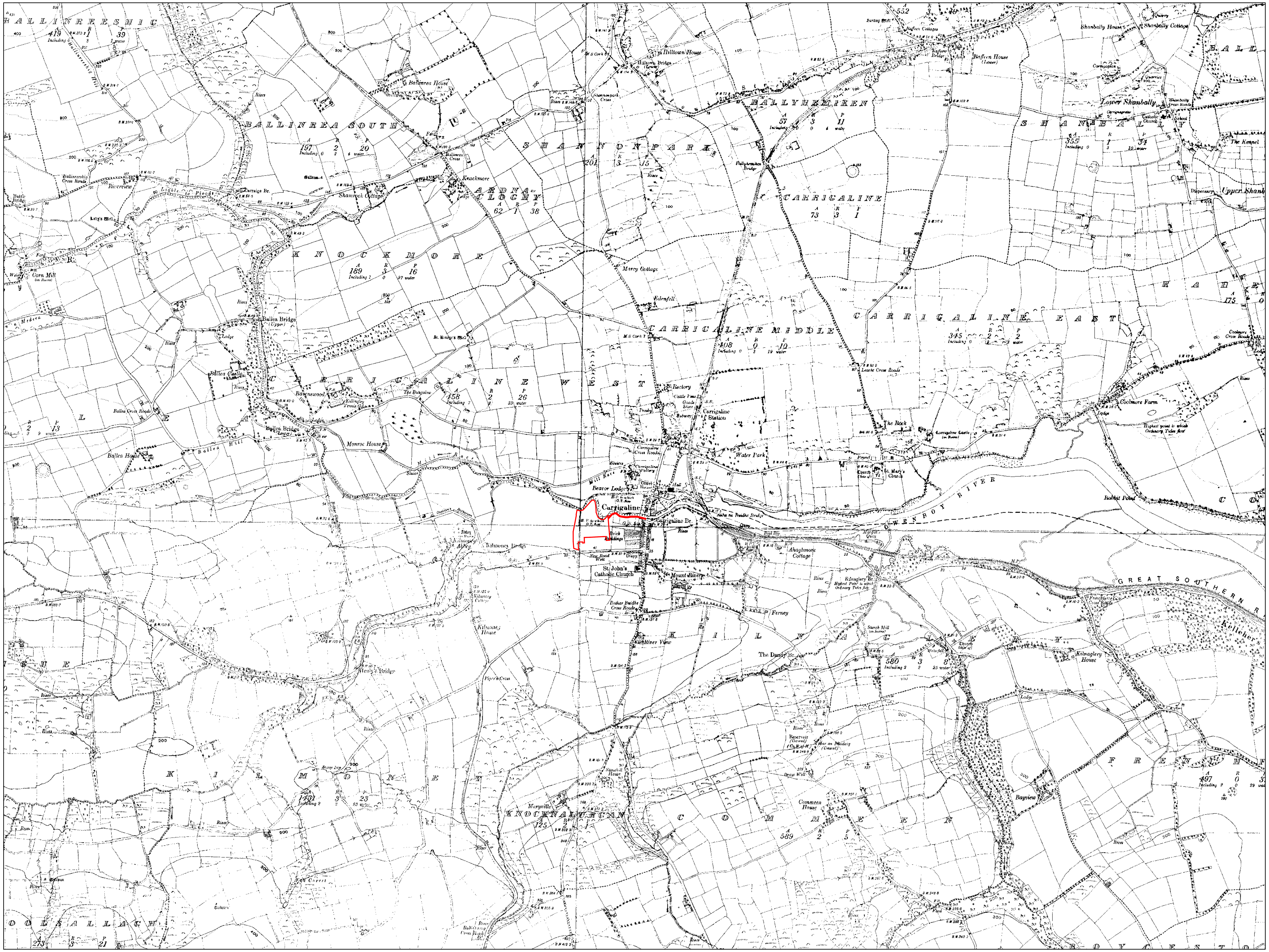
Appendix A



1 SITE LOCATION MAP
1:10560

NOTE
ALL DIMENSIONS TO BE CHECKED ON SITE
NO DIMENSIONS TO BE SCALED FROM THIS DRAWING
THIS DRAWING IS TO BE READ IN CONJUNCTION WITH RELEVANT CONSULTANTS DRAWINGS
ALL MEASUREMENTS ARE METRIC. ALL LONGITUDINAL MEASUREMENTS AND SELECTED VERTICAL SEPERATION DISTANCES IN MM (ie 4020). ALL VERTICAL REFERENCE HEIGHTS IN METRES OD (ie +27.600). ALL FFL IN METRES OF (ie +3.800)

N

Site Boundary

Data Source:
===========
CK086
Revision Date =
Survey Date =
Levelled Date = 31-Dec-1938

CK087
Revision Date =
Survey Date = 31-Dec-1929
Levelled Date = 31-Dec-1934

CK098
Revision Date =
Survey Date = 31-Dec-1930
Levelled Date = 31-Dec-1934

CK099
Revision Date =
Survey Date = 31-Dec-1929
Levelled Date = 31-Dec-1934

Clip Extent:
============
LLX,LLY= 569298.0,559877.0
LRX,LRY= 576308.0,559877.0
ULX,ULY= 569298.0,565071.0
URX,URY= 576308.0,565071.0

Projection:
===========
ITM

ITM Centre Point Co-ordinate:
============================
X,Y = 572803.0,562474.0

Extraction Date:
================
04-Dec-2020

Copyright:
==========

REV	DATE	DESCRIPTION	CHKD	DRN
P1	05/05/2022	PLANNING DRAFT	KMM	JI

ISSUED FOR PLANNING APPROVAL

Henry J Lyons

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info@henryjlyons.com
16 Lavitt's Quay
Cork T12 ED74

CLIENT
Reside Investments Ltd.

PROJECT
Carrigaline SHD
Co. Cork

JOB NUMBER:	95-0829
DATE	Jul 2021
SCALE:	1:10560 @A1
DRAWN	HL
CHECKED	KMM
FILE NAME	950829_X_PROPOSED SITE LOCATION MAP

DRAWING
Site Location Map

BLOCK	DRAWING NUMBER	ZONE	REVISION
	P0000		P1

R:\jobs\90-\950829 Carrigaline SHD\CAD\Xref

1 SITE LOCATION PLAN

1:1000

NOTE
ALL DIMENSIONS TO BE CHECKED ON SITE
NO DIMENSIONS TO BE SCALED FROM THIS DRAWING
THIS DRAWING IS TO BE READ IN CONJUNCTION WITH RELEVANT CONSULTANTS DRAWINGS
ALL MEASUREMENTS ARE METRIC. ALL LONGITUDINAL MEASUREMENTS AND SELECTED VERTICAL SEPERATION DISTANCES IN MM (ie 4020). ALL VERTICAL REFERENCE HEIGHTS IN METRES OD (ie +27.600). ALL FFL IN METRES OF (ie +3.800)

N

Site Boundary

Site Notice Location

Map Series:
===========
1:1,000 | 6510-12
1:1,000 | 6510-17
1:2,500 | 6510-A
1:2,500 | 6510-C

Clip Extent:
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URX,URY= 573218.0,562781.5

Projection:
===========
ITM

ITM Centre Point Co-ordinate:
=============================
X,Y= 572803.0,562474.0

Extraction Date:
================
04-Dec-2020

REV	DATE	DESCRIPTION	CHKD	DRN
P1	29/04/2022	PLANNING		

ISSUED FOR PLANNING APPROVAL

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Reside Investments Ltd.

PROJECT
Carrigaline SHD
Co. Cork

JOB NUMBER:	95-0829
DATE	Jul 2021
SCALE:	1:1000 @A1
DRAWN	HL
CHECKED	KMM
FILE NAME	950829_X_EXISTING SITE LAYOUT PLAN

DRAWING
Existing Site Layout Plan

BLOCK	DRAWING NUMBER	ZONE	REVISION
	P0001		P1

R:\jobs\90-\950829 Carrigaline SHD\CAD\Xref

1 GA - SITE LAYOUT PLAN

1 : 500

ALL DIMENSIONS TO BE CHECKED ON SITE
NO DIMENSIONS TO BE SCALED FROM THIS DRAWING
DRAWING IS TO BE READ IN CONJUNCTION WITH RELEVANT CONSULTANTS DRAWINGS

N

SITE BOUNDARY LINE

SITE NOTICE LOCATION

REV	DATE	DESCRIPTION	CKH	DRN
P1	05/05/2022	PLANNING	KMM	NL

STATUS CODE DESCRIPTION
ISSUED FOR PLANNING APPROVAL

CLIENT
RESIDE INVESTMENTS LTD.

PROJECT
CARRIGALINE SHD

DRAWING
PROPOSED SITE LAYOUT PLAN

PROJECT NUMBER	DATE
950829	29/04/2022
SCALE@ A1: 1 : 500	DRAWN/CHECKED: HL/ KMM

STATUS CODE:	DRAWING NUMBER	REVISION
A1	0002	P1

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Appendix B

S.I. Ltd Contract No: 4404C

Site Investigation for a Road at Carrigaline, Co. Cork

Factual Report

Prepared by:

....

Deirdre Larkin

Issue Date:	10/05/2007
Status	**Final**
Revision	2

Contents

1.0 Preamble

On the instructions of Mott MacDonald Pettit, a ground investigation was carried out by "Site Investigations Ltd" over the period 05/10/2006 to 04/01/2007 for a road project at Carrigaline, Co. Cork.

2.0 Scope

The scope of the site investigation was to investigate subsurface ground conditions by means of cable percussion boreholes with rotary follow-on, trial pits and lab testing.

3.0 Site Works

3.1 General

The ground investigation and sampling was carried out in accordance with BS5930:1999 - 'British Standard Code of Practice for Site Investigation', and BS1377:1990 - 'British Standard Methods of Test for Soils for Civil Engineering Purposes.

The trial pit and borehole numbers are prefixed with the letter 'C' to indicate Carrigaline. The locations of all the site works are shown on the Exploratory Hole Location Plan in Appendix I.

3.2 Trial Pits

Ten number trial pits were excavated.

CTP1 to CTP10 were excavated along the proposed route of the road. The ground profile shown on the trial pit logs is representative of all faces, since no significant differences were noted between the face profiles during excavation.

The trial pit logs are presented in Appendix II.

3.3 Boreholes

Cable percussion boreholes were sunk at seven locations. These holes were then further progressed using follow-on rotary coring. The borehole records are presented in Appendix III.

Since soil information requires a different reporting format from rock information, the detailed soil information is presented on the main borehole log along with the underlying basic rock description. Detailed rock information is provided as a separate attached 'Rock Core Details' sheet(s).

Piezometers for groundwater monitoring and permeability testing were installed in the boreholes where requested by the client.

Notes on the methodology and limitations of cable percussion boring are given in Appendix VII.

3.4 Groundwater monitoring

Groundwater levels were monitored in the piezometers installed during site works.

Groundwater readings are presented in Appendix V.

3.5 Permeability Testing

A number of permeability tests were carried out (in the piezometers).

Test results and permeability values are presented in Appendix V.

4.0 Lab Testing

A particular testing regime was undertaken as specified by the Engineer. Testing includes:

Soils testing

- Moisture content
- Atterberg limits
- Grading
- SO3 & pH
- MCV Calibration
- Organic (loss on ignition)
- Chloride
- Sulphur
- Compaction (2.5kg)
- CBR multiple
- Mott Macdonald chemical suite 4

Rock testing

- Point load Index
- Unconfined compressive strength
- Slake durability
- Natural water content
- Porosity/density
- Aggregate abrasion value
- Aggregate impact value

4.1 Environmental Testing (soils)

Two number environmental soil samples were retrieved for lab testing from selected trial pits, using the specified technique. The samples were taken as one number amber glass jar (250g), one number amber glass vial (60g), one number plastic tub (500g) and one sterile plastic jar.

The lab testing was carried out in accordance with BS1377:1990 - 'British Standard Methods of Test for Soils for Civil Engineering Purposes and the results are presented in Appendix V.

5.0 Revealed Ground Conditions

The ground profile along the route is detailed on the trial pit and borehole logs in Appendices II and III.

6.0 Groundwater Conditions

Groundwater levels and/or seepage into the trial pits and boreholes at the time of excavation are noted on the logs in Appendices II and III. Piezometers for groundwater monitoring and permeability testing were installed in the boreholes where requested by the client. The monitoring and permeability results are presented in Appendix V.

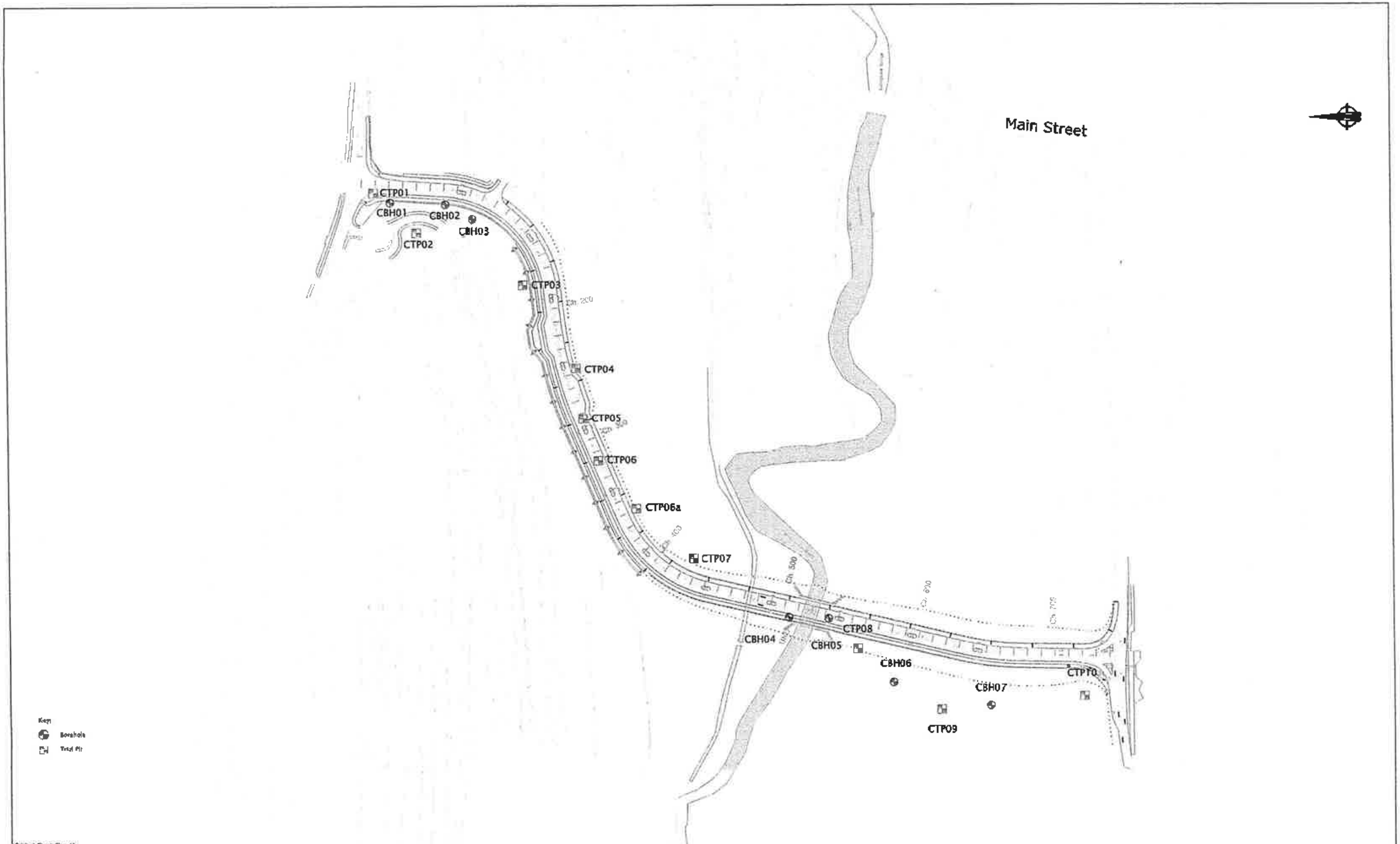
It should be noted that waterlevels noted on the trial pit logs do not generally give an accurate indication of the actual groundwater conditions as the trial pit is rarely left open for sufficient time for the waterlevel to reach equilibrium.

Also, waterlevels and waterstrikes noted on the borehole logs do not generally give an accurate indication of the actual groundwater conditions as the borehole is rarely left standing at the relevant depth for a sufficient time for the waterlevel to reach equilibrium, a permeable stratum may have been sealed off by the borehole casing, or water may have been added to facilitate progress.

Furthermore, groundwater levels vary with time of year, rainfall, nearby construction and other factors.

Appendix I

Exploratory Hole Location Plan



Original Sheet Size A1.
This drawing should not be relied on or used in circumstances other than those for which it was originally prepared and for which Mott MacDonald EPO was commissioned. Mott MacDonald EPO accepts no responsibility for this document to any other party other than the person by whom it was commissioned.

CORK COUNTY COUNCIL

Road Design Office, Co. Cork.

COUNTY ENGINEER

PROJECT ENGINEER

Mott MacDonald

Mott MacDonald EPO

2, Lee House, Riverview Business Park, Blackrock, Cork.
Tel: +353 (021) 2302000
Fax: +353 (021) 2302050
Web: www.mottmacepo.com

Notes
1 This drawing is the property of the Cork County Council. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2 All levels are referred to Ordnance Survey Datum, Malin Head.
3 DO NOT SCALE, use figured dimensions only, if in doubt ask.

Rev.	Date	Description	Appr.
P2	May 06	Revised to meet client requirements	JTM
P1	Apr 06	Issued for comments	JTM

Project Title:
Ground Investigation for Road Projects at Bottlehill, Carrigaline and Midleton

Drawing Title:
Carrigaline Exploration Hole Location Plan including Landowners Holdings

Status: PRE

Designed:	MMEPO	File Name:	..\227008-GI-202 RevP2
Drawn:	DAT		
Approved:	JTM	Scale:	1:1250 @ A1
Checked:	BM	Date:	24/04/06

Drawing No.: 227008-GI-202

Rev.: P2

Appendix II

Trial Pit Records & Photographs

TRIAL PIT RECORD

Contract: Midleton, Carrigaline and Bottlehill Roads | **Hole ID:** **CTP01**

Client: Cork County Council
Consultant: Mott Macdonald Pettit
Site Address: : Carrigaline
Excavation Commenced: 19/10/2006
Excavation Completed: 19/10/2006
Type of Excavator: Komatsu Avance PC130

Elevation: 9.529 m.O.D.
Co-ordinates: E9465.032 N10115.675
Logged by: D. Larkin

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Water Depth (m)	Date
FILL (dry brown sandy gravelly silt with many inclusions of concrete blocks)	0.00		9.53					
Moist reddish brown very clayey sandy subangular fine to coarse GRAVEL with some tree roots and rootlets.	1.00		8.53	B D	1.00 1.00	282		
Moist reddish brown silty sandy subrounded fine to coarse GRAVEL. Refusal at 2.1m, limestone, presumed rockhead, possible boulder.	1.50		8.03	B D	2.00 2.00	283		
	2.10	Hole End	7.43					

Scale: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0

Note: If deemed necessary, pit face sketches are given on the last sheet.
Strata descriptions refer to all faces unless otherwise specified.

Remarks:
Pit easily excavated to 2.1m.
Terminated at 2.1m on presumed rockhead.
No visible ingress of groundwater during excavation.
Pit stable (no sidewall collapse).

Key to Symbols
- B Bulk disturbed sample
- D Small disturbed sample
- U Undisturbed sample
- V(60) In-situ hand shear vane test(kPa)
- P Hand Penetrometer Test(N value)
- Waterstrike depth
- Water level depth 20mins after strike

Pit Orientation and Dimensions

C / B / D / A 0 deg

Width: 0.60m
Length: 3.00m
Depth: 2.10m

Site Investigations Ltd

TRIAL PIT RECORD

Contract: Midleton, Carrigaline and Bottlehill Roads — Hole ID: **CTP02**

Client: Cork County Council

Consultant: Mott Macdonald Pettit

Site Address: : Carrigaline

Excavation Commenced: 05/10/2006

Excavation Completed: 05/10/2006

Type of Excavator: JCB (New Holland LB 115)

Elevation: 11.840 m.O.D.

Co-ordinates: E9495.954 N10086.976

Logged by: D. Larkin

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Water Depth (m)	Date
TOPSOIL (moist reddish brown slightly sandy SILT with some rootlets)	0.00		11.84					
Dry light yellowish brown clayey sandy subangular to subrounded fine to coarse GRAVEL with some cobbles	0.40		11.44	B	1.00	311		
Dry light yellowish brown clayey sandy subangular fine to coarse GRAVEL with occasional subangular cobbles	1.50		10.34	B D	2.30 2.30	312 -		
Moist light yellowish brown clayey very sandy subangular to subrounded fine to coarse GRAVEL with occasional subangular cobbles	3.20		8.64					
	3.50	Hole End	8.34	B D	3.50 3.50	313 -		

Note: If deemed necessary, pit face sketches are given on the last sheet.
Strata descriptions refer to all faces unless otherwise specified.

Remarks:
Pit easily excavated to 3.5m.
No visible ingress of groundwater during excavation.
Terminated at 3.50m as pit became unstable (slight sidewall collapse at 3.00m).

Key to Symbols

B	Bulk disturbed sample
D	Small disturbed sample
U	Undisturbed sample
V(60)	In-situ hand shear vane test(kPa)
P	Hand Penetrometer Test(N value)
	Waterstrike depth
	Water level depth 20mins after strike

Pit Orientation and Dimensions

C — B — D — A () deg

Width: 0.60m
Length: 3.00m
Depth: 3.50m

Site Investigations Ltd

TRIAL PIT 4404CARRIGALINETP.GPJ COREHOLE.GDT 28/03/07

TRIAL PIT RECORD

Contract: Midleton, Carrigaline and Bottlehill Roads — **Hole ID:** CTP03

Client: Cork County Council
Consultant: Mott Macdonald Pettit
Site Address: : Carrigaline
Excavation Commenced: 05/10/2006
Excavation Completed: 05/10/2006
Type of Excavator: JCB (New Holland LB 115)

Elevation: 7.690 m.O.D.
Co-ordinates: E9572.889 N10048.942
Logged by: D. Larkin

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Water Depth (m)	Date
FILL (dry reddish brown slightly very gravelly sandy CLAY/SILT with many inclusions of plastic bags, timber, metal and old wiring)	0.00		7.69					
				E	0.60	-		
				B	1.00	314		
				D	1.00	-		
Moist (firm to stiff) yellowish brown slightly gravelly sandy CLAY with some nodules of decayed organic matter	1.70		5.99					
				B	2.00	315		
				D	2.00	-		
Saturated grey slightly sandy clayey subangular fine to coarse GRAVEL with some subangular cobbles	2.20		5.49				2.20	05/10/2006
				B	3.00	316		
				D	3.00	-		
	3.90	Hole End	3.79					

**Note: If deemed necessary, pit face sketches are given on the last sheet.
Strata descriptions refer to all faces unless otherwise specified.**

Remarks:
Pit easily excavated to 3.90m.
Terminated at 3.90m on JCB limit.
Moderate waterstrike at 2.20m.
Excavation continued to 3.90m (water continuously entering pit during excavation). Water rose to 3.86m in 5 mins.
Pit stable to 2.00m. Unstable from 2.00 to 3.90m.

Key to Symbols
B Bulk disturbed sample
D Small disturbed sample
U Undisturbed sample
V(60) In-situ hand shear vane test(kPa)
P Hand Penetrometer Test(N value)
Waterstrike depth
Water level depth 20mins after strike

Pit Orientation and Dimensions
C
B — D
A () deg
Width: 0.60m
Length: 3.00m
Depth: 3.90m

Site Investigations Ltd

TRIAL PIT 4404CARRIGALINETP.GPJ COREHOLE.GDT 28/03/07

TRIAL PIT RECORD

Contract: Midleton, Carrigaline and Bottlehill Roads — **Hole ID:** CTP04

Client: Cork County Council
Consultant: Mott Macdonald Pettit
Site Address: : Carrigaline
Excavation Commenced: 05/10/2006
Excavation Completed: 05/10/2006
Type of Excavator: JCB (New Holland LB 115)

Elevation: 5.848 m.O.D.
Co-ordinates: E9610.978 N9988.489
Logged by: D. Larkin

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Samples/Tests Depth (m)	Samples/Tests Ref No.	Water Depth (m)	Date
TOPSOIL (moist reddish brown sandy SILT with some rootlets)	0.00		5.85					
Moist (firm to stiff) reddish brown sandy gravelly CLAY/SILT with some subrounded cobbles	0.60		5.25	B B D	1.00 1.00 1.00	317 318 -		
							1.90	05/10/2006
				B D	2.00 2.00	319 -		
Saturated (soft) light reddish brown very sandy very gravelly CLAY/SILT with many subangular to subrounded cobbles	2.10		3.75					
							3.00	05/10/2006
	3.30	Hole End	2.55	B	3.30	320		

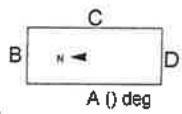
Note: If deemed necessary, pit face sketches are given on the last sheet.
Strata descriptions refer to all faces unless otherwise specified.

Remarks:
Pit easily excavated to 3.30m.
Terminated at 3.30m as pit became unstable.
Slight seepage at 1.90m. Material moist from 1.90m.
Moderate waterstrike at 3.00m.
Excavation continued to 3.30. Water rose to 3.10m in 10 mins.
Pit stable to 2.50m. Unstable from 2.50m to 3.30m.

Key to Symbols

B	Bulk disturbed sample
D	Small disturbed sample
U	Undisturbed sample
V(60)	In-situ hand shear vane test(kPa)
P	Hand Penetrometer Test(N value)
▼	Waterstrike depth
▽	Water level depth 20mins after strike

Pit Orientation and Dimensions



Width: 0.60m
Length: 3.00m
Depth: 3.30m

Site Investigations Ltd

TRIAL PIT RECORD

Contract: Midleton, Carrigaline and Bottlehill Roads **Hole ID:** **CTP05**

Client: Cork County Council

Consultant: Mott Macdonald Pettit

Site Address: : Carrigaline

Excavation Commenced: 05/10/2006

Excavation Completed: 05/10/2006

Type of Excavator: JCB (New Holland LB 115)

Elevation: 5.908 m.O.D.

Co-ordinates: E9615.827 N9951.017

Logged by: D. Larkin

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Water Depth (m)	Date
TOPSOIL (moist reddish brown slightly sandy SILT with some rootlets)	0.00		5.91					
Moist (firm) reddish brown sandy very gravelly CLAY/SILT with occasional subrounded cobbles and some black nodules of decayed organic matter	0.60		5.31	B D	1.00 1.00	322 -		
Moist (soft to firm) reddish brown sandy very gravelly CLAY with occasional subrounded cobbles and some black nodules of decayed organic matter	2.30		3.61	B D	2.50 2.50	323 -	2.30	05/10/2006
Saturated grey clayey very sandy subangular fine to coarse GRAVEL with occasional subangular cobbles	2.70		3.21	B D	3.00 3.00	324 -		
	3.60	Hole End	2.31					

Note: If deemed necessary, pit face sketches are given on the last sheet. Strata descriptions refer to all faces unless otherwise specified.

Remarks:

Pit easily excavated to 3.60m.
Terminated at 3.60m as pit became unstable.
Moderate waterstrike at 2.30m.
Excavation continued to 3.60m. Water rose to 3.55 in 5 mins.
Pit stable to 3.00m. Unstable to 3.60m.

Key to Symbols

B Bulk disturbed sample
D Small disturbed sample
U Undisturbed sample
V(60) In-situ hand shear vane test(kPa)
P Hand Penetrometer Test(N value)
Waterstrike depth
Water level depth 20mins after strike

Pit Orientation and Dimensions

C, B, D, A () deg

Width: 0.60m
Length: 3.00m
Depth: 3.60m

Site Investigations Ltd

TRIAL PIT 4404CARRIGALINETP.GPJ COREHOLE.GDT 28/03/07

TRIAL PIT RECORD

Contract: Midleton, Carrigaline and Bottlehill Roads | **Hole ID:** CTP06

Client: Cork County Council
Consultant: Mott Macdonald Pettit
Site Address: : Carrigaline
Excavation Commenced: 05/10/2006
Excavation Completed: 05/10/2006
Type of Excavator: JCB (New Holland LB 115)

Elevation: 5.997 m.O.D.
Co-ordinates: E9626.549 N9920.176
Logged by: D. Larkin

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Water Depth (m)	Date
TOPSOIL (moist reddish brown slightly sandy slightly gravelly SILT with some rootlets)	0.00		6.00					
Moist (firm) reddish brown sandy gravelly CLAY	0.40		5.60	B	1.00	325		
	2.90	Hole End	3.10				2.90	

Note: If deemed necessary, pit face sketches are given on the last sheet.
Strata descriptions refer to all faces unless otherwise specified.

Remarks:
Pit easily excavated to 2.90m.
Terminated at 2.90m.
Slight waterstrike at 2.90m.
Pit stable to 2.90m.
Excavated 30m from set-out location. Moved to CTP06A.

Key to Symbols
B Bulk disturbed sample
D Small disturbed sample
U Undisturbed sample
V(60) In-situ hand shear vane test(kPa)
P Hand Penetrometer Test(N value)
Waterstrike depth
Water level depth 20mins after strike

Pit Orientation and Dimensions
C
B D
A () deg
Width: 0.60m
Length: 3.00m
Depth: 2.90m

Site Investigations Ltd

TRIAL PIT 4404CARRIGALINETP.GPJ COREHOLE.GDT 28/03/07

TRIAL PIT RECORD

Contract: Midleton, Carrigaline and Bottlehill Roads | **Hole ID:** CTP06A

Client: Cork County Council
Consultant: Mott Macdonald Pettit
Site Address: : Carrigaline
Excavation Commenced: 05/10/2006
Excavation Completed: 05/10/2006
Type of Excavator: JCB (New Holland LB 115)

Elevation: 5.303 m.O.D.
Co-ordinates: E9653.728 N9885.086
Logged by: D. Larkin

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Water Depth (m)	Date
TOPSOIL (moist reddish brown slightly sandy SILT with some rootlets)	0.00		5.30					
Moist (firm to stiff) greyish brown gravelly very sandy CLAY/SILT	0.60		4.70	B D E	1.00 1.00 1.20	326 - -		
Moist (firm to stiff) grey slightly gravelly sandy CLAY/SILT	2.20		3.10	B D	2.50 2.50	327 -		
Moist (stiff to very stiff) grey sandy gravelly CLAY/SILT	3.00		2.30					
	3.70	Hole End	1.60	B	3.70	328	3.70	05/10/2006

Depth scale: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0

Note: If deemed necessary, pit face sketches are given on the last sheet. Strata descriptions refer to all faces unless otherwise specified.

Remarks:
Pit easily excavated to 3.00m. Moderate excavation from 3.00 to 3.70m.
Terminated at 3.70m on JCB limit.
Slight waterstrike at 3.70m (no rise).
Pit stable to 3.70m.
Some black material at 1.20m (possible organic material / contamination?).

* E = Environmental sample consisting of 1 no. 200g glass jar, 1 no. 60g glass vial, 1 no. 250g plastic tub and 1 no. clear plastic jar.

Key to Symbols
- B Bulk disturbed sample
- D Small disturbed sample
- U Undisturbed sample
- V(60) In-situ hand shear vane test(kPa)
- P Hand Penetrometer Test(N value)
- Waterstrike depth
- Water level depth 20mins after strike

Pit Orientation and Dimensions

C, B, D, N, A () deg

Width: 0.60m
Length: 3.00m
Depth: 3.70m

Site Investigations Ltd

TRIAL PIT RECORD

Contract: Midleton, Carrigaline and Bottlehill Roads — **Hole ID:** **CTP07**

Client: Cork County Council

Consultant: Mott Macdonald Pettit

Site Address: : Carrigaline

Excavation Commenced: 05/10/2006

Excavation Completed: 05/10/2006

Type of Excavator: JCB (New Holland LB 115)

Elevation: 4.685 m.O.D.

Co-ordinates: E9695.021 N9848.630

Logged by: D. Larkin

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Water Depth (m)	Date
TOPSOIL (moist reddish brown slightly sandy SILT with some rootlets)	0.00		4.69					
Moist (firm to stiff) mottled grey and orange slightly sandy very gravelly CLAY/SILT with many lenses of yellow fine sand and black nodules of decayed organic matter (4 cm in diameter)	0.40		4.29	B D	1.00 1.00	329 -		
Moist (stiff) light reddish brown sandy very gravelly CLAY/SILT	1.30		3.39	B D	2.00 2.00	330 -		
Moist (stiff to very stiff) light greyish brown very sandy very gravelly CLAY/SILT with occasinal lenses of orange sand	2.80		1.89	B D	3.00 3.00	331 -		
	3.30	Hole End	1.39					

Note: If deemed necessary, pit face sketches are given on the last sheet. Strata descriptions refer to all faces unless otherwise specified.

Remarks:
Pit easily excavated to 2.80m. Moderate excavation from 2.80 to 3.30m.
Terminated at 3.30m on JCB limit.
No visible ingress of groundwater during excavation.
Material very moist from 2.80m.
Pit stable to 3.30m.

Key to Symbols

B	Bulk disturbed sample
D	Small disturbed sample
U	Undisturbed sample
V(60)	In-situ hand shear vane test(kPa)
P	Hand Penetrometer Test(N value)
	Waterstrike depth
	Water level depth 20mins after strike

Pit Orientation and Dimensions

C, B, D, A () deg, N

Width: 0.60m
Length: 3.00m
Depth: 3.30m

Site Investigations Ltd

TRIAL PIT 4404CARRIGALINETP.GPJ COREHOLE.GDT 28/03/07

TRIAL PIT RECORD

Contract: Midleton, Carrigaline and Bottlehill Roads — **Hole ID:** **CTP08**

Client: Cork County Council

Consultant: Mott Macdonald Pettit

Site Address: : Carrigaline

Excavation Commenced: 19/10/2006

Excavation Completed: 19/10/2006

Type of Excavator: Komatsu Avance PC130

Elevation: 3.225 m.O.D.

Co-ordinates: E9813.520 N9784.186

Logged by: D. Larkin

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Samples/Tests Depth (m)	Samples/Tests Ref No.	Water Depth (m)	Date
TOPSOIL (moist reddish brown sandy gravelly silt with many rootlets)	0.00		3.23					
Moist reddish brown silty sandy subangular to subrounded fine to coarse GRAVEL with many nodules of decayed organic matter (2cm in diameter).	0.40		2.83	B D	0.50 0.50	290		
Moist (firm to stiff) orangish brown sandy gravelly CLAY with some subrounded cobbles.	0.60		2.63					
Saturated greyish brown clayey sandy angular to subangular, fine to coarse (predominately coarse) GRAVEL with many angular to subangular cobbles. Possible weathered rock.	1.00		2.23				1.00	19/10/2006
Saturated brownish grey slightly clayey very sandy angular to subangular, fine to coarse (predominately coarse) GRAVEL with many subangular cobbles. Possible weathered rock.	1.50		1.73	B	1.50	291		
	3.00	Hole End	0.23	B	3.00	292		

Note: If deemed necessary, pit face sketches are given on the last sheet. Strata descriptions refer to all faces unless otherwise specified.

Remarks:
Pit easily excavated to 1.0m.
Moderate excavation from 1.0m to 3.0m. Terminated at 3.0m as pit became unstable.
Moderate water strike at 1.0m. Excavation continued to 3.0m. Water rose to 2.6m in 10 minutes.
Pit stable to 1.5m. Slight collapse of faces from 1.5m to 3.0m with rapid water entry.

Key to Symbols

B	Bulk disturbed sample
D	Small disturbed sample
U	Undisturbed sample
V(60)	In-situ hand shear vane test(kPa)
P	Hand Penetrometer Test(N value)
▼	Waterstrike depth
▽	Water level depth 20mins after strike

Pit Orientation and Dimensions

C — B — D — A () deg — N

Width: 0.60m
Length: 3.00m
Depth: 3.00m

Site Investigations Ltd

TRIAL PIT 4404CARRIGALINETP.GPJ COREHOLE.GDT 28/03/07

TRIAL PIT RECORD

Contract: Midleton, Carrigaline and Bottlehill Roads — **Hole ID:** **CTP09**

Client: Cork County Council

Consultant: Mott Macdonald Pettit

Site Address: : Carrigaline

Elevation: 4.097 m.O.D.

Excavation Commenced: 19/10/2006

Co-ordinates: E9874.666 N9740.019

Excavation Completed: 19/10/2006

Logged by: D. Larkin

Type of Excavator: Komatsu Avance PC130

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Samples/Tests Depth (m)	Samples/Tests Ref No.	Water Depth (m)	Date
TOPSOIL (moist reddish brown sandy silt with many rootlets)	0.00		4.10					
Moist (firm to stiff) mottled brown and grey slightly sandy gravelly CLAY with many subangular to subrounded cobbles.	0.20		3.90	B D	1.00 1.00	287		
Saturated brownish grey clayey sandy angular to subangular, fine to coarse (predominately coarse) GRAVEL with many subangular limestone cobbles. Possible weathered rock.	2.20		1.90	B B	2.50 2.50	288	2.10	19/10/2006
	3.50	Hole End	0.60	B	3.50	289		

Note: If deemed necessary, pit face sketches are given on the last sheet.
Strata descriptions refer to all faces unless otherwise specified.

Remarks:
Pit easily excavated to 2.2m
Moderate excavation from 2.2m to 3.5m.
Terminated at 3.5m as pit became unstable.
Rapid water strike at 2.1m.
Pit stable to 2.2m, slight collapse of faces from 2.2m to 3.5m due to rapid water entry.

Key to Symbols

B	Bulk disturbed sample
D	Small disturbed sample
U	Undisturbed sample
V(60)	In-situ hand shear vane test(kPa)
P	Hand Penetrometer Test(N value)
	Waterstrike depth
	Water level depth 20mins after strike

Pit Orientation and Dimensions

C — B — D — A () deg

Width: 0.60m
Length: 3.00m
Depth: 3.50m

Site Investigations Ltd

TRIAL PIT RECORD

Contract: Midleton, Carrigaline and Bottlehill Roads — **Hole ID:** CTP10

Client: Cork County Council
Consultant: Mott Macdonald Pettit
Site Address: : Carrigaline
Excavation Commenced: 19/10/2006
Excavation Completed: 19/10/2006
Type of Excavator: Komatsu Avance PC130

Elevation: 10.488 m.O.D.
Co-ordinates: E9978.876 N9749.939
Logged by: D. Larkin

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Water Depth (m)	Date
TOPSOIL (moist light brown sandy silt with many subrounded cobbles)	0.00		10.49					
Moist orangish brown silty sandy subangular fine to coarse GRAVEL with some subrounded cobbles and some lenses of grey fine sand. Refusal at 1.9m, limestone, presumed rockhead, possible boulder.	0.30		10.19	B	0.50	284		
				B	1.00	285		
				D	1.00			
	1.90	Hole End	8.59	B	1.90	286	1.90	19/10/2006
				D	1.90			

Note: If deemed necessary, pit face sketches are given on the last sheet. Strata descriptions refer to all faces unless otherwise specified.

Remarks:
Pit easily excavated to 1.9m.
Terminated at 1.9m on presumed rockhead.
Slight water strike at 1.9m (base). Water did not rise in 10 minutes.
Pit stable (no sidewall collapse)
Hand vane at 0.6m, peak: 110, residual: 45.

Key to Symbols

B	Bulk disturbed sample
D	Small disturbed sample
U	Undisturbed sample
V(60)	In-situ hand shear vane test(kPa)
P	Hand Penetrometer Test(N value)
	Waterstrike depth
	Water level depth 20mins after strike

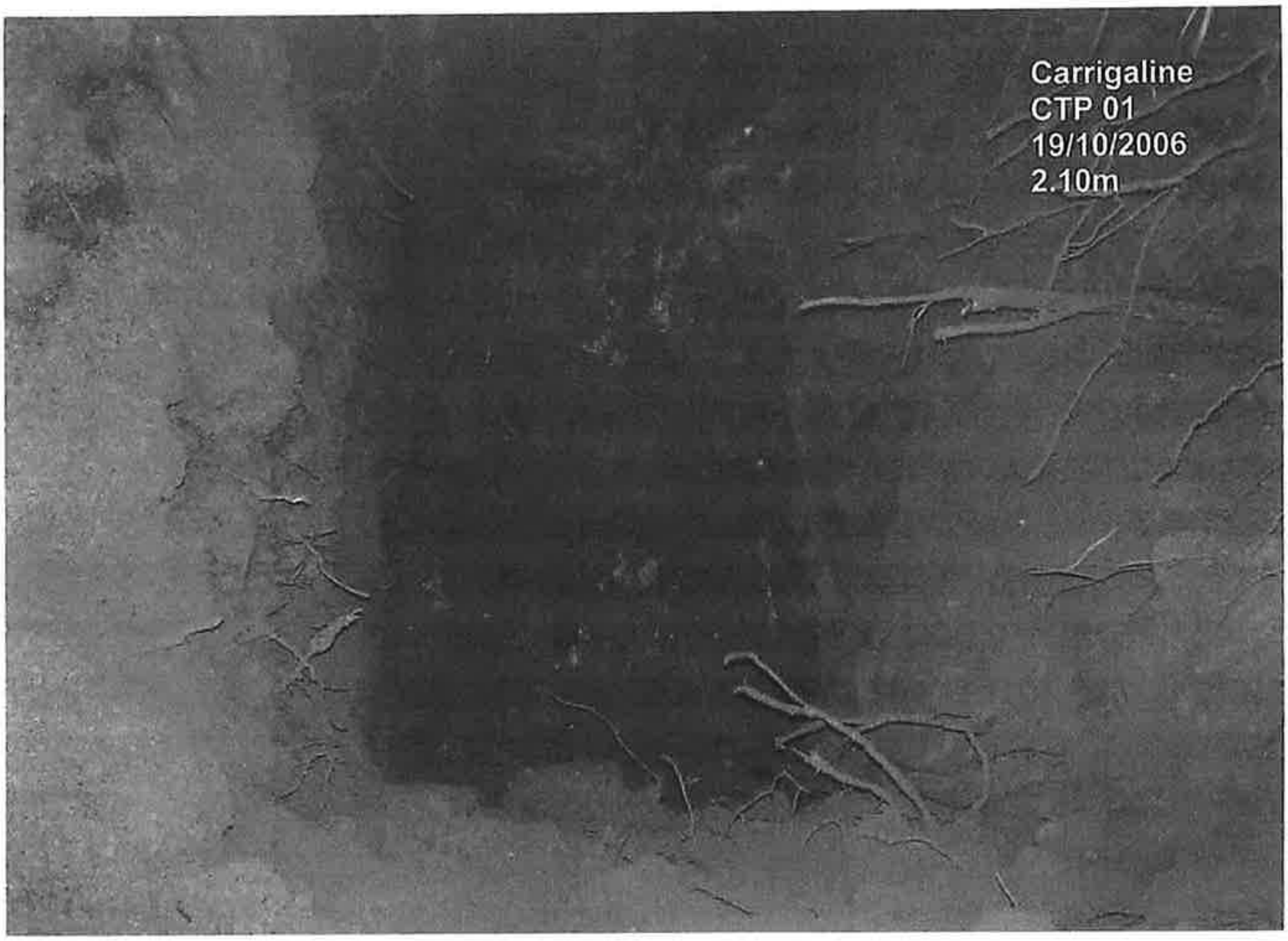
Pit Orientation and Dimensions

C
B — D
A () deg

Width: 0.60m
Length: 3.00m
Depth: 1.90m

Site Investigations Ltd

TRIAL PIT 4404CARRIGALINETP.GPJ COREHOLE.GDT 28/03/07


Carrigaline
CTP 01
19/10/2006
2.10m


Carrigaline
CTP 01
19/10/2006
2.10m

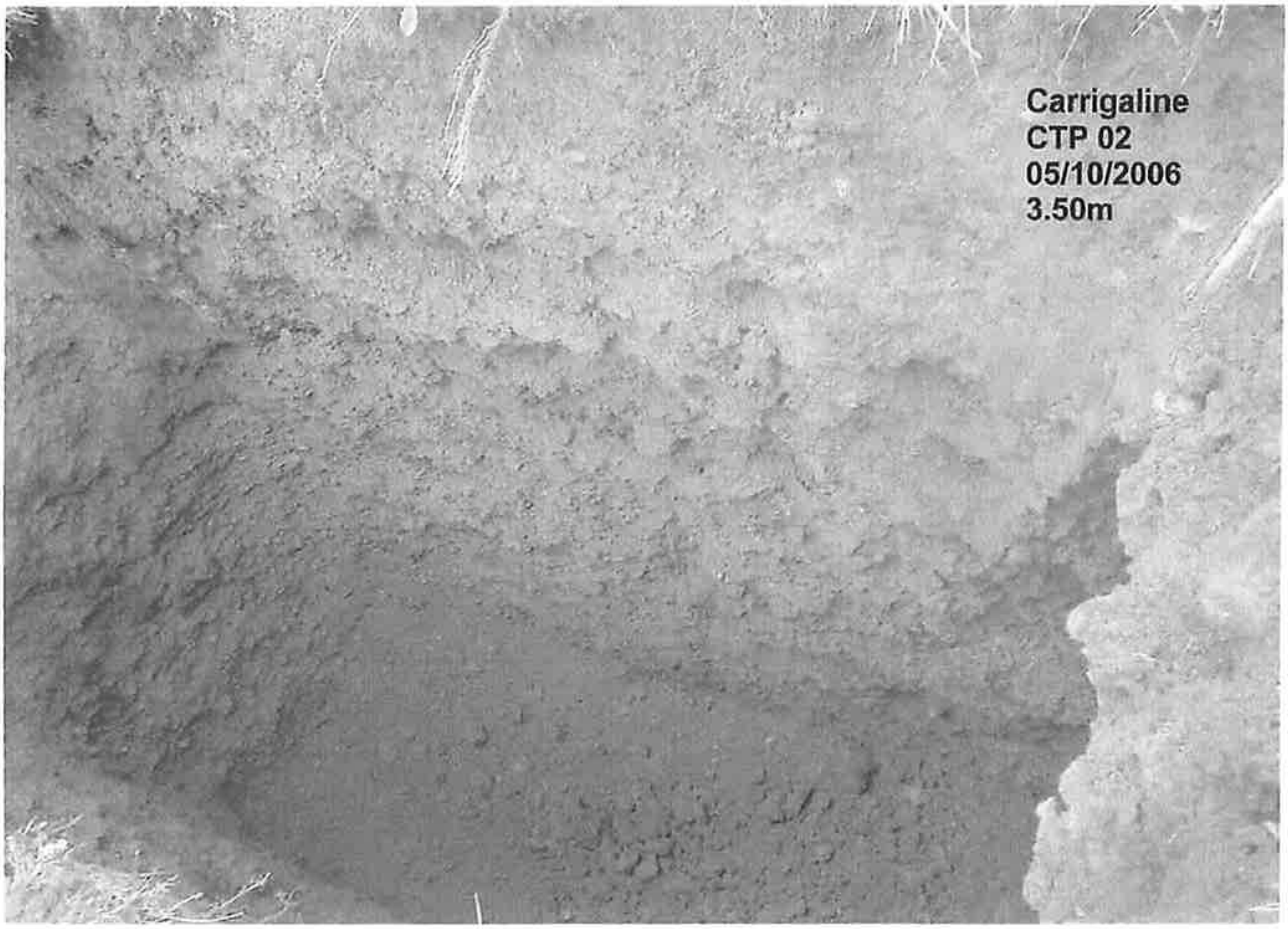

Carrigaline
CTP 01
19/10/2006
2.10m


Carrigaline
CTP 01
19/10/2006
Material Excavated


Carrigaline
CTP 02
05/10/2006
3.50m


Carrigaline
CTP 02
05/10/2006
3.50m


Carrigaline
CTP 02
05/10/2006
3.50m


Carrigaline
CTP 02
05/10/2006
3.50m


Carrigaline
CTP 02
05/10/2006
Material Excavated


Carrigaline
CTP 02
05/10/2006
Material Excavated


Carrigaline
CTP 03
05/10/2006
3.90m


Carrigaline
CTP 03
05/10/2006
3.90m


Carrigaline
CTP 03
05/10/2006
3.90m


Carrigaline
CTP 03
05/10/2006
3.90m


Carrigaline
CTP 03
05/10/2006
Material Excavated


Carrigaline
CTP 04
05/10/2006
3.30m


Carrigaline
CTP 04
05/10/2006
Material Excavated


Carrigaline
CTP 05
05/10/2006
3.60m


Carrigaline
CTP 05
05/10/2006
3.60m


HOLLAND
Carrigaline
CTP 05
05/10/2006
Material Excavated


Carrigaline
CTP 06
05/10/2006
2.90m


Carrigaline
CTP 06
05/10/2006
2.90m


Carrigaline
CTP 06
05/10/2006
Material Excavated


Carrigaline
CTP 06A
05/10/2006
3.70m

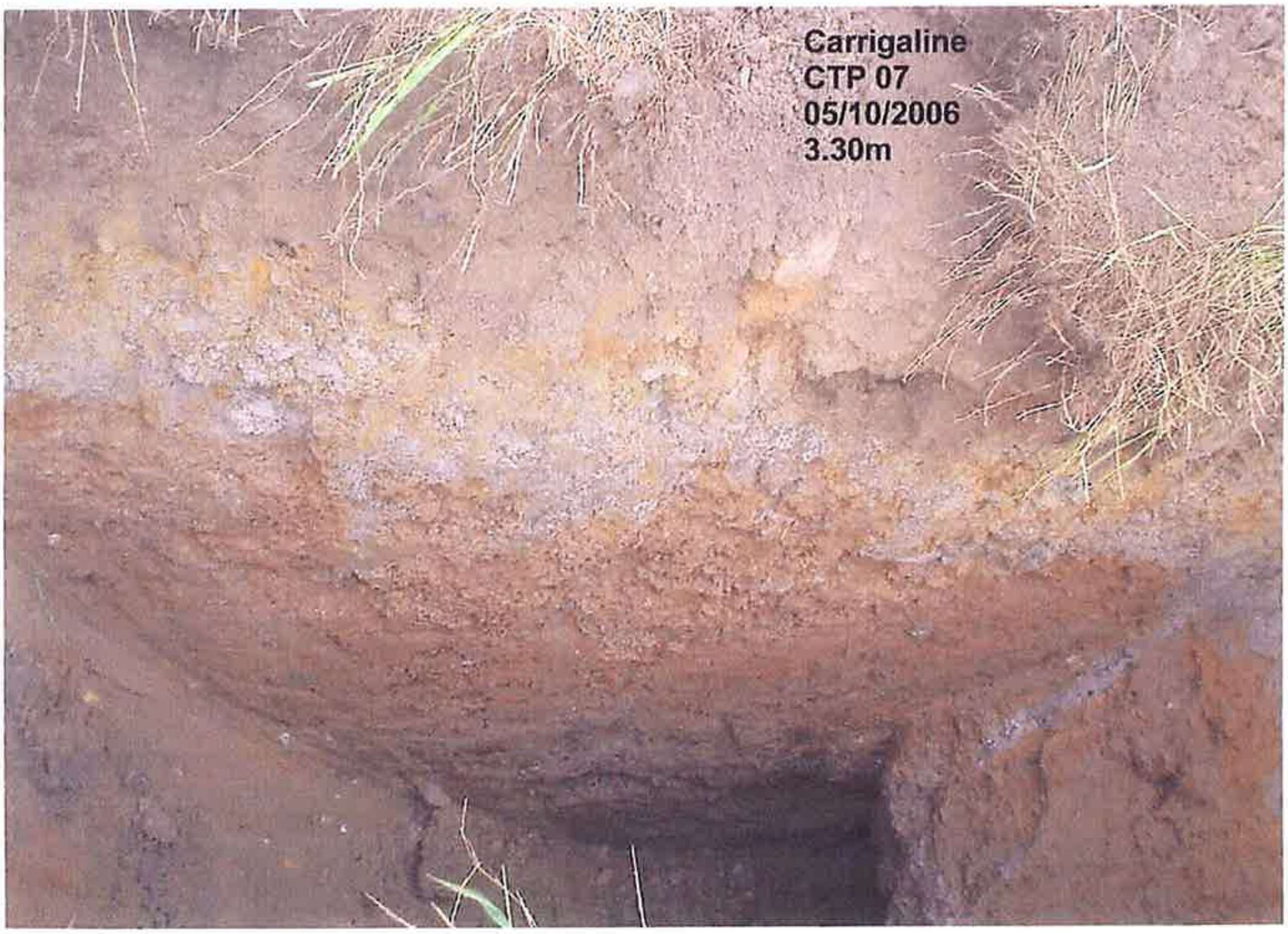

Carrigaline
CTP 06A
05/10/2006
3.70m


Carrigaline
CTP 06A
05/10/2006
Material Excavated


Carrigaline
CTP 07
05/10/2006
3.30m


Carrigaline
CTP 07
05/10/2006
3.30m


Carrigaline
CTP 07
05/10/2006
3.30m


Carrigaline
CTP 07
05/10/2006
3.30m

Carrigaline
CTP 07
05/10/2006
Material Excavated


Carrigaline
CTP 08
19/10/2006
3.00m


Carrigaline
CTP 08
19/10/2006
3.00m

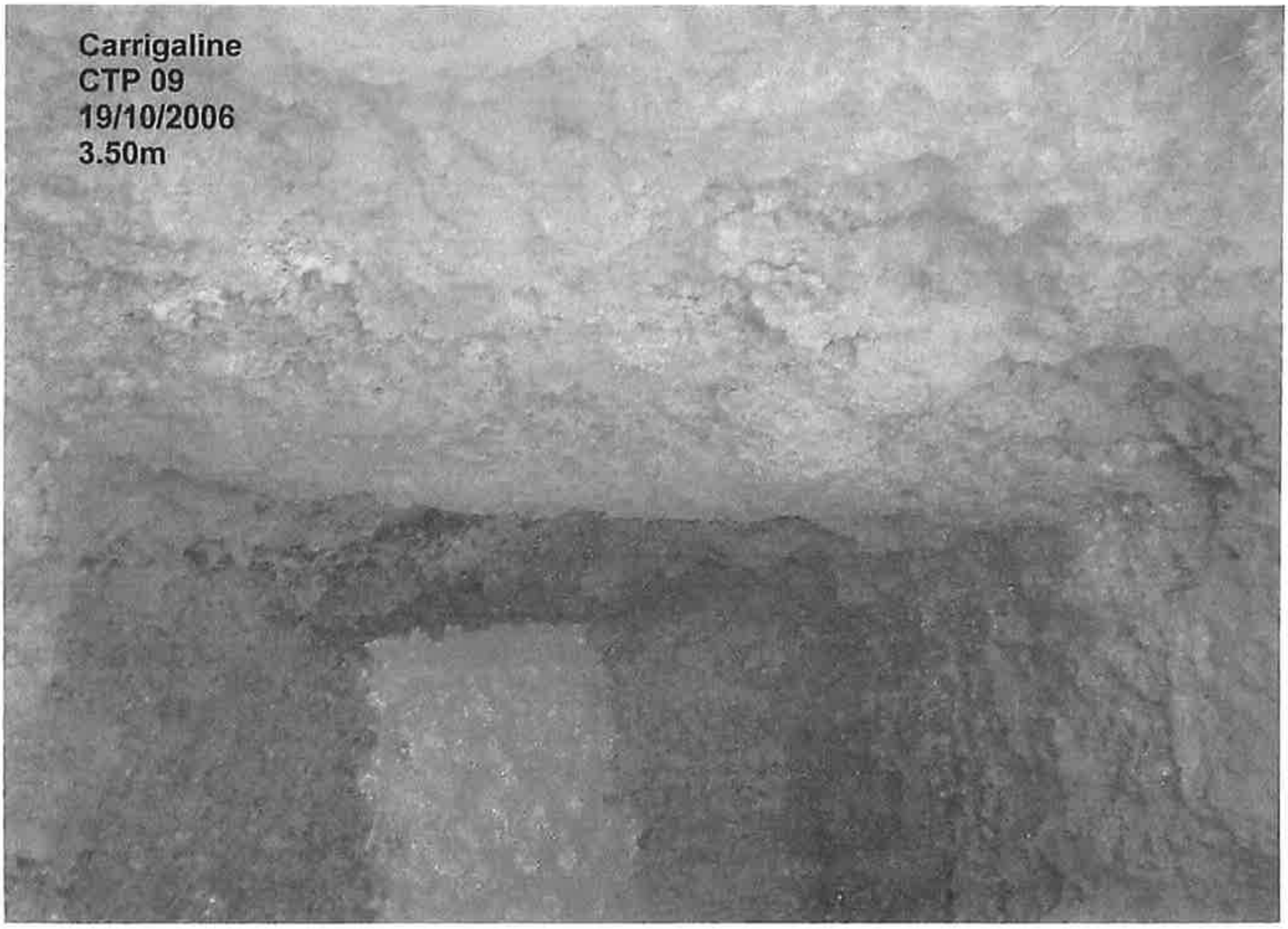

Carrigaline
CTP 08
19/10/2006
3.00m


Carrigaline
CTP 08
19/10/2006
Material Excavated


Carrigaline
CTP 09
19/10/2006
3.50m


Carrigaline
CTP 09
19/10/2006
3.50m


Carrigaline
CTP 09
19/10/2006
3.50m


Carrigaline
CTP 09
19/10/2006
3.50m


Carrigaline
CTP 09
19/10/2006
Material Excavated


Carrigaline
CTP 10
19/10/2006
1.90m


Carrigaline
CTP 10
19/10/2006
1.90m


Carrigaline
CTP 10
19/10/2006
1.90m


Carrigaline
CTP 10
19/10/2006
1.90m


Carrigaline
CTP 10
19/10/2006
Material Excavated


Carrigaline
CTP 05
05/10/2006
3.60m


Carrigaline
CTP 05
05/10/2006
3.60m

Appendix III

Borehole Records & Rock Core Photographs

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH1**

Client:	Cork County Council	**Elevation:**	10.480 m.O.D.
Consultant:	Mott McDonald Pettit	**Co-ordinates**	E9477.042 N10108.742
Site Address:	Carrigaline.	**Hole Diameter:**	200 & 95 mm
Boring Commenced:	02/11/2006	**Drilled by:**	G. C & P. G
Boring Completed:	04/01/2007	**Logged by:**	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Samples/Tests Depth (m)	Samples/Tests Ref No.	Progress/Water Hole Depth (m)	Progress/Water Date	Progress/Water Water Depth (m)
TOPSOIL (reddish brown slightly sandy SILT with some rootlets).	0.00		10.48						
Reddish brown sandy very gravelly CLAY with occasional subrounded cobbles.	0.10		10.38						
Stiff reddish brown sandy gravelly CLAY with occasional angular cobbles	1.10		9.38	D B C(13)	1.00 1.00 1.00				
				D B C(18)	2.00 2.00 2.00				
				D B C(50)	3.00 3.00 3.00				
BOULDER	4.00		6.48	C(50)	4.00			02/11/2006 02/11/2006 02/11/2006 02/11/2006	4.00(20) 4.10(20) 4.30 4.50
Stiff reddish brown sandy gravelly CLAY with occasional angular cobbles	4.60		5.88	C(50)	4.60		4.60	02/11/2006	-(E)
Strong light grey LIMESTONE Slightly to moderately weathered	7.00		3.48						
Moderately strong to moderately weak light grey LIMESTONE with clay bands and limestone gravel Highly weathered	8.50		1.98						

Remarks: ***(Note: Stratum bands <200mm are not indicated pictorially)***

Chiselling from 3.3m to 3.6m for 0.75hrs.
Chiselling from 4.0m to 4.6m for 1hr.
Water strike at 4.3m rose to 4.1m
Water strike at 4.5m rose to 4.0m.
Rotary follow on from 4.7m to 13.5m
Piezometer installed t0 4.5m,
Pea gravel filter from 5.0m to 4.0m
Concrete: GL to 0.10m.
Bentonite seal: 0.10 to 4.00m.
Bentonite seal: 5.00 to 7.50m.
Flush cover installed.

Key to Symbols

B	Bulk Disturbed Sample	S(9)	Standard Penetration Test(N value)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
W	Water sample		Waterstrike depth
U(9)	Undisturbed sample (drive blows)		Water level depth 20mins after strike
	Water Sample	17.20(E)	Depth to water (E)nd of shift
		12.20(S)	Depth to water (S)tart of shift

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH1**

Client:	Cork County Council	**Elevation:**	10.480 m.O.D.
Consultant:	Mott McDonald Pettit	**Co-ordinates**	E9477.042 N10108.742
Site Address:	Carrigaline.	**Hole Diameter:**	200 & 95 mm
Boring Commenced:	02/11/2006	**Drilled by:**	G. C & P. G
Boring Completed:	04/01/2007	**Logged by:**	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

Sheet 2 of 2

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests: Type	Depth (m)	Ref No.	Progress/Water: Hole Depth (m)	Date	Water Depth (m)
Strong light grey LIMESTONE Slightly weathered	10.00		0.48						
	13.50	Hole End	-3.02						

Depth scale: 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0

Remarks: ***(Note: Stratum bands <200mm are not indicated pictorially)***

Chiselling from 3.3m to 3.6m for 0.75hrs.
Chiselling from 4.0m to 4.6m for 1hr.
Water strike at 4.3m rose to 4.1m
Water strike at 4.5m rose to 4.0m.
Rotary follow on from 4.7m to 13.5m
Piezometer installed to 4.5m,
Pea gravel filter from 5.0m to 4.0m
Concrete: GL to 0.10m.
Bentonite seal: 0.10 to 4.00m.
Bentonite seal: 5.00 to 7.50m.
Flush cover installed.

Key to Symbols

B	Bulk Disturbed Sample	S(9)	Standard Penetration Test(N value))
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
W	Water sample		Waterstrike depth
U(9)	Undisturbed sample (drive blows)		Water level depth 20mins after strike
	Water Sample	17.20(E)	Depth to water (E)nd of shift
		12.20(S)	Depth to water (S)tart of shift

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH1**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 02/11/2006
Boring Completed: 04/01/2007
Type of Boring: Cable Percussion & Rotary

Elevation: 10.480 m.O.D.
E9477.042 N10108.742
Hole Diameter: 200 & 95 mm
Drilled by: G. C & P. G
Logged by: D. Larkin & J. Allely
Sheet 1 of 2

Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES	Unit Depth (m)	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
0.00	-	-	-	NA	Not applicable	0.00	10.48	TOPSOIL (reddish brown slightly sandy SILT with some rootlets).
						0.10	10.38	Reddish brown sandy very gravelly CLAY with occasional subrounded cobbles.
						1.10	9.38	Stiff reddish brown sandy gravelly CLAY with occasional angular cobbles
						4.00	6.48	BOULDER
						4.60	5.88	Stiff reddish brown sandy gravelly CLAY with occasional angular cobbles
7.00	92	92	72	7	Discontinuities closely spaced, subhorizontal and 45 degrees and occasionally subvertical, planar to undulating, smooth, some clay infilling and mineral lining with brown staining.	7.00	3.48	Strong light grey LIMESTONE Slightly to moderately weathered
				NI	Non intact	8.50	1.98	Moderately strong to moderately weak light grey LIMESTONE with clay bands and limestone gravel Highly weathered
9.00	90	83	83					

Downhole Depth (m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Remarks:
(Note: Stratum bands <100mm are not indicated pictorially;
NA = not applicable; NR = not recordable; NI = non-inact)
Chiselling from 3.3m to 3.6m for 0.75hrs.
Chiselling from 4.0m to 4.6m for 1hr.
Water strike at 4.3m rose to 4.1m.
Water strike at 4.5m rose to 4.0m.
Rotary follow on from 4.7m to 13.5m
Piezometer installed t0 4.5m,
Pea gravel filter from 5.0m to 4.0m
Concrete: GL to 0.10m.
Bentonite seal: 0.10 to 4.00m.
Bentonite seal: 5.00 to 7.50m.
Flush cover installed.

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH1**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 02/11/2006
Boring Completed: 04/01/2007
Type of Boring: Cable Percussion & Rotary

Elevation: 10.480 m.O.D.
E9477.042 N10108.742
Hole Diameter: 200 & 95 mm
Drilled by: G. C & P. G
Logged by: D. Larkin & J. Allely
Sheet 2 of 2

Downhole Depth (m)	Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES	Unit Depth (m)	Legend	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
10.0					9	Discontinuities closely spaced, occasionally very closely spaced,subhorizontal and 45 degrees and occasionally subvertical, planar to undulating, smooth, some clay infilling and mineral lining with brown staining.	10.00		0.48	Strong light grey LIMESTONE Slightly weathered
11.0										
	11.50	98	84	73						
12.0										
13.0										
							13.50	Hole End	-3.02	
14.0										
15.0										
16.0										
17.0										
18.0										
19.0										
20.0										

Remarks:
(Note: Stratum bands <100mm are not indicated pictorially; NA = not applicable; NR = not recordable; NI = non-inact)
Chiselling from 3.3m to 3.6m for 0.75hrs.
Chiselling from 4.0m to 4.6m for 1hr.
Water strike at 4.3m rose to 4.1m
Water strike at 4.5m rose to 4.0m.
Rotary follow on from 4.7m to 13.5m
Piezometer installed t0 4.5m,
Pea gravel filler from 5.0m to 4.0m
Concrete: GL to 0.10m
Bentonite seal: 0.10 to 4.00m.
Bentonite seal: 5.00 to 7.50m.
Flush cover installed.

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH2**

Client:	Cork County Council	Elevation:	10.606 m.O.D.
Consultant:	Mott McDonald Pettit	Co-ordinates	E9517.264 N10107.291
Site Address:	Carrigaline.	Hole Diameter:	200 mm
Boring Commenced:	07/11/2006	Drilled by:	P Gilmartin.
Boring Completed:	07/11/2006	Logged by:	D. Larkin
Type of Boring:	Cable Percussion		

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Samples/Tests Depth (m)	Samples/Tests Ref No.	Progress/Water Hole Depth (m)	Progress/Water Date	Progress/Water Water Depth (m)
TOPSOIL (reddish brown very sandy SILT with some rootlets).	0.00		10.61						
FILL (brown sandy gravelly clay).	0.10		10.51						
				B	1.00	1794			
				C(8)	1.00				
				B	2.00	1795			
				C(8)	2.00				
				B	3.00	1796			
				C(50)	3.00				
	3.30	Hole End	7.31				3.30	07/11/2006	dry(E)

Remarks: ***(Note: Stratum bands <200mm are not indicated pictorially)***
Hole terminated at 3.3m as sewer pipe encountered.

Key to Symbols

B	Bulk Disturbed Sample	S(9)	Standard Penetration Test(N value)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
W	Water sample		Waterstrike depth
U(9)	Undisturbed sample (drive blows)		Water level depth 20mins after strike
	Water Sample	17.20(E)	Depth to water (E)nd of shift
		12.20(S)	Depth to water (S)tart of shift

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH2A**

Client:	Cork County Council	Elevation:	10.606 m.O.D.
Consultant:	Mott McDonald Pettit	Co-ordinates	E9518.264 N10106.291
Site Address:	Carrigaline.	Hole Diameter:	200 mm
Boring Commenced:	08/11/2006	Drilled by:	P Gilmartin.
Boring Completed:	08/11/2006	Logged by:	D. Larkin
Type of Boring:	Cable Percussion		

Sheet 1 of 1

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Samples/Tests Depth (m)	Samples/Tests Ref No.	Progress/Water Hole Depth (m)	Progress/Water Date	Progress/Water Water Depth (m)
TOPSOIL (reddish brown slightly sandy SILT with some rootlets).	0.00		10.61						
FILL (brown sandy gravelly CLAY). Concrete at 3.5m.	0.10		10.51						
	3.50	Hole End	7.11				3.50	08/11/2006	dry(E)

Depth scale: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*

Key to Symbols

B	Bulk Disturbed Sample	S(9)	Standard Penetration Test(N value)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
W	Water sample		Waterstrike depth
U(9)	Undisturbed sample (drive blows)		Water level depth 20mins after strike
	Water Sample	17.20(E)	Depth to water (E)nd of shift
		12.20(S)	Depth to water (S)tart of shift

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH2B**

Client:	Cork County Council	Elevation:	10.606 m.O.D.
Consultant:	Mott McDonald Pettit	Co-ordinates	E9519.264 N10105.291
Site Address:	Carrigaline.	Hole Diameter:	200 & 95 mm
Boring Commenced:	09/11/2006	Drilled by:	P Gilmartin.
Boring Completed:	19/12/2006	Logged by:	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

Sheet 1 of 2

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Progress/Water Hole Depth (m)	Date	Water Depth (m)
TOPSOIL (reddish brown very sandy SILT with some rootlets).	0.00		10.61						
FILL (sandy gravelly CLAY).	0.10		10.51						
limestone FILL.	1.80		8.81	B	1.80	1797			
Stiff brown sandy gravelly CLAY.	2.20		8.41	B C(24)	4.00 4.00	1798			
				B C(50) B	5.00 5.00 5.30	1799 1800			
								09/11/2006	5.70
COBBLES with much finer material. Finer material is sandy clayey gravel	6.00		4.61				6.00	09/11/2006	5.70(E)
Presumed sandy gravelly CLAY. Poor recovery.	7.00		3.61						
Strong light grey LIMESTONE. Slightly weathered	9.00		1.61						

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling at 6.0m for 1hr.
Rotary follow on from 6.0m to 14.0m.
Backfilled

Key to Symbols

B	Bulk Disturbed Sample	U(9)	Undisturbed Sample(drive blows)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
S(9)	Standard Penetration Test(N value)	C(*)	Cone Penetration Test(refusal)
S(*)	Standard Penetration Test(refusal)		Waterstrike depth
W	Water Sample		Water level depth 20mins after strike

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. HOLE ID: **CBH2B**

Client:	Cork County Council	Elevation:	10.606 m.O.D.
Consultant:	Mott McDonald Pettit	Co-ordinates	E9519.264 N10105.291
Site Address:	Carrigaline.	Hole Diameter:	200 & 95 mm
Boring Commenced:	09/11/2006	Drilled by:	P Gilmartin.
Boring Completed:	19/12/2006	Logged by:	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

Sheet 2 of 2

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Progress/Water Hole Depth (m)	Date	Water Depth (m)
As previous									
	14.00	Hole End	-3.39						

Depth scale: 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling at 6.0m for 1hr
Rotary follow on from 6.0m to 14.0m.
Backfilled

Key to Symbols

B	Bulk Disturbed Sample	U(9)	Undisturbed Sample(drive blows)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
S(9)	Standard Penetration Test(N value)	C(*)	Cone Penetration Test(refusal)
S(*)	Standard Penetration Test(refusal)		Waterstrike depth
W	Water Sample		Water level depth 20mins after strike

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH2B**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 09/11/2006
Boring Completed: 19/12/2006
Type of Boring: Cable Percussion & Rotary

Elevation: 10.606 m.O.D.
E9519.264 N10105.291
Hole Diameter: 200 & 95 mm
Drilled by: P Gilmartin.
Logged by: D. Larkin & J. Allely
Sheet 1 of 2

Downhole Depth (m)	Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES
0.0	0.00	-	-	-	NA	Not applicable
6.0	6.00	80	30	15		
7.0	7.00	8	5	5		
9.0	9.00	84	84	52	10	Fractures closely spaced, occasionally very closely spaced, 20 to 45 degrees (bedding) and occasionally 70 degrees, planar to undulating, smooth, some clay infilling and brown staining.
	9.50	60	80	72		
10.0						

Unit Depth (m)	Legend	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
0.00		10.61	TOPSOIL (reddish brown very sandy SILT with some rootlets).
0.10		10.51	FILL (sandy gravelly CLAY).
1.80		8.81	limestone FILL.
2.20		8.41	Stiff brown sandy gravelly CLAY.
6.00		4.61	COBBLES with much finer material. Finer material is sandy clayey gravel
7.00		3.61	Presumed sandy gravelly CLAY. Poor recovery.
9.00		1.61	Strong light grey LIMESTONE. Slightly weathered

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling at 6.0m for 1hr.
Rotary follow on from 6.0m to 14.0m.
Backfilled

Site Investigations Ltd

CORE DETAILS UPDATED 4404CARRIGALINEBHJA.GPJ COREHOLE.GDT 17/05/07

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads.

HOLE ID: **CBH2B**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 09/11/2006
Boring Completed: 19/12/2006
Type of Boring: Cable Percussion & Rotary

Elevation: 10.606 m.O.D.
E9519.264 N10105.291
Hole Diameter: 200 & 95 mm
Drilled by: P Gilmartin.
Logged by: D. Larkin & J. Allely
Sheet 2 of 2

Downhole Depth (m)	Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES	Unit Depth (m)	Legend	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
10.0	10.00	92	82	70		As previous				As previous
11.0										
	11.60	94	90	84						
12.0										
	12.50	97	97	89						
13.0										
14.0							14.00	Hole End	-3.39	
15.0										
16.0										
17.0										
18.0										
19.0										
20.0										

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling at 6.0m for 1hr.
Rotary follow on from 6.0m to 14.0m.
Backfilled

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH3**

Client:	Cork County Council	**Elevation:**	10.201 m.O.D.
Consultant:	Mott McDonald Pettit	**Co-ordinates**	E9536.660 N10096.270
Site Address:	Carrigaline.	**Hole Diameter:**	200 & 75 mm
Boring Commenced:	03/11/2006	**Drilled by:**	G. C & P. G
Boring Completed:	13/12/2006	**Logged by:**	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

Sheet 1 of 2

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Progress/Water Hole Depth (m)	Date	Water Depth (m)
TOPSOIL (reddish brown very sandy SILT with many rootlets).	0.00		10.20						
FILL (sandy gravelly CLAY with inclusions wood and plastic)	0.30		9.90	D B C(7)	1.00 1.00 1.00				
Firm brown sandy gravelly CLAY with some subrounded cobbles.	1.70		8.50	D B C(16)	2.00 2.00 2.00				
Stiff reddish brown gravelly very sandy CLAY with many subrounded cobbles.	2.50		7.70	D B C(32)	3.00 3.00 3.00				
Stiff yellowish brown slightly gravelly sandy CLAY with some grey fine sand lenses.	3.80		6.40	D B C(20)	4.00 4.00 4.00				
Stiff brown sandy gravelly CLAY with some subangular to subrounded cobbles.	4.60		5.60	D B C(50)	5.00 5.00 5.00				
Stiff light brown slightly sandy CLAY with many angular to subangular cobbles and occasional boulders.	5.60		4.60					03/11/2006 03/11/2006	5.90(20) 6.10
				D B C(30)	6.50 6.50 6.50				
				C(40)	7.00				
				D B	8.00 8.00			03/11/2006 03/11/2006 03/11/2006	8.10(20) 8.60 9.00(20)
				D B C(50)	9.50 9.50 9.50				

Depth scale: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*

Chiselling from 5.4m to 5.7m for 0.75hrs.
Chiselling from 7.3m to 7.5m for 0.5hr.
Chiselling from 9.1m to 9.3m for 0.75hrs.
Chiselling from 10.2m to 10.4m for 0.5hrs.
Chiselling from 11.3m to 11.4m for 1hr.
Water strike at 6.1m rose to 5.9m.
Water strike at 8.6m rose to 8.1m.
Water strike at 11.0m rose to 9.0m.
Rotary follow on from 11.4m to 19.6m
Piezometer installed at 12.5m
Filter from 13.0m to 6.0m

Key to Symbols

B	Bulk Disturbed Sample	S(9)	Standard Penetration Test(N value)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
W	Water sample	▼3.50	Waterstrike depth
U(9)	Undisturbed sample (drive blows)	▽1.50(20)	Water level depth 20mins after strike
	Water Sample	17.20(E)	Depth to water (E)nd of shift
		12.20(S)	Depth to water (S)tart of shift

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH3**

Client:	Cork County Council	**Elevation:**	10.201 m.O.D.
Consultant:	Mott McDonald Pettit	**Co-ordinates**	E9536.660 N10096.270
Site Address:	Carrigaline.	**Hole Diameter:**	200 & 75 mm
Boring Commenced:	03/11/2006	**Drilled by:**	G. C & P. G
Boring Completed:	13/12/2006	**Logged by:**	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

Sheet 2 of 2

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Samples/Tests Depth (m)	Samples/Tests Ref No.	Progress/Water Hole Depth (m)	Progress/Water Date	Progress/Water Water Depth (m)
As previous.	10.0								
	11.0			D	11.00			03/11/2006	11.00
				B	11.00				
				C(50)	11.00				
BOULDER	11.30		-1.10						
Stiff light brown slightly sandy CLAY with many angular to subangular cobbles and occasional boulders.	11.40		-1.20				11.40	03/11/2006	-(E)
	12.0								
	13.0								
	14.0								
Moderately strong to very strong grey LIMESTONE BRECCIA Moderately weathered	14.50		-4.30						
	15.0								
	16.0								
Strong grey LIMESTONE Moderately weathered	16.50		-6.30						
	17.0								
Strong light grey LIMESTONE BRECCIA Slightly weathered	18.00		-7.80						
	19.0								
	19.60	Hole End	-9.40						
	20.0								

Remarks: ***(Note: Stratum bands <200mm are not indicated pictorially)***

Chiselling from 5.4m to 5.7m for 0.75hrs.
Chiselling from 7.3m to 7.5m for 0.5hr.
Chiselling from 9.1m to 9.3m for 0.75hrs.
Chiselling from 10.2m to 10.4m for 0.5hrs.
Chiselling from 11.3m to 11.4m for 1hr.
Water strike at 6.1m rose to 5.9m.
Water strike at 8.6m rose to 8.1m.
Water strike at 11.0m rose to 9.0m.
Rotary follow on from 11.4m to 19.6m
Piezometer installed at 12.5m
Filter from 13.0m to 6.0m

Key to Symbols

B	Bulk Disturbed Sample	S(9)	Standard Penetration Test(N value)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
W	Water sample	▼	Waterstrike depth
U(9)	Undisturbed sample (drive blows)	▽	Water level depth 20mins after strike
	Water Sample	17.20(E)	Depth to water (E)nd of shift
		12.20(S)	Depth to water (S)tart of shift

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH3**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 03/11/2006
Boring Completed: 13/12/2006
Type of Boring: Cable Percussion & Rotary

Elevation: 10.201 m.O.D.
E9536.660 N10096.270
Hole Diameter: 200 & 75 mm
Drilled by: G. C & P. G
Logged by: D. Larkin & J. Allely
Sheet 1 of 2

Downhole Depth (m)	Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES
0.0	0.00	-	-	-	NA	Not applicable

Unit Depth (m)	Legend	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
0.00	— T —	10.20	TOPSOIL (reddish brown very sandy SILT with many rootlets).
0.30		9.90	FILL (sandy gravelly CLAY with inclusions wood and plastic)
1.70		8.50	Firm brown sandy gravelly CLAY with some subrounded cobbles.
2.50		7.70	Stiff reddish brown gravelly very sandy CLAY with many subrounded cobbles.
3.80		6.40	Stiff yellowish brown slightly gravelly sandy CLAY with some grey fine sand lenses.
4.60		5.60	Stiff brown sandy gravelly CLAY with some subangular to subrounded cobbles.
5.60		4.60	Stiff light brown slightly sandy CLAY with many angular to subangular cobbles and occasional boulders.

Depth scale: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Remarks:
(Note: Stratum bands <100mm are not indicated pictorially;
NA = not applicable; NR = not recordable; NI = non-inact)
Chiselling from 5.4m to 5.7m for 0.75hrs.
Chiselling from 7.3m to 7.5m for 0.5hr.
Chiselling from 9.1m to 9.3m for 0.75hrs.
Chiselling from 10.2m to 10.4m for 0.5hrs.
Chiselling from 11.3m to 11.4m for 1hr.
Water strike at 6.1m rose to 5.9m.
Water strike at 8.6m rose to 8.1m.
Water strike at 11.0m rose to 9.0m.
Rotary follow on from 11.4m to 19.6m
Piezometer installed at 12.5m
Filter from 13.0m to 6.0m

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads.

HOLE ID: CBH3

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 03/11/2006
Boring Completed: 13/12/2006
Type of Boring: Cable Percussion & Rotary

Elevation: 10.201 m.O.D.
E9536.660 N10096.270
Hole Diameter: 200 & 75 mm
Drilled by: G. C & P. G
Logged by: D. Larkin & J. Allely
Sheet 2 of 2

Downhole Depth (m)	Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES	Unit Depth (m)	Legend	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
10.0						As previous				As previous.
							11.30		-1.10	BOULDER
							11.40		-1.20	Stiff light brown slightly sandy CLAY with many angular to subangular cobbles and occasional boulders.
	14.50	98	90	81	6	Discontinuities are closely occasionally very closely spaced, subhorizontal and 45 degrees, undulating to stepped, smooth to rough with clay infill.	14.50		-4.30	Moderately strong to very strong grey LIMESTONE BRECCIA Moderately weathered
					NI	Not intact				
	16.00	93	93	89	8	Discontinuities are closely occasionally very closely spaced, subhorizontal and 45 degrees, undulating to stepped, smooth to rough with clay infill.				
					5	Discontinuities are closely occasionally very closely spaced, subhorizontal and 45 degrees, undulating to stepped, smooth to rough with clay infill.	16.50		-6.30	Strong grey LIMESTONE Moderately weathered
	17.80	97	97	81						
							18.00		-7.80	Strong light grey LIMESTONE BRECCIA Slightly weathered
20.0							19.60	Hole End	-9.40	

Remarks:
(Note: Stratum bands <100mm are not indicated pictorially;
NA = not applicable; NR = not recordable; NI = non-inact)
Chiselling from 5.4m to 5.7m for 0.75hrs.
Chiselling from 7.3m to 7.5m for 0.5hr.
Chiselling from 9.1m to 9.3m for 0.75hrs.
Chiselling from 10.2m to 10.4m for 0.5hrs.
Chiselling from 11.3m to 11.4m for 1hr.
Water strike at 6.1m rose to 5.9m.
Water strike at 8.6m rose to 8.1m.
Water strike at 11.0m rose to 9.0m.
Rotary follow on from 11.4m to 19.6m
Piezometer installed at 12.5m
Filter from 13.0m to 6.0m

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH4**

Client:	Cork County Council	Elevation:	2.589 m.O.D.
Consultant:	Mott McDonald Pettit	Co-ordinates	E9763.802 N9806.895
Site Address:	Carrigaline.	Hole Diameter:	200 & 75 mm
Boring Commenced:	02/11/2006	Drilled by:	G. C & E. D
Boring Completed:	31/11/2006	Logged by:	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

Sheet 1 of 2

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Progress/Water Hole Depth (m)	Date	Water Depth (m)
TOPSOIL (reddish brown very sandy SILT with some rootlets).	0.00	—T—	2.59						
Brown sandy gravelly CLAY with some subrounded cobbles.	0.30		2.29					02/11/2006	0.80(20)
								02/11/2006	1.10
				D	1.00				
				B	1.00				
Medium dense brown and grey slightly sandy clayey subangular to subrounded fine to coarse GRAVEL with some subangular to subrounded cobbles.	1.10		1.49	C(21)	1.00				
								02/11/2006	1.70(20)
								02/11/2006	1.80
Stiff grey slightly sandy gravelly CLAY with many subangular cobbles.	1.80		0.79						
				D	2.00				
				B	2.00				
				C(44)	2.00				
				D	3.00				
				B	3.00				
				C(43)	3.00				
Presumed sandy gravelly CLAY with many cobbles and boulders	4.00		-1.41	D	4.00		4.00	29/11/2006	-(S)
				B	4.00				
				C(50)	4.00				
				D	5.00				
				B	5.00				
				C(50)	5.00				
				C(50)	6.20		6.20	02/11/2006	-(E)
Very strong to extremely strong grey SILTSTONE. Slightly to moderately weathered.	8.70		-6.11						

Depth scale: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Remarks: ***(Note: Stratum bands <200mm are not indicated pictorially)***

Chiselling from 4.2m to 4.4m for 0.75hrs.
Chiselling from 5.5m to 5.8m for 0.75hrs.
Chiselling from 6.1m to 6.2m for 1hr.
Water strike at 1.1m rose to 0.8m.
Water strike at 1.8m rose to 1.7m.
Rotary follow-on from 4.0m to 13.0m.
Hole backfilled.

Key to Symbols

B	Bulk Disturbed Sample	U(9)	Undisturbed Sample(drive blows)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
S(9)	Standard Penetration Test(N value)	C(*)	Cone Penetration Test(refusal)
S(*)	Standard Penetration Test(refusal)	▼	Waterstrike depth
W	Water Sample	▽	Water level depth 20mins after strike

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH4**

Client:	Cork County Council	Elevation:	2.589 m.O.D.
Consultant:	Mott McDonald Pettit	Co-ordinates	E9763.802 N9806.895
Site Address:	Carrigaline.	Hole Diameter:	200 & 75 mm
Boring Commenced:	02/11/2006	Drilled by:	G. C & E. D
Boring Completed:	31/11/2006	Logged by:	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

Sheet 2 of 2

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Samples/Tests Depth (m)	Samples/Tests Ref No.	Progress/Water Hole Depth (m)	Progress/Water Date	Progress/Water Water Depth (m)
	10.0								
Very strong to extremely strong grey SILTSTONE. Slightly weathered.	10.50		-7.91						
	13.00	Hole End	-10.41				13.00	30/11/2006	-(E)

Depth scale: 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 4.2m to 4.4m for 0.75hrs.
Chiselling from 5.5m to 5.8m for 0.75hrs.
Chiselling from 6.1m to 6.2m for 1hr.
Water strike at 1.1m rose to 0.8m.
Water strike at 1.8m rose to 1.7m.
Rotary follow-on from 4.0m to 13.0m.
Hole backfilled.

Key to Symbols

B	Bulk Disturbed Sample	U(9)	Undisturbed Sample(drive blows)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
S(9)	Standard Penetration Test(N value)	C(*)	Cone Penetration Test(refusal)
S(*)	Standard Penetration Test(refusal)		Waterstrike depth
W	Water Sample		Water level depth 20mins after strike

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID: CBH4**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 02/11/2006
Boring Completed: 31/11/2006
Type of Boring: Cable Percussion & Rotary

Elevation: 2.589 m.O.D.
E9763.802 N9806.895
Hole Diameter: 200 & 75 mm
Drilled by: G. C & E. D
Logged by: D. Larkin & J. Allely
Sheet 1 of 2

Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES
0.00	-	-	-	NA	Not applicable
4.00	15	8	8		
7.00	34	0	0		
8.50	98	65	8	14	Discontinuities are closely to very closely spaced, subvertical and subhorizontal to 20 degrees, occasionally 70 degrees, stepped to planar, smooth to rough with some mineral and clay infill.

Downhole Depth (m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Unit Depth (m)	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
0.00	2.59	TOPSOIL (reddish brown very sandy SILT with some rootlets).
0.30	2.29	Brown sandy gravelly CLAY with some subrounded cobbles.
1.10	1.49	Medium dense brown and grey slightly sandy clayey subangular to subrounded fine to coarse GRAVEL with some subangular to subrounded cobbles.
1.80	0.79	Stiff grey slightly sandy gravelly CLAY with many subangular cobbles.
4.00	-1.41	Presumed sandy gravelly CLAY with many cobbles and boulders
8.70	-6.11	Very strong to extremely strong grey SILTSTONE. Slightly to moderately weathered.

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 4.2m to 4.4m for 0.75hrs.
Chiselling from 5.5m to 5.8m for 0.75hrs.
Chiselling from 6.1m to 6.2m for 1hr.
Water strike at 1.1m rose to 0.8m.
Water strike at 1.8m rose to 1.7m.
Rotary follow-on from 4.0m to 13.0m.
Hole backfilled.

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH4**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 02/11/2006
Boring Completed: 31/11/2006
Type of Boring: Cable Percussion & Rotary

Elevation: 2.589 m.O.D.
E9763.802 N9806.895
Hole Diameter: 200 & 75 mm
Drilled by: G. C & E. D
Logged by: D. Larkin & J. Allely
Sheet 2 of 2

Downhole Depth (m)	Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES	Unit Depth (m)	Legend	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
10.0	10.00	96	96	84						
					14	Discontinuities are closely spaced, subhorizontal and 70 degrees to subvertical, stepped and planar, smooth with some clay infill.	10.50		-7.91	Very strong to extremely strong grey SILTSTONE. Slightly weathered.
11.0										
	11.50	100	100	98						
12.0										
13.0							13.00	Hole End	-10.41	
14.0										
15.0										
16.0										
17.0										
18.0										
19.0										
20.0										

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 4.2m to 4.4m for 0.75hrs.
Chiselling from 5.5m to 5.6m for 0.75hrs.
Chiselling from 6.1m to 6.2m for 1hr
Water strike at 1.1m rose to 0.8m.
Water strike at 1.8m rose to 1.7m.
Rotary follow-on from 4.0m to 13.0m.
Hole backfilled.

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH5**

Client:	Cork County Council	**Elevation:**	3.243 m.O.D.
Consultant:	Mott McDonald Pettit	**Co-ordinates**	E9792.757 N9806.071
Site Address:	Carrigaline.	**Hole Diameter:**	200 & 75 mm
Boring Commenced:	01/11/2006	**Drilled by:**	G. C & E. D
Boring Completed:	27/11/20065	**Logged by:**	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

Sheet 1 of 2

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Samples/Tests Depth (m)	Samples/Tests Ref No.	Progress/Water Hole Depth (m)	Progress/Water Date	Progress/Water Water Depth (m)
TOPSOIL (reddish brown very sandy SILT with some rootlets).	0.00		3.24						
Brown sandy gravelly CLAY.	0.40		2.84						
Stiff reddish brown slightly gravelly sandy CLAY with some subrounded cobbles.	0.90		2.34	D B C(42)	1.00 1.00 1.00			01/11/2006 01/11/2006	1.30(20) 1.50
Dense reddish brown very gravelly medium to coarse SAND.	1.60		1.64	D B C(50)	2.00 2.00 2.00			01/11/2006 01/11/2006	2.70(20) 2.90
Stiff greyish brown slightly sandy gravelly CLAY with some subangular to subrounded cobbles.	2.90		0.34	D B C(50) D B C(50) D B C(50)	3.00 3.00 3.00 4.00 4.00 4.00 5.00 5.00 5.00				
Stiff grey slightly sandy very gravelly CLAY with some angular to subangular cobbles.	6.00		-2.76	D B C(41) C(50)	6.50 6.50 6.50 7.00		7.00		-(S)
Moderately strong to very strong grey SILTSTONE. Moderately to highly weathered.	8.10		-4.86				8.10	01/11/2006	-(E)

Remarks: ***(Note: Stratum bands <200mm are not indicated pictorially)***

Chiselling from 3.2m to 3.5m for 0.75hrs.
Chiselling from 5.0m to 5.5m for 2hrs.
Chiselling 8.0m to 8.1m for 1hr.
Water strike at 1.5m rose to 1.3m.
Water strike at 2.9m rose to 2.7m.
Piezometer installed to 3.00m.
Concrete: GL to 0.10m.
Bentonite seal: 0.10 to 2.00m.
Pea gravel filter: 2.00 to 3.50m.
Bentonite seal: 3.50 to 16.0m.
Flush cover installed.

Key to Symbols

B Bulk Disturbed Sample
D Small disturbed sample
W Water sample
U(9) Undisturbed sample (drive blows)
Water Sample

S(9) Standard Penetration Test(N value)
C(9) Cone Penetration Test(N value)
Waterstrike depth
Water level depth 20mins after strike
17.20(E) Depth to water (E)nd of shift
12.20(S) Depth to water (S)tart of shift

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH5**

Client:	Cork County Council	**Elevation:**	3.243 m.O.D.
Consultant:	Mott McDonald Pettit	**Co-ordinates**	E9792.757 N9806.071
Site Address:	Carrigaline.	**Hole Diameter:**	200 & 75 mm
Boring Commenced:	01/11/2006	**Drilled by:**	G. C & E. D
Boring Completed:	27/11/20065	**Logged by:**	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Progress/Water Hole Depth (m)	Date	Water Depth (m)
Moderately strong, occasionally moderately weak grey SILTSTONE. Moderately to slightly weathered.	10.20	× × ×	-6.96						
Moderately strong to strong grey SILTSTONE. Moderately to highly weathered.	13.00	× × ×	-9.76						
Strong to very strong grey SILTSTONE. Slightly weathered.	14.40	× × ×	-11.16						
	16.00	Hole End	-12.76				16.00		-(E)

Depth scale: 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0

Remarks: ***(Note: Stratum bands <200mm are not indicated pictorially)***
Chiselling from 3.2m to 3.5m for 0.75hrs.
Chiselling from 5.0m to 5.5m for 2hrs.
Chiselling 8.0m to 8.1m for 1hr.
Water strike at 1.5m rose to 1.3m.
Water strike at 2.9m rose to 2.7m.
Piezometer installed to 3.00m.
Concrete: GL to 0.10m.
Bentonite seal: 0.10 to 2.00m.
Pea gravel filter: 2.00 to 3.50m.
Bentonite seal: 3.50 to 16.0m.
Flush cover installed.

Key to Symbols

B	Bulk Disturbed Sample	S(9)	Standard Penetration Test(N value))
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
W	Water sample		Waterstrike depth
U(9)	Undisturbed sample (drive blows)		Water level depth 20mins after strike
	Water Sample	17.20(E)	Depth to water (E)nd of shift
		12.20(S)	Depth to water (S)tart of shift

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH5**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 01/11/2006
Boring Completed: 27/11/20065
Type of Boring: Cable Percussion & Rotary

Elevation: 3.243 m.O.D.
E9792.757 N9806.071
Hole Diameter: 200 & 75 mm
Drilled by: G. C & E. D
Logged by: D. Larkin & J. Allely
Sheet 1 of 2

Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES
0.00	-	-	-	NA	Not applicable
7.00	30	13	13	NA	
				NI	Non-intact
8.50	54	9	9		

Unit Depth (m)	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
0.00	3.24	TOPSOIL (reddish brown very sandy SILT with some rootlets).
0.40	2.84	Brown sandy gravelly CLAY.
0.90	2.34	Stiff reddish brown slightly gravelly sandy CLAY with some subrounded cobbles.
1.60	1.64	Dense reddish brown very gravelly medium to coarse SAND.
2.90	0.34	Stiff greyish brown slightly sandy gravelly CLAY with some subangular to subrounded cobbles.
6.00	-2.76	Stiff grey slightly sandy very gravelly CLAY with some angular to subangular cobbles.
8.10	-4.86	Moderately strong to very strong grey SILTSTONE. Moderately to highly weathered.

Downhole Depth (m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Remarks:
(Note: Stratum bands <100mm are not indicated pictorially; NA = not applicable; NR = not recordable; NI = non-inact)
Chiselling from 3.2m to 3.5m for 0.75hrs.
Chiselling from 5.0m to 5.5m for 2hrs.
Chiselling 8.0m to 8.1m for 1hr.
Water strike at 1.5m rose to 1.3m.
Water strike at 2.9m rose to 2.7m.
Piezometer installed to 3.00m.
Concrete: GL to 0.10m.
Bentonite seal: 0.10 to 2.00m.
Pea gravel filter: 2.00 to 3.50m.
Bentonite seal: 3.50 to 16.0m.
Flush cover installed.

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH5**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 01/11/2006
Boring Completed: 27/11/20065
Type of Boring: Cable Percussion & Rotary

Elevation: 3.243 m.O.D.
E9792.757 N9806.071
Hole Diameter: 200 & 75 mm
Drilled by: G. C & E. D
Logged by: D. Larkin & J. Allely
Sheet 2 of 2

Downhole Depth (m)	Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES	Unit Depth (m)	Legend	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
10.0	10.00	83	66	19						
					25	Discontinuities are closely, occasionally extremely closely spaced, 45 to 70 degrees & subhorizontal, planar to undulating, occasionally stepped, smooth. Some clay infilling and brown staining.	10.20		-6.96	Moderately strong, occasionally moderately weak grey SILTSTONE. Moderately to slightly weathered.
11.0										
	11.50	93	65	13						
12.0										
13.0	13.00	77	10	10	NI	Non-intact	13.00		-9.76	Moderately strong to strong grey SILTSTONE. Moderately to highly weathered.
14.0										
	14.50	99	77	72	36	Discontinuities are closely, occasionally extremely closely spaced, 45 to 70 degrees & subhorizontal, planar to stepped, smooth and rough with some brown staining and mineral infilling.	14.40		-11.16	Strong to very strong grey SILTSTONE. Slightly weathered.
15.0										
16.0							16.00	Hole End	-12.76	
17.0										
18.0										
19.0										
20.0										

Remarks:
(Note: Stratum bands <100mm are not indicated pictorially;
NA = not applicable; NR = not recordable; NI = non-inact)
Chiselling from 3.2m to 3.5m for 0.75hrs.
Chiselling from 5.0m to 5.5m for 2hrs.
Chiselling 8.0m to 8.1m for 1hr.
Water strike at 1.5m rose to 1.3m.
Water strike at 2.9m rose to 2.7m.
Piezometer installed to 3.00m.
Concrete: GL to 0.10m.
Bentonite seal: 0.10 to 2.00m.
Pea gravel filter: 2.00 to 3.50m.
Bentonite seal: 3.50 to 16.0m.
Flush cover installed.

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH6**

Client:	**Cork County Council**	**Elevation:**	**3.243 m.O.D.**
Consultant:	**Mott McDonald Pettit**	**Co-ordinates**	**E9839.834 N9759.693**
Site Address:	**Carrigaline.**	**Hole Diameter:**	**200 & 75 mm**
Boring Commenced:	**31/10/2006**	**Drilled by:**	**G. C & E. D**
Boring Completed:	**29/11/2006**	**Logged by:**	**D. Larkin & J. Allely**
Type of Boring:	**Cable Percussion & Rotary**		

Sheet 1 of 2

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests: Type	Depth (m)	Ref No.	Progress/Water: Hole Depth (m)	Date	Water Depth (m)
TOPSOIL (reddish brown very sandy SILT with many rootlets).	0.00		3.24						
Stiff light brown gravelly sandy CLAY	0.40		2.84					31/10/2006	0.90(20)
								31/10/2006	1.10
				D	1.00				
				B	1.00				
				C(24)	1.00				
Brown slightly sandy clayey subangular to subrounded fine to coarse GRAVEL with some subrounded cobbles.	1.30		1.94					31/10/2006	1.50(20)
Dense brown slightly clayey sandy angular to subrounded fine to coarse GRAVEL with occasional angular to subangular cobbles.	1.80		1.44					31/10/2006	1.80
				D	2.00				
				B	2.00				
				C(50)	2.00				
Dense brown slightly sandy clayey subangular to subrounded fine to coarse GRAVEL with some subangular cobbles.	2.70		0.54						
				D	3.00				
				B	3.00				
				C(50)	3.00				
Dense light brown very clayey sandy subangular to subrounded fine to coarse GRAVEL with occasional angular to subangular cobbles.	3.50		-0.26						
				D	4.00		4.00	31/10/2006	-(E)
				B	4.00		4.00	01/11/2006	0.20(S)
				C(37)	4.00			01/11/2006	4.30(20)
Stiff greyish brown slightly sandy very gravelly CLAY with many angular to subangular cobbles.	5.00		-1.76	D	5.00			01/11/2006	5.00
				B	5.00				
				C(36)	5.00				
								01/11/2006	5.70(20)
				D	6.50				
				B	6.50				
				C(50)	6.50				
							7.00		-(S)
				D	7.10				
				B	7.10				
				C(50)	7.10				
Strong to very strong, occasionally moderately weak to moderately strong grey SILTSTONE. Slightly weathered.	7.50		-4.26					01/11/2006	7.50
							7.60	01/11/2006	-(E)

Remarks: ***(Note: Stratum bands <200mm are not indicated pictorially)***
Chiselling from 2.3m to 2.5m for 0.75hrs.
Chiselling from 3.4m to 3.6m for 0.75hrs.
Chiselling from 4.7m to 4.9m for 0.5hrs.
Chiselling from 5.6m to 5.8m for 0.75hrs.
Chiselling from 7.5m to 7.6m for 1hr.
Water strike at 1.1m rose to 0.9m.
Water strike at 1.8m rose to 1.6m.
Water strike at 5.0m rose to 4.3m.
Water strike at 7.5m rose to 5.7m.
Piezometer installed to 7.50m.
Concrete: GL to 0.10m.
Bentonite seal: 0.10 to 6.50m.
Pea gravel filter: 6.50 to 7.60m.
Bentonite seal: 7.60 to 13.0m.

Key to Symbols

B	Bulk Disturbed Sample	U(9)	Undisturbed Sample(drive blows)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
S(9)	Standard Penetration Test(N value)	C(*)	Cone Penetration Test(refusal)
S(*)	Standard Penetration Test(refusal)		Waterstrike depth
W	Water Sample		Water level depth 20mins after strike

Site Investigations Ltd

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH6**

Client:	Cork County Council	Elevation:	3.243 m.O.D.
Consultant:	Mott McDonald Pettit	Co-ordinates	E9839.834 N9769.693
Site Address:	Carrigaline.	Hole Diameter:	200 & 75 mm
Boring Commenced:	31/10/2006	Drilled by:	G. C & E. D
Boring Completed:	29/11/2006	Logged by:	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

Sheet 2 of 2

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Samples/Tests Depth (m)	Samples/Tests Ref No.	Progress/Water Hole Depth (m)	Progress/Water Date	Progress/Water Water Depth (m)
As previous									
	13.00	Hole End	-9.76				13.00		-(E)

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 2.3m to 2.5m for 0.75hrs.
Chiselling from 3.4m to 3.6m for 0.75hrs.
Chiselling from 4.7m to 4.9m for 0.5hrs.
Chiselling from 5.6m to 5.8m for 0.75hrs.
Chiselling from 7.5m to 7.6m for 1hr.
Water strike at 1.1m rose to 0.9m.
Water strike at 1.8m rose to 1.5m.
Water strike at 5.0m rose to 4.3m.
Water strike at 7.5m rose to 5.7m.
Piezometer installed to 7.60m.
Concrete: GL to 0.10m.
Bentonite seal: 0.10 to 6.50m.
Pea gravel filter: 6.50 to 7.60m.
Bentonite seal: 7.60 to 13.0m.

Key to Symbols

B	Bulk Disturbed Sample	U(9)	Undisturbed Sample(drive blows)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
S(9)	Standard Penetration Test(N value)	C(*)	Cone Penetration Test(refusal)
S(*)	Standard Penetration Test(refusal)		Waterstrike depth
W	Water Sample		Water level depth 20mins after strike

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH6**

Client: Cork County Council	Elevation: 3.243 m.O.D.
Consultant: Mott McDonald Pettit	E9839.834 N9759.693
Site Address: : Carrigaline.	Hole Diameter: 200 & 75 mm
Boring Commenced: 31/10/2006	Drilled by: G. C & E. D
Boring Completed: 29/11/2006	Logged by: D. Larkin & J. Allely
Type of Boring: Cable Percussion & Rotary	*Sheet 1 of 2*

Downhole Depth (m)	Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES	Unit Depth (m)	Legend	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
0.0	0.00	-	-	-		Not applicable	0.00		3.24	TOPSOIL (reddish brown very sandy SILT with many rootlets).
							0.40		2.84	Stiff light brown gravelly sandy CLAY
1.0							1.30		1.94	Brown slightly sandy clayey subangular to subrounded fine to coarse GRAVEL with some subrounded cobbles.
							1.80		1.44	Dense brown slightly clayey sandy angular to subrounded fine to coarse GRAVEL with occasional angular to subangular cobbles.
2.0							2.70		0.54	Dense brown slightly sandy clayey subangular to subrounded fine to coarse GRAVEL with some subangular cobbles.
3.0							3.50		-0.26	Dense light brown very clayey sandy subangular to subrounded fine to coarse GRAVEL with occasional angular to subangular cobbles.
4.0										
5.0							5.00		-1.76	Stiff greyish brown slightly sandy very gravelly CLAY with many angular to subangular cobbles.
6.0										
7.0	7.00	63	50	18	NA					
					20	Discontinuities are closely, occasionally very closely spaced, 70, 45 degrees and subvertical, planar, undulating and stepped, smooth, clean with some mineral infilling.	7.50		-4.26	Strong to very strong, occasionally moderately weak to moderately strong grey SILTSTONE. Slightly weathered.
8.0	8.50	96	91	56						
9.0										
10.0										

Remarks: ***(Note: Stratum bands <200mm are not indicated pictorially)***

Chiselling from 2.3m to 2.5m for 0.75hrs.
Chiselling from 3.4m to 3.6m for 0.75hrs.
Chiselling from 4.7m to 4.9m for 0.5hrs.
Chiselling from 5.6m to 5.8m for 0.75hrs.
Chiselling from 7.5m to 7.6m for 1hr.
Water strike at 1.1m rose to 0.9m.
Water strike at 1.8m rose to 1.5m.
Water strike at 5.0m rose to 4.3m.
Water strike at 7.5m rose to 5.7m.
Piezometer installed to 7.50m.
Concrete: GL to 0.10m.
Bentonite seal: 0.10 to 6.50m.
Pea gravel filter: 6.50 to 7.60m.
Bentonite seal: 7.60 to 13.0m.

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH6**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 31/10/2006
Boring Completed: 29/11/2006
Type of Boring: Cable Percussion & Rotary

Elevation: 3.243 m.O.D.
E9839.834 N9759.693
Hole Diameter: 200 & 75 mm
Drilled by: G. C & E. D
Logged by: D. Larkin & J. Allely
Sheet 2 of 2

Downhole Depth (m)	Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES	Unit Depth (m)	Legend	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
10.0	10.00	97	74	47		As previous				As previous
11.0										
	11.50	99	87	48						
12.0										
13.0							13.00	Hole End	-9.76	
14.0										
15.0										
16.0										
17.0										
18.0										
19.0										
20.0										

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 2.3m to 2.5m for 0.75hrs.
Chiselling from 3.4m to 3.6m for 0.75hrs.
Chiselling from 4.7m to 4.9m for 0.5hrs.
Chiselling from 5.6m to 5.8m for 0.75hrs.
Chiselling from 7.5m to 7.6m for 1hr.
Water strike at 1.1m rose to 0.9m.
Water strike at 1.8m rose to 1.5m.
Water strike at 5.0m rose to 4.3m.
Water strike at 7.5m rose to 5.7m.
Piezometer installed to 7.50m.
Concrete: GL to 0.10m.
Bentonite seal: 0.10 to 6.50m.
Pea gravel filter: 6.50 to 7.60m.
Bentonite seal: 7.60 to 13.0m

Site Investigations Ltd

CORE DETAILS UPDATED 4404CARRIGALINEBHJA.GPJ COREHOLE.GDT 17/05/07

BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID:** **CBH7**

Client:	Cork County Council	**Elevation:**	4.528 m.O.D.
Consultant:	Mott McDonald Pettit	**Co-ordinates**	E9910.528 N9742.479
Site Address:	Carrigaline.	**Hole Diameter:**	200 & 75 mm
Boring Commenced:	26/10/2006	**Drilled by:**	G. C & E. D
Boring Completed:	29/11/2006	**Logged by:**	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

DESCRIPTION OF STRATA	Unit Depth (m)	Elevation (M.O.D.)	Samples/Tests Type	Depth (m)	Ref No.	Progress/Water Hole Depth (m)	Date	Water Depth (m)
TOPSOIL (reddish brown slightly sandy SILT with some rootlets).	0.00	4.53						
Firm light brown slightly sandy slightly gravelly CLAY with occasional subrounded cobbles.	0.30	4.23	D B C(13)	1.00 1.00 1.00			26/10/2006	1.60(20)
Light brown slightly gravelly very sandy CLAY with some subrounded cobbles.	1.80	2.73	D B C(50)	2.00 2.00 2.00		 2.50 2.50	26/10/2006 26/10/2006 27/10/2006	1.90 -(E) -(S)
Dense grey slightly clayey sandy angular to subangular fine to coarse GRAVEL with some subangular cobbles.	2.70	1.83	D B C(50)	3.00 3.00 3.00				
Dense grey very sandy subangular to subrounded fine to coarse GRAVEL with some subangular cobbles.	3.50	1.03	D B C(50) D B C(43)	4.00 4.00 4.00 5.00 5.00 5.00				
Stiff greyish brown slightly sandy very gravelly CLAY with many subangular cobbles.	5.70	-1.17						
Stiff grey sandy CLAY	6.00	-1.47	D B C(45) D B C(31)	6.50 6.50 6.50 8.00 8.00 8.00		6.50 6.50	27/10/2006 31/10/2006	-(E) 1.20(S)
Moderately strong dark grey SILTSTONE. Highly weathered.	8.50	-3.97						
Strong dark grey SILTSTONE. Slightly to moderately weathered.	9.00	-4.47	C(50)	9.40		9.40	31/10/2006	-(E)

10.0

Remarks: ***(Note: Stratum bands <200mm are not indicated pictorially)***

Chiselling from 1.7m to 1.9m to 0.75hrs.
Chiselling from 2.3m to 2.5m for 0.5hrs.
Chiselling from 2.m to 3.0m for 0.5hrs.
Chiselling from 3.3m to 3.5m for 0.75hrs.
Chiselling from 6.8m to 7.om for 0.75hrs.
Chiselling from 9.1m to 9.2m for 0.75hrs.
Rotary follow-on from 8.5 to 14.5m.
Hole backfilled.

Key to Symbols

B	Bulk Disturbed Sample	S(9)	Standard Penetration Test(N value)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
W	Water sample		Waterstrike depth
U(9)	Undisturbed sample (drive blows)		Water level depth 20mins after strike
	Water Sample	17.20(E)	Depth to water (E)nd of shift
		12.20(S)	Depth to water (S)tart of shift

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BOREHOLE RECORD

(where relevant, refer to attached coring record for rock core details)

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. HOLE ID: **CBH7**

Client:	Cork County Council	Elevation:	4.528 m.O.D.
Consultant:	Mott McDonald Pettit	Co-ordinates	E9910.528 N9742.479
Site Address:	Carrigaline.	Hole Diameter:	200 & 75 mm
Boring Commenced:	26/10/2006	Drilled by:	G. C & E. D
Boring Completed:	29/11/2006	Logged by:	D. Larkin & J. Allely
Type of Boring:	Cable Percussion & Rotary		

Sheet 2 of 2

DESCRIPTION OF STRATA	Unit Depth (m)	Legend	Elevation (M.O.D.)	Samples/Tests Type	Samples/Tests Depth (m)	Samples/Tests Ref No.	Progress/Water Hole Depth (m)	Progress/Water Date	Progress/Water Water Depth (m)
As previous									
Strong dark grey SILTSTONE. Moderately weathered.	11.40		-6.87						
Very strong dark grey SILTSTONE. Slightly weathered.	13.10		-8.57						
	14.50	Hole End	-9.97						

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 1.7m to 1.9m to 0.75hrs.
Chiselling from 2.3m to 2.5m for 0.5hrs.
Chiselling from 2.m to 3.0m for 0.5hrs.
Chiselling from 3.3m to 3.5m for 0.75hrs.
Chiselling from 6.8m to 7.om for 0.75hrs.
Chiselling from 9.1m to 9.2m for 0.75hrs.
Rotary follow-on from 8.5 to 14.5m.
Hole backfilled.

Key to Symbols

B	Bulk Disturbed Sample	S(9)	Standard Penetration Test(N value)
D	Small disturbed sample	C(9)	Cone Penetration Test(N value)
W	Water sample		Waterstrike depth
U(9)	Undisturbed sample (drive blows)		Water level depth 20mins after strike
	Water Sample	17.20(E)	Depth to water (E)nd of shift
		12.20(S)	Depth to water (S)tart of shift

Site Investigations Ltd

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. **HOLE ID: CBH7**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 26/10/2006
Boring Completed: 29/11/2006
Type of Boring: Cable Percussion & Rotary

Elevation: 4.528 m.O.D.
E9910.528 N9742.479
Hole Diameter: 200 & 75 mm
Drilled by: G. C & E. D
Logged by: D. Larkin & J. Allely
Sheet 1 of 2

Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES	Unit Depth (m)	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
0.00	-	-	-	NA	Not applicable	0.00	4.53	TOPSOIL (reddish brown slightly sandy SILT with some rootlets).
						0.30	4.23	Firm light brown slightly sandy slightly gravelly CLAY with occasional subrounded cobbles.
						1.80	2.73	Light brown slightly gravelly very sandy CLAY with some subrounded cobbles.
						2.70	1.83	Dense grey slightly clayey sandy angular to subangular fine to coarse GRAVEL with some subangular cobbles.
						3.50	1.03	Dense grey very sandy subangular to subrounded fine to coarse GRAVEL with some subangular cobbles.
						5.70	-1.17	Stiff greyish brown slightly sandy very gravelly CLAY with many subangular cobbles.
						6.00	-1.47	Stiff grey sandy CLAY
8.50	87	48	37	NI	Non-intact	8.50	-3.97	Moderately strong dark grey SILTSTONE. Highly weathered.
				27	Discontinuities are closely spaced, subvertical and subhorizontal, occasionally extremely closely spaced, undulating and planar, smooth, clean with some clay infilling and brown staining.	9.00	-4.47	Strong dark grey SILTSTONE. Slightly to moderately weathered.

Downhole Depth (m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Remarks:
(Note: Stratum bands <100mm are not indicated pictorially;
NA = not applicable; NR = not recordable; NI = non-inact)
Chiselling from 1.7m to 1.9m to 0.75hrs.
Chiselling from 2.3m to 2.5m for 0.5hrs.
Chiselling from 2.m to 3.0m for 0.5hrs.
Chiselling from 3.3m to 3.5m for 0.75hrs.
Chiselling from 6.8m to 7.0m for 0.75hrs.
Chiselling from 9.1m to 9.2m for 0.75hrs.
Rotary follow-on from 8.5 to 14.5m.
Hole backfilled

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CORE DETAILS UPDATED 4404CARRIGALINEBHJA.GPJ COREHOLE.GDT 28/03/07

Rock Core Details

CONTRACT: Midleton, Carrigaline and Bottlehill Roads. HOLE ID: **CBH7**

Client: Cork County Council
Consultant: Mott McDonald Pettit
Site Address: : Carrigaline.
Boring Commenced: 26/10/2006
Boring Completed: 29/11/2006
Type of Boring: Cable Percussion & Rotary

Elevation: 4.528 m.O.D.
E9910.528 N9742.479
Hole Diameter: 200 & 75 mm
Drilled by: G. C & E. D
Logged by: D. Larkin & J. Allely
Sheet 2 of 2

Downhole Depth (m)	Core Run Depth (m)	Total Core Recovery%	Solid Core Recovery%	Rock Quality Designation%	Fracture Index (Fractures per m)	DISCONTINUITIES	Unit Depth (m)	Legend	Elevation (M.O.D.)	GEOLOGICAL DESCRIPTION
10.0	10.00	84	63	55						As previous
11.0	11.50	75	9	9	NI	Non-intact	11.40		-6.87	Strong dark grey SILTSTONE. Moderately weathered.
12.0										
13.0	13.00	97	89	89	8	Discontinuities are closely spaced, subhorizontal and subvertical, undulating, smooth with some brown staining.	13.10		-8.57	Very strong dark grey SILTSTONE. Slightly weathered.
14.0							14.50	Hole End	-9.97	
15.0										
16.0										
17.0										
18.0										
19.0										
20.0										

Remarks:
(Note: Stratum bands <100mm are not indicated pictorially;
NA = not applicable; NR = not recordable; NI = non-inact)
Chiselling from 1.7m to 1.9m to 0.75hrs.
Chiselling from 2.3m to 2.5m for 0.5hrs.
Chiselling from 2.m to 3.0m for 0.5hrs.
Chiselling from 3.3m to 3.6m for 0.75hrs.
Chiselling from 6.8m to 7.om for 0.75hrs.
Chiselling from 9.1m to 9.2m for 0.75hrs.
Rotary follow-on from 8.5 to 14.5m.
Hole backfilled

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Carrigaline
BH1 Box 1 of 3

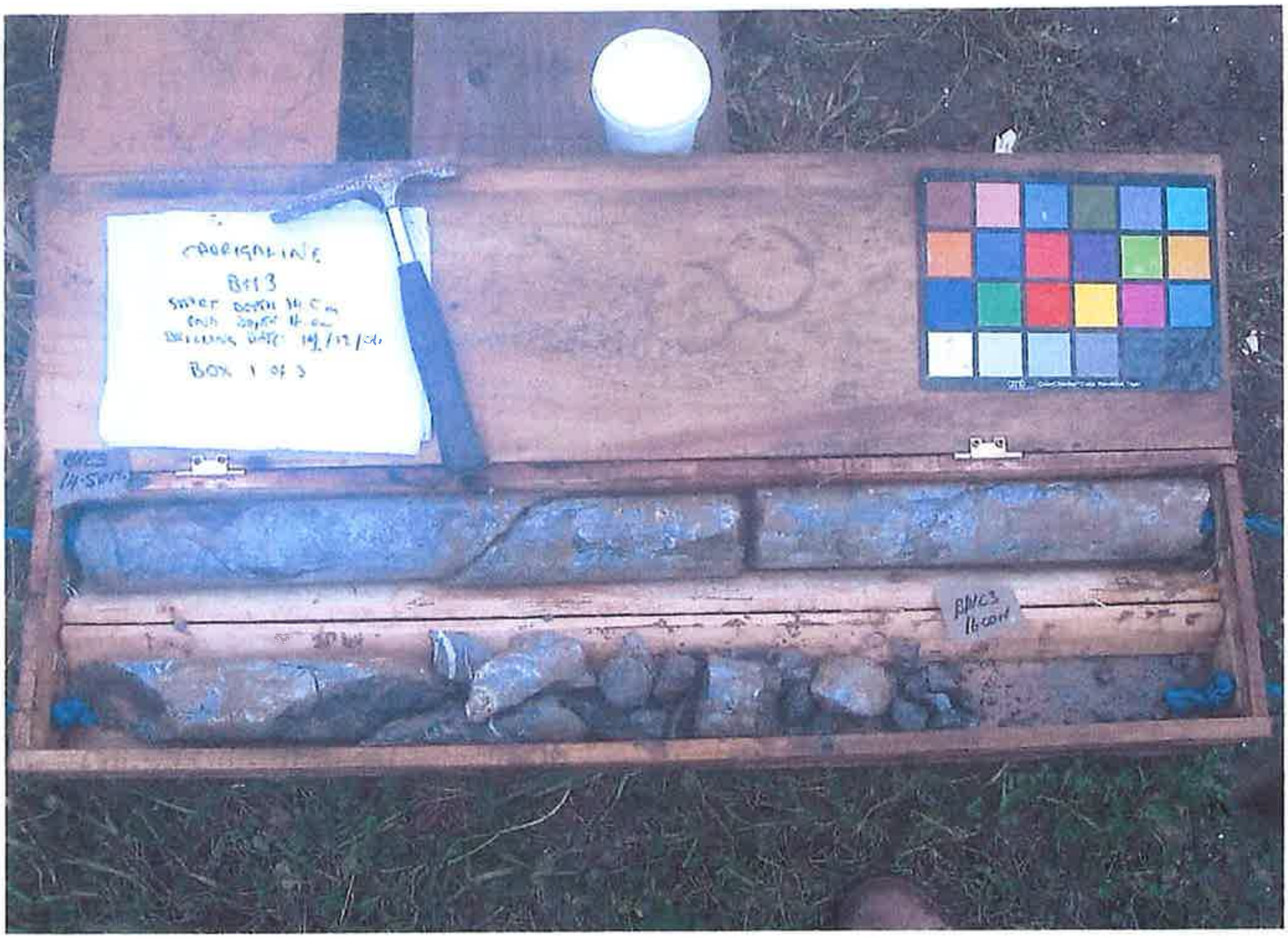

Carrigaline
BH1 Box 2 of 3


Carrigaline
BH1 Box 3 of 3


B/HC2 6.00M
B/HC2 9.00M
B/HC2 9.50
B/HC2 10.00M


B/HC2 12.50M


BHC2
12.50M
BHC2
14.00M


CARRIGALINE
BH3
BOX 1 OF 3


19.60.


BH- 4
Box 1

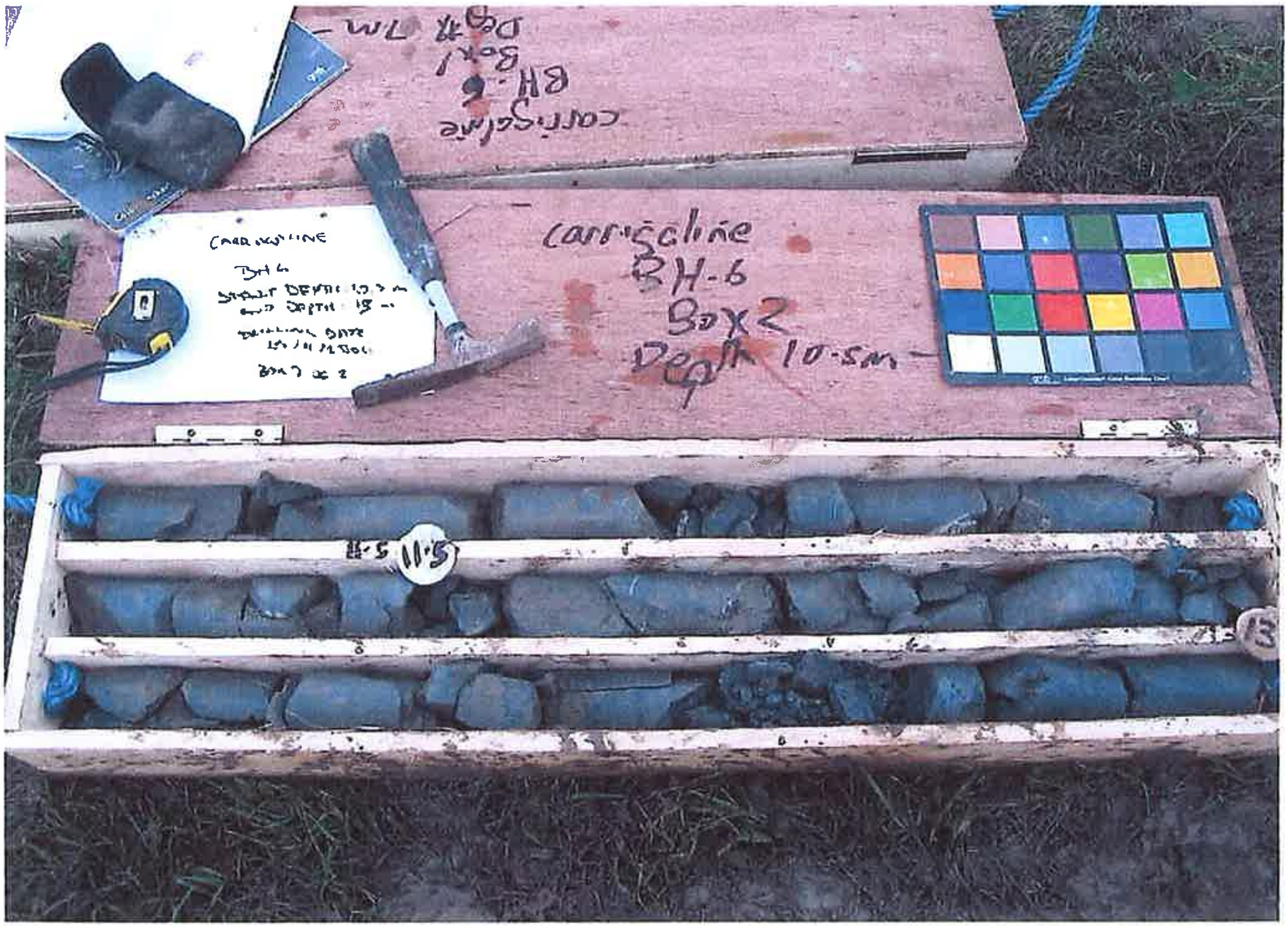

BH- 4
Box

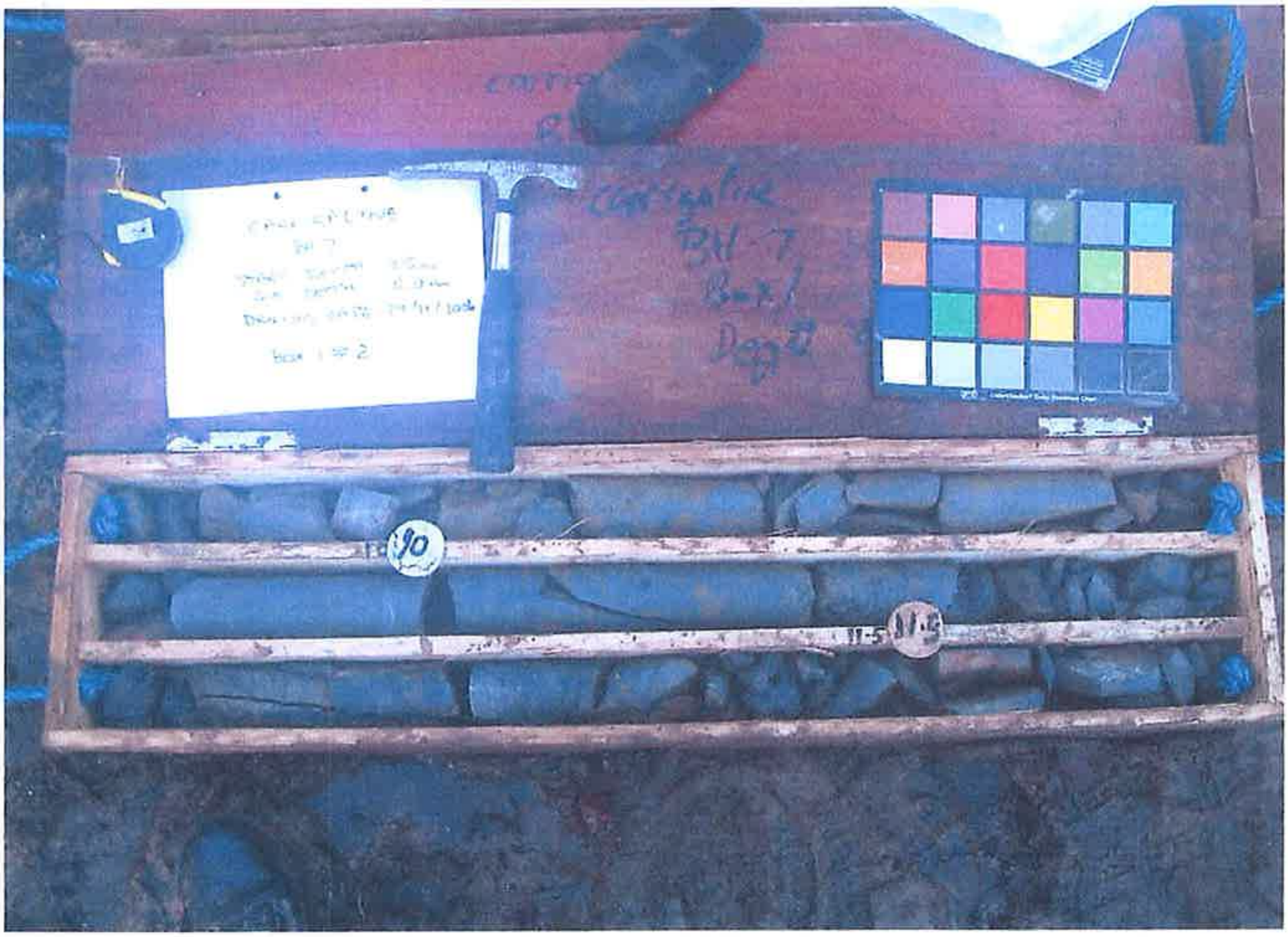

Carrigaline
BH
8.5
10


CARRIGALINE
BH5
Box 2 of 3
13
14.5


Depth 7m


CARRIGALINE
BH 6
START DEPTH : 7 m
END DEPTH : 10.5 m
DRILLING DATE : 27/11/20
BOX 1 OF 2
Carrigaline
BH-6
Box 1
Depth 7m - 10
8.5
10


Carrigaline
BH-6
Box 2
Depth 10.5m -
11.5
13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Box 1


Box 2
Depth 12m

Appendix IV

Groundwater monitoring & Permeability tests

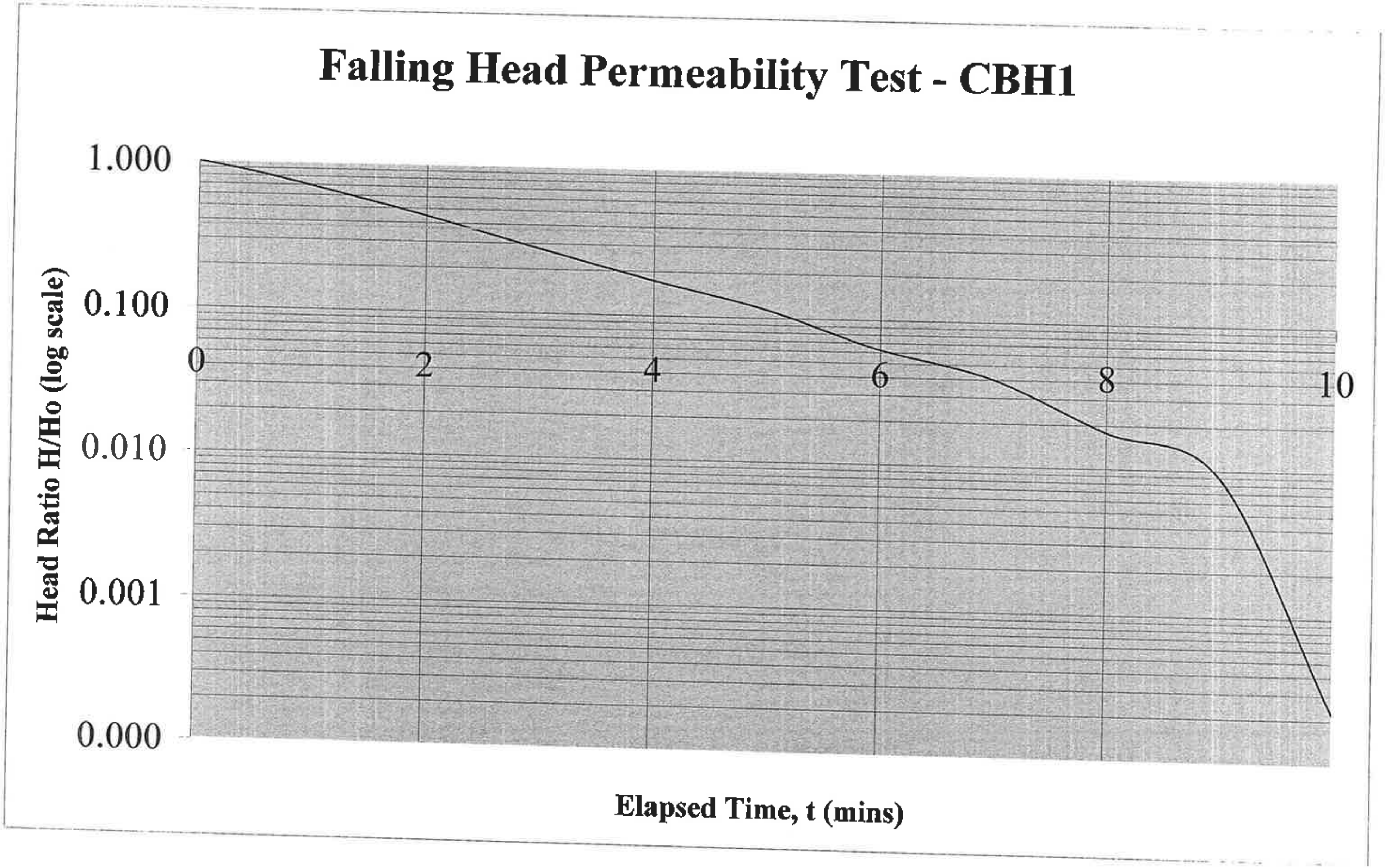
Waterlevel Monitoring Results

Project: *4404 - Midleton, Carrigaline and Bottlehill Roads*

Location: *Carrigaline*

Borehole ID	Installation Type	Depth to water (mBGL)			Depth to Bottom of Installation (mBGL)	Comments
		23/12/06 09:00	01/02/07 11:00	16/04/07 11:00		
CBH1	Piezometer	4.49	4.86	Dry	4.92	
CBH3	Piezometer	4.96	5.14	5.26	14.73	
CBH5	Piezometer	0	0	0.15	3.30	Artesian
CBH6	Piezometer	0.05	0.29	0.10	5.55	

Falling Head Permeability Test					
Project	Carrigaline				
Borehole No.	**CBH1**				
Configuration: Piezometer tip at 4.92mBGL, filter range 4 to 5m.					
Diameter of piezometer element (mm)			22		
Date of test			08/01/2007		
Elapsed Time t (mins)	Fall of water (m)	Groundwater level (mBGL)	Falling Head H (m)	Initial Head H_0 (m)	Head Ratio H/H_0
0	0.000	4.490	4.490	4.490	1.000
0.5	0.700	4.490	3.790	4.490	0.844
1.0	1.390	4.490	3.100	4.490	0.690
2.0	2.480	4.490	2.010	4.490	0.448
3.0	3.250	4.490	1.240	4.490	0.276
4.0	3.710	4.490	0.780	4.490	0.174
5.0	3.980	4.490	0.510	4.490	0.114
6.0	4.210	4.490	0.280	4.490	0.062
7.0	4.310	4.490	0.180	4.490	0.040
8.0	4.410	4.490	0.080	4.490	0.018
9.0	4.450	4.490	0.040	4.490	0.009
10.0	4.489	4.490	0.001	4.490	0.000


Falling Head Permeability Test - CBH1
1.000
0.100
0.010
0.001
0.000
Head Ratio H/Ho (log scale)
0
2
4
6
8
10
Elapsed Time, t (mins)

Permability Calculations Hole ID **BH1008A** Date 31/08/2005

1. **Area (A)**

A = Pi.r squared

Where....

r = internal radius of piezo pipe (m)= 0.011

A= 0.0003801

A= 0.000380132711084365

2. **Intake Factor (F)**

F = equation as used in fig. 7, pg 51 BS5930 (NOTE 2)

Where...

L = Length of filter (m)

D = Diameter of hole (m)

L =	1.000	
D =	0.2	
L/D	5	
L/D^2	25	
F =	1.0348144	

F = 1.03481438857679

3. **Basic Time Lag (T)**

T is taken from graph attached (taken from example in fig. 8, pg 52, BS5930)

T= 125 secs

T=125 secs

4. **Soil Permeability (k)**

k = A/ (F.T)

Where...

A = 0.0003801

F = 1.0348144

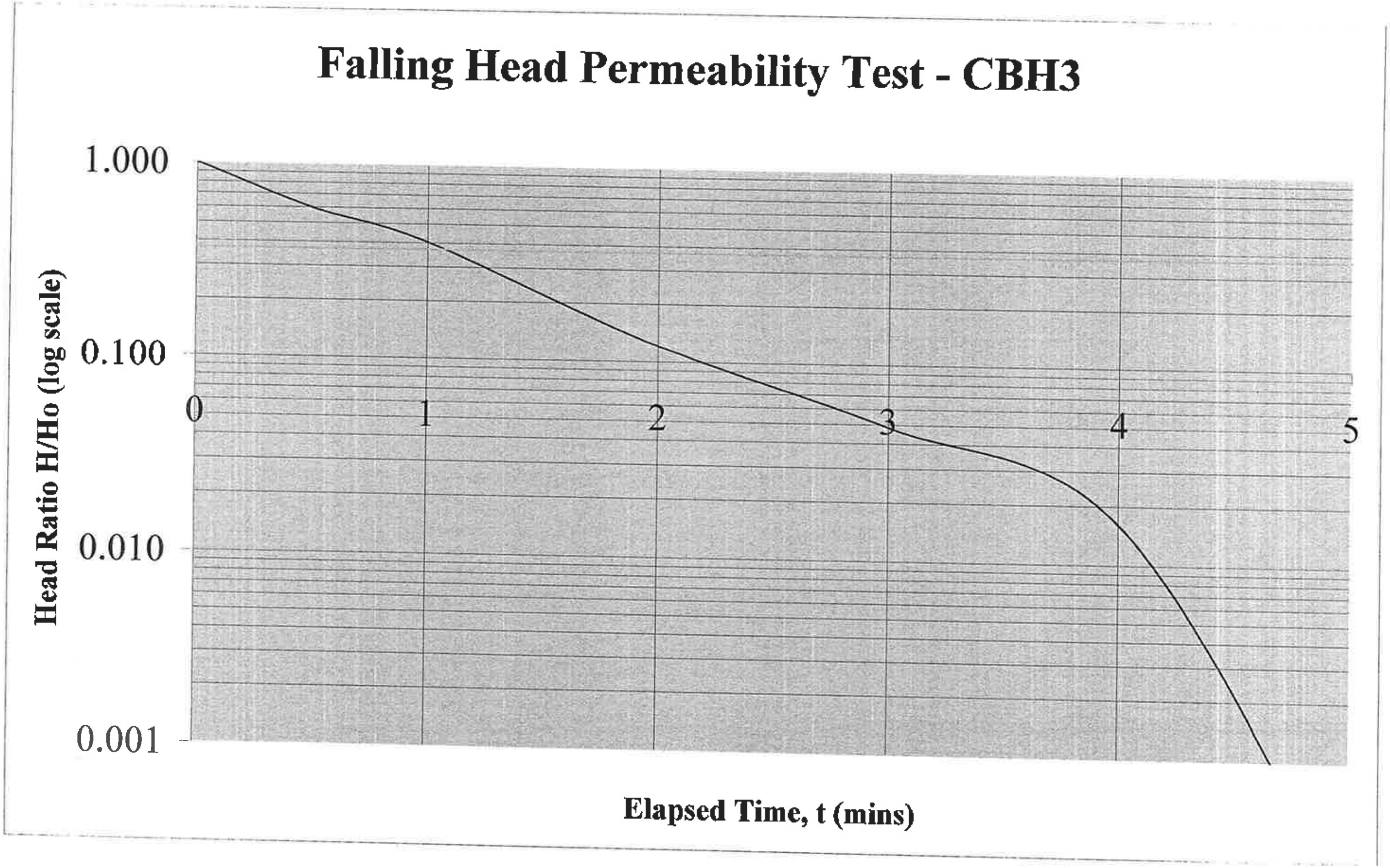
T = 125

Therefore

k = 2.939E-06 m/sec

k = 2.93875087382325E-06 m/sec

Falling Head Permeability Test					
Project	Carrigaline				
Borehole No.	**CBH3**				
Configuration: Piezometer tip at 14.73mBGL, filter range 15 to 6m.					
Diameter of piezometer element (mm)			22		
Date of test			23/12/2006		
Elapsed Time t (mins)	Fall of water (m)	Groundwater level (mBGL)	Falling Head H (m)	Initial Head H_0 (m)	Head Ratio H/H_0
0	0.000	4.960	4.960	4.960	1.000
0.5	2.000	4.960	2.960	4.960	0.597
1.0	2.960	4.960	2.000	4.960	0.403
2.0	4.360	4.960	0.600	4.960	0.121
3.0	4.720	4.960	0.240	4.960	0.048
4.0	4.880	4.960	0.080	4.960	0.016
5.0	4.959	4.960	0.001	4.960	0.000


Falling Head Permeability Test - CBH3
1.000
0.100
0.010
0.001
Head Ratio H/Ho (log scale)
0
1
2
3
4
5
Elapsed Time, t (mins)

Permability Calculations Hole ID **CBH3** Date 23/12/2006

1. **Area (A)**

A = Pi.r squared

Where.... r = internal radius of piezo pipe (m)= 0.011

A= 0.0003801

A= 0.000380132711084365

2. **Intake Factor (F)**

F = equation as used in fig. 7, pg 51 BS5930 (NOTE 2)

Where... L = Length of filter (m)

D = Diameter of hole (m)

L =	9.000	
D =	0.2	
L/D	45	
L/D^2	2025	
F =	11.551165	

F = 11.5511653726845

3. **Basic Time Lag (T)**

T is taken from graph attached (taken from example in fig. 8, pg 52, BS5930)

T= 65 secs

T=65 secs

4. **Soil Permeability (k)**

k = A/ (F.T)

Where... A = 0.0003801

F = 11.551165

T = 65

Therefore

k = 5.063E-07 m/sec

k = 5.06286194202841E-07 m/sec

Rising Head Test

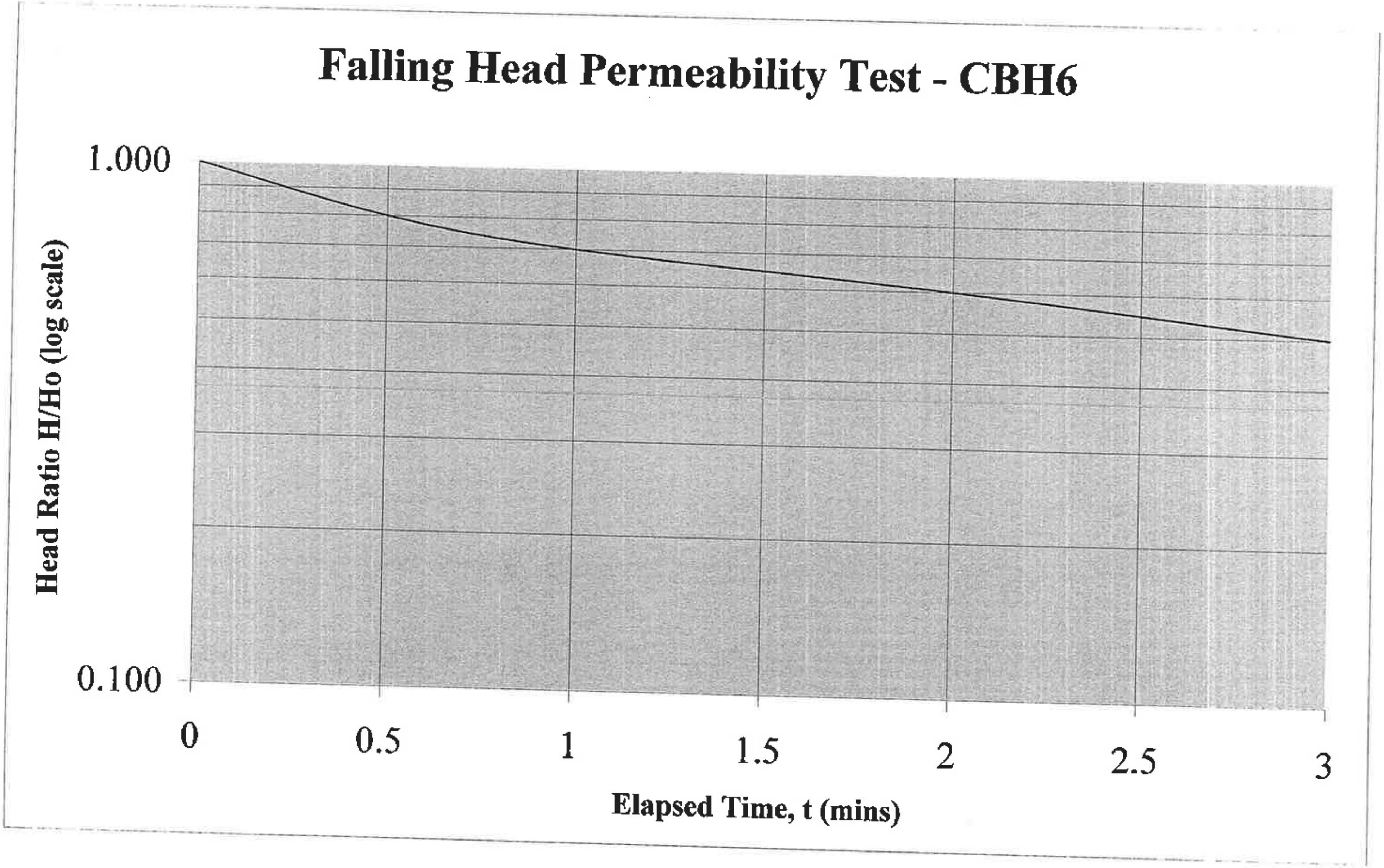
Date of test: 19/12/2006

Hole ID:	**CBH5**
Water Level before test (m):	0
Piezometer Depth (m):	3.3
Pipe Diameter:	20
Height of Pipe above ground level (m):	0
Water level measured from:	Top of pipe
Time test started (after water pumped out):	12:58

Remarks: Spent 15 mins pumping out water but only went down 42cm (water coming in almost as fast as I could pump it out - 20mm diameter watera tubing used)

Time	Water level
0	0.42
1	0

Falling Head Permeability Test					
Project	Carrigaline				
Borehole No.	**CBH6**				
Configuration: Piezometer tip at 5.55mBGL, filter range 7.6 to 6.5m.					
Diameter of piezometer element (mm)			22		
Date of test			23/12/2006		
Elapsed Time t (mins)	Fall of water (m)	Groundwater level (mBGL)	Falling Head H (m)	Initial Head H_0 (m)	Head Ratio H/H_0
0	0.000	0.050	0.100	0.100	1.000
0.5	0.020	0.050	0.080	0.100	0.800
1.0	0.030	0.050	0.070	0.100	0.700
2.0	0.040	0.050	0.060	0.100	0.600
3.0	0.050	0.050	0.050	0.100	0.500



Falling Head Permeability Test - CBH6
1.000
0.100
Head Ratio H/Ho (log scale)
0
0.5
1
1.5
2
2.5
3
Elapsed Time, t (mins)

Permability Calculations Hole ID **CBH6** Date 23/12/2006

1. Area (A)

A = Pi.r squared

Where.... r = internal radius of piezo pipe (m)= 0.011

A= 0.0003801

A= 0.000380132711084365

2. Intake Factor (F)

F = equation as used in fig. 7, pg 51 BS5930 (NOTE 2)

Where... L = Length of filter (m)

D = Diameter of hole (m)

L =	1.100	
D =	0.2	
L/D	5.5	
L/D^2	30.25	
F =	1.1521365	

F = 1.1521364572486

3. Basic Time Lag (T)

T is taken from graph attached (taken from example in fig. 8, pg 52, BS5930)

T= 6000 secs

T=6000 secs

4. Soil Permeability (k)

k = A/ (F.T)

Where... A = 0.0003801

F = 1.1521365

T = 6000

Therefore

k = 5.499E-08 m/sec

k = 5.49895383040757E-08 m/sec

Appendix V

Lab Results

Trial pit Lab results

Contents:

Classification (moisture content, liquid limits, plastic limits)
PSDs
Dry density/ Moisture content
MCV Cal
Compaction
CBR
Chemical
Environmental

Summary of Soil Classification Tests

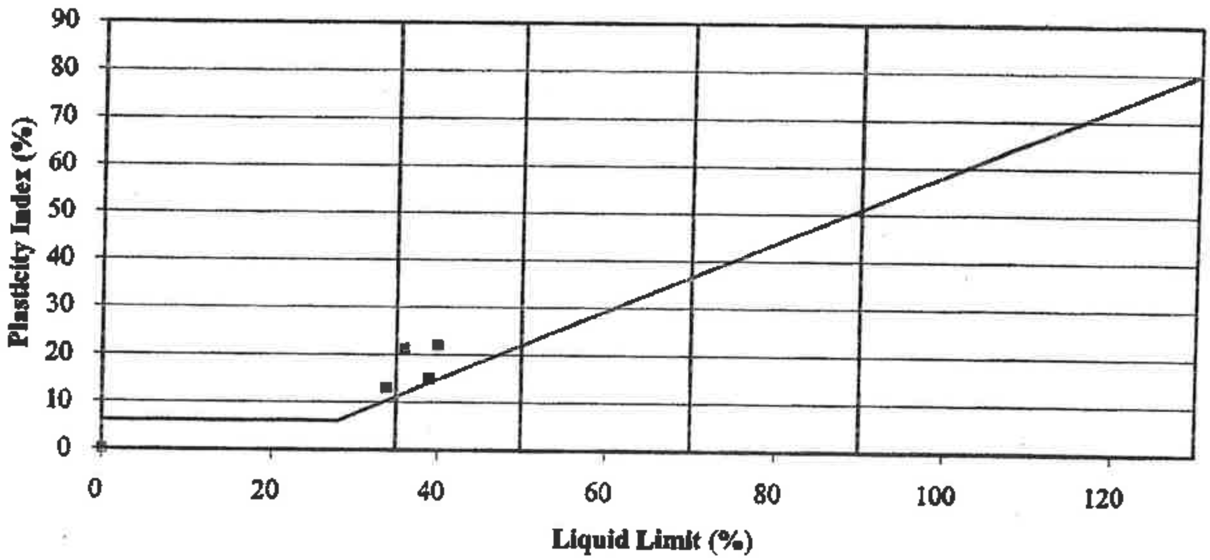
BS 1377:Part 2:1990

Hole/ Sample Number	Sample Type	Depth m	Moisture Content % Cl. 3.2	Liquid Limit % Cl. 4.3/4.4	Plastic Limit % Cl. 5.	Plasticity Index % Cl. 6.	% Passing .425mm	Remarks
CTP01/282	B	1.00	15		NP		40	
CTP01/283	B	2.00	12		NP		30	
CTP08/290	B	0.50	11					
CTP08/291	B	1.50	9.4		NP		8	
CTP08/292	B	3.00	6.5					
CTP09/287	B	1.00	19	36	15	21	90	CI Intermediate Plasicticity
CTP09/288	B	2.50	7.9					
CTP10/284	B	0.50	14	40	18	22	80	CI Intermediate Plasicticity
CTP10/285	B	1.00	16	34	21	13	35	CL Low Plasticticity
CTP10/286	B	1.90	20	39	24	15	35	CI Intermediate Plasicticity

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

BS 5930:1999



Checked by 4/12/06 Date

Approved by 04/12/06 Date

Summary of Soil Classification Tests

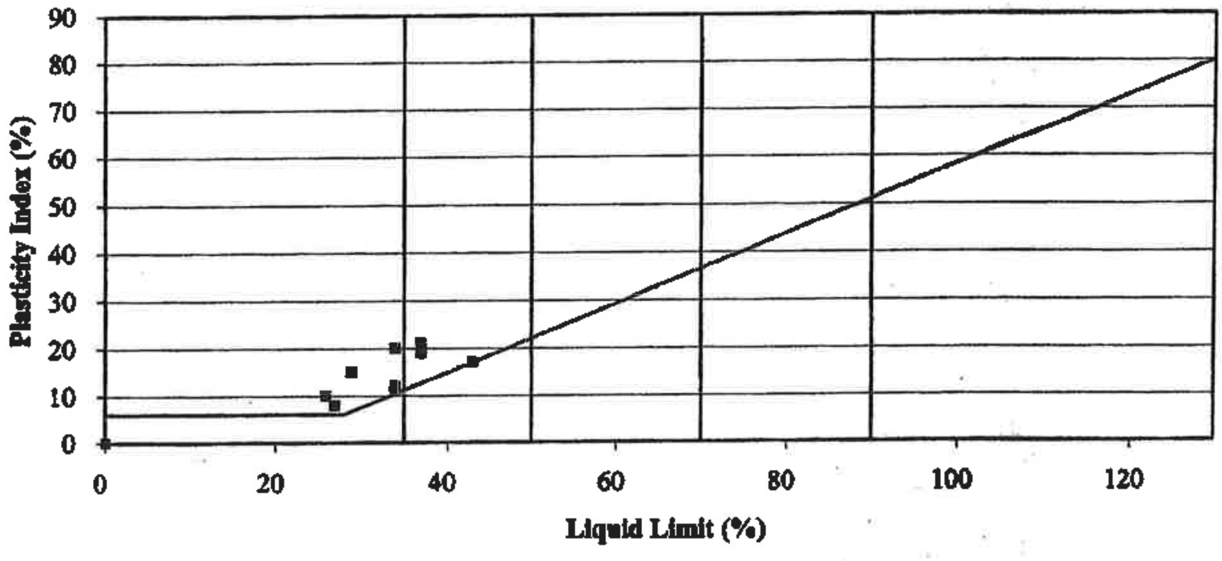
BS 1377:Part 2:1990

Hole/ Sample Number	Sample Type	Depth m	Moisture Content % Cl. 3.2	Liquid Limit % Cl. 4.3/4.4	Plastic Limit % Cl. 5.	Plasticity Index % Cl. 6.	% Passing .425mm	Remarks
CTP02/311	B	1.00	18	26	16	10	20	CL Low Plasicticity
CTP02/312	B	2.30	11					
CTP02/313	B	3.50	10					
CTP03/314	B	1.00	30	37	16	21	45	CI Intermediate Plasicticity
CTP03/315	B	2.00	15	29	14	15	80	CL Low Plasicticity
CTP03/316	B	3.00	10					
CTP04/318	B	1.00	17	34	14	20	60	CL Low Plasicticity
CTP04/319	B	2.00	18	27	19	8	50	CL Low Plasicticity
CTP04/320	B	3.30	13					
CTP05/322	B	1.00	18	43	26	17	45	CI Intermediate Plasicticity
CTP05/324	B	3.00	10					
CTP06A/326	B	1.00	14	34	22	12	60	CL Low Plasicticity
CTP06A/327	B	2.50	20	37	18	19	85	CI Intermediate Plasicticity
CTP06A/328	B	3.70	34					

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

BS 5930:1999



Checked by 4/12/06 Date

Approved by 04/12/06 Date

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: N/A

Summary of Soil Classification Tests

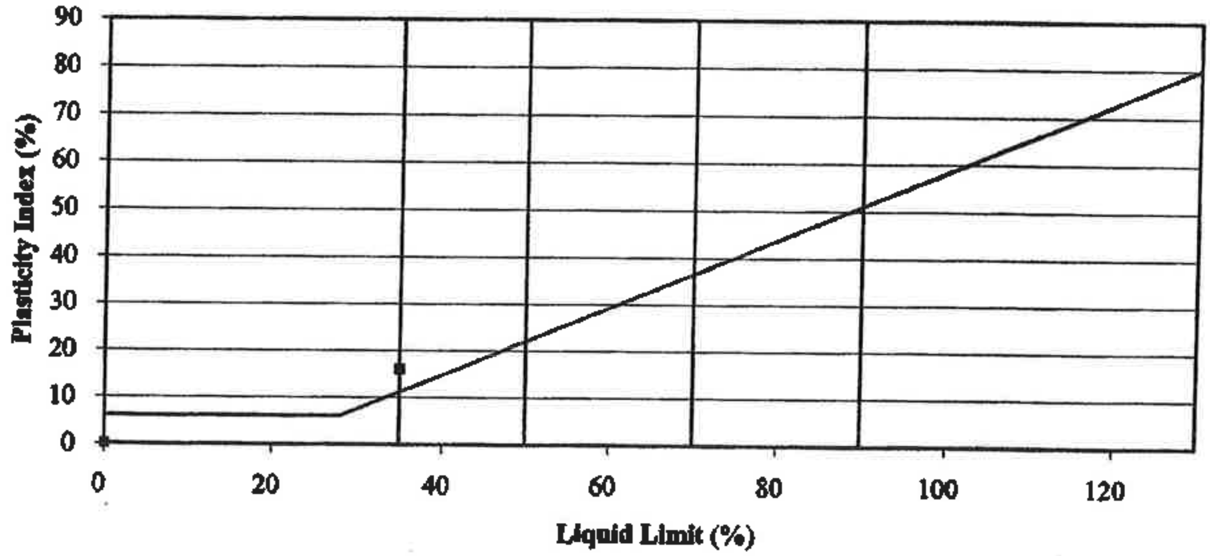
BS 1377:Part 2:1990

Hole/ Sample Number	Sample Type	Depth m	Moisture Content % Cl. 3.2	Liquid Limit % Cl. 4.3/4.4	Plastic Limit % Cl. 5.	Plasticity Index % Cl. 6.	% Passing .425mm	Remarks
CTP07/329	B	1.00	19	35	19	16	50	CL/I Low/Inter. Plasticity
CTP07/330	B	2.00	13					
CTP07/331	B	3.00	13					

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

BS 5930:1999



Checked by 4/12/06 Date

Approved by 02/12/06 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: N/A

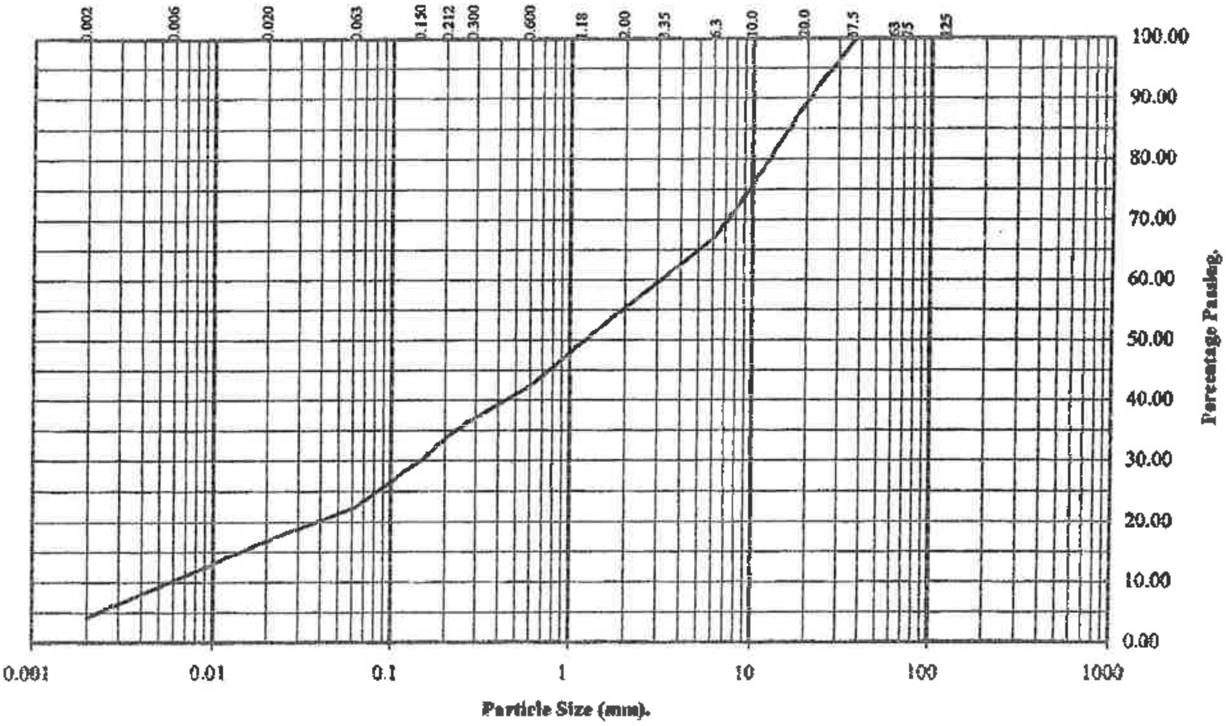
UKAS 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP01 **Sample Number:** 282 **Depth (m)** 1.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	89
10	76
6.3	67
3.35	61
2	55
1.18	50
0.6	42
0.3	37
0.212	34
0.15	30
0.063	22

Particle Diameter	Percentage Passing
0.02	17
0.006	10
0.002	4

Soil Fraction	Total Percentage
Cobbles	0
Gravel	45
Sand	33
Silt	18
Clay	4

Remarks:

Cl 9.4.8 - Sample has not been pretreated

4/12/06

Checked by Date

04/12/06

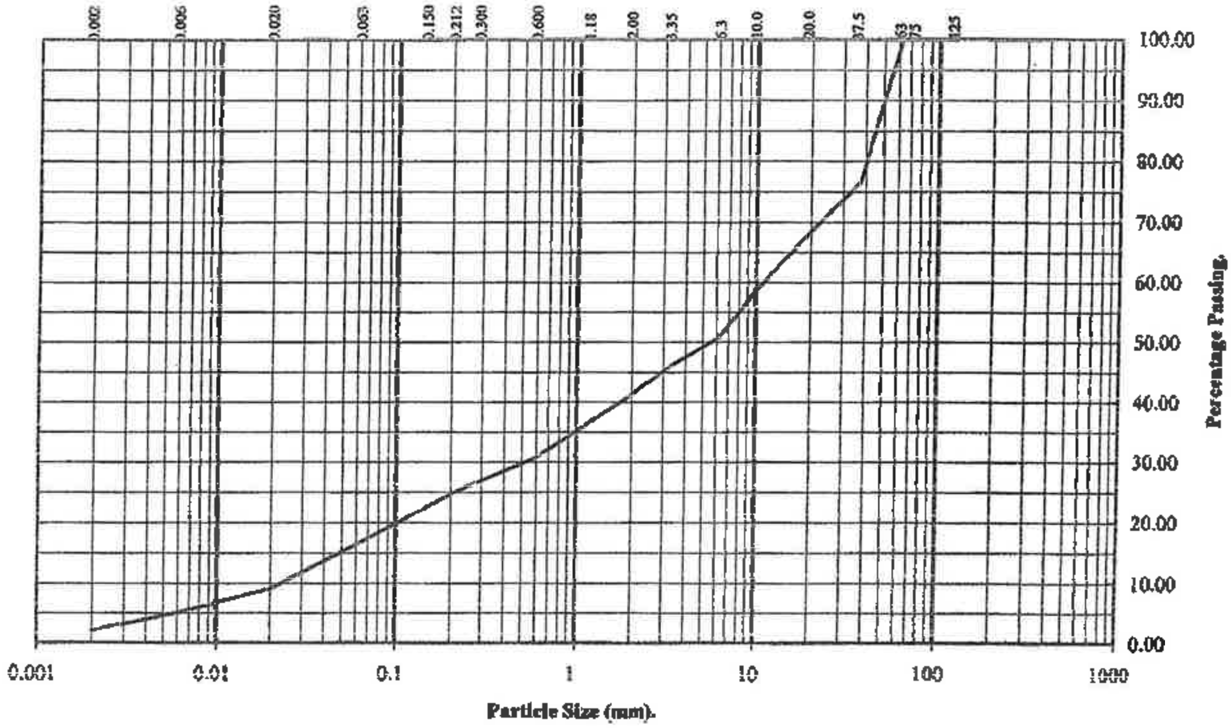
Approved by Date

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP01 **Sample Number:** 283 **Depth (m)** 2.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	76
20	68
10	59
6.3	51
3.35	46
2	41
1.18	37
0.6	31
0.3	27
0.212	25
0.15	23
0.063	17

Particle Diameter	Percentage Passing
0.02	9
0.006	5
0.002	2

Soil Fraction	Total Percentage
Cobbles	0
Gravel	59
Sand	24
Silt	15
Clay	2

Remarks:

Cl 9.4.8 - Sample has not been pretreated

4/12/06

Checked by **Date**

04/12/06

Approved by **Date**

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: n/a

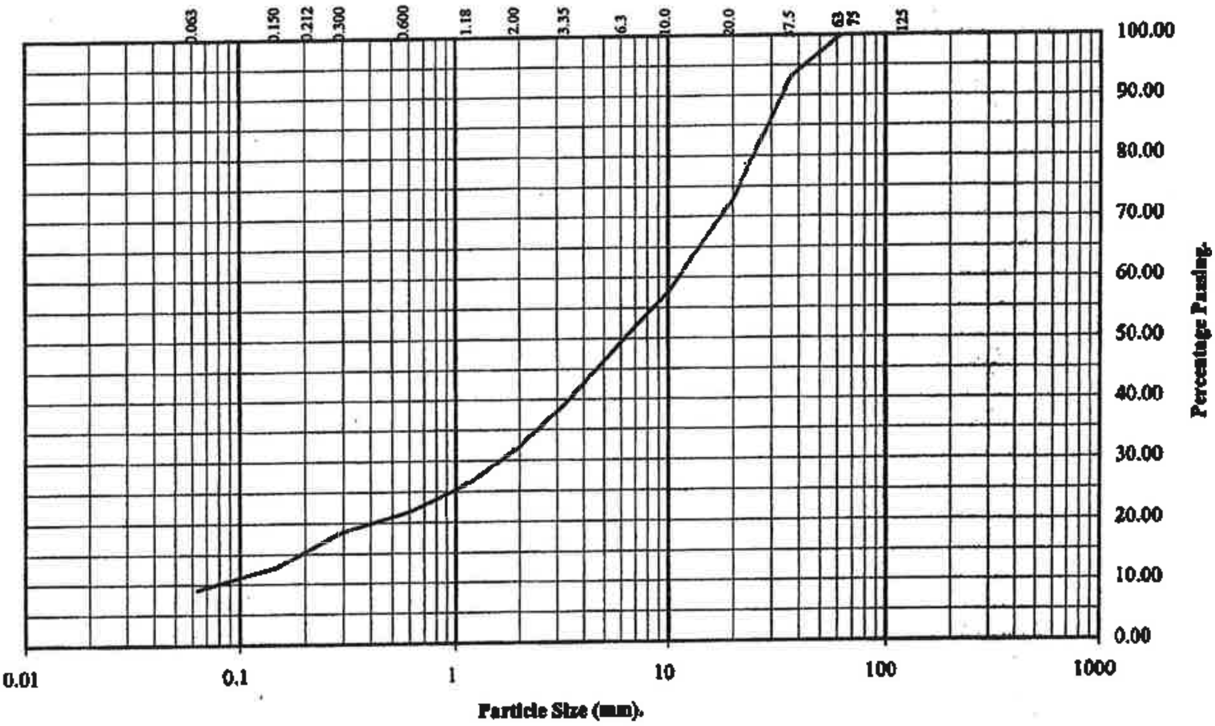
UKAS 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: CTP02 **Sample Number:** 311 **Depth (m):** 1.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	93
20	73
10	58
6.3	50
3.35	40
2	32
1.18	26
0.6	22
0.3	18
0.212	16
0.15	13
0.063	9

Soil Fraction	Total Percentage
Cobbles	0
Gravel	68
Sand	23
Silt and Clay	9

Remarks:

Checked by 4/12/06 Date

Approved by 04/12/06 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

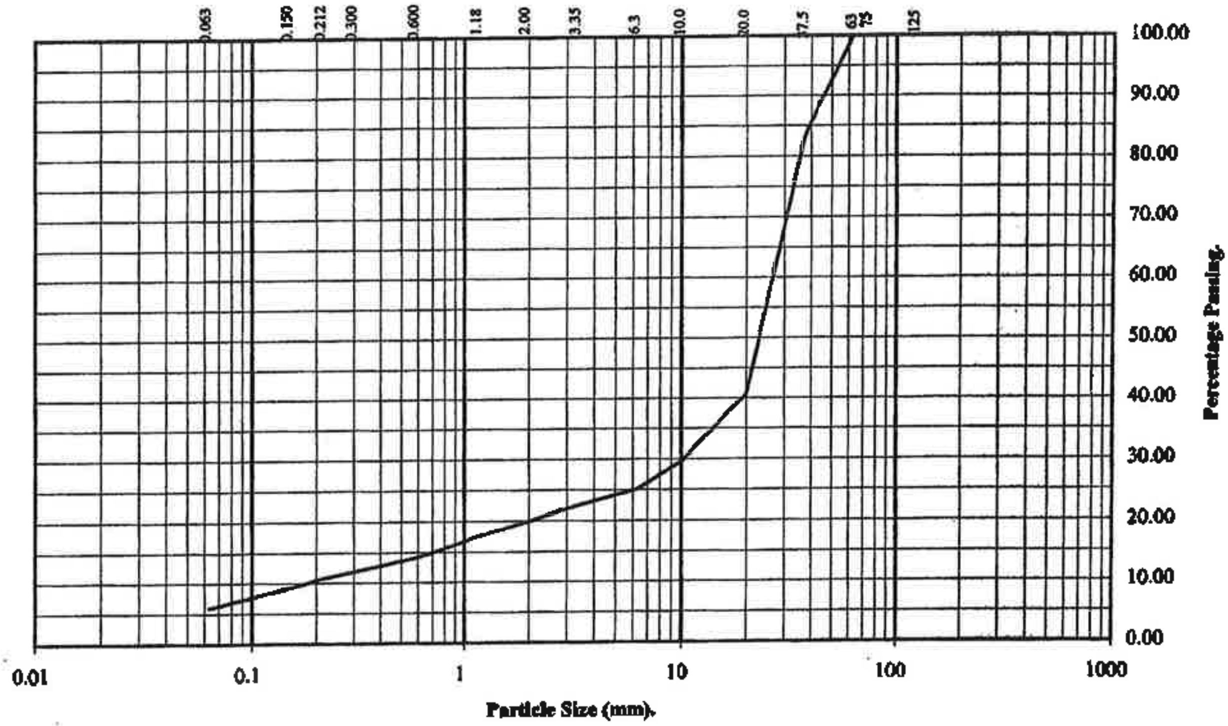
Client Ref No: n/a

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: CTP02 **Sample Number:** 312 **Depth (m):** 2.30



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	83
20	41
10	30
6.3	25
3.35	22
2	20
1.18	18
0.6	14
0.3	12
0.212	11
0.15	9
0.063	6

Soil Fraction	Total Percentage
Cobbles	0
Gravel	80
Sand	14
Silt and Clay	6

Remarks:

4/12/06

Checked by Date

04/12/06

Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

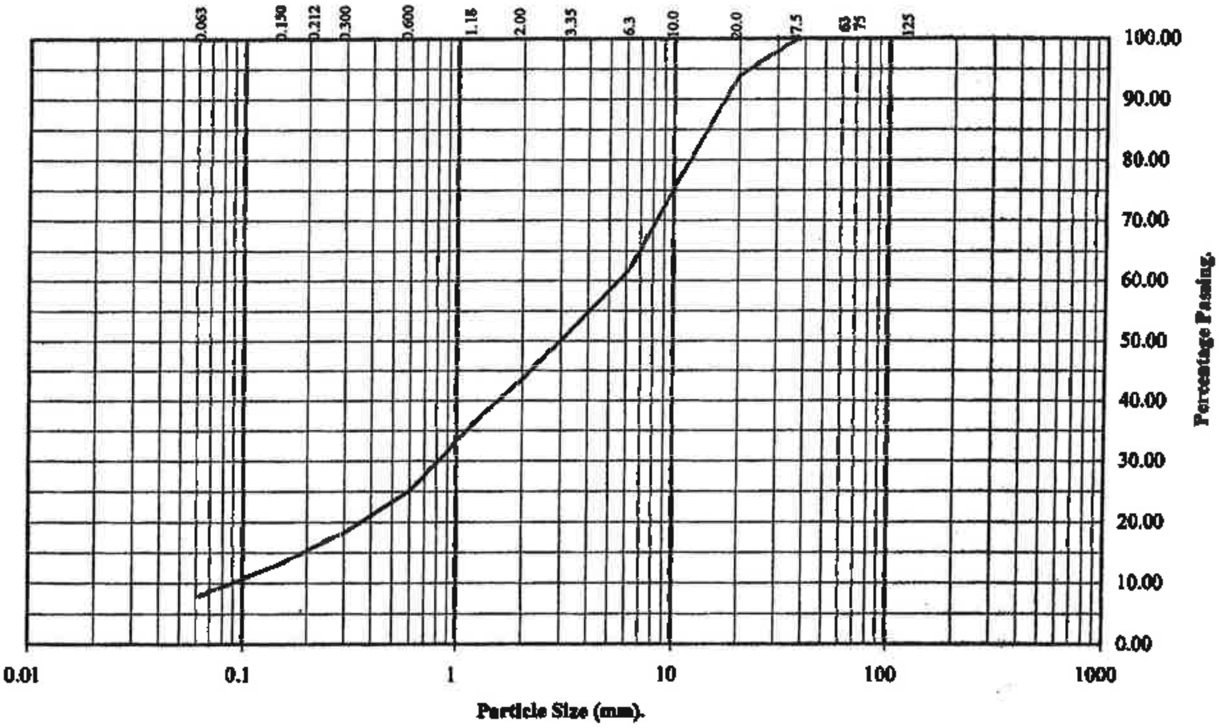
Contract No.: GEO/3196/06

Client Ref No: n/a

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.
Wet sieve Clause 9.2

Hole Number: CTP02 **Sample Number:** 313 **Depth (m):** 3.50



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	94
10	75
6.3	62
3.35	52
2	43
1.18	36
0.6	25
0.3	18
0.212	16
0.15	13
0.063	8

Soil Fraction	Total Percentage
Cobbles	0
Gravel	57
Sand	35
Silt and Clay	8

Remarks:

4/12/06

Checked by Date

04/12/06

Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

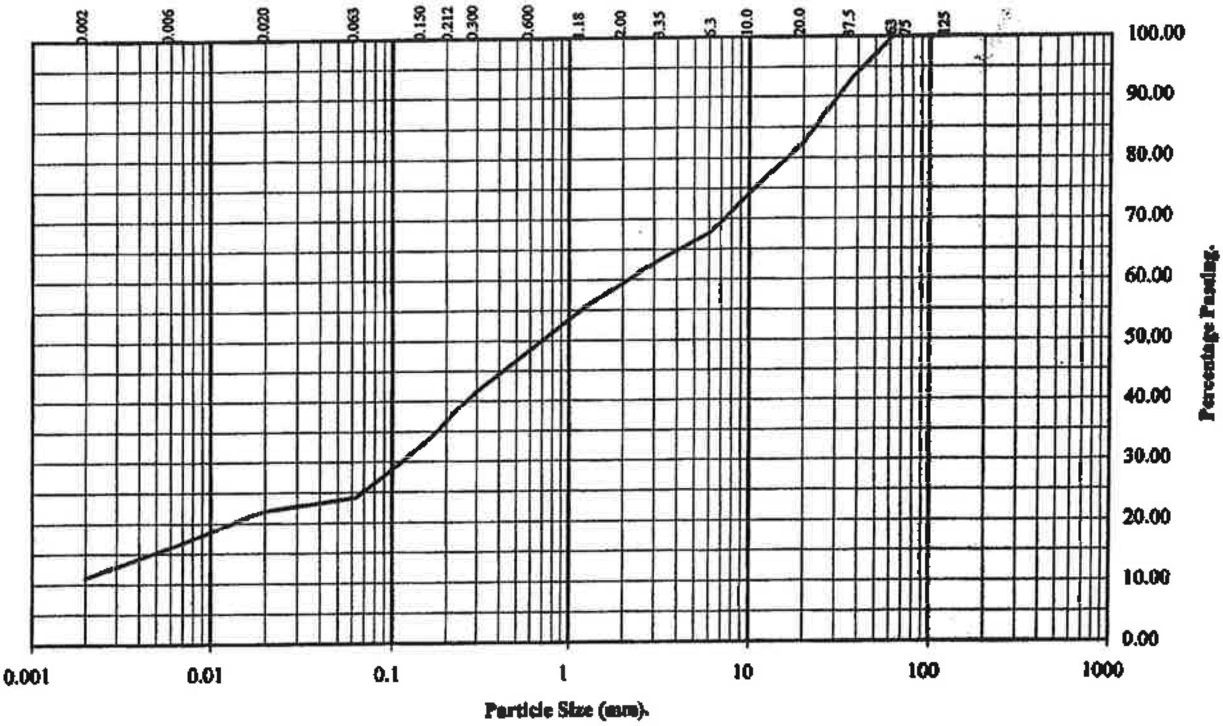
Contract No.: GEO/3196/06
Client Ref No: n/a

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP03 **Sample Number:** 314 **Depth (m)** 1.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	93
20	82
10	74
6.3	68
3.35	64
2	59
1.18	55
0.6	48
0.3	42
0.212	37
0.15	33
0.063	24

Particle Diameter	Percentage Passing
0.02	22
0.006	16
0.002	11

Soil Fraction	Total Percentage
Cobbles	0
Gravel	41
Sand	35
Silt	13
Clay	11

Remarks:
Cl 9.4.8 - Sample has not been pretreated

4/12/06
Checked by Date

04/12/06
Approved by Date

GEO LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06
Client Ref No: n/a

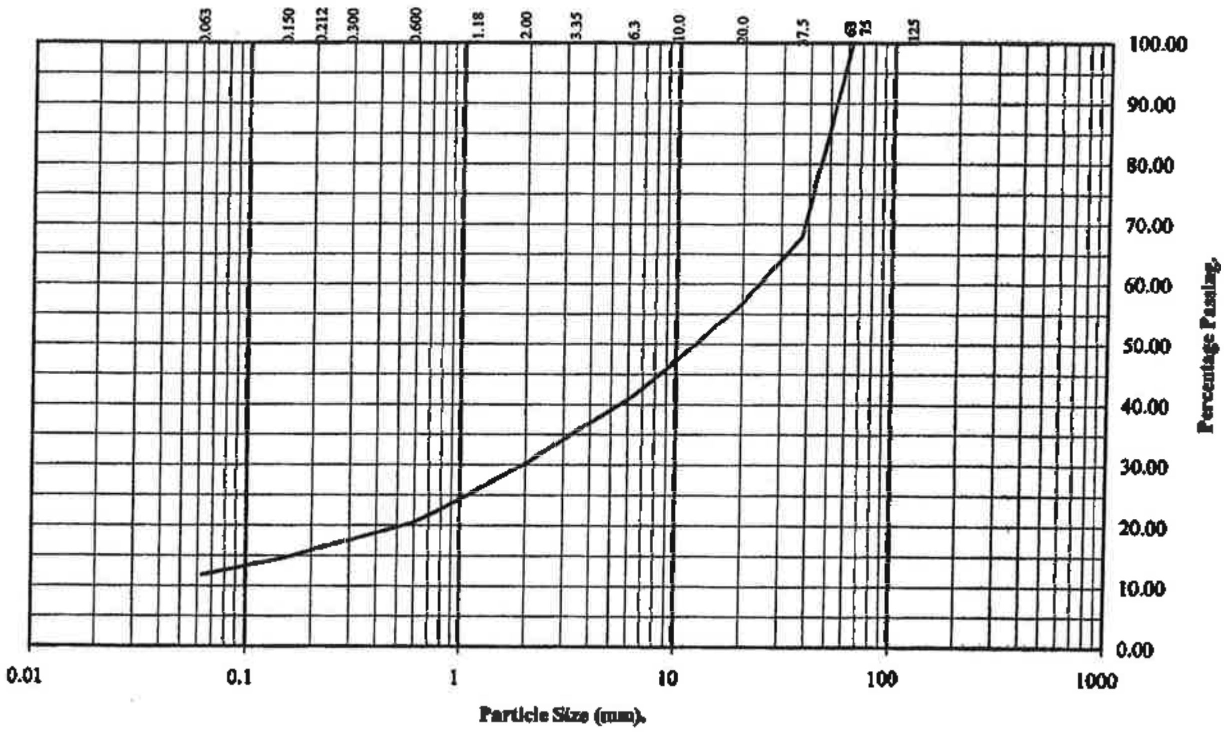
UKAS 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: CTP03 **Sample Number:** 316 **Depth (m):** 3.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	68
20	57
10	47
6.3	41
3.35	35
2	30
1.18	26
0.6	20
0.3	17
0.212	16
0.15	15
0.063	12

Soil Fraction	Total Percentage
Cobbles	0
Gravel	70
Sand	18
Silt and Clay	12

Remarks:

4/12/06

Checked by Date

04/12/06

Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

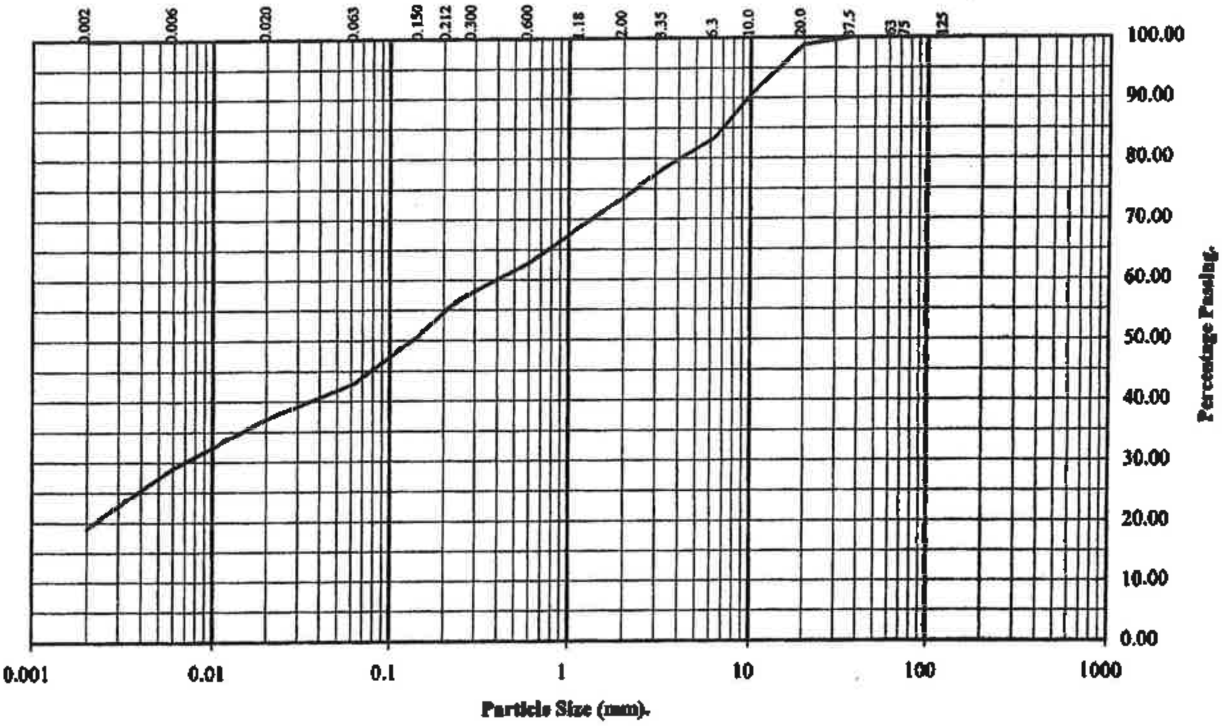
Client Ref No: n/a

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP04 **Sample Number:** 318 **Depth (m)** 1.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	99
10	90
6.3	83
3.35	78
2	73
1.18	69
0.6	63
0.3	58
0.212	55
0.15	51
0.063	43

Particle Diameter	Percentage Passing
0.02	37
0.006	29
0.002	19

Soil Fraction	Total Percentage
Cobbles	0
Gravel	27
Sand	30
Silt	24
Clay	19

Remarks:

Cl 9.4.8 - Sample has not been pretreated

4/12/06

Checked by Date

04/12/06

Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: n/a

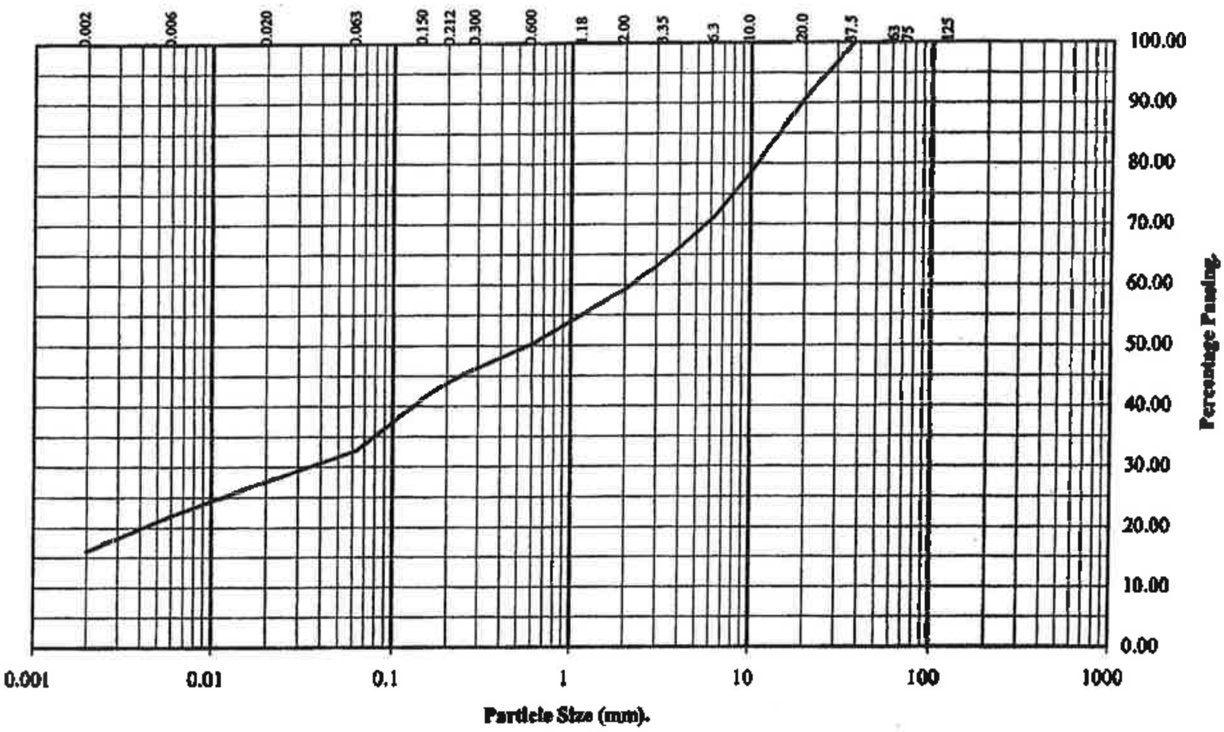
2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP04 **Sample Number:** 319 **Depth (m)** 2.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	91
10	78
6.3	71
3.35	64
2	59
1.18	55
0.6	50
0.3	46
0.212	44
0.15	41
0.063	33

Particle Diameter	Percentage Passing
0.02	28
0.006	22
0.002	16

Soil Fraction	Total Percentage
Cobbles	0
Gravel	41
Sand	26
Silt	17
Clay	16

Remarks:

Cl 9.4.8 - Sample has not been pretreated

4/12/06

Checked by Date

04/12/06

Approved by Date

GEO LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: n/a

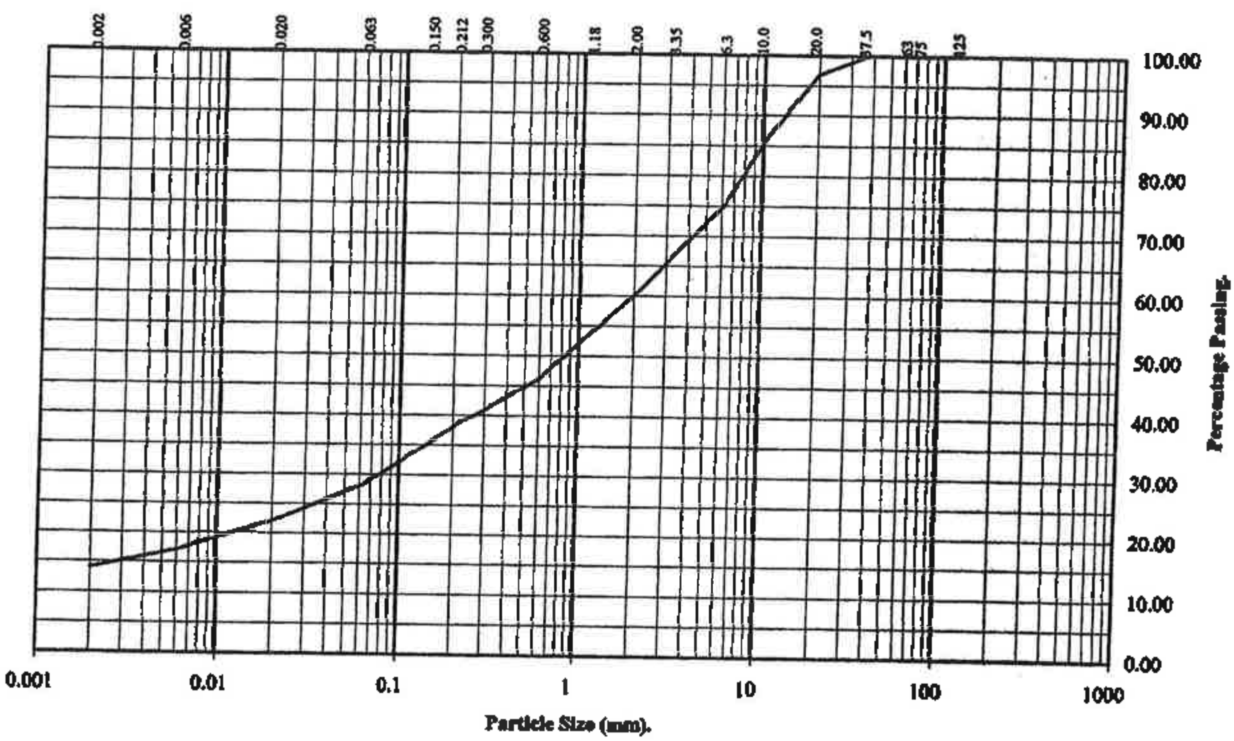
UKAS 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP04 **Sample Number:** 320 **Depth (m)** 3.30



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	97
10	85
6.3	75
3.35	67
2	60
1.18	54
0.6	46
0.3	41
0.212	38
0.15	35
0.063	28

Particle Diameter	Percentage Passing
0.02	22
0.006	17
0.002	14

Soil Fraction	Total Percentage
Cobbles	0
Gravel	40
Sand	32
Silt	14
Clay	14

Remarks:

Cl 9.4.8 - Sample has not been pretreated

4/12/06

Checked by Date

Approved by Date

LABORATORY TESTING SERVICES LIMITED

GEO/104-2 Dec 05

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: n/a

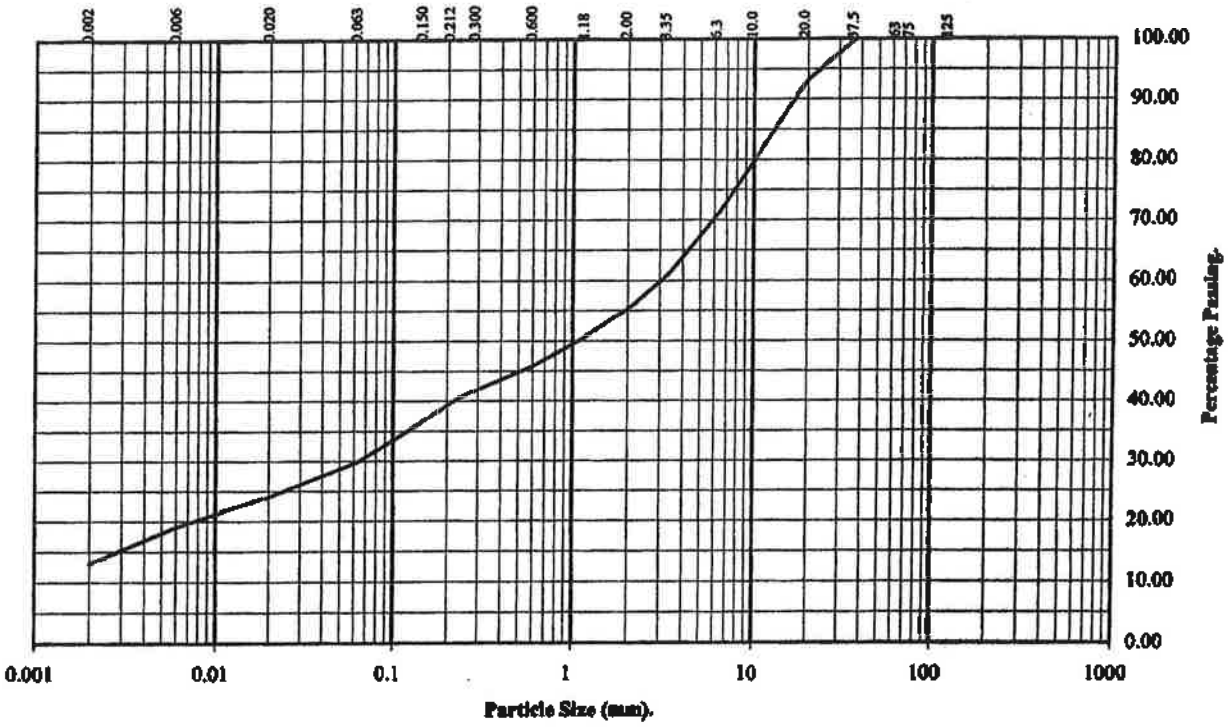
Issue No 1.2

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP05 **Sample Number:** 322 **Depth (m)** 1.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	93
10	80
6.3	71
3.35	61
2	55
1.18	51
0.6	46
0.3	42
0.212	40
0.15	37
0.063	30

Particle Diameter	Percentage Passing
0.02	24
0.006	19
0.002	13

Soil Fraction	Total Percentage
Cobbles	0
Gravel	45
Sand	25
Silt	17
Clay	13

Remarks:

Cl 9.4.8 - Sample has not been pretreated

Checked by: 4/12/06 Date

Approved by: 04/12/06 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: n/a

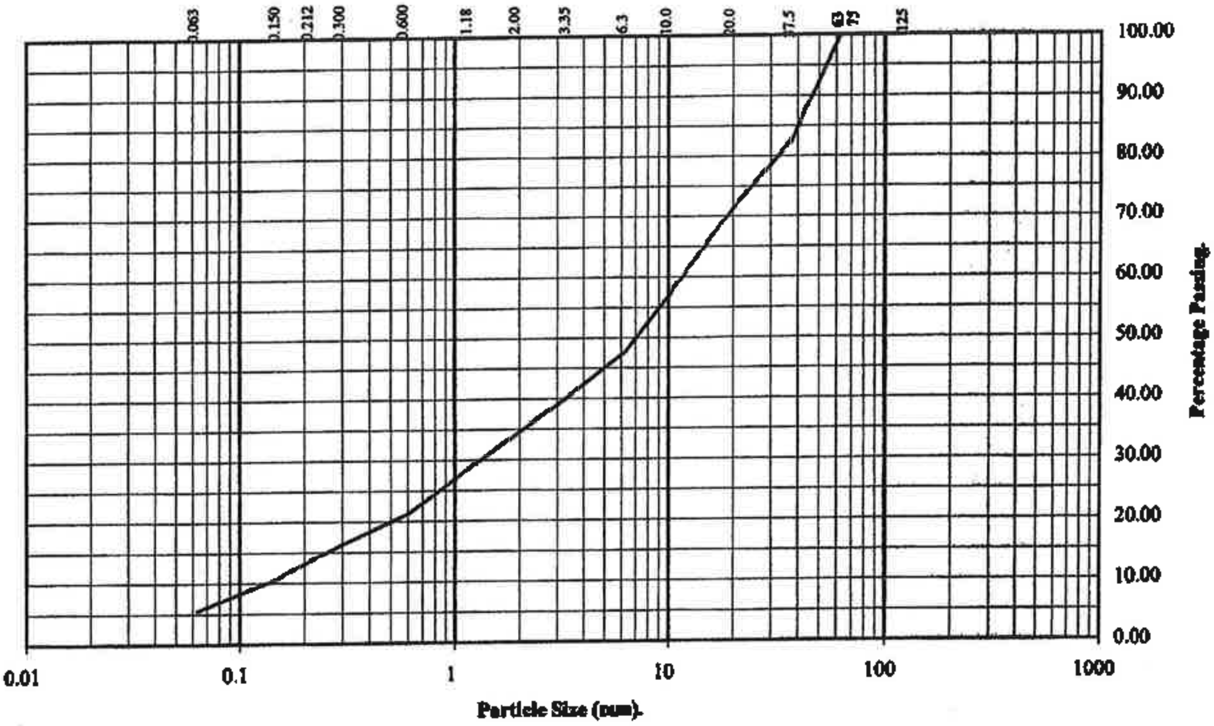
2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: CTP05 **Sample Number:** 324 **Depth (m):** 3.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	82
20	71
10	57
6.3	48
3.35	40
2	35
1.18	29
0.6	21
0.3	16
0.212	14
0.15	11
0.063	6

Soil Fraction	Total Percentage
Cobbles	0
Gravel	65
Sand	29
Silt and Clay	6

Remarks:

Checked by 4/12/06 Date

Approved by 04/12/06 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: n/a

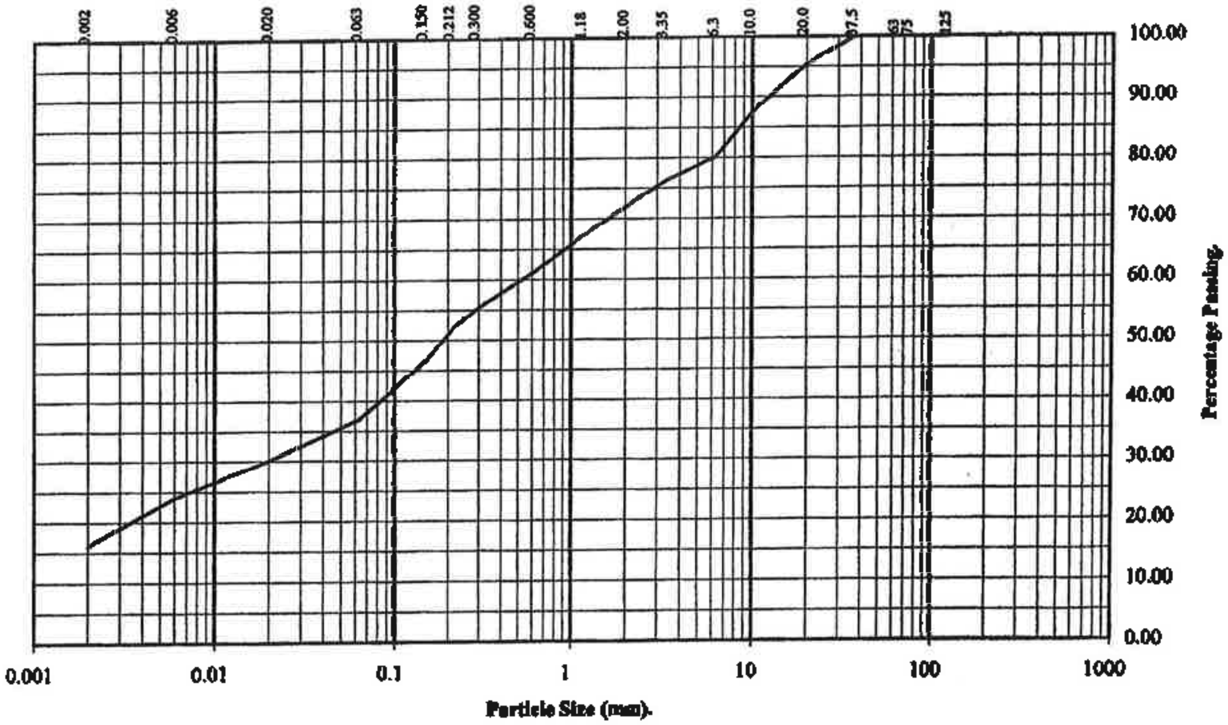
2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP06A **Sample Number:** 326 **Depth (m)** 1.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	95
10	87
6.3	80
3.35	76
2	72
1.18	67
0.6	61
0.3	55
0.212	52
0.15	47
0.063	37

Particle Diameter	Percentage Passing
0.02	30
0.006	24
0.002	16

Soil Fraction	Total Percentage
Cobbles	0
Gravel	28
Sand	35
Silt	21
Clay	16

Remarks:
Cl 9.4.8 - Sample has not been pretreated

Checked by 4/12/06 Date

Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06
Client Ref No: n/a

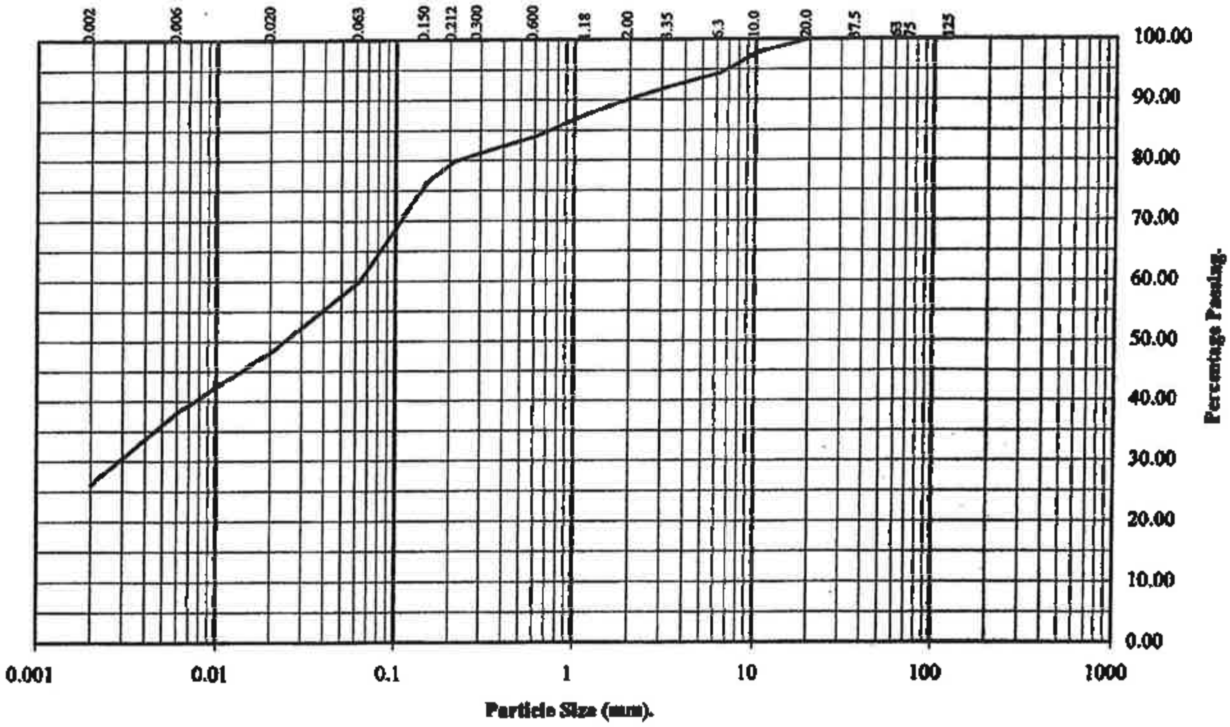
2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP06A **Sample Number:** 327 **Depth (m)** 2.50



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	98
6.3	94
3.35	92
2	90
1.18	88
0.6	84
0.3	81
0.212	80
0.15	76
0.063	60

Particle Diameter	Percentage Passing
0.02	48
0.006	38
0.002	26

Soil Fraction	Total Percentage
Cobbles	0
Gravel	10
Sand	30
Silt	34
Clay	26

Remarks:

Cl 9.4.8 - Sample has not been pretreated

4/12/06

Checked by Date

04/12/06

Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: n/a

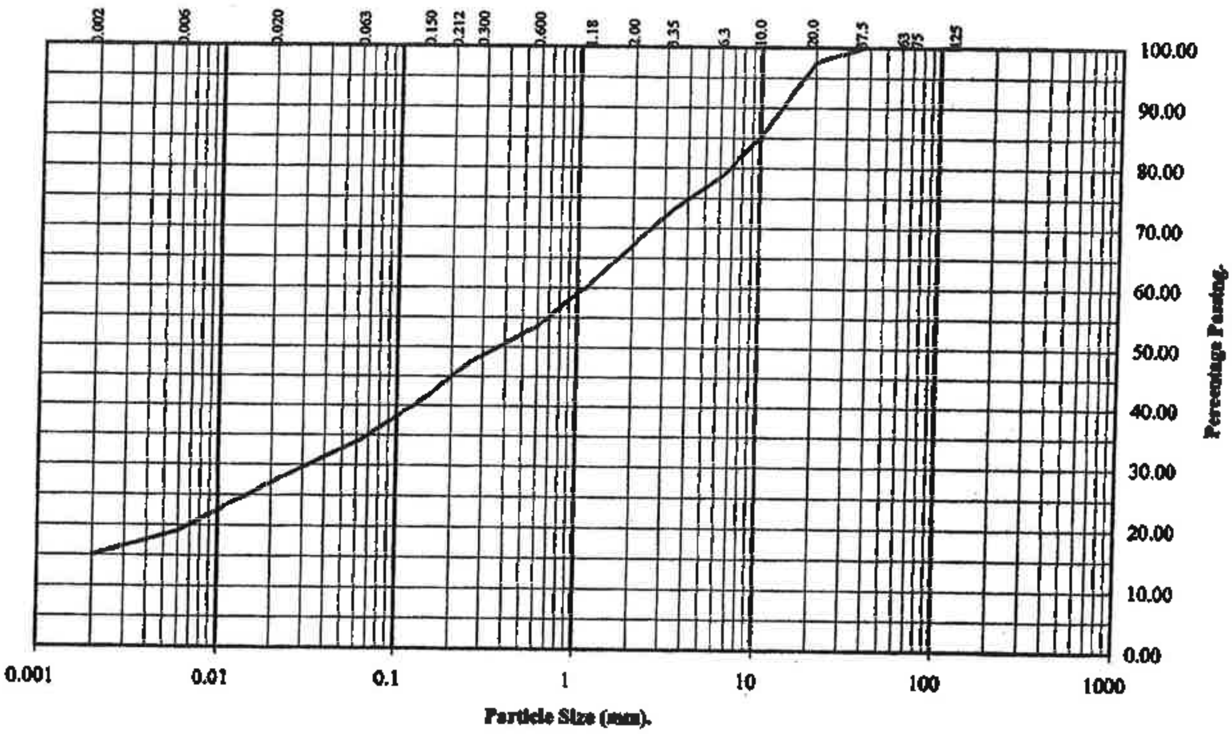
2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP06A **Sample Number:** 328 **Depth (m)** 3.70



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	97
10	85
6.3	79
3.35	73
2	67
1.18	61
0.6	53
0.3	49
0.212	46
0.15	42
0.063	34

Particle Diameter	Percentage Passing
0.02	27
0.006	19
0.002	15

Soil Fraction	Total Percentage
Cobbles	0
Gravel	33
Sand	33
Silt	19
Clay	15

Remarks:

Cl 9.4.8 - Sample has not been pretreated

4/12/06

Checked by Date

Approved by Date

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: n/a

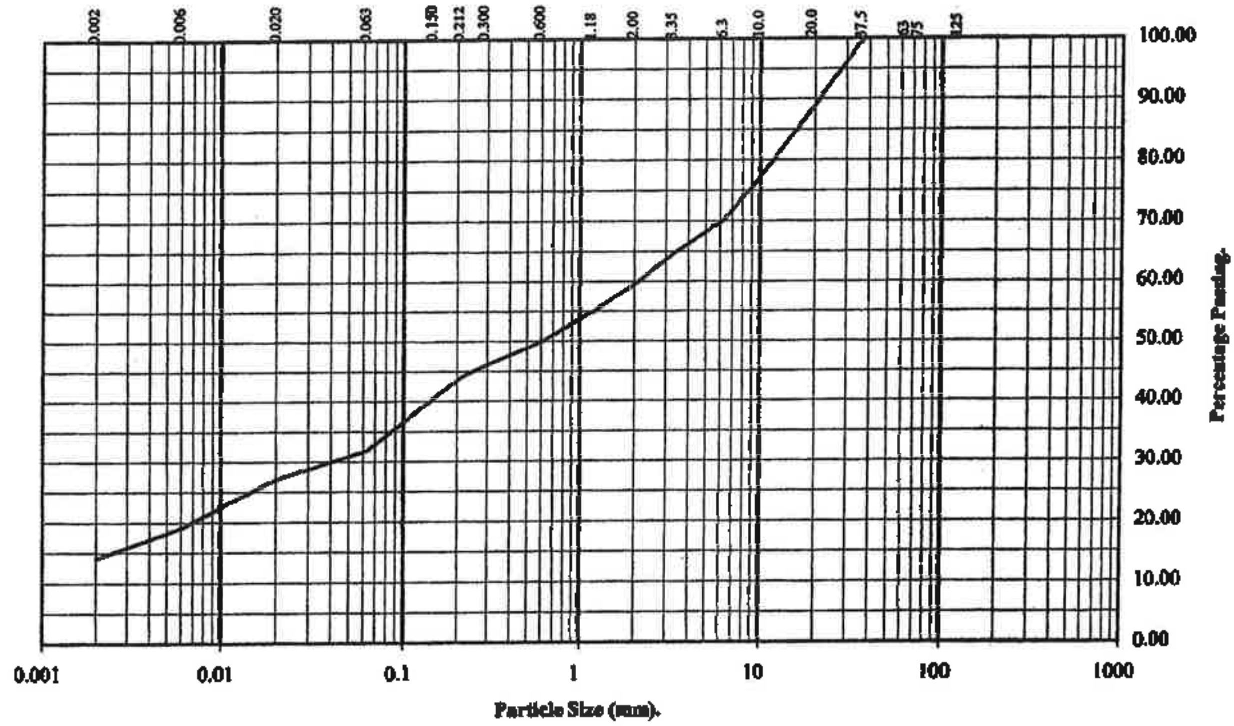
LABORATORY TESTING SERVICES LIMITED

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP07 **Sample Number:** 329 **Depth (m)** 1.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	89
10	77
6.3	70
3.35	65
2	59
1.18	55
0.6	50
0.3	46
0.212	44
0.15	41
0.063	32

Particle Diameter	Percentage Passing
0.02	27
0.006	19
0.002	14

Soil Fraction	Total Percentage
Cobbles	0
Gravel	41
Sand	27
Silt	18
Clay	14

Remarks:
Cl 9.4.8 - Sample has not been pretreated

Checked by 4/12/06 Date

Approved by 6/12/06 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06
Client Ref No: n/a

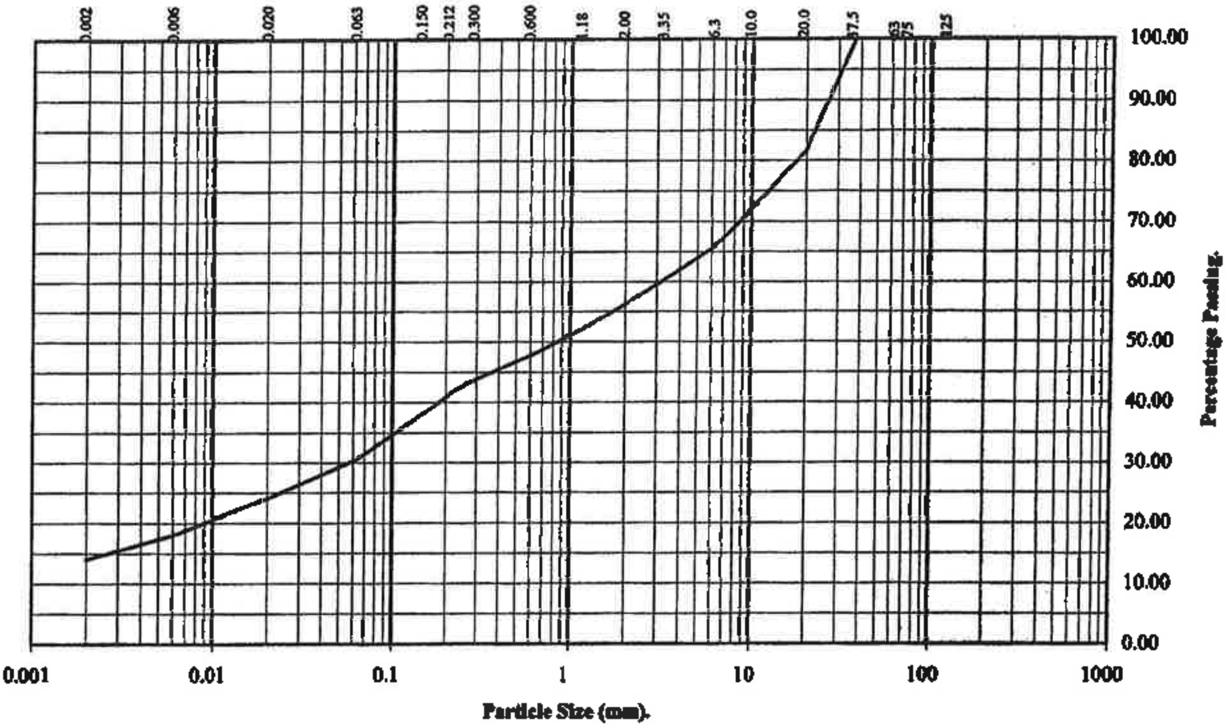
2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP07 **Sample Number:** 330 **Depth (m)** 2.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	82
10	72
6.3	66
3.35	60
2	56
1.18	52
0.6	48
0.3	44
0.212	41
0.15	38
0.063	31

Particle Diameter	Percentage Passing
0.02	24
0.006	18
0.002	14

Soil Fraction	Total Percentage
Cobbles	0
Gravel	44
Sand	25
Silt	17
Clay	14

Remarks:
Cl 9.4.8 - Sample has not been pretreated

4/12/06

Checked by Date

Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

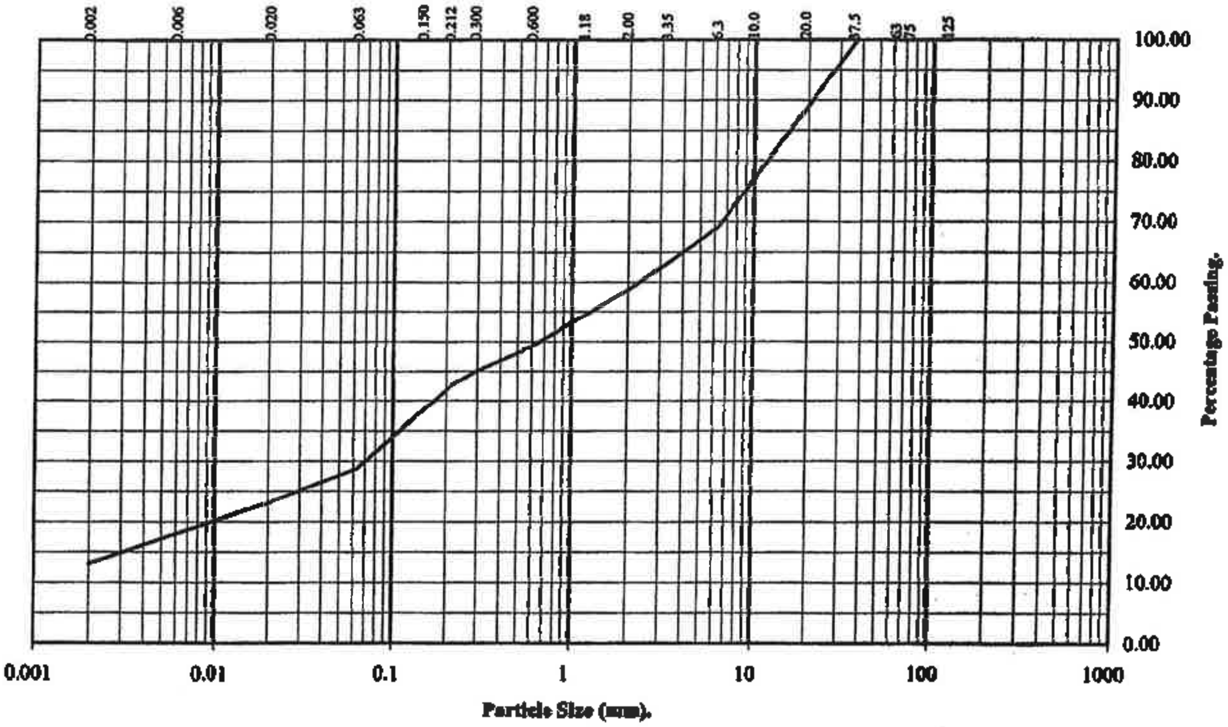
Contract No.: GEO/3196/06
Client Ref No: n/a

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP07 **Sample Number:** 331 **Depth (m)** 3.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	89
10	77
6.3	69
3.35	63
2	59
1.18	54
0.6	49
0.3	45
0.212	42
0.15	39
0.063	29

Particle Diameter	Percentage Passing
0.02	23
0.006	18
0.002	13

Soil Fraction	Total Percentage
Cobbles	0
Gravel	41
Sand	30
Silt	16
Clay	13

Remarks:
Cl 9.4.8 - Sample has not been pretreated

4/12/06
Checked by Date

04/12/06
Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06
Client Ref No: n/a

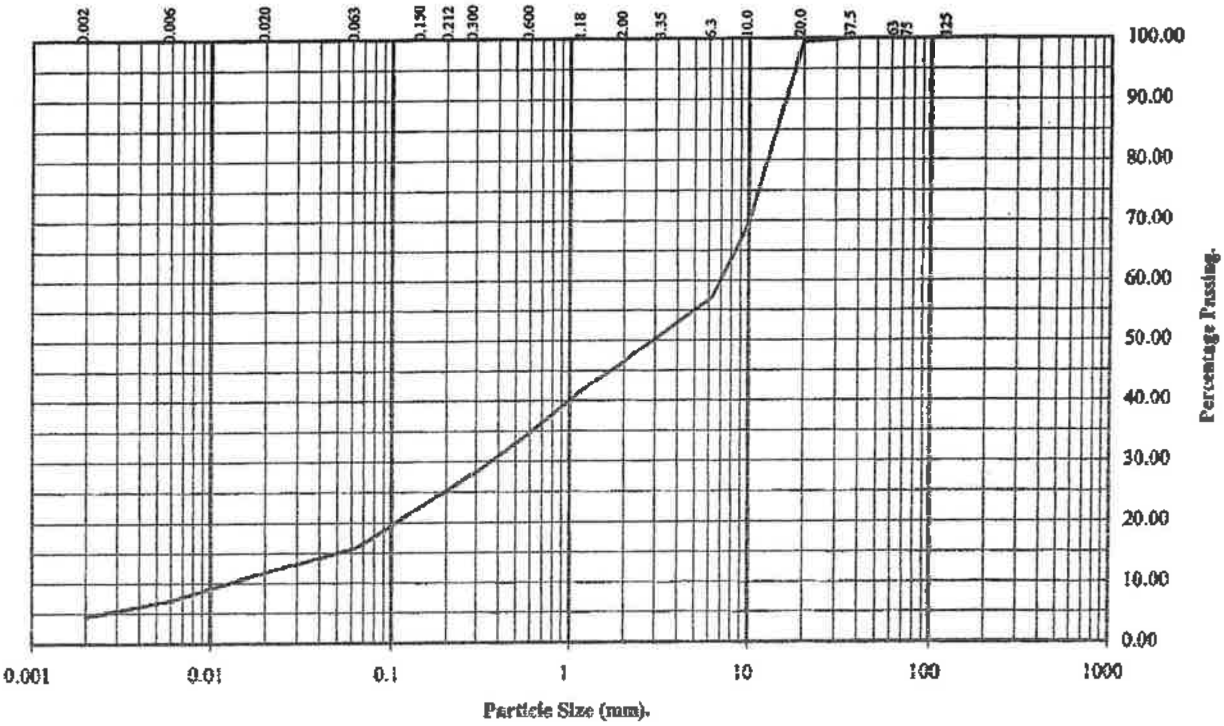
2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP08 **Sample Number:** 290 **Depth (m)** 0.50



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	99
10	69
6.3	57
3.35	51
2	46
1.18	42
0.6	35
0.3	28
0.212	26
0.15	23
0.063	16

Particle Diameter	Percentage Passing
0.02	12
0.006	7
0.002	4

Soil Fraction	Total Percentage
Cobbles	0
Gravel	54
Sand	30
Silt	12
Clay	4

Remarks:

Cl 9.4.8 - Sample has not been pretreated

4/1/06

Checked by **Date**

06/1/06

Approved by **Date**

Carrigaline

Contract No.: GEO/3196/06

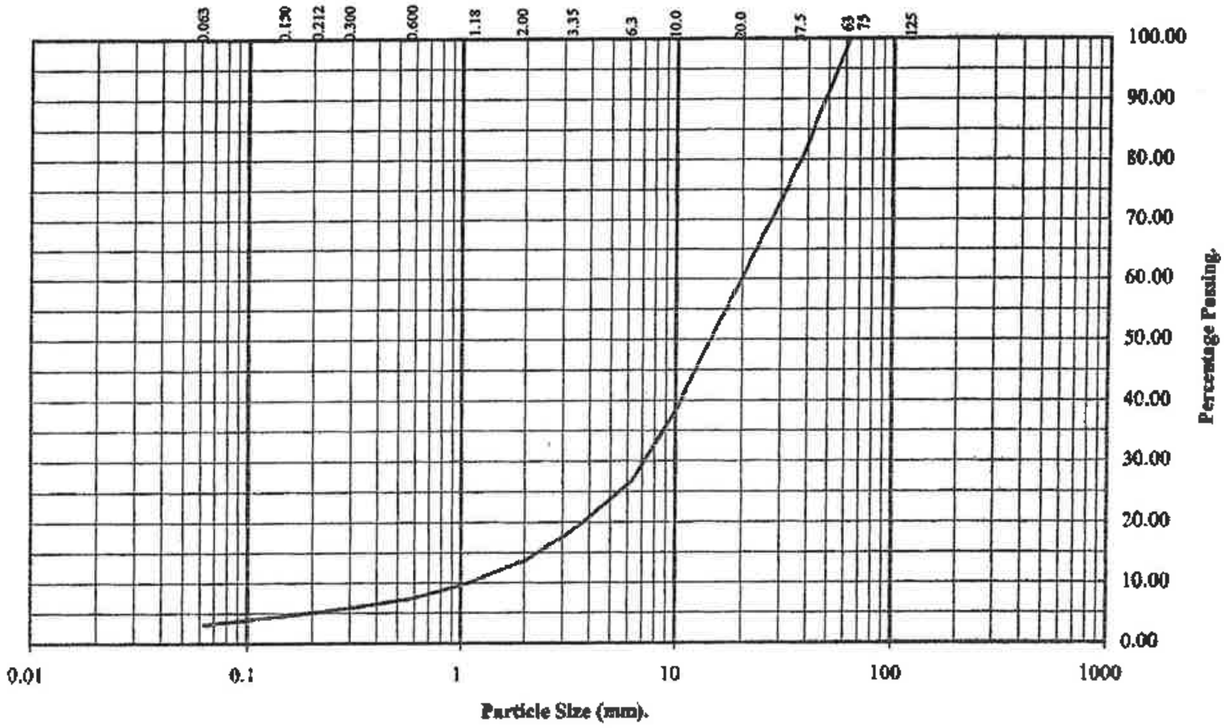
Client Ref No: n/a

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: **CTP08** **Sample Number:** **291** **Depth (m):** **1.50**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	80
20	60
10	38
6.3	27
3.35	18
2	14
1.18	10
0.6	7
0.3	6
0.212	5
0.15	5
0.063	3

Soil Fraction	Total Percentage
Cobbles	0
Gravel	86
Sand	11
Silt and Clay	3

Remarks:

4/12/06
Checked by Date

04/12/06
Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06
Client Ref No: n/a

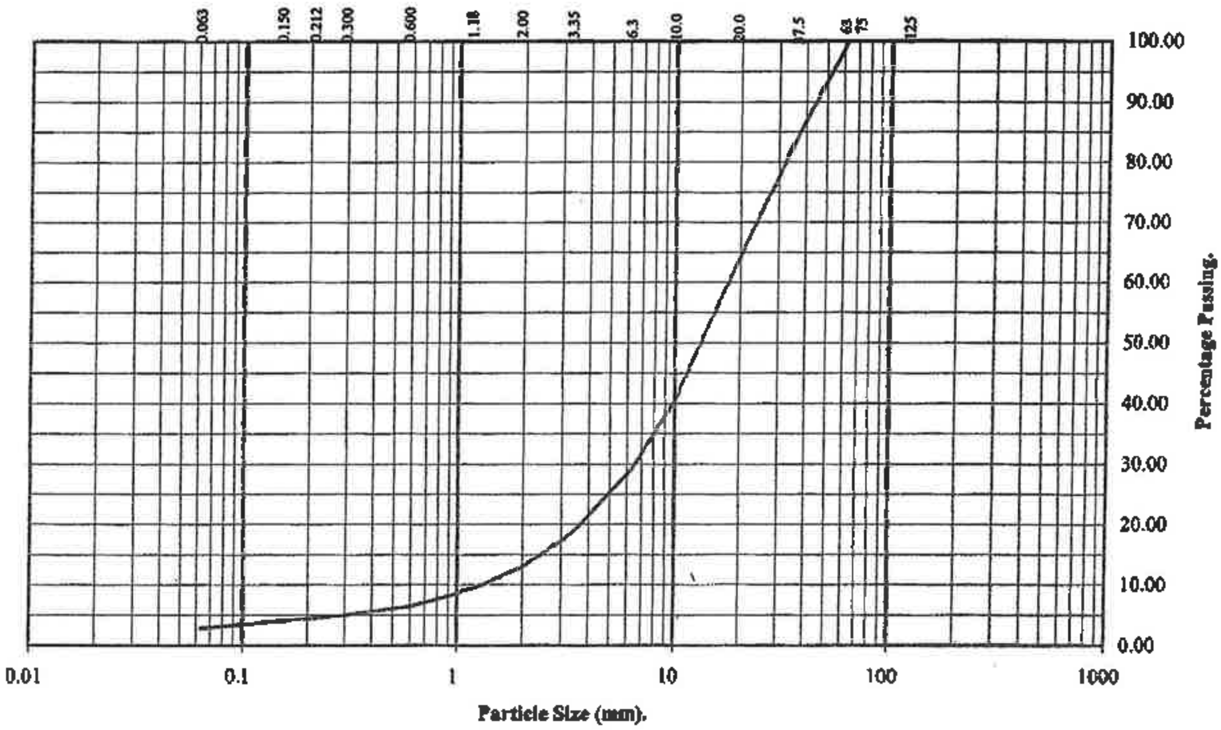
2768

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: CTP08 **Sample Number:** 292 **Depth (m):** 3.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	85
20	64
10	40
6.3	29
3.35	18
2	13
1.18	9
0.6	6
0.3	5
0.212	4
0.15	4
0.063	3

Soil Fraction	Total Percentage
Cobbles	0
Gravel	87
Sand	10
Silt and Clay	3

Remarks:

Checked by [signature] Date 4/12/06

Approved by [signature] Date 04/12/06

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

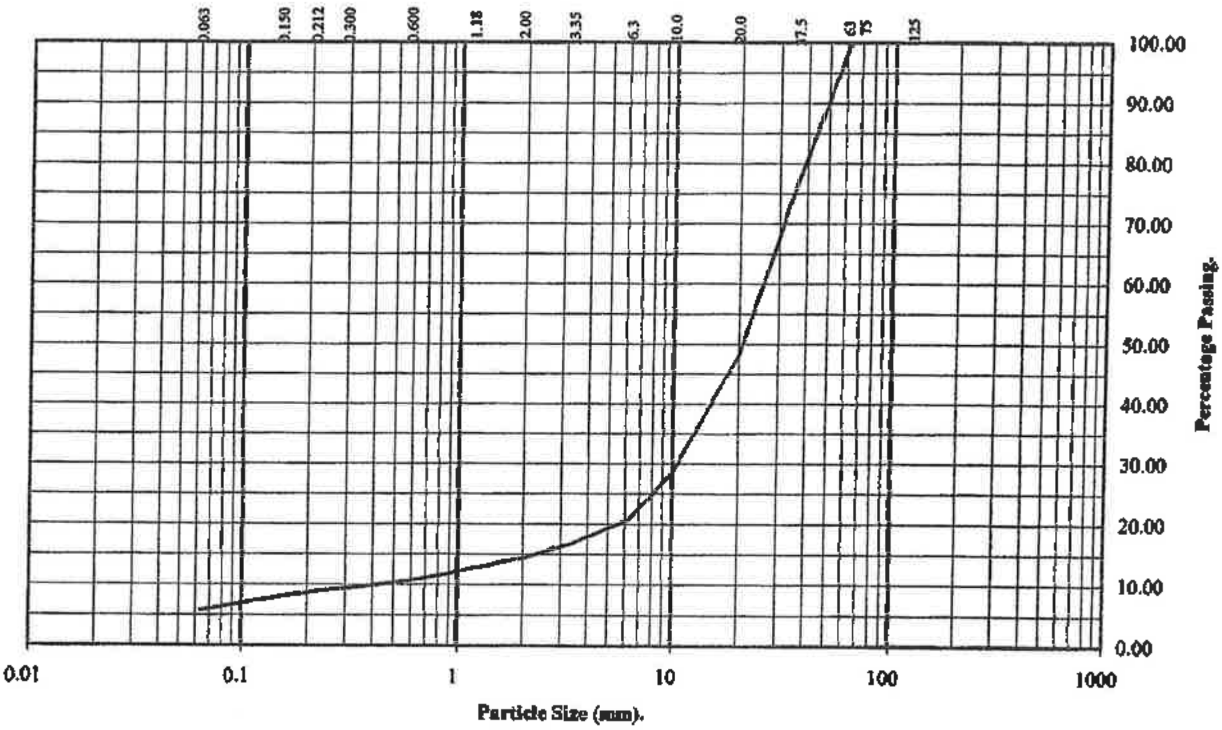
Client Ref No: n/a

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: CTP09 **Sample Number:** 288 **Depth (m):** 2.50



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	78
20	48
10	28
6.3	21
3.35	17
2	14
1.18	13
0.6	11
0.3	9
0.212	9
0.15	8
0.063	6

Soil Fraction	Total Percentage
Cobbles	0
Gravel	86
Sand	8
Silt and Clay	6

Remarks:

4/12/06

Checked by **Date**

04/12/06

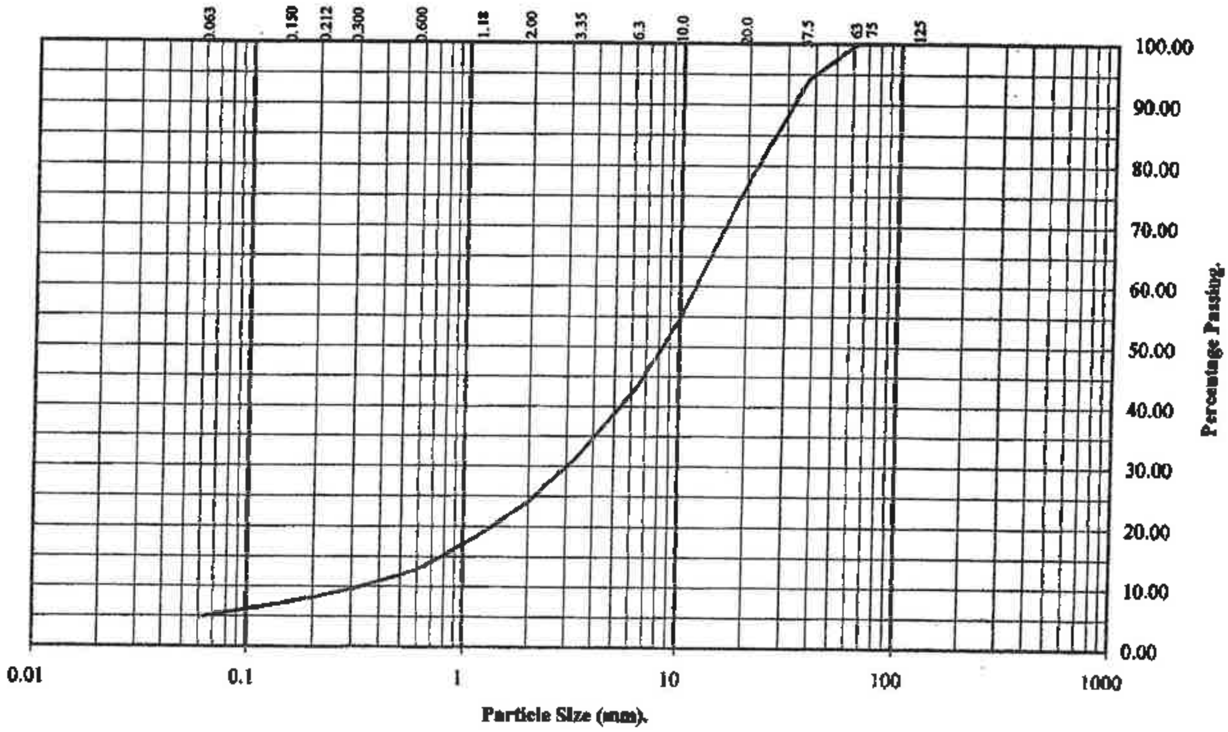
Approved by **Date**

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: CTP09 **Sample Number:** 289 **Depth (m):** 3.50



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	94
20	77
10	55
6.3	43
3.35	31
2	24
1.18	18
0.6	13
0.3	9
0.212	8
0.15	7
0.063	5

Soil Fraction	Total Percentage
Cobbles	0
Gravel	76
Sand	19
Silt and Clay	5

Remarks:

Checked by 4/12/06 Date

Approved by 04/12/06 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

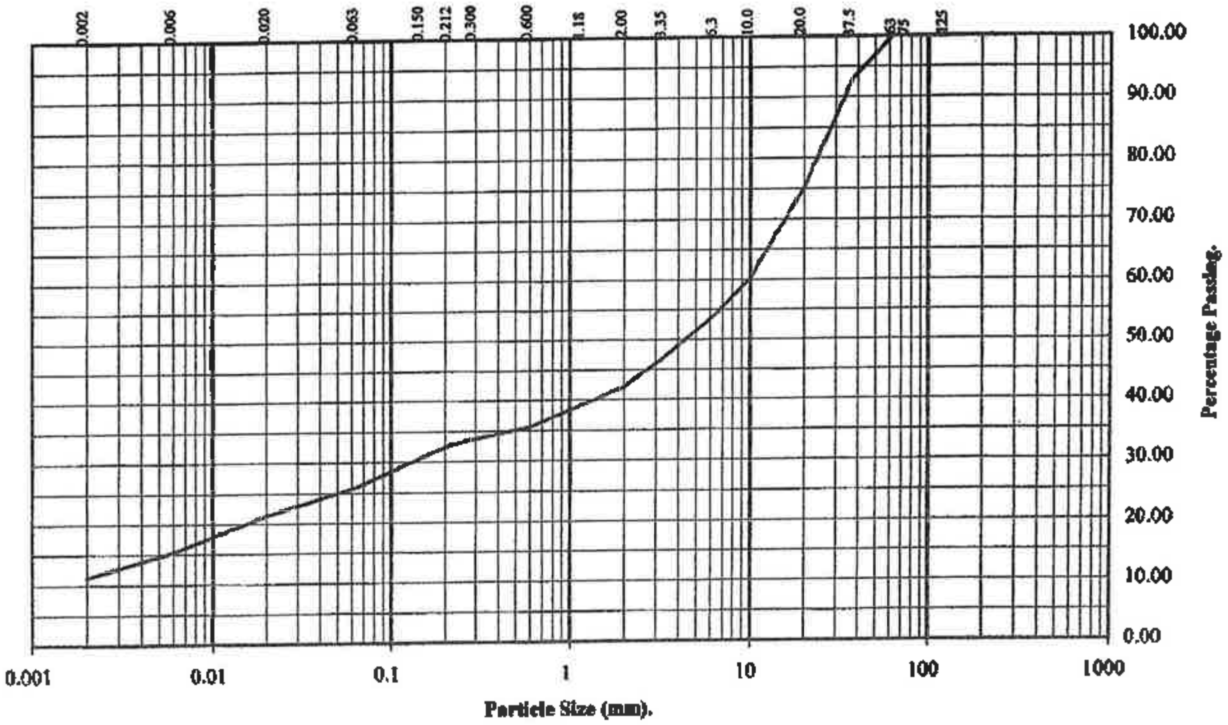
Client Ref No: n/a

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP10 **Sample Number:** 285 **Depth (m)** 1.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	93
20	75
10	60
6.3	54
3.35	47
2	42
1.18	39
0.6	36
0.3	34
0.212	33
0.15	31
0.063	26

Particle Diameter	Percentage Passing
0.02	21
0.006	15
0.002	11

Soil Fraction	Total Percentage
Cobbles	0
Gravel	58
Sand	16
Silt	15
Clay	11

Remarks:

Cl 9.4.8 - Sample has not been pretreated

Checked by Date 4/12/06

Approved by Date 04/12/06

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: n/a

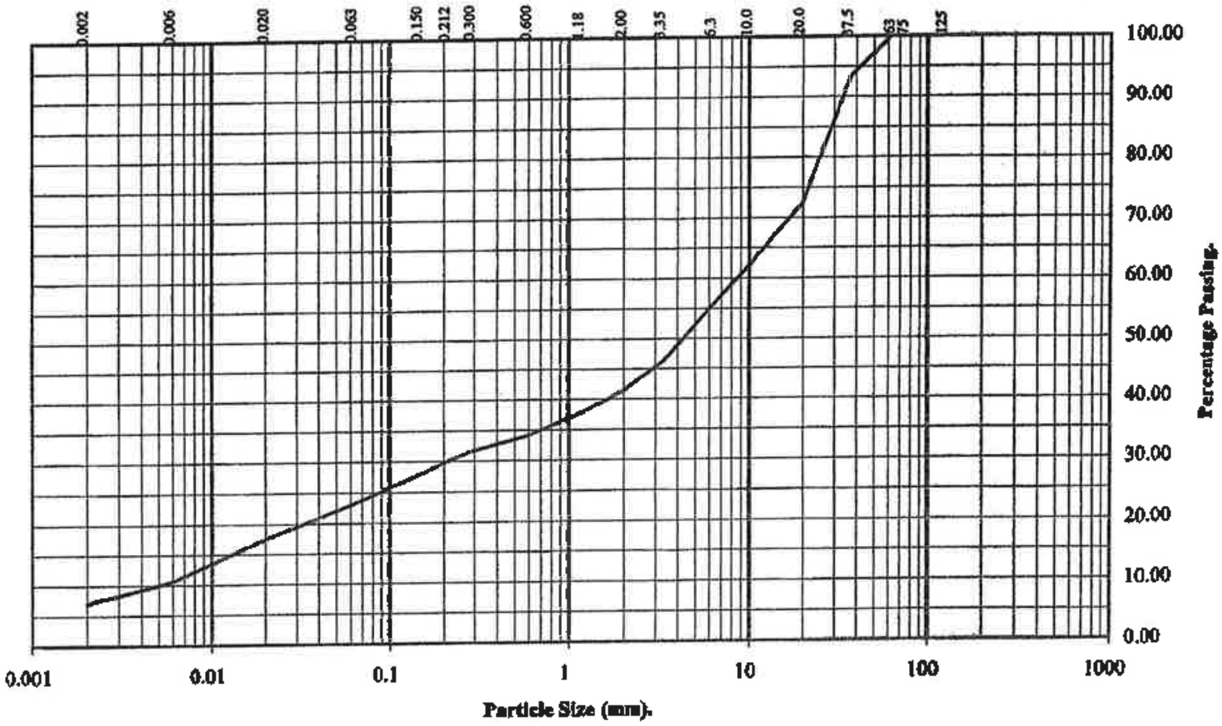
2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CTP10 **Sample Number:** 286 **Depth (m)** 1.90



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	94
20	72
10	62
6.3	56
3.35	46
2	41
1.18	38
0.6	34
0.3	32
0.212	30
0.15	28
0.063	23

Particle Diameter	Percentage Passing
0.02	17
0.006	11
0.002	7

Soil Fraction	Total Percentage
Cobbles	0
Gravel	59
Sand	18
Silt	16
Clay	7

Remarks:

Cl 9.4.8 - Sample has not been pretreated

Checked by Date 4/12/06

Approved by Date 04/12/06

LABORATORY TESTING SERVICES LIMITED

Carrigaline

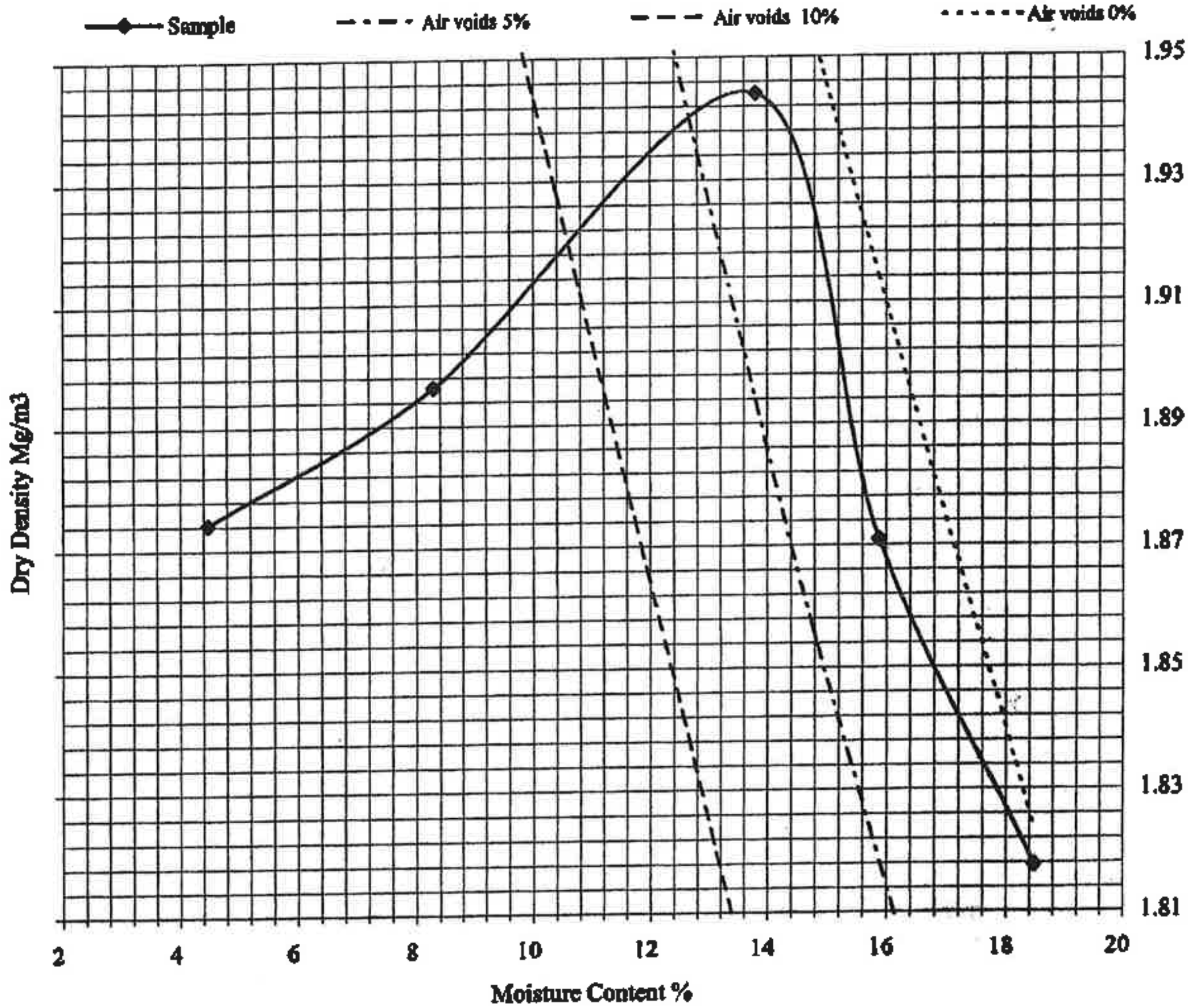
Contract No.: GEO/3196/06

Client Ref No: n/a

Dry Density/Moisture Content Relationship

BS 1377:Part 4:1990

Hole Number: CTP05 **Sample Number:** 323 **Depth(m):** 2.50



Initial Moisture Content:	18	Method of Compaction	2.5Kg Rammer / Single Sample	
Particle Density (Mg/m3):	2.75* Assumed	Material Retained on 37.5 mm Test Sieve (%):		3
Maximum Dry Density (mg/m3):	1.94	Material Retained on 20.0 mm Test Sieve (%):		6
Optimum Moisture Content (%):	14	Sample Preparation Clause :		3.2.5.2

** - not included in laboratory scope of accreditation*

Remarks

Checked by 4/12/06 Date

Approved by 04/12/06 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

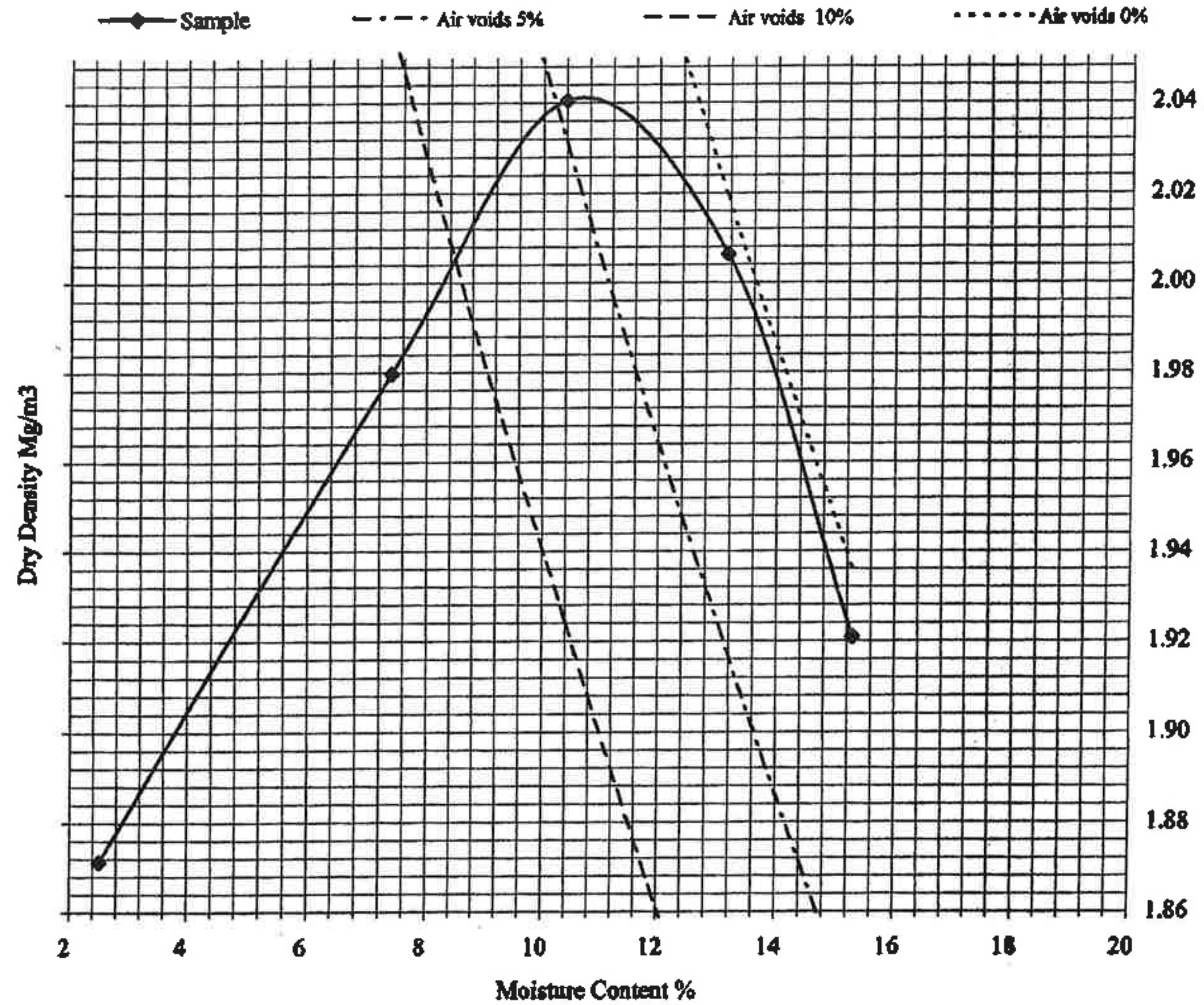
Client Ref No: N/A

2788

Dry Density/Moisture Content Relationship

BS 1377:Part 4:1990

Hole Number: **CTP07** **Sample Number:** **330** **Depth(m):** **2.00**



Initial Moisture Content:	13	Method of Compaction	2.5Kg Rammer / Single Sample
Particle Density (Mg/m3):	2.75* Assumed	Material Retained on 37.5 mm Test Sieve (%):	0
Maximum Dry Density (mg/m3):	2.04	Material Retained on 20.0 mm Test Sieve (%):	18
Optimum Moisture Content (%):	10	Sample Preparation Clause :	3.2.5.1

** - not included in laboratory scope of accreditation*

Remarks

4/12/06

Checked by Date

04/12/06

Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

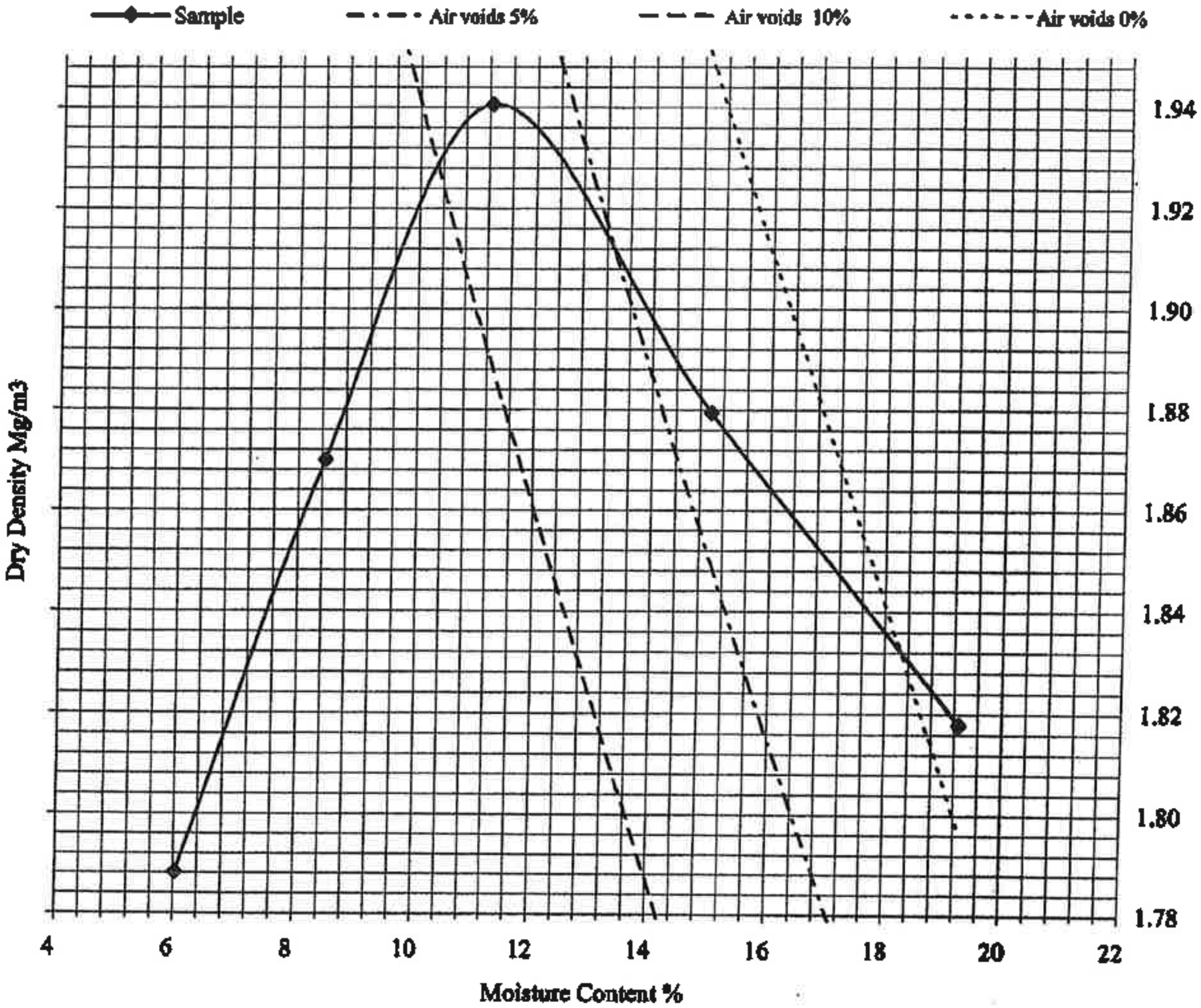
Client Ref No: N/A

UKAS 2788

Dry Density/Moisture Content Relationship

BS 1377:Part 4:1990

Hole Number: CTP09 **Sample Number:** 287 **Depth(m):** 1.00



Initial Moisture Content:		19	Method of Compaction	2.5Kg Rammer / Single Sample	
Particle Density (Mg/m3):	2.75* Assumed		Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (mg/m3):		1.94	Material Retained on 20.0 mm Test Sieve (%):		0
Optimum Moisture Content (%):		11	Sample Preparation Clause :		0.0

** - not included in laboratory scope of accreditation*

Remarks

Checked by 4/11/06 Date

Approved by 04/10/06 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

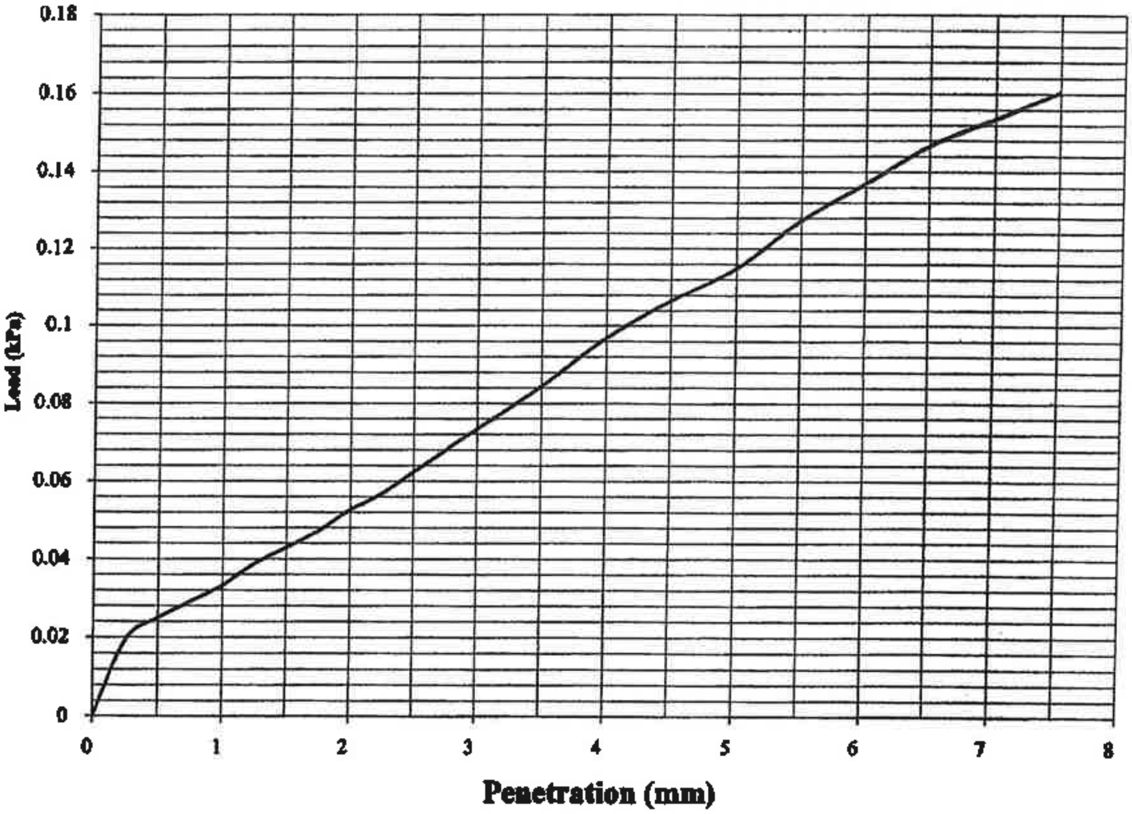
Contract No.: GEO/3195/06
Client Ref No: N/A

UKAS 2788

California Bearing Ratio Test.

BS 1377:Part 4:1990

Hole Number: CTP09 **Sample Number:** 287 **Depth (m)** 1.00



Initial Sample Conditions		Test Conditions		Method of compaction : 2.5 Kg Rammer	
Moisture Content:	19	Surcharge Kg:	2.0	Final Moisture Content %	
Bulk Density Mg/m3:	2.17	Soaking Time hrs	n/a	Sample Top	19
Dry Density Mg/m3:	1.82	Swelling mm:	n/a	Sample Bottom	N/A
C.B.R. Value %	Sample Top	0.57		Sample Bottom	N/A
Percentage retained on 20mm BS test sieve:		0	Remarks:		

Checked by 4/12/06 Date

Approved by 04/12/06. Date

GEO LABORATORY TESTING SERVICES LIMITED

Carrigaline

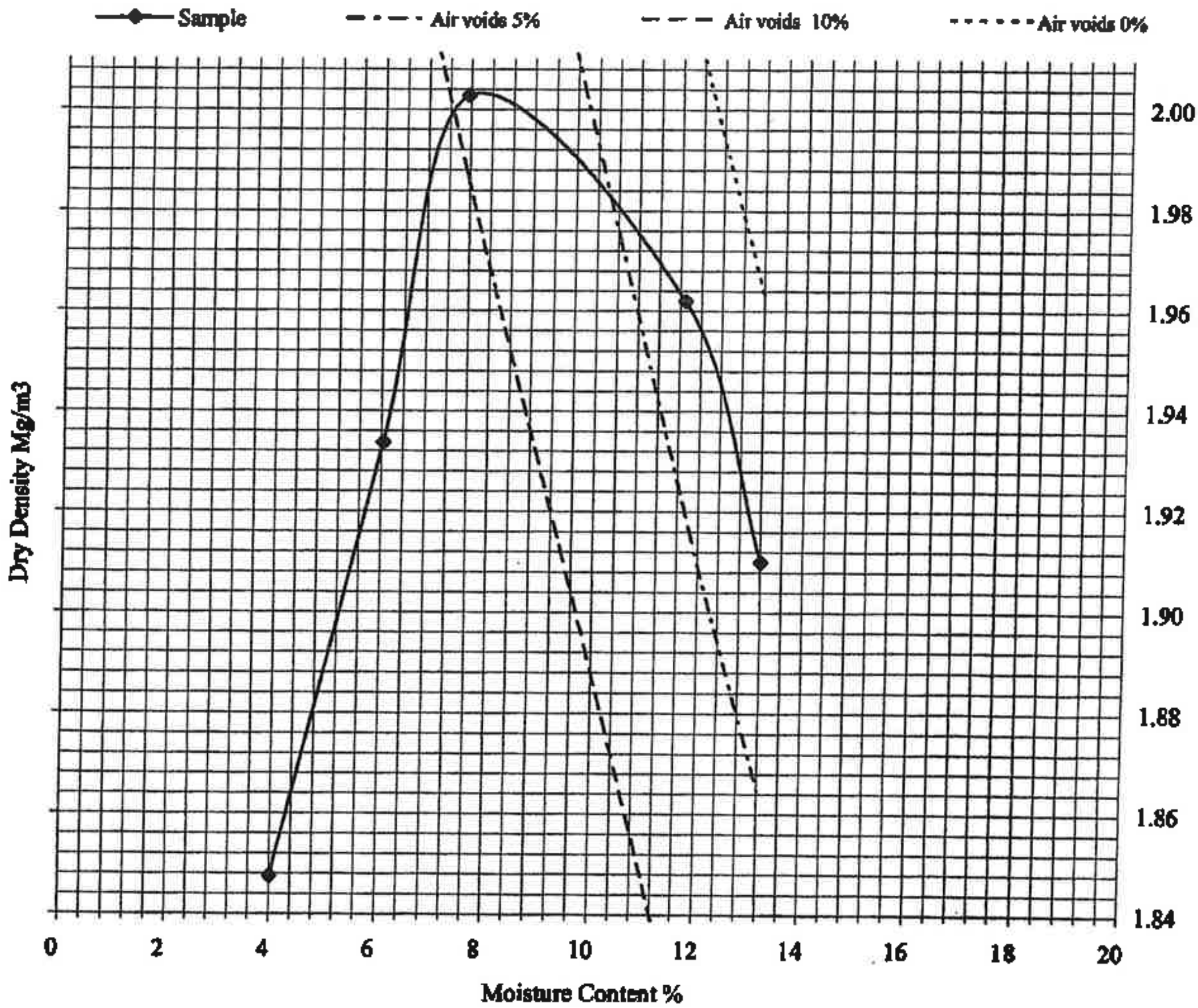
Contract No.: GEO/3195/06

Client Ref No: N/A

Dry Density/Moisture Content Relationship

BS 1377:Part 4:1990

Hole Number: CTP10 **Sample Number:** 285 **Depth(m):** 1.00



Initial Moisture Content:		19	Method of Compaction	2.5Kg Rammer / Single Sample
Particle Density (Mg/m3):	2.65* Assumed		Material Retained on 37.5 mm Test Sieve (%):	7
Maximum Dry Density (mg/m3):		2.00	Material Retained on 20.0 mm Test Sieve (%):	25
Optimum Moisture Content (%):		7.6	Sample Preparation Clause :	0.0

** - not included in laboratory scope of accreditation*

Remarks

4/12/06

Checked by **Date**

Approved by **Date** 04/12/06

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3195/06

Client Ref No: N/A

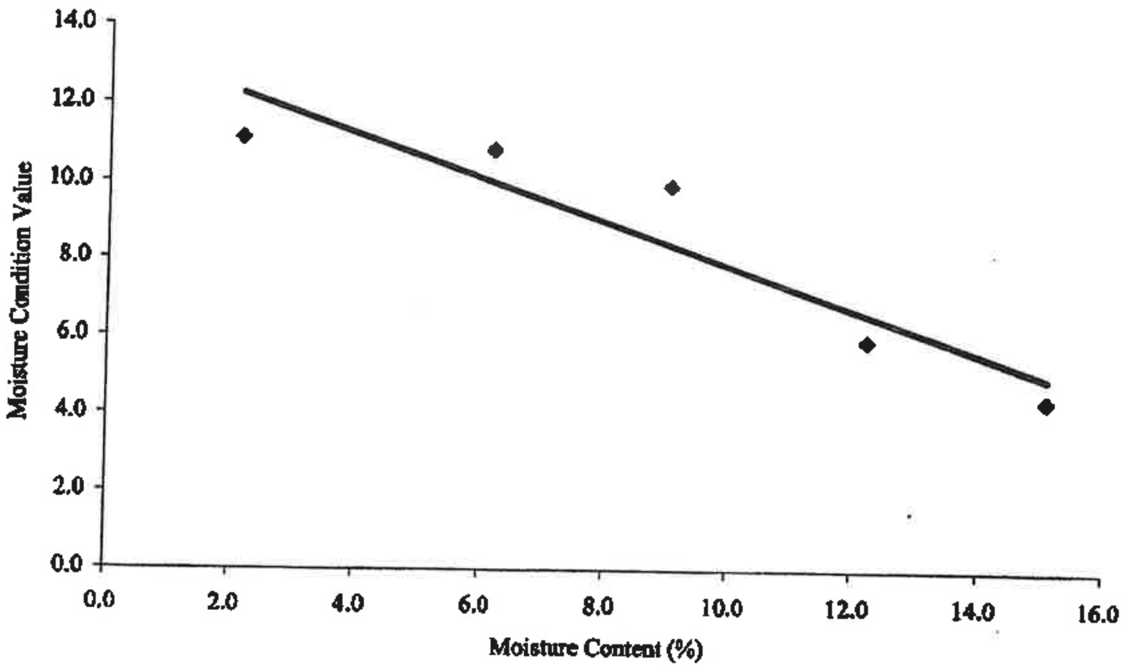
UKAS 2789

Moisture Condition Value Calibration

BS 1377:Part 4:1990

Hole Number: CTP01 **Sample Number:** 282 **Depth (m).:** 1.00

Initial Moisture Content (%).:	15
Single/Separate Samples Tested.	Single
Material Retained on the 20mm BS Test Sieve (%).:	11



Test Results.

Test Number.	1	2	3	4	5
Moisture Content (%).	2.2	6.2	9.0	12	15
MCV	14.0	10.8	9.9	5.9	4.4

* reading unobtainable.

4/12/06
Checked by Date

01/12/06
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LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3195/06
Client Ref No: N/A

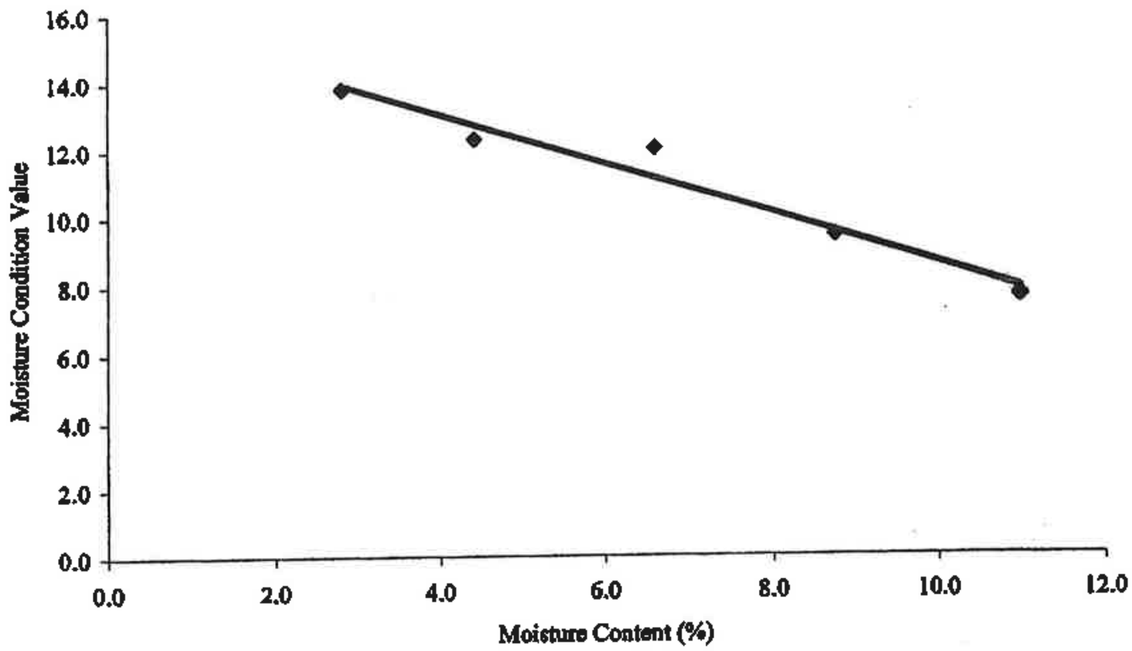
2788

Moisture Condition Value Calibration

BS 1377:Part 4:1990

Hole Number: CTP02 **Sample Number:** 312 **Depth (m).:** 2.30

Initial Moisture Content (%).:	11
Single/Separate Samples Tested.	Single
Material Retained on the 20mm BS Test Sieve (%).:	59



Test Results.

Test Number.	1	2	3	4	5
Moisture Content (%).	2.8	4.4	6.6	8.7	11
MCV	14.0	12.3	12.0	9.4	7.6

* reading unobtainable.

4/12/06

Checked by Date

04/12/06

Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: N/A

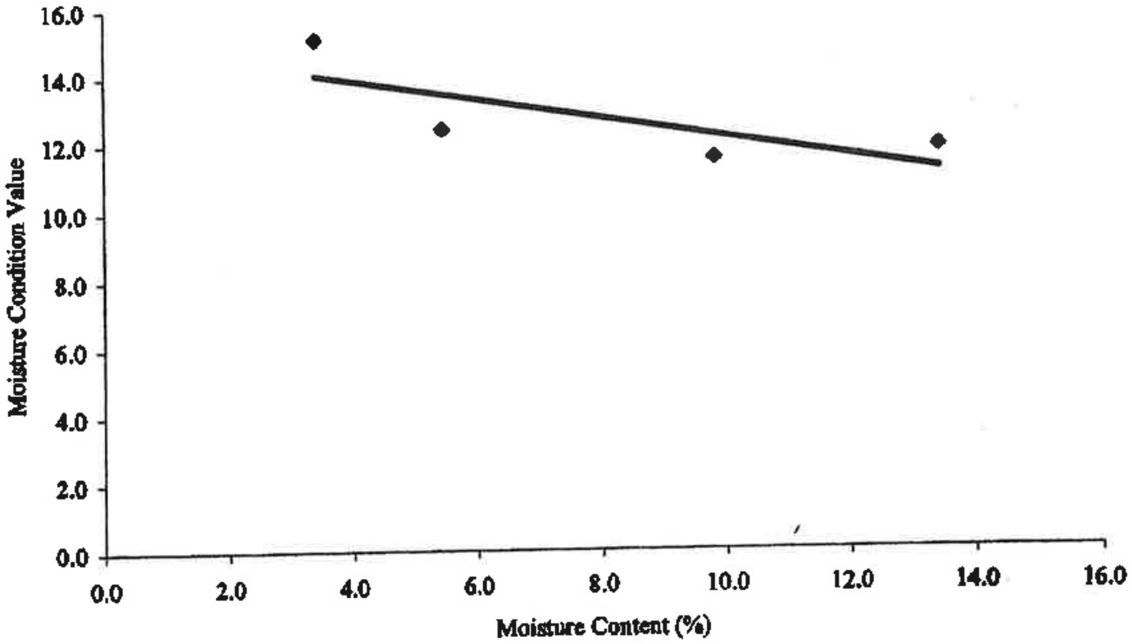
2708

Moisture Condition Value Calibration

BS 1377:Part 4:1990

Hole Number: CTP03 **Sample Number:** 314 **Depth (m).:** 1.00

Initial Moisture Content (%).:	29
Single/Separate Samples Tested.	Single
Material Retained on the 20mm BS Test Sieve (%).:	18



Test Results.

Test Number.	1	2	3	4	5
Moisture Content (%).	3.4	5.4	9.8	13	29
MCV	14.0	12.4	11.5	11.8	*

* reading unobtainable.

Checked by Date 4/12/06

Approved by Date 04/12/06

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

Client Ref No: N/A

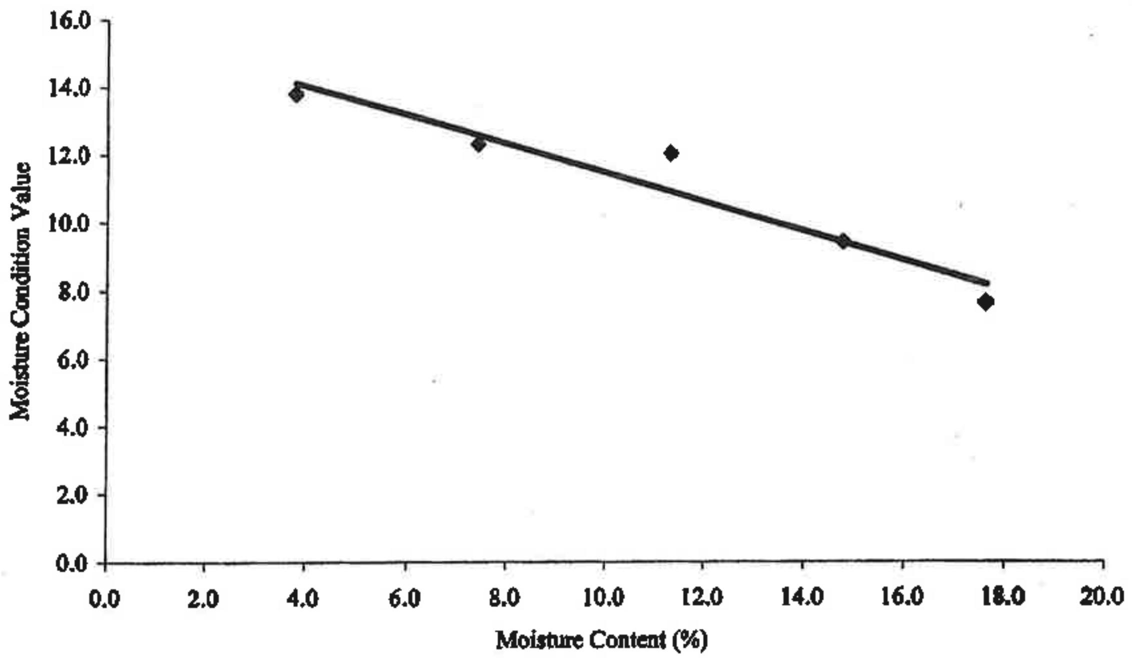
2788

Moisture Condition Value Calibration

BS 1377:Part 4:1990

Hole Number: CTP04 **Sample Number:** 319 **Depth (m).:** 2.00

Initial Moisture Content (%).:	18
Single/Separate Samples Tested.	Single
Material Retained on the 20mm BS Test Sieve (%).:	9



Test Results.

Test Number.	1	2	3	4	5
Moisture Content (%).	3.8	7.4	11	15	18
MCV	14.0	12.3	12.0	9.4	7.6

* reading unobtainable.

Checked by 4/12/06 Date Approved by 04/12/06 Date

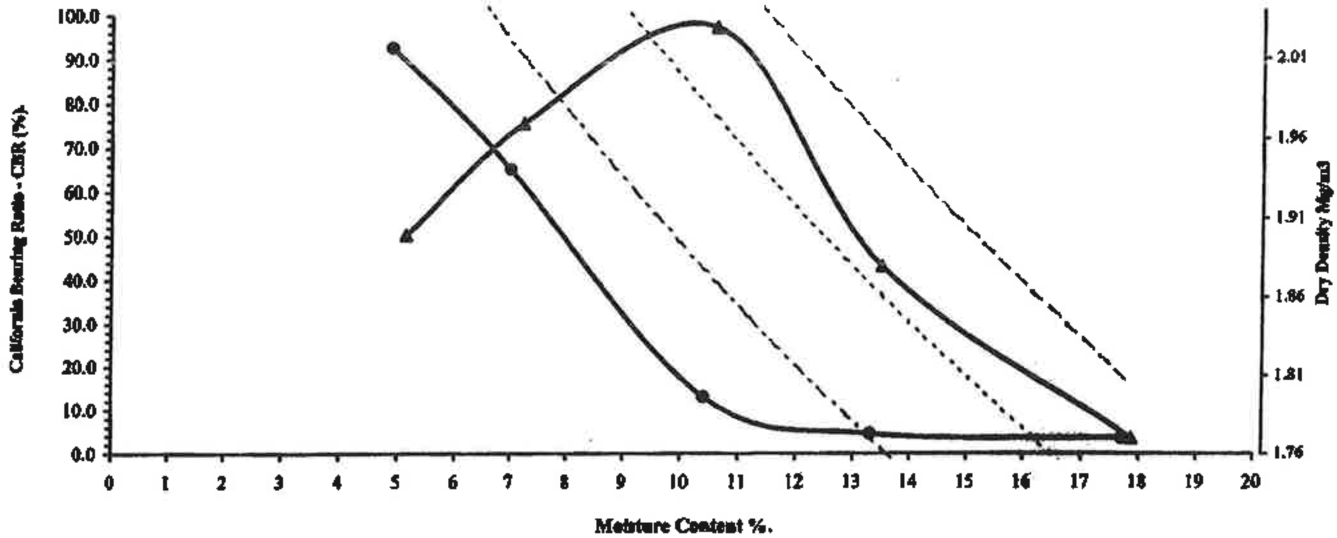
Carrigaline

Contract No.: GEO/3196/06
Client Ref No: N/A

LABORATORY TESTING SERVICES LIMITED

CALIFORNIA BEARING RATIO/
DRY DENSITY/MOISTURE CONTENT RELATIONSHIP

Hole Number: CTP02 **Sample Number:** 311 **Depth (m)** 1.00



Summary Table of Test Results

Moisture Content	4.9	7.0	10	13	18
Mean CBR Value	93	65	13.0	4.5	3.51
Dry Density	1.90	1.97	2.03	1.88	1.77

Initial Sample Conditions:		Method of Compaction 2.5kg Rammer	
Initial Moisture Content (%):	18	Single sample Tested	
Material Retained on the 37.5mm BS Sieve (%):	7	Maximum Dry Density (Mg/m³):	2.03
Material Retained on the 20.0mm BS Sieve (%):	27	Optimum Moisture Content (%):	10
Particle Density (Mg/m³): Assumed	2.65		

** - not included in laboratory scope of accreditation*

Checked by 4/12/06 Date

Approved by Date 04/12/06

LABORATORY TESTING SERVICES LIMITED

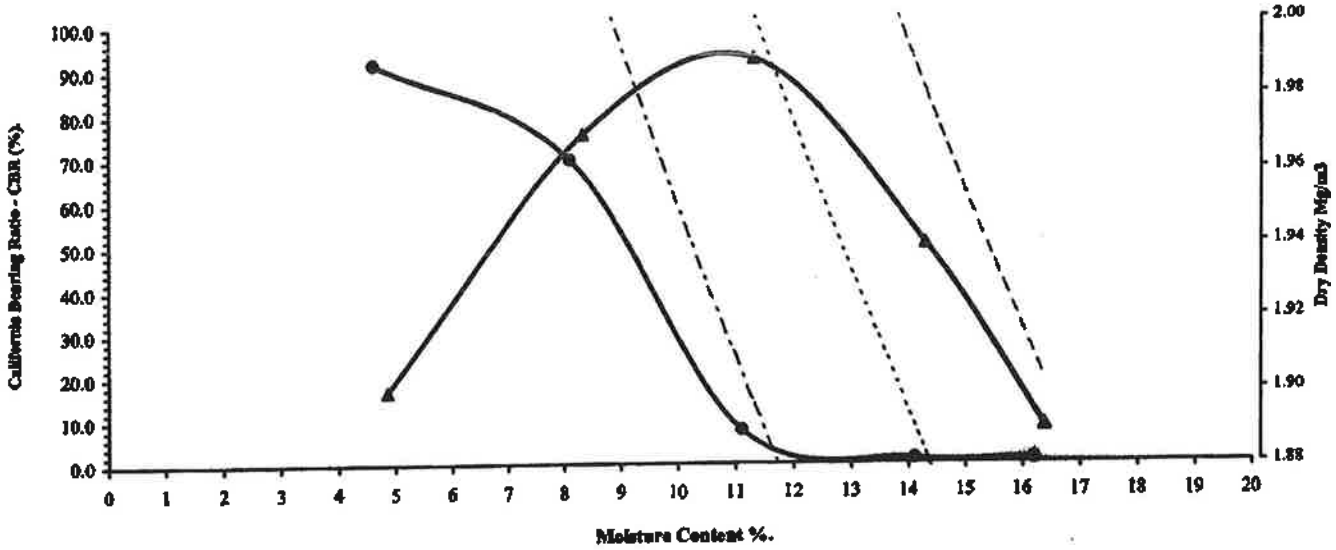
Carrigaline

Contract No.:
GEO/3196/06
Client Ref No:
n/a

UKAS 2788

CALIFORNIA BEARING RATIO/
DRY DENSITY/MOISTURE CONTENT RELATIONSHIP

Hole Number: CTP03 **Sample Number:** 315 **Depth (m)** 2.00



Summary Table of Test Results

Moisture Content	4.6	8.1	11	14	16
Mean CBR Value	92	70	7.7	0.93	0.78
Dry Density	1.90	1.97	1.99	1.94	1.89

Initial Sample Conditions:			Method of Compaction 2.5kg Rammer	
Initial Moisture Content (%):		14	Single sample Tested	
Material Retained on the 37.5mm BS Sieve (%):		10	Maximum Dry Density (Mg/m³):	1.99
Material Retained on the 20.0mm BS Sieve (%):		8	Optimum Moisture Content (%):	11
Particle Density (Mg/m³):	Assumed	2.75		

** - not included in laboratory scope of accreditation*

Checked by 4/12/06 Date

Approved by 06/12/06 Date

LABORATORY TESTING SERVICES LIMITED

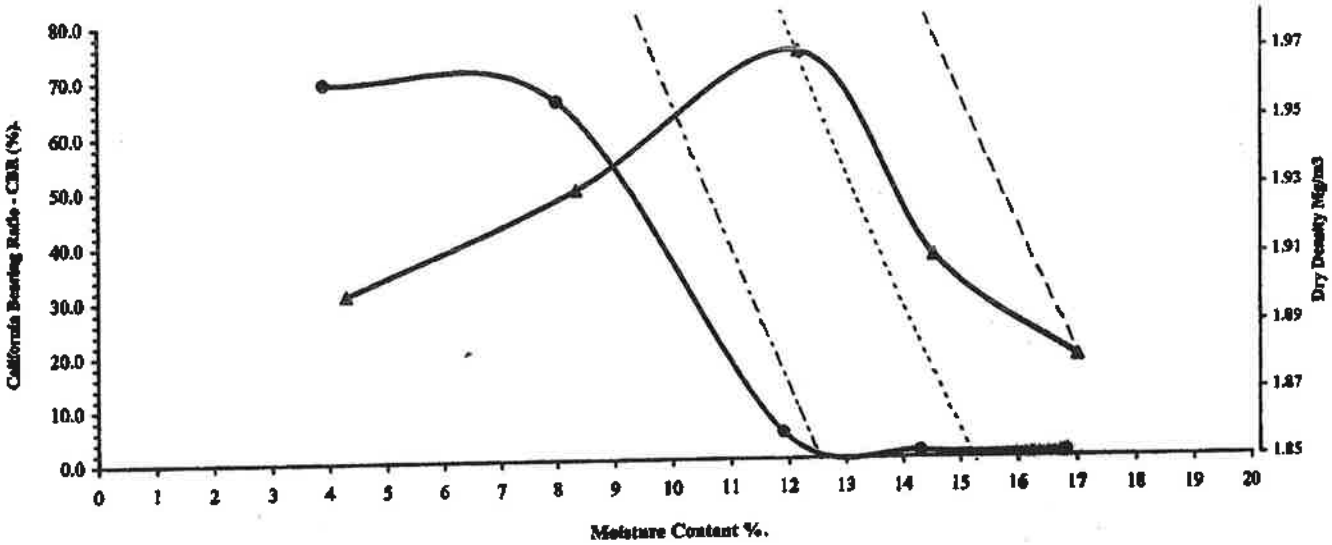
Carrigaline

Contract No.: GEO/3196/06
Client Ref No: n/a

UKAS 2788

CALIFORNIA BEARING RATIO/
DRY DENSITY/MOISTURE CONTENT RELATIONSHIP

Hole Number: CTP04 **Sample Number:** 318 **Depth (m)** 1.00



Summary Table of Test Results

Moisture Content	3.9	8.0	12	14	17
Mean CBR Value	69	66	4.9	1.2	0.87
Dry Density	1.90	1.93	1.97	1.91	1.88

Initial Sample Conditions:		Method of Compaction	2.5kg Rammer
Initial Moisture Content (%):	17	Single sample Tested	
Material Retained on the 37.5mm BS Sieve (%):	0	Maximum Dry Density (Mg/m^3):	1.97
Material Retained on the 20.0mm BS Sieve (%):	1	Optimum Moisture Content (%):	12
Particle Density (Mg/m^3): Assumed	2.75		

** - not included in laboratory scope of accreditation*

Checked by 4/12/06 Date

Approved by 04/12/06 Date

LABORATORY TESTING SERVICES LIMITED

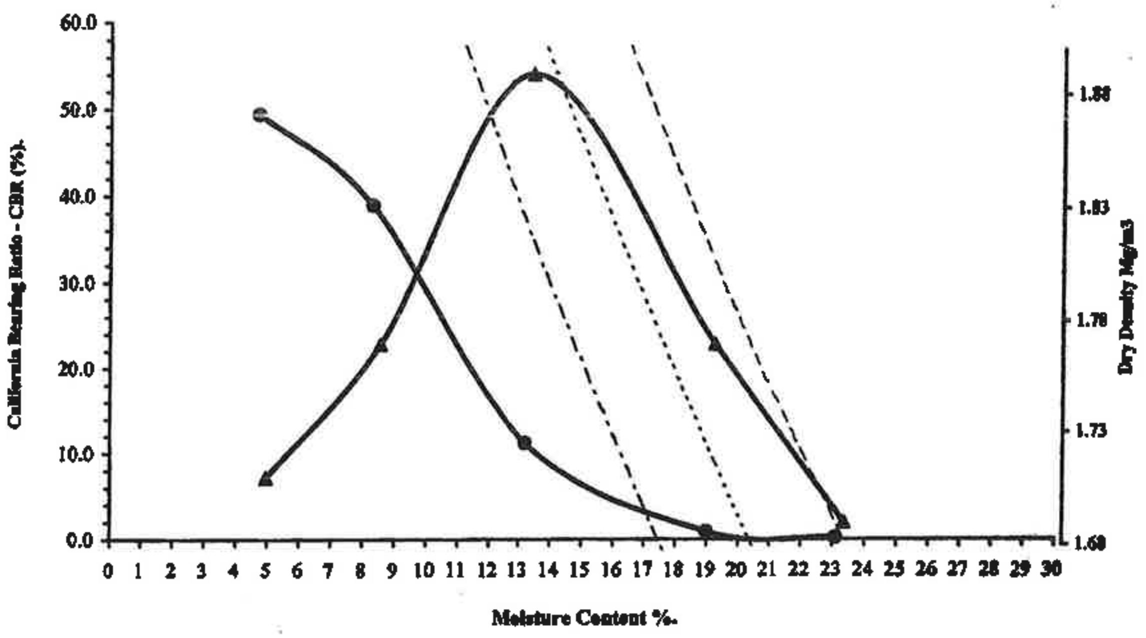
Carrigaline

Contract No.: GEO/3196/06
Client Ref No: n/a

UKAS 2788

CALIFORNIA BEARING RATIO/ DRY DENSITY/MOISTURE CONTENT RELATIONSHIP

Hole Number: **CTP05** Sample Number: **322** Depth (m): **1.00**



Summary Table of Test Results

Moisture Content	4.7	8.3	13	19	23
Mean CBR Value	49	39	11	0.88	0.21
Dry Density	1.71	1.77	1.89	1.77	1.69

Initial Sample Conditions:			Method of Compaction 2.5kg Rammer	
Initial Moisture Content (%):		19	Single sample Tested	
Material Retained on the 37.5mm BS Sieve (%):		0	Maximum Dry Density (Mg/m^3) :	1.89
Material Retained on the 20.0mm BS Sieve (%):		7	Optimum Moisture Content (%):	13
Particle Density (Mg/m^3) :	Assumed*	2.75		

** - not included in laboratory scope of accreditation*

4/12/06
Checked by Date

04/12/06
Approved by Date

GEO
LABORATORY TESTING SERVICES LIMITED

Carrigaline

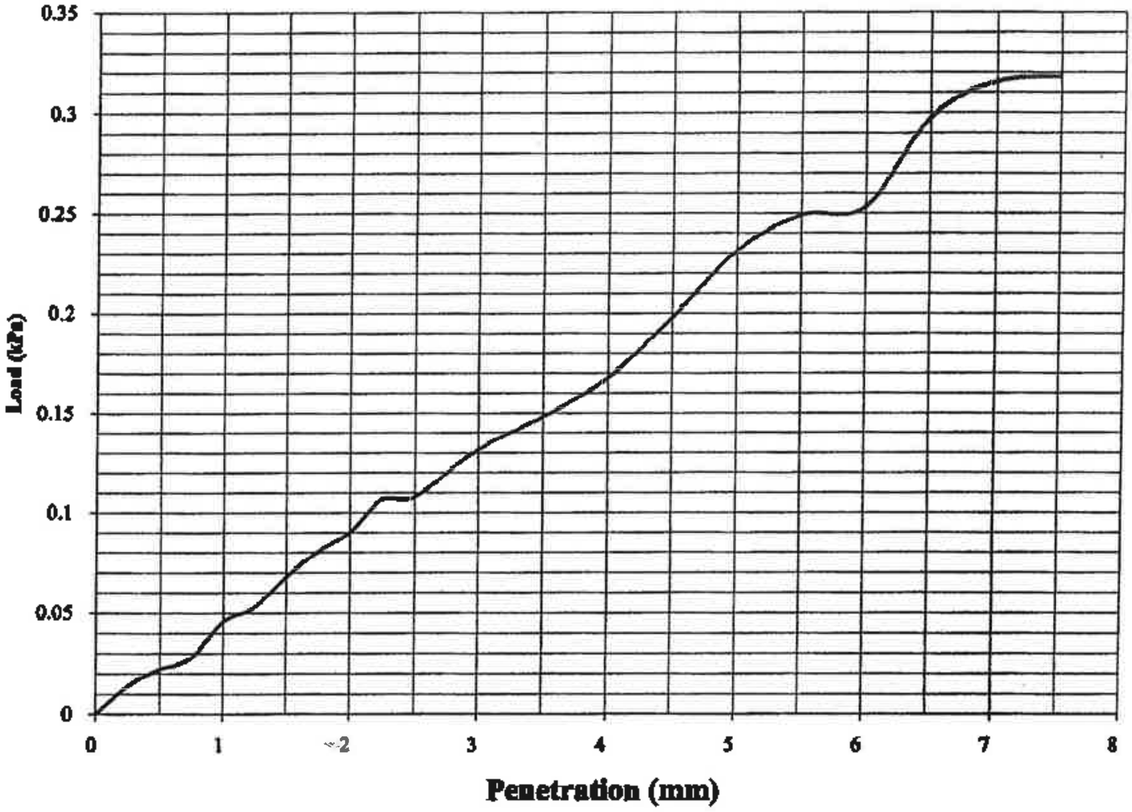
Contract No.:
GEO/3196/06
Client Ref No:
N/A

Bynea, Llanelli, Carmarthenshire, SA14 9SU

California Bearing Ratio Test.

BS 1377:Part 4:1990

Hole Number: CTP08 **Sample Number:** 290 **Depth (m)** 0.50



Initial Sample Conditions		Test Conditions		Method of compaction : 2.5 Kg Rammer	
Moisture Content:	11	Surcharge Kg:	2.0	Final Moisture Content %	
Bulk Density Mg/m3:	2.17	Soaking Time hrs	n/a	Sample Top	11
Dry Density Mg/m3:	1.96	Swelling mm:	n/a	Sample Bottom	N/A
C.B.R. Value %	Sample Top	1.2		Sample Bottom	N/A
Percentage retained on 20mm BS test sieve:		36	Remarks:		

Checked by 28/11/06 Date

Approved by Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3195/06

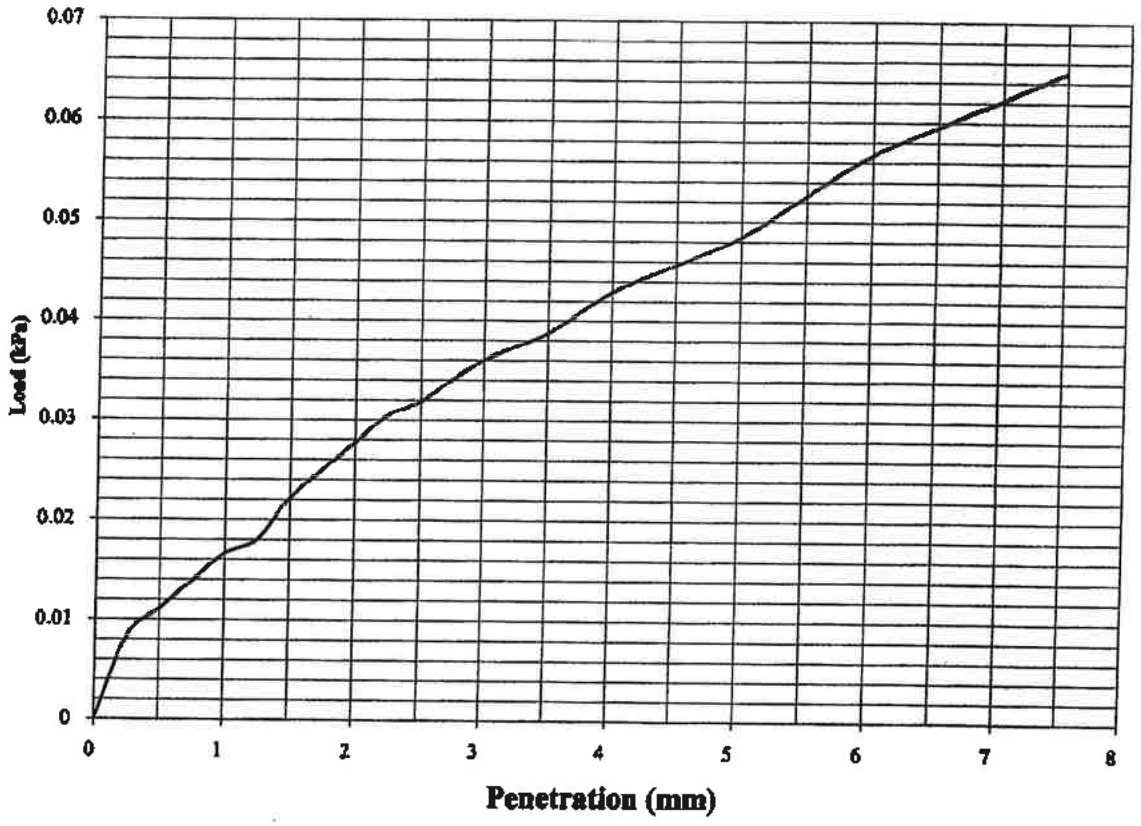
Client Ref No: N/A

2788

California Bearing Ratio Test.

BS 1377:Part 4:1990

Hole Number: CTP10 **Sample Number:** 285 **Depth (m)** 1.00



Initial Sample Conditions		Test Conditions		Method of compaction : 2.5 Kg Rammer	
Moisture Content:	7.6	Surcharge Kg:	2.0	Final Moisture Content %	
Bulk Density Mg/m3:	2.15	Soaking Time hrs	n/a	Sample Top	7.6
Dry Density Mg/m3:	2.00	Swelling mm:	n/a	Sample Bottom	N/A
C.B.R. Value %	Sample Top	0.24		Sample Bottom	N/A
Percentage retained on 20mm BS test sieve:		25	Remarks:		

Checked by 4/12/06 Date

Approved by 4/12/06 Date

GEO LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3195/06

Client Ref No: N/A

UKAS 2788

SUMMARY OF CHEMICAL ANALYSES

(B.S. 1377 : PART 3 : 1990 AND BRE CP2/79)

Hole Number	Sample Number	Depth m	Sulphate Content SO3 (as SO_4): Acid Soluble Sulphate as % SO_4 Clause 5.5.	Aqueous Extract Sulphate as g/l SO_4 Clause 5.5.	Ground-water g/l Clause 5.4.	Chloride Content: Soluble Chloride as % equiv. NaCl Clause 7.3	Ground-water g/l Clause 7.2	pH Value @ 25°C Clause 9.	Organic Matter Content % Clause 3.	Loss on Ignition % Clause 4.	Remarks
CTP1		1.00		<.01 (<.01)		NCP		6.52	2.0	1.97	
CTP1		2.00		<.01 (<.01)				6.84			
CTP8		0.50							3.7	3.04	
CTP9		1.00		<.01 (<.01)				5.75			
CTP9		2.50		<.01 (<.01)				6.15			
CTP9		3.50		<.01 (<.01)				6.10			

NCP -No Chloride present

Checked By

17/05/07
Date

Approved By

17/05/07.
Date

CARRIGALINE

Contract No. GEO/3195/06

Client Ref No. N/A

Page of

SUMMARY OF CHEMICAL ANALYSES

(B.S. 1377 : PART 3 : 1990 AND BRE CP2/79)

Hole Number	Sample Number	Depth m	Sulphate Content SO3 (as SO_4)			Chloride Content		pH Value @ 25°C	Organic Matter Content %	Loss on Ignition %	Total Sulphur %	Remarks
			Acid Soluble Sulphate as % SO_4 Clause 5.5.	Aqueous Extract Sulphate as g/l SO_4 Clause 5.5.	Ground-water g/l Clause 5.4.	Soluble Chloride as % equiv. NaCl Clause 7.3	Ground-water g/l Clause 7.2	Clause 9.	Clause 3.	Clause 4.		
CTP2	311	1.00	0.07 ([illegible])	<.01 (<.01)		NCP		[illegible]			0.03	
CTP3	314	1.00	0.03 (0.04)	<.01 (<.01)		NCP		6.66			0.01	
CTP3	315	2.00							0.98	1.11		
CTP4	318	1.00	0.07 (0.08)	<.01 (<.01)		NCP		6.60			0.03	
CTP5	322	1.00		<.01 (<.01)		NCP		6.30	2.33	2.70		
CTP5	323	2.50							1.99	2.38		
CTP7	329	1.00							1.65	2.15		

NCP -No Chloride present

Checked By — Date 4/12/06

Approved By — Date 4/12/06

Contract No. GEO/3196/06

CARRIGALINE

Client Ref No.

LABORATORY TESTING SERVICES LIMITED

Bynea, Llanelli, SA14 9SU.

GEO/003 June-04 Issue No.1

LABORATORY TESTING SERVICES LTD

TEST AMENDMENT NOTICE

(Please tick boxes as appropriate)

From: Dafydd

To: Site Investigations

Date: 20 / 02 /2006

Laboratory Ref:

Contract Number:

Location: Carrigaline

o BH ✓ TP Sample Number 4 Depth (m): 1·00m

Sample Type: o U ✓ B o D o W o P o C

Test/s: Compaction, CBR.

The above sample cannot be tested for the following reasons

- ☐ The sample has not been received.
- ☐ There is insufficient material for BS1377: 1990 testing
  - Maximum Grain Size (mm):
  - Sample Mass (kg):
  - Required Mass (kg):
- ☐ The Sample has been previously tested
- ☐ The Sample has been misplaced in the Laboratory
- ☑ The Sample is unsuitable for testing because: Insufficient material

Please advise action required:

- ☐ Perform original test on the following alternative Sample
  - o BH o TP Sample Number: Depth (m):
  - Sample Type: o U o B o D o W o P o C
- ☐ Combine original Sample with the following sample:
  - o BH o TP Sample Number: Depth (m):
  - Sample Type: o U o B o D o W o P o C
- ☐ Perform the following alternative test/s on the original Sample
- ☐ Perform non-standard test on material available
  (Written Confirmation is required from the Client).
- ☐ Take no further action.

Signed .... Date ....
(Project Engineer)

ALcontrol Laboratories (Dublin)

18a Rosemount Business Park,
Ballycoolin,
Dublin 11
Ireland
Tel: +353 (0) 1 8829893
Fax: +353 (0) 1 8829895

CERTIFICATE OF ANALYSIS

Client: Site Investigations Ltd (Newcastle)
Main Street
Newcastle
Co. Dublin
Ireland

Attention: Deirdre Larkin

Date: 2 November, 2006

Our Reference: 06-B06315/01

Your Reference: Carrigaline Rd

Location: Carrigaline Rd

A total of 2 samples was received for analysis on Friday, 6 October 2006. Accredited laboratory tests are defined in the log sheet, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation. We are pleased to enclose our final report, it was a pleasure to be of service to you, and we look forward to our continuing association.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Signed

Ken Scally

Ken Scally
General Manager, Ireland

Lorraine McNamara

Lorraine McNamara
Laboratory Technical Manager

UKAS TESTING
1291
GROUP

Compiled By Janne Juurikas
Janne Juurikas

ALcontrol Laboratories Ireland

Test Schedule

Ref Number: 06-B06315/01
Client: Site Investigations Ltd (Newcastle)
Date of Receipt: 06/10/2006

Sample Type: SOIL
Location: Carrigaline Rd
Client Contact: Deirdre Larkin
Client Ref: Carrigaline Rd

Detection Method				GC	GC	GC	GCMS	GRAVIMETRIC	GRAVIMETRIC	HPLC	ICP	ICP	ICP	ICP	ICP	ICP	ICP
UKAS Accredited [Testing Laboratory] No. 1291				✓		✓	✓					✓		✓	✓	✓	✓
ALcontrol Reference	Sample Identity	Other ID	P / V	DRO + Mineral Oil by GC	DRO Interpretation	PRO	PAH EPA (16)	Natural Moisture Content	Solvent Extractable Matter	Total Phenols by HPLC	Total Sulphate (Acid Soluble)**	Arsenic Low Level	Barium	Beryllium	Cadmium Low Level	Chromium	Copper
06-B06315-S0014-A01	CTP6A	1.2m	Plastic tub	-	-	-	-	-	-	-	X	X	X	X	X	X	X
06-B06315-S0014-A13	CTP6A	1.2m	Amber Jar	X	X	-	X	X	X	X	-	-	-	-	-	-	-
06-B06315-S0014-A20	CTP6A	1.2m	Volatile Vial	-	-	X	-	-	-	-	-	-	-	-	-	-	-
06-B06315-S0014-A22	CTP6A	1.2m	250ml Sterile	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06-B06315-S0015-A01	CTP3	0.6 M	Plastic tub	-	-	-	-	-	-	-	X	X	X	X	X	X	X
06-B06315-S0015-A13	CTP3	0.6 M	Amber Jar	X	X	-	X	X	X	X	-	-	-	-	-	-	-
06-B06315-S0015-A20	CTP3	0.6 M	Volatile Vial	-	-	X	-	-	-	-	-	-	-	-	-	-	-
06-B06315-S0015-A22	CTP3	0.6 M	250ml Sterile	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes : NUMERIC VALUES INDICATE ADDITIONAL SCHEDULING

Printed at 17:31 on 03/11/2006

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

ALcontrol Laboratories Ireland

Test Schedule

Ref Number: 06-B06315/01
Client: Site Investigations Ltd (Newcastle)
Date of Receipt: 06/10/2006

Sample Type: SOIL
Location: Carrigaline Rd
Client Contact: Deirdre Larkin
Client Ref: Carrigaline Rd

	Detection Method			ICP	ICP	ICP	ICP	ICP	ICP	ICP OES	Inspection	KONE	KONE	LECO	LECO	METER	Pour Plate
UKAS Accredited [Testing Laboratory] No. 1291				✓	✓	✓	✓	✓	✓				✓		✓	✓	
ALcontrol Reference	Sample Identity	Other ID	P / V	Lead	Mercury Low Level	Nickel	Selenium Low Level	Vanadium	Zinc	Water Soluble Boron	Asbestos Screening	Acid Soluble Sulphide	Nitrate as NO3	Organic Matter**	Total Sulphur**	pH (Solid)	Total Coliforms*
06-B06315-S0014-A01	CTP6A	1.2m	Plastic tub	X	X	X	X	X	X	X	X	X	X	X	X	X	-
06-B06315-S0014-A13	CTP6A	1.2m	Amber Jar	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06-B06315-S0014-A20	CTP6A	1.2m	Volatile Vial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06-B06315-S0014-A22	CTP6A	1.2m	250ml Sterile	-	-	-	-	-	-	-	-	-	-	-	-	-	X
06-B06315-S0015-A01	CTP3	0.6 M	Plastic tub	X	X	X	X	X	X	X	X	X	X	X	X	X	-
06-B06315-S0015-A13	CTP3	0.6 M	Amber Jar	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06-B06315-S0015-A20	CTP3	0.6 M	Volatile Vial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06-B06315-S0015-A22	CTP3	0.6 M	250ml Sterile	-	-	-	-	-	-	-	-	-	-	-	-	-	X

Notes : NUMERIC VALUES INDICATE ADDITIONAL SCHEDULING

Printed at 17:31 on 03/11/2006

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

ALcontrol Laboratories Ireland

Test Schedule

Ref Number: 06-B06315/01
Client: Site Investigations Ltd (Newcastle)
Date of Receipt: 06/10/2006

Sample Type: SOIL
Location: Carrigaline Rd
Client Contact: Deirdre Larkin
Client Ref: Carrigaline Rd

	Detection Method			SPECTRO	SPECTRO
UKAS Accredited [Testing Laboratory] No. 1291					
ALcontrol Reference	Sample Identity	Other ID	P / V	Free Cyanide	Total Cyanide
06-B06315-S0014-A01	CTP6A	1.2m	Plastic tub	X	X
06-B06315-S0014-A13	CTP6A	1.2m	Amber Jar	-	-
06-B06315-S0014-A20	CTP6A	1.2m	Volatile Vial	-	-
06-B06315-S0014-A22	CTP6A	1.2m	250ml Sterile	-	-
06-B06315-S0015-A01	CTP3	0.6 M	Plastic tub	X	X
06-B06315-S0015-A13	CTP3	0.6 M	Amber Jar	-	-
06-B06315-S0015-A20	CTP3	0.6 M	Volatile Vial	-	-
06-B06315-S0015-A22	CTP3	0.6 M	250ml Sterile	-	-

Notes : NUMERIC VALUES INDICATE ADDITIONAL SCHEDULING

Printed at 17:31 on 03/11/2006

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

ALcontrol Laboratories Ireland

Test Schedule Summary

Ref Number: **06-B06315/01**
Client: Site Investigations Ltd (Newcastle)
Date of Receipt: 06/10/2006

Sample Type: **SOIL**
Location: Carrigaline Rd
Client Contact: Deirdre Larkin
Client Ref: Carrigaline Rd

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

SCHEDULE	METHOD	TEST NAME	TOTAL
X	GC	DRO + Mineral Oil by GC	2
X	GC	DRO Interpretation	2
X	GC	PRO	2
X	GCMS	PAH EPA (16)	2
X	GRAVIMETRIC	Natural Moisture Content	2
X	GRAVIMETRIC	Solvent Extractable Matter	2
X	HPLC	Total Phenols by HPLC	2
X	ICP	Total Sulphate (Acid Soluble)**	2
X	ICP	Arsenic Low Level	2
X	ICP	Barium	2
X	ICP	Beryllium	2
X	ICP	Cadmium Low Level	2
X	ICP	Chromium	2
X	ICP	Copper	2
X	ICP	Lead	2
X	ICP	Mercury Low Level	2
X	ICP	Nickel	2
X	ICP	Selenium Low Level	2
X	ICP	Vanadium	2
X	ICP	Zinc	2
X	ICP OES	Water Soluble Boron	2
X	Inspection	Asbestos Screening	2
X	KONE	Acid Soluble Sulphide	2
X	KONE	Nitrate as NO3	2
X	LECO	Organic Matter**	2
X	LECO	Total Sulphur**	2
X	METER	pH (Solid)	2
X	Pour Plate	Total Coliforms*	2
X	SPECTRO	Free Cyanide	2
X	SPECTRO	Total Cyanide	2

☐ Interim

☑ Validated

ALcontrol Laboratories Ireland

Table Of Results

Ref Number: 06-B06315/01

Client: Site Investigations Ltd (Newcastle)

Date of Receipt: 06/10/2006

(of first sample)

Sample Type: SOIL

Location: Carrigaline Rd

Client Contact: Deirdre Larkin

Client Ref: Carrigaline Rd

		Detection Method	GC	GC	GC	GC	GC	GCMS	GCMS	GCMS	GCMS	GCMS	GCMS	GCMS	GCMS	GCMS	GCMS
		Method Detection Limit	<1mg/kg	<1mg/kg	n/a	<10ug/kg	<10ug/kg	<1ug/kg	<1ug/kg	<1ug/kg	<1ug/kg	<1ug/kg	<1ug/kg	<1ug/kg	<1ug/kg	<1ug/kg	<1ug/kg
UKAS Accredited [Testing Laboratory] No. 1291			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ALcontrol Reference	Sample Identity	Other ID	Diesel Range Organics	Mineral Oil by GC	DRO Interpretation	Petrol Range Organics C5-C9	Petrol Range Organics C10-12	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene
			mg/kg	mg/kg		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
06-B06315-S0014	CTP6A	1.2m	<1	<1	See attached	<10	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
06-B06315-S0015	CTP3	0.6 M	<1	<1	See attached	<10	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Notes : METHOD DETECTION LIMITS ARE NOT ALWAYS ACHIEVABLE DUE TO VARIOUS CIRCUMSTANCES BEYOND OUR CONTROL.

NDP = NO DETERMINATION POSSIBLE

Checked By : Janne Juurikas

Printed at 17:31 on 03/11/2006

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

- [ ] Interim
- [x] Validated

ALcontrol Laboratories Ireland

Table Of Results

Ref Number: 06-B06315/01
Client: Site Investigations Ltd (Newcastle)
Date of Receipt: 06/10/2006
(of first sample)

Sample Type: SOIL
Location: Carrigaline Rd
Client Contact: Deirdre Larkin
Client Ref: Carrigaline Rd

		Detection Method	GCMS	GCMS	GCMS	GCMS	GCMS	GCMS	GRAVIMETRIC	GRAVIMETRIC	HPLC	ICP	ICP	ICP	ICP	ICP	ICP
		Method Detection Limit	<1ug/kg	<1ug/kg	<1ug/kg	<1ug/kg	<1ug/kg	<1ug/kg	<0.1%	<10mg/kg	<0.01mg/kg	<50mg/kg	<0.5mg/kg	<1mg/kg	<1mg/kg	<0.5mg/kg	<1mg/kg
UKAS Accredited [Testing Laboratory] No. 1291			✓	✓	✓	✓	✓	✓					✓		✓	✓	✓
ALcontrol Reference	Sample Identity	Other ID	Benzo(b)+Benzo(k) fluoranthene	Benzo(a)pyrene	Indeno(123cd)pyrene	Dibenzo(ah)anthracene	Benzo(ghi)perylene	Total 16 EPA PAHs	Natural Moisture Content	Solvent Extractable Matter	Total Phenols	Total Sulphate**	Arsenic Low Level	Barium	Beryllium	Cadmium Low Level	Chromium
			ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
06-B06315-S0014	CTP6A	1.2m	<1	<1	<1	<1	<1	<1	16.6	11385	<0.01	4628	<0.5	51	1	<0.5	10
06-B06315-S0015	CTP3	0.6 M	<1	<1	<1	<1	<1	<1	11.3	75	<0.01	187	<0.5	68	2	<0.5	10

Notes : METHOD DETECTION LIMITS ARE NOT ALWAYS ACHIEVABLE DUE TO VARIOUS CIRCUMSTANCES BEYOND OUR CONTROL.

NDP = NO DETERMINATION POSSIBLE

Checked By : Janne Juurikas

Printed at 17:31 on 03/11/2006

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

☐ Interim
☑ Validated

ALcontrol Laboratories Ireland

Table Of Results

Ref Number: 06-B06315/01
Client: Site Investigations Ltd (Newcastle)
Date of Receipt: 06/10/2006
(of first sample)

Sample Type: SOIL
Location: Carrigaline Rd
Client Contact: Deirdre Larkin
Client Ref: Carrigaline Rd

Detection Method			ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP OES	Inspection	KONE	KONE	LECO	LECO	METER	Pour Plate
Method Detection Limit			<1mg/kg	<1mg/kg	<0.3mg/kg	<1mg/kg	<0.5mg/kg	<1mg/kg	<1mg/kg	<1mg/kg	n/a	<5mg/kg	<2mg/kg	<0.01%	<0.01%	napH Units	<10cfu/g
UKAS Accredited [Testing Laboratory] No. 1291			✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	
ALcontrol Reference	Sample Identity	Other ID	Copper	Lead	Mercury Low Level	Nickel	Selenium Low Level	Vanadium	Zinc	Water Soluble Boron	Asbestos Screening	Acid Soluble Sulphide	Nitrate as NO3	Total Organic Matter**	Total Sulphur**	pH	Total Coliforms*
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg	%	%	pH Units	cfu/g
06-B06315-S0014	CTP6A	1.2m	222	160	<0.3	31	<0.5	42	267	<1	No Fibres Detected	<5	3	1.69	0.13	7.11	260
06-B06315-S0015	CTP3	0.6 M	59	66	<0.3	73	<0.5	50	297	<1	No Fibres Detected	<5	4	0.85	0.01	7.36	<10

Notes : METHOD DETECTION LIMITS ARE NOT ALWAYS ACHIEVABLE DUE TO VARIOUS CIRCUMSTANCES BEYOND OUR CONTROL.

NDP = NO DETERMINATION POSSIBLE

Checked By : Janne Juurikas

Printed at 17:31 on 03/11/2006

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

☐ Interim
☑ Validated

ALcontrol Laboratories Ireland
Table Of Results

Ref Number: 06-B06315/01
Client: Site Investigations Ltd (Newcastle)
Date of Receipt: 06/10/2006
(of first sample)

Sample Type: SOIL
Location: Carrigaline Rd
Client Contact: Deirdre Larkin
Client Ref: Carrigaline Rd

		Detection Method	SPECTRO	SPECTRO
		Method Detection Limit	<0.5mg/kg	<2.5mg/kg
UKAS Accredited [Testing Laboratory] No. 1291				
ALcontrol Reference	Sample Identity	Other ID	Free Cyanide	Total Cyanide
			mg/kg	mg/kg
06-B06315-S0014	CTP6A	1.2m	<0.5	<2.5
06-B06315-S0015	CTP3	0.6 M	<0.5	<2.5

Notes : METHOD DETECTION LIMITS ARE NOT ALWAYS ACHIEVABLE DUE TO VARIOUS CIRCUMSTANCES BEYOND OUR CONTROL.

NDP = NO DETERMINATION POSSIBLE

Checked By : Janne Juurikas

Printed at 17:31 on 03/11/2006

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

Geochem Analytical Services

Diesel Range Organics/Mineral Oil
by
G.C.

Client Name Site Investigations Ltd (Newcastle)
Client Ref Carrigaline Rd
Sample Matrix Soil

Job Number 6315
Date Extracted/Prepared 16-10-06
Date Analysed 17-10-06

Separatory Funnel Ext No
Soxtec Extraction No
Column Extraction No

Sample number	Sample Identity	Depth	Diesel Range Hydrocarbons (mg/kg)	Mineral Oil (mg/kg)	Interpretation
014	CTP6A	1.2m	< 1	< 1	No Identification Possible
015	CTP3	-	< 1	< 1	No Identification Possible

Checked by Patricia Morado

APPENDIX

APPENDIX

1. Results are expressed as mg/kg dry weight (dried at 30°C) on all soil analyses except for the following: NRA Leach tests, flash point, and ammoniacal N_2 by the BRE method, VOC, PRO, Cyanide, Acid Soluble Sulphide, SVOC, DRO, PAH, PCB, TPH CWG ,TPH by IR, OFGs and SEM.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. A sub sample of all samples received will be retained free of charge for one month for soils and one month for waters (sample size permitting), but may then be discarded unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, an asbestos screen is done in-house on soils and if no fibres are found will be reported as NFD – no fibres detected. If fibres are detected, then identification and quantification is carried out by ALcontrol Technichem or Alcontrol Shutlers in the UK . If a sample is suspected of containing asbestos, then drying and crushing will be suspended on that sample until the asbestos results are known. If asbestos is present, then no analysis requiring dry sample are undertaken.

7. If no separate volatile sample is supplied by the client, the integrity of the data may be compromised if the laboratory is required to create a sub-sample from the bulk sample – similarly, if a headspace is present in the volatile sample.

8. NDP – No Determination Possible due to insufficient/unsuitable sample.

9. Metals in water are performed on a filtered sample, and therefore represent dissolved metals – total metals must be requested separately.

10. A table containing the date of analysis for each parameter is not routinely included with the report, but is available upon request.

Last updated February 2005

Borehole Lab results

<u>Contents:</u>

Soils:

Classification (moisture content, liquid limits, plastic limits)
PSDs
Dry density/ Moisture content
MCV Cal
CBR (single)
Chemical

Rock:

Point Load & UCS
Porosity/Density & Natural Moisture content
AAV
Slake Durability Index

Summary of Soil Classification Tests

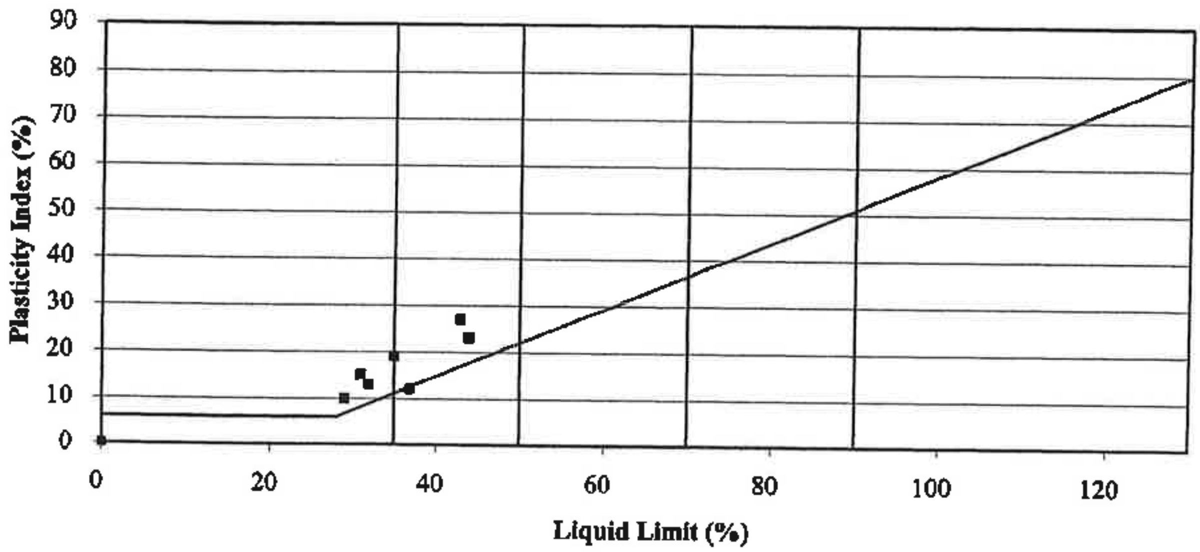
BS 1377:Part 2:1990

Hole/ Sample Number	Sample Type	Depth m	Moisture Content % Cl. 3.2	Liquid Limit % Cl. 4.3/4.4	Plastic Limit % Cl. 5.	Plasticity Index % Cl. 6.	% Passing .425mm	Remarks
CBH1	B	1.00	17	35	16	19	40	CL/I Low/Inter. Plasticity
CBH1	B	2.00	15	32	19	13	60	CL Low Plasicticity
CBH1	B	3.00	4.2					
CBH2/1794	B	1.00	15	29	19	10	30	CL Low Plasicticity
CBH2/1795	B	2.00	11		NP		50	
CBH2B/1797	B	1.80	7.9					
CBH2B/1799	B	5.00	11	31	16	15	20	CL Low Plasicticity
CBH2B/1800	B	5.30	0.3					
CBH3	B	1.00	23	44	21	23	20	CI Intermediate Plasicticity
CBH3	B	2.00	20	37	25	12	90	MI Intermediate Plasicticity
CBH3	B	3.00	13	43	16	27	50	CI Intermediate Plasicticity
CBH3	B	6.50	5.2		NP		15	
CBH3	B	9.50	8.4		NP		10	
CBH3	B	11.00	7.2		NP		10	

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

BS 5930:1999



Checked by 06/03/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

UKAS TESTING 2788

Summary of Soil Classification Tests

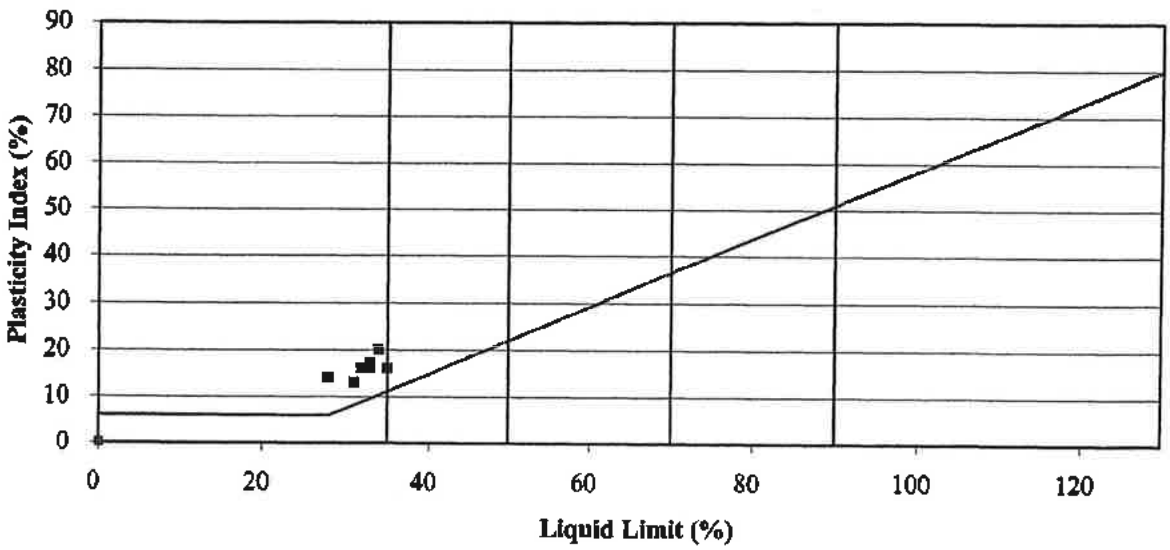
BS 1377:Part 2:1990

Hole/ Sample Number	Sample Type	Depth m	Moisture Content % Cl. 3.2	Liquid Limit % Cl. 4.3/4.4	Plastic Limit % Cl. 5.	Plasticity Index % Cl. 6.	% Passing .425mm	Remarks
CBH4	B	1.00	15					
CBH4	B	2.00	17	35	19	16	70	CL/I Low/Inter. Plasticity
CBH4	B	3.00	13	32	16	16	75	CL Low Plasicticity
CBH4	B	5.00	11	34	14	20	25	CL Low Plasicticity
CBH5	B	1.00	9.4		NP		25	
CBH5	B	2.00	5.3					
CBH5	B	4.00	15	31	18	13	65	CL Low Plasicticity
CBH5	B	6.50	16	33	16	17	45	CL Low Plasicticity
CBH6	B	1.00	25	33	17	16	98	CL Low Plasicticity
CBH6	B	2.00	5.0					
CBH6	B	5.00	10	28	14	14	25	CL Low Plasicticity
CBH6	B	7.10	3.9					

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

BS 5930:1999



Checked by 06/03/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

UKAS TESTING 2788

Summary of Soil Classification Tests

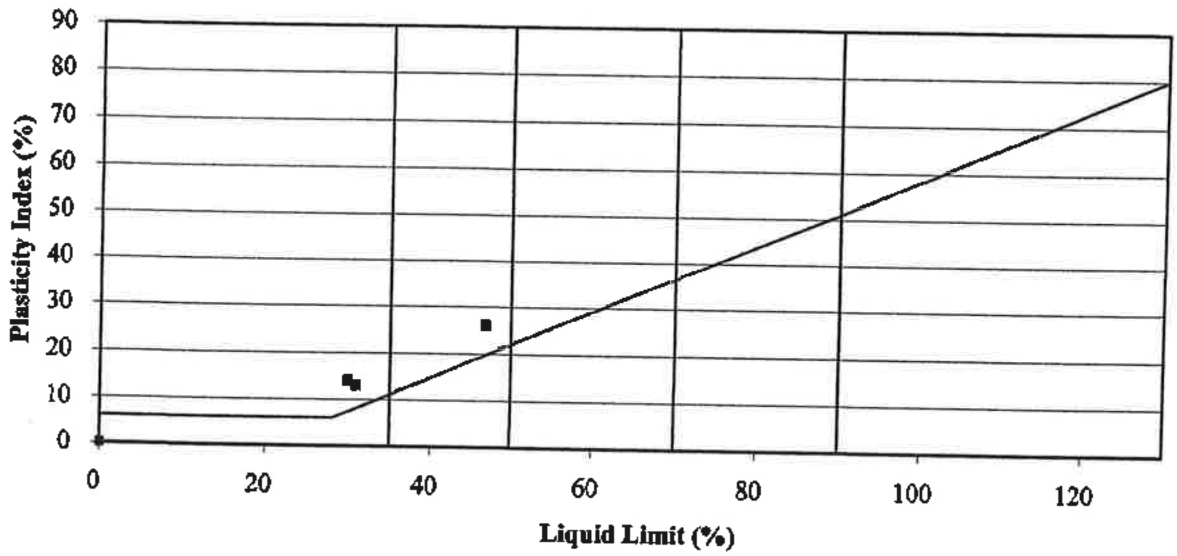
BS 1377:Part 2:1990

Hole/ Sample Number	Sample Type	Depth m	Moisture Content % Cl. 3.2	Liquid Limit % Cl. 4.3/4.4	Plastic Limit % Cl. 5.	Plasticity Index % Cl. 6.	% Passing .425mm	Remarks
CBH7	B	1.00	14	47	21	26	55	CI Intermediate Plasicticity
CBH7	B	2.00	14	31	18	13	70	CL Low Plasicticity
CBH7	B	4.00	6.9					
CBH7	B	6.50	14		NP		50	
CBH7	B	8.00	16	30	16	14	70	CL Low Plasicticity

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

BS 5930:1999



Checked by Date 6/03/07

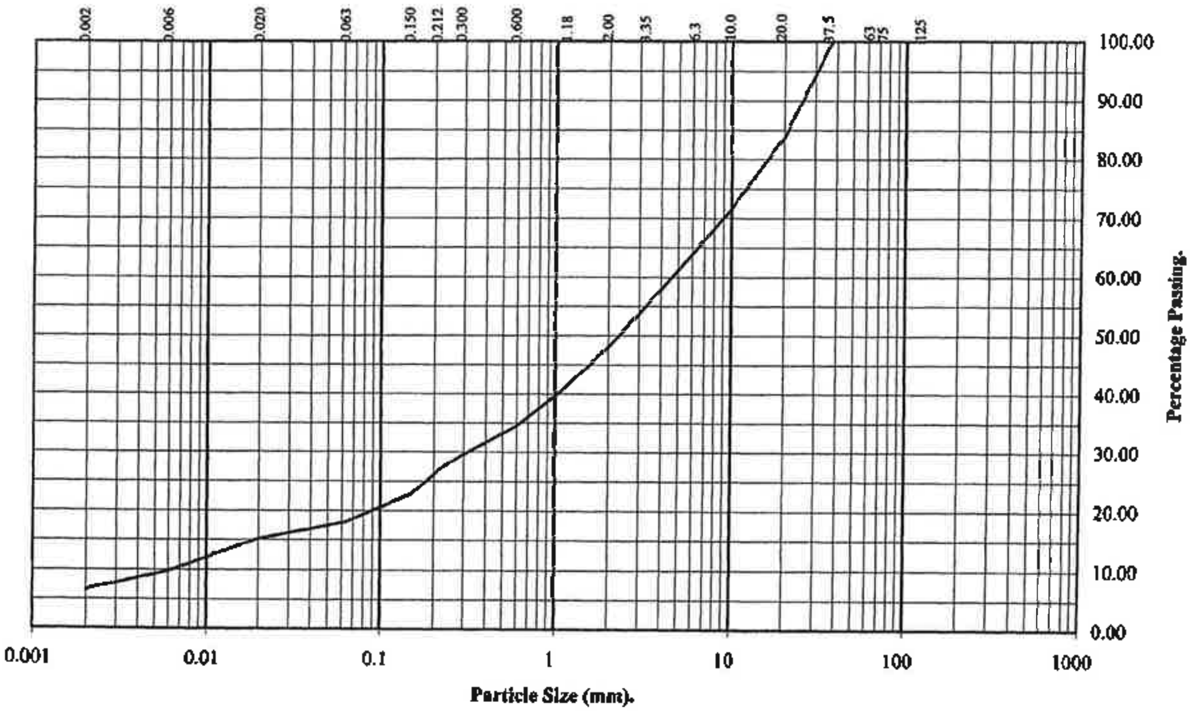
Approved by Date 06/03/07

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: **CBH1** **Depth (m)** **1.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	84
10	72
6.3	65
3.35	55
2	48
1.18	41
0.6	34
0.3	30
0.212	27
0.15	23
0.063	18

Particle Diameter	Percentage Passing
0.02	15
0.006	10
0.002	7

Soil Fraction	Total Percentage
Cobbles	0
Gravel	52
Sand	30
Silt	11
Clay	7

Remarks:

Cl 9.4.8 - Sample has not been pretreated

Checked by 6/3/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

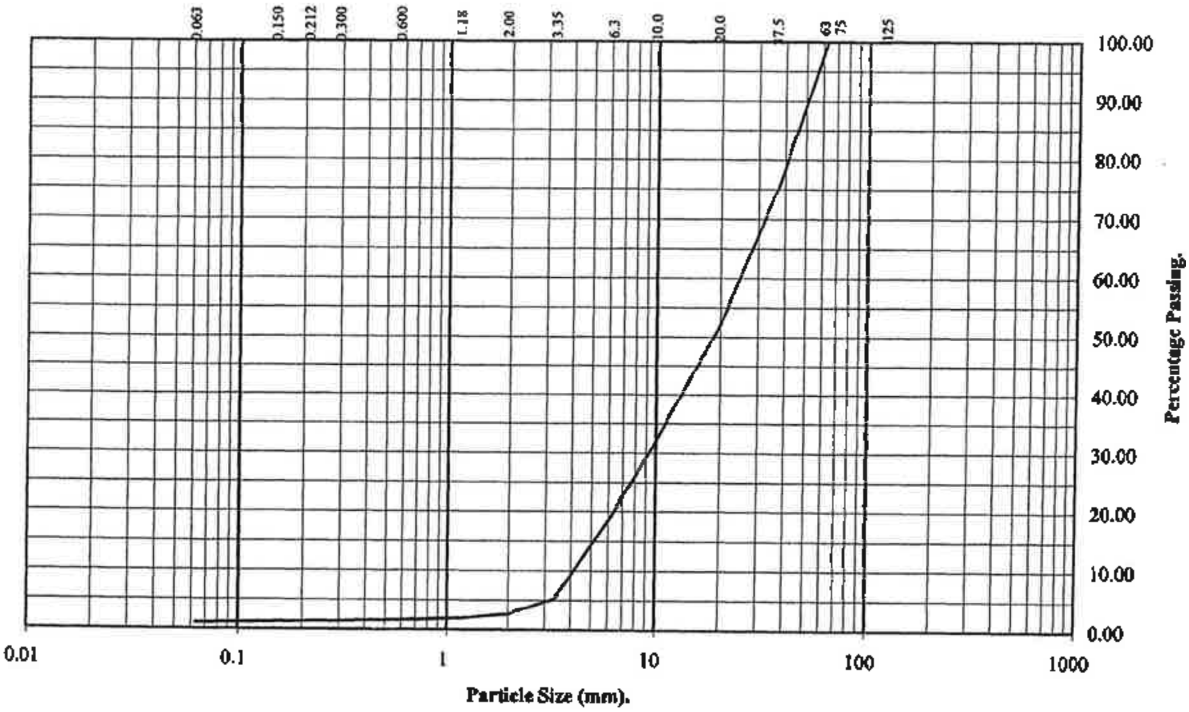
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: **CBH1** **Depth (m):** **3.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	76
20	52
10	32
6.3	20
3.35	5
2	3
1.18	2
0.6	2
0.3	1
0.212	1
0.15	1
0.063	1

Soil Fraction	Total Percentage
Cobbles	0
Gravel	97
Sand	2
Silt and Clay	1

Remarks:

Checked by Date 6/03/07

Approved by Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

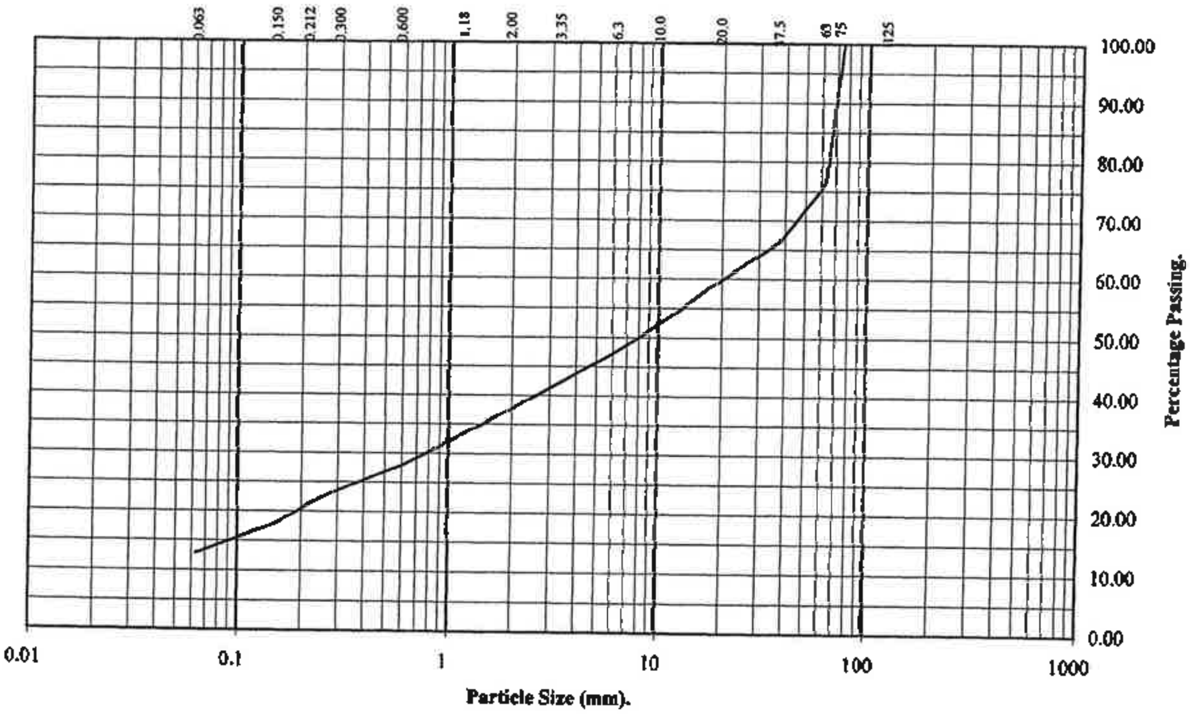
Client Ref No: N/A

UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.
Wet sieve Clause 9.2

Hole Number: **CBH2** **Depth (m):** **1.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	76
37.5	66
20	60
10	52
6.3	48
3.35	42
2	38
1.18	33
0.6	28
0.3	24
0.212	21
0.15	18
0.063	13

Soil Fraction	Total Percentage
Cobbles	24
Gravel	38
Sand	25
Silt and Clay	13

Remarks:

Checked by 06/03/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07
Client Ref No: N/A

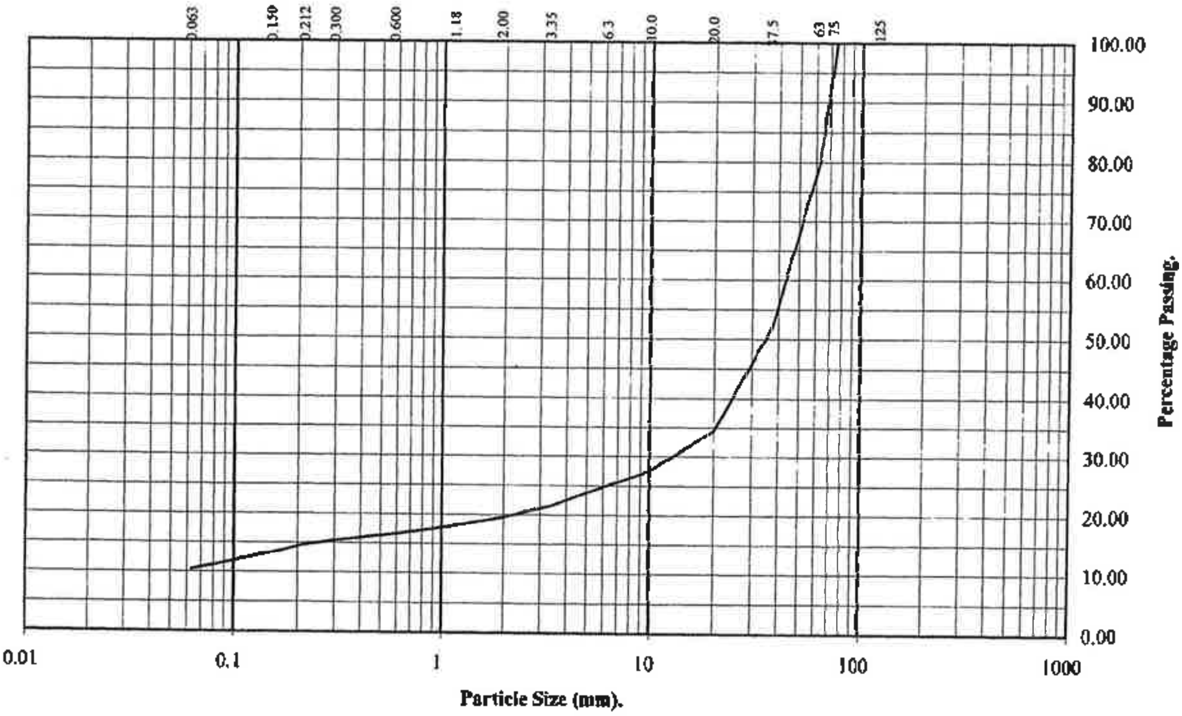
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: CBH2B **Sample Number:** 1797 **Depth (m):** 1.80



BS Test Sieve	Percentage Passing
125	100
75	100
63	80
37.5	52
20	34
10	27
6.3	25
3.35	21
2	20
1.18	18
0.6	17
0.3	15
0.212	15
0.15	13
0.063	10

Soil Fraction	Total Percentage
Cobbles	20
Gravel	60
Sand	10
Silt and Clay	10

Remarks:

Checked by 06/03/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

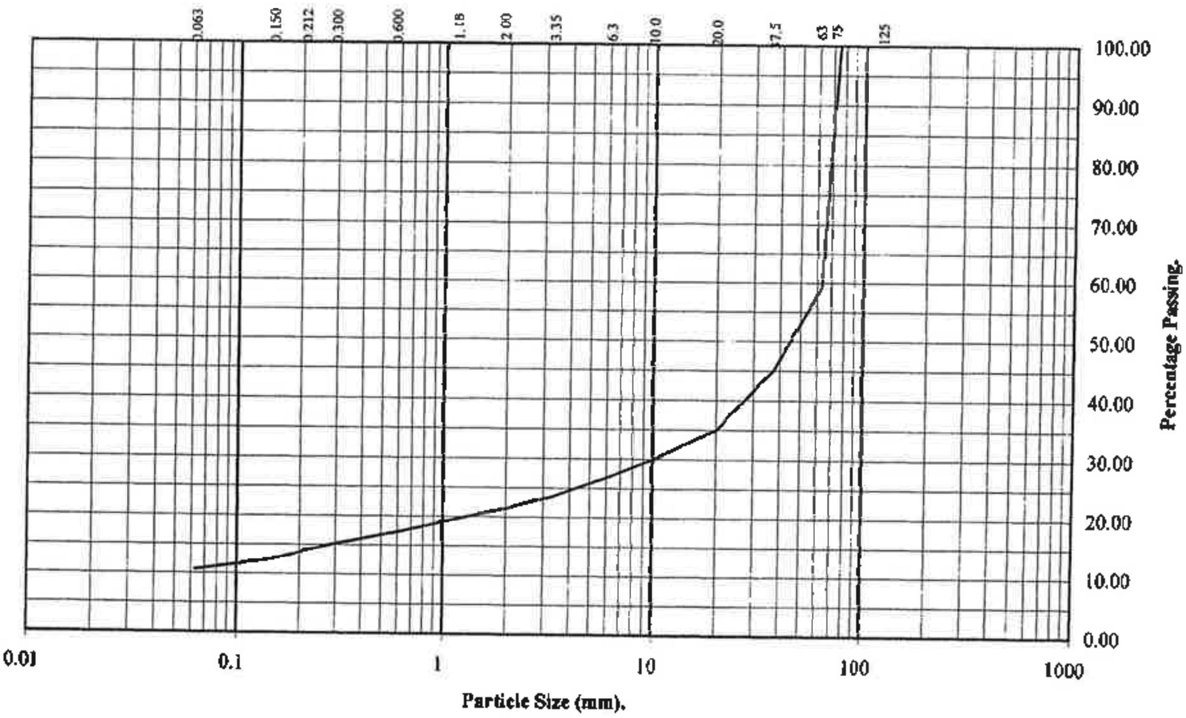
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: CBH2B **Sample Number:** 1799 **Depth (m):** 5.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	59
37.5	45
20	35
10	30
6.3	27
3.35	24
2	21
1.18	20
0.6	17
0.3	15
0.212	14
0.15	12
0.063	11

Soil Fraction	Total Percentage
Cobbles	41
Gravel	38
Sand	10
Silt and Clay	11

Remarks:

Checked by — Date 06/03/07

Approved by — Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

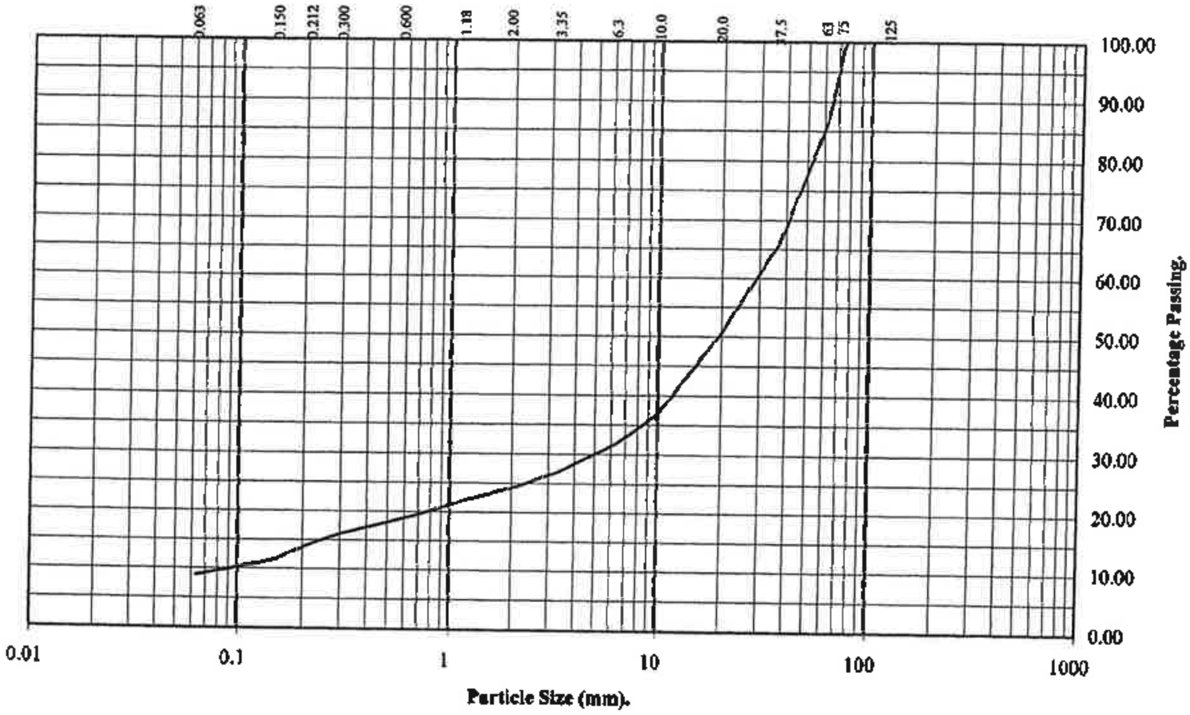
Client Ref No: N/A

UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.
Wet sieve Clause 9.2

Hole Number: **CBH3** **Depth (m):** **1.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	87
37.5	66
20	51
10	37
6.3	32
3.35	27
2	24
1.18	22
0.6	19
0.3	16
0.212	14
0.15	12
0.063	9

Soil Fraction	Total Percentage
Cobbles	13
Gravel	63
Sand	15
Silt and Clay	9

Remarks:

Checked by Date 06/03/07

Approved by Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07
Client Ref No: N/A

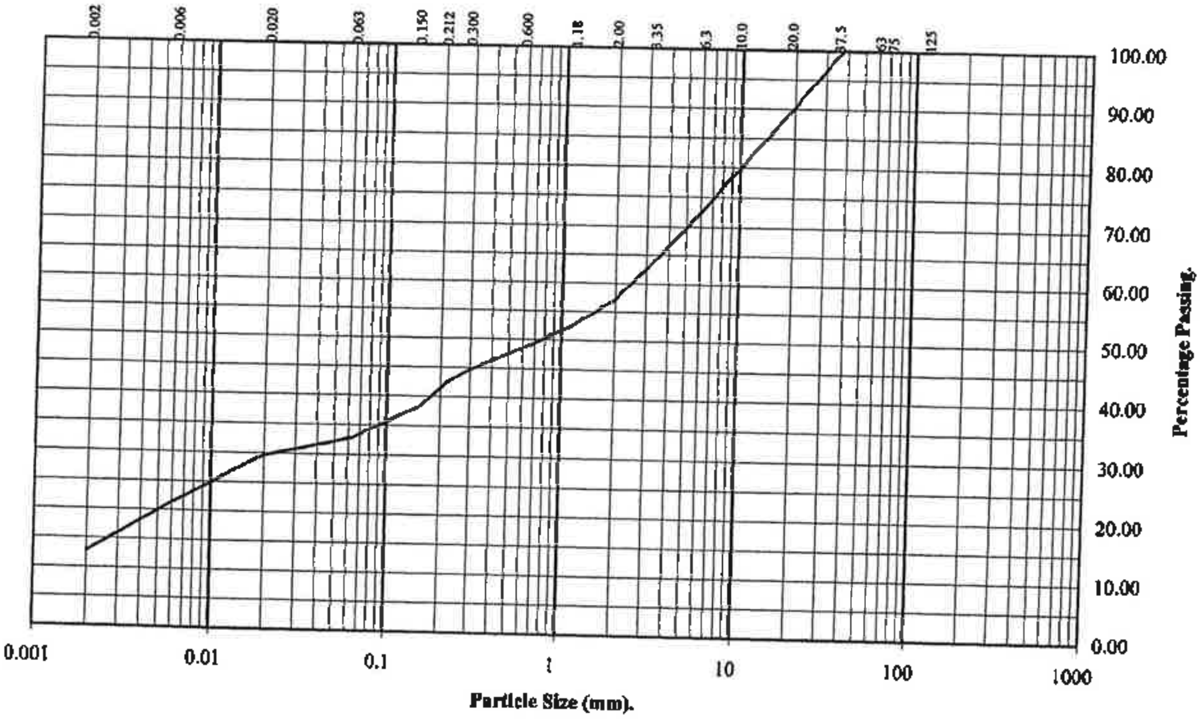
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: **CBH3** **Depth (m)** **3.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	90
10	80
6.3	73
3.35	64
2	57
1.18	53
0.6	48
0.3	45
0.212	42
0.15	38
0.063	33

Particle Diameter	Percentage Passing
0.02	30
0.006	21
0.002	13

Soil Fraction	Total Percentage
Cobbles	0
Gravel	43
Sand	24
Silt	20
Clay	13

Remarks:

Cl 9.4.8 - Sample has not been pretreated

Checked by Date 06/03/07

Approved by Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

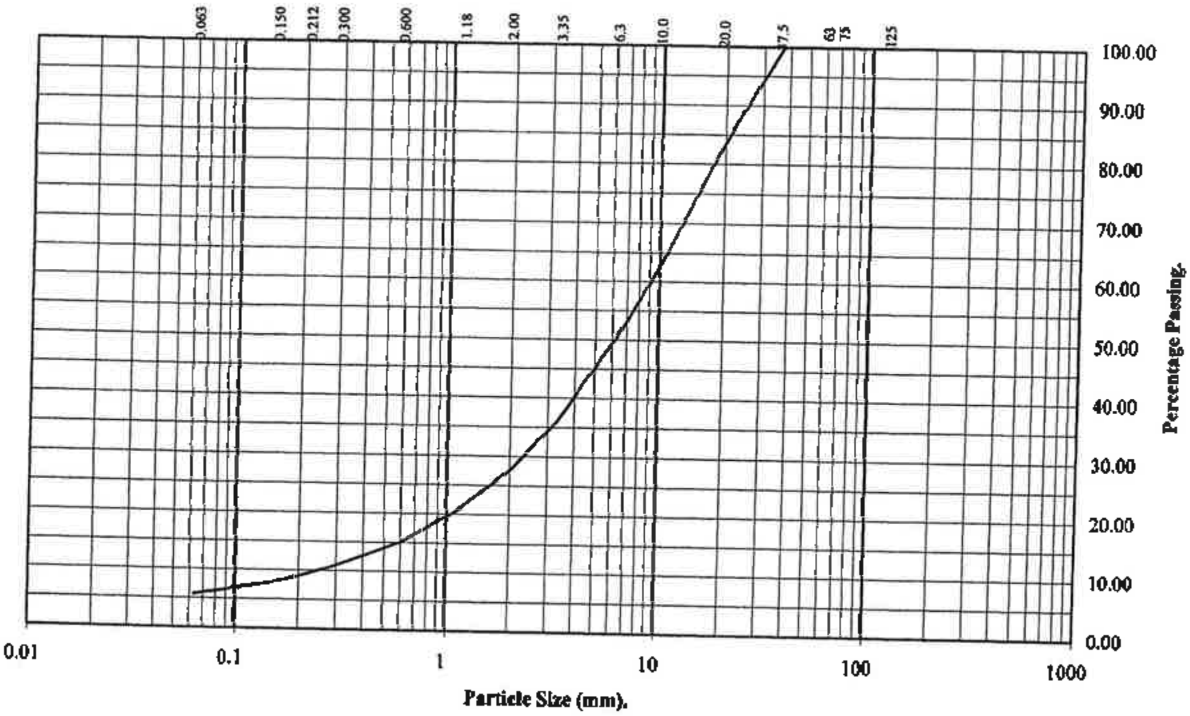
Client Ref No: N/A

UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.
Wet sieve Clause 9.2

Hole Number: CBH3 **Depth (m):** 6.50



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	84
10	62
6.3	50
3.35	36
2	28
1.18	21
0.6	15
0.3	11
0.212	9
0.15	8
0.063	6

Soil Fraction	Total Percentage
Cobbles	0
Gravel	72
Sand	22
Silt and Clay	6

Remarks:

Checked by Date 06/03/07

Approved by Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

GEO/004-1 Dec 05

Carrigaline

Issue No 1.2

Contract No.: GEO/3543/07
Client Ref No: N/A

UKAS TESTING 2788

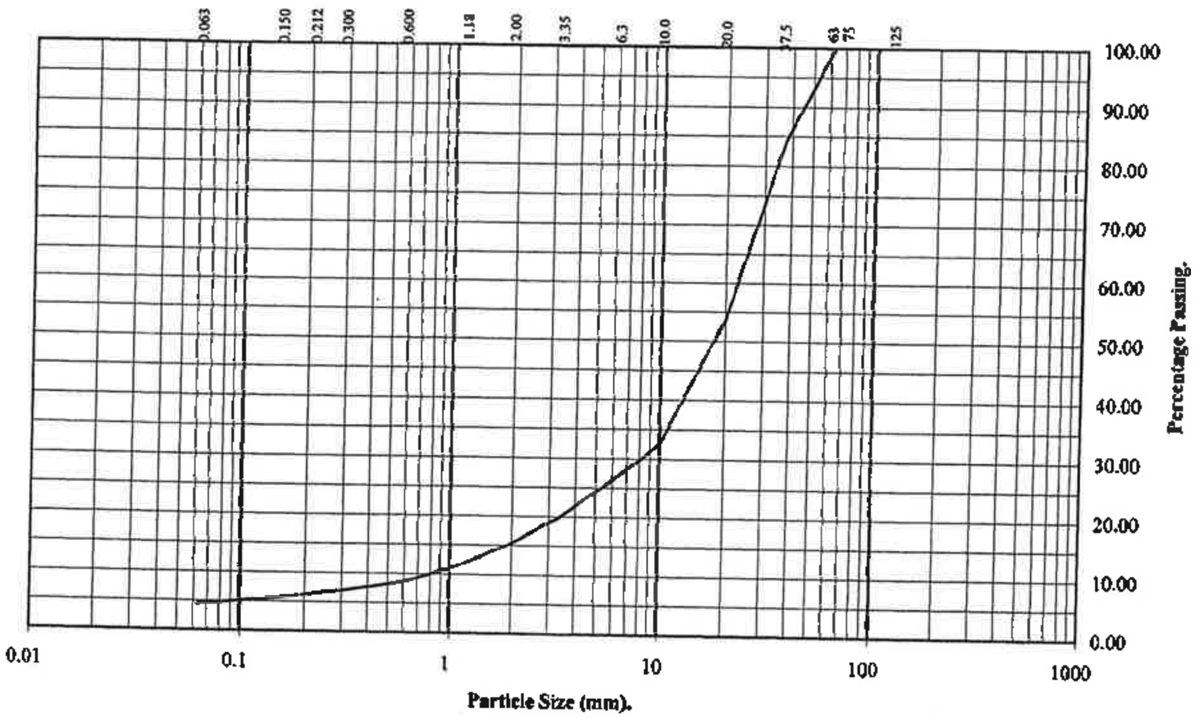
Page of

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: **CBH3** **Depth (m):** **11.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	84
20	54
10	32
6.3	27
3.35	20
2	15
1.18	12
0.6	9
0.3	7
0.212	6
0.15	6
0.063	4

Soil Fraction	Total Percentage
Cobbles	0
Gravel	85
Sand	11
Silt and Clay	4

Remarks:

Checked by 06/03/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

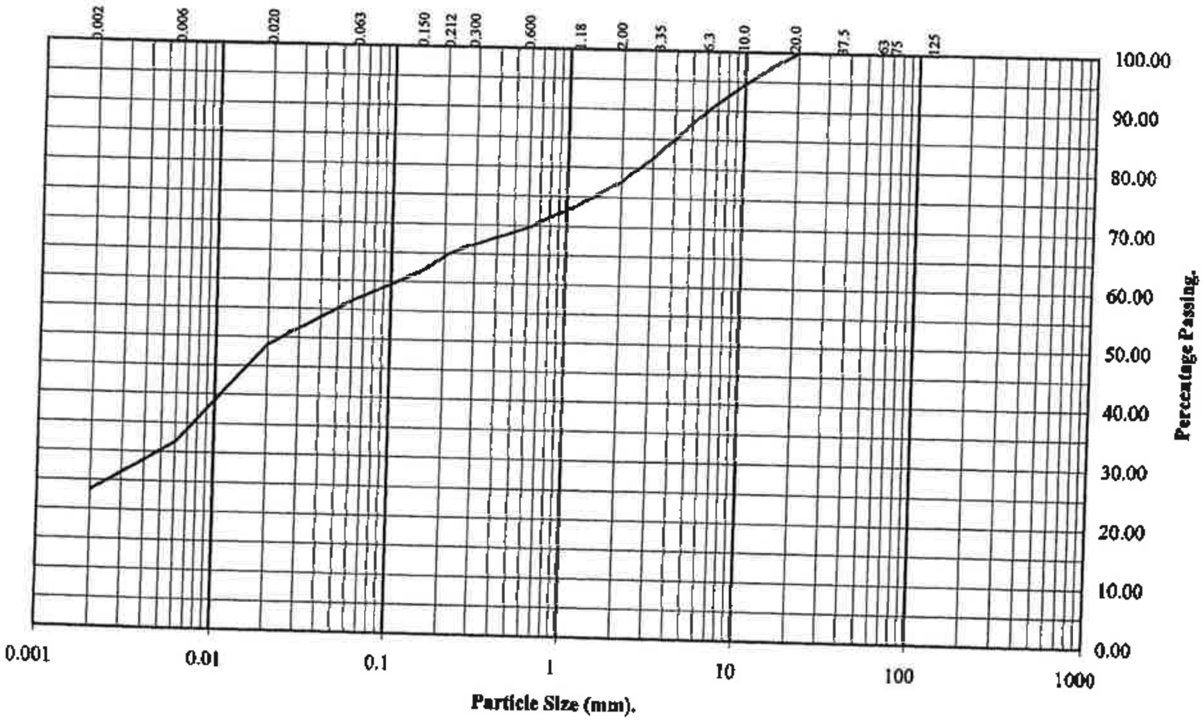
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: **CBH4** **Depth (m)** **2.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	95
6.3	90
3.35	83
2	78
1.18	74
0.6	70
0.3	67
0.212	65
0.15	62
0.063	57

Particle Diameter	Percentage Passing
0.02	49
0.006	32
0.002	23

Soil Fraction	Total Percentage
Cobbles	0
Gravel	22
Sand	21
Silt	34
Clay	23

Remarks:

Cl 9.4.8 - Sample has not been pretreated

Checked by Date 06/03/07

Approved by Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.:
GEO/3543/07
Client Ref No:
N/A

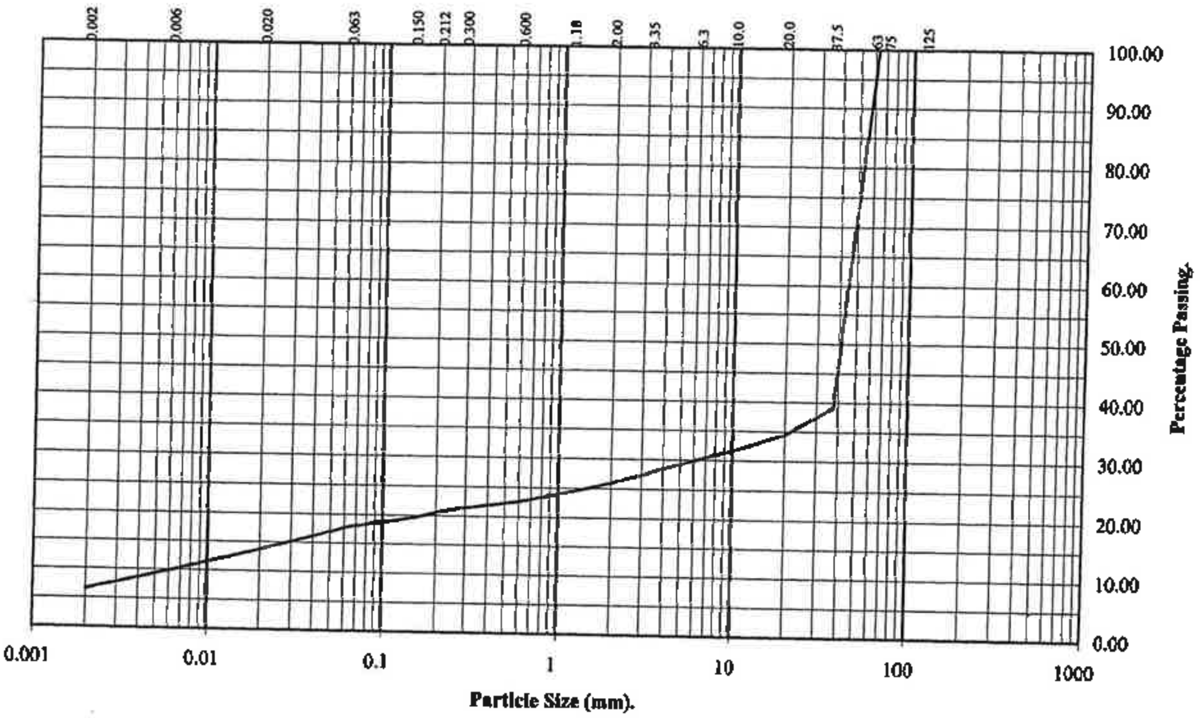
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: **CBH4** **Depth (m)** **5.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	39
20	34
10	32
6.3	30
3.35	28
2	26
1.18	24
0.6	23
0.3	21
0.212	21
0.15	20
0.063	18

Particle Diameter	Percentage Passing
0.02	14
0.006	10
0.002	7

Soil Fraction	Total Percentage
Cobbles	0
Gravel	74
Sand	8
Silt	11
Clay	7

Remarks:
Cl 9.4.8 - Sample has not been pretreated

Checked by Date 06/03/07

Approved by Date 06/03/07

GEO LABORATORY TESTING SERVICES LIMITED

Carrigaline

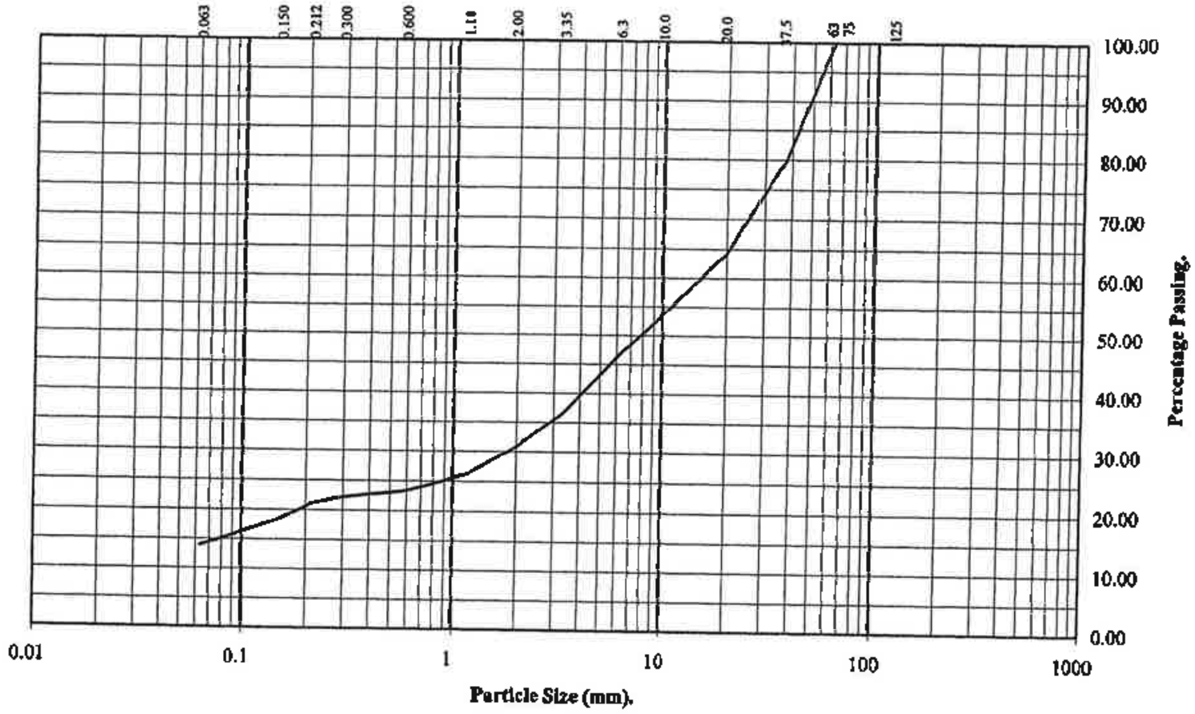
Contract No.: GEO/3543/07
Client Ref No: N/A

UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.
Wet sieve Clause 9.2

Hole Number: **CBH5** **Depth (m):** **1.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	80
20	64
10	54
6.3	47
3.35	37
2	31
1.18	26
0.6	23
0.3	22
0.212	21
0.15	18
0.063	14

Soil Fraction	Total Percentage
Cobbles	0
Gravel	69
Sand	17
Silt and Clay	14

Remarks:

Checked by 06/03/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: **GEO/3543/07**
Client Ref No: **N/A**

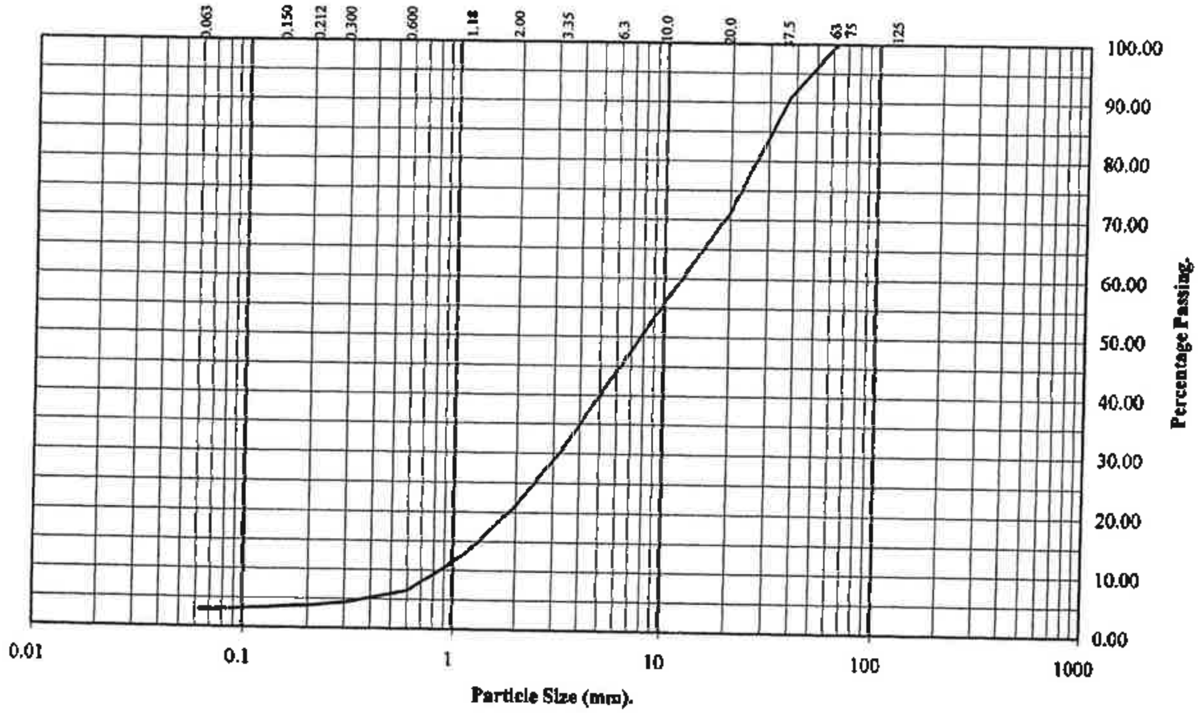
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: **CBH5** **Depth (m):** **2.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	91
20	71
10	56
6.3	45
3.35	31
2	21
1.18	13
0.6	6
0.3	4
0.212	4
0.15	4
0.063	3

Soil Fraction	Total Percentage
Cobbles	0
Gravel	79
Sand	18
Silt and Clay	3

Remarks:

Checked by 06/03/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

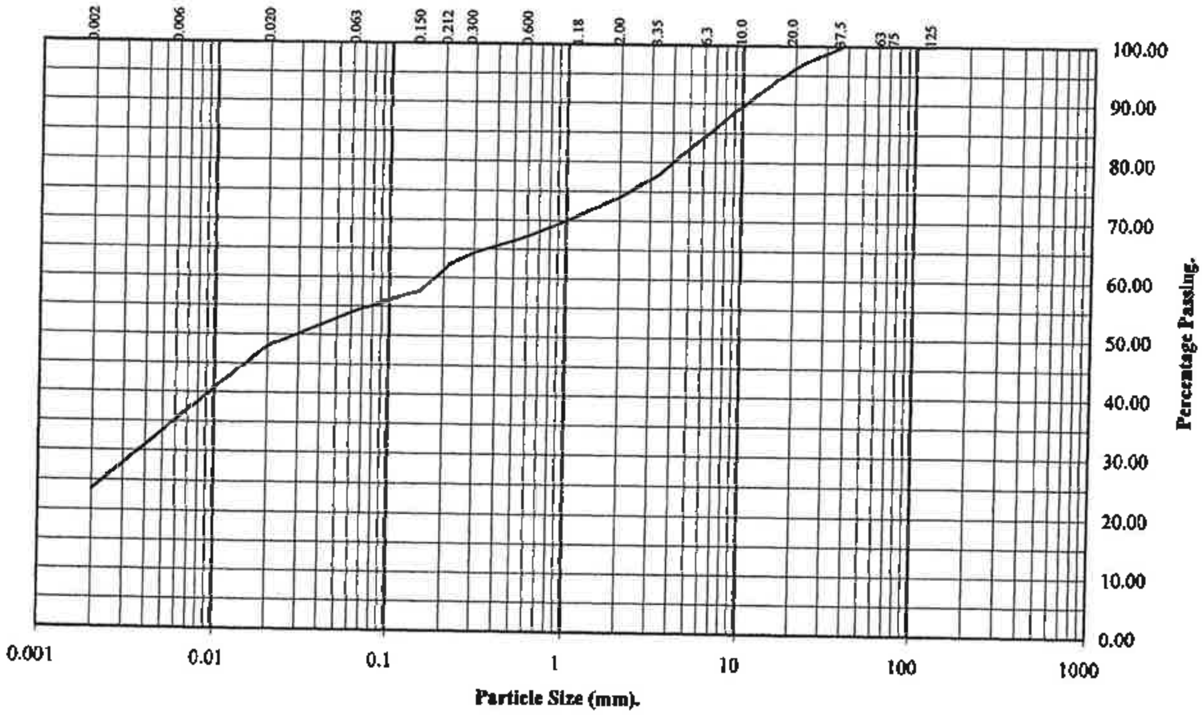
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CBH5 **Depth (m)** 4.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	96
10	90
6.3	85
3.35	78
2	74
1.18	71
0.6	67
0.3	64
0.212	62
0.15	58
0.063	54

Particle Diameter	Percentage Passing
0.02	48
0.006	35
0.002	23

Soil Fraction	Total Percentage
Cobbles	0
Gravel	26
Sand	20
Silt	31
Clay	23

Remarks:

Cl 9.4.8 - Sample has not been pretreated

Checked by Date 06/03/07

Approved by Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

GEO/104-2 Dec 05

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

UKAS TESTING 2788

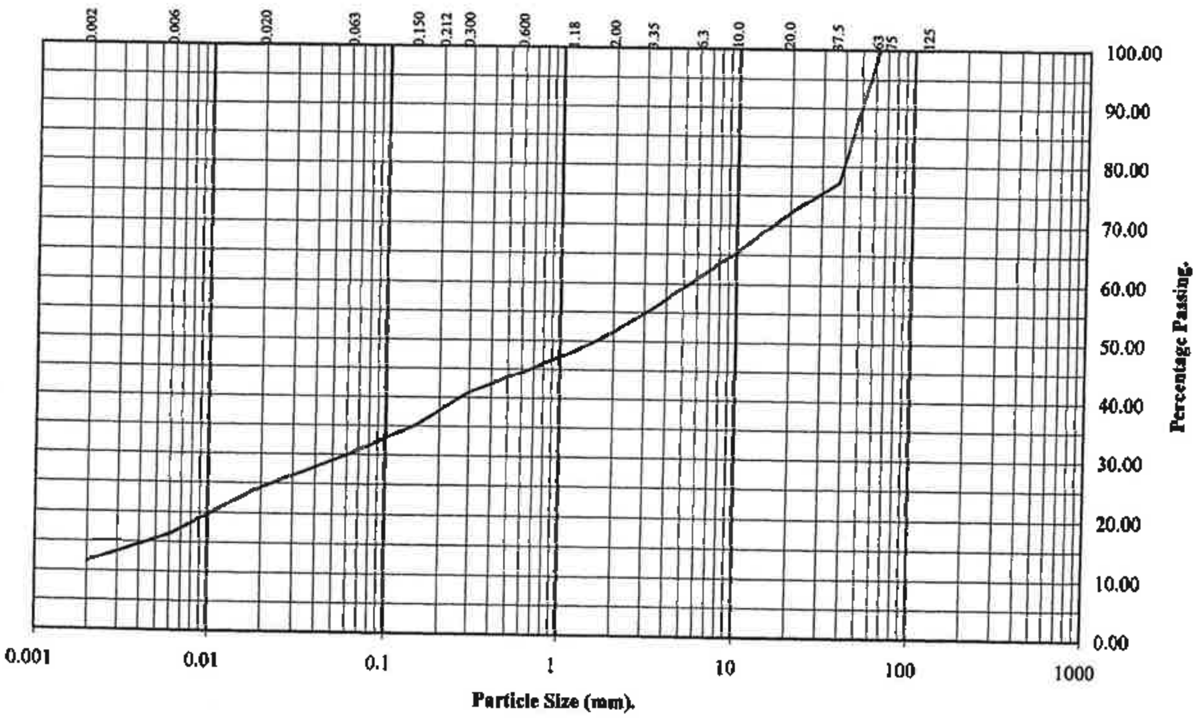
Issue No 1.2

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: **CBH5** **Depth (m)** **6.50**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	77
20	72
10	65
6.3	61
3.35	56
2	52
1.18	48
0.6	44
0.3	41
0.212	38
0.15	35
0.063	30

Particle Diameter	Percentage Passing
0.02	24
0.006	16
0.002	12

Soil Fraction	Total Percentage
Cobbles	0
Gravel	48
Sand	22
Silt	18
Clay	12

Remarks:

Cl 9.4.8 - Sample has not been pretreated

Checked by Date 06/03/07

Approved by Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

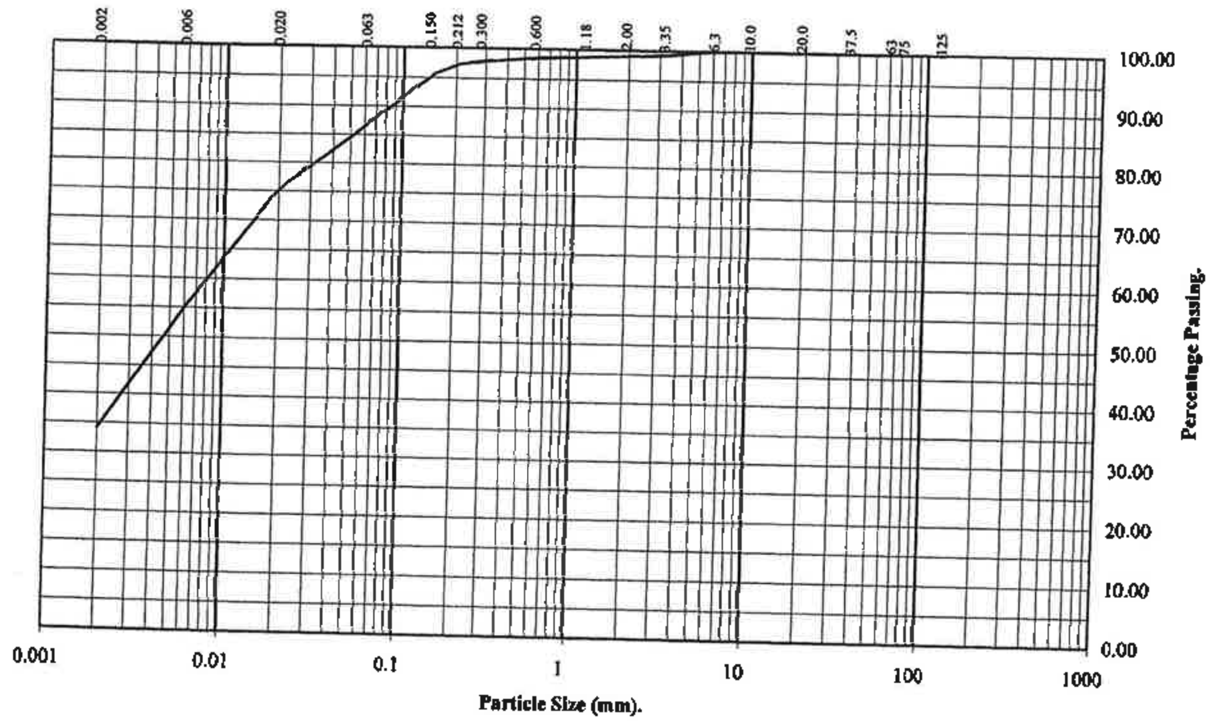
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: **CBH6** **Depth (m)** **1.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	99
2	99
1.18	99
0.6	98
0.3	98
0.212	97
0.15	96
0.063	87

Particle Diameter	Percentage Passing
0.02	75
0.006	55
0.002	34

Soil Fraction	Total Percentage
Cobbles	0
Gravel	1
Sand	12
Silt	53
Clay	34

Remarks:

Cl 9.4.8 - Sample has not been pretreated

Checked by Date 06/03/07

Approved by Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

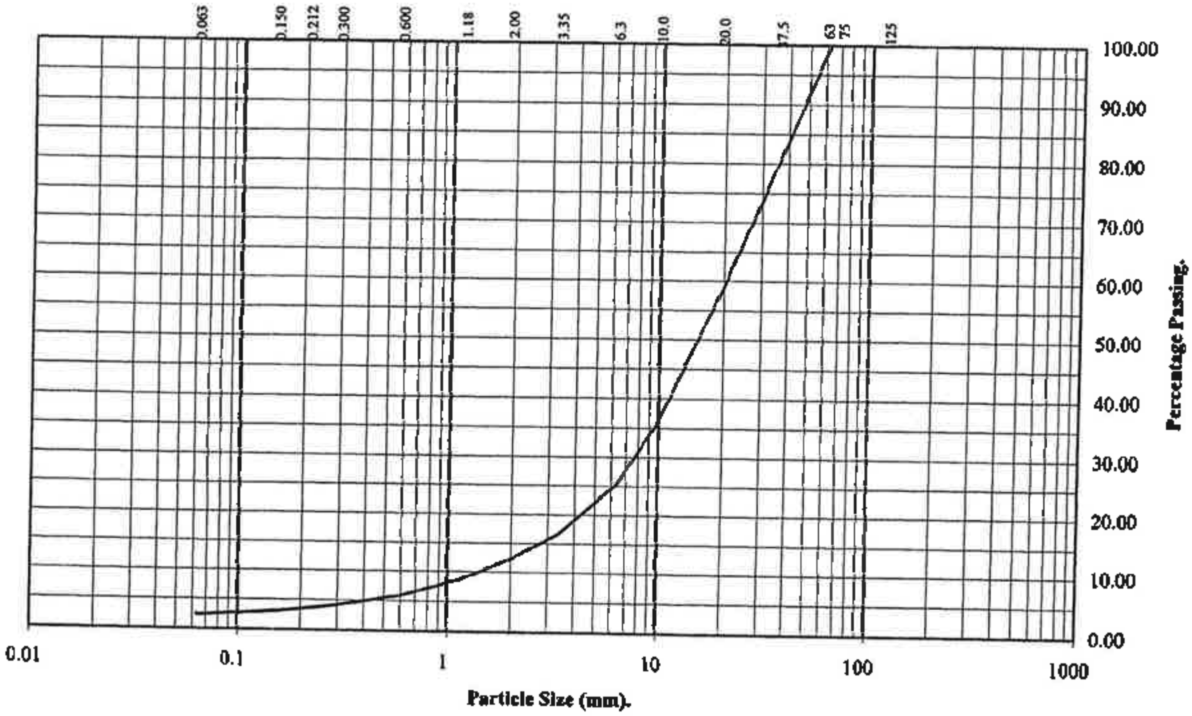
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: **CBH6** **Depth (m):** **2.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	81
20	59
10	36
6.3	25
3.35	17
2	12
1.18	9
0.6	6
0.3	4
0.212	4
0.15	3
0.063	2

Soil Fraction	Total Percentage
Cobbles	0
Gravel	88
Sand	10
Silt and Clay	2

Remarks:

Checked by 06/03/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

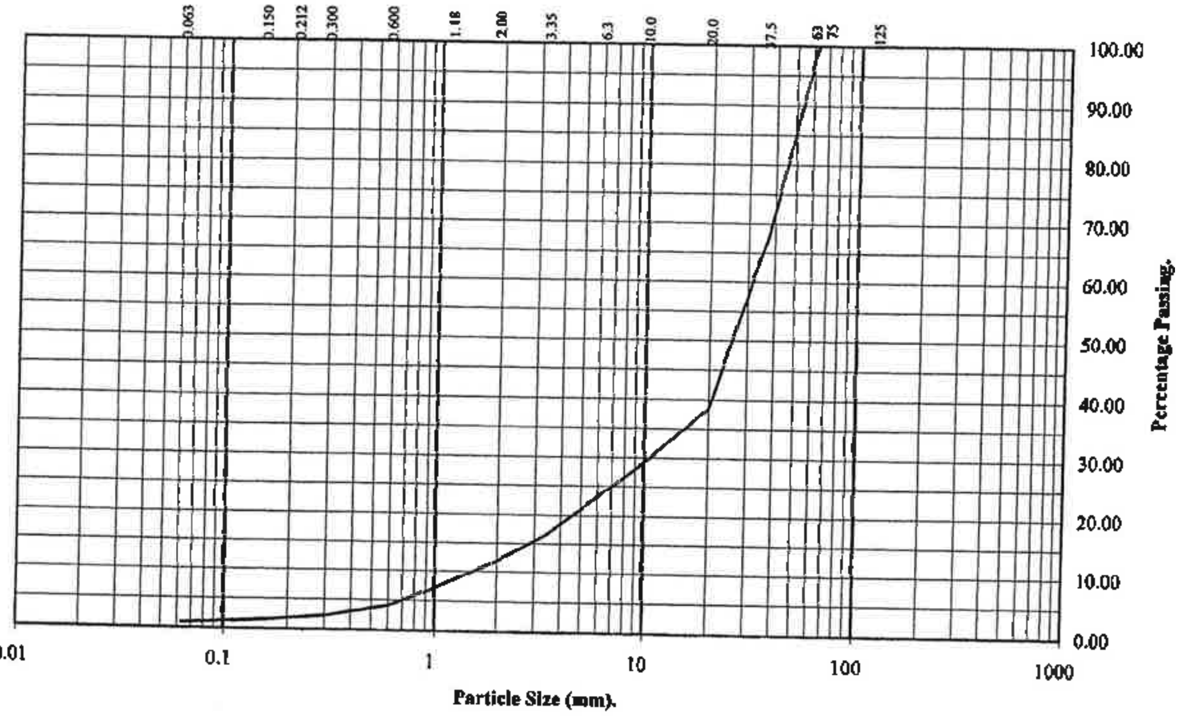
Client Ref No: N/A

UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.
Wet sieve Clause 9.2

Hole Number: **CBH6** **Depth (m):** **3.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	68
20	38
10	29
6.3	24
3.35	16
2	12
1.18	8
0.6	4
0.3	2
0.212	2
0.15	1
0.063	1

Soil Fraction	Total Percentage
Cobbles	0
Gravel	88
Sand	11
Silt and Clay	1

Remarks:

Checked by Date 06/03/07

Approved by Date 06/03/07

GEO LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07
Client Ref No: N/A

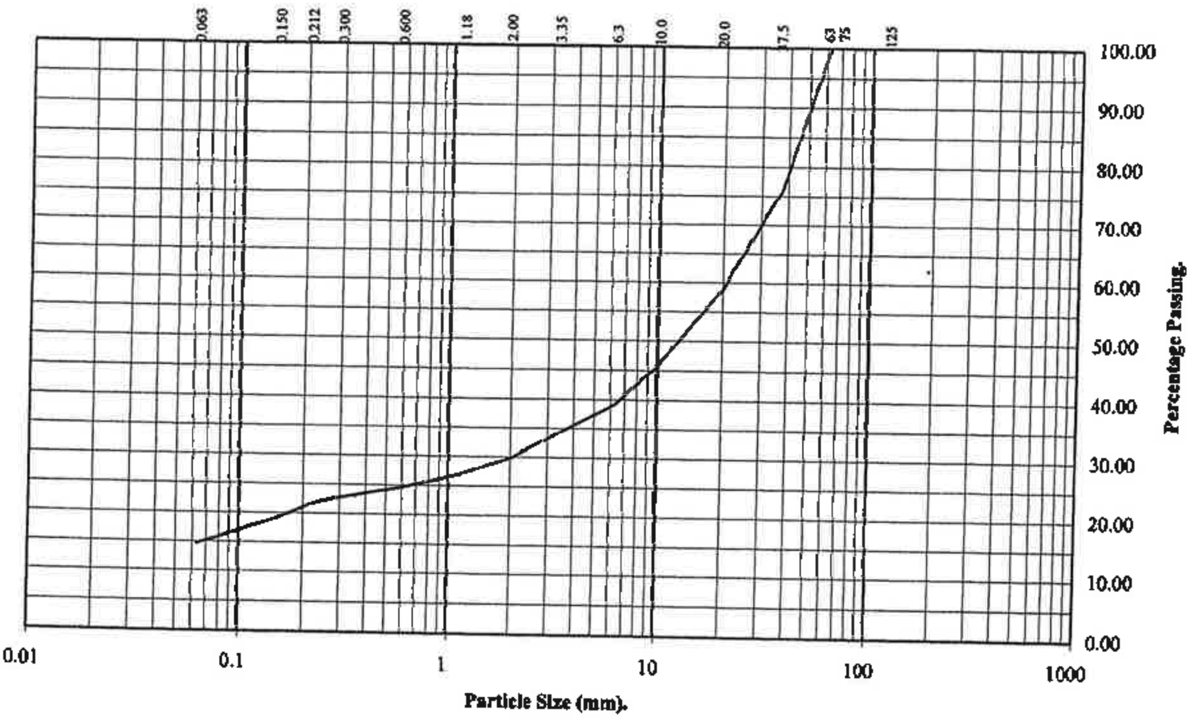
UKAS TESTING 2798

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: **CBH6** **Depth (m):** **5.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	76
20	59
10	46
6.3	39
3.35	34
2	30
1.18	27
0.6	25
0.3	23
0.212	21
0.15	19
0.063	15

Soil Fraction	Total Percentage
Cobbles	0
Gravel	70
Sand	15
Silt and Clay	15

Remarks:

Checked by 06/03/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

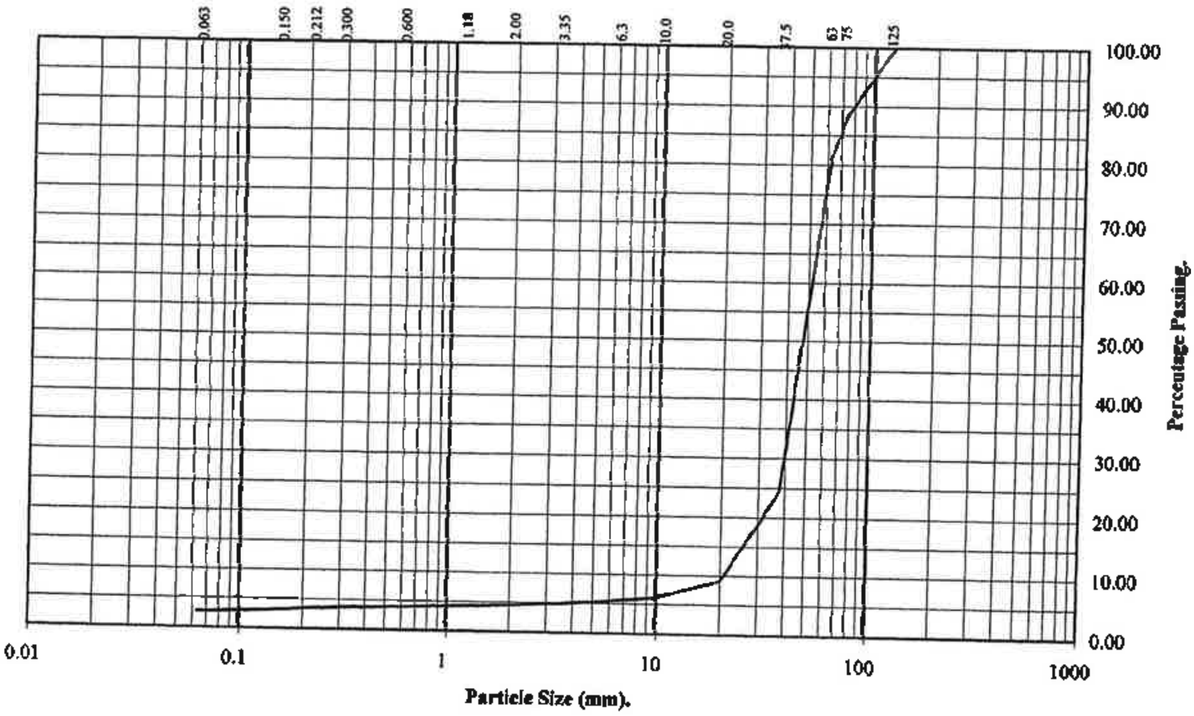
UKAS TESTING 2786

PARTICLE SIZE DISTRUBUTION TEST

BS 1377:Part 2:1990.

Wet sieve Clause 9.2

Hole Number: **CBH6** **Depth (m):** **7.10**



BS Test Sieve	Percentage Passing
125	100
75	89
63	81
37.5	24
20	9
10	6
6.3	6
3.35	5
2	5
1.18	4
0.6	4
0.3	4
0.212	3
0.15	3
0.063	3

Soil Fraction	Total Percentage
Cobbles	19
Gravel	76
Sand	2
Silt and Clay	3

Remarks:

Checked by 06/03/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

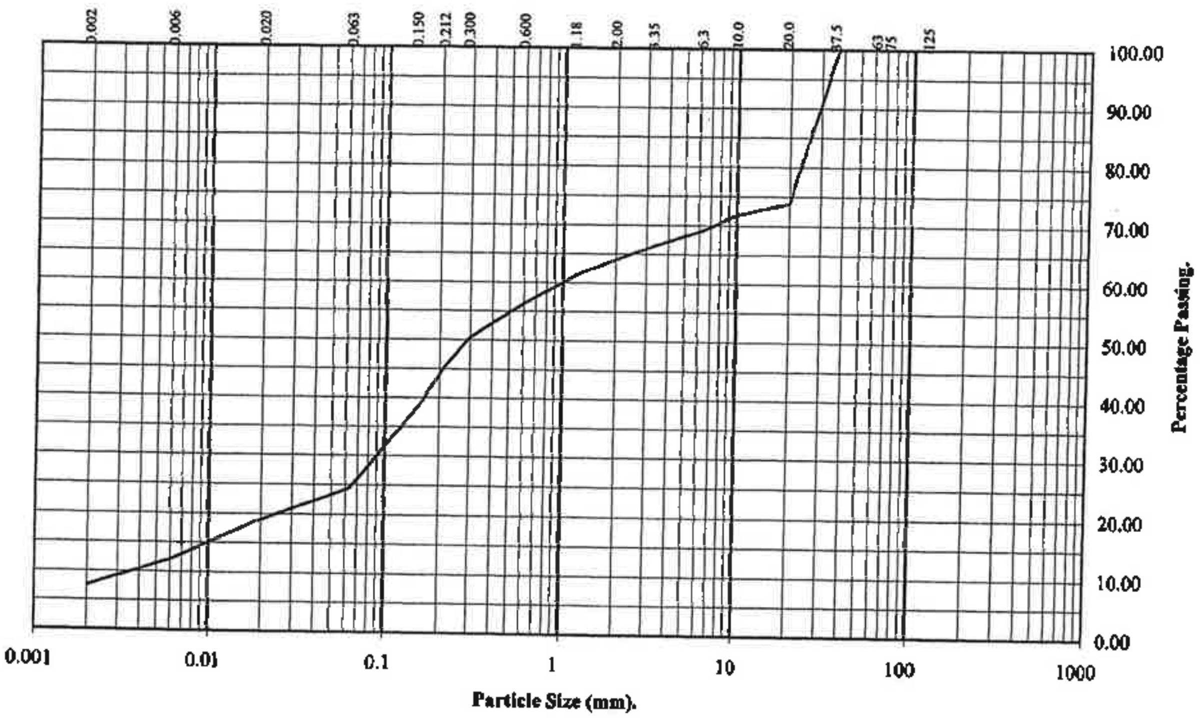
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: CBH7 **Depth (m)** 1.00



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	74
10	72
6.3	69
3.35	66
2	64
1.18	61
0.6	56
0.3	50
0.212	45
0.15	38
0.063	24

Particle Diameter	Percentage Passing
0.02	19
0.006	12
0.002	8

Soil Fraction	Total Percentage
Cobbles	0
Gravel	36
Sand	40
Silt	16
Clay	8

Remarks:

Cl 9.4.8 - Sample has not been pretreated

Checked by Date 06/08/07

Approved by Date 06/08/07

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

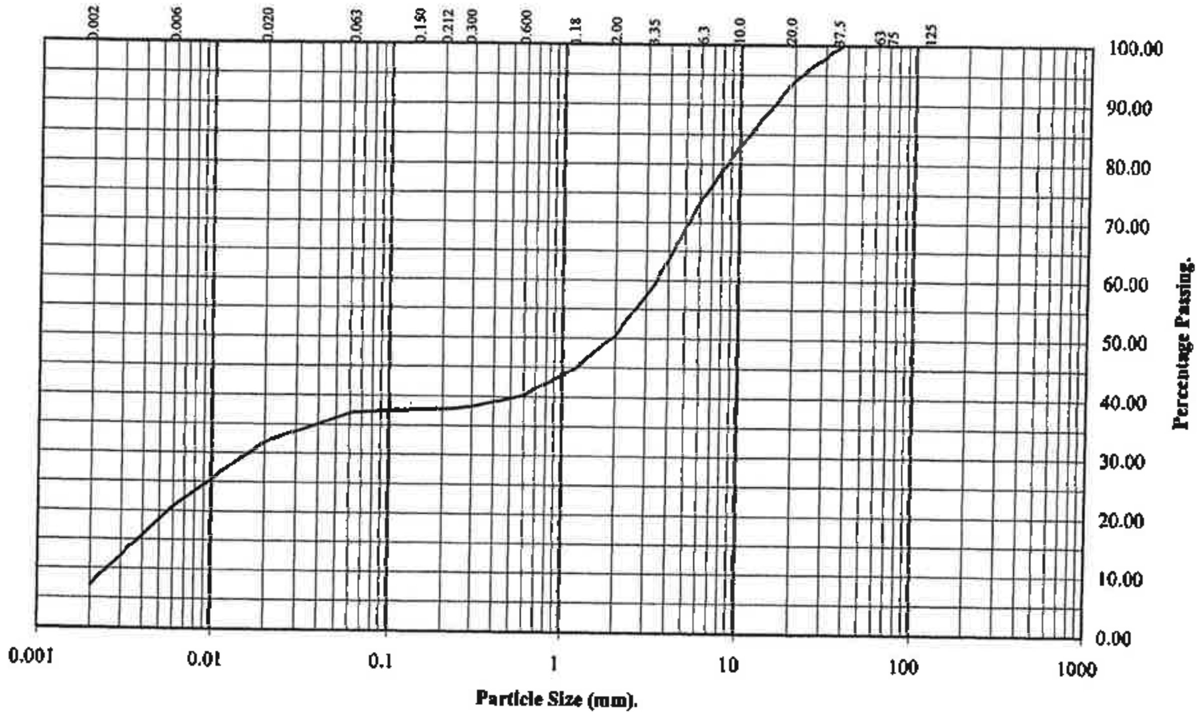
UKAS TESTING 2788

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: **CBH7** **Depth (m)** **4.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	94
10	83
6.3	74
3.35	59
2	50
1.18	45
0.6	40
0.3	38
0.212	38
0.15	38
0.063	37

Particle Diameter	Percentage Passing
0.02	32
0.006	21
0.002	7

Soil Fraction	Total Percentage
Cobbles	0
Gravel	50
Sand	13
Silt	30
Clay	7

Remarks:

Cl 9.4.8 - Sample has not been pretreated

Checked by Date 06/03/07

Approved by Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

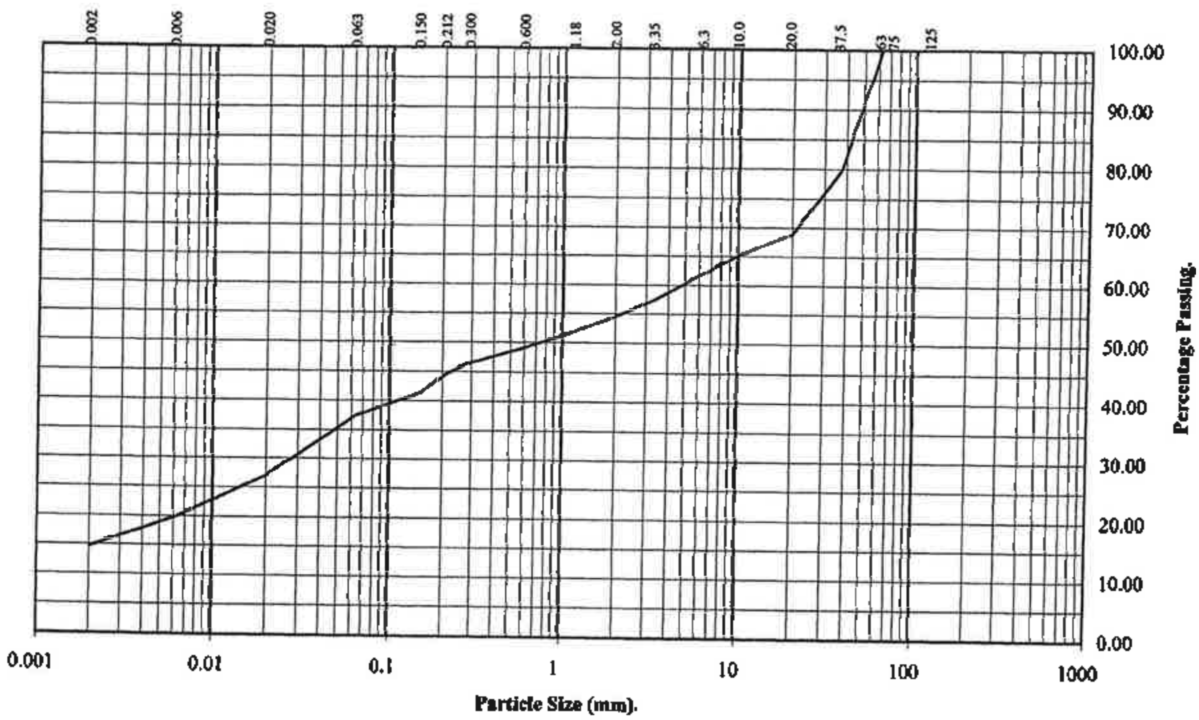
Client Ref No: N/A

PARTICLE SIZE DISTRUBUTION TEST

BS 1377 Part 2:1990.

Wet sieve Pipette analysis Clause 9.2 9.4

Hole Number: **CBH7** **Depth (m)** **6.50**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	80
20	69
10	65
6.3	62
3.35	57
2	55
1.18	52
0.6	49
0.3	46
0.212	45
0.15	41
0.063	37

Particle Diameter	Percentage Passing
0.02	27
0.006	20
0.002	15

Soil Fraction	Total Percentage
Cobbles	0
Gravel	45
Sand	18
Silt	22
Clay	15

Remarks:

Cl 9.4.8 - Sample has not been pretreated

06/03/07

Checked by **Date**

06/03/07

Approved by **Date**

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

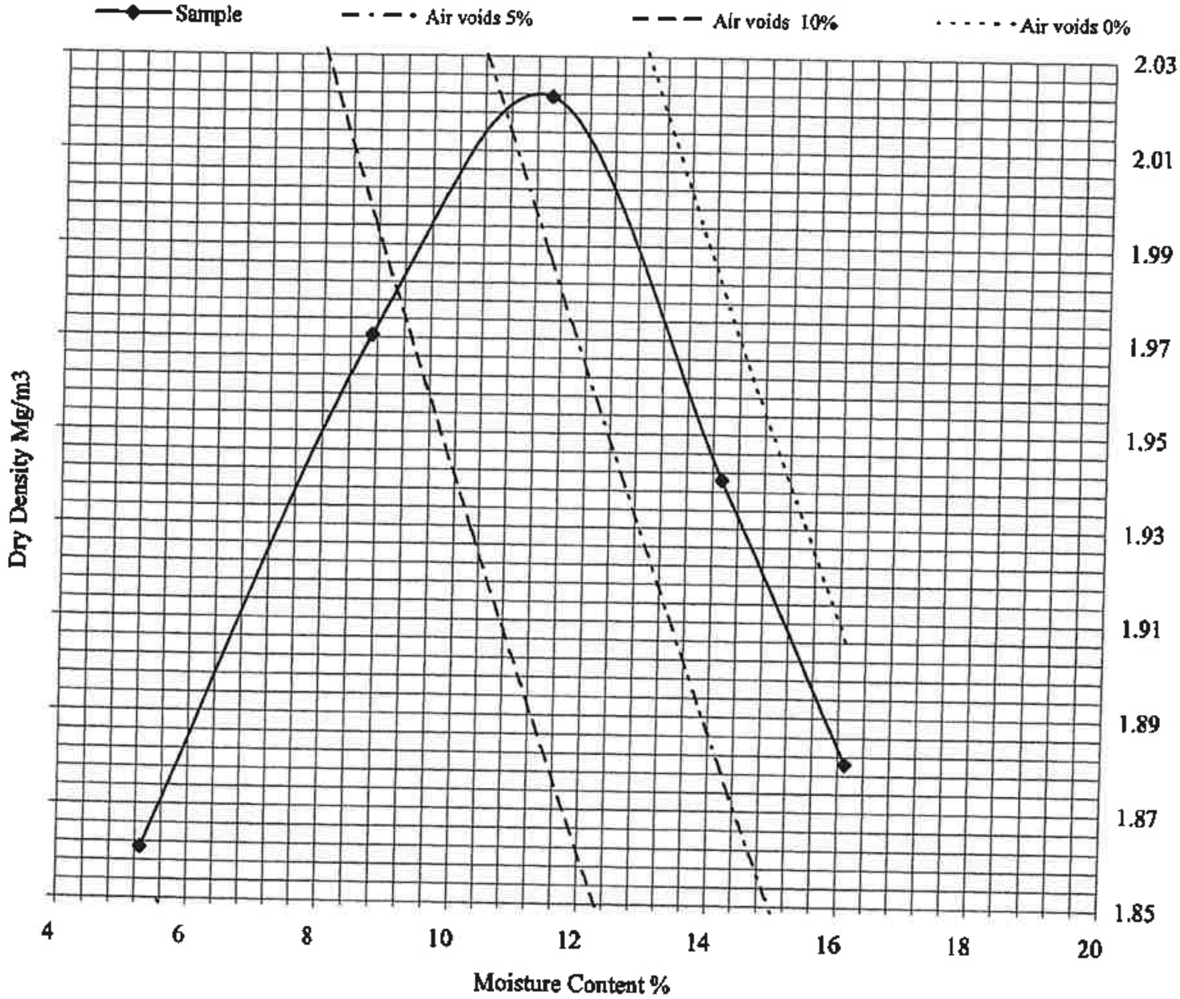
Client Ref No: N/A

UKAS TESTING 2788

Dry Density/Moisture Content Relationship

BS 1377:Part 4:1990

Hole Number: CBH2 **Sample Number:** 1795 **Depth(m):** 2.00



Initial Moisture Content:	11	Method of Compaction	2.5Kg Rammer / Single Sample	
Particle Density (Mg/m3):	2.75* Assumed	Material Retained on 37.5 mm Test Sieve (%):		4
Maximum Dry Density (mg/m3):	2.02	Material Retained on 20.0 mm Test Sieve (%):		7
Optimum Moisture Content (%):	11	Sample Preparation Clause :		3.2.5.2

** - not included in laboratory scope of accreditation*

Remarks

Checked by Date 06/03/07

Approved by Date 27/02/07

GEO LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

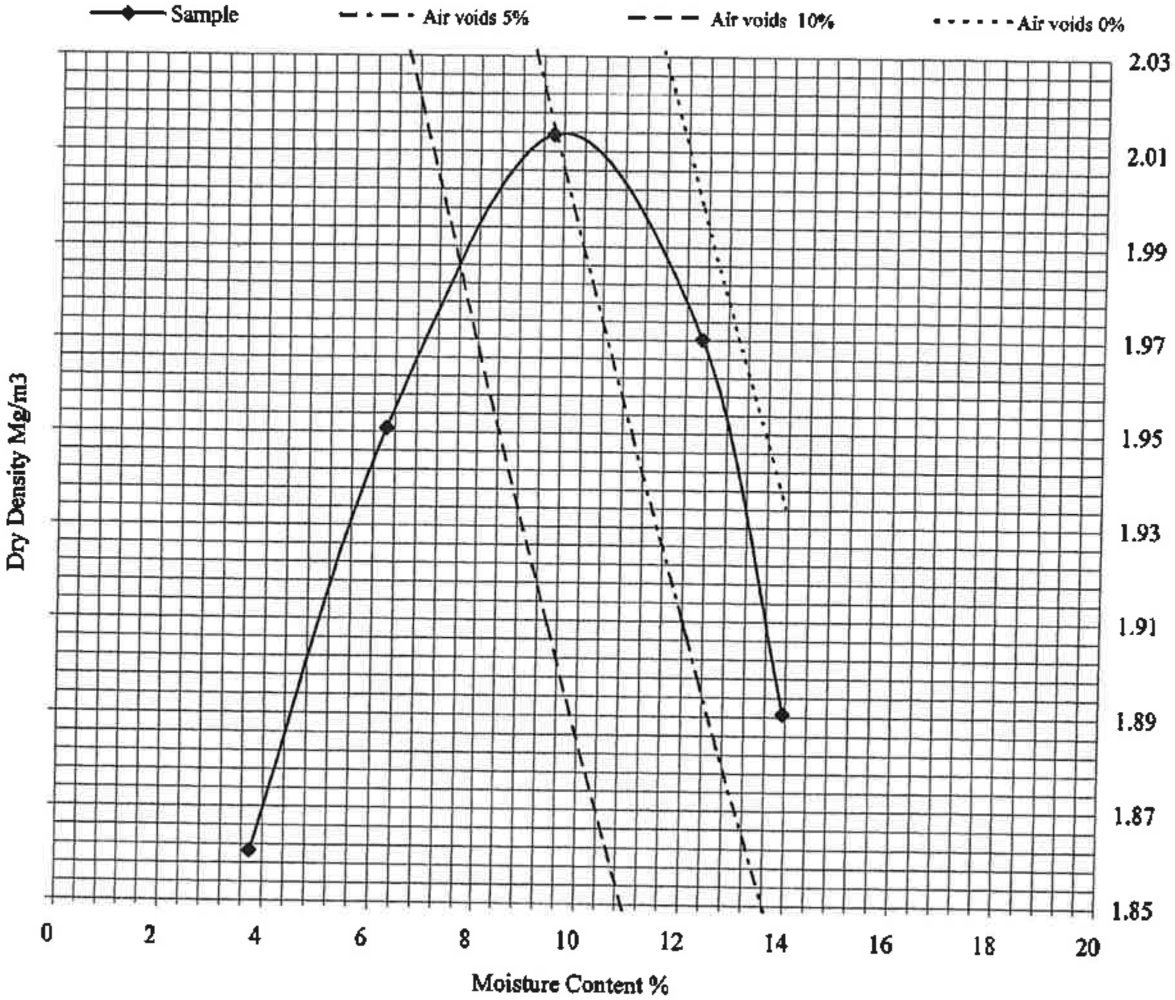
Client Ref No: N/A

UKAS TESTING 2788

Dry Density/Moisture Content Relationship

BS 1377:Part 4:1990

Hole Number: **CBH5** **Depth(m):** **1.00**



Initial Moisture Content:	9.4	Method of Compaction	2.5Kg Rammer / Single Sample	
Particle Density (Mg/m3):	2.65* Assumed	Material Retained on 37.5 mm Test Sieve (%):		20
Maximum Dry Density (mg/m3):	2.01	Material Retained on 20.0 mm Test Sieve (%):		36
Optimum Moisture Content (%):	9.4	Sample Preparation Clause :		Non-Standard

** - not included in laboratory scope of accreditation*

Remarks

Checked by Date 06/03/07

Approved by Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

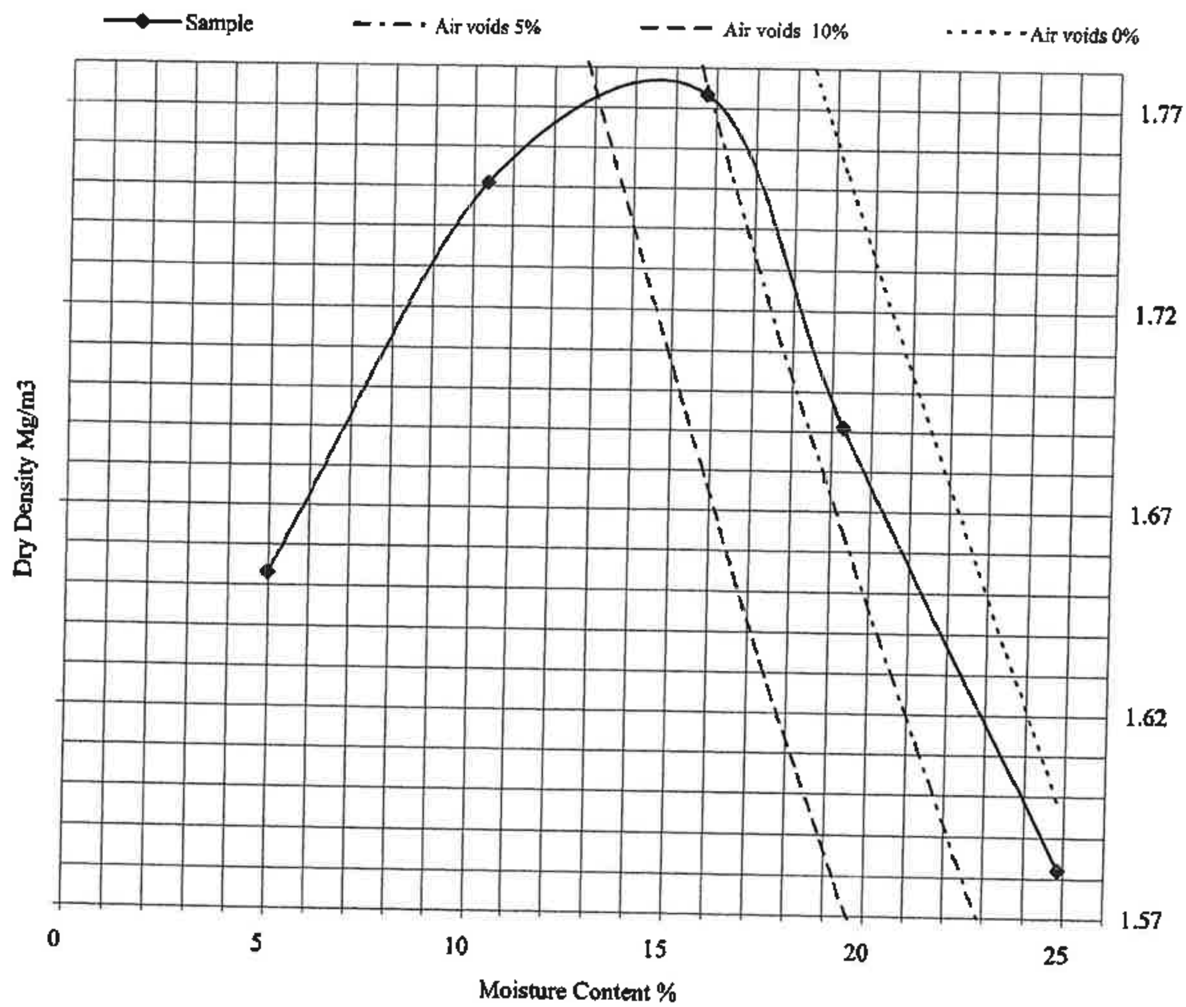
Client Ref No: N/A

UKAS TESTING 2788

Dry Density/Moisture Content Relationship

BS 1377:Part 4:1990

Hole Number: **CBH6** **Depth(m):** **1.00**



Initial Moisture Content:	25	Method of Compaction	2.5Kg Rammer / Single Sample	
Particle Density (Mg/m3):	2.65* Assumed	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (mg/m3):	1.77	Material Retained on 20.0 mm Test Sieve (%):		0
Optimum Moisture Content (%):	16	Sample Preparation Clause :		3.2.4.1

** - not included in laboratory scope of accreditation*

Remarks

Checked by 06/10/07 Date

Approved by 27/10/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

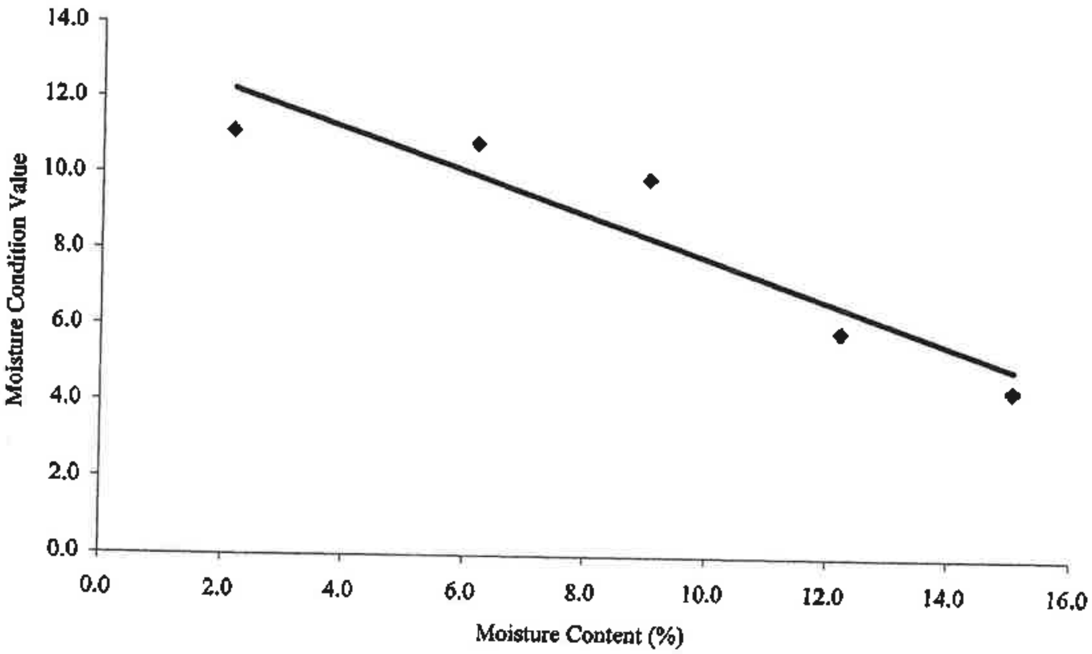
UKAS TESTING 2788

Moisture Condition Value Calibration

BS 1377:Part 4:1990

Hole Number: **CBH2** **Sample Number:** **1794** **Depth (m).:** **1.00**

Initial Moisture Content (%).:	15
Single/Separate Samples Tested.	Single
Material Retained on the 20mm BS Test Sieve (%).:	40



Test Results.

Test Number.	1	2	3	4	5
Moisture Content (%).	2.2	6.2	9.0	12	15
MCV	11.1	10.8	9.9	5.9	4.4

*** reading unobtainable.**

Checked by 06/03/07 Date

Approved by 27/02/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3196/06

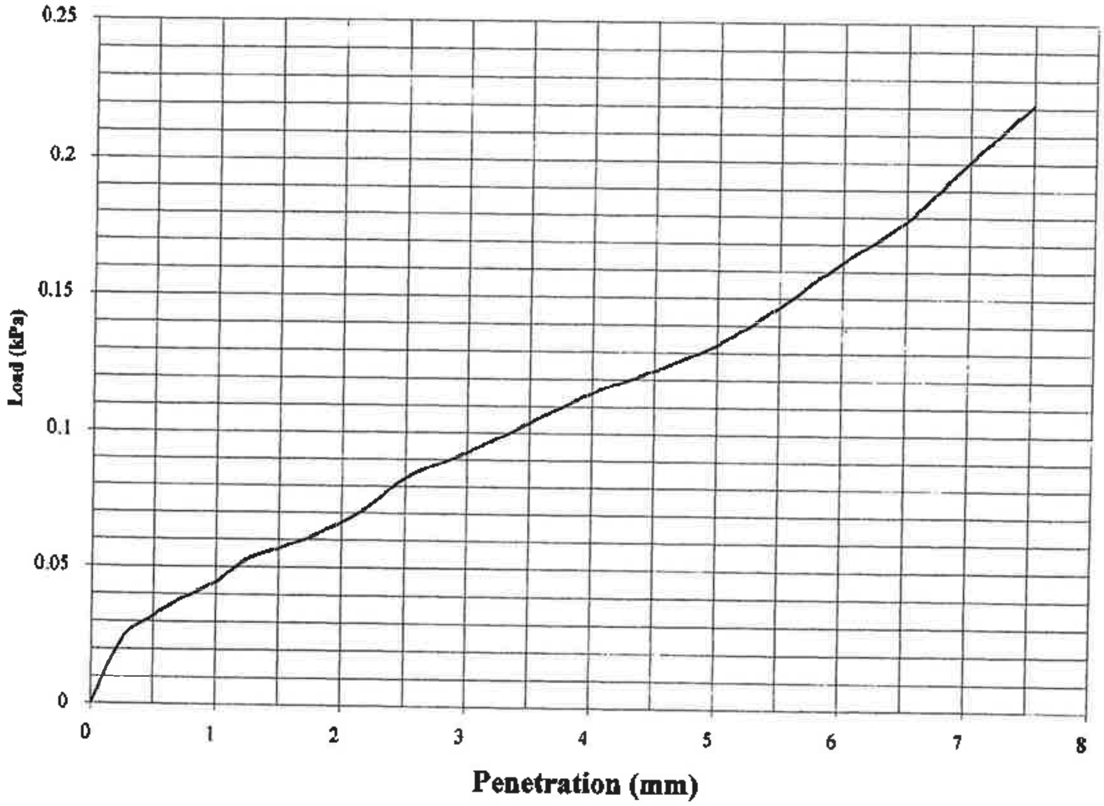
Client Ref No: N/A

UKAS TESTING 2788

California Bearing Ratio Test.

BS 1377:Part 4:1990

Hole Number: CBH1 **Sample Number:** N/A **Depth (m)** 1.00



Initial Sample Conditions		Test Conditions		Method of compaction : 2.5 Kg Rammer	
Moisture Content:	17	Surcharge Kg:	2.0	Final Moisture Content %	
Bulk Density Mg/m3:	4.83	Soaking Time hrs	n/a	Sample Top	17
Dry Density Mg/m3:	4.13	Swelling mm:	n/a	Sample Bottom	N/A
C.B.R. Value %	Sample Top	0.7		Sample Bottom	N/A
Percentage retained on 20mm BS test sieve:		0	Remarks:		

Checked by Date 06/03/07

Approved by Date 06/03/07

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

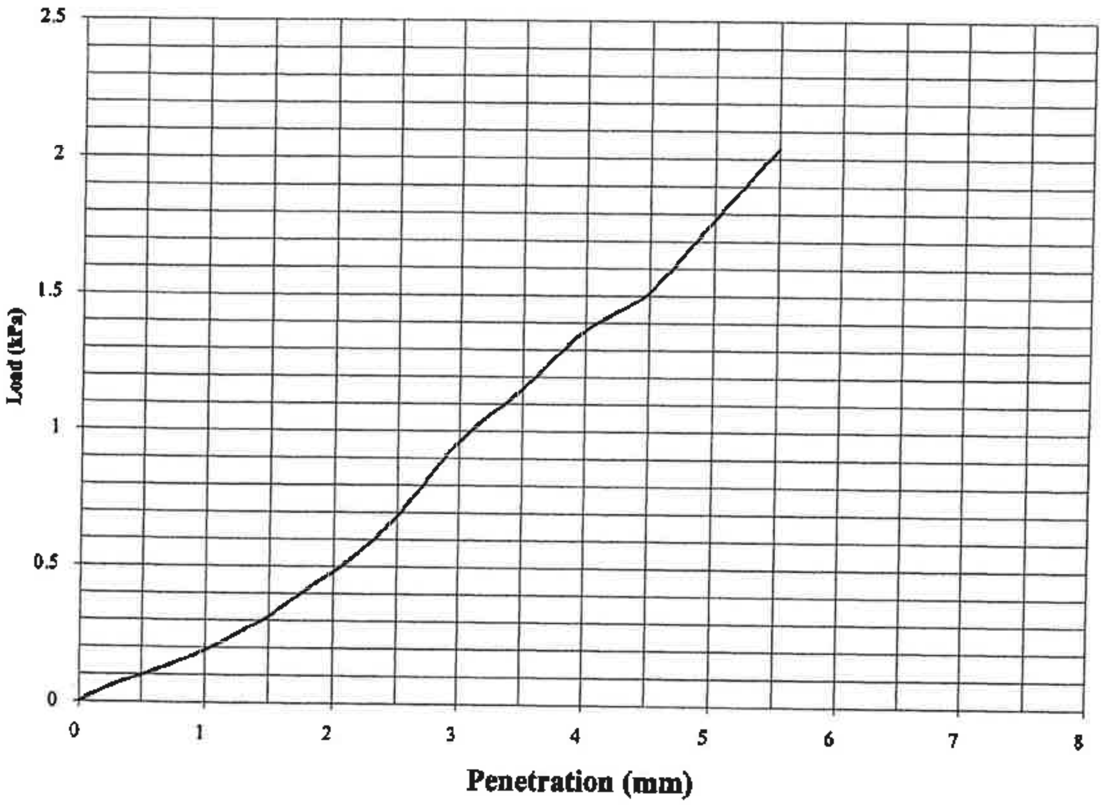
Client Ref No: N/A

UKAS TESTING 2788

California Bearing Ratio Test.

BS 1377:Part 4:1990

Hole Number: **CBH5** **Depth (m)** **1.00**



Initial Sample Conditions		Test Conditions		Method of compaction : 2.5 Kg Rammer	
Moisture Content:	9.4	Surcharge Kg:	2.0	Final Moisture Content %	
Bulk Density Mg/m3:	2.21	Soaking Time hrs	n/a	Sample Top	9.4
Dry Density Mg/m3:	2.02	Swelling mm:	n/a	Sample Bottom	N/A
C.B.R. Value %	Sample Top	8.9		Sample Bottom	N/A
Percentage retained on 20mm BS test sieve:		36	Remarks:		

Checked by 06/03/07 Date

Approved by 06/03/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

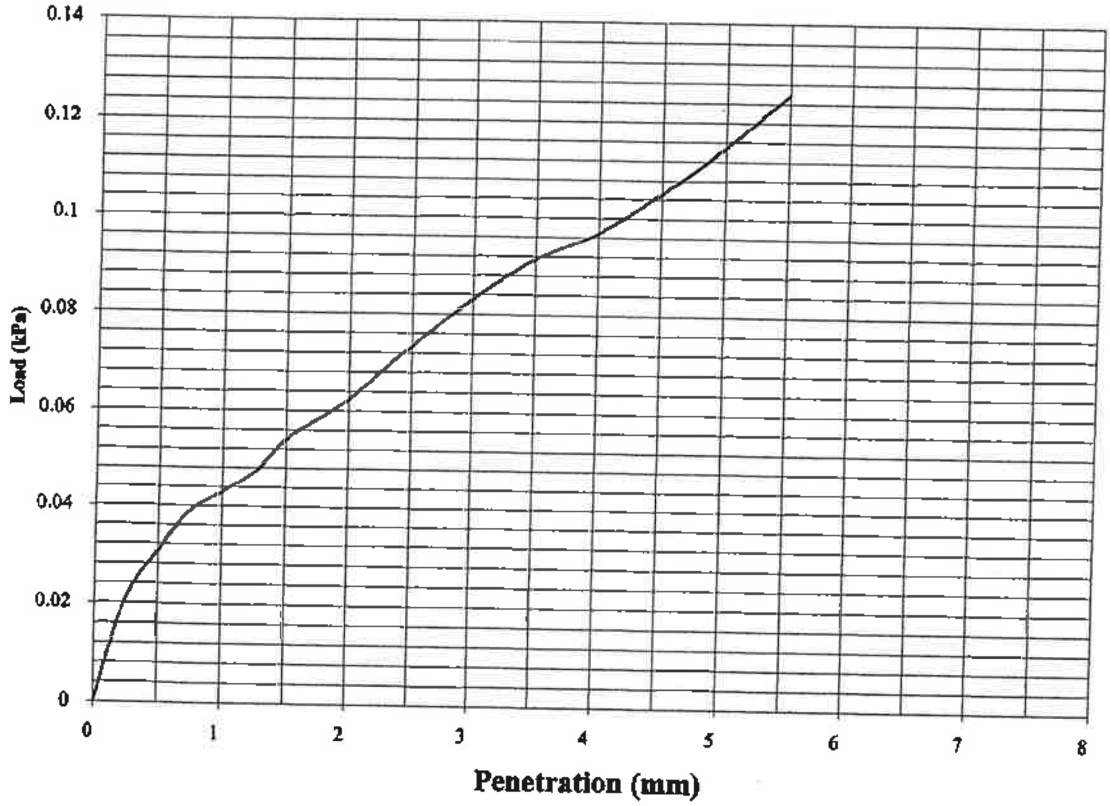
Client Ref No: N/A

UKAS TESTING 2788

California Bearing Ratio Test.

BS 1377:Part 4:1990

Hole Number: **CBH6** **Depth (m)** **1.00**



Initial Sample Conditions		Test Conditions		Method of compaction : 2.5 Kg Rammer	
Moisture Content:	25	Surcharge Kg:	2.0	Final Moisture Content %	
Bulk Density Mg/m3:	1.97	Soaking Time hrs	n/a	Sample Top	25
Dry Density Mg/m3:	1.58	Swelling mm:	n/a	Sample Bottom	N/A
C.B.R. Value %	Sample Top	0.57		Sample Bottom	N/A
Percentage retained on 20mm BS test sieve:		0	Remarks:		

Checked by 06/03/07 Date

Approved by 27/02/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.: GEO/3543/07

Client Ref No: N/A

UKAS TESTING 2766

SUMMARY OF CHEMICAL ANALYSES

(B.S. 1377 : PART 3 : 1990 AND BRE CP2/79)

Hole Number	Sample Number	Depth m	Sulphate Content SO3 (as SO_4) Acid Soluble Sulphate as % SO_4 Clause 5.5.	Aqueous Extract Sulphate as g/l SO_4 Clause 5.5.	Ground-water g/l Clause 5.4.	Chloride Content Soluble Chloride as % equiv. NaCl Clause 7.3	Ground-water g/l Clause 7.2	pH Value @ 25°C Clause 9.	Total Sulphur %	LOI	Organic	Nitrate mg/l
CBH1		2.00	0.10 (0.12)	<.01 (<.01)				7.83	0.03			
CBH2		1.00		<.01 (<.01)				7.70				
CBH3		1.00	0.27 (0.33)	<.01 (0.01)		NCP		7.11	0.09	0.72	0.46	
CBH3		2.00		<.01 (<.01)				7.58				
CBH4		2.00		<.01 (0.01)				6.87				
CBH5		2.00		<.01 (<.01)				7.23				
CBH5		4.00		<.01 (<.01)				6.63				
CBH6		2.00		<.01 (<.01)				6.80				
CBH6		3.00		0.01 (0.01)				6.49				
CBH6		7.10		<.01 (<.01)				6.23				

NCP -No Chloride present

Checked By

29/03/07
Date

Approved By

29/03/07
Date

LABORATORY TESTING SERVICES LIMITED

CARRIGALINE

Contract No. GEO/3543/07

Client Ref No. 0

Bynea, Llanelli, SA14 9SU.

TEST AMENDMENT NOTICE

LABORATORY TESTING SERVICES LTD

(Please tick boxes as appropriate)

From: Dafydd   To: Site Investigations

Date: 20 / 02 /2006   Laboratory Ref:

Contract Number: Location: Carrigaline

☑ BH o TP Sample Number 4   Depth (m): 1.00m

Sample Type: o U ☑ B o D o W o P

Test/s: Compaction, CBR.

The above sample cannot be tested for the following reasons:

- [illegible] been received
- ❑ There is [illegible] material for BS1377 1990 [illegible]
  - Maximum Grain size [illegible]
  - Sample Mass (kg)
  - Required Mass (kg)
- ❑ The Sample has [illegible] previously tested
- ❑ The Sample has [illegible] misplaced in the Laboratory
- ☑ The Sample is unsuitable for testing because Insufficient material

Please advise action required:

- ❑ Perform original test on the following alternative Sample
  - o BH o TP Sample Number: Depth (m):
  - Sample Type: o U o B o D o W o P o C
- ❑ Combine original Sample with the following sample:
  - o BH o TP Sample Number: Depth (m):
  - Sample Type: o U o B o D o W o P o C
- ❑ Perform the following alternative test/s on the original Sample
- ❑ Perform non-standard test on material available (Written Confirmation is required from the Client).
- ❑ Take no further action.

Signed .... Date ....
(Project Engineer)

LABORATORY TESTING SERVICES LTD

TEST AMENDMENT NOTICE

(Please tick boxes as appropriate)

From: Dafydd

To: Site investigations

Date: 20/ 02 /2006

Laboratory Ref:

Contract Number: Geo 3543 / 07

Location: Carrigaline

☑ BH o TP Sample Number 28 Depth (m): 1 · 80m

Sample Type: [illegible] ☑ B o D [illegible] o P [illegible]

Test/s: CBR

The above sample [illegible] be tested for the following [illegible]

- [illegible] been received
- ☐ There [illegible] material for BS 1377 [illegible] testing
  - Maximum Grain Size [illegible]
  - Sample Mass (kg)
  - Required Mass (kg)
- ☐ The Sample [illegible] previously tested.
- ☐ The Sample has been misplaced in the Laboratory
- ☑ The Sample is unsuitable for testing because: Not enough Sample for CBR Testing

---

Please advise action required:

- ☐ Perform original test on the following alternative Sample
  - o BH o TP Sample Number: Depth (m):
  - Sample Type: o U o B o D o W o P o C
- ☐ Combine original Sample with the following sample:
  - o BH o TP Sample Number: Depth (m):
  - Sample Type: o U o B o D o W o P o C
- ☐ Perform the following alternative test/s on the original Sample
- ☐ Perform non-standard test on material available
  (Written Confirmation is required from the Client).
- ☐ Take no further action.

Signed .... Date ....
(Project Engineer)

LABORATORY TESTING SERVICES LTD

TEST AMENDMENT NOTICE

(Please tick boxes as appropriate)

From: Dafydd　　To: Site investigations

Date: 20 / 02 /2006　　Laboratory Ref:

Contract Number: Geo 3543 / 07　　Location: Carrigaline

☑ BH　○ TP　Sample Number 7　Depth (m): 1.00m

Sample Type: ○ U　☑ B　○ D　○ W　○ P

Test/s: Compaction

The above sample cannot be tested for the following reasons:

- ❑ The sample has not been received
- ❑ There is insufficient material for BS1377:1990 testing
  - Maximum Grain Size (Mm mm)
  - Sample Mass (kg)
  - Required Mass (kg)
- ❑ The Sample has been previously tested.
- ❑ The Sample has been misplaced in the Laboratory
- ☑ The Sample is unsuitable for testing because: Insufficient material

---

Please advise action required:

- ❑ Perform original test on the following alternative Sample
  - ○ BH　○ TP　Sample Number:　Depth (m):
  - Sample Type: ○ U　○ B　○ D　○ W　○ P　○ C
- ❑ Combine original Sample with the following sample:
  - ○ BH　○ TP　Sample Number:　Depth (m):
  - Sample Type: ○ U　○ B　○ D　○ W　○ P　○ C
- ❑ Perform the following alternative test/s on the original Sample
- ❑ Perform non-standard test on material available (Written Confirmation is required from the Client).
- ❑ Take no further action.

Signed ....　Date ....
(Project Engineer)

LABORATORY TESTING SERVICES LTD

TEST AMENDMENT NOTICE

(Please tick boxes as appropriate)

From: Dafydd | To: Site Investigations
Date: 20 / 02 /2006 | Laboratory Ref:
Contract Number: | Location: Carrigaline

☑ BH o TP Sample Number 4 Depth (m): 1.00m

Sample Type: o [illegible] ☑ B o D [illegible] o P

Test/s: Compaction , CBR .

The above sample cannot be tested for the following reasons

- ❑ [illegible] been received
- ❑ There is [illegible] material for BS1377: 1990 [illegible]
  - Maximum Grain Size (Millimetres)
  - Sample Mass (kg)
  - Required Mass (kg)
- ❑ The Sample has been previously tested
- ❑ The Sample has been misplaced in the Laboratory
- ☑ The Sample is unsuitable for testing because: Insufficient Material

---

Please advise action required:

- ❑ Perform original test on the following alternative Sample
  - o BH o TP Sample Number: Depth (m):
  - Sample Type: o U o B o D o W o P o C
- ❑ Combine original Sample with the following sample:
  - o BH o TP Sample Number: Depth (m):
  - Sample Type: o U o B o D o W o P o C
- ❑ Perform the following alternative test/s on the original Sample
- ❑ Perform non-standard test on material available
  (Written Confirmation is required from the Client).
- ❑ Take no further action.

Signed .... Date ....
(Project Engineer)

GEO LABORATORY TESTING SERVICES LTD

TEST AMENDMENT NOTICE

(Please tick boxes as appropriate)

From: Dafydd　　　To: Site Investigations

Date: 20 / 02 /2006　　　Laboratory Ref:

Contract Number: Geo 3543 / 07　　　Location: Carrigaline

✓ BH　o TP　Sample Number 3　　　Depth (m): 1.00m

Sample Type: o U　✓ B　o D　o W　o P　o C

Test/s: MCV Calibration

The above sample cannot be tested for the following reasons:

- ☐ The sample has not been received
- ☐ There is insufficient material for BS1377: 1990 testing
  - Maximum Grain Size / Minimum
  - Sample Mass (kg)
  - Required Mass (kg)
- ☐ The Sample has been previously tested.
- ☐ The Sample has been misplaced in the Laboratory
- ✓ The Sample is unsuitable for testing because: Insufficient material

---

Please advise action required:

- ☐ Perform original test on the following alternative Sample:
  - o BH　o TP　Sample Number　　Depth (m):
  - Sample Type: o U　o B　o D　o W　o P　o C
- ☐ Combine original Sample with the following sample:
  - o BH　o TP　Sample Number　　Depth (m):
  - Sample Type: o U　o B　o D　o W　o P　o C
- ☐ Perform the following alternative tests on the original Sample
- ☐ Perform non-standard test on material available (Written Confirmation is required from the Client).
- ☐ Take no further action.

Signed ....　　Date ....
(Project Engineer)

Point Load Test Broch,E. & Franklin,J.A.,IRSM Point Load Test Method

Uniaxial Compressive Strength in accordance with BS1881

Client	Mott McDonald
Site	Carrigaline
S.I. File No	4404 / 06
Test Lab	Site Investigations Ltd., Main Street, Newcastle, Co. Dublin. Tel: (01) 4589944 Fax: (01) 4589418
Test Date	28th February 2007

Hole ID	Depth	Lab Ref.	Sample Type	Diameter / Height (mm)	Test Type	Is (MN/m2)	Is50 (MN/m2)	Strength (MPa)	Strength Designation	Approx. Equivalent UCS Value (MN/m2)	Remarks
CBH02	13.00	07/369	C	77	PL	2.74	4.00		Strong	75.0	
CBH02	13.80	07/370	C	77	PL	2.98	4.50		Strong	82.0	
CBH03	14.50	07/416	C	76 / 154	UCS			34.5	Moderately Strong		
CBH03	15.00	07/371	C	77	PL	6.09	8.00		Very Strong	167.5	
CBH03	15.50	07/372	C	77	PL	1.16	1.60		Moderately Strong	32.0	
CBH03	16.00	07/373	C	77	PL	1.10	2.00		Moderately Strong	30.0	
CBH03	17.00	07/374	C	77	PL	1.83	4.00		Strong	50.5	
CBH03	17.40	07/375	C	77	PL	2.63	4.50		Strong	72.5	
CBH04	6.90	07/376	C	64	PL	5.46	6.20		Very Strong	140.0	
CBH04	8.00	07/377	C	64	PL	1.82	2.80		Strong	46.5	
CBH04	9.00	07/378	C	64	PL	2.08	2.80		Strong	53.5	
CBH04	10.00	07/379	C	64	PL	8.33	10.50		Extremely Strong	213.5	
CBH04	10.90	07/417	C	63 / 116	UCS			59.0	Strong		
CBH04	11.20	07/380	C	64	PL	4.44	5.10		Very Strong	113.5	
CBH04	12.00	07/381	C	64	PL	4.30	5.10		Very Strong	110.0	
CBH04	13.00	07/382	C	64	PL	8.00	10.50		Extremely Strong	205.0	
CBH05	8.00	07/383	C	64	PL	4.76	6.00		Very Strong	120.0	
CBH05	8.50	07/384	C	64	PL	1.18	1.60		Moderately Strong	29.5	
CBH05	10.50	07/385	C	64	PL	2.49	4.50		Strong	62.5	
CBH05	11.00	07/386	C	64	PL	2.42	4.50		Strong	61.0	
CBH05	12.40	07/387	C	64	PL	0.44	0.55		Moderately Weak	11.0	
CBH05	13.00	07/388	C	64	PL	3.38	5.00		Strong	85.0	
CBH05	14.50	07/389	C	64	PL	1.46	1.90		Moderately Strong	37.0	
CBH05	15.00	07/390	C	64	PL	3.12	4.50		Strong	78.5	

SN Printed 28/02/2007

Paddy McGonagle
Site Investigations Ltd

Point Load Test Broch,E. & Franklin,J.A.,IRSM Point Load Test Method

Uniaxial Compressive Strength in accordance with BS1881

Client	Mott McDonald
Site	Carrigaline
S.I. File No	4404 / 06
Test Lab	Site Investigations Ltd., Main Street, Newcastle, Co. Dublin. Tel: (01) 4589944 Fax: (01) 4589418
Test Date	28th February 2007

Hole ID	Depth	Lab Ref.	Sample Type	Diameter / Height (mm)	Test Type	Is (MN/m2)	Is50 (MN/m2)	Strength (MPa)	Strength Designation	Approx. Equivalent UCS Value (MN/m2)	Remarks
CBH05	15.80	07/391	C	64	PL	5.85	7.00		Very Strong	147.5	
CBH06	7.90	07/392	C	64	PL	2.15	4.00		Strong	54.0	
CBH06	8.00	07/418	C	63 / 120	UCS			44.5	Moderately Strong		
CBH06	8.90	07/393	C	64	PL	0.58	1.60		Moderately Strong	14.5	
CBH06	9.50	07/394	C	64	PL	4.57	6.00		Very Strong	115.0	
CBH06	11.00	07/395	C	64	PL	3.76	5.00		Strong	95.0	
CBH06	12.00	07/396	C	64	PL	0.42	0.55		Moderately Weak	10.5	
CBH06	13.00	07/397	C	64	PL	2.15	4.00		Strong	54.0	
CBH06	8.6-8.7	07/398	C	64	PL	2.15	4.00		Strong	54.0	
CBH07	8.90	07/399	C	64	PL	3.49	5.00		Strong	88.0	
CBH07	9.50	07/400	C	64	PL	2.86	4.00		Strong	72.0	
CBH07	10.00	07/401	C	64	PL	4.31	6.00		Very Strong	108.5	
CBH07	10.20	07/402	C	64	PL	2.42	4.00		Strong	61.0	
CBH07	13.00	07/403	C	64	PL	1.42	1.90		Moderately Strong	35.5	
CBH07	13.50	07/404	C	64	PL	1.17	1.60		Moderately Strong	29.5	
CBH07	14.50	07/405	C	64	PL	2.77	4.00		Strong	70.0	

Paddy McGonagle
Site Investigations Ltd

LABORATORY TESTING SERVICES LIMITED

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SUGGESTED METHOD FOR POROSITY/DENSITY DETERMINATION USING SATURATION AND CALIPER TECHNIQUES

(Rock Characterization Testing and Monitoring ISRM Suggested Methods Part 1 : 2 : Page 83)

Contract Number: GEO/3627/07

Location Carrigaline

Borehole Number	CBH02	CBH03	CBH04
Depth (m)	13 – 14.0m	14.5 – 19.6m	4.0 – 13.0m
Bulk Density - p (Mg/m3):	2.68	2.66	2.56
Dry Density - pd (Mg/m3):	2.68	2.64	2.52
Bulk Volume - V (g):	161.2	204.1	137.9
Moisture Content - w (%)	0.2	0.4	1.7
Porosity - n (%):	0.9	1.6	4.7

Approved Signatories:

D V Edwards (Managing Director) **Date** 02/04/07

D A Walters (Technical Manager) **Date**

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SUGGESTED METHOD FOR POROSITY/DENSITY DETERMINATION USING SATURATION AND CALIPER TECHNIQUES

(Rock Characterization Testing and Monitoring ISRM Suggested Methods Part 1 : 2 : Page 83)

Contract Number: GEO/3627/07

Location Carrigaline

Borehole Number	CBH05	CBH06	CBH07
Depth (m)	8.1 – 16.0m	7.0 – 13.0m	8.5 – 14.0m
Bulk Density - p (Mg/m3):	2.56	2.57	2.58
Dry Density - pd (Mg/m3):	2.51	2.52	2.55
Bulk Volume - V (g):	95.0	128.7	105.5
Moisture Content - w (%)	1.8	2.0	1.4
Porosity - n (%):	5.0	5.6	4.6

Approved Signatories:

D V Edwards (Managing Director) **Date** 02/04/07

D A Walters (Technical Manager) **Date**

Determination of Aggregate Abrasion Value(AAV).

BS 812 : Part 113 : 1990.

Client:	**Site Investigations Limited**
Date Sampled:	**unknown**
Date tested:	**18/03/2007**
Hole Number:	**CBH2**
Depth(m):	13 – 14.0m
Method of Sampling:	**BS 812: Part 102: 1989**
Sampled By:	**unknown**
Aggregate Type and Nominal Size:	**Passing 14mm, Retianed 20-14 flake**
Test Condition:	**dry**
Target Specification:	**N/A**

The Average Aggregate Abrasion Value(AAV):	**20.4%**

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

	02/04/07		02/04/07
Checked by	**Date**	**Approved by**	**Date**

GEO LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.
GEO/3427/07

Client Ref No.
n/a

Determination of the Slake Durability index.

ISRM Suggested Methods pp 92-94, 1981.

Date:	28-Mar-07
Hole Number:	CBH02
Sample Number:	N/A
Depth (m):	13 - 14.0m
Nature of slaking Fluid:	Fine Sandstone.
Temperature (°C):	20
Rock type:	Dark grey Sandstone.
Date Tested:	19/03/2007
Operator:	Vince Williams

Slake-Durability index (first cycle) %	99.3

Slake-Durability index (second cycle) %	99.1

Appearance of fragments retained in drum:

11no rock fragments of sub-angular to rounded in appearance with worn corners and edges

Appearance of material passing through the drum:

<2mm rock fragments angular to well rounded to silty/clay.

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

Checked by 02/04/07 Date

Approved by 02/04/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.
GEO/3627/07

Client Ref No.
N/A

Determination of the Slake Durability index.

ISRM Suggested Methods pp 92-94, 1981.

Date:	28-Mar-07
Hole Number:	CBH03
Sample Number:	N/A
Depth (m):	14.5 - 14.6 m
Nature of slaking Fluid:	Fine Sandstone.
Temperature (^{0}C):	20
Rock type:	Dark grey Sandstone.
Date Tested:	19/03/2007
Operator:	Vince Williams

Slake-Durability index (first cycle) %	98.3

Slake-Durability index (second cycle) %	97.8

Appearance of fragments retained in drum:

11no rock fragments of sub-angular to rounded in appearance with worn corners and edges

Appearance of material passing through the drum:

<2mm rock fragments angular to well rounded to silty/clay.

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

Checked by 02/04/07 Date

Approved by 02/04/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.
GEO/3627/07

Client Ref No.
N/A

Determination of the Slake Durability index.

ISRM Suggested Methods pp 92-94, 1981.

Date:	28-Mar-07
Hole Number:	CBH04
Sample Number:	N/A
Depth (m):	" 4.0-13.0m
Nature of slaking Fluid:	Fine Sandstone.
Temperature (^{0}C):	20
Rock type:	Dark grey Sandstone.
Date Tested:	19/03/2007
Operator:	Vince Williams

Slake-Durability index (first cycle) %	97.4
Slake-Durability index (second cycle) %	96.9

Appearance of fragments retained in drum:

11no rock fragments of sub-angular to rounded in appearance with worn corners and edges

Appearance of material passing through the drum:

<2mm rock fragments angular to well rounded to silty/clay.

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

Checked by 02/04/07 Date

Approved by 02/04/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.
GEO/3627/07

Client Ref No.
N/A

Determination of the Slake Durability index.

ISRM Suggested Methods pp 92-94, 1981.

Date:	28-Mar-07
Hole Number:	CBH05
Sample Number:	N/A
Depth (m):	8.1 - 16.0m
Nature of slaking Fluid:	Fine Sandstone.
Temperature (°C):	20
Rock type:	Dark grey Sandstone.
Date Tested:	19/03/2007
Operator:	Vince Williams

Slake-Durability index (first cycle) %	97.8

Slake-Durability index (second cycle) %	97.5

Appearance of fragments retained in drum:

11no rock fragments of sub-angular to rounded in appearance with worn corners and edges

Appearance of material passing through the drum:

<2mm rock fragments angular to well rounded to silty/clay.

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

Checked by 2/04/07 Date

Approved by 02/04/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.
GEO/3627/07

Client Ref No.
N/A

Determination of the Slake Durability index.

ISRM Suggested Methods pp 92-94, 1981.

Date:	28-Mar-07
Hole Number:	CBH06
Sample Number:	N/A
Depth (m):	7.0 - 13.0 m
Nature of slaking Fluid:	Fine Sandstone.
Temperature (°C):	20
Rock type:	Dark grey Sandstone.
Date Tested:	19/03/2007
Operator:	Vince Williams

Slake-Durability index (first cycle) %	**95.1**

Slake-Durability index (second cycle) %	**94.2**

Appearance of fragments retained in drum:

11no rock fragments of sub-angular to rounded in appearance with worn corners and edges

Appearance of material passing through the drum:

<2mm rock fragments angular to well rounded to silty/clay.

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

Checked by 04/04/07 Date

Approved by 04/04/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.
GEO/3627/07

Client Ref No.
N/A

Determination of the Slake Durability index.

ISRM Suggested Methods pp 92-94, 1981.

Date:	28-Mar-07
Hole Number:	CBH07
Sample Number:	N/A
Depth (m):	8.5 – 14.0m
Nature of slaking Fluid:	Fine Sandstone.
Temperature (^{0}C):	20
Rock type:	Dark grey Sandstone.
Date Tested:	19/03/2007
Operator:	Vince Williams

Slake-Durability index (first cycle) %	**96.6**

Slake-Durability index (second cycle) %	**96.0**

Appearance of fragments retained in drum:

10no rock fragments of sub-angular to rounded in appearance with worn corners and edges

Appearance of material passing through the drum:

<2mm rock fragments angular to well rounded to silty/clay.

Remarks:
All remaining samples shall be retained for a period of one month from the above date, after which time all samples shall be disposed of.

Checked by 02/04/07 Date

Approved by 02/04/07 Date

LABORATORY TESTING SERVICES LIMITED

Carrigaline

Contract No.
GEO/3627/07

Client Ref No.
N/A

Appendix VI

Notes on the Methodology and Limitations of Cable Percussion Boring

Notes on the Methodology and Limitations of Cable Percussion Boring

The notes below outline the general procedures adopted in this geotechnical site investigation for cable percussion boreholes and the associated in-situ tests and sampling techniques. The procedures are in accordance with BS5930:1999 - 'British Standard Code of Practice for Site Investigation', and BS1377:1990 - 'British Standard Methods of Test for Soils for Civil Engineering Purposes.

The standard method of boring in soil for site investigation is known as the cable percussion method. It consists of using a shell in non cohesive soils and a clay cutter in cohesive soils, both operated on a wire cable. Very hard soils, boulders and other hard obstructions are broken up by chiselling and the fragments removed with the shell. Where ground conditions make it necessary, the boreholes are lined with 200mm diameter steel casing. While the use of the shell & auger method of boring gives the maximum data on soil conditions, some mixing of laminated soil is inevitable. For this reason thin lenses of granular material may not be noticed.

Undisturbed samples cannot be obtained in course soils or in fine soils containing course gravel or cobbles.

Disturbed samples are taken from the boring tools at depths such that a representative sample is obtained from the top of each stratum and at regular intervals within each stratum. The samples are then sealed and sent to the laboratory where they are visually examined and tested as per the Client's schedule.

Borehole water levels are recorded, together with the depths at which seepage of water or inflows are detected and the observations are presented on the borehole logs. In general these observations do not give an accurate indication of the actual ground water conditions as the borehole is rarely left standing at the relevant depth for a sufficient time for the water level to reach equilibrium, a permeable stratum may have been sealed off by the borehole casing, or water may have been added to the borehole to facilitate progress.

Standard Penetration Tests are carried out in all the boreholes. The results of these tests, together with the depths at which the tests were taken are presented on the borehole records. The test consists of a thick wall sampler tube, 50mm external diameter, being driven into the soil by a monkey weighing 65Kg and with a free drop of 760mm. For gravels and glacial till the driving shoe is replaced by a solid 60° cone.

The Standard Penetration Test number, referred to as the 'N' value, is the number of blows required to drive the tube 300mm, after an initial seating penetration of 150mm. The number gives a guide to the consistency or density of the soil and can also be used to estimate the bearing capacity and compressibility of the soil.

Appendix VII

Plant Type Used

Carrigaline

Point ID	Plant Type	Rotary follow-on		
		Plant Type	Coring Method	Core Diameter (mm)
CBH1	Dando 150	Truckmounted Hands Engine Topdrive Rig	Rotary Cored with water flush	82
CBH2	Dando 150			
CBH2A	Dando 150			
CBH2B	Dando 150	Truckmounted Hands Engine Topdrive Rig	Rotary Cored with water flush	82
CBH3	Dando 150	Truckmounted Hands Engine Topdrive Rig	Rotary Cored with water flush	82
CBH4	Dando 150 & Hiltwister 2000	Hiltwister 2000 Quill drive Rig	Rotary Cored with water flush	62
CBH5	Dando 150 & Hiltwister 2000	Hiltwister 2000 Quill drive Rig	Rotary Cored with water flush	62
CBH6	Dando 150 & Hiltwister 2000	Hiltwister 2000 Quill drive Rig	Rotary Cored with water flush	62
CBH7	Dando 150 & Hiltwister 2000	Hiltwister 2000 Quill drive Rig	Rotary Cored with water flush	62
CTP01	Komatsu Avance PC130			
CTP02	JCB (New Holland LB 115)			
CTP03	JCB (New Holland LB 115)			
CTP04	JCB (New Holland LB 115)			
CTP05	JCB (New Holland LB 115)			
CTP06	JCB (New Holland LB 115)			
CTP06A	JCB (New Holland LB 115)			
CTP07	JCB (New Holland LB 115)			
CTP08	Komatsu Avance PC130			
CTP09	Komatsu Avance PC130			
CTP10	Komatsu Avance PC130			

Appendix C

Project: Carrigaline Residential Development

Report Title: Daylight, Sunlight and Overshadowing Analysis

Report By: Passive Dynamics Sustainability Consultants

Date of Issue: 26/04/2021

Contact: info@passivedynamics.ie

Client: Reside Investments Ltd.

Revision:	Date:	Revision Details	Report by:	Approved by:
00	11/10/2021	Draft Issue to Design Team	JT	CMcC
01	26/04/2022	Issued for Planning	JT	CMcC

TABLE OF CONTENTS

EXECUTIVE SUMMARY

A comprehensive Daylight, Sunlight and Overshadowing Assessment for this proposed project is presented in this report. This assessment makes reference to the prescribed methodologies of the BRE guide and applied the specific daylight / sunlight quantitative performance standards contained therein. The BRE guidance refers to the BRE document 'Site Layout Planning for Sunlight and Daylight: A Guide to Good Practice' (2011) (herein referred to as the "BRE Guide") by P J Littlefair, which is based on the previous British daylighting standard (BS 8206-2:2008) and has been accepted as good practice by Planning Authorities.

The BRE Guide gives advice on site layout to achieve provision of daylight and sunlight both within buildings, and in the open spaces between them. In general, it aims to aid designers in considering the relationship between new and existing buildings to ensure that each retains the potential to achieve good daylighting and sunlight levels. This authoritative document is widely used to provide guidance during the planning and design stages of building development in the UK and Ireland.

It is noted that BS 8206-2:2008: Lighting for Buildings - Part 2: Code of practice for daylighting was recently replaced with EN 17037:2018 Daylight in Buildings. BRE is currently revising the BRE Guide (BR209) to align their guidance with the new EN 17037:2018 however, this updated guidance document has not yet been published. Until the new BRE Guide is released, the position of BRE can be summarised from a post by Dr. Littlefair on the LinkedIn Planning Daylight & Sunlight Group (BRE BR209):

"BR209 currently refers to the former British Standard BS 8206 Part 2. For the time being, until BR209 is rewritten, we are adopting a flexible approach to applying the two standards, for example in assessing the daylight and sunlight available in new buildings. So for example if we were reviewing a daylight report for a local authority, we would consider it reasonable to accept either average daylight factor tables calculated using BS8206 or median daylight factors/median illuminances calculated using EN17037, provided they were calculated and presented properly.
EN17037 does not deal with loss of daylight or sunlight to existing buildings, so the current BR209 methodology can be used here, until the revised version is published.".

The British implementation of this standard (BS EN 17037) includes a "National Annex" with requirements for dwellings that mean it is comparable with the previous standard (BS8206). In Ireland, there is only IS EN 17037:2018. Unlike the British Standard (BS EN 17037), the Irish implementation does not contain a National Annex. The ‘Sustainable Urban Housing: Design Standards for New Apartments’ (last revised 23 December 2020), the ‘Urban Development and Building Heights Guidelines for Planning Authorities” (published December 2018) do not mention, address or require compliance with the European Standard (published 12 December 2018) or the Irish implementation (published 28 January 2019).

As a consequence of this, we have carried out a comprehensive daylighting analysis using both standards, providing daylighting results in terms of Average Daylight Factor (based on previous British Standard – BS 8206-2) and Spatial Daylight Autonomy (based on current European Standard – EN 17037) and the National Annex within the British implementation of the European Standard (BS EN 17037). The sunlight component of this assessment has been carried out in accordance with existing BRE guidance (BR209).

It is important that the guidelines that exist in relation to daylight and sunlight are read in the correct context and are not viewed as mandatory requirements. Requirements for daylight should be balanced against other elements of the design such as thermal performance (which is directly impacted by the size, shape and location of glazing) and the risk of overheating due to excessive glazing areas. This approach will ensure an optimal overall solution is reached for the development.

Impact of loss of daylight to neighbouring properties

The Vertical Sky Component (VSC) Analysis is covered in detail in *Section 7* of this report. A summary of the results are as follows;

A simulation was run to quantify any reduction in VSC of the surrounding buildings resulting from the proposed development massing. Where the VSC is greater than 27% reasonable daylighting levels are available according to the BRE Industry standard. Where the VSC is found to be less than 27% but the comparison between the "before and after scenarios" is less than a 20% reduction, daylighting is unlikely to be significantly affected / noticed.

Our simulation analyses the impact that the proposed development has on the windows of its surrounding buildings. The existing adjacent buildings are residential properties and so, and in keeping with the guidance protocols, the windows of these buildings were assessed for potential loss of daylight.

As there was no information available regarding the glazing positioning or areas within the adjacent existing properties, notional windows were modelled so that the VSC could be assessed for these buildings. These notional windows provide an indication of whether or not the daylighting within the existing adjacent buildings will be impacted by the proposed development.

The assessed surrounding buildings along Kilmoney Street Lower largely meet the recommended VSC value according to the BRE Guide. Of the 59 notional openings assessed, 58 openings (98.3%) achieve a VSC result that meets the recommendation outlined in the BRE Guide.

As a result of this analysis, it is our understanding that the vast majority of adjacent building openings achieve a VSC in line with the recommendation of the BRE Guide, with one opening (Surrounding Block 10, north-facing opening) experiencing a "minor adverse" impact (according to BRE guidance) due to the proposed development.

Consideration should be given to the fact that the comparison being made is between an under-utilised existing site and the proposed development, which is inevitably going to have some form of an impact given its proximity and relative height. The planning authority should consider applying flexibility with regard to BRE standards to balance the objective of achieving urban regeneration with any potential impacts.

Average Daylight Factor within the proposed apartments

Average Daylight Factor results are covered in detail in *Section 8* of this report. Daylight performance for this development has been assessed using BR209 (BRE guidance document based on the standards outlined in BS8206-2) and EN 17037 (latest European Standard which supersedes BS8206). A summary of the results are as follows;

Average Daylight Factor (BS8206-2: 2008)

Minimum recommended Average Daylight Factors (ADF) are:

- Bedrooms – 1.00 %
- Kitchen/Living– 2.00 %

Calculated ADF results for all rooms eligible for assessment are as follows:

- **98.0%** of Bedrooms achieve an ADF of ≥ 1.00%
- **94.6%** of the Kitchen/Living rooms achieve an ADF of ≥ 2.00%

The calculated ADF results for each space assessed are presented in *Section 8* and Appendix C of this report.

Spatial Daylight Autonomy (EN 17037:2018)

In order to comply with the daylighting standard set out in EN 17037, each space assessed must achieve the following:

- 300 Lux over at least 50% of its floor area for over 50% of annual daylit hours, and
- 100 Lux over at least 95% of its floor area for over 50% of annual daylit hours

The results of this spatial daylight autonomy assessment are summarised below and tabulated in detail in Appendix C of this report in accordance with EN 17037.

- **90.7%** of the total number of spaces assessed achieve the annual required illuminance according to EN 17037 (Bedrooms and Kitchen/Living spaces assessed using the EN17037 metric outlined above)

Spatial Daylight Autonomy using British National Annex Illuminance Targets (BS EN 17037:2018)

The spaces were also assessed for spatial daylight autonomy using the British National Annex illuminance targets shown below. This BS EN standard includes a national annex which provides adjusted illuminance targets for each room type as shown in *Table NA.1 — Values of target illuminance for room types in UK dwellings*, the minimum target daylight provisions for bedrooms and kitchen/living spaces are:

- Kitchen/Living – 200 Lux achieved over at least 50% of the reference plane (0.85m) and
- Bedrooms – 100 Lux achieved over at least 50% of the reference plane (0.85m)

Table NA.1 — Values of target illuminance for room types in UK dwellings

Room type	Target illuminance E_T (lx)
Bedroom	100
Living room	150
Kitchen	200

A summary of the results are as follows;

- 100.0% of bedrooms achieve the required annual illuminance according to BS EN 17037 (100 Lux test)
- 99.5% of kitchens/living/dining rooms achieve the required annual illuminance according to BS EN 17037 (200 Lux test)
- **99.8%** of the total number of spaces assessed achieve the annual required illuminance according to the National Annex within BS EN 17037.

The results of this spatial daylight autonomy assessment are summarised below and tabulated in detail in Appendix E of this report in accordance with EN 17037.

A number of compensatory factors exist within the spaces that do not meet the daylight performance criteria outlined above. These are described in *Section 10* of this report.

Sunlight availability – proposed living spaces
The BRE guidance document states that rooms will appear reasonably sunlit provided: • at least one main window wall faces within 90º of due south and • the centre of at least one window to a main living room can receive 25% of annual probable sunlight hours, including at least 5% of annual probable sunlight hours in the winter months between 21st September and 21st March. 1. All Kitchen/living room openings within the proposed development that face within 90º of due south were assessed for annual sunlight availability. While many of the assessed openings achieve the recommended level of annual sunlight hours, there are a number of windows assessed that do not achieve the BRE recommended levels of annual sunlight due to their location and proximity to other sections of the building and shading devices. 2. All kitchen/living room openings within the proposed development that face within 90º of due south were assessed for sunlight availability during the winter months (September to March). While the majority of the assessed openings achieve the recommended level of winter sunlight hours, there are a number of windows assessed that do not achieve the BRE recommended levels of annual sunlight due to their location and proximity to other sections of the building and shading devices. As the proposed development is located north of the neighbouring residential properties, the windows that are eligible for sunlight assessment in line with BRE guidance within the neighbouring properties will not be impacted by the proposed development. For this reason, the surrounding residential properties were not assessed for sunlight availability. This information is presented in detail in Section 9 of this report.
Sunlight availability within amenity spaces
Sunlight availability results are covered in detail in Section 9 of this report. The proposed courtyards and neighbouring garden areas were assessed for sunlight availability. BRE Guidelines recommend that for an amenity space to appear adequately sunlit throughout the year, <u>at least half of the amenity space should receive at least two hours of sunlight on the design day, March 21st.</u> If, as a result of a new development, an existing garden or amenity area does not meet the above, and the area which can receive two hours of sun on March 21st is less than 0.8 times its former value, then the loss of sunlight is likely to be noticeable. The analysis confirms that the amenity areas of the proposed development achieve upward of 2 hours of sunlight on the design day (21st March) across the vast majority of their areas, therefore complying with the BRE Guidelines.

The gardens of the neighbouring properties were also assessed for sunlight availability. These areas receive sufficient levels of sunlight in line with the BRE guidance, achieving 2 hours of sunlight over the vast majority of their total area on the design day. The proposed development will not cause a significant impact to the level of sunlight in the neighbouring gardens as the development is located north of the gardens themselves.

Overshadowing Analysis

March 21st

No significant additional overshadowing of neighbouring properties resulting from the proposed development with any minor impact limited to short time periods in the late evening.

June 21st

No significant additional overshadowing of neighbouring properties resulting from the proposed development with any minor impact limited to short time periods in the late evening.

September 21st

No significant additional overshadowing of neighbouring properties resulting from the proposed development with any minor impact limited to short time periods in the late evening.

December 21st

No significant additional overshadowing of neighbouring properties resulting from the proposed development with any minor impact limited to short time periods in the late evening.

See Appendix A for Overshadowing Images.

1. INTRODUCTION

Passive Dynamics Sustainability Consultants has prepared this Daylight, Sunlight and Overshadowing report for and on behalf of Reside Investments Ltd. to accompany the planning application for the proposed Carrigaline residential development. The scope of the assessment was to determine the following:

- Impact of loss of daylight to neighbouring properties
- Average Daylight Factor within the proposed apartments
- Sunlight availability within the proposed development and proposed/neighbouring amenity spaces
- Overshading analysis and impact to neighbouring properties

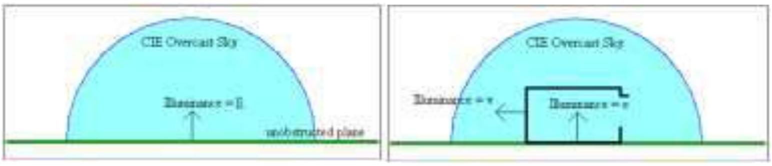
Daylight and Sunlight calculations have been carried out in accordance with BRE's 'Site Layout Planning for Sunlight and Daylight: A Guide to Good Practice' (2011) (herein referred to as the "BRE Guide") by P J Littlefair, which is accepted as good practice by Planning Authorities. The Design Standards for New Apartments - Guidelines for Planning Authorities (March 2018) were also considered as part of this study.

The BRE Guide gives advice on site layout to achieve provision of daylight and sunlight both within buildings, and in the open spaces between them. In general, it aims to aid designers in considering the relationship between new and existing buildings to ensure that each retains the potential to achieve good daylighting and sunlight levels.

The BRE Guide states in the introduction that: "The guide is intended for building designers and their clients, consultants and planning officials. ***<u>The advice given here is not mandatory and the guide should not be seen as an instrument of planning policy;</u>*** *its aim is to help rather than constrain the designer. Although it gives numerical guidelines,* ***<u>these should be interpreted flexibly since natural lighting is only one of many factors in site layout design.</u>*** *In special circumstances the developer or planning authority may wish to use different target values. For example, in a historic city centre, or in an area with modern high-rise buildings, a higher degree of obstruction may be unavoidable if new developments are to match the height and proportions of existing buildings".* **It is therefore important that the guidelines that exist in relation to daylight and sunlight are read in the correct context and are not viewed as mandatory requirements.**

2. DEFINITIONS

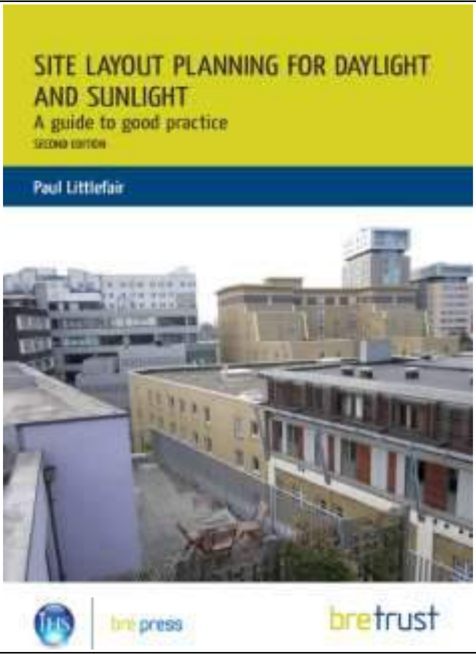
The technical definitions that are referred to in this report are explained below.

BRE	The Building Research Establishment (BRE) is a centre of building science in the United Kingdom, owned by charitable organisation the BRE Trust. It is a former UK government national laboratory that was privatised in 1997.
Vertical Sky Component (VSC)	The Vertical Sky Component (VSC) measures the amount of skylight available to a window. This represents the amount of daylight available to the window. The BRE Guide describes the VSC as the "Ratio of that part of illuminance, at a point on a given vertical plane that is received directly from a CIE standard overcast sky, to illuminance on a horizontal plane due to an unobstructed hemisphere of this sky. Usually the "given vertical plane" is the outside of a window wall. The VSC does not include reflected light, either from the ground or from other buildings."  E= illuminance on an unobstructed plane. (the amount of daylight available in an open space with no obstructions) v= illuminance at a point in the centre of a vertical opening (the amount of daylight available at a point in the centre of a vertical opening) Vertical Sky Component = v/E
CIE Standard Overcast Sky	CIE Standard Overcast Sky is a typical overcast sky used for daylight analysis. For this completely overcast sky, the ratio of its luminance Ly at an angle of elevation y above the horizontal to the luminance Lz at the zenith is given by: $L_y = L_z \frac{(1+2\sin y)}{3}$ The CIE standard overcast sky is darkest at the horizon and brightest at the zenith (vertically overhead).
Average Daylight Factor (ADF)	This is a measure of the amount of daylight available to a space relative to the level of light outside. The ratio of total daylight flux incident on a reference area to total area of reference area, expressed as a percentage of outdoor illuminance on a horizontal plane due to an unobstructed hemisphere of sky of assumed or known luminance distribution. Thus a 1% ADF would mean that the average indoor illuminance would be one hundredth the outdoor unobstructed illuminance.

Annual Probable Sunlight Hours (APSH)	Annual Probable Sun Hours (APSH) represents the sunlight that a given window may expect over a year period. APSH is expressed as the percentage of direct sunlight hours divided by number of hours when sky was clear with sun.
sDA	Spatial Daylight Autonomy (sDA) examines whether a space receives enough daylight during standard operating hours (8 a.m. to 6 p.m.) on an annual basis using hourly illuminance grids on the horizontal work plane. sDA is calculated virtually through computational simulation with precise parameters. It references a local climate file to run hourly illuminance maps in the lighting software package.
EN	European Norm (EN) abbreviation verifies that the technical standard referenced throughout this report (EN 17037) is drafted and maintained by the European Committee for Standardisation (CEN).

3. GUIDANCE DOCUMENTS REFERENCED DURING THIS STUDY

This Daylight, Sunlight and Overshadowing Assessment has been carried out in accordance with the following best practice standard as outlined by the BRE and cross referenced by the Department of Housing, Planning and Local Government.

<table>
<tr>
<td>
</td>
<td>This document gives advice on site layout planning to achieve good sun lighting and daylighting, both within buildings and in the open spaces between them. This authoritative document is widely used to provide advice during the planning and design stages of building development in the UK and Ireland.

Guidance is given on site layout for good sun lighting and daylighting; safeguarding of daylight and sunlight within existing buildings nearby; and the protection of daylighting of adjoining land for future development.</td>
</tr>
<tr>
<td>An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreachta
Department of Housing, Local Government and Heritage

Sustainable Urban Housing: Design Standards for New Apartments

Guidelines for Planning Authorities issued under Section 28 of the Planning and Development Act, 2000 (as amended)

December 2020</td>
<td>Design Standards for New Apartments - Guidelines for Planning Authorities (December 2020). This document outlines the design guides that should be used to assess daylight provision for new apartments.

6.6 Planning authorities should have regard to quantitative performance approaches to daylight provision outlined in guides like the BRE guide 'Site Layout Planning for Daylight and Sunlight' (2nd edition) or BS 8206-2: 2008 – 'Lighting for Buildings – Part 2: Code of Practice for Daylighting' when undertaken by development proposers which offer the capability to satisfy minimum standards of daylight provision.</td>
</tr>
</table>

<table>
<tr>
<td>

I.S. EN 17037:2018
EUROPEAN STANDARD EN 17037
NORME EUROPÉENNE
EUROPÄISCHE NORM December 2018
English Version
Daylight in buildings
</td>
<td>
EN 17037:2018
This European standard provides target illumincance levels to be achieved within a horizontal plane in a space in order for the space to be considered adequately daylit.

The standard “encourages building designers to assess and ensure successfully daylit spaces. It also allows building designers and developers to target ambitions with respect to daylighting, as well as addressing other issues related to daylight design”.

The document defines metrics used for the evaluation of daylighting conditions and gives principles of calculation and verification. These principles address the issue of variability of daylight over the days and the year.
</td>
</tr>
</table>

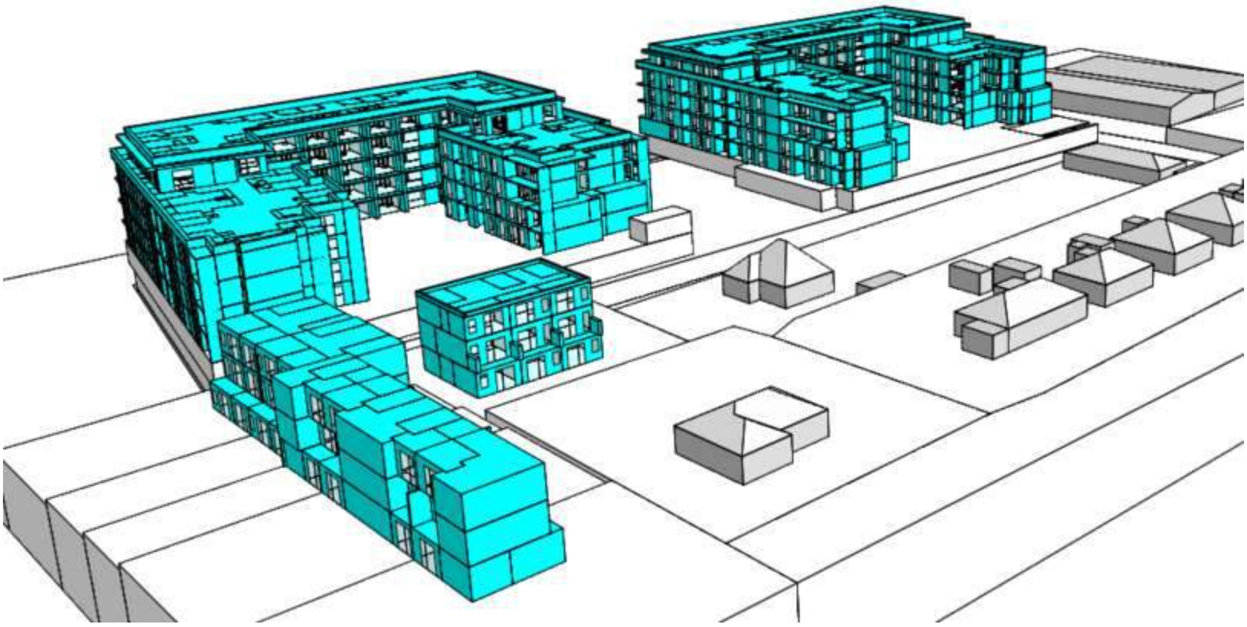
It is noted that BS 8206-2:2008: Lighting for buildings - Part 2: Code of practice for daylighting was recently replaced with BS EN 17037:2018 Daylight in Buildings. BRE is currently looking to update and re-publish BR209 to align their guidance with the new EN 17037:2018 in 2020. Until then, the position of BRE can be summarised from a post by Dr. Littlefair on the LinkedIn Planning Daylight & Sunlight Group (BRE BR209):

“BR209 currently refers to the former British Standard BS 8206 Part 2. For the time being, until BR209 is rewritten, we are adopting a flexible approach to applying the two standards, for example in assessing the daylight and sunlight available in new buildings. So for example if we were reviewing a daylight report for a local authority, we would consider it reasonable to accept either average daylight factor tables calculated using BS8206 or median daylight factors/median illuminances calculated using EN17037, provided they were calculated and presented properly.

EN17037 does not deal with loss of daylight or sunlight to existing buildings, so the current BR209 methodology can be used here, until the revised version is published.”.

4. SIMULATION MODEL IMAGES

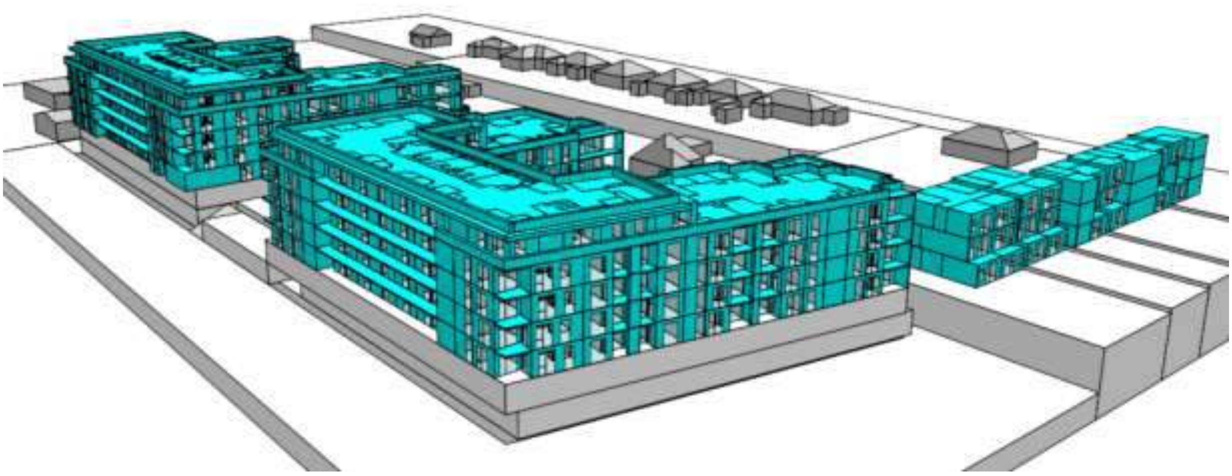
The following images show the simulation model that was constructed to analyse the daylight, sunlight, and overshadowing performance for this proposed scheme.



Above: Simulation model image of the proposed development from the Southwest

Above: Simulation model image of the proposed development from the Southeast.

Above: Simulation model image of the proposed development from the Northeast**.**



Above: Simulation model image of the proposed development from the Northwest.

5. SIMULATION SOFTWARE DESCRIPTION

IES VIRTUAL ENVIRONMENT

IES Virtual Environment is the world's leading building performance analysis tool. The software provides an in-depth suite of integrated analysis tools which allow an integrated design approach and highly detailed results.

IES VIRTUAL ENVIRONMENT - RADIANCE

Radiance is a software package developed by the Lighting Systems Research group at the Lawrence Berkeley Laboratory in California, USA. Radiance was developed as a research tool for predicting the distribution of visible radiation in illuminated spaces.

IES VIRTUAL ENVIRONMENT - SUNCAST

SunCast enables engineers to perform shading and solar insolation analysis studies and can generate images and animations. SunCast generates shadows and internal solar insolation from any sun position defined by date, time, orientation, site latitude and longitude. SunCast can be used at any stage of the design process from a model created by the IES Model Builder.

LIGHTSTANZA

LightStanza is a web-based application used for daylighting and glare simulations. The application runs on the validated Radiance engine to provide accurate daylighting results in terms of Average Daylight Factor (ADF) and Spatial Daylight Autonomy (sDA).

6. ASSESSMENT METHODOLOGY

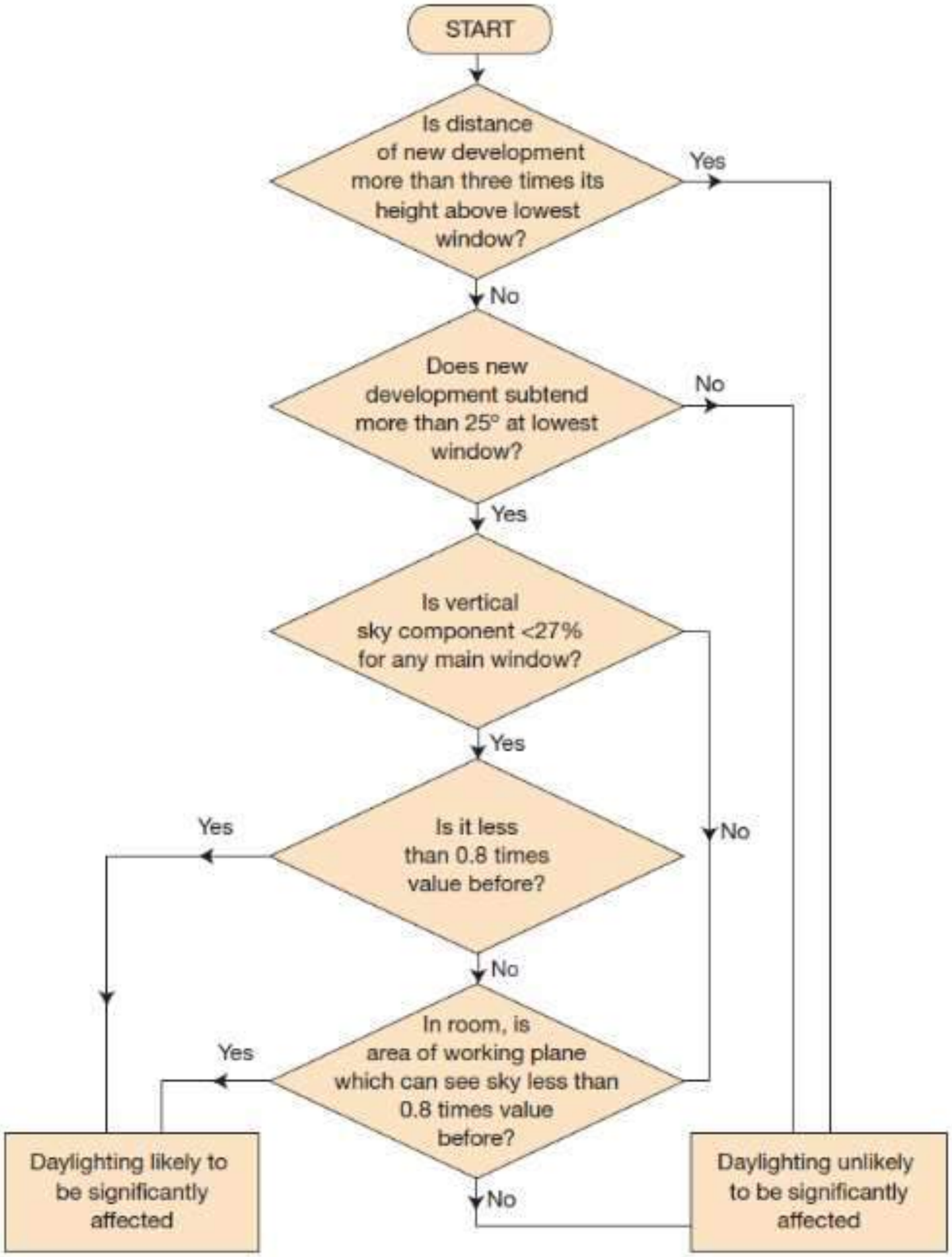
DAYLIGHT ASSESSMENT – NEIGHBOURING PROPERTIES

The guidelines given within the BRE Guide are intended for use for rooms in adjoining dwellings where daylight is required, including living rooms, kitchens and bedrooms. Windows to bathrooms, toilets, storerooms and circulation areas need not be analysed.

To analyse the effects of the proposed development on the adjacent applicable buildings in the immediate surrounding area, a Vertical Sky Component (VSC) simulation was carried out using the IES Radiance software package. For the VSC definition refer to Section 2.0 of this report. The VSC was calculated with the proposed development in place using a simulation model. In accordance with Section 2.2 of the BRE Guide, where a VSC of 27% or greater is achieved, "enough skylight should still be reaching the existing building" and therefore daylighting will not be significantly affected. The BRE Methodology is summarised on page 14 of this report. Where a VSC less than 27% is achieved, further analysis is required to determine the likely daylight levels that will be achieved in affected spaces. Any reductions in VSC should be limited to 20%.

The surrounding residential buildings are numbered below so that they could be easily referenced during the analysis.

Methodology (as referenced in Section 2.2 of the BRE Guide)



Above: Decision chart / methodology used to quantify the impact of a new development on daylight levels of nearby buildings / dwellings.

DAYLIGHT ASSESSMENT – PROPOSED DEVELOPMENT

The assessment methodology used for this analysis is taken from the BRE Guidance document (BR209) based on the standards set out in the British Standard BS8206:2. This analysis also refers to the standards outlined in European Standard EN 17037:2018 and the British national annex provided in the BS EN 17037 standard for additional information.

Average Daylight Factor (ADF) Using BS 8206-2:2008 / BR209)

BRE's 2011 guidance document Site Layout Planning for Daylight and Sunlight states the following with respect to Average Daylight Factors (ADF).

> C4 If a predominantly daylit appearance is required, then the ADF should be 5% or more if there is no supplementary electric lighting, or 2% or more if supplementary electric lighting is provided. There are additional recommendations for dwellings of 2% for kitchens, 1.5% for living rooms and 1% for bedrooms. These additional recommendations are minimum values of ADF which should be attained even if a predominantly daylit appearance is not achievable.

Above: From BRE's 2011 guidance document Site Layout Planning for Daylight and Sunlight

Therefore, in line with this guidance, minimum recommended average daylight factors are:

- **Bedrooms – 1.00 %**
- **Kitchen/Living – 2.00 %**

The following assumptions have been applied in this study:

- Sky Conditions: Standard CIE overcast sky
- Time (24hr): 12:00
- Date: 21 September
- Working Plane: 0.85m

Spatial Daylight Autonomy (sDA) Using EN 17037:2018

EN 17037:2018 – Daylight in Buildings states the following with respect to daylight provision within a space:

> **5.1.2 Criteria for daylight provision**
>
> A space is considered to provide adequate daylight if a target illuminance level is achieved across a fraction of the reference plane within a space for at least half of the daylight hours.
>
> In addition, for spaces with vertical or inclined daylight openings, a minimum target illuminance level is also to be achieved across the reference plane.
>
> The reference plane of the space is located 0,85 m above the floor, unless otherwise specified. A small fraction of the reference plane may be disregarded to account for singularities.
>
> Values for target illuminances, minimum target illuminances and fractions of reference plane are given in Table A.1.

This assessment was carried out in accordance with *Method 2* which is described below:

> Method 2) Calculation method of illuminance levels on the reference plane using climatic data for the given site and an adequate time step. Annex A gives values for target illuminances and minimum target illuminances to be achieve.

Table A.1 – Recommendations of daylight provision by daylight openings in vertical and inclined surfaces provides target illuminance values which are required to meet the minimum level of recommendation for daylight provision.

In line with the European standard, the following targets were adopted for all spaces assessed during this analysis:

- **300 Lux achieved over at least 50% of the reference plane (0.85m) and**
- **100 Lux achieved over at least 95% of the reference plane (0.85m)**

A space is considered to provide adequate daylight if both target illuminance levels above are achieved across the specified fraction of the space (as per above) for at least 50% of the daylight hours.

Table A.1 — Recommendations of daylight provision by daylight openings in vertical and inclined surface					
Level of recommendation for vertical and inclined daylight opening	Target illuminance E_T lx	Fraction of space for target level $F_{plane,\%}$	Minimum target illuminance E_{TM} lx	Fraction of space for minimum target level $F_{plane,\%}$	Fraction of daylight hours $F_{time,\%}$
Minimum	300	50 %	100	95 %	50 %
Medium	500	50 %	300	95 %	50 %
High	750	50 %	500	95 %	50 %
NOTE Table A.3 gives target daylight factor (D_T) and minimum target daylight factor (D_{TM}) corresponding to target illuminance level and minimum target illuminance, respectively, for the CEN capital cities.					

Above: *Table A.1 – Recommendations of daylight provision by daylight openings in vertical and inclined surfaces taken from EN 17037:2018*

The working plane has been set at 0.85m in accordance with EN17037.

Spatial Daylight Autonomy (sDA) Using BS EN 17037:2018

This study also assessed the daylight performance of the scheme using the British national annex within BS EN 17037. This National Annex recommends that the target illuminance values provided in *Table NA.1* are achieved over at least 50% of the area of the working plane (0.85m from floor level).

Table NA.1 — Values of target illuminance for room types in UK dwellings

Room type	Target illuminance E_T (lx)
Bedroom	100
Living room	150
Kitchen	200

Where one room in a UK dwelling serves more than a single purpose, the UK committee recommends that the target illuminance is that for the room type with the highest value – for example, in a space that combines a living room and a kitchen the target illuminance is recommended to be 200 lx.

In line with the recommendation of the British National Annex, an additional spatial daylight autonomy assessment was carried out to assess the number of Bedrooms that achieve the target illuminance of 100 lux over 50% of their areas, as well as the percentage of Kitchen/Living spaces achieving 200 lux over at least 50% of the areas. Following the recommendation of the British national annex above, an illuminance test for 95% of the floor area of each space was not conducted. If the analysed rooms achieve the specified illuminance level over at least 50% of their area, they are deemed to be adequately daylit according to the British national annex.

The following surface reflectance's were applied in this study:

Material Surface	Reflectance Value	Glass/Window Details
External Wall	0.82	-
Internal Partition	0.82	-
Floor/Ceiling (Floor)	0.40	-
Floor/Ceiling (Ceiling)	0.88	-
Glass Light Transmittance	-	70%

SUNLIGHT ASSESSMENT – AMENITY SPACES

BRE Guidelines recommend that in order for an amenity space to appear adequately sunlit throughout the year, at least half of the amenity space should receive at least two hours of sunlight on the design day, March 21st. If, as a result of a new development, an existing garden or amenity area does not meet the above, and the area which can receive two hours of sun on March 21st is less than 0.8 times its former value, then the loss of sunlight is likely to be noticeable.

> **Summary**
>
> 3.3.17 It is recommended that for it to appear adequately sunlit throughout the year, at least half of a garden or amenity area should receive at least two hours of sunlight on 21 March. If as a result of new development an existing garden or amenity area does not meet the above, and the area which can receive two hours of sun on 21 March is less than 0.8 times its former value, then the loss of sunlight is likely to be noticeable. If a detailed calculation cannot be carried out, it is recommended that the centre of the area should receive at least two hours of sunlight on 21 March.

Above: BRE Guidance in relation to protecting Sunlight in Gardens, Open Spaces and Amenity spaces.

The amount of sunlight available to proposed and surrounding amenity spaces is assessed as part of this analysis. The results are outlined in Section 9 of this report.

SUNLIGHT ASSESSMENT – PROPOSED AND SURROUNDING BUILDINGS

According to the BRE guide, living spaces will appear reasonably sunlit if they receive 25% or more of their annual probable sunlight hours for the year, and 5% or more of their annual probable sunlight hours during the winter months. Analysis was carried out in line with BRE 209 guidance, ensuring that the proposed development receives adequate levels of sunlight and no substantial loss of sunlight is incurred in the surrounding buildings.

> ### Summary (new buildings)
>
> 3.1.15 In general a dwelling, or non-domestic building which has a particular requirement for sunlight, will appear reasonably sunlit provided:
>
> - at least one main window wall faces within 90° of due south and
> - the centre of at least one window to a main living room can receive 25% of annual probable sunlight hours, including at least 5% of annual probable sunlight hours in the winter months between 21 September and 21 March.

Above: BRE Guidance in relation to achieving adequate levels of sunlight in new buildings.

Summary

3.2.11 If a living room of an existing dwelling has a main window facing within 90° of due south, and any part of a new development subtends an angle of more than 25° to the horizontal measured from the centre of the window in a vertical section perpendicular to the window, then the sunlighting of the existing dwelling may be adversely affected. This will be the case if the centre of the window:

- receives less than 25% of annual probable sunlight hours, or less than 5% of annual probable sunlight hours between 21 September and 21 March and
- receives less than 0.8 times its former sunlight hours during either period and
- has a reduction in sunlight received over the whole year greater than 4% of annual probable sunlight hours.

Above: BRE Guidance in relation to maintaining adequate levels of sunlight in existing buildings

Results for this assessment are shown in Section 9 of this report.

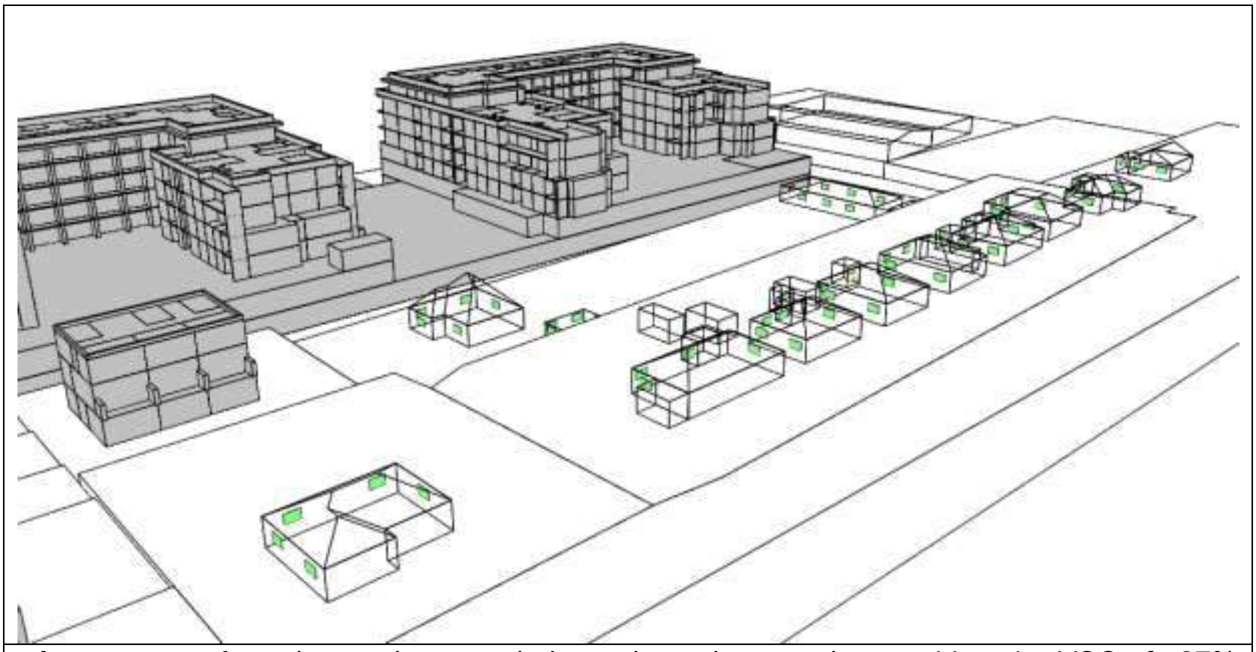
7. VSC RESULTS

The surrounding buildings are numbered below so that they can be referenced throughout this analysis. For the BRE Guidance on Vertical Sky Component refer to Section 6 of this report.

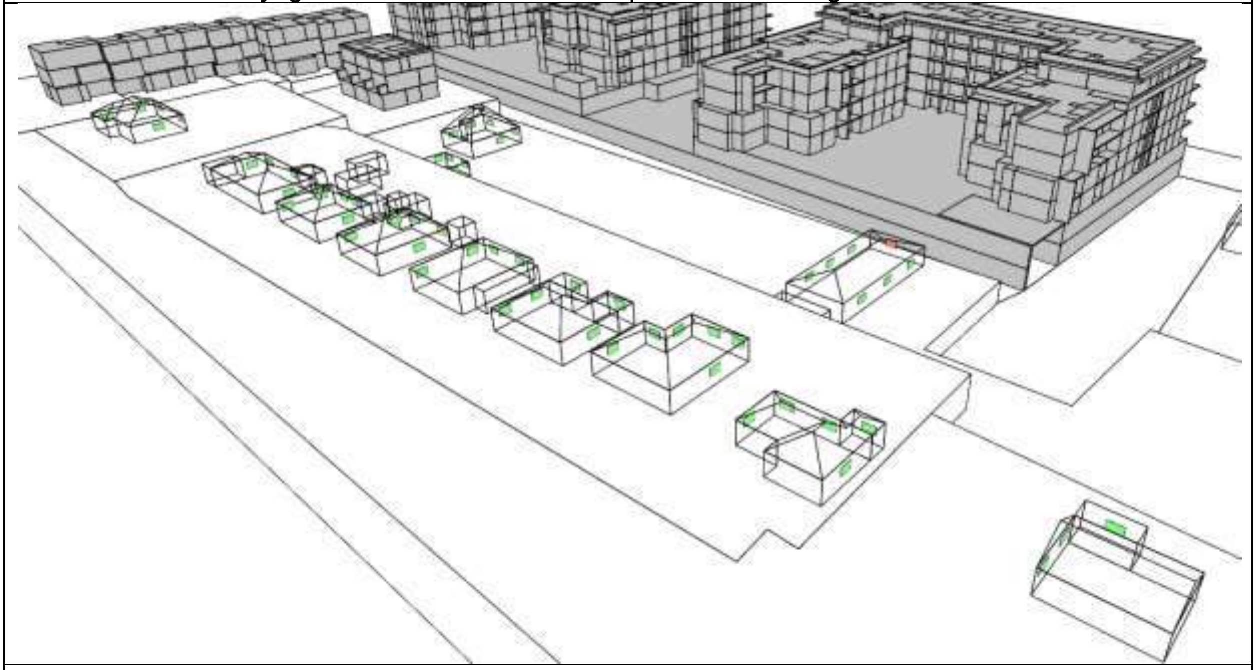
As there was no information available regarding the glazing positioning or areas within the adjacent existing properties, notional windows were modelled so that the VSC could be assessed for these buildings. These notional windows will provide an indication of whether or not the daylighting within the existing adjacent buildings will be impacted by the proposed development.

The vertical sky component results are detailed for each of the assessed surrounding buildings below and tabulated in Appendix B of this report.

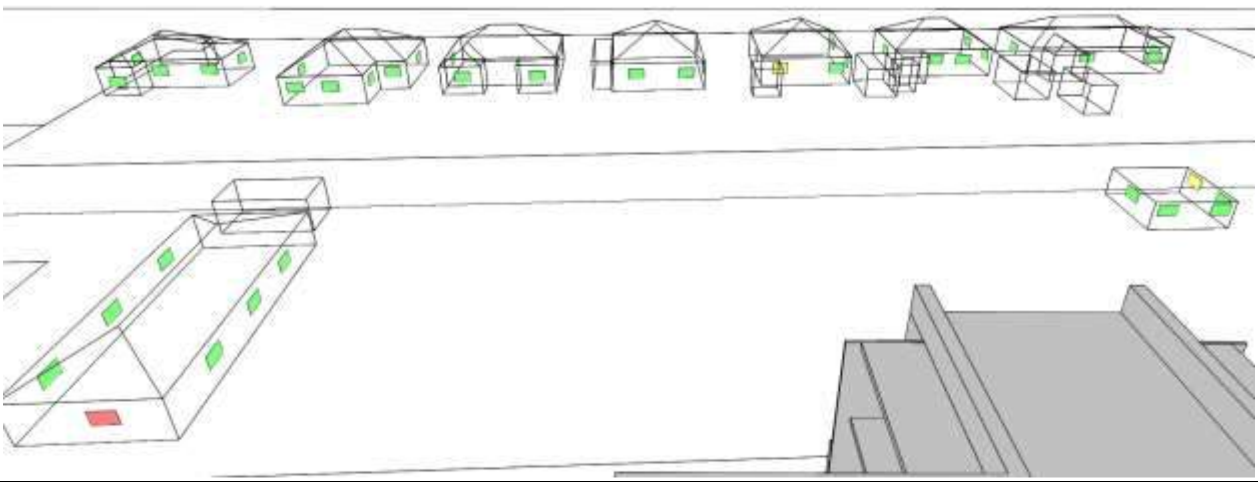
Passive Dynamics
SUSTAINABILITY CONSULTANTS



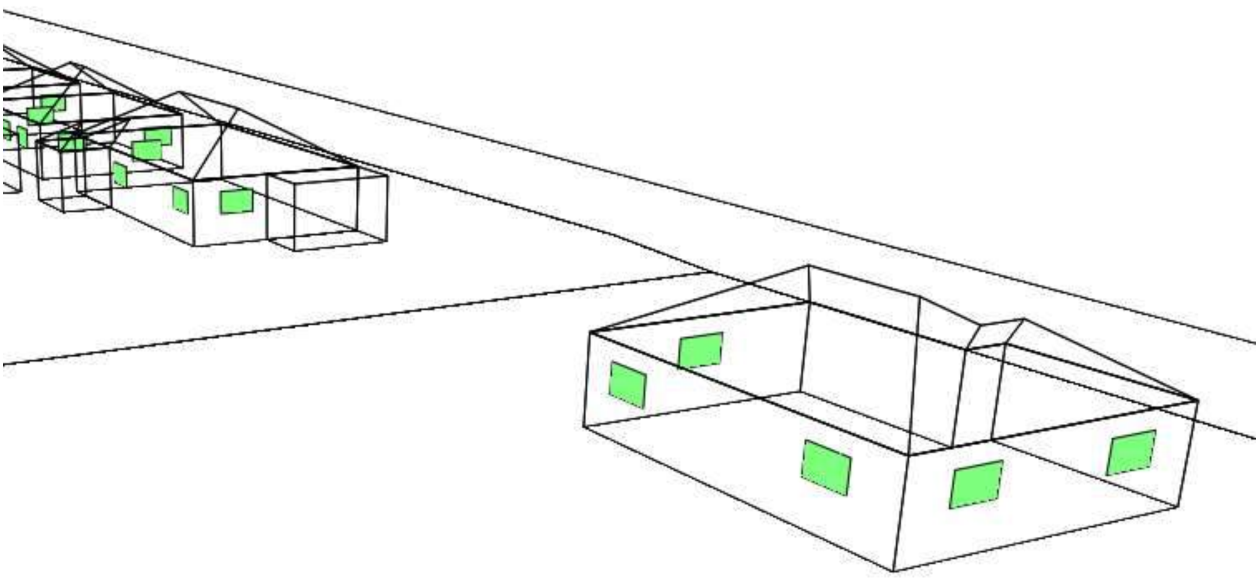
Above: Image from the southwest. Windows shown in green have achieved a VSC of ≥27% complying with the BRE Criteria. Windows shown in yellow above are still meeting the BRE criteria due to the fact that any reduction in daylight is less than 20% compared to the original baseline. The windows in red above fall outside the BRE Guidelines as the VSC is ≤ 27% and the reduction in daylight is more than 20% compared to the original baseline.



Above: Image from the southeast. Windows shown in green have achieved a VSC of ≥27% complying with the BRE Criteria. Windows shown in yellow above are still meeting the BRE criteria due to the fact that any reduction in daylight is less than 20% compared to the original baseline. The windows in red above fall outside the BRE Guidelines as the VSC is ≤ 27% and the reduction in daylight is more than 20% compared to the original baseline.



Above: Surrounding Blocks 2, 4, 5, 6, 7, 8 ,9, 10 and 11 from the north. Windows shown in green have achieved a VSC of ≥27%. If the VSC is greater than 27% then enough skylight should be reaching the window of the existing buildings. Windows shown in yellow above are still meeting the BRE criteria due to the fact that any reduction in daylight is less than 20% compared to the original baseline. The windows in red above fall outside the BRE Guidelines as the VSC is ≤ 27% and the reduction in daylight is more than 20% compared to the original baseline value.



Above: Surrounding Blocks 1 and 2 from the northwest. Windows shown in green have achieved a VSC of ≥27%.

A full breakdown of the VSC results for each opening analysed can be found in Appendix B of this report.

Our simulation analyses the impact that the proposed development has on the windows of its surrounding buildings. The existing adjacent buildings are residential properties and so, and in keeping with the guidance protocols, the windows of these buildings were assessed for potential loss of daylight. The assessed surrounding buildings along Kilmoney Road Lower largely meet the recommended VSC value according to the BRE Guide.

Of the 59 notional openings assessed, 58 openings (98.3%) achieve a VSC result that meets the recommendation outlined in the BRE Guide.

The VSC reduction experienced in the north facing opening of Surrounding Block 10 would be classed as a “minor adverse” impact according to BRE Guidance where “only a small number of windows or limited area of open space are affected”. Here, there is 1 window that has had its VSC reduced to less than 80% of their pre-development value (65.72%). This VSC impact is due to the proximity and relative height of the proposed development. All other assessed windows within this adjacent property meet the recommendations of the BRE Guide.

As a result of this analysis, it is our understanding that the vast majority of adjacent building openings achieve a VSC in line with the recommendation of the BRE Guide, with one opening (Surrounding Block 10, north-facing) experiencing a minor adverse impact due to the proposed development.

Consideration should be given to the fact that the comparison being made is between an under-utilised existing site and the proposed development, which is inevitably going to have some form of an impact given its proximity and relative height. The planning authority should consider applying flexibility with regard to BRE standards to balance the objective of achieving urban regeneration with any potential impacts.

8. AVERAGE DAYLIGHT FACTOR RESULTS – PROPOSED SCHEME

As this development consists of combined kitchen/living spaces, the Minimum recommended Average Daylight Factors (ADF) according to BRE Guidance are:

- Bedrooms – 1.00 %
- Kitchen/Living Rooms – 2.00 %

An iterative design process was carried out to increase the daylight performance of the regularly occupied spaces within this development. Further design developments such as increased window sizes, additional windows, reduced balcony overhangs and reduced side screens have enabled more units to reach their target ADF performance in line with BRE guidance. The average daylight factor (ADF) for the bedrooms and kitchen/living spaces have been assessed as per the methodology outlined in Section 6 of this report.

ADF Results Summary

The calculated ADF results are summarised below:

% of Bedrooms with an ADF ≥ 1.00	% of Living/Kitchen with an ADF ≥ 2.00
98.0	**94.6**

A detailed breakdown of the ADF result achieved in each space can be seen in Appendix C of this report.

sDA Results Summary (EN17037 and BS EN17037)

This scheme was also assessed using the latest European Standard EN17037 as well as the British national annex provided in BS EN17037.

Spatial Daylight Autonomy - EN17037 All spaces recommended to achieve 300 lux over 50% of area **and** 100 Lux over 95% of area for at least 50% of daylight hours	
Room Type	**Passing (%)**
Bedroom	88.9
KLD	94.0
Overall	**90.7**

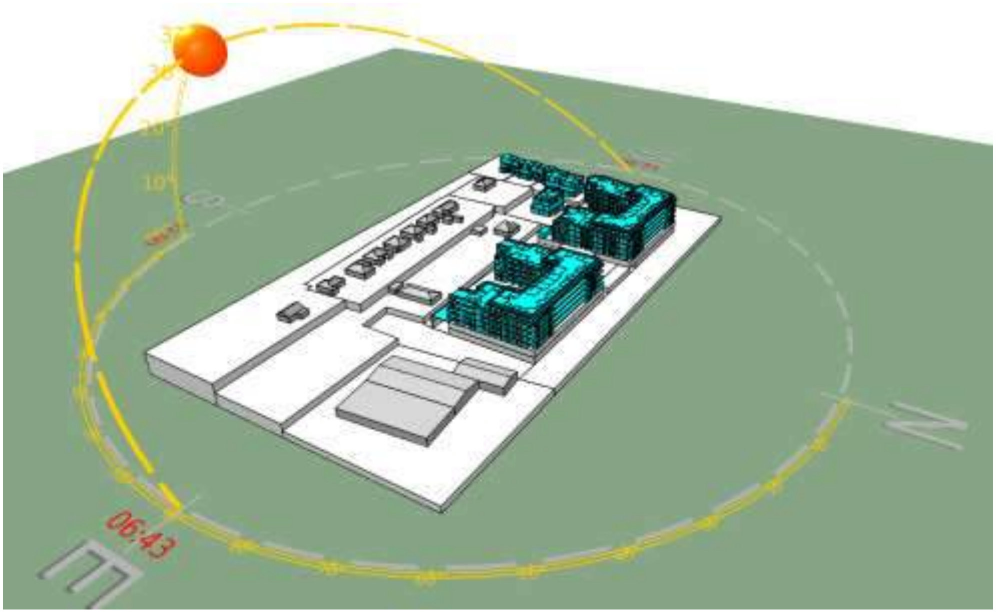
Spatial Daylight Autonomy – BS EN17037 British National Annex KLD recommended to achieve 200 lux over 50% area for at least 50% of daylight hours Bedrooms recommended to achieve 100 lux over 50% area for at least 50% of daylight hours	
Room Type	**Passing (%)**
Bedroom	100.0
KLD	99.5
Overall	**99.8**

The results of these assessments are tabulated in detail in Appendix D and Appendix E of this document.

9. SUNLIGHT RESULTS

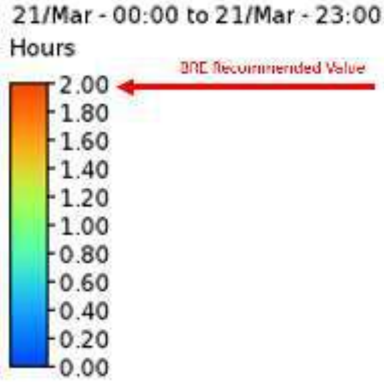
For the BRE Guidance on sunlight refer to Section 6 of this report.

Above: Google Earth Image of the existing site.



Above: Sun path over the proposed development on the 21st March.

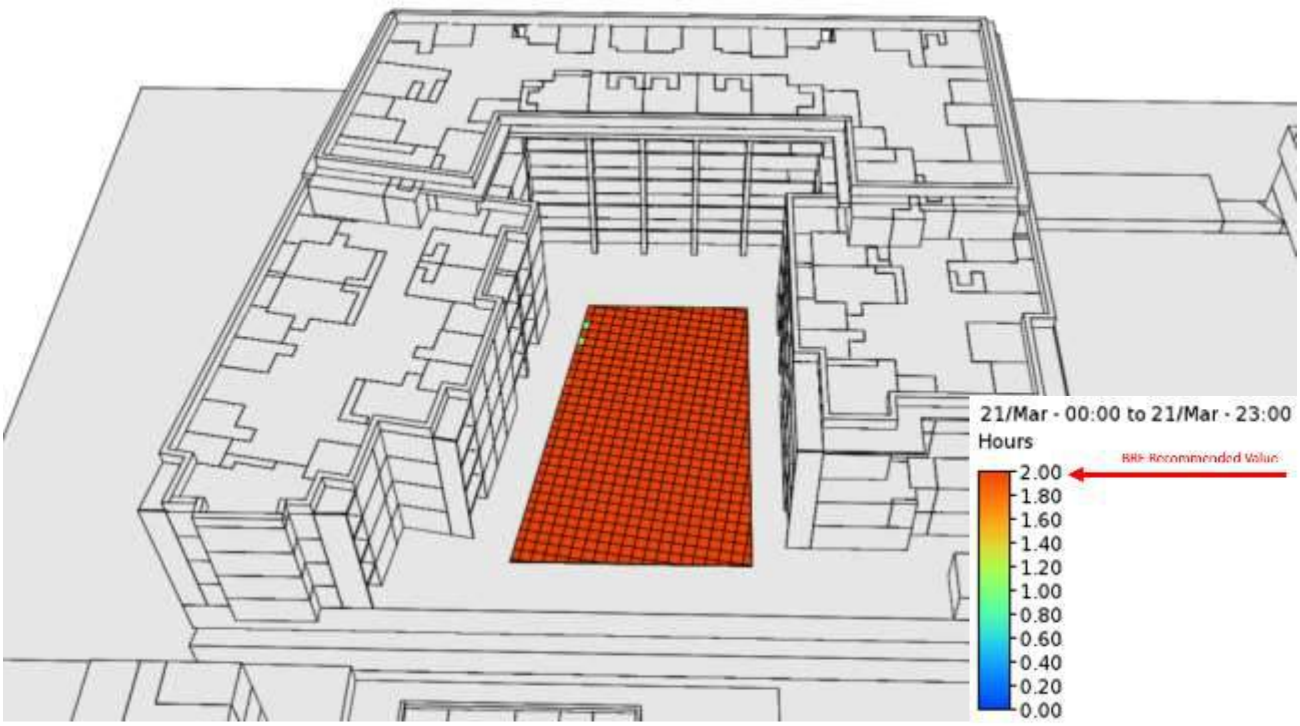
Annual Probable Sunlight Hours – Amenity Spaces



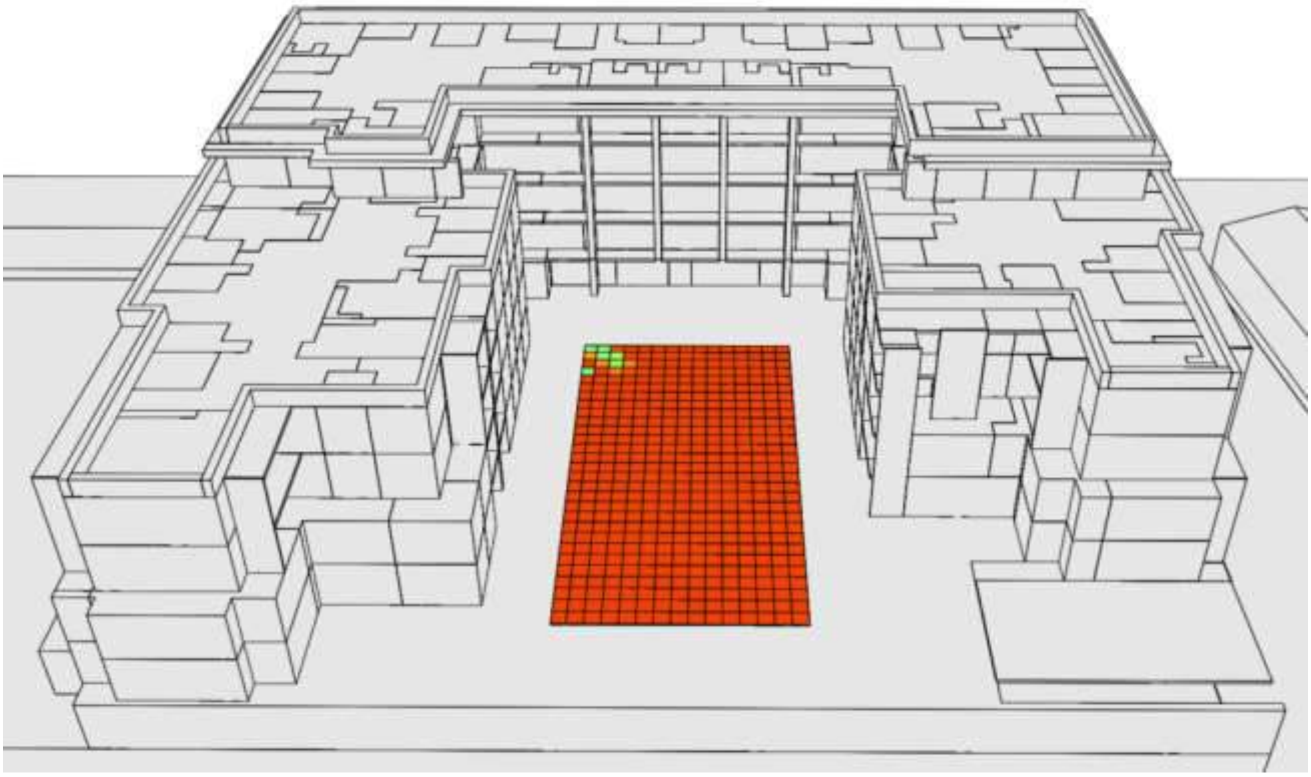
Above: Probable sunlight hours on March 21st (hours) legend

Amenity Areas – Proposed Development

BRE Guidelines recommend that in order for an amenity space to appear adequately sunlit throughout the year, at least half of the amenity space should receive at least two hours of sunlight on the design day, March 21st.



Above: The amenity area within Block 1. Areas that meet the recommended level of sunlight on the design day (March 21st) are shown in red. This area receives sufficient levels of sunlight in line with the BRE guidance, achieving 2 hours of sunlight over the vast majority of its total area on the design day.



Above: The amenity area within Block 2. Areas that meet the recommended level of sunlight on the design day (March 21st) are shown in red. This area receives sufficient levels of sunlight in line with the BRE guidance, achieving 2 hours of sunlight over the vast majority of its total area on the design day.

Amenity Areas – Neighbouring Properties

BRE Guidelines recommend that in order for an amenity space to appear adequately sunlit throughout the year, at least half of the amenity space should receive at least two hours of sunlight on the design day, March 21st.

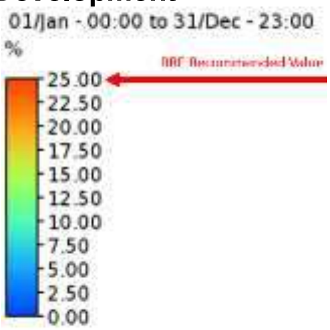
Above: The garden areas of neighbouring properties. Areas that meet the recommended level of sunlight on the design day (March 21st) are shown in red. These areas receive sufficient levels of sunlight in line with the BRE guidance, achieving 2 hours of sunlight over the vast majority of their total area on the design day. The proposed development will not cause a significant impact to the level of sunlight in the neighbouring gardens as the development is located north of the gardens themselves. Localised areas that do not achieve the recommended level of sunlight are shading by the neighbouring properties themselves rather than the proposed development.

Annual Probable Sunlight Hours – Proposed Development

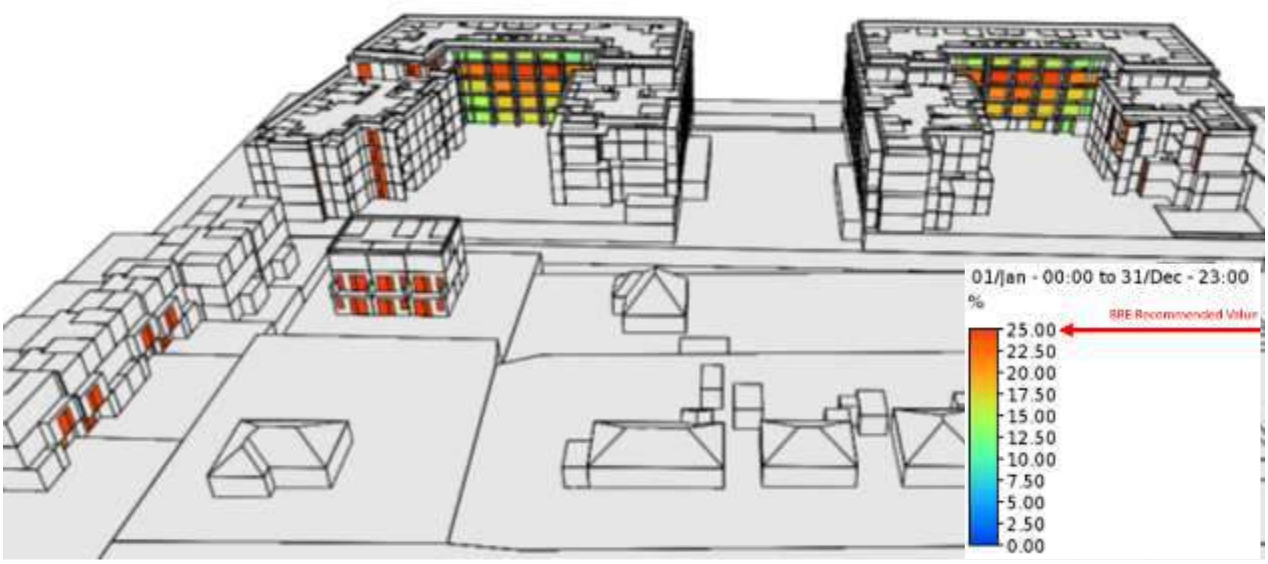
As outlined in *Section 7* of this report, the living spaces of these developments will appear adequately sunlit provided they receive 25% of their annual probable sunlight hours during the year and 5% of their probable sunlight hours during the winter months If a living room of an existing dwelling has a **main window facing within 90º of due south**, and any part of a new development subtends an angle of more than 25º to the horizontal measured from the centre of the window in a vertical section perpendicular to the window, then the sunlighting of the existing dwelling may be adversely affected. . The results of this assessment are represented below for all relevant areas.

As windows that are more than 90º from due south are not expected to achieve the criteria outlined in the BRE Guide any such windows have not been considered as part of the annual probable sunlight analysis.

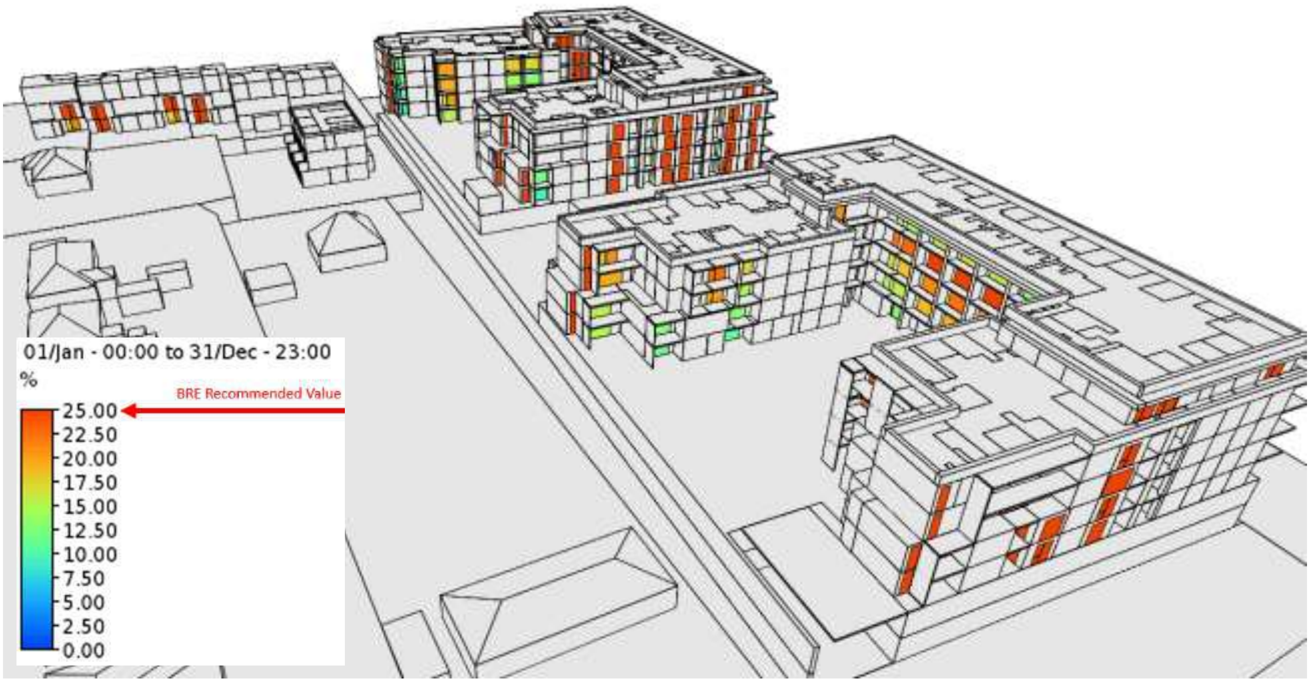
Annual Assessment – Proposed Development



Above: Annual probable sunlight hours (%) legend



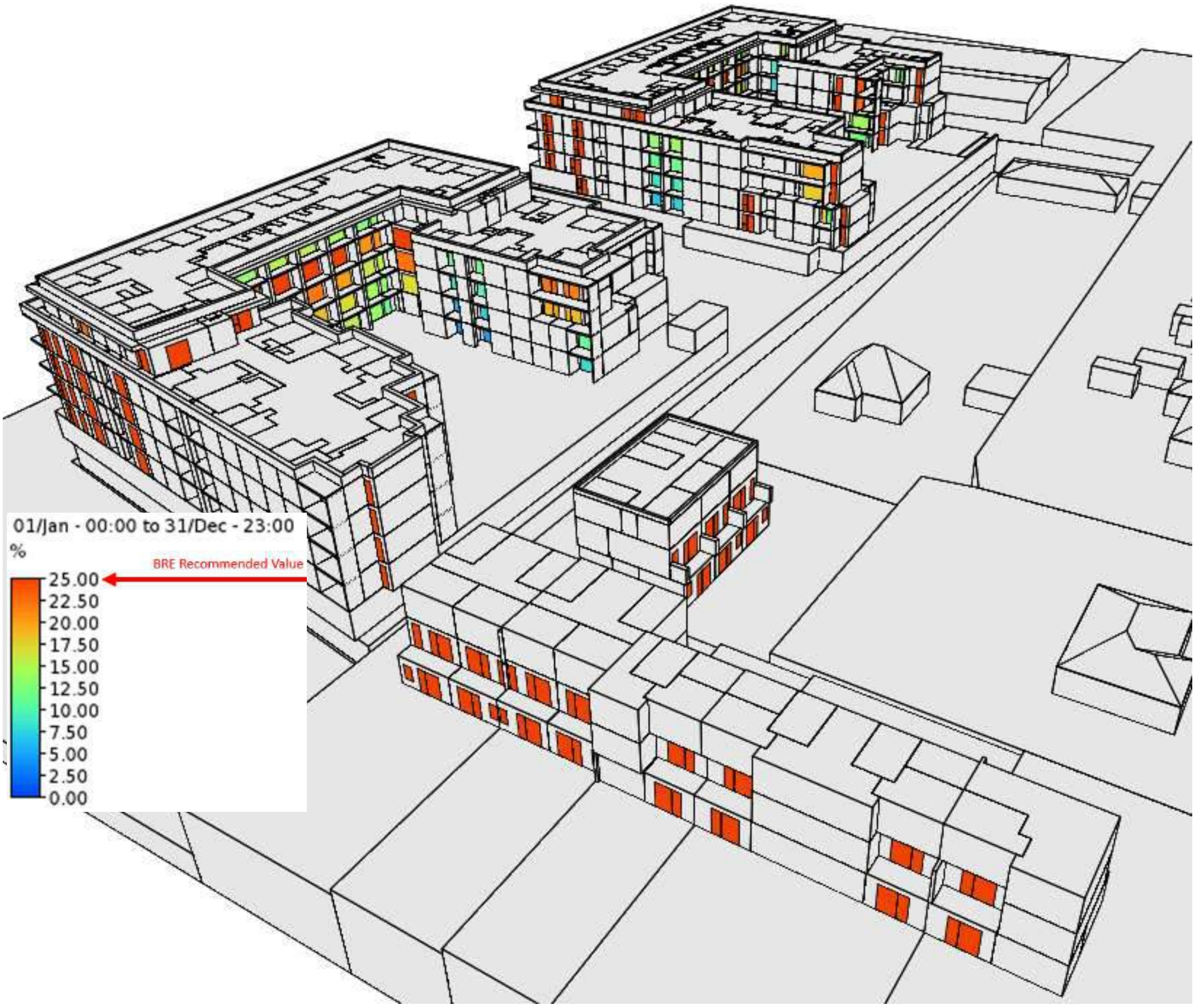
Above: The image above (taken from the south) shows the living spaces of the proposed development. As shown, openings that achieve at least 25% of their annual probable sunlight hours are highlighted in red. These openings will appear adequately sunlit in line with BRE 209 guidance. Other openings (shown in orange, yellow and green) do not achieve the BRE recommended annual probable sunlight hours value.



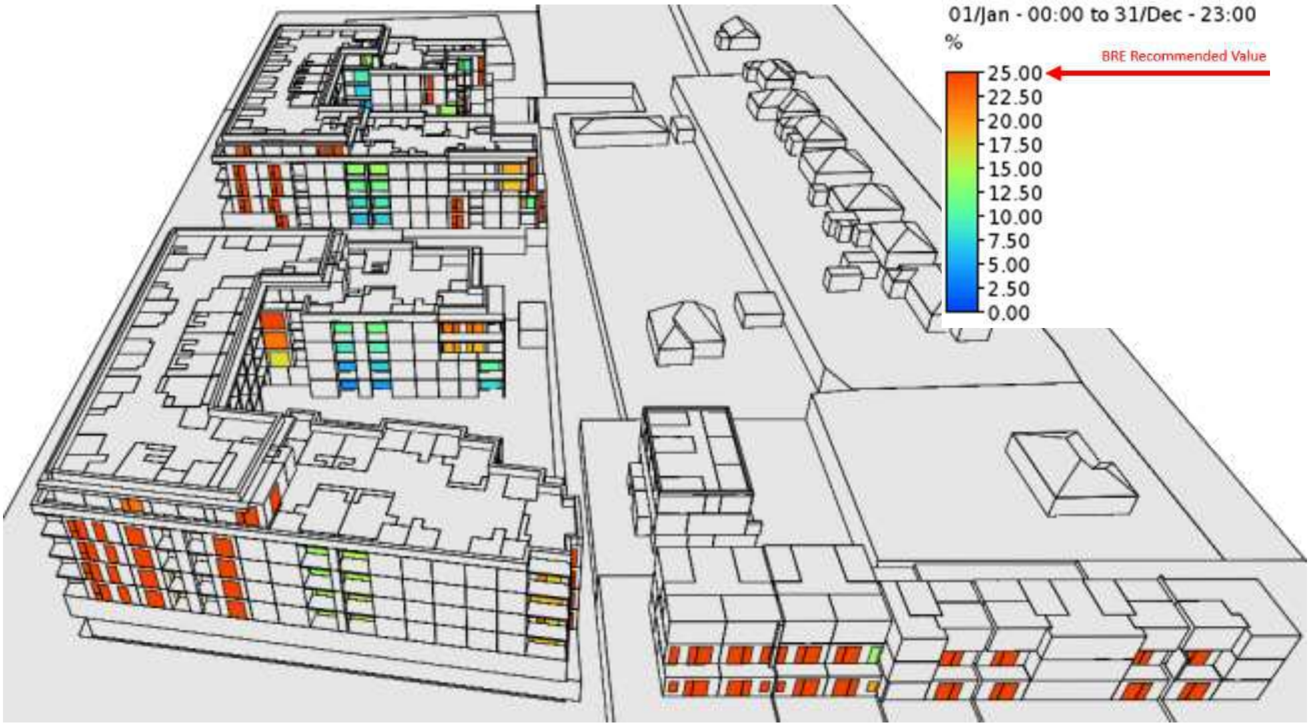
Above: The image above (taken from the southeast) shows the living spaces of the proposed development. As shown, openings that achieve at least 25% of their annual probable sunlight hours are highlighted in red. These openings will appear adequately sunlit in line with BRE 209 guidance.

Other openings (shown in orange, yellow and green) do not achieve the BRE recommended annual probable sunlight hours value.

Above: The image above (taken from the east) shows the living spaces of the proposed development. As shown, openings that achieve at least 25% of their annual probable sunlight hours are highlighted in red. These openings will appear adequately sunlit in line with BRE 209 guidance. Other openings (shown in orange, yellow and green) do not achieve the BRE recommended annual probable sunlight hours value.



Above: The image above (taken from the southwest) shows the living spaces of the proposed development. As shown, openings that achieve at least 25% of their annual probable sunlight hours are highlighted in red. These openings will appear adequately sunlit in line with BRE 209 guidance. Other openings (shown in orange, yellow and green) do not achieve the BRE recommended annual probable sunlight hours value.

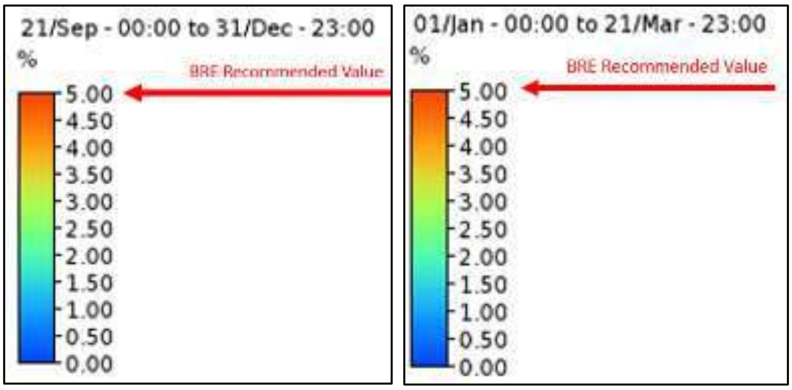


Above: The image above (taken from the west) shows the living spaces of the proposed development. As shown, openings that achieve at least 25% of their annual probable sunlight hours are highlighted in red. These openings will appear adequately sunlit in line with BRE 209 guidance. Other openings (shown in orange, yellow and green) do not achieve the BRE recommended annual probable sunlight hours value.

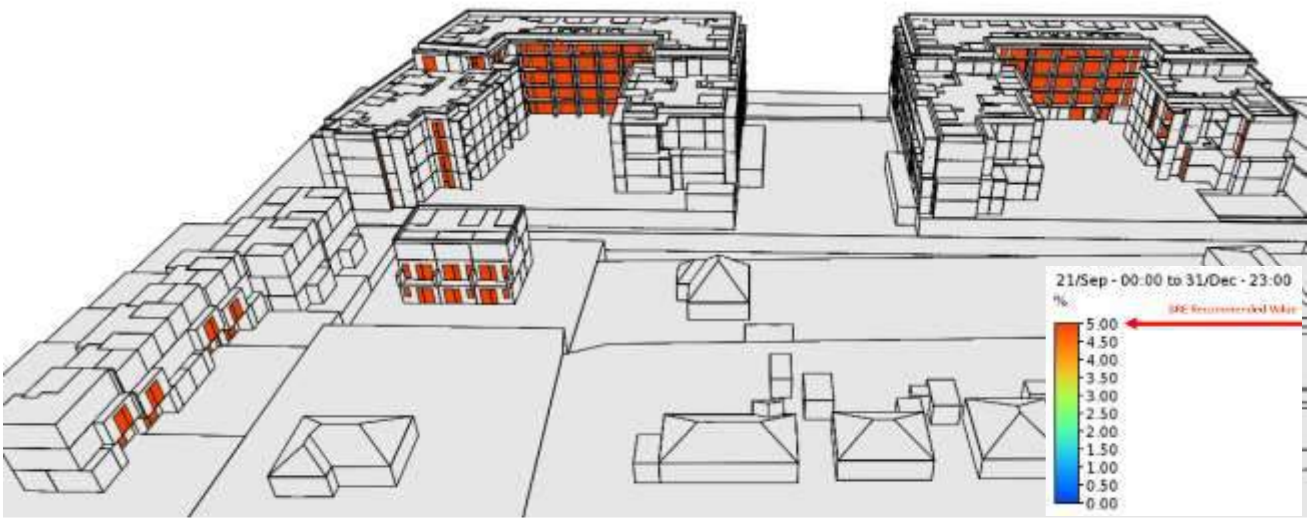
The graphics above shows the living spaces within the proposed development that achieve 25% of their annual probable sunlight hours (highlighted in red) meaning these spaces will appear adequately sunlit in line with BRE 209 guidance. As shown, there are a number of windows assessed that do not achieve the BRE recommended levels of annual sunlight due to their location and proximity to other sections of the building and shading devices.

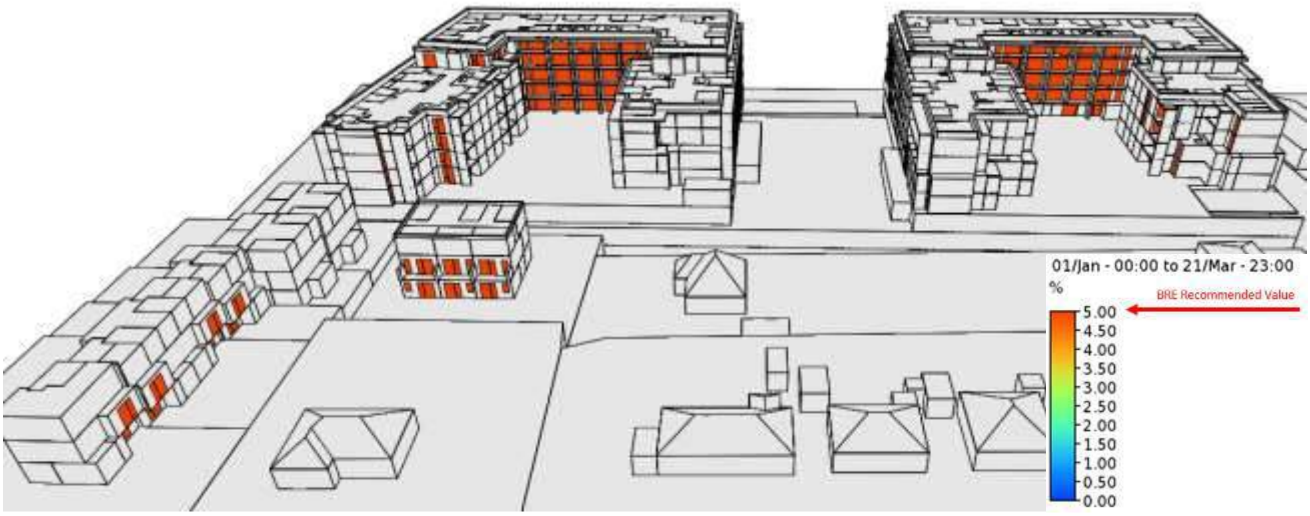
It should be noted that windows that are more than 90º from due south are not expected to achieve the criteria outlined in the BRE Guide and so should not be considered as part of the annual probable sunlight analysis.

Annual Probable Sunlight Hours – Proposed Development: Winter Assessment

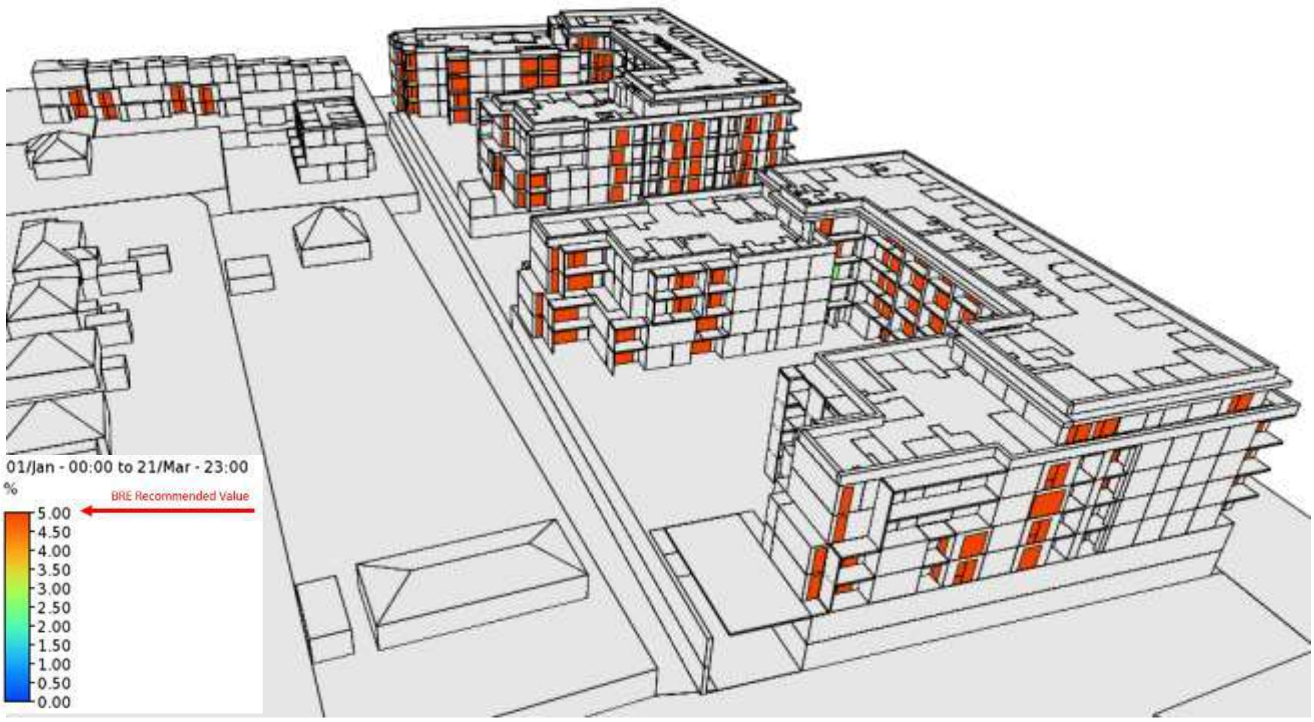


Above: Probable sunlight hours from September 21st to March 21st (%) legend

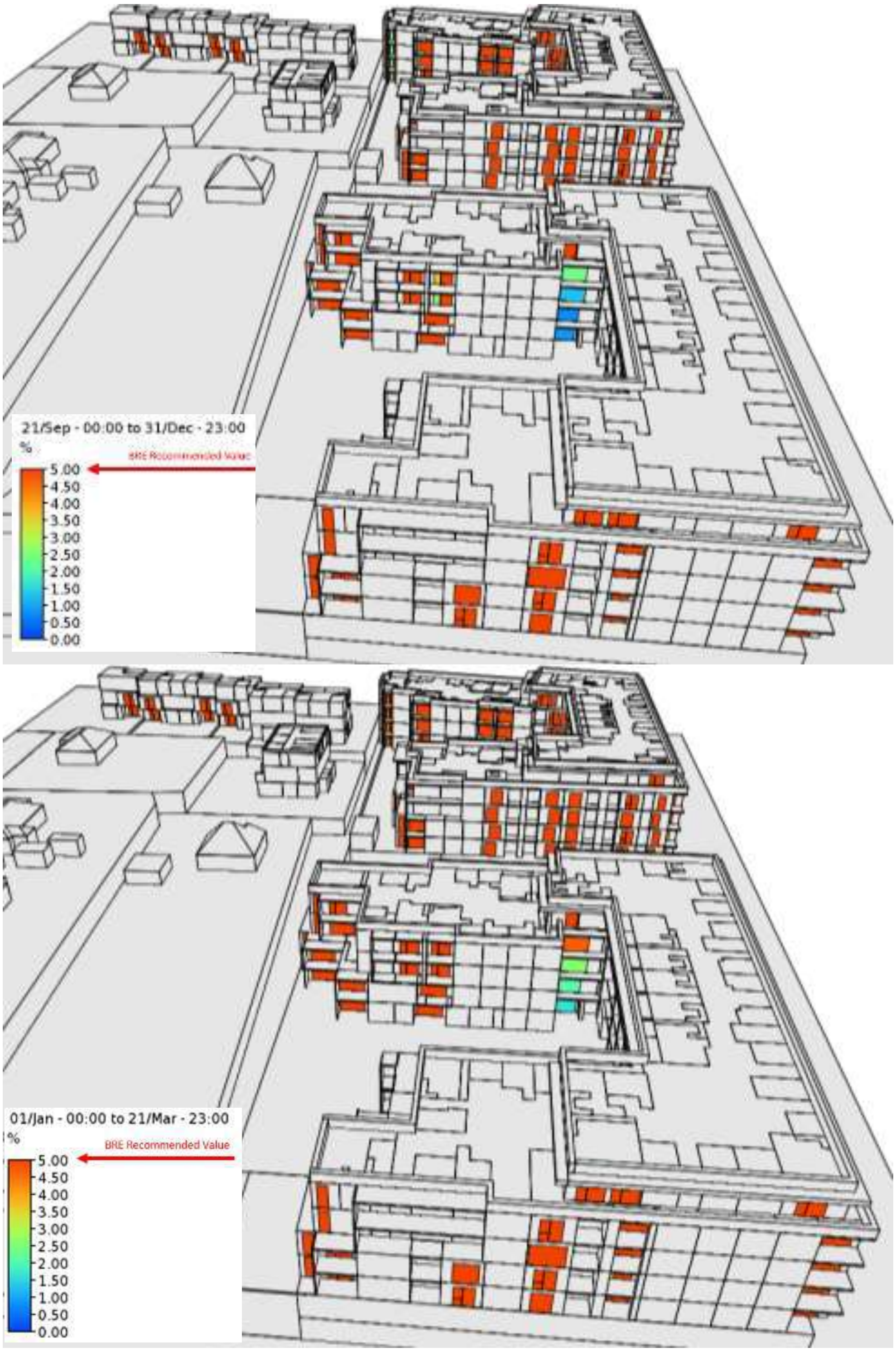




Above: The images above (taken from the south) show the living spaces of the proposed development. As shown, openings that achieve at least 5% of their probable sunlight hours during winter months are highlighted in red. These openings will appear adequately sunlit in line with BRE 209 guidance.



Above: The images above (taken from the southeast) show the living spaces of the proposed development. As shown, openings that achieve at least 5% of their annual probable sunlight hours are highlighted in red. These openings will appear adequately sunlit in line with BRE 209 guidance. Other openings (shown in yellow, green and blue) do not achieve the BRE recommended annual probable sunlight hours value.

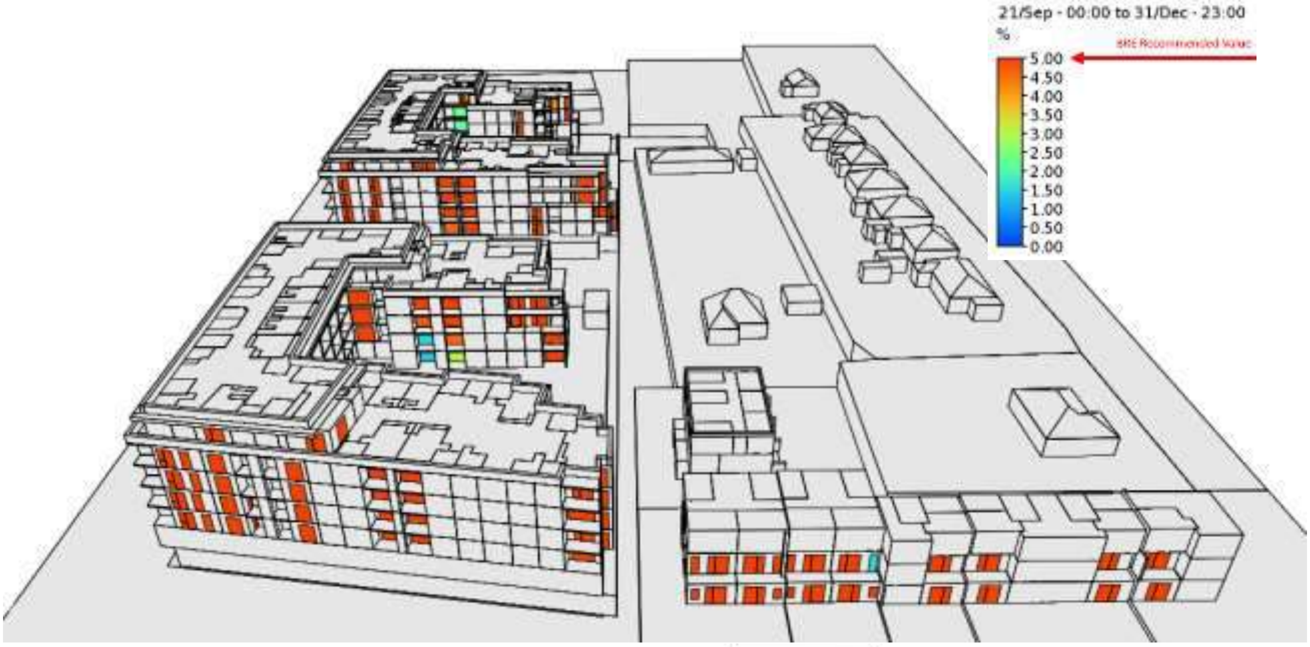


Above: The images above (taken from the east) show the living spaces of the proposed development. As shown, openings that achieve at least 5% of their annual probable sunlight hours are highlighted in red. These openings will appear adequately sunlit in line with BRE 209 guidance. Other openings (shown in yellow, green and blue) do not achieve the BRE recommended annual probable sunlight hours value.

Passive Dynamics
SUSTAINABILITY CONSULTANTS

Above: The images above (taken from the southwest) show the living spaces of the proposed development. As shown, openings that achieve at least 5% of their annual probable sunlight hours are highlighted in red. These openings will appear adequately sunlit in line with BRE 209 guidance.

Other openings (shown in yellow, green and blue) do not achieve the BRE recommended annual probable sunlight hours value.



Above: The images above (taken from the west) show the living spaces of the proposed development. As shown, openings that achieve at least 5% of their annual probable sunlight hours are highlighted in red. These openings will appear adequately sunlit in line with BRE 209 guidance. Other openings (shown in yellow, green and blue) do not achieve the BRE recommended annual probable sunlight hours value.

The graphics above show the living spaces within the proposed development that achieve 5% of their annual probable sunlight hours (highlighted in red) meaning these spaces will appear adequately sunlit in line with BRE 209 guidance. As shown, there are a number of windows assessed that do not achieve the BRE recommended levels of winter sunlight due to their location and proximity to other sections of the building and shading devices.

It should be noted that windows that are more than 90º from due south are not expected to achieve the criteria outlined in the BRE Guide and so should not be considered as part of the annual probable sunlight analysis.

As the proposed development is located north of the neighbouring residential properties, the windows that are eligible for sunlight assessment in line with BRE guidance will not be impacted by the proposed development. For this reason, the surrounding residential properties were not assessed for sunlight availability.

10. COMPENSATORY MEASURES

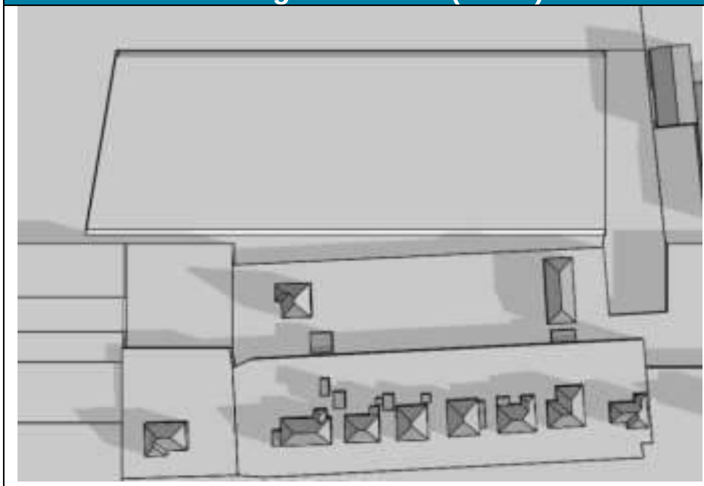
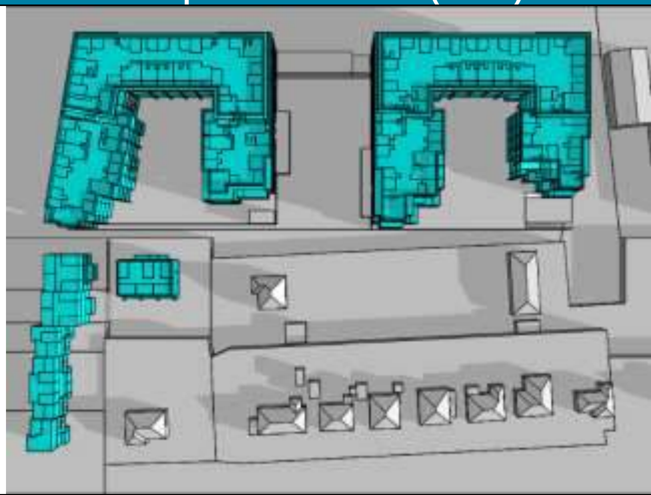
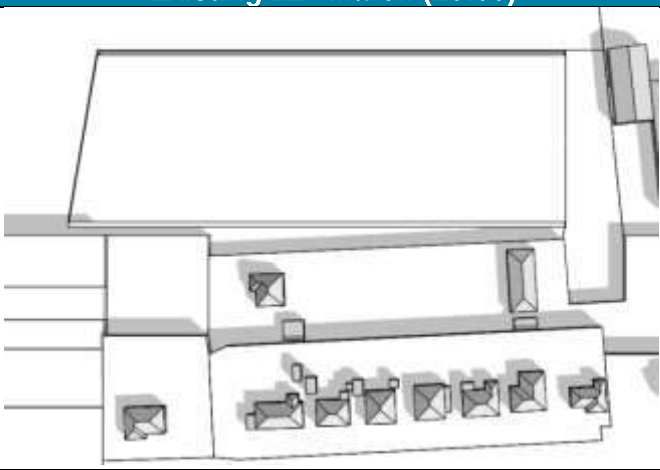
Of the 224 units proposed, 54% enjoy a dual aspect configuration and share full access to a courtyard amenity space which is usable all year round. This courtyard space receives a sufficient level of sunlight across the vast majority of its area according to BRE guidance.

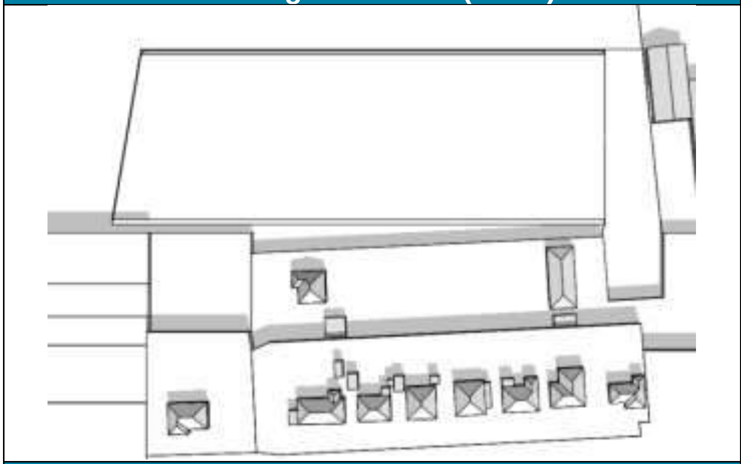
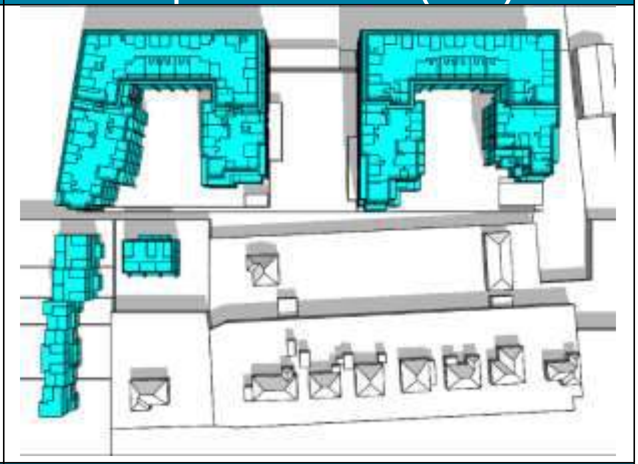
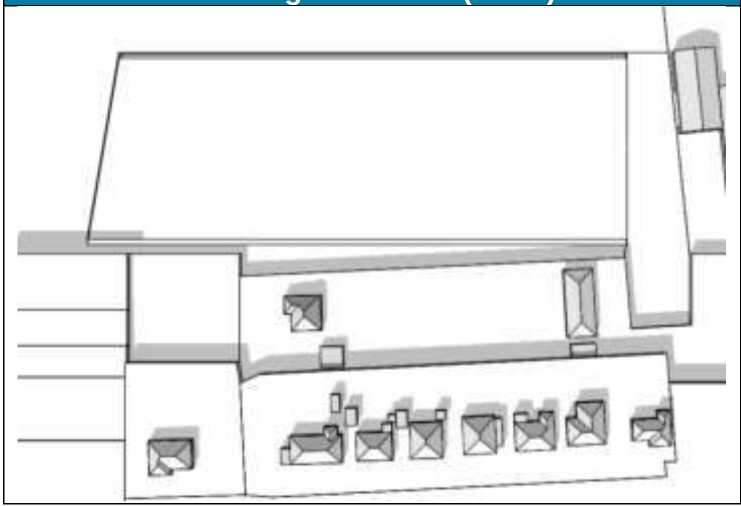
All units also have higher than average ceilings at a height of 2.7m.

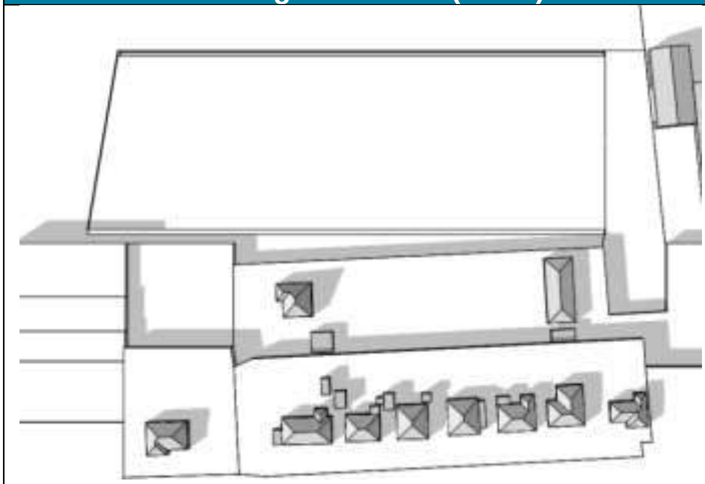
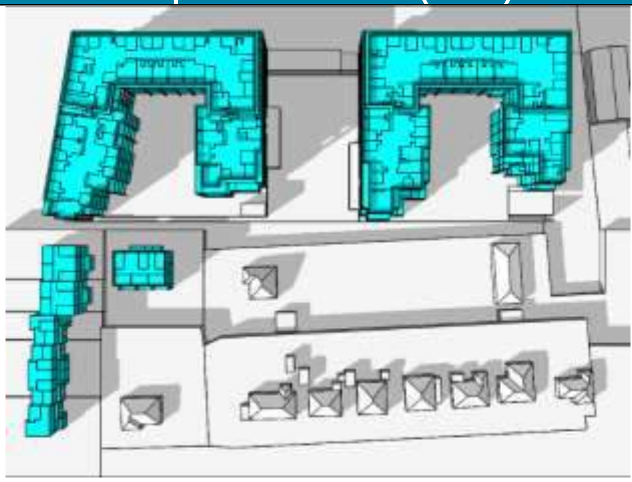
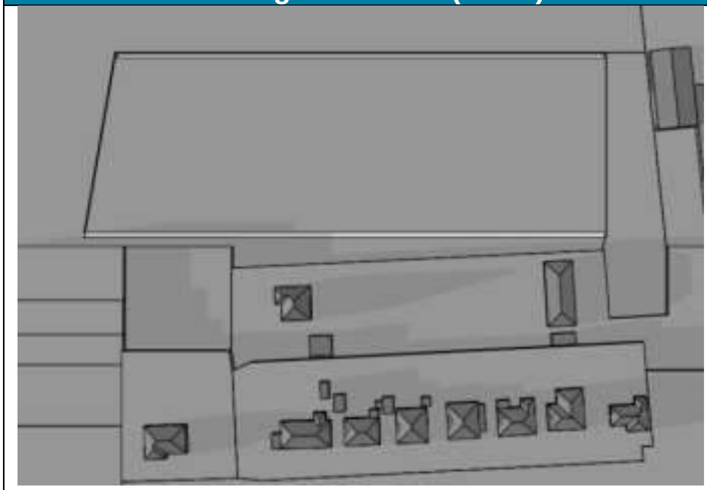
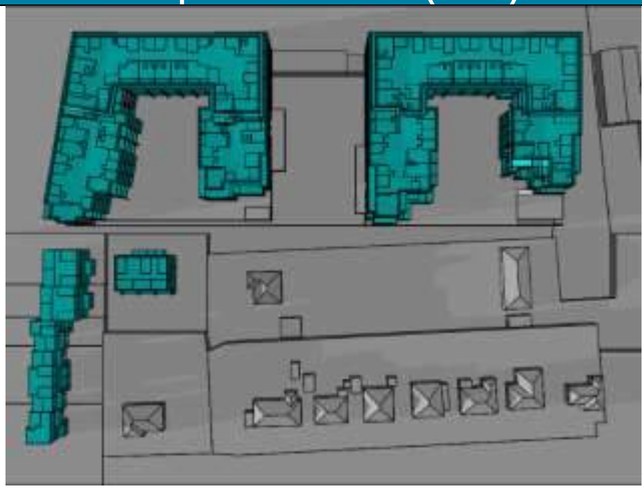
APPENDIX A | OVERSHADOWING IMAGES

Plan View Images

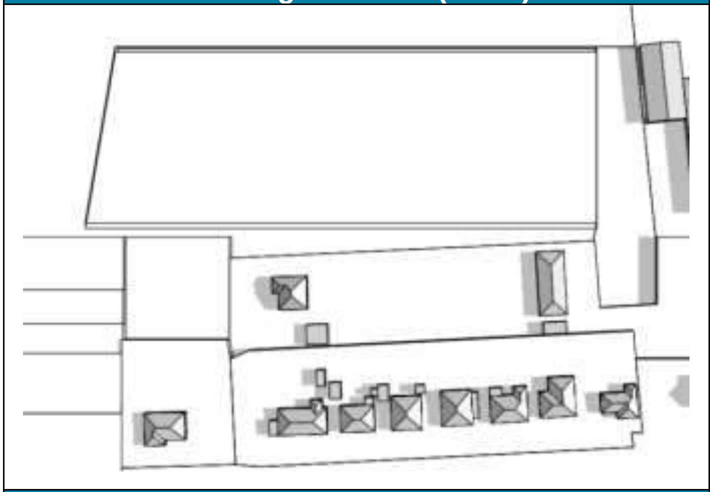
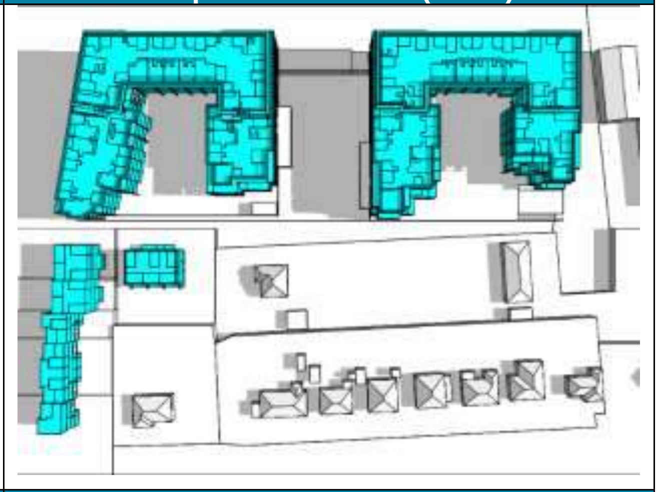
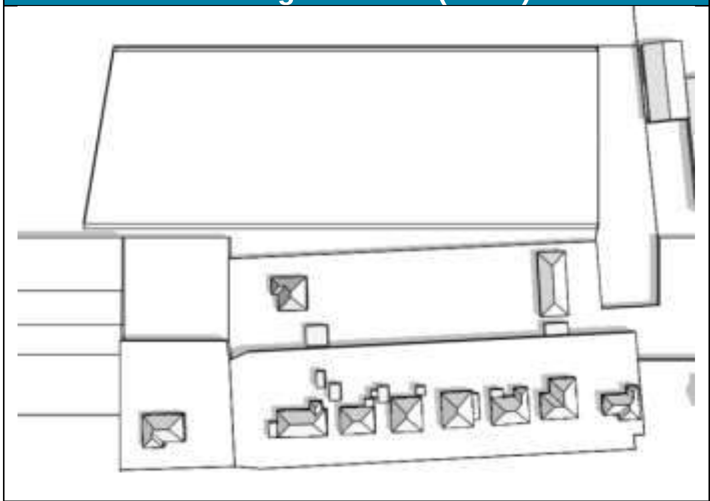
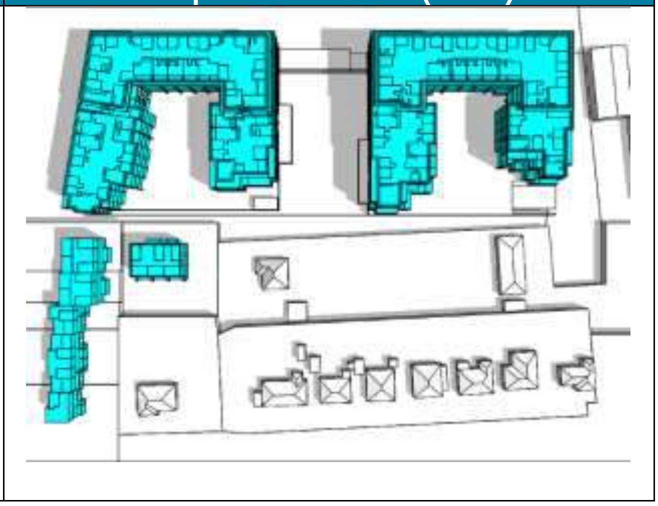
Plan View – 21st March

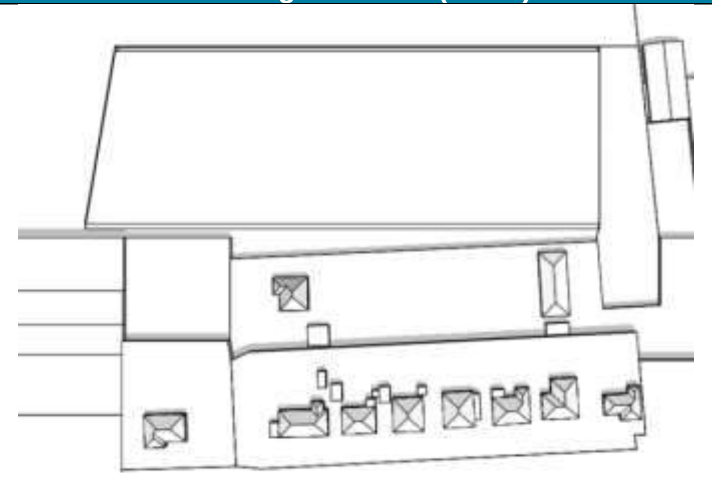
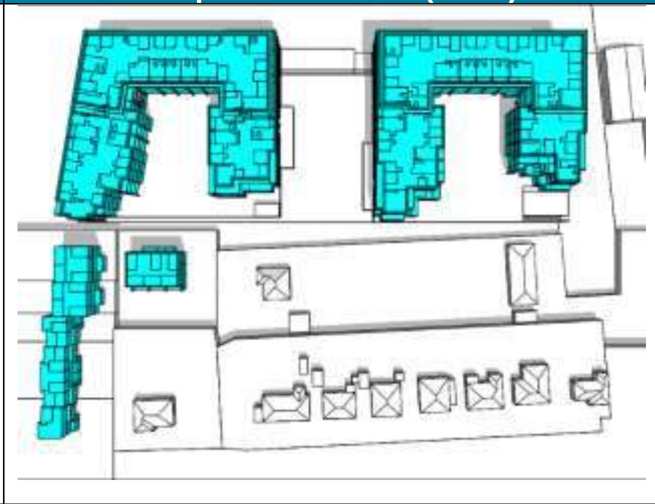
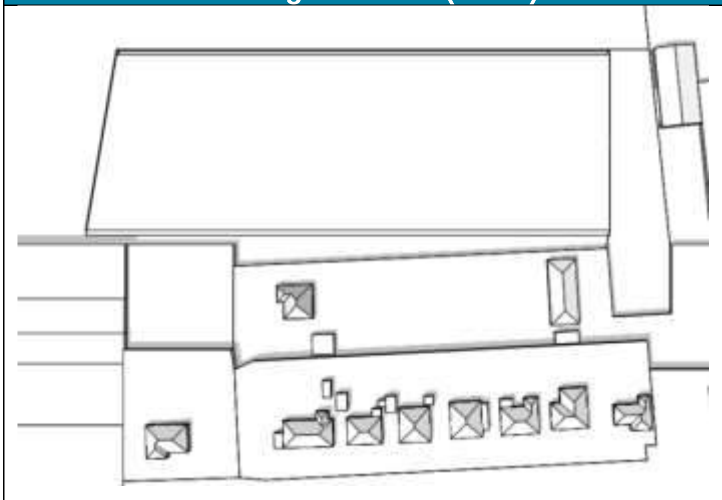
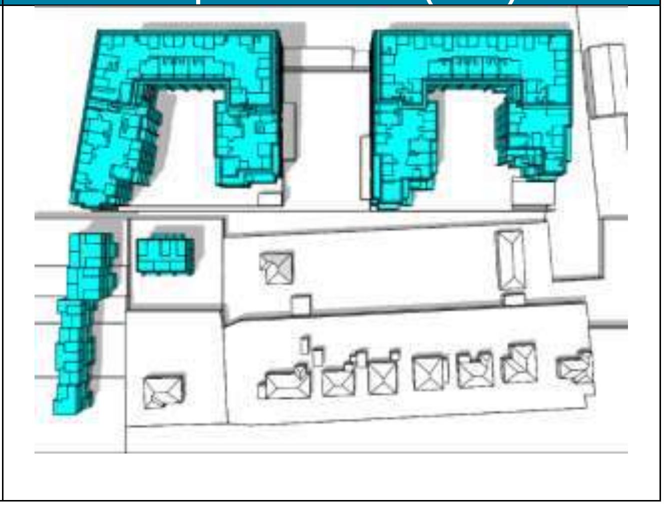
Existing 21st March (08:00)	Proposed 21st March (08:00)
	
Existing 21st March (10:00)	**Proposed 21st March (10:00)**
	

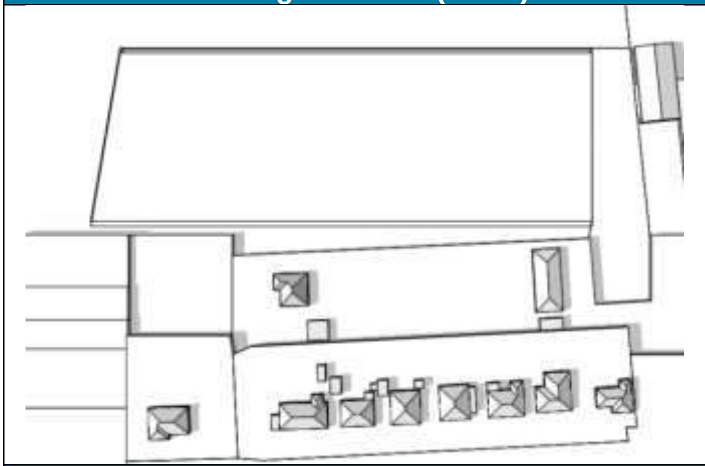
Existing 21st March (12:00)	Proposed 21st March (12:00)
	
Existing 21st March (14:00)	**Proposed 21st March (14:00)**
	

Existing 21st March (16:00)	Proposed 21st March (16:00)
	
Existing 21st March (18:00)	**Proposed 21st March (18:00)**
	

Plan View – 21st June

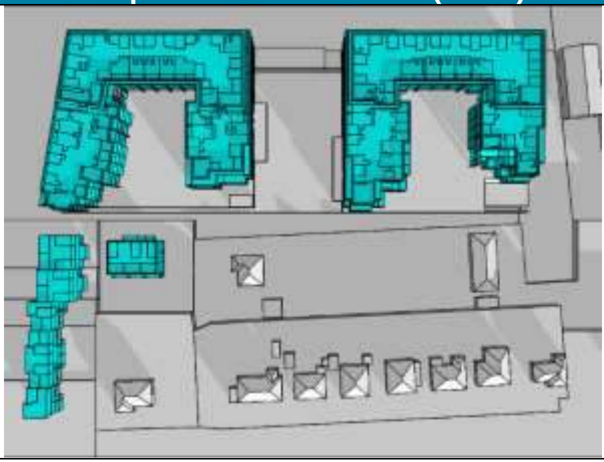
Existing 21st June (08:00)	Proposed 21st June (08:00)
	
Existing 21st June (10:00)	**Proposed 21st June (10:00)**
	

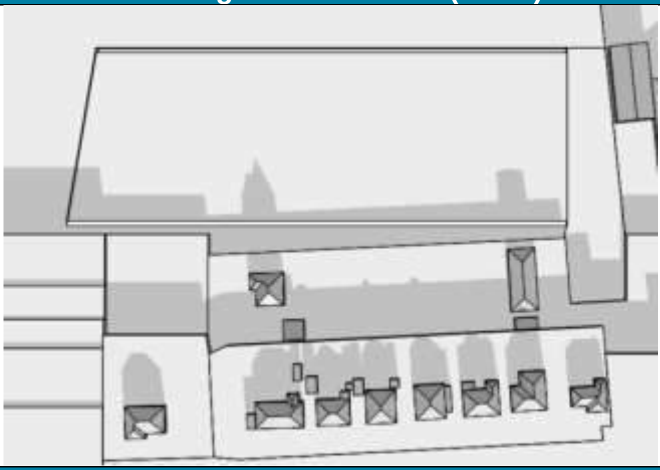
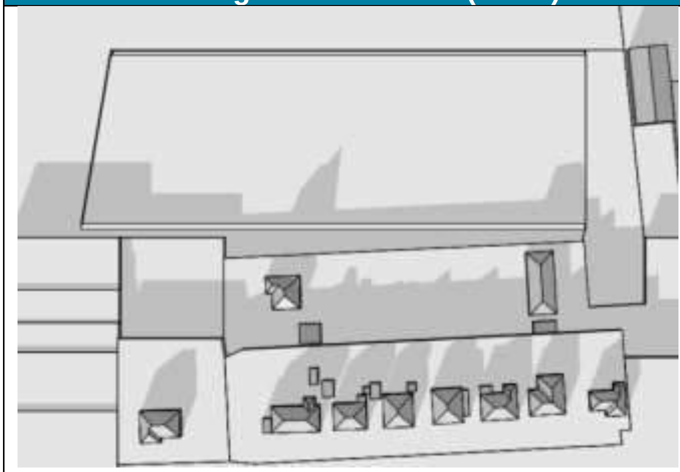
Existing 21st June (12:00)	Proposed 21st June (12:00)
	
Existing 21st June (14:00)	**Proposed 21st June (14:00)**
	

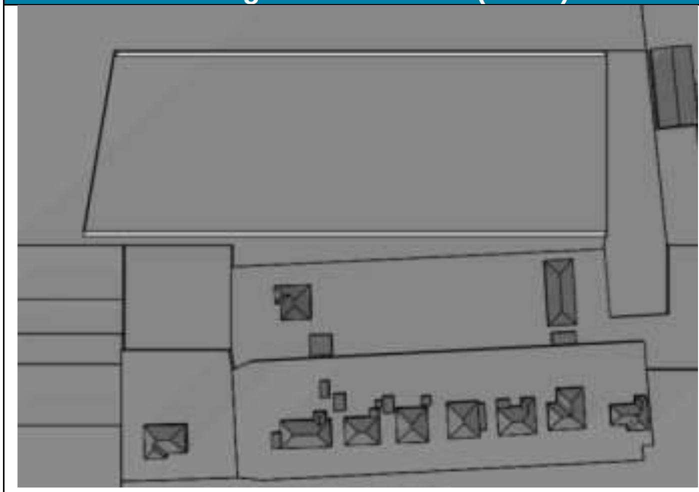
Existing 21st June (16:00)	Proposed 21st June (16:00)
	
Existing 21st June (18:00)	**Proposed 21st June (18:00)**
	

Plan

Plan View – 21st December

Existing 21st December (08:00)	Proposed 21st December (08:00)
	
Existing 21st December (10:00)	**Proposed 21st December (10:00)**
	

Existing 21st December (12:00)	Proposed 21st December (12:00)
	
Existing 21st December (14:00)	**Proposed 21st December (14:00)**
	

Existing 21st December (16:00)	Proposed 21st December (16:00)
	
Existing 21st December (18:00)	**Proposed 21st December (18:00)**
	

APPENDIX B | VERTICAL SKY COMPONENT RESULTS

Ref No.	Surrounding Building	Surface	Opening	Resultant VSC (Post-Development)	Existing VSC (Pre-Development)	Status	% of Existing VSC Maintained
1	Block 4	2	0	26.44	28.51	Pass2	92.74
2	Block 4	2	1	31.12	32.97	Pass	94.39
3	Block 4	3	0	31.07	34.54	Pass	89.95
4	Block 4	3	1	32.11	36.45	Pass	88.09
5	Block 4	4	0	31.49	33.42	Pass	94.23
6	Block 6	2	0	34.02	34.03	Pass	99.97
7	Block 6	2	1	27.06	27.15	Pass	99.67
8	Block 6	3	0	34.01	36.12	Pass	94.16
9	Block 6	3	1	25.96	27.33	Pass2	94.99
10	Block 6	4	0	33.25	33.38	Pass	99.61
11	Block 5	2	0	32.70	33.26	Pass	98.32
12	Block 5	2	1	31.65	31.92	Pass	99.15
13	Block 5	3	0	31.75	32.05	Pass	99.06
14	Block 5	5	0	34.75	36.41	Pass	95.44
15	Block 5	5	1	32.81	34.66	Pass	94.66
16	Block 10	1	0	33.38	37.99	Pass	87.87
17	Block 10	1	1	33.88	37.32	Pass	90.78
18	Block 10	1	2	33.90	37.82	Pass	89.64
19	Block 10	2	0	25.73	39.15	*Note 1	65.72
20	Block 10	3	0	36.98	37.44	Pass	98.77
21	Block 10	3	1	36.72	38.48	Pass	95.43
22	Block 10	3	2	37.39	38.04	Pass	98.29
23	Block 12	3	0	38.01	39.15	Pass	97.09
24	Block 12	2	0	37.66	38.60	Pass	97.56
25	Block 12	2	1	37.19	38.43	Pass	96.77
26	Block 11	2	0	35.12	35.95	Pass	97.69
27	Block 11	3	0	38.52	38.52	Pass	100.00
28	Block 11	5	0	36.98	38.55	Pass	95.93
29	Block 11	5	1	32.04	33.73	Pass	94.99
30	Block 11	2	0	37.38	39.09	Pass	95.63
31	Block 9	2	0	30.36	30.43	Pass	99.77
32	Block 9	3	0	36.90	39.21	Pass	94.11
33	Block 9	3	1	36.70	39.14	Pass	93.77
34	Block 9	4	0	37.21	37.24	Pass	99.92
35	Block 9	6	0	33.24	34.48	Pass	96.40
36	Block 9	7	0	31.34	33.73	Pass	92.91
37	Block 8	2	0	36.41	39.18	Pass	92.93
38	Block 8	3	0	36.24	39.02	Pass	92.88

Ref No.	Surrounding Building	Surface	Opening	Resultant VSC (Post-Development)	Existing VSC (Pre-Development)	Status	% of Existing VSC Maintained
39	Block 8	2	0	33.90	34.18	Pass	99.18
40	Block 8	2	1	32.09	32.62	Pass	98.38
41	Block 8	3	0	31.17	31.22	Pass	99.84
42	Block 1	2	0	33.92	39.11	Pass	86.73
43	Block 1	2	1	32.41	39.24	Pass	82.59
44	Block 1	3	0	34.63	39.08	Pass	88.61
45	Block 1	3	1	35.35	39.07	Pass	90.48
46	Block 1	4	0	38.12	38.84	Pass	98.15
47	Block 3	2	0	31.73	38.05	Pass	83.39
48	Block 3	3	0	27.37	39.11	Pass	69.98
49	Block 3	3	1	29.70	39.16	Pass	75.84
50	Block 3	4	0	34.81	37.65	Pass	92.46
51	Block 3	6	0	31.84	36.08	Pass	88.25
52	Block 2	2	0	31.54	31.89	Pass	98.90
53	Block 2	4	0	32.67	34.10	Pass	95.81
54	Block 2	5	0	36.18	38.92	Pass	92.96
55	Block 2	5	1	32.15	34.03	Pass	94.48
56	Block 7	1	0	34.45	34.61	Pass	99.54
57	Block 7	1	1	33.71	34.09	Pass	98.89
58	Block 7	2	0	36.02	39.10	Pass	92.12
59	Block 7	2	1	36.33	39.15	Pass	92.80

Pass2: VSC value is below target of 27% but has not been reduced to less than 80% of its pre-development value.

*Note 1: Result does not meet the recommended BRE guideline value.

APPENDIX C | AVERAGE DAYLIGHT FACTOR RESULTS

Bedroom ADF Results

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
1	2.13 Bedroom 1	1.71	Yes
2	2.12 Bedroom 1	1.87	Yes
3	2.11 Bedroom 1	1.96	Yes
4	2.10 Bedroom 1	1.86	Yes
5	2.10 Bedroom 2	1.70	Yes
6	2.14 Bedroom 1	1.67	Yes
7	2.07 Bedroom 1	3.13	Yes
8	2.20 Bedroom 1	4.64	Yes
9	2.09 Bedroom 2	3.88	Yes
10	2.09 Bedroom 1	9.89	Yes
11	2.20 Bedroom 2	4.70	Yes
12	3.05 Bedroom 2	4.97	Yes
13	3.14 Bedroom 1	1.70	Yes
14	3.13 Bedroom 1	1.74	Yes
15	3.12 Bedroom 1	1.69	Yes
16	3.05 Bedroom 3	4.28	Yes
17	3.05 Bedroom 1	5.50	Yes
18	4.14 Bedroom 1	1.70	Yes
19	4.13 Bedroom 1	1.74	Yes
20	4.12 Bedroom 1	1.73	Yes
21	6.07 Bedroom 1	2.79	Yes
22	6.06 Bedroom 1	2.89	Yes
23	6.05 Bedroom 1	2.99	Yes
24	6.08 Bedroom 1	2.85	Yes
25	6.04 Bedroom 1	3.04	Yes
26	6.03 Bedroom 1	6.80	Yes
27	6.03 Bedroom 2	3.45	Yes
28	6.02 Bedroom 2	2.69	Yes
29	6.02 Bedroom 1	2.55	Yes
30	6.01 Bedroom 1	2.12	Yes
31	6.10 Bedroom 2	4.60	Yes
32	6.10 Bedroom 1	3.18	Yes
33	6.11 Bedroom 2	1.38	Yes
34	6.11 Bedroom 1	1.67	Yes
35	6.09 Bedroom 1	3.52	Yes
36	6.09 Bedroom 2	2.60	Yes
37	2.24 Bedroom 1	2.83	Yes
38	2.24 Bedroom 2	4.89	Yes
39	2.41 Bedroom 2	2.95	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
40	2.28 Bedroom 1	4.80	Yes
41	2.31 Bedroom 1	4.57	Yes
42	2.38 Bedroom 1	4.73	Yes
43	2.36 Bedroom 1	4.35	Yes
44	2.36 Bedroom 2	6.48	Yes
45	2.42 Bedroom 1	2.91	Yes
46	2.40 Bedroom 1	4.06	Yes
47	2.27 Bedroom 2	4.39	Yes
48	2.27 Bedroom 1	4.21	Yes
49	3.43 Bedroom 1	5.56	Yes
50	3.41 Bedroom 1	4.89	Yes
51	3.41 Bedroom 2	6.99	Yes
52	3.38 Bedroom 1	2.37	Yes
53	3.37 Bedroom 1	2.45	Yes
54	3.36 Bedroom 1	2.30	Yes
55	3.39 Bedroom 1	2.60	Yes
56	2.32 Bedroom 1	3.71	Yes
57	2.35 Bedroom 1	3.32	Yes
58	2.34 Bedroom 1	5.48	Yes
59	2.34 Bedroom 2	5.02	Yes
60	2.33 Bedroom 2	5.53	Yes
61	2.33 Bedroom 1	5.64	Yes
62	3.39 Bedroom 2	2.27	Yes
63	3.26 Bedroom 1	4.10	Yes
64	3.26 Bedroom 2	6.06	Yes
65	3.34 Bedroom 3	6.17	Yes
66	3.34 Bedroom 1	5.20	Yes
67	3.34 Bedroom 2	10.01	Yes
68	3.40 Bedroom 1	5.07	Yes
69	4.35 Bedroom 1	1.59	Yes
70	4.34 Bedroom 1	1.64	Yes
71	4.27 Bedroom 1	3.56	Yes
72	4.27 Bedroom 2	2.29	Yes
73	4.41 Bedroom 3	3.86	Yes
74	4.28 Bedroom 2	1.97	Yes
75	4.28 Bedroom 1	3.09	Yes
76	6.18 Bedroom 1	2.56	Yes
77	6.17 Bedroom 1	2.59	Yes
78	6.16 Bedroom 1	2.98	Yes
79	6.20 Bedroom 1	3.74	Yes
80	6.20 Bedroom 2	3.21	Yes
81	6.14 Bedroom 2	3.91	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
82	6.14 Bedroom 1	2.92	Yes
83	2.05 Bedroom 2	4.42	Yes
84	2.05 Bedroom 1	4.05	Yes
85	2.22 Bedroom 2	3.55	Yes
86	2.22 Bedroom 1	3.80	Yes
87	2.23 Bedroom 1	2.84	Yes
88	2.06 Bedroom 2	4.59	Yes
89	2.06 Bedroom 1	4.35	Yes
90	2.03 Bedroom 2	6.38	Yes
91	2.03 Bedroom 1	3.86	Yes
92	3.18 Bedroom	3.24	Yes
93	3.17 Bedroom	3.24	Yes
94	3.06 Bedroom 2	4.49	Yes
95	3.06 Bedroom 1	4.07	Yes
96	3.07 Bedroom 1	4.72	Yes
97	3.07 Bedroom 2	4.15	Yes
98	3.04 Bedroom 1	6.70	Yes
99	3.04 Bedroom 2	3.87	Yes
100	3.15 Bedroom 2	2.48	Yes
101	3.15 Bedroom 1	1.56	Yes
102	3.09 Bedroom 1	3.43	Yes
103	3.08 Bedroom 1	3.28	Yes
104	3.03 Bedroom 1	3.74	Yes
105	3.02 Bedroom 1	3.20	Yes
106	3.11 Bedroom 1	2.72	Yes
107	3.11 Bedroom 2	1.89	Yes
108	3.01 Bedroom 1	1.60	Yes
109	2.15 Bedroom 2	4.85	Yes
110	2.15 Bedroom 1	2.54	Yes
111	3.10 Bedroom 2	3.31	Yes
112	3.10 Bedroom 1	9.65	Yes
113	2.01 Bedroom 2	3.37	Yes
114	2.01 Bedroom 1	3.41	Yes
115	4.05 Bedroom 3	5.53	Yes
116	4.05 Bedroom 2	4.10	Yes
117	4.05 Bedroom 1	5.39	Yes
118	4.06 Bedroom 2	4.31	Yes
119	4.06 Bedroom 1	4.20	Yes
120	4.07 Bedroom 1	4.50	Yes
121	4.07 Bedroom 2	4.21	Yes
122	4.04 Bedroom 2	6.70	Yes
123	4.04 Bedroom 1	4.22	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
124	4.03 Bedroom 1	3.95	Yes
125	4.02 Bedroom 1	3.43	Yes
126	4.11 Bedroom 1	2.75	Yes
127	4.11 Bedroom 2	1.72	Yes
128	4.01 Bedroom 1	1.72	Yes
129	4.10 Bedroom 2	3.77	Yes
130	4.10 Bedroom 1	9.42	Yes
131	5.14 Bedroom 1	1.67	Yes
132	5.13 Bedroom 1	1.70	Yes
133	5.12 Bedroom 1	1.70	Yes
134	5.05 Bedroom 1	6.10	Yes
135	5.05 Bedroom 3	4.46	Yes
136	5.05 Bedroom 2	5.82	Yes
137	5.06 Bedroom 1	4.40	Yes
138	5.06 Bedroom 2	4.40	Yes
139	5.07 Bedroom 1	4.78	Yes
140	5.07 Bedroom 2	3.98	Yes
141	5.04 Bedroom 2	7.12	Yes
142	5.04 Bedroom 1	4.30	Yes
143	5.09 Bedroom 1	3.00	Yes
144	5.08 Bedroom 1	2.82	Yes
145	5.03 Bedroom 1	4.01	Yes
146	5.02 Bedroom 1	3.84	Yes
147	5.11 Bedroom 1	2.67	Yes
148	5.11 Bedroom 2	1.68	Yes
149	5.01 Bedroom 1	2.15	Yes
150	5.10 Bedroom 2	2.94	Yes
151	5.10 Bedroom 1	8.48	Yes
152	4.22 Bedroom 1	4.24	Yes
153	4.22 Bedroom 2	4.20	Yes
154	4.15 Bedroom 2	2.31	Yes
155	4.15 Bedroom 1	1.51	Yes
156	4.24 Bedroom 1	1.43	Yes
157	5.19 Bedroom 1	3.49	Yes
158	5.18 Bedroom 1	3.71	Yes
159	5.17 Bedroom 1	3.28	Yes
160	5.20 Bedroom 1	3.85	Yes
161	5.15 Bedroom 2	2.27	Yes
162	5.15 Bedroom 1	1.50	Yes
163	2.21 Bedroom 1	4.07	Yes
164	2.21 Bedroom 2	5.30	Yes
165	2.23 Bedroom 2	2.72	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
166	3.25 Bedroom 1	1.13	Yes
167	3.23 Bedroom 2	3.88	Yes
168	3.23 Bedroom 1	3.71	Yes
169	3.24 Bedroom 1	3.24	Yes
170	5.21 Bedroom 1	2.66	Yes
171	5.21 Bedroom 2	4.78	Yes
172	5.21 Bedroom 3	2.62	Yes
173	5.22 Bedroom 2	4.44	Yes
174	5.22 Bedroom 1	4.18	Yes
175	5.23 Bedroom 1	4.15	Yes
176	5.24 Bedroom 1	1.90	Yes
177	3.16 Bedroom 2	6.04	Yes
178	3.16 Bedroom 1	3.55	Yes
179	4.16 Bedroom 1	3.46	Yes
180	5.16 Bedroom 1	3.26	Yes
181	2.45 Bedroom 1	11.25	Yes
182	2.40 Bedroom 2	4.26	Yes
183	3.45 Bedroom 1	5.16	Yes
184	3.45 Bedroom 2	5.06	Yes
185	5.40 Bedroom 2	4.36	Yes
186	5.40 Bedroom 1	4.14	Yes
187	5.36 Bedroom 1	1.89	Yes
188	5.35 Bedroom 1	1.73	Yes
189	5.34 Bedroom 1	1.60	Yes
190	5.27 Bedroom 1	3.39	Yes
191	5.27 Bedroom 2	2.17	Yes
192	5.28 Bedroom 2	2.29	Yes
193	5.28 Bedroom 1	3.23	Yes
194	6.13 Bedroom 2	4.57	Yes
195	6.13 Bedroom 1	2.76	Yes
196	6.21 Bedroom 1	4.35	Yes
197	6.21 Bedroom 3	4.64	Yes
198	6.21 Bedroom 2	2.82	Yes
199	6.22 Bedroom 1	2.59	Yes
200	6.12 Bedroom 1	2.64	Yes
201	2.30 Bedroom 1	4.26	Yes
202	2.30 Bedroom	4.09	Yes
203	3.22 Bedroom 1	6.29	Yes
204	3.22 Bedroom 2	3.86	Yes
205	4.16 Bedroom 2	6.69	Yes
206	5.16 Bedroom 2	5.56	Yes
207	5.41 Bedroom 1	3.72	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
208	5.41 Bedroom 2	4.18	Yes
209	3.29 Bedroom 2	4.77	Yes
210	3.29 Bedroom 1	4.81	Yes
211	3.33 Bedroom 1	3.76	Yes
212	4.32 Bedroom 3	5.86	Yes
213	4.32 Bedroom 1	4.61	Yes
214	4.32 Bedroom 2	7.02	Yes
215	4.31 Bedroom 1	3.20	Yes
216	5.29 Bedroom 2	4.57	Yes
217	5.29 Bedroom 1	4.45	Yes
218	5.32 Bedroom 3	5.07	Yes
219	5.32 Bedroom 1	4.06	Yes
220	5.32 Bedroom 2	6.48	Yes
221	5.31 Bedroom 1	3.39	Yes
222	5.30 Bedroom 1	7.17	Yes
223	5.30 Bedroom 2	7.11	Yes
224	4.25 Bedroom 1	4.12	Yes
225	5.26 Bedroom 2	4.35	Yes
226	5.26 Bedroom 1	6.19	Yes
227	5.25 Bedroom 1	4.29	Yes
228	5.25 Bedroom 2	6.14	Yes
229	3.44 Bedroom 2	4.90	Yes
230	3.44 Bedroom 1	4.79	Yes
231	3.47 Bedroom 1	3.60	Yes
232	3.46 Bedroom 1	4.47	Yes
233	3.46 Bedroom 2	3.94	Yes
234	4.44 Bedroom 1	3.20	Yes
235	5.44 Bedroom 1	4.00	Yes
236	4.43 Bedroom 1	3.86	Yes
237	4.41 Bedroom 2	3.83	Yes
238	5.43 Bedroom 1	3.88	Yes
239	5.41 Bedroom 3	4.60	Yes
240	5.42 Bedroom 1	4.89	Yes
241	4.39 Bedroom 1	4.44	Yes
242	4.38 Bedroom 2	4.51	Yes
243	5.39 Bedroom 1	4.03	Yes
244	5.39 Bedroom 2	6.30	Yes
245	5.38 Bedroom 1	4.16	Yes
246	2.39 Bedroom 1	3.88	Yes
247	4.42 Bedroom 1	3.99	Yes
248	4.42 Bedroom 2	5.01	Yes
249	3.35 Bedroom 1	2.20	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
250	3.35 Bedroom 2	2.51	Yes
251	4.33 Bedroom 1	1.64	Yes
252	5.37 Bedroom 2	1.71	Yes
253	5.37 Bedroom 1	1.32	Yes
254	5.33 Bedroom 1	1.81	Yes
255	5.33 Bedroom 2	1.65	Yes
256	6.15 Bedroom 1	2.51	Yes
257	6.16 Bedroom 2	2.80	Yes
258	3.30 Bedroom 1	4.07	Yes
259	6.19 Bedroom 2	3.01	Yes
260	6.19 Bedroom 1	2.60	Yes
261	4.37 Bedroom 2	1.81	Yes
262	2.04 Bedroom 1	4.44	Yes
263	2.04 Bedroom 3	4.17	Yes
264	2.04 Bedroom 2	5.83	Yes
265	2.37 Bedroom 2	4.20	Yes
266	2.37 Bedroom 1	3.93	Yes
267	2.25 Bedroom 2	3.89	Yes
268	2.25 Bedroom 1	5.21	Yes
269	2.26 Bedroom 2	4.08	Yes
270	2.26 Bedroom 1	6.05	Yes
271	3.42 Bedroom 2	4.78	Yes
272	3.42 Bedroom 1	4.52	Yes
273	4.29 Bedroom 1	4.47	Yes
274	4.29 Bedroom 2	4.28	Yes
275	4.30 Bedroom 1	4.59	Yes
276	4.30 Bedroom 2	4.26	Yes
277	3.27 Bedroom 2	4.07	Yes
278	3.27 Bedroom 1	6.03	Yes
279	3.28 Bedroom 2	5.87	Yes
280	3.28 Bedroom 1	7.28	Yes
281	3.31 Bedroom 2	4.79	Yes
282	3.31 Bedroom 1	4.58	Yes
283	3.32 Bedroom 1	7.37	Yes
284	3.32 Bedroom 2	7.18	Yes
285	4.40 Bedroom 2	4.11	Yes
286	4.40 Bedroom 1	3.96	Yes
287	2.29 Bedroom 2	4.31	Yes
288	2.29 Bedroom 1	3.56	Yes
289	3.21 Bedroom 1	4.21	Yes
290	3.21 Bedroom 2	5.50	Yes
291	4.21 Bedroom 1	2.85	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
292	4.21 Bedroom 2	4.26	Yes
293	4.21 Bedroom 3	2.72	Yes
294	4.26 Bedroom 2	3.86	Yes
295	4.26 Bedroom 1	5.60	Yes
296	2.41 Bedroom 1	1.33	Yes
297	4.25 Bedroom 2	5.71	Yes
298	4.33 Bedroom 2	1.69	Yes
299	4.36 Bedroom 1	1.66	Yes
300	4.37 Bedroom 1	1.36	Yes
301	4.39 Bedroom 2	6.28	Yes
302	4.41 Bedroom 1	3.77	Yes
303	4.09 Bedroom 1	3.37	Yes
304	4.08 Bedroom 1	3.04	Yes
305	4.17 Bedroom 1	3.20	Yes
306	4.18 Bedroom 1	3.28	Yes
307	4.19 Bedroom 1	3.38	Yes
308	4.20 Bedroom 1	3.71	Yes
309	3.20 Bedroom 1	3.38	Yes
310	3.19 Bedroom 1	3.40	Yes
311	2.08 Bedroom 1	3.62	Yes
312	2.16 Bedroom 1	3.15	Yes
313	2.17 Bedroom 1	3.11	Yes
314	2.19 Bedroom 1	4.45	Yes
315	2.18 Bedroom 1	3.54	Yes
316	2.19 Bedroom 1	3.49	Yes
317	2.44 Bedroom 1	6.67	Yes
318	2.14 Bedroom 2	1.84	Yes
319	2.39 Bedroom 2	4.58	Yes
320	2.43 Bedroom 1	12.81	Yes
321	2.43 Bedroom 1	8.05	Yes
322	C0.01_Bedroom	0.90	Marginally below target value
323	C0.02_Bedroom	0.40	No
324	C0.03_Bedroom	1.20	Yes
325	D0.01_Bedroom	1.12	Yes
326	D0.02_Bedroom	1.10	Yes
327	D0.03_Bedroom	0.85	Marginally below target value
328	D0.04_Bedroom	0.72	No
329	D0.05_Bedroom	1.07	Yes
330	D0.06_Bedroom	1.17	Yes
331	D0.07_Bedroom	1.06	Yes
332	D0.08_Bedroom	1.00	Yes
333	C2.01_Bedroom 01	6.16	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
334	C2.01_Bedroom 02	1.11	Yes
335	C2.02_Bedroom 01	5.87	Yes
336	C2.02_Bedroom 02	1.32	Yes
337	C2.03_Bedroom 01	5.96	Yes
338	C2.03_Bedroom 02	1.14	Yes
339	D2.01_Bedroom 01	6.73	Yes
340	D2.01_Bedroom 02	1.21	Yes
341	D2.02_Bedroom 01	6.42	Yes
342	D2.02_Bedroom 02	1.38	Yes
343	D2.03_Bedroom 01	6.66	Yes
344	D2.03_Bedroom 02	1.00	Yes
345	D2.04_Bedroom 01	6.56	Yes
346	D2.04_Bedroom 02	0.86	Marginally below target value
347	D2.05_Bedroom 01	6.61	Yes
348	D2.05_Bedroom 02	3.59	Yes
349	D2.06_Bedroom 01	3.66	Yes
350	D2.06_Bedroom 02	6.79	Yes
351	D2.07_Bedroom 01	3.56	Yes
352	D2.07_Bedroom 02	6.74	Yes
353	D2.08_Bedroom	6.85	Yes

Passive Dynamics
SUSTAINABILITY CONSULTANTS

Kitchen/Living Room ADF Results

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
1	2.13 Living/Kitchen	2.41	Yes
2	2.12 Living/Kitchen	2.62	Yes
3	2.11 Living/Kitchen	2.72	Yes
4	2.10 Living/Kitchen	2.06	Yes
5	2.14 Living/Kitchen	1.92	*Note 1
6	2.07 Living/Kitchen	2.81	Yes
7	2.20 Living/Kitchen	2.83	Yes
8	3.14 Living/Kitchen	2.89	Yes
9	3.13 Living/Kitchen	2.94	Yes
10	3.12 Living/Kitchen	2.78	Yes
11	4.14 Living/Kitchen	3.14	Yes
12	4.13 Living/Kitchen	3.49	Yes
13	4.12 Living/Kitchen	3.14	Yes
14	6.07 Living/Kitchen	2.89	Yes
15	6.06 Living/Kitchen	2.93	Yes
16	6.04 Living/Kitchen	2.87	Yes
17	6.08 Living/Kitchen	2.60	Yes
18	6.02 Living/Kitchen	5.84	Yes
19	6.03 Living/Kitchen	2.68	Yes
20	6.01 Living/Kitchen	7.92	Yes
21	6.10 Living/Kitchen	5.68	Yes
22	6.11 Living/Kitchen	7.26	Yes
23	6.09 Living/Kitchen	5.32	Yes
24	2.24 Living/Kitchen	1.80	*Note 1
25	2.41 Living/Kitchen	3.99	Yes
26	2.28 Living/Kitchen	3.93	Yes
27	2.31 Living/Kitchen	3.55	Yes
28	2.38 Living/Kitchen	4.51	Yes
29	2.36 Living/Kitchen	8.85	Yes
30	2.42 Living/Kitchen	2.30	Yes
31	2.40 Living/Kitchen	6.49	Yes
32	3.43 Living/Kitchen	5.84	Yes
33	3.41 Living/Kitchen	9.44	Yes
34	3.38 Living/Kitchen	3.99	Yes
35	3.37 Living/Kitchen	4.32	Yes
36	3.36 Living/Kitchen	3.71	Yes
37	3.39 Living/Kitchen	2.69	Yes
38	2.32 Living/Kitchen	3.78	Yes
39	2.35 Living/Kitchen	3.63	Yes
40	2.44 Living/Kitchen	3.51	Yes
41	2.34 Living/Kitchen	5.20	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
42	2.33 Living/Kitchen	5.46	Yes
43	3.26 Living/Kitchen	1.88	*Note 1
44	3.34 Living/Kitchen	6.03	Yes
45	3.40 Living/Kitchen	4.49	Yes
46	4.36 Living/Kitchen	3.85	Yes
47	4.35 Living/Kitchen	3.43	Yes
48	4.27 Living/Kitchen	2.60	Yes
49	4.42 Living/Kitchen	2.74	Yes
50	4.28 Living/Kitchen	4.94	Yes
51	6.17 Living/Kitchen	3.10	Yes
52	6.16 Living/Kitchen	3.23	Yes
53	6.20 Living/Kitchen	5.00	Yes
54	2.22 Living/Kitchen	1.31	*Note 1
55	2.23 Living/Kitchen	1.26	*Note 2
56	2.06 Living/Kitchen	5.31	Yes
57	2.03 Living/Kitchen	4.65	Yes
58	2.17 Living/Kitchen	3.53	Yes
59	3.19 Living/Kitchen	3.77	Yes
60	3.18 Living/Kitchen	3.59	Yes
61	3.17 Living/Kitchen	3.70	Yes
62	3.06 Living/Kitchen	2.47	Yes
63	3.07 Living/Kitchen	2.46	Yes
64	3.04 Living/Kitchen	4.50	Yes
65	3.09 Living/Kitchen	2.55	Yes
66	3.08 Living/Kitchen	2.68	Yes
67	3.11 Living/Kitchen	2.49	Yes
68	3.01 Living/Kitchen	2.97	Yes
69	3.05 Living/Kitchen	3.19	Yes
70	2.21 Living/Kitchen	3.35	Yes
71	2.15 Living/Kitchen	6.13	Yes
72	3.10 Living/Kitchen	4.40	Yes
73	2.01 Living/Kitchen	1.95	*Note 1
74	4.06 Living/Kitchen	2.47	Yes
75	4.07 Living/Kitchen	2.36	Yes
76	4.04 Living/Kitchen	4.94	Yes
77	4.11 Living/Kitchen	2.65	Yes
78	4.01 Living/Kitchen	3.30	Yes
79	4.05 Living/Kitchen	3.30	Yes
80	4.10 Living/Kitchen	4.36	Yes
81	5.14 Living/Kitchen	3.48	Yes
82	5.13 Living/Kitchen	3.55	Yes
83	5.12 Living/Kitchen	3.55	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
84	5.06 Living/Kitchen	2.50	Yes
85	5.07 Living/Kitchen	2.54	Yes
86	5.04 Living/Kitchen	5.47	Yes
87	5.09 Living/Kitchen	2.25	Yes
88	5.08 Living/Kitchen	2.40	Yes
89	5.11 Living/Kitchen	3.00	Yes
90	5.01 Living/Kitchen	3.58	Yes
91	5.05 Living/Kitchen	3.94	Yes
92	5.10 Living/Kitchen	4.03	Yes
93	4.15Living/Kitchen	2.53	Yes
94	4.24 Living/Kitchen	3.35	Yes
95	5.19 Living/Kitchen	4.16	Yes
96	5.18 Living/Kitchen	3.60	Yes
97	5.17 Living/Kitchen	3.94	Yes
98	5.20 Living/Kitchen	3.70	Yes
99	5.15 Living/Kitchen	3.00	Yes
100	2.43 Living/Kitchen	2.40	Yes
101	5.21 Living/Kitchen	3.89	Yes
102	5.22 Living/Kitchen	2.52	Yes
103	5.23 Living/Kitchen	2.36	Yes
104	5.24 Living/Kitchen	3.68	Yes
105	3.16 Living/Kitchen	5.81	Yes
106	4.16 Living/Kitchen	5.89	Yes
107	5.16 Living/Kitchen	5.35	Yes
108	3.45 Living/Kitchen	6.72	Yes
109	5.40 Living/Kitchen	3.07	Yes
110	5.36 Living/Kitchen	3.82	Yes
111	5.35 Living/Kitchen	3.62	Yes
112	5.34 Living/Kitchen	3.65	Yes
113	5.27 Living/Kitchen	2.23	Yes
114	5.42 Living/Kitchen	4.53	Yes
115	5.28 Living/Kitchen	4.90	Yes
116	6.13 Living/Kitchen	4.03	Yes
117	6.21 Living/Kitchen	4.10	Yes
118	2.30 Living/Kitchen	3.44	Yes
119	3.22 Living/Kitchen	4.07	Yes
120	6.05 Living/Kitchen	3.03	Yes
121	5.41 Living/Kitchen	2.79	Yes
122	3.29 Living/Kitchen	5.87	Yes
123	3.33 Living/Kitchen	3.19	Yes
124	4.32 Living/Kitchen	4.97	Yes
125	4.31 Living/Kitchen	2.97	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
126	5.29 Living/Kitchen	3.13	Yes
127	5.32 Living/Kitchen	5.04	Yes
128	5.31 Living/Kitchen	2.73	Yes
129	5.30 Living/Kitchen	2.97	Yes
130	4.25 Living/Kitchen	1.64	*Note 1
131	5.26 Living/Kitchen	2.80	Yes
132	5.25 Living/Kitchen	1.95	*Note 1
133	3.44 Living/Kitchen	2.86	Yes
134	3.47 Living/Kitchen	2.32	Yes
135	3.46 Living/Kitchen	3.85	Yes
136	4.44 Living/Kitchen	1.94	*Note 1
137	5.44 Living/Kitchen	2.37	Yes
138	4.43 Living/Kitchen	4.48	Yes
139	5.43 Living/Kitchen	4.81	Yes
140	4.39 Living/Kitchen	7.87	Yes
141	4.38 Living/Kitchen	3.74	Yes
142	5.39 Living/Kitchen	7.11	Yes
143	5.38 Living/Kitchen	3.22	Yes
144	3.35 Living/Kitchen	2.98	Yes
145	4.33 Living/Kitchen	2.32	Yes
146	5.37 Living/Kitchen	2.66	Yes
147	5.33 Living/Kitchen	2.75	Yes
148	6.15 Living/Kitchen	2.77	Yes
149	Living/Kitchen	4.41	Yes
150	3.30 Living/Kitchen	4.46	Yes
151	6.19 Living/Kitchen	2.32	Yes
152	4.37 Living/Kitchen	2.37	Yes
153	2.04 Living/Kitchen	2.98	Yes
154	2.37 Living/Kitchen	3.54	Yes
155	2.25 Living/Kitchen	3.17	Yes
156	2.26 Living/Kitchen	4.59	Yes
157	3.42 Living/Kitchen	3.79	Yes
158	4.29 Living/Kitchen	2.63	Yes
159	4.30 Living/Kitchen	2.38	Yes
160	3.28 Living/Kitchen	2.86	Yes
161	3.28 Living/Kitchen	3.39	Yes
162	3.31 Living/Kitchen	3.03	Yes
163	4.40 Living/Kitchen	2.99	Yes
165	2.29 Living/Kitchen	3.48	Yes
166	3.21 Living/Kitchen	3.19	Yes
167	4.21 Living/Kitchen	3.56	Yes
168	4.26 Living/Kitchen	2.21	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
169	6.18 Living/Kitchen	3.24	Yes
170	4.34 Living/Kitchen	2.99	Yes
171	4.41 Living/Kitchen	2.63	Yes
172	4.09 Living/Kitchen	2.53	Yes
173	4.08 Living/Kitchen	2.62	Yes
174	4.17 Living/Kitchen	4.17	Yes
175	4.18 Living/Kitchen	3.94	Yes
176	4.19 Living/Kitchen	3.95	Yes
177	4.20 Living/Kitchen	4.07	Yes
178	3.02 Living/Kitchen	2.52	Yes
179	3.03 Living/Kitchen	3.34	Yes
180	3.23 Living/Kitchen	1.89	*Note 1
181	3.24 Living/Kitchen	1.75	*Note 1
182	3.25 Living/Kitchen	2.87	Yes
183	3.15 Living/Kitchen	2.22	Yes
184	3.20 Living/Kitchen	4.06	Yes
185	2.08 Living/Kitchen	2.77	Yes
186	2.09 Living/Kitchen	4.66	Yes
187	2.16 Living/Kitchen	3.67	Yes
188	2.18 Living/Kitchen	4.18	Yes
189	2.27 Living/Kitchen	6.23	Yes
190	2.45 Living/Kitchen	2.43	Yes
191	2.05 Living/Kitchen	2.29	Yes
192	2.39 Living/Kitchen	3.23	Yes
193	3.32 Living/Kitchen	3.01	Yes
194	2.02 Living/Kitchen	2.56	Yes
195	4.03 Living/Kitchen	3.58	Yes
196	4.02 Living/Kitchen	10.13	Yes
197	4.23 Living/Kitchen	2.04	Yes
198	5.03 Living/Kitchen	4.25	Yes
199	5.02 Living/Kitchen	3.73	Yes
200	6.22 Living/Kitchen	1.73	*Note 1
201	6.14 Living/Kitchen	5.27	Yes
202	6.12 Living/Kitchen	3.42	Yes
203	C0.01_Living	3.56	Yes
204	C0.02_Living	3.66	Yes
205	C0.03_Living	3.72	Yes
206	D0.01_Living	4.06	Yes
207	D0.02_Living	4.02	Yes
208	D0.03_Living	4.01	Yes
209	D0.04_Living	3.94	Yes
210	D0.05_Living	4.58	Yes

Reference Number	Room Name	% ADF	Achieves the BRE Best Practice Guidelines
211	D0.06_Living	4.55	Yes
212	D0.07_Living	4.58	Yes
213	D0.08_Living	4.58	Yes
214	C1.01_Living	3.25	Yes
215	C1.02_Living	3.34	Yes
216	C1.03_Living	3.32	Yes
217	D1.01_Living	3.77	Yes
218	D1.02_Living	3.62	Yes
219	D1.03_Living	3.80	Yes
220	D1.04_Living	3.61	Yes
221	D1.05_Living	5.34	Yes
222	D1.06_Living	5.40	Yes
223	D1.07_Living	5.27	Yes
224	D1.08_Living	5.38	Yes

*Note 1: The room achieves the BRE Target ADF for Living Room spaces (for example, not a combined kitchen/living room space) of 1.50%. The result achieved is only marginally below the BRE Target value for kitchen/living room spaces (2.00%).

*Note 2: The room does not achieve the recommended BRE ADF target value.

APPENDIX D | SPATIAL DAYLIGHT AUTONOMY (sDA) RESULTS – EN17037

All Rooms

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
1	2.13 Bedroom 1	52.00	100.00	Yes
2	2.13Living/Kitchen	89.80	100.00	Yes
3	2.12 Bedroom 1	48.00	100.00	No
4	2.12 Living/Kitchen	97.96	100.00	Yes
5	2.11 Bedroom 1	56.00	100.00	Yes
6	2.11 Living/Kitchen	95.83	100.00	Yes
7	2.10 Bedroom 1	57.58	100.00	Yes
8	2.10 Bedroom 2	36.00	100.00	No
9	2.10 Living/Kitchen	76.92	95.38	Yes
10	2.14 Bedroom 1	36.00	100.00	No
11	2.14 Living/Kitchen	71.64	85.07	No
12	2.07 Bedroom 1	100.00	100.00	Yes
13	2.07 Living/Kitchen	66.67	100.00	Yes
14	2.20 Bedroom 1	96.88	100.00	Yes
15	2.09 Bedroom 2	100.00	100.00	Yes
16	2.09 Bedroom 1	100.00	100.00	Yes
17	2.20 Living/Kitchen	78.75	100.00	Yes
18	2.20 Bedroom 2	100.00	100.00	Yes
19	3.05 Bedroom 2	100.00	100.00	Yes
20	3.14 Bedroom 1	52.00	100.00	Yes
21	3.13 Bedroom 1	48.00	100.00	No
22	3.12 Bedroom 1	52.00	100.00	Yes
23	3.14 Living/Kitchen	97.96	100.00	Yes
24	3.13 Living/Kitchen	100.00	100.00	Yes
25	3.12 Living/Kitchen	100.00	100.00	Yes
26	3.05 Bedroom 3	100.00	100.00	Yes
27	3.05 Bedroom 1	100.00	100.00	Yes
28	4.14 Bedroom 1	48.00	100.00	No
29	4.13 Bedroom 1	44.00	100.00	No
30	4.12 Bedroom 1	48.00	100.00	No
31	4.14 Living/Kitchen	100.00	100.00	Yes
32	4.13 Living/Kitchen	100.00	100.00	Yes
33	4.12 Living/Kitchen	100.00	100.00	Yes
34	6.07 Bedroom 1	96.00	100.00	Yes
35	6.06 Bedroom 1	96.00	100.00	Yes
36	6.05 Bedroom 1	96.00	100.00	Yes
37	6.07 Living/Kitchen	100.00	100.00	Yes
38	6.06 Living/Kitchen	100.00	100.00	Yes
39	6.04 Living/Kitchen	100.00	100.00	Yes

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
40	6.08 Living/Kitchen	100.00	100.00	Yes
41	6.08 Bedroom 1	96.77	100.00	Yes
42	6.04 Bedroom 1	100.00	100.00	Yes
43	6.03 Bedroom 1	100.00	100.00	Yes
44	6.03 Bedroom 2	81.82	100.00	Yes
45	6.02 Bedroom 2	93.75	100.00	Yes
46	6.02 Bedroom 1	81.25	100.00	Yes
47	6.02 Living/Kitchen	100.00	100.00	Yes
48	6.03 Living/Kitchen	79.41	100.00	Yes
49	6.01 Living/Kitchen	100.00	100.00	Yes
50	6.01 Bedroom 1	72.41	100.00	Yes
51	6.10 Bedroom 2	100.00	100.00	Yes
52	6.10 Living/Kitchen	100.00	100.00	Yes
53	6.10 Bedroom 1	100.00	100.00	Yes
54	6.11 Bedroom 2	36.00	100.00	No
55	6.11 Living/Kitchen	100.00	100.00	Yes
56	6.11 Bedroom 1	81.82	100.00	Yes
57	6.09 Bedroom 1	93.33	100.00	Yes
58	6.09 Bedroom 2	90.63	100.00	Yes
59	6.09 Living/Kitchen	100.00	100.00	Yes
60	2.24 Bedroom 1	78.13	100.00	Yes
61	2.24 Bedroom 2	100.00	100.00	Yes
62	2.24 Living/Kitchen	36.36	83.12	No
63	2.41 Bedroom 2	73.53	97.06	Yes
64	2.41 Living/Kitchen	100.00	100.00	Yes
65	2.28 Living/Kitchen	77.78	100.00	Yes
66	2.28 Bedroom 1	91.18	91.18	No
67	2.31 Living/Kitchen	75.56	100.00	Yes
68	2.31 Bedroom 1	91.18	91.18	No
69	2.38 Living/Kitchen	100.00	100.00	Yes
70	2.38 Bedroom 1	100.00	100.00	Yes
71	2.36 Bedroom 1	100.00	100.00	Yes
72	2.36 Bedroom 2	100.00	100.00	Yes
73	2.36 Living/Kitchen	100.00	100.00	Yes
74	2.42 Bedroom 1	62.50	100.00	Yes
75	2.42 Living/Kitchen	46.81	100.00	No
76	2.40 Living/Kitchen	100.00	100.00	Yes
77	2.40 Bedroom 1	100.00	100.00	Yes
78	2.27 Bedroom 2	88.89	100.00	Yes
79	2.27 Bedroom 1	100.00	100.00	Yes
80	3.43 Living/Kitchen	100.00	100.00	Yes
81	3.43 Bedroom 1	97.06	97.06	Yes

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
82	3.41 Bedroom 1	100.00	100.00	Yes
83	3.41 Bedroom 2	100.00	100.00	Yes
84	3.41 Living/Kitchen	100.00	100.00	Yes
85	3.38 Bedroom 1	88.00	100.00	Yes
86	3.37 Bedroom 1	84.00	100.00	Yes
87	3.36 Bedroom 1	84.00	100.00	Yes
88	3.38 Living/Kitchen	100.00	100.00	Yes
89	3.37 Living/Kitchen	100.00	100.00	Yes
90	3.36 Living/Kitchen	100.00	100.00	Yes
91	3.39 Bedroom 1	95.45	100.00	Yes
92	3.39 Living/Kitchen	98.44	100.00	Yes
93	2.32 Living/Kitchen	88.89	100.00	Yes
94	2.32 Bedroom 1	100.00	100.00	Yes
95	2.35 Living/Kitchen	67.86	100.00	Yes
96	2.35 Bedroom 1	100.00	100.00	Yes
97	2.44 Living/Kitchen	94.74	100.00	Yes
98	2.34 Living/Kitchen	88.46	100.00	Yes
99	2.34 Bedroom 1	100.00	100.00	Yes
100	2.34 Bedroom 2	100.00	100.00	Yes
101	2.33 Living/Kitchen	100.00	100.00	Yes
102	2.33 Bedroom 2	100.00	100.00	Yes
103	2.33 Bedroom 1	100.00	100.00	Yes
104	3.39 Bedroom 2	68.00	100.00	Yes
105	3.26 Bedroom 1	96.00	100.00	Yes
106	3.26 Bedroom 2	100.00	100.00	Yes
107	3.26 Living/Kitchen	62.64	98.90	Yes
108	3.34 Living/Kitchen	96.10	100.00	Yes
109	3.34 Bedroom 3	100.00	100.00	Yes
110	3.34 Bedroom 1	100.00	100.00	Yes
111	3.34 Bedroom 2	100.00	100.00	Yes
112	3.40 Living/Kitchen	95.45	100.00	Yes
113	3.40 Bedroom 1	96.88	96.88	Yes
114	4.35 Bedroom 1	44.00	100.00	No
115	4.34 Bedroom 1	52.00	100.00	Yes
116	4.36 Living/Kitchen	100.00	100.00	Yes
117	4.35 Living/Kitchen	100.00	100.00	Yes
118	4.27 Living/Kitchen	57.33	100.00	Yes
119	4.27 Bedroom 1	79.49	100.00	Yes
120	4.27 Bedroom 2	93.33	100.00	Yes
121	4.42 Living/Kitchen	100.00	100.00	Yes
122	4.41 Bedroom 3	96.55	100.00	Yes
123	4.28 Living/Kitchen	100.00	100.00	Yes

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
124	4.28 Bedroom 2	92.00	100.00	Yes
125	4.28 Bedroom 1	100.00	100.00	Yes
126	6.18 Bedroom 1	96.00	100.00	Yes
127	6.17 Bedroom 1	96.00	100.00	Yes
128	6.16 Bedroom 1	93.55	100.00	Yes
129	6.17 Living/Kitchen	100.00	100.00	Yes
130	6.16 Living/Kitchen	100.00	100.00	Yes
131	6.20 Living/Kitchen	100.00	100.00	Yes
132	6.20 Bedroom 1	100.00	100.00	Yes
133	6.20 Bedroom 2	93.33	100.00	Yes
134	6.14 Bedroom 2	100.00	100.00	Yes
135	6.14 Bedroom 1	67.74	100.00	Yes
136	2.05 Bedroom 2	100.00	100.00	Yes
137	2.05 Bedroom 1	100.00	100.00	Yes
138	2.22 Bedroom 2	87.50	100.00	Yes
139	2.22 Bedroom 1	81.25	100.00	Yes
140	2.22 Living/Kitchen	31.15	100.00	No
141	2.23 Bedroom 1	53.13	100.00	Yes
142	2.23 Living/Kitchen	26.23	98.36	No
143	2.06 Bedroom 2	100.00	100.00	Yes
144	2.06 Bedroom 1	100.00	100.00	Yes
145	2.06 Living/Kitchen	82.02	95.51	Yes
146	2.03 Bedroom 2	100.00	100.00	Yes
147	2.03 Bedroom 1	87.50	100.00	Yes
148	2.03 Living/Kitchen	100.00	100.00	Yes
149	2.17 Living/Kitchen	66.67	100.00	Yes
150	3.19 Living/Kitchen	77.78	100.00	Yes
151	3.18 Bedroom	100.00	100.00	Yes
152	3.18 Living/Kitchen	77.78	100.00	Yes
153	3.17 Bedroom	100.00	100.00	Yes
154	3.17 Living/Kitchen	77.78	100.00	Yes
155	3.06 Bedroom 2	100.00	100.00	Yes
156	3.06 Bedroom 1	100.00	100.00	Yes
157	3.06 Living/Kitchen	81.33	98.67	Yes
158	3.07 Bedroom 1	100.00	100.00	Yes
159	3.07 Bedroom 2	100.00	100.00	Yes
160	3.07 Living/Kitchen	76.81	100.00	Yes
161	3.04 Bedroom 1	100.00	100.00	Yes
162	3.04 Bedroom 2	86.11	100.00	Yes
163	3.04 Living/Kitchen	100.00	100.00	Yes
164	3.15 Bedroom 2	86.36	100.00	Yes
165	3.15 Bedroom 1	32.26	100.00	No

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
166	3.09 Bedroom 1	96.88	96.88	Yes
167	3.09 Living/Kitchen	66.67	100.00	Yes
168	3.08 Bedroom 1	96.88	96.88	Yes
169	3.08 Living/Kitchen	66.67	100.00	Yes
170	3.03 Bedroom 1	100.00	100.00	Yes
171	3.02 Bedroom 1	100.00	100.00	Yes
172	3.11 Bedroom 1	100.00	100.00	Yes
173	3.11 Living/Kitchen	100.00	100.00	Yes
174	3.11 Bedroom 2	38.71	100.00	No
175	3.01 Bedroom 1	45.45	100.00	No
176	3.01 Living/Kitchen	73.24	100.00	Yes
177	3.05 Living/Kitchen	99.12	100.00	Yes
178	2.21 Living/Kitchen	90.43	100.00	Yes
179	2.15 Bedroom 2	92.31	100.00	Yes
180	2.15 Bedroom 1	59.38	100.00	Yes
181	2.15 Living/Kitchen	100.00	100.00	Yes
182	3.10 Bedroom 2	96.00	100.00	Yes
183	3.10 Bedroom 1	100.00	100.00	Yes
184	3.10 Living/Kitchen	100.00	100.00	Yes
185	2.01 Living/Kitchen	49.33	100.00	No
186	2.01 Bedroom 2	71.88	100.00	Yes
187	2.01 Bedroom 1	94.29	100.00	Yes
188	4.05 Bedroom 3	100.00	100.00	Yes
189	4.05 Bedroom 2	100.00	100.00	Yes
190	4.05 Bedroom 1	100.00	100.00	Yes
191	4.06 Bedroom 2	100.00	100.00	Yes
192	4.06 Bedroom 1	100.00	100.00	Yes
193	4.06 Living/Kitchen	89.71	100.00	Yes
194	4.07 Bedroom 1	100.00	100.00	Yes
195	4.07 Bedroom 2	100.00	100.00	Yes
196	4.07 Living/Kitchen	81.43	100.00	Yes
197	4.04 Bedroom 2	100.00	100.00	Yes
198	4.04 Bedroom 1	100.00	100.00	Yes
199	4.04 Living/Kitchen	100.00	100.00	Yes
200	4.03 Bedroom 1	100.00	100.00	Yes
201	4.02 Bedroom 1	100.00	100.00	Yes
202	4.11 Bedroom 1	100.00	100.00	Yes
203	4.11 Living/Kitchen	100.00	100.00	Yes
204	4.11 Bedroom 2	38.71	100.00	No
205	4.01 Bedroom 1	52.00	100.00	Yes
206	4.01 Living/Kitchen	78.87	100.00	Yes
207	4.05 Living/Kitchen	99.12	100.00	Yes

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
208	4.10 Bedroom 2	100.00	100.00	Yes
209	4.10 Bedroom 1	100.00	100.00	Yes
210	4.10 Living/Kitchen	100.00	100.00	Yes
211	5.14 Bedroom 1	48.00	100.00	No
212	5.13 Bedroom 1	44.00	100.00	No
213	5.12 Bedroom 1	52.00	100.00	Yes
214	5.14 Living/Kitchen	100.00	100.00	Yes
215	5.13 Living/Kitchen	100.00	100.00	Yes
216	5.12 Living/Kitchen	100.00	100.00	Yes
217	5.05 Bedroom 1	100.00	100.00	Yes
218	5.05 Bedroom 3	84.85	100.00	Yes
219	5.05 Bedroom 2	100.00	100.00	Yes
220	5.06 Bedroom 1	100.00	100.00	Yes
221	5.06 Bedroom 2	100.00	100.00	Yes
222	5.06 Living/Kitchen	81.43	100.00	Yes
223	5.07 Bedroom 1	100.00	100.00	Yes
224	5.07 Bedroom 2	100.00	100.00	Yes
225	5.07 Living/Kitchen	80.88	100.00	Yes
226	5.04 Bedroom 2	100.00	100.00	Yes
227	5.04 Bedroom 1	100.00	100.00	Yes
228	5.04 Living/Kitchen	100.00	100.00	Yes
229	5.09 Bedroom 1	100.00	100.00	Yes
230	5.09 Living/Kitchen	59.57	100.00	Yes
231	5.08 Bedroom 1	100.00	100.00	Yes
232	5.08 Living/Kitchen	64.44	100.00	Yes
233	5.03 Bedroom 1	100.00	100.00	Yes
234	5.02 Bedroom 1	100.00	100.00	Yes
235	5.11 Bedroom 1	100.00	100.00	Yes
236	5.11 Living/Kitchen	100.00	100.00	Yes
237	5.11 Bedroom 2	35.48	100.00	No
238	5.01 Bedroom 1	100.00	100.00	Yes
239	5.01 Living/Kitchen	84.72	98.61	Yes
240	5.05 Living/Kitchen	100.00	100.00	Yes
241	5.10 Bedroom 2	96.00	100.00	Yes
242	5.10 Bedroom 1	100.00	100.00	Yes
243	5.10 Living/Kitchen	100.00	100.00	Yes
244	4.22 Bedroom 1	100.00	100.00	Yes
245	4.22 Bedroom 2	96.88	100.00	Yes
246	4.15 Bedroom 2	86.36	100.00	Yes
247	4.15Living/Kitchen	95.08	100.00	Yes
248	4.15 Bedroom 1	32.26	100.00	No
249	4.24 Bedroom 1	27.27	100.00	No

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
250	4.24 Living/Kitchen	78.38	100.00	Yes
251	5.19 Bedroom 1	100.00	100.00	Yes
252	5.19 Living/Kitchen	82.22	100.00	Yes
253	5.18 Bedroom 1	100.00	100.00	Yes
254	5.18 Living/Kitchen	82.22	100.00	Yes
255	5.17 Bedroom 1	100.00	100.00	Yes
256	5.17 Living/Kitchen	82.22	100.00	Yes
257	5.20 Bedroom 1	100.00	100.00	Yes
258	5.20 Living/Kitchen	72.73	100.00	Yes
259	5.15 Bedroom 2	86.36	100.00	Yes
260	5.15 Living/Kitchen	98.36	100.00	Yes
261	5.15 Bedroom 1	35.48	100.00	No
262	2.21 Bedroom 1	91.43	100.00	Yes
263	2.21 Bedroom 2	100.00	100.00	Yes
264	2.43 Living/Kitchen	55.10	100.00	Yes
265	2.23 Bedroom 2	59.09	100.00	Yes
266	3.25 Bedroom 1	18.18	100.00	No
267	3.23 Bedroom 2	100.00	100.00	Yes
268	3.23 Bedroom 1	96.88	100.00	Yes
269	3.24 Bedroom 1	81.25	100.00	Yes
270	5.21 Bedroom 1	100.00	100.00	Yes
271	5.21 Living/Kitchen	100.00	100.00	Yes
272	5.21 Bedroom 2	100.00	100.00	Yes
273	5.21 Bedroom 3	100.00	100.00	Yes
274	5.22 Bedroom 2	100.00	100.00	Yes
275	5.22 Bedroom 1	100.00	100.00	Yes
276	5.22 Living/Kitchen	65.28	100.00	Yes
277	5.23 Bedroom 1	100.00	100.00	Yes
278	5.23 Living/Kitchen	73.02	100.00	Yes
279	5.24 Bedroom 1	72.73	100.00	Yes
280	5.24 Living/Kitchen	83.78	100.00	Yes
281	3.16 Bedroom 2	100.00	100.00	Yes
282	3.16 Bedroom 1	100.00	100.00	Yes
283	3.16 Living/Kitchen	100.00	100.00	Yes
284	4.16 Bedroom 1	96.88	100.00	Yes
285	4.16 Living/Kitchen	100.00	100.00	Yes
286	5.16 Bedroom 1	96.88	100.00	Yes
287	5.16 Living/Kitchen	100.00	100.00	Yes
288	2.45 Bedroom 1	100.00	100.00	Yes
289	2.40 Bedroom 2	100.00	100.00	Yes
290	3.45 Living/Kitchen	100.00	100.00	Yes
291	3.45 Bedroom 1	100.00	100.00	Yes

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
292	3.45 Bedroom 2	100.00	100.00	Yes
293	5.40 Bedroom 2	100.00	100.00	Yes
294	5.40 Bedroom 1	100.00	100.00	Yes
295	5.40 Living/Kitchen	100.00	100.00	Yes
296	5.36 Bedroom 1	52.00	100.00	Yes
297	5.35 Bedroom 1	48.00	100.00	No
298	5.34 Bedroom 1	48.00	100.00	No
299	5.36 Living/Kitchen	100.00	100.00	Yes
300	5.35 Living/Kitchen	100.00	100.00	Yes
301	5.34 Living/Kitchen	100.00	100.00	Yes
302	5.27 Living/Kitchen	56.47	100.00	Yes
303	5.27 Bedroom 1	89.74	100.00	Yes
304	5.27 Bedroom 2	93.33	100.00	Yes
305	5.42 Living/Kitchen	98.73	98.73	Yes
306	5.28 Living/Kitchen	100.00	100.00	Yes
307	5.28 Bedroom 2	96.00	100.00	Yes
308	5.28 Bedroom 1	100.00	100.00	Yes
309	6.13 Living/Kitchen	100.00	100.00	Yes
310	6.13 Bedroom 2	100.00	100.00	Yes
311	6.13 Bedroom 1	96.97	100.00	Yes
312	6.21 Living/Kitchen	100.00	100.00	Yes
313	6.21 Bedroom 1	100.00	100.00	Yes
314	6.21 Bedroom 3	100.00	100.00	Yes
315	6.21 Bedroom 2	90.91	100.00	Yes
316	6.22 Bedroom 1	100.00	100.00	Yes
317	6.12 Bedroom 1	95.65	100.00	Yes
318	2.30 Bedroom 1	100.00	100.00	Yes
319	2.30 Bedroom	93.75	100.00	Yes
320	2.30 Living/Kitchen	64.86	97.30	Yes
321	3.22 Living/Kitchen	100.00	100.00	Yes
322	3.22 Bedroom 1	100.00	100.00	Yes
323	3.22 Bedroom 2	94.29	100.00	Yes
324	4.16 Bedroom 2	100.00	100.00	Yes
325	5.16 Bedroom 2	100.00	100.00	Yes
326	6.05 Living/Kitchen	100.00	100.00	Yes
327	5.41 Bedroom 1	100.00	100.00	Yes
328	5.41 Bedroom 2	100.00	100.00	Yes
329	5.41 Living/Kitchen	72.37	100.00	Yes
330	3.29 Bedroom 2	100.00	100.00	Yes
331	3.29 Living/Kitchen	100.00	100.00	Yes
332	3.29 Bedroom 1	100.00	100.00	Yes
333	3.33 Living/Kitchen	82.09	100.00	Yes

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
334	3.33 Bedroom 1	100.00	100.00	Yes
335	4.32 Living/Kitchen	94.81	100.00	Yes
336	4.32 Bedroom 3	100.00	100.00	Yes
337	4.32 Bedroom 1	100.00	100.00	Yes
338	4.32 Bedroom 2	100.00	100.00	Yes
339	4.31 Living/Kitchen	76.12	100.00	Yes
340	4.31 Bedroom 1	100.00	100.00	Yes
341	5.29 Bedroom 2	100.00	100.00	Yes
342	5.29 Bedroom 1	100.00	100.00	Yes
343	5.29 Living/Kitchen	91.55	100.00	Yes
344	5.32 Living/Kitchen	94.59	100.00	Yes
345	5.32 Bedroom 3	100.00	100.00	Yes
346	5.32 Bedroom 1	95.24	100.00	Yes
347	5.32 Bedroom 2	100.00	100.00	Yes
348	5.31 Living/Kitchen	65.67	100.00	Yes
349	5.31 Bedroom 1	100.00	100.00	Yes
350	5.30 Bedroom 1	100.00	100.00	Yes
351	5.30 Bedroom 2	100.00	100.00	Yes
352	5.30 Living/Kitchen	91.55	100.00	Yes
353	4.25 Bedroom 1	92.00	100.00	Yes
354	4.25 Living/Kitchen	49.45	96.70	No
355	5.26 Bedroom 2	100.00	100.00	Yes
356	5.26 Bedroom 1	100.00	100.00	Yes
357	5.26 Living/Kitchen	84.51	100.00	Yes
358	5.25 Bedroom 1	100.00	100.00	Yes
359	5.25 Bedroom 2	100.00	100.00	Yes
360	5.25 Living/Kitchen	68.13	100.00	Yes
361	3.44 Bedroom 2	100.00	100.00	Yes
362	3.44 Bedroom 1	100.00	100.00	Yes
363	3.44 Living/Kitchen	92.00	94.67	No
364	3.47 Living/Kitchen	97.14	100.00	Yes
365	3.47 Bedroom 1	80.00	100.00	Yes
366	3.46 Bedroom 1	100.00	100.00	Yes
367	3.46 Bedroom 2	96.88	100.00	Yes
368	3.46 Living/Kitchen	100.00	100.00	Yes
369	4.44 Living/Kitchen	85.71	100.00	Yes
370	4.44 Bedroom 1	65.52	100.00	Yes
371	5.44 Bedroom 1	88.00	100.00	Yes
372	5.44 Living/Kitchen	98.57	100.00	Yes
373	4.43 Living/Kitchen	100.00	100.00	Yes
374	4.43 Bedroom 1	100.00	100.00	Yes
375	4.41 Bedroom 2	100.00	100.00	Yes

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
376	5.43 Living/Kitchen	100.00	100.00	Yes
377	5.43 Bedroom 1	100.00	100.00	Yes
378	5.41 Bedroom 3	100.00	100.00	Yes
379	5.42 Bedroom 1	100.00	100.00	Yes
380	4.39 Bedroom 1	88.00	88.00	No
381	4.39 Living/Kitchen	100.00	100.00	Yes
382	4.38 Living/Kitchen	75.00	100.00	Yes
383	4.38 Bedroom 2	96.88	96.88	Yes
384	5.39 Bedroom 1	100.00	100.00	Yes
385	5.39 Bedroom 2	100.00	100.00	Yes
386	5.39 Living/Kitchen	100.00	100.00	Yes
387	5.38 Living/Kitchen	72.73	100.00	Yes
388	5.38 Bedroom 1	96.88	96.88	Yes
389	2.39 Bedroom 1	88.89	100.00	Yes
390	4.42 Bedroom 1	100.00	100.00	Yes
391	4.42 Bedroom 2	100.00	100.00	Yes
392	3.35 Bedroom 1	86.36	100.00	Yes
393	3.35 Living/Kitchen	100.00	100.00	Yes
394	3.35 Bedroom 2	65.22	100.00	Yes
395	4.33 Bedroom 1	45.45	100.00	No
396	4.33 Living/Kitchen	93.65	100.00	Yes
397	5.37 Bedroom 2	63.64	100.00	Yes
398	5.37 Living/Kitchen	98.36	100.00	Yes
399	5.37 Bedroom 1	25.71	100.00	No
400	5.33 Bedroom 1	45.45	100.00	No
401	5.33 Living/Kitchen	96.88	100.00	Yes
402	5.33 Bedroom 2	39.13	100.00	No
403	6.15 Bedroom 1	96.00	100.00	Yes
404	6.15 Living/Kitchen	98.41	100.00	Yes
405	6.16 Bedroom 2	100.00	100.00	Yes
406	Living/Kitchen	100.00	100.00	Yes
407	3.30 Living/Kitchen	100.00	100.00	Yes
408	3.30 Bedroom 1	91.18	91.18	No
409	6.19 Bedroom 2	95.45	100.00	Yes
410	6.19 Living/Kitchen	98.51	100.00	Yes
411	6.19 Bedroom 1	76.19	100.00	Yes
412	4.37 Bedroom 2	63.64	100.00	Yes
413	4.37 Living/Kitchen	98.57	100.00	Yes
414	2.04 Bedroom 1	100.00	100.00	Yes
415	2.04 Bedroom 3	100.00	100.00	Yes
416	2.04 Bedroom 2	100.00	100.00	Yes
417	2.04 Living/Kitchen	98.00	100.00	Yes

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
418	2.37 Bedroom 2	100.00	100.00	Yes
419	2.37 Bedroom 1	100.00	100.00	Yes
420	2.37 Living/Kitchen	100.00	100.00	Yes
421	2.25 Bedroom 2	89.66	100.00	Yes
422	2.25 Bedroom 1	100.00	100.00	Yes
423	2.25 Living/Kitchen	66.22	100.00	Yes
424	2.26 Bedroom 2	96.55	100.00	Yes
425	2.26 Bedroom 1	100.00	100.00	Yes
426	2.26 Living/Kitchen	98.65	100.00	Yes
427	3.42 Bedroom 2	100.00	100.00	Yes
428	3.42 Bedroom 1	100.00	100.00	Yes
429	3.42 Living/Kitchen	100.00	100.00	Yes
430	4.29 Bedroom 1	100.00	100.00	Yes
431	4.29 Bedroom 2	100.00	100.00	Yes
432	4.29 Living/Kitchen	78.38	100.00	Yes
433	4.30 Bedroom 1	100.00	100.00	Yes
434	4.30 Bedroom 2	100.00	100.00	Yes
435	4.30 Living/Kitchen	72.06	98.53	Yes
436	3.27 Bedroom 2	100.00	100.00	Yes
437	3.27 Bedroom 1	100.00	100.00	Yes
438	3.28 Living/Kitchen	91.89	100.00	Yes
439	3.28 Bedroom 2	100.00	100.00	Yes
440	3.28 Bedroom 1	100.00	100.00	Yes
441	3.28 Living/Kitchen	100.00	100.00	Yes
442	3.31 Bedroom 2	100.00	100.00	Yes
443	3.31 Bedroom 1	100.00	100.00	Yes
444	3.31 Living/Kitchen	93.06	94.44	No
445	3.32 Bedroom 1	100.00	100.00	Yes
446	3.32 Bedroom 2	100.00	100.00	Yes
447	4.40 Bedroom 2	100.00	100.00	Yes
448	4.40 Bedroom 1	100.00	100.00	Yes
449	4.40 Living/Kitchen	100.00	100.00	Yes
450	2.29 Bedroom 2	100.00	100.00	Yes
451	2.29 Bedroom 1	83.33	100.00	Yes
452	2.29 Living/Kitchen	65.71	98.57	Yes
453	3.21 Bedroom 1	96.88	100.00	Yes
454	3.21 Living/Kitchen	92.94	100.00	Yes
455	3.21 Bedroom 2	100.00	100.00	Yes
456	4.21 Bedroom 1	100.00	100.00	Yes
457	4.21 Living/Kitchen	100.00	100.00	Yes
458	4.21 Bedroom 2	100.00	100.00	Yes
459	4.21 Bedroom 3	100.00	100.00	Yes

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
460	4.26 Bedroom 2	100.00	100.00	Yes
461	4.26 Bedroom 1	100.00	100.00	Yes
462	4.26 Living/Kitchen	68.85	100.00	Yes
463	6.18 Living/Kitchen	100.00	100.00	Yes
464	4.25 Bedroom 2	100.00	100.00	Yes
465	4.33 Bedroom 2	39.13	100.00	No
466	4.34 Living/Kitchen	100.00	100.00	Yes
467	4.36 Bedroom 1	48.00	100.00	No
468	4.37 Bedroom 1	25.71	100.00	No
469	4.39 Bedroom 2	100.00	100.00	Yes
470	4.41 Living/Kitchen	72.73	100.00	Yes
471	4.41 Bedroom 1	96.55	100.00	Yes
472	4.09 Living/Kitchen	66.67	100.00	Yes
473	4.09 Bedroom 1	96.88	96.88	Yes
474	4.08 Bedroom 1	96.88	96.88	Yes
475	4.08 Living/Kitchen	66.67	100.00	Yes
476	4.17 Living/Kitchen	80.00	100.00	Yes
477	4.17 Bedroom 1	100.00	100.00	Yes
478	4.18 Bedroom 1	100.00	100.00	Yes
479	4.18 Living/Kitchen	77.78	100.00	Yes
480	4.19 Living/Kitchen	82.22	100.00	Yes
481	4.19 Bedroom 1	100.00	100.00	Yes
482	4.20 Bedroom 1	100.00	100.00	Yes
483	4.20 Living/Kitchen	82.22	100.00	Yes
484	3.02 Living/Kitchen	68.89	100.00	Yes
485	3.03 Living/Kitchen	72.31	98.46	Yes
486	3.23 Living/Kitchen	41.89	97.30	No
487	3.24 Living/Kitchen	44.78	100.00	No
488	3.25 Living/Kitchen	75.00	100.00	Yes
489	3.15 Living/Kitchen	94.55	100.00	Yes
490	3.20 Bedroom 1	100.00	100.00	Yes
491	3.19 Bedroom 1	100.00	100.00	Yes
492	3.20 Living/Kitchen	77.78	100.00	Yes
493	2.08 Bedroom 1	100.00	100.00	Yes
494	2.08 Living/Kitchen	66.67	100.00	Yes
495	2.09 Living/Kitchen	100.00	100.00	Yes
496	2.16 Living/Kitchen	71.11	100.00	Yes
497	2.16 Bedroom 1	100.00	100.00	Yes
498	2.17 Bedroom 1	100.00	100.00	Yes
499	2.18 Living/Kitchen	77.78	100.00	Yes
500	2.19 Bedroom 1	80.00	100.00	Yes
501	2.18 Bedroom 1	100.00	100.00	Yes

Reference Number	Room	% Area achieving 300 Lux	% Area achieving 100 Lux	EN 17037 Compliant
502	2.19 Bedroom 1	100.00	100.00	Yes
503	2.27 Living/Kitchen	100.00	100.00	Yes
504	2.45 Living/Kitchen	61.22	100.00	Yes
505	2.44 Bedroom 1	100.00	100.00	Yes
506	2.14 Bedroom 2	40.63	100.00	No
507	2.05 Living/Kitchen	78.69	100.00	Yes
508	2.39 Bedroom 2	100.00	100.00	Yes
509	2.39 Living/Kitchen	82.67	97.33	Yes
510	2.43 Bedroom 1	100.00	100.00	Yes
511	2.43 Bedroom 1	100.00	100.00	Yes
512	3.32 Living/Kitchen	90.28	94.44	No
513	2.02 Living/Kitchen	63.93	98.36	Yes
514	2.02 Bed 1	100.00	100.00	Yes
515	4.03 Living/Kitchen	73.85	98.46	Yes
516	4.02 Living/Kitchen	73.83	89.72	No
517	4.23 Living/Kitchen	63.08	100.00	Yes
518	4.23 Bed 1	87.50	100.00	Yes
519	5.03 Living/Kitchen	94.37	100.00	Yes
520	5.02 Living/Kitchen	93.62	100.00	Yes
521	6.22 Living/Kitchen	50.00	100.00	Yes
522	6.14 Living/Kitchen	100.00	100.00	Yes
523	6.12 Living/Kitchen	85.37	90.24	No

APPENDIX E | SPATIAL DAYLIGHT AUTONOMY (sDA) RESULTS – BS EN17037 BRITISH NATIONAL ANNEX

Bedrooms

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
1	2.13 Bedroom 1	100.00	Yes
2	2.12 Bedroom 1	100.00	Yes
3	2.11 Bedroom 1	100.00	Yes
4	2.10 Bedroom 1	100.00	Yes
5	2.10 Bedroom 2	100.00	Yes
6	2.14 Bedroom 1	100.00	Yes
7	2.07 Bedroom 1	100.00	Yes
8	2.20 Bedroom 1	100.00	Yes
9	2.09 Bedroom 2	100.00	Yes
10	2.09 Bedroom 1	100.00	Yes
11	2.20 Bedroom 2	100.00	Yes
12	3.05 Bedroom 2	100.00	Yes
13	3.14 Bedroom 1	100.00	Yes
14	3.13 Bedroom 1	100.00	Yes
15	3.12 Bedroom 1	100.00	Yes
16	3.05 Bedroom 3	100.00	Yes
17	3.05 Bedroom 1	100.00	Yes
18	4.14 Bedroom 1	100.00	Yes
19	4.13 Bedroom 1	100.00	Yes
20	4.12 Bedroom 1	100.00	Yes
21	6.07 Bedroom 1	100.00	Yes
22	6.06 Bedroom 1	100.00	Yes
23	6.05 Bedroom 1	100.00	Yes
24	6.08 Bedroom 1	100.00	Yes
25	6.04 Bedroom 1	100.00	Yes
26	6.03 Bedroom 1	100.00	Yes
27	6.03 Bedroom 2	100.00	Yes
28	6.02 Bedroom 2	100.00	Yes
29	6.02 Bedroom 1	100.00	Yes
30	6.01 Bedroom 1	100.00	Yes
31	6.10 Bedroom 2	100.00	Yes
32	6.10 Bedroom 1	100.00	Yes
33	6.11 Bedroom 2	100.00	Yes
34	6.11 Bedroom 1	100.00	Yes
35	6.09 Bedroom 1	100.00	Yes
36	6.09 Bedroom 2	100.00	Yes
37	2.24 Bedroom 1	100.00	Yes
38	2.24 Bedroom 2	100.00	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
39	2.41 Bedroom 2	97.06	Yes
40	2.28 Bedroom 1	91.18	Yes
41	2.31 Bedroom 1	91.18	Yes
42	2.38 Bedroom 1	100.00	Yes
43	2.36 Bedroom 1	100.00	Yes
44	2.36 Bedroom 2	100.00	Yes
45	2.42 Bedroom 1	100.00	Yes
46	2.40 Bedroom 1	100.00	Yes
47	2.27 Bedroom 2	100.00	Yes
48	2.27 Bedroom 1	100.00	Yes
49	3.43 Bedroom 1	97.06	Yes
50	3.41 Bedroom 1	100.00	Yes
51	3.41 Bedroom 2	100.00	Yes
52	3.38 Bedroom 1	100.00	Yes
53	3.37 Bedroom 1	100.00	Yes
54	3.36 Bedroom 1	100.00	Yes
55	3.39 Bedroom 1	100.00	Yes
56	2.32 Bedroom 1	100.00	Yes
57	2.35 Bedroom 1	100.00	Yes
58	2.34 Bedroom 1	100.00	Yes
59	2.34 Bedroom 2	100.00	Yes
60	2.33 Bedroom 2	100.00	Yes
61	2.33 Bedroom 1	100.00	Yes
62	3.39 Bedroom 2	100.00	Yes
63	3.26 Bedroom 1	100.00	Yes
64	3.26 Bedroom 2	100.00	Yes
65	3.34 Bedroom 3	100.00	Yes
66	3.34 Bedroom 1	100.00	Yes
67	3.34 Bedroom 2	100.00	Yes
68	3.40 Bedroom 1	96.88	Yes
69	4.35 Bedroom 1	100.00	Yes
70	4.34 Bedroom 1	100.00	Yes
71	4.27 Bedroom 1	100.00	Yes
72	4.27 Bedroom 2	100.00	Yes
73	4.41 Bedroom 3	100.00	Yes
74	4.28 Bedroom 2	100.00	Yes
75	4.28 Bedroom 1	100.00	Yes
76	6.18 Bedroom 1	100.00	Yes
77	6.17 Bedroom 1	100.00	Yes
78	6.16 Bedroom 1	100.00	Yes
79	6.20 Bedroom 1	100.00	Yes
80	6.20 Bedroom 2	100.00	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
81	6.14 Bedroom 2	100.00	Yes
82	6.14 Bedroom 1	100.00	Yes
83	2.05 Bedroom 2	100.00	Yes
84	2.05 Bedroom 1	100.00	Yes
85	2.22 Bedroom 2	100.00	Yes
86	2.22 Bedroom 1	100.00	Yes
87	2.23 Bedroom 1	100.00	Yes
88	2.06 Bedroom 2	100.00	Yes
89	2.06 Bedroom 1	100.00	Yes
90	2.03 Bedroom 2	100.00	Yes
91	2.03 Bedroom 1	100.00	Yes
92	3.18 Bedroom	100.00	Yes
93	3.17 Bedroom	100.00	Yes
94	3.06 Bedroom 2	100.00	Yes
95	3.06 Bedroom 1	100.00	Yes
96	3.07 Bedroom 1	100.00	Yes
97	3.07 Bedroom 2	100.00	Yes
98	3.04 Bedroom 1	100.00	Yes
99	3.04 Bedroom 2	100.00	Yes
100	3.15 Bedroom 2	100.00	Yes
101	3.15 Bedroom 1	100.00	Yes
102	3.09 Bedroom 1	96.88	Yes
103	3.08 Bedroom 1	96.88	Yes
104	3.03 Bedroom 1	100.00	Yes
105	3.02 Bedroom 1	100.00	Yes
106	3.11 Bedroom 1	100.00	Yes
107	3.11 Bedroom 2	100.00	Yes
108	3.01 Bedroom 1	100.00	Yes
109	2.15 Bedroom 2	100.00	Yes
110	2.15 Bedroom 1	100.00	Yes
111	3.10 Bedroom 2	100.00	Yes
112	3.10 Bedroom 1	100.00	Yes
113	2.01 Bedroom 2	100.00	Yes
114	2.01 Bedroom 1	100.00	Yes
115	4.05 Bedroom 3	100.00	Yes
116	4.05 Bedroom 2	100.00	Yes
117	4.05 Bedroom 1	100.00	Yes
118	4.06 Bedroom 2	100.00	Yes
119	4.06 Bedroom 1	100.00	Yes
120	4.07 Bedroom 1	100.00	Yes
121	4.07 Bedroom 2	100.00	Yes
122	4.04 Bedroom 2	100.00	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
123	4.04 Bedroom 1	100.00	Yes
124	4.03 Bedroom 1	100.00	Yes
125	4.02 Bedroom 1	100.00	Yes
126	4.11 Bedroom 1	100.00	Yes
127	4.11 Bedroom 2	100.00	Yes
128	4.01 Bedroom 1	100.00	Yes
129	4.10 Bedroom 2	100.00	Yes
130	4.10 Bedroom 1	100.00	Yes
131	5.14 Bedroom 1	100.00	Yes
132	5.13 Bedroom 1	100.00	Yes
133	5.12 Bedroom 1	100.00	Yes
134	5.05 Bedroom 1	100.00	Yes
135	5.05 Bedroom 3	100.00	Yes
136	5.05 Bedroom 2	100.00	Yes
137	5.06 Bedroom 1	100.00	Yes
138	5.06 Bedroom 2	100.00	Yes
139	5.07 Bedroom 1	100.00	Yes
140	5.07 Bedroom 2	100.00	Yes
141	5.04 Bedroom 2	100.00	Yes
142	5.04 Bedroom 1	100.00	Yes
143	5.09 Bedroom 1	100.00	Yes
144	5.08 Bedroom 1	100.00	Yes
145	5.03 Bedroom 1	100.00	Yes
146	5.02 Bedroom 1	100.00	Yes
147	5.11 Bedroom 1	100.00	Yes
148	5.11 Bedroom 2	100.00	Yes
149	5.01 Bedroom 1	100.00	Yes
150	5.10 Bedroom 2	100.00	Yes
151	5.10 Bedroom 1	100.00	Yes
152	4.22 Bedroom 1	100.00	Yes
153	4.22 Bedroom 2	100.00	Yes
154	4.15 Bedroom 2	100.00	Yes
155	4.15 Bedroom 1	100.00	Yes
156	4.24 Bedroom 1	100.00	Yes
157	5.19 Bedroom 1	100.00	Yes
158	5.18 Bedroom 1	100.00	Yes
159	5.17 Bedroom 1	100.00	Yes
160	5.20 Bedroom 1	100.00	Yes
161	5.15 Bedroom 2	100.00	Yes
162	5.15 Bedroom 1	100.00	Yes
163	2.21 Bedroom 1	100.00	Yes
164	2.21 Bedroom 2	100.00	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
165	2.23 Bedroom 2	100.00	Yes
166	3.25 Bedroom 1	100.00	Yes
167	3.23 Bedroom 2	100.00	Yes
168	3.23 Bedroom 1	100.00	Yes
169	3.24 Bedroom 1	100.00	Yes
170	5.21 Bedroom 1	100.00	Yes
171	5.21 Bedroom 2	100.00	Yes
172	5.21 Bedroom 3	100.00	Yes
173	5.22 Bedroom 2	100.00	Yes
174	5.22 Bedroom 1	100.00	Yes
175	5.23 Bedroom 1	100.00	Yes
176	5.24 Bedroom 1	100.00	Yes
177	3.16 Bedroom 2	100.00	Yes
178	3.16 Bedroom 1	100.00	Yes
179	4.16 Bedroom 1	100.00	Yes
180	5.16 Bedroom 1	100.00	Yes
181	2.45 Bedroom 1	100.00	Yes
182	2.40 Bedroom 2	100.00	Yes
183	3.45 Bedroom 1	100.00	Yes
184	3.45 Bedroom 2	100.00	Yes
185	5.40 Bedroom 2	100.00	Yes
186	5.40 Bedroom 1	100.00	Yes
187	5.36 Bedroom 1	100.00	Yes
188	5.35 Bedroom 1	100.00	Yes
189	5.34 Bedroom 1	100.00	Yes
190	5.27 Bedroom 1	100.00	Yes
191	5.27 Bedroom 2	100.00	Yes
192	5.28 Bedroom 2	100.00	Yes
193	5.28 Bedroom 1	100.00	Yes
194	6.13 Bedroom 2	100.00	Yes
195	6.13 Bedroom 1	100.00	Yes
196	6.21 Bedroom 1	100.00	Yes
197	6.21 Bedroom 3	100.00	Yes
198	6.21 Bedroom 2	100.00	Yes
199	6.22 Bedroom 1	100.00	Yes
200	6.12 Bedroom 1	100.00	Yes
201	2.30 Bedroom 1	100.00	Yes
202	2.30 Bedroom	100.00	Yes
203	3.22 Bedroom 1	100.00	Yes
204	3.22 Bedroom 2	100.00	Yes
205	4.16 Bedroom 2	100.00	Yes
206	5.16 Bedroom 2	100.00	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
207	5.41 Bedroom 1	100.00	Yes
208	5.41 Bedroom 2	100.00	Yes
209	3.29 Bedroom 2	100.00	Yes
210	3.29 Bedroom 1	100.00	Yes
211	3.33 Bedroom 1	100.00	Yes
212	4.32 Bedroom 3	100.00	Yes
213	4.32 Bedroom 1	100.00	Yes
214	4.32 Bedroom 2	100.00	Yes
215	4.31 Bedroom 1	100.00	Yes
216	5.29 Bedroom 2	100.00	Yes
217	5.29 Bedroom 1	100.00	Yes
218	5.32 Bedroom 3	100.00	Yes
219	5.32 Bedroom 1	100.00	Yes
220	5.32 Bedroom 2	100.00	Yes
221	5.31 Bedroom 1	100.00	Yes
222	5.30 Bedroom 1	100.00	Yes
223	5.30 Bedroom 2	100.00	Yes
224	4.25 Bedroom 1	100.00	Yes
225	5.26 Bedroom 2	100.00	Yes
226	5.26 Bedroom 1	100.00	Yes
227	5.25 Bedroom 1	100.00	Yes
228	5.25 Bedroom 2	100.00	Yes
229	3.44 Bedroom 2	100.00	Yes
230	3.44 Bedroom 1	100.00	Yes
231	3.47 Bedroom 1	100.00	Yes
232	3.46 Bedroom 1	100.00	Yes
233	3.46 Bedroom 2	100.00	Yes
234	4.44 Bedroom 1	100.00	Yes
235	5.44 Bedroom 1	100.00	Yes
236	4.43 Bedroom 1	100.00	Yes
237	4.41 Bedroom 2	100.00	Yes
238	5.43 Bedroom 1	100.00	Yes
239	5.41 Bedroom 3	100.00	Yes
240	5.42 Bedroom 1	100.00	Yes
241	4.39 Bedroom 1	88.00	Yes
242	4.38 Bedroom 2	96.88	Yes
243	5.39 Bedroom 1	100.00	Yes
244	5.39 Bedroom 2	100.00	Yes
245	5.38 Bedroom 1	96.88	Yes
246	2.39 Bedroom 1	100.00	Yes
247	4.42 Bedroom 1	100.00	Yes
248	4.42 Bedroom 2	100.00	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
249	3.35 Bedroom 1	100.00	Yes
250	3.35 Bedroom 2	100.00	Yes
251	4.33 Bedroom 1	100.00	Yes
252	5.37 Bedroom 2	100.00	Yes
253	5.37 Bedroom 1	100.00	Yes
254	5.33 Bedroom 1	100.00	Yes
255	5.33 Bedroom 2	100.00	Yes
256	6.15 Bedroom 1	100.00	Yes
257	6.16 Bedroom 2	100.00	Yes
258	3.30 Bedroom 1	91.18	Yes
259	6.19 Bedroom 2	100.00	Yes
260	6.19 Bedroom 1	100.00	Yes
261	4.37 Bedroom 2	100.00	Yes
262	2.04 Bedroom 1	100.00	Yes
263	2.04 Bedroom 3	100.00	Yes
264	2.04 Bedroom 2	100.00	Yes
265	2.37 Bedroom 2	100.00	Yes
266	2.37 Bedroom 1	100.00	Yes
267	2.25 Bedroom 2	100.00	Yes
268	2.25 Bedroom 1	100.00	Yes
269	2.26 Bedroom 2	100.00	Yes
270	2.26 Bedroom 1	100.00	Yes
271	3.42 Bedroom 2	100.00	Yes
272	3.42 Bedroom 1	100.00	Yes
273	4.29 Bedroom 1	100.00	Yes
274	4.29 Bedroom 2	100.00	Yes
275	4.30 Bedroom 1	100.00	Yes
276	4.30 Bedroom 2	100.00	Yes
277	3.27 Bedroom 2	100.00	Yes
278	3.27 Bedroom 1	100.00	Yes
279	3.28 Bedroom 2	100.00	Yes
280	3.28 Bedroom 1	100.00	Yes
281	3.31 Bedroom 2	100.00	Yes
282	3.31 Bedroom 1	100.00	Yes
283	3.32 Bedroom 1	100.00	Yes
284	3.32 Bedroom 2	100.00	Yes
285	4.40 Bedroom 2	100.00	Yes
286	4.40 Bedroom 1	100.00	Yes
287	2.29 Bedroom 2	100.00	Yes
288	2.29 Bedroom 1	100.00	Yes
289	3.21 Bedroom 1	100.00	Yes
290	3.21 Bedroom 2	100.00	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
291	4.21 Bedroom 1	100.00	Yes
292	4.21 Bedroom 2	100.00	Yes
293	4.21 Bedroom 3	100.00	Yes
294	4.26 Bedroom 2	100.00	Yes
295	4.26 Bedroom 1	100.00	Yes
296	4.25 Bedroom 2	100.00	Yes
297	4.33 Bedroom 2	100.00	Yes
298	4.36 Bedroom 1	100.00	Yes
299	4.37 Bedroom 1	100.00	Yes
300	4.39 Bedroom 2	100.00	Yes
301	4.41 Bedroom 1	100.00	Yes
302	4.09 Bedroom 1	96.88	Yes
303	4.08 Bedroom 1	96.88	Yes
304	4.17 Bedroom 1	100.00	Yes
305	4.18 Bedroom 1	100.00	Yes
306	4.19 Bedroom 1	100.00	Yes
307	4.20 Bedroom 1	100.00	Yes
308	3.20 Bedroom 1	100.00	Yes
309	3.19 Bedroom 1	100.00	Yes
310	2.08 Bedroom 1	100.00	Yes
311	2.16 Bedroom 1	100.00	Yes
312	2.17 Bedroom 1	100.00	Yes
313	2.19 Bedroom 1	100.00	Yes
314	2.18 Bedroom 1	100.00	Yes
315	2.19 Bedroom 1	100.00	Yes
316	2.44 Bedroom 1	100.00	Yes
317	2.14 Bedroom 2	100.00	Yes
318	2.39 Bedroom 2	100.00	Yes
319	2.43 Bedroom 1	100.00	Yes
320	2.43 Bedroom 1	100.00	Yes

Kitchen/Living

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
1	2.13 Living/Kitchen	100.00	Yes
2	2.12 Living/Kitchen	100.00	Yes
3	2.11 Living/Kitchen	100.00	Yes
4	2.10 Living/Kitchen	80.00	Yes
5	2.14 Living/Kitchen	77.61	Yes
6	2.07 Living/Kitchen	84.44	Yes
7	2.20 Living/Kitchen	100.00	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
8	3.14 Living/Kitchen	100.00	Yes
9	3.13 Living/Kitchen	100.00	Yes
10	3.12 Living/Kitchen	100.00	Yes
11	4.14 Living/Kitchen	100.00	Yes
12	4.13 Living/Kitchen	100.00	Yes
13	4.12 Living/Kitchen	100.00	Yes
14	6.07 Living/Kitchen	100.00	Yes
15	6.06 Living/Kitchen	100.00	Yes
16	6.04 Living/Kitchen	100.00	Yes
17	6.08 Living/Kitchen	100.00	Yes
18	6.02 Living/Kitchen	100.00	Yes
19	6.03 Living/Kitchen	100.00	Yes
20	6.01 Living/Kitchen	100.00	Yes
21	6.10 Living/Kitchen	100.00	Yes
22	6.11 Living/Kitchen	100.00	Yes
23	6.09 Living/Kitchen	100.00	Yes
24	2.24 Living/Kitchen	55.84	Yes
25	2.41 Living/Kitchen	100.00	Yes
26	2.28 Living/Kitchen	97.78	Yes
27	2.31 Living/Kitchen	91.11	Yes
28	2.38 Living/Kitchen	100.00	Yes
29	2.36 Living/Kitchen	100.00	Yes
30	2.42 Living/Kitchen	78.72	Yes
31	2.40 Living/Kitchen	100.00	Yes
32	3.43 Living/Kitchen	100.00	Yes
33	3.41 Living/Kitchen	100.00	Yes
34	3.38 Living/Kitchen	100.00	Yes
35	3.37 Living/Kitchen	100.00	Yes
36	3.36 Living/Kitchen	100.00	Yes
37	3.39 Living/Kitchen	100.00	Yes
38	2.32 Living/Kitchen	100.00	Yes
39	2.35 Living/Kitchen	98.21	Yes
40	2.44 Living/Kitchen	100.00	Yes
41	2.34 Living/Kitchen	92.31	Yes
42	2.33 Living/Kitchen	100.00	Yes
43	3.26 Living/Kitchen	79.12	Yes
44	3.34 Living/Kitchen	100.00	Yes
45	3.40 Living/Kitchen	100.00	Yes
46	4.36 Living/Kitchen	100.00	Yes
47	4.35 Living/Kitchen	100.00	Yes
48	4.27 Living/Kitchen	78.67	Yes
49	4.42 Living/Kitchen	100.00	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
50	4.28 Living/Kitchen	100.00	Yes
51	6.17 Living/Kitchen	100.00	Yes
52	6.16 Living/Kitchen	100.00	Yes
53	6.20 Living/Kitchen	100.00	Yes
54	2.22 Living/Kitchen	50.82	Yes
55	2.23 Living/Kitchen	45.90	No
56	2.06 Living/Kitchen	95.51	Yes
57	2.03 Living/Kitchen	100.00	Yes
58	2.17 Living/Kitchen	82.22	Yes
59	3.19 Living/Kitchen	82.22	Yes
60	3.18 Living/Kitchen	84.44	Yes
61	3.17 Living/Kitchen	95.56	Yes
62	3.06 Living/Kitchen	98.67	Yes
63	3.07 Living/Kitchen	100.00	Yes
64	3.04 Living/Kitchen	100.00	Yes
65	3.09 Living/Kitchen	82.22	Yes
66	3.08 Living/Kitchen	84.44	Yes
67	3.11 Living/Kitchen	100.00	Yes
68	3.01 Living/Kitchen	88.73	Yes
69	3.05 Living/Kitchen	100.00	Yes
70	2.21 Living/Kitchen	95.74	Yes
71	2.15 Living/Kitchen	100.00	Yes
72	3.10 Living/Kitchen	100.00	Yes
73	2.01 Living/Kitchen	72.00	Yes
74	4.06 Living/Kitchen	100.00	Yes
75	4.07 Living/Kitchen	100.00	Yes
76	4.04 Living/Kitchen	100.00	Yes
77	4.11 Living/Kitchen	100.00	Yes
78	4.01 Living/Kitchen	94.37	Yes
79	4.05 Living/Kitchen	100.00	Yes
80	4.10 Living/Kitchen	100.00	Yes
81	5.14 Living/Kitchen	100.00	Yes
82	5.13 Living/Kitchen	100.00	Yes
83	5.12 Living/Kitchen	100.00	Yes
84	5.06 Living/Kitchen	100.00	Yes
85	5.07 Living/Kitchen	100.00	Yes
86	5.04 Living/Kitchen	100.00	Yes
87	5.09 Living/Kitchen	78.72	Yes
88	5.08 Living/Kitchen	82.22	Yes
89	5.11 Living/Kitchen	100.00	Yes
90	5.01 Living/Kitchen	97.22	Yes
91	5.05 Living/Kitchen	100.00	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
92	5.10 Living/Kitchen	100.00	Yes
93	4.15Living/Kitchen	100.00	Yes
94	4.24 Living/Kitchen	94.59	Yes
95	5.19 Living/Kitchen	100.00	Yes
96	5.18 Living/Kitchen	97.78	Yes
97	5.17 Living/Kitchen	100.00	Yes
98	5.20 Living/Kitchen	100.00	Yes
99	5.15 Living/Kitchen	100.00	Yes
100	2.43 Living/Kitchen	77.55	Yes
101	5.21 Living/Kitchen	100.00	Yes
102	5.22 Living/Kitchen	100.00	Yes
103	5.23 Living/Kitchen	100.00	Yes
104	5.24 Living/Kitchen	98.65	Yes
105	3.16 Living/Kitchen	100.00	Yes
106	4.16 Living/Kitchen	100.00	Yes
107	5.16 Living/Kitchen	100.00	Yes
108	3.45 Living/Kitchen	100.00	Yes
109	5.40 Living/Kitchen	100.00	Yes
110	5.36 Living/Kitchen	100.00	Yes
111	5.35 Living/Kitchen	100.00	Yes
112	5.34 Living/Kitchen	100.00	Yes
113	5.27 Living/Kitchen	85.88	Yes
114	5.42 Living/Kitchen	98.73	Yes
115	5.28 Living/Kitchen	100.00	Yes
116	6.13 Living/Kitchen	100.00	Yes
117	6.21 Living/Kitchen	100.00	Yes
118	Living/Kitchen	98.55	Yes
119	Living/Kitchen	100.00	Yes
120	Living/Kitchen	100.00	Yes
121	Living/Kitchen	100.00	Yes
122	Living/Kitchen	100.00	Yes
123	Living/Kitchen	68.35	Yes
124	Living/Kitchen	78.52	Yes
125	Living/Kitchen	79.19	Yes
126	Living/Kitchen	72.00	Yes
127	2.30 Living/Kitchen	93.24	Yes
128	3.22 Living/Kitchen	100.00	Yes
129	6.05 Living/Kitchen	100.00	Yes
130	5.41 Living/Kitchen	90.79	Yes
131	3.29 Living/Kitchen	100.00	Yes
132	3.33 Living/Kitchen	100.00	Yes
133	4.32 Living/Kitchen	97.40	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
134	4.31 Living/Kitchen	97.01	Yes
135	5.29 Living/Kitchen	100.00	Yes
136	5.32 Living/Kitchen	95.95	Yes
137	5.31 Living/Kitchen	98.51	Yes
138	5.30 Living/Kitchen	100.00	Yes
139	4.25 Living/Kitchen	72.53	Yes
140	5.26 Living/Kitchen	100.00	Yes
141	5.25 Living/Kitchen	76.92	Yes
142	3.44 Living/Kitchen	93.33	Yes
143	3.47 Living/Kitchen	100.00	Yes
144	3.46 Living/Kitchen	100.00	Yes
145	4.44 Living/Kitchen	100.00	Yes
146	5.44 Living/Kitchen	100.00	Yes
147	4.43 Living/Kitchen	100.00	Yes
148	5.43 Living/Kitchen	100.00	Yes
149	4.39 Living/Kitchen	100.00	Yes
150	4.38 Living/Kitchen	100.00	Yes
151	5.39 Living/Kitchen	100.00	Yes
152	5.38 Living/Kitchen	100.00	Yes
153	3.35 Living/Kitchen	100.00	Yes
154	4.33 Living/Kitchen	100.00	Yes
155	5.37 Living/Kitchen	100.00	Yes
156	5.33 Living/Kitchen	100.00	Yes
157	6.15 Living/Kitchen	100.00	Yes
158	Living/Kitchen	100.00	Yes
159	3.30 Living/Kitchen	100.00	Yes
160	6.19 Living/Kitchen	100.00	Yes
161	4.37 Living/Kitchen	100.00	Yes
162	2.04 Living/Kitchen	100.00	Yes
163	2.37 Living/Kitchen	100.00	Yes
164	2.25 Living/Kitchen	98.65	Yes
165	2.26 Living/Kitchen	100.00	Yes
166	3.42 Living/Kitchen	100.00	Yes
167	4.29 Living/Kitchen	100.00	Yes
168	4.30 Living/Kitchen	98.53	Yes
169	3.28 Living/Kitchen	100.00	Yes
170	3.28 Living/Kitchen	100.00	Yes
171	3.31 Living/Kitchen	94.44	Yes
172	4.40 Living/Kitchen	100.00	Yes
173	2.29 Living/Kitchen	95.71	Yes
174	3.21 Living/Kitchen	100.00	Yes
175	4.21 Living/Kitchen	100.00	Yes

Reference Number	Room	% Area achieving 100 Lux	BS EN 17037 Compliant
176	4.26 Living/Kitchen	100.00	Yes
177	6.18 Living/Kitchen	100.00	Yes
178	4.34 Living/Kitchen	100.00	Yes
179	4.41 Living/Kitchen	92.21	Yes
180	4.09 Living/Kitchen	82.22	Yes
181	4.08 Living/Kitchen	84.44	Yes
182	4.17 Living/Kitchen	100.00	Yes
183	4.18 Living/Kitchen	93.33	Yes
184	4.19 Living/Kitchen	97.78	Yes
185	4.20 Living/Kitchen	100.00	Yes
186	3.02 Living/Kitchen	84.44	Yes
187	3.03 Living/Kitchen	90.77	Yes
188	3.23 Living/Kitchen	60.81	Yes
189	3.24 Living/Kitchen	70.15	Yes
190	3.25 Living/Kitchen	90.38	Yes
191	3.15 Living/Kitchen	100.00	Yes
192	3.20 Living/Kitchen	95.56	Yes
193	2.08 Living/Kitchen	86.67	Yes
194	2.09 Living/Kitchen	100.00	Yes
195	2.16 Living/Kitchen	91.11	Yes
196	2.18 Living/Kitchen	95.56	Yes
197	2.27 Living/Kitchen	100.00	Yes
198	2.45 Living/Kitchen	87.76	Yes
199	2.05 Living/Kitchen	100.00	Yes
200	2.39 Living/Kitchen	96.00	Yes
201	3.32 Living/Kitchen	94.44	Yes
202	2.02 Living/Kitchen	83.61	Yes
203	4.03 Living/Kitchen	96.92	Yes
204	4.02 Living/Kitchen	88.79	Yes
205	4.23 Living/Kitchen	78.46	Yes
206	5.03 Living/Kitchen	100.00	Yes
207	5.02 Living/Kitchen	100.00	Yes
208	6.22 Living/Kitchen	100.00	Yes
209	6.14 Living/Kitchen	100.00	Yes
210	6.12 Living/Kitchen	87.80	Yes

Appendix D

ARUP

Reside Investments Limited

SHD Residential at Carrigaline

Flood Risk Assessment

Reference:

Final 01 | 9 May 2022

Job number 282898-00

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		Signature			
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			Prepared by	**Checked by**	**Approved by**
		Name	Rodoula Gregoriou	Mesfin Desta	Alan Leen
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		Description			
			Prepared by	**Checked by**	**Approved by**
		Name			
		Signature			

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Executive Summary

Reside Investments Ltd are submitting a Planning Application for a mixed-use development in Carrigaline consisting of 224 no. new dwelling units and small and large commercial units. The development incorporates a 2-storey car park, a creche and double-height retail units.

Arup is commissioned to undertake a Flood Risk Assessment (FRA) for the proposed residential development. The FRA is undertaken in accordance with 'The Planning System and Flood Risk Management' Guidelines for Planning Authorities published in November 2009, jointly by the Office of Public Works (OPW) and the then Department of Environment, Heritage and Local Government (DEHLG).

An assessment of fluvial, tidal, pluvial and groundwater flood risk to the site was carried out. The predominant flood risk to the site is fluvial and tidal from the Owenboy River. The Lee CFRAMS mapping and Cork County Development Plan (January 2022) SFRA mapping indicated that parts of the site near the river are located within Flood Zones A (high risk) and B (medium risk), with areas at the south and higher grounds in Flood Zone C (low risk). A detailed and site-specific hydraulic modelling of the area is undertaken to confirm design flood levels and assess in detail fluvial and tidal flood risk. As a result, the flood zones have been re-calculated and adjusted.

Flood mitigation measures are proposed to prevent inundation of the site. These include dedicating large areas within Flood Zone A for open space amenity uses that are water compatible, raising finished floor levels above the design flood protection level and proposing highly vulnerable uses to higher levels to provide vertical differentiation. Water tanking construction methods are proposed if groundwater proves to be problematic subject to ground investigations. As parts of the development proposals lie within Flood Zone A, level for level flood compensation is proposed within the site to replace any flood storage taken by the development. As such, there are no negative flood impacts from the proposed development to other sites. The measures are designed to adequately protect the site from flooding and allow safe access and egress to the site for up to the 0.5% annual exceedance probability tidal event with allowance for climate change and freeboard.

The proposed drainage system for the development will not increase flood risk to the site or off site. The system proposes to control the rate of run-off from the new development to Greenfield rates, thereby managing any increase in run-off to the Owenboy River. Attenuation storage will be provided underneath the buildings and a petrol interceptor will be installed to capture hydrocarbons before the surface water is discharged to the river.

The potential impacts of the development on flood storage, conveyance and surface water run-off were assessed. The impact of the development on these issues are local to the proposals and negligible at other upstream or downstream receptors. The residual risks to the occupants of the development were assessed as part of the FRA. The residual risk of flooding is considered acceptable.

A Development Management Justification Test was carried out in accordance with the Guidelines. It is demonstrated that the proposed development satisfies all the criteria of the development management Justification Test.

This FRA has demonstrated that the risks relating to flooding can be managed and mitigated to acceptable levels and therefore comply with DoEHLG / OPW and Cork County Council planning guidance.

1. Introduction

1.1 Project Background

Arup was approached by Reside Investments Ltd to undertake a Flood Risk Assessment (FRA) for a proposed mixed-use development comprising residential, retail, childcare space, car parking and public realm works at Carrigaline, Co., Cork. This is a Strategic Housing Development comprising of 224 no. residential units.

The purpose of the FRA is to identify current and potential future risks of flooding to the existing site, as well as outline the flood mitigation measures proposed to ensure the development is safe from flooding in line with the applicable guidelines. This assessment was completed in accordance with 'The Planning System and Flood Risk Management' Guidelines for Planning Authorities published in November 2009, jointly by the Office of Public Works (OPW) and the then Department of Environment, Heritage and Local Government (DEHLG).

1.2 Scope

The scope of the FRA included the following:

- Confirmation of the sources of flooding which may affect the site.
- Review of the availability and adequacy of existing information including but not limited to:
  - The OPW Preliminary Flood Risk Assessment Mapping (PFRA)
  - Lee Catchment Flood Risk Assessment and Management (CFRAM) Study
  - Historic flooding information for the area
  - Groundwater information from OPW's Draft Preliminary FRA
  - Existing drainage records
  - Available topographical information for the site.
- Hydrological assessment and hydraulic modelling of the Owenboy River to assess the risk of flooding to the site and to adjacent sites as a result of construction of the proposed development.
- Identification of possible measures which could mitigate the flood risk to acceptable levels.

1.3 Summary of Data Used

In preparing this report, data regarding flood risk relevant to the proposed development and surrounding area has been obtained from the following sources:

- OPW National Flood Hazard Mapping website (https://www.floodinfo.ie/).
- Lee CFRAM Hydrology and Hydraulics Reports and predictive flood mapping (https://www.floodinfo.ie/).
- Draft Cork County Development Plan 2022-2028 (https://www.corkcoco.ie/en/cork-county-development-plan-2022-2028)
- Cork County Development Plan 2021 Strategic Flood Risk Assessment
- Ballincollig - Carrigaline Municipal District - Local Area Plan 2017, Environmental Reports and Map (http://corklocalareaplans.com/ballincollig-carrigaline-municipal-district/)
- Site Geological and hydrogeological data from the Geological Survey of Ireland website (www.gsi.ie).
- Topographical survey of the site and environs.

- Survey data of Owenboy River.
- Proposed Development Planning Application Drawings.
- Aerial photography and mapping from Bing Maps and Google Maps.

All levels referred to in this report are to Malin Head Ordnance Datum (OD) unless otherwise stated.

2. Site Description

2.1 Site Location

The development site is approximately 3.0ha in area and is located west of Carrigaline town centre, Co. Cork.

An overview of the area is shown in Figure 1 below, with the development boundary outlined in red.

Figure 1: Site location (©2022 Google, Maxar Technologies Map Data ©2021)

The site is bounded to the south by a residential housing and Kilmoney Road Lower, to the east by the Dairygold Co Op superstore, to the north by Owenboy River and west by agricultural land. The Western Relief Road is currently under construction along the western boundary.

The site is currently a greenfield and is zoned for Town Centre uses. It slopes from south to north towards the Owenboy River, which meanders along the northern site boundary from east to west. The topography ranges significantly within the site, with higher levels at the southwest boundary at 11.0m OD and lower levels at the north along the river at 1.8m OD.

A topographic survey of the site was undertaken in December 2020 by Precise Control and an extract is shown in Figure 2. This is also included in Appendix A.

Figure 2: Site topography

2.2 Proposed Development

It is proposed to construct 224 no. new dwelling units on a net developable area of 2.0ha at Kilmoney Rd Lower, Carrigaline. The dwelling units are proposed to be incorporated within two 4 storey apartment blocks with own door units provided.

The proposed development will consist of the following components:

- The construction of 224 no. residential units consisting of 202 no. proposed apartments in 2 no. blocks, ranging in height from 6 to 7 storey and 22 no. townhouse/duplex units:
- A 184 m^2 creche/childcare facility;
- The provision of landscaping and amenity areas to include 1 no. local play area, 1 no. kick about areas, an activity trail/greenway along the river, a gathering area/amphitheatre with tired seating areas, a civic space/promenade and 2 no. courtyard areas;
- The provision of 3 no. retail units, residential amenity and management spaces at ground and first floor level; and
- All associated ancillary development including vehicular access on to the Kilmoney Road Lower, and a cycle/pedestrian connection on to the R611 (via an activity trail/greenway along the river), lighting, drainage, roads boundary treatments, ESB Substation, bicycle & car parking and bin storage.

Figure 3: Proposed development (Henry J Lyons Architects)

3. Methodology

The following planning policy documents were used to assess the proposed development:

- The Planning System and Flood Risk Management Guidelines for Planning Authorities - OPW & Department of the Environment, Heritage and Local Government (November 2009)
- Draft Cork County Development Plan 2022-2028 and SFRA
- Ballincollig - Carrigaline Municipal District - Local Area Plan 2017.

3.1 The Planning System and Flood Risk Management Guidelines

In November 2009, the Department of Environment, Heritage and Local Government and the Office of Public Works jointly published a Guidance Document for Planning Authorities entitled “The Planning System and Flood Risk Management”, herein referred to as the Planning Guidelines.

The Planning Guidelines are issued under Section 28 of the Planning and Development Act 2000. Planning Authorities and An Bord Pleanála are therefore required to implement these guidelines in carrying out their functions under the Planning Acts.

The aim of the Planning Guidelines is to ensure that flood risk is neither created nor increased by inappropriate development.

The Planning Guidelines require the Planning system to avoid development in areas at risk of flooding, unless the development can be justified on wider sustainability grounds and the risk can be reduced or managed to an acceptable level.

The guidelines require the adoption of a Sequential Approach to Flood Risk Management of Avoidance, Reduction, Justification and Mitigation and they require the incorporation of Flood Risk Assessment into the process of making decisions on Planning Applications and Planning Appeals. The assessments are completed in three stages:

i. Stage 1 – Flood risk identification,

ii. Stage 2 - Initial flood risk assessment, and

iii. Stage 3 - Detailed flood risk assessment

Key to the Planning guidelines is the introduction of flood risk zoning and the classifications of different types of development having regard to their vulnerability. The management of flood risk is now a key element of any development proposal in an area of potential flood risk and should therefore be addressed as early as possible in the site master planning stage.

Safe access and egress during a flood event are also a fundamental part of the guidelines.

3.1.1 Definition of Flood Zones

Flood Zones are geographical areas within which the likelihood of flooding is in a particular range.

There are three types of flood zones defined in the Planning guidelines as follows:

Table 3-1: Flood Zone Categories

Flood Zone A	Probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding).
Flood Zone B	Probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 year and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and
Flood Zone C	Probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

3.1.2 Definition of Vulnerability Classes

The following table summarises the Vulnerability Classes defined in the Planning Guidelines and provides a sample of the most common type of development applicable to each. The proposed development uses in Carrigaline are a) residential, b) retail and c) amenity open space with riverside greenway and are considered *Highly Vulnerable*, *Less Vulnerable* and *Water Compatible* respectively.

Table 3-2: Vulnerability Classes

Highly Vulnerable Development	Includes Garda, ambulance and fire stations, hospitals, schools, **residential dwellings,** residential institutions, essential infrastructure, such as primary transport and utilities distribution and SEVESO and IPPC sites, etc.
Less Vulnerable Development	Includes **retail**, leisure, warehousing, commercial, industrial and non-residential institutions, etc.
Water Compatible Development	Includes Flood Control Infrastructure, docks, marinas, wharves, navigation facilities, water-based recreation facilities, amenity open spaces and outdoor sport and recreation facilities

3.1.3 Sequential Approach and Justification Test

The Planning Guidelines outline the sequential approach that is to be applied to all levels of the planning process. This approach should also be used in the design and layout of a development and the broad philosophy is shown in Figure 4. In general, development in areas with a high risk of flooding should be avoided as per the sequential approach.

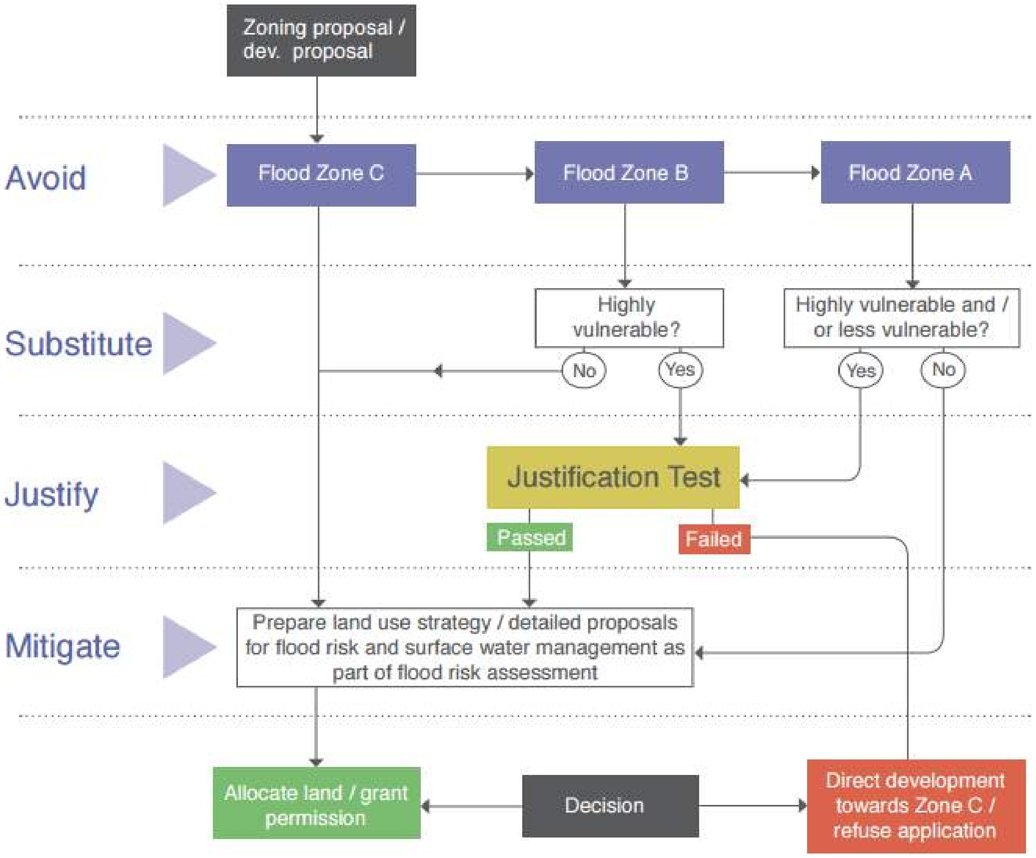

Figure 4: Sequential approach (reproduced from the Planning Guidelines)

The Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of developments that are being considered in areas of moderate or high flood risk. The test comprises the following two processes.

- The first is the Plan-making Justification Test and is used at the plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding.

- The second is the Development Management Justification Test and is used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land.

Table 3-3 illustrates the different types of Vulnerability Class appropriate to each zone and indicates where the Justification Test is required.

Table 3-3: Vulnerability classes matrix

	Flood Zone A	Flood Zone B	Flood Zone C
Highly Vulnerable	Justification Test	Justification Test	Appropriate
Less Vulnerable	Justification Test	Appropriate	Appropriate
Water Compatible	Appropriate	Appropriate	Appropriate

The Planning Guidelines recognise that there is a need to reconcile the desire to avoid development in areas at risk of flooding while also ensuring sequential and compact urban development as several large urban centres are already located in areas that are at risk of flooding.

3.2 Draft Cork County Development Plan 2022-2028

The Draft Cork County Development Plan 2022 (CDP) has become available for public consultation and amendments are being considered (no amendments are proposed for the subject site yet), with the aim that the plan is expected to be adopted on 25th April 2022 and come into effect on 6th June 2022.

The draft Plan includes policies and actions specific to flood risk management which were informed by the Flood Risk Management Guidelines. Chapter 11 – Water management of the Plan details Cork County Council's approach to Flood Protection and Flood Risk. The following summarises sections of particular interest to the proposed development in Carrigaline.

3.2.1 WM 11-13: Floodplains and Wetlands

The plan states that floodplains, wetlands and coastal areas subject to flooding are protected as vital green infrastructure that provide space for storage and conveyance, enabling flood risk to be more effectively managed and reducing the need to provide flood defences in the future.

3.2.2 WM 11-14: Flood Risk – Overall Approach

The Draft Cork County Development Plan states that the following approach is implemented to reduce the risk of new development being affected by possible future flooding:

- Avoid development in areas at risk of flooding; and
- Where development in floodplains cannot be avoided, take a sequential approach to flood risk management based on avoidance, reduction and mitigation of risk;
- Implement the recommendations of the South Western CFRAM study.
- Where a development proposal is in 'Zone A' – an area with a high probability of flooding:

"avoid development other than 'water compatible development' as described in Section 3 of The Planning System and Flood Risk Management Guidelines for Planning Authorities issued in November 2009 by DoEHLG".

- If the development proposal is in 'Zone B' – an area where there is a moderate probability of flooding:

"avoid 'highly vulnerable development' described in Section 3 of 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' issued in November 2009 by DoEHLG".

3.2.3 WM 11-15: Development in Flood Risk Areas

The Plan states that all proposals for development falling within Flood Zones A & B identified as being at risk from flooding will need to be supported by a site-specific flood risk assessment and are consistent with the Ministerial Guidelines – 'The Planning System and Flood Risk Management".

Cork County Council has developed flood zone maps as part of the Strategic Flood Risk Assessment. The flood zones are based on the flood risk mapping outputs from the CFRAM studies.

In the Draft CDP the site is zoned for town centre uses with the following CL-T-01 objective: "*This area denotes the built existing footprint of the town centre and any proposals for development within this core area should comply with the overall uses acceptable in town centre areas. The western inner relief is due to commence construction in 2021 and the delivery of this road offers opportunities to deliver an updated public realm for the town including the introduction of new public spaces. These should be designed to accommodate a number of community functions including a market space, festival space, meeting place, seating area etc. The desirable location of these future public spaces are:*

- *The site of the existing car park adjoining the Main Street and River;*
- *Within the town centre expansion area west of the Main Street and should form part of a wider public realm strategy for the town.*

Community uses which will be considered appropriate for this site include youth facilities, theatre, cinema, town hall / multi purpose building and town square. Within the site there will be opportunity for regeneration and town centre expansion. The road scheme will give priority to pedestrians and cyclists and will provide permeability to the rest of the town including the open space area directly adjacent to the site (CL-GR-02)"* (* denotes the requirement for a Flood Risk Assessment).

There are no amendments proposed to the CL-T-01 objective and therefore the above zoning objective will be the adopted/operative zoning for the subject site in the forthcoming CDP.

The draft Plan and proposed amendments were subject to a Strategic Flood Risk Assessment (SFRA) in accordance with the "Plan Making Justification Test" in the 'The Planning System and Flood Risk Management' Guidelines for Planning Authorities published in November 2009.

The SFRA highlights the following design considerations relevant to the site:

- Raising finished floor levels can be an effective way of avoiding damage to the interior of a building in times of flood. Levels should be raised at a minimum to the following:
    - Fluvial, undefended: 1% AEP flood + climate change + 300mm freeboard
    - Tidal, undefended: 0.5% AEP flood + climate change + 300mm freeboard (or +500mm freeboard where wave overtopping, and surge is an additional risk).
- The climate change allowances shall be as described in Table 49 of the SFRA, summarised below:
    - Less vulnerable & Highly vulnerable development: 20% increase in flows and 0.5m increase in sea levels (Mid-Range Future Scenario - MRFS).

3.3 Ballincollig - Carrigaline Local Area Plan 2017

The Ballincollig - Carrigaline Local Area Plan (LAP) contains the policies and objectives to guide development and land use in the Municipal District. The area of the development is zoned for Town Centre uses with objectives for community uses, priority to pedestrian and cyclists and expansion and regeneration of the urban centre. The southern part of the site backing into existing residential development on the Kilmoney Road may have a mix of residential development.

All proposals for development within areas identified as being at risk of flooding shall comply with the objective of the objectives under Chapter 11 – Water management of the Cork County Development Plan and with the provisions of the Ministerial Guidelines – 'The Planning System and Flood Risk Management'. A site-specific Flood Risk Assessment will be required.

3.4 Consultations with Cork County Council

A 247 meeting was held with Cork County Council on 11th August 2021. Among other subjects, flood risk and management at the site was presented to the council and discussed.

A follow up meeting with the Drainage division of the council was held on 14th January 2022 to discuss the management of flood risk on site.

The overall flood management strategy for the site was presented and the Council pointed out that the following items are considered and included in the site-specific FRA:

- Climate change factors and associated OPW guidelines on uplift figures are being followed,
- Operation and maintenance of the flood mitigation measures (storage areas, or crates), including access requirements, regularity of maintenance and responsibility, and
- A Flood Awareness Plan and preliminary Flood Emergency Response Plan shall be prepared for developments within either Flood Zones A or B.

The council also noted that Carrigaline was identified as AFA (area for further assessment) under the Lee CFRAMS and that the South Western CFRAM and '*the Carrigaline Flood Relief Scheme is under review to confirm the technical aspects and viability, and, subject to outcomes, will then progress to Outline Design and Planning.'*

The council had expressed no objection to the proposed approach as set out in the presentation other than the comments above are considered.

4. Stage I – Flood Risk Identification

4.1 Potential Flood Sources

In broad terms, the potential sources of flooding at the site and its vicinity can be categorised as:

- Fluvial (River) Flooding – There is a potential risk of fluvial flooding from the Owenboy River at the northern part of the site,
- Coastal / Tidal Flooding – There is a potential risk of tidal flooding from Owenboy estuary at the site,
- Pluvial Flooding/urban drainage - Pluvial flooding occurs when the capacity of the local surface water network is exceeded during periods of intense rainfall. At these times, water can collect at low points in the topography and cause flooding,
- Groundwater Flooding - This can occur during lengthy periods of heavy rainfall, typically during late winter / early spring when the ground water table is already high. If the groundwater level rises above ground level, it can pond at local low points and cause periods of flooding.

4.2 Historic Flood Data

Records of historic fluvial and tidal floods were obtained (accessed in March 2022) from the OPW National Flood Hazard mapping website, http://wwww.floodinfo.ie.

There are no records of fluvial or tidal flooding within the site boundary. There are, however, a number of events recorded at close proximity.

An extract map is shown in Figure 5 below with the site boundary indicated in red and details of the events are included in Table 6-1. A summary report is contained in Appendix B.

Figure 5: Historic Flood Points (source floodinfo.ie)

Table 4-1: Historic Flood Events (source floodinfo.ie)

Point	Flood event	Date	Source
1	Carrigaline Main Street Area	26/10/2004	Coastal/ Estuarine
2	Property (Rosie's Pub) in Carrigaline centre	16-17/10/2012	High tides and pluvial flooding
3	Property (Rosie's Pub) in Carrigaline centre	14/12/2012	High tidal water/surface depression
4	Carrigaline City Centre (Main Street, Strand Road and Crosshaven road)	02/01/2014	High tide driven by high winds
5	Carrigaline bridge	19/10/2009	Heavy rainfall, surface water drainage.

4.3 Fluvial Flood Risk

The Lee CFRAM study was undertaken on behalf of OPW to assess flood risk from rivers and the sea in the Lee catchment between 2009 and 2012. Flood maps were produced and are openly available on floodinfo.ie.

An extract from the Lee CFRAMS fluvial (current) flood extent map is displayed in Figure 6. The predicted fluvial flood extents for three separate return period events are presented on the map: 1 in 10 (10% Annual Exceedance Probability AEP), 1 in 100 (1% AEP) and 1 in 1000-year (0.1% AEP) fluvial flood extents.

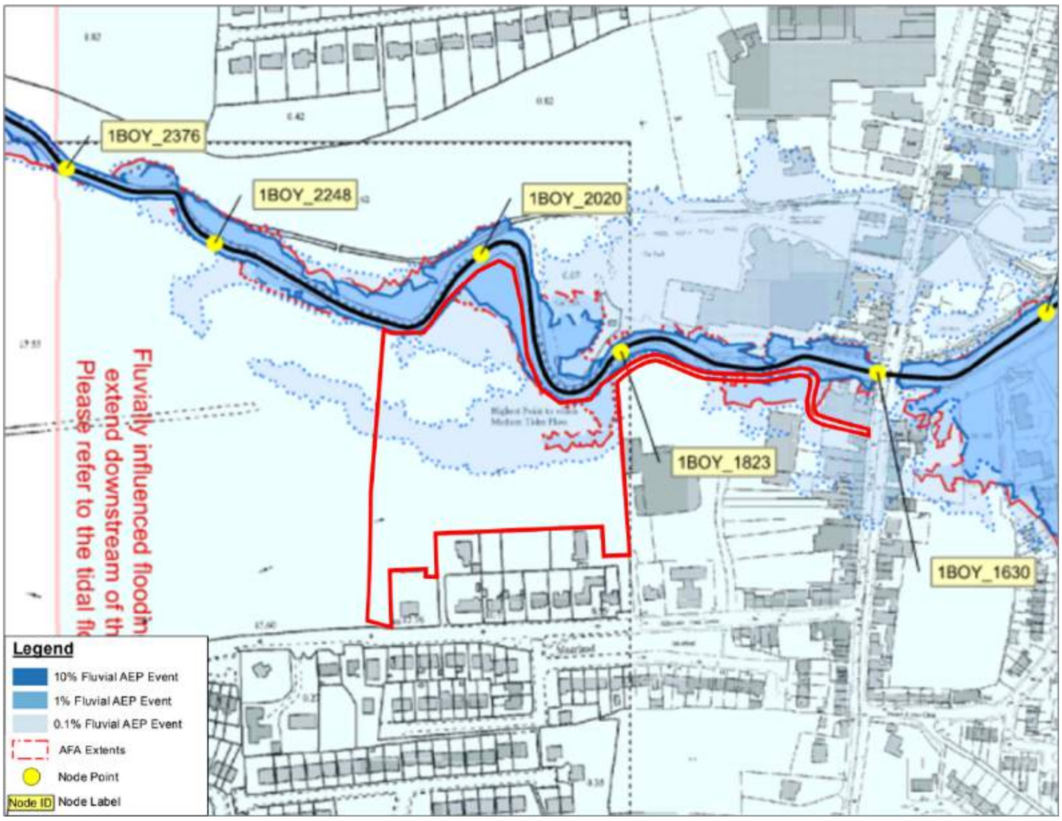

Figure 6: Lee CFRAMS fluvial flood extents (current scenario)

The CFRAM flood mapping indicates that parts of the site on the low-lying north part and riverside greenway lie within the 10%, 1% and 0.1% AEP extents. The 0.1% fluvial event extends to the centre of the site, where some buildings are proposed. The development site therefore partially lies in Flood Zones A, B and C.

The peak fluvial flood level at the site (node 1BOY_2020) during the 1% AEP event is 2.88mOD and during the 0.1% event is 3.13mOD.

The above modelling is based on the hydrological assessment done for Owenboy river as part of the Lee CFRAM studies in 2009 by Halcrow, on behalf of the OPW. The assessment made use of the Flood Estimation Handbook (FEH) method and Flood Studies Report (FSR) techniques for UK and Ireland. Since then, these methods have been superseded by the Flood Studies Update (FSU) methodology for Ireland developed by the OPW. Furthermore, more hydrometric data have been collected since the study was done. As such, a new analysis has been done for the Owenboy River for the purposes of this FRA and updated flood maps have been produced. The updated hydrology and hydraulic modelling for the site are presented in Chapters 5 and 6.2.

4.4 Tidal Flood Risk

As part of the 2009 Lee CFRAM studies, the risk of flooding due to tidal inundation was also assessed.

An extract from the Lee CFRAMS tidal (current) flood extent map is displayed in Figure 7. The predicted fluvial flood extents for three separate return period events are presented on the map: 1 in 10 (10% AEP), 1 in 200 (0.5% AEP) and 1 in 1000-year (0.1% AEP) fluvial flood extents.

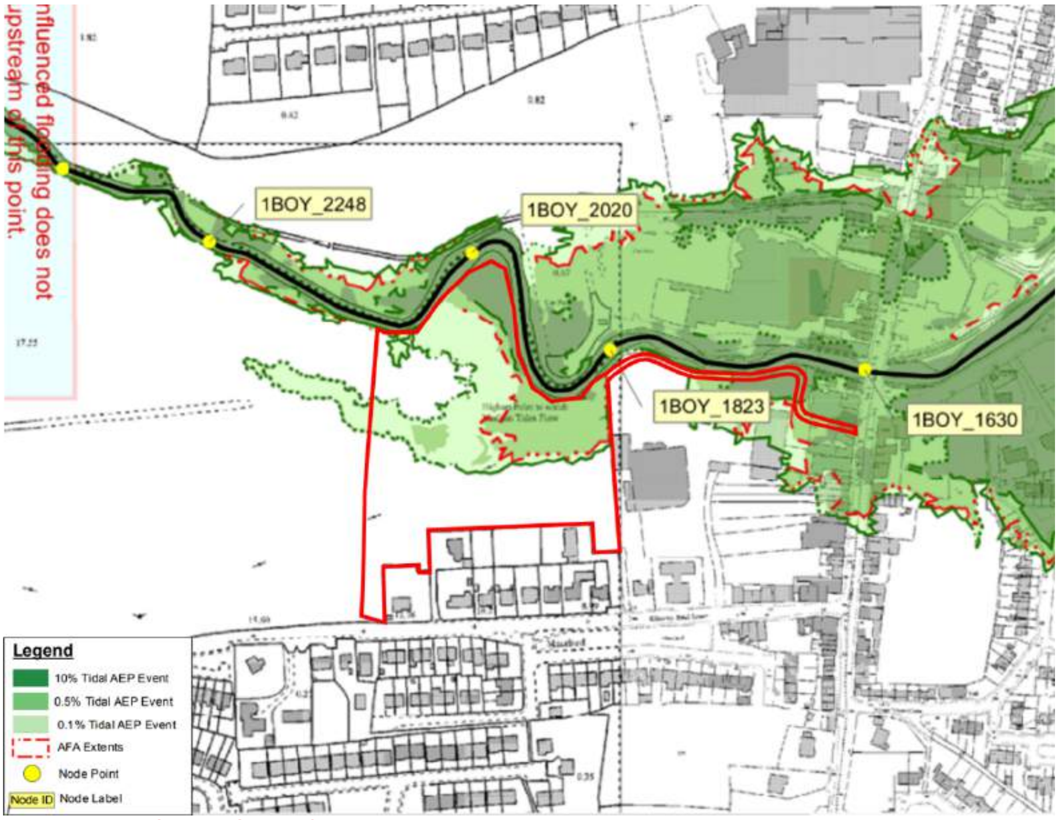

Figure 7: Lee CFRAMS tidal flood extents (current scenario)

The CFRAM flood mapping indicates that parts of the site on the low-lying north part and riverside greenway lie within the 10%, 0.5% and 0.1% AEP extents. The 0.5% and 0.1% AEP tidal event extents further to the centre of the site. The development site therefore partially lies in Flood Zones A, B and C.

The peak fluvial flood level at the site (node 1BOY_2020) during the 0.5% AEP event is 2.98mOD and during the 0.1% AEP event is 3.16mOD.

As with the fluvial modelling, tidal modelling has also been updated with an updated hydrology, following the latest guidance by OPW. Updated flood extents have been produced and are presented in Section 6.2.

4.5 Pluvial Flood Risk

Pluvial flooding occurs when extreme rainfall overwhelms drainage systems or soil infiltration capacity, causing excess rainwater to pond above ground at low points in the topography.

The site is greenfield and as such there are no known surface water drainage sewers within the site.

The OPW has prepared Preliminary Flood Risk Assessment (PFRA) mapping for all sources of flooding.

The fluvial maps have been superseded by the CFRAM studies; however, flood risk from pluvial flooding has not yet been assessed in higher accuracy or detail.

An extract from the draft PFRA map is presented in Figure 8. No pockets of pluvial flooding are found at the site or in the vicinity. However, it should be noted that the accuracy of the maps is low and only indicative.

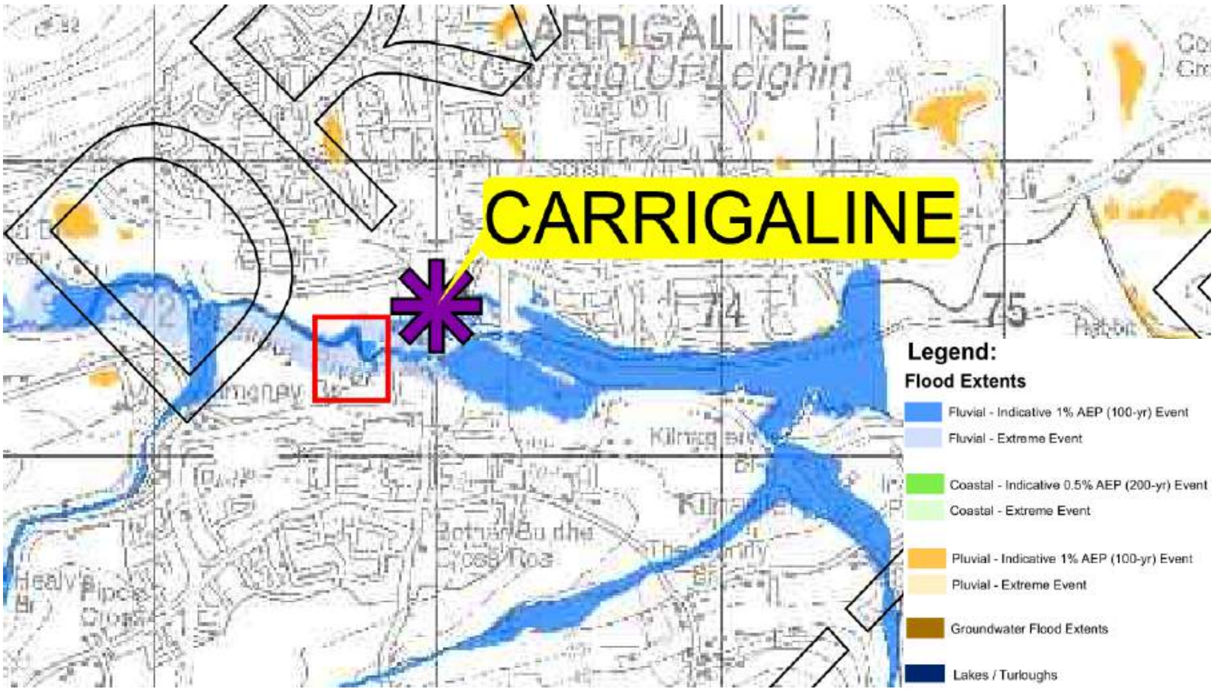

Figure 8: PFRA Draft Pluvial Flood Map

There appears to be little history of pluvial flooding at the site, and the available predictive pluvial flood mapping has not highlighted a particular risk. However, surface water run-off from higher grounds surrounding the site could potentially pose a risk of pluvial flooding to the properties. Appropriate landscaping and regrading to direct any run-off away from the buildings are proposed.

4.6 Groundwater Flood Risk

Groundwater flooding can occur during lengthy periods of heavy rainfall, typically during later winter/early spring when the groundwater table is already high. If the groundwater level rises above surface level, it can pond at local points and cause periods of flooding.

The Geological Survey of Ireland (GSI) "GWFlood" project predictive flood mapping[1] did not indicate a risk of groundwater flooding at the site.

No evidence of historic groundwater flood risk at the site was found.

[1] https://www.gsi.ie/en-ie/programmes-and-projects/groundwater-and-geothermal-unit/activities/groundwater-flooding/gwflood-project-2016-2019/Pages/default.aspx

Figure 9 presents information on the Geological Survey of Ireland (GSI) groundwater vulnerability for the proposed development. It can be seen from the figure that the groundwater vulnerability is indicated as moderate and high for the site, indicating that the groundwater table has a moderate and high level of vulnerability as the overburden soils are likely to be permeable. However, this mapping does not give a clear indication of the potential for groundwater flood risk at the site.

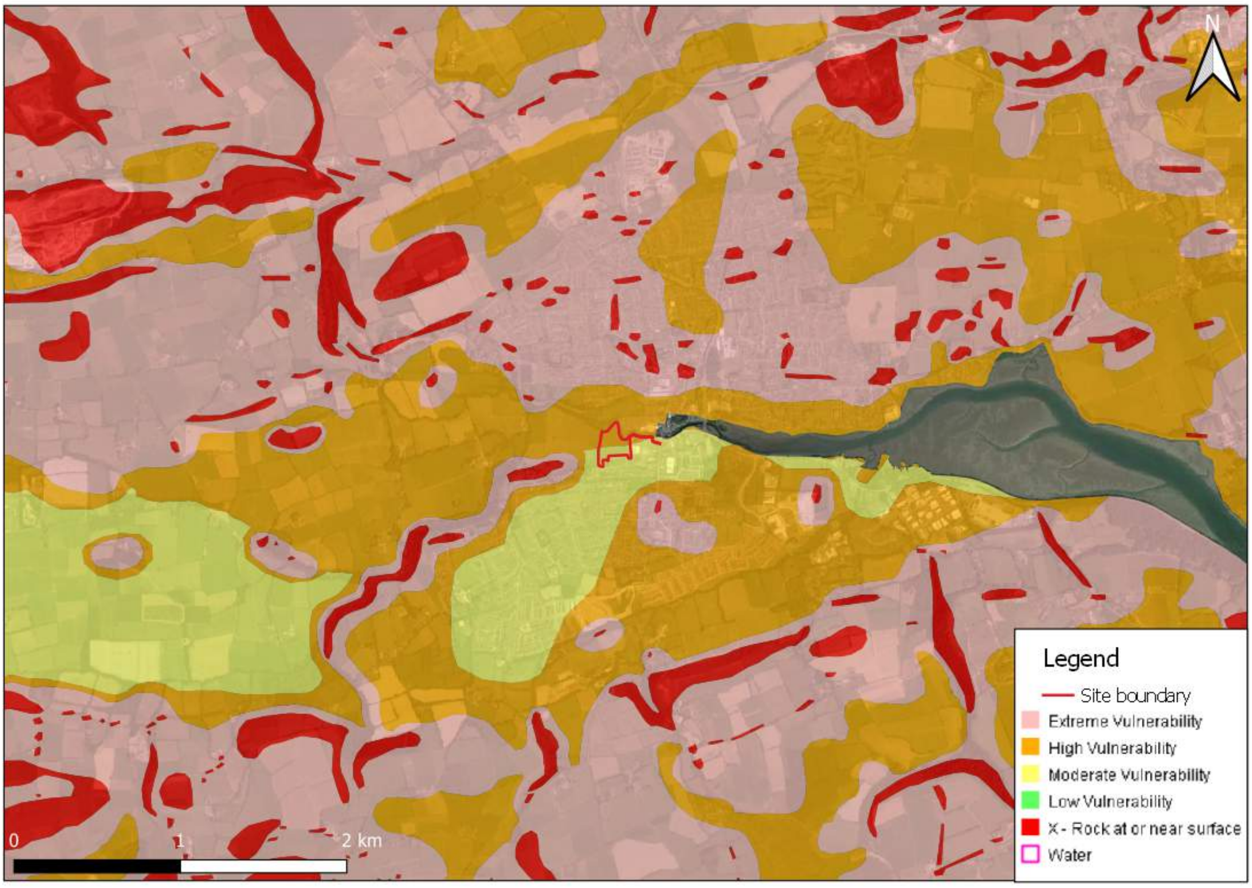

Figure 9: Groundwater Vulnerability Map – Geological Survey of Ireland (www.gsi.ie)

Ground investigations have been undertaken for the purposes of the adjacent Western Relief Road over the period 05/10/2006 to 04/01/2007. The scope of the site investigation was to investigate subsurface ground conditions by means of cable percussion boreholes with rotary follow-on, trial pits and lab testing. The locations of the boreholes and trial pits closer to the site are shown in Figure 10.

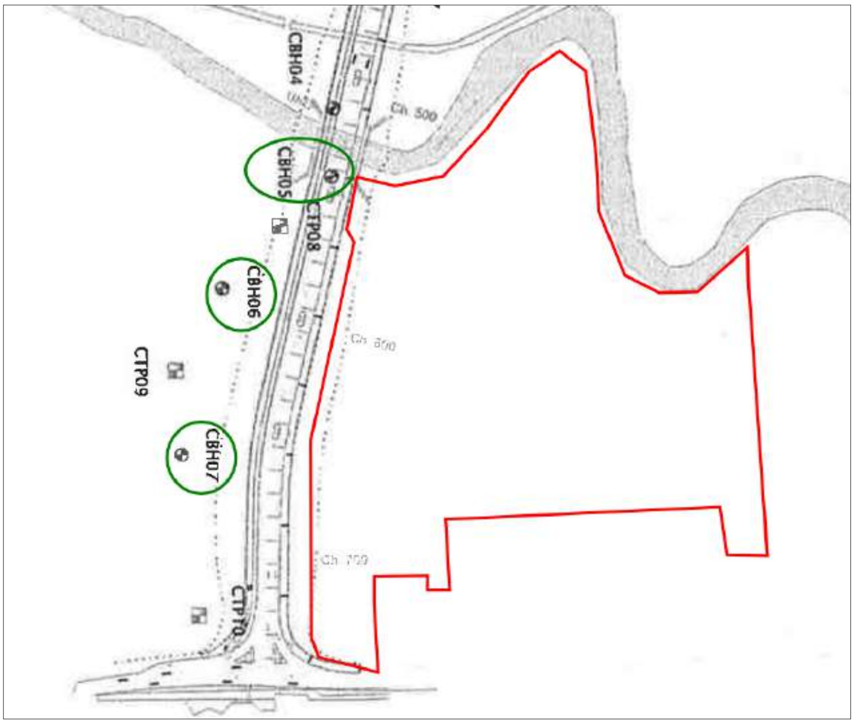

Figure 10: Location of boreholes and trial pits near the site (Western Relief Road site investigation, 2007)

The trial pits closest to the site indicated that the alluvium layers are mainly gravels. Three boreholes are located very close to the site, CBH5, CBH6 and CBH7. Borehole CBH5 located closest to the river shows 8m of clay with a band of sand from 1.6-2.9m b.g.l. (below ground level). CBH06 indicates gravels from 1.3-7.5m b.g.l. CBH07 indicates 8.5m of clay with a band of gravel from 2.7-5.7m b.g.l.

Monitoring of groundwater was undertaken between 23/12/06 to 16/04/07 at CBH05 and CBH06. The monitoring indicates artesian conditions at CBH05 and very shallow groundwater (0.05-0.29m b.g.l) at CBH06. CBH06 is shown at 3.243m AOD, indicating the groundwater levels could be at 3.193m AOD (when groundwater levels is as high as 0.05m b.g.l). This level is higher than the average river level during normal conditions (recorded at 1.2m AOD during river surveys in August 2021).

The above information indicates shallow ground water levels near the site. The risk of groundwater flooding to the site is therefore considered moderate. It is recommended that the groundwater levels are monitored long-term as part of the site investigations and measures are put in place to prevent hydrostatic uplift during construction, construction dewatering as well as measures to prevent water ingress to lower levels and basements.

4.7 Summary of Existing Flood Risk

The risk of flooding to the existing site from fluvial, tidal, pluvial and groundwater sources was assessed. Historical records show that the site is at low risk of flooding. However, the Lee CFRAM study 2009 indicates that the site lies in areas at risk of flooding from fluvial and tidal sources. Therefore, the development site partially lies within Flood Zones A and B.

The risk of pluvial flooding to the site is currently low. However, the drainage system may increase the risk of flooding, if not designed properly

Groundwater information from nearby boreholes indicate shallow groundwater table due to its proximity to the Owenboy River and hence the risk of groundwater flooding to the site is considered moderate.

As a result of the risks identified, the assessment is progressed to Stage II – Flood Risk Assessment.

5. Stage II – Initial Flood Risk Assessment

The purpose of Stage 2-FRA is to confirm flooding sources, appraise the adequacy of existing information and to scope the extent of the risk of flooding and assess possible mitigation measures. Stage 1 flood risk assessment has identified the primary sources of flooding to the site. The Source-Pathway-Receptor model outlined in Section 5.1 below shows the appraisal of these sources.

5.1 Source-Pathway-Receptor Model

A Source-Pathway-Receptor model was developed to assess the risks from the various sources of flooding. The model provides the likelihood of flooding from the specified source and its consequence taking account of the vulnerability classification of the development and mitigation measures in place. The basis of the scores is shown below:

- Likelihood:
    - Remote (1): less the 0.1% AEP
    - Unlikely (2): 0.1% AEP
    - Possible (3): 1% AEP
    - Likely (4):10% AEP
- Consequence:
    - Minimal (1): inconvenience
    - Medium (2): damage to property
    - High (3): damage to property and injury
    - Major (4): loss of life and damage to property
- Risk: Low (<=3), Medium (b/n 3 and 6), High (b/n 8 and 12), Very High (>16)

Table 5-1 Source-Pathway-Receptor Model

Source	Pathway	Receptor	Likelihood	Consequence	Risk
Fluvial	Overbank Flow	People/ Property	Possible (3)	High (3)	High (9)
Tidal	Sea Level Rise	People/ property	Possible (3)	High (3)	High (9)
Surface water	Blockage/ Overflow	People/ Property	Remote (1)	Medium (2)	Low (2)
Groundwater	Rising Water Table	People /Property	Remote (1)	Medium (2)	Low (2)

The risk of fluvial and tidal flooding sources is appraised as “high”. Therefore, it will be necessary to further assess the risk of flooding from these sources. The flood event that would result in the worst flood levels and extents is the tidal source and hence will be used to set the flood protection levels for the development site.

5.2 Conclusion of Stage II – Initial Flood Risk Assessment

The proposed site for redevelopment is classified as within Flood Zones A and B from both fluvial and tidal flood sources. Therefore, the impact of the development on flooding elsewhere and the scope of possible mitigation measures must be assessed using a hydraulic model. The CFRAM 2009 study was based on hydrological methods that have now been superseded by new data have become available since its completion. As such, the hydrological analysis and hydraulic modelling had to be updated to re-produce flood extents, revised Flood Zones and to:

- Propose the development FFLs,
- Assess the impact, if any, of the development on flood risk elsewhere,
- Assess the adequacy of the proposed mitigation measures, and
- Determine the residual risk, if any.

For this reason, the Flood Risk Assessment was progressed to Stage III – Detailed Flood Risk Assessment.

6. Stage III – Detailed Flood Risk Assessment

6.1 Hydrological Assessment

The following chapter explains the methodologies and hydrological analysis undertaken to derive the design event hydrology for the updated Owenboy model.

A hydrological assessment was carried out for Owenboy River as part of the Lee CFRAM studies in 2009 by Halcrow, on behalf of the OPW. The assessment made use of the Flood Estimation Handbook (FEH) method and Flood Studies Report (FSR) techniques for UK and Ireland. Since then, these methods have been superseded by the Flood Studies Update (FSU) methodology for Ireland developed by the OPW. Furthermore, more hydrometric data have been collected since the study was completed. Therefore, a new analysis is carried out for the Owenboy River for the purposes of this FRA.

The methodology is summarised as follows:

- The Q_{MED} (median flow) was derived at the site location using the FSU 7-variable Physical Catchment Descriptors (PCD) equation.
- The Ballea Bridge Gauging station located upstream of the site was used as a Pivotal site to adjust the Q_{MED}.
- A flood frequency analysis was undertaken to develop a flood growth curve, using a pooling group with a total of 506 years of records. The curve provides growth factors for higher order events, such as the 1 in 100 and 1 in 1000.
- The growth factors and Q_{MED} were multiplied to produce flood flow estimates for a series of events.
- The hydrograph shape from the historic November 2009 flood event has been used to create the design hydrograph. The hydrograph was scaled to the peak flood flow estimates for each flood event.

6.1.1 Q_{MED} Derivation

The OPW FSU method for ungauged catchments as described in Work Package 2.3 was used to estimate the Q_{MED}. The methodology uses 7 PCDs to estimate the Q_{MED} value at the site location. The equation is shown below, and the parameters used are listed in Table 6-1.

$$Q_{MED} = 1.237\times10^{-5}\ AREA^{0.937}\ BFIsoils^{-0.922}\ SAAR^{1.306}\ FARL^{2.21}\ {}^{7}DRAIND^{0.341}\ S1085^{0.185}\ (1+ARTDRAIN2)^{0.408}$$

An OPW gauging station (19001) is located approximately 3m downstream of Ballea Bridge Upper and 2750m upstream from the site location. The station is a crumped weir of 7.74m width and lower crest elevation of 8.56m AOD. The station has been used as a Pivotal site to adjust the estimated flows at the site location and reduce the inherent error of the 7-variable equation.

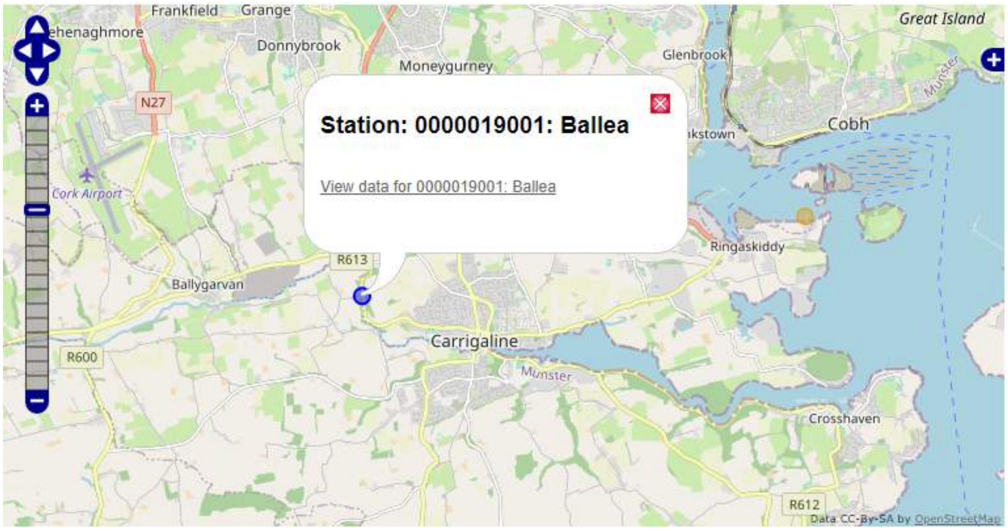

Figure 11: Location of Ballea bridge gauging station in relation to Carrigaline

The 7-variable equation was used to estimate the $Q_{MED(PCD)}$ at the Pivotal site. The PCDs at the site location and the Pivotal site, as well as the estimated $Q_{MED\ (PCD)}$ values are shown in Table 6-1. The catchments at the two locations are shown in Figure 12.

Table 6-1: Flow calculations on Owenboy River

FSU Physical Catchment Descriptors	Owenboy at site	Pivotal site (Ballea bridge upper)
Location number	19_1968_3	19_731_3
Catchment area	115.63 km^2	103.292 km^2
BFISOIL	0.657	0.6399
FARL	1	1
SAAR	1171.05 mm	1175.67 mm
DRAIND	1.064 km/km^2	1.036 km/km^2
S1085	2.7136 m/km^2	3.7507 m/km^2
ARTDRAIN2	0	0
URBEXT	0.0201	0.019
$Q_{MED\ (PCD\ rural)}$	19.5256 m^3/s	19.0341 m^3/s
$Q_{MED\ (PCD\ urban)}$	20.11 m^3/s	19.5725 m^3/s

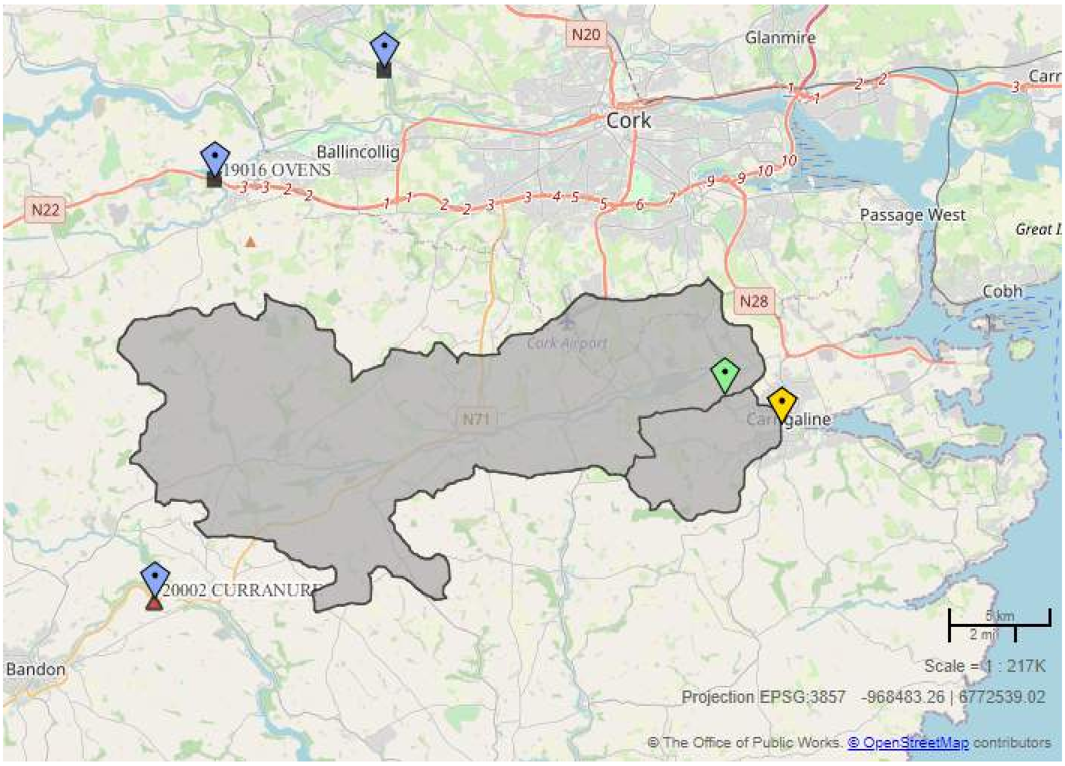

Figure 12: Site location and Pivotal site catchments

Annual Maxima records (AMAX) from Ballea Bridge Gauging station from 1974 were obtained from https://waterlevel.ie/hydro-data and the gauged Q_{MED} was calculated. A table with the AMAX can be found in Appendix C. The adjustment factor between the Q_{MED} as calculated using the 7-variable equation and the gauged Q_{MED} was used to adjust the Site Q_{MED}.

Parameter	Values
Pivotal site $Q_{MED\ (PCD\ urban)}$	19.5725 m^3/s
Pivotal site $Q_{MED\ (gauged)}$	28.9 m^3/s
Adjustment factor	1.4765
Site $Q_{MED\ (PCD\ urban)}$	20.11 m^3/s
Site $Q_{MED\ (adjusted)}$	29.69 m^3/s

6.1.2 Growth Curve Derivation

Although the Ballea Bridge gauging station is suitable for estimation of the QMED, the station does not have sufficient record of data to allow an estimation of the 1 in 100-year flood event. Therefore, a pooling group analysis was undertaken with a dataset of approximately 500 years of recorded data to allow for a better estimate. The online FSU application was used to perform this analysis.

The pooling group analysis was based on Euclidian distance of the stations with the site (the hydrological similarity of the stations to the site based on PCDs). All chosen stations have a Euclidian distance of less than 1, indicating high similarity. A list of the stations used is presented in Table 6-2.

Table 6-2: Pooling group analysis

Station	Euclidean DIST(ij)	Number of years in FSU database	Cumulative number of station-years
19020	0.359	28	28
19016	0.499	11	39
19015	0.542	28	67
25038	0.551	17	84
19046	0.565	9	93
25044	0.579	40	133
16006	0.675	33	166
29001	0.699	40	206
6012	0.723	47	253
34011	0.75	30	283
26014	0.769	16	299
16005	0.777	30	329
26018	0.79	48	377
25027	0.793	42	419
30021	0.817	26	445
26010	0.821	35	480
29071	0.83	26	**506**

Two and three parameter distributions were compared to assess which distribution best fits the pooling group data. The Lee CFRAMs recommended the use of GEV as the best fit curve for return periods less than 50 years based on a pooled group analysis based on the FEH methodology (as the FSU method was not still available) and the FSR method for flows greater than a 50-year return period. The GEV is still considered valid for our pooling group. However, we noted that the GEV is concave downwards slightly underestimating the design flows. Therefore, for conservatism, the EV1 distribution was adopted and used to produce the growth curve for the site.

The resulting growth curve factors and flood frequency curve at the site location for a series of return periods is shown in Table 6-3 and Figure 13 below.

Table 6-3: Growth curve factors and design flows

Return period (years)	Growth Factors	Design Peak Flows (m^3/s)
1.3	0.82	24.48
2	1.00	29.69
5	1.27	37.58
10	1.44	42.80

Return period (years)	Growth Factors	Design Peak Flows (m^3/s)
20	1.61	47.81
30	1.71	50.69
50	1.83	54.30
100	1.99	59.15
200	2.16	64.00
500	2.37	70.38
1000	2.53	75.21

Figure 13: Flood frequency curve for Carrigaline site

6.1.3 Flood Hydrograph

Time varying hydrographs have been produced to represent a realistic flood event. Records from the historic November 2009 event at Ballea gauging station has been used and scaled proportionally to the estimated peak flows for each event.

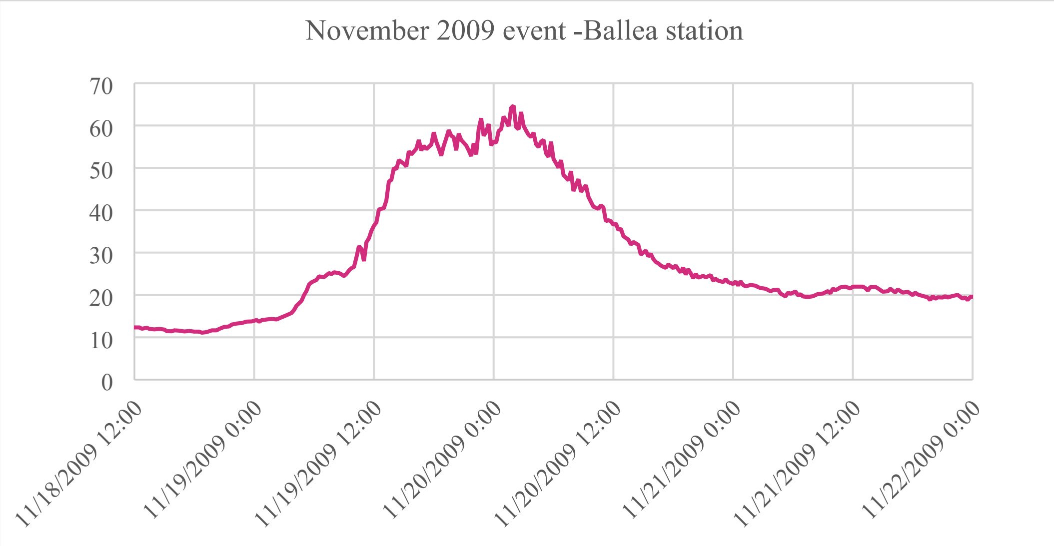

Figure 14: Ballea gauging station records - November 2009 flood event

The hydrographs for each event at the site location are shown in Figure 15.

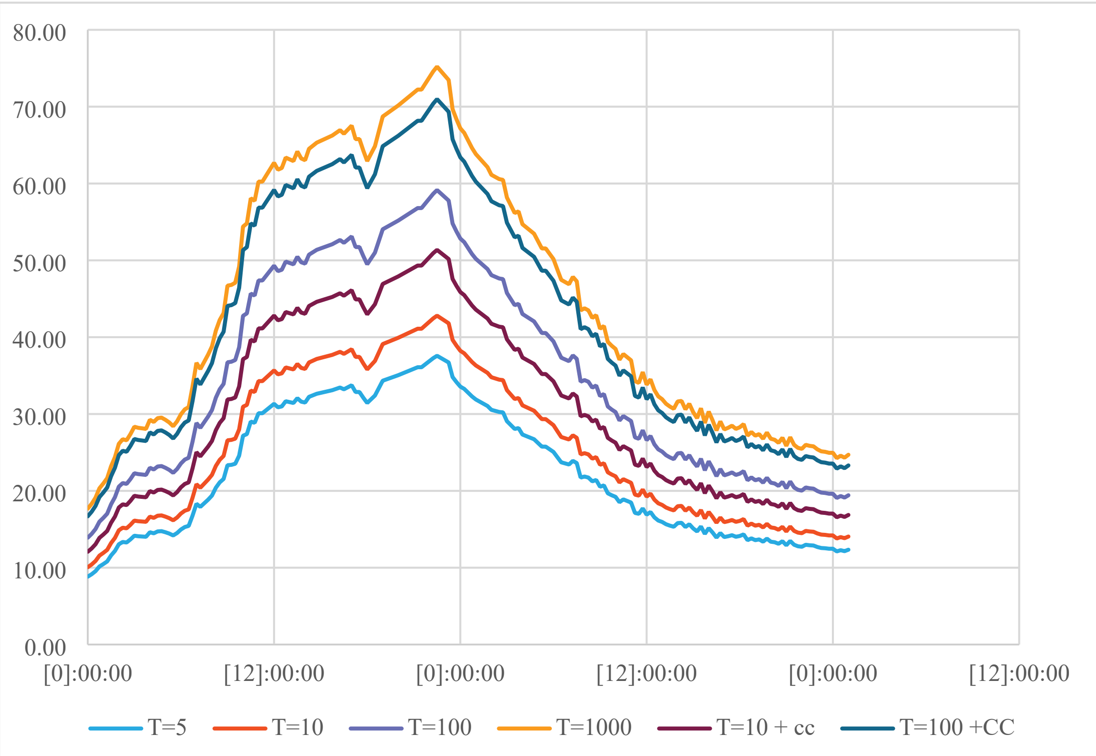

Figure 15: Design hydrographs (return period in years)

6.1.4 Coastal Tidal Boundary

The tidal boundary condition of the hydraulic model for the design runs has been set as a tidal curve within the Owenboy Estuary. The tidal curve has been created using information from the Lee CFRAM Studies and the closest tidal gauging station in Ringaskiddy NMCI (Station number 19069).

The extreme value tidal analysis undertaken as part of the Lee CFRAM Study has been used to set the peak water levels at the downstream boundary in the Owenboy estuary. The values are taken from CFRAM model at node 1BOY_0 and have been applied at the same location in the new model created for the purposes of this FRA. The peak tidal values used are shown in Table 6-4.

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Table 6-4: Peak tidal levels (Lee CFRAM study)

Event (AEP % – return period)	Tidal level (CFRAM node 1BOY_0)
MHWS	1.93m AOD
2% - 1 in 50-year event	2.63m AOD
0.5% - 1 in 200-year event	2.77m AOD
0.1% - 1 in 1000-year event	2.93m AOD
Climate change scenarios	
MHWS CC – MHWS + 0.5m	2.43m AOD
0.5% CC - 1 in 200-year event + 0.5m	3.27m AOD

The closest gauging station is located at Ringaskiddy NMCI, 5km away from the site and outside the Owenboy estuary. Recorded tidal water levels from the station were obtained from waterlevel.ie and were used to define the shape of the tidal curve. Records of data are only available from 2012 to present. The most extreme tidal event was identified as the 03/04 February 2014 tidal event. The curves from that event for the duration of the modelling simulation were extracted, as shown in Figure 16.

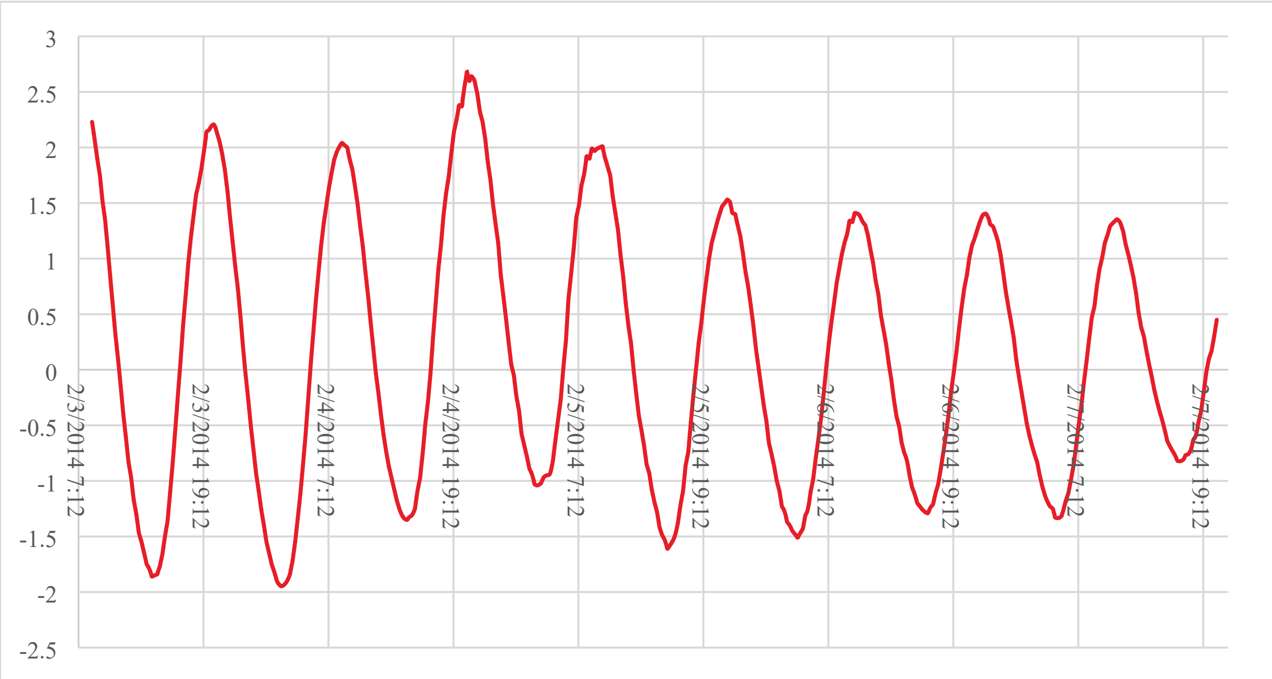


Figure 16: Tidal curve from Ringaskiddy NMCI gauging station (19069) during the February 2014 tidal event

As the design water levels in the outer harbour are different from the levels in the Owenboy Estuary, the tidal curves were adjusted by uplifting the peak levels of the tidal curve to match the Lee CFRAM levels above. The curves are shown in Figure 17.

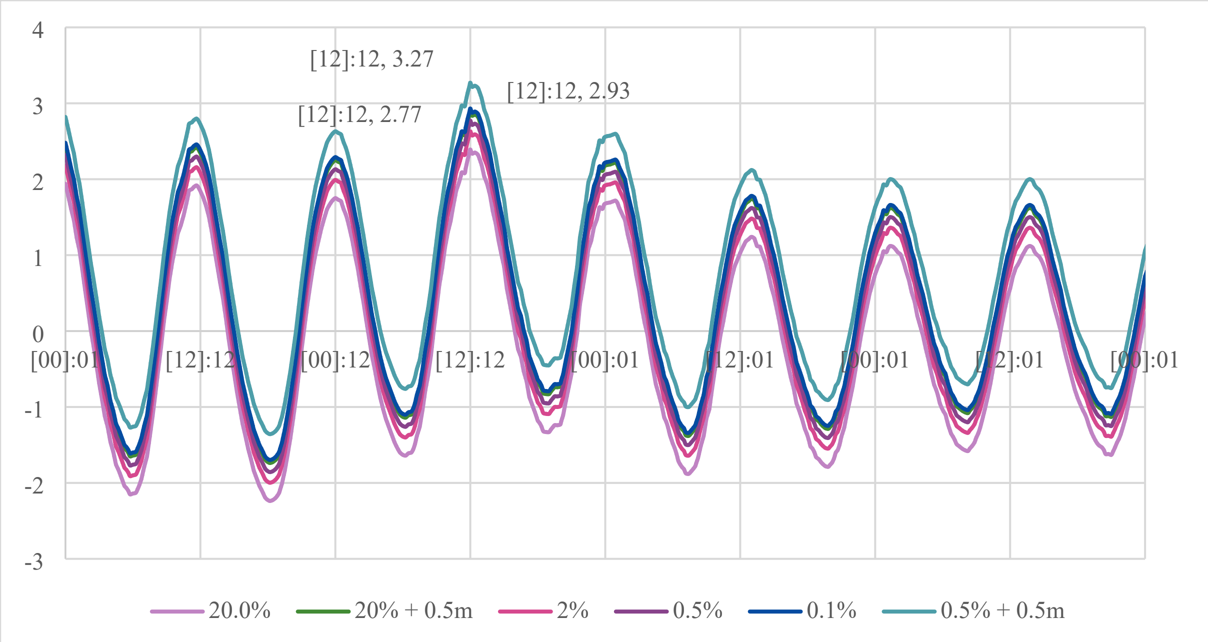


Figure 17: Tidal curves for Owenboy Estuary for the modelled flood events

6.1.5 Climate Change Considerations

Future climate change is predicted to result in several effects, including more extreme rainfall, more severe floods, and an increase in mean sea level.

Current OPW guidance on climate change for flood risk management defines two possible future scenarios of varying severity, with an equivalent allowance for increase in flows:

- Mid-range future scenario (MRFS) – 20% increase in fluvial flows and 0.5m increase in sea level rise
- High-end future scenario (HEFS) – 30% increase in fluvial flows and 1m increase in sea level rise.

In accordance with the Cord County Development Plan SFRA, the allowances for the MRFS apply for less vulnerable and highly vulnerable development. As such, the MRFS scenario has been included in the analysis to estimate appropriate finished floor levels and assess residual risks.

6.1.6 Joint Probability Assessment

A joint probability analysis between the tidal and fluvial events was carried out as part of the Lee CFRAM study. The CFRAM analysis was based on an application of the "Joint Probability – Dependence Mapping and Best Practice (2006)" by UK DEFRA, using assumptions about the dependence of tidal/fluvial floods in the Lee catchment. The combinations were then acknowledged to be conservative and are shown in Figure 18.

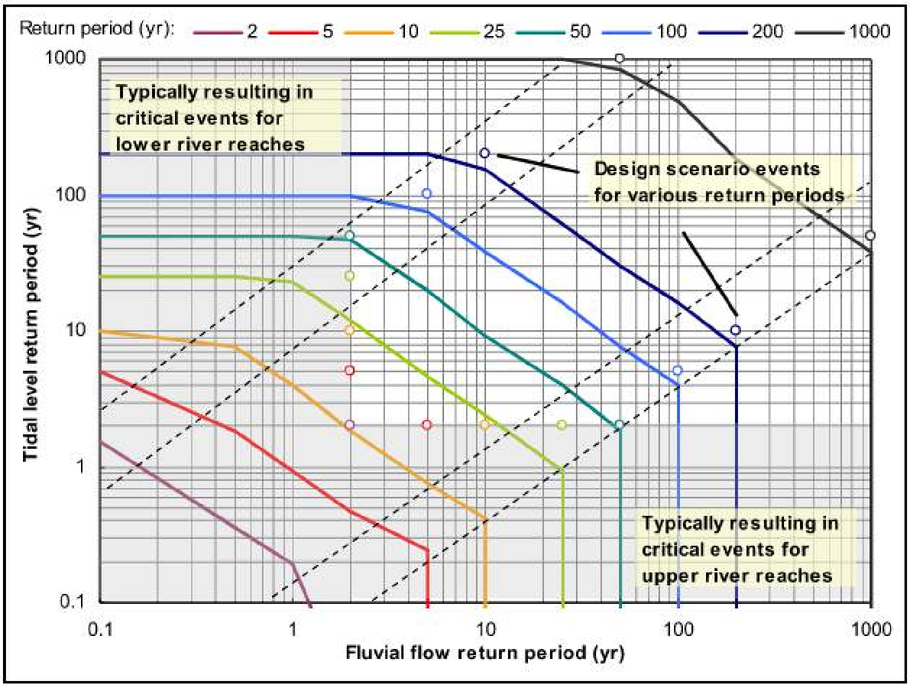


Figure 18: Joint probability combinations explored in the Lee CFRAM study

The proposed joint probability combinations for this FRA are shown below and form six scenarios that modelling has been done for the purposes of the FRA. The peak flows and peak tidal levels applied under each scenario are also included in Table 6-5.

Table 6-5: Design fluvial and tidal joint probability scenarios

Scenario	Design event	Purpose	Fluvial (AEP)	Tidal (AEP)	Upstream flow (m^3/s)	Tidal level boundary (m AOD)
1	1% Fluvial	Flood Zone definition	1%	MHWS	59.15 m3/s	1.93 m AOD
2	1% Fluvial MRFS	Design levels	1% + 20%CC uplift	MHWS +0.5m sea level rise	70.98 m3/s	2.43 m AOD
3	0.5% Tidal	Flood Zone definition	10%	0.5%	42.8 m3/s	2.77 m AOD
4	0.5% Tidal MRFS	Design levels	10% + 20%CC uplift	0.5% +0.5m sea level rise	51.36 m3/s	3.27 m AOD
5	0.1% Fluvial	Flood Zone definition	0.1%	2%	75.21 m3/s	2.63 m AOD
6	0.1% Tidal	Flood Zone definition	2%	0.1%	54.3 m3/s	2.93 m AOD

6.2 Baseline Hydraulic Modelling

A combined 1D-2D model was built using MIKE FLOOD Flexible Mesh (MIKE FLOOD FM) software, by DHI. The 1D domain was represented in MIKE 11 and its hydrodynamic module was used to simulate river flows and water levels in the Owenboy River. A 2D model was created in MIKE21 to model the floodplain.

The domain of the model was chosen to focus on the area of interest, i.e., the proposed development site. The extent of the model domain is presented in Figure 19, shown by the yellow line, including the proposed development site which is outlined in red.

Figure 19: Hydraulic model extent

This section of the report details the model development and presents results from the design model runs.

6.2.1 Available Data

6.2.1.1 River survey

A section of the Owenboy River channel was surveyed by Murphy's Surveys Ltd. in August 2021 and was used to build the 1D part of the model. This survey included 50 cross-sections of the river and floodplain, from the Carrigaline United AFC sports grounds, through Carrigaline town and into the river estuary. The locations of the cross-sections from the survey are shown below in Figure 20 in blue (the extent of the 1D-2D model can be seen in yellow, with the development site outlined in red).

Two road crossing bridges (R611 and R612) in Carrigaline were also surveyed as part of the river channel survey completed by Murphy's Surveys in August 2021 and relevant river channel and bridge geometric information were recorded.

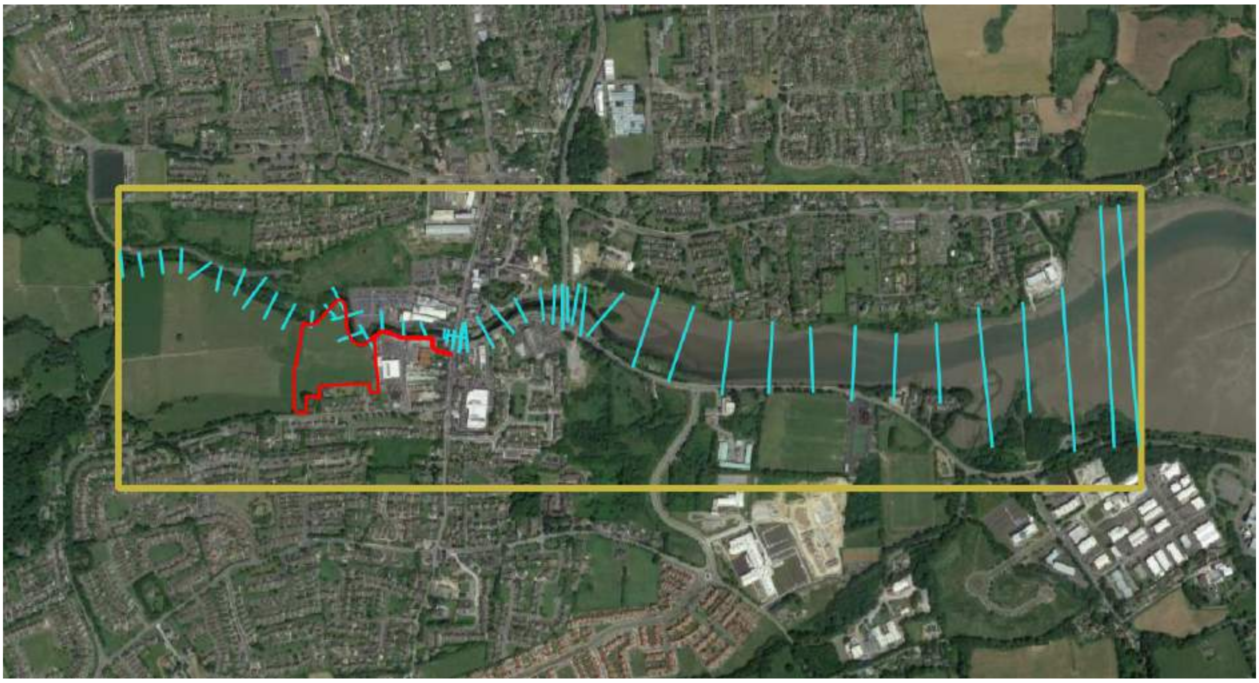


Figure 20: Cross-section location of river channel survey

6.2.1.2 *Topographic surveys*

A topographic survey of the site was completed in December 2020 by Precise Control. The survey was not directly used in the model build as it only covers a small part of the study area, however it was used to inform the model and calibrate the OSi Lidar data.

A topographic survey undertaken for the purposes of the Western Relief Road was also made available and was used to validate the adjustments required to the Lidar Data.

6.2.1.3 *OSi Lidar data*

Lidar data were purchased from Ordnance Survey Ireland (OSi). This data was captured in 2006 at a 2m horizontal resolution and 0.25m vertical accuracy. This LiDAR dataset was compared to the site topographic survey and the Western Relief Road survey using point sampling using a GIS software. The ground level values from the LiDAR dataset were found to be approximately 0.5m higher than the levels recorded by the topographic surveys. As such, the LiDAR dataset was reduced by 0.5m to adjust for this difference before being used in the hydraulic model.

6.2.1.4 *Western relief road proposals*

The Western Relief Road is currently under construction and the construction drawings were made available. The road is planned to finish ahead of the development being constructed and as such the proposals have been represented in the model as part of the Baseline hydraulic model (existing condition).

The works with a potential to impact on the flood mechanism consists of the proposed road elevated on an embankment along the western boundary of the development site, the new road bridge over the river immediately upstream of the site boundary, and a foul pumping station and access road within the development boundary. The proposals are shown in Figure 21

Figure 21: Western Relief Road work extents

6.2.2 Model schematisation

As described above, a combined 1D-2D model was built using MIKE FLOOD Flexible Mesh (MIKE FLOOD FM) software, by DHI. The Baseline model was developed using data sources described below.

The 1D domain was represented in MIKE 11 using the river channel cross-sections obtained through the August 2021 survey completed by Murphy's Surveys Ltd. These sections were interpolated in MIKE11 to generate the river channel in the 1D model.

Three bridges on the river were included in the 1D model, as these bridges were deemed to impact on the hydrodynamics of the watercourse by obstructing the flow and adding head losses. The two existing bridges mentioned above were modelled using the details and cross-sections provided by the August 2021 River channel survey. A third bridge and accompanying roadway immediately upstream of the site were also included in the model. This bridge and roadway were under construction at the time of the river channel survey and were therefore not included in the cross-sections provided. This new bridge was represented in the Baseline model using "For Construction" drawings provided by Mott McDonald, dated March 2021. All three bridges were modelled as culverts, with a weir above to represent the bridge deck and allow flow over the top of the bridge.

A 2D model was created in MIKE21 to model the floodplain. The mesh used in the 2D model was created using the LiDAR dataset obtained from Ordnance Survey Ireland (OSi) and adjusted to the site topographic data, as explained in Section 6.2.1.2.

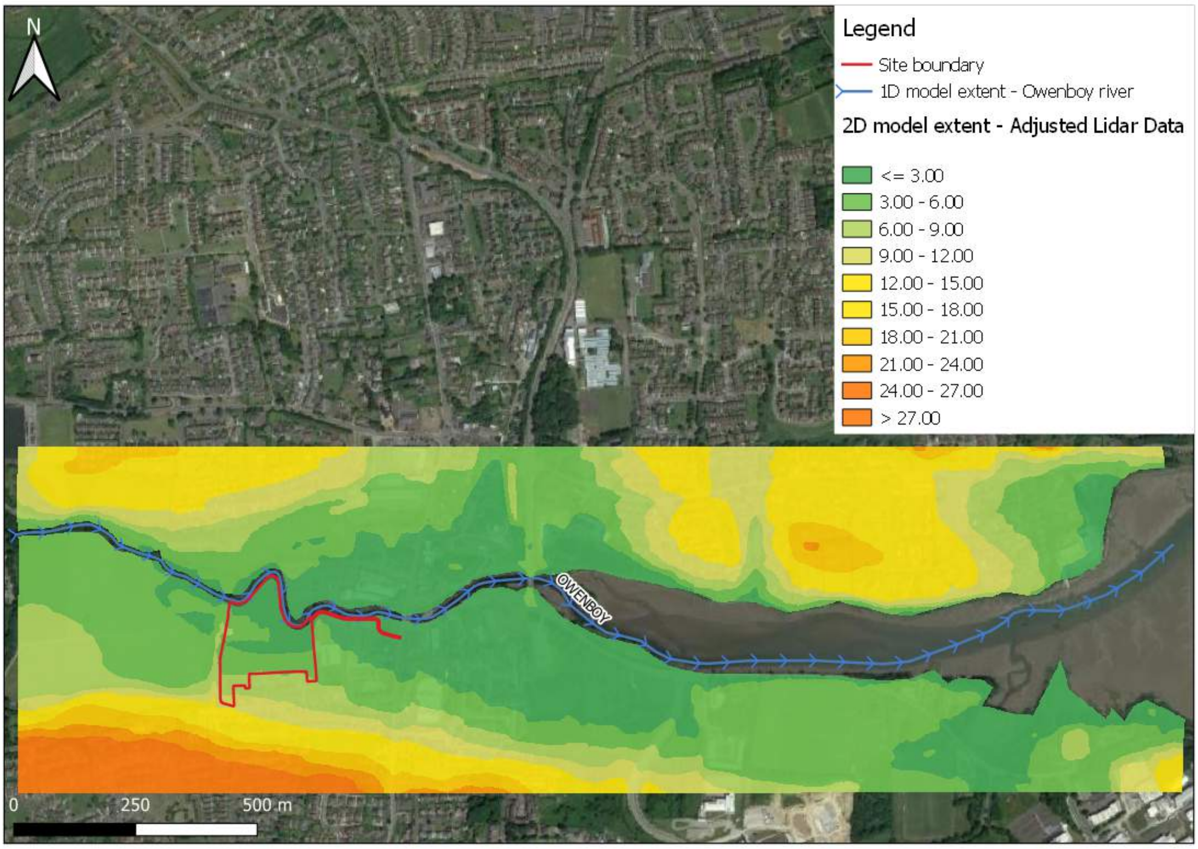


Figure 22: 1D and 2D model extents

The 2D model resolution was set by the area of the triangular mesh elements of the 2D model grid. As the model was a flexible mesh model, the resolution varied throughout the domain. A high resolution was set for the area of interest, while the rest of the model area was set to a slightly lower resolution. The model cell size was typically 30m^2 in open areas and reduced to circa 6m^2 in areas where more detail was required.

The Manning's values used in the model for the floodplain were selected based on standard values in the literature matching as closely as possible the description of the river channel and floodplain and Arup's extensive experience in hydraulic modelling. Buildings were accounted for by applying a low Manning's "M" value (10) to the grid cells which form part of the building footprint. Representing the buildings in this manner allowed for flow paths through the buildings to be simulated and storage volume within the buildings to be accounted for, while simultaneously ensuring that the reduction in flow and velocity caused by the fabric of the building is represented. A higher Manning's "M" value (50) was applied to roads and carparks to allow greater conveyance of water.

The hydrographs calculated as part of this study (shown in Figure 15, Section 6.1.3) were used as the upstream flow boundary conditions for the model. The downstream water level boundary of the model was informed by extreme tidal levels from the Lee CFRAM study and the closest tidal gauging station at Ringaskiddy NMCI. The tidal curves used are shown in Figure 17.

6.2.3 Model Calibration

The model was not calibrated against recorded data due to a lack of a suitable historic flood data at the site. The accuracy of the model however was ensured by following best practice in the model build and adopting standard values of model parameters from literature.

Verification of the model was undertaken. The Arup model was run with the design flows used for the CFRAM studies. The extents produced by the CFRAM studies are compared with the validation run extents in Figure 23 and Figure 24.

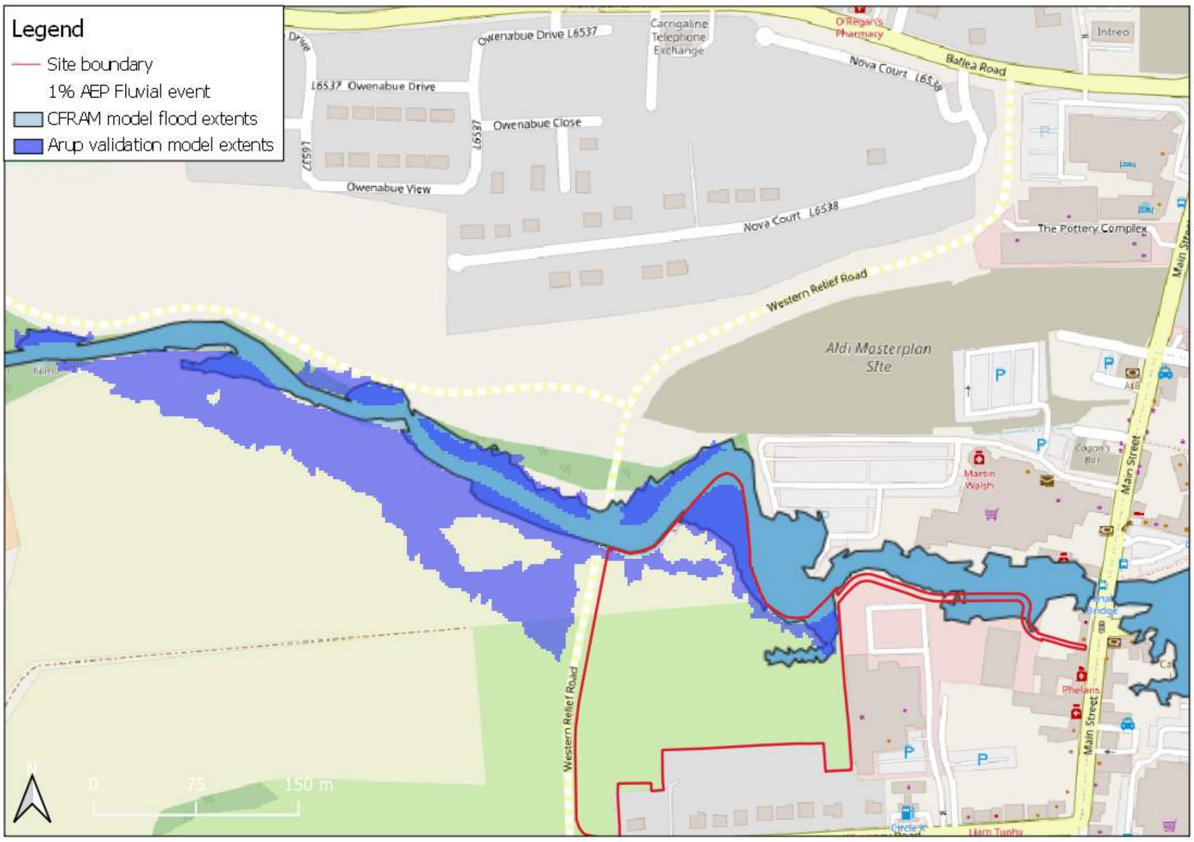


Figure 23: 1% AEP Fluvial event – validation run

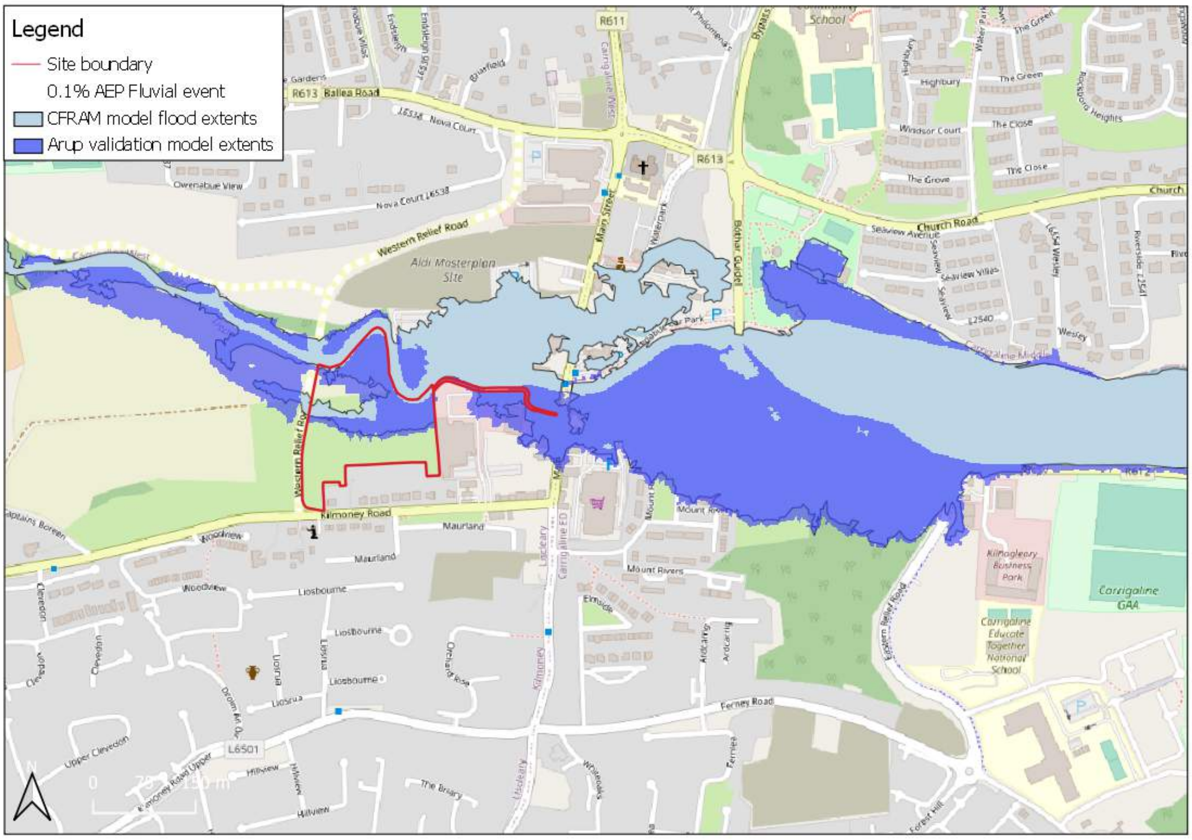


Figure 24: 0.1% AEP Fluvial event - validation run

It is noted that the flood extents at the right bank upstream of the site are larger than estimated by the CFRAM studies. This is believed to be due to the lower ground level used during the CFRAM study at the location. There is very good correlation between the flood extents on the right bank downstream of the site for both the 1% and 0.1% AEP.

The extents of flooding northeast of the site on the left bank are estimated much smaller by the Arup model. More detailed topographic data were available for the SuperValu Car park, which showed the topographic levels to be higher than the Arup modelled flood levels, or the CFRAM flood levels.

The flood levels for the 1% AEP are within 150mm between the CFRAM studies and the Arup validation runs, and up to 200mm for the 0.1% AEP. This generally shows good agreement between the two models.

Comparisons were also made between the Arup final design runs (with update hydrology) and the flood extents derived by the CFRAM studies. These are presented in the following section. The extents were not significantly different outside the site. Within the redline boundary, the differences in flood extents between the CFRAM and the Arup study were as a result of the increase in design flows, updates in the topographic information, the inclusion of the Western Relief Road and pump station. Therefore, the model developed was used for predicting flood levels with the updated design flows and topography.

6.2.4 Baseline Model Results

A series of fluvial and tidal events were modelled for the Baseline scenario. These are described under Table 6-5 and the results from these events are presented below. Flood levels within the site during these events are also shown in Table 6-6.

The 1% AEP and 0.1% AEP fluvial flood events and the 0.5% and 0.1% AEP tidal flood events were simulated to produce flood extents and re-define the flood zones near the site. These are compared with the CFRAM extents in the figures below.

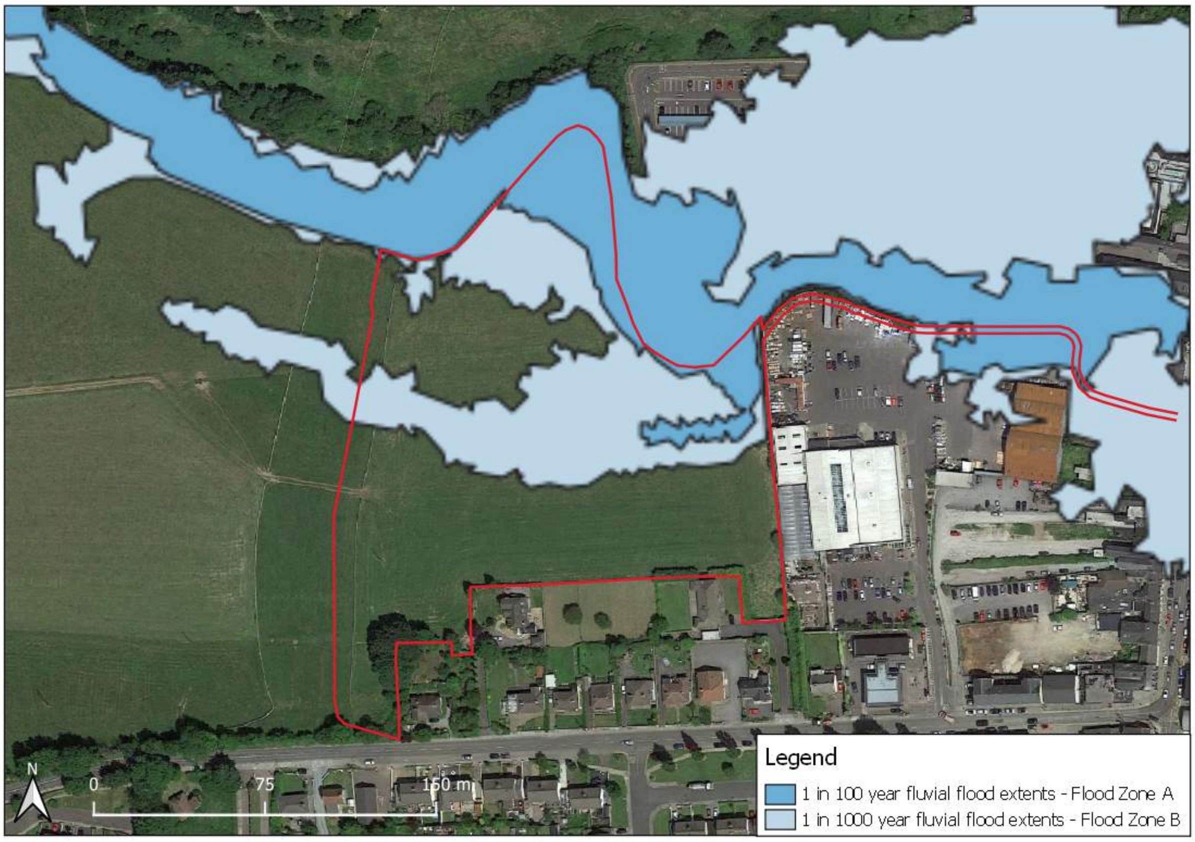


Figure 25: CFRAM fluvial flood extents. 1% AEP (1 in 100 year) and 0.1% AEP (1 in 1000 year) events (Flood Zones A and B)

Figure 26: Arup model Baseline fluvial flood extents. 1% AEP (1 in 100 year) and 0.1% AEP (1 in 1000 year) events (Flood Zones A and B)

The fluvial flood extents for the 1% AEP within the site are significantly larger than the extents shown by the Lee CFRAM study, see Figure 26 and Figure 28. This is due to the revised hydrological analysis resulting in much larger flows for the 1% AEP event (CFRAM flow of 38.4m^3/s compared to the Arup model flow of 59.15m^3/s). The flood levels within the site responded to the increase in flows, with levels near the site increasing from 2.88m AOD under CFRAMS (Node 1BOY_2020), to 3.01m AOD under this study (see Chainage 350,Table 6-6).

For the 0.1% AEP, the flow has increased from 49.04m^3/s in CRFAM to 75.21m^3/s in the Arup analysis and the levels corresponding to this change were from 3.13m AOD to 3.30m AOD, respectively. These levels mostly impacted the central part of the site where the topography is very steep and hence changes in level did not necessarily result in proportional change in extents.

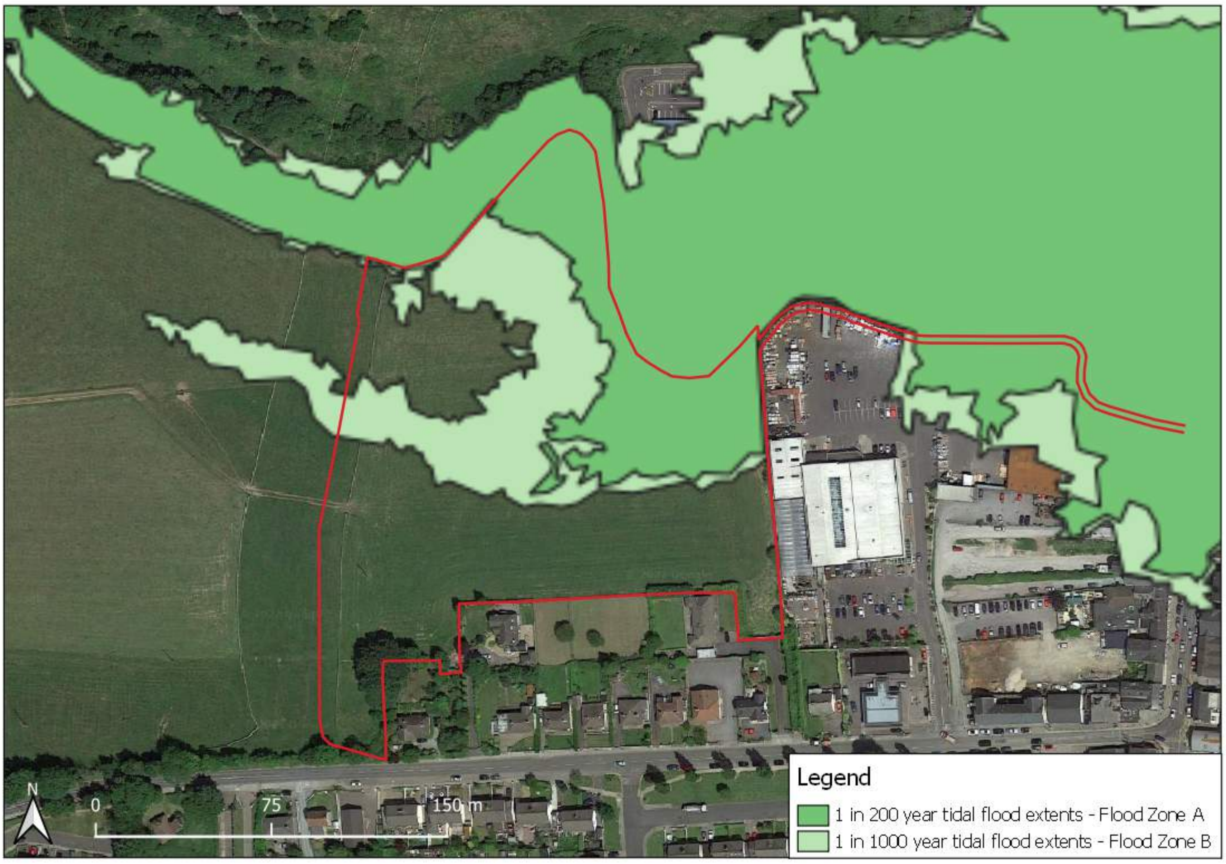


Figure 27: CFRAM tidal flood extents. 0.5% AEP (1 in 200 year) and 0.1% AEP (1 in 1000 year) events (Flood Zones A and B)

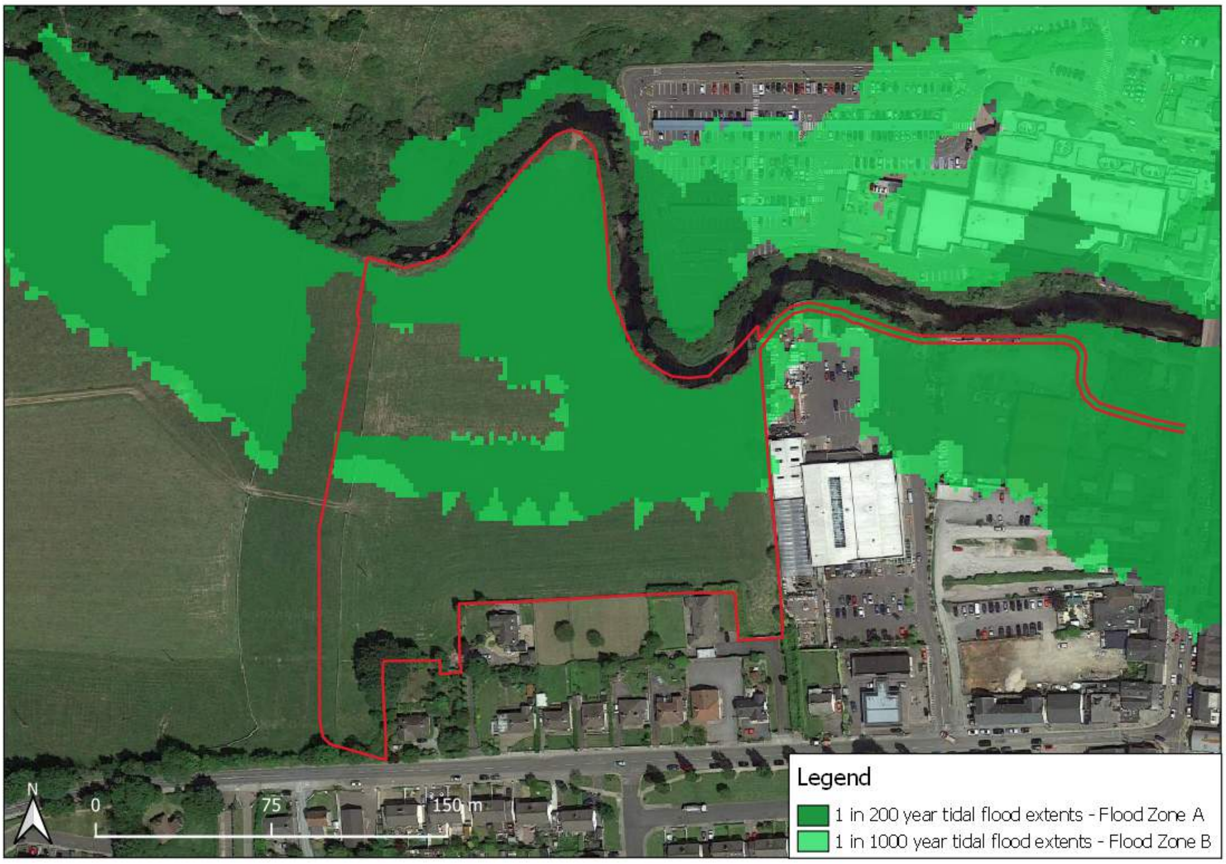


Figure 28: Arup model Baseline tidal flood extents. 0.5% AEP (1 in 200 year) and 0.1% AEP (1 in 1000 year) events (Flood Zones A and B)

The tidal flood extent for the 0.5% AEP event is larger than shown in the CFRAM studies, see Figure 27 and Figure 28. The tidal inputs are the same between the CFRAM and the Arup studies and the flood levels near the site for the 0.5% AEP correspond to that (CFRAM: 2.98m AOD, Arup model: 3.02m AOD). The changes in extent are mainly in the northern low-lying area near the river and are attributed to the revised topography of the site, which was calibrated to site specific topographic survey data.

There are no significant changes in the flood extents during the 0.1% AEP tidal event, with the flood levels changing from 3.16m AOD (CFRAM) to 3.20m AOD (Arup model). The flood extents do not change significantly due to the steepness of the site at these levels.

For all the above events, there were significant increases in flood extents in the areas directly west of the site boundary.

The 1% AEP fluvial and 0.5% AEP tidal Mid- Range Future Scenario (MRFS) were also modelled and are plotted for the area around the site in Figure 29.

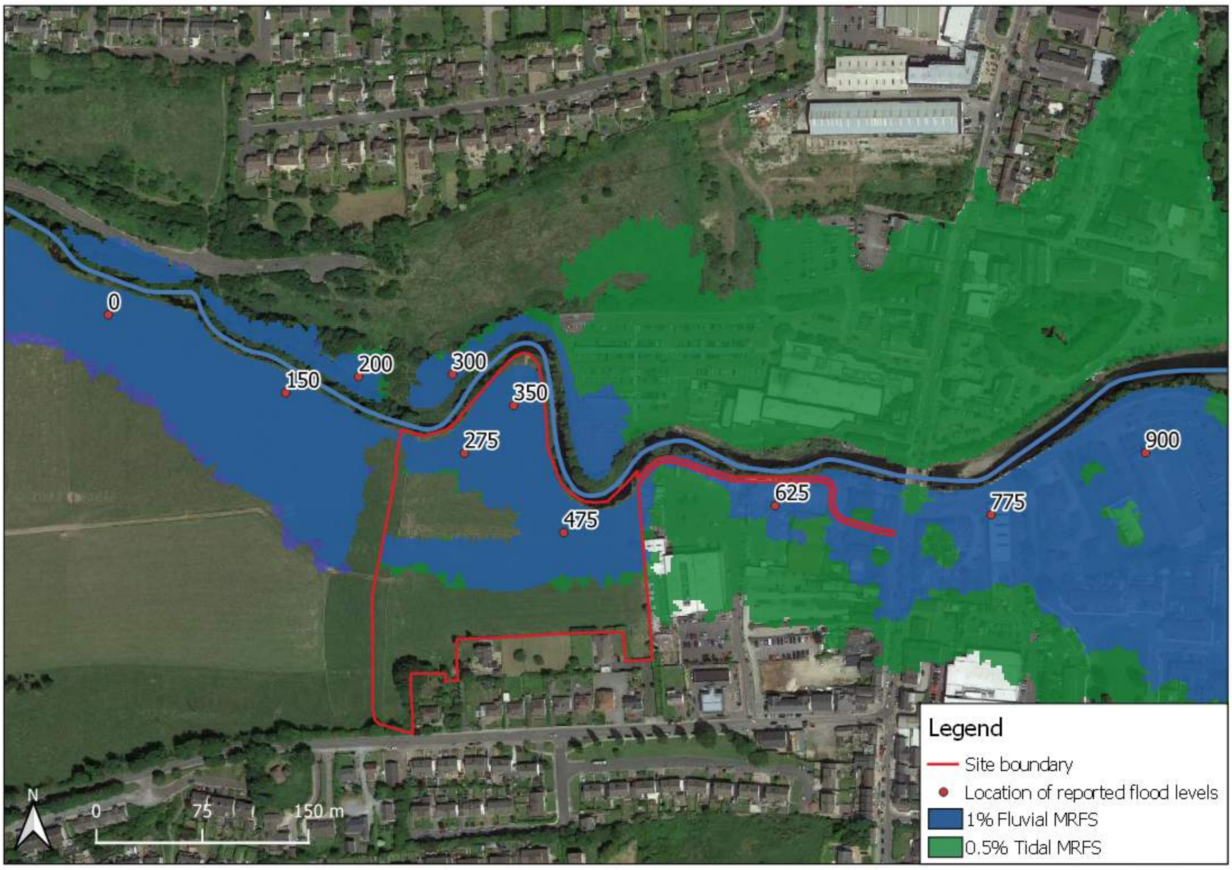


Figure 29:Baseline Mid-Range Future Scenario (MRFS) flood extents. 01% Fluvial MRFS and 0.5% AEP (1 in 200 year). Location of reporting points

Table 6-6: Baseline flood levels near the site for different flood events (maximum levels within site shown in bold)

Chainage (m)	1% Fluvial (m AOD)	1% Fluvial MRFS (m AOD)	0.5% Tidal (m AOD)	0.5% Tidal MRFS (m AOD)	0.1% Fluvial (m AOD)	0.1% Tidal (m AOD)
0	3.80	3.99	3.65	3.81	4.05	3.78
150	3.47	3.80	3.28	3.70	3.88	3.53
200	3.23	3.45	3.11	3.58	3.52	3.32

Chainage (m)	1% Fluvial (m AOD)	1% Fluvial MRFS (m AOD)	0.5% Tidal (m AOD)	0.5% Tidal MRFS (m AOD)	0.1% Fluvial (m AOD)	0.1% Tidal (m AOD)
275	3.01	3.23	3.01	**3.41**	3.29	3.20
300	3.04	3.27	3.04	3.44	3.33	3.23
350	3.01	3.23	3.02	**3.39**	3.30	3.20
475	2.91	3.13	2.97	**3.38**	3.21	3.16
625	2.31	2.46	2.82	3.32	2.79	2.98
775	1.76	2.18	2.80	3.31	2.70	2.96
900	No flooding	2.18	2.80	3.31	2.69	2.96

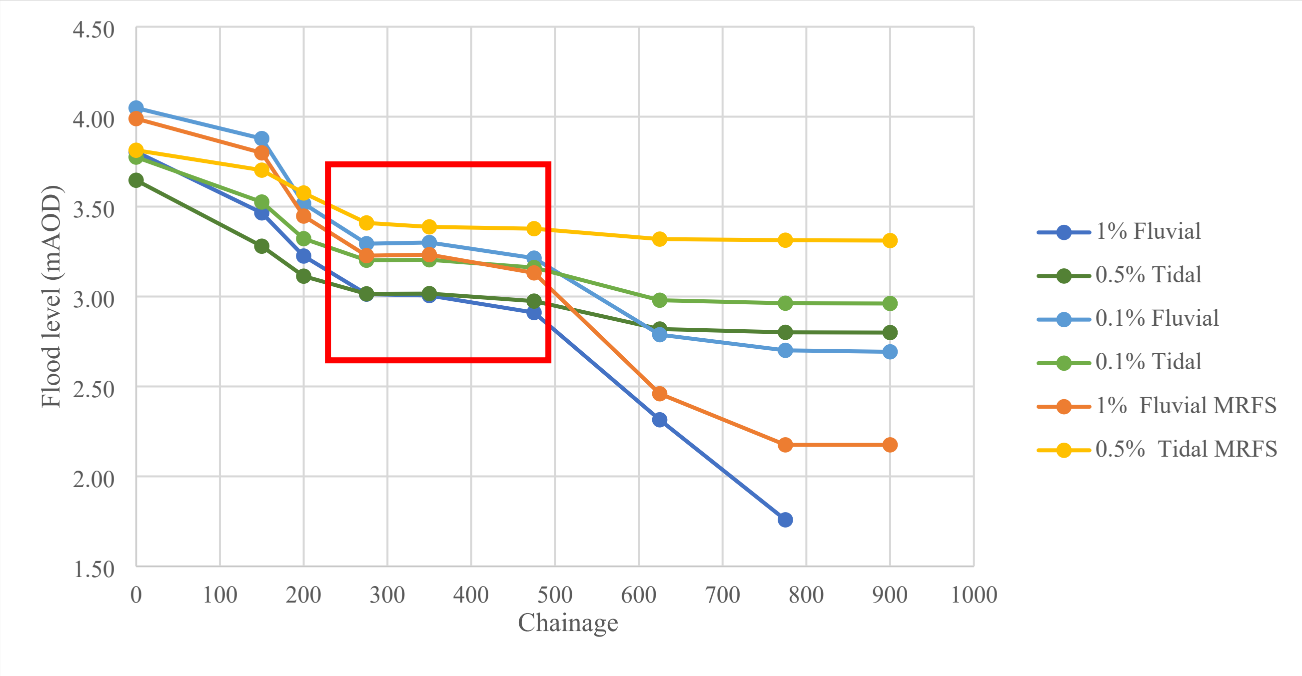


Figure 30: Flood levels upstream, on-site (in red box) and downstream the site for different flood events

Figure 30 demonstrated that the site is located at the point of transition between tidal dominance and fluvial dominance. It is noticeable that the transition between the two happens at different location depending on the event but occurs near the site between chainages 150m to 550m. The event that would result in the highest flood levels on site is the 0.5% MRFS Tidal event shown in yellow. This event will be used to set the flood protection levels for the development.

The two events that define the new Flood Zones for the site are:

- Flood Zone A: 0.5% tidal flood event (as it results in larger extents and higher levels than the 1% fluvial within the site extents)
- Flood Zone B: 0.1% fluvial flood event (as it results in larger extents and higher levels than the 0.1% tidal within the site extents).

6.3 Hydraulic Modelling of Development Proposals

6.3.1 With Scheme Hydraulic Model

The "With Development" model was based on the Baseline model as described in Section 6.2. In addition, the masterplan proposals have been added to assess the impact this could have onsite and offsite to upstream and downstream areas. The proposed road and building development are modelled as a raised ground above the proposed finished floor levels of 4.0m AOD.

The changes in flood extents due to the proposals during the 1% AEP fluvial flood event is shown in Figure 31. The raising of the proposed buildings and road to 4.0m AOD, resulted in a general reduction in flood extents within the site. The area where the buildings and road are proposed are now shown outside the flood extents. There is no increase in flood extents as a result of the development in the entire model domain.

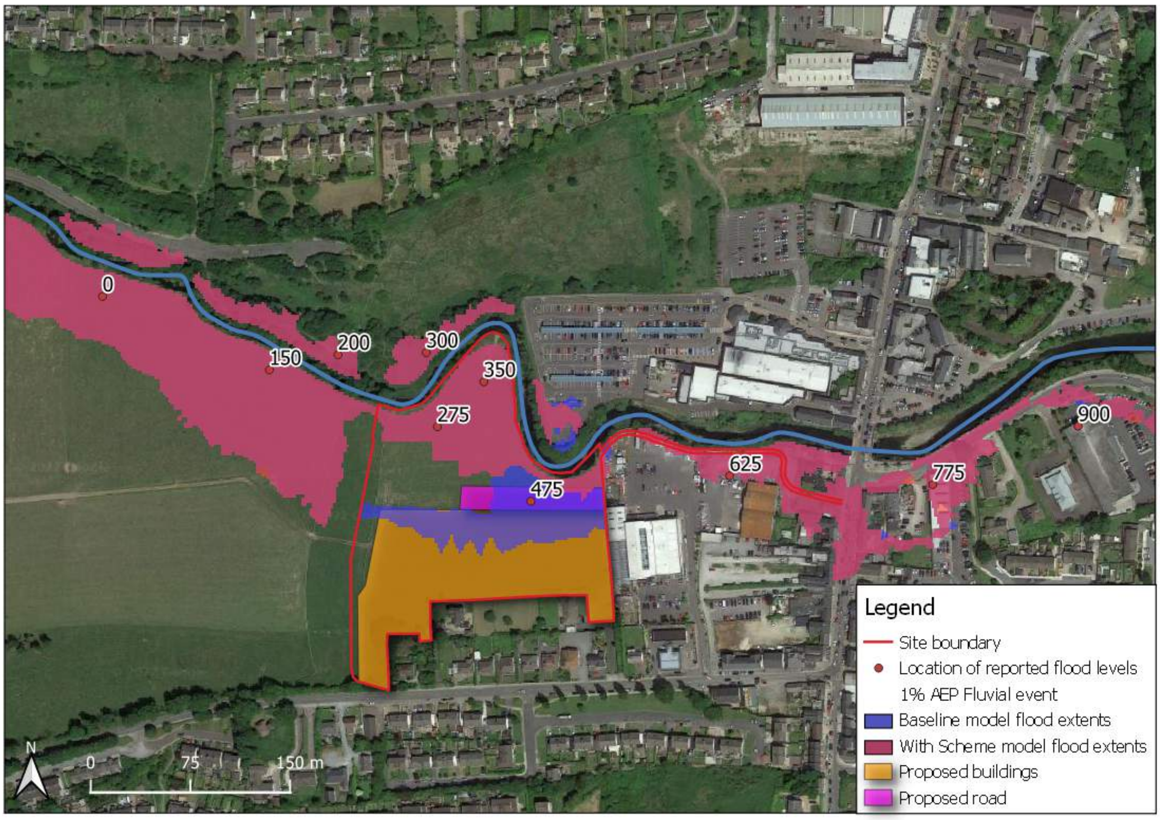


Figure 31: Flood extents during Baseline and With Development scenarios (1%AEP fluvial flood event)

6.3.2 Assessment of Offsite Impacts

A comparison of the changes in flood levels at the site vicinity are illustrated in Figure 32 and reported in Table 6-7.

The "With Development" model shows local increases in levels directly upstream the site of approximately 10-20mm. Across the site, at Ch.300m the increase in levels is up to 30mm. Within the site, flood levels increase by up to 93mm, with some local decreases at the north-eastern parts of up to 50mm. These changes in levels diminish at Chainage 0m (230m upstream of the site). There is no change in levels at downstream locations.

Changes in flood levels within the site are accommodated within the allowances made for the proposed finished floor levels, which have been set 970mm above the estimated "With Development" level for the 1% AEP event.

Figure 32: Changes in flood levels due to proposals 1% AEP (red shows increase, blue decrease)

Table 6-7: Flood level during the 1% AEP, Baseline and With Development

Chainage (m)	Baseline model - 1% Fluvial (m AOD)	With Development model - 1% Fluvial (m AOD)	Increase due to scheme (m)
0	3.80	3.80	0.00
150	3.47	3.48	0.01
200	3.23	3.25	0.02
275	3.01	3.04	0.03
300	3.04	3.06	0.02
350	3.01	3.03	0.02
475	2.91	No flooding	N/A
625	2.31	2.31	0.00
775	1.76	1.76	0.00
900	No flooding	No flooding	N/A

The above changes in flood levels and off-site impact are a result of uptake of flood volume within Flood Zone A (1% AEP fluvial extents) by the proposed development. Level-for-level compensation is proposed to be provided within the site to accommodate the displaced volumes and ensure there is no negative impact from the development to the flood regime off site.

6.3.3 Impact on Flood Storage

The floodplain volumes removed from Flood Zone A due to the proposed development were calculated on a 100mm interval and are presented in Table 6-8.

Table 6-8: Flood volume removed from Flood Zone A due to proposals

Level increment (m AOD)	Flood volumes lost due to development (m^3)
2.8 - 2.9	528
2.7-2.8	482
2.6-2.7	420
2.5-2.6	354
2.4-2.5	174
2.3-2.4	60
2.2-2.3	16
2.1-2.2	0
Total	**2035**

These volumes will be provided as level-for-level compensation in storage crates underneath the new proposed road and car parking areas to ensure all flood compensation is provided for the flood storage removed by the proposals.

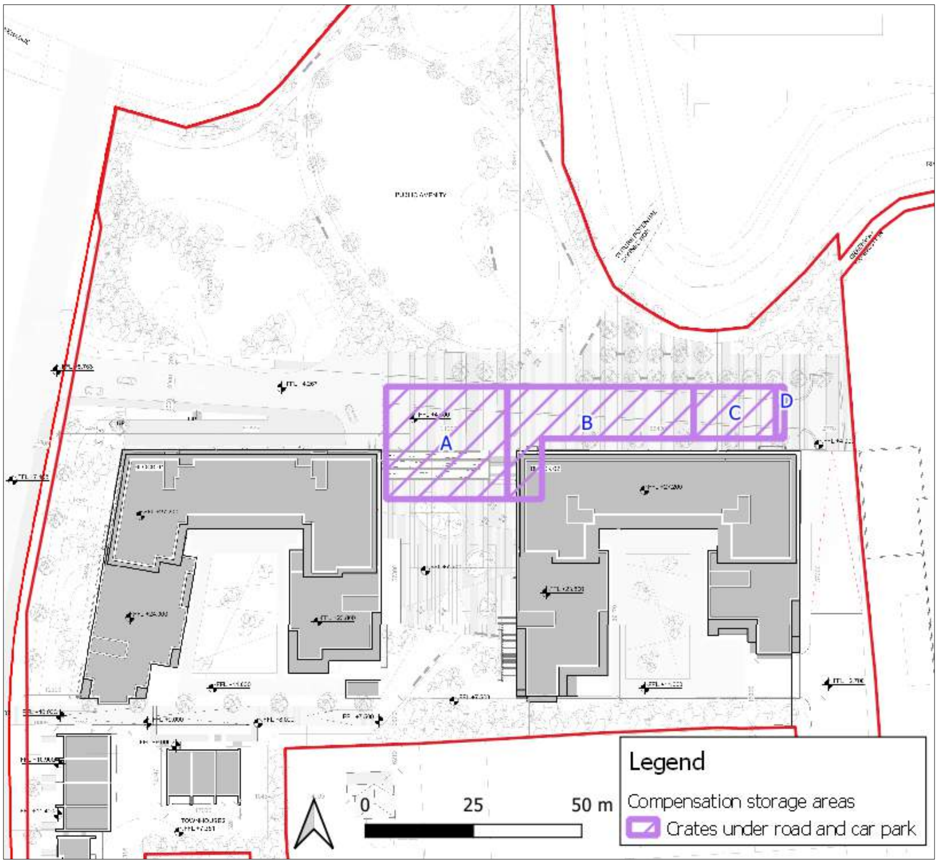


Figure 33: Flood compensation storage areas

The storage crates will be sized to accommodate the above volumes and designed to allow water in, only when the flood levels reach the correct level at which compensation should be provided. The storage crates will utilise a long inlet parallel to the access road and facing the park at the relevant level, at which the water can weir into the crate. An outlet will be provided at 1.2m AOD to discharge the water to the river when the river levels recede. The outlet will be designed to drain down within 12 hours. Figure 34 shows a cross section of the storage crates.

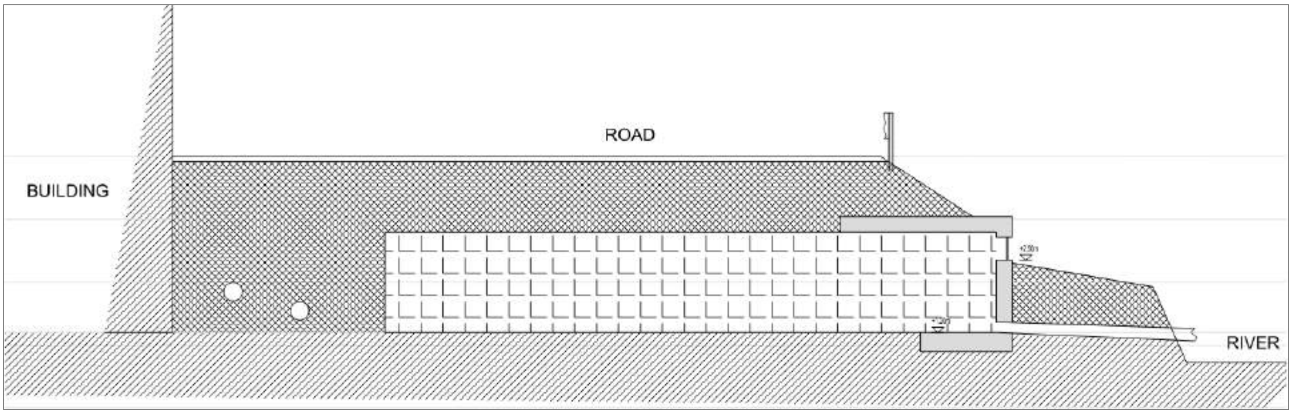


Figure 34: Cross section of the flood compensation storage under the proposed road, showing weir inlet, crates and outlet to river

There are 4no. separate tanks proposed for the purposes of flood compensation, which will provide storage at 200mm increments. It was not considered practical to provide 8 separate tanks to provide storage at 100mm increments. The storage tanks, weir crest levels and volumes are shown in Table 6-9.

Table 6-9: Design of storage crates under proposed road

Compensation increment	Crates under road	Volume (m^3)	Weir level (m AOD)	Effective crate volume (95%, m^3)	Depth of crate to IL of 1.2m (m)	Area (m2)
2.7 - 2.9	Crate A	1010	2.7	1063	1.5	709
2.5-2.7	Crate B	774	2.5	814	1.3	627
2.3-2.5	Crate C	235	2.3	247	1.1	225
2.1-2.3	Crate D	16	2.1	17	0.9	19
Total volume in crates		**2035m^3**				1579m^2

The option of providing flood compensation in the open areas of the park is also considered as an alternative. This would entail lowering the park levels to 2.5m AOD and would accommodate up to 800m^3 of water, thereby reducing the size and extent of the storage crates under the proposed road. The provision of storage at the park area could be compromised in the presence of shallow groundwater levels. The solution will therefore be considered further during design development if groundwater levels are found to be lower, following ground investigations and monitoring of groundwater levels.

6.3.4 Impact on Conveyance

The development occupies an area which is largely cut off from the main flow paths of the river. This is as a result of the construction of the Western Relief Road embankment along the west of the site, the foul pumping station and associated access road, which provide a barrier between the development site and the river. As such, the conveyance of the Owenboy River will not be affected as a result of the proposed development.

6.4 Proposed Flood Mitigation Measures

In order to manage and reduce flood risk to the site, a number of flood mitigation measures are considered during design development. These are summarised in the list below and described in detail in the following sections. The proposals for the development and flood extents are demonstrated in Figure 35.

Summary of proposed mitigation measures:

- Vulnerable uses are moved away from areas at risk of flooding. Areas at highest risk of flooding are limited to water compatible uses, such as open amenity space and riverside greenway.
- The FFL of the buildings partially located within the Flood Zones A and B are set above the 0.5% AEP tidal event with climate change allowances and adequate provision of freeboard.
- Vertical differentiation of uses was applied in areas at flood risk where buildings are proposed. Commercial uses (less vulnerable development) are located at lower levels, with residential uses (highly vulnerable development) at higher levels.
- Flood compensation is provided within the site to prevent any increase in flood risk elsewhere due to encroachment of the development to the floodplain.

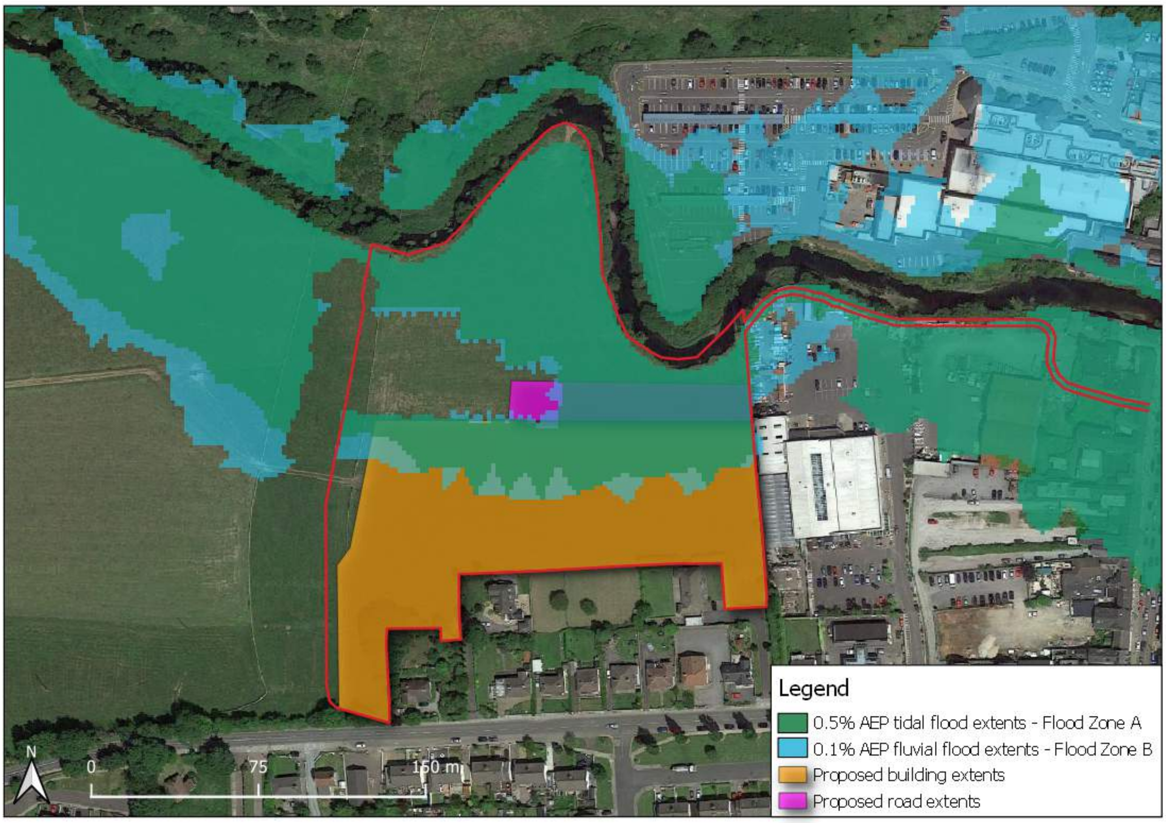


Figure 35: Updated Flood Zone extents with proposed buildings and road

6.4.1 Layout of Development

A large extent of the site is at risk of flooding in the current scenario (Baseline model). Most of the floodplain (as predicted in the Arup model) is designated for water compatible uses under the proposed development, such as recreational green space and amenities. However, some sections of the proposed buildings (marked orange in Figure 35) are at risk of flooding (within Flood Zones A & B). It was therefore necessary to reduce flood risk to these areas by setting appropriate finished floor level (FFL).

6.4.2 Appropriate Finished Floor Levels

The SFRA of the draft Cork County Development Plan recommends that FFLs are set above the design flood level (1% AEP fluvial or 0.5% AEP tidal event, whichever higher) with inclusion for climate change and a freeboard allowance.

The hydraulic modelling results indicated that the maximum flood level for the design scenario (0.5% AEP tidal MRFS event) at the reporting points within the subject site vary from 3.38 – 3.42 m AOD, see Table 6-6. This level rises to 3.6m AOD within the Owenboy River adjacent to the site during this design event. This is considered conservative and was taken forward as the design flood level.

A minimum freeboard of 300mm is provided in line with the recommendations included in the SFRA. Thus, the recommended minimum finished floor level for the development was calculated as:

Recommended FFL = 3.6mOD (0.5% AEP tidal MRFS flood level) + 0.3m (freeboard) **= 3.9mOD**

For the proposed development, buildings and hardstanding areas are set at **4.0mOD**, which is above the minimum recommended.

6.4.3 Vertical Differentiation of Uses

The risk of flooding to the development is further mitigated by vertical differentiation of uses, with the ground floor level being dedicated to less vulnerable development such as car parking and retail uses (4m AOD). Highly vulnerable development such as residential lounges and creche are proposed for the first-floor level (7.5m AOD), while residential sleeping accommodation is proposed for the second-floor level (11.0m AOD) and above.

6.4.4 Mitigation of Groundwater Flood Risk

Groundwater information from nearby boreholes indicate shallow groundwater table due to the site's proximity to the river. The groundwater levels and variation through the seasons need to be better understood to support design development and as such, it is recommended that long-term groundwater monitoring is undertaken during site investigations.

If groundwater levels are found to be shallow within the site, consideration shall be given to waterproofing/watertight 'tanking' techniques for basement structures and underground utilities.

6.4.5 Mitigation of Offsite Impacts

It is proposed to mitigate risk of flooding to the development site by means of appropriate land uses and raised finished floor levels. However, raising of the site above the recommended minimum FFL will remove flood storage volume from the site, sending it offsite and potentially negatively impacting other receptors by increasing flood levels and extents. The hydraulic model developed for the site was used to assess the off-site flood risk impacts associated with the proposed development with the proposed mitigation measures. It was determined that offsite impacts are minimal. Flood compensation is proposed to be provided within the site in the form of storage underneath the access road to reduce offsite impacts. Further details on the findings of the "With Development" modelling and the associated proposed flood compensation measures are described in Section 6.3.2.

6.5 Residual Risks

6.5.1 Operation and Maintenance of Mitigation Measures

It is key that the flood compensation measures proposed are maintained to perform their purpose. This should be detailed in an operation and maintenance plan which the management staff will be able to refer to.

6.5.2 Storage Crates

The storage crates will be positioned underneath the access road. Access to the crates will be provided to inspect and monitor their performance, allow flushing of the system in case of silt accumulation and removal of any debris that might obstruct the inlets or outlets.

The development management will be responsible for the inspection and maintenance of the crates and park area. It is recommended that inspection of both areas is undertaken annually.

6.5.3 Park Area

If during design development is considered feasible to provide flood compensation in the park area following GIs, the levels within the park area should not be raised in the future without providing the designed compensation somewhere else.

The Park area and riverside greenway will be equipped with bollards at entry points. This will be used to close off with chains and signs the area following a flood warning and ahead of a flood event and prevent public from entering the space.

Following a flood event, some silt and debris could settle in the park area or greenway. Jet washing of hardstanding area or litter picking might be required to remove the silt and any solid waste.

6.5.4 Residual Risk from Failure of Mitigation Measures

While the flood mitigation measures such as the storage areas provided would mitigate against any increases in offsite impacts from the development, there is an unlikely risk that the measures could fail, due to blockage of the inlets or other disfunction of the systems. In the case where the storage compensation areas are not available to be utilised during the design event, it is expected that the flood levels would rise in upstream areas (as far as 250m from the site boundary) to up to 30mm during the 1% AEP and 47mm during the 1% AEP MRFS event. There will be no impact to downstream areas.

Currently, the impacted sites are Greenfield and as such the small increase in flood levels during failure of the measures is not anticipated to cause increased damages. If the areas are developed in the future, developments will be constructed setting their floor levels in accordance with the OPW Guidelines and the Cork Council Development Plan SFRA guidelines, incorporating appropriate freeboard, which would prevent any increased damages due to the 30mm increase in levels.

6.5.5 Residual Risk of Rainfall Exceedance Event

Whilst the proposed surface water drainage system and associated storage are designed in accordance with the latest industry standard, including an allowance for climate change, there remains a risk of a rainfall event in excess of the design standard. In practice, this risk is quite small as the design event assumes a conservative joint probability of extreme rainfall event and high tide. It is unlikely that these will coincide and therefore the on-site storage tanks will have sufficient capacity to deal with extreme rainfall events.

6.5.6 Safe Access and Egress

Access and egress from the site will be via an entrance from the proposed development to the new road, currently under construction, to the west of the site. An emergency egress strategy will be implemented for the proposed development which will allow for emergency egress to the higher existing ground levels to the south of the development site, as follows:

- The design will facilitate emergency egress to the south-west of the site to take advantage of the existing higher levels of the site as it rises towards Kilmoney Rd Lower. Access is provided for both vehicles and pedestrians, as shown in Figure 36.

- From Kilmoney Rd Lower, there is flood-free access to areas at higher ground, the local Carrigaline Health Care Centre and other essential facilities.
- As flood risk to the site is predominantly caused by a combination of high river flows and high tides, potential flood events could be predicted. Therefore, advance warnings will be issued to development users to take appropriate action.
- Access and egress procedures will be documented in a detailed emergency response plan.

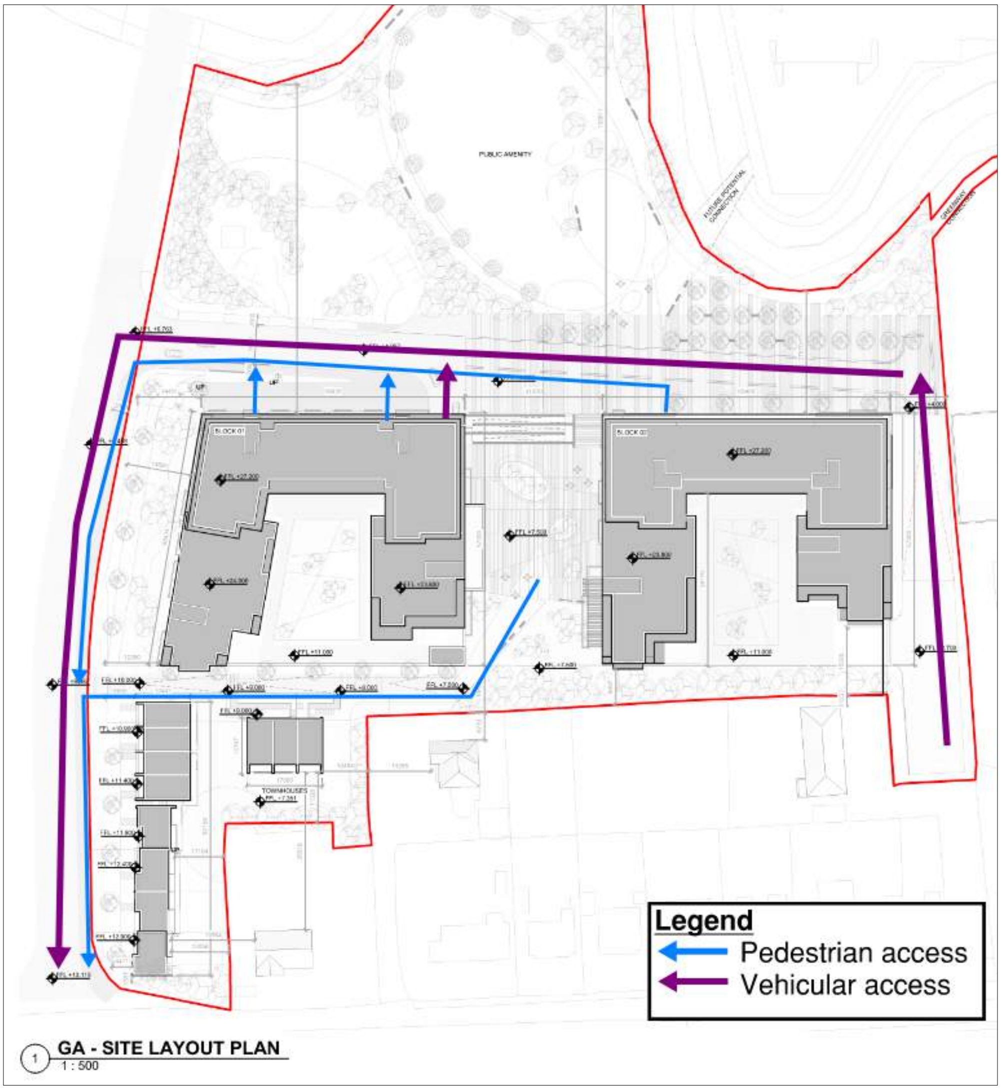


Figure 36: Safe access and egress routes to Kilmoney road

6.5.7 Flood Emergency Plan

The buildings are at very close proximity to areas at risk of flooding and as such, a flood emergency response plan will be developed for the building and park area users. This will be implemented in the event of a significant flood event being forecasted for Carrigaline.

The development management will develop a Flood Emergency Plan in accordance with the OPW Planning Guidelines which will be updated annually to take account of the latest knowledge on flooding, available flood protection for Carrigaline and the latest Cork City Emergency Plan. The Flood Emergency Plan will be informed by the Emergency Response Plans of Cork County Council. The plan will detail triggers for activation, including receipt of a timely flood warning, a staged response and to set out the management and operational roles and responsibilities. The plan will set out arrangements for access and egress, both for pedestrians, vehicles and emergency services.

Met Éireann Forecast services will be used to provide flood warning and trigger activation of the emergency plan. As part of the emergency plan, the management staff of the proposed development and park area will be required to maintain awareness of flood and weather forecasts on an ongoing basis as well as receive warning from Cork County Council and Met Éireann. A text service is available for Cork County Council that the management staff will sign up to.

In the event of an extreme flood being forecast, then it is likely that advisories will be issued by Cork County Council and the Emergency Authorities for the prior evacuation of all vulnerable parts of the County, and that such evacuation will be carried out in a safe and timely manner.

In the event of forecasts of significant or severe flooding, the general response plan will be as follows:

- The Park area will be equipped with bollards at entry points. Following a flood warning for a severe event, the management staff will close off the Park area at the entry points, by securing chains and signs on the bollards to prevent public entry to the park.
- Warnings of the impending flood with details of timings and likely levels of impact will be communicated to all building users.
- Occupants of the buildings will be provided with sufficient notice to either leave in advance of the flood if needed or stay in the building until the flood recedes.
- Where possible, building users will remain inside until any flood recedes.
- People choosing to leave the building during a flood would be responsible for their own safety and would have to exercise appropriate care and caution. They would be advised of the best route to take to get to higher ground. Safe access and egress can be provided via the Western Relief Road or Kilmoney road.
- Where an individual or individuals are required to leave the building due to a medical emergency, depending on the severity of the flooding, they would be evacuated by emergency vehicle as required.
- The development management and management of the individual tenancies will, as part of their Emergency Evacuation Plans, be connected to the medical services at appropriate hospitals and will have a plan to deal with the treatment and evacuation of a medical emergency during a flood.

6.5.8 Surface Water Drainage Strategy

The Surface Water Drainage Strategy (SWDS) for the site is prepared by Horgan Lynch Consultants. A summary is included below.

The SWDS proposes to control the rate of run-off from the new development. The maximum permitted surface water outflow from the new development is proposed to be restricted to Greenfield rates of run-off, thereby managing any increase in run-off to the Owenboy River.

Control of run-off by attenuation methods requires a hydraulic control to restrict the magnitude of flows passing downstream, together with an upstream storage capacity to contain the volume of run-off held back. The flows are proposed to be attenuated in the surface water system by adopting a flood storage detention tank underneath the buildings along with a restricted outlet as the control device.

The network is piped and has been sized to the following standards:

- 1 in 2-year return period events were used to ensure that the system does not surcharge;
- 1 in 100-year return period events were used to ensure that flooding does not occur.

The outfall from the detention tank discharges to River Owenboy.

A petrol interceptor is proposed to capture hydrocarbons prior to discharge to the river.

6.6 Justification Test

6.6.1 Flood Zones

Based on the updated Baseline flood model and mapping of the site, parts of the site are within Flood Zones A, B and C.

6.6.2 Vulnerability Classification

The proposed mixed used development contains residential and creche uses, classed as a 'highly vulnerable development', and retail uses, which are classified as 'less vulnerable development' as per the vulnerability classification of the Planning Guidelines.

6.6.3 Sequential Approach

Figure 4 illustrates the sequential approach to be adopted under the 'Planning System and Flood Risk Management' Guidelines. The proposed development is 'highly or less vulnerable development' and partially lies within Flood Zone A and B. A Justification Test is therefore required to be undertaken.

6.6.4 Development Management Justification Test

The Development Management Justification Test is undertaken when developments vulnerable to flooding are proposed in areas at moderate or high risk of flooding (Flood Zones A and B). Prior to granting permission for the development, the planning authority must be satisfied that the development meets the criteria set out in the Development Management Justification Test described in Section 5 of The Planning Guidelines. These criteria are included in Table 6-10. It is demonstrated that the proposed development satisfies the criteria of the Development Management Justification Test.

Table 6-10: Justification test for Development management

Justification Test Criteria	Response based on findings of FRA
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 these Guidelines	The current 2014 Cork County Development Plan, Draft Cork County Development Plan for 2022-2028 and the Ballingollic – Carrigaline LAP 2017 have zoned the land for Town Centre Uses with objectives for mixed use development including commercial, community uses, pedestrian/cyclists' facilities and expansion and regeneration of the urban centre. The 2014 CDP specifically stated the southern part of the site backing into existing residential development on the Kilmoney Road could have a mix of residential development The development proposals include creche (community uses), retail and residential uses, which all align with the recommendation of the Development Plans. Therefore, it is considered that the proposed development satisfies the criteria of Part 1 of the development management Justification Test.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:	

Justification Test Criteria	Response based on findings of FRA
i. The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;	In terms of assessing whether the development would increase flood risk elsewhere, flood mitigation measures are proposed to reduce flood risk to the development as well as areas outside the site boundary. The buildings are raised above the 0.5% MRFS tidal level with freeboard. A hydraulic model was used to assess the impact of these measures in terms of flood risk to other areas. It was identified that due to raising the ground level within Flood Zone A, flood levels could increase up to 30mm to offsite areas. As such, further mitigation measures are proposed to ensure no increase in flood levels. Flood compensation is proposed to provide the same volume of flood storage taken in a level for level manner. Therefore, it is considered that the proposed development satisfies the criteria of Part 2(i) of the development management Justification Test.
ii. The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;	The proposed development and flood mitigation measures are designed to prevent the development from being inundated during and up to at least the 0.5% AEP tidal flood event with an allowance for climate change and freeboard. The defence level provides resilience to climate change and exceedance events such as the 0.1% flood events. As per above, flood compensation is proposed to ensure no negative flood impact to other sites. It is considered that the proposed development satisfies the criteria of Part 2(ii) of the development management Justification Test.
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 flood mitigation measures proposed herein have been assessed against climate change and a higher order event (1 in 1000) to evaluate residual risks. The proposed development and access road are safe from flooding for these events and do not increase flood risk elsewhere. Safe dry access and egress is provided to and from the site via Kilmoney Road Lower. It is considered that the proposed development therefore satisfies the criteria of Part 2(iii) of the development management Justification Test.
iv. The development proposed addresses 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.	The proposed development supports the development of a vibrant and active town centre and objective for increasing housing provision and therefore is in line with wider planning objectives. It is considered that the proposed development satisfies the criteria of Part 2(iv) of the development management Justification Test.

7. Conclusion

The FRA has assessed risks of flooding to the development from fluvial, tidal, pluvial and groundwater flood sources. Part of the site is at risk from fluvial and tidal flooring from the Owenboy River. The Lee CFRAMS mapping indicates that the site is partially located within Flood Zones A and B.

A hydrological analysis and hydraulic modelling were undertaken to assess in detail the risk of fluvial and tidal flooding from the river. The modelling showed increases in the flood zones compared to the CFRAM mapping.

Flood mitigation measures were developed to ensure the development is safe from flooding now and in the future. Measures include raising of development levels above the flood protection level, vertical differentiation of uses, and water tanking construction methods to prevent groundwater ingress to lower levels if needed.

Parts of the development are proposed within Flood Zone A. The impact of building within the flood zone was assessed and found to result in 20-30mm increases in flood levels to upstream greenfield sites. As such, a level-for-level flood compensation is proposed in the form of storage crates underneath the proposed road. The entire volume taken by the development will be compensated by the crates, in line with the DoEHLG / OPW Planning Guidelines for flood risk management. As a result of the provision of flood compensation, there is no anticipated impact from the development to upstream or downstream sites in terms of flood risk. The measures are designed to adequately protect the site from flooding and allow safe access and egress to the site for up to the 0.5% annual exceedance probability tidal event with allowance for climate change and freeboard.

The potential impacts of the development on flood storage, conveyance and surface water run-off were also assessed. No impact was detected on properties upstream and downstream the site.

The residual risks to the occupants of the development were assessed as part of the FRA. It was determined that the residual risk of flooding was considered acceptable.

The proposed development is a 'highly vulnerable development', and partially lies within Flood Zone A. Therefore, a Justification Test in accordance with the OPW Guidelines was carried out. It has been demonstrated that the proposed development satisfies all the Development Management Justification Test criteria.

This FRA has demonstrated that the risks relating to flooding can be managed and mitigated to acceptable levels and therefore comply with DoEHLG / OPW and Cork County Council planning guidance.

Appendix A

Topographic Survey – Precise Control

Survey Notes:

GRID:

THIS SURVEY IS RELATED TO ORDNANCE SURVEY GRID. IRISH TRANSVERSE MERCATOR (OSGM15).

DATUM:

LEVELS ARE RELATED TO ORDNANCE SURVEY DATUM. (MALIN HEAD, OSGM15 ADJUSTMENT).

SURVEY ABBREVIATION LIST.

AV : WATER MAIN AIR VALVE
BH : BENCH
BL : BOLLARD
BS : BUS STOP
CL : COVER LEVEL
C/L : CENTRE LINE
DP : DOWN PIPE
EIC : ESB INSPECTION COVER
EM : ESB MARKER
EP : ESB POLE
EPL : ESB PILLAR
ER : EARTH ROD
ESB : ELECTRICITY SUPPLY BOARD
FFL : FINISHED FLOOR LEVEL
FH : FIRE HYDRANT
FHR : FIRE HYDRANT RISER
FP : FLAG POLE
GM : GAS MARKER
GUY : GUY WIRE TO POLE
GV : GAS VALVE
IC : INSPECTION COVER
IL : INVERT LEVEL
LP : LIGHT POST
LS : LIGHT STANDARD
LT : LIGHT TOWER
MH : MANHOLE
O/H : OVERHEAD
OSBM : O.S. BENCH MARK
PB : POST BOX
RG : ROAD GULLY
SAP : TREE SAPLING
SC : WATER MAIN STOP COCK
SH : SHORE
SN : SIGN
STN : SURVEY STATION
SV : WATER MAIN SLUICE VALVE
TBM : TEMPORARY BENCH MARK
TFL : LEVEL AT DOOR THRESHOLD
TIC : TELECOM INSPECTION COVER
TK : TELEPHONE KIOSK
TL : TRAFFIC LIGHT
TM : TELECOM MARKER
TOF : TOP OF FENCE LEVEL
TOT : TOP OF TREE LEVEL
TOW : TOP OF WALL LEVEL
TP : TELECOM POLE
TPL : TELECOM PILLAR
TRIC : TRAFFIC INSPECTION COVER
U/G : UNDERGROUND
UM : UTILITY MARKER
UP : UTILITY PILLAR
VL : VALVE
VP : VENT PIPE
WM : WATER MAIN METER
WV : WATER MAIN VALVE

NOTES:

FURTHER LEVELS ARE SHOWN ON FROZEN LAYERS WITHIN THE AUTOCAD DRAWING. (LAYERS PRECEDED WITH 'Z')

EVERY EFFORT HAS BEEN MADE TO OBTAIN ALL DETAIL. HOWEVER SOME DETAIL MAY HAVE BEEN HIDDEN AT THE TIME OF THE SURVEY DUE TO PARKED CARS OR OTHER OBSTRUCTIONS.

Rev.	Drn.	Date.	Description.

PRECISE CONTROL
LAND AND ENGINEERING SURVEYORS
Unit 11, Eastgate Way, Eastgate, Little Island, T45 TD77, Co. Cork.
t: 021 4351050 - e: info@precisecontrol.com - w: www.precisecontrol.com

Job Title:
Kilmoney Road, Carrigaline, Co. Cork.

Survey:
3d Topographic Survey

For:
Henry J Lyons (Hallmark Dev.)

Plot Scale:	1:500 (A1)	Surveyed by :	md
Date :	18-12-20	Drawn by :	md
Job Nr. :	20111	Checked by :	hme
Drg. Nr.:	20111d.dwg	Rev.:	0

Appendix B

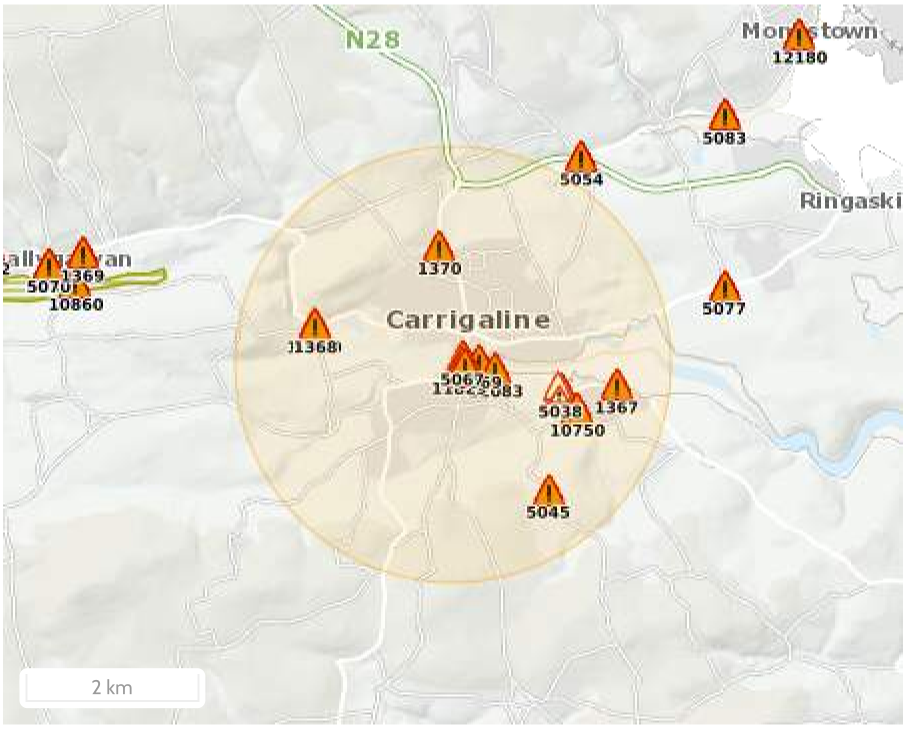
National Flood Hazard Mapping Website Report

Past Flood Event Local Area Summary Report

Report Produced: **29/3/2022 10:29**

This Past Flood Event Summary Report summarises all past flood events within 2.5 kilometres of the map centre.

This report has been downloaded from www.floodinfo.ie (the **"Website"**). The users should take account of the restrictions and limitations relating to the content and use of the Website that are explained in the Terms and Conditions. It is a condition of use of the Website that you agree to be bound by the disclaimer and other terms and conditions set out on the Website and to the privacy policy on the Website.



Map Legend

- Single Flood Event
- Recurring Flood Event
- Past Flood Event Extents
- Drainage Districts Benefited Lands*
- Land Commission Benefited Lands*
- Arterial Drainage Schemes Benefited Lands*

* Important: These maps do not indicate flood hazard or flood extent. Their purpose and scope is explained on Floodinfo.ie

17 Results

	Name (Flood_ID)	Start Date	Event Location
1.	Shannonpark (R611) Carrigaline Nov 2002 (ID-1370)	27/11/2002	Approximate Point
	Additional Information: Reports (3) Press Archive (0)		
2.	Carrigaline walk Owenboy Estuary Cork Nov 1994 (ID-1367)	03/11/1994	Approximate Point
	Additional Information: Reports (3) Press Archive (0)		
3.	Owenboy Ballea Bridge, Carrigaline Recurring (ID-1368)	n/a	Approximate Point
	Additional Information: Reports (5) Press Archive (1)		
4.	Crosshaven Road Carrigaline Oct 2004 (ID-5038)	27/10/2004	Approximate Point
	Additional Information: Reports (2) Press Archive (0)		
5.	Commeen Hill LP2495 Nov 2002 (ID-5045)	27/11/2002	Approximate Point
	Additional Information: Reports (2) Press Archive (0)		
6.	Carrigaline Main Street area Oct 2004 (ID-5067)	27/10/2004	Approximate Point
	Additional Information: Reports (3) Press Archive (0)		

	Name (Flood_ID)	Start Date	Event Location
7.	Carrigaline Strand Road area Oct 2004 (ID-5069)	27/10/2004	Approximate Point
	Additional Information: Reports (4) Press Archive (0)		
8.	Ballea Road Nov 2002 (ID-5071)	27/11/2002	Exact Point
	Additional Information: Reports (3) Press Archive (0)		
9.	Carrigaline Town Nov 2002 (ID-5074)	27/11/2002	Approximate Point
	Additional Information: Reports (1) Press Archive (3)		
10.	Carrigaline Co.Cork 14th.December 2012 (ID-11829)	14/12/2012	Approximate Point
	Additional Information: Reports (1) Press Archive (0)		
11.	Flooding at Carrigaline, Co.Cork on 3rd February 2014 (ID-12083)	03/02/2014	Approximate Point
	Additional Information: Reports (1) Press Archive (0)		
12.	Carrigaline Co.Cork 2nd January 2014 (ID-12091)	02/01/2014	Approximate Point
	Additional Information: Reports (2) Press Archive (0)		
13.	Carrigaline Co.Cork 16th/17th October 2012 (ID-11824)	16/10/2012	Approximate Point
	Additional Information: Reports (1) Press Archive (0)		
14.	Kilnaglery Bridge, Carrigaline, Co. Cork Recurring (ID-1575)	n/a	Approximate Point
	Additional Information: Reports (3) Press Archive (0)		
15.	Kilnagleary,Carrigaline,Co.Cork (ID-10750)	11/11/2009	Approximate Point
	Additional Information: Reports (1) Press Archive (0)		
16.	Ballea Bridge (Lower) Carrigaline,Co.Cork.19th.Nov.2009 (ID-11000)	19/11/2009	Approximate Point
	Additional Information: Reports (1) Press Archive (0)		
17.	Carrigaline Bridge,Co.Cork 19th.Nov.2009 (ID-11034)	19/11/2009	Approximate Point
	Additional Information: Reports (1) Press Archive (0)		

Appendix C

AMAX data at Ballea Gauging Station

Date recorded	AMAX value (m^3/s)
10-07-1975	23.6
23-10-1975	49
20-02-1977	30.8
22-02-1978	67.2
10-02-1979	49.9
27-12-1979	49.9
01-03-1981	28.9
13-12-1981	48.2
09-11-1982	50
26-01-1984	38.6
08-02-1985	21.5
25-08-1986	27.7
26-10-1988	25.4
17-12-1989	25.4
01-01-1991	14.5
25-11-1991	19
19-09-1993	14.5
22-02-1994	30.3
10-03-1995	36.4
14-03-1996	40.1
25-10-1996	14.9
17-11-1997	31.6
29-12-1998	24.2
20-12-1999	27.1
15-11-2000	48.1
04-02-2002	23.1
21-11-2002	55.3
03-02-2004	24.2
29-10-2004	25.5
19-10-2005	39.1
03-12-2006	53.2

Date recorded	AMAX value (m^3/s)
10-01-2008	25.2
30-01-2009	26.2
20-11-2009	64.7
27-12-2010	18.0
28-06-2012	34.5
25-01-2013	26.1
01-01-2014	22.9
13-11-2014	19.9
06-02-2017	14.3
17-04-2018	45.7
15-04-2019	52.5
14-10-2019	29.8
Q_{MED}	28.9

Appendix E

Reside Investments Ltd

PROPOSED SHD AT CARRIGALINE, CO. CORK

ProPG: Acoustic Design Statement

604216 (00)

MAY 2022

EXECUTIVE SUMMARY

RSK Ireland Limited (RSK) was instructed by Reside Investments Ltd to conduct an operational phase noise impact assessment in respect of a proposed SHD at Carrigaline, Co. Cork.

This document considers the potential impact of the existing and future noise sources on future residents of the proposed dwellings, along with an assessment of the potential operational phase noise impact of the proposed development to nearby existing receptors.

To assist with this assessment, the baseline noise environment at the development site has been determined through noise surveys over an extended period of 7-days, between 6th and 12th May 2022.

This report considers the potential impact of existing traffic and the future Carrigaline Western Relief Road (CWRR) traffic noise on the proposed development. The baseline noise survey has been used to assess the sites noise risk category, as per the ProPG "Stage 1" assessment. The noise risk category for the proposed development facades that are most exposed to road traffic is **Low** to **Medium** for daytime and **Low** to **Medium**/**High** for night-time periods. This indicates that *the site is likely to be acceptable from a noise perspective* subject to the inclusion of suitable noise conditions.

Requirements to mitigate noise emissions, as specified in the ProPG "Stage 2" Acoustic Design Statement, are as follows:

- Provision of glazing with minimum sound insulation properties as outlined in Table 12 of this document, and;
- Provision of acoustically attenuated ventilation with minimum sound insulation properties as outlined in Table 13 of this document.

The calculated noise levels from the CWRR are considered to be worst-case, in the event that actual noise levels, post construction from the CWRR are lower than the values projected above, the façade sound insulation performance specification may be reduced, subject to achieving compliance with the BS8233 internal noise level requirements for living, dining and bedrooms.

In the developments operational phase, criteria have also been set for any new building services plant items associated with the proposed SHD, in accordance with the methodologies outlined in BS 4142:2014+A1:2019. It has been concluded that the likely noise impact of the developments in its operational phase are not significant.

In summary, once consideration is given to the range of mitigation measures outlined in this report, the expected noise impact of the proposed development, on existing and future residents, is not significant.

RSK GENERAL NOTES

Project No.: 604216 (00)

Title: Proposed SHD at Carrigaline, Co. Cork. Noise Impact Assessment

Client: Reside Investments Ltd

Date: 30th May 2022

Office: Dublin

Status: **FINAL**

Author	James Mangan, MIOA Associate Director (Acoustics)	**Technical reviewer**	Aarron Hamilton, (Acoustic Consultant)
Signature	James Mangan	Signature	Aarron Hamilton
Date:	30th May 2022	Date:	30th May 2022

RSK Ireland Ltd. Bluebell Business Centre, Old Naas Road, Bluebell, Dublin 12

CONTENTS

List of Appendices

1 INTRODUCTION

Reside Investments Ltd instructed RSK to conduct an assessment of the potential noise impact associated with the proposed SHD during the operational phase on its surrounding environment. The potential inward noise impact of existing and future traffic noise on the proposed development has also been considered in this report.

Mitigation measures are included, where relevant, to ensure the proposed development is operated in an environmentally sustainable manner in order to ensure its minimal impact on the receiving noise climate.

1.1 Aim and Objectives

The aim of the assessment is as follows:

- Quantify the baseline noise environment at locations that are representative of nearby noise sensitive locations.
- Provide an assessment of the likely impacts of operational phase noise emissions to nearby existing receptors.
- Provide design advice and recommendations for mitigation measures, where necessary, to reduce impacts to an appropriate level for future apartment occupants.

The objective of this assessment is to reduce the risk of nuisance to nearby noise sensitive locations resulting from operational phase noise emissions and to provide a performance specification for the proposed building façade to control road traffic noise ingress to the proposed dwellings.

2 THE PROPOSED DEVELOPMENT

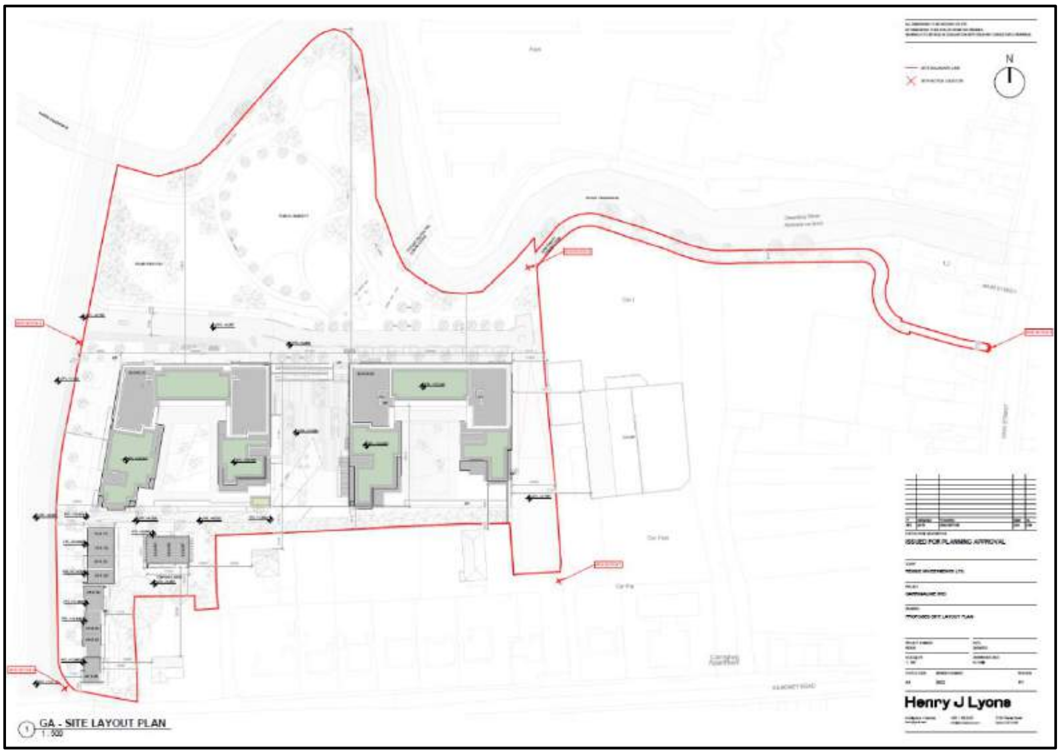
Reside Investments Ltd intend to apply for permission for a SHD at a site a site at Carrigaline, Co. Cork. The proposed residential development consists:

- The construction of 224 no. residential units consisting of 202 no. proposed apartments in 2 no. blocks, ranging in height from 6 to 7 storeys and 22 no. townhouse/duplex units:
- A 184 m^2 creche/childcare facility;
- The provision of landscaping and amenity areas to include 1 no. local play area, 1 no. kick about areas, an activity trail/greenway along the river, a gathering area/amphitheatre with tired seating areas, a civic space/promenade and 2 no. courtyard areas;
- The provision of 3 no. retail units, residential amenity and management spaces at ground and first floor level; and
- All associated ancillary development including vehicular access on to the Kilmoney Road Lower, and a cycle/pedestrian connection on to the R611 (via an activity trail/greenway along the river), lighting, drainage, roads boundary treatments, ESB Substation, bicycle & car parking and bin storage.

The site setting is predominately in a mixed residential area with nearby dwellings to the south, on either side of the R611. There are also residential dwellings to the north, on the opposite side of the River Owenabue. The west of the site is currently green field with the Carrigaline Western Relief Road (CWRR) currently under construction. The east of the site adjoins the Dairygold Co-Op Superstore, which includes some industrial/commercial use.

Figure 1 shows the proposed site location in the context of the surrounding environment.

Figure 1: Proposed Site Layout Plan



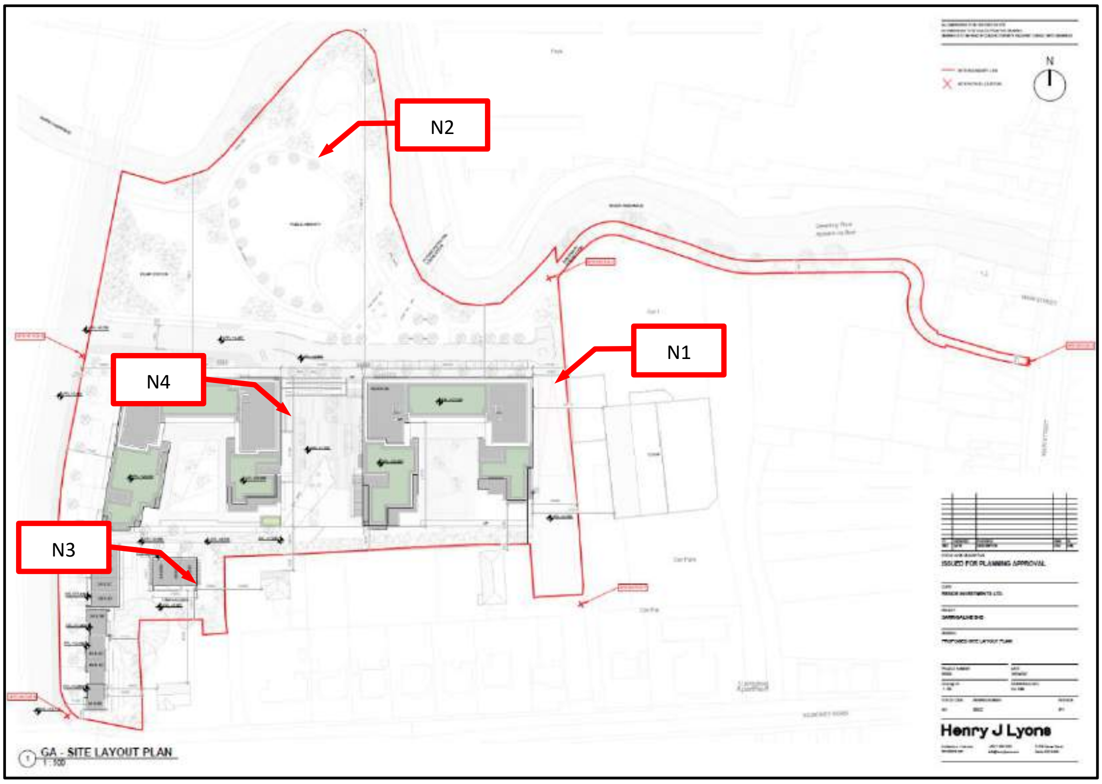
3 BASELINE NOISE SURVEY

Environmental noise surveys have been conducted on site in order to establish the baseline noise environment. Noise surveys have been conducted in accordance with ISO 1996-2:2017 "*Acoustics -- Description, measurement and assessment of environmental noise -- Part 2: Determination of sound pressure levels*".

3.1 Monitoring Location

Unattended noise measurements were conducted at Location N1. Attended noise measurements were conducted at locations N2 – N4. The approximate noise measurement locations are shown in Figure 2. A photograph of the measurement position can be seen below.

Figure 2: Proposed Site Plan Showing Baseline Monitoring Position



Location N1 to the east of the site with the microphone positioned at a location representative of the proposed development facade that is closest to the nearby Co-Op Superstore. This noise survey position comprised of unattended monitoring for an approximate 7-day period. Noise data, including audio recording, captured at this location is used as reference in order to estimate noise levels at the proposed development façade during both day and night-time periods.

Location N2 to the north of the site with the microphone positioned at ground floor level at a location representative of the proposed amenity space. This noise survey position comprised attended daytime monitoring.

Location N3 to the south of the site with the microphone positioned at ground floor level at a location representative of the proposed development facade that is close to the R611 and nearby existing residents. This noise survey position comprised attended daytime monitoring.

Location N4 at the centre of the site with the microphone positioned at ground floor level at a location representative of a proposed development façade and proposed amenity space. This noise survey position comprised attended daytime monitoring

3.2 Survey Periods

Noise measurements were conducted over the source of the following periods:

Table 1: Noise Survey Periods

Period	Location	Date	Start Time	Stop Time
Daytime 07:00 – 23:00hrs	N1	06 May – 12 May 2022	06 May at 11:22	12 Nov at 16:07
	N2 – N4	12 May 2022	12 May at 16:29	12 May at 19:05
Night-time 23:00 – 07:00hrs	N1	06 May – 12 May 2022	06 May at 23:00	12 Nov at 07:00

3.3 Weather

The weather during the unattended survey of 6th to 12th May 2022 is summarised as follows (ref. https://www.met.ie/climate/available-data/daily-data) from the Cork Airport met station.

Table 2: Weather Conditions

Date	Period	Temperature Degrees Celsius	Precipitation	Wind Speed m/s	Wind Direction
06/05	Daytime	10 – 16	15:00 – 16:00	3.5 – 6	WSW
06-07/05	Night- time	8 – 10	No	1.5 – 4	NNW
07/05	Daytime	10 – 16	No	2 – 4	ESE
07-08/05	Night-time	9 – 11	No	1.5 – 2.5	SE
08/05	Daytime	11 – 13.5	No	3.5 – 6	S
08-09/05	Night-time	11 –12	No	4 – 6	S
09/05	Daytime	9 – 13	No	5 – 10	SW
09-10/05	Night-time	9 – 11	No	5 – 6	WSW
10/05	Daytime	9 – 15	No	5 – 10	WSW
10-11/05	Night-time	8 – 10	No	2 – 6	WSW
11/05	Daytime	9 – 14	No	3 – 7.5	WNW
11-12/05	Night-time	7 – 9	No	2.5 – 3.5	WSW
12/05	Daytime	9 – 14	No	4 – 7	WSW

In line with best practice, periods of rain and elevated winds have been omitted from the study.

3.4 Instrumentation

The noise measurements were undertaken using the following equipment.

Table 3: Survey Equipment

Equipment	Type	Serial No.
Class 1 Sound Level Meter	Rion NL - 52	00710314

The equipment used has a calibration history that is traceable to a certified calibration institution. The calibration of the sound level meter was field checked prior to commencing measurements and prior to removing the equipment from site upon completion. A calibration drift of -0.1dB was noted upon commencement of the survey and +0.1 upon survey completion. The sound level meter calibration certificates are available on request.

The sound level meter conformed to the Class 1 requirements of BS EN 61672-1:2013 '*Electroacoustics. Sound level meter, Specifications*'. The calibrator used conforms to the requirements of BS EN IEC 60942:2018 '*Electroacoustics. Sound calibrators*'.

3.5 Measurement Parameters

The noise survey results are presented in decibels (dB), using the following parameters:

$L_{Aeq,T}$ is the equivalent continuous sound level and is used to describe a fluctuating sound as a single value over the sample period (T).

$L_{AFmax,T}$ The maximum A-weighted sound pressure level occurring within a specified time period (T). Measured using the "Fast" time weighting.

$L_{AF10,T}$ Refers to those A-weighted noise levels in the top 10 percentile of the sampling interval; it is the level which is exceeded for 10% of the measurement period (T). It is used to determine the intermittent high noise level features of locally generated noise and usually gives an indicator of the level of road traffic. Measured using the "Fast" time weighting.

$L_{AF90,T}$ Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval (T). It is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to describe a background level without contribution from intermittent sources.

All sound levels in this report are expressed in terms of decibels (dB) relative to 2x10-5 Pa. Noise measurements use a reference time period (T) of 15-minutes.

3.6 Measurement Results

3.6.1 Location N1

Table 4 summarises the measured daytime (i.e. 07:00 to 23:00) noise levels at Location N1.

Table 4: Measured Daytime Noise Levels at Location N1

Period	Date	Time	Measured Noise Levels (dB re. 2x10^{-5} Pa)				Notes
			L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}	
Daytime	06/05 Fr	11:22-23:00	51	80	51	45	Local and distant road traffic dominant
	07/05 Sat	07:00-23:00	47	78	48	41	
	08/05 Sun		46	83	48	40	
	09/05 Mon		55	89	56	48	
	10/05 Tue		54	80	56	48	
	11/05 Wed		53	91	54	47	
	12/05 Thur	07:00-16:07	50	82	55	48	

The daily daytime ambient noise levels were in the range 46 to 51 dB $L_{Aeq,16hr}$. Road traffic movements were noted to be the dominant source of noise at this measurement position.

Table 5 summarises the measured night-time (i.e. 23:00 to 07:00hrs) noise levels at Location N1.

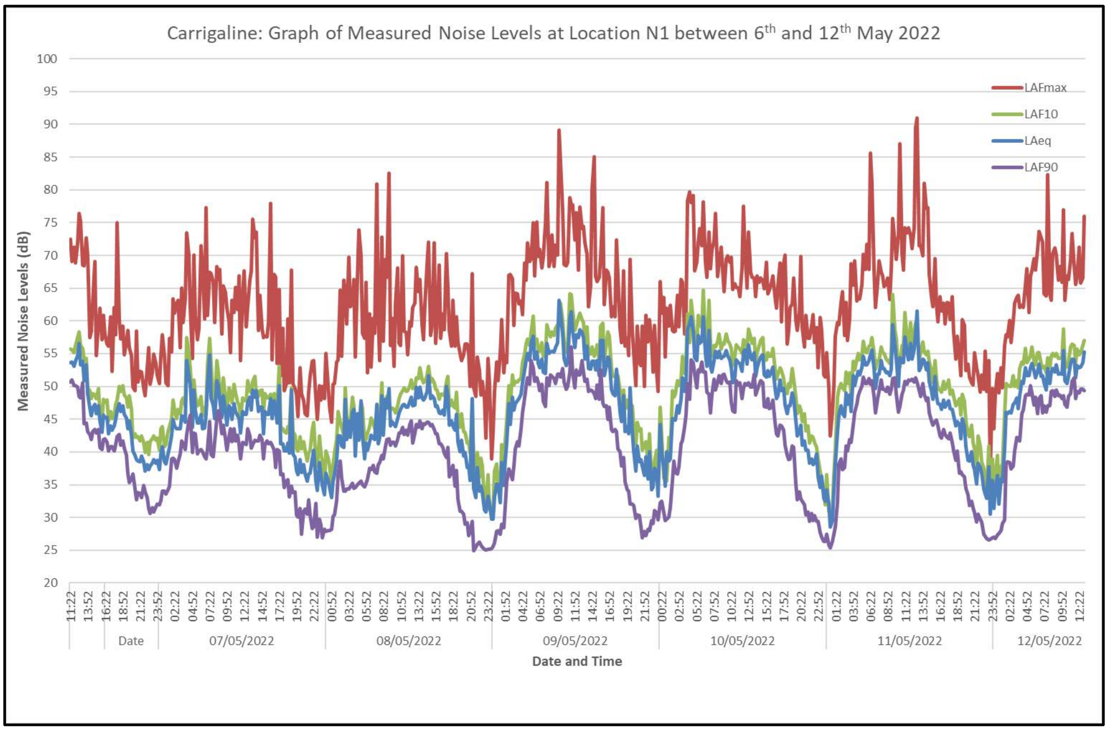
Table 5: Measured Night-time Noise Levels at Location N1

Period	Date	Time	Measured Noise Levels (dB re. 2x10^{-5} Pa)				Notes
			L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}	
Night-time	06-07/05	23:00 - 07:00	41	65	43	35	Local and distant road traffic dominant
	07-08/05		40	70	41	31	
	08-09/05		42	67	41	30	
	09-10/05		44	66	44	33	
	10-11/05		43	70	43	32	
	11-12/05		43	64	42	32	

The night-time ambient noise levels were in the range 40 to 44 dB $L_{Aeq,8hr}$. Local and distant road traffic were dominant noise sources during night-time period.

Figure 3 shows the time-history graph of measured noise levels between 6th and 12th May 2022 at Location N1.

Figure 3: Profile of Baseline Noise Monitoring Results at Location N1



3.6.2 Location N2

Table 6 summarises the measured noise levels at Location N2.

Table 6: Measured Noise Level at Location N2

Period	Date	Start Time	Measured Noise Levels (dB re. 2x10^{-5} Pa)				Notes
			L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}	
Daytime	12/05	16:29	55	72	59	48	Distant and local road traffic dominant
		17:06	51	66	53	47	
		18:18	57	62	50	44	

The daytime ambient noise levels were in the range 51 to 57 dB $L_{Aeq,15min}$. Road traffic was the dominant source of noise. Birdsong and noise from the nearby river were also audible as secondary sources.

3.6.3 Location N3

Table 7 summarises the measured noise levels at Location N3.

Table 7: Measured Noise Level at Location N3

Period	Date	Start Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)				Notes
			L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}	
Daytime	12/05	16:50	56	90	57	50	Distant and local road traffic dominant
		17:45	51	66	53	47	
		18:34	54	70	56	48	

The daytime ambient noise levels were in the range 51 to 56 dB $L_{Aeq,15min}$. Road traffic was the dominant source of noise. Construction noise, birdsong, wind in foliage and dogs barking were also audible as secondary sources.

3.6.4 Location N4

Table 8 summarises the measured noise levels at Location N4.

Table 8: Measured Noise Level at Location N4

Period	Date	Start Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)				Notes
			L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}	
Daytime	12/05	17:06	51	66	53	47	Distant and local road traffic dominant
		18:02	54	70	56	48	
		18:50	51	65	53	47	

The daytime ambient noise levels were in the range 51 to 54 dB $L_{Aeq,15min}$. Road traffic was the dominant source of noise. Construction noise, birdsong and wind in foliage were also audible as secondary sources.

4 NOISE CRITERIA

In deriving noise criteria for the development, consideration has been given to the following documents:

- *Cork County Council Noise Action Plan* 2018 – 2023 (NAP).
- *The Professional Guidance on Planning & Noise* (ProPG), May 2017.
- BS 8233 *Guidance on sound insulation and noise reduction for buildings.*
- BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound*.

4.1 Cork County Council Noise Action Plan 2018 – 2023

With regard to inward noise impact on the proposed dwellings reference is made to the *Cork County Council Noise Action Plan 2018 – 2023* (NAP) which provides guidance for the scenario whereby a residential development is proposed in an area exposed to pre-existing levels of environmental noise.

Section 2 of the Cork County Council *Noise Action Plan 2018 – 2023* provides an overview of existing noise management legislation, regulations and guidance in Ireland at a national, regional and local scale. Section 2.1.9 (reproduced below) refers to *Professional Planning Guidance (ProPG) on Planning & Noise: New Residential Development* in order to encourage the use of good acoustic design process in and around proposed new residential development, having regard to national policy.

> *"The ProPG for new residential developments was published in May 2017 by the Association and Noise Consultants (ANC), Chartered Institute of Environmental Health and UK Institute of Acoustics. It's primary goal is to provide assistance in planning to deliver sustainable development by promoting good health and well-being in relation to noise. It encourages the use of good acoustic design process in and around proposed new residential development, having regard to national policy.*
>
> *Any issues related to noise should be given consideration at the earliest stages of the development process in order to facilitate streamlined decision making in planning. The ProPG follows a systematic, proportionate, risk based, two-stage, approach.*
>
> *Stage One is an Initial Site Noise Risk Assessment which should be conducted to establish the level of risk from noise, not including any mitigation measures. There are four noise risk categories (negligible, low, medium and high). The outcome of this assessment should not directly inform a decision, rather to allow for the consideration of good acoustic design.*
>
> *Stage Two is a full noise assessment including four recommended key elements:*
>
> - *Element 1 - demonstrating a "Good Acoustic Design Process"*
> - *avoiding "unreasonable" and preventing "unacceptable" acoustic*
> - *conditions;*
> - *Element 2 - observing "Internal Noise Level Guidelines";*
> - *Element 3 - undertaking an "External Amenity Area Noise Assessment";*
> - *Element 4 - consideration of "Other Relevant Issues"*
>
> *To support proposals for a development an Acoustic Design Statement should be produced which will aid recommendations formulated by the decision maker.".*

The noise levels measured and predicted on site will therefore be compared to relevant guidance for assessing the suitability of the site for residential development i.e. ProPG: *ProPG: Professional Practice guidance on Planning and Noise for new Residential Development* (May 2017).

4.2 ProPG: Professional Practice Guidance on Planning and Noise for new Residential Development

ProPG provides a two staged approach for evaluating noise exposure on a proposed residential development. The two stages of the approach can be summarised as follows:

Stage 1 - Involves a high-level initial noise risk assessment of the proposed site considering either measured and or predicted noise levels.

Stage 2 – Involves a full detailed appraisal of the proposed development covering four “key elements” that include.:

Element 1 - Good Acoustic Design Process;

Element 2 - Noise Level Guidelines;

Element 3 - External Amenity Area Noise Assessment, and;

Element 4 - Other Relevant Issues.

An Acoustic Design Statement (ADS) is then prepared for submission to the planning authority. This ADS outlines the findings of the Stage 1 and Stage 2 assessments; and allows the planning authority to make an informed decision on the suitability of the site for development, with consideration of noise control measures where required. The ProPG document outlines the following potential outcome with respect of the ADS:

A. Planning consent may be granted without any need for noise conditions;

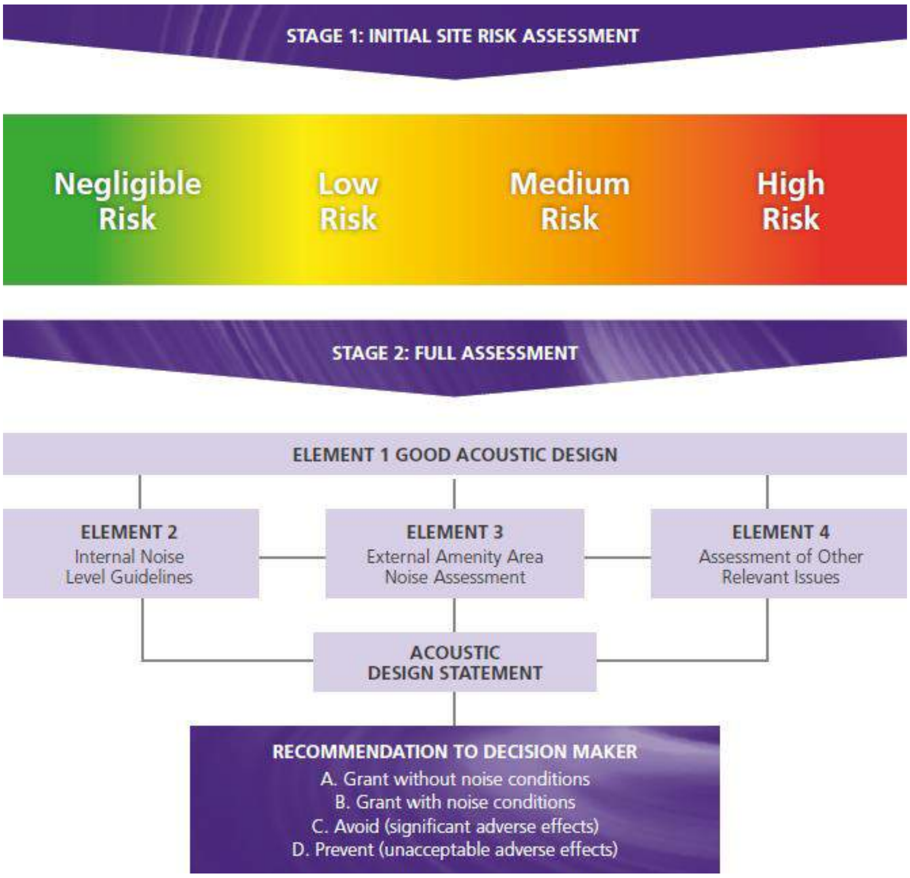
B. Planning consent may be granted subject to the inclusion of suitable noise conditions;

C. Planning consent should be refused on noise grounds in order to avoid significant adverse effects (“avoid”); or,

D. Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects (“prevent”).

A summary of the ProPG approach is illustrated in Figure 4.

Figure 4: ProPG Assessment Strategy (Source: ProPG)



4.2.1 ProPG and BS 8233 *Guidance on sound insulation and noise reduction for buildings*

BS 8233 is referenced in ProPG with regard to internal noise levels within the proposed new dwellings. The following internal noise targets are presented as derived from BS 8233 (2014).

Table 9: ProPG Internal Noise Targets (derived from BS 8233:2014)

Activity	Location	Daytime (07:00 to 23:00hrs)	Night-time (23:00 to 07:00hrs)
Resting	Living room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB $L_{Amax,T}$*

* internal $L_{AFmax,T}$ noise level may be exceeded up to 10 times per night without a significant impact occurring.

4.2.2 ProPG and BS 4142 *Methods for rating and assessing industrial and commercial sound*

Given that the site is in a commercial area, it is appropriate also to consider the guidance provided in BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound*. ProPG states the following *in the case of sites exposed to industrial and/or commercial noise*:

2.13 As stated in the Introduction, the scope of this ProPG is restricted to sites that are exposed predominantly to noise from transportation sources. The key concerns regarding new residential development near existing industrial and/or commercial land uses are:

- *The future occupants of the new noise sensitive development may be subject to adverse effects of noise, and*
- *The existing industrial and/or commercial business may become subject to complaints from future occupants of the new noise sensitive development and at risk of having to modify operations and/or incur additional costs.*

2.14 In the special case where industrial or commercial noise is present on the site but is "not dominant" (i.e. where the impact would be rated as lower than adverse (subject to context) if a BS4142:2014 assessment was to be carried out), its contribution may be included in the noise level used to establish the degree of risk (and if included, this should be clearly stated).

2.15 Where industrial or commercial noise is present on the site and is considered to be "dominant" (i.e. where the impact would be rated as adverse or greater (subject to context) if a BS4142:2014 assessment was to be carried out), then the risk assessment should not be applied to the industrial or commercial noise component and regard should be had to the guidance in BS4142:2014. The judgement on whether or not to undertake a BS4142 assessment to determine dominance should be proportionate to the level of risk. In low risk cases a subjective judgement of dominance, based on audibility, would normally be sufficient.

The Dairygold Co-op site adjoins the developments eastern boundary. This site includes some industrial/commercial use. The baseline noise survey included attended monitoring along this boundary, as well as the provision of a 7-day monitor with continuous audio recording enabled, thus allowing for the listening back of events to establish the extent of industrial sound sources that are audible on the proposed development site. The dominant noise sources observed for day and night-time periods were road traffic from the surrounding public road network. There were occasional sounds from the Dairygold Co-op site which included rolling of trolleys and vehicle movements. In this instance and based upon a subjective judgement of personnel conducting the baseline noise surveys, it is concluded that industrial/commercial noise is audible occasionally, but is "not dominant" at any location across the site. As such the contribution to measured noise levels from any industrial or commercial noise is included in the noise level used to establish the ProPG degree of risk, and a separate BS 4142 assessment of industrial or commercial noise is not required.

5 IMPACT OF EXISTING AND FUTURE NOISE SOURCES ON THE PROPOSED DEVELOPMENT

ProPG outlines a systematic risk based 2 stage approach for evaluating noise exposure on prospective sites for residential development. The two primary stages of the approach can be summarised as follows:

Stage 1 - Comprises a high-level initial noise risk assessment of the proposed site considering either measured and or predicted noise levels, and;

Stage 2 – Involves a full detailed appraisal of the proposed development covering four "key elements" that include:

- Element 1 - Good Acoustic Design Process;
- Element 2 - Noise Level Guidelines;
- Element 3 - External Amenity Area Noise Assessment, and;
- Element 4 - Other Relevant Issues.

ProPG is intended to outline the methodology and findings of the assessments, so as the planning authority can make an informed decision on the permission. ProPG outlines the following possible recommendations in relation to the findings:

A. Planning consent may be granted without any need for noise conditions;
B. Planning consent may be granted subject to the inclusion of suitable noise conditions;
C. Planning consent should be refused on noise grounds in order to avoid significant adverse effects ("avoid"); or,
D. Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects ("prevent").

The following sections present the results of both the Stage 1 and Stage 2 studies.

5.1 ProPG Stage 1 (Initial Noise Risk Assessment)

The initial noise risk assessment is intended to provide an early indication of any acoustic issues that may be encountered. It calls for the categorization of the site as a negligible, low, medium or high risk based on the pre-existing noise environment.

Paragraph 2.9 of ProPG states that,

> *"The noise risk assessment may be based on measurements or prediction (or a combination of both) as appropriate and should aim to describe noise levels over a "typical worst case" 24 hour day either now or in the foreseeable future."*

5.1.1 Calculated Noise from Existing Sources

In assessing typical noise levels currently present on site, reference is made to the baseline nose survey and associated results presented in Section 3.0.

5.1.2 Calculated Noise from Future Sources

In assessing typical noise levels in the "*foreseeable future*", reference is made to the new Carrigaline Western Relief Road (CWRR) which is currently under construction and adjoins the sites western boundary.

In order to assess the potential noise impact of the proposed CWWR, a proprietary road traffic noise model of the site has been developed.

5.1.2.1 Noise Model Details

In order to assess the likely noise emissions from the CWWR, a 3D noise model of the proposed site was developed, using the following information, provided by the design team:

- OS mapping of surrounding environment;
- Layout plans of proposed scheme including boundary treatments, and;
- Supplied traffic data.

The model was developed using a proprietary noise calculation package SoundPLAN. This is an acoustic modelling package for computing noise levels in the vicinity of different types of noise sources. For road traffic noise, the model calculates noise levels in accordance with the UK's *Calculation of Road Traffic Noise* (CRTN - 1988) standard, and the TRL report '*Converting the UK traffic noise index LA10,18h to EU indices for noise mapping*'.

The model takes account of various factors affecting the propagation of sound in accordance with the standard, including:

- The total traffic flow along the road;
- The percentage Heavy Goods Vehicle (% HGV);
- The proposed road surface finish;
- The traffic speed along the road;
- The distance between the source and receiver;
- The presence of obstacles such as screens or barriers in the propagation path;
- The presence of reflecting surfaces;
- The hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption, and
- Meteorological effects such as wind gradient, temperature gradient and humidity.

Noise levels have been modelled to the proposed development site. Noise predictions are made to the various floors of the residential buildings.

5.1.2.2 *Traffic Flow Data*

Martin Hanley Traffic and Transportation Consulting Engineers have provided the traffic data in relation to the CWRR for the following scenarios:

- Base scenario for the year 2021 (i.e. the estimated current traffic flows along the existing roads).
- Do Something for the year 2039 (i.e. all surrounding roads including the Development of CWRR).

Table 10 presents the provided Annual Average Daily Traffic (AADT) traffic flows, along with the expected percentage of Heavy Goods Vehicles (HGV) and traffic speeds (km/h) for the Design Year along the Roads under consideration.

Table 10: Traffic Flow Projections

Road	Year 2039 "Do Something" Scenario		
	AADT	% HGV	Speed Limit (km/h)
Main Street R611	9780	5.2	30
R611 Kilmoney Road	14,402	6.3	50
Western Relief Road	14,573	5.0	30
Internal Link Road	2,439	5.0	30
R613 Ballea Road	19,585	3.0	50
Roundabout Cork Road R611	18,304	3.7	50
Church Road	10,231	3.7	50
R612 Crosshaven Road	21,024	2.3	50

The hourly Diurnal Profiles for HGV and Non-HGV Traffic have been calculated as per the TII *Guidelines for the Treatment of Noise & Vibration in National Road Schemes*, Appendix 1, *Diurnal Profiles for Non-HCV and HCV Traffic*.

5.1.2.3 Predicted Noise Levels

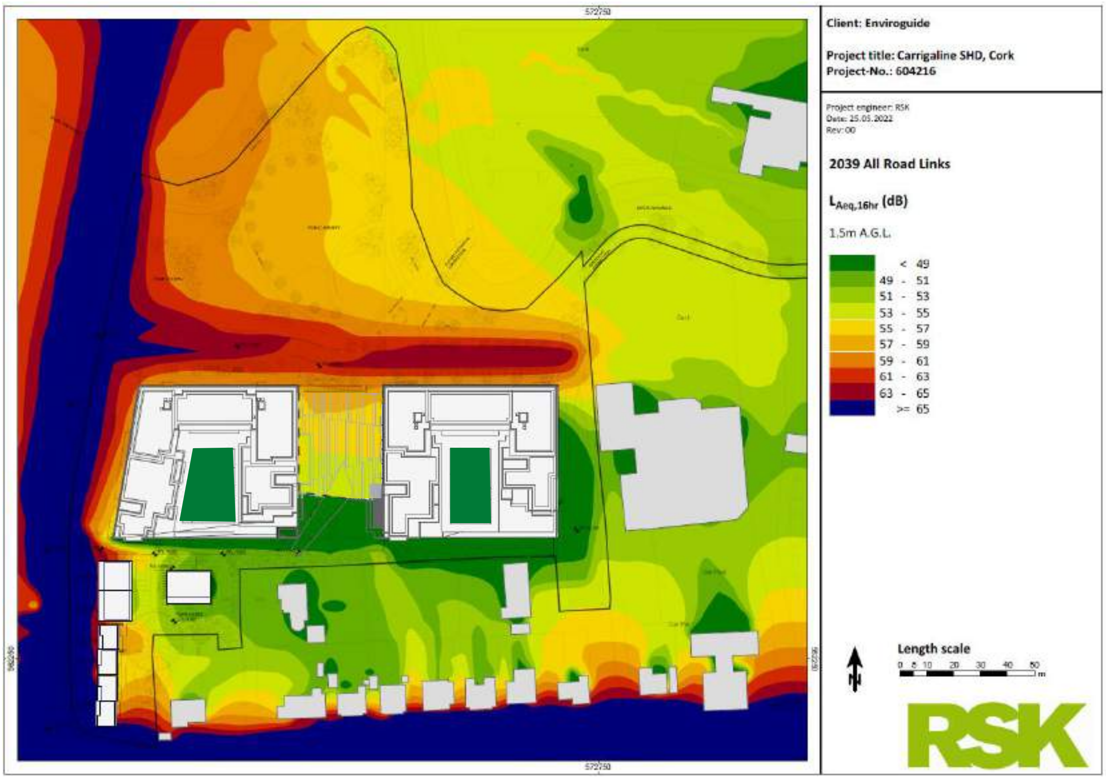
Figures 5 and 6 present the traffic noise prediction contours for daytime and night-time scenarios to the proposed building façades.

Figure 5: Do Something Noise Contour Plot (2039 inc. CWRR): Daytime

Figure 6: Do Something Noise Contour Plot (2039 inc. CWRR): Night-time

Figure 7 present the traffic noise prediction contours for the daytime scenarios to the proposed development lands for the purposes of the analysis of noise levels in external amenity spaces.

Figure 7: Site Plan indicating Communal Amenity Areas

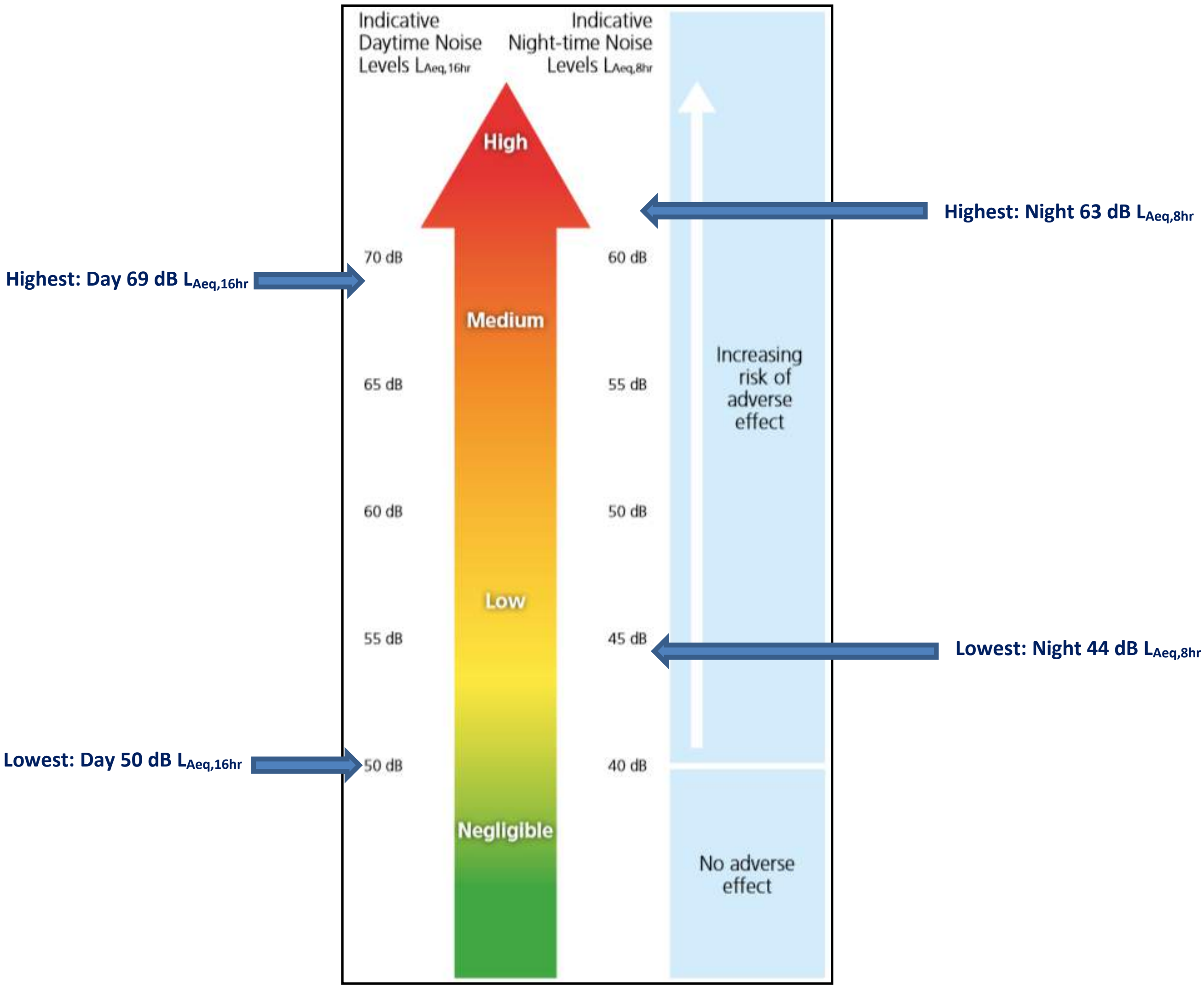


The calculated noise levels from the CWRR are considered to be worst-case, in the event that actual noise levels, post construction from the CWRR are lower than the values projected above, the façade sound insulation performance specification may be reduced, subject to achieving compliance with the BS8233 internal noise level requirements for living, dining and bedrooms.

5.1.3 ProPG Stage 1 Noise Risk Categories

Figure 8 presents the basis of the initial noise risk assessment; it provides appropriate risk categories for a range of continuous noise levels measured and/or predicted on site. The range expected noise levels (including the expected contribution from the CWRR) on the site are indicated on Figure 8.

Figure 8 ProPG Stage 1 - Noise Risk Assessment Categories (Highest expected Site Noise Levels Indicated)



ProPG also states that a site should not be considered a negligible risk if more than 10 L_{AFmax} events exceed 60 dB during the night period and the site should be considered a high risk if the

L_{AFmax} events exceed 80 dB more than 20 times a night. Reference to Figure 3 confirms that 80dB L_{AFmax} was not exceeded on any occasion over the course of the 7-night survey (23:00 – 07:00hrs), thus would not fall within the high risk category.

A Stage 1 noise risk assessment of the proposed site has been conducted, based on measured noise levels on site and expected noise levels on site in the foreseeable future, with comparison to the categories outlined in Figure 8.

With reference to the existing noise levels measured on site (as presented in Tables 4 to 8), the initial ProPG noise risk categories, for the facades most exposed to road traffic noise, are summarised as follows:

Daytime: **Low** to **Medium**

Night-time **Low** to **Medium/High**

5.2 ProPG Stage 2 (Acoustic Design Statement)

With consideration of the Stage 1 review, as presented above, it is considered that the site is suitable for residential development, provided that an appraisal of the proposed development is carried out, covering four key elements that include:

- Element 1 - Good Acoustic Design Process.
- Element 2 - Noise Level Guidelines.
- Element 3 - External Amenity Area Noise Assessment.
- Element 4 - Other Relevant Issues.

5.2.1 Element 1: Good Acoustic Design (GAD) Process

Good acoustic design should aim to deliver optimum acoustic design for a site without adversely affecting amenity or quality of life or compromising other sustainable design objectives ProPG states that good acoustic design is not equivalent to overdesign of all new development but that it seeks to deliver an optimum acoustic environment for a given site. ProPG outlines the following checklist for GAD:

- Check the feasibility of relocating or reducing noise levels from relevant sources.
- Consider options for planning the site or building layout.
- Consider the orientation of proposed building(s).
- Select construction types and methods for meeting building performance requirements.
- Examine the effects of noise control measures on ventilation, fire regulation, health and safety, cost, CDM (construction, design and management) etc.
- Assess the viability of alternative solutions.
- Assess external amenity area noise.

Each item listed above have been addressed in the following sections.

5.2.1.1 *Relocation or Reduction of Noise from Source*

The dominant noise source impacting upon the site is road traffic from existing roads and future noise from the CWRR that is currently under construction. Given that the roads are located outside the site boundary, additional reduction of noise as source cannot be considered in respect of this development.

A reduction in noise emissions to the proposed site can sometimes be achieved via the provision of a perimeter barrier screens. However, the height of the proposed development in relation to surrounding noise sources is such that the effectiveness of a noise barrier will be limited i.e. the proposed development facades will overlook any perimeter acoustic barrier of reasonable height.

5.2.1.2 *Planning, Layout and Orientation*

Development buildings are set back from the nearby transport network in accordance with local planning guidelines. It is considered that the layout and orientation of the proposed development is sufficient in the context of noise emissions and GAD.

5.2.1.3 *Select Construction Types for meeting Building Regulations*

Concrete constructions will be used for external walls of dwellings. Solid concrete constructions provide high levels of sound insulation performance.

Glazing and ventilation paths are typically the weakest façade elements in terms of sound insulation performance. The provision of glazing and ventilators offering an appropriate level of sound insulation will therefore be provided.

Calculation’s indicate that it will possible to achieve the desirable internal acoustic environments when windows are open along the majority of building facades. Additional review of specific locations in provided in the following sections.

It will be necessary to provide habitable rooms with acoustically rated ventilators along the building elevations most exposed to traffic noise. Occupants will have the options to open the windows if they so wish, however, doing so will increase the internal noise level. This approach to mitigation is acknowledged in ProPG, as reproduced below:

> *“2.22 Using fixed unopenable glazing for sound insulation purposes is generally unsatisfactory and should be avoided; occupants generally prefer the ability to have control over the internal environment using openable windows, even if the acoustic conditions would be considered unsatisfactory when open. Solely relying on sound insulation of the building envelope to achieve acceptable acoustic conditions in new residential development, when other methods could reduce the need for this approach, is not regarded as good acoustic design. Any reliance upon building envelope insulation with closed windows should be justified in supporting documents “*
>
> *Note 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in*

the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded

2.34 Where the LPA accepts that there is a justification that the internal target noise levels can only be practically achieved with windows closed, which may be the case in urban areas and at sites adjacent to transportation noise sources, special care must be taken to design the accommodation so that it provides good standards of acoustics, ventilation and thermal comfort without unduly compromising other aspects of the living environment. In such circumstances, internal noise levels can be assessed with windows closed but with any façade openings used to provide "whole dwelling ventilation" in accordance with Building Regulations Approved Document F (e.g. trickle ventilators) in the open position (see Supplementary Document 2). Furthermore, in this scenario the internal L_{Aeq} target noise levels should not generally be exceeded."

It is therefore acceptable to provide building facades with appropriate sound insulation, with windows closed and vents open, that result in a good internal acoustic environment.

5.2.1.4 *Impact of noise control measures on fire, health and safety etc*

The proposed noise control measures do not have a significant impact on fire or other health and safety issues.

5.2.1.5 *Assess Viability of Alternative Solutions*

The major noise sources incident on the site are road traffic. Road traffic is mitigated by the distance from the road edge to the building, screening by existing/proposed structures, off and on-site buildings and orientation of windows. All the measures listed above aid in the control of noise intrusion to the living areas and bedrooms across the majority of the development.

5.2.1.6 *Assess External Amenity Area Noise*

ProPG advises the following in relation to external noise levels in amenity areas:

The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$.

An assessment of noise within external amenity areas is addressed in the relevant section of this document.

5.2.1.7 *GAD Summary*

It is considered that the principles of Good Acoustic Design have been applied to the development.

5.2.2 Element 2: Internal Noise Level Guidelines

5.2.2.1 Internal Noise Criteria

ProPG recommends internal noise targets as derived from BS 8233. These internal noise level targets are presented in Table 9.

ProPG acknowledges that there can be some flexibility given in cases where the development is necessary or desirable, and that a relaxation by up to 5dB of the internal L_{Aeq} values can still provide reasonable internal conditions.

5.2.2.2 Assessed External Noise Levels

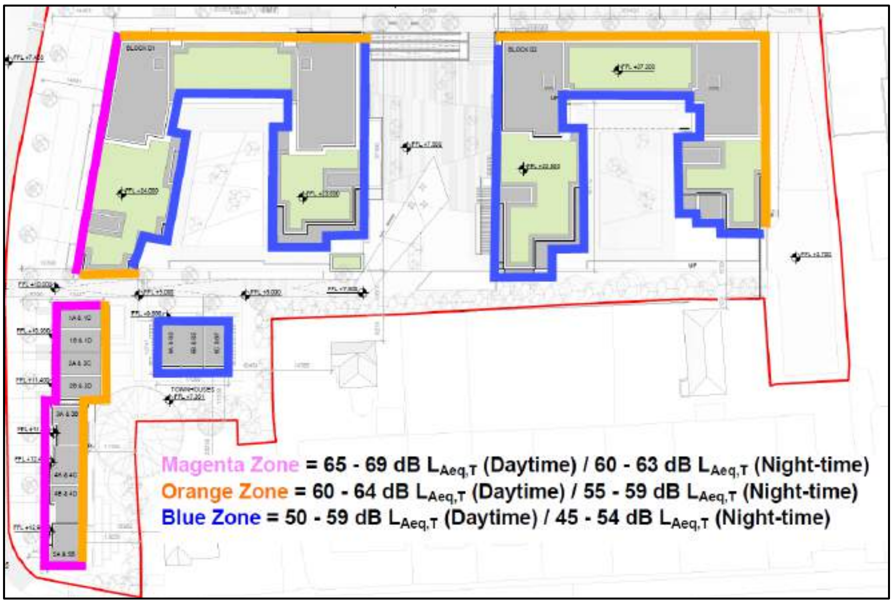
Noise surveys and calculations have been conducted across the site in order to establish the range and magnitude of noise levels at various positions on-site. Table 11 presents the free-field noise levels used for assessment purposes.

Table 11: Projected Traffic Noise Levels at Development Facades

Development Zone (Ref. Figure 9)	Period	Assessment Level (dB $L_{Aeq,T}$)
Zone A (Magenta)	Daytime (07:00 to 23:00)	65 - 69
Zone B (Orange)		60 - 64
Zone C (Blue)		50 - 59
Zone A (Magenta)	Night-time (23:00 to 07:00)	60 - 63
Zone B (Orange)		55 - 59
Zone C (Blue)		45 - 54

Figure 9 indicates the how the noise level zones described above relate to the proposed development façades.

Figure 9: Façade Noise Level Designation



5.2.2.3 *Façade Acoustic Performance Specification*

The methodology to estimate internal noise level within a building is outlined in Annex G of BS 8233: 2014 and is derived from BS EN 12354-3: 2000: B*uilding acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound*. The methodology calculates internal noise levels based on a reference external noise level (i.e. octave band frequency data as measured in baseline noise surveys) and proposed façade constructions. The standard takes into account the following site-specific characteristics:

- External noise level;
- Area and type of each façade element (i.e. window, wall, etc.);
- Shape of the façade, and;
- Characteristics of the receiving room (i.e. room volume, reverberation time etc.)

This method has been used to determine the required sound insulation performance for the various building façade elements.

<u>Glazing</u>

Facades shall be provided with glazing that achieves the following minimum sound insulation performance.

Table 12: Glazing Acoustic Specification (Ref. Figure 9)

Specification (Ref Figure 9)	Sound Reduction Performance Requirements (dB) in Octave Frequency Bands (Hz)						Typical Overall dB R_w
	125	250	500	1k	2k	4k	
Zone A (Magenta)	29	30	38	47	55	61	43
Zone B (Orange)	28	25	36	43	46	47	39
Zone C (Blue)	26	22	27	37	40	37	33

The overall R_w values outlined above are provided for information purposes only. The over-riding requirement is the Octave Band sound insulation performance values.

The acoustic performance specifications are minimum requirements which apply to the overall glazing system. The 'glazing system' is understood to include any and all of the component parts that form part of the glazed element of the façade, i.e. glass, frames, seals, openable elements etc.

The window supplier shall provide laboratory tests confirming the sound insulation performance, (to British Standard 2750 Part 3:1980 and British Standard 5821, or British Standard EN ISO 140 Part 3 1995 and British Standard EN ISO 717, 1997).

Wall / Roof Constructions

Masonry wall and roof constructions with plasterboard linings typically offer sound insulation performance much greater than that offered by the glazed elements.

The calculated internal noise levels across the building façade have assumed a minimum sound reduction index of 55 dB R_w for these constructions. The performance of non-glazed elements of the façade will be confirmed as part of the detailed design phase.

Acoustic Attenuation to Ventilation Systems

Acoustic attenuation to ventilation systems shall be provided to the following rooms:

Table 13: Specification for Acoustic Ventilators to Dwellings (Ref. Figure 9)

Specification	Room Type	Required Overall dB $D_{n,e,w}$
Zone A (Magenta)	Living Room, Dining Rooms and Bedrooms	42
Zone B (Orange)	Living Room, Dining Rooms and Bedrooms	38
Zone C (Blue)	Dining Rooms and Bedrooms	32

The ventilation supplier shall provide evidence, consisting of calculations and/or laboratory tests confirming the acoustic performance of ventilation systems.

5.2.2.4 *Element 3: External Amenity Area Noise Assessment*

It is a ProPG requirement, as part of the acoustic design statement, to assess noise levels within external amenity spaces. ProPG refers to guidance contained in BS 8233 (2014) for this element of the assessment, the relevant extract of BS 8233 (2014) states:

> *"The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 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 as 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 levels in these external amenity spaces, but should not be prohibited."*

BS 8233 also comments that:

> *Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying*

washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space."

In addition, ProPG, Element 3(v) states the following in relation to external amenity areas:

"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:

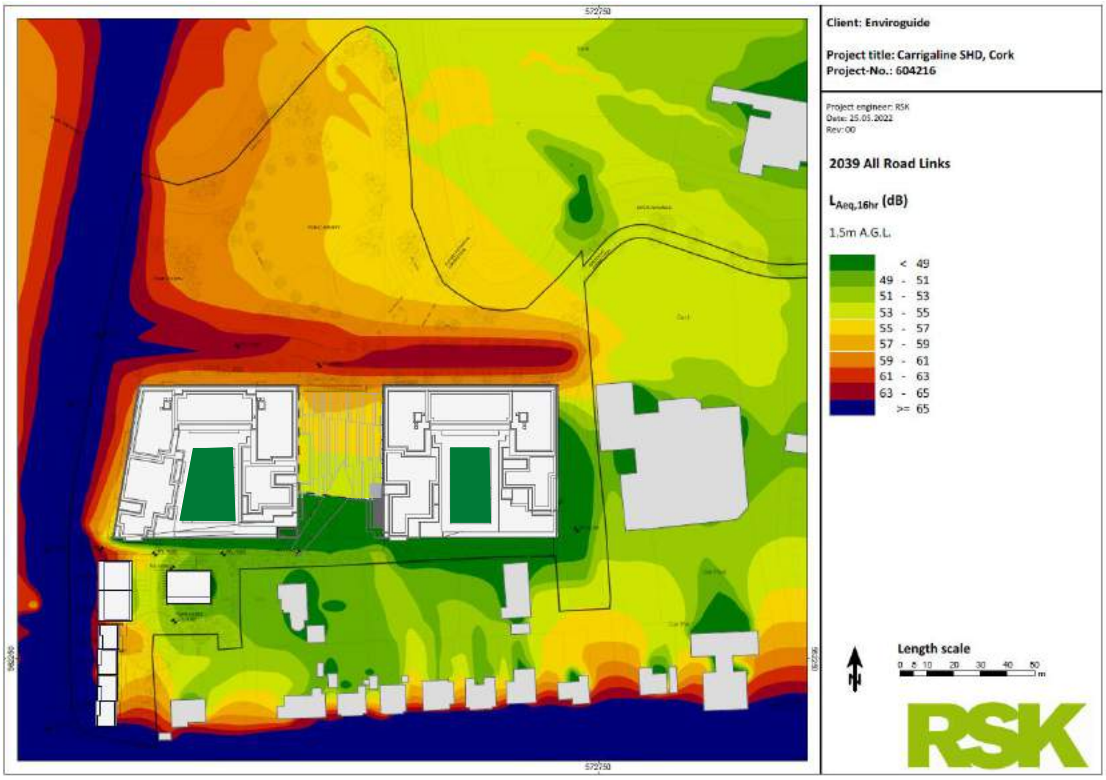
- a relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet *externally ventilated space (i.e. an enclosed balcony) as part of their dwelling; and/or;*
- *a relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or large open balcony in a different, protected, location); and/or;*
- *a relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and/or;*
- *a relatively quiet, protected, publically accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquility) that is nearby (e.g. within a 5 minutes walking distance). The local planning authority could link such provision to the definition and management of Quiet Areas under the Environmental Noise Regulations.*

With consideration of the various open amenity spaces / gardens proposed as part of the development, the following comments are provided:

Proposed External Amenity Areas

There is a public amenity space proposed as part of the development to the north of the proposed site, as well as balconies that are both internal and external facing, and courtyard areas between & within the internal facing courtyard areas of apartment blocks 1 and 2. The external noise levels in these amenity areas are indicated in Figure 10.

Figure 10: Site Plan indicating Expected Noise Levels in External Amenity Areas



The public amenity space to the north of the site, along with outward facing balconies have noise levels that are calculated to exceed the recommended range of noise levels as outlined in ProPG Guidance i.e. *noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,T}$*. There are however, open communal areas in the internal facing courtyard areas of blocks 1 and 2 where daytime noise levels are calculated to fall within the recommended 50 – 55 dB $L_{Aeq,T}$. In addition, the majority of the courtyard area between blocks 1 and 2 has noise levels calculated to fall within the recommended 50 – 55 dB $L_{Aeq,T}$ range outlined in ProPG Guidance.

As such we consider that the intent of ProPG (Ref. Element 3(v)) has been achieved with regard to noise in external amenity areas, as all residents will have access to either:

> *a relatively quiet façade, a relatively quiet alternative or additional external amenity space, a nearby relatively quiet external amenity space for sole use by a limited group of residents, or, a nearby relatively quiet, protected, publically accessible, external amenity space.*

5.2.2.5 *Element 4: Assessment of Other Relevant Issues*

ProPG defines a number of other issues that should be considered and may prove pertinent to the assessment:

- 4(i) compliance with relevant national and local policy
- 4(ii) magnitude and extent of compliance with ProPG
- 4(iii) likely occupants of the development
- 4(iv) acoustic design v unintended adverse consequences
- 4(v) acoustic design v wider planning objectives

Each of the above considerations are discussed below.

Compliance with Relevant National and Local Policy

Section 2 of the Cork County Council *Noise Action Plan 2018 – 2023* provides an overview of existing noise management legislation, regulations and guidance in Ireland at a national, regional and local scale.

Section 2.1.9 of the refers to *Professional Planning Guidance (ProPG) on Planning & Noise: New Residential Development* in order to encourage the use of good acoustic design process in and around proposed new residential development, having regard to national policy. This report has therefore been prepared in compliance with the requirements of national and Local policy.

Magnitude and extent of compliance with ProPG

The following conclusions are made in relation to the magnitude and extent of compliance with ProPG:

- All dwellings have been designed to achieve the good internal noise levels, as specified within ProPG, when windows are closed.
- Dwellings that are screened by the development buildings can achieve good to reasonable internal noise levels with windows partially open.
- The remainder of dwellings can achieve good internal noise levels with windows closed and acoustic ventilators open.
- There is an external amenity space available for use by residents that has been assessed and is determined to be within the ProPG guidance for noise levels in external amenity areas.

It is therefore concluded that the proposed development is in compliance with the requirements of ProPG.

Likely occupants of the development

The development consists of apartments and is designed for the purpose of residential accommodation. The criteria adopted as part of this assessment are based on those recommended for permanent dwellings and are therefore considered robust and appropriate for the occupants.

Acoustic design v unintended adverse consequences

There have not been any unintended adverse consequences identified resulting from the acoustic design and control measures.

Acoustic design v wider planning objectives

Acoustic design has been considered in the context of wider planning objectives, particularly the National Planning Framework 2040. (NPF) The NPF is taken into consideration in the production of local planning policy/guidelines and plans. In following existing local / national guidelines and policies, it is considered that the acoustic design is compliant with wider planning objectives.

6 PLANT NOISE EMISSIONS FROM PROPOSED DEVELOPMENT

Reference is made to BS 4142:2014+A1: 2019 in setting criteria for new mechanical plant items i.e. any proposed extract fans, heat pumps, air conditioning units etc.

Based upon measured day and night-time background sound levels on the site, appropriate plant noise criteria to nearby dwellings are as follows:

- Daytime (07:00 to 23:00hrs) 45 dB $L_{Aeq,1hr}$
- Night-time (23:00 to 07:00hrs) 35 dB $L_{Aeq,15\text{-}min}$

Plant noise emissions should not contain any characteristics that would warrant any acoustic feature penalties under the BS 4142:2014 assessment procedure.

At detailed design stage, noise emissions from new plant servicing the development shall be designed so as not to exceed the above limit values.

7 CONCLUSIONS

RSK Ireland Limited (RSK) was instructed by Reside Investments Ltd to conduct a noise impact assessment and Acoustic Design Statement (ADS) in respect of a proposed SHD at Carrigaline, Co. Cork.

The aim of this study is to assess the potential impacts to future residents and nearby receptors and to provide recommendations, where necessary, to the risk of nuisance arising from operational phase noise emissions.

Baseline monitoring has found pre-existing noise levels are typical of a suburban location in the vicinity of a busy road network. Future noise emissions from the Carrigaline Western Relief Road (CWRR) have been taken into account and resultant expectant future noise levels on site established via modelling.

This report also considers the potential inward impact of road traffic on the proposed development. Assessment methodologies use guidance from *The Professional Guidance on Planning & Noise* (ProPG), May 2017. The two primary stages of the ProPG assessment are the "Stage 1" initial noise risk assessment of the proposed site and "Stage 2" detailed appraisal of the proposed development and preparation of an Acoustic Design Statement.

The site noise survey has also been used to assess the sites noise risk categories, as per the ProPG "Stage 1" assessment. The ProPG noise risk categories, for façades most exposed to road traffic, are **Low** to **Medium** for daytime and **Low** to **Medium**/**High** for night-time periods.

Recommendation to mitigate noise emissions, as specified in the "Stage 2" Acoustic Design Statement, include the following:

- Provision of glazing with minimum sound insulation properties as outlined in this document.
- Provision of acoustic attenuation to ventilation systems for dwellings as outlined in this document.

In the developments operational phase, criteria have also been set for new building services plant in accordance with the methodologies outlined in BS 4142:2014+A1:2019. It has been concluded that the likely noise impact of the developments in its operational phase is not significant.

In summary, it is considered that the site is suitable for residential development subject to the provision of the noise control recommendations as outlined in this report.

APPENDIX A
SERVICE CONSTRAINTS

RSK ENVIRONMENT LIMITED SERVICE CONSTRAINTS

1. This report (the "Services") was compiled and carried out by RSK Ireland Limited (RSK) for Reside Investments Ltd . (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be** well advised to seek independent advice from a competent environmental consultant and/or lawyer.

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

Enviroguide CONSULTING

Appendix F

Verified Photomontages and CGIs of Proposed Development at Carrigaline, Co. Cork

Date: April, 2022

Prepared for:
Hallmark Developments

Prepared by:
G-Net 3D
NSC Campus, Mahon, Cork
Tel: 021-2307043,
info@gnet3d.com

Photomontage Methodology

Photography

The photos for the views were taken on the September 23rd, 2021, February 25th, 2022 and March 21st, 2022. A Canon EOS REBEL T5i camera was used for all the photography.
Leica GS08plus Smart Antenna was used to accurately record the viewpoint coordinates and height levels. Viewpoint locations are indicated in table to the right and viewpoint map on the next page.

Modelling

Preparation of an accurate 3D model of the proposed residential development including landscape and infrastructure.

Setup

The following information is used to accurately position the model of the proposed development into the photographs:
-Site survey,
-Photographs,
-Verified viewpoint coordinates and height levels are accurately marked on the location OSi map.

To match the 3D camera view with the photograph we take the following steps:
The camera height is taken from information gathered on the levels from where the photos are taken (table below). The height levels of the proposed development are outlined on the site. Focal length is based on the photograph EXIF info.

This data is imported into our 3D software and the 3D camera is matched with the selected photographs. To match the 3D camera accurately we use all the above data, and the reference 3D models. The reference 3D models are existing structures i.e., buildings, roads, lamps, etc which are visible on the photographs. These items are modelled based on the survey information. After all the above conditions are fulfilled and we are satisfied that the camera matches correctly, we proceed to the next step.

Rendering

We apply the materials and textures prior to rendering the photomontage images. Light settings are adjusted to match the brightness of the photographs and sun is positioned according to the date and time the photo was taken.

Post processing

This process means incorporating a 3D image of the proposed development into the photograph to achieve the result.

Viewpoint info

View No	Easting	Northing	Orthometric Height (m)	Camera focal length	Date of photography	Time (24h)
V1	572176.52	562848.79	12.34	18mm	23/09/2021	14:10
V2	573025.30	562830.30	11.81	18mm	23/09/2021	11:20
V3	572833.29	562793.76	9.23	18mm	23/09/2021	11:09
V4	572522.70	562650.76	12.74	18mm	23/09/2021	10:45
V5	572787.03	562513.54	2.75	18mm	23/09/2021	11:43
V6	572947.08	562398.74	3.06	18mm	23/09/2021	11:51
V7	572586.76	562531.07	5.09	18mm	23/09/2021	15:41
V8	572497.15	562203.29	15.45	18mm	23/09/2021	12:44
V9	572832.07	562218.69	6.20	18mm	23/09/2021	12:15
V10	572091.70	562235.46	9.91	35mm	23/09/2021	13:08
V11	572402.66	561993.44	40.25	35mm	23/09/2021	13:24
V12	572899.92	561908.02	33.59	18mm	23/09/2021	13:42
V13	572603.006	562204.845	12.081	18mm	25/02/2022	11:53
V14	572691.962	562206.794	10.406	18mm	21/03/2022	14:40
V15	572777.155	562213.044	8.136	18mm	25/02/2022	11:38
V16	572819.662	562271.865	4.712	18mm	25/02/2022	11:31
V17	572813.967	562386.540	2.535	18mm	25/02/2022	11:23

PHOTOMONTAGE VIEWPOINT MAP

NET3D

View 1. Existing

View 1. Proposed. Red outline indicates the location of proposed development

View 2. Existing

View 2. Proposed. Red outline indicates the location of proposed development

View 3. Existing

View 3. Proposed. Red outline indicates the location of proposed development

NET3D

View 4. Existing

View 4. Proposed. Red outline indicates the location of proposed development

View 5. Existing

NET3D

View 5. Proposed

View 6. Existing

View 6. Proposed. Red outline indicates the location of proposed development

View 7. Existing

View 7. Proposed

View 8. Existing

NET3D

View 8. Proposed

View 9. Existing

NET3D

View 9. Proposed

NET3D

View 10. Existing

View 10. Proposed

View 11. Existing

View 11. Proposed. Red outline indicates the location of proposed development

View 12. Existing

View 12. Proposed. Red outline indicates the location of proposed development

View 13. Existing

View 13. Proposed

View 14. Existing

View 14. Proposed

View 15. Existing

View 15. Proposed

NET3D

View 16. Existing

View 16. Proposed

NET3D

View 17. Existing

View 17. Proposed

NET3D

CGI Viewpoint Map

CGI View 1

NET 3D

CGI View 2

CGI View 3

CGI View 4

CGI View 5

NET3D

CGI View 6

CGI View 7

NET3D

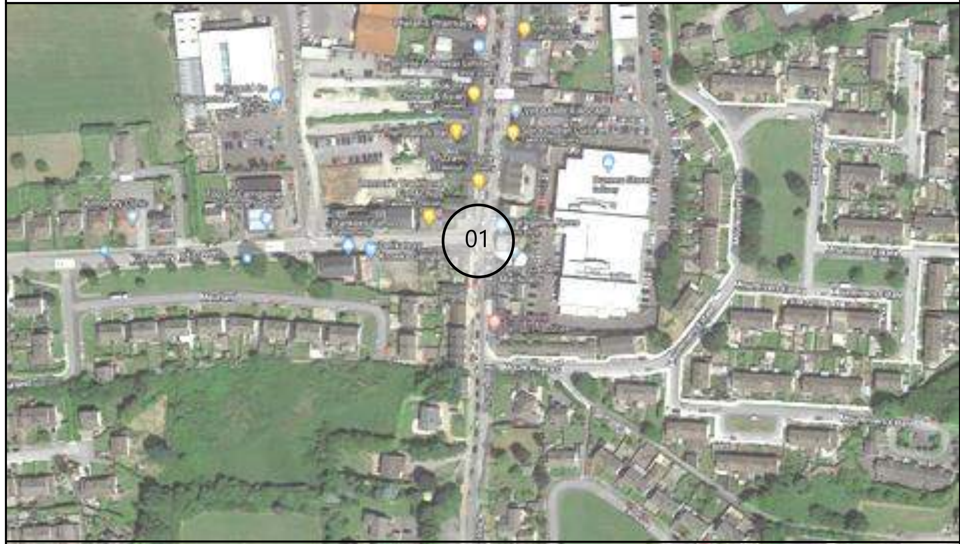
Appendix G

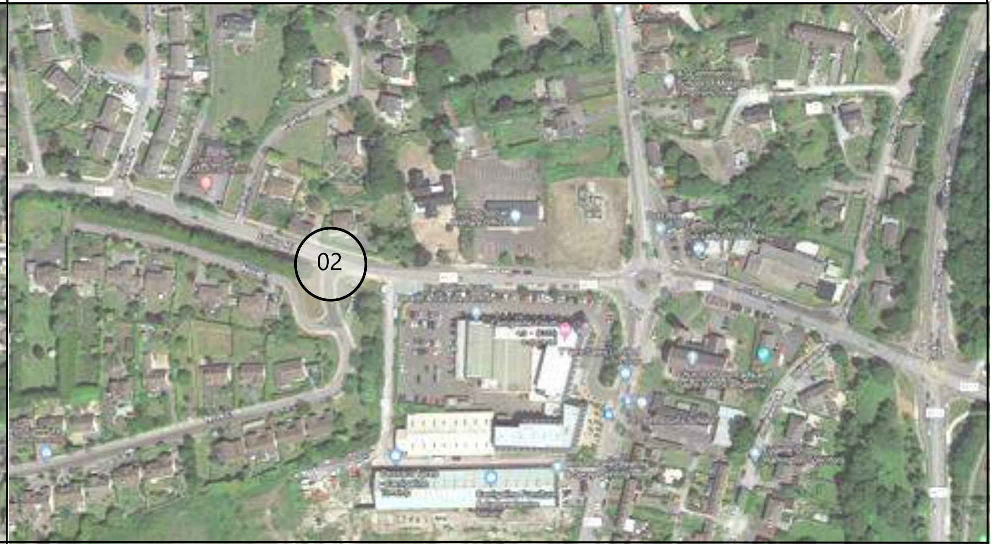
12.0 Appendices

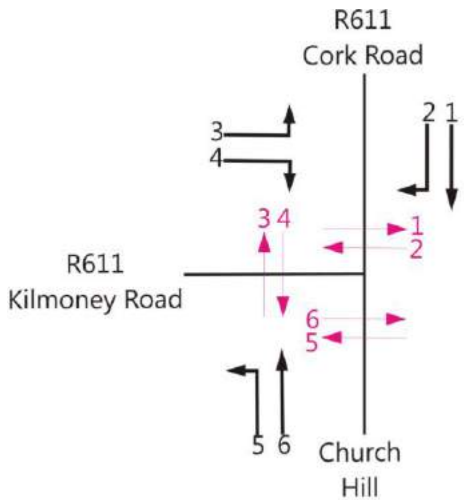
12.0 Appendix A – Traffic Count Data

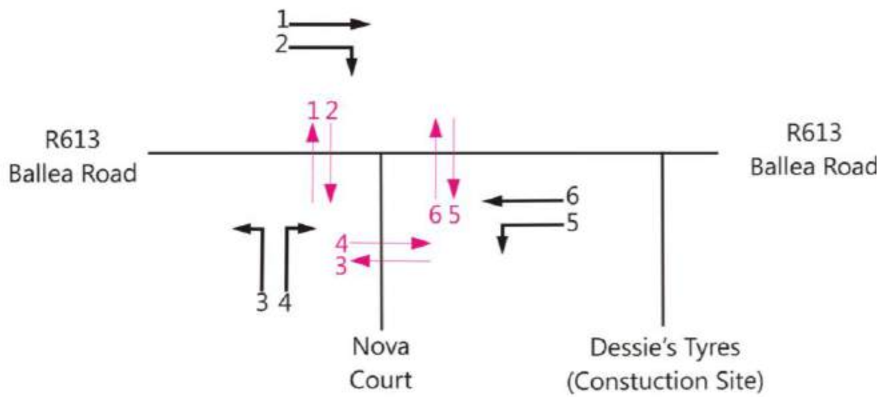
Traffic Counts 2021 & Cork County Council Traffic Counts 2018

Site 01	Site 02









	Job number: TRA/21/156	Job date: 16th September 2021	Drawing No: TRA/21/156-01	traffinomics ie
	Client: Martin Hanley Consulting Engineers	Job day Thursday	Author: SPW	

CARRIGALINE TRAFFIC COUNTS **SEPTEMBER 2021**

MANUAL CLASSIFIED JUNCTION TURNING COUNTS **TRA/21/156**

SITE: 01 DATE: 16th September 2021

LOCATION: R611/Church Hill DAY: Thursday

	MOVEMENT 1								MOVEMENT 2								MOVEMENT 3							
TIME	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**
07:30	0	0	17	10	0	0	27	27	0	0	33	11	3	2	49	54	0	0	67	11	7	2	87	96
07:45	0	0	18	9	3	1	31	35	0	0	21	6	0	0	27	27	1	0	68	12	3	1	85	88
08:00	0	0	42	8	2	0	52	54	1	0	29	4	3	1	38	41	2	0	87	12	3	4	108	113
08:15	0	0	38	4	2	0	44	46	0	0	34	6	0	2	42	44	4	0	128	6	5	2	145	149
H/TOT	0	0	115	31	7	1	154	162	1	0	117	27	6	5	156	166	7	0	350	41	18	9	425	446
08:30	0	0	33	6	1	0	40	41	1	0	47	3	1	0	52	52	1	0	118	8	4	1	132	136
08:45	0	0	49	6	3	0	58	61	1	0	61	4	3	0	69	71	0	0	75	9	1	1	86	88
09:00	0	0	42	5	0	0	47	47	0	0	55	8	5	1	69	75	0	0	66	8	4	1	79	84
09:15	0	0	28	5	1	0	34	35	1	0	51	11	3	3	69	74	2	0	73	12	5	0	92	95
H/TOT	0	0	152	22	5	0	179	184	3	0	214	26	12	4	259	273	3	0	332	37	14	3	389	404
P/TOT	0	0	267	53	12	1	333	346	4	0	331	53	18	9	415	439	10	0	682	78	32	12	814	850

	MOVEMENT 1								MOVEMENT 2								MOVEMENT 3							
TIME	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**
16:30	1	0	58	11	0	1	71	71	0	0	60	14	3	2	79	84	0	0	81	16	4	1	102	107
16:45	1	0	56	3	1	0	61	61	0	0	63	11	3	2	79	84	0	0	89	12	1	1	103	105
17:00	0	0	58	9	0	0	67	67	1	1	67	10	2	1	82	84	0	0	84	14	1	1	100	102
17:15	0	0	57	6	1	0	64	65	1	0	80	8	3	0	92	94	2	1	93	13	2	1	112	113
H/TOT	2	0	229	29	2	1	263	264	2	1	270	43	11	5	332	346	2	1	347	55	8	4	417	427
17:30	0	0	71	6	0	0	77	77	0	0	90	5	1	2	98	101	0	0	85	9	0	1	95	96
17:45	0	1	68	11	1	0	81	81	0	0	77	6	0	0	83	83	0	0	70	9	0	1	80	81
18:00	0	0	74	14	0	0	88	88	0	0	82	3	1	0	86	87	0	0	106	10	1	0	117	118
18:15	0	0	60	7	0	0	67	67	0	0	74	7	0	2	83	85	1	0	83	8	1	1	94	95
H/TOT	0	1	273	38	1	0	313	313	0	0	323	21	2	4	350	356	1	0	344	36	2	3	386	390
P/TOT	2	1	502	67	3	1	576	578	2	1	593	64	13	9	682	702	3	1	691	91	10	7	803	817

TRAFFINOMICS LIMITED

CARRIGALINE TRAFFIC COUNTS **SEPTEMBER 2021**

MANUAL CLASSIFIED JUNCTION TURNING COUNTS **TRA/21/156**

SITE: 01 DATE: 16th September 2021

LOCATION: R611/Church Hill DAY: Thursday

	MOVEMENT 4								MOVEMENT 5								MOVEMENT 6							
TIME	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**
07:30	0	0	2	1	0	0	3	3	0	0	7	2	0	0	9	9	0	1	47	7	2	1	58	60
07:45	0	0	3	1	0	0	4	4	0	0	1	5	0	0	6	6	0	0	52	12	0	0	64	64
08:00	0	0	15	2	0	0	17	17	0	0	3	2	0	0	5	5	0	0	61	2	1	0	64	65
08:15	0	0	5	0	0	0	5	5	0	0	3	0	0	0	3	3	3	0	65	3	0	0	71	69
H/TOT	0	0	25	4	0	0	29	29	0	0	14	9	0	0	23	23	3	1	225	24	3	1	257	258
08:30	0	0	2	2	0	0	4	4	0	0	3	0	0	0	3	3	1	0	65	9	2	0	77	78
08:45	0	0	4	0	0	0	4	4	0	0	5	2	1	0	8	9	0	0	35	5	0	0	40	40
09:00	0	0	2	1	0	0	3	3	0	0	8	0	0	0	8	8	0	0	43	7	3	0	53	56
09:15	0	0	9	1	0	0	10	10	0	0	5	1	0	0	6	6	0	0	55	3	0	0	58	58
H/TOT	0	0	17	4	0	0	21	21	0	0	21	3	1	0	25	26	1	0	198	24	5	0	228	232
P/TOT	0	0	42	8	0	0	50	50	0	0	35	12	1	0	48	49	4	1	423	48	8	1	485	490

	MOVEMENT 4								MOVEMENT 5								MOVEMENT 6							
TIME	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**
16:30	0	1	7	0	0	0	8	7	0	0	6	0	0	0	6	6	1	0	38	6	0	1	46	46
16:45	0	0	6	2	1	0	9	10	0	0	7	1	0	0	8	8	0	0	32	4	1	0	37	38
17:00	0	0	2	3	0	0	5	5	1	0	9	2	1	0	13	13	0	0	25	7	0	0	32	32
17:15	0	0	10	0	0	0	10	10	0	0	8	1	0	0	9	9	0	0	33	4	0	0	37	37
H/TOT	0	1	25	5	1	0	32	32	1	0	30	4	1	0	36	36	1	0	128	21	1	1	152	153
17:30	0	0	9	0	0	0	9	9	0	0	6	0	1	0	7	8	0	0	35	4	0	0	39	39
17:45	0	0	7	2	1	0	10	11	0	0	8	0	0	0	8	8	0	0	32	5	1	0	38	39
18:00	0	0	6	2	1	0	9	10	0	0	7	2	0	0	9	9	1	0	41	3	0	0	45	44
18:15	0	0	10	0	0	0	10	10	0	0	3	1	0	0	4	4	0	0	30	1	1	1	33	35
H/TOT	0	0	32	4	2	0	38	40	0	0	24	3	1	0	28	29	1	0	138	13	2	1	155	157
P/TOT	0	1	57	9	3	0	70	72	1	0	54	7	2	0	64	65	2	0	266	34	3	2	307	310

CARRIGALINE TRAFFIC COUNTS **SEPTEMBER 2021**

MANUAL CLASSIFIED JUNCTION TURNING COUNTS **TRA/21/156**

SITE: 01 DATE: 16th September 2021

LOCATION: R611/Church Hill DAY: Thursday

PCU's Through Junction		PEDESTRIAN COUNT MOVEMENTS					
		P1	**P2**	**P3**	**P4**	**P5**	**P6**
249	07:30	0	0	2	1	0	0
224	07:45	0	0	3	0	0	2
296	08:00	0	1	11	0	0	0
315	08:15	0	0	20	2	1	4
1085	**H/TOT**	0	1	36	3	1	6
315	08:30	0	0	8	0	0	3
273	08:45	1	0	5	2	0	0
273	09:00	0	0	6	5	0	0
279	09:15	0	0	6	4	0	0
1139	**H/TOT**	1	0	25	11	0	3
2224	**P/TOT**	1	1	61	14	1	9

PCU's Through Junction		PEDESTRIAN COUNT MOVEMENTS					
		P1	**P2**	**P3**	**P4**	**P5**	**P6**
322	16:30	0	0	12	5	1	2
306	16:45	0	0	7	5	1	1
303	17:00	0	0	10	4	5	1
328	17:15	0	0	5	5	2	0
1259	**H/TOT**	0	0	34	19	9	4
330	17:30	0	0	4	4	6	1
303	17:45	0	0	6	5	11	6
356	18:00	0	1	7	3	5	5
296	18:15	0	0	7	2	4	2
1286	**H/TOT**	0	1	24	14	26	14
2545	**P/TOT**	0	1	58	33	35	18

CARRIGALINE TRAFFIC COUNTS **SEPTEMBER 2021**

MANUAL CLASSIFIED JUNCTION TURNING COUNTS **TRA/21/156**

SITE: 02 DATE: 16th September 2021

LOCATION: R613/Access to Dessie's Tyres DAY: Thursday

	MOVEMENT 1								MOVEMENT 2								MOVEMENT 3							
TIME	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**
07:30	0	0	57	6	0	0	63	63	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
07:45	0	0	59	9	5	0	73	78	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
08:00	1	0	82	5	1	1	90	91	0	0	0	1	0	0	1	1	0	0	1	0	0	0	1	1
08:15	1	0	98	7	1	0	107	107	0	0	1	0	0	0	1	1	0	0	2	0	0	0	2	2
H/TOT	2	0	296	27	7	1	333	339	0	0	1	1	0	0	2	2	0	0	4	1	0	0	5	5
08:30	0	0	100	6	2	1	109	112	0	0	1	1	0	0	2	2	2	0	1	0	0	0	3	1
08:45	1	0	62	6	1	0	70	70	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
09:00	0	0	78	8	4	0	90	94	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
09:15	0	0	46	9	2	0	57	59	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
H/TOT	1	0	286	29	9	1	326	335	0	0	1	1	0	0	2	2	3	0	1	2	0	0	6	4
P/TOT	3	0	582	56	16	2	659	675	0	0	2	2	0	0	4	4	3	0	5	3	0	0	11	9

	MOVEMENT 1								MOVEMENT 2								MOVEMENT 3							
TIME	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**
16:30	0	0	65	7	1	0	0	74	0	0	2	0	0	0	2	2	0	0	0	0	0	0	0	0
16:45	0	0	64	12	5	0	81	86	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0
17:00	1	0	79	12	1	0	93	93	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	1
17:15	0	1	63	10	0	0	74	73	0	0	1	0	0	0	1	1	0	0	2	0	0	0	2	2
H/TOT	1	1	271	41	7	0	321	327	0	0	5	0	0	0	5	5	0	0	3	0	0	0	3	3
17:30	0	0	59	4	1	0	64	65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	1	0	78	5	1	0	85	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	1	0	91	7	0	0	99	98	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0
18:15	0	0	62	5	0	1	68	69	0	0	2	0	0	0	2	2	0	0	0	0	0	0	0	0
H/TOT	2	0	290	21	2	1	316	317	0	0	3	0	0	0	3	3	0	0	0	0	0	0	0	0
P/TOT	3	1	561	62	9	1	637	644	0	0	8	0	0	0	8	8	0	0	3	0	0	0	3	3

TRAFFINOMICS LIMITED

CARRIGALINE TRAFFIC COUNTS **SEPTEMBER 2021**

MANUAL CLASSIFIED JUNCTION TURNING COUNTS **TRA/21/156**

SITE: 02 DATE: 16th September 2021

LOCATION: R613/Access to Dessie's Tyres DAY: Thursday

	MOVEMENT 4								MOVEMENT 5								MOVEMENT 6							
TIME	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**
07:30	0	0	2	0	0	0	2	2	0	0	2	0	0	0	2	2	0	0	42	7	5	0	54	59
07:45	0	0	2	0	0	0	2	2	0	0	1	0	0	0	1	1	1	0	39	6	0	1	47	47
08:00	0	0	2	1	0	0	3	3	0	0	1	3	0	0	4	4	0	0	67	9	6	0	82	88
08:15	0	0	3	0	0	0	3	3	0	0	1	0	0	0	1	1	0	0	72	4	3	0	79	82
H/TOT	0	0	9	1	0	0	10	10	0	0	5	3	0	0	8	8	1	0	220	26	14	1	262	276
08:30	2	0	3	0	0	0	5	3	0	0	2	0	0	0	2	2	0	0	75	8	1	0	84	85
08:45	0	0	0	1	0	0	1	1	0	0	2	1	0	0	3	3	0	0	77	10	1	1	89	91
09:00	0	0	2	0	0	0	2	2	0	0	2	1	0	0	3	3	0	0	58	9	2	0	69	71
09:15	0	0	1	0	0	0	1	1	0	0	3	0	1	0	4	5	1	0	45	8	1	0	55	55
H/TOT	2	0	6	1	0	0	9	7	0	0	9	2	1	0	12	13	1	0	255	35	5	1	297	302
P/TOT	2	0	15	2	0	0	19	17	0	0	14	5	1	0	20	21	2	0	475	61	19	2	559	578

	MOVEMENT 4								MOVEMENT 5								MOVEMENT 6							
TIME	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**	**PCL**	**MCL**	**CAR**	**LGV**	**HGV**	**BUS**	**TOT**	**PCU**
16:30	1	0	3	0	0	0	4	3	0	0	4	0	0	1	5	6	1	0	72	12	3	0	88	90
16:45	0	0	3	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	78	7	0	0	85	85
17:00	0	0	7	1	0	0	8	8	0	0	5	0	0	0	5	5	0	0	87	10	1	0	98	99
17:15	0	0	2	1	0	0	3	3	0	0	0	1	0	1	2	3	1	0	84	8	1	0	94	94
H/TOT	1	0	15	2	0	0	18	17	0	0	9	1	0	2	12	14	2	0	321	37	5	0	365	368
17:30	2	0	1	0	0	0	3	1	0	0	3	0	0	0	3	3	1	2	82	11	3	0	99	100
17:45	1	0	1	0	0	0	2	1	0	0	3	0	0	0	3	3	0	0	88	7	0	0	95	95
18:00	0	0	1	0	0	0	1	1	0	0	3	0	0	0	3	3	0	0	73	5	1	0	79	80
18:15	0	0	3	0	0	0	3	3	0	0	4	0	0	0	4	4	1	1	60	9	0	0	71	70
H/TOT	3	0	6	0	0	0	9	7	0	0	13	0	0	0	13	13	2	3	303	32	4	0	344	345
P/TOT	4	0	21	2	0	0	27	24	0	0	22	1	0	2	25	27	4	3	624	69	9	0	709	713

TRAFFINOMICS LIMITED

CARRIGALINE TRAFFIC COUNTS **SEPTEMBER 2021**

MANUAL CLASSIFIED JUNCTION TURNING COUNTS **TRA/21/156**

SITE: 02 DATE: 16th September 2021

LOCATION: R613/Access to Dessie's Tyres DAY: Thursday

PCU's Through Junction		**PEDESTRIAN COUNT MOVEMENTS**					
		P1	**P2**	**P3**	**P4**	**P5**	**P6**
127	07:30	0	0	1	5	0	0
129	07:45	0	0	1	5	2	0
188	08:00	1	1	2	6	0	0
196	08:15	0	0	28	11	0	0
641	**H/TOT**	1	1	32	27	2	0
206	08:30	0	0	30	36	1	2
165	08:45	0	0	12	26	2	0
171	09:00	0	1	2	9	0	0
121	09:15	1	0	3	49	0	0
663	**H/TOT**	1	1	47	120	3	2
1304	**P/TOT**	2	2	79	147	5	2

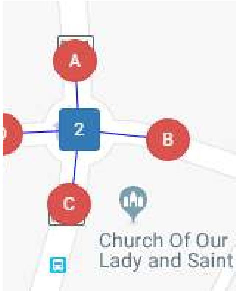
PCU's Through Junction		**PEDESTRIAN COUNT MOVEMENTS**					
		P1	**P2**	**P3**	**P4**	**P5**	**P6**
175	16:30	0	0	2	2	0	0
175	16:45	0	1	8	2	0	0
207	17:00	0	0	9	2	0	0
177	17:15	0	0	13	4	1	0
734	**H/TOT**	0	1	32	10	1	0
169	17:30	0	0	3	0	0	0
184	17:45	0	0	11	5	0	0
183	18:00	1	1	2	4	0	0
148	18:15	0	0	4	0	0	0
685	**H/TOT**	1	1	20	9	0	0
1419	**P/TOT**	1	2	52	19	1	0

IDASO

Survey Name : IDA-18-060 Carrigaline
Site : 2
Date : 01/05/18
Location : Cork Rd (R611) / Church Rd (R613) / Ballea Rd (R613)

	A=>A									A=>B					
TIME	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2
07:00	0	0	1	0	0	0	0	1	1	0	0	17	6	1	0
07:15	0	0	0	0	0	0	0	0	0	1	0	11	5	0	0
07:30	0	0	1	0	0	0	0	1	1	0	0	14	5	1	0
07:45	0	0	0	0	0	0	0	0	0	0	0	17	3	0	0
H/TOT	0	0	2	0	0	0	0	2	2	1	0	59	19	2	0
08:00	0	0	0	0	0	0	0	0	0	0	0	21	5	0	0
08:15	0	0	1	0	0	0	0	1	1	0	0	22	0	0	0
08:30	0	0	0	0	0	0	0	0	0	0	0	36	0	0	0
08:45	0	0	0	0	0	0	0	0	0	1	0	34	3	1	0
H/TOT	0	0	1	0	0	0	0	1	1	1	0	113	8	1	0
09:00	0	0	1	0	0	0	0	1	1	0	0	16	3	0	0
09:15	0	0	3	0	0	0	0	3	3	0	0	29	1	1	0
09:30	0	0	1	0	0	0	0	1	1	0	0	22	3	1	0
09:45	0	0	0	0	0	0	0	0	0	0	0	14	1	2	0
H/TOT	0	0	5	0	0	0	0	5	5	0	0	81	8	4	0
10:00	0	0	2	0	0	0	0	2	2	0	0	11	3	0	1
10:15	0	0	0	0	0	0	0	0	0	0	0	11	3	0	0
10:30	0	0	2	0	0	0	0	2	2	0	0	16	6	0	0
10:45	0	0	3	0	0	0	0	3	3	0	0	14	2	1	0
H/TOT	0	0	7	0	0	0	0	7	7	0	0	52	14	1	1
11:00	0	0	1	1	0	0	0	2	2	0	0	14	3	0	0
11:15	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0
11:30	0	0	0	0	0	0	0	0	0	0	0	20	4	0	0
11:45	0	0	0	0	0	0	0	0	0	0	0	19	0	0	0
H/TOT	0	0	1	1	0	0	0	2	2	0	0	67	7	0	0
12:00	0	0	2	0	0	0	0	2	2	0	0	16	2	0	1
12:15	0	0	1	0	0	0	0	1	1	0	0	14	1	0	0
12:30	0	0	1	1	0	0	0	2	2	0	0	21	3	0	0
12:45	0	0	4	1	0	0	0	5	5	0	0	24	6	1	0
H/TOT	0	0	8	2	0	0	0	10	10	0	0	75	12	1	1
13:00	0	0	0	0	0	0	0	0	0	0	0	33	3	0	0
13:15	0	0	1	0	0	0	0	1	1	0	0	28	1	0	0
13:30	0	0	3	0	0	0	0	3	3	0	0	23	3	0	0
13:45	0	0	5	0	0	0	0	5	5	0	0	16	3	0	0
H/TOT	0	0	9	0	0	0	0	9	9	0	0	100	10	0	0
14:00	0	0	5	0	0	0	0	5	5	0	0	19	1	0	0
14:15	0	0	0	0	0	0	0	0	0	0	0	21	1	0	0

14:30	0	0	2	0	0	0	0	2	2	0	0	26	1	0	0
14:45	0	0	0	0	0	0	0	0	0	0	0	34	0	0	0
H/TOT	0	0	7	0	0	0	0	7	7	0	0	100	3	0	0
15:00	0	0	1	0	0	0	0	1	1	0	0	13	4	0	0
15:15	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0
15:30	0	0	1	0	0	0	0	1	1	0	0	22	3	0	0
15:45	0	0	1	0	0	0	0	1	1	0	0	25	0	1	0
H/TOT	0	0	3	0	0	0	0	3	3	0	0	82	7	1	0
16:00	0	0	5	0	0	0	0	5	5	0	0	24	0	1	0
16:15	0	0	3	0	0	1	0	4	5.3	0	0	22	4	0	0
16:30	0	0	1	0	0	0	0	1	1	0	0	31	2	0	0
16:45	0	0	4	0	0	0	0	4	4	0	0	26	3	1	0
H/TOT	0	0	13	0	0	1	0	14	15.3	0	0	103	9	2	0
17:00	0	0	0	0	0	0	0	0	0	0	0	20	2	0	0
17:15	0	0	1	0	0	0	0	1	1	0	0	19	2	0	0
17:30	0	0	0	1	0	0	0	1	1	0	0	18	0	0	0
17:45	0	0	2	1	0	0	0	3	3	0	0	24	1	0	0
H/TOT	0	0	3	2	0	0	0	5	5	0	0	81	5	0	0
18:00	0	0	0	1	0	0	0	1	1	0	0	18	0	0	0
18:15	0	0	1	1	0	0	0	2	2	0	0	14	2	0	0
18:30	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0
18:45	0	0	1	0	0	0	0	1	1	0	0	28	0	0	0
H/TOT	0	0	2	2	0	0	0	4	4	0	0	78	2	0	0
12 TOT	0	0	61	7	0	1	0	69	70.3	2	0	991	104	12	2



			A=>C									A=>D			
SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV
0	24	24.5	0	0	19	11	1	0	1	32	33.5	0	0	4	1
0	17	16.2	0	0	22	8	2	0	1	33	35	0	0	6	1
0	20	20.5	0	0	22	6	0	0	1	29	30	0	0	8	1
0	20	20	0	0	46	12	0	1	1	60	62.3	0	0	16	2
0	81	81.2	0	0	109	37	3	1	4	154	160.8	0	0	34	5
0	26	26	0	0	37	7	1	0	2	47	49.5	0	0	32	0
0	22	22	0	0	52	8	2	0	0	62	63	2	0	45	0
0	36	36	0	0	65	10	1	0	0	76	76.5	0	0	28	1
0	39	38.7	0	0	75	5	3	0	1	84	86.5	0	0	36	3
0	123	122.7	0	0	229	30	7	0	3	269	275.5	2	0	141	4
0	19	19	0	0	59	16	1	1	1	78	80.8	0	0	29	5
0	31	31.5	0	0	57	8	1	2	1	69	73.1	0	0	15	1
0	26	26.5	0	0	60	7	2	0	4	73	78	0	0	18	2
0	17	18	0	0	65	8	0	0	0	73	73	0	0	23	1
0	93	95	0	0	241	39	4	3	6	293	304.9	0	0	85	9
0	15	16.3	0	0	61	14	0	1	1	77	79.3	0	0	25	1
0	14	14	0	0	53	9	1	2	0	65	68.1	1	0	13	2
0	22	22	0	0	66	6	1	0	2	75	77.5	0	0	17	2
0	17	17.5	0	0	65	11	0	0	0	76	76	0	0	10	2
0	68	69.8	0	0	245	40	2	3	3	293	300.9	1	0	65	7
0	17	17	0	0	57	12	0	1	1	71	73.3	0	0	14	6
0	14	14	0	1	74	10	0	1	1	87	88.7	0	0	11	6
0	24	24	0	0	60	6	0	0	1	67	68	0	0	20	1
0	19	19	0	1	62	10	2	1	0	76	77.7	0	0	26	1
0	74	74	0	2	253	38	2	3	3	301	307.7	0	0	71	14
0	19	20.3	0	0	76	9	1	2	1	89	93.1	0	0	14	2
0	15	15	0	0	76	5	0	1	1	83	85.3	0	0	16	3
0	24	24	1	0	64	13	4	0	1	83	85.2	0	0	23	2
0	31	31.5	0	0	77	15	0	0	0	92	92	0	0	27	2
0	89	90.8	1	0	293	42	5	3	3	347	355.6	0	0	80	9
0	36	36	0	0	67	14	1	1	1	84	86.8	0	0	28	1
0	29	29	0	0	65	9	0	0	1	75	76	0	0	22	3
0	26	26	0	0	69	13	0	0	0	82	82	0	0	26	3
0	19	19	0	0	78	7	0	1	1	87	89.3	0	0	26	1
0	110	110	0	0	279	43	1	2	3	328	334.1	0	0	102	8
0	20	20	0	1	67	5	1	0	2	76	77.9	0	0	19	0
0	22	22	0	0	84	4	1	0	1	90	91.5	0	0	7	0

0	27	27	0	0	77	8	2	0	0	87	88	0	0	21	2
0	34	34	0	0	65	8	1	0	1	75	76.5	0	0	34	1
0	103	103	0	1	293	25	5	0	4	328	333.9	0	0	81	3
0	17	17	0	0	65	7	1	0	0	73	73.5	0	0	24	1
0	22	22	0	1	61	10	0	0	2	74	75.4	0	0	29	1
0	25	25	0	0	54	11	0	1	1	67	69.3	0	0	31	3
0	26	26.5	0	3	76	7	3	0	1	90	90.7	0	0	32	4
0	90	90.5	0	4	256	35	4	1	4	304	308.9	0	0	116	9
1	26	27.5	0	0	83	9	1	0	0	93	93.5	0	0	32	2
0	26	26	0	0	63	3	0	0	2	68	70	0	0	33	4
0	33	33	0	1	65	8	3	0	2	79	81.9	0	1	29	1
0	30	30.5	0	0	89	7	0	0	3	99	102	0	0	36	3
1	115	117	0	1	300	27	4	0	7	339	347.4	0	1	130	10
0	22	22	0	0	50	11	1	1	0	63	64.8	0	0	43	2
0	21	21	0	0	99	8	0	0	0	107	107	0	0	30	1
0	18	18	0	0	87	8	1	1	1	98	100.8	0	1	33	3
0	25	25	0	0	84	7	0	1	1	93	95.3	0	1	45	3
0	86	86	0	0	320	34	2	3	2	361	367.9	0	2	151	9
0	18	18	0	0	74	6	3	0	1	84	86.5	0	0	40	1
0	16	16	0	0	80	6	0	0	1	87	88	0	0	31	4
0	18	18	0	0	95	9	0	1	0	105	106.3	1	0	42	4
0	28	28	0	1	81	3	2	0	0	87	87.4	0	0	34	3
0	80	80	0	1	330	24	5	1	2	363	368.2	1	0	147	12
1	1112	1120	1	9	3148	414	44	20	44	3680	3766	4	3	1203	99

82 390

								B=>A							
OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL
0	0	0	5	5	0	0	16	4	0	0	0	20	20	0	0
0	0	0	7	7	0	0	22	2	0	0	0	24	24	0	0
0	0	0	9	9	0	0	9	5	0	0	0	14	14	0	0
0	0	0	18	18	0	1	10	0	0	0	1	12	12.4	0	0
0	0	0	39	39	0	1	57	11	0	0	1	70	70.4	0	0
0	0	0	32	32	0	0	12	1	1	0	0	14	14.5	0	0
0	0	0	47	45.4	0	0	12	2	0	0	0	14	14	0	0
0	0	0	29	29	0	0	27	1	0	0	0	28	28	0	0
0	0	0	39	39	0	0	23	3	0	0	0	26	26	0	0
0	0	0	147	145.4	0	0	74	7	1	0	0	82	82.5	0	0
0	0	0	34	34	0	0	20	0	0	0	0	20	20	0	0
1	0	0	17	17.5	0	0	13	0	1	0	1	15	16.5	0	0
1	0	0	21	21.5	0	0	19	1	0	0	0	20	20	0	0
1	0	0	25	25.5	0	0	15	3	0	0	0	18	18	0	0
3	0	0	97	98.5	0	0	67	4	1	0	1	73	74.5	0	0
1	0	0	27	27.5	0	0	15	3	0	0	0	18	18	0	0
1	0	0	17	16.7	0	0	18	0	0	0	0	18	18	0	0
0	0	0	19	19	0	0	16	5	0	0	0	21	21	0	0
0	0	0	12	12	0	0	14	0	0	1	0	15	16.3	0	0
2	0	0	75	75.2	0	0	63	8	0	1	0	72	73.3	0	0
0	1	0	21	22.3	0	0	11	1	0	0	0	12	12	0	0
0	0	0	17	17	0	0	12	3	1	0	1	17	18.5	0	0
0	0	0	21	21	0	0	13	0	0	0	0	13	13	0	0
0	0	0	27	27	0	0	11	1	0	0	0	12	12	0	0
0	1	0	86	87.3	0	0	47	5	1	0	1	54	55.5	0	0
0	0	0	16	16	0	0	13	2	0	0	0	15	15	0	0
1	0	0	20	20.5	0	0	19	0	0	0	0	19	19	0	0
0	0	0	25	25	0	0	21	3	0	0	0	24	24	0	0
0	0	0	29	29	0	0	18	2	0	0	0	20	20	0	0
1	0	0	90	90.5	0	0	71	7	0	0	0	78	78	0	0
1	0	0	30	30.5	0	0	14	2	2	0	0	18	19	0	0
1	0	0	26	26.5	0	0	17	1	0	0	0	18	18	0	0
0	0	0	29	29	0	0	17	2	0	0	0	19	19	0	0
1	0	1	29	30.5	0	0	15	5	0	0	0	20	20	0	0
3	0	1	114	116.5	0	0	63	10	2	0	0	75	76	0	0
0	0	0	19	19	0	0	15	0	0	0	0	15	15	0	0
0	0	0	7	7	0	0	16	1	0	0	1	18	19	0	0

0	0	0	23	23	0	0	22	1	0	0	0	23	23	0	0
0	0	0	35	35	0	0	29	4	0	0	0	33	33	0	0
0	0	0	84	84	0	0	82	6	0	0	1	89	90	0	0
0	0	0	25	25	0	0	13	4	0	0	0	17	17	0	0
0	0	0	30	30	0	0	16	0	0	0	0	16	16	0	0
0	0	1	35	36	0	0	19	1	0	0	0	20	20	0	0
0	0	0	36	36	0	0	20	2	0	0	0	22	22	0	0
0	0	1	126	127	0	0	68	7	0	0	0	75	75	0	0
0	0	0	34	34	0	0	40	0	0	0	0	40	40	0	0
0	0	0	37	37	1	0	28	3	1	0	0	33	32.7	0	0
0	0	0	31	30.4	2	0	24	1	0	0	0	27	25.4	0	0
0	0	0	39	39	0	0	25	1	1	0	0	27	27.5	0	0
0	0	0	141	140.4	3	0	117	5	2	0	0	127	125.6	0	0
0	0	0	45	45	0	0	25	0	0	0	0	25	25	0	0
0	0	0	31	31	0	0	21	2	0	0	0	23	23	0	0
0	0	0	37	36.4	0	0	12	1	0	0	0	13	13	0	0
0	0	0	49	48.4	0	0	23	1	0	0	0	24	24	0	0
0	0	0	162	160.8	0	0	81	4	0	0	0	85	85	0	0
0	0	0	41	41	0	0	28	2	0	0	0	30	30	0	0
0	0	0	35	35	0	0	13	1	0	0	0	14	14	0	0
0	0	0	47	46.2	0	0	15	1	0	0	0	16	16	0	0
0	0	0	37	37	0	1	14	1	0	0	0	16	15.4	0	0
0	0	0	160	159.2	0	1	70	5	0	0	0	76	75.4	0	0
9	1	2	1321	1324	3	2	860	79	7	1	4	956	961.2	0	0

157 90

B=>B							B=>C								
CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU
0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4
0	0	0	0	0	0	0	0	0	8	0	0	0	0	8	8
0	0	0	0	0	0	0	0	0	2	1	0	0	0	3	3
1	0	0	0	0	1	1	0	0	1	0	0	0	0	1	1
1	0	0	0	0	1	1	0	0	15	1	0	0	0	16	16
0	0	0	0	0	0	0	0	0	4	1	1	0	0	6	6.5
0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4
1	0	0	0	0	1	1	0	0	8	0	0	0	0	8	8
0	0	0	0	0	0	0	0	0	15	1	0	0	0	16	16
1	0	0	0	0	1	1	0	0	31	2	1	0	0	34	34.5
2	0	0	0	0	2	2	0	0	14	0	0	0	0	14	14
1	0	0	0	0	1	1	0	0	13	1	0	0	0	14	14
0	0	0	0	0	0	0	0	0	9	2	0	0	0	11	11
1	0	0	0	0	1	1	0	0	17	0	0	0	0	17	17
4	0	0	0	0	4	4	0	0	53	3	0	0	0	56	56
1	0	0	0	0	1	1	0	0	19	1	1	0	0	21	21.5
0	0	0	0	0	0	0	0	0	11	0	0	0	0	11	11
1	0	0	0	0	1	1	0	0	16	0	0	0	0	16	16
1	0	0	0	0	1	1	0	0	10	1	0	0	0	11	11
3	0	0	0	0	3	3	0	0	56	2	1	0	0	59	59.5
1	0	0	0	0	1	1	0	0	9	0	0	0	0	9	9
1	0	0	0	0	1	1	0	0	11	1	0	0	0	12	12
0	0	0	0	0	0	0	0	0	9	1	0	0	0	10	10
3	0	0	0	0	3	3	0	0	14	2	0	0	0	16	16
5	0	0	0	0	5	5	0	0	43	4	0	0	0	47	47
0	0	0	0	0	0	0	0	0	9	0	0	0	0	9	9
0	0	0	0	0	0	0	0	0	15	1	0	0	0	16	16
0	0	0	0	0	0	0	0	0	13	1	0	0	0	14	14
2	0	0	0	0	2	2	0	0	12	0	0	0	0	12	12
2	0	0	0	0	2	2	0	0	49	2	0	0	0	51	51
1	0	0	0	0	1	1	0	0	18	0	1	0	0	19	19.5
0	0	0	0	0	0	0	0	0	13	0	0	0	0	13	13
4	0	0	0	0	4	4	0	0	13	0	0	0	0	13	13
1	0	0	0	0	1	1	0	0	14	2	0	0	0	16	16
6	0	0	0	0	6	6	0	0	58	2	1	0	0	61	61.5
1	0	0	0	0	1	1	0	0	5	1	0	0	0	6	6
0	0	0	0	0	0	0	0	0	11	1	0	0	0	12	12

0	0	0	0	0	0	0	0	0	10	3	0	0	0	13	13
5	0	0	0	0	5	5	0	0	18	1	0	0	0	19	19
6	0	0	0	0	6	6	0	0	44	6	0	0	0	50	50
0	1	0	0	0	1	1	0	0	12	0	0	0	0	12	12
0	0	0	0	0	0	0	0	0	7	1	0	0	0	8	8
1	0	0	0	0	1	1	0	0	13	0	0	0	0	13	13
2	0	0	0	0	2	2	0	0	8	2	0	0	0	10	10
3	1	0	0	0	4	4	0	0	40	3	0	0	0	43	43
2	0	0	0	0	2	2	0	0	15	0	0	0	0	15	15
2	0	0	0	0	2	2	1	0	11	0	0	0	0	12	11.2
0	0	0	0	0	0	0	0	0	20	0	0	0	0	20	20
0	0	0	0	0	0	0	0	0	9	1	0	0	0	10	10
4	0	0	0	0	4	4	1	0	55	1	0	0	0	57	56.2
1	0	0	0	0	1	1	0	0	14	3	0	0	0	17	17
2	0	0	0	0	2	2	0	0	5	1	0	0	0	6	6
0	0	0	0	0	0	0	0	0	8	1	0	0	0	9	9
0	0	0	0	0	0	0	0	0	11	0	0	0	0	11	11
3	0	0	0	0	3	3	0	0	38	5	0	0	0	43	43
0	0	0	0	0	0	0	0	0	5	1	0	0	0	6	6
0	0	0	0	0	0	0	0	0	7	0	0	0	0	7	7
0	0	0	0	0	0	0	0	0	8	0	0	0	0	8	8
1	0	0	0	0	1	1	0	0	7	0	0	0	0	7	7
1	0	0	0	0	1	1	0	0	27	1	0	0	0	28	28
39	1	0	0	0	40	40	1	0	509	32	3	0	0	545	545.7

2

B=>D									C=>A						
PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU
0	0	21	2	0	0	0	23	23	0	0	78	17	1	0	2
0	0	35	2	0	0	0	37	37	0	1	73	13	2	0	2
0	0	51	3	0	0	0	54	54	0	2	84	7	3	0	0
0	0	54	7	0	0	0	61	61	0	1	79	15	1	1	2
0	0	161	14	0	0	0	175	175	0	4	314	52	7	1	6
0	0	49	5	0	0	0	54	54	0	0	70	9	0	0	3
0	0	44	1	0	0	0	45	45	0	0	88	5	2	0	0
0	0	68	3	0	1	1	73	75.3	0	0	86	3	1	0	0
0	0	60	5	0	0	0	65	65	0	0	80	9	2	0	2
0	0	221	14	0	1	1	237	239.3	0	0	324	26	5	0	5
0	0	36	3	0	0	0	39	39	0	0	109	13	1	0	2
0	0	28	0	0	0	0	28	28	0	0	89	8	3	1	0
1	0	18	0	1	0	0	20	19.7	0	1	76	7	3	1	0
0	0	12	3	1	0	0	16	16.5	0	0	58	11	1	2	1
1	0	94	6	2	0	0	103	103.2	0	1	332	39	8	4	3
1	0	13	3	0	1	0	18	18.5	0	0	52	10	2	0	2
1	0	17	3	0	0	0	21	20.2	0	0	83	10	2	1	0
0	0	24	3	0	0	0	27	27	0	0	86	7	0	0	1
0	0	11	3	0	1	0	15	16.3	0	0	73	9	2	1	0
2	0	65	12	0	2	0	81	82	0	0	294	36	6	2	3
0	0	11	0	0	0	0	11	11	0	0	69	10	0	2	2
0	0	13	4	0	2	0	19	21.6	0	0	81	7	2	0	0
0	0	18	4	0	0	0	22	22	0	0	82	9	0	0	1
0	0	25	2	0	0	0	27	27	0	0	73	13	0	2	0
0	0	67	10	0	2	0	79	81.6	0	0	305	39	2	4	3
0	0	25	2	0	1	0	28	29.3	0	0	66	10	0	0	2
0	0	22	3	0	0	0	25	25	0	0	79	11	0	1	0
1	0	17	2	0	0	1	21	21.2	0	0	67	10	1	0	1
0	0	17	3	0	0	0	20	20	0	0	96	12	1	0	0
1	0	81	10	0	1	1	94	95.5	0	0	308	43	2	1	3
0	0	23	2	0	0	0	25	25	0	0	64	8	2	0	2
0	0	27	0	0	0	0	27	27	0	0	73	11	1	2	0
0	0	31	2	0	0	0	33	33	0	0	63	18	2	1	1
0	0	26	5	0	0	0	31	31	0	0	66	12	0	1	0
0	0	107	9	0	0	0	116	116	0	0	266	49	5	4	3
1	0	25	0	0	1	0	27	27.5	0	0	83	11	2	1	2
0	1	31	1	0	0	0	33	32.4	0	1	96	7	1	0	1

1	0	33	4	0	0	0	38	37.2	0	0	68	6	1	1	1
0	0	21	1	0	0	0	22	22	0	0	61	9	1	0	0
2	1	110	6	0	1	0	120	119.1	0	1	308	33	5	2	4
0	0	22	6	0	0	0	28	28	0	0	79	8	1	1	2
0	0	24	2	0	0	0	26	26	0	0	89	6	2	0	0
0	0	31	5	0	0	1	37	38	0	0	78	14	3	1	1
0	0	18	1	0	0	0	19	19	0	1	95	7	0	1	0
0	0	95	14	0	0	1	110	111	0	1	341	35	6	3	3
0	0	45	1	0	0	0	46	46	0	0	97	10	0	0	2
0	0	38	2	2	0	1	43	45	0	1	64	5	0	1	1
1	0	48	6	0	0	0	55	54.2	0	0	58	12	0	0	0
0	0	39	5	1	0	0	45	45.5	0	0	69	8	1	1	1
1	0	170	14	3	0	1	189	190.7	0	1	288	35	1	2	4
1	0	47	4	0	0	0	52	51.2	0	0	71	13	1	0	1
0	0	35	2	0	0	0	37	37	0	0	74	9	1	1	1
0	0	43	4	0	0	0	47	47	0	0	88	7	0	0	1
0	0	40	1	0	0	0	41	41	0	1	74	12	3	0	0
1	0	165	11	0	0	0	177	176.2	0	1	307	41	5	1	3
0	0	35	4	0	0	0	39	39	0	0	78	9	0	0	0
0	0	34	4	0	0	0	38	38	0	0	83	6	0	0	3
0	0	26	1	0	0	0	27	27	0	0	68	4	1	0	1
0	0	21	1	0	0	0	22	22	0	0	52	7	0	0	0
0	0	116	10	0	0	0	126	126	0	0	281	26	1	0	4
8	1	1452	130	5	7	4	1607	1616	0	9	3668	454	53	24	44

				C=>B									C=>C		
TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1
98	100.5	0	0	16	2	0	0	0	18	18	0	0	0	0	0
91	93.4	0	0	15	3	0	0	0	18	18	0	0	0	0	0
96	96.3	0	0	23	3	0	0	0	26	26	0	0	0	0	0
99	102.2	0	0	28	1	0	0	0	29	29	0	0	0	0	0
384	392.4	0	0	82	9	0	0	0	91	91	0	0	0	0	0
82	85	0	1	30	1	0	0	0	32	31.4	0	0	0	0	0
95	96	0	0	54	3	0	0	0	57	57	0	0	1	0	0
90	90.5	0	0	43	2	0	0	1	46	47	0	0	0	0	0
93	96	0	0	38	2	0	0	0	40	40	0	0	1	0	0
360	367.5	0	1	165	8	0	0	1	175	175.4	0	0	2	0	0
125	127.5	0	0	18	0	0	0	0	18	18	0	0	1	0	0
101	103.8	0	0	22	1	0	0	0	23	23	0	0	4	0	0
88	90.2	0	0	15	0	0	0	0	15	15	0	0	2	0	0
73	77.1	0	0	15	1	0	1	0	17	18.3	0	0	2	0	0
387	398.6	0	0	70	2	0	1	0	73	74.3	0	0	9	0	0
66	69	0	0	17	4	0	0	0	21	21	0	0	2	0	0
96	98.3	0	0	16	4	0	0	0	20	20	0	0	0	0	0
94	95	0	0	14	0	0	0	0	14	14	0	0	0	0	0
85	87.3	0	0	17	1	0	0	0	18	18	0	0	1	0	0
341	349.6	0	0	64	9	0	0	0	73	73	0	0	3	0	0
83	87.6	0	0	17	3	1	0	0	21	21.5	0	0	2	0	0
90	91	0	0	21	2	0	0	0	23	23	0	0	2	0	0
92	93	0	0	26	2	0	0	0	28	28	0	0	0	0	0
88	90.6	0	0	30	3	0	0	0	33	33	0	0	1	1	0
353	362.2	0	0	94	10	1	0	0	105	105.5	0	0	5	1	0
78	80	0	0	26	0	0	0	0	26	26	0	0	2	0	0
91	92.3	0	0	22	1	0	0	0	23	23	0	0	2	0	0
79	80.5	0	0	24	0	0	0	0	24	24	0	0	1	2	0
109	109.5	0	0	20	2	0	0	0	22	22	0	0	0	0	0
357	362.3	0	0	92	3	0	0	0	95	95	0	0	5	2	0
76	79	0	0	29	2	0	0	0	31	31	0	0	7	2	0
87	90.1	0	0	26	2	0	0	0	28	28	0	0	1	1	0
85	88.3	0	0	36	2	0	0	0	38	38	0	0	3	1	0
79	80.3	0	0	27	0	0	0	0	27	27	0	0	1	0	0
327	337.7	0	0	118	6	0	0	0	124	124	0	0	12	4	0
99	103.3	0	0	18	2	0	0	0	20	20	0	0	3	0	0
106	106.9	0	0	31	1	0	0	0	32	32	0	0	2	0	0

77	79.8	0	0	15	0	0	0	0	15	15	0	0	5	1	0
71	71.5	0	1	19	1	0	0	0	21	20.4	0	0	2	0	0
353	361.5	0	1	83	4	0	0	0	88	87.4	0	0	12	1	0
91	94.8	0	0	22	2	0	0	0	24	24	0	0	0	0	0
97	98	0	0	25	1	0	0	0	26	26	0	0	0	0	0
97	100.8	0	0	40	2	0	0	0	42	42	0	0	3	0	0
104	104.7	0	0	33	0	0	0	0	33	33	0	0	2	0	0
389	398.3	0	0	120	5	0	0	0	125	125	0	0	5	0	0
109	111	0	0	33	2	0	0	0	35	35	0	0	0	0	0
72	73.7	0	0	33	1	0	0	0	34	34	0	0	1	0	0
70	70	0	0	21	1	0	0	0	22	22	0	0	1	1	0
80	82.8	0	0	23	2	0	0	0	25	25	0	0	3	0	0
331	337.5	0	0	110	6	0	0	0	116	116	0	0	5	1	0
86	87.5	0	0	32	1	0	0	0	33	33	0	0	2	1	0
86	88.8	0	0	29	3	1	0	0	33	33.5	0	0	2	0	0
96	97	0	0	18	1	0	0	1	20	21	0	0	0	0	0
90	90.9	0	0	17	0	1	0	0	18	18.5	0	0	3	1	0
358	364.2	0	0	96	5	2	0	1	104	106	0	0	7	2	0
87	87	0	0	25	2	0	0	0	27	27	0	0	1	0	0
92	95	0	0	16	0	0	0	0	16	16	0	0	1	0	0
74	75.5	0	0	14	1	0	0	0	15	15	0	0	1	0	0
59	59	0	0	18	4	0	0	0	22	22	0	0	1	0	0
312	316.5	0	0	73	7	0	0	0	80	80	0	0	4	0	0
4252	4348	0	2	1167	74	3	1	2	1249	1253	0	0	69	11	0

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							C=>D								
OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR
0	0	0	0	0	0	7	0	0	0	0	7	7	0	0	15
0	0	0	0	0	0	7	2	1	0	0	10	10.5	0	0	29
0	0	0	0	0	0	14	1	0	1	0	16	17.3	1	0	32
0	0	0	0	0	0	21	4	0	0	0	25	25	0	0	32
0	0	0	0	0	0	49	7	1	1	0	58	59.8	1	0	108
0	0	0	0	0	0	19	0	0	0	0	19	19	0	0	34
0	0	1	1	0	1	20	1	0	0	0	22	21.4	0	0	38
0	0	0	0	0	0	17	2	0	0	0	19	19	0	0	23
0	0	1	1	0	0	11	0	1	0	0	12	12.5	0	0	35
0	0	2	2	0	1	67	3	1	0	0	72	71.9	0	0	130
0	0	1	1	0	0	16	1	0	0	0	17	17	0	0	34
0	0	4	4	0	0	17	2	1	1	0	21	22.8	0	0	15
0	0	2	2	0	0	19	1	0	0	0	20	20	0	0	17
0	0	2	2	0	0	31	0	0	1	0	32	33.3	0	0	28
0	0	9	9	0	0	83	4	1	2	0	90	93.1	0	0	94
0	0	2	2	0	0	9	2	0	0	0	11	11	0	0	28
0	0	0	0	0	0	14	1	1	0	0	16	16.5	0	0	25
0	0	0	0	0	0	24	0	0	0	0	24	24	0	0	22
0	0	1	1	0	0	11	1	0	0	0	12	12	0	0	31
0	0	3	3	0	0	58	4	1	0	0	63	63.5	0	0	106
0	0	2	2	0	0	18	0	0	1	0	19	20.3	0	0	18
0	0	2	2	0	0	10	0	0	0	1	11	12	0	0	23
0	0	0	0	0	0	23	4	0	1	0	28	29.3	0	0	21
0	0	2	2	0	0	23	2	0	0	0	25	25	0	0	13
0	0	6	6	0	0	74	6	0	2	1	83	86.6	0	0	75
0	0	2	2	0	0	14	2	0	0	0	16	16	0	0	26
0	0	2	2	0	0	18	3	0	0	0	21	21	0	0	20
0	0	3	3	0	0	20	1	0	0	0	21	21	0	0	20
0	0	0	0	0	0	23	1	1	0	0	25	25.5	0	0	12
0	0	7	7	0	0	75	7	1	0	0	83	83.5	0	0	78
0	0	9	9	0	0	18	1	0	0	0	19	19	0	1	27
0	0	2	2	0	0	18	1	1	0	1	21	22.5	0	0	17
0	0	4	4	0	0	26	3	0	0	0	29	29	0	1	31
0	0	1	1	0	0	25	2	0	0	0	27	27	0	1	22
0	0	16	16	0	0	87	7	1	0	1	96	97.5	0	3	97
0	0	3	3	0	0	45	1	0	0	0	46	46	0	0	24
0	0	2	2	0	0	45	2	0	0	0	47	47	0	0	26

0	0	6	6	0	0	20	1	0	0	0	21	21	0	0	37
0	0	2	2	0	0	27	2	0	0	0	29	29	0	0	38
0	0	13	13	0	0	137	6	0	0	0	143	143	0	0	125
0	0	0	0	0	0	26	0	0	0	0	26	26	0	0	20
0	0	0	0	0	0	27	0	0	0	0	27	27	0	0	26
0	0	3	3	0	0	16	2	0	0	0	18	18	0	0	38
0	0	2	2	0	0	17	0	0	0	0	17	17	0	0	17
0	0	5	5	0	0	86	2	0	0	0	88	88	0	0	101
0	0	0	0	0	0	19	0	0	0	0	19	19	0	0	29
0	0	1	1	0	0	22	1	0	0	0	23	23	0	0	24
0	0	2	2	0	0	17	4	0	0	0	21	21	1	0	28
0	0	3	3	0	0	23	3	0	0	0	26	26	0	0	23
0	0	6	6	0	0	81	8	0	0	0	89	89	1	0	104
0	0	3	3	0	0	13	2	1	0	0	16	16.5	0	0	22
0	0	2	2	0	0	18	1	0	0	0	19	19	0	0	16
0	0	0	0	0	0	17	0	1	0	0	18	18.5	0	0	33
0	0	4	4	0	0	20	1	0	0	0	21	21	0	0	28
0	0	9	9	0	0	68	4	2	0	0	74	75	0	0	99
0	0	1	1	0	0	30	1	0	0	0	31	31	0	0	32
0	0	1	1	0	0	30	1	0	0	0	31	31	0	0	36
0	0	1	1	0	0	24	1	0	0	0	25	25	0	0	38
0	0	1	1	0	0	23	1	0	0	0	24	24	0	0	28
0	0	4	4	0	0	107	4	0	0	0	111	111	0	0	134
0	0	80	80	0	1	972	62	8	5	2	1050	1062	2	3	1251

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89.5

D=>A									D=>B						
LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL
2	0	0	0	17	17	0	0	17	0	2	0	0	19	20	0
5	0	0	0	34	34	0	0	36	6	0	0	0	42	42	0
4	0	0	0	37	36.2	0	0	65	3	1	0	0	69	69.5	0
1	0	0	0	33	33	1	0	47	5	0	0	0	53	52.2	0
12	0	0	0	121	120.2	1	0	165	14	3	0	0	183	183.7	0
3	0	0	0	37	37	0	0	36	4	0	0	0	40	40	0
2	0	0	0	40	40	0	0	54	2	0	0	0	56	56	0
1	0	0	0	24	24	0	0	30	1	0	0	0	31	31	0
4	0	0	0	39	39	2	0	39	2	0	1	0	44	43.7	0
10	0	0	0	140	140	2	0	159	9	0	1	0	171	170.7	0
0	1	0	0	35	35.5	0	0	30	4	0	0	0	34	34	0
1	0	0	0	16	16	0	0	28	2	1	0	0	31	31.5	1
5	2	0	0	24	25	0	0	22	3	0	0	0	25	25	0
5	0	0	0	33	33	0	0	12	2	0	0	0	14	14	2
11	3	0	0	108	109.5	0	0	92	11	1	0	0	104	104.5	3
2	0	0	0	30	30	0	0	21	2	0	1	0	24	25.3	0
2	1	0	0	28	28.5	1	0	16	2	0	0	0	19	18.2	0
4	1	0	0	27	27.5	0	0	17	3	0	2	0	22	24.6	1
3	1	1	0	36	37.8	0	0	22	3	0	0	0	25	25	0
11	3	1	0	121	123.8	1	0	76	10	0	3	0	90	93.1	1
1	0	0	0	19	19	0	0	21	1	1	1	0	24	25.8	0
1	1	0	0	25	25.5	0	0	14	0	0	0	0	14	14	0
2	0	0	1	24	25	0	0	30	2	1	0	0	33	33.5	0
2	0	0	0	15	15	0	0	21	4	0	0	0	25	25	0
6	1	0	1	83	84.5	0	0	86	7	2	1	0	96	98.3	0
2	0	0	0	28	28	0	0	28	2	0	1	0	31	32.3	0
1	1	0	0	22	22.5	0	0	17	4	0	0	0	21	21	0
4	0	0	0	24	24	0	0	19	1	0	0	0	20	20	0
0	1	0	0	13	13.5	0	0	24	5	0	0	0	29	29	0
7	2	0	0	87	88	0	0	88	12	0	1	0	101	102.3	0
2	0	0	1	31	31.4	1	0	27	2	0	0	0	30	29.2	0
2	0	0	0	19	19	0	0	23	1	0	1	0	25	26.3	1
6	1	1	0	40	41.2	0	0	21	1	0	0	0	22	22	0
6	0	0	0	29	28.4	1	0	31	0	0	0	0	32	31.2	0
16	1	1	1	119	120	2	0	102	4	0	1	0	109	108.7	1
1	0	0	0	25	25	0	0	25	1	0	0	0	26	26	0
3	0	0	0	29	29	0	0	25	0	0	0	0	25	25	0

2	0	0	0	39	39	0	0	41	4	0	0	0	45	45	0
3	0	1	0	42	43.3	0	0	21	2	0	0	0	23	23	1
9	0	1	0	135	136.3	0	0	112	7	0	0	0	119	119	1
1	0	0	0	21	21	0	0	15	3	1	0	0	19	19.5	0
0	0	0	0	26	26	0	0	26	2	0	0	0	28	28	0
1	0	0	1	40	41	0	0	35	1	0	1	0	37	38.3	0
3	0	0	0	20	20	0	0	37	1	1	0	0	39	39.5	0
5	0	0	1	107	108	0	0	113	7	2	1	0	123	125.3	0
3	0	0	0	32	32	0	0	36	0	0	0	0	36	36	0
2	0	0	0	26	26	0	0	29	3	0	0	0	32	32	0
2	0	0	0	31	30.2	0	0	19	3	0	0	0	22	22	0
2	0	0	0	25	25	0	0	33	1	1	0	0	35	35.5	0
9	0	0	0	114	113.2	0	0	117	7	1	0	0	125	125.5	0
3	0	0	0	25	25	1	0	25	4	1	0	0	31	30.7	0
3	0	0	0	19	19	0	0	32	3	0	0	0	35	35	0
2	0	0	0	35	35	0	0	37	4	0	0	0	41	41	0
2	0	0	0	30	30	0	0	42	3	0	0	0	45	45	0
10	0	0	0	109	109	1	0	136	14	1	0	0	152	151.7	0
3	0	0	0	35	35	1	0	32	3	0	0	0	36	35.2	0
0	0	0	0	36	36	0	0	25	4	0	0	0	29	29	0
1	0	0	0	39	39	0	0	47	0	0	0	0	47	47	1
1	0	0	0	29	29	0	0	38	1	0	0	0	39	39	0
5	0	0	0	139	139	1	0	142	8	0	0	0	151	150.2	1
111	10	3	3	1383	1392	8	0	1388	110	10	8	0	1524	1533	7

119 156

D=>C								D=>D							
MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT
0	6	0	2	0	0	8	9	0	0	0	0	0	0	0	0
0	6	2	0	0	0	8	8	0	0	0	1	0	0	0	1
0	5	1	0	0	0	6	6	0	0	1	0	0	0	0	1
0	11	3	0	0	0	14	14	0	0	1	0	0	0	0	1
0	28	6	2	0	0	36	37	0	0	2	1	0	0	0	3
0	13	2	0	3	0	18	21.9	0	0	0	0	0	0	0	0
0	8	1	0	1	0	10	11.3	0	0	0	0	0	0	0	0
0	11	2	0	1	0	14	15.3	0	0	0	0	0	0	0	0
0	17	0	0	0	0	17	17	0	0	1	0	0	0	0	1
0	49	5	0	5	0	59	65.5	0	0	1	0	0	0	0	1
0	15	3	0	0	0	18	18	0	0	1	0	0	0	0	1
0	20	1	0	0	0	22	21.2	0	0	0	0	0	0	0	0
0	12	3	1	0	0	16	16.5	0	0	0	0	0	0	0	0
0	15	2	1	0	0	20	18.9	0	0	0	0	1	0	0	1
0	62	9	2	0	0	76	74.6	0	0	1	0	1	0	0	2
0	25	0	0	1	1	27	29.3	0	0	0	0	0	0	0	0
0	22	4	0	0	0	26	26	0	0	1	1	0	0	0	2
0	14	4	1	1	0	21	22	0	0	0	0	0	0	0	0
0	21	4	0	0	0	25	25	0	0	0	0	0	0	0	0
0	82	12	1	2	1	99	102.3	0	0	1	1	0	0	0	2
0	12	2	0	0	0	14	14	0	0	0	0	0	0	0	0
0	21	2	0	0	0	23	23	0	0	0	0	0	0	0	0
0	12	3	0	0	0	15	15	0	0	0	0	0	0	0	0
0	20	3	1	0	0	24	24.5	0	0	1	0	0	0	0	1
0	65	10	1	0	0	76	76.5	0	0	1	0	0	0	0	1
0	21	1	0	0	0	22	22	0	0	1	0	0	0	0	1
0	31	0	0	0	0	31	31	0	0	1	0	0	0	0	1
0	12	0	0	0	0	12	12	0	0	0	0	0	0	0	0
0	18	0	0	0	0	18	18	0	0	1	0	0	0	0	1
0	82	1	0	0	0	83	83	0	0	3	0	0	0	0	3
0	12	1	0	0	0	13	13	0	0	0	0	0	0	0	0
0	16	1	0	0	0	18	17.2	0	0	1	0	0	0	0	1
0	17	0	0	0	0	17	17	0	0	0	0	0	0	0	0
0	20	1	0	0	1	22	23	0	0	0	0	0	0	0	0
0	65	3	0	0	1	70	70.2	0	0	1	0	0	0	0	1
0	22	2	1	0	1	26	27.5	0	0	0	0	0	0	0	0
0	9	1	0	0	0	10	10	0	0	2	0	0	0	0	2

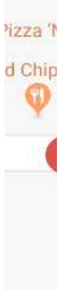
1	46	0	0	0	0	47	46.4	0	0	0	0	0	0	0	0
0	11	3	0	0	0	15	14.2	0	0	0	0	0	0	0	0
1	88	6	1	0	1	98	98.1	0	0	2	0	0	0	0	2
0	18	1	0	0	0	19	19	0	0	1	0	0	0	0	1
0	31	0	0	0	0	31	31	0	0	1	0	0	0	0	1
0	33	3	0	0	0	36	36	0	0	0	0	0	0	0	0
0	16	2	0	0	1	19	20	0	0	1	0	0	0	0	1
0	98	6	0	0	1	105	106	0	0	3	0	0	0	0	3
0	20	0	0	0	0	20	20	0	0	1	0	0	0	0	1
0	21	1	0	1	0	23	24.3	0	0	0	0	0	0	0	0
0	24	1	0	0	0	25	25	0	0	0	0	0	0	0	0
0	12	2	0	0	0	14	14	0	0	0	0	0	0	0	0
0	77	4	0	1	0	82	83.3	0	0	1	0	0	0	0	1
0	15	1	0	0	0	16	16	0	0	1	0	0	0	0	1
0	24	2	0	0	0	26	26	0	0	0	0	0	0	0	0
0	14	3	0	0	0	17	17	0	0	1	0	0	0	0	1
0	21	0	0	0	0	21	21	0	0	1	0	0	0	0	1
0	74	6	0	0	0	80	80	0	0	3	0	0	0	0	3
0	24	3	0	0	0	27	27	0	0	0	0	0	0	0	0
0	20	1	0	0	0	21	21	0	0	0	0	0	0	0	0
0	17	2	0	0	0	20	19.2	0	0	0	0	0	0	0	0
0	21	1	0	0	0	22	22	0	0	0	0	0	0	0	0
0	82	7	0	0	0	90	89.2	0	0	0	0	0	0	0	0
1	852	75	7	8	4	954	965.7	0	0	19	2	1	0	0	22

PCU			
0	282.5		
1	334.1		
1	383.8		
1	432.1		
3	1432.5	1432.5	
0	416.8	1566.8	
0	477.1	1709.8	
0	480.6	1806.6	
1	521.4	1895.9	
1	1895.9		
1	461.8	**1940.9**	**Peak Hour 08:15-09:15**
0	406.9	1870.7	
0	371.4	1761.5	
1.5	367.1		
2.5	1607.2		
0			
2			
0			
0			
2			
0			
0			
0			
1			
1			
1			
1			
0			
1			
3			
0			
1			
0			
0			
1			
0			
2			

0		
0		
2		
1		
1		
0		
1		
3	1721	
1		
0		
0		
0		
1	1868.1	
1	438.7	
0	451.3	
1	455.7	
1	479.1	1824.8
3	1824.8	
0	464.7	**1850.8 Peak Hour 17:15-18:15**
0	429	1828.5
0	443.2	1816
0	394.8	
0	1731.7	
22.5		

2

IDASO

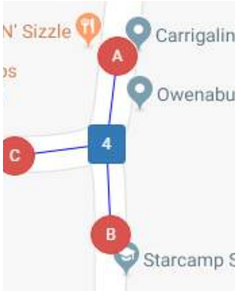


Survey Name : IDA-18-060 Carrigaline 0
Site : 4
Date : 01/05/18
Location : Main St (R611) / Church Hill / Kilmoney RdLower (R611)

	A=>A									A=>B					
TIME	PCL	MCL	CAR	LGV	OGV1	OGV2	3V (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2
07:00	0	0	0	0	0	0	0	0	0	0	0	11	1	0	0
07:15	0	0	0	0	0	0	0	0	0	0	0	13	3	0	0
07:30	0	0	0	0	0	0	0	0	0	0	0	11	2	0	0
07:45	0	0	0	0	0	0	0	0	0	0	0	29	3	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	64	9	0	0
08:00	0	0	0	0	0	0	0	0	0	0	0	15	4	0	1
08:15	0	0	0	0	0	0	0	0	0	0	0	27	4	1	0
08:30	0	0	0	0	0	0	0	0	0	0	1	41	3	0	0
08:45	0	0	0	0	0	0	0	0	0	0	0	52	3	0	1
H/TOT	0	0	0	0	0	0	0	0	0	0	1	135	14	1	2
09:00	0	0	0	0	0	0	0	0	0	0	0	38	9	2	0
09:15	0	0	0	0	0	0	0	0	0	0	0	30	2	1	0
09:30	0	0	0	0	0	0	0	0	0	0	0	36	0	4	0
09:45	0	0	0	0	0	0	0	0	0	0	0	26	2	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	130	13	7	0
10:00	0	0	0	0	0	0	0	0	0	0	0	30	3	0	0
10:15	0	0	0	0	0	0	0	0	0	0	0	32	3	0	1
10:30	0	0	0	0	0	0	0	0	0	0	0	32	4	0	0
10:45	0	0	0	0	0	0	0	0	0	0	0	34	3	0	1
H/TOT	0	0	0	0	0	0	0	0	0	0	0	128	13	0	2
11:00	0	0	0	0	0	0	0	0	0	0	0	31	6	0	0
11:15	0	0	0	0	0	0	0	0	0	0	1	32	6	0	0
11:30	0	0	0	0	0	0	0	0	0	0	0	42	1	0	0
11:45	0	0	0	0	0	0	0	0	0	0	1	35	5	1	1
H/TOT	0	0	0	0	0	0	0	0	0	0	2	140	18	1	1
12:00	0	0	0	0	0	0	0	0	0	0	0	47	3	1	0
12:15	0	0	0	0	0	0	0	0	0	0	0	39	2	0	1
12:30	0	0	0	0	0	0	0	0	0	0	0	45	2	0	0
12:45	0	0	0	0	0	0	0	0	0	1	0	51	5	1	0
H/TOT	0	0	0	0	0	0	0	0	0	1	0	182	12	2	1
13:00	0	0	1	0	0	0	0	1	1	0	0	51	7	1	0
13:15	0	0	0	0	0	0	0	0	0	0	0	44	6	0	0
13:30	0	0	1	0	0	0	0	1	1	0	0	47	4	0	0
13:45	0	0	0	0	0	0	0	0	0	0	0	37	5	0	0
H/TOT	0	0	2	0	0	0	0	2	2	0	0	179	22	1	0
14:00	0	0	0	0	0	0	0	0	0	0	0	39	2	0	0
14:15	0	0	1	0	0	0	0	1	1	0	0	39	2	1	0

14:30	0	0	0	0	0	0	0	0	0	0	1	39	6	0	0
14:45	0	0	0	0	0	0	0	0	0	0	0	67	3	1	0
H/TOT	0	0	1	0	0	0	0	1	1	0	1	184	13	2	0
15:00	0	0	0	0	0	0	0	0	0	0	0	39	7	2	0
15:15	0	0	0	0	0	0	0	0	0	0	0	39	0	0	0
15:30	0	0	0	0	0	0	0	0	0	0	0	72	7	0	0
15:45	0	0	1	0	0	0	0	1	1	0	1	43	4	2	0
H/TOT	0	0	1	0	0	0	0	1	1	0	1	193	18	4	0
16:00	0	0	1	0	0	0	0	1	1	0	0	66	2	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	59	5	1	0
16:30	0	0	1	0	0	0	0	1	1	1	0	55	1	0	0
16:45	0	0	0	0	0	0	0	0	0	0	2	74	9	0	0
H/TOT	0	0	2	0	0	0	0	2	2	1	2	254	17	1	0
17:00	0	0	0	0	0	0	0	0	0	0	0	54	6	1	1
17:15	0	0	0	0	0	0	0	0	0	0	0	61	8	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	62	7	0	1
17:45	0	0	0	0	0	0	0	0	0	0	0	70	7	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	247	28	1	2
18:00	0	0	0	0	0	0	0	0	0	0	0	54	7	2	0
18:15	0	0	0	0	0	0	0	0	0	0	0	54	3	0	0
18:30	0	0	0	0	0	0	0	0	0	0	0	64	3	0	0
18:45	0	0	0	0	0	0	0	0	0	0	0	57	0	2	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	229	13	4	0
12 TOT	0	0	6	0	0	0	0	6	6	2	7	2065	190	24	8

0



209

184

					A=>C										B=>A
SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV
0	12	12	1	0	21	5	1	0	0	28	27.7	0	0	45	9
0	16	16	0	0	21	6	0	0	2	29	31	0	2	58	6
0	13	13	0	0	24	4	1	0	0	29	29.5	0	1	45	3
0	32	32	0	0	37	10	1	1	1	50	52.8	0	0	56	7
0	73	73	1	0	103	25	3	1	3	136	141	0	3	204	25
0	20	21.3	0	0	28	2	1	2	2	35	40.1	0	0	48	1
0	32	32.5	0	0	27	10	0	0	0	37	37	2	0	55	3
0	45	44.4	0	0	37	3	0	2	0	42	44.6	0	0	71	3
0	56	57.3	0	0	60	2	3	0	1	66	68.5	0	0	75	6
0	153	155.5	0	0	152	17	4	4	3	180	190.2	2	0	249	13
0	49	50	0	0	53	6	0	0	0	59	59	0	0	56	5
0	33	33.5	0	0	53	8	1	3	1	66	71.4	0	0	60	3
0	40	42	0	0	39	5	0	0	2	46	48	0	1	49	4
0	28	28	0	0	50	7	0	0	1	58	59	0	0	31	3
0	150	153.5	0	0	195	26	1	3	4	229	237.4	0	1	196	15
0	33	33	0	0	56	5	2	2	1	66	70.6	0	0	44	5
0	36	37.3	0	0	41	6	1	2	0	50	53.1	0	0	34	2
0	36	36	0	0	43	8	2	0	0	53	54	0	0	33	1
0	38	39.3	0	0	57	5	0	0	1	63	64	0	0	29	4
0	143	145.6	0	0	197	24	5	4	2	232	241.7	0	0	140	12
0	37	37	0	0	56	3	2	1	0	62	64.3	0	0	31	0
0	39	38.4	0	1	61	8	0	1	1	72	73.7	0	0	29	0
0	43	43	0	0	49	11	0	0	0	60	60	0	0	35	6
0	43	44.2	0	0	66	4	0	0	1	71	72	0	0	34	6
0	162	162.6	0	1	232	26	2	2	2	265	270	0	0	129	12
0	51	51.5	0	0	69	7	1	3	0	80	84.4	0	0	32	2
0	42	43.3	0	0	63	5	0	0	1	69	70	0	0	41	6
0	47	47	0	0	63	10	3	0	1	77	79.5	0	0	43	8
0	58	57.7	0	0	61	12	0	1	0	74	75.3	0	0	37	2
0	198	199.5	0	0	256	34	4	4	2	300	309.2	0	0	153	18
0	59	59.5	0	0	63	8	1	1	0	73	74.8	0	0	41	3
0	50	50	0	0	76	13	0	0	2	91	93	0	0	35	6
0	51	51	0	0	77	8	0	0	0	85	85	0	0	26	6
0	42	42	0	0	89	4	1	0	1	95	96.5	0	0	36	5
0	202	202.5	0	0	305	33	2	1	3	344	349.3	0	0	138	20
2	43	45	0	0	44	6	1	0	1	52	53.5	0	0	23	7
0	42	42.5	0	0	38	9	2	0	0	49	50	0	0	44	2

0	46	45.4	0	0	80	4	1	0	0	85	85.5	0	0	24	1
0	71	71.5	0	0	75	8	0	0	1	84	85	0	0	27	7
2	202	204.4	0	0	237	27	4	0	2	270	274	0	0	118	17
0	48	49	0	0	75	10	0	0	0	85	85	0	0	33	3
0	39	39	0	0	73	10	0	0	1	84	85	0	0	43	3
0	79	79	0	0	59	2	0	0	0	61	61	0	0	32	1
0	50	50.4	0	1	69	5	3	0	3	81	84.9	0	0	41	3
0	216	217.4	0	1	276	27	3	0	4	311	315.9	0	0	149	10
0	68	68	0	1	78	4	0	0	0	83	82.4	0	0	33	3
0	65	65.5	0	2	92	7	2	0	1	104	104.8	0	0	36	2
0	57	56.2	0	0	76	3	1	0	2	82	84.5	0	0	26	4
0	85	83.8	0	0	77	13	1	0	2	93	95.5	0	0	21	6
0	275	273.5	0	3	323	27	4	0	5	362	367.2	0	0	116	15
0	62	63.8	0	0	78	10	1	0	1	90	91.5	0	0	39	4
0	69	69	0	0	86	5	1	0	0	92	92.5	0	0	18	4
0	70	71.3	0	0	90	7	1	0	0	98	98.5	0	0	25	3
0	77	77	0	1	87	4	1	1	0	94	95.2	0	0	41	4
0	278	281.1	0	1	341	26	4	1	1	374	377.7	0	0	123	15
0	63	64	0	0	112	2	2	0	2	118	121	0	0	24	6
0	57	57	0	0	72	4	0	0	1	77	78	0	0	30	2
0	67	67	0	0	80	3	1	1	0	85	86.8	0	0	33	2
0	59	60	0	0	82	6	1	0	0	89	89.5	0	0	40	6
0	246	248	0	0	346	15	4	1	3	369	375.3	0	0	127	16
2	2298	2317	1	6	2963	307	40	21	34	3372	3449	2	4	1842	188

281

407

				281									0		
								B=>B							
OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL
0	0	1	55	56	0	0	0	0	0	0	0	0	0	0	0
0	0	1	67	66.8	0	0	0	0	0	0	0	0	0	0	0
1	1	1	52	54.2	0	0	0	0	0	0	0	0	0	0	0
0	0	1	64	65	0	0	0	0	0	0	0	0	0	0	0
1	1	4	238	242	0	0	0	0	0	0	0	0	0	0	0
0	0	1	50	51	0	0	0	0	0	0	0	0	0	0	0
1	0	0	61	59.9	0	0	0	0	0	0	0	0	0	0	0
1	0	1	76	77.5	0	0	0	0	0	0	0	0	0	0	0
0	0	0	81	81	0	0	0	0	0	0	0	0	0	0	0
2	0	2	268	269.4	0	0	0	0	0	0	0	0	0	0	0
0	0	1	62	63	0	0	0	0	0	0	0	0	0	0	0
1	0	0	64	64.5	0	0	0	0	0	0	0	0	0	0	0
1	1	0	56	57.2	0	0	0	0	0	0	0	0	0	0	0
0	1	1	36	38.3	0	0	0	0	0	0	0	0	0	0	0
2	2	2	218	223	0	0	0	0	0	0	0	0	0	0	0
1	0	1	51	52.5	0	0	0	0	0	0	0	0	0	0	0
0	0	0	36	36	0	0	0	0	0	0	0	0	0	0	0
0	0	1	35	36	0	0	0	0	0	0	0	0	0	0	0
0	1	0	34	35.3	0	0	0	0	0	0	0	0	0	0	0
1	1	2	156	159.8	0	0	0	0	0	0	0	0	0	0	0
0	1	1	33	35.3	0	0	0	0	0	0	0	0	0	0	0
0	0	0	29	29	0	0	0	0	0	0	0	0	0	0	0
0	1	1	43	45.3	0	0	0	0	0	0	0	0	0	0	0
0	0	0	40	40	0	0	0	0	0	0	0	0	0	0	0
0	2	2	145	149.6	0	0	0	0	0	0	0	0	0	0	0
0	0	1	35	36	0	0	0	0	0	0	0	0	0	0	0
0	0	0	47	47	0	0	0	0	0	0	0	0	0	0	0
0	0	1	52	53	0	0	0	0	0	0	0	0	0	0	0
0	0	0	39	39	0	0	0	0	0	0	0	0	0	0	0
0	0	2	173	175	0	0	0	0	0	0	0	0	0	0	0
1	1	1	47	49.8	0	0	0	0	0	0	0	0	0	0	0
2	1	0	44	46.3	0	0	0	0	0	0	0	0	0	0	0
1	0	1	34	35.5	0	0	0	0	0	0	0	0	0	0	0
0	0	0	41	41	0	0	0	0	0	0	0	0	0	0	0
4	2	2	166	172.6	0	0	0	0	0	0	0	0	0	0	0
0	0	1	31	32	0	0	0	0	0	0	0	0	0	0	0
0	0	0	46	46	0	0	0	0	0	0	0	0	0	0	0

0	0	1	26	27	0	0	0	0	0	0	0	0	0	0	0
1	0	0	35	35.5	0	0	0	0	0	0	0	0	0	0	0
1	0	2	138	140.5	0	0	0	0	0	0	0	0	0	0	0
1	0	1	38	39.5	0	0	0	0	0	0	0	0	0	0	0
0	1	0	47	48.3	0	0	0	0	0	0	0	0	0	0	0
1	0	1	35	36.5	0	0	0	0	0	0	0	0	0	0	0
0	1	0	45	46.3	0	0	0	0	0	0	0	0	0	0	0
2	2	2	165	170.6	0	0	0	0	0	0	0	0	0	0	0
0	0	1	37	38	0	0	0	0	0	0	0	0	0	0	0
0	0	0	38	38	0	0	0	0	0	0	0	0	0	0	0
0	0	0	30	30	0	0	0	0	0	0	0	0	0	0	0
0	0	1	28	29	0	0	0	0	0	0	0	0	0	0	0
0	0	2	133	135	0	0	0	0	0	0	0	0	0	0	0
0	0	0	43	43	0	0	0	0	0	0	0	0	0	0	0
0	0	1	23	24	0	0	0	0	0	0	0	0	0	0	0
0	0	0	28	28	0	0	0	0	0	0	0	0	0	0	0
2	0	0	47	48	0	0	0	0	0	0	0	0	0	0	0
2	0	1	141	143	0	0	0	0	0	0	0	0	0	0	0
0	0	1	31	32	0	0	0	0	0	0	0	0	0	0	0
0	0	1	33	34	0	0	0	0	0	0	0	0	0	0	0
1	0	1	37	38.5	0	0	0	0	0	0	0	0	0	0	0
2	0	0	48	49	0	0	0	0	0	0	0	0	0	0	0
3	0	3	149	153.5	0	0	0	0	0	0	0	0	0	0	0
18	10	26	2090	2134	0	0	0	0	0	0	0	0	0	0	0

18 481

B=>C							C=>A								
CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU
2	1	0	0	0	3	3	0	0	63	8	1	0	0	72	72.5
5	1	0	0	0	6	6	0	0	61	10	2	0	0	73	74
9	2	0	0	0	11	11	0	0	92	8	3	0	0	103	104.5
6	0	0	0	0	6	6	0	1	85	10	2	0	0	98	98.4
22	4	0	0	0	26	26	0	1	301	36	8	0	0	346	349.4
7	2	0	0	0	9	9	1	1	98	4	0	0	1	105	104.6
2	1	0	0	0	3	3	0	1	155	7	1	0	0	164	163.9
0	0	0	0	0	0	0	0	0	133	4	2	0	1	140	142
5	4	0	0	0	9	9	0	1	88	3	1	0	0	93	92.9
14	7	0	0	0	21	21	1	3	474	18	4	0	2	502	503.4
6	0	0	0	0	6	6	0	0	75	6	1	0	0	82	82.5
13	0	0	0	0	13	13	0	0	86	5	2	1	0	94	96.3
7	1	0	0	0	8	8	1	0	77	4	1	3	0	86	89.6
5	1	0	0	0	6	6	0	0	66	9	0	2	0	77	79.6
31	2	0	0	0	33	33	1	0	304	24	4	6	0	339	348
6	1	0	0	0	7	7	0	0	63	6	1	0	0	70	70.5
10	2	0	0	0	12	12	0	1	81	6	2	1	0	91	92.7
2	1	0	0	0	3	3	0	0	79	6	0	0	0	85	85
1	0	0	0	0	1	1	0	0	65	6	2	1	0	74	76.3
19	4	0	0	0	23	23	0	1	288	24	5	2	0	320	324.5
5	0	0	0	0	5	5	0	0	76	5	2	1	0	84	86.3
0	1	0	0	0	1	1	1	0	82	7	1	0	1	92	92.7
3	2	0	0	0	5	5	0	1	75	6	0	1	0	83	83.7
6	1	0	0	0	7	7	0	0	75	9	2	1	0	87	89.3
14	4	0	0	0	18	18	1	1	308	27	5	3	1	346	352
8	2	0	0	0	10	10	0	0	57	5	0	0	0	62	62
4	1	0	0	0	5	5	0	0	54	5	0	2	0	61	63.6
3	1	0	0	0	4	4	0	0	53	5	0	1	0	59	60.3
8	1	0	0	0	9	9	0	0	70	7	2	0	0	79	80
23	5	0	0	0	28	28	0	0	234	22	2	3	0	261	265.9
5	0	0	0	0	5	5	0	0	82	5	2	0	0	89	90
9	1	0	0	0	10	10	0	0	81	8	0	0	1	90	91
5	0	0	0	0	5	5	0	0	58	11	1	2	0	72	75.1
12	1	0	0	0	13	13	0	1	83	4	0	0	0	88	87.4
31	2	0	0	0	33	33	0	1	304	28	3	2	1	339	343.5
3	2	0	0	0	5	5	0	0	85	6	2	0	1	94	96
9	1	0	0	0	10	10	0	0	86	9	2	0	1	98	100

3	0	0	0	0	3	3	0	0	50	4	1	1	0	56	57.8
9	3	0	0	0	12	12	0	0	68	5	0	0	0	73	73
24	6	0	0	0	30	30	0	0	289	24	5	1	2	321	326.8
3	2	0	0	0	5	5	0	0	74	5	0	1	0	80	81.3
7	2	0	0	0	9	9	0	0	97	5	1	0	0	103	103.5
13	1	0	0	0	14	14	0	0	93	9	2	1	0	105	107.3
5	1	0	0	0	6	6	0	0	89	6	0	0	0	95	95
28	6	0	0	0	34	34	0	0	353	25	3	2	0	383	387.1
7	1	0	0	0	8	8	0	0	84	5	1	0	1	91	92.5
3	1	0	0	0	4	4	0	0	60	1	0	1	0	62	63.3
9	1	0	0	0	10	10	0	1	60	9	0	0	0	70	69.4
5	1	0	0	0	6	6	0	0	77	5	1	0	0	83	83.5
24	4	0	0	0	28	28	0	1	281	20	2	1	1	306	308.7
9	2	0	0	0	11	11	0	0	73	14	1	1	0	89	90.8
4	0	0	0	0	4	4	0	0	82	8	1	0	0	91	91.5
12	2	0	0	0	14	14	0	0	83	5	0	0	1	89	90
7	0	0	0	0	7	7	0	0	74	7	1	0	0	82	82.5
32	4	0	0	0	36	36	0	0	312	34	3	1	1	351	354.8
7	1	0	0	0	8	8	0	0	71	6	0	0	0	77	77
9	1	0	0	0	10	10	0	0	100	6	1	0	0	107	107.5
3	0	0	0	0	3	3	1	0	65	1	0	0	0	67	66.2
3	1	0	0	0	4	4	0	0	72	6	0	0	0	78	78
22	3	0	0	0	25	25	1	0	308	19	1	0	0	329	328.7
284	51	0	0	0	335	335	4	8	3756	301	45	21	8	4143	4193

C=>B									C=>C						
PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	5	1	0	0	0	6	6	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0
0	0	10	1	0	0	0	11	11	0	0	0	0	0	0	0
0	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0
0	0	3	3	0	0	0	6	6	0	0	0	0	0	0	0
0	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0
0	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0
0	0	10	3	0	0	0	13	13	0	0	0	0	0	0	0
0	0	3	0	1	0	0	4	4.5	0	0	0	0	0	0	0
0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0
0	0	6	0	1	0	0	7	7.5	0	0	0	0	0	0	0
0	0	5	1	0	0	0	6	6	0	0	0	0	0	0	0
0	0	19	1	2	0	0	22	23	0	0	0	0	0	0	0
0	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0
0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0
0	0	1	1	0	0	0	2	2	0	0	0	0	0	0	0
0	0	3	1	0	0	0	4	4	0	0	0	0	0	0	0
0	0	11	2	0	0	0	13	13	0	0	0	0	0	0	0
0	0	7	0	0	0	0	7	7	0	0	0	0	0	0	0
0	0	5	1	0	0	0	6	6	0	0	0	0	0	0	0
0	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0
0	0	3	2	0	0	0	5	5	0	0	0	0	0	0	0
0	0	17	3	0	0	0	20	20	0	0	0	0	0	0	0
0	0	2	2	0	0	0	4	4	0	0	0	0	0	0	0
0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0
0	0	3	2	0	0	0	5	5	0	0	0	0	0	0	0
0	0	1	1	0	0	0	2	2	0	0	0	0	0	0	0
0	0	11	5	0	0	0	16	16	0	0	0	0	0	0	0
0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0
0	0	10	3	0	0	0	13	13	0	0	0	0	0	0	0
0	0	5	2	0	0	0	7	7	0	0	0	0	0	0	0
0	0	5	2	0	0	0	7	7	0	0	0	0	0	0	0
0	0	25	7	0	0	0	32	32	0	0	0	0	0	0	0
0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0
0	0	5	1	0	0	0	6	6	0	0	0	0	0	0	0

0	0	10	1	0	0	0	11	11	0	0	0	0	0	0	0
0	0	8	1	0	0	0	9	9	0	0	0	0	0	0	0
0	0	28	3	0	0	0	31	31	0	0	0	0	0	0	0
0	0	7	0	0	0	0	7	7	0	0	0	0	0	0	0
0	0	6	1	0	0	0	7	7	0	0	0	0	0	0	0
0	0	8	0	0	0	0	8	8	0	0	0	0	0	0	0
0	0	10	3	0	0	0	13	13	0	0	0	0	0	0	0
0	0	31	4	0	0	0	35	35	0	0	0	0	0	0	0
0	0	7	0	0	0	0	7	7	0	0	0	0	0	0	0
0	0	6	1	0	0	0	7	7	0	0	0	0	0	0	0
0	0	13	1	0	0	0	14	14	0	0	0	0	0	0	0
0	0	9	4	0	0	0	13	13	0	0	0	0	0	0	0
0	0	35	6	0	0	0	41	41	0	0	0	0	0	0	0
0	0	7	2	0	0	0	9	9	0	0	0	0	0	0	0
0	0	12	1	0	0	0	13	13	0	0	0	0	0	0	0
0	0	18	2	0	0	0	20	20	0	0	0	0	0	0	0
0	0	14	0	0	0	0	14	14	0	0	0	0	0	0	0
0	0	51	5	0	0	0	56	56	0	0	0	0	0	0	0
0	0	14	0	0	0	0	14	14	0	0	0	0	0	0	0
0	0	13	0	0	0	0	13	13	0	0	0	0	0	0	0
0	0	16	1	0	0	0	17	17	0	0	0	0	0	0	0
0	0	14	0	0	0	0	14	14	0	0	0	0	0	0	0
0	0	57	1	0	0	0	58	58	0	0	0	0	0	0	0
0	0	305	41	2	0	0	348	349	0	0	0	0	0	0	0

0

TOT	PCU
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0	0
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259.2

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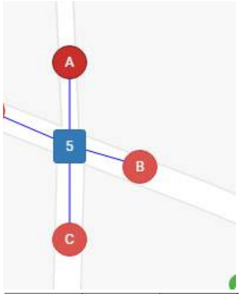
IDASO

Survey Name : IDA-18-060 Carrigaline
Site : 5
Date : 01/05/18
Location : Cork Rd / Church Rd (R612) / R612 / Church Rd (R613)

	A=>A									A=>B					
TIME	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2
07:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00	0	0	0	0	0	0	0	0	0	0	0	44	2	0	0
08:15	0	0	0	0	0	0	0	0	0	0	0	33	3	0	0
08:30	0	0	0	0	0	0	0	0	0	1	0	26	2	0	0
08:45	0	0	0	0	0	0	0	0	0	1	0	22	1	0	0
H/TOT	0	0	0	0	0	0	0	0	0	2	0	125	8	0	0
09:00	0	0	0	0	0	0	0	0	0	0	0	24	2	0	0
09:15	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0
09:30	0	0	0	0	0	0	0	0	0	0	0	6	2	0	0
09:45	0	0	0	0	0	0	0	0	0	0	0	11	1	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	47	5	0	0
10:00	0	0	0	0	0	0	0	0	0	0	0	6	1	0	0
10:15	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0
10:30	0	0	0	0	0	0	0	0	0	0	0	5	1	1	0
10:45	0	0	0	0	0	0	0	0	0	0	0	6	1	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	21	4	1	0
11:00	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0
11:15	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0
11:30	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0
11:45	0	0	0	0	0	0	0	0	0	0	0	6	0	1	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	22	2	1	0
12:00	0	0	0	0	0	0	0	0	0	0	0	12	1	0	0
12:15	0	0	0	0	0	0	0	0	0	0	0	10	2	1	0
12:30	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0
12:45	0	0	0	0	0	0	0	0	0	0	0	8	1	1	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	39	4	2	0
13:00	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
13:15	0	0	0	0	0	0	0	0	0	0	0	5	1	0	0
13:30	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0
13:45	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	24	4	0	0
14:00	0	0	0	0	0	0	0	0	0	0	0	6	3	0	0
14:15	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0

14:30	0	0	0	0	0	0	0	0	0	0	0	12	3	0	0
14:45	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	26	9	0	0
15:00	0	0	0	0	0	0	0	0	0	0	0	13	1	0	0
15:15	0	0	0	0	0	0	0	0	0	1	0	4	1	0	0
15:30	0	0	0	0	0	0	0	0	0	0	0	13	4	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	1	0	50	6	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	9	1	0	0
16:15	0	0	0	0	0	0	0	0	0	0	1	6	2	2	0
16:30	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	1	26	3	2	0
17:00	0	0	0	0	0	0	0	0	0	0	0	9	1	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	12	2	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	0	31	3	0	0
18:00	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0
18:15	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
18:30	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0
18:45	0	0	0	0	0	0	0	0	0	0	0	19	1	0	0
H/TOT	0	0	0	0	0	0	0	0	0	0	1	37	1	0	0
12 TOT	0	0	0	0	0	0	0	0	0	3	2	448	49	6	0

Footage missing due to incorrect time seeting on camera.



113 423 100 37

					A=>C										A=>D
SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	46	46	0	0	76	9	1	3	0	89	93.4	0	0	1	0
0	36	36	1	0	118	12	1	0	1	133	133.7	0	0	10	0
0	29	28.2	0	1	71	9	1	0	0	82	81.9	0	0	40	0
0	24	23.2	1	0	78	4	2	0	0	85	85.2	0	0	30	1
0	135	133.4	2	1	343	34	5	3	1	389	394.2	0	0	81	1
0	26	26	0	0	103	12	5	0	0	120	122.5	0	0	16	1
0	6	6	0	0	54	4	0	2	0	60	62.6	0	0	2	0
0	8	8	0	0	37	5	1	3	0	46	50.4	0	0	1	0
0	12	12	0	0	52	11	3	1	0	67	69.8	0	0	6	0
0	52	52	0	0	246	32	9	6	0	293	305.3	0	0	25	1
0	7	7	0	1	33	9	0	3	0	46	49.3	0	0	1	0
0	5	5	0	0	40	4	0	0	0	44	44	0	0	5	0
0	7	7.5	0	0	35	5	0	2	0	42	44.6	0	0	2	0
0	7	7	0	0	31	7	1	3	0	42	46.4	0	0	1	0
0	26	26.5	0	1	139	25	1	8	0	174	184.3	0	0	9	0
0	4	4	0	0	33	7	3	1	0	44	46.8	0	0	0	0
0	5	5	0	0	48	4	0	1	0	53	54.3	0	0	3	1
0	9	9	0	0	46	9	2	3	0	60	64.9	0	0	4	0
0	7	7.5	0	0	53	14	1	0	0	68	68.5	0	0	1	0
0	25	25.5	0	0	180	34	6	5	0	225	234.5	0	0	8	1
0	13	13	0	0	50	10	1	1	0	62	63.8	0	0	4	0
0	13	13.5	0	0	59	8	4	2	0	73	77.6	0	0	2	0
0	9	9	0	0	72	11	0	0	0	83	83	0	0	3	0
0	10	10.5	0	0	52	8	0	2	0	62	64.6	0	0	2	0
0	45	46	0	0	233	37	5	5	0	280	289	0	0	11	0
0	10	10	0	0	54	8	0	0	0	62	62	0	0	2	0
0	6	6	0	0	62	1	0	1	1	65	67.3	0	0	2	0
0	5	5	0	0	84	11	0	0	1	96	97	0	0	5	0
1	8	9	0	0	94	15	3	4	0	116	122.7	0	0	7	0
1	29	30	0	0	294	35	3	5	2	339	349	0	0	16	0
0	9	9	0	0	56	7	0	1	0	64	65.3	0	0	3	0
0	7	7	0	0	77	6	2	4	0	89	95.2	0	0	1	0

0	15	15	0	0	63	7	4	1	1	76	80.3	0	0	5	0
0	4	4	0	0	99	9	0	1	1	110	112.3	0	0	5	1
0	35	35	0	0	295	29	6	7	2	339	353.1	0	0	14	1
0	14	14	0	0	67	11	2	0	0	80	81	0	0	8	1
0	6	5.2	0	0	71	5	2	5	0	83	90.5	0	0	1	0
0	17	17	0	0	87	14	0	2	0	103	105.6	0	0	2	0
0	20	20	0	0	77	14	0	1	0	92	93.3	0	0	3	0
0	57	56.2	0	0	302	44	4	8	0	358	370.4	0	0	14	1
0	10	10	1	0	83	9	1	1	0	95	96	0	0	12	0
0	11	11.4	0	1	87	11	1	1	1	102	104.2	0	0	3	0
0	7	7	0	0	82	10	0	2	0	94	96.6	1	0	2	0
0	4	4	0	0	98	10	0	0	0	108	108	0	0	3	0
0	32	32.4	1	1	350	40	2	4	1	399	404.8	1	0	20	0
0	10	10	0	0	88	7	1	0	0	96	96.5	0	0	1	1
0	7	7	0	1	91	6	0	1	0	99	99.7	0	0	2	0
0	14	14	0	0	106	6	0	1	0	113	114.3	0	0	1	0
0	3	3	0	1	78	6	0	0	0	85	84.4	0	0	1	1
0	34	34	0	2	363	25	1	2	0	393	394.9	0	0	5	2
0	5	4.4	0	0	119	11	0	0	0	130	130	0	0	1	2
0	5	5	0	1	110	7	1	1	0	120	121.2	0	0	1	0
0	9	9	0	1	87	8	0	1	0	97	97.7	0	0	2	2
0	20	20	0	0	81	3	0	0	0	84	84	0	0	3	0
0	39	38.4	0	2	397	29	1	2	0	431	432.9	0	0	7	4
1	509	509.4	3	7	3142	364	43	55	6	3620	3712	1	0	210	11

28.4

428

								B=>A							
OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	1	0	0	4	0	0	0	0	4	4	0	0
0	0	0	10	10	0	0	11	0	0	0	0	11	11	0	0
0	0	1	41	42	0	0	7	3	0	0	0	10	10	0	0
0	0	0	31	31	0	0	4	0	0	0	0	4	4	0	0
0	0	1	83	84	0	0	26	3	0	0	0	29	29	0	0
0	0	0	17	17	0	0	11	1	0	0	0	12	12	0	0
0	0	1	3	4	0	0	14	1	0	0	0	15	15	0	0
0	0	0	1	1	0	0	6	3	1	0	0	10	10.5	0	0
0	0	0	6	6	0	0	3	1	0	0	0	4	4	0	0
0	0	1	27	28	0	0	34	6	1	0	0	41	41.5	0	0
0	0	0	1	1	0	0	4	2	0	0	0	6	6	0	0
0	0	0	5	5	0	0	3	1	0	0	0	4	4	0	0
0	0	0	2	2	0	0	4	1	0	0	0	5	5	0	0
0	0	0	1	1	0	0	6	0	0	0	0	6	6	0	0
0	0	0	9	9	0	0	17	4	0	0	0	21	21	0	0
0	0	0	0	0	0	0	10	1	0	0	0	11	11	0	0
0	0	1	5	6	0	0	3	1	0	0	0	4	4	0	0
0	0	0	4	4	0	0	4	1	0	0	0	5	5	0	0
0	0	0	1	1	0	0	7	1	1	0	0	9	9.5	0	0
0	0	1	10	11	0	0	24	4	1	0	0	29	29.5	0	0
0	0	0	4	4	0	0	14	0	0	0	0	14	14	0	0
0	0	0	2	2	0	0	18	1	0	0	0	19	19	0	0
0	0	1	4	5	0	0	6	2	0	0	0	8	8	0	0
0	0	0	2	2	0	0	6	1	0	0	0	7	7	0	0
0	0	1	12	13	0	0	44	4	0	0	0	48	48	0	0
0	0	0	2	2	0	0	13	1	0	0	0	14	14	0	0
0	0	0	2	2	0	0	12	1	0	0	0	13	13	0	0
0	0	0	5	5	0	0	9	0	0	0	0	9	9	0	0
0	0	0	7	7	0	0	5	2	0	0	0	7	7	0	0
0	0	0	16	16	0	0	39	4	0	0	0	43	43	0	0
0	0	0	3	3	0	0	5	0	0	0	0	5	5	0	0
0	0	1	2	3	0	0	9	1	0	0	0	10	10	0	0

0	0	0	5	5	0	0	4	2	0	0	0	6	6	0	0
0	0	0	6	6	0	0	6	1	0	0	0	7	7	0	0
0	0	1	16	17	0	0	24	4	0	0	0	28	28	0	0
0	0	0	9	9	0	0	6	0	1	0	0	7	7.5	0	0
1	0	0	2	2.5	0	0	5	1	0	0	0	6	6	0	0
0	0	0	2	2	1	0	5	0	0	0	0	6	5.2	0	0
0	0	0	3	3	0	0	12	2	0	0	0	14	14	0	0
1	0	0	16	16.5	1	0	28	3	1	0	0	33	32.7	0	0
0	0	0	12	12	0	0	16	1	0	0	0	17	17	0	0
0	0	1	4	5	0	0	14	1	0	0	0	15	15	0	0
0	0	0	3	2.2	0	0	12	3	1	0	0	16	16.5	0	0
0	0	0	3	3	0	0	20	1	0	0	0	21	21	0	0
0	0	1	22	22.2	0	0	62	6	1	0	0	69	69.5	0	0
0	0	0	2	2	0	0	12	0	0	0	0	12	12	0	0
0	0	0	2	2	0	0	21	2	0	0	0	23	23	0	0
0	0	0	1	1	0	0	14	0	0	0	0	14	14	0	0
0	0	0	2	2	0	0	17	2	0	0	0	19	19	0	0
0	0	0	7	7	0	0	64	4	0	0	0	68	68	0	0
0	0	0	3	3	0	0	9	1	0	0	0	10	10	0	0
0	0	0	1	1	0	0	9	1	0	0	0	10	10	0	0
0	0	0	4	4	0	0	5	0	0	0	0	5	5	0	0
0	0	0	3	3	0	0	6	0	0	0	0	6	6	0	0
0	0	0	11	11	0	0	29	2	0	0	0	31	31	0	0
1	0	6	229	234.7	1	0	391	44	4	0	0	440	441.2	0	0

295 185 335

B=>B							B=>C								
CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	38	0	0	0	0	38	38
0	0	0	0	0	0	0	0	0	47	8	0	0	0	55	55
0	0	0	0	0	0	0	0	0	55	2	0	0	0	57	57
0	0	0	0	0	0	0	1	0	95	3	0	0	0	99	98.2
0	0	0	0	0	0	0	1	0	235	13	0	0	0	249	248.2
0	0	0	0	0	0	0	0	0	81	1	0	1	0	83	84.3
0	0	0	0	0	0	0	0	0	53	3	0	0	0	56	56
0	0	0	0	0	0	0	1	0	27	1	0	0	0	29	28.2
0	0	0	0	0	0	0	0	0	22	3	0	0	0	25	25
0	0	0	0	0	0	0	1	0	183	8	0	1	0	193	193.5
0	0	0	0	0	0	0	0	0	25	3	1	0	0	29	29.5
0	0	0	0	0	0	0	0	0	27	8	0	0	0	35	35
0	0	0	0	0	0	0	0	0	33	3	0	0	0	36	36
0	0	0	0	0	0	0	0	0	23	3	0	0	0	26	26
0	0	0	0	0	0	0	0	0	108	17	1	0	0	126	126.5
0	0	0	0	0	0	0	0	0	27	2	1	0	0	30	30.5
0	0	0	0	0	0	0	0	1	20	3	0	0	0	24	23.4
0	0	0	0	0	0	0	0	0	20	2	1	0	0	23	23.5
0	0	0	0	0	0	0	0	0	40	2	1	0	0	43	43.5
0	0	0	0	0	0	0	0	1	107	9	3	0	0	120	120.9
0	0	0	0	0	0	0	0	1	57	4	1	0	0	63	62.9
0	0	0	0	0	0	0	0	0	28	5	0	0	0	33	33
0	0	0	0	0	0	0	0	0	45	2	0	0	0	47	47
0	0	0	0	0	0	0	0	0	49	3	2	0	0	54	55
0	0	0	0	0	0	0	0	1	179	14	3	0	0	197	197.9
0	0	0	0	0	0	0	0	0	57	4	0	0	0	61	61
0	0	0	0	0	0	0	0	0	49	0	1	0	1	51	52.5
0	0	0	0	0	0	0	0	0	58	4	0	0	0	62	62
0	0	0	0	0	0	0	0	0	56	2	1	0	0	59	59.5
0	0	0	0	0	0	0	0	0	220	10	2	0	1	233	235
0	0	0	0	0	0	0	0	0	30	2	2	0	0	34	35
0	0	0	0	0	0	0	0	0	39	4	0	0	0	43	43

0	0	0	0	0	0	0	0	0	61	4	1	0	0	66	66.5
0	0	0	0	0	0	0	0	0	71	3	0	0	0	74	74
0	0	0	0	0	0	0	0	0	201	13	3	0	0	217	218.5
0	0	0	0	0	0	0	0	0	43	4	0	0	0	47	47
0	0	0	0	0	0	0	0	0	40	1	1	0	0	42	42.5
0	0	0	0	0	0	0	0	0	62	3	1	0	0	66	66.5
0	0	0	0	0	0	0	0	1	62	3	0	0	0	66	65.4
0	0	0	0	0	0	0	0	1	207	11	2	0	0	221	221.4
0	0	0	0	0	0	0	0	1	84	3	0	0	0	88	87.4
0	0	0	0	0	0	0	0	2	84	4	1	0	0	91	90.3
0	0	0	0	0	0	0	0	0	61	4	0	0	0	65	65
0	0	0	0	0	0	0	0	0	67	8	0	0	0	75	75
0	0	0	0	0	0	0	0	3	296	19	1	0	0	319	317.7
0	0	0	0	0	0	0	0	0	63	0	0	0	0	63	63
0	0	0	0	0	0	0	0	0	78	2	0	0	0	80	80
0	0	0	0	0	0	0	0	0	89	3	0	0	0	92	92
0	0	0	0	0	0	0	0	0	99	8	0	0	0	107	107
0	0	0	0	0	0	0	0	0	329	13	0	0	0	342	342
0	0	0	0	0	0	0	0	0	76	4	1	0	0	81	81.5
0	0	0	0	0	0	0	0	0	51	3	0	0	0	54	54
0	0	0	0	0	0	0	0	0	53	1	0	0	0	54	54
0	0	0	0	0	0	0	0	0	67	2	1	0	0	70	70.5
0	0	0	0	0	0	0	0	0	247	10	2	0	0	259	260
0	0	0	0	0	0	0	2	6	2312	137	17	1	1	2476	2482

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B=>D									C=>A						
PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	16	3	1	0	0	20	20.5	0	1	94	6	1	0	0
0	0	33	0	0	0	0	33	33	0	0	79	6	1	0	1
0	0	48	3	0	0	0	51	51	0	2	83	1	1	4	1
0	0	46	2	0	0	0	48	48	0	0	77	4	1	2	1
0	0	143	8	1	0	0	152	152.5	0	3	333	17	4	6	3
0	0	52	1	0	0	0	53	53	0	0	51	4	0	2	0
0	0	34	0	0	0	0	34	34	0	0	87	5	2	2	0
0	0	19	1	0	0	0	20	20	0	0	63	14	2	1	0
1	0	20	2	1	0	0	24	23.7	0	0	54	9	4	0	0
1	0	125	4	1	0	0	131	130.7	0	0	255	32	8	5	0
0	0	24	2	0	0	0	26	26	0	0	63	12	2	3	1
1	0	9	0	0	0	0	10	9.2	0	0	61	3	0	1	0
0	0	19	1	0	0	0	20	20	0	0	69	13	5	0	0
0	0	22	0	0	0	0	22	22	0	0	60	4	1	2	0
1	0	74	3	0	0	0	78	77.2	0	0	253	32	8	6	1
0	0	14	2	0	0	0	16	16	0	0	39	8	1	2	0
0	0	16	3	0	0	0	19	19	0	0	57	11	1	1	1
0	0	26	3	0	0	0	29	29	0	0	66	6	2	3	0
0	0	26	3	0	0	0	29	29	0	0	62	12	1	2	0
0	0	82	11	0	0	0	93	93	0	0	224	37	5	8	1
0	0	22	1	0	0	0	23	23	0	0	50	6	1	2	0
0	0	29	1	0	0	0	30	30	0	0	66	9	3	1	0
0	0	23	5	0	0	0	28	28	0	0	53	13	1	0	0
0	0	28	3	0	0	0	31	31	0	0	66	4	1	3	0
0	0	102	10	0	0	0	112	112	0	0	235	32	6	6	0
0	0	40	1	1	0	0	42	42.5	0	0	64	5	1	0	0
0	0	36	2	0	0	0	38	38	0	0	61	4	3	1	0
0	0	19	2	0	0	0	21	21	0	0	62	0	0	0	1
0	0	26	4	0	0	0	30	30	0	1	71	3	3	1	0
0	0	121	9	1	0	0	131	131.5	0	1	258	12	7	2	1
0	0	25	1	0	0	0	26	26	0	0	62	8	2	0	0
0	0	27	2	0	0	0	29	29	0	0	59	7	0	2	0

1	0	36	4	0	0	0	41	40.2	0	0	66	9	1	1	0
0	0	35	2	0	0	0	37	37	0	0	77	10	4	6	0
1	0	123	9	0	0	0	133	132.2	0	0	264	34	7	9	0
0	0	23	2	0	0	0	25	25	0	0	70	15	2	2	0
0	0	21	2	0	0	0	23	23	0	0	86	5	1	1	0
0	0	32	4	0	0	0	36	36	0	1	110	6	1	0	0
0	0	24	1	0	0	0	25	25	0	0	82	10	3	0	1
0	0	100	9	0	0	0	109	109	0	1	348	36	7	3	1
0	0	35	3	1	0	0	39	39.5	0	0	66	9	2	3	2
0	0	40	3	0	0	0	43	43	0	1	88	9	2	1	0
0	0	49	4	0	0	0	53	53	1	0	92	18	0	2	1
0	0	51	2	1	0	0	54	54.5	0	0	101	17	2	1	0
0	0	175	12	2	0	0	189	190	1	1	347	53	6	7	3
0	0	37	2	0	0	0	39	39	0	0	98	10	2	0	1
0	0	40	1	0	0	0	41	41	0	0	85	13	1	0	0
0	0	30	2	0	0	0	32	32	0	0	70	13	1	0	0
0	0	38	0	0	0	0	38	38	0	0	61	1	0	1	0
0	0	145	5	0	0	0	150	150	0	0	314	37	4	1	1
0	0	22	4	0	0	0	26	26	0	0	90	7	0	0	0
0	0	37	2	0	0	0	39	39	0	0	70	4	0	0	0
0	0	25	0	0	0	0	25	25	0	0	70	8	0	0	0
0	1	20	0	0	0	0	21	20.4	0	0	46	4	0	0	0
0	1	104	6	0	0	0	111	110.4	0	0	276	23	0	0	0
3	1	1294	86	5	0	0	1389	1389	1	6	3107	345	62	53	11

				C=>B									C=>C		
TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
102	101.9	1	0	57	6	1	0	0	65	64.7	0	0	0	0	0
87	88.5	0	1	52	2	0	0	0	55	54.4	0	0	0	0	0
92	97.5	0	1	52	1	0	0	0	54	53.4	0	0	0	0	0
85	89.1	0	1	52	4	1	0	0	58	57.9	0	0	0	0	0
366	377	1	3	213	13	2	0	0	232	230.4	0	0	0	0	0
57	59.6	0	0	50	1	0	0	0	51	51	0	0	0	0	0
96	99.6	0	0	41	4	0	0	0	45	45	0	0	0	0	0
80	82.3	0	0	29	3	0	1	0	33	34.3	0	0	0	0	0
67	69	0	0	16	4	0	0	0	20	20	0	0	0	0	0
300	310.5	0	0	136	12	0	1	0	149	150.3	0	0	0	0	0
81	86.9	0	0	18	4	0	0	0	22	22	0	0	0	0	0
65	66.3	0	0	25	2	0	0	0	27	27	0	0	0	0	0
87	89.5	0	0	20	1	0	0	0	21	21	0	0	0	0	0
67	70.1	0	0	28	4	0	0	0	32	32	0	0	0	0	0
300	312.8	0	0	91	11	0	0	0	102	102	0	0	0	0	0
50	53.1	0	0	28	2	0	0	0	30	30	0	0	0	0	0
71	73.8	0	0	17	1	0	0	0	18	18	0	0	0	0	0
77	81.9	0	1	35	2	0	0	0	38	37.4	0	0	0	0	0
77	80.1	0	0	32	1	1	0	0	34	34.5	0	0	0	0	0
275	288.9	0	1	112	6	1	0	0	120	119.9	0	0	0	0	0
59	62.1	0	0	24	4	0	0	0	28	28	0	0	0	0	0
79	81.8	0	0	33	2	0	0	0	35	35	0	0	0	0	0
67	67.5	0	0	33	2	1	0	0	36	36.5	0	0	0	0	0
74	78.4	0	0	30	4	0	0	0	34	34	0	0	0	0	0
279	289.8	0	0	120	12	1	0	0	133	133.5	0	0	0	0	0
70	70.5	0	0	32	0	0	0	0	32	32	0	0	0	0	0
69	71.8	0	0	30	2	0	0	0	32	32	0	0	0	0	0
63	64	0	0	29	3	0	0	0	32	32	0	0	0	0	0
79	81.2	0	0	30	2	1	0	0	33	33.5	0	0	0	0	0
281	287.5	0	0	121	7	1	0	0	129	129.5	0	0	0	0	0
72	73	0	0	36	2	0	0	1	39	40	0	0	0	0	0
68	70.6	0	0	23	3	1	0	0	27	27.5	0	0	0	0	0

77	78.8	0	0	27	3	0	0	0	30	30	0	0	0	0	0
97	106.8	0	0	24	3	0	0	0	27	27	0	0	0	0	0
314	329.2	0	0	110	11	1	0	1	123	124.5	0	0	0	0	0
89	92.6	0	0	29	1	0	0	0	30	30	0	0	0	0	0
93	94.8	0	0	28	4	1	0	0	33	33.5	0	0	0	0	0
118	117.9	0	0	37	4	0	0	0	41	41	0	0	0	0	0
96	98.5	0	0	52	3	0	0	0	55	55	0	0	0	0	0
396	403.8	0	0	146	12	1	0	0	159	159.5	0	0	0	0	0
82	88.9	0	0	41	3	1	0	0	45	45.5	0	0	0	0	0
101	102.7	0	0	37	2	0	0	0	39	39	0	0	0	0	0
114	116.8	0	0	20	4	0	0	0	24	24	0	0	0	0	0
121	123.3	0	0	36	3	0	0	0	39	39	0	0	0	0	0
418	431.7	0	0	134	12	1	0	0	147	147.5	0	0	0	0	0
111	113	0	0	35	4	0	0	0	39	39	0	0	0	0	0
99	99.5	0	0	27	8	0	0	0	35	35	0	0	0	0	0
84	84.5	0	0	37	3	0	0	0	40	40	0	0	0	0	0
63	64.3	0	0	32	3	0	0	0	35	35	0	0	0	0	0
357	361.3	0	0	131	18	0	0	0	149	149	0	0	0	0	0
97	97	0	0	35	2	0	0	0	37	37	0	0	0	0	0
74	74	0	0	32	3	0	0	0	35	35	0	0	0	0	0
78	78	0	0	36	1	0	0	0	37	37	0	0	0	0	0
50	50	0	0	34	0	0	0	0	34	34	0	0	0	0	0
299	299	0	0	137	6	0	0	0	143	143	0	0	0	0	0
3585	3692	1	4	1451	120	8	1	1	1586	1589	0	0	0	0	0

345 147

							C=>D								
OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	45	3	0	0	0	48	48	0	0	3
0	0	0	0	0	0	28	1	0	0	0	29	29	0	0	7
0	0	0	0	0	0	15	2	0	1	0	18	19.3	0	0	17
0	0	0	0	0	0	14	2	0	0	0	16	16	0	0	19
0	0	0	0	0	0	102	8	0	1	0	111	112.3	0	0	46
0	0	0	0	0	0	20	1	0	0	0	21	21	0	0	3
0	0	0	0	0	0	39	2	0	0	0	41	41	0	0	9
0	0	0	0	0	0	25	2	0	0	0	27	27	0	0	5
0	0	0	0	1	0	31	5	2	0	0	39	39.2	0	0	1
0	0	0	0	1	0	115	10	2	0	0	128	128.2	0	0	18
0	0	0	0	0	0	23	4	0	0	0	27	27	0	0	5
0	0	0	0	0	0	34	2	0	1	0	37	38.3	0	0	4
0	0	0	0	0	0	27	4	0	0	0	31	31	0	0	4
0	0	0	0	0	0	24	2	0	2	0	28	30.6	0	0	3
0	0	0	0	0	0	108	12	0	3	0	123	126.9	0	0	16
0	0	0	0	0	0	17	2	0	0	0	19	19	0	0	5
0	0	0	0	0	0	14	3	1	2	0	20	23.1	0	0	4
0	0	0	0	0	0	18	2	0	0	0	20	20	0	0	3
0	0	0	0	0	0	24	1	0	0	0	25	25	0	0	0
0	0	0	0	0	0	73	8	1	2	0	84	87.1	0	0	12
0	0	0	0	0	0	28	3	1	0	0	32	32.5	0	0	1
0	0	0	0	0	0	25	3	0	1	0	29	30.3	0	0	8
0	0	0	0	1	0	28	5	0	0	0	34	33.2	0	0	8
0	0	0	0	0	0	20	4	1	0	0	25	25.5	0	0	5
0	0	0	0	1	0	101	15	2	1	0	120	121.5	0	0	22
0	0	0	0	0	0	19	3	0	0	0	22	22	0	0	7
0	0	0	0	0	0	24	0	0	0	0	24	24	0	0	7
0	0	0	0	0	0	19	0	0	0	0	19	19	0	0	11
0	0	0	0	0	0	21	4	0	0	0	25	25	0	0	7
0	0	0	0	0	0	83	7	0	0	0	90	90	0	0	32
0	0	0	0	0	0	21	4	0	0	0	25	25	0	0	6
0	0	0	0	0	1	24	1	0	1	0	27	27.7	0	0	12

0	0	0	0	0	0	37	3	0	0	0	40	40	0	0	7
0	0	0	0	0	0	42	5	0	0	0	47	47	0	0	3
0	0	0	0	0	1	124	13	0	1	0	139	139.7	0	0	28
0	0	0	0	0	0	28	7	0	0	0	35	35	0	0	10
0	0	0	0	0	0	29	2	0	0	0	31	31	0	0	13
0	0	0	0	0	0	33	2	0	0	0	35	35	0	0	10
0	0	0	0	0	0	30	2	0	0	0	32	32	0	0	13
0	0	0	0	0	0	120	13	0	0	0	133	133	0	0	46
0	0	0	0	2	0	37	2	0	0	0	41	39.4	0	0	21
0	0	0	0	0	0	40	2	2	0	0	44	45	0	0	2
0	0	0	0	0	0	36	3	0	0	0	39	39	0	0	5
0	0	0	0	0	0	30	5	1	0	0	36	36.5	0	0	6
0	0	0	0	2	0	143	12	3	0	0	160	159.9	0	0	34
0	0	0	0	0	0	34	2	0	0	0	36	36	0	0	7
0	0	0	0	0	0	28	6	0	0	0	34	34	0	0	1
0	0	0	0	1	0	28	2	0	0	0	31	30.2	0	0	3
0	0	0	0	0	0	39	1	0	0	0	40	40	0	0	6
0	0	0	0	1	0	129	11	0	0	0	141	140.2	0	0	17
0	0	0	0	0	0	36	3	0	0	0	39	39	0	0	7
0	0	0	0	0	0	21	4	0	0	0	25	25	0	0	7
0	0	0	0	0	0	23	1	0	0	0	24	24	0	0	3
0	0	0	0	0	0	18	1	0	0	0	19	19	0	0	4
0	0	0	0	0	0	98	9	0	0	0	107	107	0	0	21
0	0	0	0	5	1	1196	118	8	8	0	1336	1346	0	0	292

D=>A									D=>B						
LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	3	3	0	0	57	5	0	0	0	62	62	0
0	0	0	0	7	7	0	1	71	2	0	0	0	74	73.4	1
0	0	0	0	17	17	0	0	57	1	0	0	0	58	58	0
0	0	0	0	19	19	0	0	56	1	0	0	1	58	59	1
0	0	0	0	46	46	0	1	241	9	0	0	1	252	252.4	2
1	0	0	0	4	4	0	0	43	2	0	0	0	45	45	0
0	1	0	0	10	10.5	0	0	23	0	0	0	0	23	23	0
0	0	0	0	5	5	0	0	30	3	1	0	0	34	34.5	0
0	0	0	0	1	1	0	0	16	0	1	1	0	18	19.8	0
1	1	0	0	20	20.5	0	0	112	5	2	1	0	120	122.3	0
0	0	0	0	5	5	0	0	19	5	1	0	0	25	25.5	0
0	0	0	0	4	4	0	0	11	4	0	0	0	15	15	0
1	0	0	0	5	5	0	0	17	5	0	0	0	22	22	0
0	0	0	0	3	3	0	0	18	2	0	0	0	20	20	0
1	0	0	0	17	17	0	0	65	16	1	0	0	82	82.5	0
0	0	0	0	5	5	0	0	29	2	1	0	0	32	32.5	0
0	0	0	0	4	4	0	0	24	4	0	0	0	28	28	0
0	0	0	0	3	3	0	0	24	1	0	0	0	25	25	0
0	0	0	0	0	0	0	0	32	3	0	0	0	35	35	0
0	0	0	0	12	12	0	0	109	10	1	0	0	120	120.5	0
0	0	0	0	1	1	0	0	36	2	0	0	0	38	38	0
0	0	0	0	8	8	0	0	30	3	0	0	0	33	33	0
0	0	0	0	8	8	0	0	21	3	0	1	0	25	26.3	0
0	0	0	0	5	5	0	0	30	2	0	0	0	32	32	0
0	0	0	0	22	22	0	0	117	10	0	1	0	128	129.3	0
0	0	0	0	7	7	0	0	46	2	0	0	0	48	48	0
1	0	0	0	8	8	0	0	21	5	0	0	0	26	26	0
1	0	0	0	12	12	0	0	42	2	0	0	0	44	44	0
2	0	0	0	9	9	0	0	29	1	0	0	0	30	30	0
4	0	0	0	36	36	0	0	138	10	0	0	0	148	148	0
1	0	0	0	7	7	0	0	26	0	0	0	0	26	26	0
1	0	0	0	13	13	0	0	31	0	0	0	0	31	31	0

0	0	0	0	7	7	0	0	25	2	0	0	0	27	27	0
0	0	0	0	3	3	0	0	20	0	0	0	0	20	20	0
2	0	0	0	30	30	0	0	102	2	0	0	0	104	104	0
1	0	0	0	11	11	0	0	26	3	0	0	0	29	29	0
0	0	0	0	13	13	0	0	19	2	0	0	0	21	21	0
0	0	0	0	10	10	0	0	37	1	0	0	0	38	38	0
0	0	0	0	13	13	0	0	39	1	0	0	0	40	40	0
1	0	0	0	47	47	0	0	121	7	0	0	0	128	128	0
0	0	0	0	21	21	0	0	23	2	0	0	0	25	25	0
0	0	0	1	3	4	0	0	39	3	0	0	0	42	42	0
0	0	0	0	5	5	0	0	16	3	0	0	0	19	19	0
1	1	0	0	8	8.5	0	0	26	2	0	0	0	28	28	0
1	1	0	1	37	38.5	0	0	104	10	0	0	0	114	114	0
1	0	0	0	8	8	0	0	30	0	1	0	0	31	31.5	0
0	0	0	0	1	1	0	0	36	3	1	0	0	40	40.5	0
0	0	0	0	3	3	0	0	45	2	0	0	1	48	49	0
0	0	0	0	6	6	0	0	28	2	0	0	0	30	30	0
1	0	0	0	18	18	0	0	139	7	2	0	1	149	151	0
0	0	0	0	7	7	1	0	28	2	1	0	0	32	31.7	0
1	0	0	0	8	8	0	0	27	4	0	0	0	31	31	0
0	0	0	0	3	3	0	0	42	2	0	0	0	44	44	0
1	0	0	0	5	5	0	0	29	3	0	0	0	32	32	0
2	0	0	0	23	23	1	0	126	11	1	0	0	139	138.7	0
13	2	0	1	308	310	1	1	1374	97	7	2	2	1484	1491	2

D=>C								D=>D							
MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	PCL	MCL	CAR	LGV	OGV1	OGV2	SV (BU	TOT
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	17	3	0	0	0	20	20	0	0	0	0	0	0	0	0
0	15	2	0	0	0	18	17.2	0	0	0	0	0	0	0	0
0	9	1	0	0	0	10	10	0	0	0	0	0	0	0	0
0	16	1	0	0	0	18	17.2	0	0	0	0	0	0	0	0
0	57	7	0	0	0	66	64.4	0	0	0	0	0	0	0	0
0	21	5	1	0	0	27	27.5	0	0	0	0	0	0	0	0
0	32	5	0	0	0	37	37	0	0	0	0	0	0	0	0
0	15	3	0	0	0	18	18	0	0	0	0	0	0	0	0
0	19	0	0	0	0	19	19	0	0	0	0	0	0	0	0
0	87	13	1	0	0	101	101.5	0	0	0	0	0	0	0	0
0	18	5	0	1	0	24	25.3	0	0	0	0	0	0	0	0
0	17	3	0	1	0	21	22.3	0	0	0	0	0	0	0	0
0	18	2	0	0	0	20	20	0	0	0	0	0	0	0	0
0	23	4	1	2	0	30	33.1	0	0	0	0	0	0	0	0
0	76	14	1	4	0	95	100.7	0	0	0	0	0	0	0	0
0	19	1	0	1	0	21	22.3	0	0	0	0	0	0	0	0
0	14	0	1	0	0	15	15.5	0	0	0	0	0	0	0	0
0	30	2	0	0	0	32	32	0	0	0	0	0	0	0	0
0	29	2	1	0	0	32	32.5	0	0	0	0	0	0	0	0
0	92	5	2	1	0	100	102.3	0	0	0	0	0	0	0	0
0	18	6	0	1	0	25	26.3	0	0	0	0	0	0	0	0
0	27	2	0	0	0	29	29	0	0	0	0	0	0	0	0
0	17	1	0	0	0	18	18	0	0	0	0	0	0	0	0
0	28	2	0	0	0	30	30	0	0	0	0	0	0	0	0
0	90	11	0	1	0	102	103.3	0	0	0	0	0	0	0	0
0	19	4	0	0	0	23	23	0	0	0	0	0	0	0	0
0	25	0	0	1	0	26	27.3	0	0	0	0	0	0	0	0
0	19	3	0	0	0	22	22	0	0	0	0	0	0	0	0
0	30	3	0	0	0	33	33	0	0	0	0	0	0	0	0
0	93	10	0	1	0	104	105.3	0	0	0	0	0	0	0	0
0	21	1	0	0	0	22	22	0	0	0	0	0	0	0	0
0	24	1	0	0	0	25	25	0	0	0	0	0	0	0	0

0	20	0	0	0	0	20	20	0	0	0	0	0	0	0	0
0	28	3	0	0	0	31	31	0	0	0	0	0	0	0	0
0	93	5	0	0	0	98	98	0	0	0	0	0	0	0	0
1	42	2	0	0	0	45	44.4	0	0	0	0	0	0	0	0
0	21	2	1	0	0	24	24.5	0	0	0	0	0	0	0	0
0	30	1	0	0	0	31	31	0	0	0	0	0	0	0	0
0	21	2	2	1	0	26	28.3	0	0	0	0	0	0	0	0
1	114	7	3	1	0	126	128.2	0	0	0	0	0	0	0	0
0	18	1	0	0	0	19	19	0	0	0	0	0	0	0	0
0	28	0	0	0	0	28	28	0	0	0	0	0	0	0	0
0	35	3	0	0	0	38	38	0	0	0	0	0	0	0	0
0	33	3	0	0	0	36	36	0	0	0	0	0	0	0	0
0	114	7	0	0	0	121	121	0	0	0	0	0	0	0	0
0	32	4	0	0	0	36	36	0	0	0	0	0	0	0	0
0	36	2	0	0	0	38	38	0	0	0	0	0	0	0	0
0	24	3	0	0	0	27	27	0	0	0	0	0	0	0	0
0	31	3	0	0	0	34	34	0	0	0	0	0	0	0	0
0	123	12	0	0	0	135	135	0	0	0	0	0	0	0	0
0	25	1	0	0	0	26	26	0	0	0	0	0	0	0	0
0	36	2	0	0	0	38	38	0	0	0	0	0	0	0	0
0	29	3	0	0	0	32	32	0	0	0	0	0	0	0	0
0	31	1	0	0	0	32	32	0	0	0	0	0	0	0	0
0	121	7	0	0	0	128	128	0	0	0	0	0	0	0	0
1	1060	98	7	8	0	1176	1188	0	0	0	0	0	0	0	0

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12.0 Appendix B – Trics Data

TRIP RATE for Land Use 03 - RESIDENTIAL/C - FLATS PRIVATELY OWNED

VEHICLES

Calculation factor: 1 DWELLS

BOLD print indicates peak (busiest) period

	ARRIVALS			DEPARTURES			TOTALS		
Time Range	No. Days	Ave. DWELLS	Trip Rate	No. Days	Ave. DWELLS	Trip Rate	No. Days	Ave. DWELLS	Trip Rate
00:00 - 01:00									
01:00 - 02:00									
02:00 - 03:00									
03:00 - 04:00									
04:00 - 05:00									
05:00 - 06:00									
06:00 - 07:00									
07:00 - 08:00	10	135	0.043	10	135	0.212	10	135	0.255
08:00 - 09:00	10	135	0.047	**10**	**135**	**0.224**	**10**	**135**	**0.271**
09:00 - 10:00	10	135	0.051	10	135	0.090	10	135	0.141
10:00 - 11:00	10	135	0.030	10	135	0.050	10	135	0.080
11:00 - 12:00	10	135	0.044	10	135	0.044	10	135	0.088
12:00 - 13:00	10	135	0.060	10	135	0.068	10	135	0.128
13:00 - 14:00	10	135	0.077	10	135	0.071	10	135	0.148
14:00 - 15:00	10	135	0.068	10	135	0.058	10	135	0.126
15:00 - 16:00	10	135	0.095	10	135	0.064	10	135	0.159
16:00 - 17:00	10	135	0.116	10	135	0.056	10	135	0.172
17:00 - 18:00	**10**	**135**	**0.187**	10	135	0.047	10	135	0.234
18:00 - 19:00	10	135	0.170	10	135	0.076	10	135	0.246
19:00 - 20:00									
20:00 - 21:00									
21:00 - 22:00									
22:00 - 23:00									
23:00 - 24:00									
Total Rates:			0.988			1.060			2.048

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.*

Parameter summary

Trip rate parameter range selected:	20 - 372 (units:)
Survey date date range:	01/01/09 - 22/11/16
Number of weekdays (Monday-Friday):	10
Number of Saturdays:	0
Number of Sundays:	0
Surveys automatically removed from selection:	1
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.

TRIP RATE for Land Use 01 - RETAIL/A - FOOD SUPERSTORE
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	32	5645	0.795	32	5645	1.068	32	5645	1.863
01:00 - 02:00	31	5502	0.399	31	5502	0.483	31	5502	0.882
02:00 - 03:00	31	5502	0.289	31	5502	0.295	31	5502	0.584
03:00 - 04:00	31	5502	0.238	31	5502	0.226	31	5502	0.464
04:00 - 05:00	31	5502	0.193	31	5502	0.174	31	5502	0.367
05:00 - 06:00	31	5502	0.424	31	5502	0.308	31	5502	0.732
06:00 - 07:00	35	5374	0.850	35	5374	0.677	35	5374	1.527
07:00 - 08:00	95	5621	1.709	95	5621	1.114	95	5621	2.823
08:00 - 09:00	113	5660	3.571	113	5660	2.345	113	5660	5.916
09:00 - 10:00	125	5655	5.058	125	5655	3.602	125	5655	8.660
10:00 - 11:00	131	5601	6.883	131	5601	5.679	131	5601	12.562
11:00 - 12:00	131	5601	7.407	131	5601	7.182	131	5601	14.589
12:00 - 13:00	**131**	**5601**	**7.501**	**131**	**5601**	**7.654**	**131**	**5601**	**15.155**
13:00 - 14:00	131	5601	7.064	131	5601	7.359	131	5601	14.423
14:00 - 15:00	131	5601	6.991	131	5601	7.044	131	5601	14.035
15:00 - 16:00	131	5601	6.821	131	5601	7.263	131	5601	14.084
16:00 - 17:00	128	5638	6.159	128	5638	6.706	128	5638	12.865
17:00 - 18:00	115	5636	6.385	115	5636	6.908	115	5636	13.293
18:00 - 19:00	110	5608	5.768	110	5608	6.382	110	5608	12.150
19:00 - 20:00	107	5576	4.370	107	5576	5.197	107	5576	9.567
20:00 - 21:00	99	5711	3.055	99	5711	3.670	99	5711	6.725
21:00 - 22:00	90	5814	2.031	90	5814	2.606	90	5814	4.637
22:00 - 23:00	46	5557	1.391	46	5557	1.874	46	5557	3.265
23:00 - 24:00	32	5645	1.072	32	5645	1.337	32	5645	2.409
Total Rates:			86.424			87.153			173.577

Parameter summary

Trip rate parameter range selected:	929 - 12642 (units: sqm)
Survey date date range:	01/01/99 - 19/05/07
Number of weekdays (Monday-Friday):	52
Number of Saturdays:	49
Number of Sundays:	30
Optional parameters used in selection:	NO
Surveys manually removed from selection:	0

TRIP RATE for Land Use 04 - EDUCATION/D - NURSERY
VEHICLES
Calculation factor: 100 sqm
Estimated TRIP rate value per 234 SQM shown in shaded columns
BOLD print indicates peak (busiest) period

	ARRIVALS				DEPARTURES				TOTALS			
Time Range	No. Days	Ave. GFA	Trip Rate	Estimated Trip Rate	No. Days	Ave. GFA	Trip Rate	Estimated Trip Rate	No. Days	Ave. GFA	Trip Rate	Estimated Trip Rate
00:00 - 01:00												
01:00 - 02:00												
02:00 - 03:00												
03:00 - 04:00												
04:00 - 05:00												
05:00 - 06:00												
06:00 - 07:00												
07:00 - 08:00	2	900	0.333	0.780	2	900	0.167	0.390	2	900	0.500	1.170
08:00 - 09:00	**2**	**900**	**2.000**	**4.680**	2	900	0.889	2.080	2	900	2.889	6.760
09:00 - 10:00	2	900	1.611	3.770	**2**	**900**	**1.778**	**4.160**	**2**	**900**	**3.389**	**7.930**
10:00 - 11:00	2	900	0.222	0.520	2	900	0.333	0.780	2	900	0.555	1.300
11:00 - 12:00	2	900	0.444	1.040	2	900	0.167	0.390	2	900	0.611	1.430
12:00 - 13:00	2	900	1.444	3.380	2	900	1.722	4.030	2	900	3.166	7.410
13:00 - 14:00	2	900	1.056	2.470	2	900	1.000	2.340	2	900	2.056	4.810
14:00 - 15:00	2	900	1.111	2.600	2	900	0.722	1.690	2	900	1.833	4.290
15:00 - 16:00	2	900	0.278	0.650	2	900	0.944	2.210	2	900	1.222	2.860
16:00 - 17:00	2	900	0.667	1.560	2	900	0.611	1.430	2	900	1.278	2.990
17:00 - 18:00	2	900	1.000	2.340	2	900	1.667	3.900	2	900	2.667	6.240
18:00 - 19:00	2	900	0.000	0.000	2	900	0.222	0.520	2	900	0.222	0.520
19:00 - 20:00												
20:00 - 21:00												
21:00 - 22:00												
22:00 - 23:00												
23:00 - 24:00												
Total Rates:			10.166	23.790			10.222	23.920			20.388	47.710

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.*

12.0 Appendix C – LinSig Traffic Analysis Output Data

Church Road / Crosshaven Road Signalised Junction

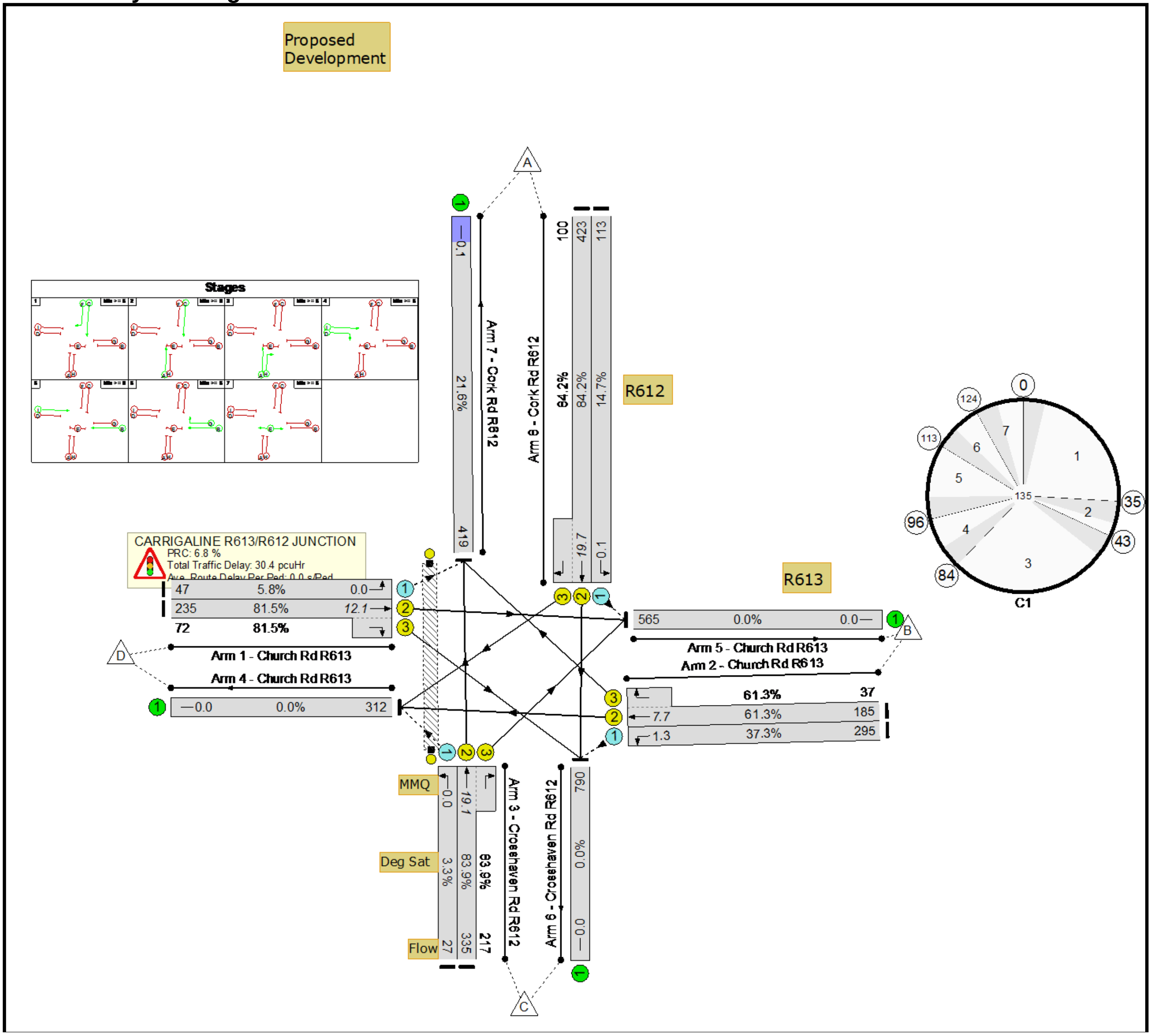
Basic Results Summary

User and Project Details

Project:	
Title:	
Location:	
Additional detail:	
File name:	Crosshaven Rd Church Road Junction Option 1.lsg3x
Author:	
Company:	
Address:	

Scenario 1: 'Scenario 1 AM 2018' (FG1: 'AM 2018', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

Network Results

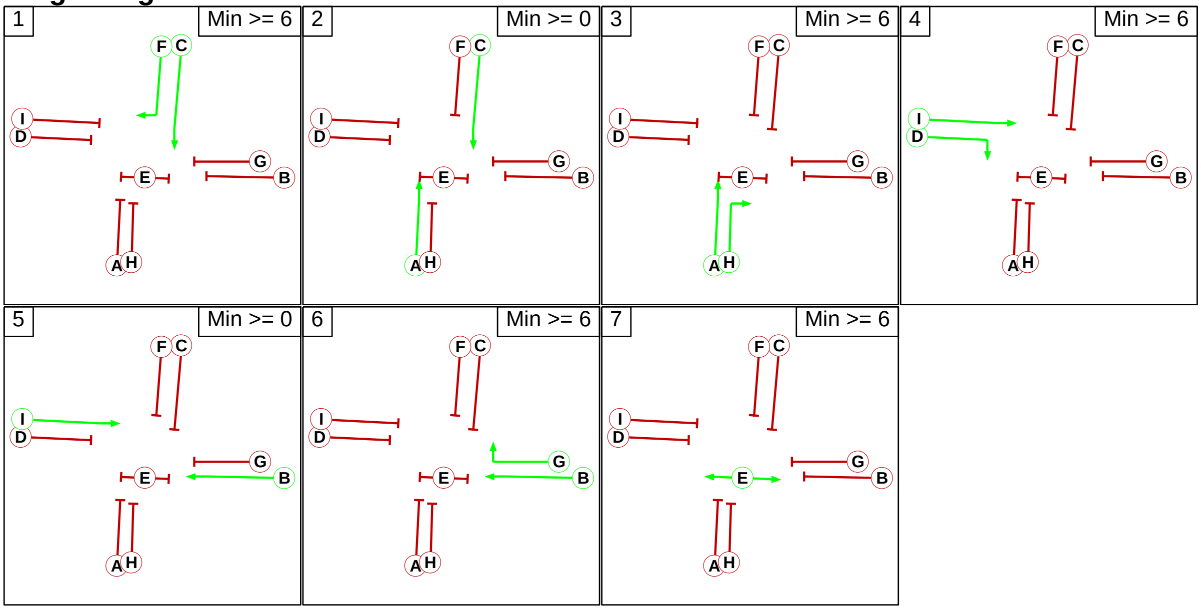
Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**84.2%**	**184**	**298**	**0**	**30.4**	**-**	**-**
CARRIGALINE R613/R612 JUNCTION	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**84.2%**	**184**	**298**	**0**	**30.4**	**-**	**-**
1/1	Church Rd R613 Left	O	-		-	-	-	47	1000	808	5.8%	18	29	0	0.0	2.4	0.0
1/2+1/3	Church Rd R613 Ahead Right	U	I D		1	24:7	-	307	1940:1849	288+88	81.5 : 81.5%	-	-	-	7.9	92.6	12.1
2/1	Church Rd R613 Left	O	-		-	-	-	295	1000	792	37.3%	103	192	0	0.3	3.7	1.3
2/2+2/3	Church Rd R613 Ahead Right	U	B G		1	23:6	-	222	1940:1849	302+60	61.3 : 61.3%	-	-	-	4.0	65.2	7.7
3/1	Crosshaven Rd R612 Left	O	-		-	-	-	27	1000	821	3.3%	11	16	0	0.0	2.3	0.0
3/2+3/3	Crosshaven Rd R612 Right Ahead	U	A H		1	44:36	-	552	1940:1724	399+259	83.9 : 83.9%	-	-	-	8.8	57.1	19.1
7/1	Cork Rd R612	U	-		-	-	-	419	1940	1940	21.6%	-	-	-	0.1	1.2	0.1
8/1	Cork Rd R612 Left	O	-		-	-	-	113	1000	770	14.7%	52	61	0	0.1	2.7	0.1
8/2+8/3	Cork Rd R612 Right Ahead	U	C F		1	38:30	-	523	2080:1940	502+119	84.2 : 84.2%	-	-	-	9.1	62.8	19.7
Ped Link: P1	Ped Crossing All Red	-	E		1	6	-	0	-	0	0.0%	-	-	-	-	-	-

C1 PRC for Signalled Lanes (%): 6.8 Total Delay for Signalled Lanes (pcuHr): 29.80 Cycle Time (s): 135

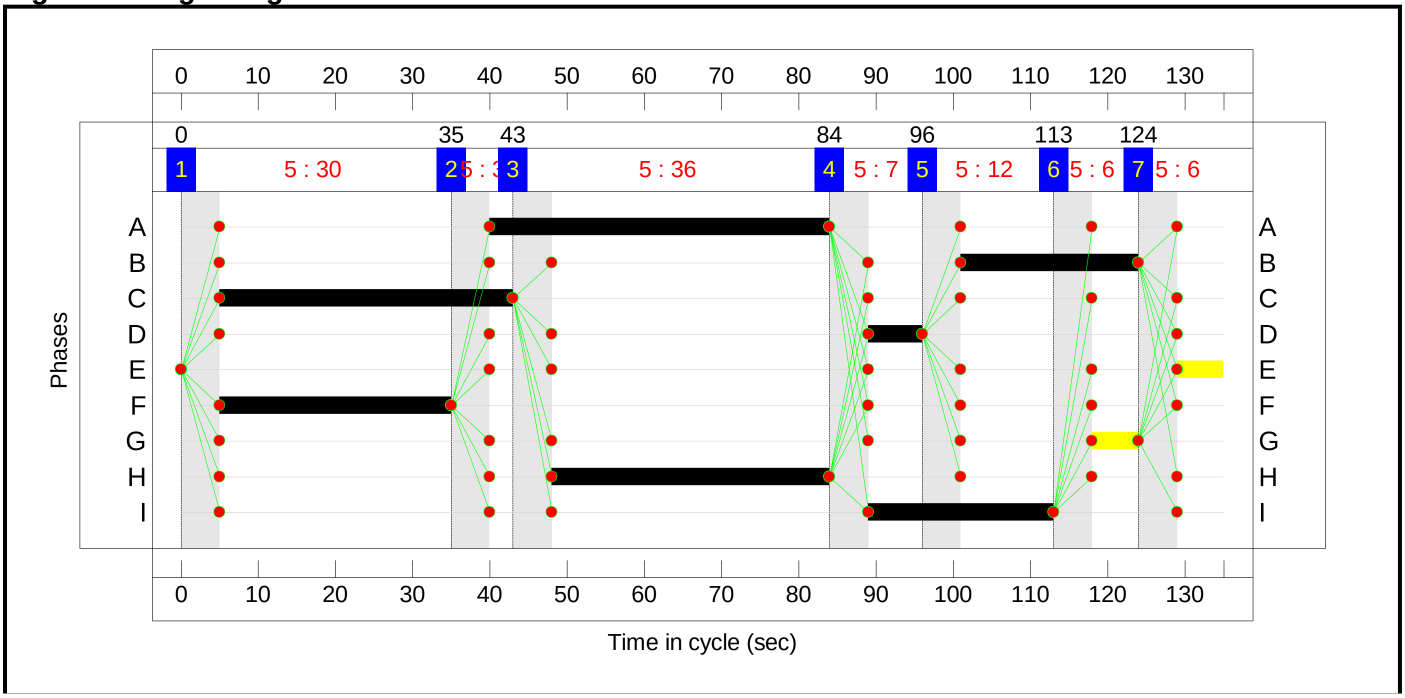
PRC Over All Lanes (%): 6.8 Total Delay Over All Lanes(pcuHr): 30.37

Basic Results Summary

Stage Diagram

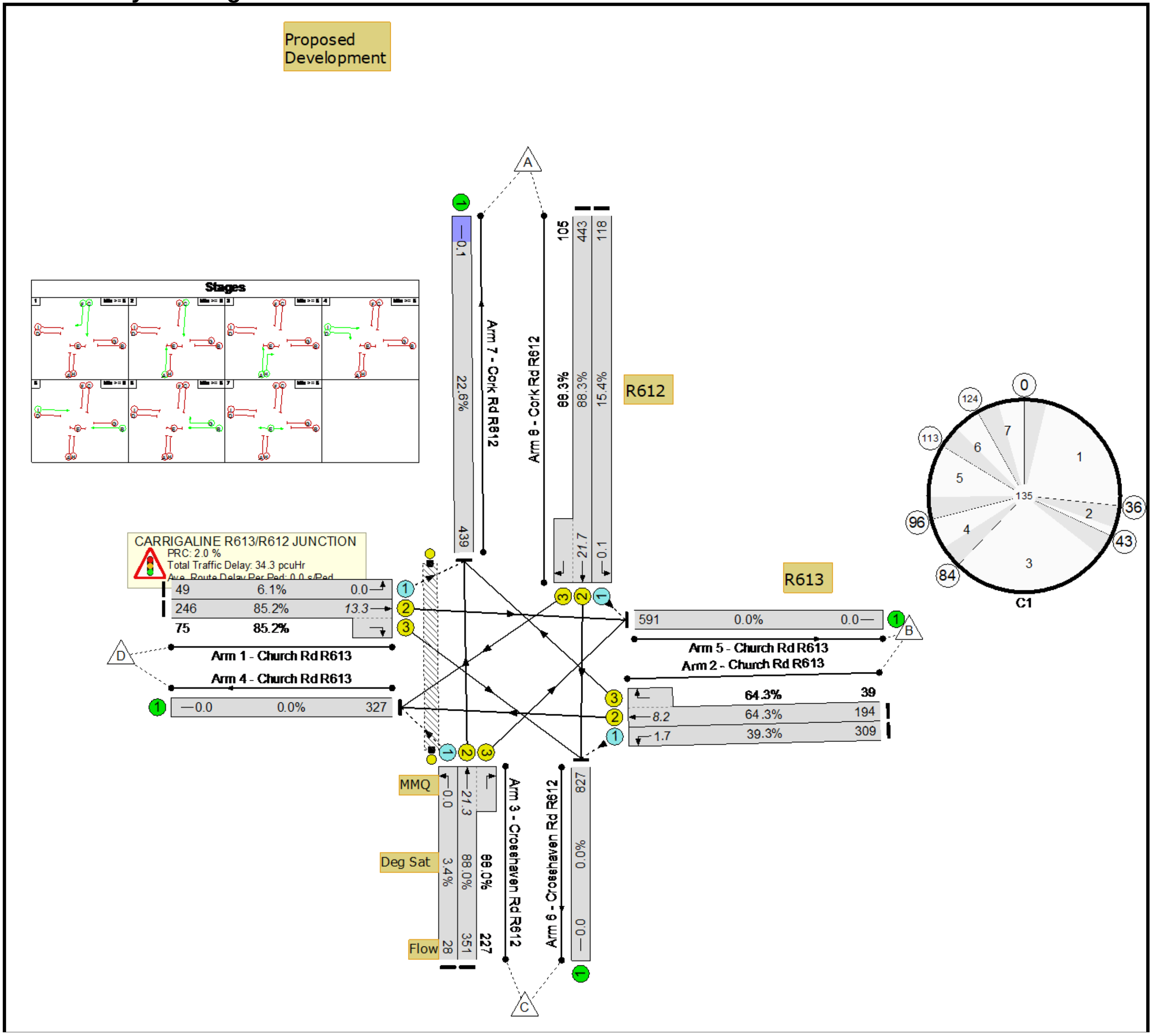


Signal Timings Diagram



Basic Results Summary

Scenario 2: 'Scenario 2 AM 2021' (FG2: 'AM 2021', Plan 1: 'Network Control Plan 1')
Network Layout Diagram



Basic Results Summary

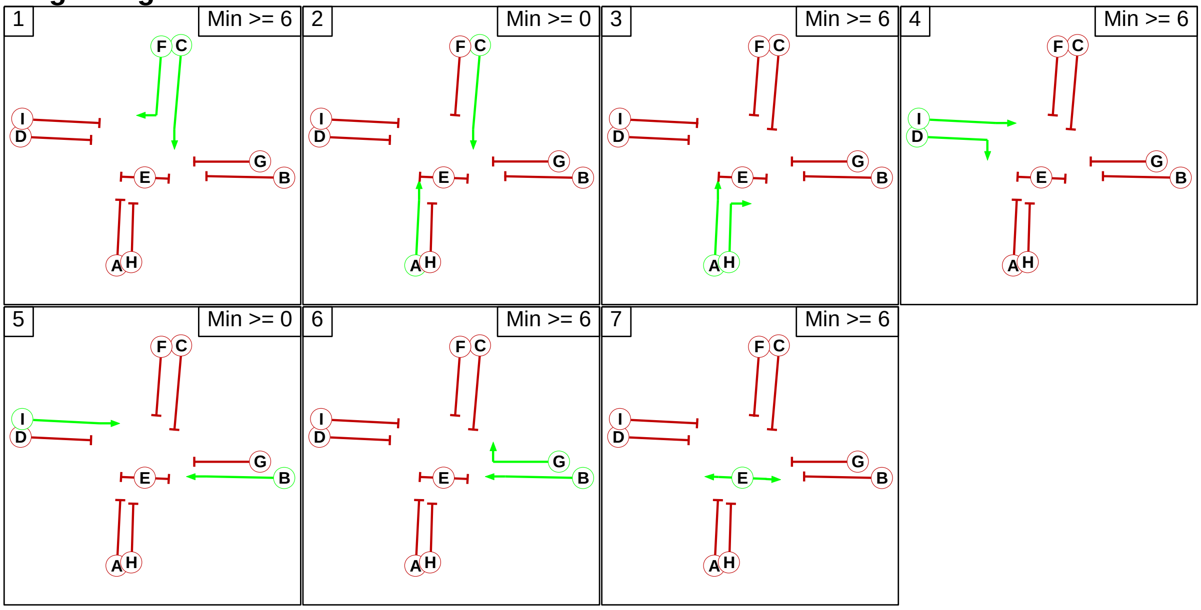
Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**88.3%**	**192**	**312**	**0**	**34.3**	**-**	**-**
CARRIGALINE R613/R612 JUNCTION	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**88.3%**	**192**	**312**	**0**	**34.3**	**-**	**-**
1/1	Church Rd R613 Left	O	-		-	-	-	49	1000	807	6.1%	19	30	0	0.0	2.4	0.0
1/2+1/3	Church Rd R613 Ahead Right	U	I D		1	24:7	-	321	1940:1849	289+88	85.2 : 85.2%	-	-	-	8.8	98.7	13.3
2/1	Church Rd R613 Left	O	-		-	-	-	309	1000	787	39.3%	108	201	0	0.3	3.8	1.7
2/2+2/3	Church Rd R613 Ahead Right	U	B G		1	23:6	-	233	1940:1849	302+61	64.3 : 64.3%	-	-	-	4.3	66.6	8.2
3/1	Crosshaven Rd R612 Left	O	-		-	-	-	28	1000	816	3.4%	12	16	0	0.0	2.3	0.0
3/2+3/3	Crosshaven Rd R612 Right Ahead	U	A H		1	43:36	-	578	1940:1724	399+258	88.0 : 88.0%	-	-	-	10.1	63.0	21.3
7/1	Cork Rd R612	U	-		-	-	-	439	1940	1940	22.6%	-	-	-	0.1	1.2	0.1
8/1	Cork Rd R612 Left	O	-		-	-	-	118	1000	765	15.4%	54	64	0	0.1	2.8	0.1
8/2+8/3	Cork Rd R612 Right Ahead	U	C F		1	38:31	-	548	2080:1940	502+119	88.3 : 88.3%	-	-	-	10.4	68.6	21.7
Ped Link: P1	Ped Crossing All Red	-	E		1	6	-	0	-	0	0.0%	-	-	-	-	-	-

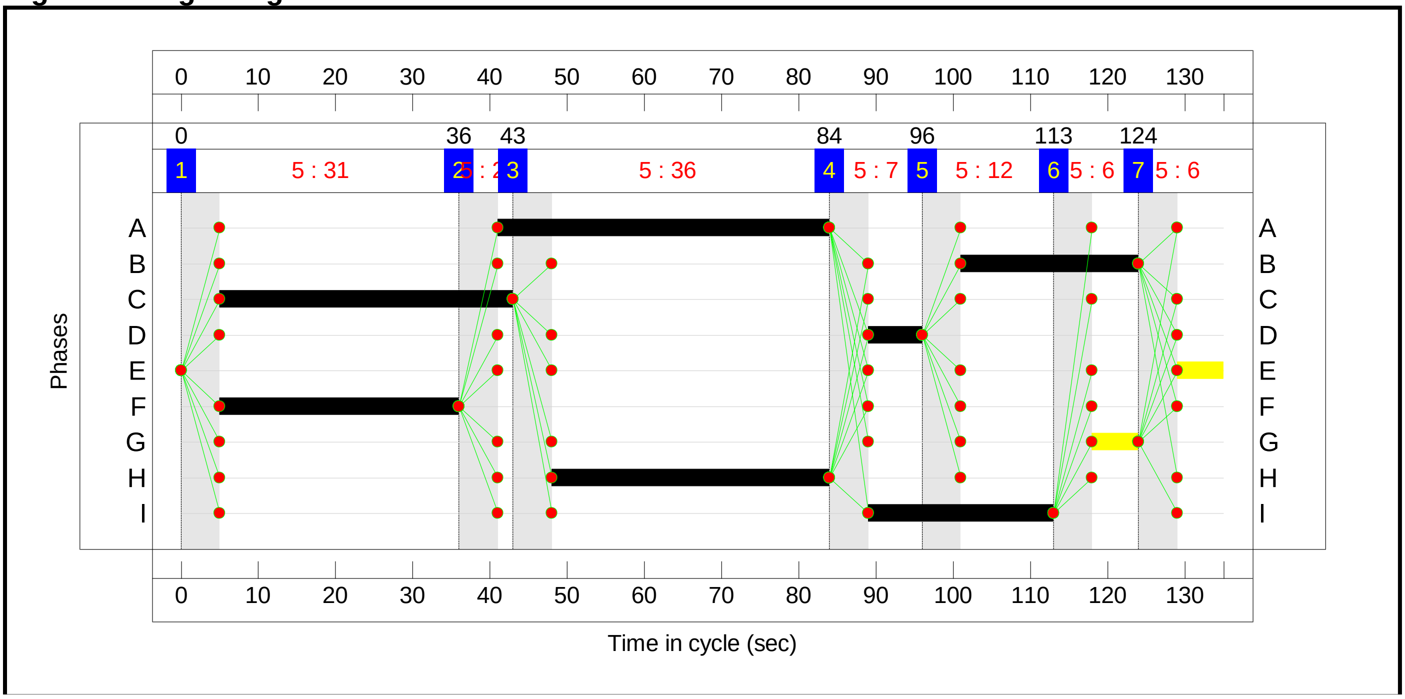
C1 PRC for Signalled Lanes (%): 2.0 Total Delay for Signalled Lanes (pcuHr): 33.66 Cycle Time (s): 135
PRC Over All Lanes (%): 2.0 Total Delay Over All Lanes(pcuHr): 34.28

Basic Results Summary

Stage Diagram



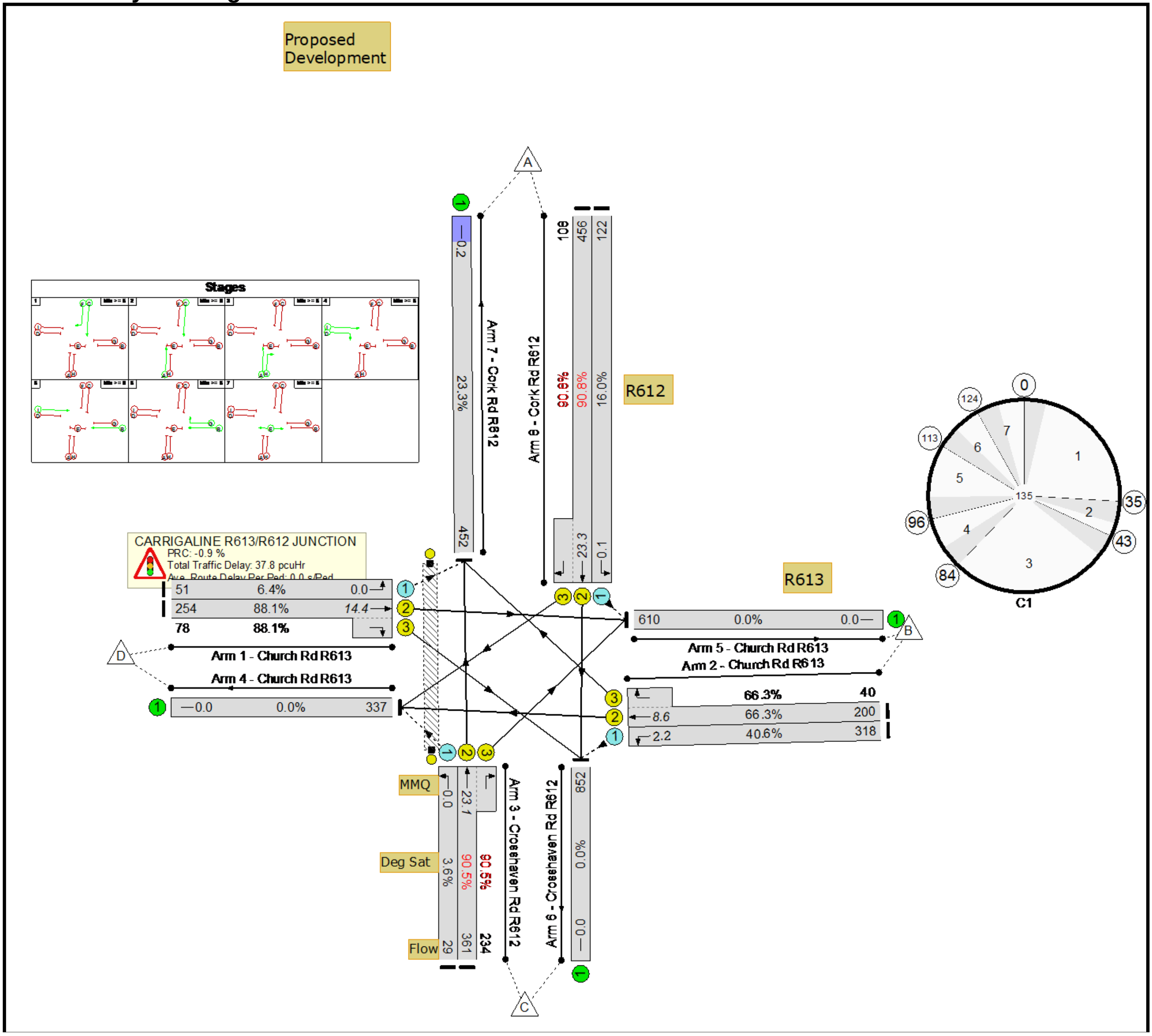
Signal Timings Diagram



Basic Results Summary

Scenario 3: 'Scenario 3 AM 2023' (FG3: 'AM 2023', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

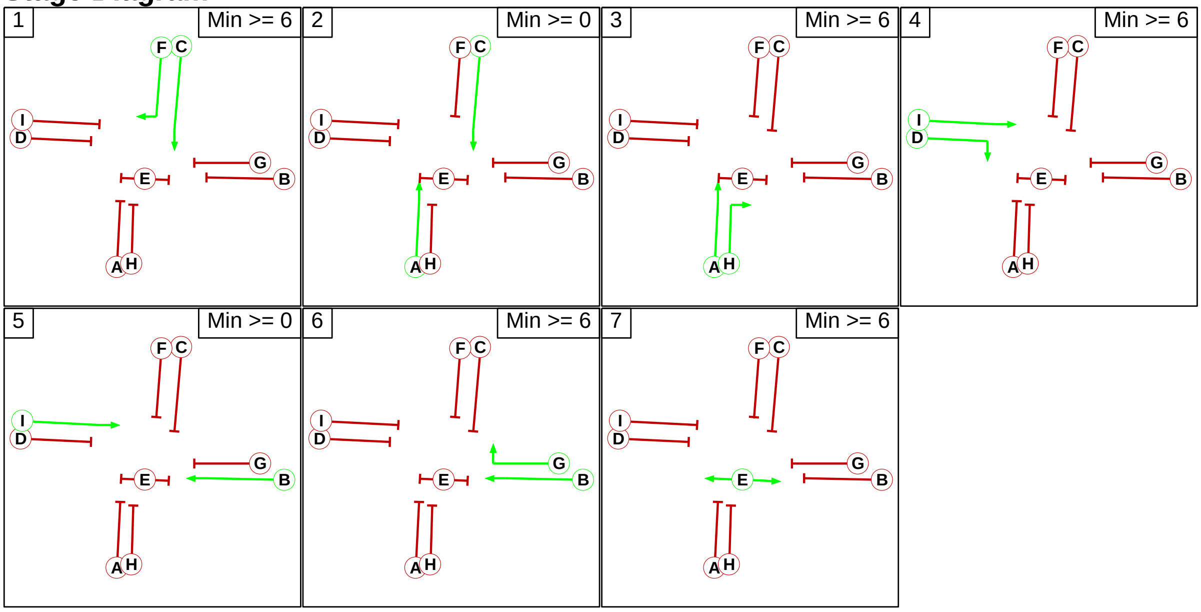
Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**90.8%**	**198**	**322**	**0**	**37.8**	**-**	**-**
CARRIGALINE R613/R612 JUNCTION	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**90.8%**	**198**	**322**	**0**	**37.8**	**-**	**-**
1/1	Church Rd R613 Left	O	-		-	-	-	51	1000	802	6.4%	20	31	0	0.0	2.4	0.0
1/2+1/3	Church Rd R613 Ahead Right	U	I D		1	24:7	-	332	1940:1849	288+89	88.1 : 88.1%	-	-	-	9.7	105.1	14.4
2/1	Church Rd R613 Left	O	-		-	-	-	318	1000	783	40.6%	111	207	0	0.4	4.0	2.2
2/2+2/3	Church Rd R613 Ahead Right	U	B G		1	23:6	-	240	1940:1849	302+60	66.3 : 66.3%	-	-	-	4.5	67.5	8.6
3/1	Crosshaven Rd R612 Left	O	-		-	-	-	29	1000	816	3.6%	12	17	0	0.0	2.3	0.0
3/2+3/3	Crosshaven Rd R612 Right Ahead	U	A H		1	44:36	-	595	1940:1724	399+259	90.5 : 90.5%	-	-	-	11.2	67.5	23.1
7/1	Cork Rd R612	U	-		-	-	-	452	1940	1940	23.3%	-	-	-	0.2	1.2	0.2
8/1	Cork Rd R612 Left	O	-		-	-	-	122	1000	762	16.0%	56	66	0	0.1	2.8	0.1
8/2+8/3	Cork Rd R612 Right Ahead	U	C F		1	38:30	-	564	2080:1940	502+119	90.8 : 90.8%	-	-	-	11.8	75.1	23.3
Ped Link: P1	Ped Crossing All Red	-	E		1	6	-	0	-	0	0.0%	-	-	-	-	-	-

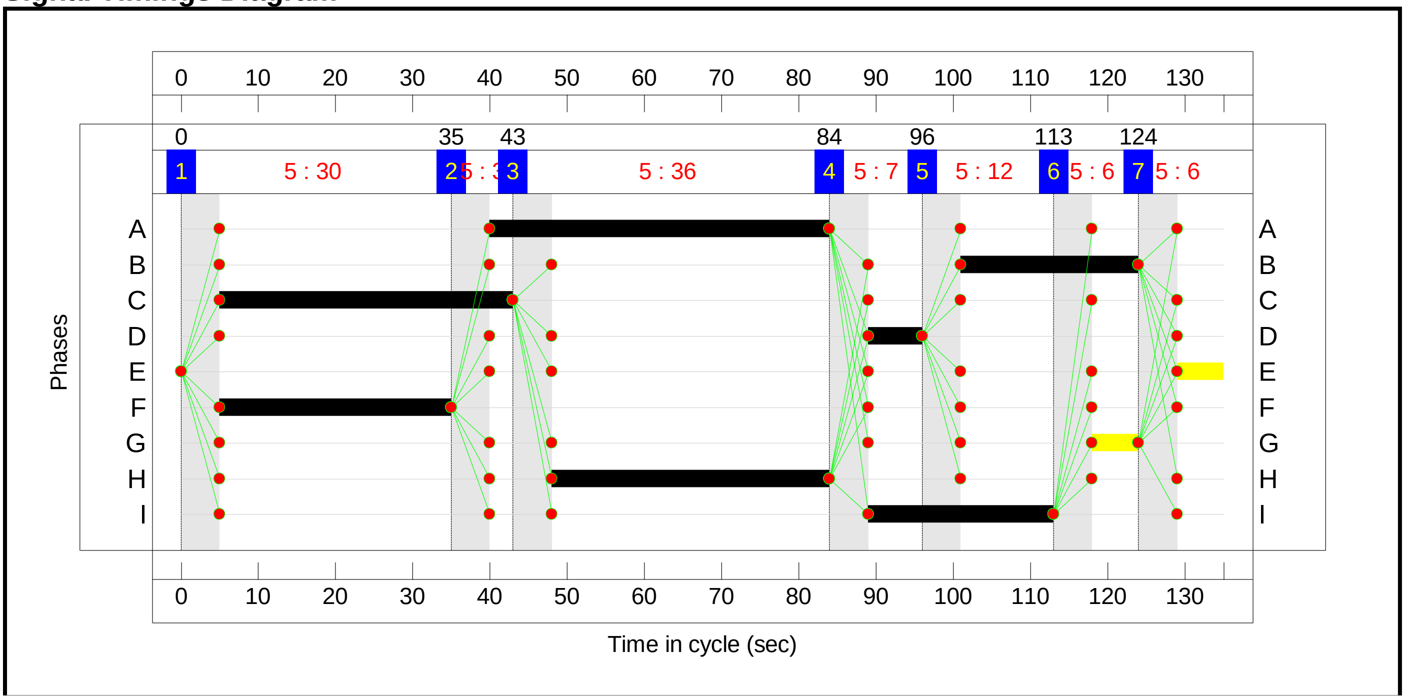
C1 PRC for Signalled Lanes (%): -0.9 Total Delay for Signalled Lanes (pcuHr): 37.12 Cycle Time (s): 135
PRC Over All Lanes (%): -0.9 Total Delay Over All Lanes(pcuHr): 37.77

Basic Results Summary

Stage Diagram



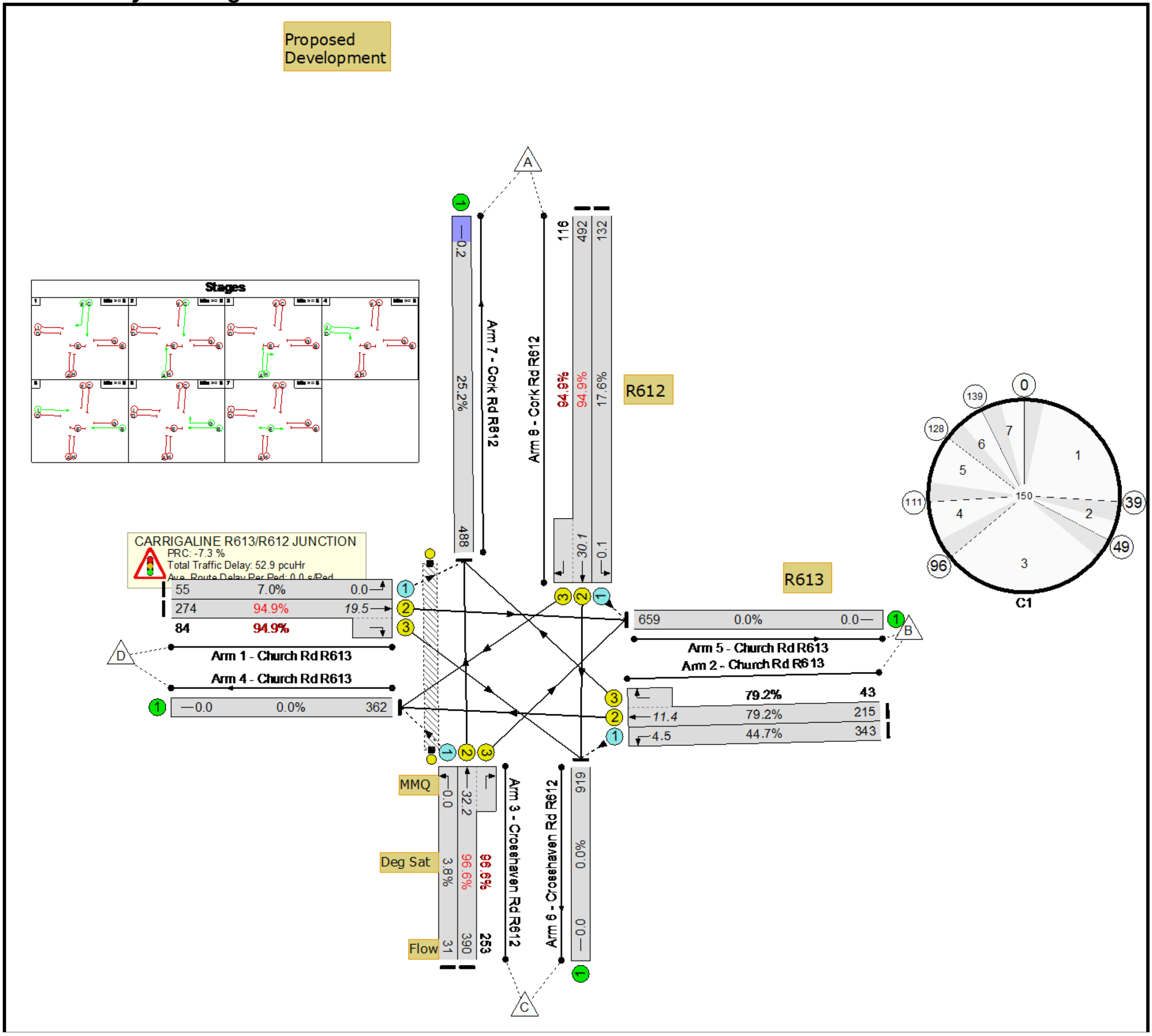
Signal Timings Diagram



Basic Results Summary

Scenario 4: 'Scenario 4 AM 2028' (FG4: 'AM 2028', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



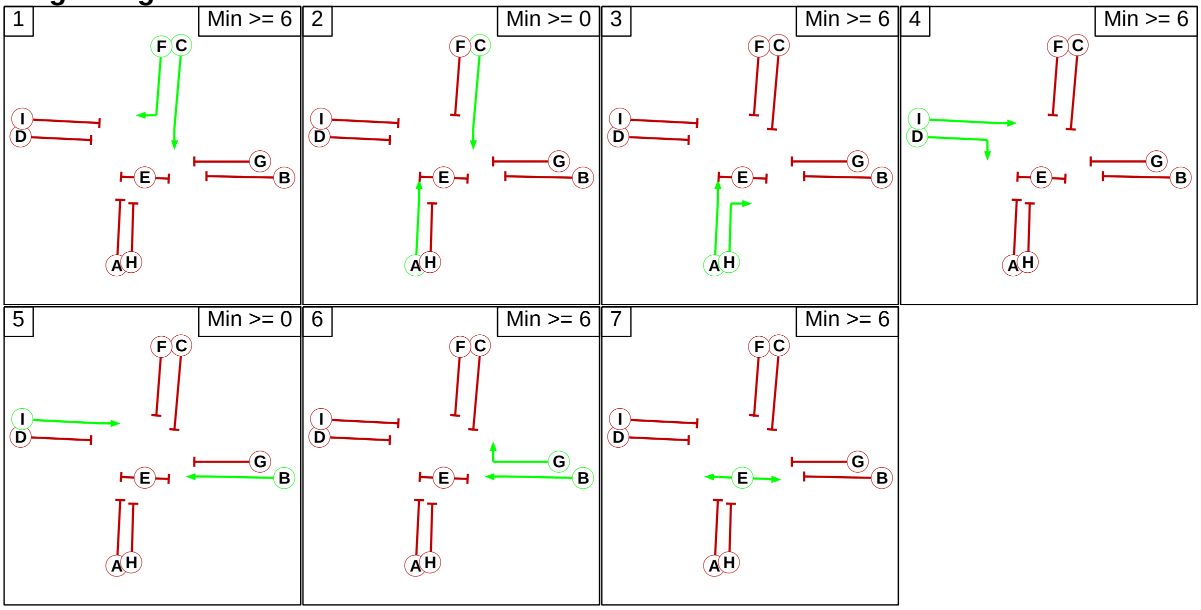
Basic Results Summary
Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**96.6%**	**225**	**336**	**0**	**52.9**	**-**	**-**
CARRIGALINE R613/R612 JUNCTION	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**96.6%**	**225**	**336**	**0**	**52.9**	**-**	**-**
1/1	Church Rd R613 Left	O	-		-	-	-	55	1000	791	7.0%	22	33	0	0.0	2.4	0.0
1/2+1/3	Church Rd R613 Ahead Right	U	I D		1	27:10	-	358	1940:1849	289+89	94.9 : 94.9%	-	-	-	13.4	135.1	19.5
2/1	Church Rd R613 Left	O	-		-	-	-	343	1000	767	44.7%	128	215	0	0.4	4.6	4.5
2/2+2/3	Church Rd R613 Ahead Right	U	B G		1	23:6	-	258	1940:1849	272+54	79.2 : 79.2%	-	-	-	6.2	86.8	11.4
3/1	Crosshaven Rd R612 Left	O	-		-	-	-	31	1000	815	3.8%	12	19	0	0.0	2.3	0.0
3/2+3/3	Crosshaven Rd R612 Right Ahead	U	A H		1	52:42	-	643	1940:1724	404+262	96.6 : 96.6%	-	-	-	16.7	93.3	32.2
7/1	Cork Rd R612	U	-		-	-	-	488	1940	1940	25.2%	-	-	-	0.2	1.2	0.2
8/1	Cork Rd R612 Left	O	-		-	-	-	132	1000	749	17.6%	62	70	0	0.1	2.9	0.1
8/2+8/3	Cork Rd R612 Right Ahead	U	C F		1	44:34	-	608	2080:1940	518+122	94.9 : 94.9%	-	-	-	15.8	93.3	30.1
Ped Link: P1	Ped Crossing All Red	-	E		1	6	-	0	-	0	0.0%	-	-	-	-	-	-

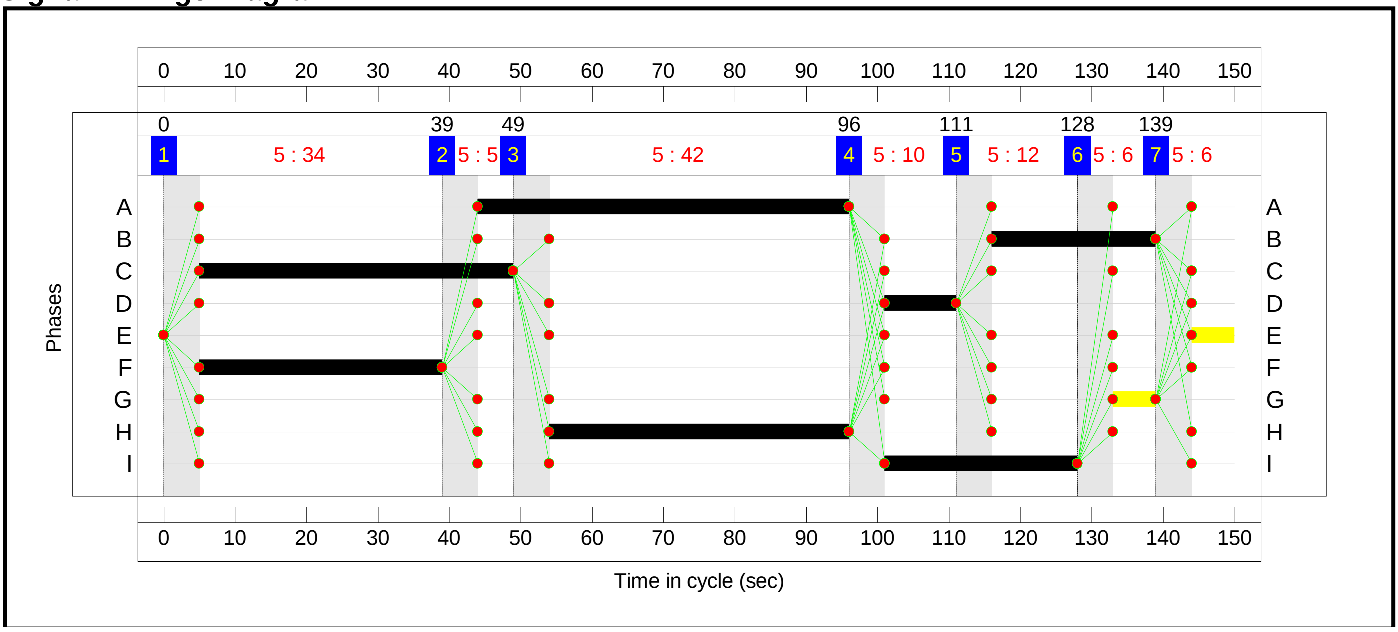
C1 PRC for Signalled Lanes (%): -7.3 Total Delay for Signalled Lanes (pcuHr): 52.09 Cycle Time (s): 150
PRC Over All Lanes (%): -7.3 Total Delay Over All Lanes(pcuHr): 52.86

Basic Results Summary

Stage Diagram



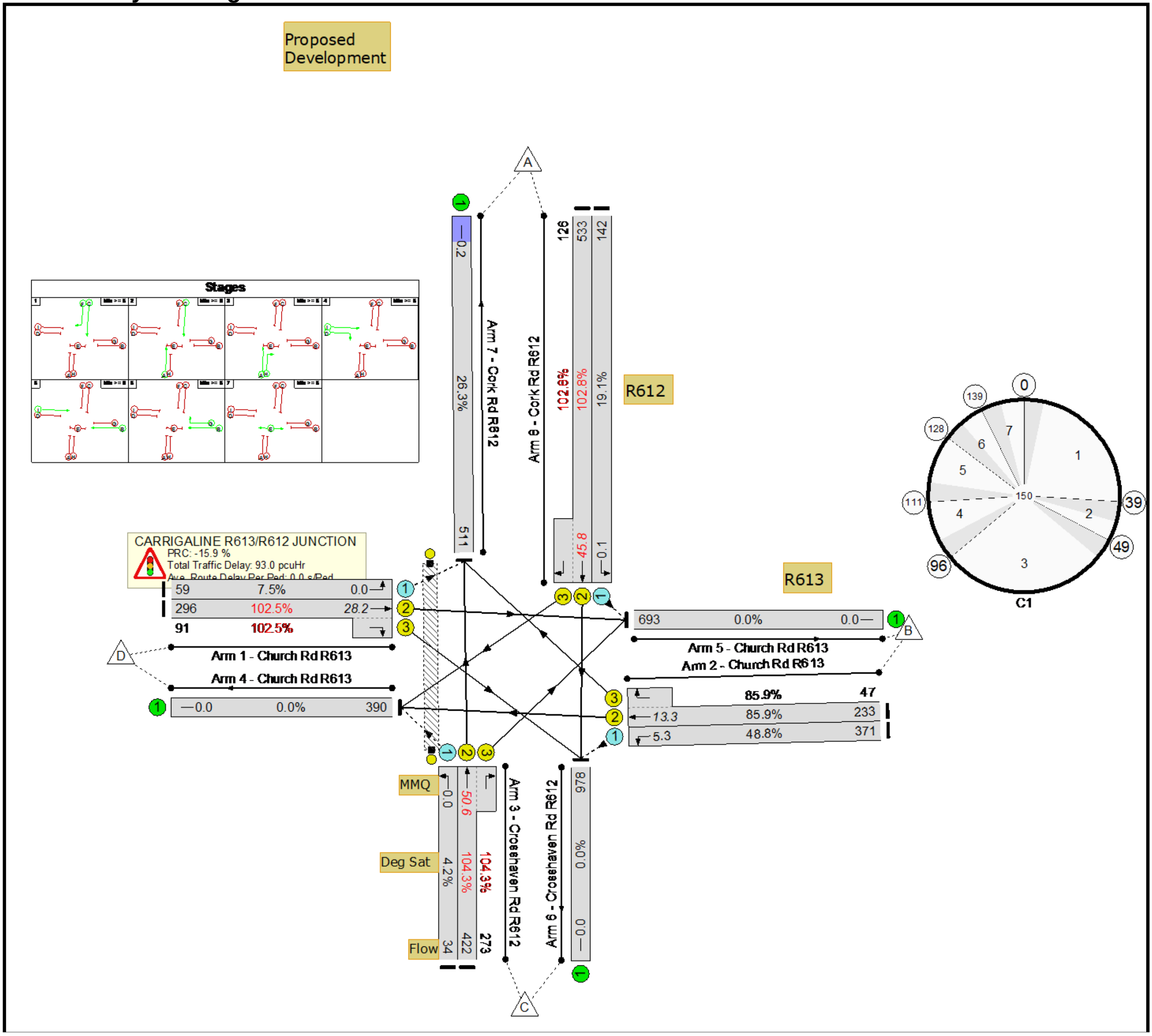
Signal Timings Diagram



Basic Results Summary

Scenario 5: 'Scenario 5 AM 2038' (FG5: 'AM 2038', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

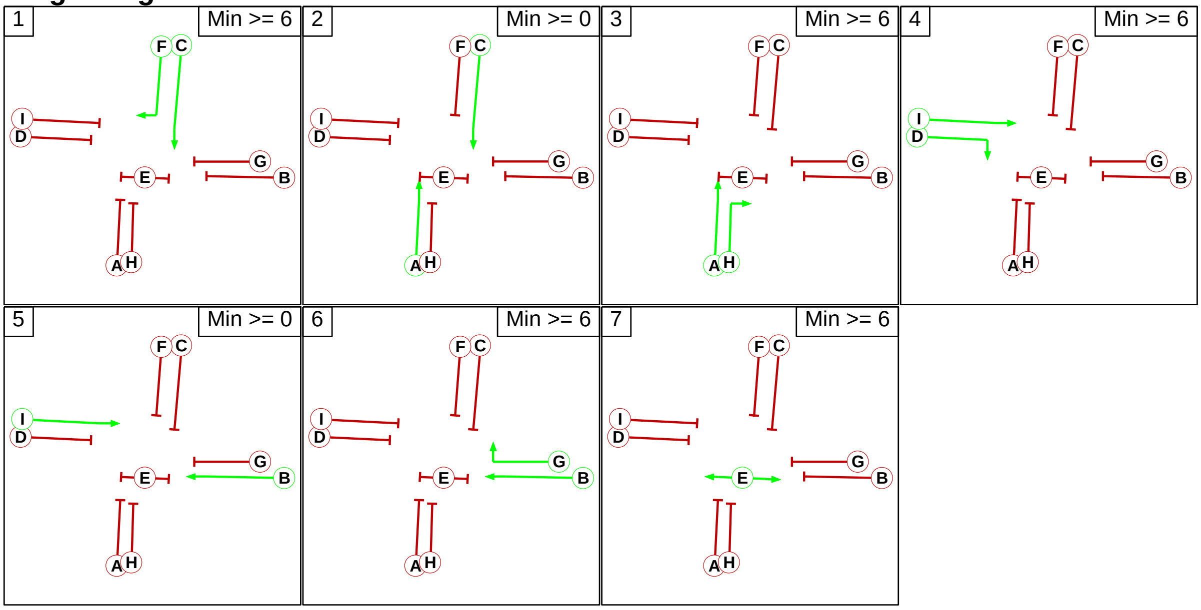
Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**104.3%**	**232**	**374**	**0**	**93.0**	**-**	**-**
CARRIGALINE R613/R612 JUNCTION	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**104.3%**	**232**	**374**	**0**	**93.0**	**-**	**-**
1/1	Church Rd R613 Left	O	-		-	-	-	59	1000	787	7.5%	24	35	0	0.0	2.5	0.0
1/2+1/3	Church Rd R613 Ahead Right	U	I D		1	27:10	-	387	1940:1849	289+89	102.5 : 102.5%	-	-	-	21.4	199.0	28.2
2/1	Church Rd R613 Left	O	-		-	-	-	371	1000	760	48.8%	128	243	0	0.6	5.6	5.3
2/2+2/3	Church Rd R613 Ahead Right	U	B G		1	23:6	-	280	1940:1849	271+55	85.9 : 85.9%	-	-	-	7.6	97.3	13.3
3/1	Crosshaven Rd R612 Left	O	-		-	-	-	34	1000	810	4.2%	13	21	0	0.0	2.3	0.0
3/2+3/3	Crosshaven Rd R612 Right Ahead	U	A H		1	52:42	-	695	1940:1724	405+262	104.3 : 104.3%	-	-	-	33.3	172.5	50.6
7/1	Cork Rd R612	U	-		-	-	-	528	1940	1940	26.3%	-	-	-	0.2	1.3	0.2
8/1	Cork Rd R612 Left	O	-		-	-	-	142	1000	744	19.1%	67	75	0	0.1	3.0	0.1
8/2+8/3	Cork Rd R612 Right Ahead	U	C F		1	44:34	-	659	2080:1940	518+123	102.8 : 102.8%	-	-	-	29.8	162.9	45.8
Ped Link: P1	Ped Crossing All Red	-	E		1	6	-	0	-	0	0.0%	-	-	-	-	-	-

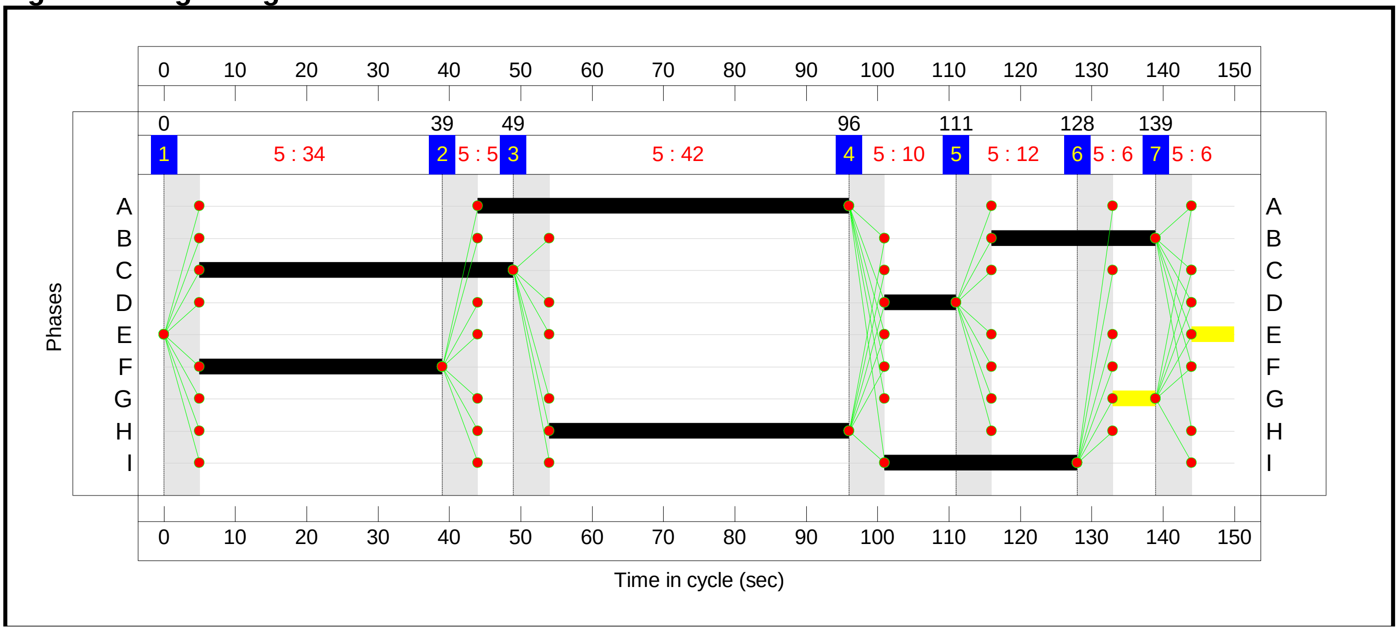
C1 PRC for Signalled Lanes (%): -15.9 Total Delay for Signalled Lanes (pcuHr): 92.07 Cycle Time (s): 150
PRC Over All Lanes (%): -15.9 Total Delay Over All Lanes(pcuHr): 93.01

Basic Results Summary

Stage Diagram



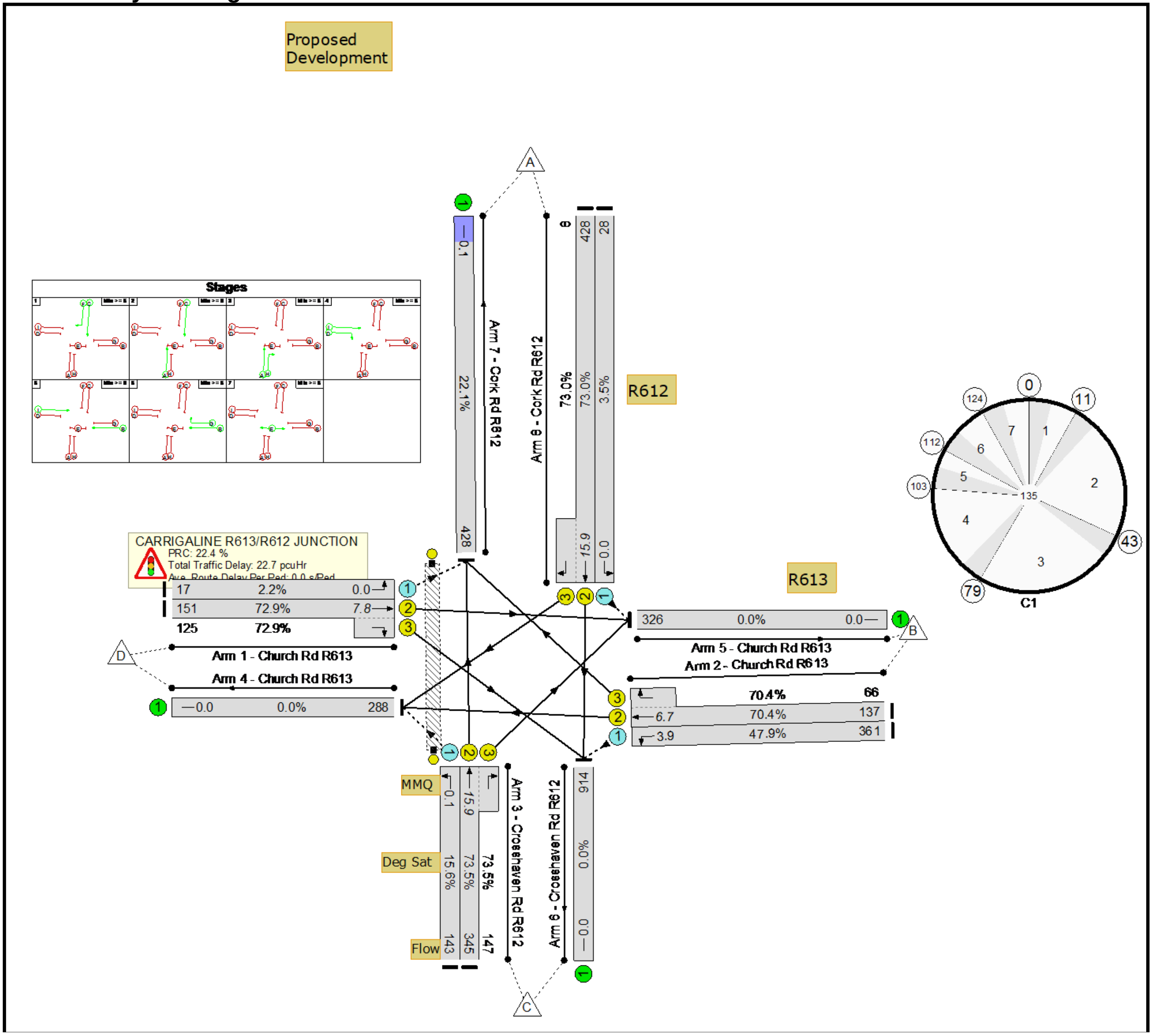
Signal Timings Diagram



Basic Results Summary

Scenario 6: 'Scenario 6 PM 2018' (FG6: 'PM 2018', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

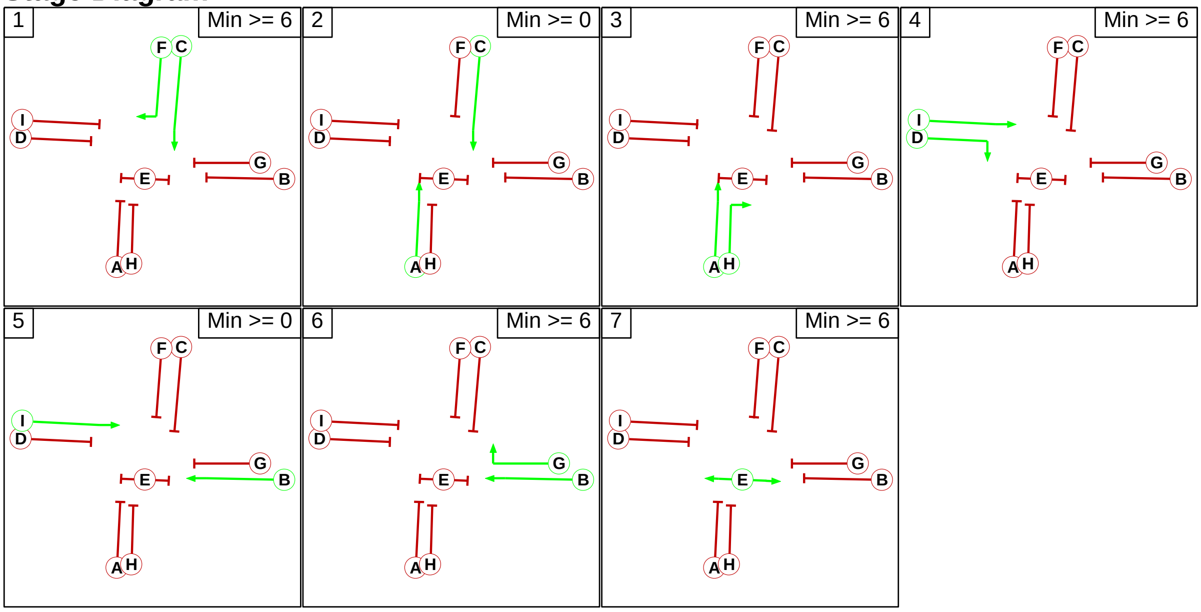
Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**73.5%**	**205**	**344**	**0**	**22.7**	**-**	**-**
CARRIGALINE R613/R612 JUNCTION	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**73.5%**	**205**	**344**	**0**	**22.7**	**-**	**-**
1/1	Church Rd R613 Left	O	-		-	-	-	17	1000	758	2.2%	9	8	0	0.0	2.4	0.0
1/2+1/3	Church Rd R613 Ahead Right	U	I D		1	28:19	-	276	1940:1849	207+171	72.9 : 72.9%	-	-	-	5.1	66.2	7.8
2/1	Church Rd R613 Left	O	-		-	-	-	361	1000	754	47.9%	158	203	0	0.5	5.4	3.9
2/2+2/3	Church Rd R613 Ahead Right	U	B G		1	16:7	-	203	1940:1849	194+94	70.4 : 70.4%	-	-	-	4.4	78.3	6.7
3/1	Crosshaven Rd R612 Left	O	-		-	-	-	143	1000	917	15.6%	25	118	0	0.1	2.3	0.1
3/2+3/3	Crosshaven Rd R612 Right Ahead	U	A H		1	63:31	-	492	1940:1724	469+200	73.5 : 73.5%	-	-	-	5.7	41.4	15.9
7/1	Cork Rd R612	U	-		-	-	-	428	1940	1940	22.1%	-	-	-	0.1	1.2	0.1
8/1	Cork Rd R612 Left	O	-		-	-	-	28	1000	806	3.5%	13	15	0	0.0	2.3	0.0
8/2+8/3	Cork Rd R612 Right Ahead	U	C F		1	38:6	-	436	2080:1940	586+11	73.0 : 73.0%	-	-	-	6.7	55.7	15.9
Ped Link: P1	Ped Crossing All Red	-	E		1	6	-	0	-	0	0.0%	-	-	-	-	-	-

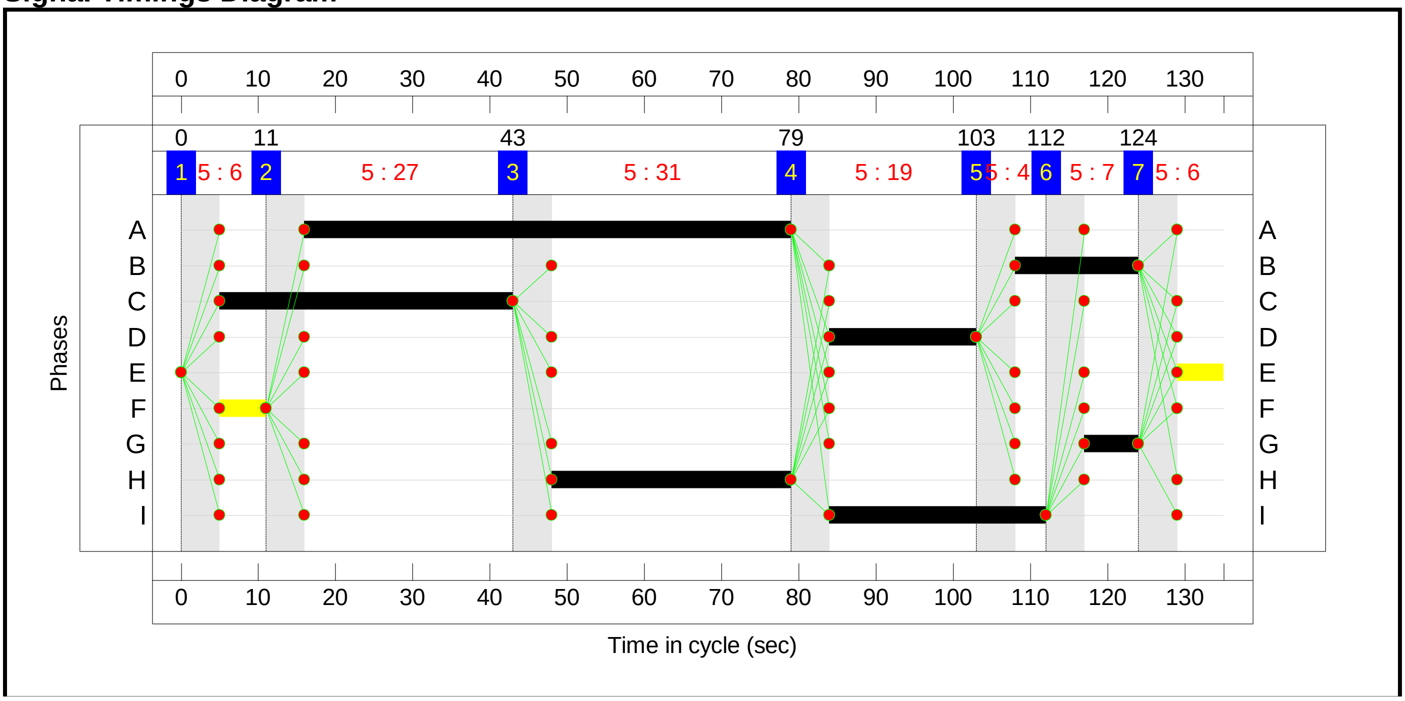
C1 PRC for Signalled Lanes (%): 22.4 Total Delay for Signalled Lanes (pcuHr): 21.89 Cycle Time (s): 135
PRC Over All Lanes (%): 22.4 Total Delay Over All Lanes(pcuHr): 22.69

Basic Results Summary

Stage Diagram



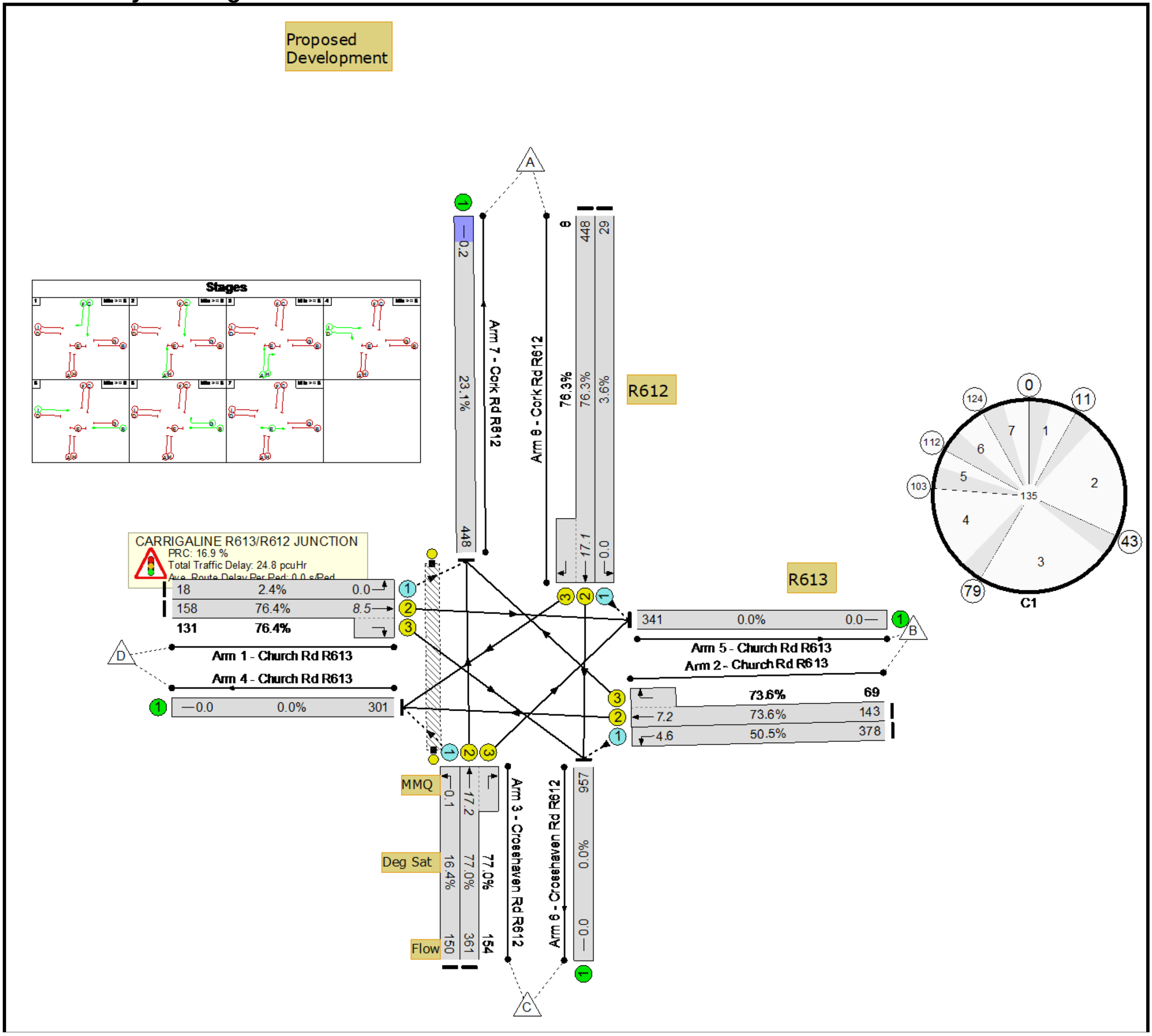
Signal Timings Diagram



Basic Results Summary

Scenario 7: 'Scenario 7 PM 2021' (FG7: 'PM 2021', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

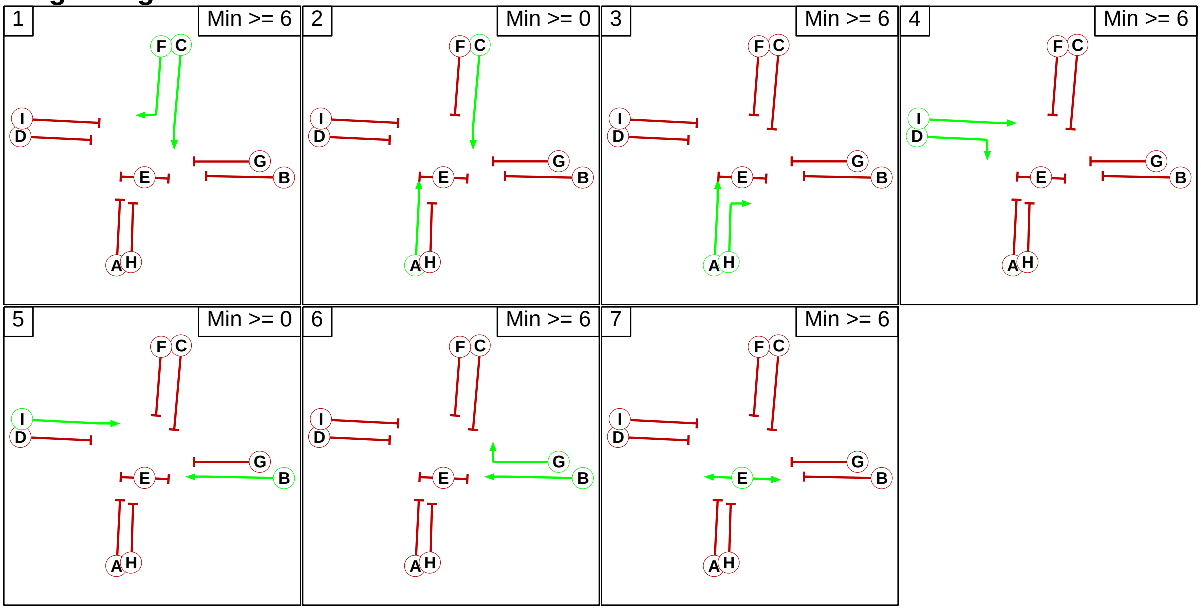
Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**77.0%**	**213**	**362**	**0**	**24.8**	**-**	**-**
CARRIGALINE R613/R612 JUNCTION	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**77.0%**	**213**	**362**	**0**	**24.8**	**-**	**-**
1/1	Church Rd R613 Left	O	-		-	-	-	18	1000	753	2.4%	10	8	0	0.0	2.4	0.0
1/2+1/3	Church Rd R613 Ahead Right	U	I D		1	28:19	-	289	1940:1849	207+172	76.4 : 76.4%	-	-	-	5.5	68.8	8.5
2/1	Church Rd R613 Left	O	-		-	-	-	378	1000	748	50.5%	164	214	0	0.6	6.0	4.6
2/2+2/3	Church Rd R613 Ahead Right	U	B G		1	16:7	-	212	1940:1849	194+94	73.6 : 73.6%	-	-	-	4.8	80.7	7.2
3/1	Crosshaven Rd R612 Left	O	-		-	-	-	150	1000	916	16.4%	27	123	0	0.1	2.3	0.1
3/2+3/3	Crosshaven Rd R612 Right Ahead	U	A H		1	63:31	-	515	1940:1724	469+200	77.0 : 77.0%	-	-	-	6.3	43.7	17.2
7/1	Cork Rd R612	U	-		-	-	-	448	1940	1940	23.1%	-	-	-	0.2	1.2	0.2
8/1	Cork Rd R612 Left	O	-		-	-	-	29	1000	803	3.6%	13	16	0	0.0	2.3	0.0
8/2+8/3	Cork Rd R612 Right Ahead	U	C F		1	38:6	-	456	2080:1940	587+10	76.3 : 76.3%	-	-	-	7.3	57.7	17.1
Ped Link: P1	Ped Crossing All Red	-	E		1	6	-	0	-	0	0.0%	-	-	-	-	-	-

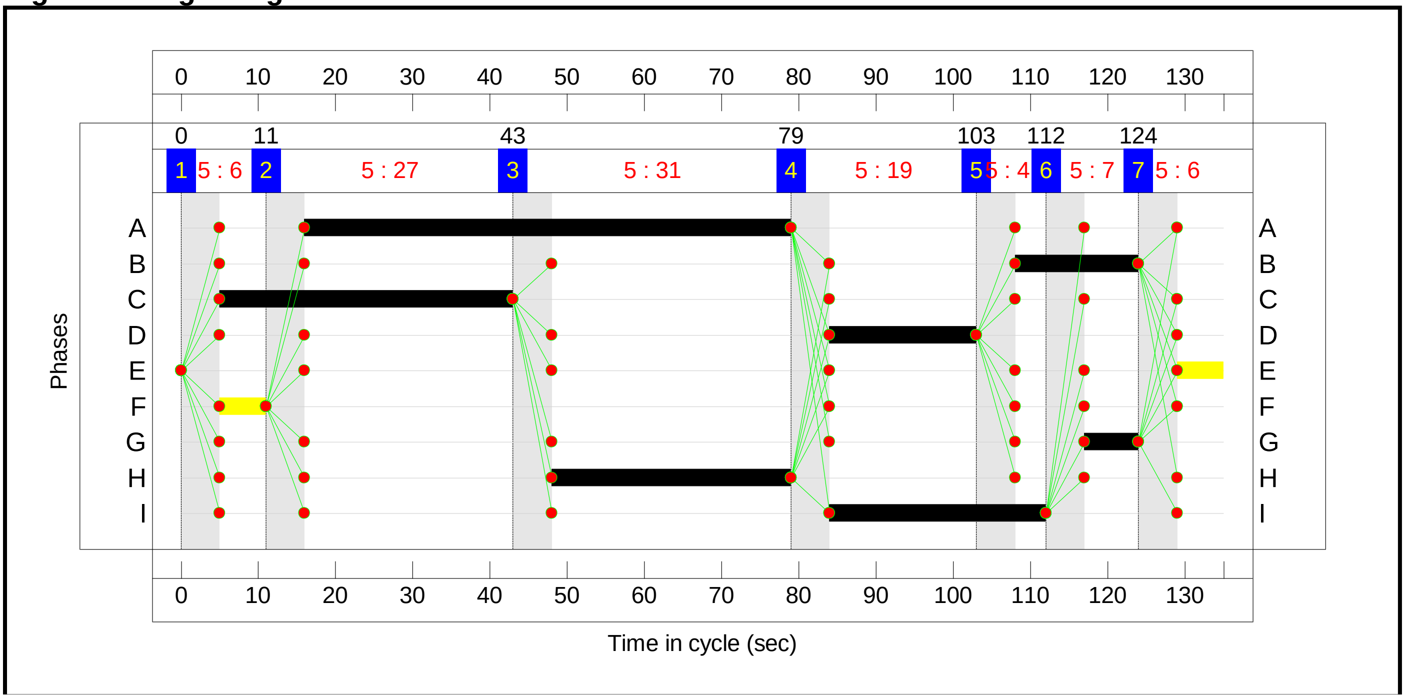
C1 PRC for Signalled Lanes (%): 16.9 Total Delay for Signalled Lanes (pcuHr): 23.84 Cycle Time (s): 135
PRC Over All Lanes (%): 16.9 Total Delay Over All Lanes(pcuHr): 24.76

Basic Results Summary

Stage Diagram



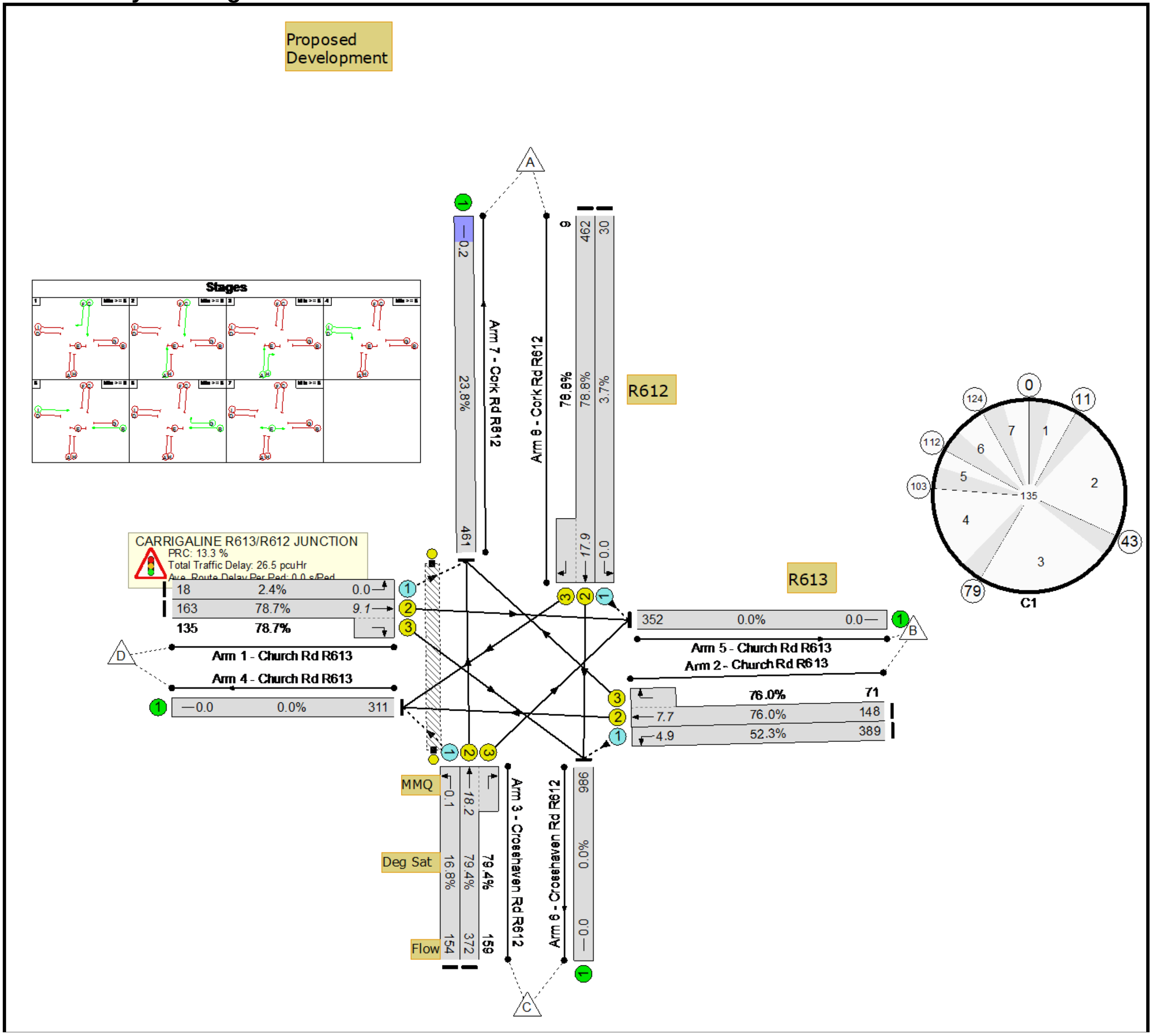
Signal Timings Diagram



Basic Results Summary

Scenario 8: 'Scenario 8 PM 2023' (FG8: 'PM 2023', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

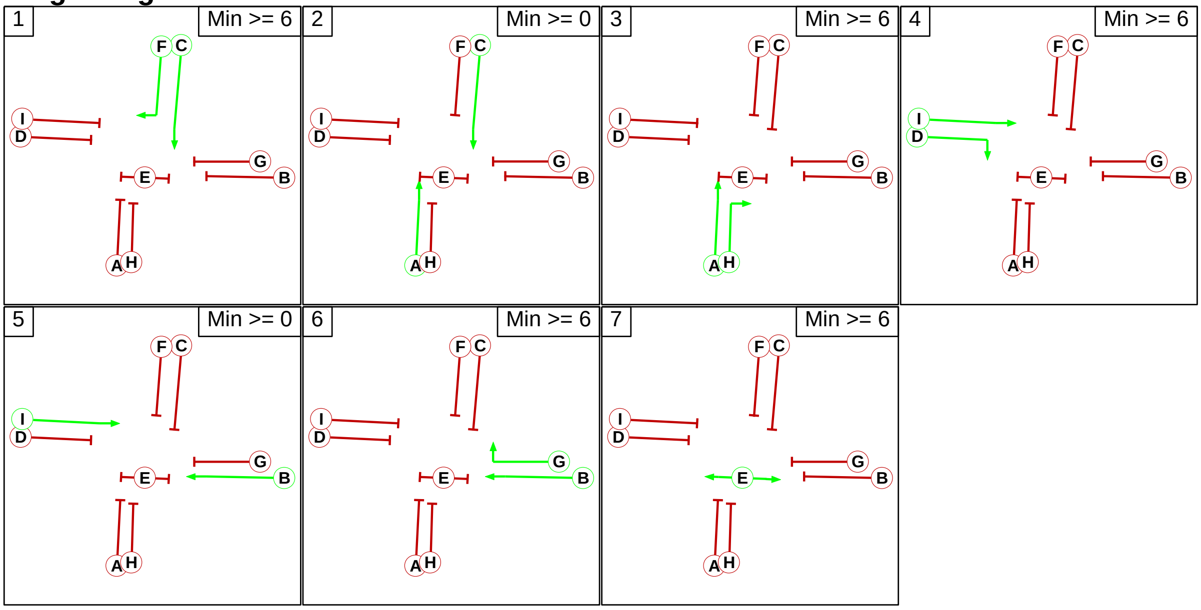
Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**79.4%**	**213**	**378**	**0**	**26.5**	**-**	**-**
CARRIGALINE R613/R612 JUNCTION	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**79.4%**	**213**	**378**	**0**	**26.5**	**-**	**-**
1/1	Church Rd R613 Left	O	-		-	-	-	18	1000	751	2.4%	10	8	0	0.0	2.5	0.0
1/2+1/3	Church Rd R613 Ahead Right	U	I D		1	28:19	-	298	1940:1849	207+172	78.7 : 78.7%	-	-	-	5.9	71.0	9.1
2/1	Church Rd R613 Left	O	-		-	-	-	389	1000	744	52.3%	163	226	0	0.7	6.5	4.9
2/2+2/3	Church Rd R613 Ahead Right	U	B G		1	16:7	-	219	1940:1849	195+93	76.0 : 76.0%	-	-	-	5.0	83.0	7.7
3/1	Crosshaven Rd R612 Left	O	-		-	-	-	154	1000	915	16.8%	27	127	0	0.1	2.4	0.1
3/2+3/3	Crosshaven Rd R612 Right Ahead	U	A H		1	63:31	-	531	1940:1724	468+200	79.4 : 79.4%	-	-	-	6.7	45.7	18.2
7/1	Cork Rd R612	U	-		-	-	-	461	1940	1940	23.8%	-	-	-	0.2	1.2	0.2
8/1	Cork Rd R612 Left	O	-		-	-	-	30	1000	800	3.7%	14	16	0	0.0	2.3	0.0
8/2+8/3	Cork Rd R612 Right Ahead	U	C F		1	38:6	-	471	2080:1940	586+11	78.8 : 78.8%	-	-	-	7.8	59.6	17.9
Ped Link: P1	Ped Crossing All Red	-	E		1	6	-	0	-	0	0.0%	-	-	-	-	-	-

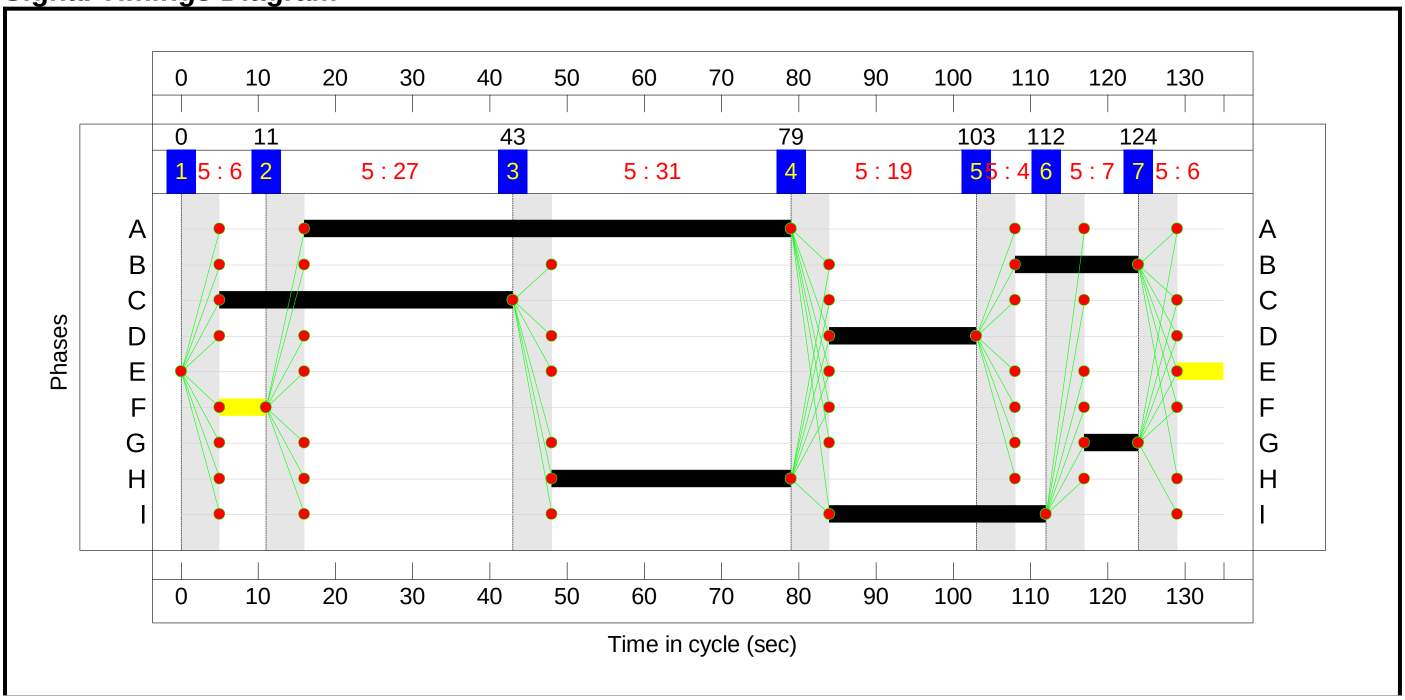
C1 PRC for Signalled Lanes (%): 13.3 Total Delay for Signalled Lanes (pcuHr): 25.47 Cycle Time (s): 135
PRC Over All Lanes (%): 13.3 Total Delay Over All Lanes(pcuHr): 26.46

Basic Results Summary

Stage Diagram



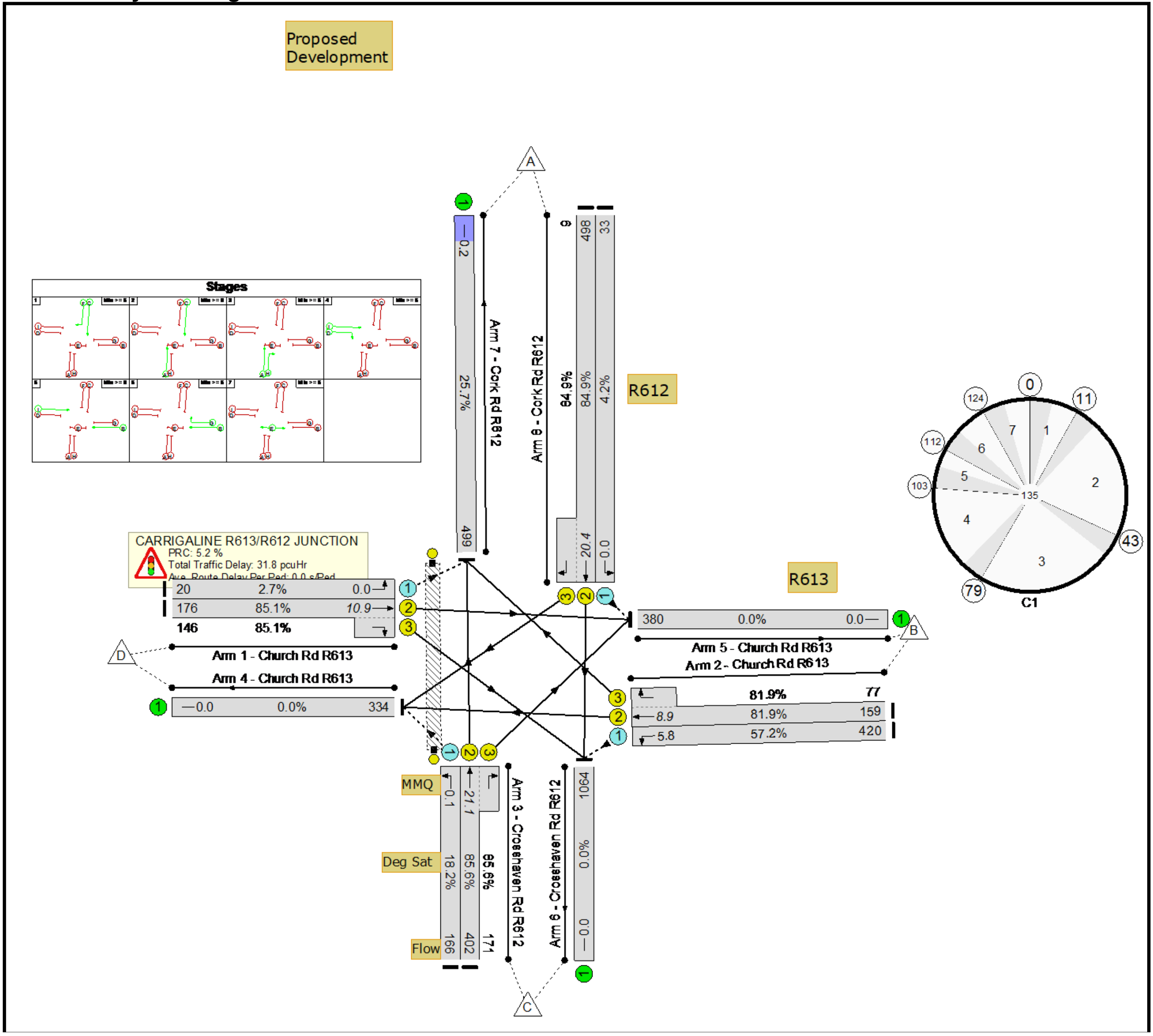
Signal Timings Diagram



Basic Results Summary

Scenario 9: 'Scenario 9 PM 2028' (FG9: 'PM 2028', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

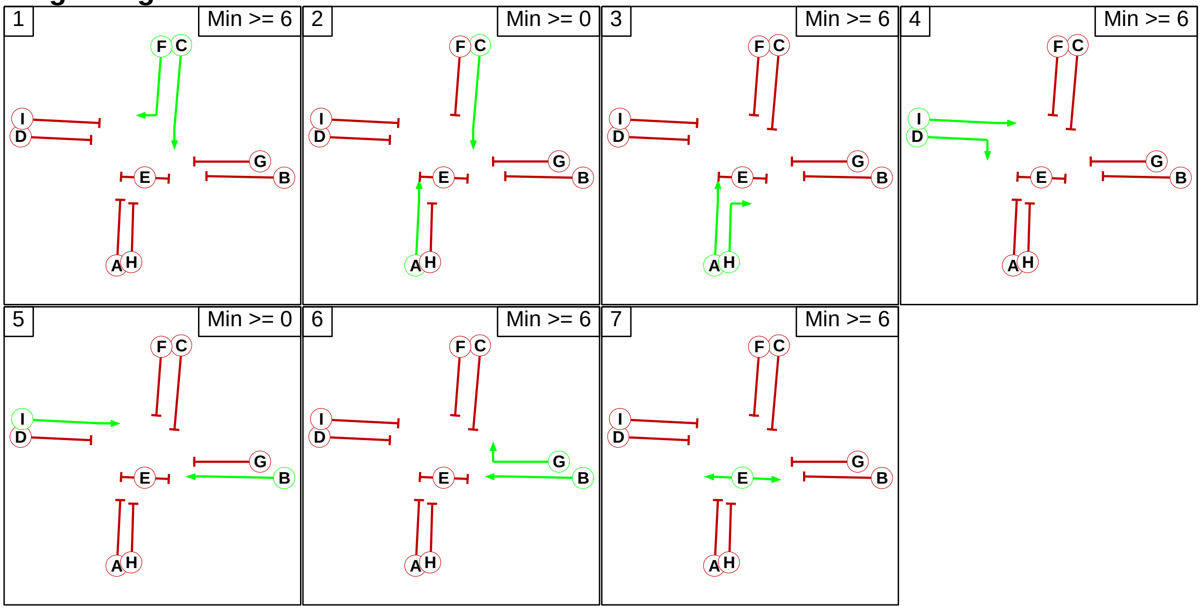
Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**85.6%**	**214**	**425**	**0**	**31.8**	**-**	**-**
CARRIGALINE R613/R612 JUNCTION	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**85.6%**	**214**	**425**	**0**	**31.8**	**-**	**-**
1/1	Church Rd R613 Left	O	-		-	-	-	20	1000	743	2.7%	11	9	0	0.0	2.5	0.0
1/2+1/3	Church Rd R613 Ahead Right	U	I D		1	28:19	-	322	1940:1849	207+172	85.1 : 85.1%	-	-	-	7.1	79.4	10.9
2/1	Church Rd R613 Left	O	-		-	-	-	420	1000	734	57.2%	159	261	0	0.9	7.8	5.8
2/2+2/3	Church Rd R613 Ahead Right	U	B G		1	16:7	-	236	1940:1849	194+94	81.9 : 81.9%	-	-	-	5.9	90.3	8.9
3/1	Crosshaven Rd R612 Left	O	-		-	-	-	166	1000	912	18.2%	30	136	0	0.1	2.4	0.1
3/2+3/3	Crosshaven Rd R612 Right Ahead	U	A H		1	63:31	-	573	1940:1724	470+200	85.6 : 85.6%	-	-	-	8.3	52.2	21.1
7/1	Cork Rd R612	U	-		-	-	-	499	1940	1940	25.7%	-	-	-	0.2	1.2	0.2
8/1	Cork Rd R612 Left	O	-		-	-	-	33	1000	795	4.2%	15	18	0	0.0	2.4	0.0
8/2+8/3	Cork Rd R612 Right Ahead	U	C F		1	38:6	-	507	2080:1940	587+11	84.9 : 84.9%	-	-	-	9.2	65.5	20.4
Ped Link: P1	Ped Crossing All Red	-	E		1	6	-	0	-	0	0.0%	-	-	-	-	-	-

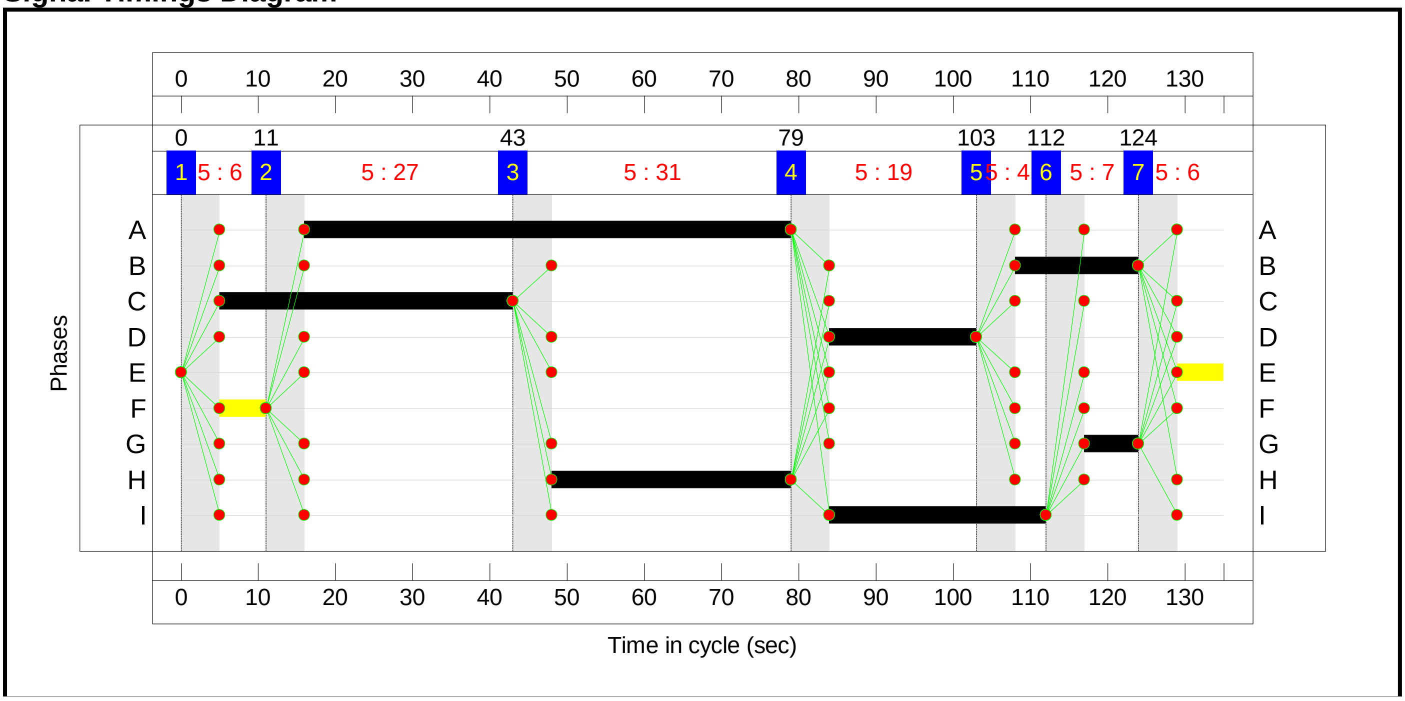
C1 PRC for Signalled Lanes (%): 5.2 Total Delay for Signalled Lanes (pcuHr): 30.57 Cycle Time (s): 135
PRC Over All Lanes (%): 5.2 Total Delay Over All Lanes(pcuHr): 31.80

Basic Results Summary

Stage Diagram



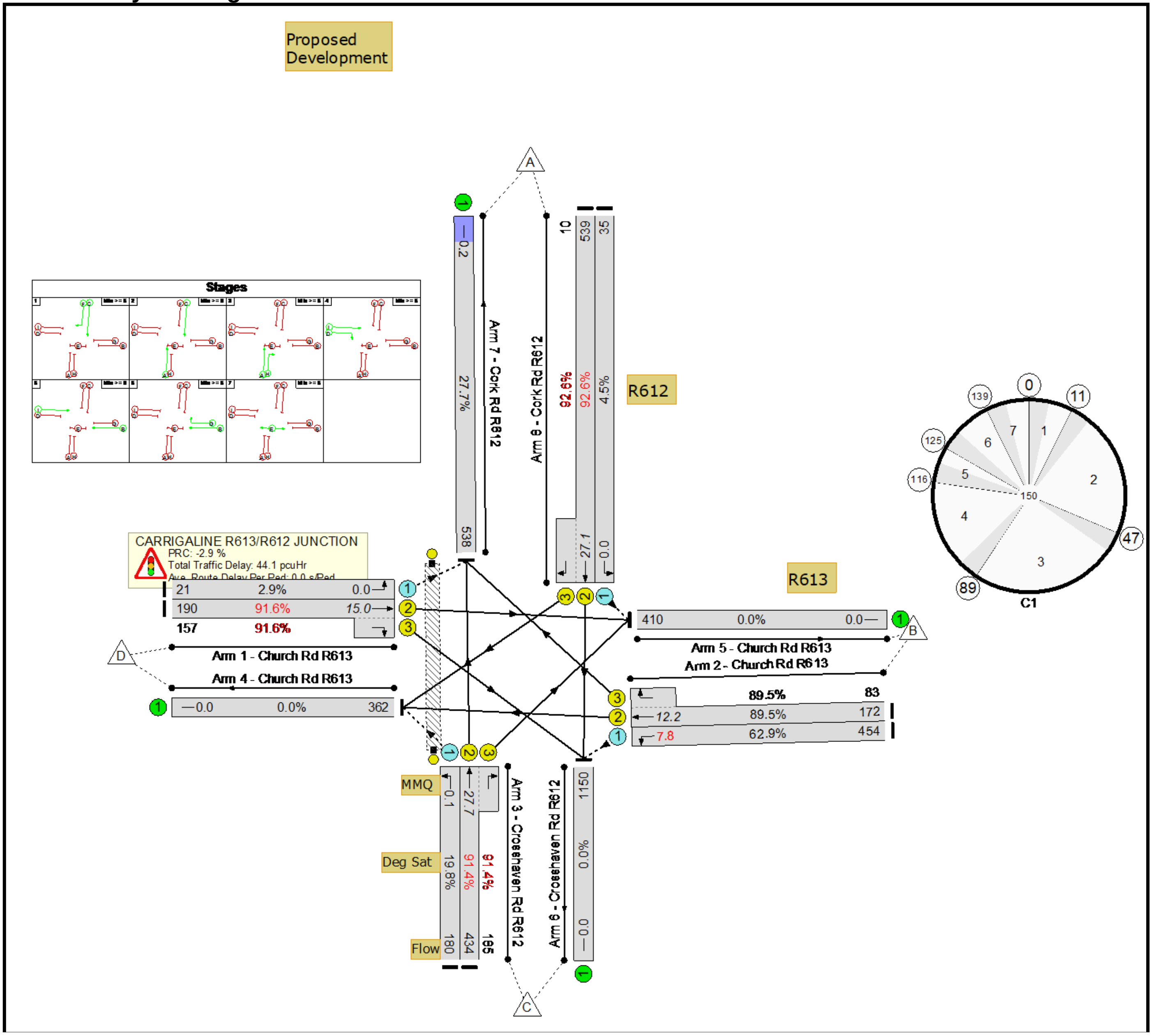
Signal Timings Diagram



Basic Results Summary

Scenario 10: 'Scenario 10 PM 2038 ' (FG10: 'PM 2038', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

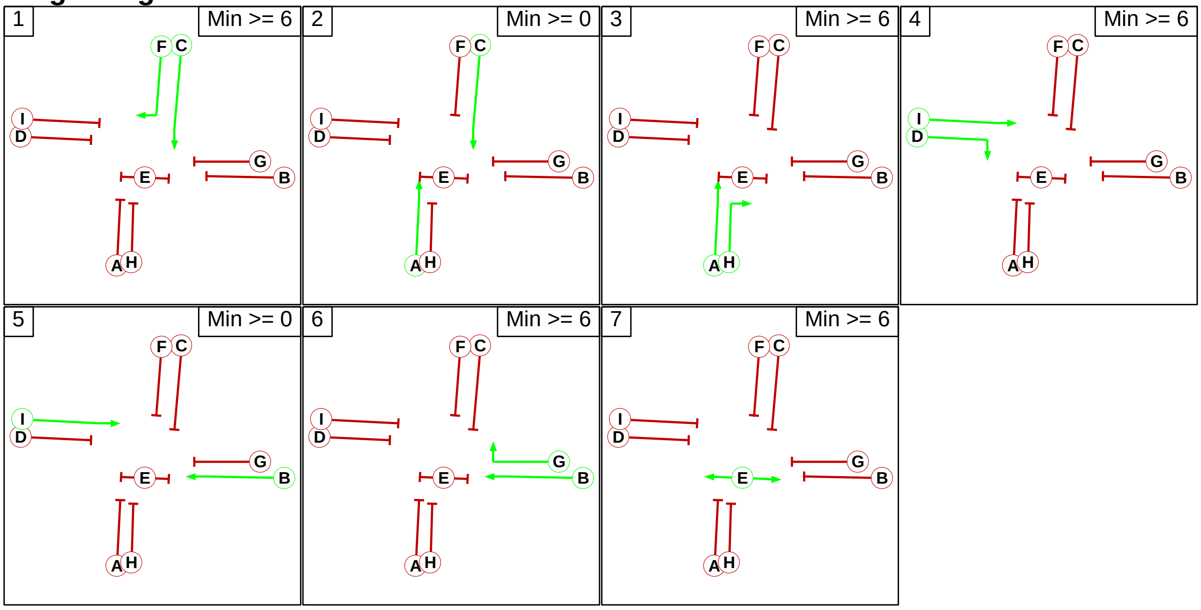
Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**92.6%**	**215**	**475**	**0**	**44.1**	**-**	**-**
CARRIGALINE R613/R612 JUNCTION	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**92.6%**	**215**	**475**	**0**	**44.1**	**-**	**-**
1/1	Church Rd R613 Left	O	-		-	-	-	21	1000	727	2.9%	12	9	0	0.0	2.6	0.0
1/2+1/3	Church Rd R613 Ahead Right	U	I D		1	31:22	-	347	1940:1849	207+171	91.6 : 91.6%	-	-	-	9.7	101.1	15.0
2/1	Church Rd R613 Left	O	-		-	-	-	454	1000	721	62.9%	156	298	0	1.2	9.8	7.8
2/2+2/3	Church Rd R613 Ahead Right	U	B G		1	18:9	-	255	1940:1849	192+93	89.5 : 89.5%	-	-	-	8.1	114.1	12.2
3/1	Crosshaven Rd R612 Left	O	-		-	-	-	180	1000	911	19.8%	31	149	0	0.1	2.5	0.1
3/2+3/3	Crosshaven Rd R612 Right Ahead	U	A H		1	73:37	-	619	1940:1724	475+202	91.4 : 91.4%	-	-	-	11.4	66.6	27.7
7/1	Cork Rd R612	U	-		-	-	-	538	1940	1940	27.7%	-	-	-	0.2	1.3	0.2
8/1	Cork Rd R612 Left	O	-		-	-	-	35	1000	784	4.5%	16	19	0	0.0	2.4	0.0
8/2+8/3	Cork Rd R612 Right Ahead	U	C F		1	42:6	-	549	2080:1940	582+11	92.6 : 92.6%	-	-	-	13.3	87.0	27.1
Ped Link: P1	Ped Crossing All Red	-	E		1	6	-	0	-	0	0.0%	-	-	-	-	-	-

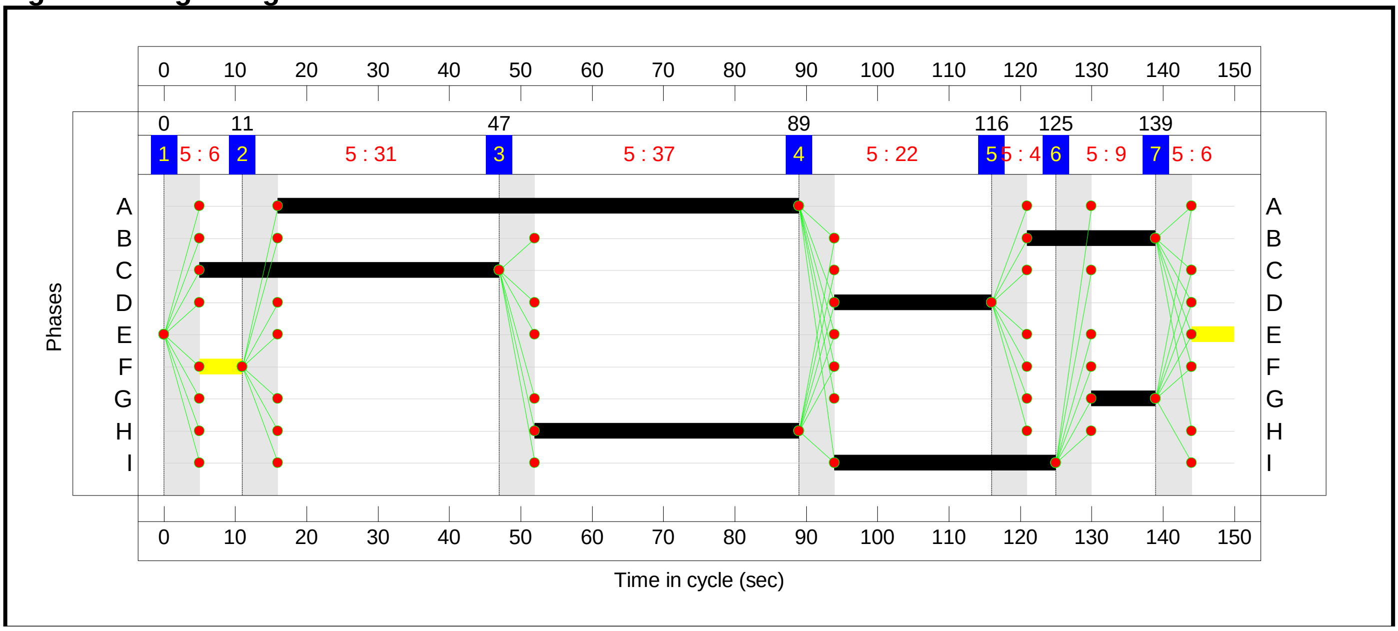
C1 PRC for Signalled Lanes (%): -2.9 Total Delay for Signalled Lanes (pcuHr): 42.54 Cycle Time (s): 150
PRC Over All Lanes (%): -2.9 Total Delay Over All Lanes(pcuHr): 44.13

Basic Results Summary

Stage Diagram



Signal Timings Diagram



Church Hill / Kilmoney Road Junction
CWRR / Kilmoney Road Signalised Junction
CWRR / Development Access Junction
CWRR / Link Road Signalised Junction
CWRR / Ballea Road Signalised Junction

Basic Results Summary

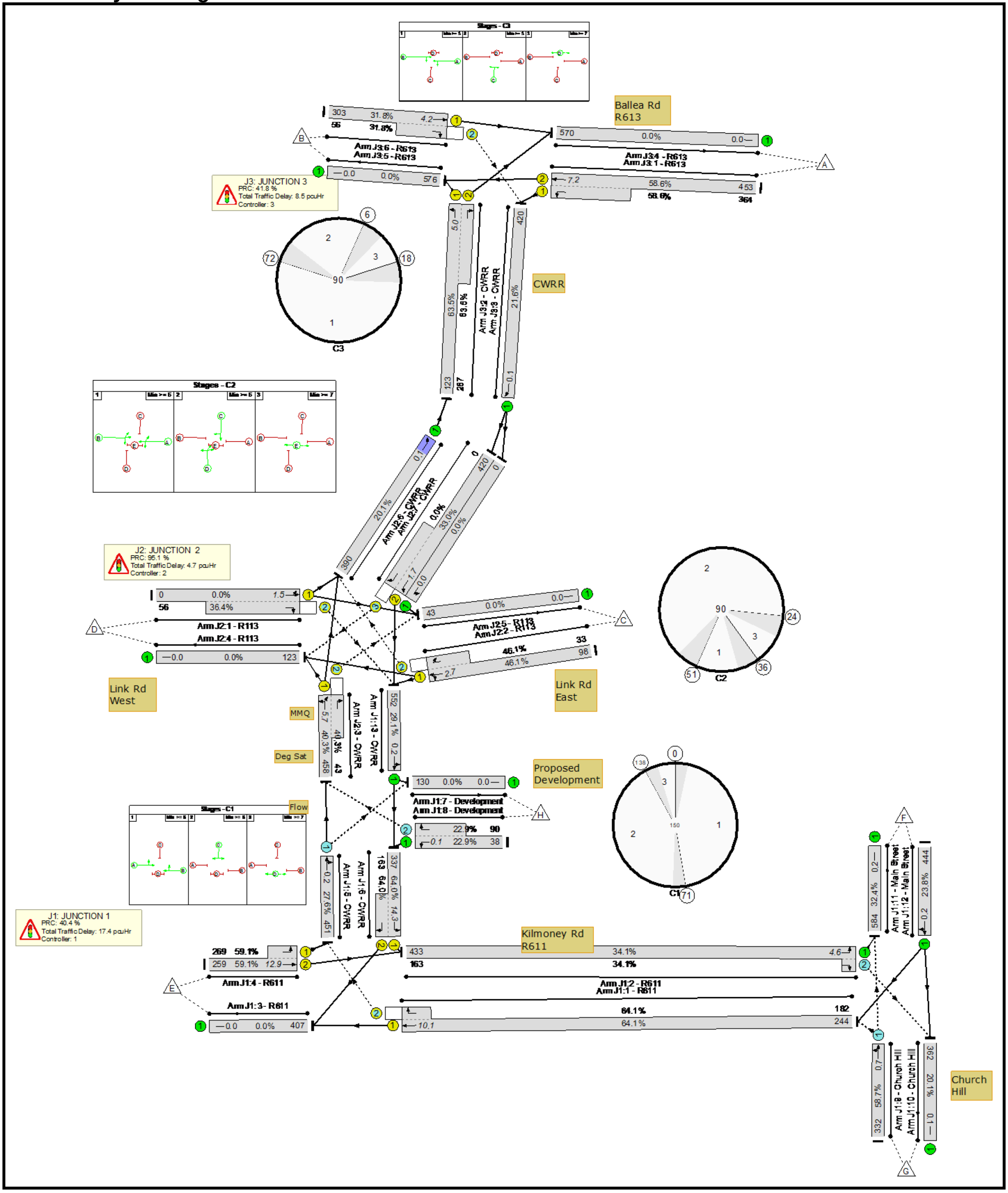
User and Project Details

Project:	
Title:	
Location:	
Additional detail:	
File name:	Carrigaline Hallmark 5 Junctions Main Street one way.lsg3x
Author:	
Company:	
Address:	

Basic Results Summary

Scenario 1: 'Scenario 1 AM 2023' (FG1: 'AM 2023', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Network Results Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	-	-	-		-	-	-	-	-	-	**64.1%**	**995**	**0**	**0**	**30.7**	-	-
J1: JUNCTION 1	-	-	-		-	-	-	-	-	-	**64.1%**	**807**	**0**	**0**	**17.4**	-	-
1/1+1/2	R611 Ahead Right	U+O	C1:B		1	66	-	426	1940:1805	381+284	64.1 : 64.1%	182	0	0	5.2	43.8	10.1
2/1+2/2	R611 Right Left	U+O	-		-	-	-	596	1687:1940	1271+478	34.1 : 34.1%	163	0	0	0.3	1.7	4.6
4/2+4/1	R611 Ahead Left	U	C1:A		1	66	-	528	1940:1687	438+455	59.1 : 59.1%	-	-	-	4.9	33.1	12.9
5/1	CWRR Ahead Right	O	-		-	-	-	451	1940	1635	27.6%	40	0	0	0.2	1.5	0.2
6/1+6/2	CWRR Left Right	U	C1:C		1	62	-	500	1687:1805	526+255	64.0 : 64.0%	-	-	-	5.3	38.4	14.3
8/1+8/2	Development Right Left	U+O	-		-	-	-	128	1665:1805	166+393	22.9 : 22.9%	90	0	0	0.1	4.2	0.1
9/1	Church Hill Left Ahead	O	-		-	-	-	332	1940	566	58.7%	332	0	0	0.7	7.6	0.7
10/1	Church Hill	U	-		-	-	-	362	1800	1800	20.1%	-	-	-	0.1	1.3	0.1
11/1	Main Street	U	-		-	-	-	584	1800	1800	32.4%	-	-	-	0.2	1.5	0.2
12/1	Main Street Right Ahead	U	-		-	-	-	444	1863	1863	23.8%	-	-	-	0.2	1.3	0.2
13/1	CWRR Ahead Left	U	-		-	-	-	552	1894	1894	29.1%	-	-	-	0.2	1.3	0.2
J2: JUNCTION 2	-	-	-		-	-	-	-	-	-	**46.1%**	**132**	**0**	**0**	**4.7**	-	-
1/1+1/2	R113 Ahead Left Right	U+O	C2:B		1	10	-	56	1940:2080	0+154	0.0 : 36.4%	56	0	0	0.9	56.0	1.5
2/1+2/2	R113 Ahead Right Left	U+O	C2:A		1	10	-	131	1738:1935	212+72	46.1 : 46.1%	33	0	0	1.8	48.2	2.7
3/1+3/2	CWRR Left Right Ahead	U+O	C2:D		1	58	-	501	1878:1805	1136+107	40.3 : 40.3%	43	0	0	1.3	9.5	5.7
6/1	CWRR Ahead	U	-		-	-	-	390	1940	1940	20.1%	-	-	-	0.1	1.2	0.1
7/1	CWRR Left	U	-		-	-	-	0	1940	1940	0.0%	-	-	-	0.0	0.0	0.0

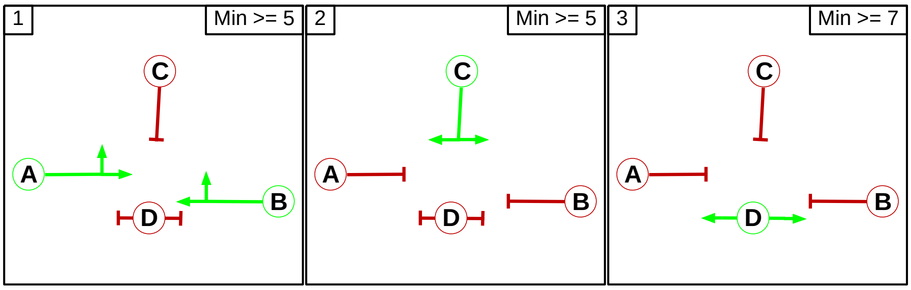
7/2+7/3	CWRR Right Ahead	U+O	C2:C		1	58	-	420	1940:1940	1272+0	33.0 : 0.0%	0	0	0	0.6	5.4	1.7
J3: JUNCTION 3	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**63.5%**	**56**	**0**	**0**	**8.5**	**-**	**-**
1/2+1/1	R613 Left Ahead	U	C3:A		1	49	-	817	1940:1940	773+621	58.6 : 58.6%	-	-	-	3.3	14.4	7.2
2/1+2/2	CWRR Right Left	U	C3:C		1	19	-	390	1940:1940	194+421	63.5 : 63.5%	-	-	-	3.8	34.6	5.0
3/1	CWRR Ahead	U	-		-	-	-	420	1940	1940	21.6%	-	-	-	0.1	1.2	0.1
6/1+6/2	R613 Right Ahead	U+O	C3:B		1	49	-	359	1940:1940	952+176	31.8 : 31.8%	56	0	0	1.4	13.9	4.2

C1 PRC for Signalled Lanes (%): 40.4 Total Delay for Signalled Lanes (pcuHr): 15.37 Cycle Time (s): 150
C2 PRC for Signalled Lanes (%): 95.1 Total Delay for Signalled Lanes (pcuHr): 4.56 Cycle Time (s): 90
C3 PRC for Signalled Lanes (%): 41.8 Total Delay for Signalled Lanes (pcuHr): 8.41 Cycle Time (s): 90
PRC Over All Lanes (%): 40.4 Total Delay Over All Lanes(pcuHr): 30.67

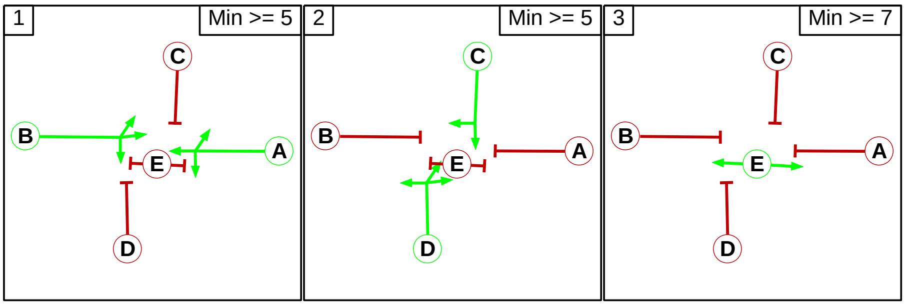
Basic Results Summary

Stage Diagram

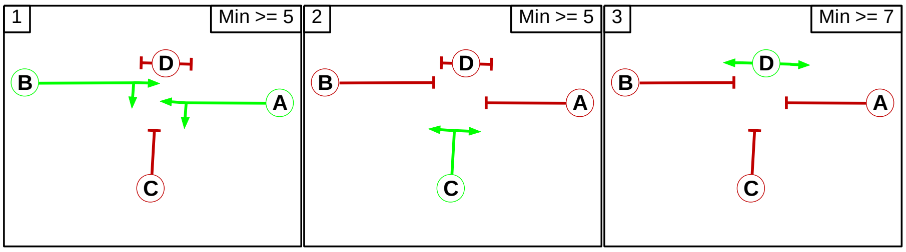
C1



C2

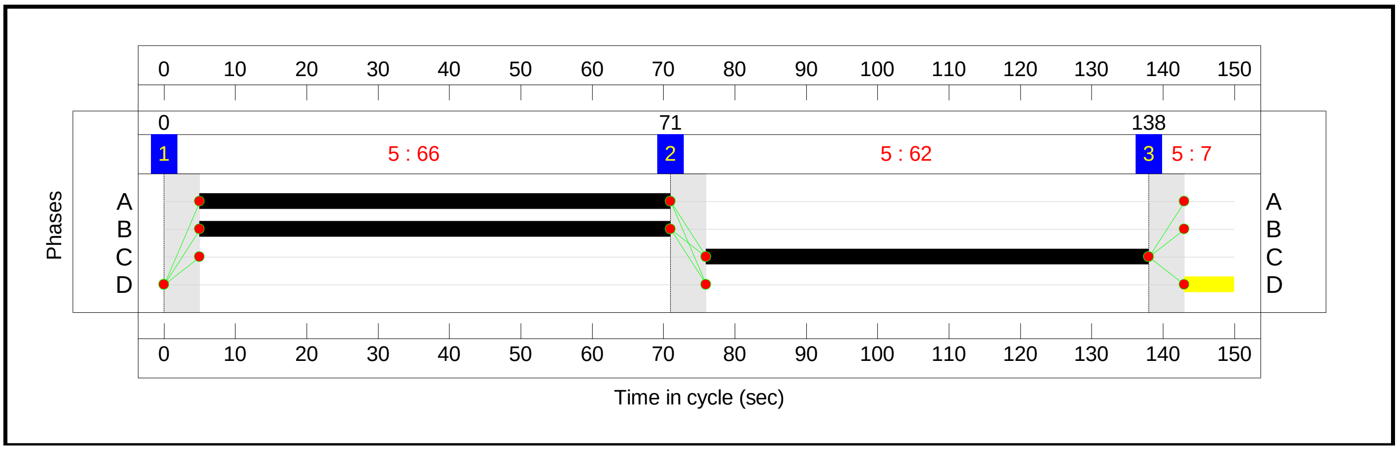


C3



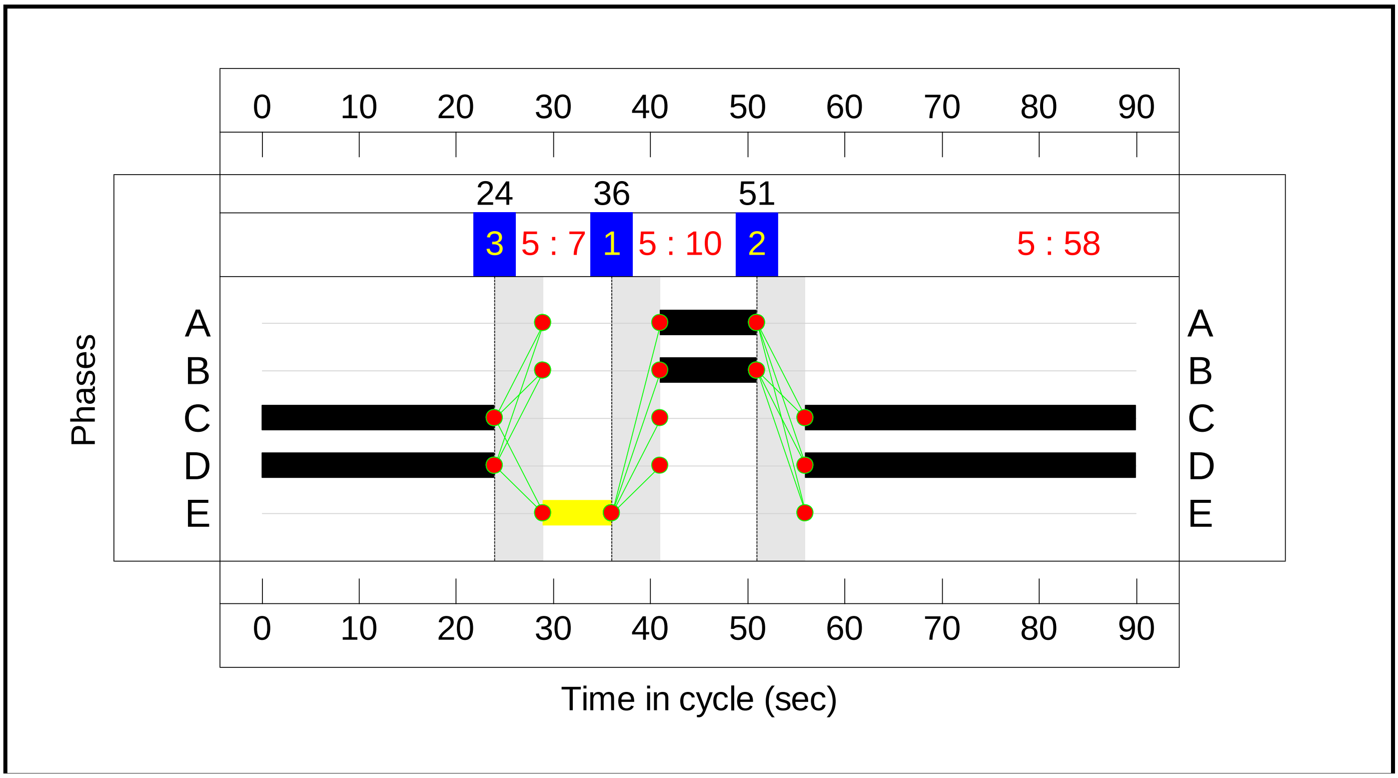
Signal Timings Diagram

C1

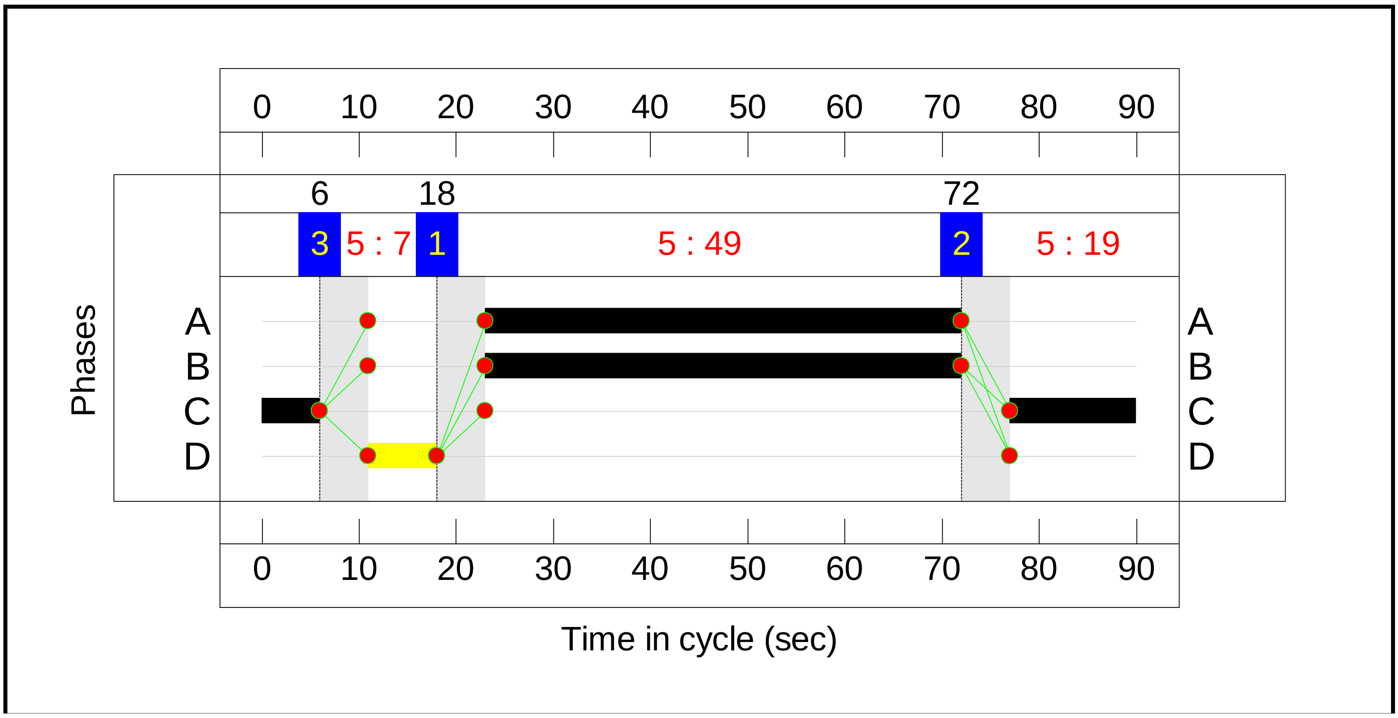


Basic Results Summary

C2



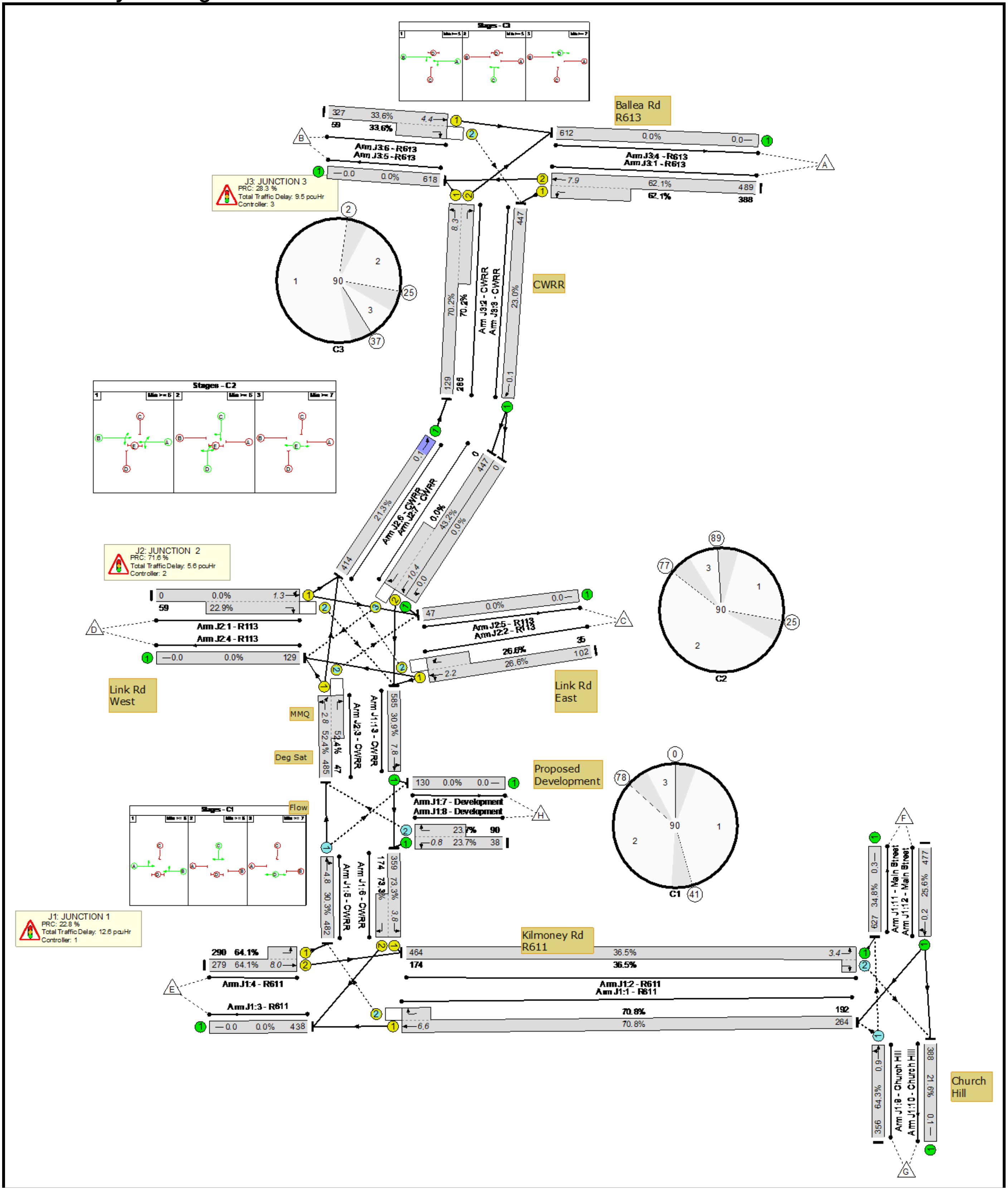
C3



Basic Results Summary

Scenario 2: 'Scenario 2 AM 2028' (FG2: 'AM 2028', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**73.3%**	**1052**	**0**	**0**	**27.7**	**-**	**-**
J1: JUNCTION 1	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**73.3%**	**852**	**0**	**0**	**12.6**	**-**	**-**
1/1+1/2	R611 Ahead Right	U+O	C1:B		1	36	-	456	1940:1805	373+271	70.8 : 70.8%	192	0	0	4.3	33.7	6.6
2/1+2/2	R611 Right Left	U+O	-		-	-	-	638	1687:1940	1272+477	36.5 : 36.5%	174	0	0	0.3	1.6	3.4
4/2+4/1	R611 Ahead Left	U	C1:A		1	36	-	569	1940:1687	435+453	64.1 : 64.1%	-	-	-	3.9	24.5	8.0
5/1	CWRR Ahead Right	O	-		-	-	-	482	1940	1589	30.3%	40	0	0	0.3	2.0	4.8
6/1+6/2	CWRR Left Right	U	C1:C		1	32	-	533	1687:1805	490+237	73.3 : 73.3%	-	-	-	2.0	13.5	3.8
8/1+8/2	Development Right Left	U+O	-		-	-	-	128	1665:1805	160+380	23.7 : 23.7%	90	0	0	0.2	5.9	0.8
9/1	Church Hill Left Ahead	O	-		-	-	-	356	1940	554	64.3%	356	0	0	0.9	9.0	0.9
10/1	Church Hill	U	-		-	-	-	388	1800	1800	21.6%	-	-	-	0.1	1.3	0.1
11/1	Main Street	U	-		-	-	-	627	1800	1800	34.8%	-	-	-	0.3	1.5	0.3
12/1	Main Street Right Ahead	U	-		-	-	-	477	1863	1863	25.6%	-	-	-	0.2	1.3	0.2
13/1	CWRR Ahead Left	U	-		-	-	-	585	1896	1896	30.9%	-	-	-	0.3	1.6	7.8
J2: JUNCTION 2	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**52.4%**	**141**	**0**	**0**	**5.6**	**-**	**-**
1/1+1/2	R113 Ahead Left Right	U+O	C2:B		1	21	-	59	1940:2080	0+257	0.0 : 22.9%	59	0	0	0.6	37.1	1.3
2/1+2/2	R113 Ahead Right Left	U+O	C2:A		1	21	-	137	1738:1935	383+131	26.6 : 26.6%	35	0	0	1.2	31.8	2.2
3/1+3/2	CWRR Left Right Ahead	U+O	C2:D		1	47	-	532	1878:1805	925+90	52.4 : 52.4%	47	0	0	1.1	7.3	2.8
6/1	CWRR Ahead	U	-		-	-	-	414	1940	1940	21.3%	-	-	-	0.1	1.2	0.1

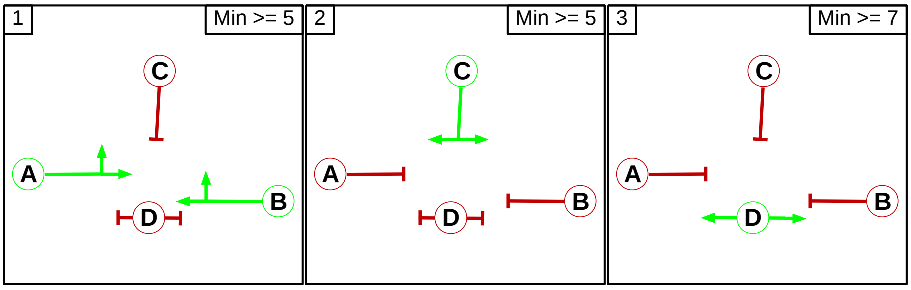
7/1	CWRR Left	U	-		-	-	-	0	1940	1940	0.0%	-	-	-	0.0	0.0	0.0
7/2+7/3	CWRR Right Ahead	U+O	C2:C		1	47	-	447	1940:1940	1035+0	43.2 : 0.0%	0	0	0	2.6	20.9	10.4
J3: JUNCTION 3	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**70.2%**	**59**	**0**	**0**	**9.5**	**-**	**-**
1/2+1/1	R613 Left Ahead	U	C3:A		1	50	-	877	1940:1940	787+625	62.1 : 62.1%	-	-	-	3.5	14.3	7.9
2/1+2/2	CWRR Right Left	U	C3:C		1	18	-	414	1940:1940	184+406	70.2 : 70.2%	-	-	-	4.4	38.0	8.3
3/1	CWRR Ahead	U	-		-	-	-	447	1940	1940	23.0%	-	-	-	0.1	1.2	0.1
6/1+6/2	R613 Right Ahead	U+O	C3:B		1	50	-	386	1940:1940	973+176	33.6 : 33.6%	59	0	0	1.5	13.6	4.4

C1	PRC for Signalled Lanes (%):	22.8	Total Delay for Signalled Lanes (pcuHr):	10.13	Cycle Time (s):	90
C2	PRC for Signalled Lanes (%):	71.6	Total Delay for Signalled Lanes (pcuHr):	5.49	Cycle Time (s):	90
C3	PRC for Signalled Lanes (%):	28.3	Total Delay for Signalled Lanes (pcuHr):	9.33	Cycle Time (s):	90
	PRC Over All Lanes (%):	22.8	Total Delay Over All Lanes(pcuHr):	27.72		

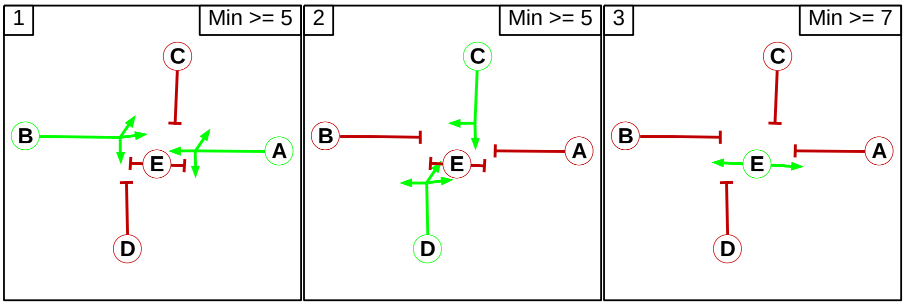
Basic Results Summary

Stage Diagram

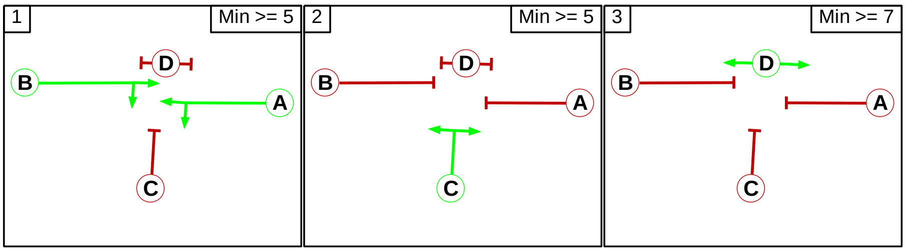
C1



C2

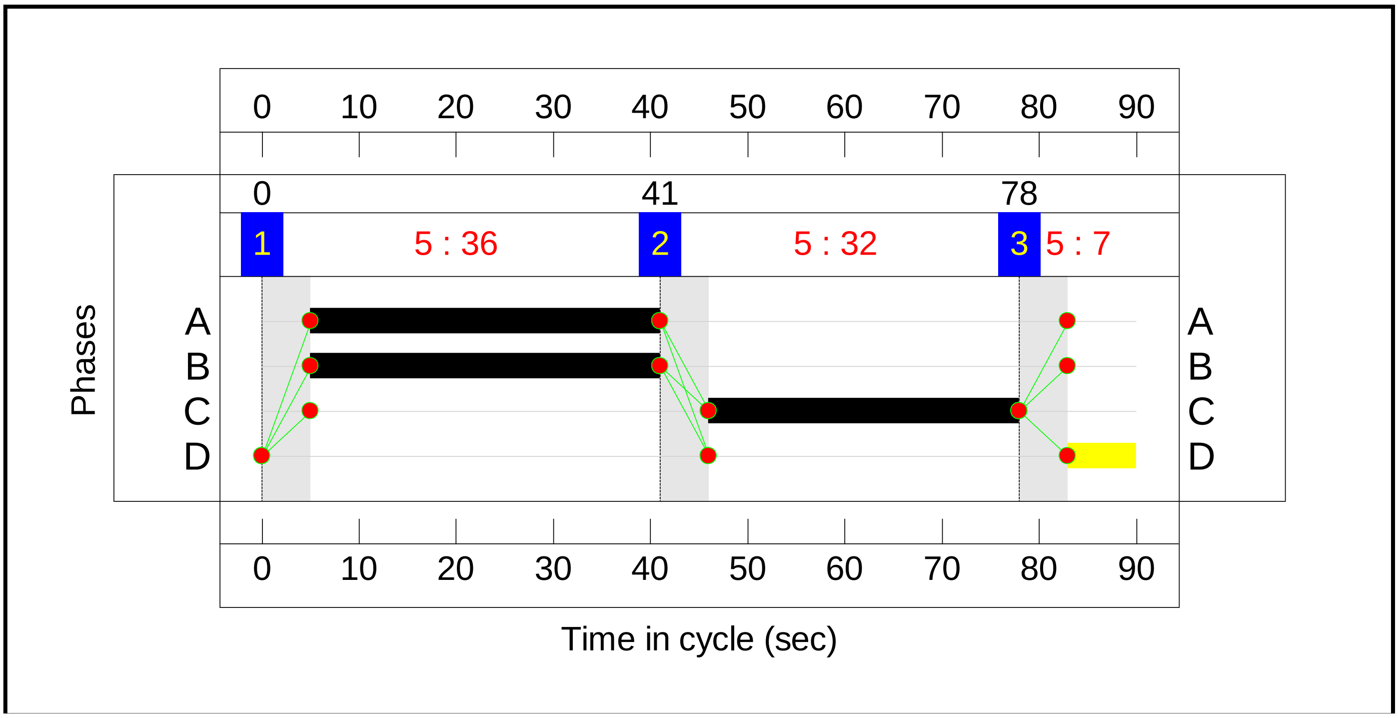


C3



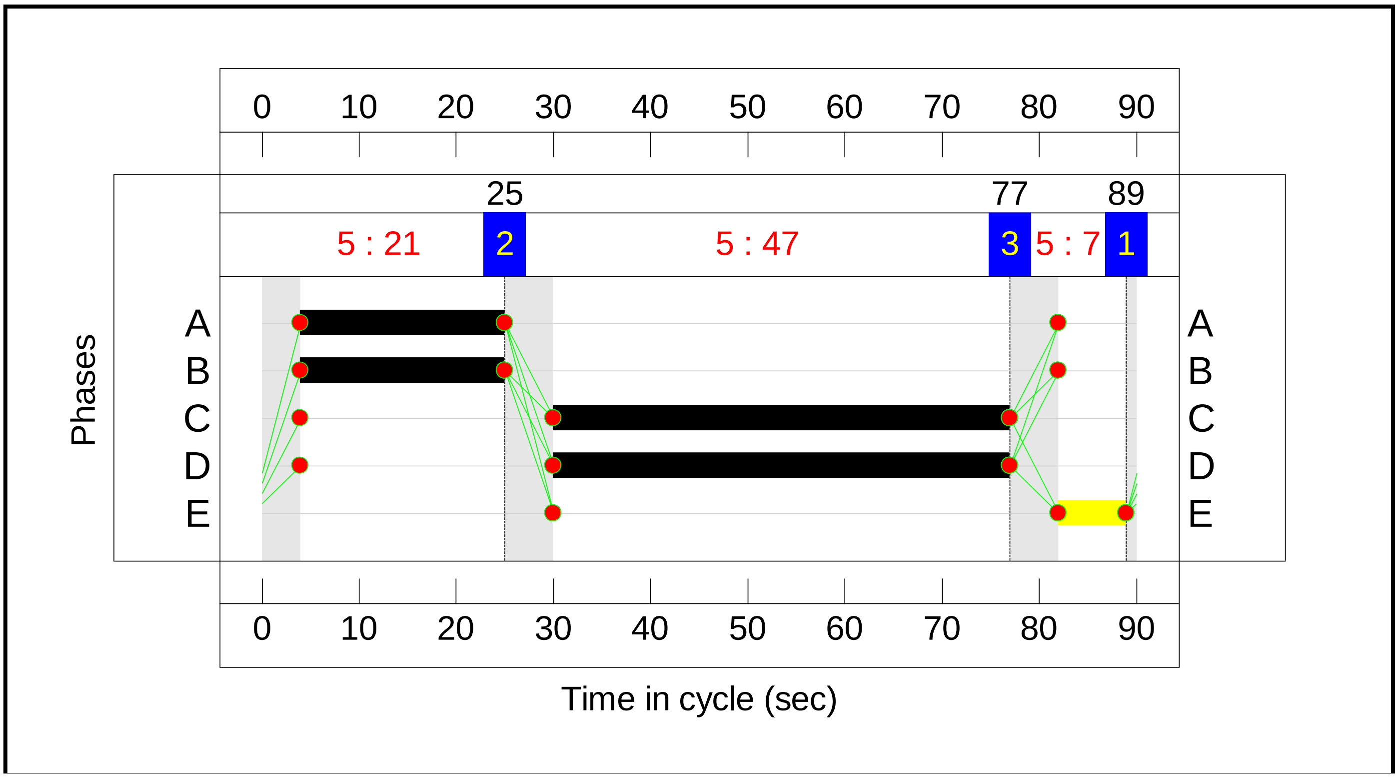
Signal Timings Diagram

C1

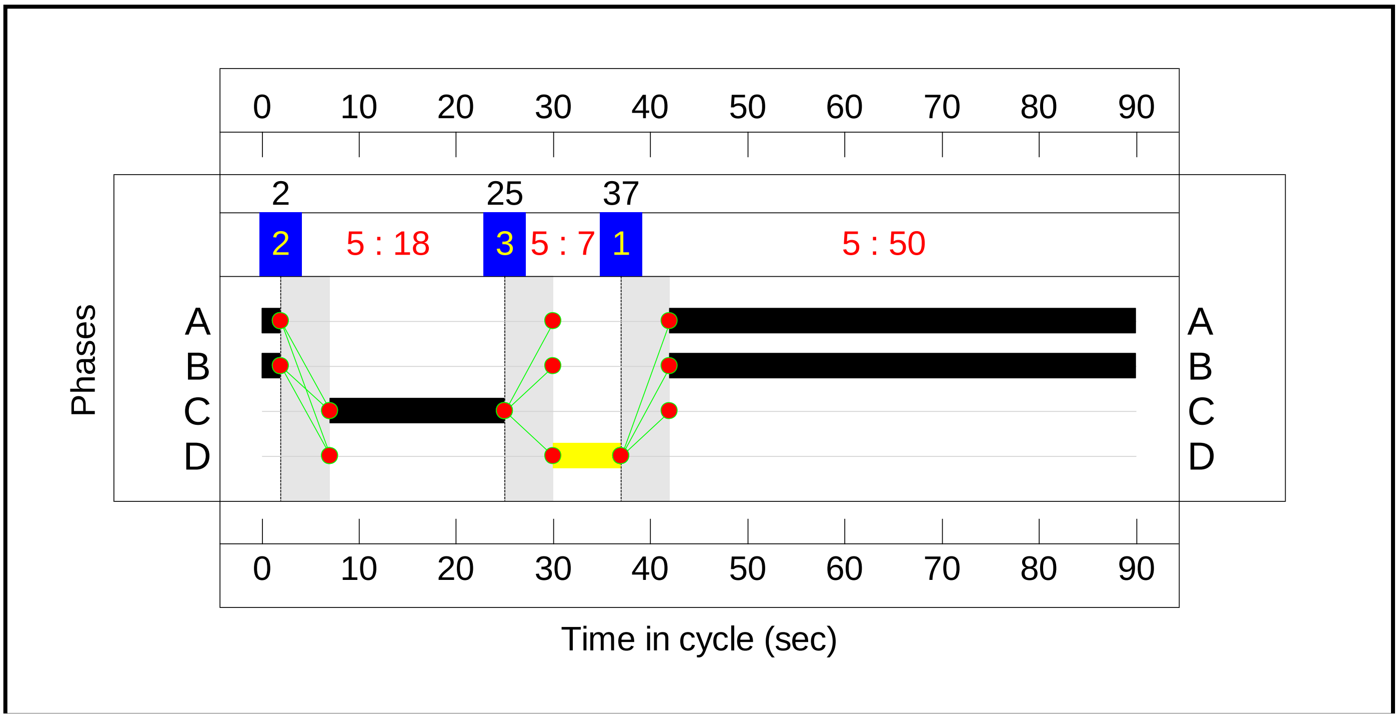


Basic Results Summary

C2



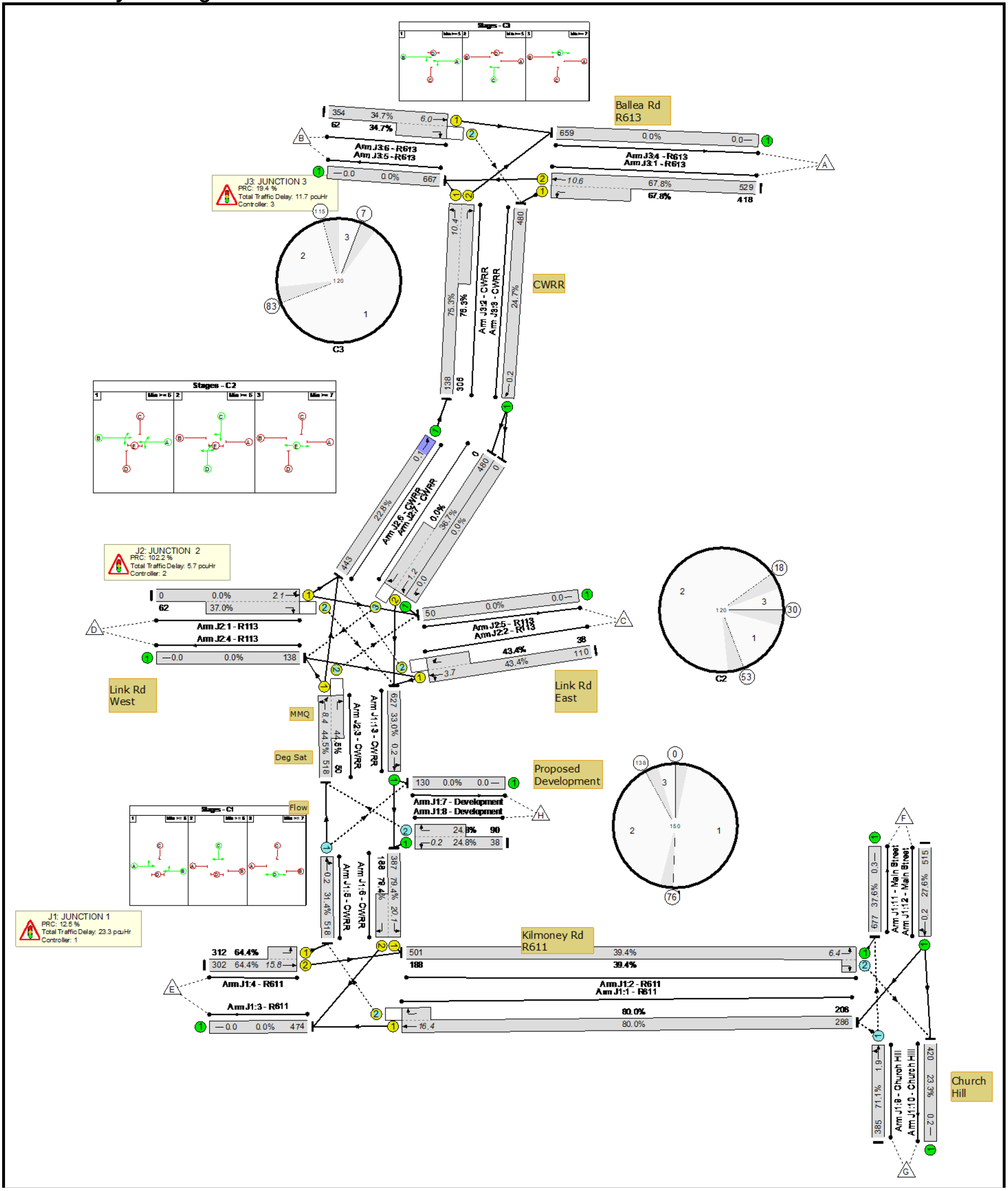
C3



Basic Results Summary

Scenario 3: 'Scenario 3 AM 2038' (FG3: 'AM 2038', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**80.0%**	**1121**	**0**	**0**	**40.6**	**-**	**-**
J1: JUNCTION 1	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**80.0%**	**909**	**0**	**0**	**23.3**	**-**	**-**
1/1+1/2	R611 Ahead Right	U+O	C1:B		1	71	-	492	1940:1805	358+258	80.0 : 80.0%	206	0	0	7.1	51.6	16.4
2/1+2/2	R611 Right Left	U+O	-		-	-	-	689	1687:1940	1272+477	39.4 : 39.4%	188	0	0	0.4	2.0	6.4
4/2+4/1	R611 Ahead Left	U	C1:A		1	71	-	614	1940:1687	469+485	64.4 : 64.4%	-	-	-	5.4	31.6	15.8
5/1	CWRR Ahead Right	O	-		-	-	-	518	1940	1652	31.4%	40	0	0	0.2	1.6	0.2
6/1+6/2	CWRR Left Right	U	C1:C		1	57	-	575	1687:1805	487+237	79.4 : 79.4%	-	-	-	8.0	50.0	20.1
8/1+8/2	Development Right Left	U+O	-		-	-	-	128	1665:1805	153+363	24.8 : 24.8%	90	0	0	0.2	4.6	0.2
9/1	Church Hill Left Ahead	O	-		-	-	-	385	1940	542	71.1%	385	0	0	1.2	11.3	1.9
10/1	Church Hill	U	-		-	-	-	420	1800	1800	23.3%	-	-	-	0.2	1.3	0.2
11/1	Main Street	U	-		-	-	-	677	1800	1800	37.6%	-	-	-	0.3	1.6	0.3
12/1	Main Street Right Ahead	U	-		-	-	-	515	1863	1863	27.6%	-	-	-	0.2	1.3	0.2
13/1	CWRR Ahead Left	U	-		-	-	-	627	1899	1899	33.0%	-	-	-	0.2	1.4	0.2
J2: JUNCTION 2	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**44.5%**	**150**	**0**	**0**	**5.7**	**-**	**-**
1/1+1/2	R113 Ahead Left Right	U+O	C2:B		1	18	-	62	1940:2080	0+168	0.0 : 37.0%	62	0	0	1.1	63.8	2.1
2/1+2/2	R113 Ahead Right Left	U+O	C2:A		1	18	-	148	1738:1935	254+88	43.4 : 43.4%	38	0	0	2.2	54.2	3.7
3/1+3/2	CWRR Left Right Ahead	U+O	C2:D		1	80	-	568	1879:1805	1164+112	44.5 : 44.5%	50	0	0	1.8	11.3	8.4
6/1	CWRR Ahead	U	-		-	-	-	443	1940	1940	22.8%	-	-	-	0.1	1.2	0.1

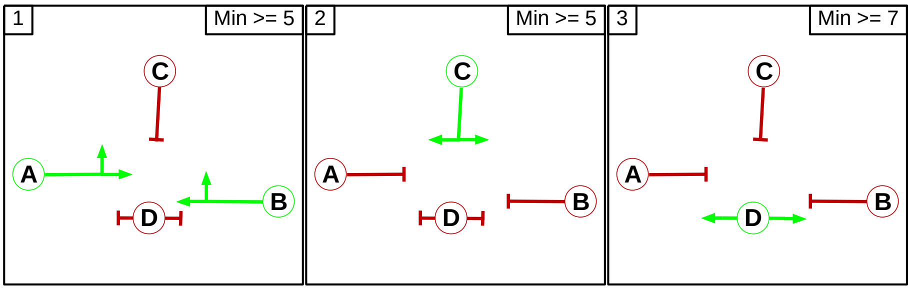
7/1	CWRR Left	U	-		-	-	-	0	1940	1940	0.0%	-	-	-	0.0	0.0	0.0
7/2+7/3	CWRR Right Ahead	U+O	C2:C		1	80	-	480	1940:1940	1310+0	36.7 : 0.0%	0	0	0	0.4	3.2	1.2
J3: JUNCTION 3	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**75.3%**	**62**	**0**	**0**	**11.7**	**-**	**-**
1/2+1/1	R613 Left Ahead	U	C3:A		1	71	-	947	1940:1940	781+617	67.8 : 67.8%	-	-	-	4.4	16.8	10.6
2/1+2/2	CWRR Right Left	U	C3:C		1	27	-	443	1940:1940	183+405	75.3 : 75.3%	-	-	-	5.3	43.1	10.4
3/1	CWRR Ahead	U	-		-	-	-	480	1940	1940	24.7%	-	-	-	0.2	1.2	0.2
6/1+6/2	R613 Right Ahead	U+O	C3:B		1	71	-	416	1940:1940	1021+179	34.7 : 34.7%	62	0	0	1.8	15.5	6.0

C1 PRC for Signalled Lanes (%): 12.5 Total Delay for Signalled Lanes (pcuHr): 20.43 Cycle Time (s): 150
C2 PRC for Signalled Lanes (%): 102.2 Total Delay for Signalled Lanes (pcuHr): 5.54 Cycle Time (s): 120
C3 PRC for Signalled Lanes (%): 19.4 Total Delay for Signalled Lanes (pcuHr): 11.50 Cycle Time (s): 120
PRC Over All Lanes (%): 12.5 Total Delay Over All Lanes(pcuHr): 40.65

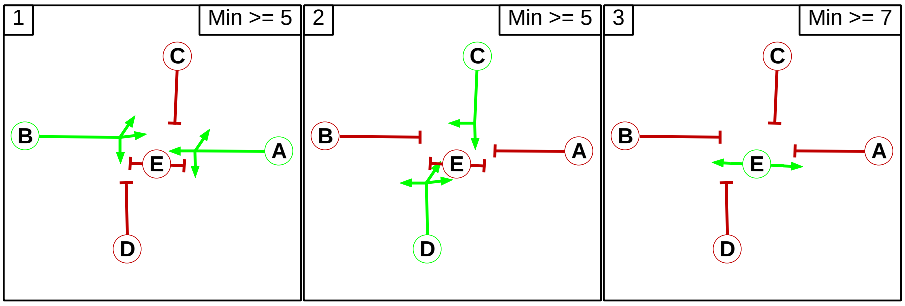
Basic Results Summary

Stage Diagram

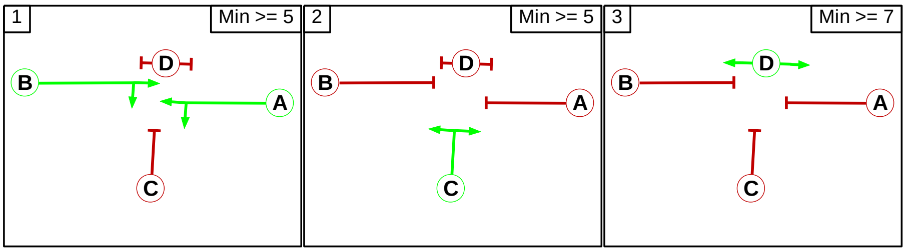
C1



C2

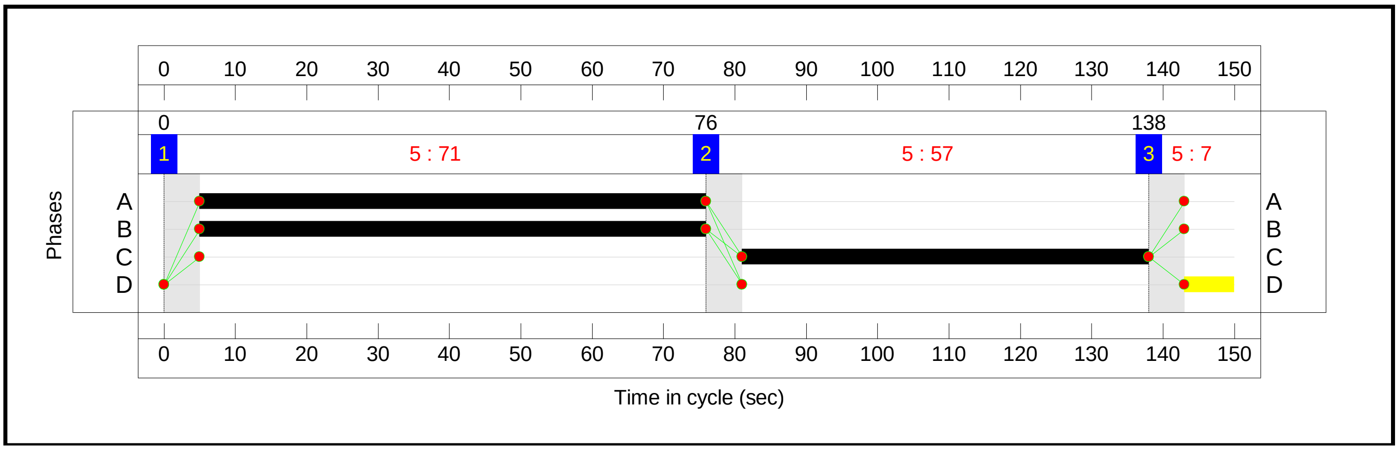


C3



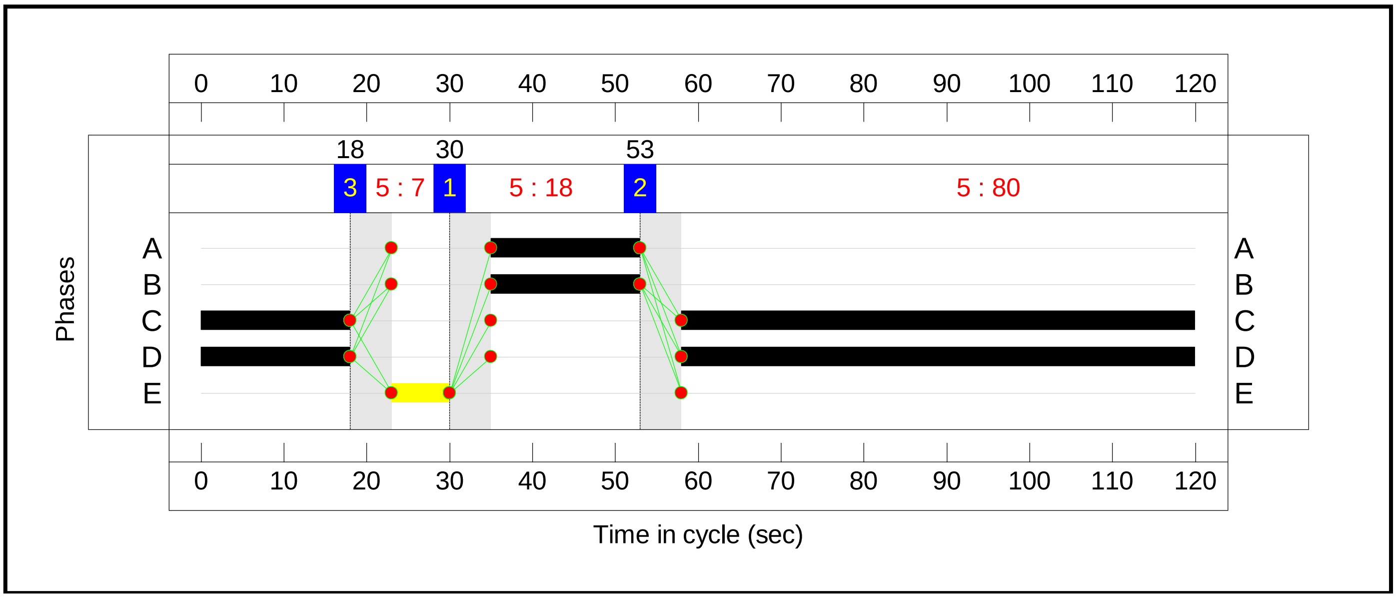
Signal Timings Diagram

C1

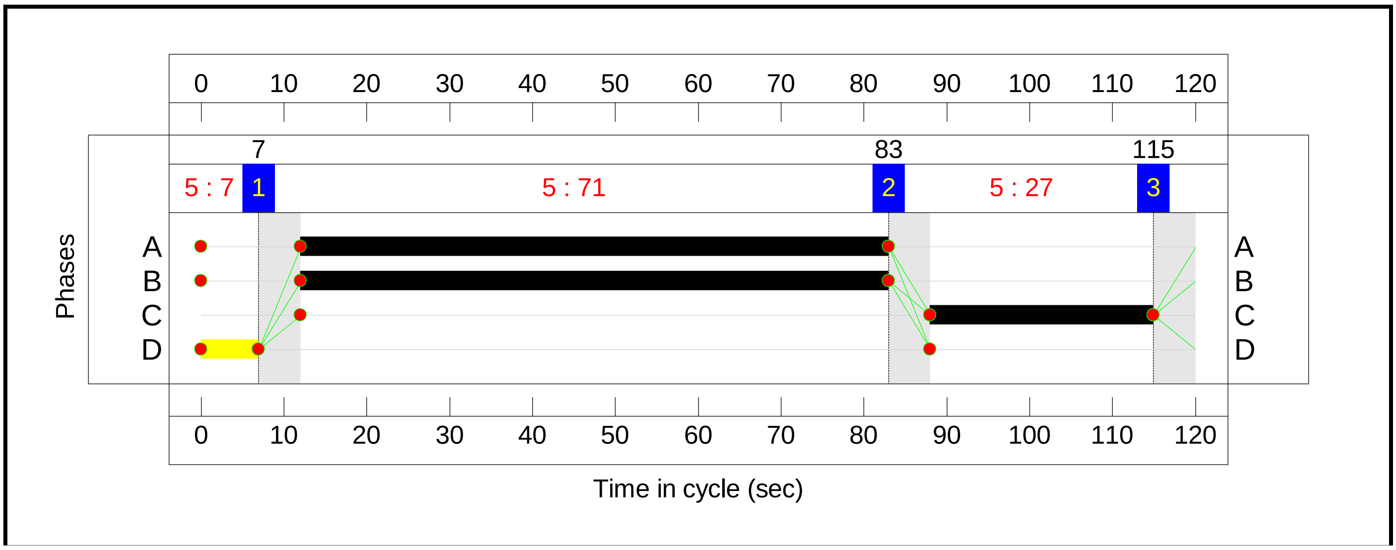


Basic Results Summary

C2



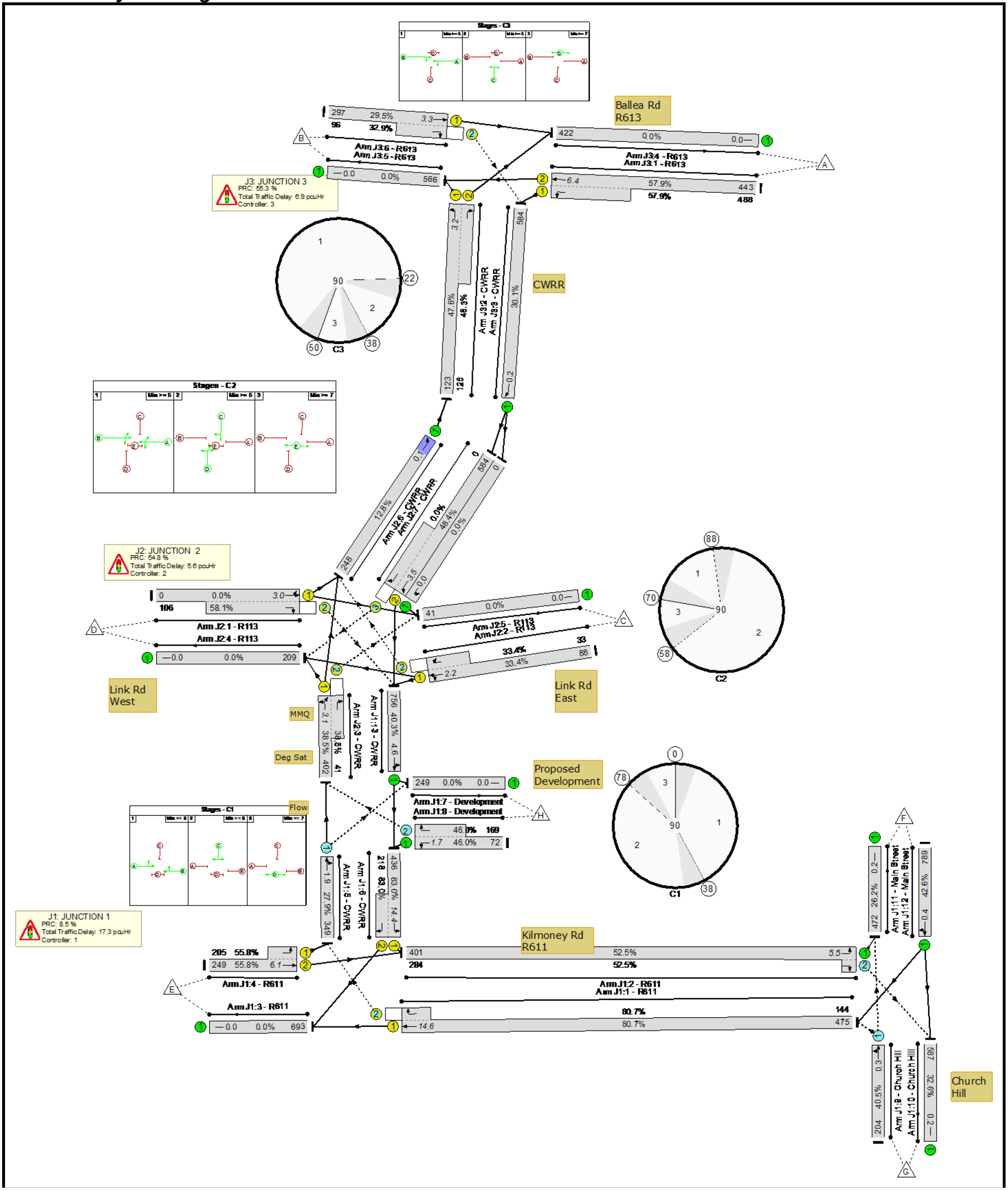
C3



Basic Results Summary

Scenario 4: 'Scenario 4 PM 2023' (FG4: 'PM 2023', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**83.0%**	**1152**	**0**	**0**	**29.8**	**-**	**-**
J1: JUNCTION 1	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**83.0%**	**876**	**0**	**0**	**17.3**	**-**	**-**
1/1+1/2	R611 Ahead Right	U+O	C1:B		1	33	-	619	1940:1805	588+178	80.7 : 80.7%	144	0	0	6.4	37.1	14.6
2/1+2/2	R611 Right Left	U+O	-		-	-	-	685	1687:1940	764+541	52.5 : 52.5%	284	0	0	0.7	3.7	5.5
4/2+4/1	R611 Ahead Left	U	C1:A		1	33	-	454	1940:1687	446+367	55.8 : 55.8%	-	-	-	3.2	25.1	6.1
5/1	CWRR Ahead Right	O	-		-	-	-	349	1940	1253	27.9%	75	0	0	0.2	2.0	1.9
6/1+6/2	CWRR Left Right	U	C1:C		1	35	-	654	1687:1805	526+263	83.0 : 83.0%	-	-	-	5.0	27.3	14.4
8/1+8/2	Development Right Left	U+O	-		-	-	-	241	1665:1805	156+367	46.0 : 46.0%	169	0	0	0.5	6.7	1.7
9/1	Church Hill Left Ahead	O	-		-	-	-	204	1940	503	40.5%	204	0	0	0.3	6.0	0.3
10/1	Church Hill	U	-		-	-	-	587	1800	1800	32.6%	-	-	-	0.2	1.5	0.2
11/1	Main Street	U	-		-	-	-	472	1800	1800	26.2%	-	-	-	0.2	1.4	0.2
12/1	Main Street Right Ahead	U	-		-	-	-	789	1854	1854	42.6%	-	-	-	0.4	1.7	0.4
13/1	CWRR Ahead Left	U	-		-	-	-	756	1875	1875	40.3%	-	-	-	0.4	1.7	4.6
J2: JUNCTION 2	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**58.1%**	**180**	**0**	**0**	**5.6**	**-**	**-**
1/1+1/2	R113 Ahead Left Right	U+O	C2:B		1	13	-	106	1940:2080	0+182	0.0 : 58.1%	106	0	0	1.8	60.7	3.0
2/1+2/2	R113 Ahead Right Left	U+O	C2:A		1	13	-	121	1744:1935	264+99	33.4 : 33.4%	33	0	0	1.4	41.0	2.2
3/1+3/2	CWRR Left Right Ahead	U+O	C2:D		1	55	-	443	1813:1805	1045+107	38.5 : 38.5%	41	0	0	1.0	8.5	3.1
6/1	CWRR Ahead	U	-		-	-	-	248	1940	1940	12.8%	-	-	-	0.1	1.1	0.1

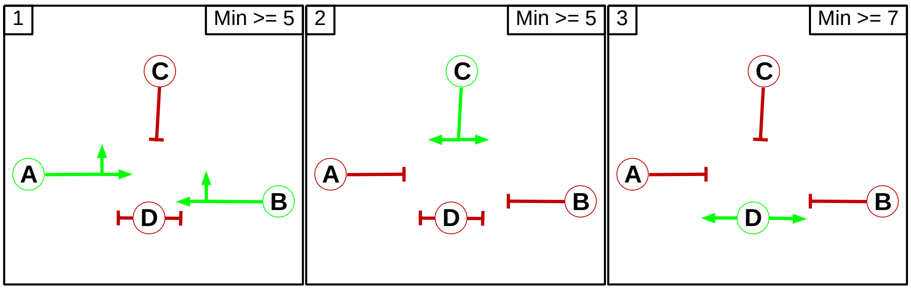
7/1	CWRR Left	U	-		-	-	-	0	1940	1940	0.0%	-	-	-	0.0	0.0	0.0
7/2+7/3	CWRR Right Ahead	U+O	C2:C		1	55	-	584	1940:1940	1207+0	48.4 : 0.0%	0	0	0	1.3	8.2	3.5
J3: JUNCTION 3	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**57.9%**	**96**	**0**	**0**	**6.9**	**-**	**-**
1/2+1/1	R613 Left Ahead	U	C3:A		1	57	-	931	1940:1940	765+842	57.9 : 57.9%	-	-	-	2.6	10.2	6.4
2/1+2/2	CWRR Right Left	U	C3:C		1	11	-	248	1940:1940	259+259	47.6 : 48.3%	-	-	-	2.9	42.1	3.2
3/1	CWRR Ahead	U	-		-	-	-	584	1940	1940	30.1%	-	-	-	0.2	1.3	0.2
6/1+6/2	R613 Right Ahead	U+O	C3:B		1	57	-	393	1940:1940	1008+292	29.5 : 32.9%	96	0	0	1.1	10.3	3.3

C1	PRC for Signalled Lanes (%):	8.5	Total Delay for Signalled Lanes (pcuHr):	14.50	Cycle Time (s):	90
C2	PRC for Signalled Lanes (%):	54.8	Total Delay for Signalled Lanes (pcuHr):	5.54	Cycle Time (s):	90
C3	PRC for Signalled Lanes (%):	55.3	Total Delay for Signalled Lanes (pcuHr):	6.65	Cycle Time (s):	90
	PRC Over All Lanes (%):	8.5	Total Delay Over All Lanes(pcuHr):	29.82		

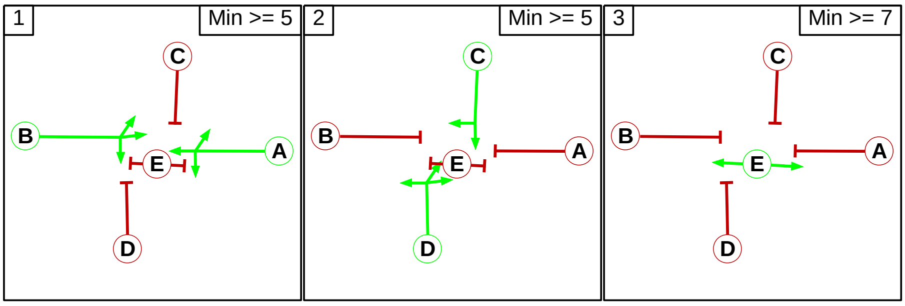
Basic Results Summary

Stage Diagram

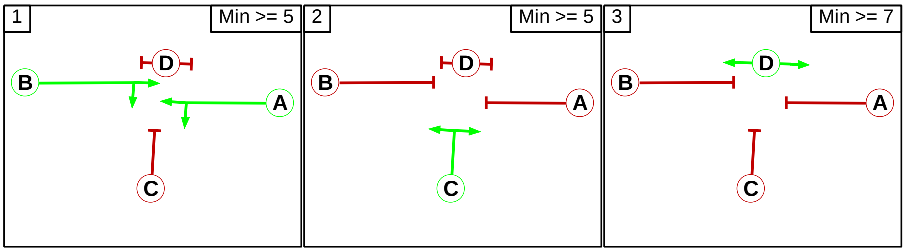
C1



C2

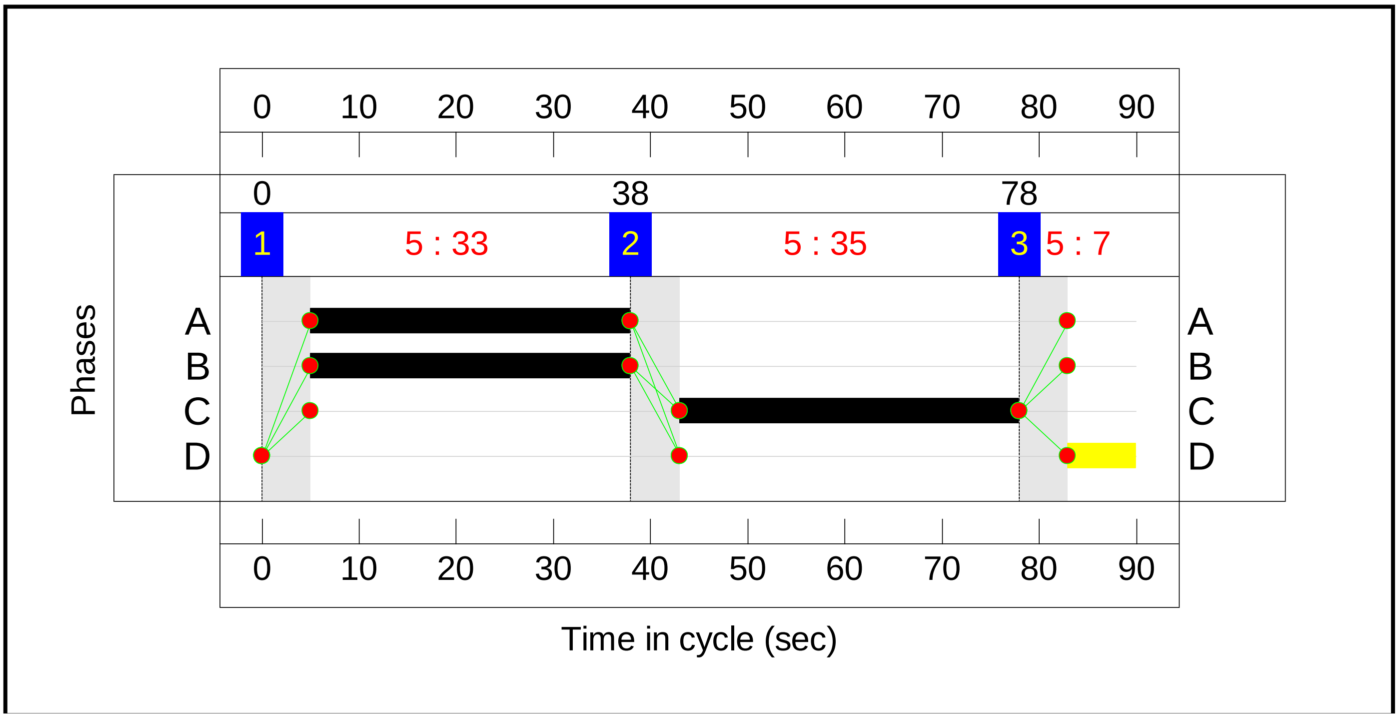


C3



Signal Timings Diagram

C1



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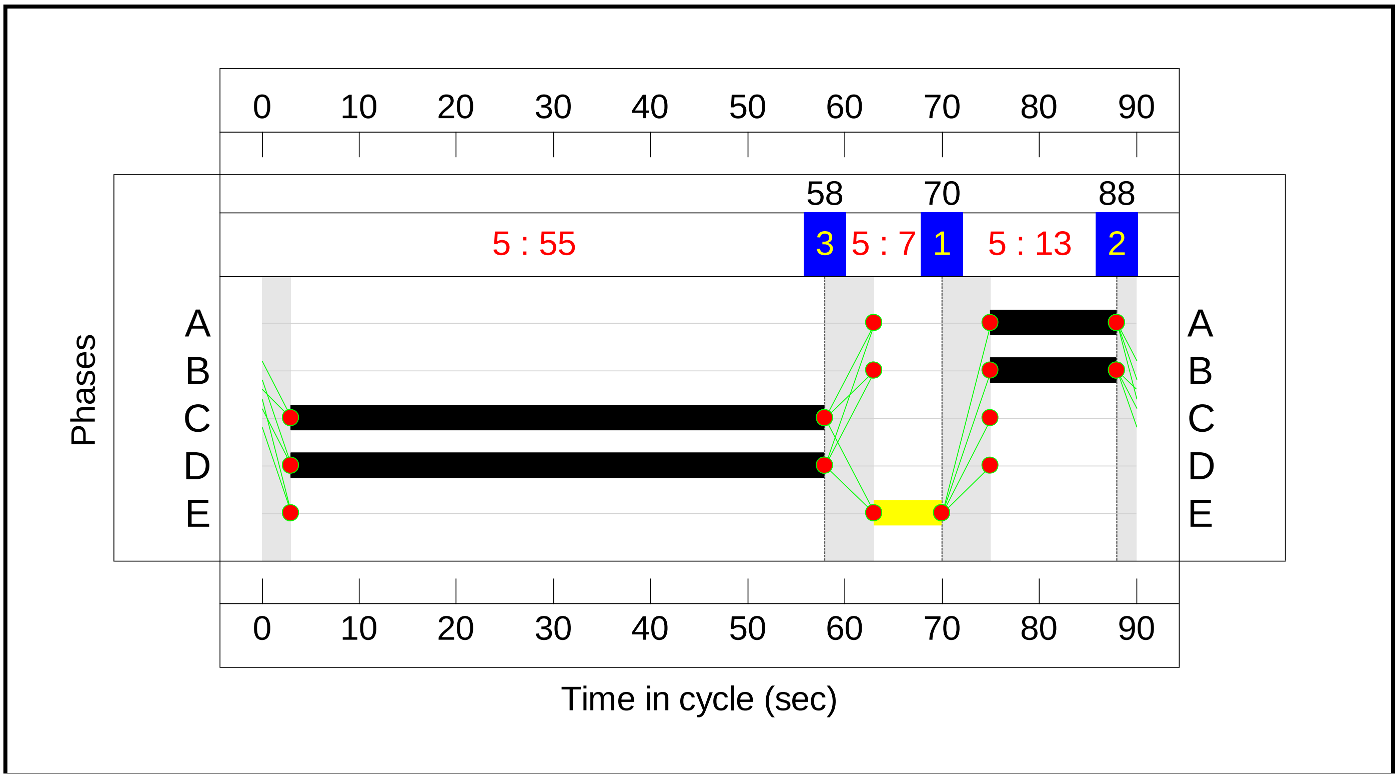
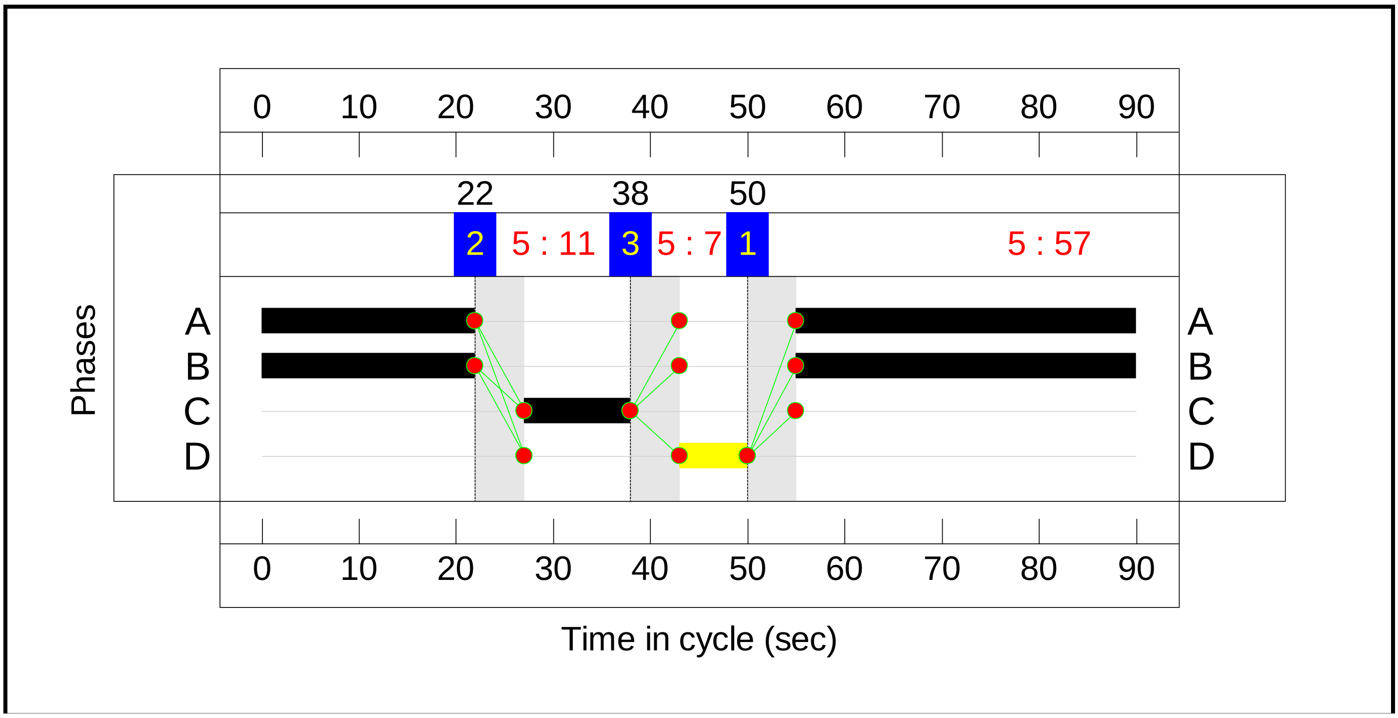

0
10
20
30
40
50
60
70
80
90
58
70
88
5 : 55
3
5 : 7
1
5 : 13
2
Phases
A
B
C
D
E
Time in cycle (sec)

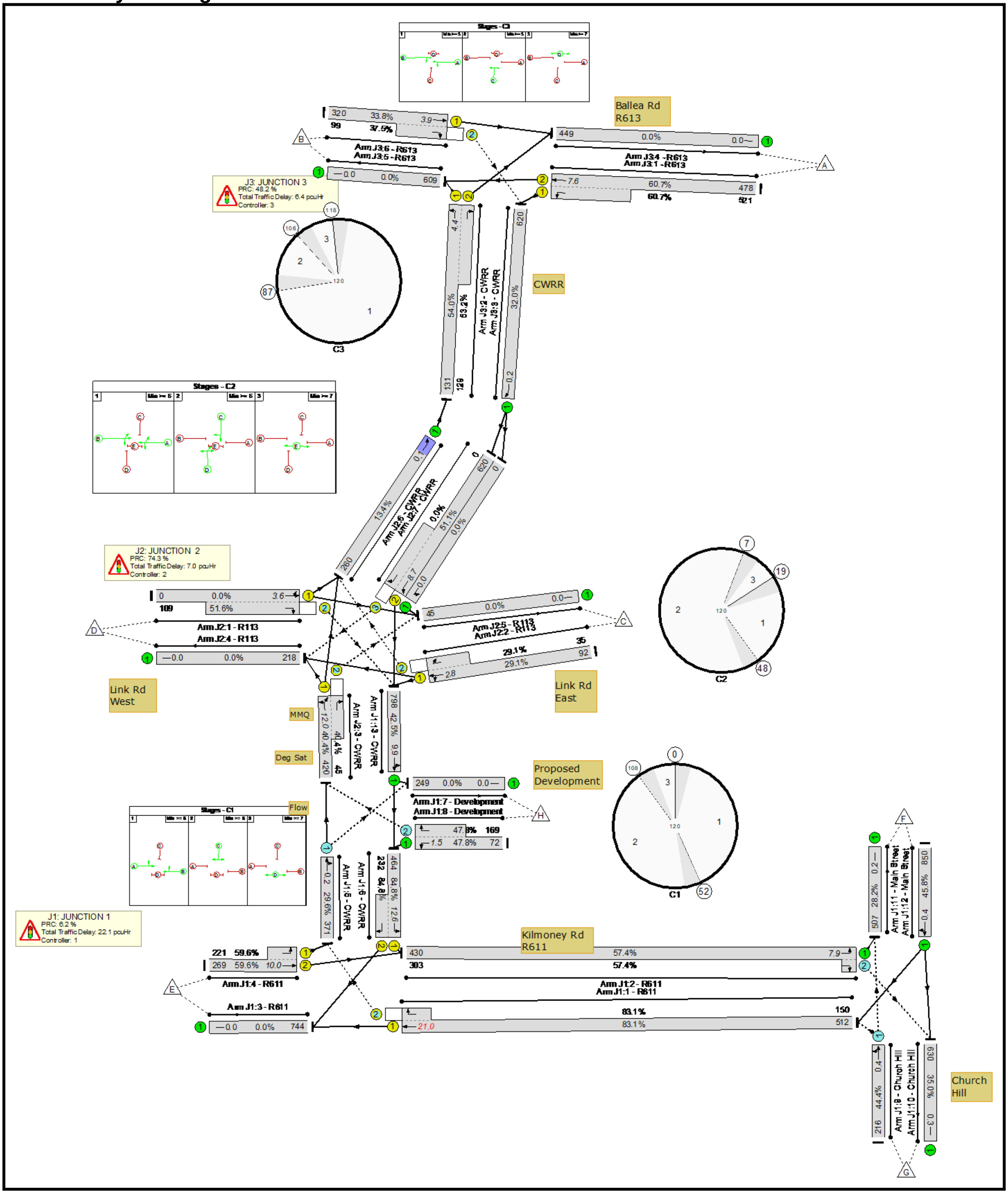
C3


0
10
20
30
40
50
60
70
80
90
22
38
50
2
5 : 11
3
5 : 7
1
5 : 57
Phases
A
B
C
D
Time in cycle (sec)

Basic Results Summary

Scenario 5: 'Scenario 5 PM 2028' (FG5: 'PM 2028', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	-	-	-		-	-	-	-	-	-	**84.8%**	**1201**	**0**	**0**	**35.5**	-	-
J1: JUNCTION 1	-	-	-		-	-	-	-	-	-	**84.8%**	**913**	**0**	**0**	**22.1**	-	-
1/1+1/2	R611 Ahead Right	U+O	C1:B		1	47	-	662	1940:1805	616+180	83.1 : 83.1%	150	0	0	8.5	46.4	21.0
2/1+2/2	R611 Right Left	U+O	-		-	-	-	733	1687:1940	749+528	57.4 : 57.4%	303	0	0	0.9	4.5	7.9
4/2+4/1	R611 Ahead Left	U	C1:A		1	47	-	490	1940:1687	451+371	59.6 : 59.6%	-	-	-	4.3	31.3	10.0
5/1	CWRR Ahead Right	O	-		-	-	-	371	1940	1255	29.6%	75	0	0	0.2	2.0	0.2
6/1+6/2	CWRR Left Right	U	C1:C		1	51	-	696	1687:1805	547+274	84.8 : 84.8%	-	-	-	6.0	30.9	12.6
8/1+8/2	Development Right Left	U+O	-		-	-	-	241	1665:1805	151+354	47.8 : 47.8%	169	0	0	0.5	7.2	1.5
9/1	Church Hill Left Ahead	O	-		-	-	-	216	1940	487	44.4%	216	0	0	0.4	6.6	0.4
10/1	Church Hill	U	-		-	-	-	630	1800	1800	35.0%	-	-	-	0.3	1.5	0.3
11/1	Main Street	U	-		-	-	-	507	1800	1800	28.2%	-	-	-	0.2	1.4	0.2
12/1	Main Street Right Ahead	U	-		-	-	-	850	1854	1854	45.8%	-	-	-	0.4	1.8	0.4
13/1	CWRR Ahead Left	U	-		-	-	-	798	1879	1879	42.5%	-	-	-	0.4	2.0	9.9
J2: JUNCTION 2	-	-	-		-	-	-	-	-	-	**51.6%**	**189**	**0**	**0**	**7.0**	-	-
1/1+1/2	R113 Ahead Left Right	U+O	C2:B		1	24	-	109	1940:2080	0+211	0.0 : 51.6%	109	0	0	1.9	61.7	3.6
2/1+2/2	R113 Ahead Right Left	U+O	C2:A		1	24	-	127	1744:1935	317+120	29.1 : 29.1%	35	0	0	1.6	45.2	2.8
3/1+3/2	CWRR Left Right Ahead	U+O	C2:D		1	74	-	465	1814:1805	1041+111	40.4 : 40.4%	45	0	0	2.0	15.7	12.0
6/1	CWRR Ahead	U	-		-	-	-	260	1940	1940	13.4%	-	-	-	0.1	1.1	0.1

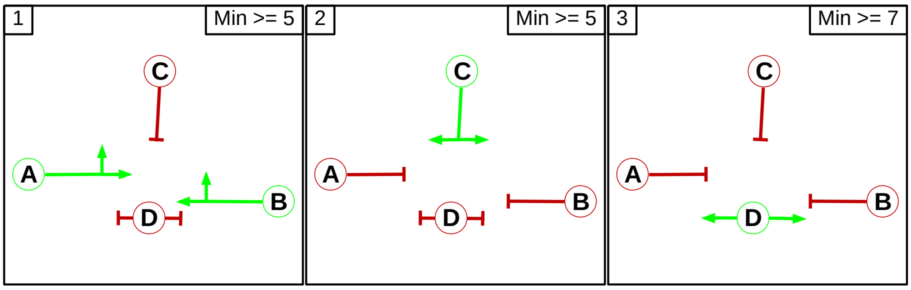
7/1	CWRR Left	U	-		-	-	-	0	1940	1940	0.0%	-	-	-	0.0	0.0	0.0
7/2+7/3	CWRR Right Ahead	U+O	C2:C		1	74	-	620	1940:1940	1213+0	51.1 : 0.0%	0	0	0	1.5	8.5	8.7
J3: JUNCTION 3	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**60.7%**	**99**	**0**	**0**	**6.4**	**-**	**-**
1/2+1/1	R613 Left Ahead	U	C3:A		1	84	-	999	1940:1940	787+858	60.7 : 60.7%	-	-	-	2.7	9.7	7.6
2/1+2/2	CWRR Right Left	U	C3:C		1	14	-	260	1940:1940	242+242	54.0 : 53.2%	-	-	-	2.3	31.9	4.4
3/1	CWRR Ahead	U	-		-	-	-	620	1940	1940	32.0%	-	-	-	0.2	1.4	0.2
6/1+6/2	R613 Right Ahead	U+O	C3:B		1	84	-	419	1940:1940	948+264	33.8 : 37.5%	99	0	0	1.2	10.1	3.9

C1 PRC for Signalled Lanes (%): 6.2 Total Delay for Signalled Lanes (pcuHr): 18.75 Cycle Time (s): 120
C2 PRC for Signalled Lanes (%): 74.3 Total Delay for Signalled Lanes (pcuHr): 6.96 Cycle Time (s): 120
C3 PRC for Signalled Lanes (%): 48.2 Total Delay for Signalled Lanes (pcuHr): 6.16 Cycle Time (s): 120
PRC Over All Lanes (%): 6.2 Total Delay Over All Lanes(pcuHr): 35.50

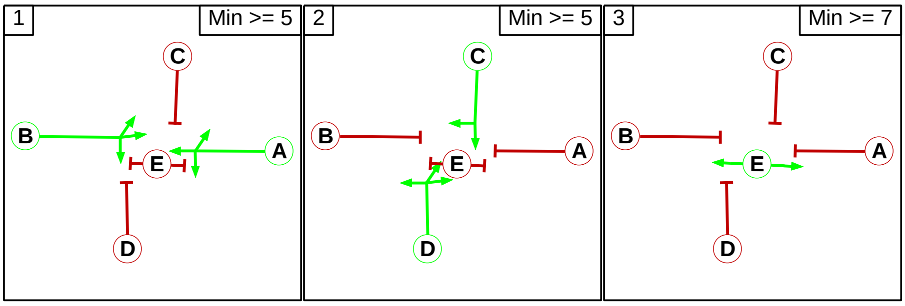
Basic Results Summary

Stage Diagram

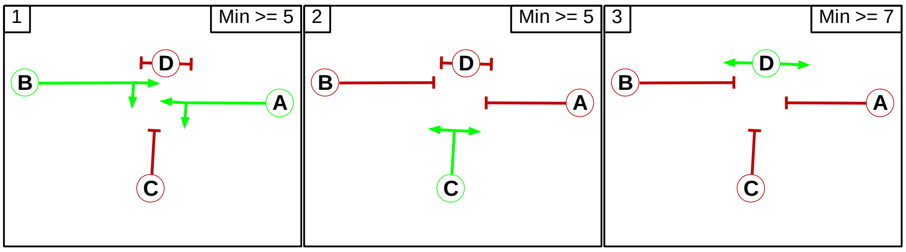
C1



C2

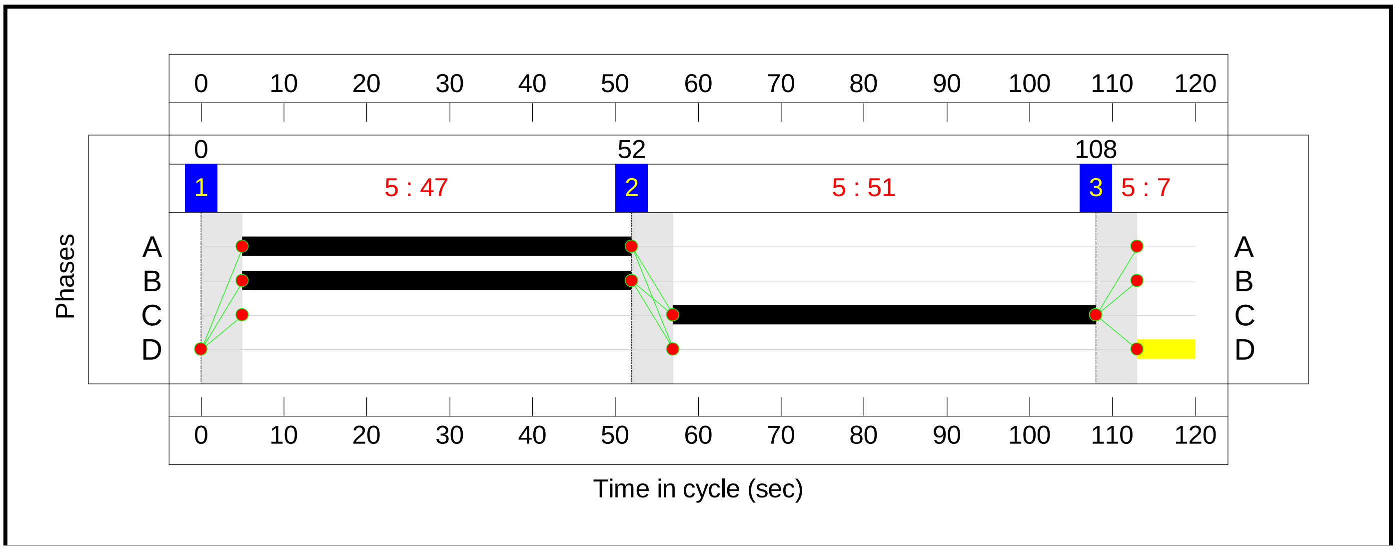


C3



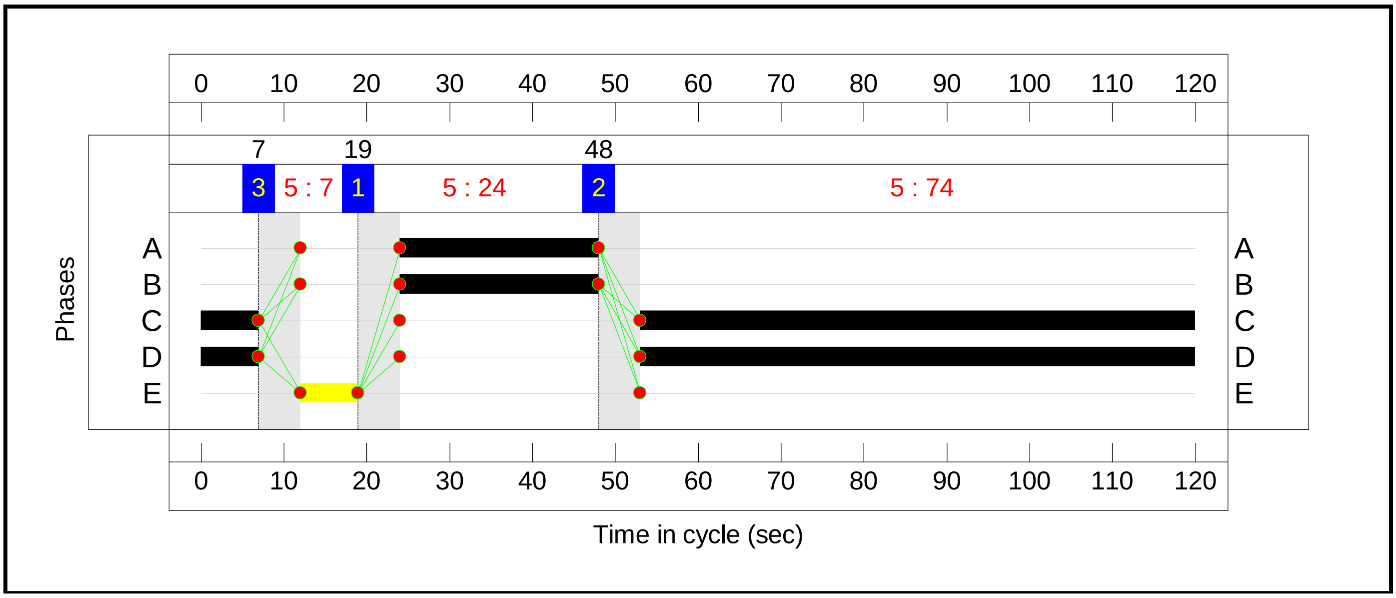
Signal Timings Diagram

C1

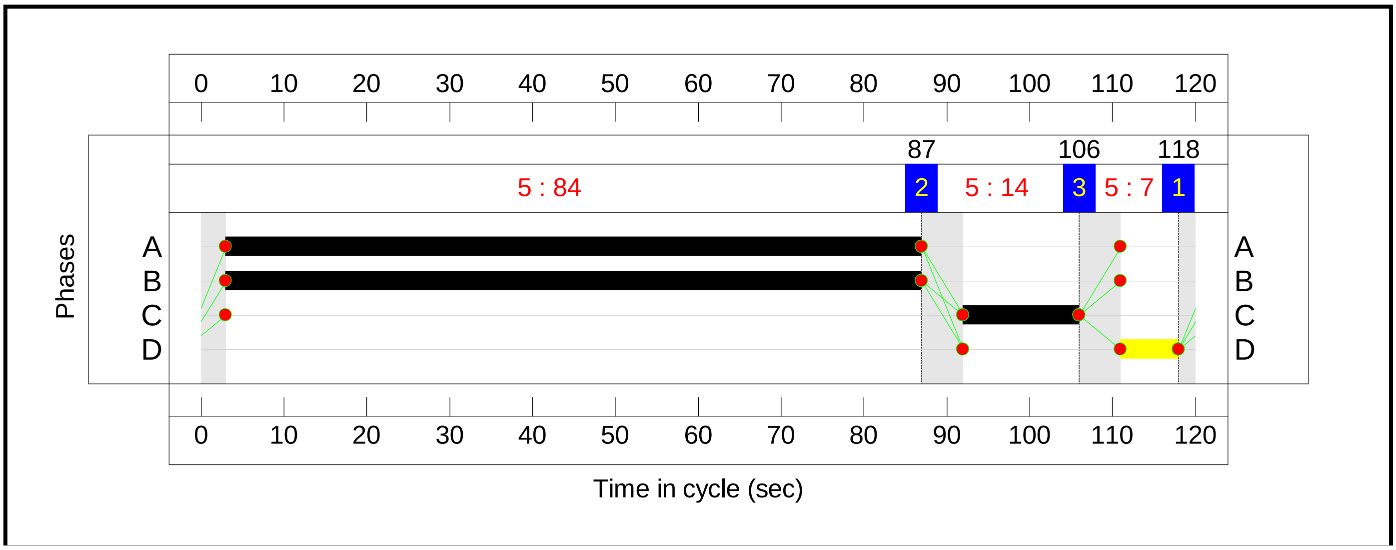


Basic Results Summary

C2



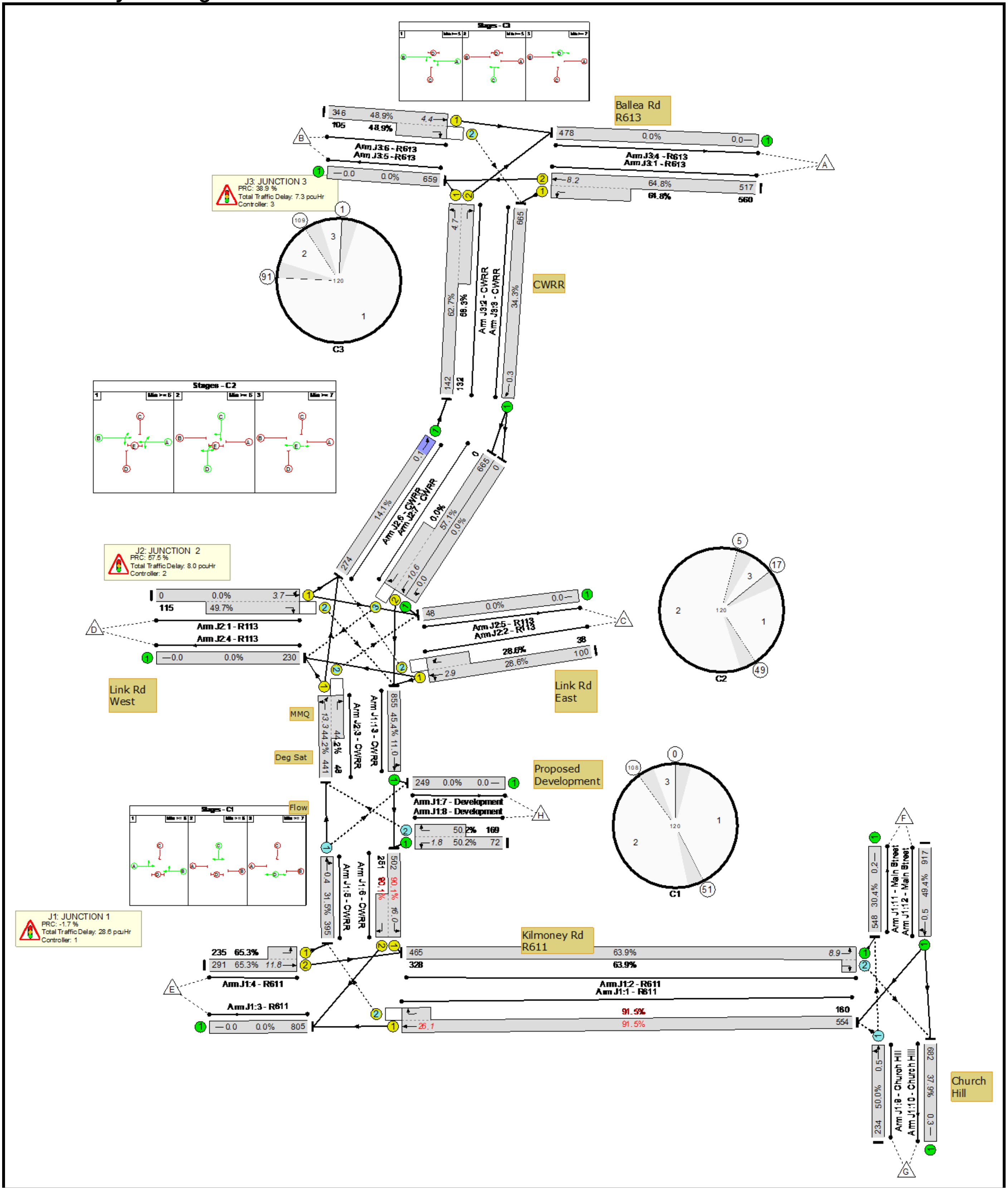
C3



Basic Results Summary

Scenario 6: 'Scenario 6 PM 2038' (FG6: 'PM 2038', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



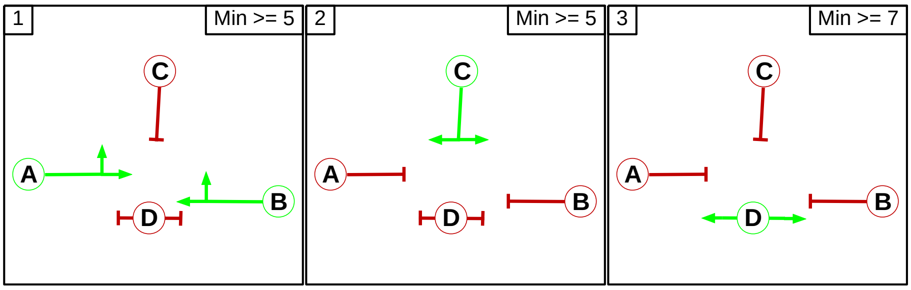
Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**91.5%**	**1272**	**0**	**0**	**43.9**	**-**	**-**
J1: JUNCTION 1	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**91.5%**	**966**	**0**	**0**	**28.6**	**-**	**-**
1/1+1/2	R611 Ahead Right	U+O	C1:B		1	46	-	714	1940:1805	605+175	91.5 : 91.5%	160	0	0	11.9	60.0	26.1
2/1+2/2	R611 Right Left	U+O	-		-	-	-	793	1687:1940	728+513	63.9 : 63.9%	328	0	0	1.2	5.6	8.9
4/2+4/1	R611 Ahead Left	U	C1:A		1	46	-	526	1940:1687	446+360	65.3 : 65.3%	-	-	-	4.9	33.7	11.8
5/1	CWRR Ahead Right	O	-		-	-	-	395	1940	1255	31.5%	75	0	0	0.2	2.1	0.4
6/1+6/2	CWRR Left Right	U	C1:C		1	52	-	753	1687:1805	557+279	90.1 : 90.1%	-	-	-	7.8	37.2	16.0
8/1+8/2	Development Right Left	U+O	-		-	-	-	241	1665:1805	143+337	50.2 : 50.2%	169	0	0	0.5	8.1	1.8
9/1	Church Hill Left Ahead	O	-		-	-	-	234	1940	468	50.0%	234	0	0	0.5	7.6	0.5
10/1	Church Hill	U	-		-	-	-	682	1800	1800	37.9%	-	-	-	0.3	1.6	0.3
11/1	Main Street	U	-		-	-	-	548	1800	1800	30.4%	-	-	-	0.2	1.4	0.2
12/1	Main Street Right Ahead	U	-		-	-	-	917	1855	1855	49.4%	-	-	-	0.5	1.9	0.5
13/1	CWRR Ahead Left	U	-		-	-	-	855	1883	1883	45.4%	-	-	-	0.5	2.0	11.0
J2: JUNCTION 2	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**57.1%**	**201**	**0**	**0**	**8.0**	**-**	**-**
1/1+1/2	R113 Ahead Left Right	U+O	C2:B		1	27	-	115	1940:2080	0+231	0.0 : 49.7%	115	0	0	1.8	57.3	3.7
2/1+2/2	R113 Ahead Right Left	U+O	C2:A		1	27	-	138	1744:1935	349+133	28.6 : 28.6%	38	0	0	1.6	42.3	2.9
3/1+3/2	CWRR Left Right Ahead	U+O	C2:D		1	71	-	489	1814:1805	998+109	44.2 : 44.2%	48	0	0	2.3	17.1	13.3
6/1	CWRR Ahead	U	-		-	-	-	274	1940	1940	14.1%	-	-	-	0.1	1.1	0.1

7/1	CWRR Left	U	-		-	-	-	0	1940	1940	0.0%	-	-	-	0.0	0.0	0.0
7/2+7/3	CWRR Right Ahead	U+O	C2:C		1	71	-	665	1940:1940	1164+0	57.1 : 0.0%	0	0	0	2.1	11.4	10.6
J3: JUNCTION 3	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**64.8%**	**105**	**0**	**0**	**7.3**	**-**	**-**
1/2+1/1	R613 Left Ahead	U	C3:A		1	85	-	1077	1940:1940	798+864	64.8 : 64.8%	-	-	-	2.9	9.7	8.2
2/1+2/2	CWRR Right Left	U	C3:C		1	13	-	274	1940:1940	226+226	62.7 : 58.3%	-	-	-	2.6	34.2	4.7
3/1	CWRR Ahead	U	-		-	-	-	665	1940	1940	34.3%	-	-	-	0.3	1.4	0.3
6/1+6/2	R613 Right Ahead	U+O	C3:B		1	85	-	451	1940:1940	707+215	48.9 : 48.9%	105	0	0	1.5	12.0	4.4

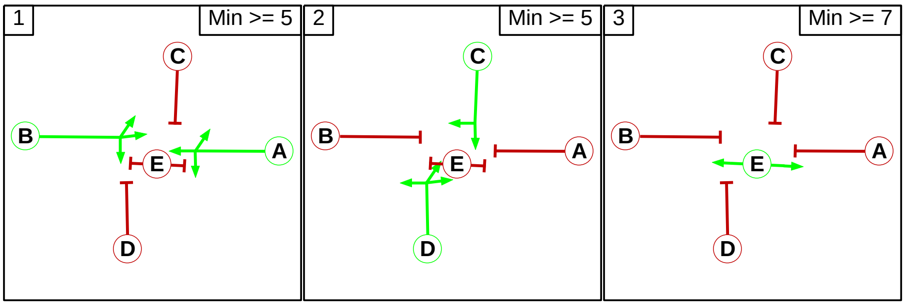
C1	PRC for Signalled Lanes (%):	-1.7	Total Delay for Signalled Lanes (pcuHr):	24.62	Cycle Time (s):	120
C2	PRC for Signalled Lanes (%):	57.5	Total Delay for Signalled Lanes (pcuHr):	7.89	Cycle Time (s):	120
C3	PRC for Signalled Lanes (%):	38.9	Total Delay for Signalled Lanes (pcuHr):	7.02	Cycle Time (s):	120
	PRC Over All Lanes (%):	-1.7	Total Delay Over All Lanes(pcuHr):	43.88		

Stage Diagram

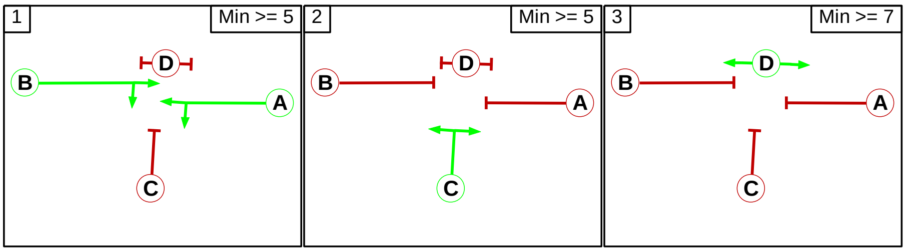
C1



C2

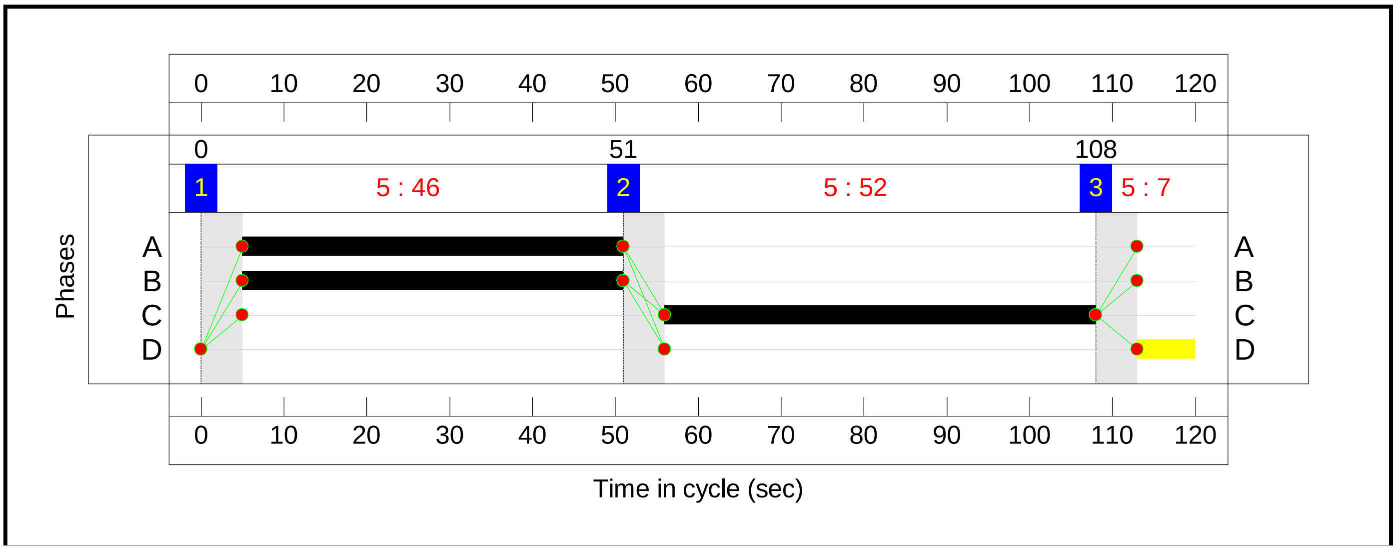


C3

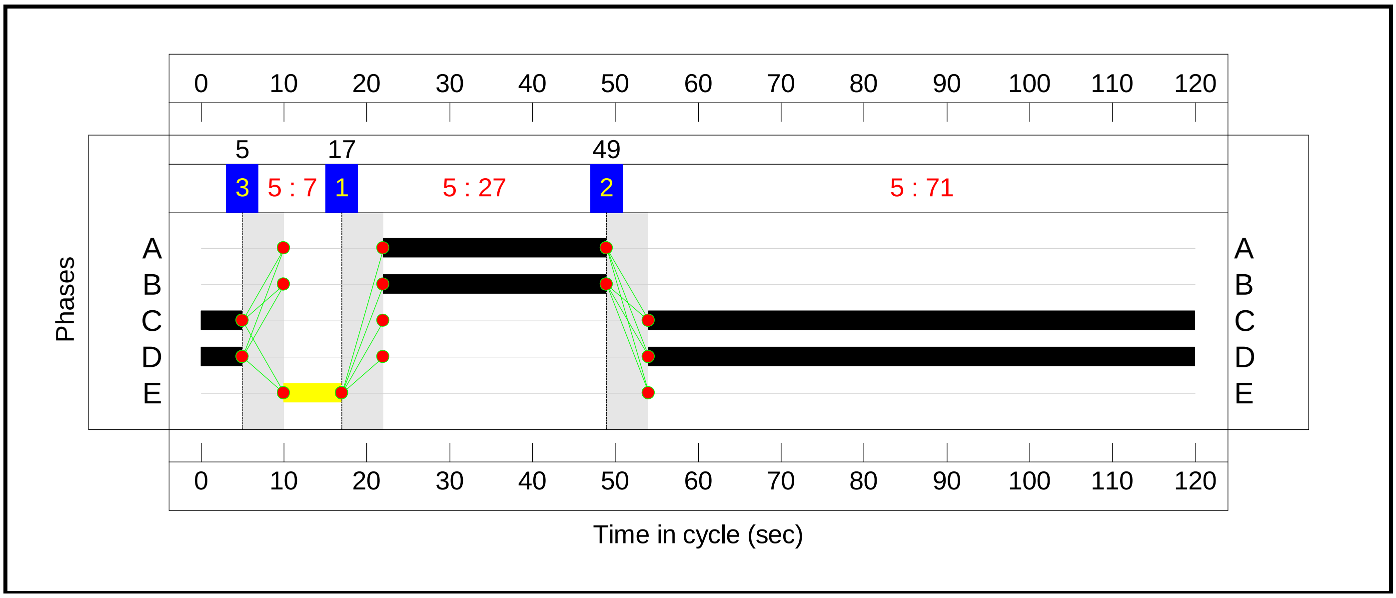


Signal Timings Diagram

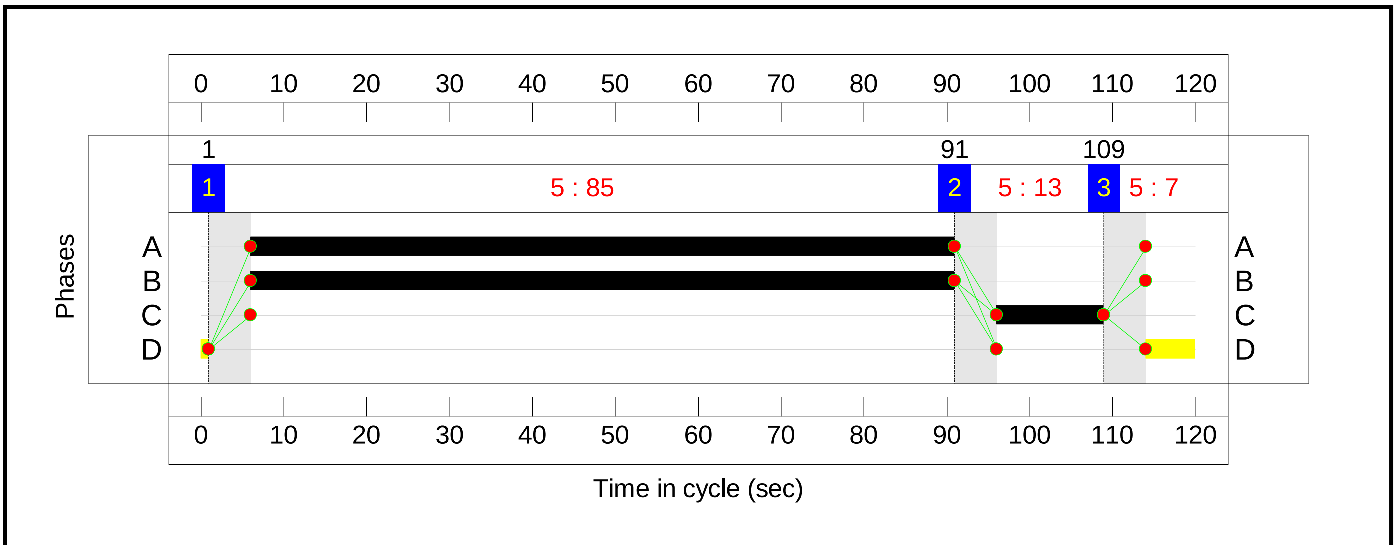
C1



C2


0 10 20 30 40 50 60 70 80 90 100 110 120
5
17
49
3
5 : 7
1
5 : 27
2
5 : 71
Phases
A
B
C
D
E
Time in cycle (sec)

C3


0 10 20 30 40 50 60 70 80 90 100 110 120
1
91
109
1
5 : 85
2
5 : 13
3
5 : 7
Phases
A
B
C
D
Time in cycle (sec)

12.0 Appendix D – Arcady Output

TRANSPORT RESEARCH LABORATORY

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****

CARRIGALINE HOTEL ROUNDABOUT 08:15- 09:15 2018

.INPUT DATA
****

ARM A - TO CORK
ARM B - TO CHURCH ROAD
ARM C - TO CARRIGALINE
ARM D - TO BALLEA ROAD

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.50	7.50	40.00	20.00	30.00	60.0	0.641	29.545
ARM B	3.50	7.50	40.00	20.00	30.00	60.0	0.641	29.545
ARM C	3.50	7.50	20.00	20.00	30.00	60.0	0.608	26.870
ARM D	3.50	7.50	5.00	20.00	30.00	60.0	0.535	20.919

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.
WARNING ARM B: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.GEOMETRIC DELAY DATA

	ARM SPEED (KPH) ENTRY	EXIT	ENTRY ANGLE ENA(DEG)	EXIT ANGLE EXA(DEG)	ENTRY RADIUS R(M)	EXIT RADIUS EXR(M)	SIGHT DISTANCE SD(M)	ANGLE BETWEEN CURRENT AND NEXT ARM (DEG)
ARM A	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM B	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM C	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM D	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0

	DISTANCE ENTRY TO CENTRE OF JUNCTION (METRES)	DISTANCE CENTRE OF JUNCTION TO EXIT (METRES)
ARM A	39.0	39.0
ARM B	39.0	39.0
ARM C	39.0	39.0
ARM D	39.0	39.0

DISTANCES THROUGH JUNCTION

FROM/TO	ARM A	ARM B	ARM C	ARM D
ARM A	200.0	50.0	100.0	150.0
ARM B	150.0	200.0	50.0	100.0
ARM C	100.0	150.0	200.0	50.0
ARM D	50.0	100.0	150.0	200.0

WARNING Geometric delays have been calculated and the
roundabout is non-circular or non-symetrical
(AG24 REF 8.4.2(v))

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

FLOW DATA USED IN THE ESTIMATION OF TURNING PROPORTIONS (VEH/MIN) -

TIME INTERVAL		ARM A	ARM B	ARM C	ARM D
08.00 - 08.15					
	ENTRY	9.3	5.7	10.5	5.8
	EXIT	9.8	7.6	6.8	7.0
08.15 - 08.30					
	ENTRY	9.3	5.7	10.5	5.8
	EXIT	9.8	7.6	6.8	7.0
08.30 - 08.45					
	ENTRY	9.3	5.7	10.5	5.8
	EXIT	9.8	7.6	6.8	7.0
08.45 - 09.00					
	ENTRY	9.3	5.7	10.5	5.8
	EXIT	9.8	7.6	6.8	7.0

TIME	FROM/TO	TURNING PROPORTIONS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C	ARM D
08.00 - 09.00					
	ARM A	0.000	0.233	0.559	0.208
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.242	0.000	0.142	0.616
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.683	0.167	0.000	0.150
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.226	0.642	0.133	0.000
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM ENTRY AND EXIT FLOWS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15								
ARM A	9.30	22.91	0.406		0.0	0.7	9.9	12.3
ARM B	5.67	21.82	0.260		0.0	0.3	5.1	8.5
ARM C	10.48	20.31	0.516		0.0	1.1	15.1	14.2
ARM D	5.77	13.56	0.426		0.0	0.7	10.5	6.9

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.15-08.30								
ARM A	9.30	22.87	0.407		0.7	0.7	10.2	12.3
ARM B	5.67	21.80	0.260		0.3	0.4	5.2	8.5
ARM C	10.48	20.29	0.516		1.1	1.1	15.8	14.3
ARM D	5.77	13.52	0.427		0.7	0.7	11.0	6.9

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.30-08.45								
ARM A	9.30	22.87	0.407		0.7	0.7	10.2	12.3
ARM B	5.67	21.80	0.260		0.4	0.4	5.3	8.5
ARM C	10.48	20.29	0.516		1.1	1.1	15.9	14.3
ARM D	5.77	13.52	0.427		0.7	0.7	11.1	6.9

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.45-09.00								
ARM A	9.30	22.87	0.407		0.7	0.7	10.3	12.3
ARM B	5.67	21.80	0.260		0.4	0.4	5.3	8.5
ARM C	10.48	20.29	0.516		1.1	1.1	16.0	14.3
ARM D	5.77	13.52	0.427		0.7	0.7	11.1	6.9

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.7	*
08.30	0.7	*
08.45	0.7	*
09.00	0.7	*

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
08.15	0.3
08.30	0.4
08.45	0.4
09.00	0.4

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.1	*
08.30	1.1	*
08.45	1.1	*
09.00	1.1	*

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.7	*
08.30	0.7	*
08.45	0.7	*
09.00	0.7	*

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * * DELAY *		* INCLUSIVE QUEUEING * * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	558.0	558.0	40.6	0.07	40.6	0.07
B	340.2	340.2	20.9	0.06	20.9	0.06
C	628.8	628.8	62.8	0.10	62.8	0.10
D	346.2	346.2	43.7	0.13	43.7	0.13
ALL	1873.2	1873.2	167.9	0.09	168.0	0.09

INCLUSIVE GEOMETRIC DELAY

ARM	TOTAL DEMAND		GEOMETRIC DELAY BY TURN (VEH MIN) (GEOMETRIC DELAY PER LIGHT VEHICLE (SEC))				TOTAL GEOM. DELAY
	(VEH)	(VEH/H)	ARM A	ARM B	ARM C	ARM D	VEH MIN
A	558.0	558.0	0.0	0.0	26.1	23.2	49.4
			(18.7)	(0.0)	(5.0)	(11.8)	
B	340.2	340.2	16.4	0.0	0.0	17.6	34.0
			(11.8)	(18.7)	(0.0)	(5.0)	
C	628.8	628.8	36.0	21.0	0.0	0.0	57.0
			(5.0)	(11.8)	(18.7)	(0.0)	
D	346.2	346.2	0.0	18.6	9.2	0.0	27.8
			(0.0)	(5.0)	(11.8)	(18.7)	
ALL	1873.2	1873.2					168.2

END OF JOB

****** ARCADY 5 run completed.

TRANSPORT RESEARCH LABORATORY

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.0 (APR 2000)

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
CARRIGALINE HOTEL ROUNDABOUT 08:15- 09:15 2023

.INPUT DATA
****
ARM A - TO CORK
ARM B - TO CHURCH ROAD
ARM C - TO CACRRIGALINE
ARM D - TO BALLEA ROAD

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.50	7.50	35.00	20.00	30.00	45.0	0.672	30.776
ARM B	3.50	7.50	35.00	20.00	30.00	60.0	0.635	29.086
ARM C	3.50	7.50	15.00	20.00	30.00	45.0	0.626	27.087
ARM D	3.50	7.50	5.00	20.00	30.00	30.0	0.597	23.349

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.
WARNING ARM B: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.GEOMETRIC DELAY DATA

	ARM SPEED (KPH) ENTRY	EXIT	ENTRY ANGLE ENA(DEG)	EXIT ANGLE EXA(DEG)	ENTRY RADIUS R(M)	EXIT RADIUS EXR(M)	SIGHT DISTANCE SD(M)	ANGLE BETWEEN CURRENT AND NEXT ARM (DEG)
ARM A	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM B	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM C	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM D	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0

	DISTANCE ENTRY TO CENTRE OF JUNCTION (METRES)	DISTANCE CENTRE OF JUNCTION TO EXIT (METRES)
ARM A	39.0	39.0
ARM B	39.0	39.0
ARM C	39.0	39.0
ARM D	39.0	39.0

DISTANCES THROUGH JUNCTION

FROM/TO	ARM A	ARM B	ARM C	ARM D
ARM A	200.0	50.0	100.0	150.0
ARM B	150.0	200.0	50.0	100.0
ARM C	100.0	150.0	200.0	50.0
ARM D	50.0	100.0	150.0	200.0

WARNING Geometric delays have been calculated and the
roundabout is non-circular or non-symetrical
(AG24 REF 8.4.2(v))

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

FLOW DATA USED IN THE ESTIMATION OF TURNING PROPORTIONS (VEH/MIN) -

TIME INTERVAL	ARM A	ARM B	ARM C	ARM D

08.00 - 08.15					
	ENTRY	10.7	6.7	11.5	4.2
	EXIT	10.9	9.7	0.0	12.4
08.15 - 08.30					
	ENTRY	10.7	6.7	11.5	4.2
	EXIT	10.9	9.7	0.0	12.4
08.30 - 08.45					
	ENTRY	10.7	6.7	11.5	4.2
	EXIT	10.9	9.7	0.0	12.4
08.45 - 09.00					
	ENTRY	10.7	6.7	11.5	4.2
	EXIT	10.9	9.7	0.0	12.4

TIME	FROM/TO	TURNING PROPORTIONS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C	ARM D
08.00 - 09.00					
	ARM A	0.000	0.474	0.000	0.526
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.267	0.000	0.000	0.733
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.690	0.147	0.000	0.163
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.288	0.712	0.000	0.000
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM ENTRY AND EXIT FLOWS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15								
ARM A	10.68	24.88	0.429		0.0	0.7	10.9	16.7
ARM B	6.65	22.89	0.290		0.0	0.4	6.0	11.4
ARM C	11.48	16.98	0.676		0.0	2.0	27.8	14.8
ARM D	4.16	14.51	0.287		0.0	0.4	5.8	3.7

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.15-08.30								
ARM A	10.68	24.85	0.430		0.7	0.8	11.2	16.8
ARM B	6.65	22.88	0.291		0.4	0.4	6.1	11.5
ARM C	11.48	16.94	0.678		2.0	2.1	30.6	15.0
ARM D	4.16	14.44	0.288		0.4	0.4	6.0	3.7

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.30-08.45								
ARM A	10.70	24.85	0.431		0.8	0.8	11.3	16.9
ARM B	6.65	22.87	0.291		0.4	0.4	6.1	11.5
ARM C	11.48	16.94	0.678		2.1	2.1	31.0	15.0
ARM D	4.16	14.43	0.288		0.4	0.4	6.0	3.7

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.45-09.00								
ARM A	10.68	24.85	0.430		0.8	0.8	11.3	16.8
ARM B	6.65	22.88	0.291		0.4	0.4	6.1	11.5
ARM C	11.48	16.94	0.678		2.1	2.1	31.2	15.0
ARM D	4.16	14.43	0.288		0.4	0.4	6.1	3.7

QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.7	*
08.30	0.8	*
08.45	0.8	*
09.00	0.8	*

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
08.15	0.4
08.30	0.4
08.45	0.4
09.00	0.4

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
08.15	2.0 **
08.30	2.1 **
08.45	2.1 **
09.00	2.1 **

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
08.15	0.4
08.30	0.4
08.45	0.4
09.00	0.4

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * * DELAY *		* INCLUSIVE QUEUEING * * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	641.1	641.1	44.7	0.07	44.7	0.07
B	399.0	399.0	24.4	0.06	24.4	0.06
C	688.8	688.8	120.7	0.18	120.8	0.18
D	249.6	249.6	23.9	0.10	23.9	0.10
ALL	1978.5	1978.5	213.6	0.11	213.7	0.11

INCLUSIVE GEOMETRIC DELAY

ARM	TOTAL DEMAND		GEOMETRIC DELAY BY TURN (VEH MIN) (GEOMETRIC DELAY PER LIGHT VEHICLE (SEC))				TOTAL GEOM. DELAY
	(VEH)	(VEH/H)	ARM A	ARM B	ARM C	ARM D	VEH MIN
A	641.1	641.1	0.0 (18.7)	0.0 (0.0)	0.0 (5.0)	67.3 (11.8)	67.3
B	399.0	399.0	21.3 (11.8)	0.0 (18.7)	0.0 (0.0)	24.5 (5.0)	45.8
C	688.8	688.8	39.8 (5.0)	20.3 (11.8)	0.0 (18.7)	0.0 (0.0)	60.1
D	249.6	249.6	0.0 (0.0)	14.9 (5.0)	0.0 (11.8)	0.0 (18.7)	14.9
ALL	1978.5	1978.5					188.1

WARNING Arm A:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm B:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm C:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm D:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

TRANSPORT RESEARCH LABORATORY

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
CARRIGALINE HOTEL ROUNDABOUT 08:15- 09:15 2028

.INPUT DATA
****
ARM A - TO CORK
ARM B - TO CHURCH ROAD
ARM C - TO CACRRIGALINE
ARM D - TO BALLEA ROAD

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.50	7.50	35.00	20.00	30.00	45.0	0.672	30.776
ARM B	3.50	7.50	35.00	20.00	30.00	60.0	0.635	29.086
ARM C	3.50	7.50	15.00	20.00	30.00	45.0	0.626	27.087
ARM D	3.50	7.50	5.00	20.00	30.00	30.0	0.597	23.349

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.
WARNING ARM B: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.GEOMETRIC DELAY DATA

	ARM SPEED (KPH) ENTRY	EXIT	ENTRY ANGLE ENA(DEG)	EXIT ANGLE EXA(DEG)	ENTRY RADIUS R(M)	EXIT RADIUS EXR(M)	SIGHT DISTANCE SD(M)	ANGLE BETWEEN CURRENT AND NEXT ARM (DEG)
ARM A	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM B	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM C	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM D	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0

	DISTANCE ENTRY TO CENTRE OF JUNCTION (METRES)	DISTANCE CENTRE OF JUNCTION TO EXIT (METRES)
ARM A	39.0	39.0
ARM B	39.0	39.0
ARM C	39.0	39.0
ARM D	39.0	39.0

DISTANCES THROUGH JUNCTION

FROM/TO	ARM A	ARM B	ARM C	ARM D
ARM A	200.0	50.0	100.0	150.0
ARM B	150.0	200.0	50.0	100.0
ARM C	100.0	150.0	200.0	50.0
ARM D	50.0	100.0	150.0	200.0

WARNING Geometric delays have been calculated and the
roundabout is non-circular or non-symetrical
(AG24 REF 8.4.2(v))

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

FLOW DATA USED IN THE ESTIMATION OF TURNING PROPORTIONS (VEH/MIN) -

TIME INTERVAL	ARM A	ARM B	ARM C	ARM D

TIME		ARM A	ARM B	ARM C	ARM D
08.00 - 08.15					
	ENTRY	11.5	7.2	12.4	4.4
	EXIT	11.7	10.5	0.0	13.3
08.15 - 08.30					
	ENTRY	11.5	7.2	12.4	4.4
	EXIT	11.7	10.5	0.0	13.3
08.30 - 08.45					
	ENTRY	11.5	7.2	12.4	4.4
	EXIT	11.7	10.5	0.0	13.3
08.45 - 09.00					
	ENTRY	11.5	7.2	12.4	4.4
	EXIT	11.7	10.5	0.0	13.3

	TURNING PROPORTIONS (PERCENTAGE OF H.V.S)				
TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D
08.00 - 09.00	ARM A	0.000	0.477	0.000	0.523
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.268	0.000	0.000	0.732
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.690	0.148	0.000	0.162
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.287	0.713	0.000	0.000
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM ENTRY AND EXIT FLOWS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15								
ARM A	11.47	24.65	0.465		0.0	0.9	12.5	17.9
ARM B	7.16	22.65	0.316		0.0	0.5	6.7	12.3
ARM C	12.37	16.42	0.753		0.0	2.9	38.4	16.0
ARM D	4.45	14.00	0.318		0.0	0.5	6.7	4.0

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.15-08.30								
ARM A	11.47	24.62	0.466		0.9	0.9	13.0	18.0
ARM B	7.16	22.63	0.316		0.5	0.5	6.9	12.3
ARM C	12.37	16.38	0.755		2.9	3.0	44.1	16.2
ARM D	4.45	13.90	0.320		0.5	0.5	7.0	4.0

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.30-08.45								
ARM A	11.47	24.62	0.466		0.9	0.9	13.0	18.0
ARM B	7.16	22.63	0.316		0.5	0.5	6.9	12.3
ARM C	12.37	16.38	0.755		3.0	3.0	45.0	16.2
ARM D	4.45	13.90	0.320		0.5	0.5	7.0	4.0

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.45-09.00								
ARM A	11.47	24.62	0.466		0.9	0.9	13.0	18.0
ARM B	7.16	22.63	0.316		0.5	0.5	6.9	12.3
ARM C	12.37	16.38	0.755		3.0	3.0	45.4	16.2
ARM D	4.45	13.90	0.320		0.5	0.5	7.0	4.0

QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.9	*
08.30	0.9	*
08.45	0.9	*
09.00	0.9	*

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
08.15	0.5
08.30	0.5
08.45	0.5
09.00	0.5

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	2.9	***
08.30	3.0	***
08.45	3.0	***
09.00	3.0	***

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
08.15	0.5
08.30	0.5
08.45	0.5
09.00	0.5

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * * DELAY *		* INCLUSIVE QUEUEING * * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	688.2	688.2	51.6	0.07	51.6	0.07
B	429.6	429.6	27.5	0.06	27.5	0.06
C	742.2	742.2	172.8	0.23	173.1	0.23
D	267.0	267.0	27.7	0.10	27.7	0.10
ALL	2127.0	2127.0	279.6	0.13	279.9	0.13

INCLUSIVE GEOMETRIC DELAY

ARM	TOTAL DEMAND		GEOMETRIC DELAY BY TURN (VEH MIN) (GEOMETRIC DELAY PER LIGHT VEHICLE (SEC))				TOTAL GEOM. DELAY
	(VEH)	(VEH/H)	ARM A	ARM B	ARM C	ARM D	VEH MIN
A	688.2	688.2	0.0	0.0	0.0	72.0	72.0
			(18.7)	(0.0)	(5.0)	(11.8)	
B	429.6	429.6	23.0	0.0	0.0	26.3	49.4
			(11.8)	(18.7)	(0.0)	(5.0)	
C	742.2	742.2	42.9	21.9	0.0	0.0	64.8
			(5.0)	(11.8)	(18.7)	(0.0)	
D	267.0	267.0	0.0	16.0	0.0	0.0	16.0
			(0.0)	(5.0)	(11.8)	(18.7)	
ALL	2127.0	2127.0					202.1

WARNING Arm A:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm B:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm C:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm D:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))

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END OF JOB

****** ARCADY 5 run completed.

TRANSPORT RESEARCH LABORATORY

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
CARRIGALINE HOTEL ROUNDABOUT 08:15- 09:15 2038

.INPUT DATA
****
ARM A - TO CORK
ARM B - TO CHURCH ROAD
ARM C - TO CACRRIGALINE
ARM D - TO BALLEA ROAD

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.50	7.50	35.00	20.00	30.00	45.0	0.672	30.776
ARM B	3.50	7.50	35.00	20.00	30.00	60.0	0.635	29.086
ARM C	3.50	7.50	15.00	20.00	30.00	45.0	0.626	27.087
ARM D	3.50	7.50	5.00	20.00	30.00	30.0	0.597	23.349

V = approach half-width   L = effective flare length   D = inscribed circle diameter
E = entry width   R = entry radius   PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.
WARNING ARM B: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.GEOMETRIC DELAY DATA

	ARM SPEED (KPH) ENTRY	ARM SPEED (KPH) EXIT	ENTRY ANGLE ENA(DEG)	EXIT ANGLE EXA(DEG)	ENTRY RADIUS R(M)	EXIT RADIUS EXR(M)	SIGHT DISTANCE SD(M)	ANGLE BETWEEN CURRENT AND NEXT ARM (DEG)
ARM A	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM B	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM C	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM D	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0

	DISTANCE ENTRY TO CENTRE OF JUNCTION (METRES)	DISTANCE CENTRE OF JUNCTION TO EXIT (METRES)
ARM A	39.0	39.0
ARM B	39.0	39.0
ARM C	39.0	39.0
ARM D	39.0	39.0

DISTANCES THROUGH JUNCTION

FROM/TO	ARM A	ARM B	ARM C	ARM D
ARM A	200.0	50.0	100.0	150.0
ARM B	150.0	200.0	50.0	100.0
ARM C	100.0	150.0	200.0	50.0
ARM D	50.0	100.0	150.0	200.0

WARNING Geometric delays have been calculated and the
roundabout is non-circular or non-symetrical
(AG24 REF 8.4.2(v))

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

FLOW DATA USED IN THE ESTIMATION OF TURNING PROPORTIONS (VEH/MIN) -

TIME INTERVAL	ARM A	ARM B	ARM C	ARM D

TIME					
08.00 - 08.15					
	ENTRY	12.4	7.7	13.4	4.8
	EXIT	12.7	11.3	0.0	14.3
08.15 - 08.30					
	ENTRY	12.4	7.7	13.4	4.8
	EXIT	12.7	11.3	0.0	14.3
08.30 - 08.45					
	ENTRY	12.4	7.3	13.4	4.8
	EXIT	12.7	11.3	0.0	14.3
08.45 - 09.00					
	ENTRY	9.3	7.7	13.4	4.8
	EXIT	12.7	11.3	0.0	14.3

		TURNING PROPORTIONS (PERCENTAGE OF H.V.S)			
TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D
08.00 - 09.00					
	ARM A	0.000	0.479	0.000	0.521
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.260	0.000	0.000	0.740
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.679	0.154	0.000	0.167
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.276	0.724	0.000	0.000
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM ENTRY AND EXIT FLOWS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15								
ARM A	12.35	24.34	0.507		0.0	1.0	14.7	19.2
ARM B	7.73	22.38	0.345		0.0	0.5	7.7	13.1
ARM C	13.36	15.79	0.846		0.0	4.7	59.2	17.1
ARM D	4.76	13.55	0.351		0.0	0.5	7.7	4.3

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.15-08.30								
ARM A	12.35	24.29	0.508		1.0	1.0	15.4	19.3
ARM B	7.73	22.36	0.346		0.5	0.5	7.9	13.2
ARM C	13.36	15.75	0.848		4.7	5.1	74.6	17.5
ARM D	4.76	13.40	0.355		0.5	0.5	8.1	4.3

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.30-08.45								
ARM A	12.35	24.29	0.509		1.0	1.0	15.4	19.3
ARM B	7.35	22.36	0.329		0.5	0.5	7.5	12.6
ARM C	13.36	15.99	0.836		5.1	5.1	76.9	17.6
ARM D	4.76	13.45	0.354		0.5	0.5	8.2	4.3

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.45-09.00								
ARM A	9.30	24.28	0.383		1.0	0.6	9.6	14.6
ARM B	7.73	23.36	0.331		0.5	0.5	7.4	13.2
ARM C	13.36	16.74	0.798		5.1	4.2	67.3	17.6
ARM D	4.76	13.36	0.356		0.5	0.5	8.2	4.3

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.0	*
08.30	1.0	*
08.45	1.0	*
09.00	0.6	*

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.5	*
08.30	0.5	*
08.45	0.5	
09.00	0.5	

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	4.7	*****
08.30	5.1	*****
08.45	5.1	*****
09.00	4.2	****

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.5	*
08.30	0.5	*
08.45	0.5	*
09.00	0.5	*

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * * DELAY *		* INCLUSIVE QUEUEING * * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	695.3	695.3	55.1	0.08	55.1	0.08
B	458.1	458.1	30.4	0.07	30.4	0.07
C	801.6	801.6	278.1	0.35	278.6	0.35
D	285.6	285.6	32.3	0.11	32.3	0.11
ALL	2240.6	2240.6	395.9	0.18	396.4	0.18

INCLUSIVE GEOMETRIC DELAY

ARM	TOTAL DEMAND		GEOMETRIC DELAY BY TURN (VEH MIN) (GEOMETRIC DELAY PER LIGHT VEHICLE (SEC))				TOTAL GEOM. DELAY
	(VEH)	(VEH/H)	ARM A	ARM B	ARM C	ARM D	VEH MIN
A	695.3	695.3	0.0	0.0	0.0	72.4	72.4
			(18.7)	(0.0)	(5.0)	(11.8)	
B	458.1	458.1	23.8	0.0	0.0	28.4	52.2
			(11.8)	(18.7)	(0.0)	(5.0)	
C	801.6	801.6	45.6	24.6	0.0	0.0	70.2
			(5.0)	(11.8)	(18.7)	(0.0)	
D	285.6	285.6	0.0	17.3	0.0	0.0	17.3
			(0.0)	(5.0)	(11.8)	(18.7)	
ALL	2240.6	2240.6					212.2

WARNING Arm A:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm B:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm C:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm D:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

TRANSPORT RESEARCH LABORATORY

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
CARRIGALINE HOTEL ROUNDABOUT 17:15- 18:15 2018

.INPUT DATA
****
ARM A - TO CORK
ARM B - TO CHURCH ROAD
ARM C - TO CARRIGALINE
ARM D - TO BALLEA ROAD

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.00	7.50	35.00	12.00	30.00	60.0	0.599	26.979
ARM B	3.00	7.50	35.00	15.00	30.00	60.0	0.610	27.488
ARM C	3.00	7.50	15.00	20.00	30.00	60.0	0.572	23.960
ARM D	3.00	7.50	5.00	20.00	30.00	60.0	0.509	18.820

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.
WARNING ARM B: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.GEOMETRIC DELAY DATA

	ARM SPEED (KPH) ENTRY	EXIT	ENTRY ANGLE ENA(DEG)	EXIT ANGLE EXA(DEG)	ENTRY RADIUS R(M)	EXIT RADIUS EXR(M)	SIGHT DISTANCE SD(M)	ANGLE BETWEEN CURRENT AND NEXT ARM (DEG)
ARM A	30.0	30.0	60.0	60.0	12.0	30.0	50.0	90.0
ARM B	30.0	30.0	60.0	60.0	15.0	30.0	50.0	90.0
ARM C	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM D	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0

	DISTANCE ENTRY TO CENTRE OF JUNCTION (METRES)	DISTANCE CENTRE OF JUNCTION TO EXIT (METRES)
ARM A	39.0	39.0
ARM B	39.0	39.0
ARM C	39.0	39.0
ARM D	39.0	39.0

DISTANCES THROUGH JUNCTION

FROM/TO	ARM A	ARM B	ARM C	ARM D
ARM A	200.0	50.0	100.0	150.0
ARM B	150.0	200.0	50.0	100.0
ARM C	100.0	150.0	200.0	50.0
ARM D	50.0	100.0	150.0	200.0

WARNING Geometric delays have been calculated and the
roundabout is non-circular or non-symetrical
(AG24 REF 8.4.2(v))

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 17.15 AND ENDS 18.15
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

FLOW DATA USED IN THE ESTIMATION OF TURNING PROPORTIONS (VEH/MIN) -

TIME INTERVAL		ARM A	ARM B	ARM C	ARM D
17.15 - 17.30					
	ENTRY	12.0	5.2	9.9	7.8
	EXIT	10.9	6.2	9.2	8.6
17.30 - 17.45					
	ENTRY	12.0	5.2	9.9	7.8
	EXIT	10.9	6.2	9.2	8.6
17.45 - 18.00					
	ENTRY	12.0	5.2	9.9	7.8
	EXIT	10.9	6.2	9.2	8.6
18.00 - 18.15					
	ENTRY	12.0	5.2	9.9	7.8
	EXIT	10.9	6.2	9.2	8.6

		TURNING PROPORTIONS (PERCENTAGE OF H.V.S)			
TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D
17.15 - 18.15					
	ARM A	0.000	0.130	0.592	0.278
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.218	0.000	0.121	0.660
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.723	0.088	0.000	0.188
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.336	0.477	0.187	0.000
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM ENTRY AND EXIT FLOWS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.15-17.30								
ARM A	11.96	20.96	0.571		0.0	1.3	18.6	18.7
ARM B	5.24	17.82	0.294		0.0	0.4	6.0	7.7
ARM C	9.91	17.28	0.574		0.0	1.3	18.6	11.5
ARM D	7.78	12.47	0.624		0.0	1.6	22.0	8.9

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.30-17.45								
ARM A	11.96	20.91	0.572		1.3	1.3	19.8	18.9
ARM B	5.24	17.76	0.295		0.4	0.4	6.2	7.8
ARM C	9.91	17.25	0.574		1.3	1.3	19.9	11.6
ARM D	7.78	12.44	0.626		1.6	1.6	24.3	9.0

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.45-18.00								
ARM A	11.96	20.91	0.572		1.3	1.3	19.9	18.9
ARM B	5.24	17.76	0.295		0.4	0.4	6.3	7.8
ARM C	9.91	17.25	0.575		1.3	1.3	20.1	11.6
ARM D	7.78	12.43	0.626		1.6	1.6	24.7	9.0

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
18.00-18.15								
ARM A	11.96	20.91	0.572		1.3	1.3	19.9	18.9
ARM B	5.24	17.76	0.295		0.4	0.4	6.3	7.8
ARM C	9.91	17.25	0.575		1.3	1.3	20.1	11.6
ARM D	7.78	12.43	0.626		1.6	1.7	24.8	9.0

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.30	1.3	*
17.45	1.3	*
18.00	1.3	*
18.15	1.3	*

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
17.30	0.4
17.45	0.4
18.00	0.4
18.15	0.4

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.30	1.3	*
17.45	1.3	*
18.00	1.3	*
18.15	1.3	*

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.30	1.6	**
17.45	1.6	**
18.00	1.6	**
18.15	1.7	**

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * * DELAY *		* INCLUSIVE QUEUEING * * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	717.6	717.6	78.2	0.11	78.3	0.11
B	314.4	314.4	24.8	0.08	24.8	0.08
C	594.6	594.6	78.8	0.13	78.8	0.13
D	466.8	466.8	95.8	0.21	95.9	0.21
ALL	2093.4	2093.4	277.6	0.13	277.8	0.13

INCLUSIVE GEOMETRIC DELAY

ARM	TOTAL DEMAND		GEOMETRIC DELAY BY TURN (VEH MIN) (GEOMETRIC DELAY PER LIGHT VEHICLE (SEC))				TOTAL GEOM. DELAY
	(VEH)	(VEH/H)	ARM A	ARM B	ARM C	ARM D	VEH MIN
A	717.6	717.6	0.0	0.0	35.6	39.8	75.4
			(18.7)	(0.0)	(5.0)	(11.8)	
B	314.4	314.4	13.7	0.0	0.0	17.4	31.1
			(11.8)	(18.7)	(0.0)	(5.0)	
C	594.6	594.6	36.0	10.5	0.0	0.0	46.5
			(5.0)	(11.8)	(18.7)	(0.0)	
D	466.8	466.8	0.0	18.7	17.4	0.0	36.1
			(0.0)	(5.0)	(11.8)	(18.7)	
ALL	2093.4	2093.4					189.2

TRANSPORT RESEARCH LABORATORY

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
CARRIGALINE HOTEL ROUNDABOUT 17:15- 18:15 2023

.INPUT DATA
****
ARM A - TO CORK
ARM B - TO CHURCH ROAD
ARM C - TO CARRIGALINE
ARM D - TO BALLEA ROAD

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.00	7.50	35.00	12.00	30.00	60.0	0.599	26.979
ARM B	3.00	7.50	35.00	15.00	30.00	60.0	0.610	27.488
ARM C	3.00	7.50	15.00	20.00	30.00	60.0	0.572	23.960
ARM D	3.00	7.50	5.00	20.00	30.00	60.0	0.509	18.820

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.
WARNING ARM B: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.GEOMETRIC DELAY DATA

	ARM SPEED (KPH) ENTRY	ARM SPEED (KPH) EXIT	ENTRY ANGLE ENA(DEG)	EXIT ANGLE EXA(DEG)	ENTRY RADIUS R(M)	EXIT RADIUS EXR(M)	SIGHT DISTANCE SD(M)	ANGLE BETWEEN CURRENT AND NEXT ARM (DEG)
ARM A	30.0	30.0	60.0	60.0	12.0	30.0	50.0	90.0
ARM B	30.0	30.0	60.0	60.0	15.0	30.0	50.0	90.0
ARM C	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM D	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0

	DISTANCE ENTRY TO CENTRE OF JUNCTION (METRES)	DISTANCE CENTRE OF JUNCTION TO EXIT (METRES)
ARM A	39.0	39.0
ARM B	39.0	39.0
ARM C	39.0	39.0
ARM D	39.0	39.0

DISTANCES THROUGH JUNCTION

FROM/TO	ARM A	ARM B	ARM C	ARM D
ARM A	200.0	50.0	100.0	150.0
ARM B	150.0	200.0	50.0	100.0
ARM C	100.0	150.0	200.0	50.0
ARM D	50.0	100.0	150.0	200.0

WARNING Geometric delays have been calculated and the
roundabout is non-circular or non-symetrical
(AG24 REF 8.4.2(v))

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 17.15 AND ENDS 18.15
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

FLOW DATA USED IN THE ESTIMATION OF TURNING PROPORTIONS (VEH/MIN) -

TIME INTERVAL	ARM A	ARM B	ARM C	ARM D

17.15 - 17.30					
	ENTRY	12.3	5.4	10.2	4.7
	EXIT	11.2	8.4	0.0	12.9
17.30 - 17.45					
	ENTRY	12.3	5.4	10.2	4.7
	EXIT	11.2	8.4	0.0	12.9
17.45 - 18.00					
	ENTRY	12.3	5.4	10.2	4.7
	EXIT	11.2	8.4	0.0	12.9
18.00 - 18.15					
	ENTRY	12.3	5.4	10.2	4.7
	EXIT	11.2	8.4	0.0	12.9

TIME	FROM/TO	TURNING PROPORTIONS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C	ARM D
17.15 - 18.15					
	ARM A	0.000	0.382	0.000	0.618
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.299	0.000	0.000	0.701
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.754	0.094	0.000	0.152
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.408	0.592	0.000	0.000
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM ENTRY AND EXIT FLOWS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.15-17.30								
ARM A	12.28	22.30	0.551		0.0	1.2	17.3	22.6
ARM B	5.39	20.39	0.264		0.0	0.4	5.2	9.5
ARM C	10.21	14.40	0.709		0.0	2.3	31.3	12.4
ARM D	4.73	11.96	0.396		0.0	0.6	9.2	3.5

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.30-17.45								
ARM A	12.28	22.28	0.551		1.2	1.2	18.2	22.7
ARM B	5.39	20.36	0.265		0.4	0.4	5.4	9.6
ARM C	10.21	14.36	0.711		2.3	2.4	35.4	12.5
ARM D	4.73	11.89	0.398		0.6	0.7	9.8	3.5

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.45-18.00								
ARM A	12.28	22.28	0.551		1.2	1.2	18.3	22.7
ARM B	5.39	20.36	0.265		0.4	0.4	5.4	9.6
ARM C	10.21	14.36	0.711		2.4	2.4	36.1	12.5
ARM D	4.73	11.89	0.398		0.7	0.7	9.8	3.5

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
18.00-18.15								
ARM A	12.28	22.28	0.551		1.2	1.2	18.3	22.7
ARM B	5.39	20.36	0.265		0.4	0.4	5.4	9.6
ARM C	10.21	14.36	0.711		2.4	2.4	36.3	12.6
ARM D	4.73	11.89	0.398		0.7	0.7	9.9	3.5

QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.30	1.2	*
17.45	1.2	*
18.00	1.2	*
18.15	1.2	*

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
17.30	0.4
17.45	0.4
18.00	0.4
18.15	0.4

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
17.30	2.3 **
17.45	2.4 **
18.00	2.4 **
18.15	2.4 **

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
17.30	0.6 *
17.45	0.7 *
18.00	0.7 *
18.15	0.7 *

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * * DELAY *		* INCLUSIVE QUEUEING * * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	736.8	736.8	72.2	0.10	72.2	0.10
B	323.4	323.4	21.4	0.07	21.4	0.07
C	612.6	612.6	139.0	0.23	139.2	0.23
D	283.8	283.8	38.7	0.14	38.7	0.14
ALL	1956.6	1956.6	271.3	0.14	271.6	0.14

INCLUSIVE GEOMETRIC DELAY

ARM	TOTAL DEMAND		GEOMETRIC DELAY BY TURN (VEH MIN) (GEOMETRIC DELAY PER LIGHT VEHICLE (SEC))				TOTAL GEOM. DELAY
	(VEH)	(VEH/H)	ARM A	ARM B	ARM C	ARM D	VEH MIN
A	736.8	736.8	0.0	0.0	0.0	91.0	91.0
			(18.7)	(0.0)	(5.0)	(11.8)	
B	323.4	323.4	19.3	0.0	0.0	19.0	38.3
			(11.8)	(18.7)	(0.0)	(5.0)	
C	612.6	612.6	38.7	11.5	0.0	0.0	50.2
			(5.0)	(11.8)	(18.7)	(0.0)	
D	283.8	283.8	0.0	14.1	0.0	0.0	14.1
			(0.0)	(5.0)	(11.8)	(18.7)	
ALL	1956.6	1956.6					193.6

WARNING Arm A:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm C:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm D:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

TRANSPORT RESEARCH LABORATORY

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
CARRIGALINE HOTEL ROUNDABOUT 17:15- 18:15 2028

.INPUT DATA
****
ARM A - TO CORK
ARM B - TO CHURCH ROAD
ARM C - TO CARRIGALINE
ARM D - TO BALLEA ROAD

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.00	7.50	35.00	12.00	30.00	60.0	0.599	26.979
ARM B	3.00	7.50	35.00	15.00	30.00	60.0	0.610	27.488
ARM C	3.00	7.50	15.00	20.00	30.00	60.0	0.572	23.960
ARM D	3.00	7.50	5.00	20.00	30.00	60.0	0.509	18.820

V = approach half-width   L = effective flare length   D = inscribed circle diameter
E = entry width   R = entry radius   PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.
WARNING ARM B: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.GEOMETRIC DELAY DATA

	ARM SPEED (KPH) ENTRY	ARM SPEED (KPH) EXIT	ENTRY ANGLE ENA(DEG)	EXIT ANGLE EXA(DEG)	ENTRY RADIUS R(M)	EXIT RADIUS EXR(M)	SIGHT DISTANCE SD(M)	ANGLE BETWEEN CURRENT AND NEXT ARM (DEG)
ARM A	30.0	30.0	60.0	60.0	12.0	30.0	50.0	90.0
ARM B	30.0	30.0	60.0	60.0	15.0	30.0	50.0	90.0
ARM C	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM D	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0

	DISTANCE ENTRY TO CENTRE OF JUNCTION (METRES)	DISTANCE CENTRE OF JUNCTION TO EXIT (METRES)
ARM A	39.0	39.0
ARM B	39.0	39.0
ARM C	39.0	39.0
ARM D	39.0	39.0

DISTANCES THROUGH JUNCTION

FROM/TO	ARM A	ARM B	ARM C	ARM D
ARM A	200.0	50.0	100.0	150.0
ARM B	150.0	200.0	50.0	100.0
ARM C	100.0	150.0	200.0	50.0
ARM D	50.0	100.0	150.0	200.0

WARNING Geometric delays have been calculated and the
roundabout is non-circular or non-symetrical
(AG24 REF 8.4.2(v))

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 17.15 AND ENDS 18.15
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

FLOW DATA USED IN THE ESTIMATION OF TURNING PROPORTIONS (VEH/MIN) -

TIME INTERVAL		ARM A	ARM B	ARM C	ARM D
17.15 - 17.30					
	ENTRY	13.2	5.8	11.0	5.0
	EXIT	12.1	9.1	0.0	13.8
17.30 - 17.45					
	ENTRY	13.2	5.8	11.0	5.0
	EXIT	12.1	9.1	0.0	13.8
17.45 - 18.00					
	ENTRY	13.2	5.8	11.0	5.0
	EXIT	12.1	9.1	0.0	13.8
18.00 - 18.15					
	ENTRY	13.2	5.8	11.0	5.0
	EXIT	12.1	9.1	0.0	13.8

TIME	FROM/TO	TURNING PROPORTIONS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C	ARM D
17.15 - 18.15					
	ARM A	0.000	0.385	0.000	0.615
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.299	0.000	0.000	0.701
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.753	0.095	0.000	0.152
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.405	0.595	0.000	0.000
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM ENTRY AND EXIT FLOWS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.15-17.30								
ARM A	13.17	22.15	0.595		0.0	1.4	20.5	24.1
ARM B	5.80	20.09	0.289		0.0	0.4	5.9	10.3
ARM C	11.00	13.88	0.792		0.0	3.5	44.6	13.3
ARM D	5.01	11.58	0.432		0.0	0.7	10.6	3.7

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.30-17.45								
ARM A	13.17	22.12	0.595		1.4	1.5	21.8	24.3
ARM B	5.80	20.05	0.289		0.4	0.4	6.1	10.3
ARM C	11.00	13.84	0.795		3.5	3.7	53.8	13.5
ARM D	5.01	11.49	0.436		0.7	0.8	11.4	3.7

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.45-18.00								
ARM A	13.17	22.12	0.596		1.5	1.5	21.9	24.3
ARM B	5.80	20.05	0.289		0.4	0.4	6.1	10.3
ARM C	11.00	13.83	0.795		3.7	3.7	55.6	13.5
ARM D	5.01	11.48	0.436		0.8	0.8	11.5	3.7

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
18.00-18.15								
ARM A	13.17	22.12	0.596		1.5	1.5	22.0	24.3
ARM B	5.80	20.05	0.289		0.4	0.4	6.1	10.3
ARM C	11.00	13.83	0.795		3.7	3.8	56.3	13.5
ARM D	5.01	11.48	0.436		0.8	0.8	11.5	3.7

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.30	1.4	*
17.45	1.5	*
18.00	1.5	*

```
   18.15          1.5  *


.QUEUE AT ARM B
 --------------

  TIME SEGMENT   NO. OF
   ENDING      VEHICLES
               IN QUEUE

   17.30          0.4
   17.45          0.4
   18.00          0.4
   18.15          0.4


.QUEUE AT ARM C
 --------------

  TIME SEGMENT   NO. OF
   ENDING      VEHICLES
               IN QUEUE

   17.30          3.5  ***
   17.45          3.7  ****
   18.00          3.7  ****
   18.15          3.8  ****


.QUEUE AT ARM D
 --------------

  TIME SEGMENT   NO. OF
   ENDING      VEHICLES
               IN QUEUE

   17.30          0.7  *
   17.45          0.8  *
   18.00          0.8  *
   18.15          0.8  *


.                QUEUEING DELAY INFORMATION OVER WHOLE PERIOD
                 --------------------------------------------

 -----------------------------------------------------------------------------
 I  ARM  I   TOTAL DEMAND  I     * QUEUEING *     I  * INCLUSIVE QUEUEING *  I
 I       I                 I      * DELAY *       I         * DELAY *        I
 I       I---------------------------------------------------------------------I
 I       I  (VEH)   (VEH/H) I  (MIN)    (MIN/VEH) I    (MIN)      (MIN/VEH)  I
 -----------------------------------------------------------------------------
 I   A   I  790.2 I  790.2 I    86.1 I    0.11    I      86.2  I     0.11    I
 I   B   I  348.0 I  348.0 I    24.1 I    0.07    I      24.1  I     0.07    I
 I   C   I  660.0 I  660.0 I   210.3 I    0.32    I     210.8  I     0.32    I
 I   D   I  300.6 I  300.6 I    45.1 I    0.15    I      45.1  I     0.15    I
 -----------------------------------------------------------------------------
 I  ALL  I 2098.8 I 2098.8 I   365.6 I    0.17    I     366.2  I     0.17    I
 -----------------------------------------------------------------------------


                 INCLUSIVE GEOMETRIC DELAY
                 -------------------------

.-------------------------------------------------------------------------------------
 I  ARM  I   TOTAL DEMAND  I       GEOMETRIC DELAY BY TURN (VEH MIN)      I TOTAL  I
 I       I                 I    (GEOMETRIC DELAY PER LIGHT VEHICLE (SEC))  I GEOM.  I
 I       I-----------------I-----------------------------------------------I DELAY  I
 I       I  (VEH)   (VEH/H) I   ARM A   I   ARM B   I   ARM C   I   ARM D   I VEH MINI
 -------------------------------------------------------------------------------------
 I   A   I  790.2 I  790.2 I      0.0  I      0.0  I      0.0  I     97.1  I   97.1 I
 I       I        I        I  (  18.7) I  (   0.0) I  (   5.0) I  (  11.8) I        I
 I       I        I        I           I           I           I           I        I
 I   B   I  348.0 I  348.0 I     20.8  I      0.0  I      0.0  I     20.4  I   41.3 I
 I       I        I        I  (  11.8) I  (  18.7) I  (   0.0) I  (   5.0) I        I
 I       I        I        I           I           I           I           I        I
 I   C   I  660.0 I  660.0 I     41.6  I     12.6  I      0.0  I      0.0  I   54.2 I
 I       I        I        I  (   5.0) I  (  11.8) I  (  18.7) I  (   0.0) I        I
 I       I        I        I           I           I           I           I        I
 I   D   I  300.6 I  300.6 I      0.0  I     15.0  I      0.0  I      0.0  I   15.0 I
 I       I        I        I  (   0.0) I  (   5.0) I  (  11.8) I  (  18.7) I        I
 -------------------------------------------------------------------------------------
 I  ALL  I 2098.8 I 2098.8 I                                               I  207.5 I
 -------------------------------------------------------------------------------------
 **WARNING** Arm A:In the calculation of geometric delays the
 approach/departure speed is less than the calculated
 junction speed (AG24 REF 8.4.2(vi))
 **WARNING** Arm C:In the calculation of geometric delays the
 approach/departure speed is less than the calculated
 junction speed (AG24 REF 8.4.2(vi))
 **WARNING** Arm D:In the calculation of geometric delays the
 approach/departure speed is less than the calculated
 junction speed (AG24 REF 8.4.2(vi))

 * DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
 * INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
 * THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

 END OF JOB

 ****** ARCADY 5 run completed.
```

TRANSPORT RESEARCH LABORATORY

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
CARRIGALINE HOTEL ROUNDABOUT 17:15- 18:15 2038

.INPUT DATA
****
ARM A - TO CORK
ARM B - TO CHURCH ROAD
ARM C - TO CARRIGALINE
ARM D - TO BALLEA ROAD

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.00	7.50	35.00	12.00	30.00	60.0	0.599	26.979
ARM B	3.00	7.50	35.00	12.00	30.00	60.0	0.599	26.979
ARM C	3.00	7.50	15.00	20.00	30.00	60.0	0.572	23.960
ARM D	3.00	7.50	5.00	20.00	30.00	60.0	0.509	18.820

V = approach half-width   L = effective flare length   D = inscribed circle diameter
E = entry width   R = entry radius   PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.
WARNING ARM B: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.GEOMETRIC DELAY DATA

	ARM SPEED (KPH) ENTRY	ARM SPEED (KPH) EXIT	ENTRY ANGLE ENA(DEG)	EXIT ANGLE EXA(DEG)	ENTRY RADIUS R(M)	EXIT RADIUS EXR(M)	SIGHT DISTANCE SD(M)	ANGLE BETWEEN CURRENT AND NEXT ARM (DEG)
ARM A	30.0	30.0	60.0	60.0	12.0	30.0	50.0	90.0
ARM B	30.0	30.0	60.0	60.0	12.0	30.0	50.0	90.0
ARM C	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0
ARM D	30.0	30.0	60.0	60.0	20.0	30.0	50.0	90.0

	DISTANCE ENTRY TO CENTRE OF JUNCTION (METRES)	DISTANCE CENTRE OF JUNCTION TO EXIT (METRES)
ARM A	39.0	39.0
ARM B	39.0	39.0
ARM C	39.0	39.0
ARM D	39.0	39.0

DISTANCES THROUGH JUNCTION

FROM/TO	ARM A	ARM B	ARM C	ARM D
ARM A	200.0	50.0	100.0	150.0
ARM B	150.0	200.0	50.0	100.0
ARM C	100.0	150.0	200.0	50.0
ARM D	50.0	100.0	150.0	200.0

WARNING Geometric delays have been calculated and the
roundabout is non-circular or non-symetrical
(AG24 REF 8.4.2(v))

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 17.15 AND ENDS 18.15
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

FLOW DATA USED IN THE ESTIMATION OF TURNING PROPORTIONS (VEH/MIN) -

TIME INTERVAL	ARM A	ARM B	ARM C	ARM D

TIME					
17.15 - 17.30					
	ENTRY	14.2	6.3	11.9	5.3
	EXIT	13.0	9.8	0.0	14.8
17.30 - 17.45					
	ENTRY	14.2	6.3	11.9	5.3
	EXIT	13.0	9.8	0.0	14.8
17.45 - 18.00					
	ENTRY	14.2	6.3	11.9	5.3
	EXIT	13.0	9.8	0.0	14.8
18.00 - 18.15					
	ENTRY	14.2	6.3	11.9	5.3
	EXIT	13.0	9.8	0.0	14.8

		TURNING PROPORTIONS (PERCENTAGE OF H.V.S)			
TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D
17.15 - 18.15					
	ARM A	0.000	0.388	0.000	0.612
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.300	0.000	0.000	0.700
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.753	0.096	0.000	0.151
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.403	0.597	0.000	0.000
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM ENTRY AND EXIT FLOWS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.15-17.30								
ARM A	14.17	21.99	0.644		0.0	1.8	24.9	25.8
ARM B	6.25	19.38	0.323		0.0	0.5	6.9	11.1
ARM C	11.87	13.31	0.892		0.0	6.2	72.3	14.1
ARM D	5.32	11.22	0.474		0.0	0.9	12.5	3.9

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.30-17.45								
ARM A	14.17	21.95	0.646		1.8	1.8	26.8	26.0
ARM B	6.25	19.34	0.323		0.5	0.5	7.1	11.1
ARM C	11.87	13.25	0.896		6.2	7.1	101.0	14.6
ARM D	5.32	11.06	0.481		0.9	0.9	13.6	4.0

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.45-18.00								
ARM A	14.17	21.94	0.646		1.8	1.8	27.0	26.0
ARM B	6.25	19.34	0.323		0.5	0.5	7.1	11.1
ARM C	11.87	13.25	0.896		7.1	7.5	110.1	14.6
ARM D	5.32	11.04	0.482		0.9	0.9	13.8	4.0

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
18.00-18.15								
ARM A	14.17	21.94	0.646		1.8	1.8	27.1	26.0
ARM B	6.25	19.34	0.323		0.5	0.5	7.1	11.1
ARM C	11.87	13.25	0.896		7.5	7.8	114.7	14.6
ARM D	5.32	11.04	0.482		0.9	0.9	13.8	4.0

QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.30	1.8	**
17.45	1.8	**
18.00	1.8	**
18.15	1.8	**

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
17.30	0.5
17.45	0.5
18.00	0.5
18.15	0.5

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.30	6.2	******
17.45	7.1	*******
18.00	7.5	********
18.15	7.8	********

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.30	0.9	*
17.45	0.9	*
18.00	0.9	*
18.15	0.9	*

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND (VEH)	TOTAL DEMAND (VEH/H)	* QUEUEING * * DELAY * (MIN)	* QUEUEING * * DELAY * (MIN/VEH)	* INCLUSIVE QUEUEING * * DELAY * (MIN)	* INCLUSIVE QUEUEING * * DELAY * (MIN/VEH)
A	850.2	850.2	105.9	0.12	106.0	0.12
B	375.0	375.0	28.3	0.08	28.3	0.08
C	712.2	712.2	398.2	0.56	400.4	0.56
D	319.2	319.2	53.6	0.17	53.7	0.17
ALL	2256.6	2256.6	586.0	0.26	588.4	0.26

INCLUSIVE GEOMETRIC DELAY

ARM	TOTAL DEMAND (VEH)	TOTAL DEMAND (VEH/H)	ARM A	ARM B	ARM C	ARM D	TOTAL GEOM. DELAY VEH MIN
			GEOMETRIC DELAY BY TURN (VEH MIN) (GEOMETRIC DELAY PER LIGHT VEHICLE (SEC))				
A	850.2	850.2	0.0	0.0	0.0	103.9	103.9
			(18.7)	(0.0)	(5.0)	(11.8)	
B	375.0	375.0	22.5	0.0	0.0	22.0	44.5
			(11.8)	(18.7)	(0.0)	(5.0)	
C	712.2	712.2	44.9	13.7	0.0	0.0	58.6
			(5.0)	(11.8)	(18.7)	(0.0)	
D	319.2	319.2	0.0	16.0	0.0	0.0	16.0
			(0.0)	(5.0)	(11.8)	(18.7)	
ALL	2256.6	2256.6					223.0

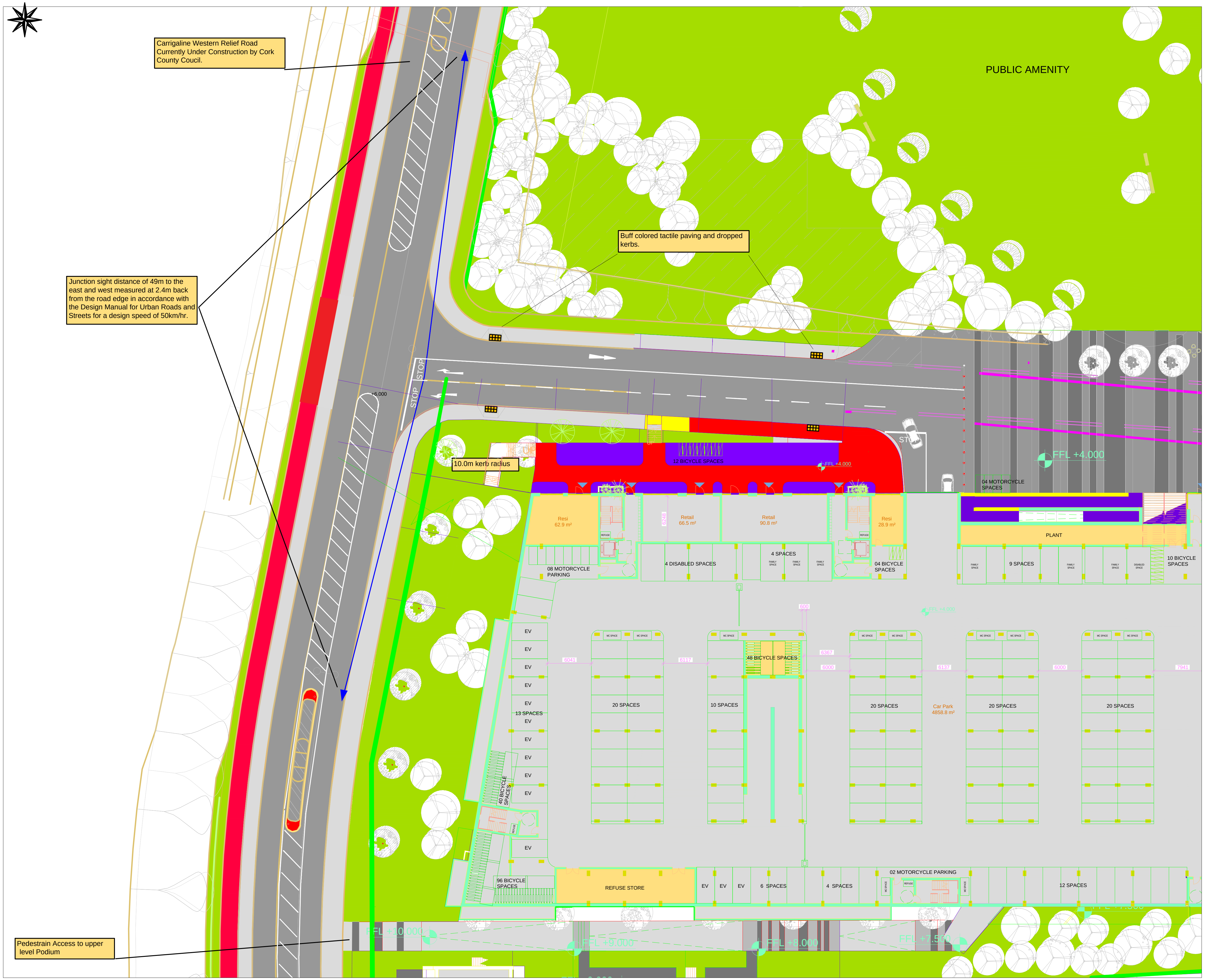
WARNING Arm A:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm C:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))
WARNING Arm D:In the calculation of geometric delays the approach/departure speed is less than the calculated junction speed (AG24 REF 8.4.2(vi))

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

12.0 Appendix E – Drawing



NOTES:

All dimensions in metres.
Do not scale from drawing.
For any discrepancies found please consult with design office.
This drawing should be read in conjunction with all contract drawings, documents and specifications.

Rev	By	Date	Description

Drawing Status: PLANNING
NOT CERTIFIED FOR CONSTRUCTION

Project Title: Mixed Use Residential Development Carrigaline, Co Cork.

Drawing Title: Roads Layout

Client: Reside Investments Ltd.

Martin Hanley
Traffic & Transportation
Consulting Engineers.
70 Lissdaell, Maryborough Hill, Douglas, Cork.
Tel: 021-4857959
E-Mail:martinrhanley1@gmail.com

Designed: MH

Scale: 1/500 at A3

Date: April 2022

Job No: 21-014TT

Drawing No: CM-RL-P01

Revision:

NOTES:

All dimensions in metres.
Do not scale from drawing.
For any discrepancies found please consult with design office.
This drawing should be read in conjunction with all contract drawings, documents and specifications.

Rev	By	Date	Description

Drawing Status: PLANNING
NOT CERTIFIED FOR CONSTRUCTION

Project Title: Mixed Use Residential Development
Carrigaline, Co Cork.

Drawing Title: Roads Layout.

Client: Reside Investments Ltd.

Martin Hanley
Traffic & Transportation
Consulting Engineers.
70 Lissdaell,
Maryborough Hill,
Douglas, Cork.
Tel: 021-4857959
E-Mail:martinrhanley1@gmail.com

Designed: MH		
Scale: 1/500 at A3	Date: April 2022	
Job No: 21-014TT	Drawing No: CM-RL-P02	Revision:

Appendix H

BUILDING LIFECYCLE REPORT

PROPOSED DEVELOPMENT:

KILMONEY ROAD, CARRIGALINE, Co. CORK.

CLIENT:

RESIDE INVESTMENTS LIMITED

TABLE OF CONTENTS

01

INTRODUCTION

1.0 INTRODUCTION

Aramark Property were instructed by Reside Investments Limited, to provide a Building Lifecycle Report for their proposed mixed-use residential development comprising 2 No. blocks, ranging in height from 6 to 7 storeys, consisting of 202 No. apartments and 22 No. townhouse/duplex style units, 3 No. single storey retail units and a creche/childcare facility at a greenfield site of approximately 2.8 Ha located to the west of Carrigaline main street, Kilmoney Road to the South and Owenabue River to the North.

The purpose of this report is to provide an initial assessment of long-term running and maintenance costs as they would apply on a per residential unit basis at the time of application, as well as demonstrating what measures have been specifically considered to effectively manage and reduce costs for the benefit of the residents. This is achieved by producing a Building Lifecycle Report.

This Building Lifecycle Report has been developed on foot of the revised guidelines for Sustainable Urban Housing: Design Standards for New Apartments - Guidelines for Planning Authorities issued under Section 28 of the Planning and Development Act 2000 (as amended) December 2020. Within these guidelines, current guidance is being provided on residential schemes.

Section 6.13 of the Apartments and the Development Management Process guidelines for Sustainable Urban Housing: Design Standards for New Apartments (December 2020) requires that:

> "planning applications for apartment development shall include a building lifecycle report which in turn includes an assessment of long-term running and maintenance costs as they would apply on a per residential unit basis at the time of application, as well as demonstrating what measures have been specifically considered by the proposer to effectively manage and reduce costs for the benefit of residents."

02

DESCRIPTION OF DEVELOPMENT

2.0 DESCRIPTION OF DEVELOPMENT

The proposed development will consist of the following components:

- The construction of 224 no. residential units consisting of 202 no. proposed apartments in 2 no. blocks, ranging in height from 6 to 7 storeys and 22 no. townhouse/duplex units;
- A 184 m2 creche/childcare facility;
- The provision of landscaping and amenity areas to include 1 no. local play area, 1 no. kick about areas, an activity trail/greenway along the river, a gathering area/amphitheatre with tired seating areas, a civic space/promenade and 2 no. courtyard areas;
- The provision of 3 no. retail units, residential amenity and management spaces at ground and first floor level; and
- All associated ancillary development including vehicular access on to the Kilmoney Road Lower, and a cycle/pedestrian connection on to the R611 (via an activity trail/greenway along the river), lighting, drainage, roads boundary treatments, ESB Substation, bicycle & car parking and bin storage.

03

EXECUTIVE SUMMARY

3.0 EXECUTIVE SUMMARY – BUILDING LIFE CYCLE REPORT

Measures to effectively manage and reduce costs for the benefit of residents

The following document reviews the outline specification set out for the proposed mixed-use 'Build-to-Sell' residential development comprising 2 No. blocks, ranging in height from 6 to 7 storeys, consisting of 202 No. apartments and 22 No townhouse/duplex style units, 3 No. single storey retail units and a creche/childcare facility at a greenfield site of approximately 2.8 Ha located to the west of Carrigaline main street, Kilmoney Road to the South and Owenabue River to the North and explores the practical implementation of the design and material principles which has informed design of building roofs, façades, internal layouts and detailing of the proposed development.

Building materials proposed for use on elevations and in the public realm achieve a durable standard of quality that will not need regular fabric replacement or maintenance outside general day to day care. The choice of high quality and long-lasting materials, as well as both soft and hardscape in the public, semi-public and private realm will contribute to lower maintenance costs for future residents and occupiers.

Please note that detailed specifications of building fabric and services have not been provided at this stage. This report reflects the outline material descriptions contained within Henry J. Lyons Architect's planning drawings received.

For any elements where information was not available, typical examples have been provided of building materials and services used for schemes of this nature and their associated lifespans and maintenance requirements. All information is therefore indicative subject to further information at detailed design stage.

As the building design develops this document will be updated and a schedule will be generated from the items below detailing maintenance and replacement costs over the lifespan of the materials and development constituent parts in a summary document. This will enable a robust schedule of building component repair and replacement costs which will be available to the property management company so that running, and maintenance costs of the development are kept within the agreed Annual operational budget, this will take the form of a Planned Preventative Maintenance Schedule (PPM)* at operational commencement of the development.

*PPM under separate instruction

04

EXTERNAL BUILDING FABRIC SCHEDULE

4.0 EXTERNAL BUILDING FABRIC SCHEDULE

4.1 Roofing

4.1.1 Green Roofs (Manufacturer / Supplier TBC)

Location	All flat roof areas (maintenance access only)
Description	Extensive green roof system to engineer's specification.
Lifecycle	Average lifecycle of 35 years on most green roofs. As used across the industry nationally and in the UK, long lifecycle typically achieved by robust detailing to adjoining roof elements, regular inspection and maintenance regime to ensure the upkeep of roofing product / materials.
Required maintenance	Quarterly maintenance visits to include inspection of drainage layer and outlets and removal of any blockages to prevent ponding. Inspection of vegetation layer for fungus and decay. Carry out weeding as necessary. No irrigation necessary with sedum blankets.
Year	Quarterly
Priority	Medium
Selection process	A green roof will add to the character of the overall scheme, as well as providing attenuation to storm water run-off and less burden on rainwater goods, increased thermal and sound insulation to the building and increased biodiversity. Natural soft finishes can provide visual amenity for residents where roof areas are visible or accessible from within areas of the scheme. Sedum roofs are a popular and varied choice for green roofs requiring minimal maintenance.
Reference	Henry J. Lyons Architect's planning drawings & Design Statement.

4.1.2 Roof (Manufacturer / Supplier TBC)

Location	Selected Flat Roof Areas (maintenance access only)
Description	• Single layer membrane roof system to engineer's specification. • Selected membrane and brick cappings.
Lifecycle	Average lifecycle of 15-25 years on most membrane roofs. Lifecycle will be extended with robust proven detailing to adjoining roof elements and appropriate and regular maintenance of the roof materials.
Required maintenance	Half-yearly maintenance visits to include inspection of membrane material for puncture / cracks on sheeting; seams and flashing details; around drainage and ventilation outlets and removal of any vegetation/moss blockages to prevent ponding.
Year	Half-Yearly / Annual
Priority	Medium
Selection process	A membrane roof with appropriate built-up system will provide durability, lacks water permeability and easily maintain without shutting down building operations during application.
Reference	Henry J. Lyons Architects' drawings & design statement.

4.1.3 Fall Arrest System for Roof Maintenance Access (Manufacturer / Supplier TBC)

Location	Flat roof areas (maintenance access only)
Description	• Fall Protection System on approved anchorage device. • Installation in accordance with BS 7883:2019 (Anchor System designed to protect people working at height) by the system manufacturer or a contractor approved by the system manufacturer.
Lifecycle	25-30 years dependent on quality of materials. Generally, steel finishes to skyward facing elements can be expected to maintain this life expectancy. As used across the industry nationally and the UK, long lifecycle is typically achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Check and reset tension on the line as per manufacturer's specifications. Check all hardware components for wear (shackles, eye bolts, turn buckles). Check elements for signs of wear and/or weathering. Lubricate all moving parts. Check for structural damage or modifications.
Year	Annually
Priority	High
Selection process	Fall protection systems are a standard life safety system, provided for safe maintenance of roofs and balconies where there is not adequate parapet protection. Fall protection systems must comply with relevant quality standards.
Reference	N/A

4.1.4 Roof Cowls (Manufacturer / Supplier TBC)

Location	Selected Flat Roof Areas
Description	Roof Cowl System to be supplied with weather apron for flat roofs.
Lifecycle	25-35 years. As used across the industry nationally and the UK, typically longer lifecycle is achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Check fixings annually, inspect for onset of leading-edge corrosion if epoxy powder coat finish and treat.
Year	Annually
Priority	Low
Selection process	Standard fitting for roof termination of mechanical ventilation system.
Reference	N/A

4.1.5 Flashings (Manufacturer / Supplier TBC)

Location	All flashing locations
Description	Lead to be used for all flashing and counter flashings.
Lifecycle	Typical life expectancy of 70 years recorded for lead flashings. Recessed joint sealing will require regular inspections. Longer lifecycle achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Check joint fixings for lead flashing, ground survey annually and close-up inspection every 5 years. Re-secure as necessary.
Year	Ground level inspection annually and close-up inspection every 5 years
Priority	Medium
Selection	Lead has longest life expectancy of comparable materials such as

process	copper (60 years) and zinc (50 years). Provided appropriate safety precautions are taken, lead is the recommended choice for large residential, commercial or industrial builds. Lead is easily formed into the required shapes for effective weathering of building junctions according to standard Lead Sheet Association details.
Reference	N/A

4.2 Rainwater Drainage (Manufacturer / Supplier TBC)

Location	All buildings
Description	• *Rainwater outlets:* Suitable for specified roof membranes • *Pipework:* Mixture of zinc/aluminium/uPVC downpipes • *Below ground drainage:* To Engineers' design and specification • *Disposal:* To surface water drainage to Engineers' design • *Controls:* To Engineers design and specification • *Accessories:* allow for outlet gradings, spigots, downspout nozzle, hopper heads, balcony and main roof outlets
Lifecycle	Metal gutters and downpipes have an expected life expectancy of 40 years in rural and suburban conditions (25 years in industrial and marine conditions), this is comparable to cast iron of 50 years and plastic, less so at 30 years. As used across the industry nationally and the UK, typically longer lifecycle is achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	As with roofing systems routine inspection is key to preserving the lifecycle of rainwater systems. Regular cleaning and rainwater heads and gutters, checking joints and fixings and regularly cleaning polyester coated surfaces (no caustic or abrasive materials).
Year	Annually, cleaning bi-annually
Priority	High
Selection process	As above, metal fittings compare well against cast iron (in terms of cost) and plastic (in terms of lifespan and aesthetic).
Reference	N/A

4.3 External Walls

4.3.1 Brick

Location	Façades
Description	Contrasting light and dark tone brickwork.
Lifecycle	Selected colour bricks have a high embodied energy, they are an extremely durable material. Brickwork in this application is expected to have a lifespan of 50-80 years. The mortar pointing however has a shorter lifespan of 25-50 years. Longer lifecycle achieved by regular inspection and maintenance regime.
Required maintenance	In general, given their durability, brickwork finishes require little maintenance. Most maintenance is preventative: checking for hairline cracks, deterioration of mortar, plant growth on walls, or other factors that could signal problems or lead to eventual damage.
Year	Annual
Priority	Low
Selection process	Aesthetic, lightweight, cost-efficient and low maintenance cladding option, indistinguishable from traditional brick construction.
Reference	Henry J. Lyons Architects' drawings & design statement.

4.3.2 Metal (Manufacturer / Supplier TBC)

Location	Façades
Description	• Standing Seam Zinc cladding at Penthouse Level. • Polyester Powder Coated (PPC) aluminium framed curtain walling system to retail units. • Stage Green PPC metal fins at select locations. • PPC pressed metal parapet capping at roof level. • PPC spandrel window panels at select locations.
Lifecycle	Lifespan expectancy generally in excess of 40 years. As used across the industry nationally and the UK, typically longer lifecycle is achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Selected paneling requires little maintenance and is resistant to corrosion. It can contribute to lower ongoing maintenance costs in comparison to exposed porous materials which may be liable to faster deterioration. Long term cleaning requirements should be taken into consideration.
Year	Inspection annually; cleaning 5 yearly
Priority	Low
Selection process	Selected paneling protects the building's structure from rainwater and weathering. Metal paneling systems are also chosen for their aesthetic impact, durability, and weathering properties.
Reference	Henry J. Lyons Architect's drawings & design statement.

4.3.3 Stone (Manufacturer / Supplier TBC)

Location	Facades
Description	Blue Limestone Panelling on support system at ground Level.
Lifecycle	Stone is expected to have a lifespan in the region of 60-80 years.
Required maintenance	In general, given its durability, stone requires little maintenance and weathers well. Most maintenance is preventative; check for deterioration of mortar, plant growth, or other factors that could signal problems or lead to eventual damage.
Year	Annual
Priority	Low
Selection process	Stone is a natural and highly durable material offering a robust aesthetic. Has a high durability and has similar mechanical properties to precast concrete.
Reference	Henry J. Lyons Architect's planning drawings & Design Statement.

4.3.4 Concrete (Manufacturer / Supplier TBC)

Location	Façades
Description	Shade Grey Techrete Single Skin Panels (reinforced precast concrete)
Lifecycle	While concrete has a high embodied energy, it is an extremely durable material. As used nationwide and in the UK, typically longer lifecycle is achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	In general concrete requires little maintenance. Most maintenance is preventative: checking for hairline cracks, vegetation growth on facades, or other factors that could signal problems or lead to eventual damage.
Year	Annual

Priority	Low
Selection process	Concrete is a durable product which is chosen for its structural properties, aesthetic, cost efficiency and rapid construction.
Reference	Henry J. Lyons Architects' planning drawings & Design Statement.

4.3.5 Render

Location	Façades
Description	Self-colouring render to select finish.
Lifecycle	Renders in general are expected to have a lifecycle of circa 25 years. Longer lifecycle achieved by regular inspection and maintenance regime.
Required maintenance	Regular inspections to check for cracking and de-bonding. Most maintenance is preventative. Coloured render requires less maintenance than traditional renders.
Year	Annually
Priority	Medium
Selection process	Appropriate detailing will contribute to a long lifespan for this installation. Insulated render is a durable and low-maintenance finish with the added benefit of this product being British Board of Agrément (BBA) certified against other render systems.
Reference	Henry J. Lyons Architect's drawings & design statement.

4.4 External Windows & Doors

Location	Façades
Description	• Anthracite full height, clear glazed windows with PPC aluminium frame. • All units to be double glazed with thermally broken frames. • All opening sections in windows to be fitted with suitable restrictors. Include for all necessary ironmongery; include for all pointing and mastic sealant as necessary; fixed using stainless steel metal straps screwed to masonry reveals; include for all bends, drips, flashings, thermal breaks etc.
Lifecycle	Aluminium has a typical lifespan of 45-60 years in comparison to uPVC which has a typical lifespan of 30-40 years. As used nationwide and in the UK, typically longer lifecycle is achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Check surface of windows and doors regularly so that damage can be detected. Vertical mouldings can become worn and require more maintenance than other surface areas. Lubricate at least once a year. Ensure regular cleaning regime. Check for condensation on frame from window and ensure ventilation.
Year	Annual
Priority	Medium
Selection process	Aluminium is durable and low maintenance with an average lifespan of 45-60 years, exceeding uPVC (30-40 years).
Reference	Henry J. Lyons Architect's drawings & design statement.

4.5 Balconies

4.5.1 Structure

Location	Apartment Blocks Façades
Description	• Concrete balcony system to engineer's detail, or • Powder-coated steel frame balcony system to engineer's detail • Thermally broken farrat plate connections to main structure of building.
Lifecycle	• Metal structure has a typical life expectancy of 70 years dependent on maintenance of components. • Precast concrete structures have a high embodied energy; however, it is an extremely durable material. Concrete frame has a typical life expectancy of 80 years. As used across the industry nationally and the UK, longer lifecycle is achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Relatively low maintenance required. Check balcony system as per manufacturer's specifications. Check all hardware components for wear. Check elements for signs of wear and/or weathering. Check for structural damage or modifications.
Year	Annual
Priority	High
Selection process	Engineered detail; designed for strength and safety.
Reference	N/A

4.5.2 Balustrades and Handrails

Location	Balconies
Description	• Metal balustrade with PPC steel handrail to selected finish. • Fixings in accordance with manufacturer's details.
Lifecycle	Typical life expectancy of over 40 years. As used nationwide and in the UK, typically longer lifecycle is achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Regular visual inspection of connection pieces for impact damage or alterations
Year	Annual
Priority	High
Selection process	Designed for strength and safety. Metal finish are chosen for their aesthetic impact, durability and weathering properties.
Reference	N/A

05

INTERNAL BUILDING FABRIC SCHEDULE

5.0 INTERNAL BUILDING FABRIC SCHEDULE

5.1 Floors

5.1.1 Common Areas

Location	Apartment Blocks Entrance
Description	• Selected anti-slip porcelain or ceramic floor tile complete with inset matwell. • Selected loop pile carpet tiles.
Lifecycle	• Lifespan expectation of 20-25 years in heavy wear areas, likely requirement to replace for modernisation within this period also. • 10-15 year lifespan for carpet. Likely requirement to replace for modernisation within this period also.
Required maintenance	Visual inspection with regular cleaning, intermittent replacement of chipped / loose tiles
Year	• Annual for floor tiles. • Quarterly inspection and cleaning of carpets as necessary
Priority	Low
Selection process	Durable, low maintenance floor finish. Slip rating required at entrance lobby, few materials provide this and are as hard wearing. Using carpet allows flexibility to alter and change as fashions alter and change providing enhanced flexibility.
Reference	N/A

Location	Stairwells, landings / half landings
Description	Selected carpet covering. Approved anodised aluminium nosings to stairs.
Lifecycle	• 10-15 year lifespan for carpet. Likely requirement to replace for modernisation within this period also. • 20-year lifespan for aluminium nosings.
Required maintenance	Visual inspection with regular cleaning.
Year	Quarterly inspection and cleaning as necessary.
Priority	Low
Selection process	Using carpet allows flexibility to alter and change as fashions alter and change providing enhanced flexibility.
Reference	N/A

Location	Lift Lobbies
Description	Carpet/vinyl and porcelain tiles to match adjacent apartment common lobbies.
Lifecycle	• Lifespan expectation of 20-30 years in heavy wear areas, likely requirement to replace for modernisation within this period also. • 10-15 year lifespan for carpet. Likely requirement to replace for modernisation within this period also.
Required maintenance	Visual inspection with regular cleaning, intermittent replacement of chipped / loose tiles.
Year	Annual
Priority	Low
Selection process	Slip rating required for lifts, few materials provide this and are as hard wearing. Using carpet allows flexibility to alter and change as fashions alter and change providing enhanced flexibility.
Reference	N/A

5.1.2 Tenant Amenity Areas

Location	Resident's work lounge, creche, gymnasium & community lounge
Description	• Timber laminate / parquet flooring, or • Carpet covering • Provide for inset matwell
Lifecycle	• Laminated / parquet timber flooring has an expected life expectancy of 25-35 years dependent on use • 10-15 year lifespan for carpet. Likely requirement to replace for modernisation within this period also
Required maintenance	Visual inspection. Sweep clean regularly ensuring to remove any dirt. Clean up spills immediately and use only recommended floor cleaners.
Year	Annual
Priority	Low
Selection process	Materials chosen for aesthetics, durability and low maintenance.
Reference	N/A

Location	All wet areas (e.g. Gymnasium WCs)
Description	Selected anti-slip ceramic floor tile.
Lifecycle	Lifespan expectation of 20-25 years in heavy wear areas, likely requirement to replace for modernisation within this period also.
Required maintenance	Visual inspection, intermittent replacement of chipped / loose tiles.
Year	Annual
Priority	Low
Selection process	Slip rating required at entrance lobby, few materials provide this and are as hard wearing.
Reference	N/A

5.2 Walls

5.2.1 Common Areas

Location	Apartment Blocks Entrance
Description	Selected paint finish with primer to skimmed plasterboard.
Lifecycle	2-10 years for finishes; 40 years for plasterboard. Longer lifecycle achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Regular maintenance required and replacement when damaged.
Year	Bi-annually
Priority	Low
Selection process	Decorative and durable finish.
Reference	N/A

Location	Lift cores / corridors / stairs
Description	Selected paint finish with primer to skimmed plasterboard.
Lifecycle	2-10 years for finishes; 40 years for plasterboard. Longer lifecycle achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Regular maintenance required and replacement when damaged.
Year	Bi-annually
Priority	Low
Selection process	Decorative and durable finish.
Reference	N/A

5.2.2 Tenant Amenity Areas

Location	Resident's work lounge, creche, gymnasium & community lounge
Description	Selected paint finish with primer to skimmed plasterboard
Lifecycle	2-10 years for finishes; 40 years for plasterboard. Longer lifecycle achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Regular maintenance required and replacement when damaged.
Year	Bi-annually
Priority	Low
Selection process	Decorative and durable finish.
Reference	N/A

Location	Wet areas (e.g. Gymnasium, WC's)
Description	Selected ceramic wall tile to plasterboard (moisture board to wet areas).
Lifecycle	Typical life expectancy of 35-40 years, less in wet room areas to 20-25 years.
Required maintenance	Bi-annual inspection to review damage, local repairs as necessary, particular detailed inspection in wet room areas.
Year	Annually
Priority	Medium
Selection process	Wet room application requires moisture board and tiling.
Reference	N/A

5.3 Ceilings

Location	Common and tenant's amenity areas
Description	Selected paint finish with primer to skimmed plasterboard ceiling on M/F frame. Acoustic ceiling to lift core and apartment lobbies. Moisture board to wet areas.
Lifecycle	2-10 years for finishes; 40 years for plasterboard. Longer lifecycle achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Regular maintenance required and replacement when damaged.
Year	Bi-annually
Priority	Low
Selection process	Decorative and durable finish
Reference	N/A

Location	Tenant amenity wet areas
Description	Selected paint finish with primer to skimmed moisture board ceiling.
Lifecycle	2-10 years for finishes; 40 years for plasterboard. Longer lifecycle achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Regular maintenance required and replacement when damaged.
Year	Bi-annually
Priority	Low
Selection process	Decorative and durable finish.
Reference	N/A

5.4 Internal Handrails & Balustrades

Location	Stairs & landings
Description	Mild steel painted balustrade and handrail.
Lifecycle	Over 40 years typical lifecycle. Longer lifecycle achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	Regular inspections of holding down bolts and joints
Year	Annually
Priority	High
Selection process	Hard-wearing long-life materials against timber options
Reference	N/A

5.5 Carpentry & Joinery

5.5.1 Internal Doors and Frames

Location	All buildings
Description	• Selected white primed and painted/varnished solid internal doors, or hardwood veneered internal doors • All fire rated doors and joinery items to be manufactured in accordance with B.S. 476 (Fire tests on building materials and structures). Timber saddle boards. • Brushed aluminium door ironmongery or similar
Lifecycle	30 years average expected lifespan. Longer lifecycle achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	General maintenance in relation to impact damage and general wear and tear
Year	Annual
Priority	Low, unless fire door High
Selection process	Industry standard
Reference	N/A

5.5.2 Skirtings & Architraves

Location	All buildings
Description	Painted timber/MDF skirtings and architraves
Lifecycle	30 years average expected lifespan. Longer lifecycle achieved by regular inspection and maintenance regime to ensure the upkeep of materials.
Required maintenance	General maintenance in relation to impact damage and general wear and tear
Year	Annual
Priority	Low
Selection process	Industry standard
Reference	N/A

5.5.3 Window Boards

Location	All Buildings
Description	Painted timber/MDF window boards
Lifecycle	30 years average expected lifespan
Required maintenance	General maintenance in relation to impact damage and general wear and tear
Year	Annual
Priority	Low
Selection process	Industry standard
Reference	N/A

06

BUILDING SERVICES

6.0 BUILDING SERVICES

6.1 Mechanical Systems

6.1.1 Mechanical Plant

Location	Residential
Description	Water Heating plant is proposed to consist primarily of Air to Water Source Heat Pumps (AWSHP). Further details to be provided by the M&E Consultant at detailed design stage.
Lifecycle	• Annual Maintenance of Air Source Heat Pumps. • Annual Maintenance / Inspection to Heating and Water Pumps. • Annual Maintenance / Inspection to Water Tanks. • Annual Maintenance / Inspection to Booster-sets. • Annual Maintenance / Inspection to DHS Tanks. • Annual Maintenance / Inspection of district heating system pipework, valves, accessories and insulation. • Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage. • Replacement of equipment at End of Life (EOL) to be determined at detailed design stage.
Required maintenance	Annual Service Inspections to be included as part of Development Planned Preventative Maintenance (PPM) Programme.
Year	Annually
Priority	Medium
Selection process	All equipment to be detailed as part of the detailed design section of the development. This equipment will be selected in conjunction with the design and management team to meet and exceed the Chartered Institution of Building Services Engineers of Ireland's (CIBSE) recommended lifecycles.
Reference	N/A

6.1.2 Soils and Wastes

Location	All Areas / Kitchens / Bathrooms etc
Description	Soils and Wastes Pipework – uPVC above basement and High-Density Polyethylene (HDPE) in basement.
Lifecycle	• Annual inspections required for all pipework within landlord areas. • Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.
Required maintenance	Annual Service Inspections to be included as part of Development Planned Preventative Maintenance (PPM) Programme
Year	Annually
Priority	Medium
Selection process	All equipment to be detailed as part of the detailed design section of the development. This equipment will be selected in conjunction with the design and management team to meet and exceed the Chartered Institution of Building Services Engineers of Ireland's (CIBSE) recommended lifecycles.
Reference	N/A

6.1.3 Water Services

Location	Residential
Description	Air to Water Source Heat Pump (AWSHP) for domestic Hot Water • The water services installation within the common basement and core areas will be copper. • Within the apartments, the water services installation will be completed using a pre-insulated multi-layered Alu-Plex type system.
Lifecycle	• Annual inspection of AWSHP. • Annual inspections required for all pipework within landlord areas. • Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.
Required maintenance	Annual Inspections, including legionella testing to be included as part of Development Planned Preventative Maintenance (PPM) Programme
Year	Annually
Priority	High
Selection process	All equipment to be detailed as part of the detailed design section of the development. This equipment will be selected in conjunction with the design and management team to meet and exceed the Chartered Institution of Building Services Engineers of Ireland's (CIBSE) recommended lifecycles.
Reference	N/A

6.1.4 Heating Services

Location	Apartments
Description	Air to Water Source Heat Pump (AWSHP) for domestic Heating
Lifecycle	• Annual Inspection of AWSHP in each unit. • Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.
Required maintenance	Annual Service Inspections to be included as part of Development Planned Preventative Maintenance (PPM) Programme
Year	Annually
Priority	Medium
Selection process	All equipment to be detailed as part of the detailed design section of the development. This equipment will be selected in conjunction with the design and management team to meet and exceed the Chartered Institution of Building Services Engineers of Ireland's (CIBSE) recommended lifecycles.
Reference	N/A

6.1.5 Ventilation Services

Location	Apartments
Description	Mechanical Extract Ventilation (MEV) • Continual extract from wet, utility and kitchen areas. • Controllable trickle vents shall be provided to each habitable room. • Separate extract to each cooker hood.
Lifecycle	• Annual inspection of extract fan and grilles. • Annual Inspection of operation of fan and boost / setback facility if provided on units. • Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.

Required maintenance	Annual Service Inspections to be included as part of Development Planned Preventative Maintenance (PPM) Programme
Year	Annually
Priority	Medium
Selection process	All equipment to be detailed as part of the detailed design section of the development. This equipment will be selected in conjunction with the design and management team to meet and exceed the Chartered Institution of Building Services Engineers of Ireland's (CIBSE) recommended lifecycles.
Reference	N/A

6.2 Electrical / Protective Services

6.2.1 Electrical Infrastructure

Location	Switch rooms / Risers
Description	Maintenance of Electrical Switchgear
Lifecycle	• Annual Inspection of Electrical Switchgear and switchboards. • Thermographic imagining of switchgear 50% of Medium Voltage (MV) Switchgear Annually and Low Voltage (LV) switchgear every 3 years. • Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.
Required maintenance	Annual / Every three years to be included as part of Development Planned Preventative Maintenance (PPM) Programme
Year	Annually
Priority	High
Selection process	All equipment to meet and exceed the Electricity Supply Board (ESB), the National Standards Authority of Ireland's National Rules for Electrical Installations (I.S.10101:2020), Chartered Institution of Building Services Engineers of Ireland's (CIBSE) recommendations and be code compliant in all cases.
Reference	N/A

6.2.2 Lighting Services internal

Location	All Areas – Internal
Description	Lighting – Light-Emitting Diode (LED) throughout with Presence detection in circulation areas and locally controlled in apartments.
Lifecycle	• Annual Inspection of All Luminaires • Quarterly Inspection of Emergency Lighting. • Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.
Required maintenance	Annual / Quarterly Inspections certification as required per above remedial works.
Year	Annually / Quarterly
Priority	High
Selection process	All equipment to meet requirements and be in accordance with the current National Standards Authority of Ireland's National Rules for Emergency Lighting Installations (IS3217:2013 + A1 2017), Part M and Disability Access Certificate (DAC) Requirements.
Reference	N/A

6.2.3 Lighting Services External

Location	All Areas – Internal
Description	Lighting – All Light-Emitting Diode (LED) with Vandal Resistant Diffusers where exposed.
Lifecycle	• Annual Inspection of All Luminaires • Quarterly Inspection of Emergency Lighting • Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.
Required maintenance	Annual / Quarterly Inspections certification as required as per the Planned Preventative Maintenance (PPM) schedule.
Year	Annually / Quarterly
Priority	High
Selection process	All equipment to meet requirements and be in accordance with the current IS3217:2013 + A1 2017, Part M and Disability Access Certificate (DAC) Requirements.
Reference	N/A

6.2.4 Protective Services – Fire Alarm

Location	All areas – Internal
Description	Fire alarm
Lifecycle	• Quarterly Inspection of panels and 25% testing of devices as per IS3218:2013 + A1 2019 requirements. • Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.
Required maintenance	Annual / Quarterly Inspections certification as required as per the Planned Preventative Maintenance (PPM) schedule.
Year	Annually / Quarterly
Priority	High
Selection process	All equipment to meet requirements and be in accordance with the current IS3218:2013 + A1 2019 and the Fire Cert
Reference	N/A

6.2.5 Protective Services – Fire Extinguishers

Location	All Areas – Internal
Description	Fire Extinguishers and Fire Blankets
Lifecycle	Annual Inspection
Required maintenance	Annual with Replacement of all extinguishers at year 10
Year	Annually
Priority	Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.
Selection process	All fire extinguishers must meet the requirements of I.S 291:2015 Selection, commissioning, installation, inspection and maintenance of portable fire extinguishers.
Reference	N/A

6.2.6 Protective Services – Apartment Sprinkler System (Where Applicable by Fire Cert)

Location	Apartments only.
Description	Apartment Sprinkler System
Lifecycle	Weekly / Annual Inspection
Required maintenance	Weekly Check of Sprinkler Pumps and plant and annual testing and certification of plant by specialist.
Year	All
Priority	Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.
Selection process	The Apartment sprinkler system shall be installed in accordance with BS 9251:2005 – Sprinkler Systems for Residential and Domestic Occupancies – Code of Practice
Reference	N/A

6.2.7 Protective Services – Dry Risers

Location	Common Area Cores of apartments
Description	Dry Risers
Lifecycle	Weekly / Annual Inspection
Required maintenance	Visual Weekly Checks of Pipework and Landing Valves with Annual testing and certification by specialist.
Year	Annually
Priority	Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.
Selection process	The system shall be installed in accordance with BS 5041 – Fire Hydrant Systems Equipment & BS 9999 – Effective Fire Safety in the Design, Management and Use of Buildings.
Reference	N/A

6.2.8 Fire Fighting Lobby Ventilation (To Fire Consultants Design and Specification)

Location	Common Area Lobbies
Description	Smoke Extract / Exhaust Systems
Lifecycle	• Regular Tests of the system • Annual inspection of Fans • Annual inspection of automatic doors and Automatic Opening Vents (AOV) • All systems to be backed up by life safety systems.
Required maintenance	Annual Service Inspections to be included as part of Development Planned Preventative Maintenance (PPM) Programme
Year	Weekly / Annually
Priority	Medium
Selection process	All equipment to be detailed as part of the detailed design section of the development. This equipment will be selected in conjunction with the design and management team to meet and exceed the Chartered Institution of Building Services Engineers of Ireland's (CIBSE) recommended lifecycles.
Reference	N/A

6.2.9 Sustainable Services

Location	Apartment
Description	Heat Pump
Lifecycle	• Annual Maintenance of Air to Water Source Heat Pumps • Cost for replacement equipment to be updated on completion of design matrix of equipment at detailed design stage.
Required maintenance	Annual Service Inspections to be included as part of Development Planned Preventative Maintenance Programme
Year	Annually
Priority	Medium
Selection process	All equipment to be detailed as part of the detailed design section of the development. This equipment will be selected in conjunction with the design and management team to meet and exceed the Chartered Institution of Building Services Engineers of Ireland's (CIBSE) recommended lifecycles.
Reference	N/A

07

CONCLUSION & CONTACT DETAILS

7.0 CONCLUSION & CONTACT DETAILS

Based on the information provided, Aramark Property have considered the schemes proposals. From our experience to date of similar schemes we manage, we have set out an overview of how we believe the overarching management of the scheme can be successfully managed in best practice for the benefit of the owners of this scheme, the future occupiers, and the wider community.

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aramark

Appendix I

Horganlynch

Carrigaline Mixed Use Development

Carrigaline, Cork

ENGINEERING SERVICES REPORT

Engineering Services Report

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Review

Prepared By:	Kevin Callaghan
Date:	21st June 2021
Other Contributors:	
Checked by:	Niall FitzGerald

Table of Contents

1.0 Introduction

The proposed development will consist of the following components:

- The construction of 224 no. residential units consisting of 202 no. proposed apartments in 2 no. blocks, ranging in height from 6 to 7 storeys and 22 no. townhouse/duplex units:
- A 184 m^2 creche/childcare facility;
- The provision of landscaping and amenity areas to include 1 no. local play area, 1 no. kick about areas, an activity trail/greenway along the river, a gathering area/amphitheatre with tired seating areas, a civic space/promenade and 2 no. courtyard areas;
- The provision of 3 no. retail units, residential amenity and management spaces at ground and first floor level; and
- All associated ancillary development including vehicular access on to the Kilmoney Road Lower, and a cycle/pedestrian connection on to the R611 (via an activity trail/greenway along the river), lighting, drainage, roads boundary treatments, ESB Substation, bicycle & car parking and bin storage.

The following is an Engineering services report in support of a planning application for the above development. This report addresses the following engineering issues:

a. Foul Effluent Disposal

b. Surface Water Disposal

c. Water Supply

d. Traffic

e. Flood Assessment

2.0 Report

a. Foul Effluent Disposal

The following is the proposed strategy for the disposal of foul effluent generated by the new development:

The foul drainage from the development will be collected by a gravity foul system, which will discharge directly to the proposed new pumping station on the site. The network will consist of 150mm to 225mm diameter upvc pipes laid to falls ranging from 1 in 60 to 1 in 100 collecting the foul waste from the residential and commercial units on the site.

The design and details will all comply with and be adopted from the Irish Water Connection and Developer Services Document for Wastewater Infrastructure Standard Details and Code of Practice.

For details of the above, see Appendix A: Drg. No. LY05-V1-XXX-VR-HLCE-CE-002 Foul Drainage Layout

b. Surface Water Disposal

The following is the proposed strategy for the disposal of surface water generated by the new development:

It is proposed that all surface water generated by the proposed development will be collected via 150mm to 375mm upvc pipes laid to falls ranging from 1 in 100 to 1in 200 and discharging via gravity to the adjacent river. All drains with pass through a Class 1 Bypass separator before discharging to the river.

The surface water drainage will be attenuated and discharge to the river will be restricted to greenfireld run-off of 8.6l/s. The network will be designed to cater for 20% climate change and 1 in 100 year return period. The resulting design requires 600m^2 of attenuated storage which will be located under the covered car park area which is located outside the flood plane. The network is also utilising the green roof which slows down the flow from the roof and therefore the time taken for the run-off from the roof into the storm network increases allowing the runoff from the paved areas at ground level to enter the system and discharge to the river.

A head wall detail and non return valve will be constructed as part of the outfall detail to the river.

For details of the above, see Appendix A: Drg. No. LY05-V1-XXX-VR-HLCE-CE-001 Storm Drainage Layout and Appendix B for Surface Water Calculations.

c. Water Supply

It is proposed to serve the proposed residential units by taking a connection from the existing 180mm diameter PE watermain on Kilmoney Road.

Fire hydrants will be installed to serve the new development and their number and position will be compliant with the Fire Safety Certificate for the development.

A sluice valve will be located immediately upstream of the proposed connection point to the existing watermain.

For details of the above, see Appendix A: Drg. No. LY05-V1-XXX-VR-HLCE-CE-003 Watermain Layout

Watermain installation (mains, sluice valves & hydrants) shall be installed in accordance with the requirements of Irish Water Standard Details and Code of Practice and the Water services section of Cork County Council.

Note: A pre-connection enquiry was submitted to Irish water on the 9th July 2021, in which the above strategy for foul and water supply were proposed. This enquiry included details of the following:

- Foul loadings from the proposed development to the proposed new pumping station
- Water demand for the proposed development
- Confirmation of Feasibility was received on the 31st of August 2021 reference CDS21004834
- Statement of Design Acceptance was received on the 30th of April 2022

See Appendix C: Pre-Connection Enquiry to Irish Water and Confirmation of Feasibility and Statement of Design Acceptance

d. Traffic

The following reports and assessments will be submitted by Martin Hanley Consulting Engineers Ltd. (Traffic and Transport) as part of the traffic and transport engineering scope for this application:

- 1. Traffic & Transport Assessment
- 2. Mobility Management Plan (Travel Plan)
- 3. Road Safety Audit Stage 1/2
- 4. Junction design with vehicle tracking analysis.

Please refer to separate reports and documentation by Martin Hanley Consulting Engineers Ltd.

e. Flood Assessment

A full site-specific Flood Risk Assessment will be carried out by ARUP as part of the submission. The FRA will meet the requirements detailed in *'The Planning System and Flood Risk Management Guidelines for Planning Authorities'* (2009), prepared by the then Department of Environment, Heritage and Local Government (DEHLG) and the Office of Public Works (OPW). The FRA will also be in line with the guidance included in the Draft Strategic Flood Risk Assessment for Ballincollig - Carrigaline Municipal District Local Area Plan (November 2020).

Please refer to separate reports and documentation by ARUP

Appendix A -

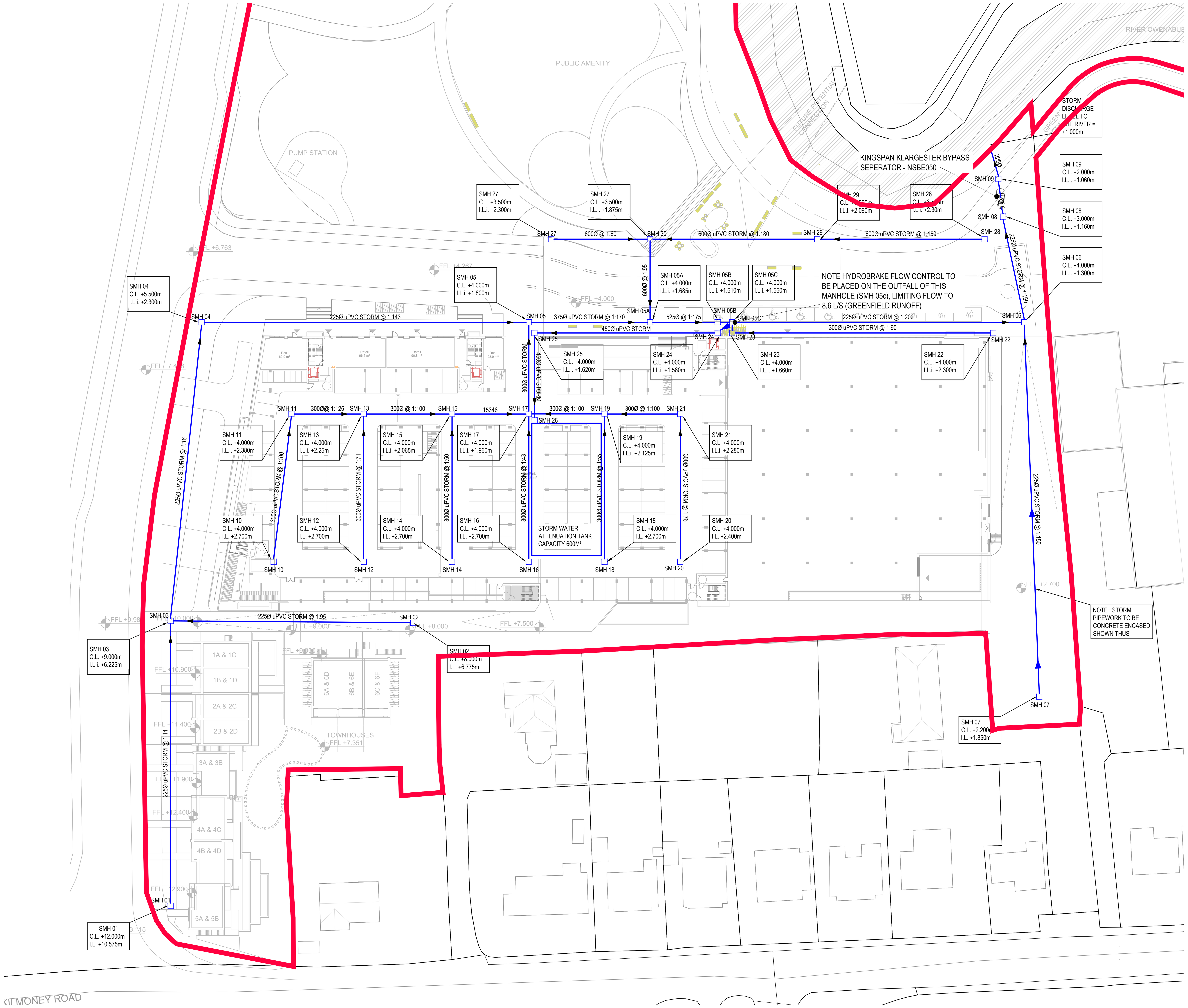
Site Services Drawings:

Drg. No. LY05-V1-XXX-VR-HLCE-CE-001 Storm Drainage Layout

Drg. No. LY05-V1-XXX-VR-HLCE-CE-002 Foul Drainage Layout

Drg. No. LY05-V1-XXX-VR-HLCE-CE-003 Watermain Layout

Drg. No. LY05-V1-XXX-VR-HLCE-CE-007 Foul Drainage Long Sections



SITE PLAN

SCALE 1:500

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2) THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECT'S, SERVICES ENGINEER'S AND HORGANLYNCH DRAWINGS, DETAILS AND SPECIFICATIONS.
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0	SC	KC	16.07.21	ISSUED FOR PRE-PLANNING
1	KL	KC	14.09.21	ISSUED FOR INFORMATION
2	SC	KC	06.10.21	ISSUED FOR PRE-APPLICATION
3	KL	KC	05.05.2022	ISSUED FOR PLANNING APPLICATION

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PROJECT
HALLMARK DEVELOPMENTS
CARRAIGALINE SHD, CORK

DRG. TITLE
SITE SERVICES
STORM LAYOUT

SCALE	DRAWN BY	CHECKED BY	APPROVED BY
AS SHOWN (@ A1)	SC	KC	KC

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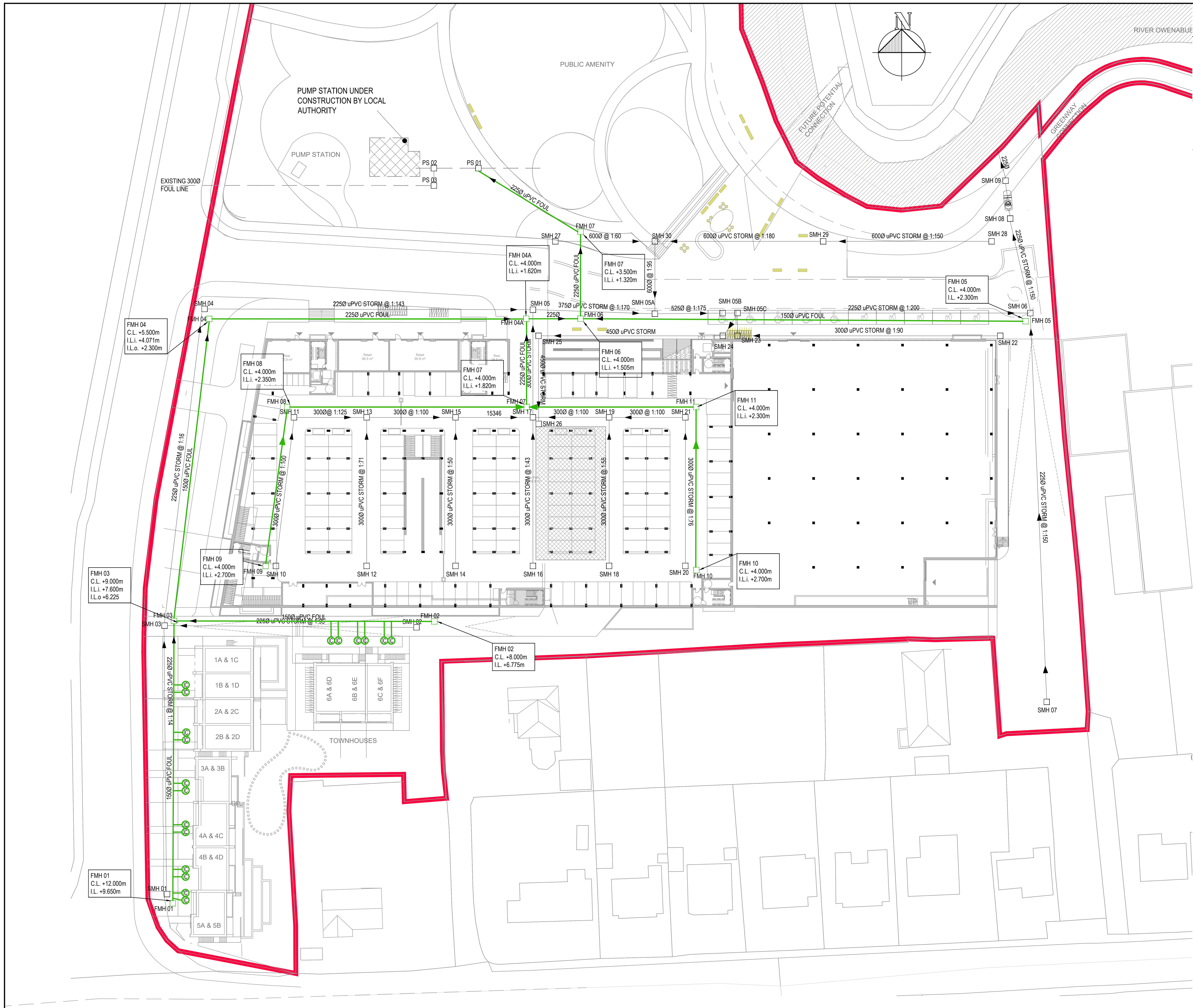
HL PROJECT REF.	STATUS	REVISION
LY05	P1	3



PROPOSED FOUL LAYOUT PLAN

SCALE 1:500

— — — PROPOSED FOUL PUMP MAINS

IC PROPOSED INSPECTION CHAMBERS

FMH 04 PROPOSED FOUL DRAINAGE MANHOLES

PROPOSED 225mm Ø FOUL DRAIN (FALL 1:100) PROPOSED FOUL NETWORK

SMH 04 PROPOSED STORM DRAINAGE MANHOLES

PROPOSED 225mm Ø STORM DRAIN (FALL 1:100) PROPOSED STORM NETWORK

LEVELS CLOUDED TO BE CONFIRMED

ALL WASTERWATER DETAILS ARE TO COMPLY WITH AND BE ADOPTED FROM THE IRISH WATER - CONNECTION AND DEVELOPER SERVICES DOCUMENT FOR WASTEWATER INFRASTRUCTURE STANDARD DETAILS. REF TO IRISH WATER DOCUMENT No IW-CDS-5030-01
CONTRACTOR IS ALSO TO REFER TO THE CODE OF PRACTICE FOR WASTEWATER INFRASTRUCTURE DOCUMENT. CONNECTIONS AND DEVELOPER SERVICES. DESIGN AND CONSTRUCTION REQUIREMENTS FOR SELF LAY DEVELOPMENTS DOCUMENT IW-CDS-5030-03

PIPE COVER CHART: WITHOUT CONCRETE ENCASEMENT	
LOCATION: MIN.COVER.	
SEWERS IN ROAD	1200
SEWERS IN OPEN SPACES	-
NOT ADJACENT TO ROADS	900
SEWERS IN GARDENS	600
WATERMAINS ALL LOCATIONS	900
WATER SERVICES ALL LOCATONS	600
ELEC/ESB CABLE DUCTS IN ROADWAY	900
ELEC/ESB CABLE DUCTS IN FOOTPATHS	500
NATURAL GAS MAINS IN ROADWAYS	800
NATURAL GAS MAINS IN FOOTPATHS	600
TELECOM DUCTS IN ROADWAYS	750
TELECOM DUCTS IN FOOTPATHS	350
CABLE TV DUCTS IN ROADS & FOOTPATHS	450

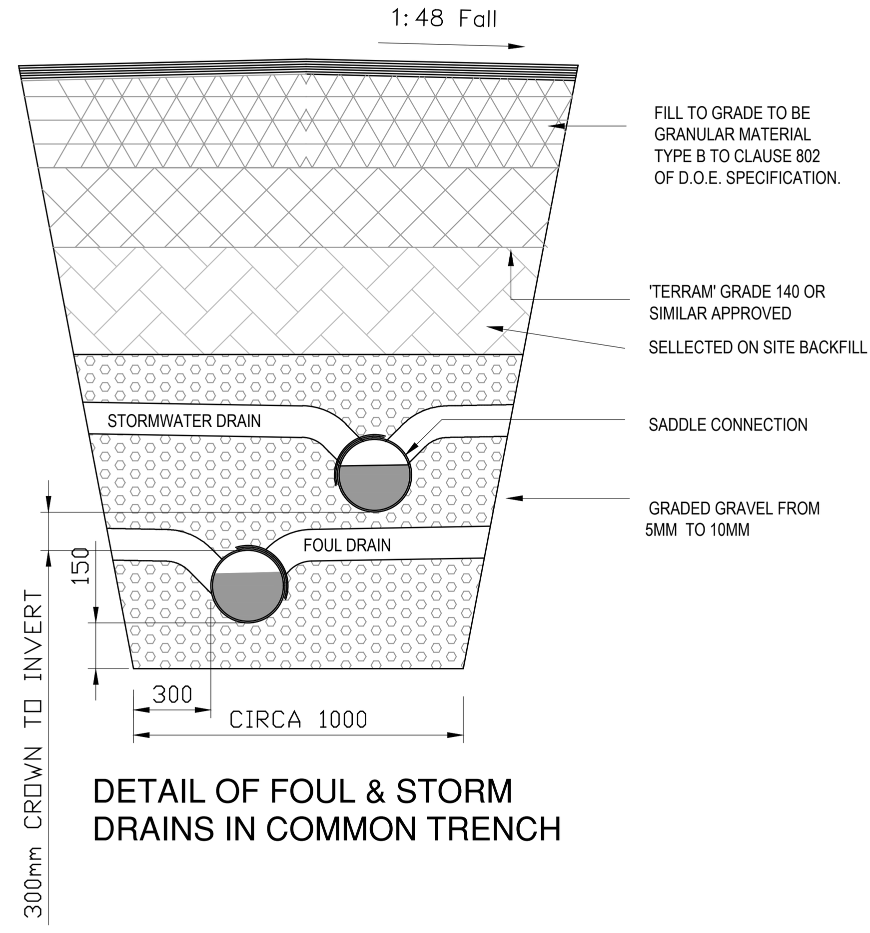
GENERAL NOTES:

1) ALL FOUL SEWER PIPES TO BE uPVC & COMPLY WITH THE PROVISIONS IS EN 1401 2009/2012. PIPES TO BE APPLICATION AREA CODE 'UD' STIFFNESS CLASS 8kN/m² (SN8), WITH A JETTING REISISTANCE OF 2600 psi (180 Bar).
2) ALL PIPES TO BE A MINIMUM DISTANCE OF 1m (TO FACE) FROM ROAD KERB.
3) ALL MANHOLES TO BE A MINIMUM DISTANCE OF 0.5m FROM THE KERB.
LOCATION OF ALL FOUL DRAINAGE IS INDICATIVE / REPRESENTATIVE ONLY. EXACT SET OUT OF FOUL DRAINAGE TO BE LOCATED ON SITE IN ACCORDANCE WITH IRISH WATER DETAILS.
4) MINIMUM SEPERATION OF ALL SERVICES ON SITE TO BE AS PER IRISH WATER DETAIL STD-W-05
5) MINIMUM OF 3M SEPERATION TO ALL WASTEWATER NETWORK FROM PROPERTIES
6) ALL INSPECTION CHAMBERS FOR PROPERTIES TO BE CONSTRUCTED IN ACCORDANCE WITH IRISH WATER TYPICAL DETAILS. PLEASE REF STD-WW-02 & STD-WW-03
7) WHERE MANHOLE COVERS TO BE LOCATED IN SOFT LANDSCAPED/GRASS AREAS; TO ENSURE THAT ALL MANHOLE COVERS ARE IDENTIFIABLE, ACCESSIBLE AND WILL NOT BECOME OVERGROWN, COVERS ARE TO BE SURROUNDED BY A CONCRETE PLINTH, 200MM ALL ROUND AND 100MM DEEP FORMED WITH C20/25 CONCRETE, 20MM AGGREGATE SIZE, BEDDED IN CLAUSE 804 MATERIAL.

WATER TEST:
8) FOUL & STORM SEWERS SHOULD BE TESTED FOR A MIN OF 30 MINUTES, UNDER A HEAD OF NOT LESS THAN 1M OR GREATER THAN 2.5M
OVER THE HIGEST POINT ON THE LINE UNDER TEST; THE PIPELINE SHOULD 'STAND' FOR A PERIOD 2 HOURS AFTER FILLING AND TOPPED UP AS NECESSARY BEFORE COMMENCING THE TEST. THE MAXIMUM AMOUNT OF WATER LOSS SHOULD BE IN ACCORDANCE WITH LOCAL AUTHORITY GUIDLINES

9) AN AIR TEST MAY BE CARRIED OUT IN LIEU OF THE ABOVE AND IN ACCORDANCE WITH LOCAL AUTHORITY GUIDLINES

10) AT TIME OF COMPLETION THE DEVELOPER SHOULD ENSURE THAT ALL DRAINS WITHIN THE SITE ARE CLEAN AND FREE OF OBSTRUCTIONS
11) A CONDITION SURVEY SHOULD ALSO BE CARRIED OUT VIA CCTV FOOTAGE AND PRESENTED TO THE LOCAL AUTHORITY PRIOR TO SITE HANDOVER



DETAIL OF FOUL & STORM DRAINS IN COMMON TRENCH

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2	SC	KC	06.10.21	ISSUED FOR PRE-APPLICATION
3	KL	KC	27.04.22	ISSUED FOR IRISH WATER STATEMENT OF DESIGN ACCEPTANCE
4	KL	KC	28.04.22	IRISH WATER COMMENTS INCORPORTATED
5	KL	KC	05.05.2022	ISSUED FOR PLANNING APPLICATION

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PROJECT
HALLMARK DEVELOPMENTS
CARRAIGALINE SHD, CORK

DRG. TITLE
SITE SERVICES
FOUL LAYOUT

SCALE	DRAWN BY	CHECKED BY	APPROVED BY
AS SHOWN (@ A1)	SC	KC	KC

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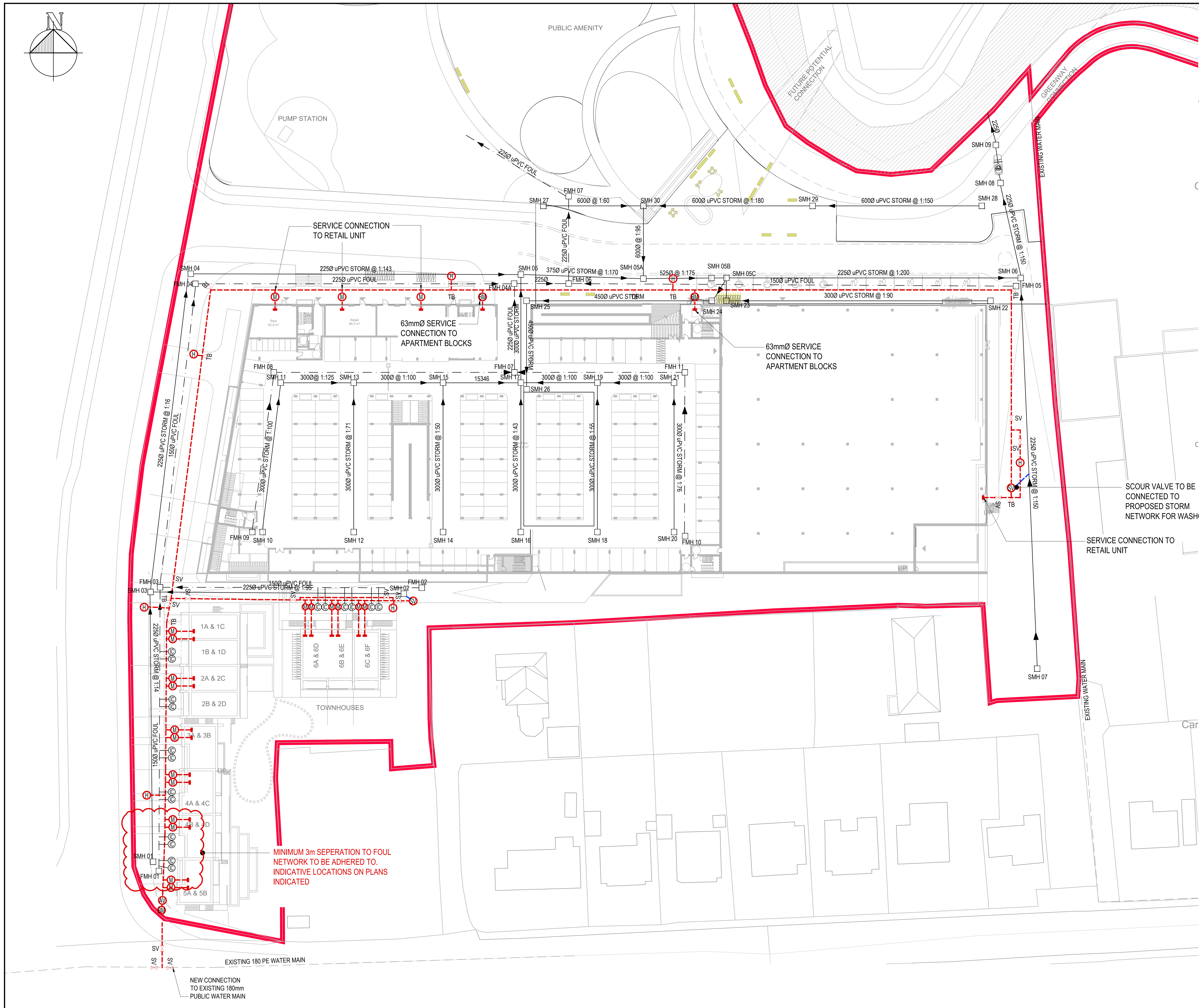
HL PROJECT REF.	STATUS	REVISION
LY05	P1	5



PROPOSED WATER SUPPLY PLAN
SCALE 1:500

FMH 04	PROPOSED FOUL DRAINAGE MANHOLES
PROPOSED 225mm Ø FOUL DRAIN (FALL 1:100)	PROPOSED FOUL NETWORK
SMH 04	PROPOSED STORM DRAINAGE MANHOLES
PROPOSED 225mm Ø STORM DRAIN (FALL 1:100)	PROPOSED STORM NETWORK
PROPOSED WATERMAIN	PROPOSED 150Ø HDPE WATERMAIN SUPPLY
EXISTING WATERMAIN	EXISTING CORK CITY COUNCIL WATERMAIN
BM	PROPOSED BULK METER BOX
TB	PROPOSED THRUST BLOCKS
M	PROPOSED WATER METER
H	PROPOSED FIRE HYDRANT
AV	PROPOSED AIR VALVE
SV	PROPOSED SCOUR VALVE
SV	PROPOSED SLUICE VALVE

ALL WATERSUPPLY DETAILS ARE TO COMPLY WITH AND BE ADOPTED FROM THE IRISH WATER - CONNECTION AND DEVELOPER SERVICES DOCUMENT FOR WATER INFRASTRUCTURE STANDARD DETAILS. REF TO IRISH WATER DOCUMENT No IW-CDS-5020-01.
CONTRACTOR IS ALSO TO REFER TO THE CODE OF PRACTICE FOR WATER INFRASTRUCTURE DOCUMENT. CONNECTIONS AND DEVELOPER SERVICES. DESIGN AND CONSTRUCTION REQUIREMENTS FOR SELF LAY DEVELOPMENTS DOCUMENT IW-CDS-5020-03

PIPE COVER CHART: WITHOUT CONCRETE ENCASEMENT

LOCATION:	MIN.COVER.
SEWERS IN ROAD	1200
SEWERS IN OPEN SPACES	-
NOT ADJACENT TO ROADS	900
SEWERS IN GARDENS	600
WATERMAINS ALL LOCATIONS	900
WATER SERVICES ALL LOCATONS	600
ELEC/ESB CABLE DUCTS IN ROADWAY	900
ELEC/ESB CABLE DUCTS IN FOOTPATHS	500
NATURAL GAS MAINS IN ROADWAYS	800
NATURAL GAS MAINS IN FOOTPATHS	600
TELECOM DUCTS IN ROADWAYS	750
TELECOM DUCTS IN FOOTPATHS	350
CABLE TV DUCTS IN ROADS & FOOTPATHS	450

1.) WATERMAIN TO BE 150Ø FOR MAIN CIRCULATION ROUTE, BRANCH MAINS TO BE 100Ø
ALL WATERMAIN LINES TO BE CLASS C 10 BAR PRESSURE.
WATERMAIN TO BE LAID A MINIMUM OF 3m FROM PROPOSED STRUCTURE

2.) EACH PREMISE SHALL HAVE :
- AN INDIVIDUAL WATER SUPPLY, TAKEN FROM A MANIFOLD BOX.
- THE MANIFOLD BOX SHALL BE LOCATED ON THE FOOTPATH OUTSIDE THE BUILDING AS CLOSE TO PROPERTY BOUNDARY AS POSSIBLE.
INDIVIDUAL WATER METERS ARE REQUIRED FOR EACH INDIVIDUAL PREMISE.

3.) THE DEVELOPER SHALL MAKE PROVISION FOR ANY REDUNDANT EXISTING WATER SERVICES CONNECTIONS, ALL REDUNDANT EXISTING WATER SERVICES CONNECTIONS SHALL BE TRACED BACK TO THE PUBLIC MAIN BY THE DEVELOPER OR IRISH WATER THROUGH THE CONNECTION AGREEMENT AND SHALL BE BLANKED OFF AT THE DEVELOPERS EXPENSE.

4.) ALL FIRE HYDRANTS WILL BE ACCESSIBLE IN AN EMERGENCY, REFER TO SECTION 3.5 OF WATER CODE OF PRACTICE.

5.) ALL PLANTING OF NEW TREES/SHRUBS ADJACENT TO THE WATERMAIN SHALL COMPLY WITH IRISH WATER STANDARD DETAIL STD-W-12A.

6.) THRUST BLOCKS TO BE PROVIDED ON WATERMAINS AT DEAD ENDS, TEES, BENDS & AT BOTH SIDES OF A SLUICE VALVE CHAMBER, ALL DETAILS TO CONFORM WITH IRISH WATER STANDARD DETAILS DOCUMENT No IW-CDS-5020, ALL INCLUDED WITH THE SPECIFICATIONS DOCUMENTS.

7) LOCATION OF ALL WATERMAINS ARE INDICATIVE / REPRESENTATIVE ONLY. EXACT SET OUT OF WATERMAIN TO BE LOCATED ON SITE IN ACCORDANCE WITH IRISH WATER DETAILS.

8) MINIMUM SEPERATION OF ALL SERVICES ON SITE TO BE AS PER IRISH WATER DETAIL STD-W-11
MINIMUM SEPERATION DISTANCES AS FOLLOWS
HORIZONTAL
300mm TO DISTRIBUTION MAINS OF LESS THAN 300mm DIAMETER
500mm TO TRUNK MAINS BETWEEN 300mm AND 450mm DIAMETER
3m TO TRUNK / ARTERIAL MAINS OF GREATER THAN 450mm DIAMETER
VERTICAL
300mm TO DISTRIBUTION MAINS OF LESS THAN 300mm DIAMETER
500mm TO TRUNK / ARTERIAL MAINS OF DIAMETER GREATER THAN 300mm

9) MINIMUM OF 1M SEPERATION TO ALL WATERMAINS FROM PROPERTY BOUNDARIES

2) THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECT'S, SERVICES ENGINEER'S AND HORGANLYNCH DRAWINGS, DETAILS AND SPECIFICATIONS.
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3	KL	KC	27.04.22	ISSUED FOR IRISH WATER STATEMENT OF DESIGN ACCEPTANCE
4	KL	KC	28.04.22	IRISH WATER COMMENTS INCORPORTATED
5	KL	KC	28.04.22	LOOP REVISED - REISSUED FOR STATEMENT OF DESIGN ACCEPTANCE
6	KL	KC	05.05.2022	ISSUED FOR PLANNING APPLICATION

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PROJECT
HALLMARK DEVELOPMENTS
CARRAIGALINE SHD, CORK

DRG. TITLE
SITE SERVICES
WATERMAIN LAYOUT

SCALE	DRAWN BY	CHECKED BY	APPROVED BY
AS SHOWN (@ A1)	SC	KC	KC

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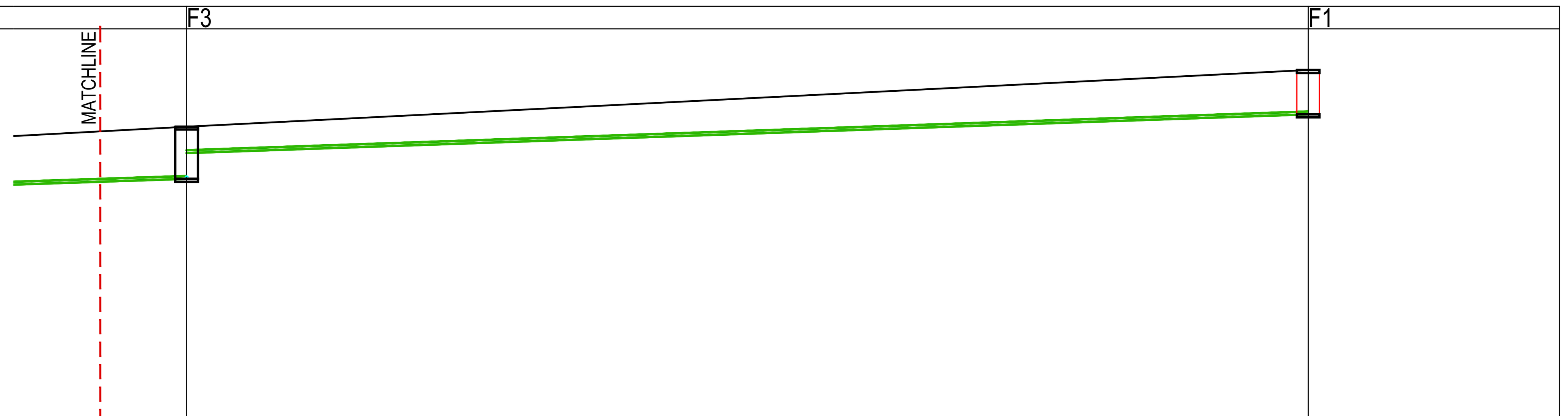
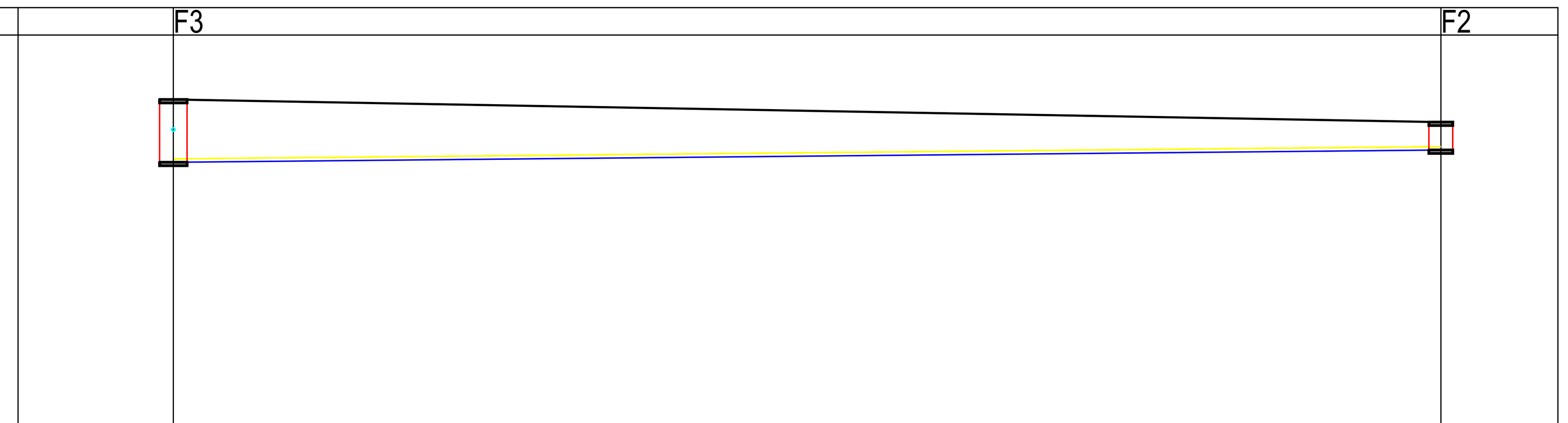
DRAWING: LY05-V1-XXX-DR-HLCE-CE-0003

HL PROJECT REF.	STATUS	REVISION
LY05	P1	6

MH Name	CONNECTION TO PUMP MAINS		F7		F6		F4A		F4		F3
Datum (m)-7.000											
PN		F1.005		F1.004		F1.003		F1.002		F1.001	
Dia (mm)		225		225		225		225		150	
Slope (1:X)		100.0		100.0		99.7		100.0		30.0	
Cover Level (m)	3.000		3.500		4.000		4.000		5.500		9.000
Invert Level (m)	1.081		1.319 1.319		1.506 1.506		1.621 1.621		4.071 2.300		7.602 6.233
Length (m)		23.782		18.678		11.468		67.883		64.868	



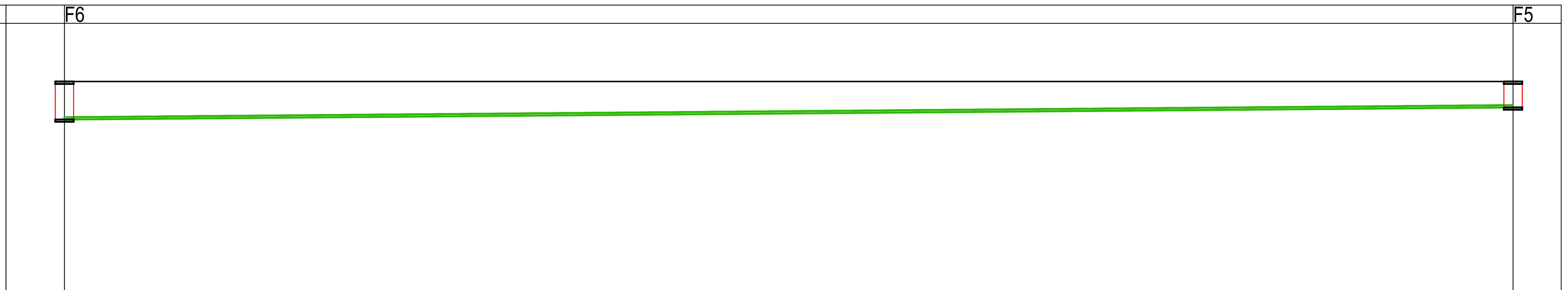
MH Name	F3		F1
Datum (m)-7.000			
PN		F1.000	
Dia (mm)		150	
Slope (1:X)		29.0	
Cover Level (m)	9.000		12.000
Invert Level (m)	7.602 6.233		9.650
Length (m)		59.393	



MH Name	F3		F2
Datum (m)-6.000			
PN		F2.000	
Dia (mm)		150	
Slope (1:X)		102.9	
Cover Level (m)	9.000		8.000
Invert Level (m)	6.233		6.775
Length (m)		55.728	

FOUL LONGSECTIONS

VERTICAL SCALE 1:250
HORIZONTAL SCALE 1:250



MH Name	F6		F5
Datum (m)-11.000			
PN		F3.000	
Dia (mm)		150	
Slope (1:X)		120.0	
Cover Level (m)	4.000		4.000
Invert Level (m)	1.506		2.300
Length (m)		95.195	

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0	KL	KC	27.04.22	ISSUED FOR IRISH WATER STATEMENT OF DESIGN ACCEPTANCE
1	KL	KC	05.05.22	ISSUED FOR PLANNING APPLICATION

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PROJECT
HALLMARK DEVELOPMENTS
CARRAIGALINE SHD, CORK

DRG. TITLE
SITE SERVICES
FOUL LONG SECTIONS

SCALE	DRAWN BY	CHECKED BY	APPROVED BY
AS SHOWN (@ A1)	SC	KC	KC

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DWG: LY05-V1-XXX-DR-HLCE-CE-0007

HL PROJECT REF.	STATUS	REVISION
LY05	P1	1

Appendix B – Surface Water Drainage Calculations

Existing Network Details for Storm

* - Indicates pipe has been modified outside of System 1

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
*	S1.000	31.780	0.212	149.9	0.131	15.00	0.600	o	600	Pipe/Conduit
*	S1.001	38.272	0.212	180.5	0.000	0.00	0.600	o	600	Pipe/Conduit
*	S2.000	20.693	0.353	58.6	0.081	15.00	0.600	o	600	Pipe/Conduit
*	S1.002	18.158	0.192	94.6	0.000	0.00	0.600	o	600	Pipe/Conduit
*	S1.003	0.952	0.012	79.3	0.000	0.00	0.600	o	600	Pipe/Conduit
	S3.000	61.298	4.350	14.1	0.088	15.00	0.600	o	225	Pipe/Conduit
	S4.000	52.403	0.550	95.3	0.096	15.00	0.600	o	225	Pipe/Conduit
	S3.001	64.476	3.931	16.4	0.000	0.00	0.600	o	225	Pipe/Conduit
	S3.002	70.438	0.492	143.1	0.000	0.00	0.600	o	225	Pipe/Conduit
*	S5.000	31.758	0.636	49.9	0.063	15.00	0.600	o	300	Pipe/Conduit
*	S6.000	31.778	0.446	71.3	0.051	15.00	0.600	o	300	Pipe/Conduit
*	S7.000	32.149	0.321	100.2	0.063	15.00	0.600	o	300	Pipe/Conduit
*	S7.001	15.534	0.125	124.3	0.057	0.00	0.600	o	300	Pipe/Conduit
*	S6.001	19.027	0.190	100.1	0.056	0.00	0.600	o	300	Pipe/Conduit
*	S5.001	16.530	0.105	157.4	0.000	0.00	0.600	o	300	Pipe/Conduit
*	S8.000	31.829	0.741	43.0	0.049	15.00	0.600	o	300	Pipe/Conduit
*	S9.000	31.817	0.419	75.9	0.058	15.00	0.600	o	300	Pipe/Conduit
*	S9.001	16.285	0.159	102.4	0.065	0.00	0.600	o	300	Pipe/Conduit
*	S10.000	31.764	0.578	55.0	0.048	15.00	0.600	o	300	Pipe/Conduit
*	S9.002	16.302	0.163	100.0	0.036	0.00	0.600	o	300	Pipe/Conduit
*	S5.002	19.658	0.157	125.2	0.046	0.00	0.600	o	300	Pipe/Conduit

	PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
*	S1.000	26	3.500	2.300	0.600	3.500	2.088	0.812		2000
*	S1.001	2	3.500	2.088	0.812	3.500	1.876	1.024		2000
*	S2.000	28	3.500	2.300	0.600	3.500	1.947	0.953		2000
*	S1.002	27	3.500	1.875	1.025	4.000	1.683	1.717		2000
*	S1.003	4	4.000	1.683	1.717	4.000	1.671	1.729	Non Return Valve	1500
	S3.000	1	12.000	10.575	1.200	9.000	6.225	2.550		1200
	S4.000	7	8.000	6.775	1.000	9.000	6.225	2.550		1200
	S3.001	2	9.000	6.225	2.550	5.500	2.294	2.981		1200
	S3.002	3	5.500	2.294	2.981	4.000	1.802	1.973		1200
*	S5.000	14	4.000	2.700	1.000	4.000	2.064	1.636		1500
*	S6.000	13	4.000	2.700	1.000	4.000	2.254	1.446		1500
*	S7.000	8	4.000	2.700	1.000	4.000	2.379	1.321		1500
*	S7.001	9	4.000	2.379	1.321	4.000	2.254	1.446		1500
*	S6.001	10	4.000	2.254	1.446	4.000	2.064	1.636		1500
*	S5.001	11	4.000	2.064	1.636	4.000	1.959	1.741		1500
*	S8.000	15	4.000	2.700	1.000	4.000	1.959	1.741		1500
*	S9.000	17	4.000	2.700	1.000	4.000	2.281	1.419		1500
*	S9.001	18	4.000	2.281	1.419	4.000	2.122	1.578		1500
*	S10.000	16	4.000	2.700	1.000	4.000	2.122	1.578		1500
*	S9.002	19	4.000	2.122	1.578	4.000	1.959	1.741		1500
*	S5.002	12	4.000	1.959	1.741	4.000	1.802	1.898		1500

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
S3.003	25.236	0.144	175.3	0.000	0.00	0.600	o	375	Pipe/Conduit
S1.004	15.677	0.049	319.9	0.000	0.00	0.600	o	375	Pipe/Conduit
S1.005	1.511	0.049	30.8	0.000	0.00	0.600	o	375	Pipe/Conduit
* S11.000	19.741	0.039	506.2	0.000	15.00	0.600	o	450	Pipe/Conduit
* S11.001	39.566	0.079	500.8	0.091	0.00	0.600	o	450	Pipe/Conduit
* S11.002	2.747	0.005	549.4	0.000	0.00	0.600	o	450	Pipe/Conduit
S12.000	57.224	0.634	90.3	0.232	15.00	0.600	o	300	Pipe/Conduit
S12.001	2.014	0.106	18.9	0.000	0.00	0.600	o	300	Pipe/Conduit
S1.006	64.261	0.260	247.2	0.000	0.00	0.600	o	525	Pipe/Conduit
S13.000	80.649	0.550	146.6	0.000	15.00	0.600	o	225	Pipe/Conduit
S1.007	23.248	0.133	174.8	0.000	0.00	0.600	o	525	Pipe/Conduit
S1.008	8.076	0.046	175.6	0.000	0.00	0.600	o	525	Pipe/Conduit

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
S3.003	4	4.000	1.802	1.823	4.000	1.658	1.967		1200
S1.004	18	4.000	1.658	1.967	4.000	1.609	2.016		1200
S1.005	23	4.000	1.609	2.016	4.000	1.560	2.065	Non Return Valve	1200
* S11.000	21	3.500	1.687	1.363	4.000	1.648	1.902		1500
* S11.001	22	4.000	1.648	1.902	4.000	1.569	1.981		1500
* S11.002	23	4.000	1.569	1.981	4.000	1.564	1.986		1500
S12.000	25	4.000	2.300	1.400	4.000	1.666	2.034		1200
S12.001	29	4.000	1.666	2.034	4.000	1.560	2.140	Non Return Valve	1200
S1.006	18	4.000	1.560	1.915	4.000	1.300	2.175	Hydro-Brake®	1200
S13.000	24	2.200	1.850	0.125	4.000	1.300	2.475		1200
S1.007	5	4.000	1.300	2.175	3.000	1.167	1.308		1200
S1.008	6	3.000	1.167	1.308	2.000	1.121	0.354		1200

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S26	3.500	1.200	Open Manhole	2000	S1.000	2.300	600				
S2	3.500	1.412	Open Manhole	2000	S1.001	2.088	600	S1.000	2.088	600	
S28	3.500	1.200	Open Manhole	2000	S2.000	2.300	600				
S27	3.500	1.625	Open Manhole	2000	S1.002	1.875	600	S1.001	1.876	600	1
								S2.000	1.947	600	72
S4	4.000	2.317	Open Manhole	1500	S1.003	1.683	600	S1.002	1.683	600	
S1	12.000	1.425	Open Manhole	1200	S3.000	10.575	225				
S7	8.000	1.225	Open Manhole	1200	S4.000	6.775	225				
S2	9.000	2.775	Open Manhole	1200	S3.001	6.225	225	S3.000	6.225	225	
								S4.000	6.225	225	
S3	5.500	3.206	Open Manhole	1200	S3.002	2.294	225	S3.001	2.294	225	
S14	4.000	1.300	Open Manhole	1500	S5.000	2.700	300				
S13	4.000	1.300	Open Manhole	1500	S6.000	2.700	300				
S8	4.000	1.300	Open Manhole	1500	S7.000	2.700	300				
S9	4.000	1.621	Open Manhole	1500	S7.001	2.379	300	S7.000	2.379	300	
S10	4.000	1.746	Open Manhole	1500	S6.001	2.254	300	S6.000	2.254	300	
								S7.001	2.254	300	
S11	4.000	1.936	Open Manhole	1500	S5.001	2.064	300	S5.000	2.064	300	
								S6.001	2.064	300	
S15	4.000	1.300	Open Manhole	1500	S8.000	2.700	300				
S17	4.000	1.300	Open Manhole	1500	S9.000	2.700	300				
S18	4.000	1.719	Open Manhole	1500	S9.001	2.281	300	S9.000	2.281	300	
S16	4.000	1.300	Open Manhole	1500	S10.000	2.700	300				
S19	4.000	1.878	Open Manhole	1500	S9.002	2.122	300	S9.001	2.122	300	
								S10.000	2.122	300	
S12	4.000	2.041	Open Manhole	1500	S5.002	1.959	300	S5.001	1.959	300	
								S8.000	1.959	300	
								S9.002	1.959	300	
S4	4.000	2.198	Open Manhole	1200	S3.003	1.802	375	S3.002	1.802	225	
								S5.002	1.802	300	
S18	4.000	2.342	Open Manhole	1200	S1.004	1.658	375	S1.003	1.671	600	238
								S3.003	1.658	375	
S23	4.000	2.391	Open Manhole	1200	S1.005	1.609	375	S1.004	1.609	375	
S21	3.500	1.813	Open Manhole	1500	S11.000	1.687	450				
S22	4.000	2.352	Open Manhole	1500	S11.001	1.648	450	S11.000	1.648	450	
S23	4.000	2.431	Open Manhole	1500	S11.002	1.569	450	S11.001	1.569	450	
S25	4.000	1.700	Open Manhole	1200	S12.000	2.300	300				
S29	4.000	2.334	Open Manhole	1200	S12.001	1.666	300	S12.000	1.666	300	
S18	4.000	2.440	Open Manhole	1200	S1.006	1.560	525	S1.005	1.560	375	
								S11.002	1.564	450	
								S12.001	1.560	300	
S24	2.200	0.350	Open Manhole	1200	S13.000	1.850	225				
S5	4.000	2.700	Open Manhole	1200	S1.007	1.300	525	S1.006	1.300	525	
								S13.000	1.300	225	
S6	3.000	1.833	Open Manhole	1200	S1.008	1.167	525	S1.007	1.167	525	
S	2.000	0.879	Open Manhole	0		OUTFALL		S1.008	1.121	525	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S26	572731.031	562374.549	572731.031	562374.549	Required	
S2	572699.251	562374.529	572699.251	562374.529	Required	
S28	572640.287	562374.716	572640.287	562374.716	Required	
S27	572660.979	562374.509	572660.979	562374.509	Required	
S4	572661.022	562356.350	572661.022	562356.350	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	572558.766	562229.826	572558.766	562229.826	Required	
S7	572611.136	562290.839	572611.136	562290.839	Required	
S2	572558.733	562291.124	572558.733	562291.124	Required	
S3	572565.358	562355.259	572565.358	562355.259	Required	
S14	572619.288	562303.903	572619.288	562303.903	Required	
S13	572600.283	562303.879	572600.283	562303.879	Required	
S8	572581.038	562303.892	572581.038	562303.892	Required	
S9	572584.711	562335.830	572584.711	562335.830	Required	
S10	572600.245	562335.657	572600.245	562335.657	Required	
S11	572619.272	562335.661	572619.272	562335.661	Required	
S15	572635.857	562303.926	572635.857	562303.926	Required	
S17	572668.389	562303.876	572668.389	562303.876	Required	
S18	572668.389	562335.693	572668.389	562335.693	Required	
S16	572652.141	562303.932	572652.141	562303.932	Required	
S19	572652.104	562335.696	572652.104	562335.696	Required	
S12	572635.802	562335.755	572635.802	562335.755	Required	
S4	572635.796	562355.413	572635.796	562355.413	Required	
S18	572661.032	562355.399	572661.032	562355.399	Required	
S23	572676.709	562355.399	572676.709	562355.399	Required	
S21	572636.766	562333.662	572636.766	562333.662	Required	
S22	572636.766	562353.404	572636.766	562353.404	Required	
S23	572676.332	562353.404	572676.332	562353.404	Required	
S25	572735.443	562353.477	572735.443	562353.477	Required	
S29	572678.219	562353.385	572678.219	562353.385	Required	
S18	572678.221	562355.399	572678.221	562355.399	Required	
S24	572745.671	562274.791	572745.671	562274.791	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S5	572742.481	562355.377	572742.481	562355.377	Required	
S6	572737.861	562378.162	572737.861	562378.162	Required	
S	572736.849	562386.174			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	600	S26	3.500	2.300	0.600	Open Manhole	2000
S1.001	o	600	S2	3.500	2.088	0.812	Open Manhole	2000
S2.000	o	600	S28	3.500	2.300	0.600	Open Manhole	2000
S1.002	o	600	S27	3.500	1.875	1.025	Open Manhole	2000
S1.003	o	600	S4	4.000	1.683	1.717	Open Manhole	1500
S3.000	o	225	S1	12.000	10.575	1.200	Open Manhole	1200
S4.000	o	225	S7	8.000	6.775	1.000	Open Manhole	1200
S3.001	o	225	S2	9.000	6.225	2.550	Open Manhole	1200
S3.002	o	225	S3	5.500	2.294	2.981	Open Manhole	1200
S5.000	o	300	S14	4.000	2.700	1.000	Open Manhole	1500
S6.000	o	300	S13	4.000	2.700	1.000	Open Manhole	1500
S7.000	o	300	S8	4.000	2.700	1.000	Open Manhole	1500
S7.001	o	300	S9	4.000	2.379	1.321	Open Manhole	1500
S6.001	o	300	S10	4.000	2.254	1.446	Open Manhole	1500
S5.001	o	300	S11	4.000	2.064	1.636	Open Manhole	1500
S8.000	o	300	S15	4.000	2.700	1.000	Open Manhole	1500
S9.000	o	300	S17	4.000	2.700	1.000	Open Manhole	1500
S9.001	o	300	S18	4.000	2.281	1.419	Open Manhole	1500
S10.000	o	300	S16	4.000	2.700	1.000	Open Manhole	1500
S9.002	o	300	S19	4.000	2.122	1.578	Open Manhole	1500
S5.002	o	300	S12	4.000	1.959	1.741	Open Manhole	1500
S3.003	o	375	S4	4.000	1.802	1.823	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	31.780	149.9	S2	3.500	2.088	0.812	Open Manhole	2000
S1.001	38.272	180.5	S27	3.500	1.876	1.024	Open Manhole	2000
S2.000	20.693	58.6	S27	3.500	1.947	0.953	Open Manhole	2000
S1.002	18.158	94.6	S4	4.000	1.683	1.717	Open Manhole	1500
S1.003	0.952	79.3	S18	4.000	1.671	1.729	Open Manhole	1200
S3.000	61.298	14.1	S2	9.000	6.225	2.550	Open Manhole	1200
S4.000	52.403	95.3	S2	9.000	6.225	2.550	Open Manhole	1200
S3.001	64.476	16.4	S3	5.500	2.294	2.981	Open Manhole	1200
S3.002	70.438	143.1	S4	4.000	1.802	1.973	Open Manhole	1200
S5.000	31.758	49.9	S11	4.000	2.064	1.636	Open Manhole	1500
S6.000	31.778	71.3	S10	4.000	2.254	1.446	Open Manhole	1500
S7.000	32.149	100.2	S9	4.000	2.379	1.321	Open Manhole	1500
S7.001	15.534	124.3	S10	4.000	2.254	1.446	Open Manhole	1500
S6.001	19.027	100.1	S11	4.000	2.064	1.636	Open Manhole	1500
S5.001	16.530	157.4	S12	4.000	1.959	1.741	Open Manhole	1500
S8.000	31.829	43.0	S12	4.000	1.959	1.741	Open Manhole	1500
S9.000	31.817	75.9	S18	4.000	2.281	1.419	Open Manhole	1500
S9.001	16.285	102.4	S19	4.000	2.122	1.578	Open Manhole	1500
S10.000	31.764	55.0	S19	4.000	2.122	1.578	Open Manhole	1500
S9.002	16.302	100.0	S12	4.000	1.959	1.741	Open Manhole	1500
S5.002	19.658	125.2	S4	4.000	1.802	1.898	Open Manhole	1200
S3.003	25.236	175.3	S18	4.000	1.658	1.967	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.004	o	375	S18	4.000	1.658	1.967	Open Manhole	1200
S1.005	o	375	S23	4.000	1.609	2.016	Open Manhole	1200
S11.000	o	450	S21	3.500	1.687	1.363	Open Manhole	1500
S11.001	o	450	S22	4.000	1.648	1.902	Open Manhole	1500
S11.002	o	450	S23	4.000	1.569	1.981	Open Manhole	1500
S12.000	o	300	S25	4.000	2.300	1.400	Open Manhole	1200
S12.001	o	300	S29	4.000	1.666	2.034	Open Manhole	1200
S1.006	o	525	S18	4.000	1.560	1.915	Open Manhole	1200
S13.000	o	225	S24	2.200	1.850	0.125	Open Manhole	1200
S1.007	o	525	S5	4.000	1.300	2.175	Open Manhole	1200
S1.008	o	525	S6	3.000	1.167	1.308	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.004	15.677	319.9	S23	4.000	1.609	2.016	Open Manhole	1200
S1.005	1.511	30.8	S18	4.000	1.560	2.065	Open Manhole	1200
S11.000	19.741	506.2	S22	4.000	1.648	1.902	Open Manhole	1500
S11.001	39.566	500.8	S23	4.000	1.569	1.981	Open Manhole	1500
S11.002	2.747	549.4	S18	4.000	1.564	1.986	Open Manhole	1200
S12.000	57.224	90.3	S29	4.000	1.666	2.034	Open Manhole	1200
S12.001	2.014	18.9	S18	4.000	1.560	2.140	Open Manhole	1200
S1.006	64.261	247.2	S5	4.000	1.300	2.175	Open Manhole	1200
S13.000	80.649	146.6	S5	4.000	1.300	2.475	Open Manhole	1200
S1.007	23.248	174.8	S6	3.000	1.167	1.308	Open Manhole	1200
S1.008	8.076	175.6	S	2.000	1.121	0.354	Open Manhole	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	20.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	4	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	17.800	Cv (Summer)	0.750
Return Period (years)	100	Ratio R	0.250	Cv (Winter)	0.840
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Storm

Non Return Valve Manhole: S4, DS/PN: S1.003, Volume (m³): 8.7

Non Return Valve Manhole: S23, DS/PN: S1.005, Volume (m³): 4.3

Non Return Valve Manhole: S29, DS/PN: S12.001, Volume (m³): 6.6

Hydro-Brake® Optimum Manhole: S18, DS/PN: S1.006, Volume (m³): 3.1

Unit Reference	MD-SHE-0118-8600-2200-8600	Sump Available	Yes
Design Head (m)	2.200	Diameter (mm)	118
Design Flow (l/s)	8.6	Invert Level (m)	1.560
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	2.200	8.6	Kick-Flo®	1.055	6.1
Flush-Flo™	0.519	7.7	Mean Flow over Head Range	-	7.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	4.2	0.600	7.6	1.600	7.4	2.600	9.3	5.000	12.7	7.500	15.4
0.200	6.6	0.800	7.3	1.800	7.8	3.000	9.9	5.500	13.3	8.000	15.9
0.300	7.3	1.000	6.5	2.000	8.2	3.500	10.7	6.000	13.8	8.500	16.3
0.400	7.6	1.200	6.5	2.200	8.6	4.000	11.4	6.500	14.4	9.000	16.8
0.500	7.7	1.400	6.9	2.400	8.9	4.500	12.0	7.000	14.9	9.500	17.2

Storage Structures for Storm

Tank or Pond Manhole: S21, DS/PN: S11.000

Invert Level (m) 1.687

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	600.0	1.000	600.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000   Manhole Headloss Coeff (Global) 0.500   MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0   Foul Sewage per hectare (l/s) 0.000   Inlet Coeffiecient 0.800
Hot Start Level (mm) 0   Additional Flow - % of Total Flow 20.000   Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0   Number of Offline Controls 0   Number of Time/Area Diagrams 0
Number of Online Controls 4   Number of Storage Structures 1   Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR   M5-60 (mm) 17.800   Cv (Summer) 0.750
Region Scotland and Ireland   Ratio R 0.250   Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 100.0   DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended)   Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 100
Climate Change (%) 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
S1.000	S26	60 Winter	100	+20%	100/30 Summer				3.323	0.423	0.000	0.06		26.4
S1.001	S2	60 Winter	100	+20%	100/15 Summer				3.317	0.629	0.000	0.06		25.2
S2.000	S28	60 Winter	100	+20%	100/30 Summer				3.314	0.414	0.000	0.03		15.8
S1.002	S27	60 Winter	100	+20%	100/15 Summer				3.311	0.836	0.000	0.09		41.1
S1.003	S4	60 Winter	100	+20%	100/15 Summer				3.201	0.918	0.000	0.17		41.7
S3.000	S1	30 Winter	100	+20%					10.640	-0.160	0.000	0.18		24.8
S4.000	S7	30 Winter	100	+20%					6.891	-0.109	0.000	0.53		27.0
S3.001	S2	30 Winter	100	+20%					6.326	-0.124	0.000	0.41		51.7
S3.002	S3	30 Winter	100	+20%	100/15 Summer				4.010	1.491	0.000	1.20		50.4
S5.000	S14	60 Winter	100	+20%	100/15 Summer				3.725	0.725	0.000	0.10		14.2
S6.000	S13	60 Winter	100	+20%	100/15 Summer				3.855	0.855	0.000	0.09		11.2
S7.000	S8	30 Winter	100	+20%	100/15 Summer				3.892	0.892	0.000	0.17		17.0
S7.001	S9	30 Winter	100	+20%	100/15 Summer				3.870	1.191	0.000	0.29		24.4
S6.001	S10	60 Winter	100	+20%	100/15 Summer				3.840	1.286	0.000	0.46		44.3
S5.001	S11	60 Winter	100	+20%	100/15 Summer				3.707	1.343	0.000	0.74		55.3
S8.000	S15	60 Winter	100	+20%	100/15 Summer				3.625	0.625	0.000	0.07		11.6
S9.000	S17	60 Winter	100	+20%	100/15 Summer				3.773	0.773	0.000	0.11		13.0
S9.001	S18	60 Winter	100	+20%	100/15 Summer				3.757	1.176	0.000	0.26		24.0
S10.000	S16	60 Winter	100	+20%	100/15 Summer				3.749	0.749	0.000	0.08		10.8
S9.002	S19	60 Winter	100	+20%	100/15 Summer				3.735	1.313	0.000	0.43		40.4
S5.002	S12	60 Winter	100	+20%	100/15 Summer				3.607	1.348	0.000	1.32		113.5
S3.003	S4	60 Winter	100	+20%	100/15 Summer				3.381	1.204	0.000	1.18		154.1
S1.004	S18	1440 Winter	100	+20%	100/15 Summer				3.241	1.208	0.000	0.35		31.5
S1.005	S23	1440 Winter	100	+20%	100/15 Summer				3.251	1.267	0.000	0.29		30.7
S11.000	S21	1440 Winter	100	+20%	100/30 Summer				3.138	1.001	0.000	0.51		51.7
S11.001	S22	1440 Winter	100	+20%	100/15 Summer				3.211	1.113	0.000	0.24		30.7
S11.002	S23	1440 Winter	100	+20%	100/15 Summer				3.252	1.233	0.000	0.13		16.4
S12.000	S25	1440 Winter	100	+20%	100/15 Summer				3.114	0.514	0.000	0.08		9.4
S12.001	S29	1440 Winter	100	+20%	100/15 Summer				3.112	1.146	0.000	0.12		9.6
S1.006	S18	1440 Winter	100	+20%	100/15 Summer				3.252	1.167	0.000	0.03		7.6
S13.000	S24	60 Winter	100	+20%					1.850	-0.225	0.000	0.00		0.0
S1.007	S5	1440 Summer	100	+20%					1.357	-0.468	0.000	0.03		7.6
S1.008	S6	1440 Summer	100	+20%					1.229	-0.463	0.000	0.03		7.6

PN	US/MH Name	Status	Level Exceeded
S1.000	S26	SURCHARGED	
S1.001	S2	SURCHARGED	
S2.000	S28	SURCHARGED	
S1.002	S27	SURCHARGED	
S1.003	S4	SURCHARGED	
S3.000	S1	OK	
S4.000	S7	OK	
S3.001	S2	OK	
S3.002	S3	SURCHARGED	
S5.000	S14	SURCHARGED	
S6.000	S13	SURCHARGED	
S7.000	S8	SURCHARGED	
S7.001	S9	SURCHARGED	
S6.001	S10	SURCHARGED	
S5.001	S11	SURCHARGED	
S8.000	S15	SURCHARGED	
S9.000	S17	SURCHARGED	
S9.001	S18	SURCHARGED	
S10.000	S16	SURCHARGED	
S9.002	S19	SURCHARGED	
S5.002	S12	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
S3.003	S4	SURCHARGED	
S1.004	S18	SURCHARGED	
S1.005	S23	SURCHARGED	
S11.000	S21	SURCHARGED	
S11.001	S22	SURCHARGED	
S11.002	S23	SURCHARGED	
S12.000	S25	SURCHARGED	
S12.001	S29	SURCHARGED	
S1.006	S18	SURCHARGED	
S13.000	S24	OK	
S1.007	S5	OK	
S1.008	S6	OK	

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	2.800	Urban	0.000
SAAR (mm)	1099	Region Number	Ireland South

Results	**l/s**
QBAR Rural	8.6
QBAR Urban	8.6
Q100 years	15.9
Q1 year	7.4
Q30 years	13.8
Q100 years	15.9

Appendix C – Pre-Connection Enquiry to Irish Water, Confirmation of Feasibility and Statement of Design Acceptance

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

Niall Fitzgerald
Tellengana Blackrock Road
Cork

29 April 2022

Re: Design Submission for Kilmoney, Carrigaline, Cork (the "Development") (the "Design Submission") / Connection Reference No: CDS21004834

Dear Niall Fitzgerald,

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: Brian Lavelle
Email: Brian.Lavelle@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

- [LY05-V1-XXX-DR-HLCE-CE-0002, LY05-V1-XXX-DR-HLCE-CE-0007]
- [LY05-V1-XXX-DR-HLCE-CE-0003]

*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.

UISCE ÉIREANN : IRISH WATER

Niall Fitzgerald
Tellengana
Blackrock Road
Cork

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

31 August 2021

Re: CDS21004834 pre-connection enquiry - Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 252 unit(s) at Kilmoney, Carrigaline, Cork

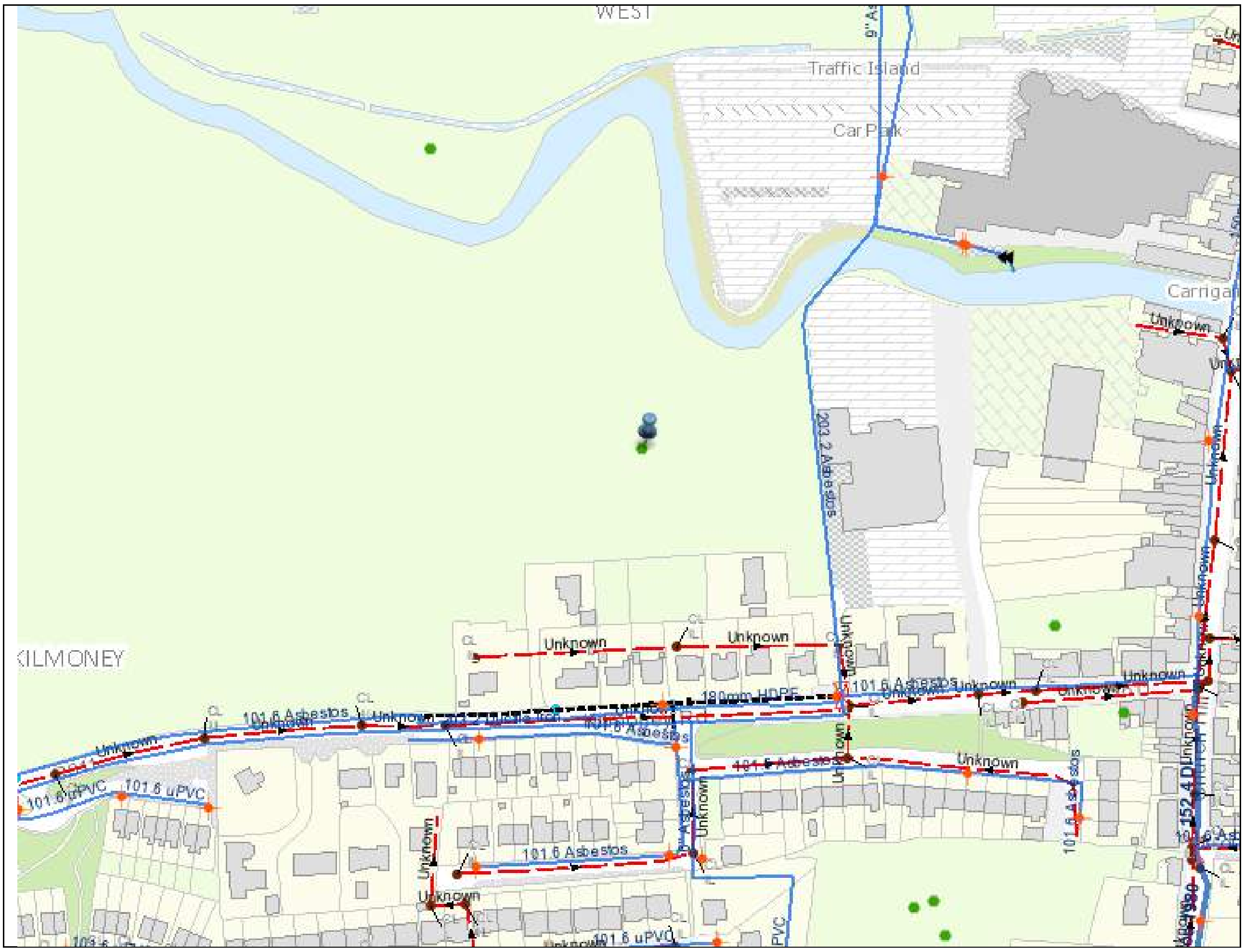
Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Kilmoney, Carrigaline, Cork (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 to be made to the new 180mm diameter PE water main on Kilmoney Road on the southern side of the proposed development
Wastewater Connection	The feasibility of the wastewater connection is subject to the completion of the pumping station and rising main on the northern side of the development to be completed as part of the Carrigaline Western Relief Road. This infrastructure is not being provided by Irish Water so the programme for this project is not under the control of Irish Water. It will be required to get permission from the owner of these assets to connect. Developer to obtain and provide full details of new Pump Station at connection application stage.
Strategic Housing Development	Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. Therefore, 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. Please submit your design to cdsdesignqa@water.ie
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

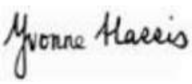
Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish 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 Dario Alvarez from the design team on + 353 2254621 or email dalvarez@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,



Yvonne Harris

Head of Customer Operations

Pre-connection enquiry form

Business developments, mixed use developments, housing developments

This form is to be filled out by applicants enquiring about the feasibility of a water and/or wastewater connection to Irish Water infrastructure. If completing this form by hand, please use BLOCK CAPITALS and black ink.

Please refer to the **Guide to completing the pre-connection enquiry form** on page 13 of this document when completing the form.

*** Denotes mandatory/ required field. Please note, if mandatory fields are not completed the application will be returned.**

Section A | Applicant details

1 *Applicant details:

Registered company name (if applicable): RESIDE INVESTMENTS LTD.

Trading name (if applicable): RESIDE GROUP

Company registration number (if applicable): 492877

If you are not a registered company/business, please provide the applicant's name:

*Contact name: KIERAN FLYNN

*Postal address: BLACKWATER HOUSE
MALLOW BUSINESS PARK
CO. CORK

*Eircode: P51K3CX

*Telephone:

Mobile: 0877931914

*Email: kieran.flynn@hallmark.ie

2 Agent details (if applicable):

Contact name: NIALL FITZGERALD

Company name (if applicable): HLCE LTD.

Postal address: HORGANLYNCH
CONSULTING ENGINEERS
TELLENGANA BLACKROCK ROAD CORK

Eircode: T12HP7R

Telephone: 021 4936100

Email: niall.fitzgerald@horganly

3 ***Please indicate whether it is the applicant or agent who should receive future correspondence in relation to the enquiry:**

Applicant [ ] Agent [x]

Section B | Site details

4 ***Site address:** KILMONEY CARRIGALINE
CO. CORK

5 ***Irish Grid co-ordinates of site:** Eastings (X) 172717 Northings (Y) 62272

Eg. co-ordinates of GPO, O'Connell St., Dublin: E(X) 315,878 N(Y) 234,619

6 ***Local Authority:**

Local Authority that granted planning permission (if applicable):

CORK COUNTY COUNCIL

7 ***Has full planning permission been granted?** Yes [ ] No [X]

If 'Yes', please provide the current or previous planning reference number:

Section C | Development details

8 Please outline the domestic and/or industry/business use proposed:

Property type	Number of units	Property type	Number of units	Property type	Number of units
House		Apartments	250	Agricultural	
Office		School		Retail unit	3,250 sq.m of Retail
Residential care home		Institution		Industrial unit	
Hotel		Factory		Other	Residential Amenity
Other (please specify type)					

9 *Approximate start date of proposed development: 04 / 04 / 2022

10 *Is the development multi-phased? Yes [ ] No [X]

If 'Yes', application must include a master-plan identifying the development phases and the current phase number.

If 'Yes', please provide details of variations in water demand volumes and wastewater discharge loads due to phasing requirements.

11 *Please indicate the type of connection required by ticking the appropriate box below:

Water [ ] Please go to Section D

Wastewater [ ] Please go to Section E

Both [X] Please complete both Sections D and E

Section D | Water connection and demand details

12	***Is there an existing connection to public water mains at the site?**	Yes [ ]	No [X]
12.1	If yes, is this enquiry for an additional connection to one already installed?	Yes [ ]	No [ ]
12.2	If yes, is this enquiry to increase the size of an existing connection?	Yes [ ]	No [ ]

13 **Approximate date water connection is required:** 04 / 04 / 2022

14 ***What diameter of water connection is required to service the development?** 100 mm

15 ***Is more than one connection required to the public infrastructure to service this development?** Yes [ ] No [X]

If 'Yes', how many? [ ]

16 **Please indicate the business water demand (shops, offices, schools, hotels, restaurants, etc.):**

Post-development peak hour water demand	7.72	**l/s**
Post-development average hour water demand	1.27	**l/s**

Please include calculations on the attached sheet provided. Where there will be a daily/weekly/seasonal variation in the water demand profile, please provide all such details.

17 **Please indicate the industrial water demand (industry-specific water requirements):**

Post-development peak hour water demand		**l/s**
Post-development average hour water demand		**l/s**

Please include calculations on the attached sheet provided. Where there will be a daily/weekly/seasonal variation in the water demand profile, please provide all such details.

18 **What is the existing ground level at the property boundary at connection point (if known) above Malin Head Ordnance Datum?**

12.50 m

19 **What is the highest finished floor level of the proposed development above Malin Head Ordnance Datum?**

23.30 m

20 **Is on-site water storage being provided?** Yes [ ] No [X]

Please include calculations on the attached sheet provided.

21 **Are there fire flow requirements?** Yes [X] No [ ]

Additional fire flow requirements over and above those identified in Q16-17	35	**l/s**

Please include calculations on the attached sheet provided, and include confirmation of requirements from the Fire Authority.

22 **Do you propose to supplement your potable water supply from other sources?** Yes [ ] No [X]

If 'Yes', please indicate how you propose to supplement your potable water supply from other sources (see **Guide to completing the application form** on page 12 of this document for further details):

Section E | Wastewater connection and discharge details

23 ***Is there an existing connection to a public sewer at the site?** Yes [ ] No [X]

23.1 If yes, is this enquiry for an additional connection to the one already installed? Yes [ ] No [ ]

23.2 If yes, is this enquiry to increase the size of an existing connection? Yes [ ] No [ ]

24 ***Approximate date that wastewater connection is required:** 04/04/2022

25 ***What diameter of wastewater connection is required to service the development?** 150 mm

26 ***Is more than one connection required to the public infrastructure to service this development?** Yes [ ] No [X]

If 'Yes', how many?

27 **Please indicate the commercial wastewater hydraulic load (shops, offices, schools, hotels, restaurants, etc.):**

Post-development peak discharge	1.5875	**l/s**
Post-development average discharge	1.27	**l/s**

Please include calculations on the attached sheet provided.

28 **Please indicate the industrial wastewater hydraulic load (industry-specific discharge requirements):**

Post-development peak discharge		**l/s**
Post-development average discharge		**l/s**

Please include calculations on the attached sheet provided.

29 **Wastewater organic load:**

Characteristic	Max concentration (mg/l)	Average concentration (mg/l)	Maximum daily load (kg/day)
Biochemical oxygen demand (BOD)			
Chemical oxygen demand (COD)			
Suspended solids (SS)			
Total nitrogen (N)			
Total phosphorus (P)			
Other			

Temperature range	
pH range	

30 ***Storm water run-off will only be accepted from brownfield sites that already have a storm/surface water connection to a combined sewer. In the case of such brownfield sites, please indicate if the development intends discharging surface water to the combined wastewater collection system:**

Yes [ ] No [X]

If 'Yes', please give reason for discharge and comment on adequacy of SUDS/attenuation measures proposed.

31 ***Do you propose to pump the wastewater?** Yes [ ] No [X]

If 'Yes', please include justification for your pumped solution with this application.

32 **What is the existing ground level at the property boundary at connection point (if known) above Malin Head Ordnance Datum?**

n/a connecting to proposed pumping station m

33 **What is the lowest finished floor level on site above Malin Head Ordnance Datum?** 3.50 m

34 **What is the proposed invert level of the pipe exiting the property to the public road?**

Proposed invert level at connection to the proposed pumping station +1.2m m

Section F | Supporting documentation

Please provide the following additional information (all mandatory):

>	Site location map: A site location map to a scale of 1:1000, which clearly identifies the land or structure to which the enquiry relates. The map shall include the following details: i. The scale shall be clearly indicated on the map. ii. The boundaries shall be delineated in red. iii. The site co-ordinates shall be marked on the site location map.	X
>	Details of planning and development exemptions (if applicable).	
>	Calculations (calculation sheets provided below).	X
>	Site layout map to a scale of 1:500 showing layout of proposed development, water network and wastewater network layouts, additional water/wastewater infrastructure if proposed, connection points to Irish Water infrastructure.	X
>	Conceptual design of the connection asset from the proposed development to the existing Irish Water infrastructure, including service conflicts, gradients, pipe sizes and invert levels.	X
>	Any other information that might help Irish Water assess this pre-connection enquiry.	

Section G | Declaration

I/We hereby make this application to Irish Water for a water and/or wastewater connection as detailed on this form.

I/We understand that any alterations made to this application must be declared to Irish Water.

The details that I/we have given with this application are accurate.

I/We have enclosed all the necessary supporting documentation.

Any personal data you provide will be stored and processed by Irish Water and may be transferred to third parties for the purposes of the water and/or wastewater connection process. I hereby give consent to Irish Water to store and process my personal data and to transfer my personal data to third parties, if required, for the purposes of the connection process.

If you wish to revoke consent at any time or wish to see Irish Water's full Data Protection Notice, please see **https://www.water.ie/privacy-notice/**

Signature: [signature] Date: 08/07/2021

Your full name (in BLOCK CAPITALS):

NIALL FITZGERALD

Irish Water will carry out a formal assessment based on the information provided on this form.
Any future connection offer made by Irish Water will be based on the information that has been provided here.

Please submit the completed form to **newconnections@water.ie** or alternatively, post to:

Irish Water
PO Box 860
South City Delivery Office
Cork City

Please note that if you are sending us your application form and any associated documentation by email, the maximum file size that we can receive in any one email is 35MB.

Please note, if mandatory fields are not completed the application will be returned.

Irish Water is subject to the provisions of the Freedom of Information Act 2014 (“FOIA”) and the codes of practice issued under FOIA as may be amended, updated or replaced from time to time. The FOIA enables members of the public to obtain access to records held by public bodies subject to certain exemptions such as where the requested records may not be released, for example to protect another individual’s privacy rights or to protect commercially sensitive information. Please clearly label any document or part thereof which contains commercially sensitive information. Irish Water accepts no responsibility for any loss or damage arising as a result of its processing of freedom of information requests.

Calculations

Water demand

1.0 Residential Development -

a. Occupancy -

250 units comprising of the following:

- 100 No. 1 bed units (1) = 100
- 10 No. 2 bed units (3) = 30
- 105 No. 2 bed units (4) = 420
- 35 No. 3 bed units (4) = 140

Total = 690

b. Demand -

Per capita consumption = 150 litres/person/day

Average daily domestic demand = 690x150 = 103,500 lites/day = 1.2 litres/sec
Average day/peak week demand = 1.25 x average daily domestic demand = 1.25x1.2 = 1.5 litre/sec
Peak demand = 5 x average day/peak week demand = 5 x 1.5 = 7.5 litres/sec

2.0 Retail -

a. Occupancy -

Total area = 3,250 sq.m
Assume occupancy of circa 100 staff

b. Demand -

per capital consumption = 60 litres/person/day

Average daily demand = 100x 60 = 6,000 litres/day = 0.07 litres/sec
Average day/peak week demand = 1.25 x 0.07 = 0.088 litres/sec
Peak demand = 2.5 x average day/peak week demand = 2.5 x 0.088 = 0.22 litres

Based on the above,

Total average daily domestic demand =1.2+0.07 = 1.27 litres/sec
Total average day/peak week demand = 1.5+0.088 = 1.588 litres/sec
Total Peak demand = 7.5+0.22 = 7.72 litres/sec

On-site storage

N/A

Fire flow requirements

1.0 Residential Development -

a. Occupancy -

250 units comprising of the following:

- 100 No. 1 bed units (1) = 100
- 10 No. 2 bed units (3) = 30
- 105 No. 2 bed units (4) = 420
- 35 No. 3 bed units (4) = 140

Total = 690

b. Foul Discharge -

wastewater flow rate = 150 litres/person/day

Average daily effluent discharge = 690x150 = 103,500 lites/day = 1.2 litres/sec
Peak effluent discharge = 1.25 x average discharge = 1.25 x 1.25 = 1.5 litres/sec

2.0 Retail -

a. Occupancy -

Total area = 3,250 sq.m
Assume occupancy of circa 100 staff

b. Foul Discharge -

wastewater flow rate = 60 litres/person/day

Average daily effluent discharge = 100 x 60 = 6,000 litres/day = 0.07 litres/sec
Peak effluent discharge = 1.25 x average discharge = 1.25 x 0.07 = 0.0875 litres

Based on the above,

Total Average effluent discharge = 1.2 + 0.07 = 1.27 litres/sec
Total Peak effluent discharge = 1.5 + 0.0875 = 1.5875 litres/sec

Guide to completing the pre-connection enquiry form

This form should be completed by applicants enquiring about the feasibility of a water and/or wastewater connection to Irish Water infrastructure.

The Irish Water Codes of Practice are available at **www.water.ie** for reference.

Section A | Applicant Details

Question 1: This question requires the applicant or company enquiring about the feasibility of a connection to identify themselves, their postal address, and to provide their contact details.

Question 2: If the applicant has employed a consulting engineer or an agent to manage the enquiry on their behalf, the agent's address and contact details should be recorded here.

Question 3: Please indicate whether it is the applicant or the agent who should receive future correspondence in relation to the enquiry.

Section B | Site details

Question 4: This is the address of the site requiring the water/wastewater service connection and for which this enquiry is being made.

Question 5: Please provide the Irish Grid co-ordinates of the proposed site. Irish grid positions on maps are expressed in two dimensions as Eastings (E or X) and Northings (N or Y) relative to an origin. You will find these coordinates on your Ordnance Survey map which is required to be submitted with an application.

Question 6: Please identify the Local Authority that is or will be dealing with your planning application, for example Cork City Council.

Question 7: Please indicate if planning permission has been granted for this application, and if so, please provide the planning permission reference number.

Section C | Development details

Question 8: Please specify the number of different property/premises types by filling in the tables provided.

Question 9: Please indicate the approximate commencement date of works on the development.

Question 10: Please indicate if a phased building approach is to be adopted when developing the site. If so, please provide details of the phase master-plan and the proposed variation in water demand/wastewater discharge as a result of the phasing of the development.

Question 11: Please indicate the type of connection required by ticking the appropriate box and proceed to complete the appropriate section or sections.

Section D | Water connection and demand details

Question 12: Please indicate if a water connection already exists for this site.

Question 12.1: Please indicate if this enquiry concerns an additional connection to one already installed on the site.

Question 12.2: Please indicate if you are proposing to upgrade the water connection to facilitate an increase in water demand. Irish Water will determine what impact this will have on our infrastructure.

Question 13: Please indicate the approximate date that the proposed connection to the water infrastructure will be required.

Question 14: Please indicate what diameter of water connection is required to service this development.

Question 15: Please indicate if more than one connection is required to service this development. Please note that the connection size provided may be used to determine the connection charge.

Question 16: If this connection enquiry concerns a business premises, please provide calculations for the water demand and include your calculations on the calculation sheet provided. Business premises include shops, offices, hotels, schools, etc. Demand rates (peak and average) are site specific. Average demand is the total daily volume divided by a 24-hour time period and expressed in litres per second (l/s). For design purposes, please refer to the Irish Water Codes of Practice for Water Infrastructure.

Question 17: If this connection enquiry is for an industrial premises, please calculate the water demand and include your calculations on the calculation sheet provided. Demand rates (peak and average) are site specific. Average demand is the total daily volume divided by a 24-hour time period and expressed in litres per second (l/s). The peak demand for sizing of the pipe network will be as per the specific business production requirements. For design purposes, please refer to the Irish Water Codes of Practice for Water Infrastructure.

Question 18: Please specify the ground level at the location where connection to the public water mains will be made. This is required in order to determine if there is sufficient pressure in the existing water infrastructure to serve your proposed development. Levels should be quoted in metres relative to Malin Head Ordnance Datum.

Question 19: Please specify the highest finished floor level on site. This is required in order to determine if there is sufficient pressure in the existing water infrastructure to serve your proposed development. Levels should be quoted in metres relative to Malin Head Ordnance Datum.

Question 20: If storage is required, water storage capacity of 24-hour water demand must usually be provided at the proposed site. In some cases, 24-hour storage capacity may not be required, for example 24-hour storage for a domestic house would be provided in an attic storage tank. Please calculate the 24-hour water storage requirements and include your calculations on the attached sheet provided. Please also confirm that on-site storage is being provided by ticking the appropriate box.

Question 21: The water supply system shall be designed and constructed to reliably convey the water flows that are required of the development including fire flow requirements by the Fire Authority. The Fire Authority will provide the requirement for fire flow rates that the water supply system will have to carry. Please note that while flows in excess of your required demand may be achieved in the Irish Water network and could be utilised in the event of a fire, Irish Water cannot guarantee a flow rate to meet your fire flow requirement. To guarantee a flow to meet the Fire Authority requirements, you should provide adequate fire storage capacity within your development. Please include your calculations on the attached sheet provided, and further provide confirmation of the Fire Authority requirements.

Question 22: Please identify proposed additional water supply sources, that is, do you intend to connect to the public water mains or the public mains and supplement from other sources? If supplementing public water supply with a supply from another source, please provide details as to how the potable water supply is to be protected from cross contamination at the premises.

Section E | Wastewater connection and discharge details

Question 23: Please indicate if a wastewater connection to a public sewer already exists for this site.

Question 23.1: Please indicate if this enquiry relates to an additional wastewater connection to one already installed.

Question 23.2: Please indicate if you are proposing to upgrade the wastewater connection to facilitate an increased discharge. Irish Water will determine what impact this will have on our infrastructure.

Question 24: Please specify the approximate date that the proposed connection to the wastewater infrastructure will be required.

Question 25: Please indicate what diameter of wastewater connection is required to service this development.

Question 26: Please indicate if more than one connection is required to service this development. Please indicate number required.

Question 27: If this enquiry relates to a business premises, please provide calculations for the wastewater discharge and include your calculations on the attached sheet provided. Business premises include shops, offices, hotels, schools, etc. Discharge rates (peak and average) are site specific. Average discharge is the total daily volume divided by a 24-hour time period and expressed in litres per second (l/s). For design purposes, please refer to the Irish Water Codes of Practice for Wastewater Infrastructure.

Question 28: If this enquiry relates to an industrial premises, please provide calculations for the wastewater discharge and include your calculations on the calculation sheet provided. Discharge rates (peak and average) are site specific. Average discharge is the total daily volume divided by a 24-hour time period and expressed in litres per second (l/s). The peak discharge for sizing of the pipe network will be as per the specific business production requirements. For design purposes, please refer to the Irish Water Codes of Practice for Wastewater Infrastructure.

Question 29: Please specify the maximum and average concentrations and the maximum daily load of each of the wastewater characteristics listed in the wastewater organic load table (if not domestic effluent), and also specify if any other significant concentrations are expected in the effluent. Please complete the table and provide additional supporting documentation if relevant. Note that the concentration shall be in mg/l and the load shall be in kg/day. Note that for business premises (shops, offices, schools, hotels, etc.) for which only domestic effluent will be discharged (excluding discharge from canteens/ restaurants which would require a Trade Effluent Discharge licence), there is no need to complete this question.

Question 30: In exceptional circumstances, such as brownfield sites, where the only practical outlet for storm/ surface water is to a combined sewer, Irish Water will consider permitting a restricted attenuated flow to the combined sewer. Storm/surface water will only be accepted from brownfield sites that already have a storm/surface water connection to a combined sewer and the applicant must demonstrate how the storm/surface water flow from the proposed site is minimised using sustainable urban drainage system (SUDS). This type of connection will only be considered on a case by case basis. Please advise if the proposed development intends discharging surface water to the combined wastewater collection system.

Question 31: Please specify if the development needs to pump its wastewater discharge to gain access to Irish Water infrastructure.

Question 32: Please specify the ground level at the location where connection to the public sewer will be made. This is required to determine if the development can be connected to the public sewer via gravity discharge. Levels should be quoted in metres relative to Malin Head Ordnance Datum.

Question 33: Please specify the lowest floor level of the proposed development. This is required in order to determine if the development can be connected to the public sewer via gravity discharge. Levels should be quoted in metres relative to Malin Head Ordnance Datum.

Question 34: Please specify the proposed invert level of the pipe exiting the property to the public road.

Section F | Supporting documentation

Please provide additional information as listed.

Section G | Declaration

Please review the declaration, sign, and return the completed application form to Irish Water by email or by post using the contact details provided in Section G.

Notes

Notes