A
D - Oldconnell	6	1120	1221	0.005	6	0.0	2.960	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	953	13	2448	0.389	954	0.6	2.413	A
B - NSOOR Eastern Link	183	891	1326	0.138	184	0.2	3.152	A
C - R445 Naas Road (West)	774	144	1720	0.450	776	0.8	3.819	A
D - Oldconnell	4	916	1362	0.003	4	0.0	2.650	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	798	11	2449	0.326	799	0.5	2.183	A
B - NSOOR Eastern Link	154	746	1437	0.107	154	0.1	2.807	A
C - R445 Naas Road (West)	648	121	1735	0.374	649	0.6	3.318	A
D - Oldconnell	4	767	1466	0.003	4	0.0	2.461	A

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Lidl Distributer Road Roundabout - Scenario B.j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario B - Lidl Rd open
Report generation date: 15/03/2022 15:27:13

»2024 Do Nothing, AM
»2024 Do Nothing, PM
»2029 Do Nothing , AM
»2029 Do Nothing, PM
»2039 Do Nothing, AM
»2039 Do Nothing, PM
»2024 Scenario B Opening Year, AM
»2024 Scenario B Opening Year, PM
»2029 Scenario B Design 5 Years, AM
»2029 Scenario B Design 5 Years, PM
»2039 Scenario B Design 15 Years, AM
»2039 Scenario B Design 15 Years, PM

Summary of junction performance

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	2024 Do Nothing							
A - R445 Naas Road (east)	0.4	2.04	0.28	A	0.5	2.21	0.34	A
B - NSOOR Eastern Link	0.1	2.42	0.07	A	0.1	2.66	0.08	A
C - R445 Naas Road (West)	0.8	3.69	0.44	A	0.6	3.33	0.38	A
D - Oldconnell	0.0	0.00	0.00	A	0.0	0.00	0.00	A
	2029 Do Nothing							
A - R445 Naas Road (east)	0.5	2.14	0.31	A	0.6	2.39	0.39	A
B - NSOOR Eastern Link	0.1	2.53	0.08	A	0.1	2.85	0.09	A
C - R445 Naas Road (West)	1.0	4.23	0.51	A	0.8	3.66	0.44	A
D - Oldconnell	0.0	0.00	0.00	A	0.0	0.00	0.00	A
	2039 Do Nothing							
A - R445 Naas Road (east)	0.5	2.21	0.33	A	0.7	2.51	0.41	A
B - NSOOR Eastern Link	0.1	2.59	0.08	A	0.1	2.96	0.09	A
C - R445 Naas Road (West)	1.2	4.56	0.55	A	0.9	3.88	0.47	A
D - Oldconnell	0.0	0.00	0.00	A	0.0	0.00	0.00	A
	2024 Scenario B Opening Year							
A - R445 Naas Road (east)	0.4	2.09	0.30	A	0.6	2.29	0.36	A
B - NSOOR Eastern Link	0.1	2.52	0.10	A	0.1	2.77	0.11	A
C - R445 Naas Road (West)	0.8	3.80	0.45	A	0.6	3.43	0.39	A
D - Oldconnell	0.0	0.00	0.00	A	0.0	0.00	0.00	A
	2029 Scenario B Design 5 Years							
A - R445 Naas Road (east)	0.5	2.24	0.34	A	0.8	2.59	0.43	A
B - NSOOR Eastern Link	0.2	2.74	0.14	A	0.2	3.07	0.14	A
C - R445 Naas Road (West)	1.2	4.69	0.54	A	0.8	3.92	0.46	A
D - Oldconnell	0.0	0.00	0.00	A	0.0	0.00	0.00	A
	2039 Scenario B Design 15 Years							
A - R445 Naas Road (east)	0.6	2.32	0.37	A	0.9	2.73	0.46	A
B - NSOOR Eastern Link	0.2	2.82	0.15	A	0.2	3.20	0.15	A
C - R445 Naas Road (West)	1.4	5.14	0.58	A	1.0	4.18	0.49	A
D - Oldconnell	0.0	0.00	0.00	A	0.0	0.00	0.00	A

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

File Description

Title	
Location	
Site number	

Date	29/04/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D7	2024 Scenario B Opening Year	AM	ONE HOUR	08:15	09:45	15
D8	2024 Scenario B Opening Year	PM	ONE HOUR	17:30	19:00	15
D9	2029 Scenario B Design 5 Years	AM	ONE HOUR	08:15	09:45	15
D10	2029 Scenario B Design 5 Years	PM	ONE HOUR	17:30	19:00	15
D11	2039 Scenario B Design 15 Years	AM	ONE HOUR	08:15	09:45	15
D12	2039 Scenario B Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2024 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.88	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	R445 Naas Road (east)	
B	NSOOR Eastern Link	
C	R445 Naas Road (West)	
D	Oldconnell	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - R445 Naas Road (east)	7.00	7.30	2.0	36.3	50.0	0.0	
B - NSOOR Eastern Link	4.60	7.00	10.0	24.0	13.0	0.0	
C - R445 Naas Road (West)	3.00	7.80	15.0	26.0	50.0	0.0	
D - Oldconnell	6.00	6.00	0.0	18.0	50.0	0.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - R445 Naas Road (east)	0.788	2458
B - NSOOR Eastern Link	0.766	2008
C - R445 Naas Road (West)	0.663	1815
D - Oldconnell	0.693	1997

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	620	100.000
B - NSOOR Eastern Link		✓	101	100.000
C - R445 Naas Road (West)		✓	701	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

	To				
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell

From	A - R445 Naas Road (east)	0	135	485	0
	B - NSOOR Eastern Link	95	0	6	0
	C - R445 Naas Road (West)	686	15	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.28	2.04	0.4	A
B - NSOOR Eastern Link	0.07	2.42	0.1	A
C - R445 Naas Road (West)	0.44	3.69	0.8	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	467	11	2449	0.191	466	0.2	1.815	A
B - NSOOR Eastern Link	76	364	1729	0.044	76	0.0	2.177	A
C - R445 Naas Road (West)	528	71	1768	0.298	526	0.4	2.895	A
D - Oldconnell	0	597	1583	0.000	0	0.0	0.000	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	557	13	2447	0.228	557	0.3	1.904	A
B - NSOOR Eastern Link	91	436	1674	0.054	91	0.1	2.273	A
C - R445 Naas Road (West)	630	85	1759	0.358	630	0.6	3.186	A
D - Oldconnell	0	715	1502	0.000	0	0.0	0.000	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	683	16	2445	0.279	682	0.4	2.042	A
B - NSOOR Eastern Link	111	534	1599	0.070	111	0.1	2.418	A
C - R445 Naas Road (West)	772	105	1746	0.442	771	0.8	3.688	A
D - Oldconnell	0	875	1391	0.000	0	0.0	0.000	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	683	17	2445	0.279	683	0.4	2.042	A
B - NSOOR Eastern Link	111	534	1599	0.070	111	0.1	2.419	A
C - R445 Naas Road (West)	772	105	1746	0.442	772	0.8	3.694	A
D - Oldconnell	0	876	1390	0.000	0	0.0	0.000	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	557	14	2447	0.228	558	0.3	1.907	A
B - NSOOR Eastern Link	91	436	1674	0.054	91	0.1	2.275	A
C - R445 Naas Road (West)	630	85	1759	0.358	631	0.6	3.194	A
D - Oldconnell	0	717	1501	0.000	0	0.0	0.000	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	467	11	2449	0.191	467	0.2	1.816	A
B - NSOOR Eastern Link	76	365	1728	0.044	76	0.0	2.180	A

C - R445 Naas Road (West)	528	72	1768	0.299	528	0.4	2.904	A
D - Oldconnell	0	600	1582	0.000	0	0.0	0.000	A

2024 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.71	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	749	100.000
B - NSOOR Eastern Link		✓	108	100.000
C - R445 Naas Road (West)		✓	609	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	114	634	1
	B - NSOOR Eastern Link	86	0	21	1
	C - R445 Naas Road (West)	603	6	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.34	2.21	0.5	A
B - NSOOR Eastern Link	0.08	2.66	0.1	A
C - R445 Naas Road (West)	0.38	3.33	0.6	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	564	5	2454	0.230	563	0.3	1.903	A
B - NSOOR Eastern Link	81	477	1643	0.050	81	0.1	2.305	A
C - R445 Naas Road (West)	458	66	1772	0.259	457	0.3	2.736	A
D - Oldconnell	0	522	1636	0.000	0	0.0	0.000	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	673	5	2453	0.274	673	0.4	2.022	A
B - NSOOR Eastern Link	97	571	1571	0.062	97	0.1	2.442	A
C - R445 Naas Road (West)	547	79	1763	0.311	547	0.4	2.961	A
D - Oldconnell	0	624	1565	0.000	0	0.0	0.000	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	825	7	2452	0.336	824	0.5	2.211	A
B - NSOOR Eastern Link	119	699	1473	0.081	119	0.1	2.658	A
C - R445 Naas Road (West)	671	97	1751	0.383	670	0.6	3.328	A
D - Oldconnell	0	764	1468	0.000	0	0.0	0.000	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	825	7	2452	0.336	825	0.5	2.211	A
B - NSOOR Eastern Link	119	699	1473	0.081	119	0.1	2.658	A
C - R445 Naas Road (West)	671	97	1751	0.383	671	0.6	3.330	A
D - Oldconnell	0	765	1467	0.000	0	0.0	0.000	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	673	5	2453	0.274	674	0.4	2.024	A
B - NSOOR Eastern Link	97	571	1570	0.062	97	0.1	2.445	A
C - R445 Naas Road (West)	547	79	1763	0.311	548	0.5	2.964	A
D - Oldconnell	0	626	1564	0.000	0	0.0	0.000	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	564	5	2454	0.230	564	0.3	1.904	A
B - NSOOR Eastern Link	81	478	1642	0.050	81	0.1	2.308	A
C - R445 Naas Road (West)	458	66	1771	0.259	459	0.4	2.745	A
D - Oldconnell	0	524	1634	0.000	0	0.0	0.000	A

2029 Do Nothing , AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.22	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	694	100.000
B - NSOOR Eastern Link		✓	106	100.000
C - R445 Naas Road (West)		✓	809	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	140	554	0
	B - NSOOR Eastern Link	100	0	6	0
	C - R445 Naas Road (West)	794	15	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.31	2.14	0.5	A
B - NSOOR Eastern Link	0.08	2.53	0.1	A
C - R445 Naas Road (West)	0.51	4.23	1.0	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	522	11	2449	0.213	521	0.3	1.868	A
B - NSOOR Eastern Link	80	416	1689	0.047	80	0.0	2.236	A
C - R445 Naas Road (West)	609	75	1766	0.345	607	0.5	3.102	A
D - Oldconnell	0	682	1525	0.000	0	0.0	0.000	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	624	13	2447	0.255	624	0.3	1.974	A
B - NSOOR Eastern Link	95	498	1627	0.059	95	0.1	2.350	A
C - R445 Naas Road (West)	727	90	1756	0.414	727	0.7	3.496	A
D - Oldconnell	0	816	1432	0.000	0	0.0	0.000	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	764	16	2445	0.313	764	0.5	2.141	A
B - NSOOR Eastern Link	117	610	1541	0.076	117	0.1	2.526	A
C - R445 Naas Road (West)	891	110	1742	0.511	889	1.0	4.213	A
D - Oldconnell	0	999	1305	0.000	0	0.0	0.000	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	764	17	2445	0.313	764	0.5	2.142	A
B - NSOOR Eastern Link	117	610	1541	0.076	117	0.1	2.527	A
C - R445 Naas Road (West)	891	110	1742	0.511	891	1.0	4.227	A
D - Oldconnell	0	1001	1304	0.000	0	0.0	0.000	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	624	14	2447	0.255	624	0.3	1.977	A
B - NSOOR Eastern Link	95	498	1626	0.059	95	0.1	2.351	A
C - R445 Naas Road (West)	727	90	1756	0.414	729	0.7	3.511	A
D - Oldconnell	0	819	1430	0.000	0	0.0	0.000	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	522	11	2449	0.213	523	0.3	1.871	A
B - NSOOR Eastern Link	80	417	1688	0.047	80	0.0	2.239	A
C - R445 Naas Road (West)	609	75	1765	0.345	610	0.5	3.118	A
D - Oldconnell	0	685	1523	0.000	0	0.0	0.000	A

2029 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.95	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	861	100.000
B - NSOOR Eastern Link		✓	110	100.000
C - R445 Naas Road (West)		✓	697	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	121	739	1
	B - NSOOR Eastern Link	88	0	21	1
	C - R445 Naas Road (West)	691	6	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.39	2.39	0.6	A
B - NSOOR Eastern Link	0.09	2.85	0.1	A
C - R445 Naas Road (West)	0.44	3.66	0.8	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	648	5	2454	0.264	647	0.4	1.989	A
B - NSOOR Eastern Link	83	556	1582	0.052	83	0.1	2.400	A
C - R445 Naas Road (West)	525	68	1771	0.296	523	0.4	2.882	A
D - Oldconnell	0	589	1589	0.000	0	0.0	0.000	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	774	5	2453	0.316	774	0.5	2.143	A
B - NSOOR Eastern Link	99	665	1499	0.066	99	0.1	2.571	A
C - R445 Naas Road (West)	627	81	1762	0.356	626	0.5	3.168	A
D - Oldconnell	0	705	1509	0.000	0	0.0	0.000	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	948	7	2452	0.387	947	0.6	2.390	A
B - NSOOR Eastern Link	121	814	1384	0.087	121	0.1	2.848	A
C - R445 Naas Road (West)	767	99	1750	0.439	767	0.8	3.658	A
D - Oldconnell	0	863	1399	0.000	0	0.0	0.000	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	948	7	2452	0.387	948	0.6	2.392	A
B - NSOOR Eastern Link	121	815	1384	0.088	121	0.1	2.849	A
C - R445 Naas Road (West)	767	99	1750	0.439	767	0.8	3.664	A
D - Oldconnell	0	864	1398	0.000	0	0.0	0.000	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	774	5	2453	0.316	775	0.5	2.146	A
B - NSOOR Eastern Link	99	666	1498	0.066	99	0.1	2.574	A
C - R445 Naas Road (West)	627	81	1762	0.356	627	0.6	3.175	A
D - Oldconnell	0	707	1508	0.000	0	0.0	0.000	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	648	5	2454	0.264	649	0.4	1.994	A
B - NSOOR Eastern Link	83	557	1581	0.052	83	0.1	2.402	A
C - R445 Naas Road (West)	525	68	1770	0.296	525	0.4	2.891	A
D - Oldconnell	0	592	1587	0.000	0	0.0	0.000	A

2039 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.42	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	739	100.000
B - NSOOR Eastern Link		✓	106	100.000
C - R445 Naas Road (West)		✓	866	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	145	594	0
	B - NSOOR Eastern Link	100	0	6	0
	C - R445 Naas Road (West)	851	15	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.33	2.21	0.5	A
B - NSOOR Eastern Link	0.08	2.59	0.1	A
C - R445 Naas Road (West)	0.55	4.56	1.2	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	556	11	2449	0.227	555	0.3	1.901	A
B - NSOOR Eastern Link	80	446	1666	0.048	80	0.1	2.269	A
C - R445 Naas Road (West)	652	75	1766	0.369	650	0.6	3.219	A
D - Oldconnell	0	725	1495	0.000	0	0.0	0.000	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	664	13	2447	0.272	664	0.4	2.019	A
B - NSOOR Eastern Link	95	534	1599	0.060	95	0.1	2.393	A
C - R445 Naas Road (West)	779	90	1756	0.443	778	0.8	3.677	A
D - Oldconnell	0	868	1396	0.000	0	0.0	0.000	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	814	16	2445	0.333	813	0.5	2.207	A
B - NSOOR Eastern Link	117	654	1507	0.077	117	0.1	2.588	A
C - R445 Naas Road (West)	953	110	1742	0.547	952	1.2	4.545	A
D - Oldconnell	0	1062	1261	0.000	0	0.0	0.000	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	814	17	2445	0.333	814	0.5	2.207	A
B - NSOOR Eastern Link	117	654	1507	0.077	117	0.1	2.588	A
C - R445 Naas Road (West)	953	110	1742	0.547	953	1.2	4.563	A
D - Oldconnell	0	1064	1260	0.000	0	0.0	0.000	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	664	14	2447	0.272	665	0.4	2.020	A
B - NSOOR Eastern Link	95	534	1599	0.060	95	0.1	2.394	A
C - R445 Naas Road (West)	779	90	1756	0.443	780	0.8	3.698	A
D - Oldconnell	0	870	1394	0.000	0	0.0	0.000	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	556	11	2449	0.227	557	0.3	1.902	A
B - NSOOR Eastern Link	80	447	1665	0.048	80	0.1	2.270	A
C - R445 Naas Road (West)	652	75	1765	0.369	653	0.6	3.237	A
D - Oldconnell	0	728	1493	0.000	0	0.0	0.000	A

2039 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.11	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	924	100.000
B - NSOOR Eastern Link		✓	109	100.000
C - R445 Naas Road (West)		✓	748	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	127	797	0
	B - NSOOR Eastern Link	88	0	21	0
	C - R445 Naas Road (West)	742	6	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.41	2.51	0.7	A
B - NSOOR Eastern Link	0.09	2.96	0.1	A
C - R445 Naas Road (West)	0.47	3.88	0.9	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	696	5	2454	0.283	694	0.4	2.043	A
B - NSOOR Eastern Link	82	599	1549	0.053	82	0.1	2.452	A
C - R445 Naas Road (West)	563	66	1772	0.318	561	0.5	2.971	A
D - Oldconnell	0	627	1563	0.000	0	0.0	0.000	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	831	5	2453	0.339	830	0.5	2.218	A
B - NSOOR Eastern Link	98	716	1460	0.067	98	0.1	2.643	A
C - R445 Naas Road (West)	672	79	1763	0.381	672	0.6	3.297	A
D - Oldconnell	0	751	1477	0.000	0	0.0	0.000	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1017	7	2452	0.415	1017	0.7	2.506	A
B - NSOOR Eastern Link	120	877	1337	0.090	120	0.1	2.958	A
C - R445 Naas Road (West)	824	97	1751	0.470	822	0.9	3.873	A
D - Oldconnell	0	919	1360	0.000	0	0.0	0.000	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1017	7	2452	0.415	1017	0.7	2.508	A
B - NSOOR Eastern Link	120	878	1336	0.090	120	0.1	2.959	A
C - R445 Naas Road (West)	824	97	1751	0.470	824	0.9	3.881	A
D - Oldconnell	0	920	1359	0.000	0	0.0	0.000	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	831	5	2453	0.339	831	0.5	2.220	A
B - NSOOR Eastern Link	98	717	1459	0.067	98	0.1	2.645	A
C - R445 Naas Road (West)	672	79	1763	0.381	673	0.6	3.309	A
D - Oldconnell	0	753	1476	0.000	0	0.0	0.000	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	696	5	2454	0.283	696	0.4	2.049	A
B - NSOOR Eastern Link	82	600	1548	0.053	82	0.1	2.457	A
C - R445 Naas Road (West)	563	66	1771	0.318	564	0.5	2.981	A
D - Oldconnell	0	630	1561	0.000	0	0.0	0.000	A

2024 Scenario B Opening Year, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.92	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D7	2024 Scenario B Opening Year	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	668	100.000
B - NSOOR Eastern Link		✓	148	100.000
C - R445 Naas Road (West)		✓	694	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	175	493	0
	B - NSOOR Eastern Link	142	0	6	0
	C - R445 Naas Road (West)	694	0	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.30	2.09	0.4	A
B - NSOOR Eastern Link	0.10	2.52	0.1	A
C - R445 Naas Road (West)	0.45	3.80	0.8	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	503	0	2458	0.205	502	0.3	1.840	A
B - NSOOR Eastern Link	111	370	1724	0.065	111	0.1	2.231	A
C - R445 Naas Road (West)	522	107	1745	0.299	521	0.4	2.938	A
D - Oldconnell	0	627	1562	0.000	0	0.0	0.000	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	601	0	2458	0.244	600	0.3	1.938	A
B - NSOOR Eastern Link	133	443	1669	0.080	133	0.1	2.343	A
C - R445 Naas Road (West)	624	128	1731	0.360	623	0.6	3.249	A
D - Oldconnell	0	751	1477	0.000	0	0.0	0.000	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	735	0	2458	0.299	735	0.4	2.090	A
B - NSOOR Eastern Link	163	542	1592	0.102	163	0.1	2.517	A
C - R445 Naas Road (West)	764	156	1712	0.446	763	0.8	3.792	A
D - Oldconnell	0	919	1360	0.000	0	0.0	0.000	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	735	0	2458	0.299	735	0.4	2.090	A
B - NSOOR Eastern Link	163	543	1592	0.102	163	0.1	2.518	A
C - R445 Naas Road (West)	764	156	1712	0.446	764	0.8	3.798	A
D - Oldconnell	0	920	1359	0.000	0	0.0	0.000	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	601	0	2458	0.244	601	0.3	1.940	A
B - NSOOR Eastern Link	133	443	1668	0.080	133	0.1	2.344	A
C - R445 Naas Road (West)	624	128	1731	0.361	625	0.6	3.260	A
D - Oldconnell	0	753	1476	0.000	0	0.0	0.000	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	503	0	2458	0.205	503	0.3	1.841	A
B - NSOOR Eastern Link	111	371	1723	0.065	111	0.1	2.234	A
C - R445 Naas Road (West)	522	107	1744	0.300	523	0.4	2.948	A
D - Oldconnell	0	630	1561	0.000	0	0.0	0.000	A

2024 Scenario B Opening Year, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.78	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D8	2024 Scenario B Opening Year	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	802	100.000
B - NSOOR Eastern Link		✓	150	100.000
C - R445 Naas Road (West)		✓	610	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	159	643	0
	B - NSOOR Eastern Link	128	0	21	1
	C - R445 Naas Road (West)	610	0	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.36	2.29	0.6	A
B - NSOOR Eastern Link	0.11	2.77	0.1	A
C - R445 Naas Road (West)	0.39	3.43	0.6	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	604	0	2458	0.246	602	0.3	1.940	A
B - NSOOR Eastern Link	113	483	1638	0.069	113	0.1	2.360	A
C - R445 Naas Road (West)	459	97	1751	0.262	458	0.4	2.781	A
D - Oldconnell	0	554	1613	0.000	0	0.0	0.000	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	721	0	2458	0.293	721	0.4	2.072	A
B - NSOOR Eastern Link	135	578	1565	0.086	135	0.1	2.515	A
C - R445 Naas Road (West)	548	116	1738	0.315	548	0.5	3.024	A
D - Oldconnell	0	663	1538	0.000	0	0.0	0.000	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	883	0	2458	0.359	882	0.6	2.286	A
B - NSOOR Eastern Link	165	707	1466	0.113	165	0.1	2.766	A
C - R445 Naas Road (West)	672	142	1721	0.390	671	0.6	3.426	A
D - Oldconnell	0	812	1435	0.000	0	0.0	0.000	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	883	0	2458	0.359	883	0.6	2.286	A
B - NSOOR Eastern Link	165	708	1466	0.113	165	0.1	2.767	A
C - R445 Naas Road (West)	672	142	1721	0.390	672	0.6	3.429	A
D - Oldconnell	0	813	1434	0.000	0	0.0	0.000	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	721	0	2458	0.293	722	0.4	2.075	A
B - NSOOR Eastern Link	135	579	1565	0.086	135	0.1	2.517	A
C - R445 Naas Road (West)	548	116	1738	0.315	549	0.5	3.030	A
D - Oldconnell	0	664	1537	0.000	0	0.0	0.000	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	604	0	2458	0.246	604	0.3	1.942	A
B - NSOOR Eastern Link	113	484	1637	0.069	113	0.1	2.363	A
C - R445 Naas Road (West)	459	97	1751	0.262	460	0.4	2.788	A
D - Oldconnell	0	556	1612	0.000	0	0.0	0.000	A

2029 Scenario B Design 5 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.43	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D9	2029 Scenario B Design 5 Years	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	764	100.000
B - NSOOR Eastern Link		✓	197	100.000
C - R445 Naas Road (West)		✓	825	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	200	564	0
	B - NSOOR Eastern Link	191	0	6	0
	C - R445 Naas Road (West)	810	15	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.34	2.24	0.5	A
B - NSOOR Eastern Link	0.14	2.74	0.2	A
C - R445 Naas Road (West)	0.54	4.69	1.2	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	575	11	2449	0.235	574	0.3	1.919	A
B - NSOOR Eastern Link	148	424	1683	0.088	148	0.1	2.344	A
C - R445 Naas Road (West)	621	143	1720	0.361	619	0.6	3.261	A
D - Oldconnell	0	762	1469	0.000	0	0.0	0.000	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	687	13	2447	0.281	686	0.4	2.045	A
B - NSOOR Eastern Link	177	507	1620	0.109	177	0.1	2.494	A
C - R445 Naas Road (West)	742	172	1702	0.436	741	0.8	3.743	A
D - Oldconnell	0	912	1365	0.000	0	0.0	0.000	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	841	16	2445	0.344	841	0.5	2.244	A
B - NSOOR Eastern Link	217	621	1533	0.142	217	0.2	2.735	A
C - R445 Naas Road (West)	908	210	1676	0.542	907	1.2	4.671	A
D - Oldconnell	0	1117	1223	0.000	0	0.0	0.000	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	841	17	2445	0.344	841	0.5	2.244	A
B - NSOOR Eastern Link	217	621	1532	0.142	217	0.2	2.736	A
C - R445 Naas Road (West)	908	210	1676	0.542	908	1.2	4.690	A
D - Oldconnell	0	1119	1222	0.000	0	0.0	0.000	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	687	14	2447	0.281	687	0.4	2.046	A
B - NSOOR Eastern Link	177	507	1619	0.109	177	0.1	2.498	A
C - R445 Naas Road (West)	742	172	1701	0.436	743	0.8	3.765	A
D - Oldconnell	0	915	1363	0.000	0	0.0	0.000	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	575	11	2449	0.235	576	0.3	1.922	A
B - NSOOR Eastern Link	148	425	1683	0.088	148	0.1	2.348	A
C - R445 Naas Road (West)	621	144	1720	0.361	622	0.6	3.280	A
D - Oldconnell	0	766	1467	0.000	0	0.0	0.000	A

2029 Scenario B Design 5 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.15	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D10	2029 Scenario B Design 5 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	966	100.000
B - NSOOR Eastern Link		✓	180	100.000
C - R445 Naas Road (West)		✓	710	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	210	756	0
	B - NSOOR Eastern Link	158	0	21	1
	C - R445 Naas Road (West)	704	6	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.43	2.59	0.8	A
B - NSOOR Eastern Link	0.14	3.07	0.2	A
C - R445 Naas Road (West)	0.46	3.92	0.8	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	727	5	2454	0.296	726	0.4	2.081	A
B - NSOOR Eastern Link	136	568	1573	0.086	135	0.1	2.503	A
C - R445 Naas Road (West)	535	119	1736	0.308	533	0.4	2.988	A
D - Oldconnell	0	651	1546	0.000	0	0.0	0.000	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	868	5	2453	0.354	868	0.5	2.271	A
B - NSOOR Eastern Link	162	679	1488	0.109	162	0.1	2.714	A
C - R445 Naas Road (West)	638	143	1721	0.371	638	0.6	3.322	A
D - Oldconnell	0	780	1457	0.000	0	0.0	0.000	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1064	7	2452	0.434	1063	0.8	2.589	A
B - NSOOR Eastern Link	198	832	1371	0.145	198	0.2	3.068	A
C - R445 Naas Road (West)	782	175	1699	0.460	781	0.8	3.915	A
D - Oldconnell	0	954	1336	0.000	0	0.0	0.000	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1064	7	2452	0.434	1064	0.8	2.591	A
B - NSOOR Eastern Link	198	832	1371	0.145	198	0.2	3.069	A
C - R445 Naas Road (West)	782	175	1699	0.460	782	0.8	3.923	A
D - Oldconnell	0	956	1335	0.000	0	0.0	0.000	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	868	5	2453	0.354	869	0.6	2.273	A
B - NSOOR Eastern Link	162	680	1487	0.109	162	0.1	2.718	A
C - R445 Naas Road (West)	638	143	1720	0.371	639	0.6	3.332	A
D - Oldconnell	0	781	1456	0.000	0	0.0	0.000	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	727	5	2454	0.296	728	0.4	2.087	A
B - NSOOR Eastern Link	136	570	1572	0.086	136	0.1	2.508	A
C - R445 Naas Road (West)	535	120	1736	0.308	535	0.4	3.001	A
D - Oldconnell	0	654	1544	0.000	0	0.0	0.000	A

2039 Scenario B Design 15 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.69	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D11	2039 Scenario B Design 15 Years	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	811	100.000
B - NSOOR Eastern Link		✓	201	100.000
C - R445 Naas Road (West)		✓	883	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	206	605	0
	B - NSOOR Eastern Link	195	0	6	0
	C - R445 Naas Road (West)	868	15	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.37	2.32	0.6	A
B - NSOOR Eastern Link	0.15	2.82	0.2	A
C - R445 Naas Road (West)	0.58	5.14	1.4	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	611	11	2449	0.249	609	0.3	1.956	A
B - NSOOR Eastern Link	151	454	1660	0.091	151	0.1	2.386	A
C - R445 Naas Road (West)	665	146	1718	0.387	662	0.6	3.400	A
D - Oldconnell	0	809	1437	0.000	0	0.0	0.000	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	729	13	2447	0.298	729	0.4	2.095	A
B - NSOOR Eastern Link	181	544	1592	0.114	181	0.1	2.551	A
C - R445 Naas Road (West)	794	175	1699	0.467	793	0.9	3.968	A
D - Oldconnell	0	968	1326	0.000	0	0.0	0.000	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	893	16	2445	0.365	892	0.6	2.319	A
B - NSOOR Eastern Link	221	666	1498	0.148	221	0.2	2.818	A
C - R445 Naas Road (West)	972	215	1673	0.581	970	1.4	5.108	A
D - Oldconnell	0	1185	1176	0.000	0	0.0	0.000	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	893	17	2445	0.365	893	0.6	2.319	A
B - NSOOR Eastern Link	221	666	1498	0.148	221	0.2	2.819	A
C - R445 Naas Road (West)	972	215	1673	0.581	972	1.4	5.137	A
D - Oldconnell	0	1187	1175	0.000	0	0.0	0.000	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	729	14	2447	0.298	730	0.4	2.098	A
B - NSOOR Eastern Link	181	544	1591	0.114	181	0.1	2.552	A
C - R445 Naas Road (West)	794	175	1699	0.467	796	0.9	3.994	A
D - Oldconnell	0	971	1324	0.000	0	0.0	0.000	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	611	11	2449	0.249	611	0.3	1.959	A
B - NSOOR Eastern Link	151	456	1659	0.091	151	0.1	2.387	A
C - R445 Naas Road (West)	665	147	1718	0.387	666	0.6	3.426	A
D - Oldconnell	0	813	1434	0.000	0	0.0	0.000	A

2039 Scenario B Design 15 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.33	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D12	2039 Scenario B Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	1030	100.000
B - NSOOR Eastern Link		✓	180	100.000
C - R445 Naas Road (West)		✓	761	100.000
D - Oldconnell		✓	0	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	216	814	0
	B - NSOOR Eastern Link	159	0	21	0
	C - R445 Naas Road (West)	755	6	0	0
	D - Oldconnell	0	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.46	2.73	0.9	A
B - NSOOR Eastern Link	0.15	3.20	0.2	A
C - R445 Naas Road (West)	0.49	4.18	1.0	A
D - Oldconnell	0.00	0.00	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	775	5	2454	0.316	774	0.5	2.141	A
B - NSOOR Eastern Link	136	611	1540	0.088	135	0.1	2.563	A
C - R445 Naas Road (West)	573	119	1736	0.330	571	0.5	3.084	A
D - Oldconnell	0	690	1519	0.000	0	0.0	0.000	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	926	5	2453	0.377	925	0.6	2.356	A
B - NSOOR Eastern Link	162	731	1448	0.112	162	0.1	2.798	A
C - R445 Naas Road (West)	684	143	1721	0.398	683	0.7	3.469	A
D - Oldconnell	0	826	1425	0.000	0	0.0	0.000	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1134	7	2452	0.462	1133	0.9	2.728	A
B - NSOOR Eastern Link	198	895	1322	0.150	198	0.2	3.201	A
C - R445 Naas Road (West)	838	175	1699	0.493	837	1.0	4.167	A
D - Oldconnell	0	1012	1296	0.000	0	0.0	0.000	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1134	7	2452	0.462	1134	0.9	2.730	A
B - NSOOR Eastern Link	198	896	1322	0.150	198	0.2	3.203	A
C - R445 Naas Road (West)	838	175	1699	0.493	838	1.0	4.179	A
D - Oldconnell	0	1013	1295	0.000	0	0.0	0.000	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	926	5	2453	0.377	927	0.6	2.359	A
B - NSOOR Eastern Link	162	733	1447	0.112	162	0.1	2.803	A
C - R445 Naas Road (West)	684	143	1720	0.398	685	0.7	3.483	A
D - Oldconnell	0	828	1423	0.000	0	0.0	0.000	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	775	5	2454	0.316	776	0.5	2.147	A
B - NSOOR Eastern Link	136	613	1538	0.088	136	0.1	2.568	A
C - R445 Naas Road (West)	573	120	1736	0.330	574	0.5	3.100	A
D - Oldconnell	0	693	1517	0.000	0	0.0	0.000	A

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Lidl Distributer Roundabout - Scenario C.j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario C- NSOOR open
Report generation date: 15/03/2022 15:40:04

»2024 Do Nothing, AM
»2024 Do Nothing, PM
»2029 Do Nothing , AM
»2029 Do Nothing, PM
»2039 Do Nothing, AM
»2039 Do Nothing, PM
»2024 Scenario D Opening Year, AM
»2024 Scenario D Opening Year, PM
»2029 Scenario D Design 5 Years, AM
»2029 Scenario D Design 5 Years, PM
»2039 Scenario D Design 15 Years, AM
»2039 Scenario D Design 15 Years, PM

Summary of junction performance

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
2024 Do Nothing								
A - R445 Naas Road (east)	0.4	2.11	0.30	A	0.5	2.26	0.35	A
B - NSOOR Eastern Link	0.2	2.47	0.16	A	0.2	2.56	0.15	A
C - R445 Naas Road (West)	0.7	3.71	0.41	A	0.4	3.02	0.29	A
D - Oldconnell	0.0	2.67	0.00	A	0.0	2.37	0.00	A
2029 Do Nothing								
A - R445 Naas Road (east)	0.6	2.39	0.38	A	0.7	2.46	0.40	A
B - NSOOR Eastern Link	0.3	2.75	0.23	A	0.2	2.73	0.18	A
C - R445 Naas Road (West)	0.9	4.46	0.49	A	0.5	3.23	0.33	A
D - Oldconnell	0.0	2.97	0.01	A	0.0	2.48	0.00	A
2039 Do Nothing								
A - R445 Naas Road (east)	0.7	2.49	0.40	A	0.8	2.58	0.43	A
B - NSOOR Eastern Link	0.3	2.80	0.24	A	0.2	2.79	0.19	A
C - R445 Naas Road (West)	1.1	4.79	0.52	A	0.5	3.36	0.35	A
D - Oldconnell	0.0	3.07	0.01	A	0.0	2.53	0.00	A
2024 Scenario D Opening Year								
A - R445 Naas Road (east)	0.6	2.31	0.36	A	0.6	2.34	0.37	A
B - NSOOR Eastern Link	0.3	2.67	0.22	A	0.2	2.66	0.18	A
C - R445 Naas Road (West)	0.8	4.08	0.44	A	0.4	3.11	0.30	A
D - Oldconnell	0.0	2.85	0.00	A	0.0	2.43	0.00	A
2029 Scenario D Design 5 Years								
A - R445 Naas Road (east)	0.7	2.51	0.41	A	0.8	2.64	0.44	A
B - NSOOR Eastern Link	0.4	2.99	0.29	A	0.3	2.91	0.23	A
C - R445 Naas Road (West)	1.0	4.91	0.51	A	0.5	3.41	0.34	A
D - Oldconnell	0.0	3.17	0.01	A	0.0	2.59	0.00	A
2039 Scenario D Design 15 Years								
A - R445 Naas Road (east)	0.8	2.63	0.43	A	0.9	2.77	0.47	A
B - NSOOR Eastern Link	0.5	3.11	0.31	A	0.3	3.01	0.24	A
C - R445 Naas Road (West)	1.2	5.43	0.55	A	0.6	3.58	0.37	A
D - Oldconnell	0.0	3.33	0.01	A	0.0	2.66	0.00	A

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

File Description

Title	
Location	
Site number	
Date	29/04/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units

m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15
D13	2024 Scenario D Opening Year	AM	ONE HOUR	08:15	09:45	15
D14	2024 Scenario D Opening Year	PM	ONE HOUR	17:30	19:00	15
D15	2029 Scenario D Design 5 Years	AM	ONE HOUR	08:15	09:45	15
D16	2029 Scenario D Design 5 Years	PM	ONE HOUR	17:30	19:00	15
D17	2039 Scenario D Design 15 Years	AM	ONE HOUR	08:15	09:45	15
D18	2039 Scenario D Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2024 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.81	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	R445 Naas Road (east)	
B	NSOOR Eastern Link	
C	R445 Naas Road (West)	
D	Oldconnell	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - R445 Naas Road (east)	7.00	7.30	2.0	36.3	50.0	0.0	
B - NSOOR Eastern Link	4.60	7.00	10.0	24.0	13.0	0.0	
C - R445 Naas Road (West)	3.00	7.80	15.0	26.0	50.0	0.0	
D - Oldconnell	6.00	6.00	0.0	18.0	50.0	0.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - R445 Naas Road (east)	0.788	2458
B - NSOOR Eastern Link	0.766	2008
C - R445 Naas Road (West)	0.663	1815
D - Oldconnell	0.693	1997

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	663	100.000
B - NSOOR Eastern Link		✓	254	100.000
C - R445 Naas Road (West)		✓	612	100.000
D - Oldconnell		✓	5	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	347	315	1
	B - NSOOR Eastern Link	235	0	19	0
	C - R445 Naas Road (West)	592	17	0	3
	D - Oldconnell	0	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
	A - R445 Naas Road (east)	0	0	0	0

From	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.30	2.11	0.4	A
B - NSOOR Eastern Link	0.16	2.47	0.2	A
C - R445 Naas Road (West)	0.41	3.71	0.7	A
D - Oldconnell	0.00	2.67	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	499	17	2445	0.204	498	0.3	1.849	A
B - NSOOR Eastern Link	191	241	1823	0.105	191	0.1	2.205	A
C - R445 Naas Road (West)	461	177	1698	0.271	459	0.4	2.902	A
D - Oldconnell	4	633	1558	0.002	4	0.0	2.315	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	596	20	2442	0.244	596	0.3	1.949	A
B - NSOOR Eastern Link	228	288	1787	0.128	228	0.1	2.309	A
C - R445 Naas Road (West)	550	212	1675	0.329	550	0.5	3.198	A
D - Oldconnell	4	758	1472	0.003	4	0.0	2.452	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	730	24	2438	0.299	730	0.4	2.106	A
B - NSOOR Eastern Link	280	353	1737	0.161	279	0.2	2.469	A
C - R445 Naas Road (West)	674	260	1643	0.410	673	0.7	3.707	A
D - Oldconnell	6	928	1354	0.004	6	0.0	2.669	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	730	24	2438	0.299	730	0.4	2.106	A
B - NSOOR Eastern Link	280	353	1737	0.161	280	0.2	2.469	A
C - R445 Naas Road (West)	674	260	1643	0.410	674	0.7	3.713	A
D - Oldconnell	6	929	1353	0.004	6	0.0	2.670	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	596	20	2442	0.244	596	0.3	1.950	A
B - NSOOR Eastern Link	228	289	1787	0.128	229	0.1	2.312	A
C - R445 Naas Road (West)	550	212	1675	0.329	551	0.5	3.208	A
D - Oldconnell	4	760	1471	0.003	4	0.0	2.456	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	499	17	2444	0.204	499	0.3	1.853	A
B - NSOOR Eastern Link	191	242	1823	0.105	191	0.1	2.208	A
C - R445 Naas Road (West)	461	178	1697	0.271	461	0.4	2.912	A
D - Oldconnell	4	636	1557	0.002	4	0.0	2.318	A

2024 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.54	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	775	100.000
B - NSOOR Eastern Link		✓	227	100.000
C - R445 Naas Road (West)		✓	441	100.000
D - Oldconnell		✓	5	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	359	415	1
	B - NSOOR Eastern Link	186	0	40	1
	C - R445 Naas Road (West)	430	8	0	3
	D - Oldconnell	1	0	4	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.35	2.26	0.5	A
B - NSOOR Eastern Link	0.15	2.56	0.2	A
C - R445 Naas Road (West)	0.29	3.02	0.4	A
D - Oldconnell	0.00	2.37	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	583	9	2450	0.238	582	0.3	1.926	A
B - NSOOR Eastern Link	171	316	1766	0.097	170	0.1	2.256	A
C - R445 Naas Road (West)	332	141	1722	0.193	331	0.2	2.587	A
D - Oldconnell	4	468	1673	0.002	4	0.0	2.156	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	697	11	2449	0.284	696	0.4	2.054	A
B - NSOOR Eastern Link	204	377	1719	0.119	204	0.1	2.376	A
C - R445 Naas Road (West)	396	169	1703	0.233	396	0.3	2.754	A
D - Oldconnell	4	561	1609	0.003	4	0.0	2.243	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	853	13	2447	0.349	853	0.5	2.258	A
B - NSOOR Eastern Link	250	462	1654	0.151	250	0.2	2.563	A
C - R445 Naas Road (West)	486	207	1678	0.289	485	0.4	3.017	A
D - Oldconnell	6	686	1522	0.004	6	0.0	2.374	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	853	13	2447	0.349	853	0.5	2.258	A
B - NSOOR Eastern Link	250	462	1654	0.151	250	0.2	2.563	A
C - R445 Naas Road (West)	486	207	1678	0.289	486	0.4	3.018	A
D - Oldconnell	6	687	1521	0.004	6	0.0	2.374	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	697	11	2449	0.284	697	0.4	2.055	A
B - NSOOR Eastern Link	204	378	1718	0.119	204	0.1	2.377	A
C - R445 Naas Road (West)	396	169	1703	0.233	397	0.3	2.758	A
D - Oldconnell	4	562	1608	0.003	4	0.0	2.246	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	583	9	2450	0.238	584	0.3	1.930	A
B - NSOOR Eastern Link	171	316	1766	0.097	171	0.1	2.257	A
C - R445 Naas Road (West)	332	142	1721	0.193	332	0.2	2.591	A
D - Oldconnell	4	470	1672	0.002	4	0.0	2.159	A

2029 Do Nothing , AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.22	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	834	100.000
B - NSOOR Eastern Link		✓	361	100.000
C - R445 Naas Road (West)		✓	693	100.000
D - Oldconnell		✓	6	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	483	350	1
	B - NSOOR Eastern Link	334	0	27	0
	C - R445 Naas Road (West)	655	34	0	4
	D - Oldconnell	0	0	6	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.38	2.39	0.6	A
B - NSOOR Eastern Link	0.23	2.75	0.3	A
C - R445 Naas Road (West)	0.49	4.46	0.9	A
D - Oldconnell	0.01	2.97	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	628	30	2434	0.258	626	0.3	1.991	A
B - NSOOR Eastern Link	272	268	1802	0.151	271	0.2	2.349	A
C - R445 Naas Road (West)	522	252	1648	0.316	520	0.5	3.184	A
D - Oldconnell	5	768	1465	0.003	5	0.0	2.464	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	750	36	2429	0.309	749	0.4	2.143	A
B - NSOOR Eastern Link	325	321	1762	0.184	324	0.2	2.503	A
C - R445 Naas Road (West)	623	301	1616	0.386	622	0.6	3.622	A
D - Oldconnell	5	919	1361	0.004	5	0.0	2.656	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	918	44	2423	0.379	918	0.6	2.390	A
B - NSOOR Eastern Link	397	393	1707	0.233	397	0.3	2.748	A
C - R445 Naas Road (West)	763	369	1571	0.486	762	0.9	4.443	A
D - Oldconnell	7	1125	1218	0.005	7	0.0	2.971	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	918	44	2423	0.379	918	0.6	2.392	A
B - NSOOR Eastern Link	397	393	1707	0.233	397	0.3	2.748	A
C - R445 Naas Road (West)	763	369	1571	0.486	763	0.9	4.456	A
D - Oldconnell	7	1126	1217	0.005	7	0.0	2.974	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	750	36	2429	0.309	750	0.4	2.144	A
B - NSOOR Eastern Link	325	321	1762	0.184	325	0.2	2.505	A
C - R445 Naas Road (West)	623	301	1615	0.386	624	0.6	3.635	A
D - Oldconnell	5	921	1359	0.004	5	0.0	2.659	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	628	30	2434	0.258	628	0.3	1.995	A
B - NSOOR Eastern Link	272	269	1802	0.151	272	0.2	2.352	A
C - R445 Naas Road (West)	522	252	1648	0.317	522	0.5	3.202	A
D - Oldconnell	5	771	1463	0.003	5	0.0	2.469	A

2029 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.73	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	893	100.000
B - NSOOR Eastern Link		✓	264	100.000
C - R445 Naas Road (West)		✓	491	100.000
D - Oldconnell		✓	6	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	427	466	0
	B - NSOOR Eastern Link	222	0	42	0
	C - R445 Naas Road (West)	478	9	0	4
	D - Oldconnell	1	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.40	2.46	0.7	A
B - NSOOR Eastern Link	0.18	2.73	0.2	A
C - R445 Naas Road (West)	0.33	3.23	0.5	A
D - Oldconnell	0.00	2.48	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	672	11	2449	0.274	671	0.4	2.022	A
B - NSOOR Eastern Link	199	354	1737	0.114	198	0.1	2.340	A
C - R445 Naas Road (West)	370	167	1705	0.217	369	0.3	2.691	A
D - Oldconnell	5	532	1628	0.003	5	0.0	2.216	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	803	13	2448	0.328	802	0.5	2.188	A
B - NSOOR Eastern Link	237	423	1684	0.141	237	0.2	2.488	A
C - R445 Naas Road (West)	441	199	1683	0.262	441	0.4	2.898	A
D - Oldconnell	5	637	1556	0.003	5	0.0	2.321	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	983	15	2445	0.402	982	0.7	2.459	A
B - NSOOR Eastern Link	291	518	1611	0.180	290	0.2	2.725	A
C - R445 Naas Road (West)	541	244	1653	0.327	540	0.5	3.232	A
D - Oldconnell	7	780	1457	0.005	7	0.0	2.481	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	983	15	2445	0.402	983	0.7	2.461	A
B - NSOOR Eastern Link	291	519	1611	0.180	291	0.2	2.726	A
C - R445 Naas Road (West)	541	244	1653	0.327	541	0.5	3.234	A
D - Oldconnell	7	781	1456	0.005	7	0.0	2.482	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	803	13	2448	0.328	804	0.5	2.191	A
B - NSOOR Eastern Link	237	424	1683	0.141	238	0.2	2.489	A
C - R445 Naas Road (West)	441	200	1683	0.262	442	0.4	2.903	A
D - Oldconnell	5	638	1555	0.003	5	0.0	2.322	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	672	11	2449	0.274	673	0.4	2.026	A
B - NSOOR Eastern Link	199	355	1736	0.114	199	0.1	2.343	A
C - R445 Naas Road (West)	370	167	1704	0.217	370	0.3	2.697	A
D - Oldconnell	5	534	1627	0.003	5	0.0	2.218	A

2039 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.40	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	889	100.000
B - NSOOR Eastern Link		✓	363	100.000
C - R445 Naas Road (West)		✓	744	100.000
D - Oldconnell		✓	6	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	511	377	1
	B - NSOOR Eastern Link	334	0	29	0
	C - R445 Naas Road (West)	705	35	0	4
	D - Oldconnell	0	0	6	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.40	2.49	0.7	A
B - NSOOR Eastern Link	0.24	2.80	0.3	A
C - R445 Naas Road (West)	0.52	4.79	1.1	A
D - Oldconnell	0.01	3.07	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	669	31	2433	0.275	668	0.4	2.037	A
B - NSOOR Eastern Link	273	288	1787	0.153	273	0.2	2.376	A
C - R445 Naas Road (West)	560	252	1648	0.340	558	0.5	3.296	A
D - Oldconnell	5	806	1439	0.003	5	0.0	2.509	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	799	37	2429	0.329	799	0.5	2.209	A
B - NSOOR Eastern Link	326	345	1744	0.187	326	0.2	2.539	A
C - R445 Naas Road (West)	669	301	1616	0.414	668	0.7	3.795	A
D - Oldconnell	5	965	1329	0.004	5	0.0	2.719	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	979	45	2422	0.404	978	0.7	2.492	A
B - NSOOR Eastern Link	400	422	1684	0.237	399	0.3	2.801	A
C - R445 Naas Road (West)	819	369	1571	0.521	818	1.1	4.770	A
D - Oldconnell	7	1181	1179	0.006	7	0.0	3.069	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	979	45	2422	0.404	979	0.7	2.494	A
B - NSOOR Eastern Link	400	423	1684	0.237	400	0.3	2.802	A
C - R445 Naas Road (West)	819	369	1571	0.522	819	1.1	4.789	A
D - Oldconnell	7	1182	1178	0.006	7	0.0	3.073	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	799	37	2428	0.329	800	0.5	2.213	A
B - NSOOR Eastern Link	326	346	1743	0.187	327	0.2	2.543	A
C - R445 Naas Road (West)	669	301	1615	0.414	670	0.7	3.817	A
D - Oldconnell	5	967	1327	0.004	5	0.0	2.725	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	669	31	2433	0.275	670	0.4	2.043	A
B - NSOOR Eastern Link	273	289	1786	0.153	273	0.2	2.379	A
C - R445 Naas Road (West)	560	252	1648	0.340	561	0.5	3.315	A
D - Oldconnell	5	810	1436	0.003	5	0.0	2.515	A

2039 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.85	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	955	100.000
B - NSOOR Eastern Link		✓	266	100.000
C - R445 Naas Road (West)		✓	528	100.000
D - Oldconnell		✓	6	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	453	502	0
	B - NSOOR Eastern Link	222	0	44	0
	C - R445 Naas Road (West)	515	9	0	4
	D - Oldconnell	1	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.43	2.58	0.8	A
B - NSOOR Eastern Link	0.19	2.79	0.2	A
C - R445 Naas Road (West)	0.35	3.36	0.5	A
D - Oldconnell	0.00	2.53	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	719	11	2449	0.294	717	0.4	2.077	A
B - NSOOR Eastern Link	200	381	1716	0.117	200	0.1	2.374	A
C - R445 Naas Road (West)	398	167	1705	0.233	396	0.3	2.748	A
D - Oldconnell	5	560	1609	0.003	5	0.0	2.243	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	859	13	2448	0.351	858	0.5	2.265	A
B - NSOOR Eastern Link	239	456	1659	0.144	239	0.2	2.534	A
C - R445 Naas Road (West)	475	199	1683	0.282	474	0.4	2.978	A
D - Oldconnell	5	670	1533	0.004	5	0.0	2.356	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1051	15	2445	0.430	1051	0.8	2.580	A
B - NSOOR Eastern Link	293	558	1581	0.185	293	0.2	2.794	A
C - R445 Naas Road (West)	581	244	1653	0.352	581	0.5	3.354	A
D - Oldconnell	7	821	1429	0.005	7	0.0	2.531	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1051	15	2445	0.430	1051	0.8	2.582	A
B - NSOOR Eastern Link	293	558	1580	0.185	293	0.2	2.795	A
C - R445 Naas Road (West)	581	244	1653	0.352	581	0.5	3.357	A
D - Oldconnell	7	821	1428	0.005	7	0.0	2.532	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	859	13	2448	0.351	859	0.5	2.267	A
B - NSOOR Eastern Link	239	456	1658	0.144	239	0.2	2.538	A
C - R445 Naas Road (West)	475	200	1683	0.282	475	0.4	2.984	A
D - Oldconnell	5	671	1532	0.004	5	0.0	2.357	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	719	11	2449	0.294	719	0.4	2.083	A
B - NSOOR Eastern Link	200	382	1715	0.117	200	0.1	2.376	A
C - R445 Naas Road (West)	398	167	1704	0.233	398	0.3	2.755	A
D - Oldconnell	5	562	1608	0.003	5	0.0	2.246	A

2024 Scenario D Opening Year, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.01	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D13	2024 Scenario D Opening Year	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	791	100.000
B - NSOOR Eastern Link		✓	351	100.000
C - R445 Naas Road (West)		✓	631	100.000
D - Oldconnell		✓	5	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	472	318	1
	B - NSOOR Eastern Link	326	0	25	0
	C - R445 Naas Road (West)	596	32	0	3
	D - Oldconnell	0	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.36	2.31	0.6	A
B - NSOOR Eastern Link	0.22	2.67	0.3	A
C - R445 Naas Road (West)	0.44	4.08	0.8	A
D - Oldconnell	0.00	2.85	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	596	28	2436	0.245	594	0.3	1.954	A
B - NSOOR Eastern Link	264	243	1821	0.145	264	0.2	2.309	A
C - R445 Naas Road (West)	475	246	1652	0.287	473	0.4	3.049	A
D - Oldconnell	4	716	1501	0.003	4	0.0	2.403	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	711	33	2431	0.292	711	0.4	2.092	A
B - NSOOR Eastern Link	316	291	1785	0.177	315	0.2	2.449	A
C - R445 Naas Road (West)	567	294	1620	0.350	567	0.5	3.414	A
D - Oldconnell	4	857	1403	0.003	4	0.0	2.572	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	871	41	2425	0.359	870	0.6	2.315	A
B - NSOOR Eastern Link	386	356	1735	0.223	386	0.3	2.669	A
C - R445 Naas Road (West)	695	360	1577	0.441	694	0.8	4.073	A
D - Oldconnell	6	1049	1270	0.004	6	0.0	2.845	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	871	41	2425	0.359	871	0.6	2.315	A
B - NSOOR Eastern Link	386	357	1735	0.223	386	0.3	2.669	A
C - R445 Naas Road (West)	695	360	1577	0.441	695	0.8	4.082	A
D - Oldconnell	6	1050	1269	0.004	6	0.0	2.847	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	711	33	2431	0.292	712	0.4	2.095	A
B - NSOOR Eastern Link	316	292	1785	0.177	316	0.2	2.451	A
C - R445 Naas Road (West)	567	294	1620	0.350	568	0.5	3.424	A
D - Oldconnell	4	859	1402	0.003	4	0.0	2.577	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	596	28	2436	0.245	596	0.3	1.956	A
B - NSOOR Eastern Link	264	244	1821	0.145	264	0.2	2.314	A
C - R445 Naas Road (West)	475	246	1652	0.288	476	0.4	3.063	A
D - Oldconnell	4	719	1499	0.003	4	0.0	2.408	A

2024 Scenario D Opening Year, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.62	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D14	2024 Scenario D Opening Year	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	825	100.000
B - NSOOR Eastern Link		✓	271	100.000
C - R445 Naas Road (West)		✓	444	100.000
D - Oldconnell		✓	5	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	407	418	0
	B - NSOOR Eastern Link	230	0	40	1
	C - R445 Naas Road (West)	433	8	0	3
	D - Oldconnell	1	0	4	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.37	2.34	0.6	A
B - NSOOR Eastern Link	0.18	2.66	0.2	A
C - R445 Naas Road (West)	0.30	3.11	0.4	A
D - Oldconnell	0.00	2.43	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	621	9	2450	0.253	620	0.3	1.966	A
B - NSOOR Eastern Link	204	317	1765	0.116	204	0.1	2.305	A
C - R445 Naas Road (West)	334	173	1700	0.197	333	0.2	2.632	A
D - Oldconnell	4	504	1648	0.002	4	0.0	2.188	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	742	11	2449	0.303	741	0.4	2.108	A
B - NSOOR Eastern Link	244	379	1717	0.142	243	0.2	2.442	A
C - R445 Naas Road (West)	399	208	1678	0.238	399	0.3	2.815	A
D - Oldconnell	4	603	1580	0.003	4	0.0	2.285	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	908	13	2447	0.371	908	0.6	2.337	A
B - NSOOR Eastern Link	298	464	1652	0.181	298	0.2	2.658	A
C - R445 Naas Road (West)	489	254	1647	0.297	488	0.4	3.108	A
D - Oldconnell	6	738	1486	0.004	6	0.0	2.431	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	908	13	2447	0.371	908	0.6	2.339	A
B - NSOOR Eastern Link	298	465	1652	0.181	298	0.2	2.658	A
C - R445 Naas Road (West)	489	254	1647	0.297	489	0.4	3.108	A
D - Oldconnell	6	739	1485	0.004	6	0.0	2.432	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	742	11	2449	0.303	742	0.4	2.111	A
B - NSOOR Eastern Link	244	380	1717	0.142	244	0.2	2.443	A
C - R445 Naas Road (West)	399	208	1677	0.238	400	0.3	2.819	A
D - Oldconnell	4	604	1579	0.003	4	0.0	2.288	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	621	9	2450	0.253	621	0.3	1.968	A
B - NSOOR Eastern Link	204	318	1764	0.116	204	0.1	2.308	A
C - R445 Naas Road (West)	334	174	1700	0.197	335	0.2	2.636	A
D - Oldconnell	4	506	1647	0.002	4	0.0	2.190	A

2029 Scenario D Design 5 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.43	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D15	2029 Scenario D Design 5 Years	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	899	100.000
B - NSOOR Eastern Link		✓	454	100.000
C - R445 Naas Road (West)		✓	699	100.000
D - Oldconnell		✓	6	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	545	353	1
	B - NSOOR Eastern Link	427	0	27	0
	C - R445 Naas Road (West)	661	34	0	4
	D - Oldconnell	0	0	6	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.41	2.51	0.7	A
B - NSOOR Eastern Link	0.29	2.99	0.4	A
C - R445 Naas Road (West)	0.51	4.91	1.0	A
D - Oldconnell	0.01	3.17	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	677	30	2434	0.278	675	0.4	2.045	A
B - NSOOR Eastern Link	342	270	1801	0.190	341	0.2	2.465	A
C - R445 Naas Road (West)	526	321	1602	0.328	524	0.5	3.334	A
D - Oldconnell	5	842	1414	0.003	5	0.0	2.553	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	808	36	2429	0.333	808	0.5	2.220	A
B - NSOOR Eastern Link	408	323	1760	0.232	408	0.3	2.662	A
C - R445 Naas Road (West)	628	385	1560	0.403	628	0.7	3.856	A
D - Oldconnell	5	1008	1299	0.004	5	0.0	2.782	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	990	44	2423	0.409	989	0.7	2.509	A
B - NSOOR Eastern Link	500	396	1705	0.293	499	0.4	2.987	A
C - R445 Naas Road (West)	770	471	1503	0.512	768	1.0	4.889	A
D - Oldconnell	7	1233	1142	0.006	7	0.0	3.168	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	990	44	2423	0.409	990	0.7	2.511	A
B - NSOOR Eastern Link	500	396	1704	0.293	500	0.4	2.988	A
C - R445 Naas Road (West)	770	471	1503	0.512	770	1.0	4.910	A
D - Oldconnell	7	1235	1141	0.006	7	0.0	3.172	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	808	36	2429	0.333	809	0.5	2.224	A
B - NSOOR Eastern Link	408	324	1760	0.232	409	0.3	2.664	A
C - R445 Naas Road (West)	628	385	1560	0.403	630	0.7	3.876	A
D - Oldconnell	5	1011	1297	0.004	5	0.0	2.786	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	677	30	2434	0.278	677	0.4	2.051	A
B - NSOOR Eastern Link	342	271	1800	0.190	342	0.2	2.469	A
C - R445 Naas Road (West)	526	322	1601	0.329	527	0.5	3.354	A
D - Oldconnell	5	846	1411	0.003	5	0.0	2.560	A

2029 Scenario D Design 5 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	2.90	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D16	2029 Scenario D Design 5 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	981	100.000
B - NSOOR Eastern Link		✓	336	100.000
C - R445 Naas Road (West)		✓	496	100.000
D - Oldconnell		✓	6	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	510	471	0
	B - NSOOR Eastern Link	294	0	42	0
	C - R445 Naas Road (West)	483	9	0	4
	D - Oldconnell	1	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.44	2.64	0.8	A
B - NSOOR Eastern Link	0.23	2.91	0.3	A
C - R445 Naas Road (West)	0.34	3.41	0.5	A
D - Oldconnell	0.00	2.59	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	739	11	2449	0.302	737	0.4	2.100	A
B - NSOOR Eastern Link	253	358	1734	0.146	252	0.2	2.428	A
C - R445 Naas Road (West)	373	221	1669	0.224	372	0.3	2.773	A
D - Oldconnell	5	590	1588	0.003	5	0.0	2.272	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	882	13	2448	0.360	881	0.6	2.298	A
B - NSOOR Eastern Link	302	428	1680	0.180	302	0.2	2.611	A
C - R445 Naas Road (West)	446	264	1640	0.272	446	0.4	3.013	A
D - Oldconnell	5	706	1508	0.004	5	0.0	2.395	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1080	15	2445	0.442	1079	0.8	2.634	A
B - NSOOR Eastern Link	370	524	1607	0.230	370	0.3	2.909	A
C - R445 Naas Road (West)	546	323	1601	0.341	546	0.5	3.409	A
D - Oldconnell	7	865	1398	0.005	7	0.0	2.586	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1080	15	2445	0.442	1080	0.8	2.636	A
B - NSOOR Eastern Link	370	524	1607	0.230	370	0.3	2.910	A
C - R445 Naas Road (West)	546	324	1601	0.341	546	0.5	3.413	A
D - Oldconnell	7	865	1398	0.005	7	0.0	2.587	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	882	13	2448	0.360	883	0.6	2.303	A
B - NSOOR Eastern Link	302	428	1680	0.180	302	0.2	2.615	A
C - R445 Naas Road (West)	446	265	1640	0.272	446	0.4	3.017	A
D - Oldconnell	5	707	1507	0.004	5	0.0	2.398	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	739	11	2449	0.302	739	0.4	2.107	A
B - NSOOR Eastern Link	253	359	1733	0.146	253	0.2	2.432	A
C - R445 Naas Road (West)	373	222	1668	0.224	374	0.3	2.783	A
D - Oldconnell	5	592	1587	0.003	5	0.0	2.274	A

2039 Scenario D Design 15 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.69	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D17	2039 Scenario D Design 15 Years	AM	ONE HOUR	08:15	09:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	955	100.000
B - NSOOR Eastern Link		✓	475	100.000
C - R445 Naas Road (West)		✓	750	100.000
D - Oldconnell		✓	6	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	574	380	1
	B - NSOOR Eastern Link	446	0	29	0
	C - R445 Naas Road (West)	711	35	0	4
	D - Oldconnell	0	0	6	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.43	2.63	0.8	A
B - NSOOR Eastern Link	0.31	3.11	0.5	A
C - R445 Naas Road (West)	0.55	5.43	1.2	A
D - Oldconnell	0.01	3.33	0.0	A

Main Results for each time segment

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	719	31	2433	0.295	717	0.4	2.096	A
B - NSOOR Eastern Link	358	291	1785	0.200	357	0.2	2.519	A
C - R445 Naas Road (West)	565	336	1593	0.355	562	0.5	3.487	A
D - Oldconnell	5	894	1378	0.003	5	0.0	2.621	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	859	37	2429	0.354	858	0.5	2.292	A
B - NSOOR Eastern Link	427	348	1742	0.245	427	0.3	2.737	A
C - R445 Naas Road (West)	674	402	1549	0.435	673	0.8	4.107	A
D - Oldconnell	5	1070	1255	0.004	5	0.0	2.879	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1051	45	2422	0.434	1051	0.8	2.624	A
B - NSOOR Eastern Link	523	426	1682	0.311	522	0.4	3.103	A
C - R445 Naas Road (West)	826	492	1489	0.555	824	1.2	5.396	A
D - Oldconnell	7	1310	1089	0.006	7	0.0	3.324	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1051	45	2422	0.434	1051	0.8	2.626	A
B - NSOOR Eastern Link	523	426	1682	0.311	523	0.5	3.106	A
C - R445 Naas Road (West)	826	492	1489	0.555	826	1.2	5.428	A
D - Oldconnell	7	1312	1088	0.006	7	0.0	3.329	A

09:15 - 09:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	859	37	2428	0.354	859	0.5	2.295	A
B - NSOOR Eastern Link	427	348	1741	0.245	428	0.3	2.740	A
C - R445 Naas Road (West)	674	402	1548	0.435	676	0.8	4.134	A
D - Oldconnell	5	1074	1253	0.004	5	0.0	2.884	A

09:30 - 09:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	719	31	2433	0.295	719	0.4	2.101	A
B - NSOOR Eastern Link	358	292	1785	0.200	358	0.3	2.525	A
C - R445 Naas Road (West)	565	337	1592	0.355	566	0.6	3.509	A
D - Oldconnell	5	899	1375	0.003	5	0.0	2.629	A

2039 Scenario D Design 15 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Lidl Distributer Roundabout	Standard Roundabout		A, B, C, D	3.04	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D18	2039 Scenario D Design 15 Years	PM	ONE HOUR	17:30	19:00	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		✓	1042	100.000
B - NSOOR Eastern Link		✓	348	100.000
C - R445 Naas Road (West)		✓	533	100.000
D - Oldconnell		✓	6	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	536	506	0
	B - NSOOR Eastern Link	304	0	44	0
	C - R445 Naas Road (West)	520	9	0	4
	D - Oldconnell	1	0	5	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A - R445 Naas Road (east)	B - NSOOR Eastern Link	C - R445 Naas Road (West)	D - Oldconnell
From	A - R445 Naas Road (east)	0	0	0	0
	B - NSOOR Eastern Link	0	0	0	0
	C - R445 Naas Road (West)	0	0	0	0
	D - Oldconnell	0	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A - R445 Naas Road (east)	0.47	2.77	0.9	A
B - NSOOR Eastern Link	0.24	3.01	0.3	A
C - R445 Naas Road (West)	0.37	3.58	0.6	A
D - Oldconnell	0.00	2.66	0.0	A

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	784	11	2449	0.320	783	0.5	2.158	A
B - NSOOR Eastern Link	262	384	1714	0.153	261	0.2	2.477	A
C - R445 Naas Road (West)	401	228	1664	0.241	400	0.3	2.846	A
D - Oldconnell	5	625	1564	0.003	5	0.0	2.308	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	937	13	2448	0.383	936	0.6	2.380	A
B - NSOOR Eastern Link	313	459	1656	0.189	313	0.2	2.679	A
C - R445 Naas Road (West)	479	273	1634	0.293	479	0.4	3.116	A
D - Oldconnell	5	748	1479	0.004	5	0.0	2.442	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1147	15	2445	0.469	1146	0.9	2.768	A
B - NSOOR Eastern Link	383	562	1577	0.243	383	0.3	3.013	A
C - R445 Naas Road (West)	587	334	1594	0.368	586	0.6	3.572	A
D - Oldconnell	7	916	1362	0.005	7	0.0	2.654	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1147	15	2445	0.469	1147	0.9	2.772	A
B - NSOOR Eastern Link	383	563	1577	0.243	383	0.3	3.014	A
C - R445 Naas Road (West)	587	335	1593	0.368	587	0.6	3.575	A
D - Oldconnell	7	917	1362	0.005	7	0.0	2.656	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	937	13	2448	0.383	938	0.6	2.387	A
B - NSOOR Eastern Link	313	460	1656	0.189	313	0.2	2.681	A
C - R445 Naas Road (West)	479	274	1634	0.293	480	0.4	3.122	A
D - Oldconnell	5	750	1478	0.004	5	0.0	2.444	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	784	11	2449	0.320	785	0.5	2.165	A
B - NSOOR Eastern Link	262	385	1713	0.153	262	0.2	2.483	A
C - R445 Naas Road (West)	401	229	1663	0.241	402	0.3	2.853	A
D - Oldconnell	5	628	1562	0.003	5	0.0	2.310	A

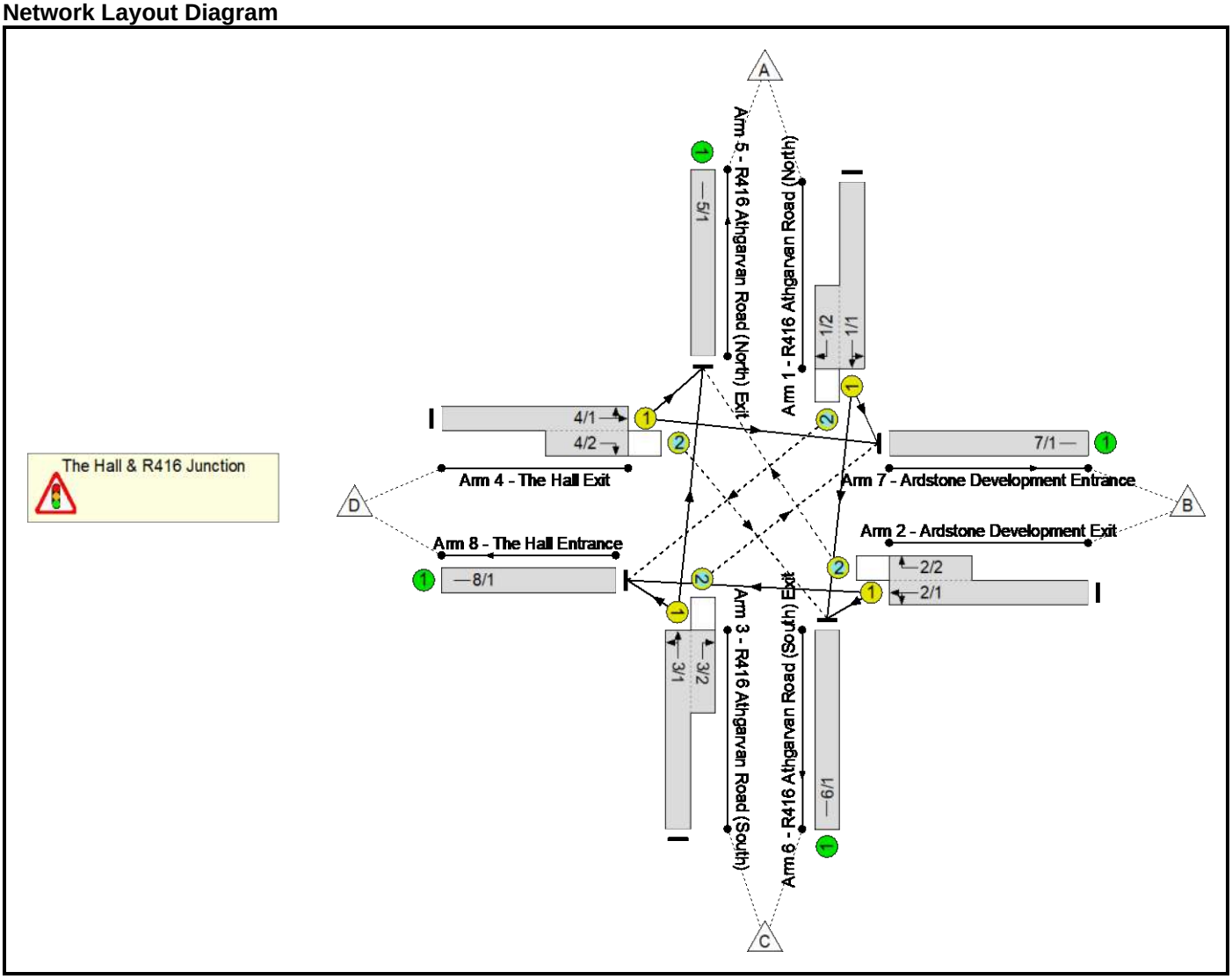
Appendix I The Hall Signalised Junction Linsig Results Output

Full Input Data And Results

User and Project Details

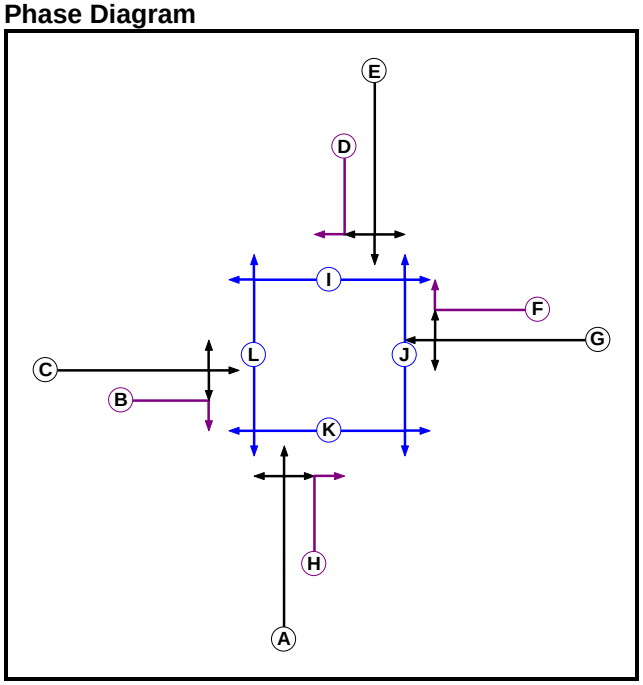
Project:	**Newbridge SHD**
Title:	
Location:	
Client:	Aston Ltd
Site Ref(s):	192229
Date Started:	April 2021
Checked By:	J Tiernan
Additional detail:	
File name:	192229 - The Hall Signalised Junction.lsg3x
Author:	S O'Coileir
Company:	PUNCH Consulting Engineers
Address:	Carnegie House, Library Road, Dun Laoghaire, Co Dublin, A96 C7W7, Ireland

Network Layout Diagram



Full Input Data And Results

Phase Diagram



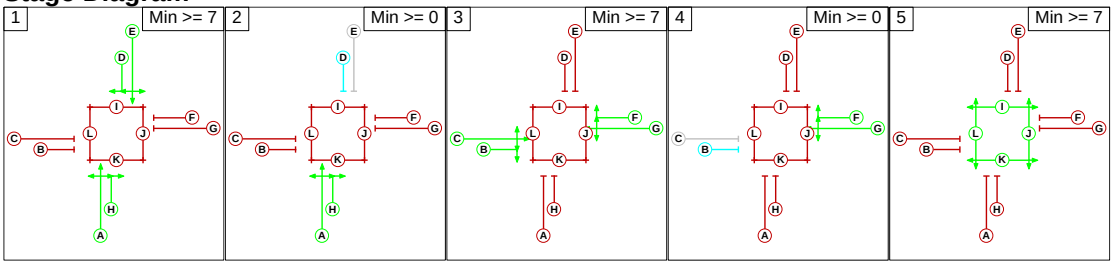
Phase Input Data

Phase Name	Phase Type	Assoc. Phase	Street Min	Cont Min
A	Traffic		7	7
B	Ind. Arrow	C	4	4
C	Traffic		7	7
D	Ind. Arrow	E	4	4
E	Traffic		7	7
F	Ind. Arrow	G	4	4
G	Traffic		7	7
H	Ind. Arrow	A	4	4
I	Pedestrian		7	7
J	Pedestrian		7	7
K	Pedestrian		7	7
L	Pedestrian		7	7

Phases in Stage

Stage No.	Phases in Stage
1	A D E H
2	A H
3	B C F G
4	F G
5	I J K L

Stage Diagram



Full Input Data And Results

Phase Intergreens Matrix

		Starting Phase											
		A	B	C	D	E	F	G	H	I	J	K	L
Terminating Phase	A		5	5	-	-	5	5	-	5	7	7	6
	B	5		-	5	5	-	-	5	7	-	-	5
	C	5	-		5	5	-	-	5	7	6	7	5
	D	-	5	5		-	5	5	-	-	5	-	6
	E	-	5	5	-		5	5	-	7	5	6	6
	F	5	-	-	5	5		-	5	-	7	5	-
	G	5	-	-	5	5	-		5	6	7	5	7
	H	-	5	5	-	-	5	5		5	-	7	-
	I	11	11	11	-	11	-	11	11		-	-	-
	J	11	-	11	11	11	11	11	-	-		-	-
	K	12	-	12	-	12	12	12	12	-	-		-
	L	12	12	12	12	12	-	12	-	-	-	-	

Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
There are no Phase Delays defined					

Prohibited Stage Change

		To Stage				
		1	2	3	4	5
From Stage	1		0	5	5	7
	2	X		5	5	7
	3	5	5		0	7
	4	5	5	X		7
	5	12	12	12	12	

Full Input Data And Results

Give-Way Lane Input Data

Junction: The Hall && R416 Junction

Lane	Movement	Max Flow when Giving Way (PCU/Hr)	Min Flow when Giving Way (PCU/Hr)	Opposing Lane	Opp. Lane Coeff.	Opp. Mvmnts.	Right Turn Storage (PCU)	Non-Blocking Storage (PCU)	RTF	Right Turn Move up (s)	Max Turns in Intergreen (PCU)
1/2 (R416 Athgarvan Road (North))	8/1 (Right)	1439	0	3/1	1.09	All	2.00	-	0.50	2	2.00
2/2 (Ardstone Development Exit)	5/1 (Right)	1439	0	4/1	1.09	All	2.00	-	0.50	2	2.00
3/2 (R416 Athgarvan Road (South))	7/1 (Right)	1439	0	1/1	1.09	All	2.00	-	0.50	2	2.00
4/2 (The Hall Exit)	6/1 (Right)	1439	0	2/1	1.09	All	2.00	-	0.50	2	2.00

Full Input Data And Results

Lane Input Data

Junction: The Hall && R416 Junction

Lane	Lane Type	Phases	Start Disp.	End Disp.	Physical Length (PCU)	Sat Flow Type	Def User Saturation Flow (PCU/Hr)	Lane Width (m)	Gradient	Nearside Lane	Turns	Turning Radius (m)
1/1 (R416 Athgarvan Road (North))	U	E	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 6 Ahead	Inf
											Arm 7 Left	8.30
1/2 (R416 Athgarvan Road (North))	O	E D	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 8 Right	12.00
2/1 (Ardstone Development Exit)	U	G	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 6 Left	5.20
											Arm 8 Ahead	Inf
2/2 (Ardstone Development Exit)	O	G F	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 5 Right	12.00
3/1 (R416 Athgarvan Road (South))	U	A	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 5 Ahead	Inf
											Arm 8 Left	8.00
3/2 (R416 Athgarvan Road (South))	O	A H	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 7 Right	12.00
4/1 (The Hall Exit)	U	C	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 5 Left	10.00
											Arm 7 Ahead	Inf
4/2 (The Hall Exit)	O	C B	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 6 Right	12.00
5/1 (R416 Athgarvan Road (North) Exit)	U		2	3	60.0	Inf	-	-	-	-	-	-
6/1 (R416 Athgarvan Road (South) Exit)	U		2	3	60.0	Inf	-	-	-	-	-	-
7/1 (Ardstone Development Entrance)	U		2	3	60.0	Inf	-	-	-	-	-	-
8/1 (The Hall Entrance)	U		2	3	60.0	Inf	-	-	-	-	-	-

Full Input Data And Results

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: '2024 Do Nothing AM'	08:30	09:30	01:00	
2: '2024 Do Nothing PM'	17:45	18:45	01:00	
3: '2029 Do Nothing AM'	08:30	09:30	01:00	
4: '2029 Do Nothing PM'	17:45	18:45	01:00	
5: '2039 Do Nothing AM'	08:30	09:30	01:00	
6: '2039 Do Nothing PM'	17:45	18:45	01:00	
7: '2024 Opening Year AM'	08:30	09:30	01:00	
8: '2024 Opening Year PM'	17:45	18:45	01:00	
9: '2029 Design 5 Years AM'	08:30	09:30	01:00	
10: '2029 Design 5 Years PM'	17:45	18:45	01:00	
11: '2039 Design 15 Years AM'	08:30	09:30	01:00	
12: '2039 Design 15 Years PM'	17:45	18:45	01:00	

Traffic Flows, Desired

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	18	330	84	432
	B	24	0	1	3	28
	C	457	1	0	82	540
	D	135	2	108	0	245
	Tot.	616	21	439	169	1245

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	18	412	127	557
	B	14	0	1	2	17
	C	307	1	0	96	404
	D	100	2	108	0	210
	Tot.	421	21	521	225	1188

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	41	368	92	501
	B	70	0	3	8	81
	C	513	1	0	92	606
	D	148	4	119	0	271
	Tot.	731	46	490	192	1459

Full Input Data And Results

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	66	464	140	670
	B	47	0	2	5	54
	C	345	2	0	107	454
	D	110	7	120	0	237
	Tot.	502	75	586	252	1415

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	41	396	100	537
	B	70	0	3	8	81
	C	552	1	0	99	652
	D	160	4	128	0	292
	Tot.	782	46	527	207	1562

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	66	499	151	716
	B	47	0	2	5	54
	C	372	2	0	115	489
	D	118	7	129	0	254
	Tot.	537	75	630	271	1513

Scenario 7: '2024 Opening Year AM' (FG7: '2024 Opening Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	18	334	84	436
	B	24	0	1	3	28
	C	461	1	0	82	544
	D	135	2	108	0	245
	Tot.	620	21	443	169	1253

Scenario 8: '2024 Opening Year PM' (FG8: '2024 Opening Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	18	416	127	561
	B	14	0	1	2	17
	C	312	1	0	96	409
	D	100	2	108	0	210
	Tot.	426	21	525	225	1197

Full Input Data And Results

Scenario 9: '2029 Design 5 Years AM' (FG9: '2029 Design 5 Years AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	41	377	92	510
	B	70	0	3	8	81
	C	519	1	0	92	612
	D	148	4	119	0	271
	Tot.	737	46	499	192	1474

Scenario 10: '2029 Design 5 Years PM' (FG10: '2029 Design 5 Years PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

	Destination					
		A	B	C	D	Tot.
Origin	A	0	66	471	140	677
	B	47	0	2	5	54
	C	354	2	0	107	463
	D	110	7	120	0	237
	Tot.	511	75	593	252	1431

Scenario 11: '2039 Design 15 Years AM' (FG11: '2039 Design 15 Years AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

	Destination					
		A	B	C	D	Tot.
Origin	A	0	41	405	100	546
	B	70	0	3	8	81
	C	558	1	0	99	658
	D	160	4	128	0	292
	Tot.	788	46	536	207	1577

Scenario 12: '2039 Design 15 Years PM' (FG12: '2039 Design 15 Years PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

	Destination					
		A	B	C	D	Tot.
Origin	A	0	66	506	151	723
	B	47	0	2	5	54
	C	380	2	0	115	497
	D	118	7	129	0	254
	Tot.	545	75	637	271	1528

Full Input Data And Results

Network Results

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**55.3%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**55.3%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	61	61	432	1922:1724	868+209	40.1 : 40.1%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	18	18	28	1810:1724	30+177	13.5 : 13.5%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	61	61	540	1886:1724	974+2	55.3 : 55.3%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	16	16	245	1690:1724	254+200	54.0 : 54.0%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	616	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	439	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	21	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	169	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**203**	**0**	**14**	**4.5**	**1.6**	**0.2**	**6.3**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**203**	**0**	**14**	**4.5**	**1.6**	**0.2**	**6.3**	**-**	**-**	**-**	**-**
1/1+1/2	432	432	71	0	13	1.1	0.3	0.2	1.6	13.6	4.5	0.3	4.9
2/1+2/2	28	28	24	0	0	0.2	0.1	0.0	0.3	34.8	0.3	0.1	0.4
3/1+3/2	540	540	1	0	0	1.6	0.6	0.0	2.2	15.0	8.2	0.6	8.9
4/1+4/2	245	245	108	0	0	1.6	0.6	0.0	2.2	32.2	2.1	0.6	2.7
5/1	616	616	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	439	439	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	21	21	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	169	169	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	62.7	Total Delay for Signalled Lanes (pcuHr):	6.34	Cycle Time (s):	120
	PRC Over All Lanes (%):	62.7	Total Delay Over All Lanes(pcuHr):	6.34		

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**49.6%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**49.6%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	63	63	557	1925:1724	867+256	49.6 : 49.6%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	16	16	17	1770:1724	38+177	7.9 : 7.9%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	63	63	404	1857:1724	995+2	40.5 : 40.5%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	14	14	210	1691:1724	225+230	45.2 : 47.0%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	421	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	521	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	21	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	225	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**250**	**0**	**0**	**4.0**	**1.3**	**0.2**	**5.5**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**250**	**0**	**0**	**4.0**	**1.3**	**0.2**	**5.5**	**-**	**-**	**-**	**-**
1/1+1/2	557	557	127	0	0	1.4	0.5	0.2	2.1	13.8	6.3	0.5	6.8
2/1+2/2	17	17	14	0	0	0.1	0.0	0.0	0.2	33.4	0.2	0.0	0.2
3/1+3/2	404	404	1	0	0	1.1	0.3	0.0	1.4	12.5	5.7	0.3	6.0
4/1+4/2	210	210	108	0	0	1.4	0.4	0.0	1.8	31.6	1.6	0.4	2.1
5/1	421	421	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	521	521	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	21	21	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	225	225	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 81.5
PRC Over All Lanes (%): 81.5

Total Delay for Signalled Lanes (pcuHr): 5.53
Total Delay Over All Lanes(pcuHr): 5.53

Cycle Time (s): 120

Full Input Data And Results

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**62.1%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**62.1%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	61	61	501	1905:1724	872+196	46.9 : 46.9%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	18	18	81	1799:1724	26+163	42.9 : 42.9%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	61	61	606	1886:1724	975+2	62.1 : 62.1%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	16	16	271	1693:1724	254+199	59.9 : 59.9%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	731	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	490	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	46	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	192	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**260**	**0**	**22**	**5.5**	**2.4**	**0.4**	**8.3**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**260**	**0**	**22**	**5.5**	**2.4**	**0.4**	**8.3**	**-**	**-**	**-**	**-**
1/1+1/2	501	501	72	0	20	1.3	0.4	0.3	2.0	14.6	5.8	0.4	6.3
2/1+2/2	81	81	68	0	2	0.5	0.4	0.1	1.0	42.7	1.0	0.4	1.4
3/1+3/2	606	606	1	0	0	1.9	0.8	0.0	2.7	16.3	9.8	0.8	10.6
4/1+4/2	271	271	119	0	0	1.8	0.7	0.0	2.5	33.8	2.5	0.7	3.2
5/1	731	731	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	490	490	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	46	46	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	192	192	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	45.0	Total Delay for Signalled Lanes (pcuHr):	8.28	Cycle Time (s):	120
	PRC Over All Lanes (%):	45.0	Total Delay Over All Lanes(pcuHr):	8.28		

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**60.5%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**60.5%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	63	63	670	1897:1724	876+231	60.5 : 60.5%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	16	16	54	1792:1724	24+163	28.8 : 28.8%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	63	63	454	1858:1724	993+4	45.5 : 45.5%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	14	14	237	1700:1724	227+230	51.6 : 52.2%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	502	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	586	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	75	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	252	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**288**	**0**	**21**	**5.1**	**1.9**	**0.3**	**7.3**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**288**	**0**	**21**	**5.1**	**1.9**	**0.3**	**7.3**	**-**	**-**	**-**	**-**
1/1+1/2	670	670	120	0	20	1.9	0.8	0.2	2.9	15.5	8.9	0.8	9.7
2/1+2/2	54	54	46	0	1	0.3	0.2	0.0	0.6	39.1	0.7	0.2	0.9
3/1+3/2	454	454	2	0	0	1.2	0.4	0.0	1.7	13.2	6.4	0.4	6.8
4/1+4/2	237	237	120	0	0	1.6	0.5	0.0	2.2	32.7	1.9	0.5	2.5
5/1	502	502	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	586	586	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	75	75	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	252	252	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 48.7
PRC Over All Lanes (%): 48.7

Total Delay for Signalled Lanes (pcuHr): 7.28
Total Delay Over All Lanes(pcuHr): 7.28

Cycle Time (s): 120

Full Input Data And Results

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**66.8%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**66.8%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	61	61	537	1908:1724	871+199	50.2 : 50.2%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	18	18	81	1799:1724	23+149	47.1 : 47.1%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	61	61	652	1886:1724	975+1	66.8 : 66.8%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	16	16	292	1692:1724	254+198	64.6 : 64.6%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	782	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	527	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	46	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	207	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**247**	**0**	**52**	**6.0**	**2.8**	**0.4**	**9.3**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**247**	**0**	**52**	**6.0**	**2.8**	**0.4**	**9.3**	**-**	**-**	**-**	**-**
1/1+1/2	537	537	55	0	45	1.4	0.5	0.3	2.3	15.1	6.3	0.5	6.8
2/1+2/2	81	81	63	0	7	0.5	0.4	0.1	1.0	46.1	1.0	0.4	1.5
3/1+3/2	652	652	1	0	0	2.1	1.0	0.0	3.2	17.4	10.9	1.0	11.9
4/1+4/2	292	292	128	0	0	1.9	0.9	0.0	2.9	35.3	2.6	0.9	3.5
5/1	782	782	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	527	527	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	46	46	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	207	207	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	34.7	Total Delay for Signalled Lanes (pcuHr):	9.31	Cycle Time (s):	120
	PRC Over All Lanes (%):	34.7	Total Delay Over All Lanes(pcuHr):	9.31		

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**64.6%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**64.6%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	63	63	716	1900:1724	875+234	64.6 : 64.6%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	16	16	54	1792:1724	22+149	31.6 : 31.6%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	63	63	489	1858:1724	994+4	49.0 : 49.0%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	14	14	254	1699:1724	227+230	55.2 : 56.1%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	537	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	630	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	75	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	271	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**296**	**0**	**33**	**5.5**	**2.2**	**0.4**	**8.1**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**296**	**0**	**33**	**5.5**	**2.2**	**0.4**	**8.1**	**-**	**-**	**-**	**-**
1/1+1/2	716	716	119	0	32	2.1	0.9	0.3	3.3	16.5	10.2	0.9	11.1
2/1+2/2	54	54	46	0	1	0.3	0.2	0.1	0.6	41.1	0.7	0.2	0.9
3/1+3/2	489	489	2	0	0	1.4	0.5	0.0	1.9	13.6	7.2	0.5	7.7
4/1+4/2	254	254	129	0	0	1.7	0.6	0.0	2.4	33.5	2.0	0.6	2.7
5/1	537	537	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	630	630	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	75	75	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	271	271	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 39.4
PRC Over All Lanes (%): 39.4

Total Delay for Signalled Lanes (pcuHr): 8.11
Total Delay Over All Lanes(pcuHr): 8.11

Cycle Time (s): 120

Full Input Data And Results

Scenario 7: '2024 Opening Year AM' (FG7: '2024 Opening Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**55.3%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**55.3%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	61	61	436	1922:1724	863+206	40.8 : 40.8%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	18	18	28	1810:1724	30+177	13.5 : 13.5%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	61	61	544	1887:1724	982+2	55.3 : 55.3%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	16	16	245	1690:1724	254+200	54.0 : 54.0%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	620	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	443	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	21	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	169	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**183**	**0**	**34**	**5.1**	**1.6**	**0.2**	**6.9**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**183**	**0**	**34**	**5.1**	**1.6**	**0.2**	**6.9**	**-**	**-**	**-**	**-**
1/1+1/2	436	436	50	0	34	1.1	0.3	0.2	1.6	13.3	4.6	0.3	4.9
2/1+2/2	28	28	24	0	0	0.2	0.1	0.0	0.3	36.2	0.4	0.1	0.5
3/1+3/2	544	544	1	0	0	2.2	0.6	0.0	2.8	18.5	8.0	0.6	8.6
4/1+4/2	245	245	108	0	0	1.7	0.6	0.0	2.3	33.3	2.5	0.6	3.1
5/1	620	620	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	443	443	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	21	21	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	169	169	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	62.8	Total Delay for Signalled Lanes (pcuHr):	6.95	Cycle Time (s):	120	
	PRC Over All Lanes (%):	62.8	Total Delay Over All Lanes(pcuHr):	6.95			

Scenario 8: '2024 Opening Year PM' (FG8: '2024 Opening Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**50.0%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**50.0%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	63	63	561	1926:1724	868+254	50.0 : 50.0%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	16	16	17	1770:1724	38+177	7.9 : 7.9%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	63	63	409	1858:1724	995+2	41.0 : 41.0%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	14	14	210	1691:1724	225+230	45.2 : 47.0%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	426	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	525	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	21	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	225	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**250**	**0**	**0**	**4.0**	**1.3**	**0.2**	**5.6**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**250**	**0**	**0**	**4.0**	**1.3**	**0.2**	**5.6**	**-**	**-**	**-**	**-**
1/1+1/2	561	561	127	0	0	1.4	0.5	0.2	2.2	13.8	6.3	0.5	6.8
2/1+2/2	17	17	14	0	0	0.1	0.0	0.0	0.2	33.4	0.2	0.0	0.2
3/1+3/2	409	409	1	0	0	1.1	0.3	0.0	1.4	12.6	5.7	0.3	6.0
4/1+4/2	210	210	108	0	0	1.4	0.4	0.0	1.8	31.6	1.6	0.4	2.1
5/1	426	426	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	525	525	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	21	21	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	225	225	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 80.1
PRC Over All Lanes (%): 80.1

Total Delay for Signalled Lanes (pcuHr): 5.58
Total Delay Over All Lanes(pcuHr): 5.58

Cycle Time (s): 120

Full Input Data And Results

Scenario 9: '2029 Design 5 Years AM' (FG9: '2029 Design 5 Years AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**62.7%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**62.7%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	61	61	510	1906:1724	875+193	47.8 : 47.8%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	18	18	81	1799:1724	26+163	42.9 : 42.9%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	61	61	612	1887:1724	975+2	62.7 : 62.7%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	16	16	271	1693:1724	254+199	59.9 : 59.9%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	737	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	499	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	46	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	192	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**257**	**0**	**25**	**5.6**	**2.4**	**0.4**	**8.4**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**257**	**0**	**25**	**5.6**	**2.4**	**0.4**	**8.4**	**-**	**-**	**-**	**-**
1/1+1/2	510	510	69	0	23	1.4	0.5	0.3	2.1	14.7	5.9	0.5	6.3
2/1+2/2	81	81	68	0	2	0.5	0.4	0.1	1.0	42.7	1.0	0.4	1.4
3/1+3/2	612	612	1	0	0	2.0	0.8	0.0	2.8	16.4	9.9	0.8	10.7
4/1+4/2	271	271	119	0	0	1.8	0.7	0.0	2.5	33.8	2.5	0.7	3.2
5/1	737	737	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	499	499	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	46	46	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	192	192	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	43.6	Total Delay for Signalled Lanes (pcuHr):	8.38	Cycle Time (s):	120
	PRC Over All Lanes (%):	43.6	Total Delay Over All Lanes(pcuHr):	8.38		

Scenario 10: '2029 Design 5 Years PM' (FG10: '2029 Design 5 Years PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**61.2%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**61.2%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	63	63	677	1898:1724	878+229	61.2 : 61.2%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	16	16	54	1792:1724	24+163	28.8 : 28.8%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	63	63	463	1859:1724	994+4	46.4 : 46.4%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	14	14	237	1700:1724	227+230	51.6 : 52.2%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	511	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	593	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	75	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	252	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**284**	**0**	**25**	**5.1**	**2.0**	**0.3**	**7.4**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**284**	**0**	**25**	**5.1**	**2.0**	**0.3**	**7.4**	**-**	**-**	**-**	**-**
1/1+1/2	677	677	116	0	24	1.9	0.8	0.2	2.9	15.7	9.2	0.8	10.0
2/1+2/2	54	54	46	0	1	0.3	0.2	0.0	0.6	39.1	0.7	0.2	0.9
3/1+3/2	463	463	2	0	0	1.3	0.4	0.0	1.7	13.3	6.7	0.4	7.1
4/1+4/2	237	237	120	0	0	1.6	0.5	0.0	2.2	32.7	1.9	0.5	2.5
5/1	511	511	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	593	593	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	75	75	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	252	252	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 47.1
PRC Over All Lanes (%): 47.1

Total Delay for Signalled Lanes (pcuHr): 7.39
Total Delay Over All Lanes(pcuHr): 7.39

Cycle Time (s): 120

Full Input Data And Results

Scenario 11: '2039 Design 15 Years AM' (FG11: '2039 Design 15 Years AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**67.4%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**67.4%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	61	61	546	1908:1724	873+196	51.1 : 51.1%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	18	18	81	1799:1724	23+149	47.1 : 47.1%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	61	61	658	1887:1724	975+1	67.4 : 67.4%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	16	16	292	1692:1724	254+198	64.6 : 64.6%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	788	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	536	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	46	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	207	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**244**	**0**	**55**	**6.1**	**2.9**	**0.5**	**9.4**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**244**	**0**	**55**	**6.1**	**2.9**	**0.5**	**9.4**	**-**	**-**	**-**	**-**
1/1+1/2	546	546	52	0	48	1.5	0.5	0.3	2.3	15.3	6.6	0.5	7.1
2/1+2/2	81	81	63	0	7	0.5	0.4	0.1	1.0	46.1	1.0	0.4	1.5
3/1+3/2	658	658	1	0	0	2.2	1.0	0.0	3.2	17.6	11.0	1.0	12.0
4/1+4/2	292	292	128	0	0	1.9	0.9	0.0	2.9	35.3	2.6	0.9	3.5
5/1	788	788	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	536	536	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	46	46	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	207	207	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	33.6	Total Delay for Signalled Lanes (pcuHr):	9.42	Cycle Time (s):	120
	PRC Over All Lanes (%):	33.6	Total Delay Over All Lanes(pcuHr):	9.42		

Scenario 12: '2039 Design 15 Years PM' (FG12: '2039 Design 15 Years PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**65.3%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**65.3%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E	D	2	63	63	723	1900:1724	876+231	65.3 : 65.3%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G	F	2	16	16	54	1792:1724	22+149	31.6 : 31.6%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A	H	2	63	63	497	1859:1724	994+4	49.8 : 49.8%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C	B	2	14	14	254	1699:1724	227+230	55.2 : 56.1%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	545	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	637	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	75	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	271	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**298**	**0**	**31**	**5.6**	**2.3**	**0.4**	**8.2**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**298**	**0**	**31**	**5.6**	**2.3**	**0.4**	**8.2**	**-**	**-**	**-**	**-**
1/1+1/2	723	723	121	0	30	2.1	0.9	0.3	3.3	16.6	10.3	0.9	11.3
2/1+2/2	54	54	46	0	1	0.3	0.2	0.1	0.6	41.1	0.7	0.2	0.9
3/1+3/2	497	497	2	0	0	1.4	0.5	0.0	1.9	13.8	7.3	0.5	7.8
4/1+4/2	254	254	129	0	0	1.7	0.6	0.0	2.4	33.5	2.0	0.6	2.6
5/1	545	545	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	637	637	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	75	75	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	271	271	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 37.9
PRC Over All Lanes (%): 37.9

Total Delay for Signalled Lanes (pcuHr): 8.22
Total Delay Over All Lanes(pcuHr): 8.22

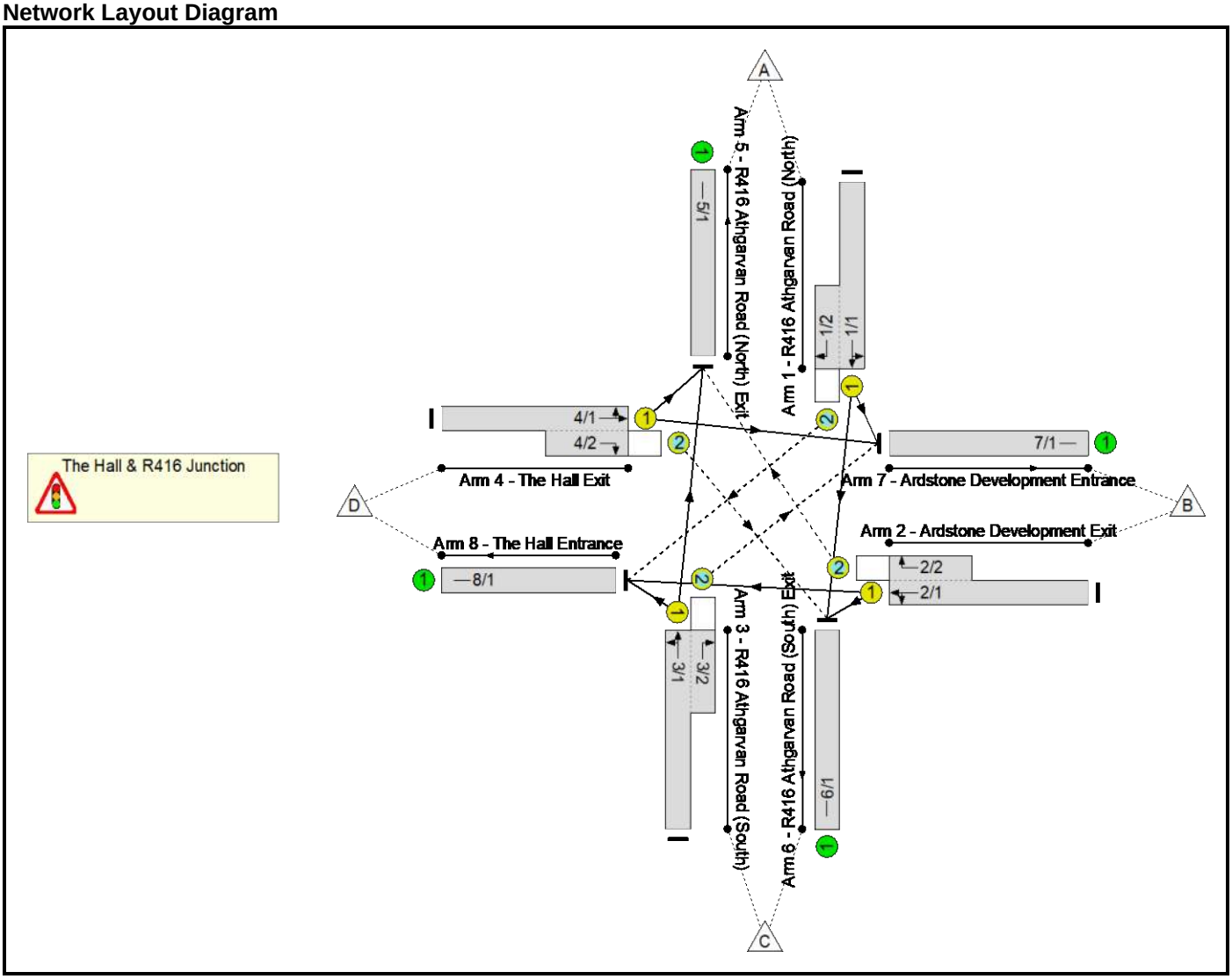
Cycle Time (s): 120

Full Input Data And Results

User and Project Details

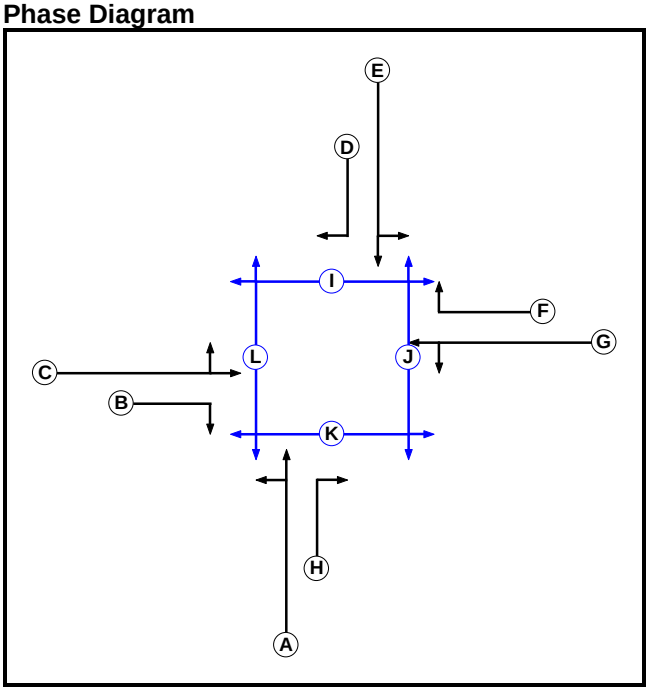
Project:	**Newbridge SHD**
Title:	
Location:	
Client:	Aston Ltd
Site Ref(s):	192229
Date Started:	April 2021
Checked By:	J Tiernan
Additional detail:	
File name:	192229 - The Hall Signalised Junction - Scenario B.lsg3x
Author:	S O'Coileir
Company:	PUNCH Consulting Engineers
Address:	Carnegie House, Library Road, Dun Laoghaire, Co Dublin, A96 C7W7, Ireland

Network Layout Diagram



Full Input Data And Results

Phase Diagram



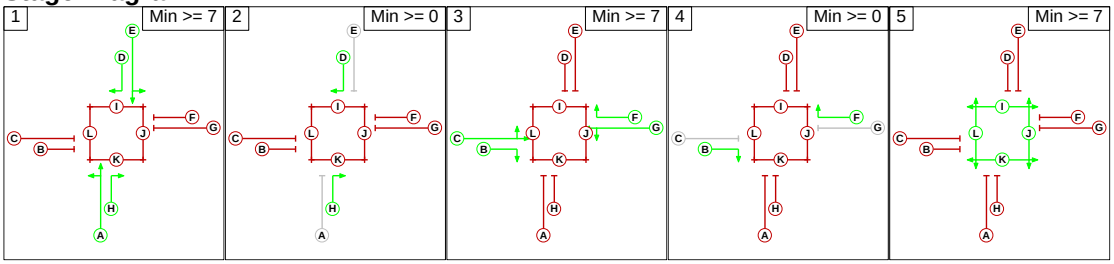
Phase Input Data

Phase Name	Phase Type	Assoc. Phase	Street Min	Cont Min
A	Traffic		7	7
B	Traffic		7	7
C	Traffic		7	7
D	Traffic		7	7
E	Traffic		7	7
F	Traffic		7	7
G	Traffic		7	7
H	Traffic		7	7
I	Pedestrian		7	7
J	Pedestrian		7	7
K	Pedestrian		7	7
L	Pedestrian		7	7

Phases in Stage

Stage No.	Phases in Stage
1	A D E H
2	D H
3	B C F G
4	B F
5	I J K L

Stage Diagram



Full Input Data And Results

Phase Intergreens Matrix

Terminating Phase \ Starting Phase	A	B	C	D	E	F	G	H	I	J	K	L
A		5	5	-	-	5	5	-	5	7	7	6
B	5		-	5	5	-	-	5	7	-	-	5
C	5	-		5	5	-	-	5	7	6	7	5
D	-	5	5		-	5	5	-	-	5	-	6
E	-	5	5	-		5	5	-	7	5	6	6
F	5	-	-	5	5		-	5	-	7	5	-
G	5	-	-	5	5	-		5	6	7	5	7
H	-	5	5	-	-	5	5		5	-	7	-
I	11	11	11	-	11	-	11	11		-	-	-
J	11	-	11	11	11	11	11	-	-		-	-
K	12	-	12	-	12	12	12	12	-	-		-
L	12	12	12	12	12	-	12	-	-	-	-	

Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
There are no Phase Delays defined					

Prohibited Stage Change

From Stage \ To Stage	1	2	3	4	5
1		0	5	5	7
2	2		5	5	7
3	5	5		0	7
4	5	5	2		7
5	12	12	12	12	

Full Input Data And Results

Give-Way Lane Input Data

Junction: The Hall && R416 Junction

Lane	Movement	Max Flow when Giving Way (PCU/Hr)	Min Flow when Giving Way (PCU/Hr)	Opposing Lane	Opp. Lane Coeff.	Opp. Mvmnts.	Right Turn Storage (PCU)	Non-Blocking Storage (PCU)	RTF	Right Turn Move up (s)	Max Turns in Intergreen (PCU)
1/2 (R416 Athgarvan Road (North))	8/1 (Right)	1439	0	3/1	1.09	All	2.00	-	0.50	2	2.00
2/2 (Ardstone Development Exit)	5/1 (Right)	1439	0	4/1	1.09	All	2.00	-	0.50	2	2.00
3/2 (R416 Athgarvan Road (South))	7/1 (Right)	1439	0	1/1	1.09	All	2.00	-	0.50	2	2.00
4/2 (The Hall Exit)	6/1 (Right)	1439	0	2/1	1.09	All	2.00	-	0.50	2	2.00

Full Input Data And Results

Lane Input Data

Junction: The Hall && R416 Junction

Lane	Lane Type	Phases	Start Disp.	End Disp.	Physical Length (PCU)	Sat Flow Type	Def User Saturation Flow (PCU/Hr)	Lane Width (m)	Gradient	Nearside Lane	Turns	Turning Radius (m)
1/1 (R416 Athgarvan Road (North))	U	E	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 6 Ahead	Inf
											Arm 7 Left	8.30
1/2 (R416 Athgarvan Road (North))	O	D	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 8 Right	12.00
2/1 (Ardstone Development Exit)	U	G	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 6 Left	5.20
											Arm 8 Ahead	Inf
2/2 (Ardstone Development Exit)	O	F	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 5 Right	12.00
3/1 (R416 Athgarvan Road (South))	U	A	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 5 Ahead	Inf
											Arm 8 Left	8.00
3/2 (R416 Athgarvan Road (South))	O	H	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 7 Right	12.00
4/1 (The Hall Exit)	U	C	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 5 Left	10.00
											Arm 7 Ahead	Inf
4/2 (The Hall Exit)	O	B	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 6 Right	12.00
5/1 (R416 Athgarvan Road (North) Exit)	U		2	3	60.0	Inf	-	-	-	-	-	-
6/1 (R416 Athgarvan Road (South) Exit)	U		2	3	60.0	Inf	-	-	-	-	-	-
7/1 (Ardstone Development Entrance)	U		2	3	60.0	Inf	-	-	-	-	-	-
8/1 (The Hall Entrance)	U		2	3	60.0	Inf	-	-	-	-	-	-

Full Input Data And Results

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: '2024 Do Nothing AM'	08:00	09:00	01:00	
2: '2024 Do Nothing PM'	17:00	18:00	01:00	
3: '2029 Do Nothing AM'	08:00	09:00	01:00	
4: '2029 Do Nothing PM'	17:00	18:00	01:00	
5: '2039 Do Nothing AM'	08:00	09:00	01:00	
6: '2039 Do Nothing PM'	17:00	18:00	01:00	
7: '2024 Opening Year AM'	08:00	09:00	01:00	
8: '2024 Opening Year PM'	17:00	18:00	01:00	
9: '2029 Design 5 Years AM'	08:00	09:00	01:00	
10: '2029 Design 5 Years PM'	17:00	18:00	01:00	
11: '2039 Design 15 Years AM'	08:00	09:00	01:00	
12: '2039 Design 15 Years PM'	17:00	18:00	01:00	

Traffic Flows, Desired

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	18	330	84	432
	B	24	0	1	3	28
	C	457	1	0	82	540
	D	135	2	108	0	245
	Tot.	616	21	439	169	1245

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	18	412	127	557
	B	14	0	1	2	17
	C	307	1	0	96	404
	D	100	2	108	0	210
	Tot.	421	21	521	225	1188

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	41	368	92	501
	B	70	0	3	8	81
	C	513	1	0	92	606
	D	148	4	119	0	271
	Tot.	731	46	490	192	1459

Full Input Data And Results

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	66	464	140	670
	B	47	0	2	5	54
	C	345	2	0	107	454
	D	110	7	120	0	237
	Tot.	502	75	586	252	1415

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	41	396	100	537
	B	70	0	3	8	81
	C	552	1	0	99	652
	D	160	4	128	0	292
	Tot.	782	46	527	207	1562

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	66	499	151	716
	B	47	0	2	5	54
	C	372	2	0	115	489
	D	118	7	129	0	254
	Tot.	537	75	630	271	1513

Scenario 7: '2024 Opening Year AM' (FG7: '2024 Opening Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	18	334	84	436
	B	24	0	1	3	28
	C	461	1	0	82	544
	D	135	2	108	0	245
	Tot.	620	21	443	169	1253

Scenario 8: '2024 Opening Year PM' (FG8: '2024 Opening Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	18	416	127	561
	B	14	0	1	2	17
	C	312	1	0	96	409
	D	100	2	108	0	210
	Tot.	426	21	525	225	1197

Full Input Data And Results

Scenario 9: '2029 Design 5 Years AM' (FG9: '2029 Design 5 Years AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	41	377	92	510
	B	70	0	3	8	81
	C	519	1	0	92	612
	D	148	4	119	0	271
	Tot.	737	46	499	192	1474

Scenario 10: '2029 Design 5 Years PM' (FG10: '2029 Design 5 Years PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

	Destination					
		A	B	C	D	Tot.
Origin	A	0	66	471	140	677
	B	47	0	2	5	54
	C	354	2	0	107	463
	D	110	7	120	0	237
	Tot.	511	75	593	252	1431

Scenario 11: '2039 Design 15 Years AM' (FG11: '2039 Design 15 Years AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

	Destination					
		A	B	C	D	Tot.
Origin	A	0	41	405	100	546
	B	70	0	3	8	81
	C	558	1	0	99	658
	D	160	4	128	0	292
	Tot.	788	46	536	207	1577

Scenario 12: '2039 Design 15 Years PM' (FG12: '2039 Design 15 Years PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

	Destination					
		A	B	C	D	Tot.
Origin	A	0	66	506	151	723
	B	47	0	2	5	54
	C	381	2	0	115	498
	D	118	7	129	0	254
	Tot.	546	75	637	271	1529

Full Input Data And Results

Network Results

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**55.3%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**55.3%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	61	-	432	1922:1724	868+209	40.1 : 40.1%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	16:18	-	28	1810:1724	30+177	13.5 : 13.5%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	61	-	540	1886:1724	974+2	55.3 : 55.3%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	16:18	-	245	1690:1724	254+200	54.0 : 54.0%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	616	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	439	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	21	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	169	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**201**	**0**	**16**	**4.5**	**1.6**	**0.2**	**6.3**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**201**	**0**	**16**	**4.5**	**1.6**	**0.2**	**6.3**	**-**	**-**	**-**	**-**
1/1+1/2	432	432	71	0	13	1.1	0.3	0.2	1.6	13.6	4.5	0.3	4.9
2/1+2/2	28	28	24	0	0	0.2	0.1	0.0	0.3	34.9	0.3	0.1	0.4
3/1+3/2	540	540	1	0	0	1.6	0.6	0.0	2.2	15.0	8.2	0.6	8.9
4/1+4/2	245	245	106	0	2	1.6	0.6	0.0	2.2	31.8	2.1	0.6	2.7
5/1	616	616	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	439	439	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	21	21	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	169	169	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	62.7	Total Delay for Signalled Lanes (pcuHr):	6.31	Cycle Time (s):	120
	PRC Over All Lanes (%):	62.7	Total Delay Over All Lanes(pcuHr):	6.31		

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**49.6%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**49.6%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	63	-	557	1925:1724	867+256	49.6 : 49.6%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	14:16	-	17	1770:1724	38+177	7.9 : 7.9%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	63	-	404	1857:1724	995+2	40.5 : 40.5%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	14:16	-	210	1691:1724	225+239	45.2 : 45.2%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	421	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	521	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	21	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	225	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**248**	**0**	**2**	**4.0**	**1.3**	**0.2**	**5.5**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**248**	**0**	**2**	**4.0**	**1.3**	**0.2**	**5.5**	**-**	**-**	**-**	**-**
1/1+1/2	557	557	127	0	0	1.4	0.5	0.2	2.1	13.8	6.3	0.5	6.8
2/1+2/2	17	17	14	0	0	0.1	0.0	0.0	0.2	33.6	0.2	0.0	0.2
3/1+3/2	404	404	1	0	0	1.1	0.3	0.0	1.4	12.5	5.7	0.3	6.0
4/1+4/2	210	210	106	0	2	1.4	0.4	0.0	1.8	30.8	1.6	0.4	2.0
5/1	421	421	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	521	521	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	21	21	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	225	225	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 81.5
PRC Over All Lanes (%): 81.5

Total Delay for Signalled Lanes (pcuHr): 5.49
Total Delay Over All Lanes(pcuHr): 5.49

Cycle Time (s): 120

Full Input Data And Results

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**62.1%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**62.1%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	61	-	501	1905:1724	872+196	46.9 : 46.9%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	16:18	-	81	1799:1724	26+163	42.9 : 42.9%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	61	-	606	1886:1724	975+2	62.1 : 62.1%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	16:18	-	271	1693:1724	254+199	59.9 : 59.9%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	731	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	490	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	46	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	192	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**258**	**0**	**24**	**5.5**	**2.4**	**0.4**	**8.3**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**258**	**0**	**24**	**5.5**	**2.4**	**0.4**	**8.3**	**-**	**-**	**-**	**-**
1/1+1/2	501	501	72	0	20	1.3	0.4	0.3	2.0	14.6	5.8	0.4	6.3
2/1+2/2	81	81	68	0	2	0.5	0.4	0.1	1.0	42.9	1.0	0.4	1.4
3/1+3/2	606	606	1	0	0	1.9	0.8	0.0	2.7	16.3	9.8	0.8	10.6
4/1+4/2	271	271	117	0	2	1.8	0.7	0.0	2.5	33.4	2.5	0.7	3.2
5/1	731	731	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	490	490	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	46	46	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	192	192	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	45.0	Total Delay for Signalled Lanes (pcuHr):	8.25	Cycle Time (s):	120
	PRC Over All Lanes (%):	45.0	Total Delay Over All Lanes(pcuHr):	8.25		

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**60.5%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**60.5%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	63	-	670	1897:1724	876+231	60.5 : 60.5%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	14:16	-	54	1792:1724	24+163	28.8 : 28.8%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	63	-	454	1858:1724	993+4	45.5 : 45.5%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	14:16	-	237	1700:1724	227+232	51.6 : 51.6%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	502	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	586	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	75	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	252	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**286**	**0**	**23**	**5.0**	**1.9**	**0.3**	**7.2**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**286**	**0**	**23**	**5.0**	**1.9**	**0.3**	**7.2**	**-**	**-**	**-**	**-**
1/1+1/2	670	670	120	0	20	1.9	0.8	0.2	2.9	15.5	8.9	0.8	9.7
2/1+2/2	54	54	46	0	1	0.3	0.2	0.0	0.6	39.2	0.7	0.2	0.9
3/1+3/2	454	454	2	0	0	1.2	0.4	0.0	1.7	13.2	6.4	0.4	6.8
4/1+4/2	237	237	118	0	2	1.6	0.5	0.0	2.1	32.2	1.9	0.5	2.5
5/1	502	502	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	586	586	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	75	75	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	252	252	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 48.7
PRC Over All Lanes (%): 48.7

Total Delay for Signalled Lanes (pcuHr): 7.25
Total Delay Over All Lanes(pcuHr): 7.25

Cycle Time (s): 120

Full Input Data And Results

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**66.8%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**66.8%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	61	-	537	1908:1724	871+199	50.2 : 50.2%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	16:18	-	81	1799:1724	23+149	47.1 : 47.1%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	61	-	652	1886:1724	975+1	66.8 : 66.8%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	16:18	-	292	1692:1724	254+198	64.6 : 64.6%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	782	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	527	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	46	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	207	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**245**	**0**	**54**	**6.0**	**2.8**	**0.4**	**9.3**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**245**	**0**	**54**	**6.0**	**2.8**	**0.4**	**9.3**	**-**	**-**	**-**	**-**
1/1+1/2	537	537	55	0	45	1.4	0.5	0.3	2.3	15.1	6.3	0.5	6.8
2/1+2/2	81	81	63	0	7	0.5	0.4	0.1	1.0	46.2	1.0	0.4	1.5
3/1+3/2	652	652	1	0	0	2.1	1.0	0.0	3.2	17.4	10.9	1.0	11.9
4/1+4/2	292	292	126	0	2	1.9	0.9	0.0	2.8	34.8	2.6	0.9	3.5
5/1	782	782	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	527	527	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	46	46	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	207	207	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	34.7	Total Delay for Signalled Lanes (pcuHr):	9.28	Cycle Time (s):	120
	PRC Over All Lanes (%):	34.7	Total Delay Over All Lanes(pcuHr):	9.28		

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**64.6%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**64.6%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	63	-	716	1900:1724	875+234	64.6 : 64.6%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	14:16	-	54	1792:1724	22+149	31.6 : 31.6%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	63	-	489	1858:1724	994+4	49.0 : 49.0%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	14:16	-	254	1699:1724	227+234	55.2 : 55.2%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	537	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	630	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	75	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	271	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**294**	**0**	**35**	**5.5**	**2.2**	**0.4**	**8.1**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**294**	**0**	**35**	**5.5**	**2.2**	**0.4**	**8.1**	**-**	**-**	**-**	**-**
1/1+1/2	716	716	119	0	32	2.1	0.9	0.3	3.3	16.5	10.2	0.9	11.1
2/1+2/2	54	54	46	0	1	0.3	0.2	0.1	0.6	41.3	0.7	0.2	0.9
3/1+3/2	489	489	2	0	0	1.4	0.5	0.0	1.9	13.6	7.2	0.5	7.7
4/1+4/2	254	254	127	0	2	1.7	0.6	0.0	2.3	32.9	2.0	0.6	2.7
5/1	537	537	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	630	630	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	75	75	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	271	271	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 39.4
PRC Over All Lanes (%): 39.4

Total Delay for Signalled Lanes (pcuHr): 8.07
Total Delay Over All Lanes(pcuHr): 8.07

Cycle Time (s): 120

Full Input Data And Results

Scenario 7: '2024 Opening Year AM' (FG7: '2024 Opening Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**55.3%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**55.3%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	61	-	436	1922:1724	863+206	40.8 : 40.8%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	16:18	-	28	1810:1724	30+177	13.5 : 13.5%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	61	-	544	1887:1724	982+2	55.3 : 55.3%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	16:18	-	245	1690:1724	254+200	54.0 : 54.0%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	620	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	443	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	21	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	169	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**181**	**0**	**36**	**5.1**	**1.6**	**0.2**	**6.9**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**181**	**0**	**36**	**5.1**	**1.6**	**0.2**	**6.9**	**-**	**-**	**-**	**-**
1/1+1/2	436	436	50	0	34	1.1	0.3	0.2	1.6	13.3	4.6	0.3	4.9
2/1+2/2	28	28	24	0	0	0.2	0.1	0.0	0.3	36.3	0.4	0.1	0.5
3/1+3/2	544	544	1	0	0	2.2	0.6	0.0	2.8	18.5	8.0	0.6	8.6
4/1+4/2	245	245	106	0	2	1.6	0.6	0.0	2.2	33.0	2.5	0.6	3.1
5/1	620	620	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	443	443	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	21	21	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	169	169	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	62.8	Total Delay for Signalled Lanes (pcuHr):	6.93	Cycle Time (s):	120
	PRC Over All Lanes (%):	62.8	Total Delay Over All Lanes(pcuHr):	6.93		

Scenario 8: '2024 Opening Year PM' (FG8: '2024 Opening Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**50.0%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**50.0%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	63	-	561	1926:1724	868+254	50.0 : 50.0%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	14:16	-	17	1770:1724	38+177	7.9 : 7.9%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	63	-	409	1858:1724	995+2	41.0 : 41.0%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	14:16	-	210	1691:1724	225+239	45.2 : 45.2%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	426	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	525	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	21	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	225	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**248**	**0**	**2**	**4.0**	**1.3**	**0.2**	**5.5**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**248**	**0**	**2**	**4.0**	**1.3**	**0.2**	**5.5**	**-**	**-**	**-**	**-**
1/1+1/2	561	561	127	0	0	1.4	0.5	0.2	2.2	13.8	6.3	0.5	6.8
2/1+2/2	17	17	14	0	0	0.1	0.0	0.0	0.2	33.6	0.2	0.0	0.2
3/1+3/2	409	409	1	0	0	1.1	0.3	0.0	1.4	12.6	5.7	0.3	6.0
4/1+4/2	210	210	106	0	2	1.4	0.4	0.0	1.8	30.8	1.6	0.4	2.0
5/1	426	426	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	525	525	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	21	21	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	225	225	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 80.1
PRC Over All Lanes (%): 80.1

Total Delay for Signalled Lanes (pcuHr): 5.54
Total Delay Over All Lanes(pcuHr): 5.54

Cycle Time (s): 120

Full Input Data And Results

Scenario 9: '2029 Design 5 Years AM' (FG9: '2029 Design 5 Years AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**62.7%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**62.7%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	61	-	510	1906:1724	875+193	47.8 : 47.8%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	16:18	-	81	1799:1724	26+163	42.9 : 42.9%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	61	-	612	1887:1724	975+2	62.7 : 62.7%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	16:18	-	271	1693:1724	254+199	59.9 : 59.9%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	737	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	499	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	46	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	192	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**255**	**0**	**27**	**5.5**	**2.4**	**0.4**	**8.4**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**255**	**0**	**27**	**5.5**	**2.4**	**0.4**	**8.4**	**-**	**-**	**-**	**-**
1/1+1/2	510	510	69	0	23	1.4	0.5	0.3	2.1	14.7	5.9	0.5	6.3
2/1+2/2	81	81	68	0	2	0.5	0.4	0.1	1.0	42.9	1.0	0.4	1.4
3/1+3/2	612	612	1	0	0	2.0	0.8	0.0	2.8	16.4	9.9	0.8	10.7
4/1+4/2	271	271	117	0	2	1.8	0.7	0.0	2.5	33.4	2.5	0.7	3.2
5/1	737	737	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	499	499	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	46	46	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	192	192	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	43.6	Total Delay for Signalled Lanes (pcuHr):	8.35	Cycle Time (s):	120
	PRC Over All Lanes (%):	43.6	Total Delay Over All Lanes(pcuHr):	8.35		

Scenario 10: '2029 Design 5 Years PM' (FG10: '2029 Design 5 Years PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**61.2%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**61.2%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	63	-	677	1898:1724	878+229	61.2 : 61.2%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	14:16	-	54	1792:1724	24+163	28.8 : 28.8%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	63	-	463	1859:1724	994+4	46.4 : 46.4%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	14:16	-	237	1700:1724	227+232	51.6 : 51.6%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	511	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	593	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	75	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	252	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**282**	**0**	**27**	**5.1**	**1.9**	**0.3**	**7.4**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**282**	**0**	**27**	**5.1**	**1.9**	**0.3**	**7.4**	**-**	**-**	**-**	**-**
1/1+1/2	677	677	116	0	24	1.9	0.8	0.2	2.9	15.7	9.2	0.8	10.0
2/1+2/2	54	54	46	0	1	0.3	0.2	0.0	0.6	39.2	0.7	0.2	0.9
3/1+3/2	463	463	2	0	0	1.3	0.4	0.0	1.7	13.3	6.7	0.4	7.1
4/1+4/2	237	237	118	0	2	1.6	0.5	0.0	2.1	32.2	1.9	0.5	2.5
5/1	511	511	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	593	593	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	75	75	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	252	252	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 47.1
PRC Over All Lanes (%): 47.1

Total Delay for Signalled Lanes (pcuHr): 7.36
Total Delay Over All Lanes(pcuHr): 7.36

Cycle Time (s): 120

Full Input Data And Results

Scenario 11: '2039 Design 15 Years AM' (FG11: '2039 Design 15 Years AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**67.4%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**67.4%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	61	-	546	1908:1724	873+196	51.1 : 51.1%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	16:18	-	81	1799:1724	23+149	47.1 : 47.1%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	61	-	658	1887:1724	975+1	67.4 : 67.4%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	16:18	-	292	1692:1724	254+198	64.6 : 64.6%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	788	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	536	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	46	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	207	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**242**	**0**	**57**	**6.0**	**2.9**	**0.4**	**9.4**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**242**	**0**	**57**	**6.0**	**2.9**	**0.4**	**9.4**	**-**	**-**	**-**	**-**
1/1+1/2	546	546	52	0	48	1.5	0.5	0.3	2.3	15.3	6.6	0.5	7.1
2/1+2/2	81	81	63	0	7	0.5	0.4	0.1	1.0	46.2	1.0	0.4	1.5
3/1+3/2	658	658	1	0	0	2.2	1.0	0.0	3.2	17.6	11.0	1.0	12.0
4/1+4/2	292	292	126	0	2	1.9	0.9	0.0	2.8	34.8	2.6	0.9	3.5
5/1	788	788	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	536	536	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	46	46	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	207	207	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	33.6	Total Delay for Signalled Lanes (pcuHr):	9.39	Cycle Time (s):	120
	PRC Over All Lanes (%):	33.6	Total Delay Over All Lanes(pcuHr):	9.39		

Scenario 12: '2039 Design 15 Years PM' (FG12: '2039 Design 15 Years PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**65.3%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**65.3%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		2	63	-	723	1900:1724	876+231	65.3 : 65.3%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		2	14:16	-	54	1792:1724	22+149	31.6 : 31.6%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		2	63	-	498	1859:1724	994+4	49.9 : 49.9%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		2	14:16	-	254	1699:1724	227+234	55.2 : 55.2%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	546	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	637	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	75	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	271	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**296**	**0**	**33**	**5.5**	**2.3**	**0.4**	**8.2**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**296**	**0**	**33**	**5.5**	**2.3**	**0.4**	**8.2**	**-**	**-**	**-**	**-**
1/1+1/2	723	723	121	0	30	2.1	0.9	0.3	3.3	16.6	10.3	0.9	11.3
2/1+2/2	54	54	46	0	1	0.3	0.2	0.1	0.6	41.2	0.7	0.2	0.9
3/1+3/2	498	498	2	0	0	1.4	0.5	0.0	1.9	13.8	7.3	0.5	7.8
4/1+4/2	254	254	127	0	2	1.7	0.6	0.0	2.3	32.9	2.0	0.6	2.6
5/1	546	546	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	637	637	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	75	75	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	271	271	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 37.9
PRC Over All Lanes (%): 37.9

Total Delay for Signalled Lanes (pcuHr): 8.19
Total Delay Over All Lanes(pcuHr): 8.19

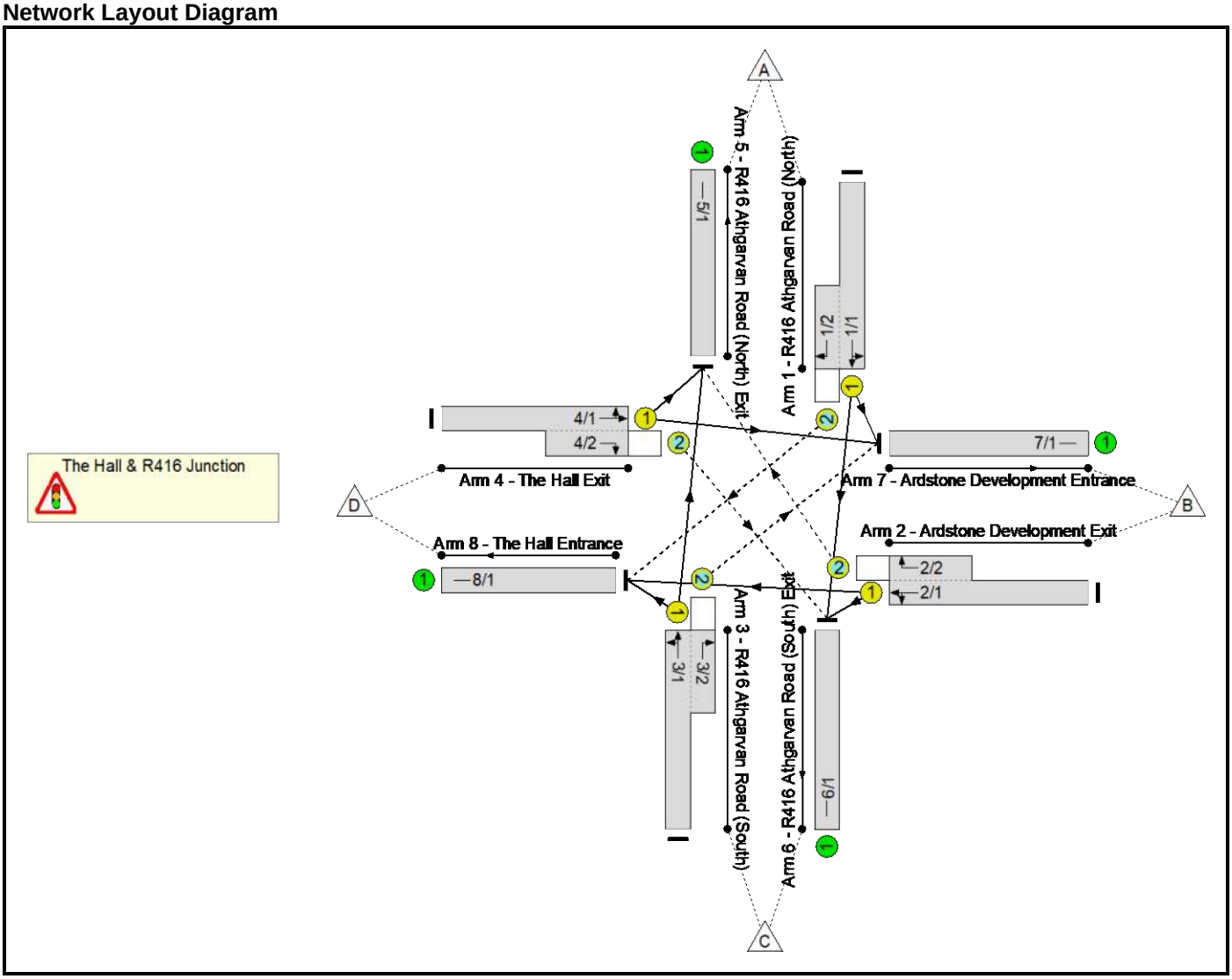
Cycle Time (s): 120

Full Input Data And Results

User and Project Details

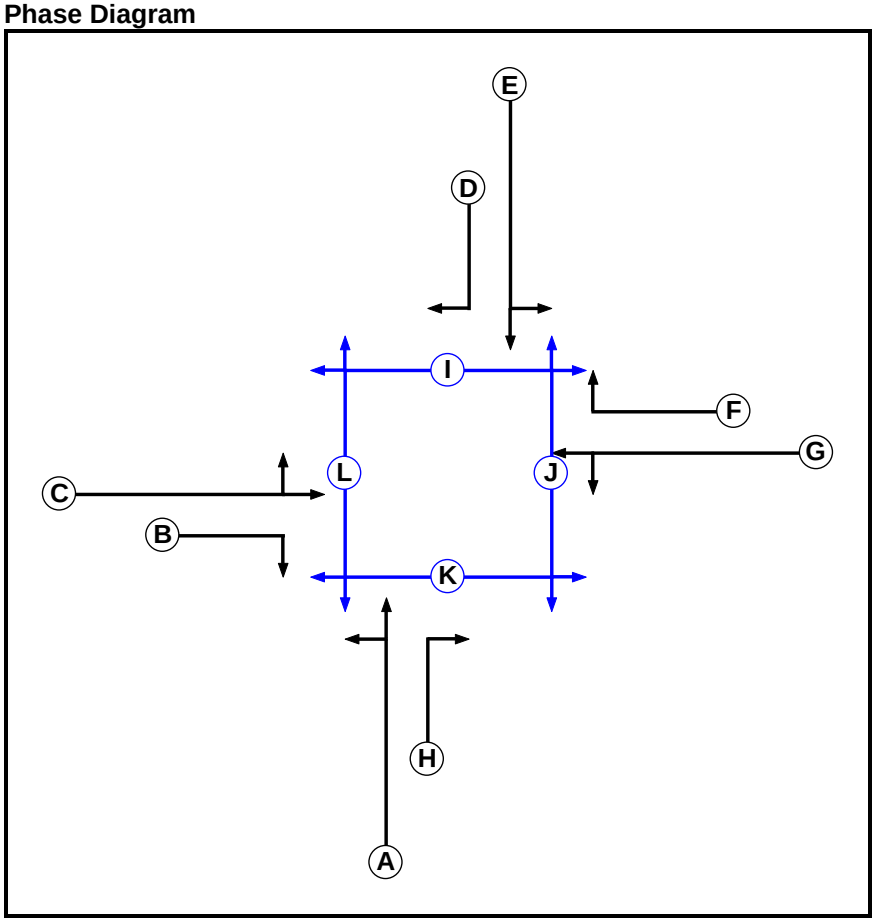
Project:	**Newbridge SHD**
Title:	
Location:	
Client:	Aston Ltd
Site Ref(s):	192229
Date Started:	April 2021
Checked By:	J Tiernan
Additional detail:	
File name:	192229 - The Hall Signalised Junction - Scenario C.lsg3x
Author:	S O'Coileir
Company:	PUNCH Consulting Engineers
Address:	Carnegie House, Library Road, Dun Laoghaire, Co Dublin, A96 C7W7, Ireland

Network Layout Diagram



Full Input Data And Results

Phase Diagram



Phase Input Data

Phase Name	Phase Type	Assoc. Phase	Street Min	Cont Min
A	Traffic		7	7
B	Traffic		7	7
C	Traffic		7	7
D	Traffic		7	7
E	Traffic		7	7
F	Traffic		7	7
G	Traffic		7	7
H	Traffic		7	7
I	Pedestrian		7	7
J	Pedestrian		7	7
K	Pedestrian		7	7
L	Pedestrian		7	7

Full Input Data And Results

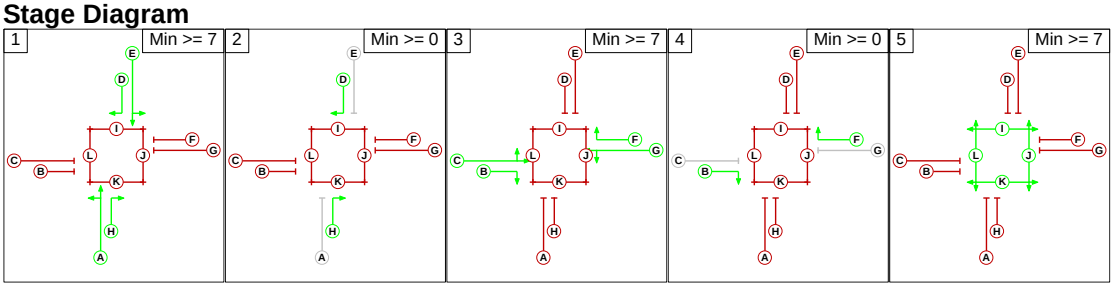
Phase Intergreens Matrix

		Starting Phase											
		A	B	C	D	E	F	G	H	I	J	K	L
Terminating Phase	A		5	5	-	-	5	5	-	5	7	7	6
	B	5		-	5	5	-	-	5	7	-	-	5
	C	5	-		5	5	-	-	5	7	6	7	5
	D	-	5	5		-	5	5	-	-	5	-	6
	E	-	5	5	-		5	5	-	7	5	6	6
	F	5	-	-	5	5		-	5	-	7	5	-
	G	5	-	-	5	5	-		5	6	7	5	7
	H	-	5	5	-	-	5	5		5	-	7	-
	I	11	11	11	-	11	-	11	11		-	-	-
	J	11	-	11	11	11	11	11	-	-		-	-
	K	12	-	12	-	12	12	12	12	-	-		-
	L	12	12	12	12	12	-	12	-	-	-	-	

Phases in Stage

Stage No.	Phases in Stage
1	A D E H
2	D H
3	B C F G
4	B F
5	I J K L

Stage Diagram



Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
There are no Phase Delays defined					

Prohibited Stage Change

		To Stage				
		1	2	3	4	5
From Stage	1		0	5	5	7
	2	2		5	5	7
	3	5	5		0	7
	4	5	5	2		7
	5	12	12	12	12	

Full Input Data And Results

Give-Way Lane Input Data

Junction: The Hall && R416 Junction

Lane	Movement	Max Flow when Giving Way (PCU/Hr)	Min Flow when Giving Way (PCU/Hr)	Opposing Lane	Opp. Lane Coeff.	Opp. Mvmnts.	Right Turn Storage (PCU)	Non-Blocking Storage (PCU)	RTF	Right Turn Move up (s)	Max Turns in Intergreen (PCU)
1/2 (R416 Athgarvan Road (North))	8/1 (Right)	1439	0	3/1	1.09	All	2.00	-	0.50	2	2.00
2/2 (Ardstone Development Exit)	5/1 (Right)	1439	0	4/1	1.09	All	2.00	-	0.50	2	2.00
3/2 (R416 Athgarvan Road (South))	7/1 (Right)	1439	0	1/1	1.09	All	2.00	-	0.50	2	2.00
4/2 (The Hall Exit)	6/1 (Right)	1439	0	2/1	1.09	All	2.00	-	0.50	2	2.00

Full Input Data And Results

Lane Input Data

Junction: The Hall && R416 Junction

Lane	Lane Type	Phases	Start Disp.	End Disp.	Physical Length (PCU)	Sat Flow Type	Def User Saturation Flow (PCU/Hr)	Lane Width (m)	Gradient	Nearside Lane	Turns	Turning Radius (m)
1/1 (R416 Athgarvan Road (North))	U	E	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 6 Ahead	Inf
											Arm 7 Left	8.30
1/2 (R416 Athgarvan Road (North))	O	D	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 8 Right	12.00
2/1 (Ardstone Development Exit)	U	G	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 6 Left	5.20
											Arm 8 Ahead	Inf
2/2 (Ardstone Development Exit)	O	F	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 5 Right	12.00
3/1 (R416 Athgarvan Road (South))	U	A	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 5 Ahead	Inf
											Arm 8 Left	8.00
3/2 (R416 Athgarvan Road (South))	O	H	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 7 Right	12.00
4/1 (The Hall Exit)	U	C	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 5 Left	10.00
											Arm 7 Ahead	Inf
4/2 (The Hall Exit)	O	B	2	3	5.0	Geom	-	3.25	0.00	Y	Arm 6 Right	12.00
5/1 (R416 Athgarvan Road (North) Exit)	U		2	3	60.0	Inf	-	-	-	-	-	-
6/1 (R416 Athgarvan Road (South) Exit)	U		2	3	60.0	Inf	-	-	-	-	-	-
7/1 (Ardstone Development Entrance)	U		2	3	60.0	Inf	-	-	-	-	-	-
8/1 (The Hall Entrance)	U		2	3	60.0	Inf	-	-	-	-	-	-

Full Input Data And Results

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: '2024 Do Nothing AM'	08:00	09:00	01:00	
2: '2024 Do Nothing PM'	17:00	18:00	01:00	
3: '2029 Do Nothing AM'	08:00	09:00	01:00	
4: '2029 Do Nothing PM'	17:00	18:00	01:00	
5: '2039 Do Nothing AM'	08:00	09:00	01:00	
6: '2039 Do Nothing PM'	17:00	18:00	01:00	
7: '2024 Opening Year AM'	08:00	09:00	01:00	
8: '2024 Opening Year PM'	17:00	18:00	01:00	
9: '2029 Design 5 Years AM'	08:00	09:00	01:00	
10: '2029 Design 5 Years PM'	17:00	18:00	01:00	
11: '2039 Design 15 Years AM'	08:00	09:00	01:00	
12: '2039 Design 15 Years PM'	17:00	18:00	01:00	

Traffic Flows, Desired

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	37	294	84	415
	B	311	0	88	46	445
	C	317	136	0	81	534
	D	94	42	108	0	244
	Tot.	722	215	490	211	1638

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	45	368	127	540
	B	225	0	81	54	360
	C	214	92	0	96	402
	D	70	32	108	0	210
	Tot.	509	169	557	277	1512

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	36	323	92	451
	B	337	0	96	48	481
	C	349	149	0	89	587
	D	104	45	118	0	267
	Tot.	790	230	537	229	1786

Full Input Data And Results

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	45	405	140	590
	B	278	0	79	40	397
	C	235	101	0	105	441
	D	77	33	118	0	228
	Tot.	590	179	602	285	1656

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	48	350	100	498
	B	379	0	106	59	544
	C	379	162	0	98	639
	D	112	52	128	0	292
	Tot.	870	262	584	257	1973

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	64	440	151	655
	B	310	0	87	48	445
	C	255	109	0	114	478
	D	83	43	129	0	255
	Tot.	648	216	656	313	1833

Scenario 7: '2024 Opening Year AM' (FG7: '2024 Opening Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	53	294	84	431
	B	330	0	91	55	476
	C	317	139	0	81	537
	D	94	49	108	0	251
	Tot.	741	241	493	220	1695

Scenario 8: '2024 Opening Year PM' (FG8: '2024 Opening Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	64	368	127	559
	B	243	0	84	62	389
	C	214	95	0	96	405
	D	70	40	108	0	218
	Tot.	527	199	560	285	1571

Full Input Data And Results

Scenario 9: '2029 Design 5 Years AM' (FG9: '2029 Design 5 Years AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	69	325	92	486
	B	389	0	104	72	565
	C	352	155	0	91	598
	D	104	59	119	0	282
	Tot.	845	283	548	255	1931

Scenario 10: '2029 Design 5 Years PM' (FG10: '2029 Design 5 Years PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	96	408	140	644
	B	317	0	85	58	460
	C	237	108	0	106	451
	D	77	56	120	0	253
	Tot.	631	260	613	304	1808

Scenario 11: '2039 Design 15 Years AM' (FG11: '2039 Design 15 Years AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	72	350	100	522
	B	415	0	111	76	602
	C	379	167	0	98	644
	D	112	63	128	0	303
	Tot.	906	302	589	274	2071

Scenario 12: '2039 Design 15 Years PM' (FG12: '2039 Design 15 Years PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	99	440	151	690
	B	338	0	91	61	490
	C	255	116	0	114	485
	D	83	58	129	0	270
	Tot.	676	273	660	326	1935

Full Input Data And Results

Network Results

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**70.0%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**70.0%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	46	-	415	1902:1724	621+157	53.3 : 53.3%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	39:43	-	445	1631:1724	191+444	70.0 : 70.0%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	46	-	534	1869:1724	571+195	69.8 : 69.8%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	39:43	-	244	1758:1724	393+312	34.6 : 34.6%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	722	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	490	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	215	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	211	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**625**	**7**	**7**	**13.4**	**3.1**	**1.2**	**17.8**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**625**	**7**	**7**	**13.4**	**3.1**	**1.2**	**17.8**	**-**	**-**	**-**	**-**
1/1+1/2	415	415	84	0	0	3.1	0.6	0.4	4.1	35.4	9.0	0.6	9.6
2/1+2/2	445	445	301	5	5	4.1	1.2	0.3	5.6	45.3	10.3	1.2	11.5
3/1+3/2	534	534	136	0	0	4.3	1.1	0.3	5.8	39.3	12.8	1.1	14.0
4/1+4/2	244	244	104	2	2	1.9	0.3	0.1	2.2	33.2	3.2	0.3	3.5
5/1	722	722	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	490	490	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	215	215	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	211	211	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	28.5	Total Delay for Signalled Lanes (pcuHr):	17.76	Cycle Time (s):	120	
	PRC Over All Lanes (%):	28.5	Total Delay Over All Lanes(pcuHr):	17.76			

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**61.0%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**61.0%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	53	-	540	1903:1724	683+210	60.5 : 60.5%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	34:36	-	360	1654:1724	221+369	61.0 : 61.0%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	53	-	402	1834:1724	661+196	46.9 : 46.9%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	34:36	-	210	1759:1724	319+337	32.0 : 32.0%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	509	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	557	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	169	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	277	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**546**	**0**	**6**	**11.3**	**2.2**	**1.0**	**14.5**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**546**	**0**	**6**	**11.3**	**2.2**	**1.0**	**14.5**	**-**	**-**	**-**	**-**
1/1+1/2	540	540	127	0	0	3.5	0.8	0.3	4.6	30.4	11.5	0.8	12.3
2/1+2/2	360	360	221	0	4	3.5	0.8	0.2	4.5	44.7	6.6	0.8	7.4
3/1+3/2	402	402	92	0	0	2.4	0.4	0.4	3.2	29.0	7.6	0.4	8.0
4/1+4/2	210	210	106	0	2	1.9	0.2	0.2	2.2	38.6	2.8	0.2	3.1
5/1	509	509	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	557	557	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	169	169	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	277	277	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 47.7
PRC Over All Lanes (%): 47.7

Total Delay for Signalled Lanes (pcuHr): 14.52
Total Delay Over All Lanes(pcuHr): 14.52

Cycle Time (s): 120

Full Input Data And Results

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**78.3%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**78.3%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	45	-	451	1905:1724	608+156	59.1 : 59.1%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	42:44	-	481	1627:1724	188+441	76.4 : 76.4%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	45	-	587	1869:1724	560+190	78.3 : 78.3%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	42:44	-	267	1756:1724	417+330	35.7 : 35.7%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	790	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	537	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	230	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	229	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**688**	**0**	**8**	**15.2**	**4.3**	**1.4**	**20.9**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**688**	**0**	**8**	**15.2**	**4.3**	**1.4**	**20.9**	**-**	**-**	**-**	**-**
1/1+1/2	451	451	92	0	0	3.6	0.7	0.5	4.8	38.4	10.4	0.7	11.1
2/1+2/2	481	481	331	0	6	4.5	1.6	0.4	6.4	48.0	11.8	1.6	13.3
3/1+3/2	587	587	149	0	0	5.1	1.8	0.4	7.3	44.9	15.3	1.8	17.0
4/1+4/2	267	267	116	0	2	2.0	0.3	0.1	2.3	31.7	3.5	0.3	3.8
5/1	790	790	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	537	537	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	230	230	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	229	229	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	15.0	Total Delay for Signalled Lanes (pcuHr):	20.90	Cycle Time (s):	120
	PRC Over All Lanes (%):	15.0	Total Delay Over All Lanes(pcuHr):	20.90		

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**68.4%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**68.4%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	51	-	590	1906:1724	658+205	68.4 : 68.4%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	34:38	-	397	1628:1724	175+408	68.2 : 68.2%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	51	-	441	1834:1724	638+189	53.3 : 53.3%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	34:38	-	228	1756:1724	325+348	33.9 : 33.9%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	590	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	602	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	179	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	285	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**624**	**7**	**7**	**13.2**	**3.0**	**1.2**	**17.3**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**624**	**7**	**7**	**13.2**	**3.0**	**1.2**	**17.3**	**-**	**-**	**-**	**-**
1/1+1/2	590	590	140	0	0	4.3	1.1	0.4	5.7	34.8	13.9	1.1	14.9
2/1+2/2	397	397	269	5	5	3.9	1.1	0.3	5.3	47.9	9.1	1.1	10.2
3/1+3/2	441	441	101	0	0	3.0	0.6	0.5	4.0	32.6	9.0	0.6	9.6
4/1+4/2	228	228	114	2	2	2.0	0.3	0.1	2.3	37.0	3.0	0.3	3.3
5/1	590	590	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	602	602	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	179	179	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	285	285	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 31.6
PRC Over All Lanes (%): 31.6

Total Delay for Signalled Lanes (pcuHr): 17.32
Total Delay Over All Lanes(pcuHr): 17.32

Cycle Time (s): 120

Full Input Data And Results

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**87.0%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**87.0%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	44	-	498	1899:1724	589+119	67.6 : 83.7%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	41:45	-	544	1637:1724	194+446	85.1 : 85.1%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	44	-	639	1868:1724	548+186	87.0 : 87.0%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	41:45	-	292	1760:1724	411+321	39.9 : 39.9%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	870	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	584	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	262	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	257	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**717**	**18**	**34**	**17.9**	**7.3**	**1.7**	**26.9**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**717**	**18**	**34**	**17.9**	**7.3**	**1.7**	**26.9**	**-**	**-**	**-**	**-**
1/1+1/2	498	498	75	0	25	4.3	1.2	0.6	6.1	43.8	12.3	1.2	13.5
2/1+2/2	544	544	357	16	6	5.3	2.7	0.4	8.5	56.0	14.3	2.7	17.0
3/1+3/2	639	639	162	0	0	6.1	3.1	0.5	9.7	54.8	17.8	3.1	21.0
4/1+4/2	292	292	124	2	2	2.2	0.3	0.1	2.6	32.5	3.9	0.3	4.2
5/1	870	870	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	584	584	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	262	262	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	257	257	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	3.4	Total Delay for Signalled Lanes (pcuHr):	26.90	Cycle Time (s):	120	
	PRC Over All Lanes (%):	3.4	Total Delay Over All Lanes(pcuHr):	26.90			

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**77.6%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**77.6%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	50	-	655	1896:1724	649+194	77.6 : 77.6%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	37:39	-	445	1636:1724	175+403	77.0 : 77.0%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	50	-	478	1834:1724	627+185	58.9 : 58.9%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	37:39	-	255	1766:1724	351+359	35.9 : 35.9%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	648	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	656	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	216	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	313	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**692**	**0**	**7**	**15.2**	**4.3**	**1.5**	**21.0**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**692**	**0**	**7**	**15.2**	**4.3**	**1.5**	**21.0**	**-**	**-**	**-**	**-**
1/1+1/2	655	655	151	0	0	5.2	1.7	0.4	7.3	40.1	16.9	1.7	18.6
2/1+2/2	445	445	305	0	5	4.5	1.6	0.3	6.4	52.0	10.9	1.6	12.6
3/1+3/2	478	478	109	0	0	3.5	0.7	0.6	4.8	36.0	10.3	0.7	11.1
4/1+4/2	255	255	127	0	2	2.1	0.3	0.1	2.5	35.7	3.3	0.3	3.5
5/1	648	648	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	656	656	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	216	216	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	313	313	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 15.9
PRC Over All Lanes (%): 15.9

Total Delay for Signalled Lanes (pcuHr): 21.03
Total Delay Over All Lanes(pcuHr): 21.03

Cycle Time (s): 120

Full Input Data And Results

Scenario 7: '2024 Opening Year AM' (FG7: '2024 Opening Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**73.0%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**73.0%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	44	-	431	1888:1724	585+142	59.3 : 59.3%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	43:45	-	476	1644:1724	202+456	72.4 : 72.4%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	44	-	537	1869:1724	545+190	73.0 : 73.0%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	43:45	-	251	1766:1724	432+326	33.1 : 33.1%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	741	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	493	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	241	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	220	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**654**	**0**	**7**	**14.2**	**3.6**	**1.3**	**19.0**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**654**	**0**	**7**	**14.2**	**3.6**	**1.3**	**19.0**	**-**	**-**	**-**	**-**
1/1+1/2	431	431	84	0	0	3.5	0.7	0.4	4.6	38.6	10.2	0.7	10.9
2/1+2/2	476	476	325	0	6	4.2	1.3	0.4	5.9	44.3	11.0	1.3	12.3
3/1+3/2	537	537	139	0	0	4.7	1.3	0.4	6.4	42.9	13.3	1.3	14.7
4/1+4/2	251	251	106	0	2	1.8	0.2	0.1	2.1	30.6	3.3	0.2	3.5
5/1	741	741	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	493	493	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	241	241	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	220	220	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	23.3	Total Delay for Signalled Lanes (pcuHr):	19.02	Cycle Time (s):	120	
	PRC Over All Lanes (%):	23.3	Total Delay Over All Lanes(pcuHr):	19.02			

Scenario 8: '2024 Opening Year PM' (FG8: '2024 Opening Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**65.3%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**65.3%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	52	-	559	1889:1724	662+195	65.3 : 65.3%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	35:37	-	389	1664:1724	227+378	64.2 : 64.2%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	52	-	405	1834:1724	646+198	48.0 : 48.0%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	35:37	-	218	1771:1724	341+335	32.3 : 32.3%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	527	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	560	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	199	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	285	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**567**	**0**	**6**	**12.1**	**2.5**	**1.1**	**15.7**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**567**	**0**	**6**	**12.1**	**2.5**	**1.1**	**15.7**	**-**	**-**	**-**	**-**
1/1+1/2	559	559	127	0	0	3.9	0.9	0.3	5.1	32.7	12.8	0.9	13.7
2/1+2/2	389	389	239	0	4	3.8	0.9	0.2	4.9	45.3	7.5	0.9	8.4
3/1+3/2	405	405	95	0	0	2.5	0.5	0.4	3.4	30.5	7.7	0.5	8.2
4/1+4/2	218	218	106	0	2	1.9	0.2	0.2	2.3	37.7	2.8	0.2	3.0
5/1	527	527	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	560	560	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	199	199	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	285	285	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 37.9
PRC Over All Lanes (%): 37.9

Total Delay for Signalled Lanes (pcuHr): 15.69
Total Delay Over All Lanes(pcuHr): 15.69

Cycle Time (s): 120

Full Input Data And Results

Scenario 9: '2029 Design 5 Years AM' (FG9: '2029 Design 5 Years AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**84.8%**
The Hall && R416 Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**84.8%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	42	-	486	1880:1724	562+128	70.1 : 71.6%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	45:47	-	565	1657:1724	209+463	84.1 : 84.1%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	42	-	598	1868:1724	522+183	84.8 : 84.8%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	45:47	-	282	1771:1724	454+331	35.9 : 35.9%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	845	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	548	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	283	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	255	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**739**	**0**	**16**	**17.4**	**6.6**	**1.6**	**25.6**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**739**	**0**	**16**	**17.4**	**6.6**	**1.6**	**25.6**	**-**	**-**	**-**	**-**
1/1+1/2	486	486	84	0	8	4.4	1.2	0.5	6.1	45.1	12.5	1.2	13.6
2/1+2/2	565	565	383	0	6	5.2	2.5	0.4	8.2	52.0	14.4	2.5	16.9
3/1+3/2	598	598	155	0	0	5.8	2.7	0.5	9.0	54.4	16.4	2.7	19.0
4/1+4/2	282	282	117	0	2	1.9	0.3	0.1	2.3	29.6	3.7	0.3	3.9
5/1	845	845	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	548	548	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	283	283	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	255	255	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	6.1	Total Delay for Signalled Lanes (pcuHr):	25.61	Cycle Time (s):	120
	PRC Over All Lanes (%):	6.1	Total Delay Over All Lanes(pcuHr):	25.61		

Scenario 10: '2029 Design 5 Years PM' (FG10: '2029 Design 5 Years PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**80.0%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**80.0%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	49	-	644	1875:1724	630+175	80.0 : 80.0%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	38:40	-	460	1656:1724	184+408	77.7 : 77.7%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	49	-	451	1834:1724	544+166	63.0 : 65.2%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	38:40	-	253	1785:1724	373+337	35.7 : 35.7%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	631	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	613	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	260	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	304	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**678**	**0**	**7**	**15.2**	**4.8**	**1.4**	**21.4**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**678**	**0**	**7**	**15.2**	**4.8**	**1.4**	**21.4**	**-**	**-**	**-**	**-**
1/1+1/2	644	644	140	0	0	5.3	2.0	0.3	7.6	42.3	17.0	2.0	19.0
2/1+2/2	460	460	312	0	5	4.6	1.7	0.3	6.6	51.6	11.3	1.7	13.0
3/1+3/2	451	451	108	0	0	3.3	0.9	0.6	4.8	38.4	9.6	0.9	10.4
4/1+4/2	253	253	118	0	2	2.1	0.3	0.1	2.4	34.8	3.2	0.3	3.5
5/1	631	631	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	613	613	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	260	260	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	304	304	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 12.5
PRC Over All Lanes (%): 12.5

Total Delay for Signalled Lanes (pcuHr): 21.43
Total Delay Over All Lanes(pcuHr): 21.43

Cycle Time (s): 120

Full Input Data And Results

Scenario 11: '2039 Design 15 Years AM' (FG11: '2039 Design 15 Years AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**95.0%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**95.0%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	44	-	522	1882:1724	586+117	72.0 : 85.5%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	40:45	-	602	1656:1724	197+437	95.0 : 95.0%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	44	-	644	1868:1724	545+191	87.5 : 87.5%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	40:45	-	303	1770:1724	411+301	42.6 : 42.6%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	906	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	589	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	302	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	274	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	-	-	**679**	**46**	**84**	**19.6**	**11.8**	**1.8**	**33.2**	-	-	-	-
The Hall && R416 Junction	-	-	**679**	**46**	**84**	**19.6**	**11.8**	**1.8**	**33.2**	-	-	-	-
1/1+1/2	522	522	72	0	28	4.6	1.4	0.6	6.6	45.8	13.5	1.4	14.9
2/1+2/2	602	602	334	43	38	6.4	6.7	0.5	13.6	81.4	17.0	6.7	23.7
3/1+3/2	644	644	151	0	16	6.2	3.3	0.6	10.1	56.5	17.9	3.3	21.2
4/1+4/2	303	303	123	3	2	2.3	0.4	0.1	2.8	33.5	4.2	0.4	4.6
5/1	906	906	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	589	589	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	302	302	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	274	274	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

Full Input Data And Results

C1	PRC for Signalled Lanes (%):	-5.6	Total Delay for Signalled Lanes (pcuHr):	33.19	Cycle Time (s):	120
	PRC Over All Lanes (%):	-5.6	Total Delay Over All Lanes(pcuHr):	33.19		

Scenario 12: '2039 Design 15 Years PM' (FG12: '2039 Design 15 Years PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	-	-	**N/A**	-	-		-	-	-	-	-	-	**85.4%**
The Hall && R416 Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**85.4%**
1/1+1/2	R416 Athgarvan Road (North) Ahead Left Right	U+O	N/A	N/A	E D		1	50	-	690	1878:1724	642+180	84.0 : 84.0%
2/1+2/2	Ardstone Development Exit Right Left Ahead	U+O	N/A	N/A	G F		1	35:39	-	490	1654:1724	178+396	85.4 : 85.4%
3/1+3/2	R416 Athgarvan Road (South) Ahead Right Left	U+O	N/A	N/A	A H		1	50	-	485	1834:1724	460+145	80.2 : 80.2%
4/1+4/2	The Hall Exit Left Right Ahead	U+O	N/A	N/A	C B		1	35:39	-	270	1783:1724	348+319	40.5 : 40.5%
5/1	R416 Athgarvan Road (North) Exit	U	N/A	N/A	-		-	-	-	676	Inf	Inf	0.0%
6/1	R416 Athgarvan Road (South) Exit	U	N/A	N/A	-		-	-	-	660	Inf	Inf	0.0%
7/1	Ardstone Development Entrance	U	N/A	N/A	-		-	-	-	273	Inf	Inf	0.0%
8/1	The Hall Entrance	U	N/A	N/A	-		-	-	-	326	Inf	Inf	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**682**	**27**	**25**	**16.9**	**7.6**	**1.6**	**26.1**	**-**	**-**	**-**	**-**
The Hall && R416 Junction	**-**	**-**	**682**	**27**	**25**	**16.9**	**7.6**	**1.6**	**26.1**	**-**	**-**	**-**	**-**
1/1+1/2	690	690	151	0	0	5.7	2.5	0.4	8.6	45.1	18.9	2.5	21.4
2/1+2/2	490	490	307	25	6	5.2	2.7	0.4	8.4	61.4	12.9	2.7	15.6
3/1+3/2	485	485	99	0	17	3.6	2.0	0.7	6.3	46.7	10.6	2.0	12.5
4/1+4/2	270	270	125	2	2	2.3	0.3	0.1	2.8	37.3	3.6	0.3	3.9
5/1	676	676	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	660	660	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	273	273	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	326	326	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1

PRC for Signalled Lanes (%): 5.4
PRC Over All Lanes (%): 5.4

Total Delay for Signalled Lanes (pcuHr): 26.09
Total Delay Over All Lanes(pcuHr): 26.09

Cycle Time (s): 120

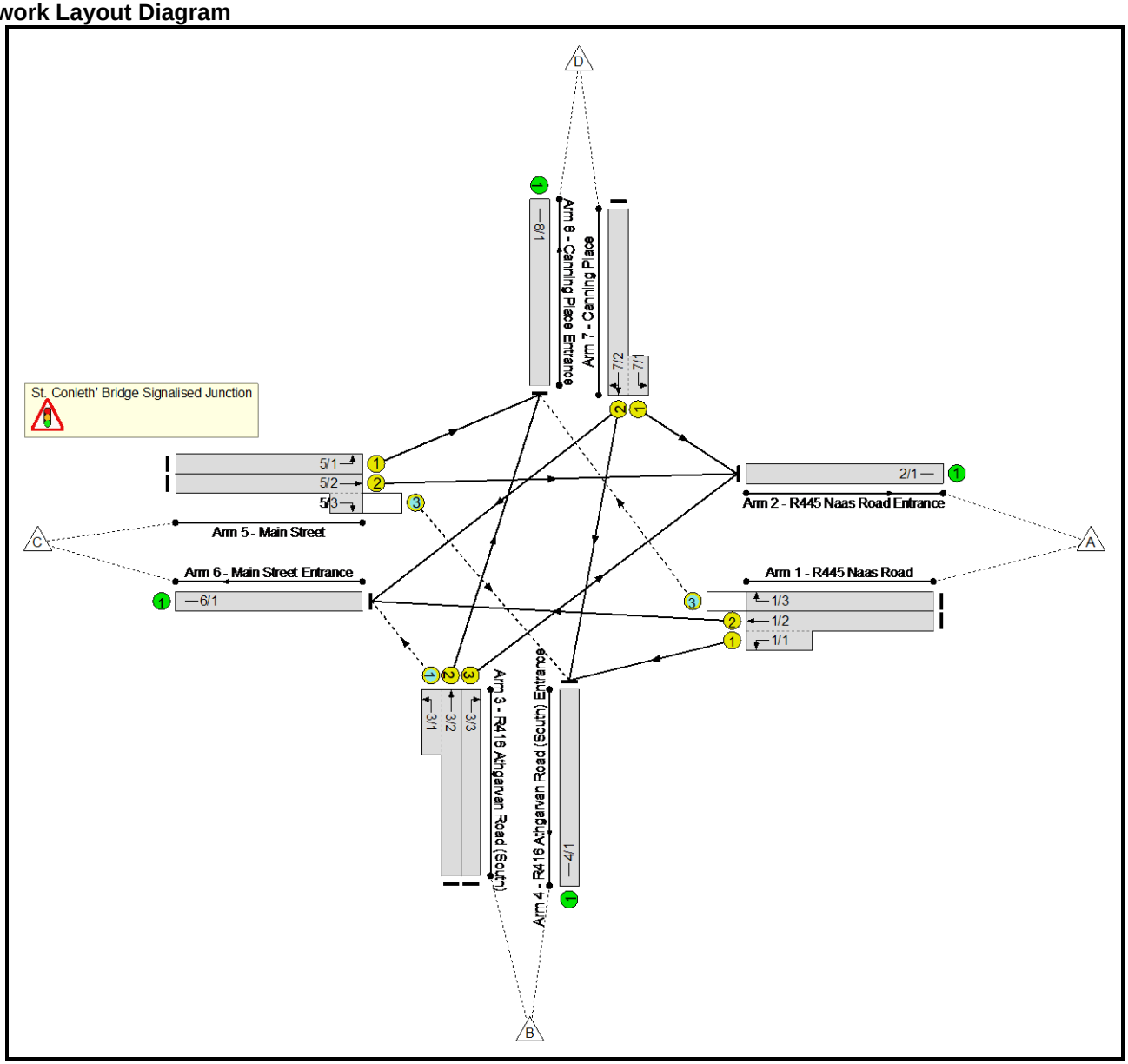
Appendix J St. Conleth's Bridge Signalised Junction Linsig Results Output

Full Input Data And Results

User and Project Details

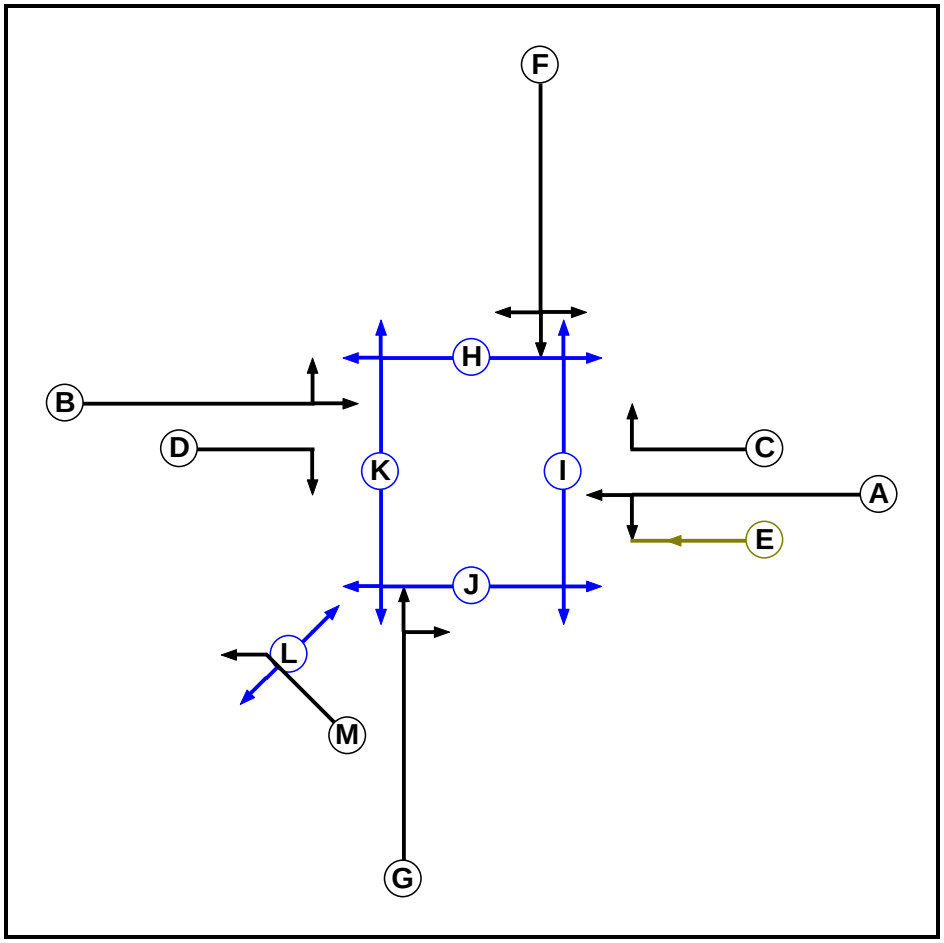
Project:	**192229**
Title:	**Newbridge SHD**
Location:	
Client:	Aston Ltd
Date Started:	April 2021
Checked By:	J Tiernan
Additional detail:	
File name:	192229 - St. Conleth's Bridge Signalised Junction - Scenario A.lsg3x
Author:	J Tiernan
Company:	PUNCH Consulting Engineers
Address:	Carnegie House, Library Road, Dun Laoghaire, Co Dublin, A96 C7W7, Ireland

Network Layout Diagram



Full Input Data And Results

Phase Diagram



Phase Input Data

Phase Name	Phase Type	Assoc. Phase	Street Min	Cont Min
A	Traffic		7	7
B	Traffic		7	7
C	Traffic		7	7
D	Traffic		7	7
E	Filter	A	4	0
F	Traffic		7	7
G	Traffic		7	7
H	Pedestrian		7	7
I	Pedestrian		7	7
J	Pedestrian		7	7
K	Pedestrian		7	7
L	Pedestrian		7	7
M	Traffic		7	7

Full Input Data And Results

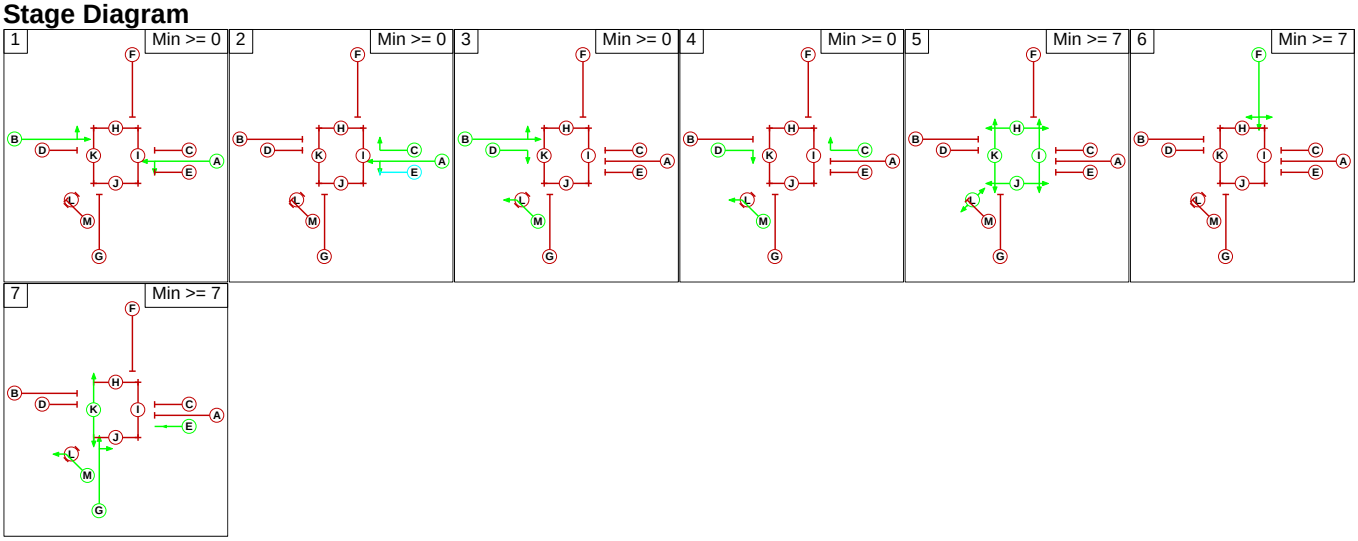
Phase Intergreens Matrix

		Starting Phase												
		A	B	C	D	E	F	G	H	I	J	K	L	M
Terminating Phase	A		-	-	6	-	6	6	8	6	9	10	10	10
	B	-		6	-	5	8	6	9	10	9	5	5	-
	C	-	5		-	-	6	5	8	6	-	-	5	-
	D	-	-	-		-	-	-	-	-	9	5	5	-
	E	-	5	-	5		5	-	-	6	9	-	5	-
	F	5	6	5	6	5		5	5	6	10	10	10	10
	G	7	6	7	5	-	8		10	9	6	-	5	-
	H	11	11	11	-	-	11	11		-	-	-	-	11
	I	17	1	17	-	17	17	17	-		-	-	-	17
	J	15	15	-	15	15	15	15	-	-		-	-	15
	K	16	16	-	16	-	16	-	-	-	-		-	-
	L	8	8	8	8	8	8	8	-	-	-	-		8
	M	5	-	-	-	-	5	-	5	5	5	-	5	

Phases in Stage

Stage No.	Phases in Stage
1	A B
2	A C
3	B D M
4	C D M
5	H I J K L
6	F
7	E G K M

Stage Diagram



Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
There are no Phase Delays defined					

Full Input Data And Results

Prohibited Stage Change

From Stage \ To Stage	1	2	3	4	5	6	7
1		6	10	10	10	8	10
2	5		10	10	10	6	10
3	5	6		6	10	8	6
4	5	5	5		9	6	5
5	17	17	17	17		17	17
6	6	5	10	10	10		10
7	21	16	X	X	X	X	

Give-Way Lane Input Data

Junction: St. Conleth' Bridge Signalised Junction

Lane	Movement	Max Flow when Giving Way (PCU/Hr)	Min Flow when Giving Way (PCU/Hr)	Opposing Lane	Opp. Lane Coeff.	Opp. Mvmnts.	Right Turn Storage (PCU)	Non-Blocking Storage (PCU)	RTF	Right Turn Move up (s)	Max Turns in Intergreen (PCU)
1/3 (R445 Naas Road)	8/1 (Right)	1439	0	5/2	1.09	All	3.00	-	0.50	3	2.00
				5/1	1.09	All					
3/1 (R416 Athgarvan Road (South))	6/1 (Left)	715	0	7/2	0.22	All	-	-	-	-	-
				1/2	0.22	All					
5/3 (Main Street)	4/1 (Right)	1439	0	1/2	1.09	All	3.00	-	0.50	3	2.00

Full Input Data And Results

Lane Input Data

Junction: St. Conleth' Bridge Signalised Junction

Lane	Lane Type	Phases	Start Disp.	End Disp.	Physical Length (PCU)	Sat Flow Type	Def User Saturation Flow (PCU/Hr)	Lane Width (m)	Gradient	Nearside Lane	Turns	Turning Radius (m)
1/1 (R445 Naas Road)	U	A	2	3	5.0	Geom	-	2.85	0.00	Y	Arm 4 Left	20.00
1/2 (R445 Naas Road)	U	A	2	3	60.0	Geom	-	2.75	0.00	Y	Arm 6 Ahead	Inf
1/3 (R445 Naas Road)	O	C	2	3	9.0	Geom	-	2.75	0.00	Y	Arm 8 Right	Inf
2/1 (R445 Naas Road Entrance)	U		2	3	60.0	Geom	-	4.20	0.00	Y		
3/1 (R416 Athgarvan Road (South))	O	M	2	3	5.0	Geom	-	4.50	0.00	Y	Arm 6 Left	29.00
3/2 (R416 Athgarvan Road (South))	U	G	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 8 Ahead	Inf
3/3 (R416 Athgarvan Road (South))	U	G	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 2 Right	Inf
4/1 (R416 Athgarvan Road (South) Entrance)	U		2	3	60.0	Geom	-	3.25	0.00	Y		
5/1 (Main Street)	U	B	2	3	6.0	Geom	-	3.25	0.00	Y	Arm 8 Left	53.00
5/2 (Main Street)	U	B	2	3	60.0	Geom	-	3.00	0.00	N	Arm 2 Ahead	Inf
5/3 (Main Street)	O	D	2	3	2.5	Geom	-	3.25	0.00	Y	Arm 4 Right	12.00
6/1 (Main Street Entrance)	U		2	3	60.0	Geom	-	5.00	0.00	Y		
7/1 (Canning Place)	U	F	2	3	3.0	Geom	-	2.75	0.00	Y	Arm 2 Left	15.00
7/2 (Canning Place)	U	F	2	3	60.0	Geom	-	3.00	0.00	Y	Arm 4 Ahead Arm 6 Right	Inf 21.30
8/1 (Canning Place Entrance)	U		2	3	60.0	Geom	-	3.00	0.00	Y		

Full Input Data And Results

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: '2024 Do Nothing AM'	08:45	09:45	01:00	
2: '2024 Do Nothing PM'	17:00	18:00	01:00	
3: '2029 Do Nothing AM'	08:45	09:45	01:00	
4: '2029 Do Nothing PM'	17:00	18:00	01:00	
5: '2039 Do Nothing AM'	08:45	09:45	01:00	
6: '2039 Do Nothing PM'	17:00	18:00	01:00	
7: '2024 Scenario A Opening Year AM'	08:45	09:45	01:00	
8: '2024 Scenario A Opening Year PM'	17:00	18:00	01:00	
9: '2029 Scenario A Design 5 Year AM'	08:45	09:45	01:00	
10: '2029 Scenario A Design 5 Year PM'	17:00	18:00	01:00	
11: '2039 Scenario A Design 15 Year AM'	08:45	09:45	01:00	
12: '2039 Scenario A Design 15 Year PM'	17:00	18:00	01:00	

Traffic Flows, Desired

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	271	284	140	695
	B	223	0	17	55	295
	C	463	67	0	25	555
	D	252	136	21	0	409
	Tot.	938	474	322	220	1954

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	317	386	197	900
	B	223	0	30	135	388
	C	299	178	0	75	552
	D	110	158	30	0	298
	Tot.	632	653	446	407	2138

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	320	313	154	787
	B	290	0	19	67	376
	C	511	74	0	28	613
	D	278	152	23	0	453
	Tot.	1079	546	355	249	2229

Full Input Data And Results

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	396	425	217	1038
	B	277	0	33	153	463
	C	330	196	0	83	609
	D	122	180	33	0	335
	Tot.	729	772	491	453	2445

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	342	338	166	846
	B	307	0	20	72	399
	C	551	79	0	30	660
	D	300	164	25	0	489
	Tot.	1158	585	383	268	2394

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	421	459	234	1114
	B	295	0	35	165	495
	C	355	212	0	89	656
	D	131	193	35	0	359
	Tot.	781	826	529	488	2624

Scenario 7: '2024 Scenario A Opening Year AM' (FG7: '2024 Scenario A Opening Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	276	298	151	725
	B	227	0	17	55	299
	C	475	67	0	25	567
	D	262	136	21	0	419
	Tot.	964	479	336	231	2010

Scenario 8: '2024 Scenario A Opening Year PM' (FG8: '2024 Scenario A Opening Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	321	398	207	926
	B	227	0	30	135	392
	C	312	178	0	75	565
	D	121	158	30	0	309
	Tot.	660	657	458	417	2192

Full Input Data And Results

Scenario 9: '2029 Scenario A Design 5 Year AM' (FG9: '2029 Scenario A Design 5 Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	329	340	175	844
	B	296	0	19	67	382
	C	529	74	0	28	631
	D	292	152	23	0	467
	Tot.	1117	555	382	270	2324

Scenario 10: '2029 Scenario A Design 5 Year PM' (FG10: '2029 Scenario A Design 5 Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	403	446	234	1083
	B	286	0	33	153	472
	C	356	196	0	83	635
	D	142	180	33	0	355
	Tot.	784	779	512	470	2545

Scenario 11: '2039 Scenario A Design 15 Year AM' (FG11: '2039 Scenario A Design 15 Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	351	364	187	902
	B	313	0	20	72	405
	C	568	79	0	30	677
	D	314	164	25	0	503
	Tot.	1195	594	409	289	2487

Scenario 12: '2039 Scenario A Design 15 Year PM' (FG12: '2039 Scenario A Design 15 Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	428	479	251	1158
	B	304	0	35	165	504
	C	382	212	0	89	683
	D	152	193	35	0	380
	Tot.	838	833	549	505	2725

Full Input Data And Results

Network Results

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**144.4%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**144.4%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	555	1890:1767	287+274	98.8 : 98.8%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	140	1890	210	66.7%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	938	2035	2035	33.3%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	72	1940:1963	166+51	33.1 : 33.1%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	223	1940	175	127.3%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	474	1940	1940	21.4%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	25	1887	328	7.6%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	530	2055:1724	321+46	144.4 : 144.4%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	322	2115	2115	14.9%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	19	-	409	1897:1718	113+182	138.6 : 138.6%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	220	1915	1915	11.5%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**161**	**42**	**52.2**	**179.9**	**0.0**	**232.0**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**161**	**42**	**52.2**	**179.9**	**0.0**	**232.0**	**-**	**-**	**-**	**-**
1/2+1/1	555	555	-	-	-	8.0	10.2	-	18.2	118.0	17.3	10.2	27.5
1/3	140	140	0	98	42	1.9	1.0	0.0	2.9	73.7	4.6	1.0	5.6
2/1	678	678	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
3/2+3/1	72	72	0	17	0	1.1	0.2	-	1.3	65.2	2.0	0.2	2.3
3/3	223	175	-	-	-	7.9	26.1	-	34.0	549.0	12.6	26.1	38.6
4/1	416	416	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	25	25	-	-	-	0.3	0.0	-	0.3	43.7	0.7	0.0	0.8
5/2+5/3	530	367	0	46	0	18.2	83.0	0.0	101.2	687.4	24.3	83.0	107.3
6/1	316	316	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	409	295	-	-	-	14.9	58.7	-	73.6	648.1	22.0	58.7	80.7
8/1	220	220	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -60.4
PRC Over All Lanes (%): -60.4

Total Delay for Signalled Lanes (pcuHr): 231.51
Total Delay Over All Lanes(pcuHr): 232.04

Cycle Time (s): 144

Full Input Data And Results

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**129.0%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**129.0%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	703	1890:1767	300+246	128.8 : 128.8%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	21	-	197	1890	302	65.3%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	632	2035	2035	24.2%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:27	-	165	1940:1963	169+38	79.8 : 79.8%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	223	1940	175	127.3%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	653	1940	1940	26.2%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	75	1887	301	24.9%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:24	-	477	2055:1724	232+138	129.0 : 129.0%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	446	2115	2115	16.7%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	298	1894:1718	147+86	127.9 : 127.9%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	407	1915	1915	21.3%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**357**	**8**	**59.4**	**200.7**	**0.0**	**260.1**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**357**	**8**	**59.4**	**200.7**	**0.0**	**260.1**	**-**	**-**	**-**	**-**
1/2+1/1	703	546	-	-	-	21.3	80.8	-	102.1	522.8	31.3	80.8	112.1
1/3	197	197	0	189	8	2.2	0.9	0.0	3.1	56.7	6.0	0.9	6.9
2/1	493	493	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	165	165	0	30	0	2.6	1.8	-	4.4	96.4	5.3	1.8	7.1
3/3	223	175	-	-	-	7.9	26.1	-	34.0	549.0	12.6	26.1	38.6
4/1	508	508	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	75	75	-	-	-	0.8	0.2	-	0.9	44.0	2.1	0.2	2.3
5/2+5/3	477	370	0	138	0	15.1	55.7	0.0	70.8	534.7	19.5	55.7	75.2
6/1	353	353	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	298	233	-	-	-	9.5	34.7	-	44.1	533.2	14.2	34.7	48.9
8/1	407	407	-	-	-	0.0	0.1	-	0.1	1.2	0.5	0.1	0.7

C1

PRC for Signalled Lanes (%): -43.3
PRC Over All Lanes (%): -43.3

Total Delay for Signalled Lanes (pcuHr): 259.53
Total Delay Over All Lanes(pcuHr): 260.10

Cycle Time (s): 144

Full Input Data And Results

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**160.0%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**160.0%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	633	1890:1767	279+285	112.2 : 112.2%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	154	1890	210	73.3%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	1079	2035	2035	33.6%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:23	-	86	1940:1963	178+50	37.7 : 37.7%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	290	1940	189	153.8%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	546	1940	1940	22.0%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	28	1887	328	8.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	585	2055:1724	321+46	159.3 : 159.3%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	355	2115	2115	14.8%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	18	-	453	1897:1718	109+174	160.0 : 160.0%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	249	1915	1915	13.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**177**	**43**	**74.1**	**289.3**	**0.0**	**363.4**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**177**	**43**	**74.1**	**289.3**	**0.0**	**363.4**	**-**	**-**	**-**	**-**
1/2+1/1	633	564	-	-	-	14.0	38.5	-	52.5	298.5	24.1	38.5	62.6
1/3	154	154	0	111	43	2.2	1.3	0.0	3.5	81.1	5.1	1.3	6.4
2/1	683	683	-	-	-	0.0	0.3	-	0.3	1.3	0.0	0.3	0.3
3/2+3/1	86	86	0	19	0	1.3	0.3	-	1.6	65.6	2.5	0.3	2.8
3/3	290	189	-	-	-	13.5	52.1	-	65.6	813.9	19.5	52.1	71.6
4/1	427	427	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	28	28	-	-	-	0.3	0.0	-	0.3	43.8	0.8	0.0	0.8
5/2+5/3	585	367	0	46	0	22.7	110.3	0.0	132.9	818.1	29.9	110.3	140.2
6/1	312	312	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	453	283	-	-	-	20.3	86.2	-	106.5	846.3	27.9	86.2	114.2
8/1	249	249	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -77.7
PRC Over All Lanes (%): -77.7

Total Delay for Signalled Lanes (pcuHr): 362.85
Total Delay Over All Lanes(pcuHr): 363.41

Cycle Time (s): 144

Full Input Data And Results

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**147.5%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**147.5%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	821	1890:1767	289+270	146.9 : 146.9%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	21	-	217	1890	302	71.9%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	729	2035	2035	24.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:27	-	186	1940:1963	181+39	84.8 : 84.8%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	277	1940	189	146.9%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	772	1940	1940	27.2%
5/1	Main Street Left	U	N/A	N/A	B		2	20	-	83	1887	288	28.8%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	20:23	-	526	2055:1724	224+133	147.5 : 147.5%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	491	2115	2115	16.3%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	335	1894:1718	148+85	144.3 : 144.3%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	453	1915	1915	23.7%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**363**	**20**	**81.8**	**322.0**	**0.0**	**403.8**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**363**	**20**	**81.8**	**322.0**	**0.0**	**403.8**	**-**	**-**	**-**	**-**
1/2+1/1	821	559	-	-	-	30.4	132.6	-	163.0	714.8	39.8	132.6	172.4
1/3	217	217	0	197	20	2.5	1.2	0.0	3.7	61.6	6.8	1.2	8.0
2/1	497	497	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	186	186	0	33	0	2.9	2.4	-	5.4	103.7	6.2	2.4	8.6
3/3	277	189	-	-	-	12.2	45.7	-	57.9	752.4	17.9	45.7	63.6
4/1	527	527	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	83	83	-	-	-	0.9	0.2	-	1.1	45.8	2.4	0.2	2.6
5/2+5/3	526	357	0	133	0	19.8	86.2	0.0	106.0	725.6	25.1	86.2	111.3
6/1	345	345	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	335	232	-	-	-	13.1	53.0	-	66.2	711.3	18.5	53.0	71.6
8/1	453	453	-	-	-	0.0	0.2	-	0.2	1.2	1.1	0.2	1.2

C1

PRC for Signalled Lanes (%): -63.9
PRC Over All Lanes (%): -63.9

Total Delay for Signalled Lanes (pcuHr): 403.24
Total Delay Over All Lanes(pcuHr): 403.84

Cycle Time (s): 144

Full Input Data And Results

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**172.7%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**172.7%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	680	1890:1767	281+284	120.2 : 120.2%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	166	1890	210	79.0%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	1158	2035	2035	33.6%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:23	-	92	1940:1963	178+49	40.5 : 40.5%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	307	1940	189	162.8%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	585	1940	1940	21.9%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	30	1887	328	9.2%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	630	2055:1724	321+46	171.7 : 171.7%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	383	2115	2115	14.9%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	18	-	489	1897:1718	109+174	172.7 : 172.7%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	268	1915	1915	14.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**189**	**43**	**87.3**	**360.0**	**0.0**	**447.3**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**189**	**43**	**87.3**	**360.0**	**0.0**	**447.3**	**-**	**-**	**-**	**-**
1/2+1/1	680	566	-	-	-	17.9	60.0	-	78.0	412.7	27.8	60.0	87.8
1/3	166	166	0	123	43	2.4	1.7	0.0	4.1	89.5	5.5	1.7	7.2
2/1	683	683	-	-	-	0.0	0.3	-	0.3	1.3	0.0	0.3	0.3
3/2+3/1	92	92	0	20	0	1.4	0.3	-	1.7	66.4	2.7	0.3	3.0
3/3	307	189	-	-	-	15.2	60.5	-	75.6	886.8	21.5	60.5	82.0
4/1	425	425	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	30	30	-	-	-	0.3	0.1	-	0.4	43.9	0.9	0.1	0.9
5/2+5/3	630	367	0	46	0	26.4	132.7	0.0	159.1	909.0	34.5	132.7	167.2
6/1	316	316	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	489	283	-	-	-	23.8	104.1	-	127.9	941.6	32.1	104.1	136.2
8/1	268	268	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -91.8
PRC Over All Lanes (%): -91.8

Total Delay for Signalled Lanes (pcuHr): 446.76
Total Delay Over All Lanes(pcuHr): 447.32

Cycle Time (s): 144

Full Input Data And Results

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**159.1%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**159.1%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	880	1890:1767	291+267	157.9 : 157.9%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	21	-	234	1890	302	77.5%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	781	2035	2035	24.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:27	-	200	1940:1963	181+38	91.3 : 91.3%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	295	1940	189	156.4%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	826	1940	1940	27.0%
5/1	Main Street Left	U	N/A	N/A	B		2	20	-	89	1887	288	30.9%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	20:23	-	567	2055:1724	223+133	159.1 : 159.1%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	529	2115	2115	16.5%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	359	1895:1718	147+85	154.6 : 154.6%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	488	1915	1915	25.5%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**368**	**34**	**94.9**	**395.0**	**0.0**	**489.9**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**368**	**34**	**94.9**	**395.0**	**0.0**	**489.9**	**-**	**-**	**-**	**-**
1/2+1/1	880	557	-	-	-	35.6	162.8	-	198.3	811.4	44.7	162.8	207.5
1/3	234	234	0	200	34	2.7	1.6	0.0	4.3	66.7	7.4	1.6	9.1
2/1	496	496	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	200	200	0	35	0	3.2	3.8	-	6.9	125.1	6.8	3.8	10.6
3/3	295	189	-	-	-	14.0	54.5	-	68.5	836.1	20.1	54.5	74.6
4/1	525	525	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	89	89	-	-	-	0.9	0.2	-	1.1	46.1	2.5	0.2	2.7
5/2+5/3	567	356	0	133	0	23.0	106.7	0.0	129.7	823.6	29.1	106.7	135.8
6/1	348	348	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	359	232	-	-	-	15.5	64.8	-	80.3	805.1	21.3	64.8	86.0
8/1	488	488	-	-	-	0.0	0.2	-	0.2	1.3	1.1	0.2	1.2

C1

PRC for Signalled Lanes (%): -76.8
PRC Over All Lanes (%): -76.8

Total Delay for Signalled Lanes (pcuHr): 489.29
Total Delay Over All Lanes(pcuHr): 489.91

Cycle Time (s): 144

Full Input Data And Results

Scenario 7: '2024 Scenario A Opening Year AM' (FG7: '2024 Scenario A Opening Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**147.8%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**147.8%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	574	1890:1767	290+268	102.8 : 102.8%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	151	1890	210	71.9%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	964	2035	2035	33.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	72	1940:1963	166+51	33.1 : 33.1%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	227	1940	175	129.6%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	479	1940	1940	21.1%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	25	1887	328	7.6%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	542	2055:1724	321+45	147.8 : 147.8%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	336	2115	2115	15.2%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	19	-	419	1897:1718	110+183	143.0 : 143.0%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	231	1915	1915	12.1%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**171**	**43**	**56.4**	**200.3**	**0.0**	**256.7**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**171**	**43**	**56.4**	**200.3**	**0.0**	**256.7**	**-**	**-**	**-**	**-**
1/2+1/1	574	558	-	-	-	9.4	16.5	-	25.9	162.6	19.4	16.5	36.0
1/3	151	151	0	108	43	2.1	1.2	0.0	3.3	79.3	5.0	1.2	6.2
2/1	680	680	-	-	-	0.0	0.3	-	0.3	1.3	0.0	0.3	0.3
3/2+3/1	72	72	0	17	0	1.1	0.2	-	1.3	65.2	2.0	0.2	2.3
3/3	227	175	-	-	-	8.3	28.0	-	36.3	575.6	13.0	28.0	41.0
4/1	409	409	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	25	25	-	-	-	0.3	0.0	-	0.3	43.7	0.7	0.0	0.8
5/2+5/3	542	367	0	45	0	19.2	89.1	0.0	108.3	719.5	25.6	89.1	114.7
6/1	322	322	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	419	293	-	-	-	16.1	64.6	-	80.6	692.9	23.4	64.6	88.0
8/1	231	231	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -64.2
PRC Over All Lanes (%): -64.2

Total Delay for Signalled Lanes (pcuHr): 256.12
Total Delay Over All Lanes(pcuHr): 256.66

Cycle Time (s): 144

Full Input Data And Results

Scenario 8: '2024 Scenario A Opening Year PM' (FG8: '2024 Scenario A Opening Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**132.2%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**132.2%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	719	1890:1767	301+243	132.2 : 132.2%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	21	-	207	1890	302	68.6%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	660	2035	2035	24.8%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:27	-	165	1940:1963	169+38	79.8 : 79.8%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	227	1940	175	129.6%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	657	1940	1940	25.8%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	75	1887	301	24.9%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:24	-	490	2055:1724	238+136	131.3 : 131.3%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	458	2115	2115	16.7%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	309	1894:1718	144+93	130.3 : 130.3%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	417	1915	1915	21.8%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**362**	**11**	**62.9**	**219.5**	**0.0**	**282.4**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**362**	**11**	**62.9**	**219.5**	**0.0**	**282.4**	**-**	**-**	**-**	**-**
1/2+1/1	719	544	-	-	-	22.8	89.5	-	112.3	562.2	32.7	89.5	122.2
1/3	207	207	0	196	11	2.3	1.1	0.0	3.4	58.7	6.4	1.1	7.4
2/1	506	506	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	165	165	0	30	0	2.6	1.8	-	4.4	96.4	5.3	1.8	7.1
3/3	227	175	-	-	-	8.3	28.0	-	36.3	575.6	13.0	28.0	41.0
4/1	500	500	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
5/1	75	75	-	-	-	0.8	0.2	-	0.9	44.0	2.1	0.2	2.3
5/2+5/3	490	373	0	136	0	15.9	60.5	0.0	76.4	561.2	20.2	60.5	80.7
6/1	354	354	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	309	237	-	-	-	10.2	38.0	-	48.2	561.4	15.0	38.0	53.0
8/1	417	417	-	-	-	0.0	0.1	-	0.1	1.2	0.5	0.1	0.7

C1

PRC for Signalled Lanes (%): -46.8
PRC Over All Lanes (%): -46.8

Total Delay for Signalled Lanes (pcuHr): 281.86
Total Delay Over All Lanes(pcuHr): 282.44

Cycle Time (s): 144

Full Input Data And Results

Scenario 9: '2029 Scenario A Design 5 Year AM' (FG9: '2029 Scenario A Design 5 Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**166.4%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**166.4%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	669	1890:1767	286+277	118.8 : 118.8%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	175	1890	210	83.3%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	1117	2035	2035	33.7%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:23	-	86	1940:1963	178+50	37.7 : 37.7%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	296	1940	189	156.9%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	555	1940	1940	21.3%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	28	1887	328	8.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	603	2055:1724	322+45	164.5 : 164.5%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	382	2115	2115	15.1%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	18	-	467	1897:1718	105+176	166.4 : 166.4%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	270	1915	1915	14.1%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**195**	**44**	**81.4**	**327.9**	**0.0**	**409.3**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**195**	**44**	**81.4**	**327.9**	**0.0**	**409.3**	**-**	**-**	**-**	**-**
1/2+1/1	669	563	-	-	-	17.1	55.9	-	73.0	392.9	27.1	55.9	83.0
1/3	175	175	0	131	44	2.6	2.2	0.0	4.8	98.1	5.8	2.2	8.0
2/1	686	686	-	-	-	0.0	0.3	-	0.3	1.3	0.0	0.3	0.3
3/2+3/1	86	86	0	19	0	1.3	0.3	-	1.6	65.6	2.5	0.3	2.8
3/3	296	189	-	-	-	14.1	55.0	-	69.1	840.5	20.2	55.0	75.2
4/1	413	413	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	28	28	-	-	-	0.3	0.0	-	0.3	43.8	0.8	0.0	0.8
5/2+5/3	603	367	0	45	0	24.2	119.4	0.0	143.6	857.5	31.8	119.4	151.2
6/1	319	319	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	467	281	-	-	-	21.9	94.4	-	116.2	896.1	29.8	94.4	124.2
8/1	270	270	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -84.8
PRC Over All Lanes (%): -84.8

Total Delay for Signalled Lanes (pcuHr): 408.69
Total Delay Over All Lanes(pcuHr): 409.25

Cycle Time (s): 144

Full Input Data And Results

Scenario 10: '2029 Scenario A Design 5 Year PM' (FG10: '2029 Scenario A Design 5 Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**152.8%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**152.8%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	849	1890:1767	292+264	152.8 : 152.8%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	21	-	234	1890	302	77.5%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	784	2035	2035	25.5%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:27	-	186	1940:1963	181+39	84.8 : 84.8%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	286	1940	189	151.6%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	779	1940	1940	26.5%
5/1	Main Street Left	U	N/A	N/A	B		2	20	-	83	1887	288	28.8%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	20:23	-	552	2055:1724	234+129	152.4 : 152.4%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	512	2115	2115	16.4%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	355	1894:1718	143+95	148.7 : 148.7%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	470	1915	1915	24.5%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**362**	**34**	**88.6**	**359.2**	**0.0**	**447.8**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**362**	**34**	**88.6**	**359.2**	**0.0**	**447.8**	**-**	**-**	**-**	**-**
1/2+1/1	849	556	-	-	-	33.1	148.1	-	181.2	768.4	42.4	148.1	190.5
1/3	234	234	0	200	34	2.7	1.6	0.0	4.3	66.7	7.4	1.6	9.1
2/1	518	518	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	186	186	0	33	0	2.9	2.4	-	5.4	103.7	6.2	2.4	8.6
3/3	286	189	-	-	-	13.1	50.1	-	63.2	795.5	19.0	50.1	69.1
4/1	514	514	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	83	83	-	-	-	0.9	0.2	-	1.1	45.8	2.4	0.2	2.6
5/2+5/3	552	363	0	129	0	21.4	96.4	0.0	117.8	768.4	27.2	96.4	123.5
6/1	347	347	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	355	239	-	-	-	14.6	59.6	-	74.2	752.3	20.0	59.6	79.7
8/1	470	470	-	-	-	0.0	0.2	-	0.2	1.2	1.1	0.2	1.2

C1

PRC for Signalled Lanes (%): -69.8
PRC Over All Lanes (%): -69.8

Total Delay for Signalled Lanes (pcuHr): 447.17
Total Delay Over All Lanes(pcuHr): 447.78

Cycle Time (s): 144

Full Input Data And Results

Scenario 11: '2039 Scenario A Design 15 Year AM' (FG11: '2039 Scenario A Design 15 Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**178.7%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**178.7%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	715	1890:1767	287+276	127.0 : 127.0%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	187	1890	210	89.0%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	1195	2035	2035	33.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	92	1940:1963	167+46	43.0 : 43.0%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	313	1940	175	178.7%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	594	1940	1940	21.5%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	30	1887	328	9.2%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	647	2055:1724	322+45	176.5 : 176.5%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	409	2115	2115	15.2%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	19	-	503	1897:1718	110+183	171.5 : 171.5%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	289	1915	1915	15.1%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**196**	**56**	**94.7**	**400.0**	**0.0**	**494.6**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**196**	**56**	**94.7**	**400.0**	**0.0**	**494.6**	**-**	**-**	**-**	**-**
1/2+1/1	715	563	-	-	-	21.1	78.4	-	99.5	500.8	30.9	78.4	109.2
1/3	187	187	0	131	56	2.8	3.2	0.0	6.0	114.9	6.2	3.2	9.4
2/1	680	680	-	-	-	0.0	0.3	-	0.3	1.3	0.0	0.3	0.3
3/2+3/1	92	92	0	20	0	1.4	0.4	-	1.8	68.7	2.7	0.4	3.1
3/3	313	175	-	-	-	16.9	70.0	-	86.9	999.8	23.3	70.0	93.3
4/1	417	417	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	30	30	-	-	-	0.3	0.1	-	0.4	43.9	0.9	0.1	0.9
5/2+5/3	647	367	0	45	0	27.8	141.4	0.0	169.2	941.3	36.3	141.4	177.7
6/1	321	321	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	503	293	-	-	-	24.4	106.0	-	130.4	933.4	33.1	106.0	139.2
8/1	289	289	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -98.6
PRC Over All Lanes (%): -98.6

Total Delay for Signalled Lanes (pcuHr): 494.08
Total Delay Over All Lanes(pcuHr): 494.65

Cycle Time (s): 144

Full Input Data And Results

Scenario 12: '2039 Scenario A Design 15 Year PM' (FG12: '2039 Scenario A Design 15 Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**164.1%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**164.1%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	907	1890:1767	293+262	163.6 : 163.6%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	20	-	251	1890	289	86.9%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	838	2035	2035	25.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:27	-	200	1940:1963	181+38	91.3 : 91.3%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	304	1940	189	161.2%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	833	1940	1940	26.4%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	89	1887	301	29.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:23	-	594	2055:1724	233+129	164.1 : 164.1%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	549	2115	2115	16.5%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	380	1895:1718	143+95	159.2 : 159.2%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	505	1915	1915	26.4%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**371**	**45**	**101.9**	**433.3**	**0.0**	**535.1**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**371**	**45**	**101.9**	**433.3**	**0.0**	**535.1**	**-**	**-**	**-**	**-**
1/2+1/1	907	554	-	-	-	38.1	177.6	-	215.7	856.1	47.2	177.6	224.8
1/3	251	251	0	206	45	3.1	2.9	0.0	6.0	85.6	8.0	2.9	10.9
2/1	517	517	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	200	200	0	35	0	3.2	3.8	-	6.9	125.1	6.8	3.8	10.6
3/3	304	189	-	-	-	14.9	59.0	-	73.8	874.5	21.1	59.0	80.1
4/1	512	512	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	89	89	-	-	-	0.9	0.2	-	1.1	45.4	2.5	0.2	2.7
5/2+5/3	594	362	0	129	0	24.7	117.3	0.0	141.9	860.2	31.3	117.3	148.6
6/1	350	350	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	380	239	-	-	-	17.0	71.9	-	89.0	843.0	22.9	71.9	94.9
8/1	505	505	-	-	-	0.0	0.2	-	0.2	1.3	1.1	0.2	1.3

C1

PRC for Signalled Lanes (%): -82.3
PRC Over All Lanes (%): -82.3

Total Delay for Signalled Lanes (pcuHr): 534.50
Total Delay Over All Lanes(pcuHr): 535.13

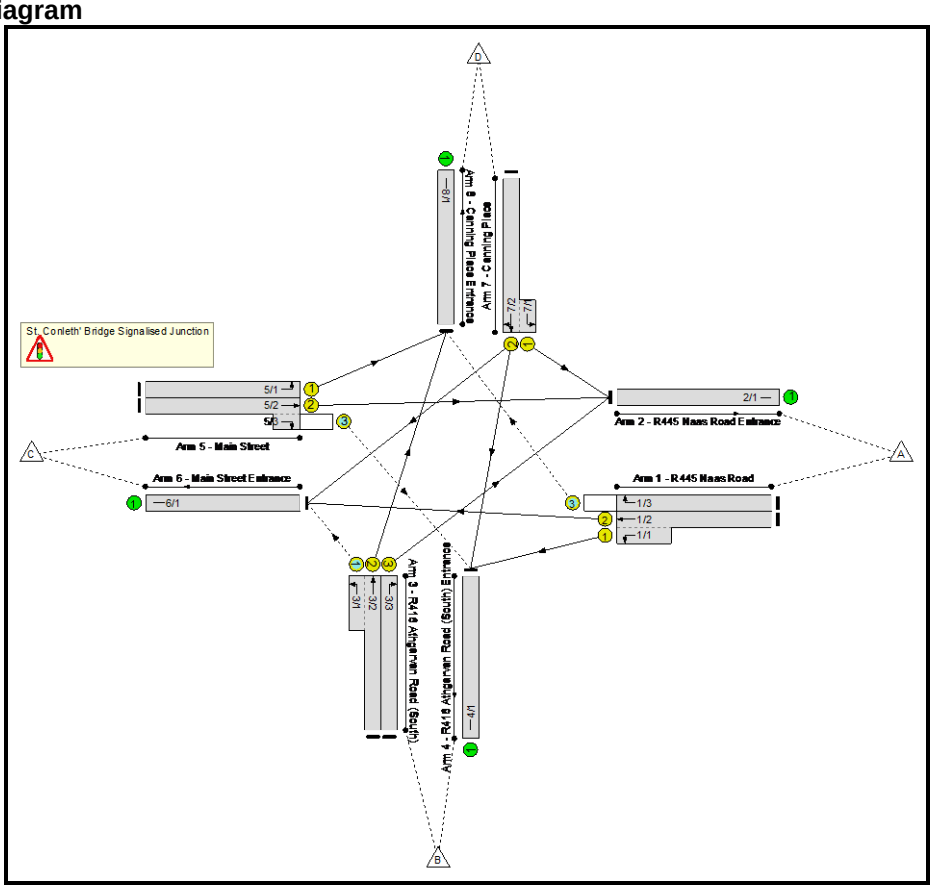
Cycle Time (s): 144

Full Input Data And Results

User and Project Details

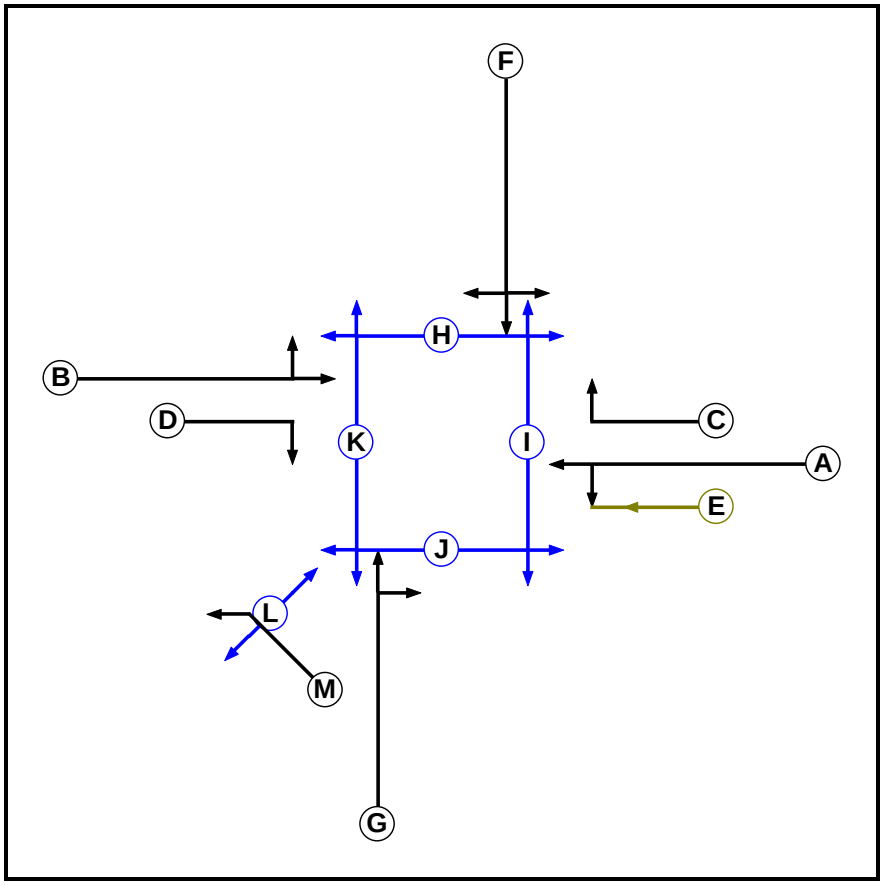
Project:	**192229**
Title:	**Newbridge SHD**
Location:	
Client:	Aston Ltd
Date Started:	April 2021
Checked By:	J Tiernan
Additional detail:	
File name:	192229 - St. Conleth's Bridge Signalised Junction - Scenario B.lsg3x
Author:	J Tiernan
Company:	PUNCH Consulting Engineers
Address:	Carnegie House, Library Road, Dun Laoghaire, Co Dublin, A96 C7W7, Ireland

Network Layout Diagram



Full Input Data And Results

Phase Diagram



Phase Input Data

Phase Name	Phase Type	Assoc. Phase	Street Min	Cont Min
A	Traffic		7	7
B	Traffic		7	7
C	Traffic		7	7
D	Traffic		7	7
E	Filter	A	4	0
F	Traffic		7	7
G	Traffic		7	7
H	Pedestrian		7	7
I	Pedestrian		7	7
J	Pedestrian		7	7
K	Pedestrian		7	7
L	Pedestrian		7	7
M	Traffic		7	7

Full Input Data And Results

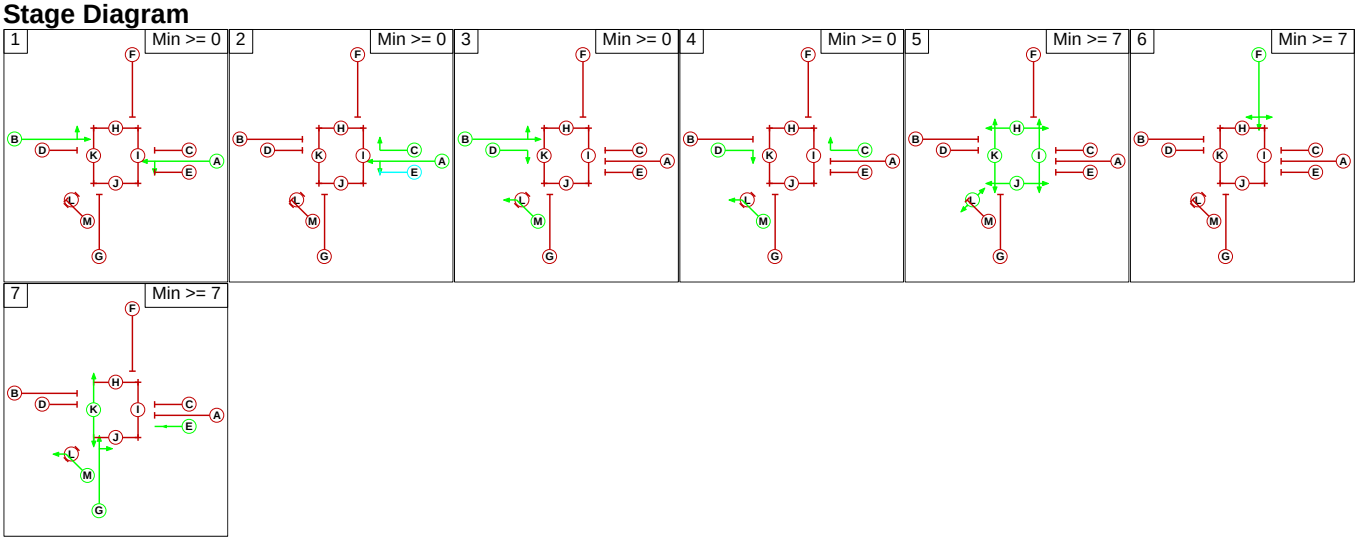
Phase Intergreens Matrix

		Starting Phase												
		A	B	C	D	E	F	G	H	I	J	K	L	M
Terminating Phase	A		-	-	6	-	6	6	8	6	9	10	10	10
	B	-		6	-	5	8	6	9	10	9	5	5	-
	C	-	5		-	-	6	5	8	6	-	-	5	-
	D	-	-	-		-	-	-	-	-	9	5	5	-
	E	-	5	-	5		5	-	-	6	9	-	5	-
	F	5	6	5	6	5		5	5	6	10	10	10	10
	G	7	6	7	5	-	8		10	9	6	-	5	-
	H	11	11	11	-	-	11	11		-	-	-	-	11
	I	17	1	17	-	17	17	17	-		-	-	-	17
	J	15	15	-	15	15	15	15	-	-		-	-	15
	K	16	16	-	16	-	16	-	-	-	-		-	-
	L	8	8	8	8	8	8	8	-	-	-	-		8
	M	5	-	-	-	-	5	-	5	5	5	-	5	

Phases in Stage

Stage No.	Phases in Stage
1	A B
2	A C
3	B D M
4	C D M
5	H I J K L
6	F
7	E G K M

Stage Diagram



Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
There are no Phase Delays defined					

Full Input Data And Results

Prohibited Stage Change

From Stage \ To Stage	1	2	3	4	5	6	7
1		6	10	10	10	8	10
2	5		10	10	10	6	10
3	5	6		6	10	8	6
4	5	5	5		9	6	5
5	17	17	17	17		17	17
6	6	5	10	10	10		10
7	21	16	X	X	X	X	

Give-Way Lane Input Data

Junction: St. Conleth' Bridge Signalised Junction

Lane	Movement	Max Flow when Giving Way (PCU/Hr)	Min Flow when Giving Way (PCU/Hr)	Opposing Lane	Opp. Lane Coeff.	Opp. Mvmnts.	Right Turn Storage (PCU)	Non-Blocking Storage (PCU)	RTF	Right Turn Move up (s)	Max Turns in Intergreen (PCU)
1/3 (R445 Naas Road)	8/1 (Right)	1439	0	5/2	1.09	All	3.00	-	0.50	3	2.00
				5/1	1.09	All					
3/1 (R416 Athgarvan Road (South))	6/1 (Left)	715	0	7/2	0.22	All	-	-	-	-	-
				1/2	0.22	All					
5/3 (Main Street)	4/1 (Right)	1439	0	1/2	1.09	All	3.00	-	0.50	3	2.00

Full Input Data And Results

Lane Input Data

Junction: St. Conleth' Bridge Signalised Junction

Lane	Lane Type	Phases	Start Disp.	End Disp.	Physical Length (PCU)	Sat Flow Type	Def User Saturation Flow (PCU/Hr)	Lane Width (m)	Gradient	Nearside Lane	Turns	Turning Radius (m)
1/1 (R445 Naas Road)	U	A	2	3	5.0	Geom	-	2.85	0.00	Y	Arm 4 Left	20.00
1/2 (R445 Naas Road)	U	A	2	3	60.0	Geom	-	2.75	0.00	Y	Arm 6 Ahead	Inf
1/3 (R445 Naas Road)	O	C	2	3	9.0	Geom	-	2.75	0.00	Y	Arm 8 Right	Inf
2/1 (R445 Naas Road Entrance)	U		2	3	60.0	Geom	-	4.20	0.00	Y		
3/1 (R416 Athgarvan Road (South))	O	M	2	3	5.0	Geom	-	4.50	0.00	Y	Arm 6 Left	29.00
3/2 (R416 Athgarvan Road (South))	U	G	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 8 Ahead	Inf
3/3 (R416 Athgarvan Road (South))	U	G	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 2 Right	Inf
4/1 (R416 Athgarvan Road (South) Entrance)	U		2	3	60.0	Geom	-	3.25	0.00	Y		
5/1 (Main Street)	U	B	2	3	6.0	Geom	-	3.25	0.00	Y	Arm 8 Left	53.00
5/2 (Main Street)	U	B	2	3	60.0	Geom	-	3.00	0.00	N	Arm 2 Ahead	Inf
5/3 (Main Street)	O	D	2	3	2.5	Geom	-	3.25	0.00	Y	Arm 4 Right	12.00
6/1 (Main Street Entrance)	U		2	3	60.0	Geom	-	5.00	0.00	Y		
7/1 (Canning Place)	U	F	2	3	3.0	Geom	-	2.75	0.00	Y	Arm 2 Left	15.00
7/2 (Canning Place)	U	F	2	3	60.0	Geom	-	3.00	0.00	Y	Arm 4 Ahead Arm 6 Right	Inf 21.30
8/1 (Canning Place Entrance)	U		2	3	60.0	Geom	-	3.00	0.00	Y		

Full Input Data And Results

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: '2024 Do Nothing AM'	08:45	09:45	01:00	
2: '2024 Do Nothing PM'	17:00	18:00	01:00	
3: '2029 Do Nothing AM'	08:45	09:45	01:00	
4: '2029 Do Nothing PM'	17:00	18:00	01:00	
5: '2039 Do Nothing AM'	08:45	09:45	01:00	
6: '2039 Do Nothing PM'	17:00	18:00	01:00	
7: '2024 Scenario A Opening Year AM'	08:45	09:45	01:00	
8: '2024 Scenario A Opening Year PM'	17:00	18:00	01:00	
9: '2029 Scenario A Design 5 Year AM'	08:45	09:45	01:00	
10: '2029 Scenario A Design 5 Year PM'	17:00	18:00	01:00	
11: '2039 Scenario A Design 15 Year AM'	08:45	09:45	01:00	
12: '2039 Scenario A Design 15 Year PM'	17:00	18:00	01:00	

Traffic Flows, Desired

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	271	284	140	695
	B	223	0	17	55	295
	C	463	67	0	25	555
	D	252	136	21	0	409
	Tot.	938	474	322	220	1954

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	317	386	197	900
	B	223	0	30	135	388
	C	299	178	0	75	552
	D	110	158	30	0	298
	Tot.	632	653	446	407	2138

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	320	313	154	787
	B	290	0	19	67	376
	C	511	74	0	28	613
	D	278	152	23	0	453
	Tot.	1079	546	355	249	2229

Full Input Data And Results

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	396	425	217	1038
	B	277	0	33	153	463
	C	330	196	0	83	609
	D	122	180	33	0	335
	Tot.	729	772	491	453	2445

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	342	338	166	846
	B	307	0	20	72	399
	C	551	79	0	30	660
	D	300	164	25	0	489
	Tot.	1158	585	383	268	2394

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	421	459	234	1114
	B	295	0	35	165	495
	C	355	212	0	89	656
	D	131	193	35	0	359
	Tot.	781	826	529	488	2624

Scenario 7: '2024 Scenario A Opening Year AM' (FG7: '2024 Scenario A Opening Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	276	299	151	726
	B	227	0	17	55	299
	C	476	67	0	25	568
	D	262	136	21	0	419
	Tot.	965	479	337	231	2012

Scenario 8: '2024 Scenario A Opening Year PM' (FG8: '2024 Scenario A Opening Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	321	399	207	927
	B	227	0	30	135	392
	C	312	178	0	75	565
	D	121	158	30	0	309
	Tot.	660	657	459	417	2193

Full Input Data And Results

Scenario 9: '2029 Scenario A Design 5 Year AM' (FG9: '2029 Scenario A Design 5 Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	329	341	176	846
	B	296	0	19	67	382
	C	529	74	0	28	631
	D	292	152	23	0	467
	Tot.	1117	555	383	271	2326

Scenario 10: '2029 Scenario A Design 5 Year PM' (FG10: '2029 Scenario A Design 5 Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	403	447	234	1084
	B	286	0	33	153	472
	C	356	196	0	83	635
	D	142	180	33	0	355
	Tot.	784	779	513	470	2546

Scenario 11: '2039 Scenario A Design 15 Year AM' (FG11: '2039 Scenario A Design 15 Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	351	365	188	904
	B	313	0	20	72	405
	C	569	79	0	30	678
	D	314	164	25	0	503
	Tot.	1196	594	410	290	2490

Scenario 12: '2039 Scenario A Design 15 Year PM' (FG12: '2039 Scenario A Design 15 Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	428	480	251	1159
	B	304	0	35	165	504
	C	382	212	0	89	683
	D	152	193	35	0	380
	Tot.	838	833	550	505	2726

Full Input Data And Results

Network Results

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**144.4%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**144.4%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	555	1890:1767	287+274	98.8 : 98.8%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	140	1890	210	66.7%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	938	2035	2035	33.3%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	72	1940:1963	166+51	33.1 : 33.1%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	223	1940	175	127.3%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	474	1940	1940	21.4%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	25	1887	328	7.6%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	530	2055:1724	321+46	144.4 : 144.4%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	322	2115	2115	14.9%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	19	-	409	1897:1718	113+182	138.6 : 138.6%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	220	1915	1915	11.5%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**161**	**42**	**52.2**	**179.9**	**0.0**	**232.0**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**161**	**42**	**52.2**	**179.9**	**0.0**	**232.0**	**-**	**-**	**-**	**-**
1/2+1/1	555	555	-	-	-	8.0	10.2	-	18.2	118.0	17.3	10.2	27.5
1/3	140	140	0	98	42	1.9	1.0	0.0	2.9	73.7	4.6	1.0	5.6
2/1	678	678	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
3/2+3/1	72	72	0	17	0	1.1	0.2	-	1.3	65.2	2.0	0.2	2.3
3/3	223	175	-	-	-	7.9	26.1	-	34.0	549.0	12.6	26.1	38.6
4/1	416	416	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	25	25	-	-	-	0.3	0.0	-	0.3	43.7	0.7	0.0	0.8
5/2+5/3	530	367	0	46	0	18.2	83.0	0.0	101.2	687.4	24.3	83.0	107.3
6/1	316	316	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	409	295	-	-	-	14.9	58.7	-	73.6	648.1	22.0	58.7	80.7
8/1	220	220	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -60.4
PRC Over All Lanes (%): -60.4

Total Delay for Signalled Lanes (pcuHr): 231.51
Total Delay Over All Lanes(pcuHr): 232.04

Cycle Time (s): 144

Full Input Data And Results

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**129.0%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**129.0%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	703	1890:1767	300+246	128.8 : 128.8%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	21	-	197	1890	302	65.3%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	632	2035	2035	24.2%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:27	-	165	1940:1963	169+38	79.8 : 79.8%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	223	1940	175	127.3%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	653	1940	1940	26.2%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	75	1887	301	24.9%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:24	-	477	2055:1724	232+138	129.0 : 129.0%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	446	2115	2115	16.7%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	298	1894:1718	147+86	127.9 : 127.9%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	407	1915	1915	21.3%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**357**	**8**	**59.4**	**200.7**	**0.0**	**260.1**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**357**	**8**	**59.4**	**200.7**	**0.0**	**260.1**	**-**	**-**	**-**	**-**
1/2+1/1	703	546	-	-	-	21.3	80.8	-	102.1	522.8	31.3	80.8	112.1
1/3	197	197	0	189	8	2.2	0.9	0.0	3.1	56.7	6.0	0.9	6.9
2/1	493	493	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	165	165	0	30	0	2.6	1.8	-	4.4	96.4	5.3	1.8	7.1
3/3	223	175	-	-	-	7.9	26.1	-	34.0	549.0	12.6	26.1	38.6
4/1	508	508	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	75	75	-	-	-	0.8	0.2	-	0.9	44.0	2.1	0.2	2.3
5/2+5/3	477	370	0	138	0	15.1	55.7	0.0	70.8	534.7	19.5	55.7	75.2
6/1	353	353	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	298	233	-	-	-	9.5	34.7	-	44.1	533.2	14.2	34.7	48.9
8/1	407	407	-	-	-	0.0	0.1	-	0.1	1.2	0.5	0.1	0.7

C1

PRC for Signalled Lanes (%): -43.3
PRC Over All Lanes (%): -43.3

Total Delay for Signalled Lanes (pcuHr): 259.53
Total Delay Over All Lanes(pcuHr): 260.10

Cycle Time (s): 144

Full Input Data And Results

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**160.0%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**160.0%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	633	1890:1767	279+285	112.2 : 112.2%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	154	1890	210	73.3%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	1079	2035	2035	33.6%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:23	-	86	1940:1963	178+50	37.7 : 37.7%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	290	1940	189	153.8%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	546	1940	1940	22.0%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	28	1887	328	8.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	585	2055:1724	321+46	159.3 : 159.3%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	355	2115	2115	14.8%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	18	-	453	1897:1718	109+174	160.0 : 160.0%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	249	1915	1915	13.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**177**	**43**	**74.1**	**289.3**	**0.0**	**363.4**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**177**	**43**	**74.1**	**289.3**	**0.0**	**363.4**	**-**	**-**	**-**	**-**
1/2+1/1	633	564	-	-	-	14.0	38.5	-	52.5	298.5	24.1	38.5	62.6
1/3	154	154	0	111	43	2.2	1.3	0.0	3.5	81.1	5.1	1.3	6.4
2/1	683	683	-	-	-	0.0	0.3	-	0.3	1.3	0.0	0.3	0.3
3/2+3/1	86	86	0	19	0	1.3	0.3	-	1.6	65.6	2.5	0.3	2.8
3/3	290	189	-	-	-	13.5	52.1	-	65.6	813.9	19.5	52.1	71.6
4/1	427	427	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	28	28	-	-	-	0.3	0.0	-	0.3	43.8	0.8	0.0	0.8
5/2+5/3	585	367	0	46	0	22.7	110.3	0.0	132.9	818.1	29.9	110.3	140.2
6/1	312	312	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	453	283	-	-	-	20.3	86.2	-	106.5	846.3	27.9	86.2	114.2
8/1	249	249	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -77.7
PRC Over All Lanes (%): -77.7

Total Delay for Signalled Lanes (pcuHr): 362.85
Total Delay Over All Lanes(pcuHr): 363.41

Cycle Time (s): 144

Full Input Data And Results

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**147.5%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**147.5%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	821	1890:1767	289+270	146.9 : 146.9%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	21	-	217	1890	302	71.9%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	729	2035	2035	24.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:27	-	186	1940:1963	181+39	84.8 : 84.8%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	277	1940	189	146.9%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	772	1940	1940	27.2%
5/1	Main Street Left	U	N/A	N/A	B		2	20	-	83	1887	288	28.8%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	20:23	-	526	2055:1724	224+133	147.5 : 147.5%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	491	2115	2115	16.3%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	335	1894:1718	148+85	144.3 : 144.3%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	453	1915	1915	23.7%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**363**	**20**	**81.8**	**322.0**	**0.0**	**403.8**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**363**	**20**	**81.8**	**322.0**	**0.0**	**403.8**	**-**	**-**	**-**	**-**
1/2+1/1	821	559	-	-	-	30.4	132.6	-	163.0	714.8	39.8	132.6	172.4
1/3	217	217	0	197	20	2.5	1.2	0.0	3.7	61.6	6.8	1.2	8.0
2/1	497	497	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	186	186	0	33	0	2.9	2.4	-	5.4	103.7	6.2	2.4	8.6
3/3	277	189	-	-	-	12.2	45.7	-	57.9	752.4	17.9	45.7	63.6
4/1	527	527	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	83	83	-	-	-	0.9	0.2	-	1.1	45.8	2.4	0.2	2.6
5/2+5/3	526	357	0	133	0	19.8	86.2	0.0	106.0	725.6	25.1	86.2	111.3
6/1	345	345	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	335	232	-	-	-	13.1	53.0	-	66.2	711.3	18.5	53.0	71.6
8/1	453	453	-	-	-	0.0	0.2	-	0.2	1.2	1.1	0.2	1.2

C1

PRC for Signalled Lanes (%): -63.9
PRC Over All Lanes (%): -63.9

Total Delay for Signalled Lanes (pcuHr): 403.24
Total Delay Over All Lanes(pcuHr): 403.84

Cycle Time (s): 144

Full Input Data And Results

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**172.7%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**172.7%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	680	1890:1767	281+284	120.2 : 120.2%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	166	1890	210	79.0%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	1158	2035	2035	33.6%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:23	-	92	1940:1963	178+49	40.5 : 40.5%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	307	1940	189	162.8%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	585	1940	1940	21.9%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	30	1887	328	9.2%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	630	2055:1724	321+46	171.7 : 171.7%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	383	2115	2115	14.9%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	18	-	489	1897:1718	109+174	172.7 : 172.7%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	268	1915	1915	14.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**189**	**43**	**87.3**	**360.0**	**0.0**	**447.3**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**189**	**43**	**87.3**	**360.0**	**0.0**	**447.3**	**-**	**-**	**-**	**-**
1/2+1/1	680	566	-	-	-	17.9	60.0	-	78.0	412.7	27.8	60.0	87.8
1/3	166	166	0	123	43	2.4	1.7	0.0	4.1	89.5	5.5	1.7	7.2
2/1	683	683	-	-	-	0.0	0.3	-	0.3	1.3	0.0	0.3	0.3
3/2+3/1	92	92	0	20	0	1.4	0.3	-	1.7	66.4	2.7	0.3	3.0
3/3	307	189	-	-	-	15.2	60.5	-	75.6	886.8	21.5	60.5	82.0
4/1	425	425	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	30	30	-	-	-	0.3	0.1	-	0.4	43.9	0.9	0.1	0.9
5/2+5/3	630	367	0	46	0	26.4	132.7	0.0	159.1	909.0	34.5	132.7	167.2
6/1	316	316	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	489	283	-	-	-	23.8	104.1	-	127.9	941.6	32.1	104.1	136.2
8/1	268	268	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -91.8
PRC Over All Lanes (%): -91.8

Total Delay for Signalled Lanes (pcuHr): 446.76
Total Delay Over All Lanes(pcuHr): 447.32

Cycle Time (s): 144

Full Input Data And Results

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**159.1%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**159.1%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	880	1890:1767	291+267	157.9 : 157.9%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	21	-	234	1890	302	77.5%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	781	2035	2035	24.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:27	-	200	1940:1963	181+38	91.3 : 91.3%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	295	1940	189	156.4%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	826	1940	1940	27.0%
5/1	Main Street Left	U	N/A	N/A	B		2	20	-	89	1887	288	30.9%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	20:23	-	567	2055:1724	223+133	159.1 : 159.1%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	529	2115	2115	16.5%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	359	1895:1718	147+85	154.6 : 154.6%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	488	1915	1915	25.5%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**368**	**34**	**94.9**	**395.0**	**0.0**	**489.9**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**368**	**34**	**94.9**	**395.0**	**0.0**	**489.9**	**-**	**-**	**-**	**-**
1/2+1/1	880	557	-	-	-	35.6	162.8	-	198.3	811.4	44.7	162.8	207.5
1/3	234	234	0	200	34	2.7	1.6	0.0	4.3	66.7	7.4	1.6	9.1
2/1	496	496	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	200	200	0	35	0	3.2	3.8	-	6.9	125.1	6.8	3.8	10.6
3/3	295	189	-	-	-	14.0	54.5	-	68.5	836.1	20.1	54.5	74.6
4/1	525	525	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	89	89	-	-	-	0.9	0.2	-	1.1	46.1	2.5	0.2	2.7
5/2+5/3	567	356	0	133	0	23.0	106.7	0.0	129.7	823.6	29.1	106.7	135.8
6/1	348	348	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	359	232	-	-	-	15.5	64.8	-	80.3	805.1	21.3	64.8	86.0
8/1	488	488	-	-	-	0.0	0.2	-	0.2	1.3	1.1	0.2	1.2

C1

PRC for Signalled Lanes (%): -76.8
PRC Over All Lanes (%): -76.8

Total Delay for Signalled Lanes (pcuHr): 489.29
Total Delay Over All Lanes(pcuHr): 489.91

Cycle Time (s): 144

Full Input Data And Results

Scenario 7: '2024 Scenario A Opening Year AM' (FG7: '2024 Scenario A Opening Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**148.1%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**148.1%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	575	1890:1767	290+268	103.1 : 103.1%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	151	1890	210	71.9%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	965	2035	2035	33.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	72	1940:1963	166+51	33.1 : 33.1%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	227	1940	175	129.6%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	479	1940	1940	21.0%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	25	1887	328	7.6%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	543	2055:1724	321+45	148.1 : 148.1%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	337	2115	2115	15.2%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	19	-	419	1897:1718	110+183	143.0 : 143.0%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	231	1915	1915	12.1%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**171**	**43**	**56.6**	**201.3**	**0.0**	**257.8**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**171**	**43**	**56.6**	**201.3**	**0.0**	**257.8**	**-**	**-**	**-**	**-**
1/2+1/1	575	558	-	-	-	9.5	17.0	-	26.5	165.9	19.5	17.0	36.6
1/3	151	151	0	108	43	2.1	1.2	0.0	3.3	79.3	5.0	1.2	6.2
2/1	680	680	-	-	-	0.0	0.3	-	0.3	1.3	0.0	0.3	0.3
3/2+3/1	72	72	0	17	0	1.1	0.2	-	1.3	65.2	2.0	0.2	2.3
3/3	227	175	-	-	-	8.3	28.0	-	36.3	575.6	13.0	28.0	41.0
4/1	408	408	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	25	25	-	-	-	0.3	0.0	-	0.3	43.7	0.7	0.0	0.8
5/2+5/3	543	367	0	45	0	19.3	89.7	0.0	108.9	722.1	25.7	89.7	115.3
6/1	322	322	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	419	293	-	-	-	16.1	64.6	-	80.6	692.9	23.4	64.6	88.0
8/1	231	231	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -64.5
PRC Over All Lanes (%): -64.5

Total Delay for Signalled Lanes (pcuHr): 257.29
Total Delay Over All Lanes(pcuHr): 257.83

Cycle Time (s): 144

Full Input Data And Results

Scenario 8: '2024 Scenario A Opening Year PM' (FG8: '2024 Scenario A Opening Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**132.4%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**132.4%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	720	1890:1767	301+242	132.4 : 132.4%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	21	-	207	1890	302	68.6%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	660	2035	2035	24.8%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:27	-	165	1940:1963	169+38	79.8 : 79.8%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	227	1940	175	129.6%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	657	1940	1940	25.7%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	75	1887	301	24.9%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:24	-	490	2055:1724	238+136	131.3 : 131.3%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	459	2115	2115	16.8%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	309	1894:1718	144+93	130.3 : 130.3%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	417	1915	1915	21.8%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**362**	**11**	**63.0**	**220.2**	**0.0**	**283.2**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**362**	**11**	**63.0**	**220.2**	**0.0**	**283.2**	**-**	**-**	**-**	**-**
1/2+1/1	720	544	-	-	-	22.9	90.1	-	113.0	565.0	32.8	90.1	122.9
1/3	207	207	0	196	11	2.3	1.1	0.0	3.4	58.7	6.4	1.1	7.4
2/1	506	506	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	165	165	0	30	0	2.6	1.8	-	4.4	96.4	5.3	1.8	7.1
3/3	227	175	-	-	-	8.3	28.0	-	36.3	575.6	13.0	28.0	41.0
4/1	499	499	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
5/1	75	75	-	-	-	0.8	0.2	-	0.9	44.0	2.1	0.2	2.3
5/2+5/3	490	373	0	136	0	15.9	60.5	0.0	76.4	561.2	20.2	60.5	80.7
6/1	354	354	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	309	237	-	-	-	10.2	38.0	-	48.2	561.4	15.0	38.0	53.0
8/1	417	417	-	-	-	0.0	0.1	-	0.1	1.2	0.5	0.1	0.7

C1

PRC for Signalled Lanes (%): -47.1
PRC Over All Lanes (%): -47.1

Total Delay for Signalled Lanes (pcuHr): 282.58
Total Delay Over All Lanes(pcuHr): 283.15

Cycle Time (s): 144

Full Input Data And Results

Scenario 9: '2029 Scenario A Design 5 Year AM' (FG9: '2029 Scenario A Design 5 Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**166.4%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**166.4%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	670	1890:1767	286+276	119.0 : 119.0%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	176	1890	210	83.8%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	1117	2035	2035	33.7%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:23	-	86	1940:1963	178+50	37.7 : 37.7%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	296	1940	189	156.9%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	555	1940	1940	21.3%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	28	1887	328	8.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	603	2055:1724	322+45	164.5 : 164.5%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	383	2115	2115	15.1%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	18	-	467	1897:1718	105+176	166.4 : 166.4%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	271	1915	1915	14.2%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**195**	**45**	**81.5**	**328.6**	**0.0**	**410.1**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**195**	**45**	**81.5**	**328.6**	**0.0**	**410.1**	**-**	**-**	**-**	**-**
1/2+1/1	670	563	-	-	-	17.2	56.5	-	73.8	396.4	27.2	56.5	83.7
1/3	176	176	0	131	45	2.6	2.3	0.0	4.9	99.3	5.8	2.3	8.1
2/1	686	686	-	-	-	0.0	0.3	-	0.3	1.3	0.0	0.3	0.3
3/2+3/1	86	86	0	19	0	1.3	0.3	-	1.6	65.6	2.5	0.3	2.8
3/3	296	189	-	-	-	14.1	55.0	-	69.1	840.5	20.2	55.0	75.2
4/1	413	413	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	28	28	-	-	-	0.3	0.0	-	0.3	43.8	0.8	0.0	0.8
5/2+5/3	603	367	0	45	0	24.2	119.4	0.0	143.6	857.5	31.8	119.4	151.2
6/1	319	319	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	467	281	-	-	-	21.9	94.4	-	116.2	896.1	29.8	94.4	124.2
8/1	271	271	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -84.8
PRC Over All Lanes (%): -84.8

Total Delay for Signalled Lanes (pcuHr): 409.52
Total Delay Over All Lanes(pcuHr): 410.08

Cycle Time (s): 144

Full Input Data And Results

Scenario 10: '2029 Scenario A Design 5 Year PM' (FG10: '2029 Scenario A Design 5 Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**153.1%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**153.1%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	850	1890:1767	292+263	153.1 : 153.1%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	21	-	234	1890	302	77.5%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	784	2035	2035	25.5%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:27	-	186	1940:1963	181+39	84.8 : 84.8%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	286	1940	189	151.6%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	779	1940	1940	26.4%
5/1	Main Street Left	U	N/A	N/A	B		2	20	-	83	1887	288	28.8%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	20:23	-	552	2055:1724	234+129	152.4 : 152.4%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	513	2115	2115	16.4%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	355	1894:1718	143+95	148.7 : 148.7%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	470	1915	1915	24.5%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**362**	**34**	**88.7**	**359.8**	**0.0**	**448.5**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**362**	**34**	**88.7**	**359.8**	**0.0**	**448.5**	**-**	**-**	**-**	**-**
1/2+1/1	850	555	-	-	-	33.2	148.8	-	181.9	770.5	42.5	148.8	191.2
1/3	234	234	0	200	34	2.7	1.6	0.0	4.3	66.7	7.4	1.6	9.1
2/1	518	518	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	186	186	0	33	0	2.9	2.4	-	5.4	103.7	6.2	2.4	8.6
3/3	286	189	-	-	-	13.1	50.1	-	63.2	795.5	19.0	50.1	69.1
4/1	513	513	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	83	83	-	-	-	0.9	0.2	-	1.1	45.8	2.4	0.2	2.6
5/2+5/3	552	363	0	129	0	21.4	96.4	0.0	117.8	768.4	27.2	96.4	123.5
6/1	347	347	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	355	239	-	-	-	14.6	59.6	-	74.2	752.3	20.0	59.6	79.7
8/1	470	470	-	-	-	0.0	0.2	-	0.2	1.2	1.1	0.2	1.2

C1

PRC for Signalled Lanes (%): -70.1
PRC Over All Lanes (%): -70.1

Total Delay for Signalled Lanes (pcuHr): 447.89
Total Delay Over All Lanes(pcuHr): 448.50

Cycle Time (s): 144

Full Input Data And Results

Scenario 11: '2039 Scenario A Design 15 Year AM' (FG11: '2039 Scenario A Design 15 Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**178.7%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**178.7%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	716	1890:1767	287+276	127.3 : 127.3%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	188	1890	210	89.5%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	1196	2035	2035	33.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	92	1940:1963	167+46	43.0 : 43.0%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	313	1940	175	178.7%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	594	1940	1940	21.4%
5/1	Main Street Left	U	N/A	N/A	B		2	23	-	30	1887	328	9.2%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	23:19	-	648	2055:1724	322+45	176.8 : 176.8%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	410	2115	2115	15.2%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	19	-	503	1897:1718	110+183	171.5 : 171.5%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	290	1915	1915	15.1%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**196**	**57**	**94.9**	**401.2**	**0.0**	**496.1**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**196**	**57**	**94.9**	**401.2**	**0.0**	**496.1**	**-**	**-**	**-**	**-**
1/2+1/1	716	563	-	-	-	21.2	79.0	-	100.2	503.9	31.0	79.0	110.0
1/3	188	188	0	131	57	2.8	3.3	0.0	6.1	116.7	6.2	3.3	9.5
2/1	680	680	-	-	-	0.0	0.3	-	0.3	1.3	0.0	0.3	0.3
3/2+3/1	92	92	0	20	0	1.4	0.4	-	1.8	68.7	2.7	0.4	3.1
3/3	313	175	-	-	-	16.9	70.0	-	86.9	999.8	23.3	70.0	93.3
4/1	416	416	-	-	-	0.0	0.1	-	0.1	1.2	0.0	0.1	0.1
5/1	30	30	-	-	-	0.3	0.1	-	0.4	43.9	0.9	0.1	0.9
5/2+5/3	648	367	0	45	0	27.9	141.9	0.0	169.8	943.2	36.4	141.9	178.3
6/1	321	321	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	503	293	-	-	-	24.4	106.0	-	130.4	933.4	33.1	106.0	139.2
8/1	290	290	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -98.6
PRC Over All Lanes (%): -98.6

Total Delay for Signalled Lanes (pcuHr): 495.55
Total Delay Over All Lanes(pcuHr): 496.12

Cycle Time (s): 144

Full Input Data And Results

Scenario 12: '2039 Scenario A Design 15 Year PM' (FG12: '2039 Scenario A Design 15 Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**164.1%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**164.1%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	34	-	908	1890:1767	293+261	163.9 : 163.9%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	20	-	251	1890	289	86.9%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	838	2035	2035	25.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	13:27	-	200	1940:1963	181+38	91.3 : 91.3%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	13	-	304	1940	189	161.2%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	833	1940	1940	26.4%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	89	1887	301	29.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:23	-	594	2055:1724	233+129	164.1 : 164.1%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	550	2115	2115	16.5%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	14	-	380	1895:1718	143+95	159.2 : 159.2%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	505	1915	1915	26.4%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**371**	**45**	**102.0**	**433.9**	**0.0**	**535.8**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**371**	**45**	**102.0**	**433.9**	**0.0**	**535.8**	**-**	**-**	**-**	**-**
1/2+1/1	908	554	-	-	-	38.2	178.2	-	216.4	858.0	47.3	178.2	225.5
1/3	251	251	0	206	45	3.1	2.9	0.0	6.0	85.6	8.0	2.9	10.9
2/1	517	517	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	200	200	0	35	0	3.2	3.8	-	6.9	125.1	6.8	3.8	10.6
3/3	304	189	-	-	-	14.9	59.0	-	73.8	874.5	21.1	59.0	80.1
4/1	512	512	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	89	89	-	-	-	0.9	0.2	-	1.1	45.4	2.5	0.2	2.7
5/2+5/3	594	362	0	129	0	24.7	117.3	0.0	141.9	860.2	31.3	117.3	148.6
6/1	350	350	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	380	239	-	-	-	17.0	71.9	-	89.0	843.0	22.9	71.9	94.9
8/1	505	505	-	-	-	0.0	0.2	-	0.2	1.3	1.1	0.2	1.3

C1

PRC for Signalled Lanes (%): -82.3
PRC Over All Lanes (%): -82.3

Total Delay for Signalled Lanes (pcuHr): 535.21
Total Delay Over All Lanes(pcuHr): 535.84

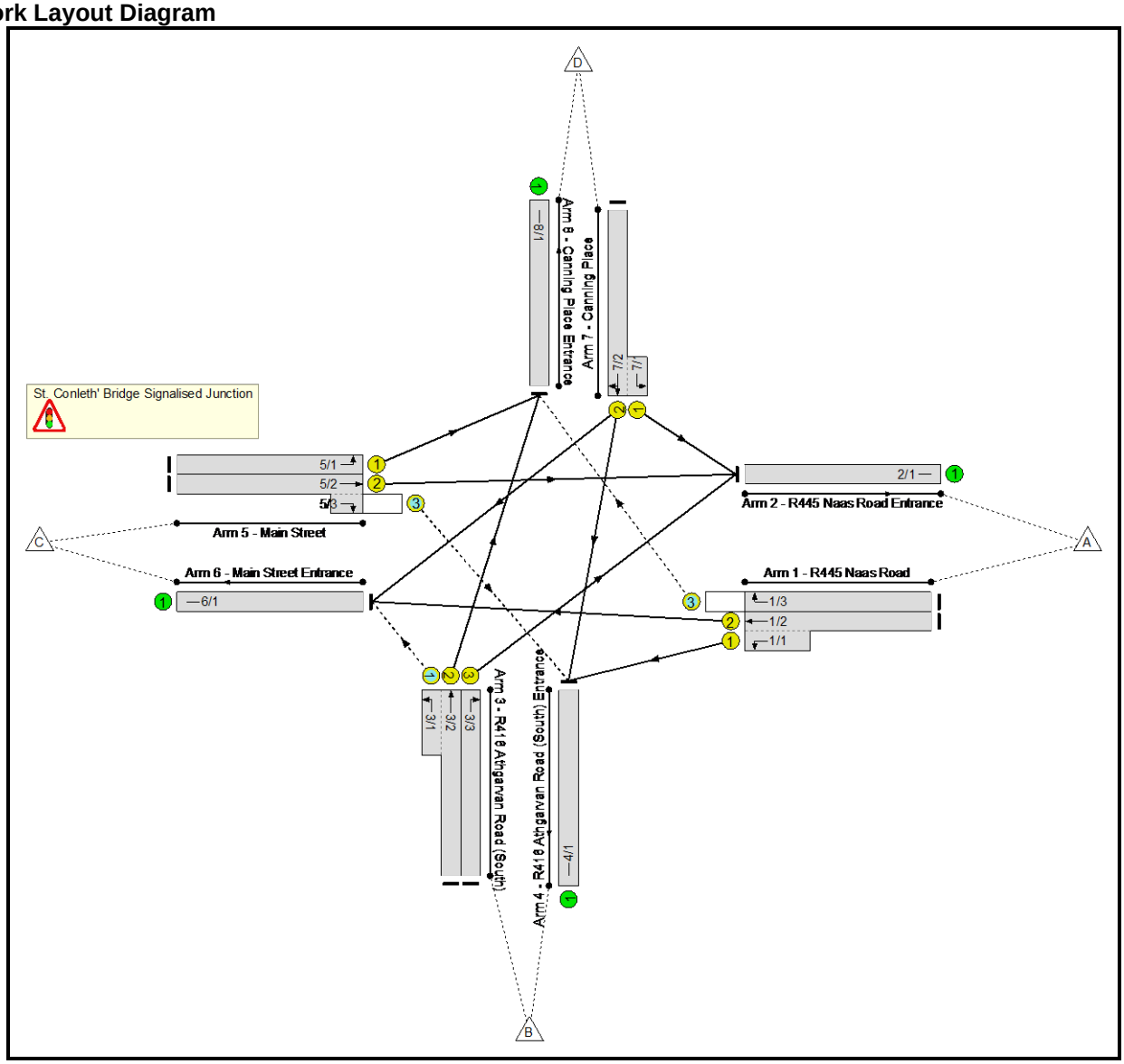
Cycle Time (s): 144

Full Input Data And Results

User and Project Details

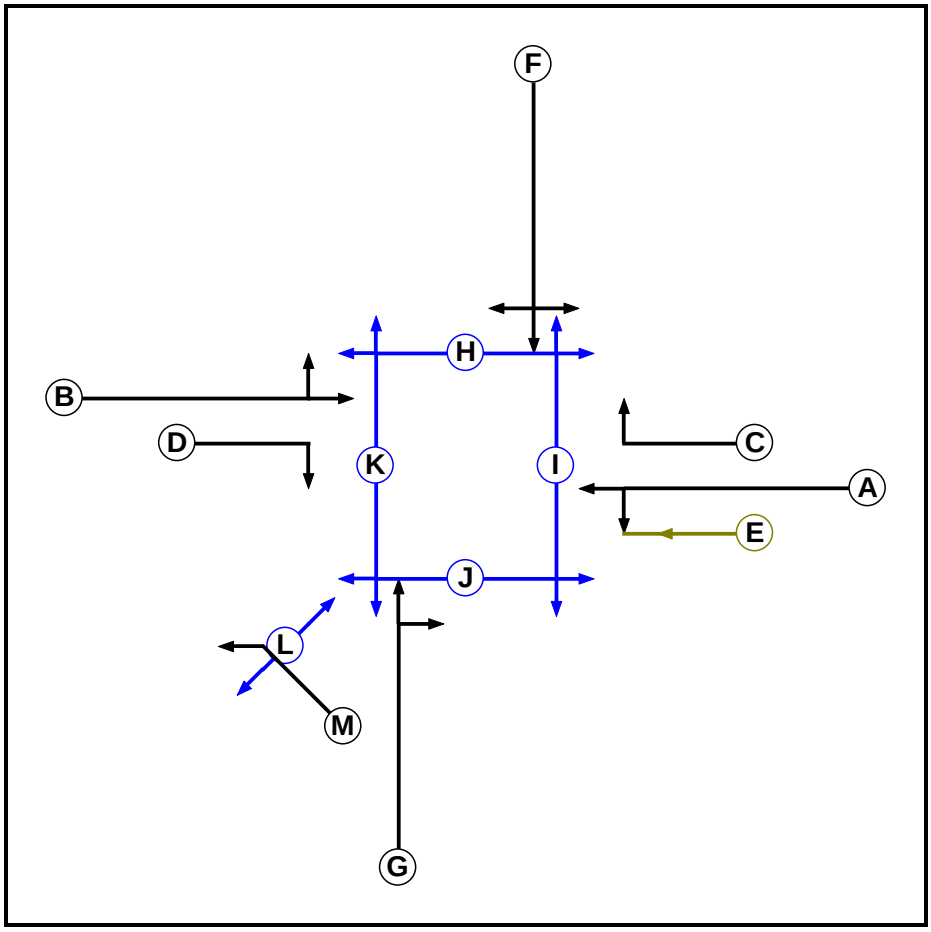
Project:	**192229**
Title:	**Newbridge SHD**
Location:	
Client:	Aston Ltd
Date Started:	April 2021
Checked By:	J Tiernan
Additional detail:	
File name:	192229 - St. Conleth's Bridge Signalised Junction - Scenario C.lsg3x
Author:	J Tiernan
Company:	PUNCH Consulting Engineers
Address:	Carnegie House, Library Road, Dun Laoghaire, Co Dublin, A96 C7W7, Ireland

Network Layout Diagram



Full Input Data And Results

Phase Diagram



Phase Input Data

Phase Name	Phase Type	Assoc. Phase	Street Min	Cont Min
A	Traffic		7	7
B	Traffic		7	7
C	Traffic		7	7
D	Traffic		7	7
E	Filter	A	4	0
F	Traffic		7	7
G	Traffic		7	7
H	Pedestrian		7	7
I	Pedestrian		7	7
J	Pedestrian		7	7
K	Pedestrian		7	7
L	Pedestrian		7	7
M	Traffic		7	7

Full Input Data And Results

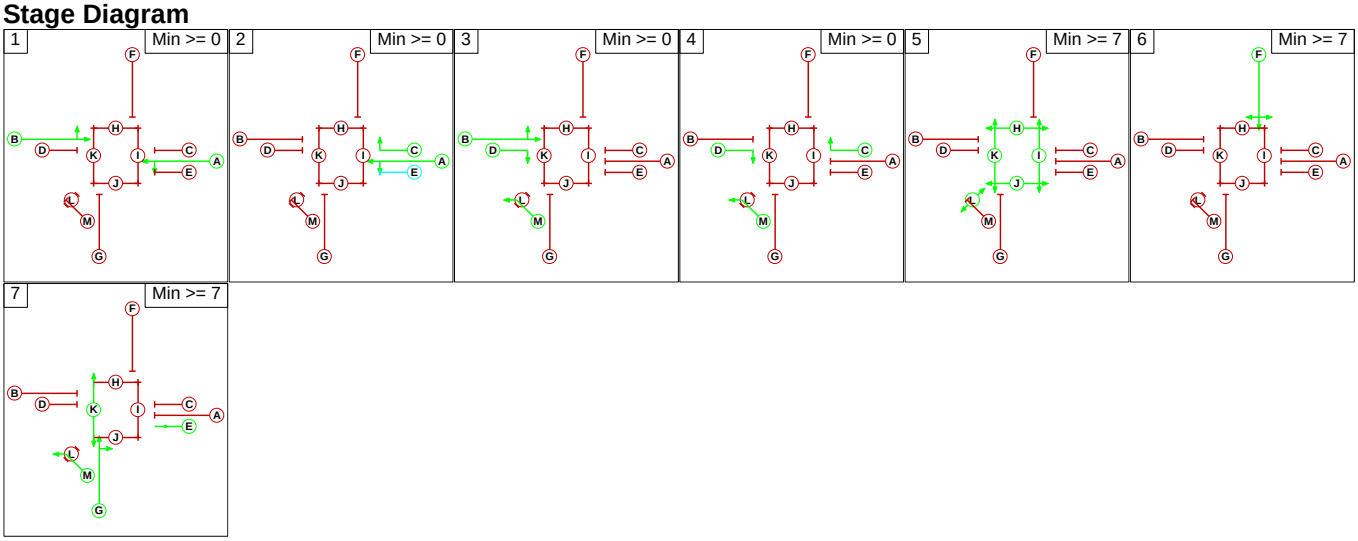
Phase Intergreens Matrix

		Starting Phase												
		A	B	C	D	E	F	G	H	I	J	K	L	M
Terminating Phase	A		-	-	6	-	6	6	8	6	9	10	10	10
	B	-		6	-	5	8	6	9	10	9	5	5	-
	C	-	5		-	-	6	5	8	6	-	-	5	-
	D	-	-	-		-	-	-	-	-	9	5	5	-
	E	-	5	-	5		5	-	-	6	9	-	5	-
	F	5	6	5	6	5		5	5	6	10	10	10	10
	G	7	6	7	5	-	8		10	9	6	-	5	-
	H	11	11	11	-	-	11	11		-	-	-	-	11
	I	17	1	17	-	17	17	17	-		-	-	-	17
	J	15	15	-	15	15	15	15	-	-		-	-	15
	K	16	16	-	16	-	16	-	-	-	-		-	-
	L	8	8	8	8	8	8	8	-	-	-	-		8
	M	5	-	-	-	-	5	-	5	5	5	-	5	

Phases in Stage

Stage No.	Phases in Stage
1	A B
2	A C
3	B D M
4	C D M
5	H I J K L
6	F
7	E G K M

Stage Diagram



Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
There are no Phase Delays defined					

Full Input Data And Results

Prohibited Stage Change

From Stage \ To Stage	1	2	3	4	5	6	7
1		6	10	10	10	8	10
2	5		10	10	10	6	10
3	5	6		6	10	8	6
4	5	5	5		9	6	5
5	17	17	17	17		17	17
6	6	5	10	10	10		10
7	21	16	X	X	X	X	

Give-Way Lane Input Data

Junction: St. Conleth' Bridge Signalised Junction

Lane	Movement	Max Flow when Giving Way (PCU/Hr)	Min Flow when Giving Way (PCU/Hr)	Opposing Lane	Opp. Lane Coeff.	Opp. Mvmnts.	Right Turn Storage (PCU)	Non-Blocking Storage (PCU)	RTF	Right Turn Move up (s)	Max Turns in Intergreen (PCU)
1/3 (R445 Naas Road)	8/1 (Right)	1439	0	5/2	1.09	All	3.00	-	0.50	3	2.00
				5/1	1.09	All					
3/1 (R416 Athgarvan Road (South))	6/1 (Left)	715	0	7/2	0.22	All	-	-	-	-	-
				1/2	0.22	All					
5/3 (Main Street)	4/1 (Right)	1439	0	1/2	1.09	All	3.00	-	0.50	3	2.00

Full Input Data And Results

Lane Input Data

Junction: St. Conleth' Bridge Signalised Junction

Lane	Lane Type	Phases	Start Disp.	End Disp.	Physical Length (PCU)	Sat Flow Type	Def User Saturation Flow (PCU/Hr)	Lane Width (m)	Gradient	Nearside Lane	Turns	Turning Radius (m)
1/1 (R445 Naas Road)	U	A	2	3	5.0	Geom	-	2.85	0.00	Y	Arm 4 Left	20.00
1/2 (R445 Naas Road)	U	A	2	3	60.0	Geom	-	2.75	0.00	Y	Arm 6 Ahead	Inf
1/3 (R445 Naas Road)	O	C	2	3	9.0	Geom	-	2.75	0.00	Y	Arm 8 Right	Inf
2/1 (R445 Naas Road Entrance)	U		2	3	60.0	Geom	-	4.20	0.00	Y		
3/1 (R416 Athgarvan Road (South))	O	M	2	3	5.0	Geom	-	4.50	0.00	Y	Arm 6 Left	29.00
3/2 (R416 Athgarvan Road (South))	U	G	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 8 Ahead	Inf
3/3 (R416 Athgarvan Road (South))	U	G	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 2 Right	Inf
4/1 (R416 Athgarvan Road (South) Entrance)	U		2	3	60.0	Geom	-	3.25	0.00	Y		
5/1 (Main Street)	U	B	2	3	6.0	Geom	-	3.25	0.00	Y	Arm 8 Left	53.00
5/2 (Main Street)	U	B	2	3	60.0	Geom	-	3.00	0.00	N	Arm 2 Ahead	Inf
5/3 (Main Street)	O	D	2	3	2.5	Geom	-	3.25	0.00	Y	Arm 4 Right	12.00
6/1 (Main Street Entrance)	U		2	3	60.0	Geom	-	5.00	0.00	Y		
7/1 (Canning Place)	U	F	2	3	3.0	Geom	-	2.75	0.00	Y	Arm 2 Left	15.00
7/2 (Canning Place)	U	F	2	3	60.0	Geom	-	3.00	0.00	Y	Arm 4 Ahead Arm 6 Right	Inf 21.30
8/1 (Canning Place Entrance)	U		2	3	60.0	Geom	-	3.00	0.00	Y		

Full Input Data And Results

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: '2024 Do Nothing AM'	08:45	09:45	01:00	
2: '2024 Do Nothing PM'	17:00	18:00	01:00	
3: '2029 Do Nothing AM'	08:45	09:45	01:00	
4: '2029 Do Nothing PM'	17:00	18:00	01:00	
5: '2039 Do Nothing AM'	08:45	09:45	01:00	
6: '2039 Do Nothing PM'	17:00	18:00	01:00	
7: '2024 Scenario A Opening Year AM'	08:45	09:45	01:00	
8: '2024 Scenario A Opening Year PM'	17:00	18:00	01:00	
9: '2029 Scenario A Design 5 Year AM'	08:45	09:45	01:00	
10: '2029 Scenario A Design 5 Year PM'	17:00	18:00	01:00	
11: '2039 Scenario A Design 15 Year AM'	08:45	09:45	01:00	
12: '2039 Scenario A Design 15 Year PM'	17:00	18:00	01:00	

Traffic Flows, Desired

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	153	170	112	435
	B	121	0	17	55	193
	C	278	67	0	25	370
	D	252	135	21	0	408
	Tot.	651	355	208	192	1406

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	180	232	158	570
	B	126	0	30	135	291
	C	179	178	0	75	432
	D	110	157	30	0	297
	Tot.	415	515	292	368	1590

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	170	188	123	481
	B	136	0	19	67	222
	C	306	74	0	28	408
	D	278	152	23	0	453
	Tot.	720	396	230	218	1564

Full Input Data And Results

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	202	255	174	631
	B	141	0	33	153	327
	C	198	196	0	83	477
	D	122	180	33	0	335
	Tot.	461	578	321	410	1770

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	183	203	133	519
	B	146	0	20	72	238
	C	330	79	0	30	439
	D	300	164	25	0	489
	Tot.	776	426	248	235	1685

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	217	275	188	680
	B	152	0	35	165	352
	C	213	212	0	89	514
	D	131	193	35	0	359
	Tot.	496	622	345	442	1905

Scenario 7: '2024 Scenario A Opening Year AM' (FG7: '2024 Scenario A Opening Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	157	176	112	445
	B	125	0	17	66	208
	C	283	67	0	25	375
	D	252	144	21	0	417
	Tot.	660	368	214	203	1445

Scenario 8: '2024 Scenario A Opening Year PM' (FG8: '2024 Scenario A Opening Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	184	237	158	579
	B	130	0	30	144	304
	C	185	178	0	75	438
	D	110	167	30	0	307
	Tot.	425	529	297	377	1628

Full Input Data And Results

Scenario 9: '2029 Scenario A Design 5 Year AM' (FG9: '2029 Scenario A Design 5 Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	175	199	123	497
	B	143	0	19	86	248
	C	315	74	0	28	417
	D	278	165	23	0	466
	Tot.	736	414	241	237	1628

Scenario 10: '2029 Scenario A Design 5 Year PM' (FG10: '2029 Scenario A Design 5 Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	209	264	174	647
	B	147	0	33	168	348
	C	209	196	0	83	488
	D	122	198	33	0	353
	Tot.	478	603	330	425	1836

Scenario 11: '2039 Scenario A Design 15 Year AM' (FG11: '2039 Scenario A Design 15 Year AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	188	214	133	535
	B	154	0	20	91	265
	C	339	79	0	30	448
	D	300	176	25	0	501
	Tot.	793	443	259	254	1749

Scenario 12: '2039 Scenario A Design 15 Year PM' (FG12: '2039 Scenario A Design 15 Year PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	225	284	188	697
	B	158	0	35	179	372
	C	225	212	0	89	526
	D	131	212	35	0	378
	Tot.	514	649	354	456	1973

Full Input Data And Results

Network Results

Scenario 1: '2024 Do Nothing AM' (FG1: '2024 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**114.4%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**114.4%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	29	-	323	1890:1767	259+233	65.7 : 65.7%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	112	1890	210	53.3%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	651	2035	2035	29.0%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	72	1940:1963	166+51	33.1 : 33.1%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	121	1940	175	69.1%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	355	1940	1940	17.1%
5/1	Main Street Left	U	N/A	N/A	B		2	18	-	25	1887	262	9.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	18:19	-	345	2055:1724	248+60	111.9 : 111.9%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	208	2115	2115	9.7%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	24	-	408	1897:1718	136+220	114.4 : 114.4%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	192	1915	1915	10.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**161**	**29**	**25.8**	**54.8**	**0.0**	**80.6**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**161**	**29**	**25.8**	**54.8**	**0.0**	**80.6**	**-**	**-**	**-**	**-**
1/2+1/1	323	323	-	-	-	4.5	0.9	-	5.4	60.3	6.9	0.9	7.8
1/3	112	112	0	83	29	1.4	0.6	0.0	2.0	64.7	3.6	0.6	4.2
2/1	590	590	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	72	72	0	17	0	1.1	0.2	-	1.3	65.3	2.0	0.2	2.3
3/3	121	121	-	-	-	2.1	1.1	-	3.2	95.5	4.7	1.1	5.7
4/1	333	333	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
5/1	25	25	-	-	-	0.3	0.1	-	0.3	49.0	0.7	0.1	0.8
5/2+5/3	345	310	0	62	0	7.2	22.3	0.0	29.5	307.8	12.5	22.3	34.7
6/1	205	205	-	-	-	0.0	0.1	-	0.1	0.9	0.0	0.1	0.1
7/2+7/1	408	357	-	-	-	9.2	29.2	-	38.4	338.6	17.0	29.2	46.2
8/1	192	192	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1

C1 PRC for Signalled Lanes (%): -27.1 Total Delay for Signalled Lanes (pcuHr): 80.15 Cycle Time (s): 144
PRC Over All Lanes (%): -27.1 Total Delay Over All Lanes(pcuHr): 80.57

Full Input Data And Results

Scenario 2: '2024 Do Nothing PM' (FG2: '2024 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**96.1%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**96.1%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	26	-	412	1890:1767	247+192	94.0 : 94.0%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	15	-	158	1890	223	70.8%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	415	2035	2035	20.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:29	-	165	1940:1963	169+38	79.8 : 79.8%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	126	1940	175	71.9%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	515	1940	1940	26.5%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	75	1887	301	24.9%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:26	-	357	2055:1724	188+187	95.0 : 95.0%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	292	2115	2115	13.8%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	20	-	297	1894:1718	195+115	96.1 : 96.1%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	368	1915	1915	19.2%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**320**	**46**	**25.5**	**22.3**	**0.0**	**47.8**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**320**	**46**	**25.5**	**22.3**	**0.0**	**47.8**	**-**	**-**	**-**	**-**
1/2+1/1	412	412	-	-	-	6.3	5.5	-	11.8	103.4	12.3	5.5	17.7
1/3	158	158	0	115	43	1.9	1.2	0.0	3.1	69.9	4.9	1.2	6.1
2/1	415	415	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
3/2+3/1	165	165	0	30	0	2.6	1.8	-	4.4	96.3	5.3	1.8	7.1
3/3	126	126	-	-	-	2.2	1.2	-	3.5	98.6	4.9	1.2	6.1
4/1	515	515	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	75	75	-	-	-	0.8	0.2	-	1.0	47.5	2.2	0.2	2.4
5/2+5/3	357	357	0	174	4	6.7	5.9	0.0	12.5	126.3	11.7	5.9	17.5
6/1	292	292	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	297	297	-	-	-	4.9	6.1	-	11.0	133.6	10.0	6.1	16.0
8/1	368	368	-	-	-	0.0	0.1	-	0.1	1.2	0.5	0.1	0.7

C1 PRC for Signalled Lanes (%): -6.7 Total Delay for Signalled Lanes (pcuHr): 47.31 Cycle Time (s): 144
PRC Over All Lanes (%): -6.7 Total Delay Over All Lanes(pcuHr): 47.82

Full Input Data And Results

Scenario 3: '2029 Do Nothing AM' (FG3: '2029 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**126.7%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**126.7%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	29	-	358	1890:1767	258+234	72.7 : 72.7%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	123	1890	210	58.6%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	720	2035	2035	29.7%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	86	1940:1963	167+47	40.1 : 40.1%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	136	1940	175	77.7%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	396	1940	1940	18.0%
5/1	Main Street Left	U	N/A	N/A	B		2	18	-	28	1887	262	10.7%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	18:19	-	380	2055:1724	248+60	123.3 : 123.3%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	230	2115	2115	10.6%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	24	-	453	1897:1718	138+219	126.7 : 126.7%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	218	1915	1915	11.4%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**163**	**39**	**34.3**	**92.8**	**0.0**	**127.1**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**163**	**39**	**34.3**	**92.8**	**0.0**	**127.1**	**-**	**-**	**-**	**-**
1/2+1/1	358	358	-	-	-	5.0	1.3	-	6.3	63.7	8.4	1.3	9.7
1/3	123	123	0	84	39	1.6	0.7	0.0	2.3	67.2	4.0	0.7	4.7
2/1	604	604	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
3/2+3/1	86	86	0	19	0	1.3	0.3	-	1.6	67.8	2.5	0.3	2.8
3/3	136	136	-	-	-	2.4	1.6	-	4.0	106.6	5.3	1.6	6.9
4/1	350	350	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
5/1	28	28	-	-	-	0.3	0.1	-	0.4	49.2	0.8	0.1	0.9
5/2+5/3	380	308	0	60	0	10.1	38.3	0.0	48.4	458.9	15.0	38.3	53.4
6/1	225	225	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	453	357	-	-	-	13.6	50.0	-	63.6	505.4	22.1	50.0	72.1
8/1	218	218	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -40.8
PRC Over All Lanes (%): -40.8

Total Delay for Signalled Lanes (pcuHr): 126.70
Total Delay Over All Lanes(pcuHr): 127.14

Cycle Time (s): 144

Full Input Data And Results

Scenario 4: '2029 Do Nothing PM' (FG4: '2029 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**106.8%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**106.8%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	25	-	457	1890:1767	239+189	106.8 : 106.8%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	174	1890	210	82.9%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	461	2035	2035	21.9%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:29	-	186	1940:1963	169+37	90.3 : 90.3%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	141	1940	175	80.5%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	578	1940	1940	28.3%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	83	1887	301	27.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:26	-	394	2055:1724	189+187	104.9 : 104.9%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	321	2115	2115	14.3%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	21	-	335	1894:1718	204+117	104.4 : 104.4%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	410	1915	1915	21.4%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**350**	**44**	**33.1**	**57.3**	**0.0**	**90.5**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**350**	**44**	**33.1**	**57.3**	**0.0**	**90.5**	**-**	**-**	**-**	**-**
1/2+1/1	457	428	-	-	-	9.3	20.3	-	29.6	233.1	16.1	20.3	36.4
1/3	174	174	0	131	43	2.3	2.2	0.0	4.5	92.8	5.4	2.2	7.6
2/1	447	447	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
3/2+3/1	186	186	0	33	0	3.0	3.5	-	6.4	124.4	6.3	3.5	9.7
3/3	141	141	-	-	-	2.5	1.9	-	4.4	111.8	5.5	1.9	7.4
4/1	548	548	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	83	83	-	-	-	0.9	0.2	-	1.1	48.6	2.5	0.2	2.7
5/2+5/3	394	376	0	186	1	8.8	15.5	0.0	24.3	222.0	14.3	15.5	29.8
6/1	303	303	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	335	321	-	-	-	6.2	13.4	-	19.6	210.5	12.4	13.4	25.8
8/1	410	410	-	-	-	0.0	0.1	-	0.1	1.2	1.1	0.1	1.2

C1

PRC for Signalled Lanes (%): -18.7
PRC Over All Lanes (%): -18.7

Total Delay for Signalled Lanes (pcuHr): 89.89
Total Delay Over All Lanes(pcuHr): 90.45

Cycle Time (s): 144

Full Input Data And Results

Scenario 5: '2039 Do Nothing AM' (FG5: '2039 Do Nothing AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**136.8%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**136.8%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	29	-	386	1890:1767	259+233	78.5 : 78.5%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	133	1890	210	63.3%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	776	2035	2035	30.2%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	92	1940:1963	167+46	43.0 : 43.0%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	146	1940	175	83.4%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	426	1940	1940	18.7%
5/1	Main Street Left	U	N/A	N/A	B		2	18	-	30	1887	262	11.4%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	18:19	-	409	2055:1724	249+59	132.8 : 132.8%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	248	2115	2115	11.4%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	24	-	489	1897:1718	138+219	136.8 : 136.8%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	235	1915	1915	12.3%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**170**	**42**	**41.3**	**125.7**	**0.0**	**167.0**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**170**	**42**	**41.3**	**125.7**	**0.0**	**167.0**	**-**	**-**	**-**	**-**
1/2+1/1	386	386	-	-	-	5.5	1.8	-	7.3	67.7	9.8	1.8	11.5
1/3	133	133	0	91	42	1.8	0.8	0.0	2.6	70.7	4.4	0.8	5.2
2/1	614	614	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
3/2+3/1	92	92	0	20	0	1.4	0.4	-	1.8	68.8	2.7	0.4	3.1
3/3	146	146	-	-	-	2.6	2.2	-	4.8	118.2	5.7	2.2	7.9
4/1	362	362	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
5/1	30	30	-	-	-	0.3	0.1	-	0.4	49.3	0.9	0.1	1.0
5/2+5/3	409	308	0	59	0	12.5	52.4	0.0	65.0	572.1	17.2	52.4	69.6
6/1	241	241	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	489	358	-	-	-	17.1	67.6	-	84.7	623.5	26.3	67.6	93.8
8/1	235	235	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -52.0
PRC Over All Lanes (%): -52.0

Total Delay for Signalled Lanes (pcuHr): 166.52
Total Delay Over All Lanes(pcuHr): 166.99

Cycle Time (s): 144

Full Input Data And Results

Scenario 6: '2039 Do Nothing PM' (FG6: '2039 Do Nothing PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**115.1%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**115.1%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	25	-	492	1890:1767	239+188	115.1 : 115.1%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	188	1890	210	89.5%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	496	2035	2035	22.5%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:29	-	200	1940:1963	170+36	97.3 : 97.3%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	152	1940	175	86.8%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	622	1940	1940	28.3%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	89	1887	301	29.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:26	-	425	2055:1724	188+187	113.1 : 113.1%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	345	2115	2115	14.4%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	21	-	359	1895:1718	204+117	111.8 : 111.8%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	442	1915	1915	23.1%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**352**	**58**	**41.0**	**99.6**	**0.0**	**140.6**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**352**	**58**	**41.0**	**99.6**	**0.0**	**140.6**	**-**	**-**	**-**	**-**
1/2+1/1	492	427	-	-	-	12.4	35.8	-	48.2	352.6	19.0	35.8	54.8
1/3	188	188	0	131	57	2.6	3.3	0.0	5.9	112.8	5.8	3.3	9.1
2/1	457	457	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
3/2+3/1	200	200	0	35	0	3.2	5.8	-	9.0	162.9	6.9	5.8	12.7
3/3	152	152	-	-	-	2.7	2.7	-	5.4	127.9	6.0	2.7	8.7
4/1	548	548	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	89	89	-	-	-	1.0	0.2	-	1.2	48.9	2.7	0.2	2.9
5/2+5/3	425	376	0	186	1	11.2	28.4	0.0	39.7	335.9	16.7	28.4	45.1
6/1	305	305	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	359	321	-	-	-	7.8	22.9	-	30.7	307.6	14.5	22.9	37.4
8/1	442	442	-	-	-	0.0	0.2	-	0.2	1.2	1.1	0.2	1.2

C1

PRC for Signalled Lanes (%): -27.9
PRC Over All Lanes (%): -27.9

Total Delay for Signalled Lanes (pcuHr): 140.06
Total Delay Over All Lanes(pcuHr): 140.64

Cycle Time (s): 144

Full Input Data And Results

Scenario 7: '2024 Scenario A Opening Year AM' (FG7: '2024 Scenario A Opening Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**116.0%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**116.0%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	29	-	333	1890:1767	259+231	67.9 : 67.9%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	112	1890	210	53.3%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	660	2035	2035	29.0%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	83	1940:1963	168+43	39.3 : 39.3%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	125	1940	175	71.4%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	368	1940	1940	17.6%
5/1	Main Street Left	U	N/A	N/A	B		2	18	-	25	1887	262	9.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	18:19	-	350	2055:1724	249+59	113.7 : 113.7%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	214	2115	2115	10.0%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	24	-	417	1898:1718	142+217	116.0 : 116.0%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	203	1915	1915	10.6%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**159**	**29**	**27.3**	**60.2**	**0.0**	**87.5**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**159**	**29**	**27.3**	**60.2**	**0.0**	**87.5**	**-**	**-**	**-**	**-**
1/2+1/1	333	333	-	-	-	4.6	1.0	-	5.7	61.2	7.4	1.0	8.4
1/3	112	112	0	83	29	1.4	0.6	0.0	2.0	64.7	3.6	0.6	4.2
2/1	591	591	-	-	-	0.0	0.2	-	0.2	1.2	0.0	0.2	0.2
3/2+3/1	83	83	0	17	0	1.3	0.3	-	1.6	68.3	2.5	0.3	2.8
3/3	125	125	-	-	-	2.2	1.2	-	3.4	98.0	4.9	1.2	6.1
4/1	341	341	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
5/1	25	25	-	-	-	0.3	0.1	-	0.3	49.0	0.7	0.1	0.8
5/2+5/3	350	308	0	60	0	7.7	24.7	0.0	32.3	332.7	12.9	24.7	37.6
6/1	211	211	-	-	-	0.0	0.1	-	0.1	0.9	0.0	0.1	0.1
7/2+7/1	417	360	-	-	-	9.8	32.0	-	41.8	360.4	17.7	32.0	49.6
8/1	203	203	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -28.8
PRC Over All Lanes (%): -28.8

Total Delay for Signalled Lanes (pcuHr): 87.09
Total Delay Over All Lanes(pcuHr): 87.52

Cycle Time (s): 144

Full Input Data And Results

Scenario 8: '2024 Scenario A Opening Year PM' (FG8: '2024 Scenario A Opening Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**98.9%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**98.9%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	25	-	421	1890:1767	240+186	98.9 : 98.9%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	158	1890	210	75.2%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	425	2035	2035	20.9%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:29	-	174	1940:1963	170+35	84.9 : 84.9%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	130	1940	175	74.2%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	529	1940	1940	27.3%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	75	1887	301	24.9%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:26	-	363	2055:1724	192+184	96.5 : 96.5%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	297	2115	2115	14.0%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	21	-	307	1895:1718	205+115	96.0 : 96.0%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	377	1915	1915	19.7%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**320**	**46**	**26.5**	**28.0**	**0.0**	**54.5**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**320**	**46**	**26.5**	**28.0**	**0.0**	**54.5**	**-**	**-**	**-**	**-**
1/2+1/1	421	421	-	-	-	6.6	9.1	-	15.8	134.7	12.8	9.1	22.0
1/3	158	158	0	115	43	2.0	1.4	0.0	3.5	78.9	4.9	1.4	6.4
2/1	425	425	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
3/2+3/1	174	174	0	30	0	2.8	2.4	-	5.2	107.5	5.8	2.4	8.2
3/3	130	130	-	-	-	2.3	1.4	-	3.7	101.5	5.1	1.4	6.4
4/1	529	529	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	75	75	-	-	-	0.8	0.2	-	1.0	48.1	2.2	0.2	2.4
5/2+5/3	363	363	0	174	4	6.9	6.8	0.0	13.7	135.8	12.2	6.8	19.0
6/1	297	297	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	307	307	-	-	-	5.1	6.1	-	11.2	130.9	10.4	6.1	16.5
8/1	377	377	-	-	-	0.0	0.1	-	0.1	1.2	1.1	0.1	1.2

C1

PRC for Signalled Lanes (%): -9.8
PRC Over All Lanes (%): -9.8

Total Delay for Signalled Lanes (pcuHr): 53.94
Total Delay Over All Lanes(pcuHr): 54.46

Cycle Time (s): 144

Full Input Data And Results

Scenario 9: '2029 Scenario A Design 5 Year AM' (FG9: '2029 Scenario A Design 5 Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**128.9%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**128.9%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	29	-	374	1890:1767	260+229	76.5 : 76.5%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	123	1890	210	58.6%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	736	2035	2035	29.9%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	105	1940:1963	169+37	50.8 : 50.8%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	143	1940	175	81.6%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	414	1940	1940	18.6%
5/1	Main Street Left	U	N/A	N/A	B		2	18	-	28	1887	262	10.7%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	18:19	-	389	2055:1724	249+58	126.5 : 126.5%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	241	2115	2115	11.2%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	24	-	466	1899:1718	146+216	128.9 : 128.9%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	237	1915	1915	12.4%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**162**	**39**	**36.8**	**102.7**	**0.0**	**139.5**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**162**	**39**	**36.8**	**102.7**	**0.0**	**139.5**	**-**	**-**	**-**	**-**
1/2+1/1	374	374	-	-	-	5.3	1.6	-	6.9	66.2	9.3	1.6	10.9
1/3	123	123	0	84	39	1.6	0.7	0.0	2.3	67.2	4.0	0.7	4.7
2/1	608	608	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
3/2+3/1	105	105	0	19	0	1.6	0.5	-	2.1	73.3	3.3	0.5	3.8
3/3	143	143	-	-	-	2.6	2.0	-	4.5	114.2	5.6	2.0	7.6
4/1	361	361	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
5/1	28	28	-	-	-	0.3	0.1	-	0.4	49.2	0.8	0.1	0.9
5/2+5/3	389	308	0	58	0	10.9	43.0	0.0	53.9	499.1	15.7	43.0	58.8
6/1	236	236	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	466	361	-	-	-	14.5	54.4	-	68.9	532.4	23.2	54.4	77.6
8/1	237	237	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -43.2
PRC Over All Lanes (%): -43.2

Total Delay for Signalled Lanes (pcuHr): 139.08
Total Delay Over All Lanes(pcuHr): 139.54

Cycle Time (s): 144

Full Input Data And Results

Scenario 10: '2029 Scenario A Design 5 Year PM' (FG10: '2029 Scenario A Design 5 Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**111.0%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**111.0%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	25	-	473	1890:1767	239+189	110.6 : 110.6%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	174	1890	210	82.9%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	478	2035	2035	22.2%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:29	-	201	1940:1963	170+33	98.7 : 98.7%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	147	1940	175	83.9%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	603	1940	1940	28.3%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	83	1887	301	27.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:26	-	405	2055:1724	194+182	107.6 : 107.6%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	330	2115	2115	14.3%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	21	-	353	1896:1718	208+110	111.0 : 111.0%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	425	1915	1915	22.2%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**345**	**44**	**37.0**	**79.8**	**0.0**	**116.8**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**345**	**44**	**37.0**	**79.8**	**0.0**	**116.8**	**-**	**-**	**-**	**-**
1/2+1/1	473	428	-	-	-	10.7	27.0	-	37.8	287.5	17.4	27.0	44.5
1/3	174	174	0	131	43	2.3	2.2	0.0	4.5	92.8	5.4	2.2	7.6
2/1	451	451	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
3/2+3/1	201	201	0	33	0	3.3	6.5	-	9.8	174.6	7.0	6.5	13.5
3/3	147	147	-	-	-	2.6	2.3	-	4.9	119.6	5.8	2.3	8.0
4/1	549	549	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	83	83	-	-	-	0.9	0.2	-	1.1	48.6	2.5	0.2	2.7
5/2+5/3	405	376	0	181	1	9.6	19.5	0.0	29.1	258.9	15.0	19.5	34.5
6/1	301	301	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	353	318	-	-	-	7.5	21.6	-	29.1	296.9	14.2	21.6	35.8
8/1	425	425	-	-	-	0.0	0.1	-	0.1	1.2	1.6	0.1	1.7

C1

PRC for Signalled Lanes (%): -23.3
PRC Over All Lanes (%): -23.3

Total Delay for Signalled Lanes (pcuHr): 116.25
Total Delay Over All Lanes(pcuHr): 116.82

Cycle Time (s): 144

Full Input Data And Results

Scenario 11: '2039 Scenario A Design 15 Year AM' (FG11: '2039 Scenario A Design 15 Year AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**138.8%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**138.8%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	29	-	402	1890:1767	260+229	82.2 : 82.2%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	133	1890	210	63.3%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	793	2035	2035	30.4%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:22	-	111	1940:1963	169+37	53.8 : 53.8%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	154	1940	175	87.9%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	443	1940	1940	19.2%
5/1	Main Street Left	U	N/A	N/A	B		2	18	-	30	1887	262	11.4%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	18:19	-	418	2055:1724	249+58	136.0 : 136.0%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	259	2115	2115	11.9%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	24	-	501	1898:1718	145+216	138.8 : 138.8%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	254	1915	1915	13.3%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**169**	**42**	**43.8**	**136.0**	**0.0**	**179.8**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**169**	**42**	**43.8**	**136.0**	**0.0**	**179.8**	**-**	**-**	**-**	**-**
1/2+1/1	402	402	-	-	-	5.8	2.2	-	8.0	71.5	10.7	2.2	12.9
1/3	133	133	0	91	42	1.8	0.8	0.0	2.6	70.7	4.4	0.8	5.2
2/1	619	619	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
3/2+3/1	111	111	0	20	0	1.7	0.6	-	2.3	74.6	3.5	0.6	4.0
3/3	154	154	-	-	-	2.8	2.9	-	5.6	131.7	6.1	2.9	8.9
4/1	373	373	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
5/1	30	30	-	-	-	0.3	0.1	-	0.4	49.3	0.9	0.1	1.0
5/2+5/3	418	307	0	58	0	13.4	57.2	0.0	70.5	607.5	18.0	57.2	75.2
6/1	252	252	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	501	361	-	-	-	18.0	71.8	-	89.8	645.4	27.3	71.8	99.1
8/1	254	254	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1

C1

PRC for Signalled Lanes (%): -54.2
PRC Over All Lanes (%): -54.2

Total Delay for Signalled Lanes (pcuHr): 179.30
Total Delay Over All Lanes(pcuHr): 179.79

Cycle Time (s): 144

Full Input Data And Results

Scenario 12: '2039 Scenario A Design 15 Year PM' (FG12: '2039 Scenario A Design 15 Year PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**119.0%**
St. Conleth' Bridge Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**119.0%**
1/2+1/1	R445 Naas Road Left Ahead	U	N/A	N/A	A		1	25	-	509	1890:1767	239+189	119.0 : 119.0%
1/3	R445 Naas Road Right	O	N/A	N/A	C		2	14	-	188	1890	210	89.5%
2/1	R445 Naas Road Entrance	U	N/A	N/A	-		-	-	-	514	2035	2035	22.7%
3/2+3/1	R416 Athgarvan Road (South) Left Ahead	U+O	N/A	N/A	G M		1:2	12:29	-	214	1940:1963	170+33	105.2 : 105.2%
3/3	R416 Athgarvan Road (South) Right	U	N/A	N/A	G		1	12	-	158	1940	175	90.2%
4/1	R416 Athgarvan Road (South) Entrance	U	N/A	N/A	-		-	-	-	649	1940	1940	28.4%
5/1	Main Street Left	U	N/A	N/A	B		2	21	-	89	1887	301	29.5%
5/2+5/3	Main Street Ahead Right	U+O	N/A	N/A	B D		2:1	21:26	-	437	2055:1724	194+183	116.1 : 116.1%
6/1	Main Street Entrance	U	N/A	N/A	-		-	-	-	354	2115	2115	14.3%
7/2+7/1	Canning Place Left Ahead Right	U	N/A	N/A	F		1	21	-	378	1896:1718	208+110	118.8 : 118.8%
8/1	Canning Place Entrance	U	N/A	N/A	-		-	-	-	456	1915	1915	23.4%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**0**	**346**	**57**	**46.4**	**127.8**	**0.0**	**174.2**	**-**	**-**	**-**	**-**
St. Conleth' Bridge Signalised Junction	**-**	**-**	**0**	**346**	**57**	**46.4**	**127.8**	**0.0**	**174.2**	**-**	**-**	**-**	**-**
1/2+1/1	509	428	-	-	-	13.9	43.5	-	57.4	406.3	20.4	43.5	63.9
1/3	188	188	0	131	57	2.6	3.3	0.0	5.9	112.8	5.8	3.3	9.1
2/1	462	462	-	-	-	0.0	0.1	-	0.1	1.1	0.0	0.1	0.1
3/2+3/1	214	203	0	33	0	4.2	10.4	-	14.6	246.1	8.2	10.4	18.6
3/3	158	158	-	-	-	2.8	3.3	-	6.2	140.6	6.2	3.3	9.6
4/1	550	550	-	-	-	0.0	0.2	-	0.2	1.3	0.0	0.2	0.2
5/1	89	89	-	-	-	1.0	0.2	-	1.2	48.9	2.7	0.2	2.9
5/2+5/3	437	376	0	182	1	12.1	33.6	0.0	45.8	376.9	17.5	33.6	51.1
6/1	301	301	-	-	-	0.0	0.1	-	0.1	1.0	0.0	0.1	0.1
7/2+7/1	378	318	-	-	-	9.7	32.8	-	42.5	405.1	16.8	32.8	49.7
8/1	447	447	-	-	-	0.0	0.2	-	0.2	1.2	1.6	0.2	1.8

C1

PRC for Signalled Lanes (%): -32.2
PRC Over All Lanes (%): -32.2

Total Delay for Signalled Lanes (pcuHr): 173.64
Total Delay Over All Lanes(pcuHr): 174.22

Cycle Time (s): 144

Appendix K Buckley's Cross Roundabout Junction 9 Results Output

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Buckleys Cross Roundabout-Scenario A-Queuing AM 2021 Flows.j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario A - Exisitng
Report generation date: 21/03/2022 16:21:04

»2024 Do Nothing, AM
»2029 Do Nothing , AM
»2039 Do Nothing, AM
»2024 Scenario A Opening Year, AM
»2029 Scenario A Design 5 Years, AM
»2039 Scenario A Design 15 Years, AM

Summary of junction performance

	AM			
	Queue (PCU)	Delay (s)	RFC	LOS
	2024 Do Nothing			
A - R445 Naas Road (east)	10.0	63.23	0.94	F
B - Great Connell	1.6	17.07	0.62	C
C - R445 Naas Road (west)	29.6	109.91	1.03	F
	2029 Do Nothing			
A - R445 Naas Road (east)	31.8	160.18	1.06	F
B - Great Connell	2.4	23.29	0.71	C
C - R445 Naas Road (west)	101.2	386.72	1.20	F
	2039 Do Nothing			
A - R445 Naas Road (east)	55.7	294.41	1.14	F
B - Great Connell	3.1	28.67	0.77	D
C - R445 Naas Road (west)	157.8	609.04	1.29	F
	2024 Scenario A Opening Year			
A - R445 Naas Road (east)	24.3	130.71	1.03	F
B - Great Connell	3.2	28.13	0.78	D
C - R445 Naas Road (west)	59.0	202.69	1.11	F
	2029 Scenario A Design 5 Years			
A - R445 Naas Road (east)	74.3	419.15	1.19	F
B - Great Connell	16.7	109.79	1.00	F
C - R445 Naas Road (west)	191.5	771.88	1.35	F
	2039 Scenario A Design 15 Years			
A - R445 Naas Road (east)	110.8	612.73	1.27	F
B - Great Connell	26.9	161.05	1.06	F
C - R445 Naas Road (west)	262.3	1080.04	1.44	F

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

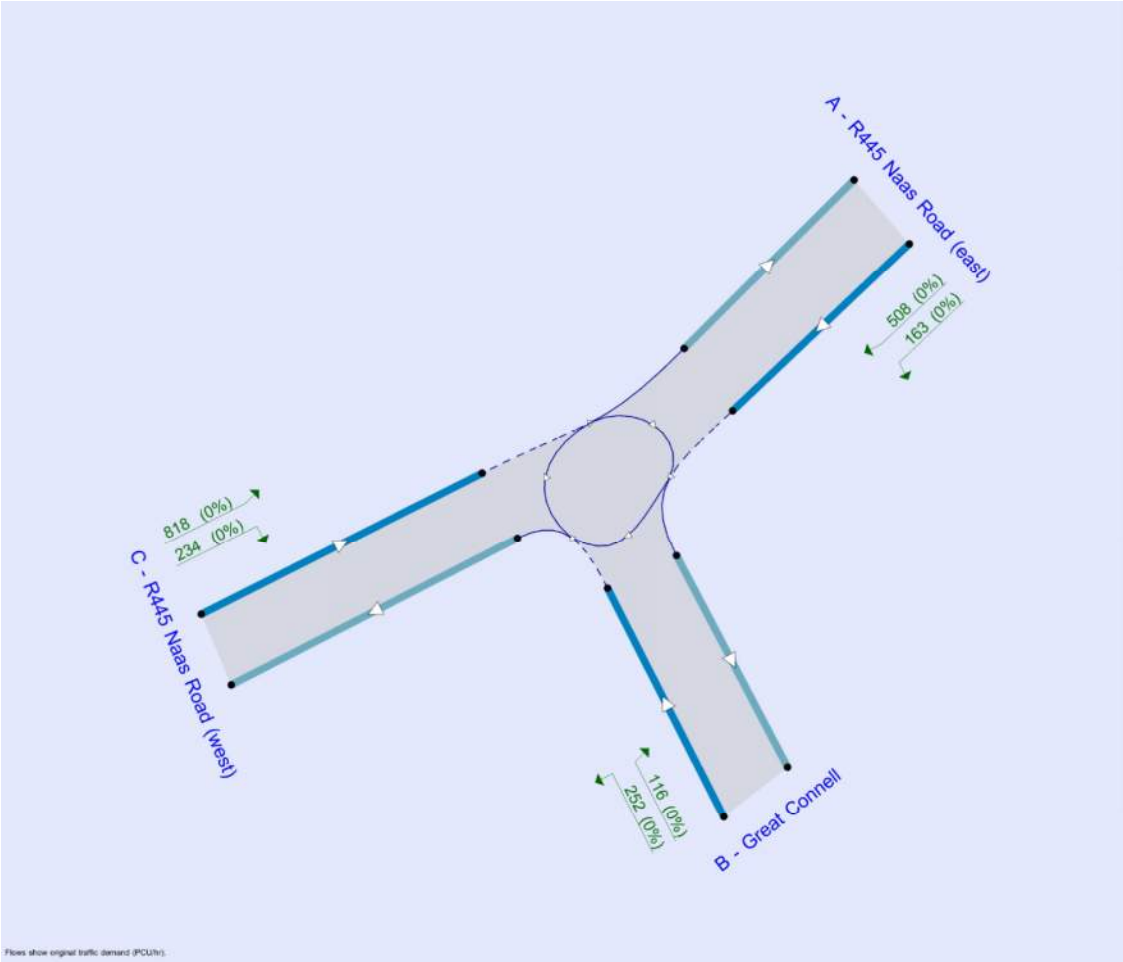
File summary

File Description

Title	
Location	
Site number	
Date	18/03/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75				0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓
D7	2024 Scenario A Opening Year	AM	ONE HOUR	08:15	09:45	15	✓
D9	2029 Scenario A Design 5 Years	AM	ONE HOUR	08:15	09:45	15	✓
D11	2039 Scenario A Design 15 Years	AM	ONE HOUR	08:15	09:45	15	✓

Analysis Set Details

ID	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	✓	100.000	100.000

2024 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	78.17	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	R445 Naas Road (east)	
B	Great Connell	
C	R445 Naas Road (west)	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - R445 Naas Road (east)	4.00	4.00	0.0	10.0	18.0	0.0	
B - Great Connell	3.00	3.50	3.0	10.0	18.0	0.0	
C - R445 Naas Road (west)	4.00	5.50	15.0	10.0	18.0	0.0	

Slope / Intercept / Capacity

Arm Intercept Adjustments

Arm	Type	Reason	Percentage intercept adjustment (%)
A - R445 Naas Road (east)	Percentage	observed queuing	60.00
B - Great Connell	Percentage	observed queuing	75.00
C - R445 Naas Road (west)	Percentage	observed queuing	60.00

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - R445 Naas Road (east)	0.595	767
B - Great Connell	0.551	798
C - R445 Naas Road (west)	0.671	985

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	550	100.000
B - Great Connell		ONE HOUR	✓	309	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	854	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	137	413
	B - Great Connell	98	0	211
	C - R445 Naas Road (west)	658	196	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.94	63.23	10.0	F	505	757
B - Great Connell	0.62	17.07	1.6	C	284	425
C - R445 Naas Road (west)	1.03	109.91	29.6	F	784	1175

2029 Do Nothing , AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	250.37	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	624	100.000
B - Great Connell		ONE HOUR	✓	343	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	984	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	151	473
	B - Great Connell	108	0	235
	C - R445 Naas Road (west)	764	220	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	1.06	160.18	31.8	F	573	859
B - Great Connell	0.71	23.29	2.4	C	315	472
C - R445 Naas Road (west)	1.20	386.72	101.2	F	903	1354

2039 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	405.93	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	671	100.000
B - Great Connell		ONE HOUR	✓	368	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	1052	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	163	508
	B - Great Connell	116	0	252
	C - R445 Naas Road (west)	818	234	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	1.14	294.41	55.7	F	616	924
B - Great Connell	0.77	28.67	3.1	D	338	507
C - R445 Naas Road (west)	1.29	609.04	157.8	F	965	1448

2024 Scenario A Opening Year, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	142.90	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D7	2024 Scenario A Opening Year	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	598	100.000
B - Great Connell		ONE HOUR	✓	395	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	880	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	185	413
	B - Great Connell	155	0	240
	C - R445 Naas Road (west)	658	222	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	1.03	130.71	24.3	F	549	823
B - Great Connell	0.78	28.13	3.2	D	362	544
C - R445 Naas Road (west)	1.11	202.69	59.0	F	808	1211

2029 Scenario A Design 5 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	510.68	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D9	2029 Scenario A Design 5 Years	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	696	100.000
B - Great Connell		ONE HOUR	✓	507	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	1022	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	223	473
	B - Great Connell	216	0	291
	C - R445 Naas Road (west)	764	258	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	1.19	419.15	74.3	F	639	958
B - Great Connell	1.00	109.79	16.7	F	465	698
C - R445 Naas Road (west)	1.35	771.88	191.5	F	938	1407

2039 Scenario A Design 15 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	726.55	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D11	2039 Scenario A Design 15 Years	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	742	100.000
B - Great Connell		ONE HOUR	✓	532	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	1090	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	234	508
	B - Great Connell	223	0	309
	C - R445 Naas Road (west)	818	272	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	1.27	612.73	110.8	F	681	1021
B - Great Connell	1.06	161.05	26.9	F	488	732
C - R445 Naas Road (west)	1.44	1080.04	262.3	F	1000	1500

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Buckleys Cross Roundabout-Scenario A-Queuing PM 2021 Flows.j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario A - Exisitng
Report generation date: 15/03/2022 15:13:35

»2024 Do Nothing, PM
»2029 Do Nothing , PM
»2039 Do Nothing, PM
»2024 Scenario A Opening Year, PM
»2029 Scenario A Design 5 Years, PM
»2039 Scenario A Design 15 Years, PM

Summary of junction performance

	PM			
	Queue (PCU)	Delay (s)	RFC	LOS
	2024 Do Nothing			
A - R445 Naas Road (east)	3.5	16.83	0.79	C
B - Great Connell	2.1	19.96	0.69	C
C - R445 Naas Road (west)	3.9	20.59	0.80	C
	2029 Do Nothing			
A - R445 Naas Road (east)	9.4	39.86	0.92	E
B - Great Connell	5.0	44.09	0.86	E
C - R445 Naas Road (west)	10.3	48.89	0.94	E
	2039 Do Nothing			
A - R445 Naas Road (east)	20.4	76.77	0.99	F
B - Great Connell	10.4	83.78	0.96	F
C - R445 Naas Road (west)	22.4	92.93	1.01	F
	2024 Scenario A Opening Year			
A - R445 Naas Road (east)	5.7	25.82	0.86	D
B - Great Connell	4.5	35.83	0.83	E
C - R445 Naas Road (west)	6.2	32.32	0.88	D
	2029 Scenario A Design 5 Years			
A - R445 Naas Road (east)	46.5	151.84	1.07	F
B - Great Connell	27.2	163.76	1.07	F
C - R445 Naas Road (west)	38.4	149.89	1.07	F
	2039 Scenario A Design 15 Years			
A - R445 Naas Road (east)	77.5	269.35	1.14	F
B - Great Connell	43.7	272.79	1.13	F
C - R445 Naas Road (west)	65.3	265.56	1.14	F

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

File Description

Title	
Location	
Site number	
Date	18/03/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75				0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓
D8	2024 Scenario A Opening Year	PM	ONE HOUR	17:30	19:00	15	✓
D10	2029 Scenario A Design 5 Years	PM	ONE HOUR	17:30	19:00	15	✓
D12	2039 Scenario A Design 15 Years	PM	ONE HOUR	17:30	19:00	15	✓

Analysis Set Details

ID	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	✓	100.000	100.000

2024 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	18.89	C

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	R445 Naas Road (east)	
B	Great Connell	
C	R445 Naas Road (west)	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - R445 Naas Road (east)	4.00	4.00	0.0	10.0	18.0	0.0	
B - Great Connell	3.00	3.50	3.0	10.0	18.0	0.0	
C - R445 Naas Road (west)	4.00	5.50	15.0	10.0	18.0	0.0	

Slope / Intercept / Capacity

Arm Intercept Adjustments

Arm	Type	Reason	Percentage intercept adjustment (%)
A - R445 Naas Road (east)	Percentage	observed queuing	85.00
B - Great Connell	Percentage	observed queuing	90.00
C - R445 Naas Road (west)	Percentage	observed queuing	60.00

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - R445 Naas Road (east)	0.595	1087
B - Great Connell	0.551	957
C - R445 Naas Road (west)	0.671	985

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	711	100.000
B - Great Connell		ONE HOUR	✓	357	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	638	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	76	635
	B - Great Connell	150	0	207
	C - R445 Naas Road (west)	497	141	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.79	16.83	3.5	C	652	979
B - Great Connell	0.69	19.96	2.1	C	328	491
C - R445 Naas Road (west)	0.80	20.59	3.9	C	585	878

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	535	134	105	1024	0.523	531	483	0.0	1.1	7.234	A
B - Great Connell	269	67	474	696	0.386	266	162	0.0	0.6	8.334	A
C - R445 Naas Road (west)	480	120	112	910	0.528	476	629	0.0	1.1	8.208	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	639	160	126	1012	0.632	637	579	1.1	1.7	9.534	A
B - Great Connell	321	80	569	644	0.498	320	194	0.6	1.0	11.052	B
C - R445 Naas Road (west)	574	143	134	895	0.641	571	754	1.1	1.7	11.012	B

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	783	196	154	996	0.786	776	705	1.7	3.4	15.884	C
B - Great Connell	393	98	693	575	0.683	389	236	1.0	2.0	18.873	C
C - R445 Naas Road (west)	702	176	163	876	0.802	695	918	1.7	3.7	19.083	C

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	783	196	155	995	0.787	782	712	3.4	3.5	16.833	C
B - Great Connell	393	98	699	572	0.687	393	239	2.0	2.1	19.956	C
C - R445 Naas Road (west)	702	176	165	875	0.803	702	926	3.7	3.9	20.587	C

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	639	160	129	1011	0.633	646	590	3.5	1.8	10.067	B
B - Great Connell	321	80	577	639	0.502	325	198	2.1	1.0	11.617	B
C - R445 Naas Road (west)	574	143	137	894	0.642	582	766	3.9	1.9	11.812	B

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	535	134	107	1023	0.523	538	490	1.8	1.1	7.455	A
B - Great Connell	269	67	480	693	0.388	270	164	1.0	0.6	8.559	A
C - R445 Naas Road (west)	480	120	114	909	0.528	483	637	1.9	1.1	8.505	A

2029 Do Nothing , PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	44.11	E

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	824	100.000
B - Great Connell		ONE HOUR	✓	397	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	734	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	84	740
	B - Great Connell	165	0	232
	C - R445 Naas Road (west)	574	160	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.92	39.86	9.4	E	756	1134
B - Great Connell	0.86	44.09	5.0	E	364	546
C - R445 Naas Road (west)	0.94	48.89	10.3	E	674	1010

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	620	155	119	1016	0.610	614	550	0.0	1.5	8.830	A
B - Great Connell	299	75	552	653	0.458	296	182	0.0	0.8	9.980	A
C - R445 Naas Road (west)	553	138	123	903	0.612	546	724	0.0	1.5	9.937	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	741	185	143	1002	0.739	736	660	1.5	2.7	13.300	B
B - Great Connell	357	89	661	593	0.602	354	218	0.8	1.5	14.928	B
C - R445 Naas Road (west)	660	165	147	887	0.744	655	868	1.5	2.7	15.225	C

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	907	227	171	985	0.921	886	791	2.7	8.1	30.968	D
B - Great Connell	437	109	795	519	0.842	426	261	1.5	4.3	35.053	E
C - R445 Naas Road (west)	808	202	177	867	0.932	785	1044	2.7	8.6	36.439	E

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	907	227	175	983	0.923	902	807	8.1	9.4	39.865	E
B - Great Connell	437	109	810	511	0.855	434	267	4.3	5.0	44.091	E
C - R445 Naas Road (west)	808	202	180	864	0.935	801	1064	8.6	10.3	48.889	E

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	741	185	150	998	0.742	766	692	9.4	3.1	17.010	C
B - Great Connell	357	89	688	578	0.617	370	228	5.0	1.7	18.291	C
C - R445 Naas Road (west)	660	165	154	882	0.748	688	904	10.3	3.2	20.809	C

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	620	155	122	1015	0.611	626	563	3.1	1.6	9.400	A
B - Great Connell	299	75	562	647	0.462	302	186	1.7	0.9	10.521	B
C - R445 Naas Road (west)	553	138	126	901	0.613	559	739	3.2	1.6	10.696	B

2039 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	84.25	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	884	100.000
B - Great Connell		ONE HOUR	✓	425	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	786	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	91	793
	B - Great Connell	177	0	248
	C - R445 Naas Road (west)	615	171	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.99	76.77	20.4	F	811	1217
B - Great Connell	0.96	83.78	10.4	F	390	585
C - R445 Naas Road (west)	1.01	92.93	22.4	F	721	1082

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	666	166	127	1011	0.658	658	589	0.0	1.9	9.991	A
B - Great Connell	320	80	590	632	0.506	316	195	0.0	1.0	11.256	B
C - R445 Naas Road (west)	592	148	132	897	0.660	584	775	0.0	1.9	11.256	B

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	795	199	152	996	0.797	788	705	1.9	3.6	16.680	C
B - Great Connell	382	96	707	568	0.673	378	233	1.0	1.9	18.617	C
C - R445 Naas Road (west)	707	177	158	880	0.803	699	927	1.9	3.7	19.184	C

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	973	243	178	981	0.992	929	826	3.6	14.7	47.900	E
B - Great Connell	468	117	833	498	0.940	446	274	1.9	7.5	54.118	F
C - R445 Naas Road (west)	865	216	186	861	1.005	819	1093	3.7	15.4	55.776	F

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	973	243	182	979	0.995	950	845	14.7	20.4	76.766	F
B - Great Connell	468	117	852	488	0.960	456	280	7.5	10.4	83.781	F
C - R445 Naas Road (west)	865	216	190	858	1.009	837	1119	15.4	22.4	92.930	F

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	795	199	169	987	0.806	858	779	20.4	4.7	36.159	E
B - Great Connell	382	96	770	533	0.716	413	257	10.4	2.8	35.321	E
C - R445 Naas Road (west)	707	177	172	870	0.812	776	1010	22.4	5.0	49.697	E

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	666	166	131	1009	0.660	676	608	4.7	2.0	11.144	B
B - Great Connell	320	80	607	623	0.514	327	201	2.8	1.1	12.411	B
C - R445 Naas Road (west)	592	148	136	894	0.662	604	797	5.0	2.0	12.876	B

2024 Scenario A Opening Year, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	30.47	D

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D8	2024 Scenario A Opening Year	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	765	100.000
B - Great Connell		ONE HOUR	✓	434	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	667	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	130	635
	B - Great Connell	200	0	234
	C - R445 Naas Road (west)	497	170	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.86	25.82	5.7	D	702	1053
B - Great Connell	0.83	35.83	4.5	E	398	597
C - R445 Naas Road (west)	0.88	32.32	6.2	D	612	918

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	576	144	127	1012	0.569	571	519	0.0	1.3	8.074	A
B - Great Connell	327	82	474	696	0.469	323	224	0.0	0.9	9.569	A
C - R445 Naas Road (west)	502	126	149	885	0.567	497	648	0.0	1.3	9.153	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	688	172	152	997	0.690	684	623	1.3	2.1	11.401	B
B - Great Connell	390	98	568	644	0.606	388	268	0.9	1.5	13.896	B
C - R445 Naas Road (west)	600	150	179	866	0.693	596	777	1.3	2.2	13.185	B

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	842	211	184	978	0.861	830	753	2.1	5.3	22.586	C
B - Great Connell	478	119	689	578	0.827	468	325	1.5	4.0	30.267	D
C - R445 Naas Road (west)	734	184	216	841	0.873	721	941	2.2	5.6	27.252	D

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	842	211	187	976	0.863	841	765	5.3	5.7	25.816	D
B - Great Connell	478	119	698	573	0.834	476	329	4.0	4.5	35.826	E
C - R445 Naas Road (west)	734	184	219	838	0.876	732	954	5.6	6.2	32.323	D

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	688	172	157	994	0.692	701	643	5.7	2.3	12.826	B
B - Great Connell	390	98	582	637	0.613	401	276	4.5	1.6	15.985	C
C - R445 Naas Road (west)	600	150	185	861	0.696	615	799	6.2	2.4	15.409	C

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	576	144	129	1010	0.570	580	529	2.3	1.4	8.441	A
B - Great Connell	327	82	481	692	0.472	330	228	1.6	0.9	10.016	B
C - R445 Naas Road (west)	502	126	152	883	0.568	506	659	2.4	1.3	9.651	A

2029 Scenario A Design 5 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	153.94	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D10	2029 Scenario A Design 5 Years	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	931	100.000
B - Great Connell		ONE HOUR	✓	524	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	790	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	191	740
	B - Great Connell	248	0	276
	C - R445 Naas Road (west)	574	216	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	1.07	151.84	46.5	F	854	1281
B - Great Connell	1.07	163.76	27.2	F	481	721
C - R445 Naas Road (west)	1.07	149.89	38.4	F	725	1087

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	701	175	160	992	0.707	692	610	0.0	2.3	11.670	B
B - Great Connell	394	99	550	654	0.603	389	302	0.0	1.5	13.279	B
C - R445 Naas Road (west)	595	149	184	862	0.690	586	754	0.0	2.1	12.696	B

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	837	209	191	973	0.860	825	728	2.3	5.2	22.669	C
B - Great Connell	471	118	656	596	0.791	464	361	1.5	3.3	25.847	D
C - R445 Naas Road (west)	710	178	219	838	0.847	700	900	2.1	4.7	24.284	C

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1025	256	218	958	1.071	935	826	5.2	27.6	77.138	F
B - Great Connell	577	144	744	548	1.054	524	410	3.3	16.5	86.823	F
C - R445 Naas Road (west)	870	217	248	819	1.062	796	1020	4.7	23.2	78.455	F

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1025	256	221	955	1.073	950	840	27.6	46.5	151.841	F
B - Great Connell	577	144	755	541	1.066	534	416	16.5	27.2	163.760	F
C - R445 Naas Road (west)	870	217	253	816	1.066	809	1036	23.2	38.4	149.894	F

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	837	209	218	957	0.874	937	829	46.5	21.5	134.586	F
B - Great Connell	471	118	745	547	0.861	527	410	27.2	13.1	143.397	F
C - R445 Naas Road (west)	710	178	250	818	0.868	797	1023	38.4	16.7	129.479	F

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	701	175	178	981	0.714	776	681	21.5	2.7	23.684	C
B - Great Connell	394	99	617	617	0.639	440	337	13.1	1.9	24.989	C
C - R445 Naas Road (west)	595	149	208	846	0.703	651	848	16.7	2.5	23.433	C

2039 Scenario A Design 15 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	268.81	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D12	2039 Scenario A Design 15 Years	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	990	100.000
B - Great Connell		ONE HOUR	✓	552	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	842	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	197	793
	B - Great Connell	261	0	291
	C - R445 Naas Road (west)	615	227	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	1.14	269.35	77.5	F	908	1363
B - Great Connell	1.13	272.79	43.7	F	507	760
C - R445 Naas Road (west)	1.14	265.56	65.3	F	773	1159

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	745	186	168	987	0.755	734	648	0.0	2.9	13.653	B
B - Great Connell	416	104	588	633	0.656	408	314	0.0	1.8	15.538	C
C - R445 Naas Road (west)	634	158	193	856	0.741	623	803	0.0	2.7	14.861	B

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	890	222	199	968	0.919	870	768	2.9	7.9	31.361	D
B - Great Connell	496	124	697	573	0.865	484	372	1.8	5.0	35.880	E
C - R445 Naas Road (west)	757	189	229	832	0.910	739	952	2.7	7.2	33.475	D

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1090	273	218	957	1.138	947	839	7.9	43.6	111.179	F
B - Great Connell	608	152	759	539	1.127	527	406	5.0	25.1	121.931	F
C - R445 Naas Road (west)	927	232	249	818	1.133	807	1037	7.2	37.1	113.331	F

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	1090	273	220	956	1.140	955	847	43.6	77.5	237.858	F
B - Great Connell	608	152	765	536	1.134	533	409	25.1	43.7	247.545	F
C - R445 Naas Road (west)	927	232	252	816	1.136	814	1046	37.1	65.3	237.216	F

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	890	222	217	958	0.929	946	838	77.5	63.6	269.354	F
B - Great Connell	496	124	757	540	0.919	528	405	43.7	35.8	272.791	F
C - R445 Naas Road (west)	757	189	250	818	0.925	806	1036	65.3	53.1	265.560	F

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	745	186	217	958	0.778	943	836	63.6	14.1	153.682	F
B - Great Connell	416	104	756	541	0.768	526	404	35.8	8.2	159.577	F
C - R445 Naas Road (west)	634	158	249	818	0.774	803	1033	53.1	10.7	149.707	F

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Buckleys Cross Roundabout - Scenario B - modelled queuing AM.j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario B - Lidl Rd open
Report generation date: 15/03/2022 15:22:27

»2024 Do Nothing, AM
»2029 Do Nothing , AM
»2039 Do Nothing, AM
»2024 Scenario B Opening Year, AM
»2029 Scenario B Design 5 Years, AM
»2039 Scenario B Design 15 Years, AM

Summary of junction performance

	AM			
	Queue (PCU)	Delay (s)	RFC	LOS
	2024 Do Nothing			
A - R445 Naas Road (east)	5.2	36.08	0.85	E
B - Great Connell	1.1	13.97	0.53	B
C - R445 Naas Road (west)	20.1	78.47	0.99	F
	2029 Do Nothing			
A - R445 Naas Road (east)	13.3	80.84	0.97	F
B - Great Connell	1.6	18.58	0.63	C
C - R445 Naas Road (west)	82.0	289.57	1.15	F
	2039 Do Nothing			
A - R445 Naas Road (east)	26.4	138.76	1.04	F
B - Great Connell	2.1	22.35	0.68	C
C - R445 Naas Road (west)	126.6	484.48	1.23	F
	2024 Scenario B Opening Year			
A - R445 Naas Road (east)	6.4	44.24	0.89	E
B - Great Connell	1.5	16.69	0.61	C
C - R445 Naas Road (west)	30.7	110.22	1.03	F
	2029 Scenario B Design 5 Years			
A - R445 Naas Road (east)	19.9	113.22	1.01	F
B - Great Connell	3.2	29.77	0.77	D
C - R445 Naas Road (west)	111.4	424.18	1.21	F
	2039 Scenario B Design 15 Years			
A - R445 Naas Road (east)	36.8	185.94	1.08	F
B - Great Connell	4.3	38.92	0.83	E
C - R445 Naas Road (west)	170.3	637.84	1.29	F

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

File Description

Title	
Location	
Site number	
Date	18/03/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75				0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓
D7	2024 Scenario B Opening Year	AM	ONE HOUR	08:15	09:45	15	✓
D9	2029 Scenario B Design 5 Years	AM	ONE HOUR	08:15	09:45	15	✓
D11	2039 Scenario B Design 15 Years	AM	ONE HOUR	08:15	09:45	15	✓

Analysis Set Details

ID	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	✓	100.000	100.000

2024 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	54.87	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	R445 Naas Road (east)	
B	Great Connell	
C	R445 Naas Road (west)	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - R445 Naas Road (east)	4.00	4.00	0.0	10.0	18.0	0.0	
B - Great Connell	3.00	3.50	3.0	10.0	18.0	0.0	
C - R445 Naas Road (west)	4.00	5.50	15.0	10.0	18.0	0.0	

Slope / Intercept / Capacity

Arm Intercept Adjustments

Arm	Type	Reason	Percentage intercept adjustment (%)
A - R445 Naas Road (east)	Percentage	observed queuing	60.00
B - Great Connell	Percentage	observed queuing	75.00
C - R445 Naas Road (west)	Percentage	observed queuing	60.00

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - R445 Naas Road (east)	0.595	767
B - Great Connell	0.551	798
C - R445 Naas Road (west)	0.671	985

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	498	100.000
B - Great Connell		ONE HOUR	✓	264	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	854	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	85	413
	B - Great Connell	53	0	211
	C - R445 Naas Road (west)	658	196	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.85	36.08	5.2	E	457	685
B - Great Connell	0.53	13.97	1.1	B	242	363
C - R445 Naas Road (west)	0.99	78.47	20.1	F	784	1175

2029 Do Nothing , AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	182.30	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	566	100.000
B - Great Connell		ONE HOUR	✓	294	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	984	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	93	473
	B - Great Connell	59	0	235
	C - R445 Naas Road (west)	764	220	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.97	80.84	13.3	F	519	779
B - Great Connell	0.63	18.58	1.6	C	270	405
C - R445 Naas Road (west)	1.15	289.57	82.0	F	903	1354

2039 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	304.34	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	608	100.000
B - Great Connell		ONE HOUR	✓	315	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	1052	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	100	508
	B - Great Connell	63	0	252
	C - R445 Naas Road (west)	818	234	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	1.04	138.76	26.4	F	558	837
B - Great Connell	0.68	22.35	2.1	C	289	434
C - R445 Naas Road (west)	1.23	484.48	126.6	F	965	1448

2024 Scenario B Opening Year, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	73.69	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D7	2024 Scenario B Opening Year	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	505	100.000
B - Great Connell		ONE HOUR	✓	303	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	880	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	92	413
	B - Great Connell	62	0	241
	C - R445 Naas Road (west)	658	222	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.89	44.24	6.4	E	463	695
B - Great Connell	0.61	16.69	1.5	C	278	417
C - R445 Naas Road (west)	1.03	110.22	30.7	F	808	1211

2029 Scenario B Design 5 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	259.29	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D9	2029 Scenario B Design 5 Years	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	577	100.000
B - Great Connell		ONE HOUR	✓	367	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	1022	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	104	473
	B - Great Connell	75	0	292
	C - R445 Naas Road (west)	764	258	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	1.01	113.22	19.9	F	529	794
B - Great Connell	0.77	29.77	3.2	D	337	505
C - R445 Naas Road (west)	1.21	424.18	111.4	F	938	1407

2039 Scenario B Design 15 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	393.46	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D11	2039 Scenario B Design 15 Years	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	619	100.000
B - Great Connell		ONE HOUR	✓	389	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	1090	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	111	508
	B - Great Connell	79	0	310
	C - R445 Naas Road (west)	818	272	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	1.08	185.94	36.8	F	568	852
B - Great Connell	0.83	38.92	4.3	E	357	535
C - R445 Naas Road (west)	1.29	637.84	170.3	F	1000	1500

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Buckleys Cross Roundabout - Scenario B - modelled queuing PM.j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario B - Lidl Rd open
Report generation date: 16/03/2022 10:29:34

»2024 Do Nothing, PM
»2029 Do Nothing , PM
»2039 Do Nothing, PM
»2024 Scenario B Opening Year, PM
»2029 Scenario B Design 5 Years, PM
»2039 Scenario B Design 15 Years, PM

Summary of junction performance

	PM			
	Queue (PCU)	Delay (s)	RFC	LOS
	2024 Do Nothing			
A - R445 Naas Road (east)	2.4	12.52	0.71	B
B - Great Connell	1.4	15.41	0.59	C
C - R445 Naas Road (west)	3.2	17.14	0.77	C
	2029 Do Nothing			
A - R445 Naas Road (east)	4.7	21.37	0.83	C
B - Great Connell	2.1	22.02	0.68	C
C - R445 Naas Road (west)	6.2	30.03	0.88	D
	2039 Do Nothing			
A - R445 Naas Road (east)	7.9	34.48	0.90	D
B - Great Connell	4.6	44.31	0.84	E
C - R445 Naas Road (west)	13.9	61.04	0.96	F
	2024 Scenario B Opening Year			
A - R445 Naas Road (east)	2.7	13.84	0.73	B
B - Great Connell	1.9	18.42	0.66	C
C - R445 Naas Road (west)	4.1	20.77	0.81	C
	2029 Scenario B Design 5 Years			
A - R445 Naas Road (east)	6.9	31.49	0.89	D
B - Great Connell	5.3	46.85	0.87	E
C - R445 Naas Road (west)	15.3	66.19	0.97	F
	2039 Scenario B Design 15 Years			
A - R445 Naas Road (east)	12.6	53.45	0.95	F
B - Great Connell	11.2	89.91	0.97	F
C - R445 Naas Road (west)	32.5	120.61	1.04	F

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

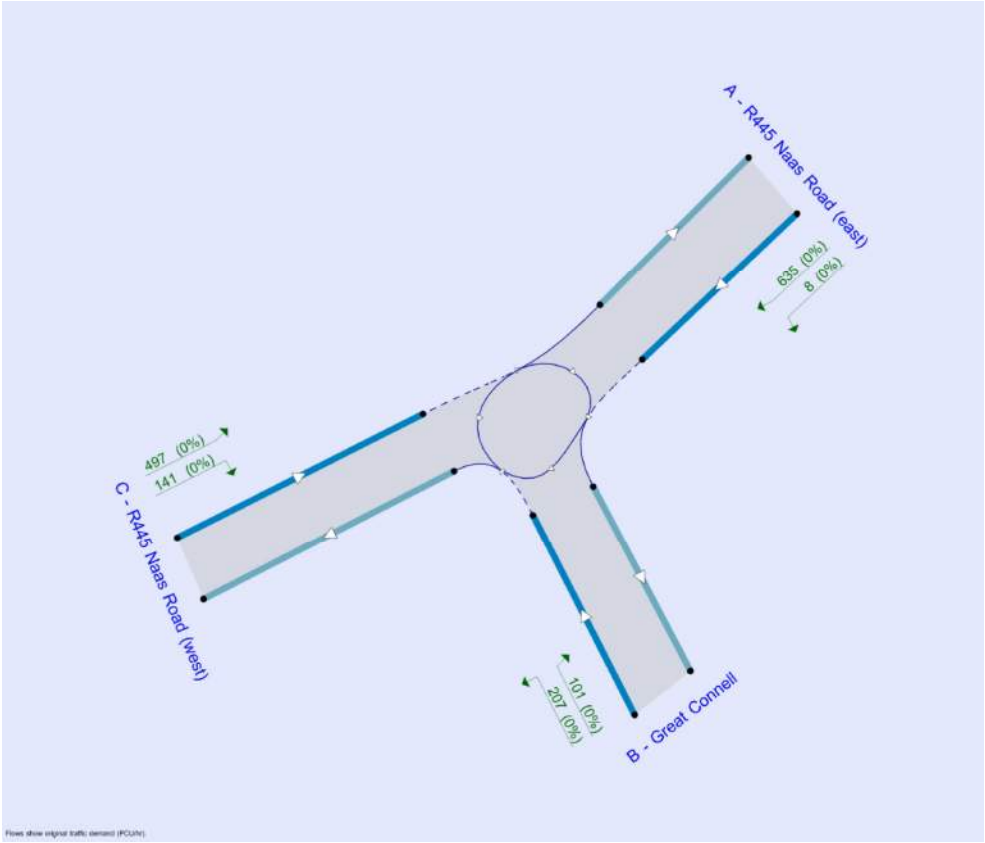
File summary

File Description

Title	
Location	
Site number	
Date	18/03/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75				0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓
D8	2024 Scenario B Opening Year	PM	ONE HOUR	17:30	19:00	15	✓
D10	2029 Scenario B Design 5 Years	PM	ONE HOUR	17:30	19:00	15	✓
D12	2039 Scenario B Design 15 Years	PM	ONE HOUR	17:30	19:00	15	✓

Analysis Set Details

ID	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	✓	100.000	100.000

2024 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	14.94	B

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	R445 Naas Road (east)	
B	Great Connell	
C	R445 Naas Road (west)	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - R445 Naas Road (east)	4.00	4.00	0.0	10.0	18.0	0.0	
B - Great Connell	3.00	3.50	3.0	10.0	18.0	0.0	
C - R445 Naas Road (west)	4.00	5.50	15.0	10.0	18.0	0.0	

Slope / Intercept / Capacity

Arm Intercept Adjustments

Arm	Type	Reason	Percentage intercept adjustment (%)
A - R445 Naas Road (east)	Percentage	observed queuing	85.00
B - Great Connell	Percentage	observed queuing	90.00
C - R445 Naas Road (west)	Percentage	observed queuing	60.00

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - R445 Naas Road (east)	0.595	1087
B - Great Connell	0.551	957
C - R445 Naas Road (west)	0.671	985

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	643	100.000
B - Great Connell		ONE HOUR	✓	308	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	638	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	8	635
	B - Great Connell	101	0	207
	C - R445 Naas Road (west)	497	141	0

Vehicle Mix

Heavy Vehicle Percentages

	To			

		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.71	12.52	2.4	B	590	885
B - Great Connell	0.59	15.41	1.4	C	283	424
C - R445 Naas Road (west)	0.77	17.14	3.2	C	585	878

2029 Do Nothing , PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	24.99	C

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	748	100.000
B - Great Connell		ONE HOUR	✓	315	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	722	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	8	740
	B - Great Connell	105	0	210
	C - R445 Naas Road (west)	571	151	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.83	21.37	4.7	C	686	1030
B - Great Connell	0.68	22.02	2.1	C	289	434
C - R445 Naas Road (west)	0.88	30.03	6.2	D	663	994

2039 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	47.00	E

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	802	100.000
B - Great Connell		ONE HOUR	✓	367	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	786	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	9	793
	B - Great Connell	119	0	248
	C - R445 Naas Road (west)	615	171	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.90	34.48	7.9	D	736	1104
B - Great Connell	0.84	44.31	4.6	E	337	505
C - R445 Naas Road (west)	0.96	61.04	13.9	F	721	1082

2024 Scenario B Opening Year, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	17.57	C

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D8	2024 Scenario B Opening Year	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	651	100.000
B - Great Connell		ONE HOUR	✓	343	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	667	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	16	635
	B - Great Connell	109	0	234
	C - R445 Naas Road (west)	497	170	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.73	13.84	2.7	B	597	896
B - Great Connell	0.66	18.42	1.9	C	315	472
C - R445 Naas Road (west)	0.81	20.77	4.1	C	612	918

2029 Scenario B Design 5 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	48.65	E

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D10	2029 Scenario B Design 5 Years	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	765	100.000
B - Great Connell		ONE HOUR	✓	401	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	790	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	25	740
	B - Great Connell	124	0	277
	C - R445 Naas Road (west)	574	216	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.89	31.49	6.9	D	702	1053
B - Great Connell	0.87	46.85	5.3	E	368	552
C - R445 Naas Road (west)	0.97	66.19	15.3	F	725	1087

2039 Scenario B Design 15 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	87.99	F

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D12	2039 Scenario B Design 15 Years	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	819	100.000
B - Great Connell		ONE HOUR	✓	424	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	842	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	26	793
	B - Great Connell	132	0	292
	C - R445 Naas Road (west)	615	227	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.95	53.45	12.6	F	752	1127
B - Great Connell	0.97	89.91	11.2	F	389	584
C - R445 Naas Road (west)	1.04	120.61	32.5	F	773	1159

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Buckleys Cross Roundabout - Scenario C - AM Modelled Queuing.j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario C- NSOOR open
Report generation date: 15/03/2022 15:28:38

»2024 Do Nothing, AM
»2029 Do Nothing , AM
»2039 Do Nothing, AM
»2024 Scenario C Opening Year, AM
»2029 Scenario C Design 5 Years, AM
»2039 Scenario C Design 15 Years, AM

Summary of junction performance

	AM			
	Queue (PCU)	Delay (s)	RFC	LOS
	2024 Do Nothing			
A - R445 Naas Road (east)	1.1	11.42	0.52	B
B - Great Connell	0.5	7.84	0.33	A
C - R445 Naas Road (west)	3.9	19.56	0.80	C
	2029 Do Nothing			
A - R445 Naas Road (east)	1.4	13.34	0.59	B
B - Great Connell	0.6	8.50	0.38	A
C - R445 Naas Road (west)	7.0	32.77	0.89	D
	2039 Do Nothing			
A - R445 Naas Road (east)	1.7	15.37	0.64	C
B - Great Connell	0.7	9.10	0.41	A
C - R445 Naas Road (west)	13.5	58.79	0.96	F
	2024 Scenario C Opening Year			
A - R445 Naas Road (east)	1.1	11.66	0.53	B
B - Great Connell	0.5	7.99	0.35	A
C - R445 Naas Road (west)	4.1	20.39	0.81	C
	2029 Scenario C Design 5 Years			
A - R445 Naas Road (east)	1.5	13.77	0.60	B
B - Great Connell	0.7	8.94	0.41	A
C - R445 Naas Road (west)	7.8	36.72	0.90	E
	2039 Scenario C Design 15 Years			
A - R445 Naas Road (east)	1.8	15.94	0.65	C
B - Great Connell	0.8	9.58	0.44	A
C - R445 Naas Road (west)	16.2	68.47	0.98	F

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

File Description

Title	
Location	
Site number	
Date	18/03/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75				0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓
D13	2024 Scenario C Opening Year	AM	ONE HOUR	08:15	09:45	15	✓
D15	2029 Scenario C Design 5 Years	AM	ONE HOUR	08:15	09:45	15	✓
D17	2039 Scenario C Design 15 Years	AM	ONE HOUR	08:15	09:45	15	✓

Analysis Set Details

ID	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	✓	100.000	100.000

2024 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	15.37	C

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	R445 Naas Road (east)	
B	Great Connell	
C	R445 Naas Road (west)	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - R445 Naas Road (east)	4.00	4.00	0.0	10.0	18.0	0.0	
B - Great Connell	3.00	3.50	3.0	10.0	18.0	0.0	
C - R445 Naas Road (west)	4.00	5.50	15.0	10.0	18.0	0.0	

Slope / Intercept / Capacity

Arm Intercept Adjustments

Arm	Type	Reason	Percentage intercept adjustment (%)
A - R445 Naas Road (east)	Percentage	observed queuing	60.00
B - Great Connell	Percentage	observed queuing	75.00
C - R445 Naas Road (west)	Percentage	observed queuing	60.00

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - R445 Naas Road (east)	0.595	767
B - Great Connell	0.551	798
C - R445 Naas Road (west)	0.671	985

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D1	2024 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	315	100.000
B - Great Connell		ONE HOUR	✓	210	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	673	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	138	177
	B - Great Connell	85	0	125
	C - R445 Naas Road (west)	512	161	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.52	11.42	1.1	B	289	434
B - Great Connell	0.33	7.84	0.5	A	193	289
C - R445 Naas Road (west)	0.80	19.56	3.9	C	618	926

2029 Do Nothing , AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	23.37	C

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D3	2029 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	349	100.000
B - Great Connell		ONE HOUR	✓	232	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	739	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	153	196
	B - Great Connell	95	0	137
	C - R445 Naas Road (west)	565	174	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.59	13.34	1.4	B	320	480
B - Great Connell	0.38	8.50	0.6	A	213	319
C - R445 Naas Road (west)	0.89	32.77	7.0	D	678	1017

2039 Do Nothing, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	38.56	E

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D5	2039 Do Nothing	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	376	100.000
B - Great Connell		ONE HOUR	✓	249	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	794	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	165	211
	B - Great Connell	101	0	148
	C - R445 Naas Road (west)	609	185	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.64	15.37	1.7	C	345	518
B - Great Connell	0.41	9.10	0.7	A	228	343
C - R445 Naas Road (west)	0.96	58.79	13.5	F	729	1093

2024 Scenario C Opening Year, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	15.88	C

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D13	2024 Scenario C Opening Year	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	318	100.000
B - Great Connell		ONE HOUR	✓	218	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	678	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	141	177
	B - Great Connell	88	0	130
	C - R445 Naas Road (west)	512	166	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.53	11.66	1.1	B	292	438
B - Great Connell	0.35	7.99	0.5	A	200	300
C - R445 Naas Road (west)	0.81	20.39	4.1	C	622	933

2029 Scenario C Design 5 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	25.57	D

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D15	2029 Scenario C Design 5 Years	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	352	100.000
B - Great Connell		ONE HOUR	✓	251	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	747	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	156	196
	B - Great Connell	102	0	149
	C - R445 Naas Road (west)	565	182	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.60	13.77	1.5	B	323	485
B - Great Connell	0.41	8.94	0.7	A	230	345
C - R445 Naas Road (west)	0.90	36.72	7.8	E	685	1028

2039 Scenario C Design 15 Years, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	43.88	E

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D17	2039 Scenario C Design 15 Years	AM	ONE HOUR	08:15	09:45	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	379	100.000
B - Great Connell		ONE HOUR	✓	267	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	803	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	168	211
	B - Great Connell	108	0	159
	C - R445 Naas Road (west)	609	194	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.65	15.94	1.8	C	348	522
B - Great Connell	0.44	9.58	0.8	A	245	368
C - R445 Naas Road (west)	0.98	68.47	16.2	F	737	1105

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896
© Copyright TRL Limited, 2018

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: 192229 - Buckleys Cross Roundabout - Scenario C - PM Modelled Queuing.j9
Path: \\w2k19-dl-fs01\users\CAD\DWGS\192\201-250\192229\OfficeDocs\Reports\Planning\Planning Package\0004_TTA\Junction 9 Stage 3 final version\Scenario C- NSOOR open
Report generation date: 15/03/2022 15:30:37

»2024 Do Nothing, PM
»2029 Do Nothing , PM
»2039 Do Nothing, PM
»2024 Scenario D Opening Year, PM
»2029 Scenario D Design 5 Years, PM
»2039 Scenario D Design 15 Years, PM

Summary of junction performance

	PM			
	Queue (PCU)	Delay (s)	RFC	LOS
	2024 Do Nothing			
A - R445 Naas Road (east)	0.8	6.38	0.45	A
B - Great Connell	0.2	5.68	0.16	A
C - R445 Naas Road (west)	1.3	8.68	0.57	A
	2029 Do Nothing			
A - R445 Naas Road (east)	1.0	7.21	0.50	A
B - Great Connell	0.3	6.37	0.23	A
C - R445 Naas Road (west)	1.8	10.75	0.65	B
	2039 Do Nothing			
A - R445 Naas Road (east)	1.2	7.93	0.55	A
B - Great Connell	0.3	6.69	0.25	A
C - R445 Naas Road (west)	2.2	12.59	0.70	B
	2024 Scenario D Opening Year			
A - R445 Naas Road (east)	0.8	6.54	0.46	A
B - Great Connell	0.3	6.07	0.21	A
C - R445 Naas Road (west)	1.4	9.32	0.59	A
	2029 Scenario D Design 5 Years			
A - R445 Naas Road (east)	1.0	7.40	0.51	A
B - Great Connell	0.3	6.55	0.25	A
C - R445 Naas Road (west)	1.9	11.28	0.66	B
	2039 Scenario D Design 15 Years			
A - R445 Naas Road (east)	1.2	8.14	0.55	A
B - Great Connell	0.4	6.88	0.27	A
C - R445 Naas Road (west)	2.4	13.29	0.71	B

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

File Description

Title	
Location	
Site number	
Date	18/03/2021
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	MPPNET\socoileir
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75				0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓
D14	2024 Scenario D Opening Year	PM	ONE HOUR	17:30	19:00	15	✓
D16	2029 Scenario D Design 5 Years	PM	ONE HOUR	17:30	19:00	15	✓
D18	2039 Scenario D Design 15 Years	PM	ONE HOUR	17:30	19:00	15	✓

Analysis Set Details

ID	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	✓	100.000	100.000

2024 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	7.42	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	R445 Naas Road (east)	
B	Great Connell	
C	R445 Naas Road (west)	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A - R445 Naas Road (east)	4.00	4.00	0.0	10.0	18.0	0.0	
B - Great Connell	3.00	3.50	3.0	10.0	18.0	0.0	
C - R445 Naas Road (west)	4.00	5.50	15.0	10.0	18.0	0.0	

Slope / Intercept / Capacity

Arm Intercept Adjustments

Arm	Type	Reason	Percentage intercept adjustment (%)
A - R445 Naas Road (east)	Percentage	observed queuing	85.00
B - Great Connell	Percentage	observed queuing	90.00
C - R445 Naas Road (west)	Percentage	observed queuing	60.00

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A - R445 Naas Road (east)	0.595	1087
B - Great Connell	0.551	957
C - R445 Naas Road (west)	0.671	985

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D2	2024 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	413	100.000
B - Great Connell		ONE HOUR	✓	109	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	489	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	77	336
	B - Great Connell	44	0	65
	C - R445 Naas Road (west)	385	104	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.45	6.38	0.8	A	379	568
B - Great Connell	0.16	5.68	0.2	A	100	150
C - R445 Naas Road (west)	0.57	8.68	1.3	A	449	673

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	311	78	78	1041	0.299	309	321	0.0	0.4	4.910	A
B - Great Connell	82	21	252	819	0.100	82	135	0.0	0.1	4.882	A
C - R445 Naas Road (west)	368	92	33	963	0.382	366	300	0.0	0.6	6.001	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	371	93	93	1032	0.360	371	385	0.4	0.6	5.443	A
B - Great Connell	98	24	302	791	0.124	98	162	0.1	0.1	5.194	A
C - R445 Naas Road (west)	440	110	40	959	0.458	439	360	0.6	0.8	6.910	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	455	114	114	1019	0.446	454	471	0.6	0.8	6.357	A
B - Great Connell	120	30	369	754	0.159	120	199	0.1	0.2	5.677	A
C - R445 Naas Road (west)	538	135	48	953	0.565	537	441	0.8	1.3	8.611	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	455	114	114	1019	0.446	455	472	0.8	0.8	6.380	A
B - Great Connell	120	30	370	753	0.159	120	199	0.2	0.2	5.683	A
C - R445 Naas Road (west)	538	135	48	953	0.565	538	441	1.3	1.3	8.682	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	371	93	94	1031	0.360	372	387	0.8	0.6	5.470	A
B - Great Connell	98	24	303	790	0.124	98	163	0.2	0.1	5.202	A
C - R445 Naas Road (west)	440	110	40	959	0.459	441	361	1.3	0.9	6.979	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	311	78	78	1040	0.299	311	324	0.6	0.4	4.942	A
B - Great Connell	82	21	253	818	0.100	82	137	0.1	0.1	4.897	A
C - R445 Naas Road (west)	368	92	33	963	0.382	369	302	0.9	0.6	6.071	A

2029 Do Nothing , PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	8.78	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D4	2029 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	460	100.000
B - Great Connell		ONE HOUR	✓	151	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	553	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	88	372
	B - Great Connell	57	0	94
	C - R445 Naas Road (west)	429	124	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.50	7.21	1.0	A	422	633
B - Great Connell	0.23	6.37	0.3	A	139	208
C - R445 Naas Road (west)	0.65	10.75	1.8	B	507	761

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	346	87	93	1032	0.336	344	363	0.0	0.5	5.221	A
B - Great Connell	114	28	278	804	0.141	113	159	0.0	0.2	5.208	A
C - R445 Naas Road (west)	416	104	43	957	0.435	413	349	0.0	0.8	6.588	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	414	103	111	1021	0.405	413	436	0.5	0.7	5.915	A
B - Great Connell	136	34	334	773	0.176	136	190	0.2	0.2	5.644	A
C - R445 Naas Road (west)	497	124	51	951	0.523	496	418	0.8	1.1	7.887	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	506	127	136	1006	0.503	505	533	0.7	1.0	7.167	A
B - Great Connell	166	42	409	732	0.227	166	233	0.2	0.3	6.356	A
C - R445 Naas Road (west)	609	152	63	943	0.645	606	512	1.1	1.8	10.586	B

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	506	127	137	1006	0.504	506	535	1.0	1.0	7.208	A
B - Great Connell	166	42	410	732	0.227	166	233	0.3	0.3	6.367	A
C - R445 Naas Road (west)	609	152	63	943	0.645	609	513	1.8	1.8	10.752	B

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	414	103	112	1020	0.405	415	439	1.0	0.7	5.959	A
B - Great Connell	136	34	335	772	0.176	136	191	0.3	0.2	5.660	A
C - R445 Naas Road (west)	497	124	51	951	0.523	500	420	1.8	1.1	8.029	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	346	87	94	1031	0.336	347	367	0.7	0.5	5.266	A
B - Great Connell	114	28	281	803	0.142	114	160	0.2	0.2	5.228	A
C - R445 Naas Road (west)	416	104	43	957	0.435	418	352	1.1	0.8	6.699	A

2039 Do Nothing, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	9.99	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D6	2039 Do Nothing	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	496	100.000
B - Great Connell		ONE HOUR	✓	160	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	595	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	95	401
	B - Great Connell	61	0	99
	C - R445 Naas Road (west)	462	133	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.55	7.93	1.2	A	455	683
B - Great Connell	0.25	6.69	0.3	A	147	220
C - R445 Naas Road (west)	0.70	12.59	2.2	B	546	819

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	373	93	99	1028	0.363	371	391	0.0	0.6	5.463	A
B - Great Connell	120	30	300	792	0.152	120	170	0.0	0.2	5.351	A
C - R445 Naas Road (west)	448	112	46	955	0.469	444	374	0.0	0.9	7.008	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	446	111	119	1016	0.439	445	469	0.6	0.8	6.295	A
B - Great Connell	144	36	360	759	0.190	144	204	0.2	0.2	5.850	A
C - R445 Naas Road (west)	535	134	55	949	0.564	533	449	0.9	1.3	8.634	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	546	137	146	1000	0.546	544	573	0.8	1.2	7.867	A
B - Great Connell	176	44	440	715	0.247	176	250	0.2	0.3	6.676	A
C - R445 Naas Road (west)	655	164	67	940	0.697	651	549	1.3	2.2	12.292	B

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	546	137	146	1000	0.546	546	576	1.2	1.2	7.928	A
B - Great Connell	176	44	441	714	0.247	176	251	0.3	0.3	6.693	A
C - R445 Naas Road (west)	655	164	67	940	0.697	655	550	2.2	2.2	12.592	B

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	446	111	120	1015	0.439	447	473	1.2	0.8	6.356	A
B - Great Connell	144	36	362	758	0.190	144	206	0.3	0.2	5.869	A
C - R445 Naas Road (west)	535	134	55	948	0.564	539	451	2.2	1.3	8.860	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	373	93	101	1027	0.364	374	395	0.8	0.6	5.520	A
B - Great Connell	120	30	303	790	0.152	121	172	0.2	0.2	5.376	A
C - R445 Naas Road (west)	448	112	46	954	0.469	450	377	1.3	0.9	7.156	A

2024 Scenario D Opening Year, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	7.80	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D14	2024 Scenario D Opening Year	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	417	100.000
B - Great Connell		ONE HOUR	✓	146	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	508	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	81	336
	B - Great Connell	54	0	92
	C - R445 Naas Road (west)	389	119	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.46	6.54	0.8	A	383	574
B - Great Connell	0.21	6.07	0.3	A	134	201
C - R445 Naas Road (west)	0.59	9.32	1.4	A	466	699

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	314	78	89	1034	0.304	312	331	0.0	0.4	4.975	A
B - Great Connell	110	27	252	819	0.134	109	150	0.0	0.2	5.071	A
C - R445 Naas Road (west)	382	96	40	958	0.399	380	320	0.0	0.7	6.197	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	375	94	107	1024	0.366	374	397	0.4	0.6	5.540	A
B - Great Connell	131	33	302	791	0.166	131	179	0.2	0.2	5.454	A
C - R445 Naas Road (west)	457	114	48	953	0.479	456	384	0.7	0.9	7.226	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	459	115	131	1009	0.455	458	486	0.6	0.8	6.519	A
B - Great Connell	161	40	369	754	0.213	160	220	0.2	0.3	6.065	A
C - R445 Naas Road (west)	559	140	59	946	0.592	557	470	0.9	1.4	9.222	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	459	115	131	1009	0.455	459	488	0.8	0.8	6.545	A
B - Great Connell	161	40	370	753	0.213	161	220	0.3	0.3	6.074	A
C - R445 Naas Road (west)	559	140	59	945	0.592	559	471	1.4	1.4	9.316	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	375	94	107	1023	0.366	376	400	0.8	0.6	5.569	A
B - Great Connell	131	33	303	790	0.166	132	180	0.3	0.2	5.468	A
C - R445 Naas Road (west)	457	114	49	953	0.479	459	386	1.4	0.9	7.317	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	314	78	90	1034	0.304	315	334	0.6	0.4	5.012	A
B - Great Connell	110	27	253	818	0.134	110	151	0.2	0.2	5.089	A
C - R445 Naas Road (west)	382	96	41	958	0.399	383	323	0.9	0.7	6.276	A

2029 Scenario D Design 5 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	9.11	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D16	2029 Scenario D Design 5 Years	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	465	100.000
B - Great Connell		ONE HOUR	✓	165	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	564	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	93	372
	B - Great Connell	62	0	103
	C - R445 Naas Road (west)	429	135	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.51	7.40	1.0	A	427	640
B - Great Connell	0.25	6.55	0.3	A	151	227
C - R445 Naas Road (west)	0.66	11.28	1.9	B	518	776

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	350	88	101	1027	0.341	348	367	0.0	0.5	5.286	A
B - Great Connell	124	31	278	804	0.155	123	170	0.0	0.2	5.286	A
C - R445 Naas Road (west)	425	106	46	954	0.445	421	356	0.0	0.8	6.719	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	418	105	121	1015	0.412	417	440	0.5	0.7	6.015	A
B - Great Connell	148	37	334	773	0.192	148	205	0.2	0.2	5.758	A
C - R445 Naas Road (west)	507	127	56	948	0.535	506	426	0.8	1.1	8.113	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	512	128	148	999	0.512	511	538	0.7	1.0	7.350	A
B - Great Connell	182	45	408	732	0.248	181	250	0.2	0.3	6.531	A
C - R445 Naas Road (west)	621	155	68	940	0.661	618	522	1.1	1.9	11.084	B

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	512	128	149	999	0.513	512	541	1.0	1.0	7.397	A
B - Great Connell	182	45	410	732	0.248	182	251	0.3	0.3	6.546	A
C - R445 Naas Road (west)	621	155	68	940	0.661	621	523	1.9	1.9	11.283	B

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	418	105	122	1014	0.412	419	444	1.0	0.7	6.065	A
B - Great Connell	148	37	335	772	0.192	149	206	0.3	0.2	5.777	A
C - R445 Naas Road (west)	507	127	56	948	0.535	510	428	1.9	1.2	8.277	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	350	88	102	1026	0.341	351	371	0.7	0.5	5.336	A
B - Great Connell	124	31	281	803	0.155	124	172	0.2	0.2	5.310	A
C - R445 Naas Road (west)	425	106	47	954	0.445	426	358	1.2	0.8	6.839	A

2039 Scenario D Design 15 Years, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Vehicle Mix		HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Buckley's Cross Roundabout	Standard Roundabout		A, B, C	10.41	B

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D18	2039 Scenario D Design 15 Years	PM	ONE HOUR	17:30	19:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A - R445 Naas Road (east)		ONE HOUR	✓	500	100.000
B - Great Connell		ONE HOUR	✓	173	100.000
C - R445 Naas Road (west)		ONE HOUR	✓	606	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	99	401
	B - Great Connell	65	0	108
	C - R445 Naas Road (west)	462	144	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		A - R445 Naas Road (east)	B - Great Connell	C - R445 Naas Road (west)
From	A - R445 Naas Road (east)	0	0	0
	B - Great Connell	0	0	0
	C - R445 Naas Road (west)	0	0	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A - R445 Naas Road (east)	0.55	8.14	1.2	A	459	688
B - Great Connell	0.27	6.88	0.4	A	159	238
C - R445 Naas Road (west)	0.71	13.29	2.4	B	556	834

Main Results for each time segment

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	376	94	108	1023	0.368	374	394	0.0	0.6	5.529	A
B - Great Connell	130	33	300	792	0.164	129	182	0.0	0.2	5.431	A
C - R445 Naas Road (west)	456	114	49	953	0.479	453	381	0.0	0.9	7.147	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	449	112	129	1010	0.445	449	472	0.6	0.8	6.410	A
B - Great Connell	156	39	360	759	0.205	155	218	0.2	0.3	5.960	A
C - R445 Naas Road (west)	545	136	58	946	0.576	543	457	0.9	1.3	8.892	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	551	138	158	993	0.554	549	577	0.8	1.2	8.068	A
B - Great Connell	190	48	440	715	0.267	190	266	0.3	0.4	6.856	A
C - R445 Naas Road (west)	667	167	71	937	0.712	663	559	1.3	2.4	12.925	B

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	551	138	158	993	0.555	550	580	1.2	1.2	8.137	A
B - Great Connell	190	48	441	714	0.267	190	267	0.4	0.4	6.876	A
C - R445 Naas Road (west)	667	167	72	937	0.712	667	560	2.4	2.4	13.286	B

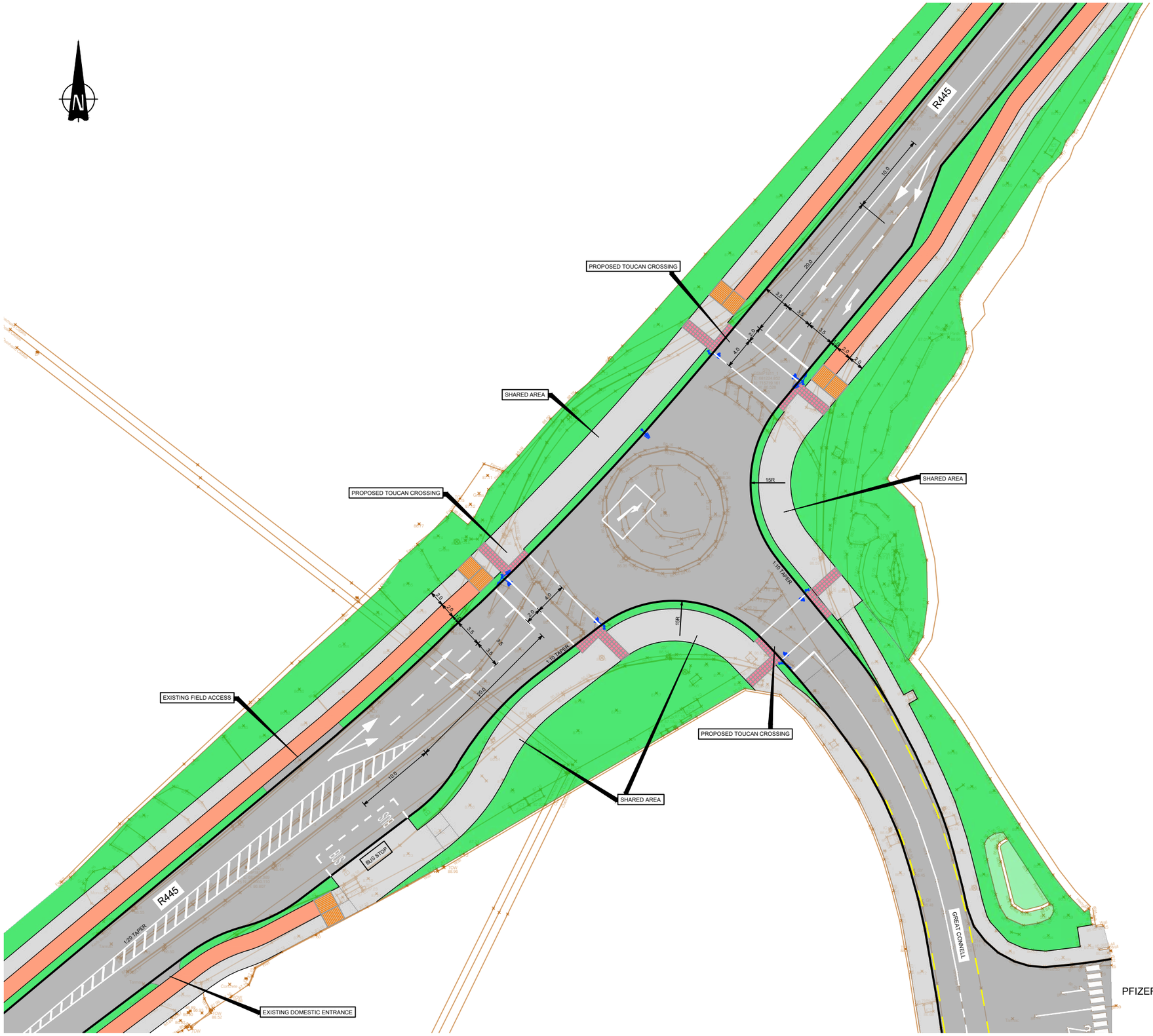
18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	449	112	130	1009	0.445	451	477	1.2	0.8	6.469	A
B - Great Connell	156	39	362	758	0.205	156	220	0.4	0.3	5.987	A
C - R445 Naas Road (west)	545	136	59	946	0.576	549	459	2.4	1.4	9.154	A

18:45 - 19:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A - R445 Naas Road (east)	376	94	109	1022	0.368	377	398	0.8	0.6	5.589	A
B - Great Connell	130	33	303	790	0.165	130	184	0.3	0.2	5.456	A
C - R445 Naas Road (west)	456	114	49	952	0.479	458	384	1.4	0.9	7.307	A

Appendix L Buckley's Cross Signalised Junction Layout



LEGEND:

- CARRIAGEWAY
- CYCLE LANE TRACK
- FOOTPATH
- GRASSED AREA
- TACTILE PAVING (RED)
- CORDUROY HAZARD WARNING PAVING

Note:
This drawing does not form part of the SHD Planning Submission Ref: ABP-311390-21.
The drawing is provided to demonstrate that a Signalised Junction compliant with the requirements of "TII document DN-GEO-03044-02 Signal Controlled Junctions and Roundabouts" can be delivered as agreed with Kildare County Council within publicly available lands

PFIZER NEWBRIDGE

Ordnance Survey Ireland Licence No. CYAL50252568
© Ordnance Survey Ireland/Government of Ireland

© PUNCH Consulting Engineers
This drawing and any design hereon is the copyright of the Consultants and must not be reproduced without their written consent.
All drawings remain the property of the Consultants.
Figured dimension only to be taken from this drawing.
Consultants to be informed immediately of any discrepancies before work proceeds.
COLOUR DRAWING

BUILDING INFORMATION MODELLING (BIM)
I.S. EN ISO 19650-2:2018
NSAI Certified

Rev	Amendment	By	Date	Rev	Amendment	By	Date

Client:

PUNCH consulting engineers
Dublin | Limerick | Cork | Galway | Glasgow
Carnegie House Library Road,
Dun Laoghaire, Co. Dublin, A96 C7W7
t +353 1 271 2200 | w punchconsulting.com

Project: ASTON ROAD & BRIDGE, GREAT CONNELL, NEWBRIDGE CO. KILDARE
Title: BUCKLEY'S CROSS - SIGNALISED JUNCTION

Drawn:	Date drawn:	Technician Check:	Engineer Check:	Approved:
S Buckley	February 2022	S Buckley	J Tiernan	J Tiernan

Project No:	Model Ref:	Drawing Status:
192229	192229-PUNCH-XX-XX-M2-C-0432	S2 (Information)

Scale @ A1:	Document No:	Revision No:
1:250	192229-PUNCH-XX-XX-DR-C-0432	P01

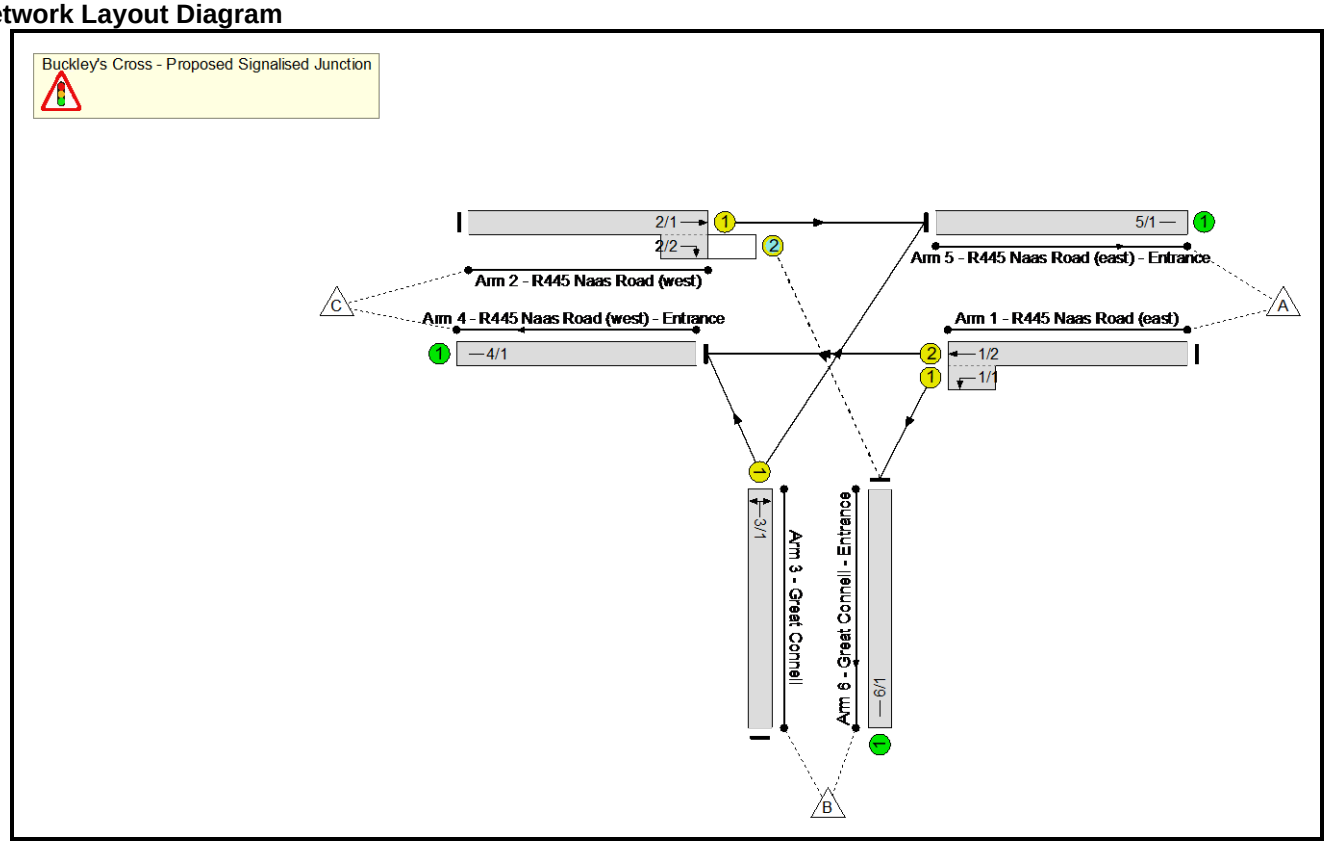
Appendix M Buckley's Cross Signalised Junction Linsig Results Output

Full Input Data And Results

User and Project Details

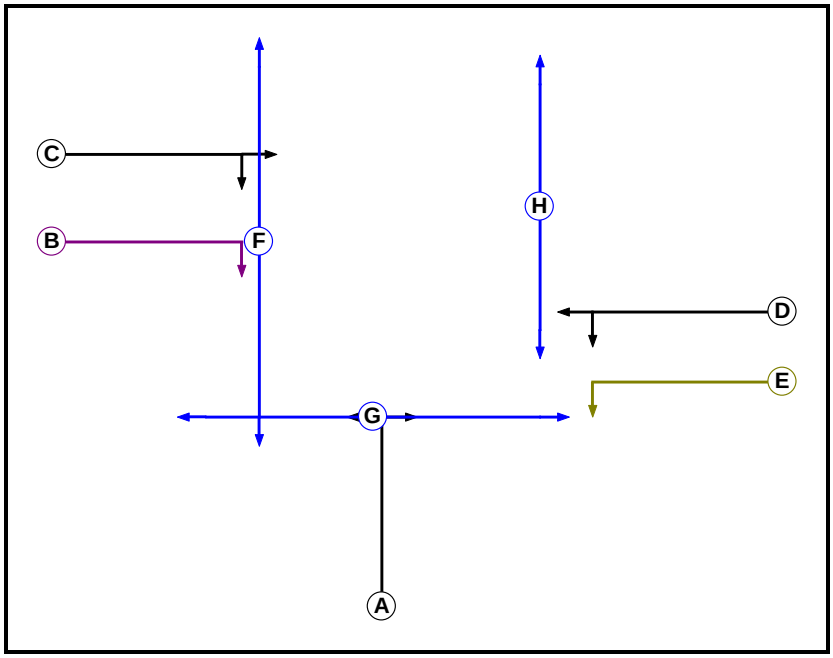
Project:	**192229**
Title:	**Newbridge SHD**
Location:	
Client:	Aston Ltd
Date Started:	May 2021
Checked By:	J Tiernan
Additional detail:	
File name:	192229 - Buckley's Cross Proposed Signalised Junction on survey.lsg3x
Author:	S O'Coileir
Company:	PUNCH Consulting Engineers
Address:	Carnegie House, Library Road, Dun Laoghaire, Co Dublin, A96 C7W7, Ireland

Network Layout Diagram



Full Input Data And Results

Phase Diagram



Phase Input Data

Phase Name	Phase Type	Assoc. Phase	Street Min	Cont Min
A	Traffic		7	7
B	Ind. Arrow	C	4	4
C	Traffic		7	7
D	Traffic		7	7
E	Filter	D	4	4
F	Pedestrian		7	7
G	Pedestrian		7	7
H	Pedestrian		7	7

Phase Intergreens Matrix

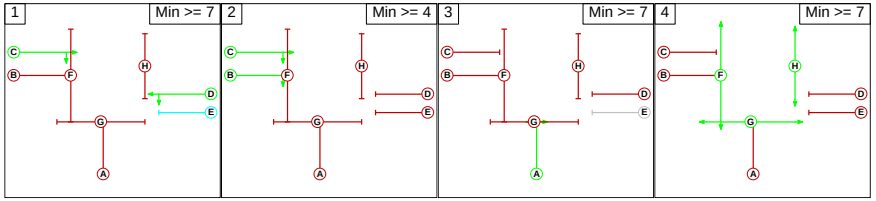
Terminating Phase \ Starting Phase	A	B	C	D	E	F	G	H
A		5	5	6	-	9	5	9
B	6		-	7	7	5	10	10
C	6	-		-	-	5	10	-
D	6	5	-		-	10	8	5
E	-	5	-	-		-	8	5
F	13	13	13	13	-		-	-
G	10	10	10	10	10	-		-
H	13	13	-	13	13	-	-	

Phases in Stage

Stage No.	Phases in Stage
1	C D
2	B C
3	A
4	F G H

Full Input Data And Results

Stage Diagram



Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
There are no Phase Delays defined					

Prohibited Stage Change

From Stage \ To Stage	1	2	3	4
1		5	6	10
2	7		6	10
3	6	5		9
4	13	13	13	

Give-Way Lane Input Data

Junction: Buckley's Cross - Proposed Signalised Junction

Lane	Movement	Max Flow when Giving Way (PCU/Hr)	Min Flow when Giving Way (PCU/Hr)	Opposing Lane	Opp. Lane Coeff.	Opp. Mvmnts.	Right Turn Storage (PCU)	Non-Blocking Storage (PCU)	RTF	Right Turn Move up (s)	Max Turns in Intergreen (PCU)
2/2 (R445 Naas Road (west))	6/1 (Right)	1439	0	1/1	1.09	All	3.00	-	0.50	3	2.00
				1/2	1.09	All					

Full Input Data And Results

Lane Input Data

Junction: Buckley's Cross - Proposed Signalised Junction

Lane	Lane Type	Phases	Start Disp.	End Disp.	Physical Length (PCU)	Sat Flow Type	Def User Saturation Flow (PCU/Hr)	Lane Width (m)	Gradient	Nearside Lane	Turns	Turning Radius (m)
1/1 (R445 Naas Road (east))	U	D E	2	3	3.0	Geom	-	3.50	0.00	Y	Arm 6 Left	15.00
1/2 (R445 Naas Road (east))	U	D	2	3	60.0	Geom	-	3.50	0.00	Y	Arm 4 Ahead	Inf
2/1 (R445 Naas Road (west))	U	C	2	3	60.0	Geom	-	3.50	0.00	Y	Arm 5 Ahead	Inf
2/2 (R445 Naas Road (west))	O	C B	2	3	3.0	Geom	-	3.50	0.00	Y	Arm 6 Right	24.00
3/1 (Great Connell)	U	A	2	3	60.0	Geom	-	3.25	0.00	Y	Arm 4 Left Arm 5 Right	15.00 27.00
4/1 (R445 Naas Road (west) - Entrance)	U		2	3	60.0	Inf	-	-	-	-	-	-
5/1 (R445 Naas Road (east) - Entrance)	U		2	3	60.0	Inf	-	-	-	-	-	-
6/1 (Great Connell - Entrance)	U		2	3	60.0	Inf	-	-	-	-	-	-

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: 'Scenario B 2024 DS AM'	08:30	09:30	01:00	
2: 'Scenario B 2024 DS PM'	17:45	18:45	01:00	
3: 'Scenario B 2029 DS AM'	08:30	09:30	01:00	
4: 'Scenario B 2029 DS PM'	17:45	18:45	01:00	
5: 'Scenario B 2039 DS AM'	08:30	09:30	01:00	
6: 'Scenario B 2039 DS PM'	17:45	18:45	01:00	
7: 'Scenario C 2024 DS AM'	08:30	09:30	01:00	
8: 'Scenario C 2024 DS PM'	17:45	18:45	01:00	
9: 'Scenario C 2029 DS AM'	08:30	09:30	01:00	
10: 'Scenario C 2029 DS PM'	17:45	18:45	01:00	
11: 'Scenario C 2039 DS AM'	08:30	09:30	01:00	
12: 'Scenario C 2039 DS PM'	17:45	18:45	01:00	

Full Input Data And Results

Traffic Flows, Desired

Scenario 1: 'Scenario B 2024 DS AM' (FG1: 'Scenario B 2024 DS AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	92	413	505
	B	62	0	241	303
	C	658	222	0	880
	Tot.	720	314	654	1688

Scenario 2: 'Scenario B 2024 DS PM' (FG2: 'Scenario B 2024 DS PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	16	635	651
	B	109	0	234	343
	C	497	170	0	667
	Tot.	606	186	869	1661

Scenario 3: 'Scenario B 2029 DS AM' (FG3: 'Scenario B 2029 DS AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	104	473	577
	B	75	0	292	367
	C	764	258	0	1022
	Tot.	839	362	765	1966

Scenario 4: 'Scenario B 2029 DS PM' (FG4: 'Scenario B 2029 DS PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	25	740	765
	B	124	0	277	401
	C	574	216	0	790
	Tot.	698	241	1017	1956

Scenario 5: 'Scenario B 2039 DS AM' (FG5: 'Scenario B 2039 DS AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	111	508	619
	B	79	0	310	389
	C	818	272	0	1090
	Tot.	897	383	818	2098

Full Input Data And Results

Scenario 6: 'Scenario B 2039 DS PM' (FG6: 'Scenario B 2039 DS PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	26	793	819
	B	132	0	292	424
	C	615	227	0	842
	Tot.	747	253	1085	2085

Scenario 7: 'Scenario C 2024 DS AM' (FG7: 'Scenario C 2024 DS AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	141	177	318
	B	88	0	130	218
	C	512	166	0	678
	Tot.	600	307	307	1214

Scenario 8: 'Scenario C 2024 DS PM' (FG8: 'Scenario C 2024 DS PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	81	336	417
	B	54	0	92	146
	C	389	119	0	508
	Tot.	443	200	428	1071

Scenario 9: 'Scenario C 2029 DS AM' (FG9: 'Scenario C 2029 DS AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	156	196	352
	B	102	0	149	251
	C	565	182	0	747
	Tot.	667	338	345	1350

Scenario 10: 'Scenario C 2029 DS PM' (FG10: 'Scenario C 2029 DS PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	93	372	465
	B	62	0	103	165
	C	429	135	0	564
	Tot.	491	228	475	1194

Full Input Data And Results

Scenario 11: 'Scenario C 2039 DS AM' (FG11: 'Scenario C 2039 DS AM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	168	211	379
	B	108	0	159	267
	C	609	194	0	803
	Tot.	717	362	370	1449

Scenario 12: 'Scenario C 2039 DS PM' (FG12: 'Scenario C 2039 DS PM', Plan 1: 'Network Control Plan 1')
Desired Flow :

		Destination			
		A	B	C	Tot.
Origin	A	0	99	401	500
	B	65	0	108	173
	C	462	144	0	606
	Tot.	527	243	509	1279

Full Input Data And Results

Network Results

Scenario 1: 'Scenario B 2024 DS AM' (FG1: 'Scenario B 2024 DS AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**74.3%**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**74.3%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	121	0	505	1965:1786	833+186	49.6 : 49.6%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	140	8	880	1965:1849	886+299	74.3 : 74.3%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	54	-	303	1778	415	73.0%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	654	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	720	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	314	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**204**	**13**	**6**	**10.3**	**3.2**	**0.5**	**14.1**	**-**	**-**	**-**	**-**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**204**	**13**	**6**	**10.3**	**3.2**	**0.5**	**14.1**	**-**	**-**	**-**	**-**
1/2+1/1	505	505	-	-	-	2.6	0.5	-	3.1	21.9	10.1	0.5	10.6
2/1+2/2	880	880	204	13	6	4.1	1.4	0.5	6.0	24.7	20.3	1.4	21.7
3/1	303	303	-	-	-	3.6	1.3	-	4.9	58.7	10.3	1.3	11.6
4/1	654	654	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	720	720	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	314	314	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 21.1 Total Delay for Signalled Lanes (pcuHr): 14.06 Cycle Time (s): 240

PRC Over All Lanes (%): 21.1 Total Delay Over All Lanes(pcuHr): 14.06

Full Input Data And Results

Scenario 2: 'Scenario B 2024 DS PM' (FG2: 'Scenario B 2024 DS PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**69.8%**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**69.8%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	111	0	651	1965:1786	911+23	69.7 : 69.7%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	130	8	667	1965:1849	813+278	61.2 : 61.2%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	64	-	343	1787	491	69.8%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	869	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	606	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	186	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**104**	**59**	**7**	**11.6**	**3.1**	**0.8**	**15.4**	**-**	**-**	**-**	**-**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**104**	**59**	**7**	**11.6**	**3.1**	**0.8**	**15.4**	**-**	**-**	**-**	**-**
1/2+1/1	651	651	-	-	-	4.5	1.1	-	5.6	31.2	17.3	1.1	18.4
2/1+2/2	667	667	104	59	7	3.3	0.8	0.8	4.9	26.3	14.0	0.8	14.8
3/1	343	343	-	-	-	3.8	1.1	-	4.9	51.4	11.2	1.1	12.4
4/1	869	869	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	606	606	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	186	186	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 28.9 Total Delay for Signalled Lanes (pcuHr): 15.41 Cycle Time (s): 240
PRC Over All Lanes (%): 28.9 Total Delay Over All Lanes(pcuHr): 15.41

Full Input Data And Results

Scenario 3: 'Scenario B 2029 DS AM' (FG3: 'Scenario B 2029 DS AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**86.9%**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**86.9%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	120	0	577	1965:1786	828+182	57.1 : 57.1%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	139	8	1022	1965:1849	879+297	86.9 : 86.9%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	55	-	367	1778	422	86.9%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	765	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	839	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	362	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**205**	**44**	**9**	**13.5**	**6.8**	**0.8**	**21.1**	**-**	**-**	**-**	**-**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**205**	**44**	**9**	**13.5**	**6.8**	**0.8**	**21.1**	**-**	**-**	**-**	**-**
1/2+1/1	577	577	-	-	-	3.2	0.7	-	3.9	24.1	13.9	0.7	14.6
2/1+2/2	1022	1022	205	44	9	5.8	3.2	0.8	9.8	34.4	31.6	3.2	34.8
3/1	367	367	-	-	-	4.5	3.0	-	7.5	73.4	11.9	3.0	14.9
4/1	765	765	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	839	839	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	362	362	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 3.6 Total Delay for Signalled Lanes (pcuHr): 21.10 Cycle Time (s): 240
PRC Over All Lanes (%): 3.6 Total Delay Over All Lanes(pcuHr): 21.10

Full Input Data And Results

Scenario 4: 'Scenario B 2029 DS PM' (FG4: 'Scenario B 2029 DS PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**85.2%**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**85.2%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	113	0	765	1965:1786	919+31	80.5 : 80.5%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	132	8	790	1965:1849	674+254	85.2 : 85.2%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	62	-	401	1786	476	84.2%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	1017	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	698	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	241	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**91**	**96**	**29**	**18.5**	**7.3**	**1.2**	**27.1**	**-**	**-**	**-**	**-**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**91**	**96**	**29**	**18.5**	**7.3**	**1.2**	**27.1**	**-**	**-**	**-**	**-**
1/2+1/1	765	765	-	-	-	6.1	2.0	-	8.2	38.4	28.2	2.0	30.2
2/1+2/2	790	790	91	96	29	6.0	2.8	1.2	10.0	45.6	33.5	2.8	36.3
3/1	401	401	-	-	-	6.4	2.5	-	8.9	79.8	15.8	2.5	18.3
4/1	1017	1017	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	698	698	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	241	241	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 5.7 Total Delay for Signalled Lanes (pcuHr): 27.06 Cycle Time (s): 240
PRC Over All Lanes (%): 5.7 Total Delay Over All Lanes(pcuHr): 27.06

Full Input Data And Results

Scenario 5: 'Scenario B 2039 DS AM' (FG5: 'Scenario B 2039 DS AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**92.7%**
Buckley's Cross - Proposed Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**92.7%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	120	0	619	1965:1786	829+181	61.3 : 61.3%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	139	8	1090	1965:1849	883+293	92.7 : 92.7%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	55	-	389	1778	422	92.1%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	818	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	897	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	383	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	-	-	**218**	**45**	**9**	**15.1**	**11.0**	**1.0**	**27.0**	-	-	-	-
Buckley's Cross - Proposed Signalised Junction	-	-	**218**	**45**	**9**	**15.1**	**11.0**	**1.0**	**27.0**	-	-	-	-
1/2+1/1	619	619	-	-	-	3.5	0.8	-	4.3	25.1	15.3	0.8	16.1
2/1+2/2	1090	1090	218	45	9	6.7	5.6	1.0	13.3	43.8	35.9	5.6	41.5
3/1	389	389	-	-	-	4.9	4.6	-	9.5	87.5	13.9	4.6	18.5
4/1	818	818	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	897	897	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	383	383	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): -3.0 Total Delay for Signalled Lanes (pcuHr): 27.03 Cycle Time (s): 240
PRC Over All Lanes (%): -3.0 Total Delay Over All Lanes(pcuHr): 27.03

Full Input Data And Results

Scenario 6: 'Scenario B 2039 DS PM' (FG6: 'Scenario B 2039 DS PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	-	-	**N/A**	-	-		-	-	-	-	-	-	**93.4%**
Buckley's Cross - Proposed Signalised Junction	-	-	**N/A**	-	-		-	-	-	-	-	-	**93.4%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	116	0	819	1965:1786	943+31	84.1 : 84.1%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	135	8	842	1965:1849	658+243	93.4 : 93.4%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	59	-	424	1786	454	93.4%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	1085	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	747	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	253	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	-	-	**73**	**110**	**44**	**18.9**	**13.7**	**1.3**	**33.9**	-	-	-	-
Buckley's Cross - Proposed Signalised Junction	-	-	**73**	**110**	**44**	**18.9**	**13.7**	**1.3**	**33.9**	-	-	-	-
1/2+1/1	819	819	-	-	-	6.2	2.6	-	8.7	38.4	28.1	2.6	30.7
2/1+2/2	842	842	73	110	44	6.8	5.9	1.3	14.1	60.3	31.6	5.9	37.6
3/1	424	424	-	-	-	5.8	5.2	-	11.1	94.1	16.1	5.2	21.4
4/1	1085	1085	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	747	747	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	253	253	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): -3.8 Total Delay for Signalled Lanes (pcuHr): 33.94 Cycle Time (s): 240
PRC Over All Lanes (%): -3.8 Total Delay Over All Lanes(pcuHr): 33.94

Full Input Data And Results

Scenario 7: 'Scenario C 2024 DS AM' (FG7: 'Scenario C 2024 DS AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**56.1%**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**56.1%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	125	0	318	1965:1786	601+478	29.5 : 29.5%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	144	8	678	1965:1849	918+298	55.8 : 55.8%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	50	-	218	1793	388	56.1%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	307	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	600	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	307	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**152**	**10**	**4**	**6.3**	**1.5**	**0.1**	**7.8**	**-**	**-**	**-**	**-**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**152**	**10**	**4**	**6.3**	**1.5**	**0.1**	**7.8**	**-**	**-**	**-**	**-**
1/2+1/1	318	318	-	-	-	1.3	0.2	-	1.5	16.9	3.2	0.2	3.4
2/1+2/2	678	678	152	10	4	2.4	0.6	0.1	3.1	16.7	11.8	0.6	12.5
3/1	218	218	-	-	-	2.5	0.6	-	3.2	52.4	6.5	0.6	7.2
4/1	307	307	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	600	600	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	307	307	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 60.4 Total Delay for Signalled Lanes (pcuHr): 7.81 Cycle Time (s): 240
PRC Over All Lanes (%): 60.4 Total Delay Over All Lanes(pcuHr): 7.81

Full Input Data And Results

Scenario 8: 'Scenario C 2024 DS PM' (FG8: 'Scenario C 2024 DS PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**40.8%**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**40.8%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	129	0	417	1965:1786	873+210	38.5 : 38.5%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	148	8	508	1965:1849	955+292	40.7 : 40.7%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	46	-	146	1790	358	40.8%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	428	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	443	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	200	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**109**	**7**	**3**	**4.9**	**1.0**	**0.2**	**6.1**	**-**	**-**	**-**	**-**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**109**	**7**	**3**	**4.9**	**1.0**	**0.2**	**6.1**	**-**	**-**	**-**	**-**
1/2+1/1	417	417	-	-	-	1.7	0.3	-	2.0	17.7	7.0	0.3	7.4
2/1+2/2	508	508	109	7	3	1.5	0.3	0.2	2.0	14.3	7.1	0.3	7.5
3/1	146	146	-	-	-	1.7	0.3	-	2.0	50.3	4.2	0.3	4.6
4/1	428	428	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	443	443	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	200	200	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 120.7 Total Delay for Signalled Lanes (pcuHr): 6.10 Cycle Time (s): 240
PRC Over All Lanes (%): 120.7 Total Delay Over All Lanes(pcuHr): 6.10

Full Input Data And Results

Scenario 9: 'Scenario C 2029 DS AM' (FG9: 'Scenario C 2029 DS AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**62.3%**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**62.3%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	123	0	352	1965:1786	592+471	33.1 : 33.1%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	142	8	747	1965:1849	907+292	62.3 : 62.3%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	52	-	251	1793	403	62.2%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	345	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	667	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	338	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**167**	**11**	**5**	**7.4**	**1.9**	**0.1**	**9.4**	**-**	**-**	**-**	**-**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**167**	**11**	**5**	**7.4**	**1.9**	**0.1**	**9.4**	**-**	**-**	**-**	**-**
1/2+1/1	352	352	-	-	-	1.5	0.2	-	1.7	17.9	4.3	0.2	4.5
2/1+2/2	747	747	167	11	5	3.0	0.8	0.1	3.9	18.8	15.6	0.8	16.5
3/1	251	251	-	-	-	2.9	0.8	-	3.7	53.6	7.6	0.8	8.4
4/1	345	345	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	667	667	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	338	338	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 44.5 Total Delay for Signalled Lanes (pcuHr): 9.39 Cycle Time (s): 240
PRC Over All Lanes (%): 44.5 Total Delay Over All Lanes(pcuHr): 9.39

Full Input Data And Results

Scenario 10: 'Scenario C 2029 DS PM' (FG10: 'Scenario C 2029 DS PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**45.5%**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**45.5%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	128	0	465	1965:1786	861+215	43.2 : 43.2%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	147	8	564	1965:1849	943+297	45.5 : 45.5%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	47	-	165	1791	366	45.1%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	475	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	491	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	228	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**124**	**8**	**3**	**5.7**	**1.2**	**0.2**	**7.2**	**-**	**-**	**-**	**-**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**124**	**8**	**3**	**5.7**	**1.2**	**0.2**	**7.2**	**-**	**-**	**-**	**-**
1/2+1/1	465	465	-	-	-	2.0	0.4	-	2.4	18.6	8.2	0.4	8.5
2/1+2/2	564	564	124	8	3	1.8	0.4	0.2	2.4	15.5	8.6	0.4	9.0
3/1	165	165	-	-	-	1.9	0.4	-	2.3	50.8	4.8	0.4	5.2
4/1	475	475	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	491	491	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	228	228	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 97.8 Total Delay for Signalled Lanes (pcuHr): 7.16 Cycle Time (s): 240

PRC Over All Lanes (%): 97.8 Total Delay Over All Lanes(pcuHr): 7.16

Full Input Data And Results

Scenario 11: 'Scenario C 2039 DS AM' (FG11: 'Scenario C 2039 DS AM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**66.9%**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**66.9%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	123	0	379	1965:1786	592+471	35.6 : 35.6%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	142	8	803	1965:1849	910+290	66.9 : 66.9%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	52	-	267	1793	403	66.2%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	370	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	717	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	362	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**178**	**11**	**5**	**8.1**	**2.2**	**0.1**	**10.5**	**-**	**-**	**-**	**-**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**178**	**11**	**5**	**8.1**	**2.2**	**0.1**	**10.5**	**-**	**-**	**-**	**-**
1/2+1/1	379	379	-	-	-	1.6	0.3	-	1.9	18.1	4.5	0.3	4.7
2/1+2/2	803	803	178	11	5	3.4	1.0	0.1	4.5	20.1	16.7	1.0	17.7
3/1	267	267	-	-	-	3.1	1.0	-	4.1	55.4	8.2	1.0	9.2
4/1	370	370	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	717	717	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	362	362	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 34.4 Total Delay for Signalled Lanes (pcuHr): 10.48 Cycle Time (s): 240
PRC Over All Lanes (%): 34.4 Total Delay Over All Lanes(pcuHr): 10.48

Full Input Data And Results

Scenario 12: 'Scenario C 2039 DS PM' (FG12: 'Scenario C 2039 DS PM', Plan 1: 'Network Control Plan 1')

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Newbridge SHD	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**48.6%**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**48.6%**
1/2+1/1	R445 Naas Road (east) Ahead Left	U	N/A	N/A	D	E	2	129	0	500	1965:1786	869+215	46.1 : 46.1%
2/1+2/2	R445 Naas Road (west) Ahead Right	U+O	N/A	N/A	C	B	2	148	8	606	1965:1849	951+296	48.6 : 48.6%
3/1	Great Connell Left Right	U	N/A	N/A	A		2	46	-	173	1791	358	48.3%
4/1	R445 Naas Road (west) - Entrance	U	N/A	N/A	-		-	-	-	509	Inf	Inf	0.0%
5/1	R445 Naas Road (east) - Entrance	U	N/A	N/A	-		-	-	-	527	Inf	Inf	0.0%
6/1	Great Connell - Entrance	U	N/A	N/A	-		-	-	-	243	Inf	Inf	0.0%

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Newbridge SHD	**-**	**-**	**132**	**8**	**4**	**6.1**	**1.4**	**0.3**	**7.8**	**-**	**-**	**-**	**-**
Buckley's Cross - Proposed Signalised Junction	**-**	**-**	**132**	**8**	**4**	**6.1**	**1.4**	**0.3**	**7.8**	**-**	**-**	**-**	**-**
1/2+1/1	500	500	-	-	-	2.2	0.4	-	2.6	18.9	9.3	0.4	9.7
2/1+2/2	606	606	132	8	4	1.9	0.5	0.3	2.7	15.9	10.0	0.5	10.5
3/1	173	173	-	-	-	2.0	0.5	-	2.5	52.2	5.1	0.5	5.6
4/1	509	509	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	527	527	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	243	243	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0

C1 PRC for Signalled Lanes (%): 85.3 Total Delay for Signalled Lanes (pcuHr): 7.81 Cycle Time (s): 240
PRC Over All Lanes (%): 85.3 Total Delay Over All Lanes(pcuHr): 7.81