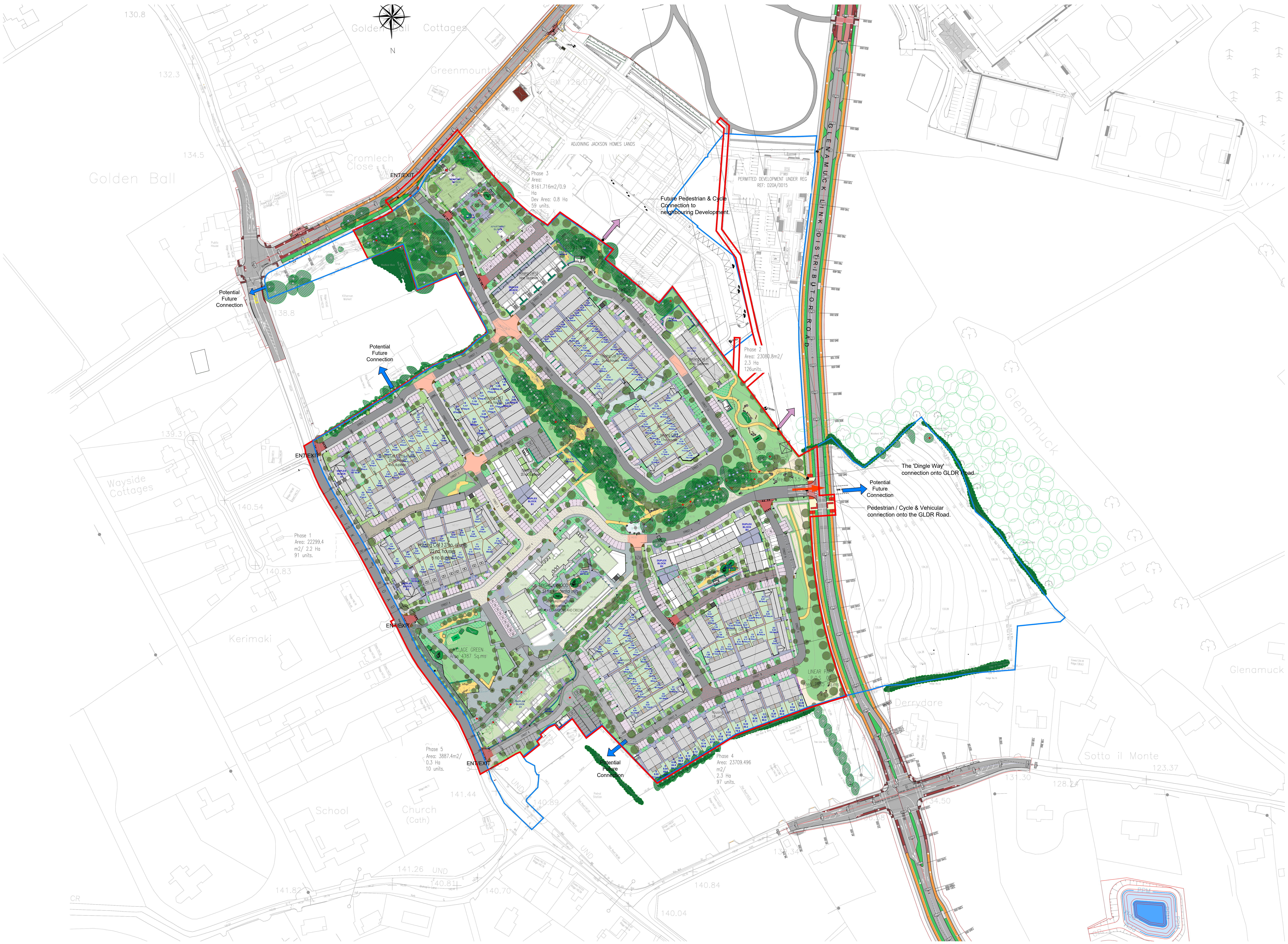
Appendix A

Appendix A



LEGEND

🟥 SITE BOUNDARY
TOTAL AREA (inclusive of drainage & road works):
11.2HA
TOTAL UNITS : 383 NO. UNITS

DEVELOPABLE SITE AREA : 8.6 HA
DENSITY: 44.5 U/HA

NOTES:

DO NOT SCALE FROM
DRAWINGS. WORK TO
FIGURED DIMENSIONS
ONLY. ARCHITECT TO
BE NOTIFIED OF ALL
DISCREPANCIES.

SHD STAGE 3

REVISIONS

DATE	DESCRIPTION	No.

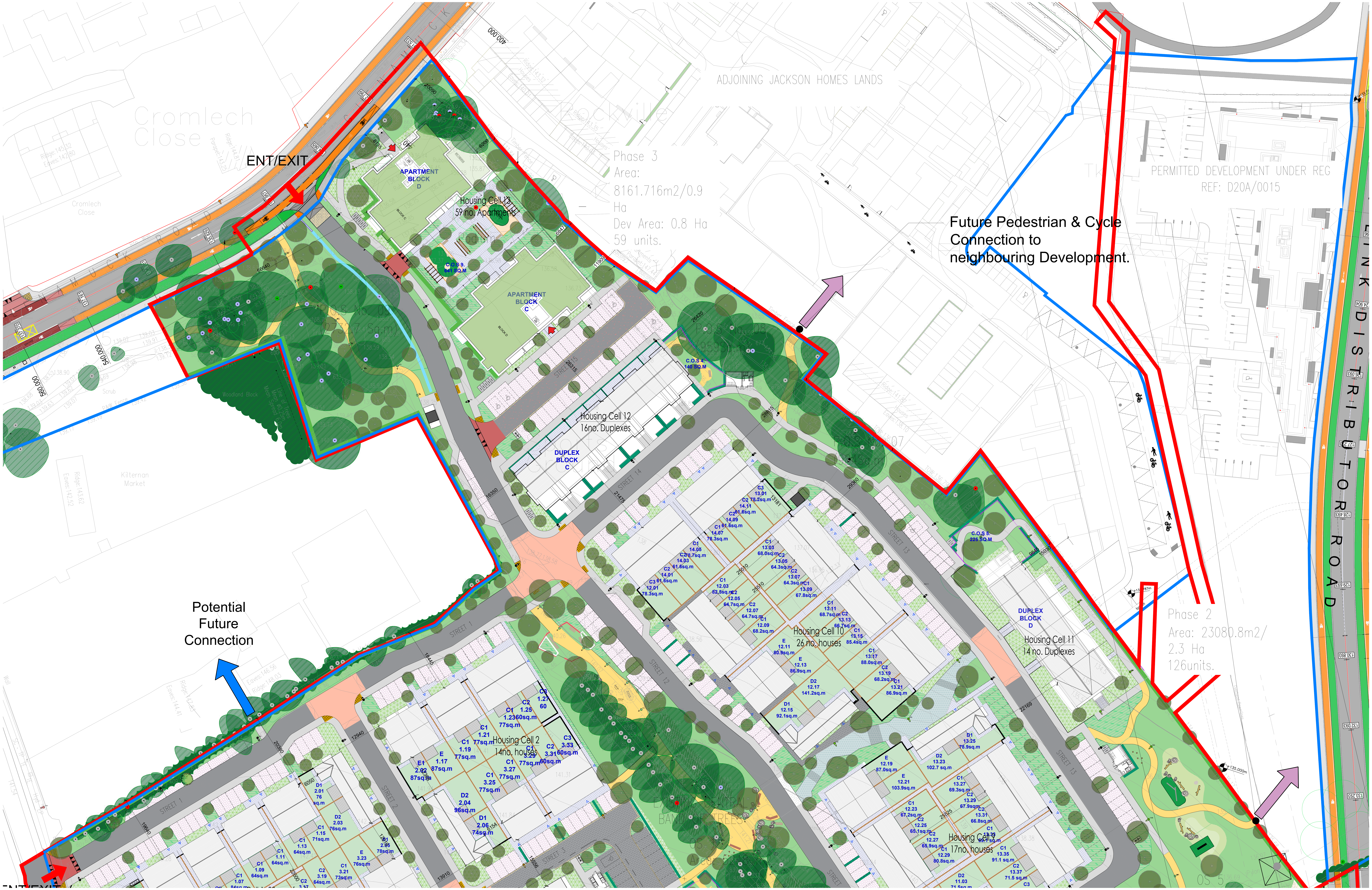
MCORM
M^C CROSSAN O ROURKE MANNING **ARCHITECTS**

PROJECT TITLE:
Kilternan Village SHD

DRAWING TITLE:
Site Layout Plan

1 Grantham Street, Dublin 8, D08 A49Y,Ireland.
Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com

DATE:	DRAWN BY:
MAY '22	LQMD
SCALE:	REVISION:
1:1000	
JOB NO:	DRAWING NO:
21009	PL101



NOTES:

DO NOT SCALE FROM DRAWINGS. WORK TO FIGURED DIMENSIONS ONLY. ARCHITECT TO BE NOTIFIED OF ALL DISCREPANCIES.

SHD STAGE 3

REVISIONS		
DATE	DESCRIPTION	No.

N

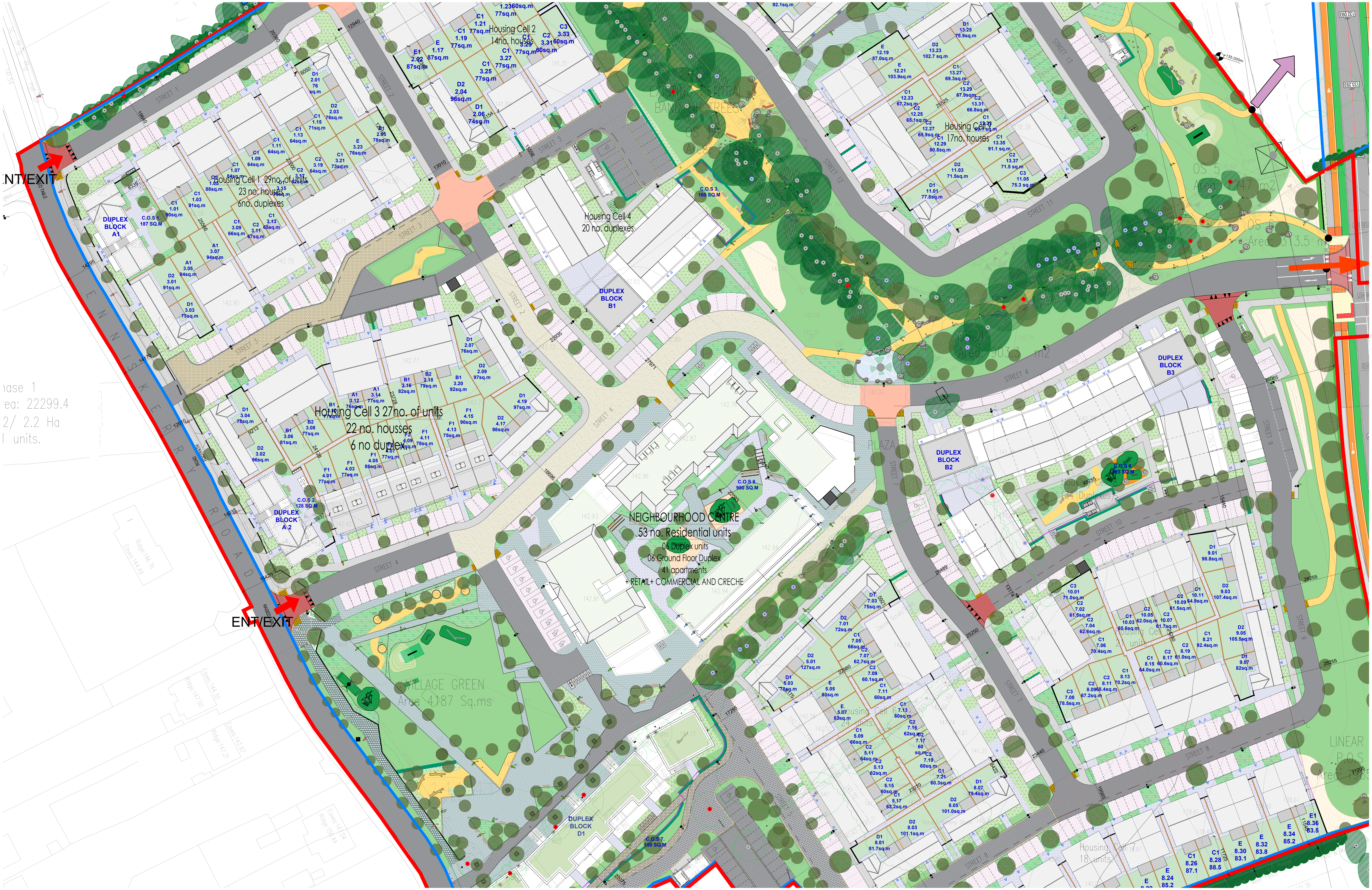
MCORM
M^C CROSSAN O ROURKE MANNING **ARCHITECTS**

PROJECT TITLE:
Kilternan Village SHD

DRAWING TITLE:
Site Layout Plan (1)

1 Grantham Street, Dublin 8, D08 A49Y, Ireland.
Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com

DATE: JUN'22	DRAWN BY: LQMD
SCALE: 1:500 @ A1	REVISION:
JOB NO: 21009	DRAWING NO: PL102



NOTES:

DO NOT SCALE FROM DRAWINGS. WORK TO FIGURED DIMENSIONS ONLY. ARCHITECT TO BE NOTIFIED OF ALL DISCREPANCIES.

SHD STAGE 3

REVISIONS

DATE	DESCRIPTION	No.

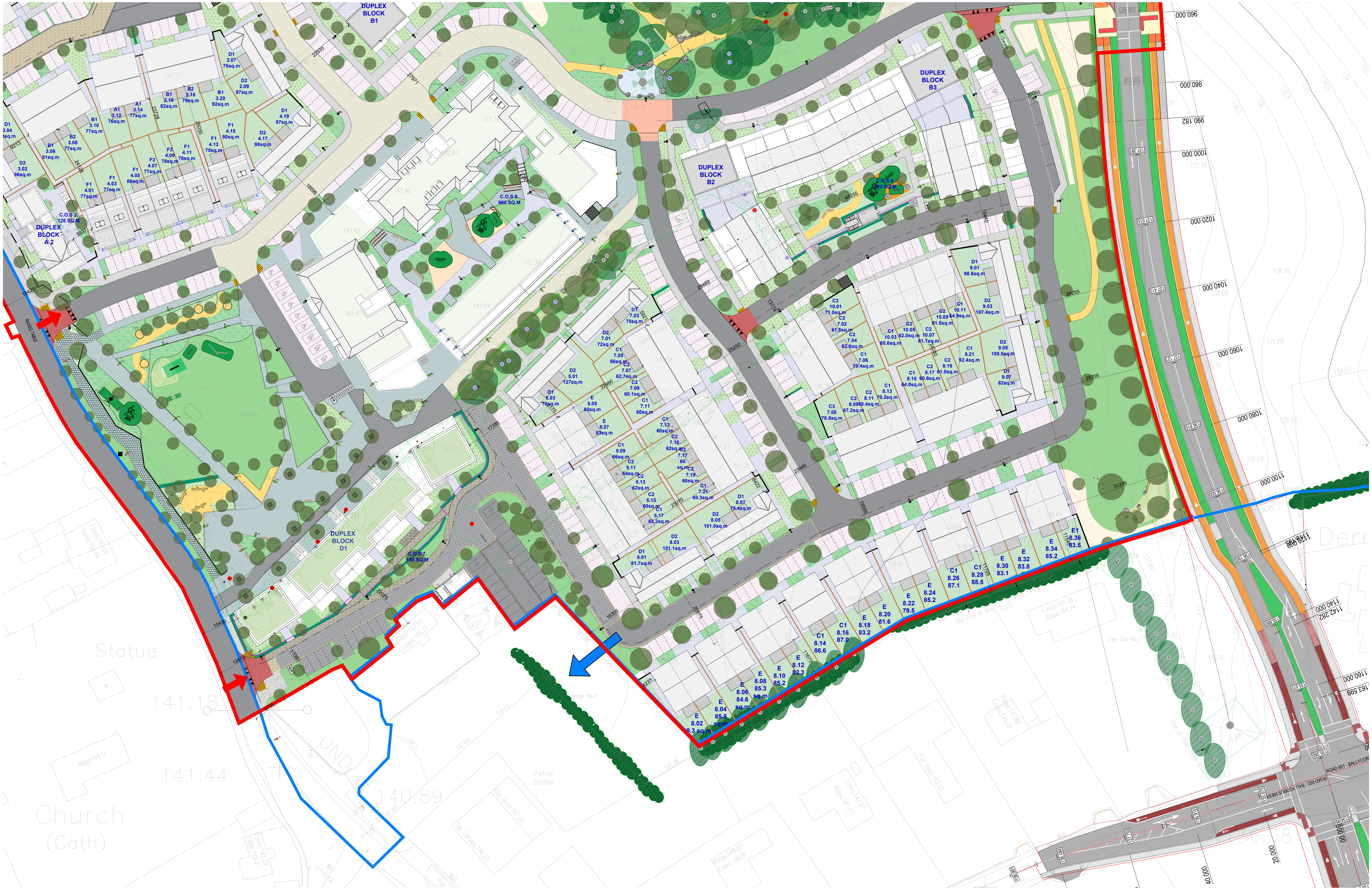
MCORM
M^C CROSSAN O ROURKE MANNING **ARCHITECTS**

PROJECT TITLE:
Kilternan Village SHD

DRAWING TITLE:
Site Layout Plan (2)

1 Grantham Street, Dublin 8, D08 A49Y, Ireland.
Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com

DATE: JUN '22
DRAWN BY: LQMD
SCALE: 1:500 @ A1
REVISION:
JOB NO: 21009
DRAWING NO: PL103



NOTES:

DO NOT SCALE FROM DRAWINGS. WORK TO FIGURED DIMENSIONS ONLY. ARCHITECT TO BE NOTIFIED OF ALL DISCREPANCIES.

SHD STAGE 3

N

REVISIONS

DATE	DESCRIPTION	No.

M C O R M

Mc CROSSAN O ROURKE MANNING **ARCHITECTS**

PROJECT TITLE:	DATE:	DRAWN BY:
Kilternan Village SHD	JUN '22	LQMD
DRAWING TITLE: Site Layout Plan (3)	SCALE: 1:500 @ A1	REVISION:
1 Grantham Street, Dublin 8, D08 A49Y, Ireland. Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com	JOB NO: 21009	DRAWING NO: PL104

PHASE 3
PHASE 2
PHASE 1
PHASE 2A
PHASE 4
PHASE 5
Compound Location - Phase 1, 2, 2A, 3 and Part 4
Waste Segregation Area
Waste Segregation Area
Compound Location - Part Phase 4 & Phase 5
Cromlech Close
Rockville
Glenamuck
Kerimaki
Derrydare
Sotto il Monte

LEGEND

🟧	PHASE 1 UNIT TOTAL: 91
🟦	PHASE 2 + PHASE 2 A UNIT TOTAL: 126 (PHASE 2 = 73 NO UNITS) (PHASE 2A = 53 NO. UNITS)
🟨	PHASE 3 UNIT TOTAL: 59
🟥	PHASE 4 UNIT TOTAL: 97
🟪	PHASE 5 UNIT TOTAL: 10
▬	SITE BOUNDARY

NOTES:

DO NOT SCALE FROM DRAWINGS. WORK TO FIGURED DIMENSIONS ONLY. ARCHITECT TO BE NOTIFIED OF ALL DISCREPANCIES.

SHD STAGE 3

N

REVISIONS

DATE	DESCRIPTION	No.

MCORM
M^C CROSSAN O ROURKE MANNING **ARCHITECTS**

PROJECT TITLE: Kilternan Village SHD	DATE: JUN.22	DRAWN BY: LQMD
DRAWING TITLE: Site Layout Plan Phasing Plan	SCALE: 1:1000@A1	REVISION:
Albert Place West, Harcourt Lane, Dublin 2, Ireland. Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com	JOB NO: 21009	DRAWING NO: PL105

Appendix B

Waterman Moylan
Engineering Consultants

Energy Statement

Proposed Kilternan Village SHD Development
at Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18

June 2022

Waterman Moylan Consulting Engineers Limited
Block S Eastpoint Business Park, Alfie Byrne Road, Dublin D03 H3F4
www.waterman-moylan.ie

Waterman Moylan
Engineering Consultants

Client Name:	Liscove Ltd
Document Reference:	21-096.r001
Project Number:	21-096

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015)

Issue	Date	Prepared by	Checked by	Approved by
1	08-10-21	Andrew Cruise	Alan Brophy	Niall Coughlan
2	05-11-21	Andrew Cruise	Alan Brophy	Niall Coughlan
3	25-05-22	Andrew Cruise	Alan Brophy	Niall Coughlan
4	01-06-22	Andrew Cruise	Alan Brophy	Niall Coughlan
5	14-06-22	Andrew Cruise	Alan Brophy	Niall Coughlan
6	15-06-22	Andrew Cruise	Alan Brophy	Niall Coughlan

Comments

Disclaimer

Content

1. Introduction

Liscove Limited intend to apply to An Bord Pleanála for permission for a strategic housing development at this c. 10.8 Ha site at lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18, which include a derelict dwelling known as 'Rockville' and associated derelict outbuildings, Enniskerry Road, Kilternan, Dublin 18, D18 Y199. The site is generally bounded by the Glenamuck Road to the north; Kilternan Country Market and the Sancta Maria property to the north and west; a recently constructed residential development named "Rockville" to the north-east; the Enniskerry Road to the south-west; dwellings to the south; and lands that will facilitate the future Glenamuck Link Distributor Road to the east.

Road works are also proposed to facilitate access to the development from the Enniskerry Road; to the approved Part 8 Enniskerry Road/Glenamuck Road Junction Upgrade Scheme on Glenamuck Road (DLRCC Part 8 Ref PC/IC/01/17); and to the approved Glenamuck District Roads Scheme (GDRS) (ABP Ref:HA06D.303945) on the Glenamuck Link Distributor Road (GLDR). Drainage and water works are also proposed to connect to services on the Glenamuck Road and Enniskerry Road.

At the Glenamuck Road access point, this will include works, inclusive of any necessary tie-ins, to the footpath and cycle track to create a side road access junction incorporating the provision of an uncontrolled pedestrian crossing across the side road junction on a raised table and the changing of the cycle track to a cycle lane at road level as the cycle facility passes the side road junction. Surface water and foul drainage infrastructure is proposed towards the north of the site into the drainage infrastructure to be constructed as part of the Part 8 scheme. Potable water is to be provided from the existing piped infrastructure adjacent to the site along Glenamuck Road. These interfacing works are proposed on an area measuring c. 0.05 Ha.

At the GLDR access point, this will include works, inclusive of any necessary tie-ins, to the footpath and cycle track to create a side road access junction incorporating the provision of short section of shared path and an uncontrolled shared pedestrian and cyclist crossing across the side road junction on a raised table. The works will also include the provision of a toucan crossing, inclusive of the necessary traffic signal equipment, immediately south of the access point to facilitate pedestrian and cyclist movement across the mainline road. All works at the GLDR access point will include the provision of the necessary tactile paving layouts and are provided on an area measuring c. 0.06 Ha.

At the Enniskerry Road, works are proposed to facilitate 3 No. new accesses for the development along with modifications to Enniskerry Road. The 3 No. side road priority access junctions incorporate the provision of an uncontrolled pedestrian crossing across the side road junction on a raised table. The modifications to Enniskerry Road fronting the development (circa 320 metres) includes the narrowing of the carriageway down to 6.5 metres (i.e. a 3.25 metres running lane in each direction) from the front of the kerb on western side of Enniskerry Road. The remaining former carriageway, which varies in width of c. 2 metres, will be reallocated for other road users and will include the introduction of a widened pedestrian footpath and landscaped buffer on the eastern side of the road adjoining the proposed development. The above works are inclusive of all necessary tie-in works such as new kerb along eastern side of Enniskerry Road, drainage details, road marking, signage and public lighting. Potable water is to be provided from the existing piped infrastructure adjacent to the site along the Enniskerry Road. The interface works on Enniskerry Road measures c. 0.19 Ha.

Surface water and foul drainage infrastructure is proposed to connect into and through the existing/permitted Rockville developments (DLR Reg. Refs. D17A/0793, D18A/0566 and D20A/0015) on a total area measuring c. 0.09 ha. The development site area and drainage and roads works areas will provide a total application site area of c. 11.2 Ha.

The development will principally consist of: the demolition of c. 573.2 sq m of existing structures on site comprising a derelict dwelling known as 'Rockville' and associated derelict outbuildings; and the provision of a mixed use development consisting of 383 No. residential units (165 No. houses, 118 No. duplex units and 100 No. apartments) and a Neighbourhood Centre, which will provide a creche (439 sq m), office (317 sq m), medical (147 sq m), retail (857 sq m), convenience retail (431 sq m) and a community facility (321 sq m). The 383 No. residential units will consist of 27 No. 1 bedroom units (19 No. apartments and 8 No. duplexes), 128 No. 2 bedroom units (78 No. apartments and 50 No. duplexes), 171 No. 3 bedroom units (108 No. houses, 3 No. apartments and 60 No. duplexes) and 57 No. 4 bedroom units (57 No. houses). The proposed development will range in height from 2 No. to 5 No. storeys (including podium/undercroft level in Apartment Blocks C and D and in the Neighbourhood Centre).

The development also provides: pedestrian links from Enniskerry Road and within the site to the neighbouring "Rockville" development to the north-east and a pedestrian/cycle route through the Dingle Way from Enniskerry Road to the future Glenamuck Link Distributor Road; 678 No. car parking spaces (110 No. in the undercroft of Blocks C and D and the Neighbourhood Centre and 568 No. at surface level) including 16 No. mobility impaired spaces, 73 No. electric vehicle spaces, 1 No. car share space, 4 No. drop-off spaces/loading bays; motorcycle parking; bicycle parking; bin storage; the decommissioning of the existing telecommunications mast at ground level and provision of new telecommunications infrastructure at roof level of the Neighbourhood Centre including shrouds, antennas and microwave link dishes (18 No. antennas and 6 No. transmission dishes, all enclosed in 9 No. shrouds together with all associated equipment); private balconies, terraces and gardens; hard and soft landscaping; sedum roofs; solar panels; boundary treatments; lighting; substations; plant; and all other associated site works above and below ground. The proposed development has a gross floor space of c. 43,120 sq m in addition to undercroft levels (under Apartment Blocks C and D measuring c. 1,347 sq m and under the Neighbourhood Centre measuring c. 2,183 sq m, which includes parking spaces, external storage, bin storage, bike storage and plant).

This report identifies the energy standards with which the proposed development will have to comply and also sets out the overall strategy that will be adopted to achieve these energy efficiency targets.

The dwellings will be required to minimise overall energy use and to incorporate an adequate proportion of renewable energy in accordance with Building Regulations Part L 2021, Conservation of Energy & Fuel (hereinafter referred to as Part L 2021).

2. Building Regulations Part L 2021 Dwellings

Compliance with Building Regulations *Part L 2021 Dwellings* is broken down into six distinct categories, known as Regulation 8; parts (a) to (f).

A summary of each of these parts as listed in Technical Guidance Document L 2011 is provided below together with a description of what is required to demonstrate compliance and suggested routes to meeting the required standards.

2.1 Regulation 8 Part (a)

The regulation requires that:

> *Providing that the energy performance of the building is such as to limit the calculated primary energy consumption and related carbon dioxide (CO2) to that of a nearly zero energy building within the meaning of the Directive insofar as is reasonably*

Part (a) is the overarching compliance target which stipulates the required overall reduction in energy consumption and carbon emissions for new dwellings.

This requires that the energy consumption and carbon emissions of every dwelling is assessed using the DEAP software and that reductions of 70% in energy consumption and 65% in carbon emissions are achieved. The baseline against which this reduction is to be measured is considered to be a dwelling which is constructed to perfectly comply with the 2005 version of Building Regulations Part L.

The ratio of the energy consumed by the proposed dwelling to a similar dwelling constructed to 2005 energy efficiency standards is referred to as the “Energy Performance Co-efficient”

2.2 Regulation 8 Part (b)

The regulation requires that:

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

This requires that the all-new dwellings are provided with a renewable energy source. The regulations state that 20% of the total energy consumed within the dwelling must be provided from renewable thermal sources (solar thermal, biomass, heat pumps) or renewable electrical sources (Photovoltaic, Micro-wind).

In practical terms, for a multiple unit development, this requirement is usually met by incorporating PV panels at roof level, incorporating air source heat pump technology or by adding an element of biomass or micro-CHP to a district heating scheme.

Where CHP is included, the renewable energy is considered to be the waste heat which is generated as a by-product of the electricity produced. Specific calculation methods are set out within TGD *Part L 2021 Dwellings* which detail how compliance should be demonstrated.

2.3 Regulation 8 Part (c)

The regulation requires that:

> *Limiting heat loss and, where appropriate, availing of heat gain through the fabric of the building;*

This requires that the fabric of the building is designed to minimise heat loss from the building and that the air permeability of the structure limits the unwanted passage of air into the building.

Typical compliant U-Values are as follows.

Pitched roof	0.16 W/m^{2}K
Flat roof	0.20 W/m^{2}K
Walls	0.18 W/m^{2}K
Floor	0.18 W/m^{2}K
Windows	1.4 W/m^{2}K

The u-values of individual elements can be relaxed if required provided that compensatory measures are taken on other elements and that the overall area weighted u-value for the entire dwelling is the same as it would have been if all individual elements had complied.

The thermal bridging details of junctions in the envelope of the building (floor-wall; wall-window; wall-roof, etc) must also be designed and constructed in accordance with the guidance set out in Limiting Thermal Bridging and Air Infiltration – Acceptable Construction Details

Every dwelling must also be subjected to an air pressure test to determine the air tightness. All dwellings must achieve and air tightness of less than 5m^3/m^2/hour when tested at 50 Pascals. In multiple dwelling developments with repeating apartment types, testing can be conducted on a representative sample of units in accordance with Table 1.5.4.3 of TGD *Part L 2021 Dwellings*.

2.4 Regulation 8 Parts (d & e)

The regulation requires that:

> *Providing and commissioning energy efficient space and water heating systems with efficient heat sources and effective controls;*
>
> *Providing that all oil and gas fired boilers shall meet a minimum seasonal efficiency of 90%;*

These require that gas or oil-fired boilers are at least 90% efficient and that heating controls allow independent time control of the heating (2 zones for dwellings larger than 100m^2) and hot water. Heating in each zone should also be controlled by room thermostats (in the case of heating) and cylinder stats (in the case of hot water).

2.5 Regulation 8 Parts (f)

The regulation requires that:

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

This requires that information is provided to the dwelling owner which relates to the effective and efficient operation of the systems installed in that dwelling. Instructions on how to control the heating & hot water systems based on time and temperature requirements.

2.6 Requirements for Common Areas

Section 0.1.2.3 requires that:

> *Where a new dwelling forms part of a larger building, the guidance in this document applies to the individual dwelling, and the relevant guidance in Technical Guidance Document L - Conservation of Fuel and Energy – Buildings other than dwellings applies to the non-dwelling parts of the building such as common areas (including common areas of apartment blocks), and in the case of mixed-use developments, the commercial or retail space.*

This requires that the common areas of the apartment blocks are design to meet *Part L 2021 BOTD* for Buildings Other Than Dwellings and will require that a portion of the energy demand for the common areas is met by a renewable energy source.

2.7 S.I No 393 of 2021 - Regulation 5 Part (e)

The regulation requires that:

> *For a new building (containing one, or more than one, dwelling), where there are more than 10 car parking spaces, ducting infrastructure, consisting of conduits for electric cables, should be provided for every parking space, to enable the subsequent installation of recharging points for electric vehicles where:*
>
> > *• the car park is located inside the building, e.g. a basement car park; or*
> >
> > *• the car park is physically adjacent to the building, i.e. the car park is within the curtilage of the site.*

This requires that ducting provision for the future installation of car charging point be made in all carparks with more than 10 parking spaces associated with multi-unit residential buildings.

3. Building Regulations Part L 2021 (Building Other than Dwellings)

. Compliance with Building Regulations *Part L 2021 BOTD* is broken down into seven distinct categories, known as Regulation L5 parts (a) to (i).

A summary of each of these parts as listed in Technical Guidance Document L 2021 BOTD is provided below together with a description of what is required to demonstrate compliance and suggested routes to meeting the required standards.

3.1 Regulation L5 Parts (a)

The regulation requires that:

> *(a) providing that the energy performance of the building is such as to limit the calculated primary energy consumption and related Carbon Dioxide (CO2) emissions to a Nearly Zero Energy Building level insofar as is reasonably practicable, when both energy consumption and Carbon Dioxide emissions are calculated using the Non-domestic Energy Assessment Procedure (NEAP) published by Sustainable Energy Authority of Ireland;*

Part (a) is the overarching compliance target which stipulates the required overall reduction in energy consumption and carbon emissions for new commercial buildings.

This requires that the energy consumption and carbon emissions of every building is assessed using the SBEM software and that the energy consumption and carbon emissions associated with the building being assessed are in line with the required standards.

3.2 Regulation L5 Parts (b)

The regulation requires that:

> *providing that, the nearly zero or very low amount of energy required is covered to a very significant extent by energy from renewable sources produced on-site or nearby.*

This requires that Renewable Energy Technologies are provided. This to be reflected by Renewable Energy Ratio (RER) which is the ratio of the primary energy from renewable energy sources to total primary energy as defined and calculated in NEAP. RER for commercial buildings was as follows

- Where the MPEPC of 1.0 and MPCPC of 1.15 is achieved an RER of 0.20
- Where an EPC of 0.9 and a CPC of 1.04 is achieved an RER of 0.10

3.3 Regulation L5 Parts (c)

The regulation requires that:

> *limiting the heat loss and, where appropriate, availing of the heat gains through the fabric of the building.*

This requires that the fabric of the building is designed to minimise heat loss from the building and that the air permeability of the structure limits the unwanted passage of air into the building.

Typical compliant U-Values are as follows.

Pitched roof	0.16 W/m^{2}K
Flat roof	0.20 W/m^{2}K
Walls	0.21 W/m^{2}K
Floor	0.21 W/m^{2}K
Windows	1.6 W/m^{2}K

The u-values of individual elements can be relaxed if required provided that compensatory measures are taken on other elements and that the overall area weighted u-value for the entire building is the same as it would have been if all individual elements had complied.

The thermal bridging details of junctions in the envelope of the building (floor-wall; wall-window; wall-roof, etc) must also be designed and constructed in accordance with Acceptable Construction Details and/or certified details for all key junctions.

Building must also be subjected to an air pressure test to determine the air tightness and must achieve an air tightness of less than 5m^3/m^2/hour when tested at 50 Pascals.

3.4 Regulation L5 Parts (d)

The regulation requires that:

> *providing and commissioning energy efficient space heating and cooling systems, heating and cooling equipment, water heating systems, and ventilation systems, with effective controls.*

This requires that heat- generators should be designed and installed so that they operate efficiently over the range of loading likely to be encountered. This means that gas or oil-fired boilers are at least 86% efficient for output less than 70kW and 93% efficient for output over 70kW. Space and water heating systems should be effectively controlled so as to limit energy use by these systems.

Additionally, buildings should be designed and constructed in such way that there is no requirement for excessive installed capacity of Air Conditioning and Mechanical Ventilation for cooling purposes and the ventilating and cooling systems installed are energy efficient and are capable of being controlled to achieve optimum energy efficiency.

3.5 Regulation L5 Parts (e)

The regulation requires that:

> *ensuring that the building is appropriately designed to limit need for cooling and, where air-conditioning or mechanical ventilation is installed, that installed systems are energy efficient, appropriately sized and adequately controlled.*

This requires that the glazed elements of the proposed building are design to limit solar gain to acceptable levels. Design approaches that are often adopted to address this requirement include reducing total glazing areas, introducing internal or external shading devices, or using specifically selected solar control glazing to reduce the solar gain.

3.6 Regulation L5 Parts (f)

The regulation requires that:

> *limiting the heat loss from pipes, ducts and vessels used for the transport or storage of heated water or air.*

This requires that hot water storage vessels, pipes, and ducts associated with the provision of heating and hot water in a building should be insulated to limit heat loss, except where the heat flow through the wall of the pipe, duct, or vessel is always useful in conditioning the surrounding space.

3.7 Regulation L5 Parts (g)

The regulation requires that:

> *limiting the heat gains by chilled water and refrigerant vessels, and by pipes and ducts that serve air conditioning systems.*

This requires that storage vessels for chilled water and refrigerant, and pipes and ducts that serve air-conditioning systems should be insulated to limit heat gain from the surrounding environment.

3.8 Regulation L5 Parts (h)

The regulation requires that:

> *providing energy efficient artificial lighting systems and adequate control of these systems.*

This requires that artificial lighting systems shall be designed and controlled so as to ensure the efficient use of energy for this purpose. Lighting controls should encourage the maximum use of daylight and help avoiding unnecessary artificial lighting.

3.9 Regulation L5 Parts (i)

The regulation requires that:

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

This requires that information is provided to the dwelling owner which relates to the effective and efficient operation of the systems installed in that house. Instructions on how to control the heating & hot water systems based on time and temperature requirements.

3.10 S.I No 393 of 2021 - Regulation 5 Part (e)

The regulation requires that:

> *A building which has more than 10 car parking spaces, that is (i) new, or (ii) undergoing major renovation, shall have installed at least one recharging point and ducting infrastructure (consisting of conduits for electric cables) for at least one in every 5 car parking spaces*

This requires that at least one functioning charging point be provided for carparks with more than 10 parking spaces and that a ducting provision be made for the future installation of additional charging points for one in every 5 spaces.

4. Building Fabric

Before considering efficient building services or renewable energy systems, the form and fabric of a building must be assessed and optimised so as to reduce the energy demand for heating, lighting and ventilation. Target performance levels have been identified by the design team and are presented below.

4.1 Elemental U-Values

The U-Value of a building element is a measure of the amount of heat energy that will pass through the constituent element of the building envelope. Increasing the insulation levels in each element will reduce the heat lost during the heating season and this in turn will reduce the consumption of fuel and the associated carbon emissions and operating costs.

It is the intention of the design team to adhere to the requirements of the building regulations. Target U-Values are identified below.

U-Values	**Range of Target Values Proposed**	**Part L 2021 (Residential) Compliant Values**	**Part L 2021 (Commercial) Compliant Values**
Floor	0.10 to 0.18 W/m^{2}K	0.18 W/m^{2}K	0.21W/m^{2}K
Roof (Flat)	0.12 to 0.20 W/m^{2}K	0.20 W/m^{2}K	0.20 W/m^{2}K
Roof (Pitched)	0.10 to 0.16 W/m^{2}K	0.16 W/m^{2}K	0.16 W/m^{2}K
Walls	0.10 to 0.18 W/m^{2}K	0.18 W/m^{2}K	0.21 W/m^{2}K
Windows	0.9 to 1.4 W/m^{2}K	1.4 W/m^{2}K	1.6 W/m^{2}K

4.2 Air Permeability

A major consideration in reducing the heat losses in a building is the air infiltration. This essentially relates to the ingress of cold outdoor air into the building and the corresponding displacement of the heated internal air. This incoming cold air must be heated if comfort conditions are to be maintained. In a traditionally constructed building, infiltration can account for 30 to 40 percent of the total heat loss, however construction standards continue to improve in this area.

With good design and strict on-site control of building techniques, infiltration losses can be significantly reduced, resulting in equivalent savings in energy consumption, emissions and running costs.

In order to ensure that a sufficient level of air tightness is achieved, air permeability testing will be specified in tender documents, with the responsibility being placed on the main contractor to carry out testing and achieve the targets identified in the tender documents.

A design air permeability target of **3 m3/m2/hr** has been identified for the apartments on the site.

The air permeability testing will be carried out in accordance with BS EN 13829:2001 ‘Determination of air permeability of buildings, fan pressurisation method’ and CIBSE TM23: 2000 ‘Testing buildings for air leakage”

4.3 Thermal Bridging

Thermal bridges occur at junctions between planar elements of the building fabric and are typically defined as areas where heat can escape the building fabric due to a lack of continuity of the insulation in the adjoin elements.

Careful design and detailing of the manner in which insulation is installed at these junctions can reduce the rate at which the heat escapes. Standard good practice details are available and are known as Acceptable Construction Details (ACDs). Adherence to these details is known to reduce the rate at which heat is lost.

The rate at which heat is lost is quantified by the Thermal Bridging Factor of the dwelling and measured in W/m2K. The Thermal Bridging Factor is used in the overall dwelling Part L calculation, this value can be entered in three different ways:

0.15W/m^{2}K	Default used where details do not match ACDs and are not thermally modelled
0.08W/m^{2}K	Used where the ACDs are fully adhered to
< 0.08 W/m^{2}K	Used where the thermal details are thermally modelled and considered to perform better than the ACDs

It is intended that the ACDs will be adhered where suitable and thermal modelling will be carried out for non-standard junction details within proposed development and that the resultant Thermal Bridging Factor will be less than 0.08W/m2K.

5. Heat Sources & Renewable Energy Options - Residential

All new dwellings must meet overall energy performance levels (as defined by the Energy Performance Coefficient - EPC) and must have a portion of their annual energy demand provided by renewable energy sources.

The renewable energy source can be thermal energy such as solar thermal collection, biomass boilers or heat pumps or it can be electrical energy as generated by photovoltaic solar panels or wind turbines. The minimum renewable energy contributions defined in Part L 2021 Part (b) is 20% of the total energy consumption for the dwelling.

Two main fuel sources are generally available for developments of this nature, natural gas and electricity. Each present distinct options for compliance with the new standards. Solutions involving gas as the primary fuel source will typically include a solar technology such as PV panels to meet the renewable energy requirements while solutions relying on electricity will include heat pump technology.

The options presented in Sections 5.1, 5.2 & 5.3 below set out the options for the houses proposed for the site and Sections 5.4, 5.5 & 5.6 set out the options for the proposed apartments. Each is based on the building fabric performance levels identified in Table 1 in Section 4.

The final selection and combination of technologies will most likely be selected from these options based on a more in-depth technical and financial appraisal of the technologies which will be carried out during detailed design.

5.1 Option 1 – Air Source Heat Pump & Mechanical Extract Ventilation (Houses)

Heat Source, Hot Water Source & Renewable Energy Sources

Air source heat pumps (ASHPs) utilise grid supplied electricity to extract thermal energy from a heat source, in this case, the external ambient air. The electricity consumed is obviously not renewable energy, however the efficiency at which a heat pump operates allows a significant portion of the heat delivered to be considered as renewable. The amount of heat considered to be renewable is determined by the efficiency of the heat pump and the “primary energy conversion factor” for grid supplied electricity. Typically, approximately 40% to 50% of the heat supplied is considered to be renewable energy

In recent years, the design of ASHPs has improved bringing about higher efficiencies and reduced costs. This, in turn, has led to an increase use of this technology in large scale housing developments. Certified seasonal efficiencies of some models can exceed 500% in heating mode and 250% to 300% in hot water mode meaning that the use of this technology can deliver compliance with Part L 2021 requirements without the need for additional renewable energy sources such as PV panels.

Air source heat pumps require an indoor and an outdoor component. The outdoor unit is the evaporator which extracts the thermal energy from the ambient air while the indoor unit typically includes the heating buffer tanks and the hot water cylinder for the dwelling. The outdoor unit is typically located in the back garden of a dwelling.

Ventilation

Mechanical Extract Ventilation (MEV) systems extract air from all wet rooms using a central extract fan which runs continuously with supply air to the dwelling being provided through trickle vents in each habitable room. It is possible to incorporate a humidity control function into the fan which will result in a system which is capable of varying air extract rates in accordance with the humidity levels in the dwelling.

5.2 Option 2 – Gas Fired Boiler, PV Panels & Heat Recovery Ventilation (Houses)

Heat & Hot Water Source

The use of natural gas to provide heating and hot water to dwellings is very common in urban and sub-urban housing developments due to its convenience and to low fuel prices. High efficiency gas fired condensing boilers convert gas to heat energy with an efficiency of over 90%.

Time and temperature zone control will allow the occupant to control the heating times and temperatures (usually for 2 “zones”) and hot water times and temperatures independently.

Ventilation

Heat Recovery Ventilation (HRV) system comprise supply and extract ductwork through-out the house and a central ventilation unit which includes a supply fan, an extract fan and a heat exchanger. Air is extracted from the kitchen and the wet rooms and is supplied into living spaces via the duct system. The HRV unit recovers the heat from the warm air being extracted from the dwelling and uses the heat recovered to raise the temperature of the incoming air stream.

The system also has the benefit of eliminating the requirement for trickle ventilation (that are typically required for other ventilation solutions) thereby increasing the benefits of an air tight construction. It is also possible to incorporate a humidity control function into the fans which will result in a system which is capable of varying supply and extract rates in accordance with the humidity levels in the dwelling.

Renewable Energy Source

Solar PV systems harvest the sun’s energy to provide a renewable energy source for the dwelling. The sun’s energy is converted into electrical energy which offsets the use of grid electricity. The number of PV panels provided on each dwelling is dependent on the geometry, extent of glazing and orientation of the dwelling. This approach allows designers to tailor the amount of renewable energy provided to each dwelling specifically to meet the overall Part L requirements (EPC) and the total renewable energy requirements (RER).

5.3 Option 3 – Gas Fired Boiler, PV Panels & Hot Water Heat Pump with Mechanical Extract Ventilation (Houses)

Heat Source

The use of natural gas to provide heating and hot water to dwellings is very common in urban housing developments due to it’s convenience and low fuel prices. High efficiency gas fired condensing boilers convert gas to heat energy with an efficiency of over 90%. In this case, the gas boiler will only be used to provide space heating to the dwelling.

Hot Water

A “hot water heat pump” is effectively an air source heat pump that is designed to provide hot water only. Rather than having an outdoor and an indoor unit as are required with an air source heat pump as described in 5.1 above, the hot water heat pump combines both components into a single indoor unit which is also combined with a hot water cylinder. Outdoor air is then ducted into the unit to allow heat energy to be extracted. Similarly to the air source heat pump, a proportion of the heat generated can be considered to be renewable due to the efficiency at which the operates.

Certified seasonal efficiencies of some models can reach 300% when producing hot water meaning that the use of this technology will make a sizeable contribution to overall compliance with the Part L 2021 requirements.

Ventilation
Mechanical Extract Ventilation (MEV) systems extract air from all wet rooms using a central extract fan which runs continuously with supply air to the dwelling being provided through trickle vents in each habitable room.

Some hot water heat pump manufacturers offer systems that allow the MEV system to be incorporated into the heat pump. This offers a dual benefit of recovering heat from the air being extracted from the dwelling and of reducing the amount of equipment being provided in each dwelling.

Renewable Energy Source

The hot water heat pump will also make a contribution to the renewable energy requirements of the dwelling but generally this will not be sufficient to meet the RER requirements. As such, PV panels will still be required but a reduced number of panels would be needed compared to the option presented in 5.1 & 5.2.

Solar PV systems harvest the sun's energy to provide a renewable energy source for the dwelling. The sun's energy is converted into electrical energy which offsets the use of grid electricity. The number of PV panels provided on each dwelling is dependent on the geometry, extent of glazing and orientation of the dwelling and of the PV panels.

5.4 Option 4 – District Heating (Commercial & Apartments)

For commercial premises or apartment blocks the approach outlined in this section would involve the generation of heat in a central location on the site and the distribution of this heat to each apartment via a network district heating pipework. The central plant used to generate the heat could include Air Source Heat Pumps, Combined Heat and Power (CHP) plan and high efficiency gas fired condensing boilers.

A CHP unit uses gas as its energy source to create electricity which can be utilised within the proposed development. This process of creating electricity results in the generation of "waste heat" which can then be used to meet a proportion of the heating and hot water demands of the housing development. Since the waste heat is captured it can be considered to be renewable energy and therefore contributes towards the overall 20% renewable energy requirement.

The Air Source Heat Pumps (ASHPs) utilise grid supplied electricity to extract thermal energy from a heat source, in this case, the external ambient air. While the electricity consumed is not considered renewable energy, the efficiency at which a heat pump operates allows a significant portion of the heat delivered to be considered as renewable energy. The amount of heat considered to be renewable is determined by the efficiency of the heat pump and the "primary energy conversion factor" for grid supplied electricity. Typically, approximately 40% to 50% of the heat supplied is considered to be renewable energy.

In order to meet the heating and hot water demands of the apartments in the proposed development a district heating plant centre will be provided in each half of the development. Each plant centre will be capable of generating approximately 750kW to 1MW of heat energy. In this arrangement, the CHP would typically be sized to provide up to 30% of the total annual energy consumption, heat pumps would provide 30 to 40% and the remaining energy demand will be met by the gas fired boilers.

Heating pipework will be installed throughout the scheme to distribute the heat generated in the plant room throughout the apartment element of this development, serving each apartment via a heat interface unit (HIU). The HIU will both control and meter the consumption of heat and hot water within each individual dwelling allowing occupants to set the times they need space heating and ensuring they are charged accordingly.

Heat Recovery Ventilation would then be provided in order meet the ventilation needs of the apartments. Air is extracted from wet rooms and supplied to living spaces via a central unit which contains supply and extract fans and a heat exchanger. This system recovers the heat from the warm air being extracted from the dwelling and uses the heat recovered to raise the temperature of the incoming air stream leading to improved overall efficiency.

5.5 Option 5 – Individual Plant with Exhaust Air Heat Pumps (Apartments)

Exhaust Air heat pumps (EAHPs) operate in a very similar manner to the more conventional air source heat pumps and utilise grid supplied electricity to extract thermal energy from a heat source, in this case, the internal air within the apartment. The internal air is extracted from kitchens and wet rooms and is drawn into the heat pump via ductwork in the ceiling void. The heat pump extracts heat from this air before expelling it from the apartment.

While the electricity consumed is not renewable energy, the efficiency at which a heat pump operates allows a significant portion of the heat delivered to the dwelling be considered as renewable energy. The amount of heat considered to be renewable is determined by the efficiency of the heat pump and the “primary energy conversion factor” for grid supplied electricity. Typically, approximately 30% to 40% of the heat supplied is considered to be renewable energy.

There are a number of manufacturers offering products of this type and the certified seasonal efficiencies of some models can exceed 450% in heating mode and 170% to 190% in hot water mode. These efficiencies can deliver Part L 2021 compliance in most circumstances but in some instances may need supplementary PV panels in order to meet the required energy targets.

There is no requirement for a separate Mechanical Extract Ventilation (MEV) systems when an exhaust air heat pump is used as the heat pump draws the air from all wet rooms in the same manner as an MEV system would. The fan will run continuously to ensure that the minimum ventilation rates are maintained and the supply air to the dwelling is provided through trickle vents in each habitable room.

5.6 Option 6 – Electric Heaters, Hot Water Heat Pumps, Heat Recovery Ventilation & PV Panels (Apartments)

This approach includes the provision of electric storage and/or convector heaters in the living & sleeping areas to meet all of the space heating requirements with electric towel rads provided in main bathrooms and en-suites.

The hot water demand is met by a hot water heat pump which utilise grid supplied electricity to extract thermal energy from a heat source in a similar manner to an Exhaust Air Heat Pump. The heat pump is ducted directly to the external façade through insulated supply & exhaust ductwork and uses external air for the hot water needs. It can use up to 3 times less electricity than direct acting water heaters and produces renewable energy to aid Part L compliance.

Heat Recovery Ventilation would then be provided in order meet the ventilation needs of the apartments. Air is extracted from wet rooms and supplied to living spaces via a central unit which contains supply and extract fans and a heat exchanger. This system recovers the heat from the warm air being extracted from the dwelling and uses the heat recovered to raise the temperature of the incoming air stream leading to improved overall efficiency.

PV panels are also then needed to improve the overall renewable energy contribution and improve the overall energy performance of the dwellings. Generally, 1 or 2 PV panels will be required for each apartment.

5.7 Apartment Corridors/Landlord Areas

In accordance with the requirements of Part L 2021, the common areas within the apartment blocks are required to meet the requirements of Part L 2021 for “Buildings Other Than Dwellings”. Under Part L 2017, a portion (10% to 20%) of the energy demand of the common areas must be met by a renewable energy source. The energy demand within these spaces will be exclusively provided by electrical energy (lighting, space heating & lifts etc) so a photovoltaic array would be best suited to meet this renewable energy demand.

6. Heat Sources & Renewable Energy Options – Non-Domestic Buildings

All new commercial buildings (Buildings Other Than Dwellings) must meet the overall energy performance standards and have a have a portion of their annual energy demand provided by renewable energy sources as set out in Part L 2021 Dwellings. This can be thermal energy such as ***solar thermal collection***, ***biomass boilers*** or ***heat pumps*** or it can be electrical energy as generated by ***photovoltaic solar panels*** or ***wind turbines.***

The minimum renewable energy contributions for a development of this nature is defined in *Part L 2021 BOTD* L5 Part (b) and is measured by the Renewable Energy Ratio (RER). This is the ratio of the primary energy from renewable energy sources to total primary energy demands of the building. Depending on the overall performance of the building, as measured by the EPC and CPC the required renewable energy contribution is either 20% or 10%.

In order to determine the most efficient and effective means of complying with the requirements of Part L 2021 BOTD Part (b) a detailed assessment of the various renewable energy systems available will be conducted during the design stage using the SBEM calculation methodology.

There is a wide variety of possible solutions for heating, cooling and ventilation of non-domestic buildings which can be tailored to suit the proposed uses of the spaces and to meet the occupancy needs. Some spaces may require mechanical ventilations systems or comfort cooling to meet the required internal comforts levels, while others may simply need heating and natural ventilation. Hot water demands in non-domestic buildings also vary considerably depending on building use.

As part of the detailed design process, an SBEM analysis will be carried out to assess the proposed design solutions for compliance with the requirements of *Part L 2021 BOTD*. Typical design solutions that will be assessed will include the following:

- Water based heating systems incorporating air source heat pumps or condensing gas boilers
- Natural ventilation where possible
- Mechanical ventilation systems incorporating heat recovery and/or heat pump technology
- Comfort cooling where required with invertor driven, R32 air conditioning technology
- LED lighting with occupancy and daylight controls
- Solar renewable energy systems (photovoltaic or solar thermal) if required to meet renewable contribution energy targets

7. Proposed Solutions for Kilternan Village

The preceding sections of this report set out the regulatory requirements with which the scheme will have to comply while identifying a number of technologies and design approaches that may be utilised to achieve compliance.

The building fabric standards and the technology solutions discussed will all be assessed in greater detail during the detailed design stage of the project. A cost benefit analysis of all these available solutions will be carried out to determine the correct balance between an efficient building envelope and the most appropriate combination of technology and renewable energy systems.

The proposed approach to achieving Part L Compliance will be based on a combination of the solutions below once a detailed analysis has been completed at detailed design stage. A final decision will be made once capital costs, renewable targets and regulation compliance have all been compared to find the most appropriate solution.

7.1 Houses

The most likely overall solution that will be implemented will include the following measures

- Exceed minimum U-Value standards by 20% to 30%,
- Achieve air tightness standards of $3m^3/m^2/hr$
- Ensure thermal bridging details are designed to achieve thermal bridging factors of $0.08W/m^2K$ or less.
- Provide an appropriate combination of technologies to ensure energy consumption is in line with Part L 2021 requirements. This will either include air source heat pumps and/or an alternative heating system such as gas boilers with PV panels for renewable energy.
- Install centralised mechanical ventilation systems to ensure adequate ventilation rates are achieved in the dwelling which maximising the benefits of the airtight construction

7.2 Apartments

The most likely overall solution that will be implemented will include the following measures

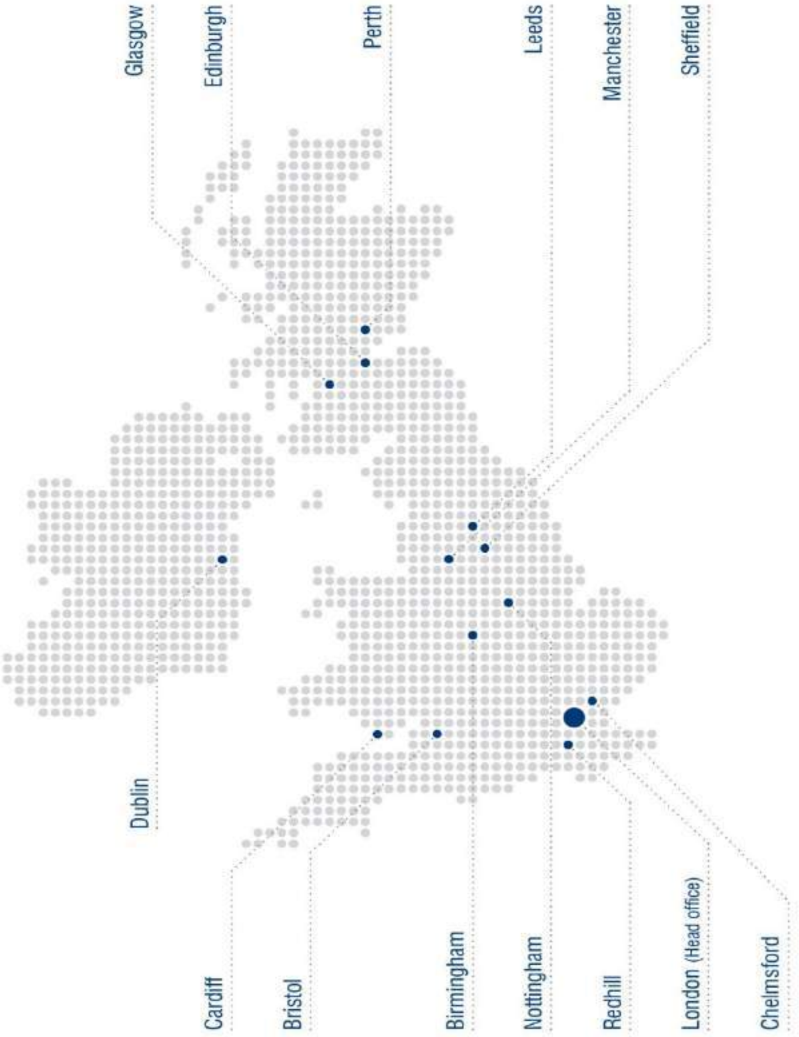
- Exceed minimum U-Value standards
- Achieve air tightness standards of $3m^3/m^2/hr$
- Ensure thermal bridging details are designed to achieve thermal bridging factors of $0.08W/m^2K$ or less.
- Provide an appropriate combination of technologies to ensure energy consumption is in line with Part L 2021 requirements. This will most likely include individual plant in each apartment, either exhaust air heat pumps or electric heaters and hot water heat pumps. It is unlikely that a district heating system will be viable on such small apartment blocks.
- Install centralised mechanical ventilation systems to ensure adequate ventilation rates are achieved in the dwelling which maximising the benefits of the airtight construction

7.3 Non-Domestic Buildings

The most likely overall solution that will be implemented will include the following measures

- Exceed minimum U-Value standards
- Achieve air tightness standards of 5 $m^3/m^2/hr$
- Provide an air source heat pump and/or PV panels to meet Part L renewable contribution requirements

UK and Ireland Office Locations



Project Number: 21-096
Document Reference: 21-096.r001

Enviroguide
CONSULTING

Appendix C

ROGER MULLARKEY & ASSOCIATES
CONSULTING STRUCTURAL and CIVIL ENGINEERS

SITE SPECIFIC FLOOD RISK ASSESSMENT
for a Residential/Commercial Development at Kilternan Village, Kilternan, Dublin 18.

PROJECT:	**KILTERNAN VILLAGE SHD - 2104**
CLIENT:	**LISCOVE LTD**
DATE:	**JUNE 2022**
ISSUE NO:	**PLANNING**
ISSUED BY:	**ROGER MULLARKEY**

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TABLE OF CONTENTS

1.0 Introduction

1.1 This document relates to the Flood Risk Assessment (FRA) for a proposed mixed residential/commercial development located on lands at Wayside, Enniskerry Road, Kilternan, Dublin 18.

1.2 We, Roger Mullarkey & Associates, were appointed by Liscove Ltd. to carry out the Site Specific Flood Risk Assessment report to accompany the suite of other drawings and documentation relating to a proposed residential and commercial development at the above noted address.

1.3 The application area c.10.8Ha, is currently predominately greenfield and includes a derelict house & outbuildings.

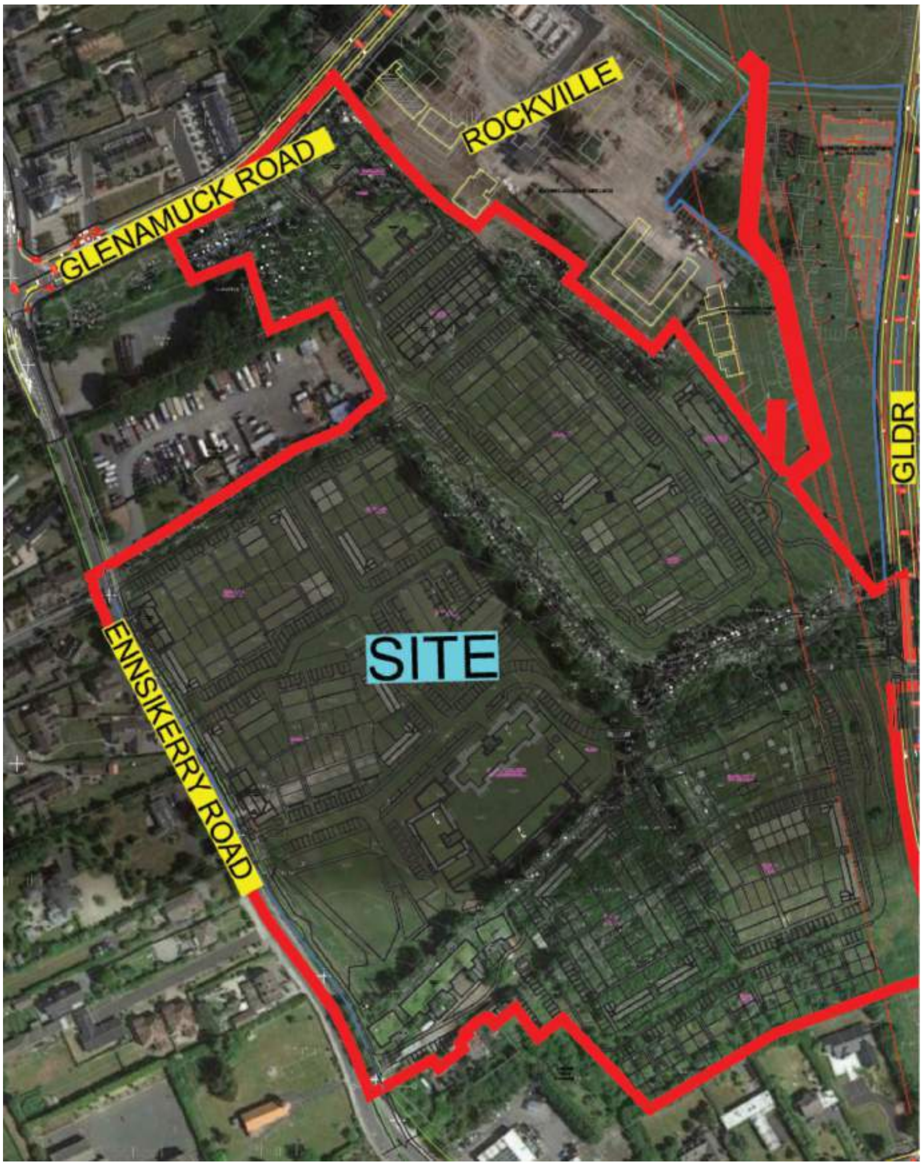


Fig.1 – Site Location

1.4 The development will principally consist of a mixed-use development consisting of 383 No. residential units and a Neighbourhood Centre incorporating a creche/office/medical/retail/community use. Please refer to Thornton O'Connor Planning Consultants for a full development description.

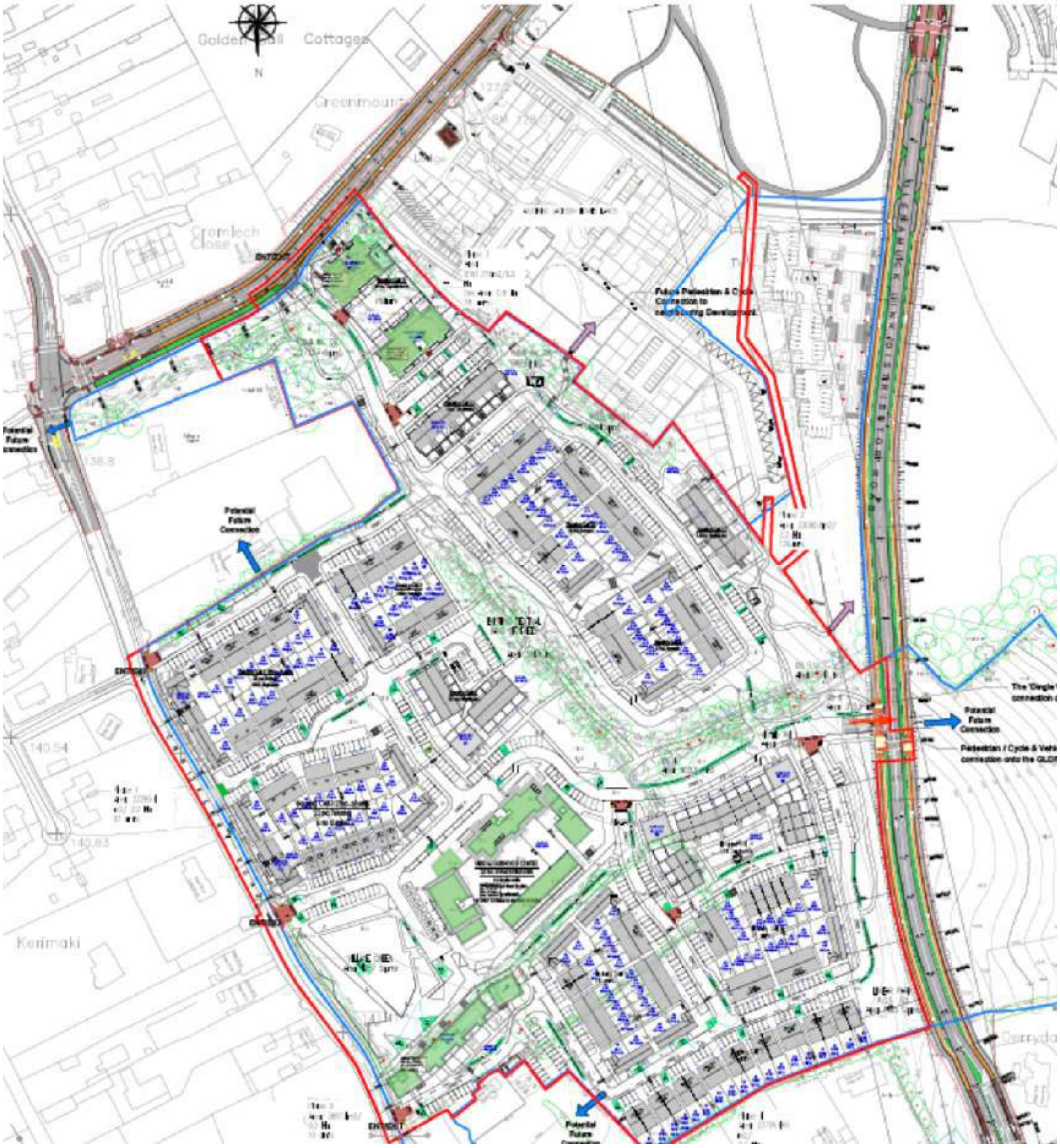

Golden Ball Cottages
N
Greenmount
Cromlech Close
Potential Future Connection
Future Pedestrian & Cycle Connection to neighbouring Development
Potential Future Connection
The 'Dingle' connection
Potential Future Connection
Pedestrian / Cycle & Vehicle connection onto the GLDR
Kerimaki
ENTRANCE
Potential Future Connection

Fig.2 – Architectural Site Layout (Not to Scale)

1.5 In accordance with the requirements set out in the DoEHLG and OPW published guidelines *The Planning System and Flood Risk Management 2009* (the Guidelines) and the Strategic Flood Risk Assessment Policy of Appendix 15 of the Dun Laoghaire Rathdown County Development Plan 2022 – 2028 a Site Specific Flood Risk Assessment (SSFRA) is carried out for this application.

1.6 The purpose of the SSFRA is to scope for possible sources of flooding, assess the types of flood risk for the proposed development and to consider if there are any possible impacts on flood risk elsewhere due to the development. Where appropriate, the SSFRA recommends flood mitigation and management measures and identifies residual risks, if any should remain after the implementation of the identified measures.

1.7 The report is intended for the sole use of the applicant, their elected agents and advisors and, further, solely for the purpose for which it was originally commissioned. It may not be assigned or copied to third parties or relied upon by third parties.

1.8 The criteria under which this Site Specific Flood Risk Assessment is carried out is in accordance with the DoEHLG and OPW requirements and the parameters ascertained by consultation with Drainage Department of Dun Laoghaire Rathdown County Council.

2.0 Flood Risk Guidelines and the Planning System

2.1 The Planning System and Flood Risk Management, Guidelines for Planning Authorities (the Guidelines) was published in November 2009. The main purpose of the Guidelines is to ensure that sustainable development can be delivered by integrating flood risk management into the planning process.

2.2 The core objectives of the guidelines are to;

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flooding elsewhere, including that which may arise from surface water runoff;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional, or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders;
- Ensure that the requirements of EU and national law in relation to the environment and nature conservation are complied with at all stages of flood risk management.

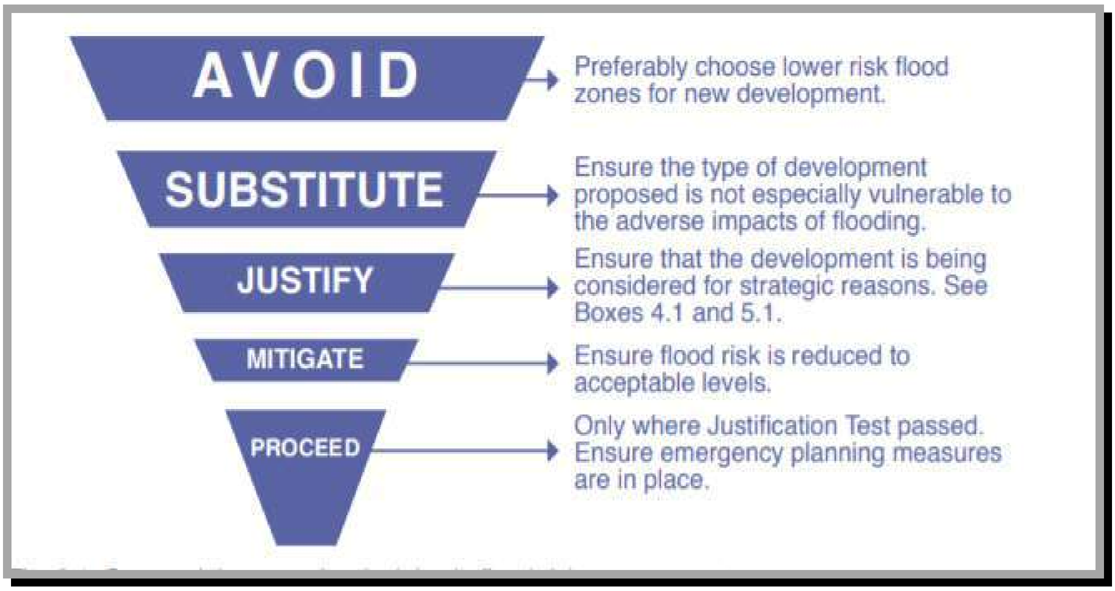
2.3 A staged approach is adopted to the Flood Risk Assessment (FRA) as follows;

2.4 ***Stage 1 - Flood risk identification*** – identify whether there may be any flooding or surface water management issues related to either the area or regional planning guidelines, development plans and LAP’s or a proposed development site that may warrant further investigation at the appropriate lower level plan or planning application levels.

2.5 ***Stage 2 - Initial flood risk assessment*** – to confirm sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information and to scope the extent of the risk of flooding which may involve preparing indicative flood zone maps. Where hydraulic models exist the potential impact of a development on flooding elsewhere and of the scope of possible mitigation measures can be assessed.

2.6 ***Stage 3 Detailed flood risk assessment*** – to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development or land to be zoned, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures.

2.7 From the Guidelines Section 3.1, the broad philosophy underpinning the sequential approach in flood risk management is laid out as follows;



Preferably choose lower risk flood zones for new development.

Ensure the type of development proposed is not especially vulnerable to the adverse impacts of flooding.

Ensure that the development is being considered for strategic reasons. See Boxes 4.1 and 5.1.

Ensure flood risk is reduced to acceptable levels.

Only where Justification Test passed. Ensure emergency planning measures are in place.

Fig.3 - Extract from *Section 3.1* of the *Guidelines*

2.8 The sequential approach to planning is a key tool in ensuring that development, particularly new development, is first and foremost directed towards land that is at low risk of flooding.

2.9 The sequential approach described in Fig.3 above should be applied to all stages of the planning and development management process and is applicable in the layout and design of development within a specific site at the development management stage.

2.10 The following flow chart from Section 3.2 of the Guidelines describes its mechanism for use in the planning process.

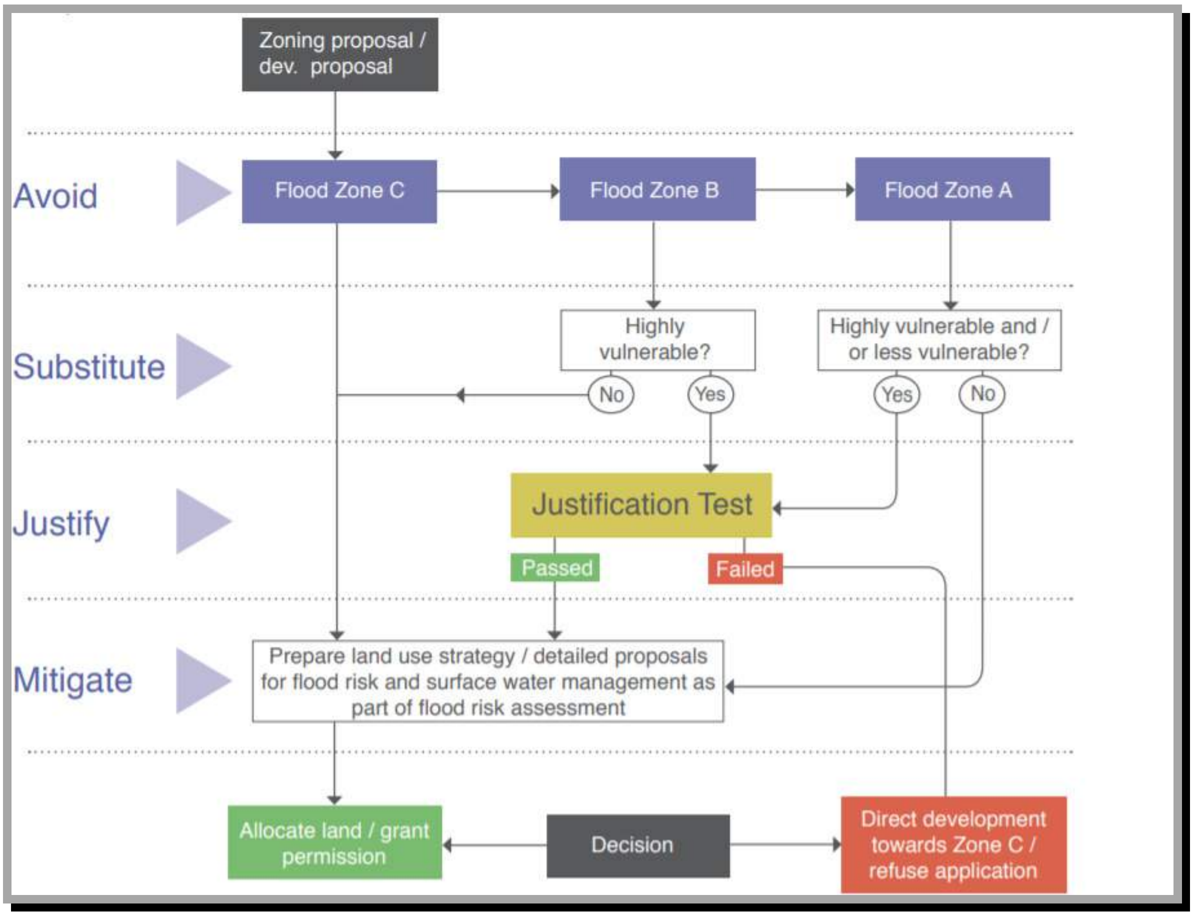

Zoning proposal / dev. proposal
Avoid
Flood Zone C
Flood Zone B
Flood Zone A
Substitute
Highly vulnerable?
Highly vulnerable and / or less vulnerable?
No
Yes
Yes
No
Justify
Justification Test
Passed
Failed
Mitigate
Prepare land use strategy / detailed proposals for flood risk and surface water management as part of flood risk assessment
Allocate land / grant permission
Decision
Direct development towards Zone C / refuse application

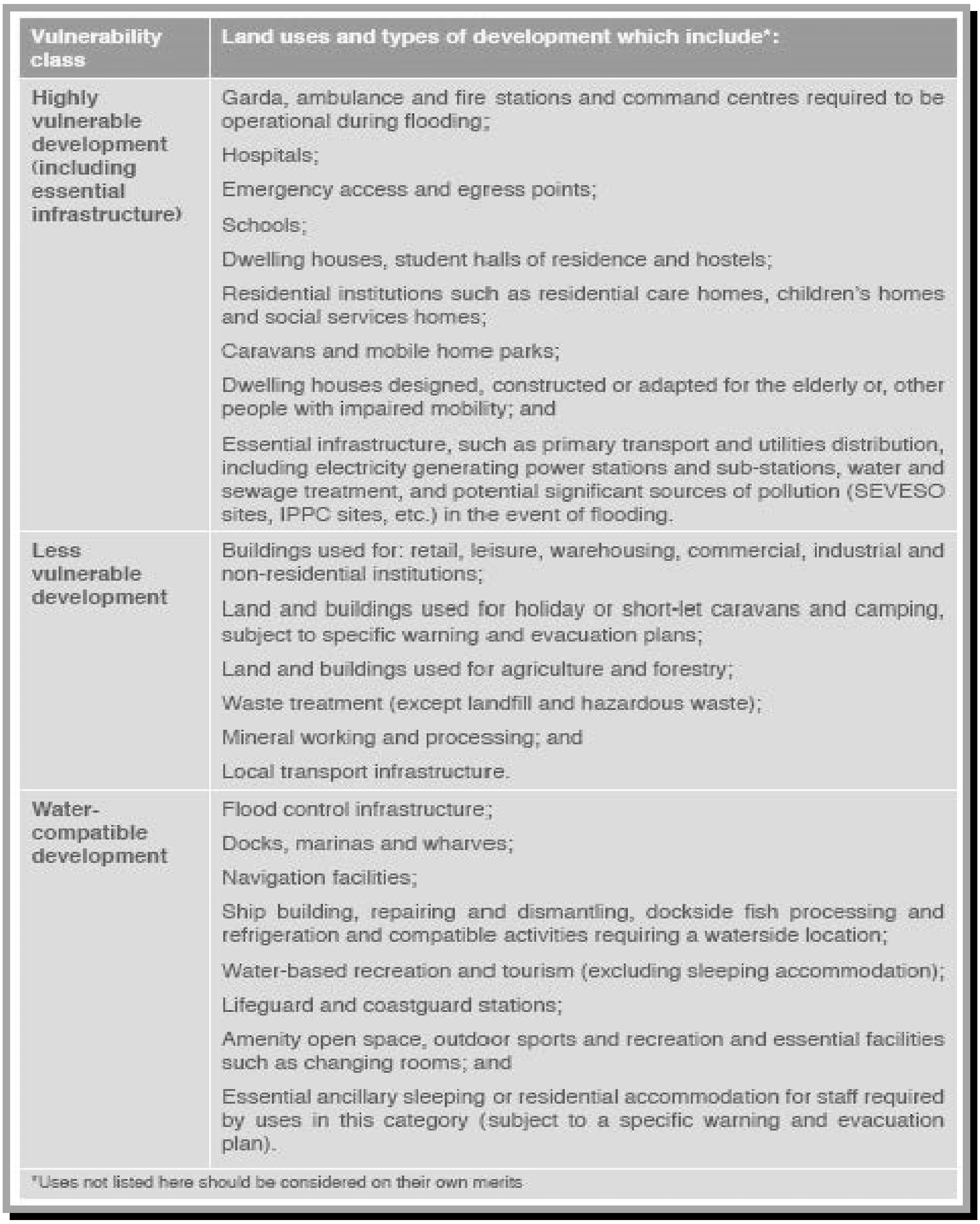
Fig.4 - Extract from *Section 3.2* of the *Guidelines*

2.11 There are 3 types or levels of flood zones defined in the Guidelines and are as described in Table 1 below;

Flood Zone	Description
A	Where the 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)
B	Where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 years and 1% or 1 in 100 years for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding)
C	Where the probability of flooding from rivers and sea is low (less than 0.1% or 1 in 1000 years for both river and coastal flooding). Flood Zone C covers all areas of the plan which are non in Zones A or B.

Table 1 – Flood Zones

2.12 The following table extracted from the Guidelines section 3.5 defines the Vulnerability Classes of various types of development.

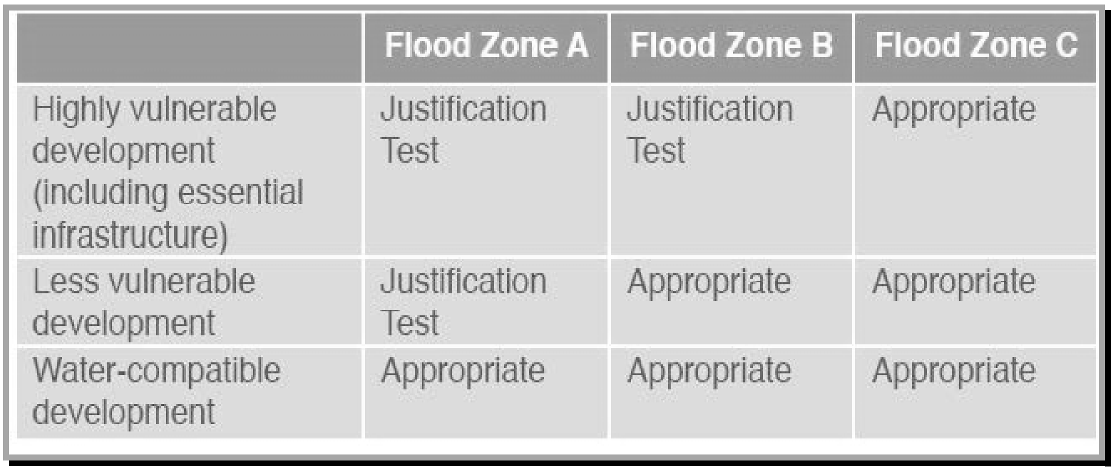


Vulnerability class	Land uses and types of development which include*:
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

*Uses not listed here should be considered on their own merits

Fig.5 – Extract from *Section 3.5* of the *Guidelines*

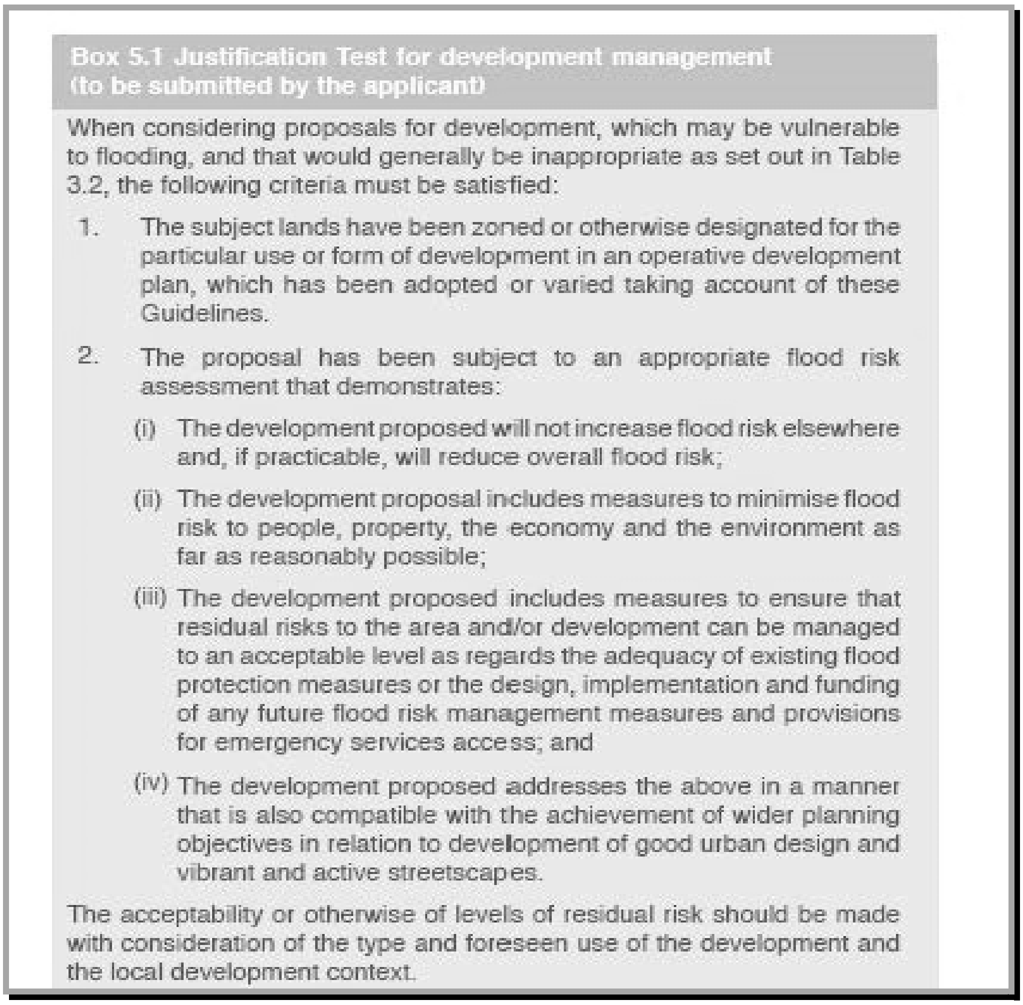
2.13 The vulnerability of class of a development and the identified flood zone are used to determine the appropriateness of the development proposed and which types of development would need to undergo a Justification Test as per the extracted table from section 3.6 of the Guidelines below;



	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Fig.6 – Extract from *Section 3.6* of the *Guidelines*

2.14 Should the review of the sequential approach determine that a Justification test is necessary ,i.e., a development lies in a high/moderate risk of flooding and be inappropriate as per the Justification test able as above, the following table extracted from the Guidelines section 5.15 needs to be satisfied;



Box 5.1 Justification Test for development management (to be submitted by the applicant)

When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:

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.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:
   - (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;
   - (ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;
   - (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; and
   - (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 acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Fig.7- Extract from *Section 5.15* of the *Guidelines*

3.0 Site Specific Flood Risk Assessment

3.1 General

3.1.1 The lands are located just east of the Enniskerry Road and south of the Glenamuck Road in Kilternan, Dublin 18.

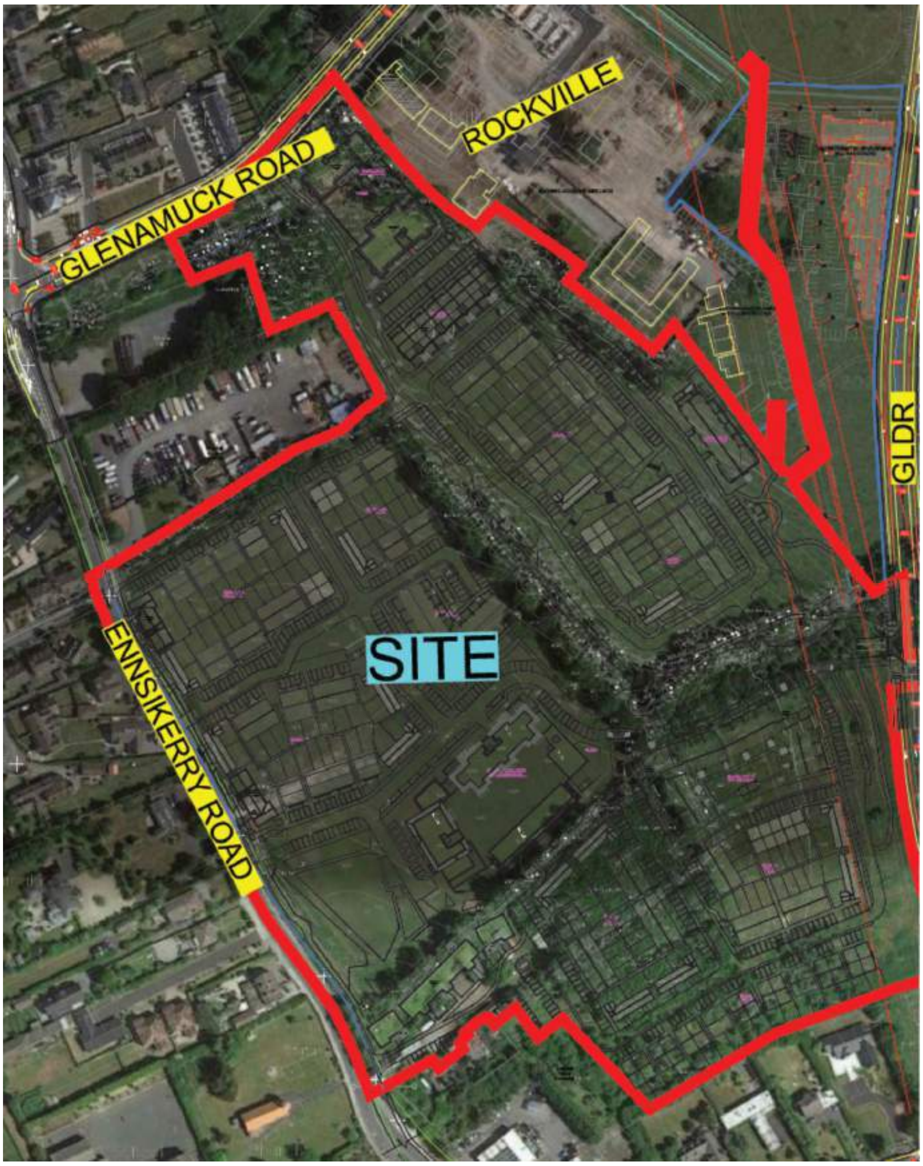


Fig.8 – Site Location from Google Maps

3.1.2 The application area c.10.8Ha, is currently predominately greenfield and includes a derelict house & outbuildings. The drained area of the site is 9.92Ha as discussed in detail in the Engineering Infrastructure & Stormwater Impact Assessment report accompanying this application.

3.1.3 The topography is generally a gradually increasing slope downwards from the Enniskerry Road (western boundary) in a North-easterly direction and then falls off sharply (c. 1/10 gradient) towards the eastern boundary. A site survey drawing is included in the application and can be viewed as background on the Road & Block Levels drawing Dwg.No.2104/01 & 02.

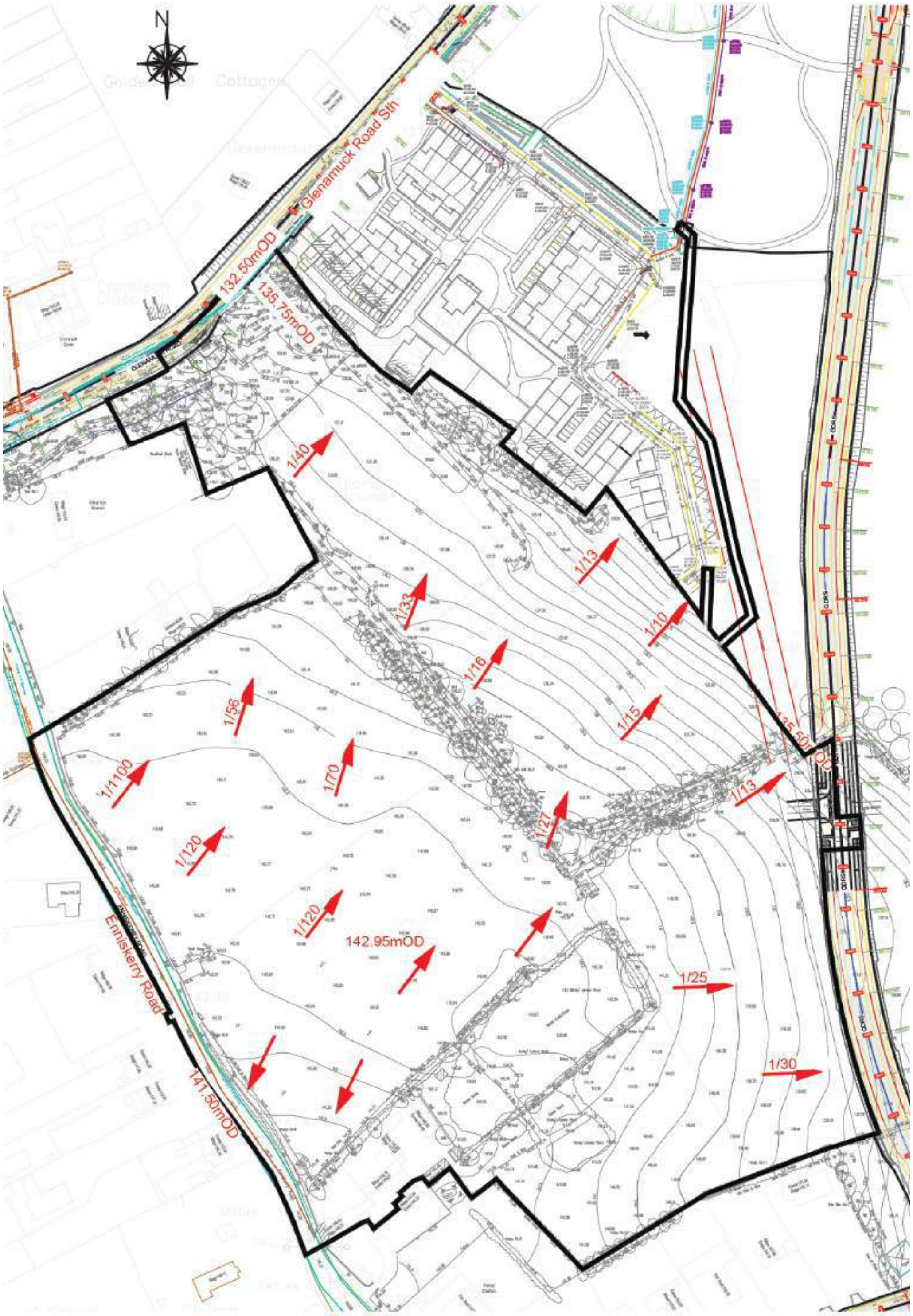


Fig.9 – Topography

3.1.4 The site is bounded by a c.1.2m high existing stone wall to the west (Enniskerry Rd), by hedgerows/trees to the northwest and north, by the Glenamuck Road to the far north, by an existing stone wall onto the

Rockville development (Reg.Ref.D17A/0793 & D18A/0566 & D20A/0015) to the northeast, by open green field and the future Glenamuck Link Distributor Road (GLDR) as part of the Glenamuck District Roads Scheme (GDRS) to the east and by hedgerow and a petrol station and detached house rear gardens along the southern boundary.

3.1.5 A Road & Block levels drawing has been prepared as part of this application and reference should be made to Dwg.No.2014/01 & 02 in this regards. Generally, the proposed road levels and house levels follow the existing contours of the site topography.

3.1.6 The following assessment will identify the potential sources of flooding and categorise the risk as either very low, low, medium, high, and very high.

3.1.7 The risks categorised above are based on the judgement and experience of the Engineer carrying out the assessment and based on the documentation sourced from the Flood Risk Indicator sources as noted in Section 3.3 of this report.

3.1.8 The initial assessment process will involve examining the flood risk indicators. Where it is demonstrated that there is a risk of flooding the study will progress to a more detailed flood risk assessment, if required. Each of the below 5 potential sources of flood risk will be assessed in this regards.

3.1.9 A Hydrological and Hydrological Risk Assessment report prepared by Enviroguide Consulting has been completed and is included with the planning application – refer to that report for further detail. That report details the risk based assessment carried out to determine any potential impacts on the receiving water environment.

3.2 Potential Sources of Flood Risk

3.2.1 Tidal

Coastal flooding is caused by higher sea levels than normal, largely because of storm surges, resulting in the sea overflowing onto the land.

3.2.2 Fluvial

Caused by the overtopping of rivers/streams when the capacity of a watercourse is exceeded or the channel is blocked or restricted, and excess water spills out from the channel onto adjacent low-lying area.

3.2.3 Pluvial

Caused when the intensity of rainfall events cannot be absorbed into the ground or urban drainage systems cannot effectively convey the flowrates.

3.2.4 Groundwater

Groundwater flooding occurs when the level of water stored in the ground, the water table, rises because of prolonged rainfall. Groundwater flooding tends to be very local and result from interactions of site specific factors such as tidal variations.

3.2.5 Human/Mechanical Error

Caused by blockages in piped systems or intervention of/failure of mechanical devices.

3.3 Flood Risk Indicators

3.3.1 The initial flood risk identification involves a scoping review of existing available information and datasets. The following source indicators were researched as part of the Stage 1 process;

- IW/DLRCC Drainage Records maps
- Available OPW flood maps and reports (from *floodmaps.ie*)
- DLRCC Carrickmines/Shanganagh River Catchment Study
- OPW Eastern CFRAM study
- OPW PFRM mapping
- Geological Survey of Ireland (GSI) website
- Teagasc soils data sets
- Ordnance Survey mapping
- Topographical survey
- Site Investigation reports
- Site walkover visits
- Discussions with DLRCC Drainage Department
- DLRCC Development Plan- Appendix 15-Strategic Flood Risk assessment
- Hydrological and Hydrological Risk Assessment report prepared by Enviroguide Consulting

3.4 Tidal Flood Risk

3.4.1 Tidal flooding is caused by higher sea levels than normal, largely because of storm surges, resulting in the sea overflowing onto the land. There are also tidal effects on groundwater levels.

3.5 Tidal Flood Risk Indicators

3.5.1 Reference to land mapping websites such as google maps/OSI mapviewer indicate that this site is more than 5.5km from the coast. The site topographical survey demonstrates that the land is elevated at c.142mOD Malin Head.

3.6 Initial Tidal Flood Risk Assessment

3.6.1 Based on the remote distance from the coastline and the elevated nature of the site, in our opinion there is no risk of Tidal flooding on this site.

3.7 Fluvial Flood Risk

3.7.1 Fluvial river/stream flooding occurs when the capacity of a watercourse is exceeded or the channel is blocked or restricted, and excess water spills out from the channel onto adjacent low-lying area.

3.8 Fluvial Flood Risk Indicators

3.8.1 Reference to the site topographical survey and the OSI mapping website determined that there is no known watercourse or stream on the subject lands. Similarly, there are no known watercourses along the Enniskerry Road that could overspill onto the subject lands.

3.8.2 Reference to the topographical survey of the subject site shown that the ground slightly higher (200-300mm) than the Enniskerry Road along the site frontage and the site slopes easterly away from the Enniskerry Road thereafter.

3.8.3 Reference to survey mapping and site visits indicate that there is a roadside drainage channel along the northern side of the Glenamuck Road to the north of the site. This roadside drainage channel currently serves as the S/W drainage for the Glenamuck Road.

3.8.4 As part of the Glenamuck District Roads Scheme (GDRS) this roadside drainage channel will be incorporated into drainage infrastructure for that project. This surface water drainage infrastructure will involve the construction of new regional attenuation ponds.

3.8.5 During pre-planning consultations with DLRCC and their GDRS design consultants (DBFL Consulting Engineers), it was confirmed that the attenuated surface water outfall from the subject application lands have been allowed for and are incorporated into the GDRS infrastructure design.

3.8.6 This subject planning application seeks to outfall the majority (c.9.63Ha of drained area) of the attenuated surface water flows into the existing piped S/W infrastructure recently constructed as part of the Rockville housing development (Reg.Ref.D17A/0793) located to the NE of the subject site. This existing 300mm S/W infrastructure currently drains the attenuated flows from the Rockville development and outfalls to the Glenamuck Road roadside drainage channel. This existing 300mm S/W pipe is to be diverted into the GLDR/GDRS regional attenuation ponds as part of the roads project and as part of the approved DLRCC Part 8 *Glenamuck Park* project. Refer to Dwg.2104/04 & 05 for further detail.

3.8.7 A smaller portion (0.29Ha drained area) of the subject planning application seeks to outfall attenuated surface water flow into the S/W infrastructure that is included in the GDRS project. A spur connection facilitating same has been agreed with the applicant and connection into same is subject to a successful grant of planning for the subject site. Refer to Dwg.2104/04 for further detail.

3.8.8 As is recommended in the DLRCC Stormwater Management Policy, the HR Wallingford UKSuDS Greenfield runoff rate estimation tool was used to calculate the Qbar for the site. The overall S/W outfall rate from the proposed development has been calculated using the drained site area of 9.92Ha (not the application “redline” area). **Qbar** was determined to be **= 44.2l/s** . The outfall flowrates are proportioned as 42.4l/s and 1.8 l/s between the two above noted outfall points. Refer to the main application submission Dwg.No.’s 2104/02-05 for the layout and detail of the proposed S/W infrastructure.

3.8.9 The regional attenuation ponds included in the GDRS project local to the Glenamuck Road ultimately drains downstream to a watercourse known as the Glenamuck Stream & Golf/Golfcourse Stream, see Fig.10 below for context;

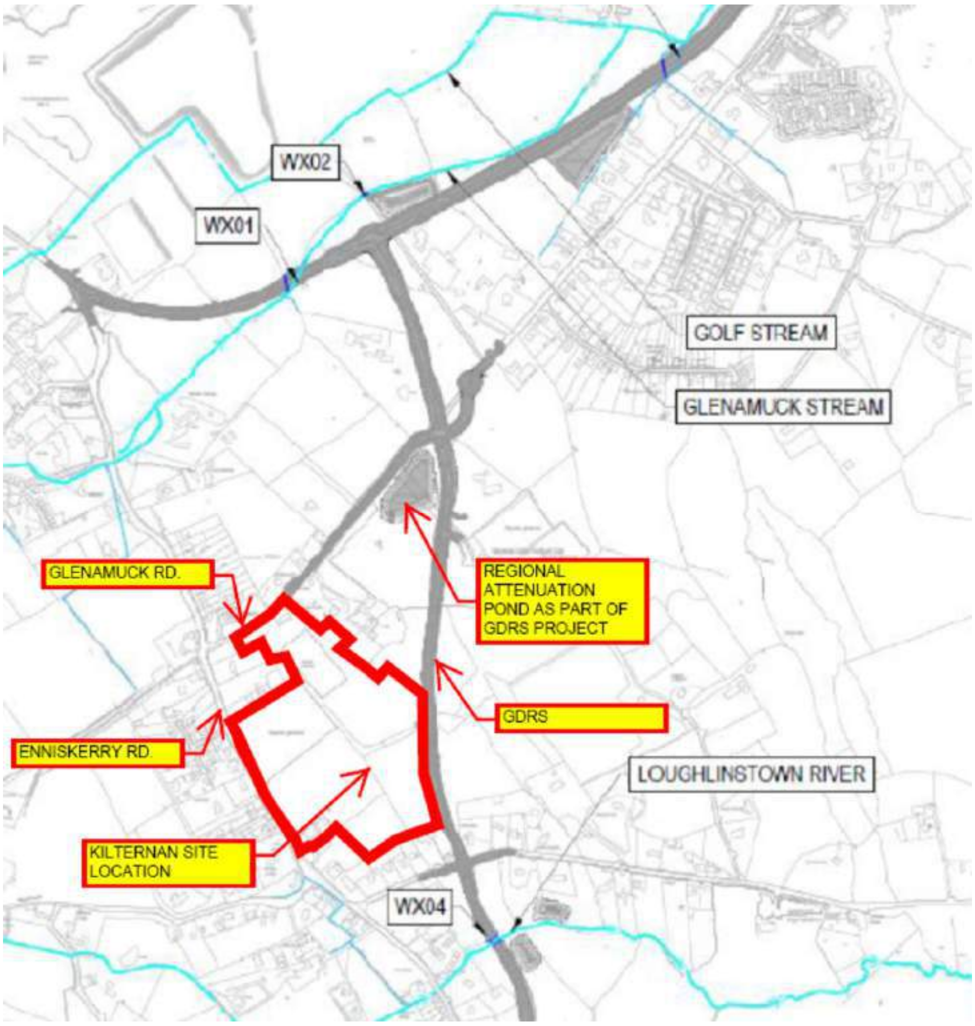
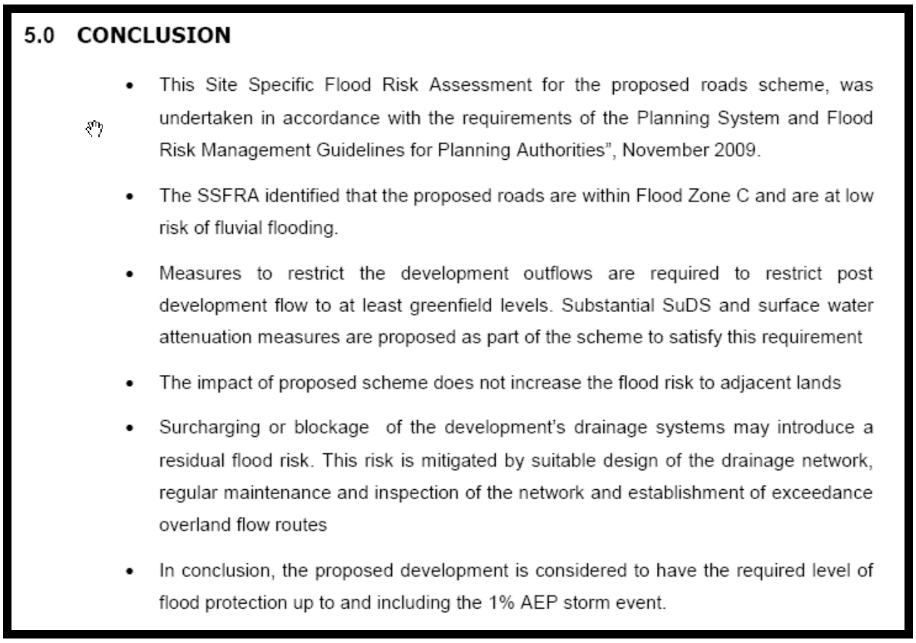


Fig.10 – Extract from GDRS SSFRA (fig.1-4)

3.8.10 A Site Specific Flood Risk Assessment was carried out by DLRCC as part of their approved GDRS project and was included in the appendix of the Environmental Impact Assessment Report (EIAR) for that project. Review of that documentation is beyond the scope of this subject SSFRA relating to the Kilternan Village application but Fig.11 below is an extract from the GDRS SSFRA conclusion chapter. The reader is referred to the GDRS EIAR for further detail (Ref.ABP303945-19).

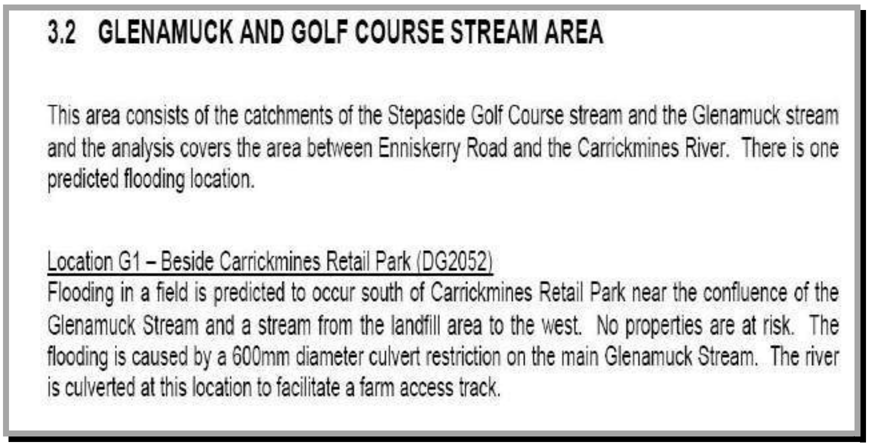


5.0 CONCLUSION

- This Site Specific Flood Risk Assessment for the proposed roads scheme, was undertaken in accordance with the requirements of the Planning System and Flood Risk Management Guidelines for Planning Authorities", November 2009.
- The SSFRA identified that the proposed roads are within Flood Zone C and are at low risk of fluvial flooding.
- Measures to restrict the development outflows are required to restrict post development flow to at least greenfield levels. Substantial SuDS and surface water attenuation measures are proposed as part of the scheme to satisfy this requirement
- The impact of proposed scheme does not increase the flood risk to adjacent lands
- Surcharging or blockage of the development's drainage systems may introduce a residual flood risk. This risk is mitigated by suitable design of the drainage network, regular maintenance and inspection of the network and establishment of exceedance overland flow routes
- In conclusion, the proposed development is considered to have the required level of flood protection up to and including the 1% AEP storm event.

Fig.11 – Extract from GDRS SSFRA (page 23)

3.8.11 DLRCC commissioned RPS Consulting Engineers to carry out the Fluvial Flooding Report for Carrickmines/Shanganagh River Catchment Stage 1 Final Report 2008. Review of that report determined that there is no risk to flooding of property along the Golfcourse Stream between Enniskerry Road and Carrickmines River. The following Fig.12 is an extract taken from the DLRCC/RPS report.



3.2 GLENAMUCK AND GOLF COURSE STREAM AREA

This area consists of the catchments of the Stepaside Golf Course stream and the Glenamuck stream and the analysis covers the area between Enniskerry Road and the Carrickmines River. There is one predicted flooding location.

Location G1 – Beside Carrickmines Retail Park (DG2052)
Flooding in a field is predicted to occur south of Carrickmines Retail Park near the confluence of the Glenamuck Stream and a stream from the landfill area to the west. No properties are at risk. The flooding is caused by a 600mm diameter culvert restriction on the main Glenamuck Stream. The river is culverted at this location to facilitate a farm access track.

Fig.12 – Extract from DLRCC/RPS Carrickmines/Shanganagh River Catchment Study

3.8.12 Research into the flooding history of the area on *floodmaps.ie* website determined that there was no flooding in the immediate area of the site. Refer to the absence of any flood point markers on the OPW National Flood Hazard map extract shown below in Fig.13 and the OPW summary report in the appendix of this document.

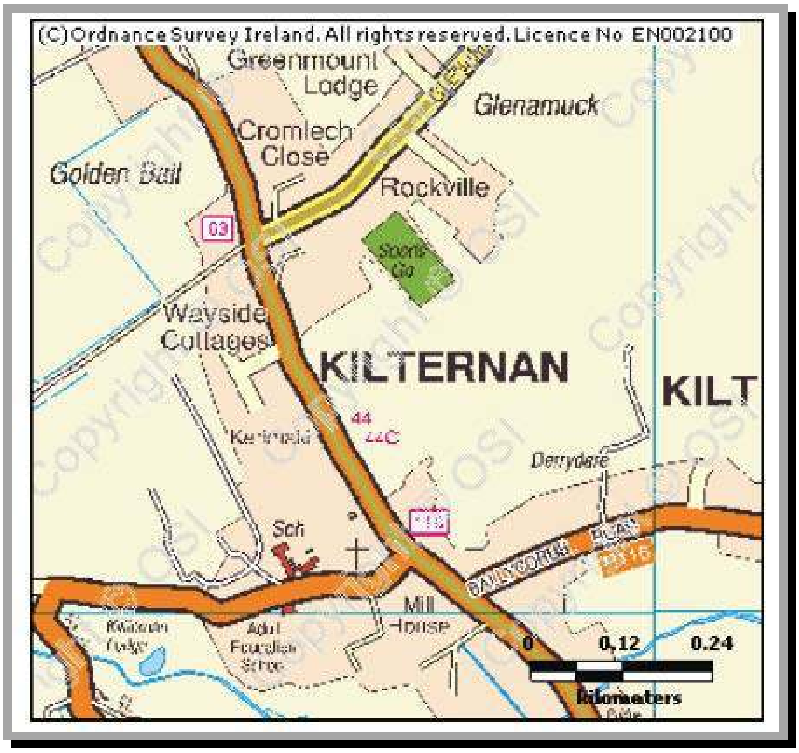


Fig.13 – Extract from the OPW National Flood Hazard Map (*floodmaps.ie*)

3.8.13 Reference to the topographical survey shows that the subject lands are elevated above the Glenamuck Road by a minimum of c.2.5m and the road falls away from the site.

3.8.14 The OPW has published the Catchment Flood Risk Assessment Management Studies and they have created a website portal for accessing the available results and mapping at *www.cfram.ie*. & *www.floodinfo.ie*

3.8.15 The mapping published indicates the flood extent boundaries for various return period events. These Annual Exceedance Probability (AEP) events of 10%, 1% and 0.1% (or 1 in 10 year, 1 in 100 year and 1 in 1000 year) were examined as part of the CFRAM mapping. Fig.14 below indicates the studied areas as shown in shaded blue.

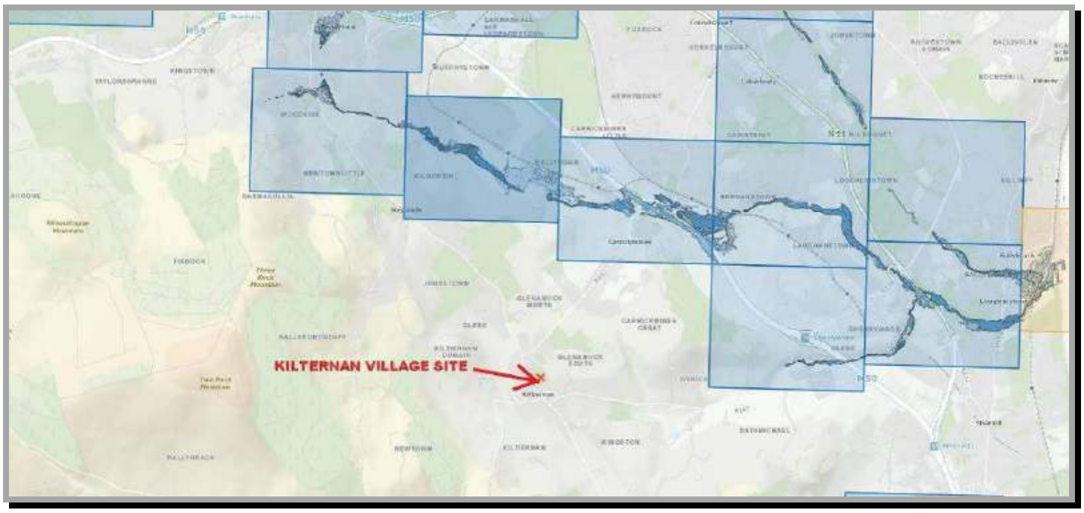


Fig.14 – Extract from CFRAM

3.8.16 It is apparent the CFRAM study (as shown in Fig.14 above in blue shading) has not been carried out in the immediate vicinity of Kilternan and is concentrated on the known Shanganagh-Carrickmines River Fluvial Extents area. Therefore, in accordance with the definition specified in the Guidelines, and as outlined in Section 2.11 above, it has been concluded that the **subject site location is within a Zone C**.

3.8.17 The draft Preliminary Flood Risk Assessment maps (No.2019/MAP/221/A) available from the OPW were also reviewed and the Kilternan Village site and general area is noted as having "*no fluvial data available*". Refer to appendix for an A3 not to scale map of same.

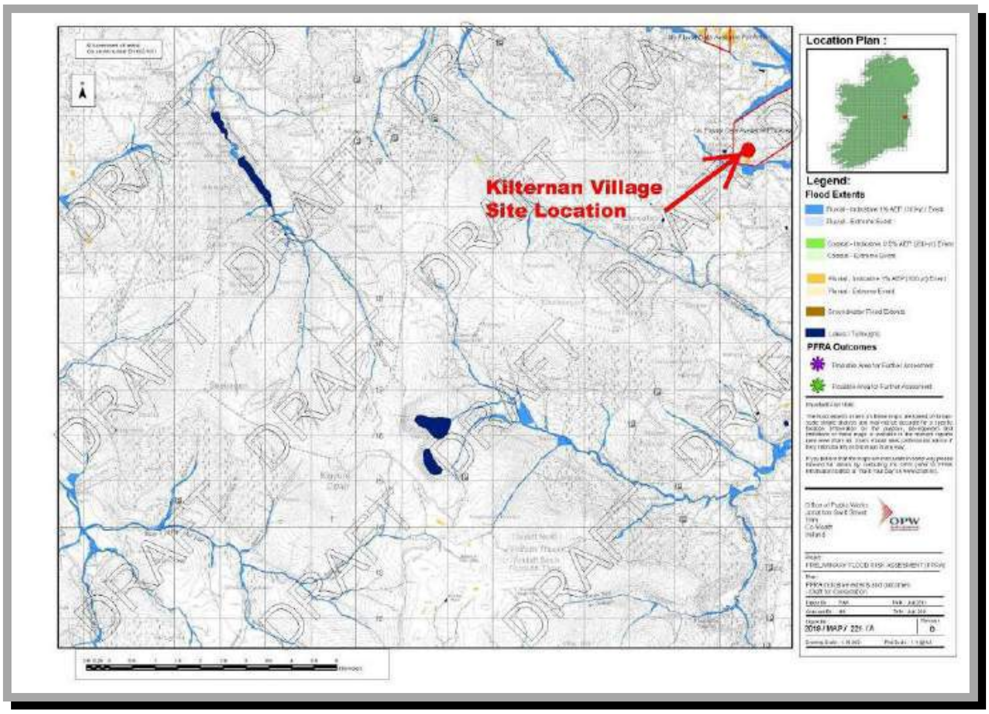
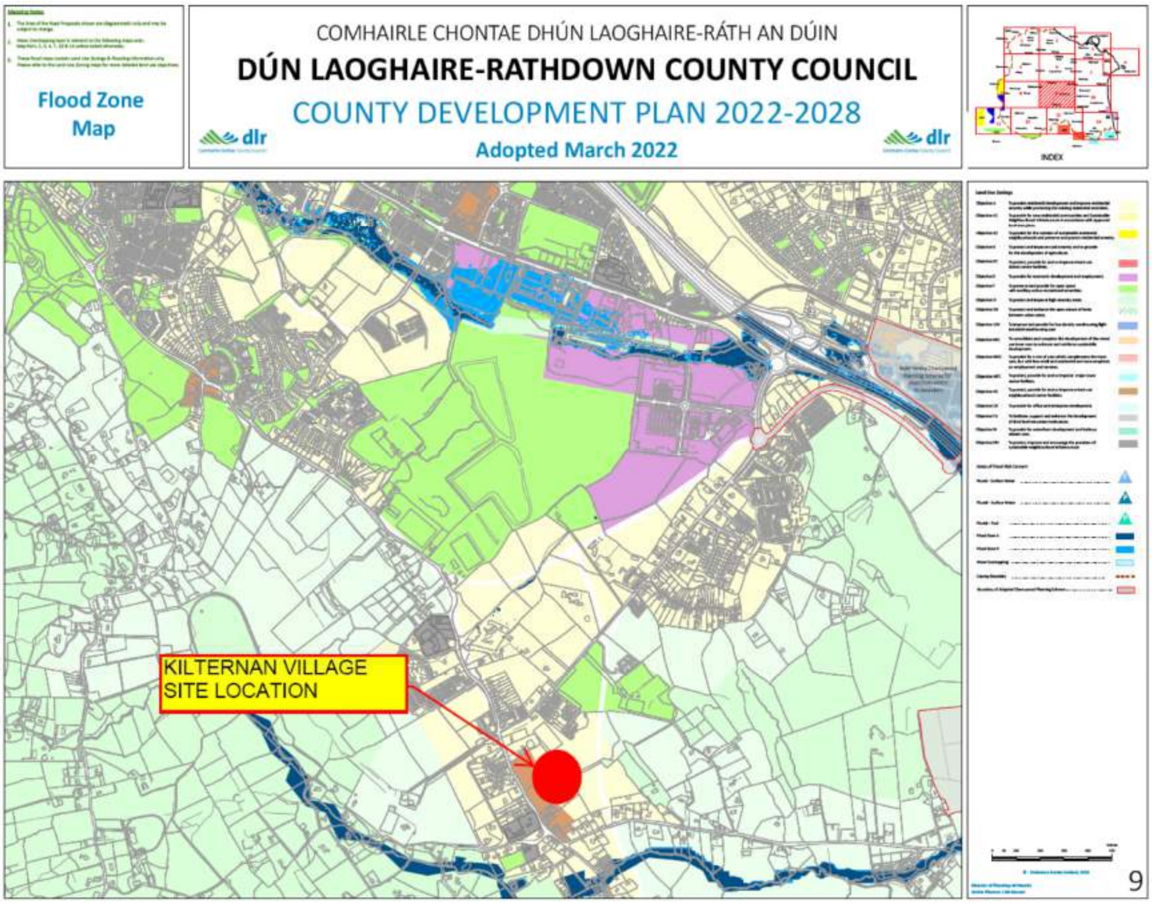


Fig.15 – OPW Preliminary Flood Risk Assessment maps (No.2019/MAP/221/A) *(Not to scale)*

3.8.18 Review of available DLRCC flood zone map No.9 was carried out and it was determined from the DLRCC map that there was no recorded Fluvial flooding at/adjacent to the subject site. Refer to appendix for a not to scale A3 map of same.


Flood Zone Map
COMHAIRLE CHONTAE DHÚN LAOGHAIRE-RÁTH AN DÚIN
DÚN LAOGHAIRE-RATHDOWN COUNTY COUNCIL
COUNTY DEVELOPMENT PLAN 2022-2028
Adopted March 2022
dlr
dlr
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KILTERNAN VILLAGE SITE LOCATION
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Fig.16 – DLRCC Flood Zone Map No.9 *(Not to scale)*

3.9 Initial Fluvial Flood Risk Assessment

3.9.1 As there are no known watercourses either on or upstream of the subject lands, and the roadside drainage channel along the Glenamuck Road is several meters below the subject lands, in our opinion there is a low risk fluvial of flooding onto the site.

3.10 Pluvial Flood Risk

3.10.1 Pluvial flooding is caused when the intensity of rainfall events cannot be absorbed into the ground or urban drainage systems cannot effectively convey the flowrates.

3.11 Pluvial Flood Risk Indicators

3.11.1 Reference was made to the available drainage records drawings of Irish Water/DLRCC. There is no known surface water drainage infrastructure system existing on the site. Refer to main Engineering Infrastructure & Stormwater Impact Assessment Report for copies of same.

3.11.2 Review of the drainage records drawings displayed no surface water pipelines along the Enniskerry Road fronting the site.

3.11.3 There is a noted 300mm diameter S/W pipeline in Glenamuck Road South some 500m northeast of the subject site.

3.11.4 As noted in 3.8.3 above, along the northern side of Glenamuck Road there is an existing roadside drainage channel. This drainage channel has a varying cross-section and is restricted by several different small diameter (c.300mm) pipes beneath road access points.

3.11.5 There is no known foul sewer network on the subject site but there 2No. old disused septic tanks on the site. One to the northeast corner of the site that once served the old Wayside Celtic football club changing rooms (now since demolished) and the other as part of the derelict house to the southwest of the site.

3.11.6 In discussing the local drainage with the DLRCC Drainage Department staff, it was noted that rainfall flows along the surface of the Glenamuck Road from the Enniskerry Road downhill in an easterly direction. This is because there is no real existing piped infrastructure other than occasional road gullies that discharge directly into the northern side roadside drainage channel.

3.11.7 Also, in reference to the design calculations contained in the appendix of the main Engineering Infrastructure & Stormwater Impact Assessment report accompanying the application, the surface water discharge rate from the site has been restricted to the agricultural greenfield run off rate, Qbar (44.2l/s), as determined from the DLRCC recommended HR Wallingford online assessment tool. The Qbar rate was determined based on the site topography, soil conditions and drained site area.

3.12 Initial Pluvial Flood Risk Assessment

3.12.1 As the risk of pluvial flooding from the new infrastructure planned is not deemed as a low risk occurrence and the vulnerability of residential development is deemed as high, it is seen as appropriate that a detailed pluvial flood risk assessment be reviewed.

3.13 Detailed Pluvial Flood Risk assessment

3.13.1 The proposed new drainage surface water infrastructure for the development has been designed to cater for flows generated by all storms up to the Q100+20%(climate change) without flooding occurring. The drainage design has also allowed for more than the min.10% Urban Creep allowance as required in the DLRCC Stormwater Management Policy document

3.13.2 The pipe sizes and gradients are designed to convey the storm water flows to a singular attenuation location where the storage capacity has been designed to exceed the Q100+20% event. Calculations for the critical rainfall events have been included in the appendix of the Engineering Infrastructure & Stormwater Impact Assessment report.

3.13.3 The **required Q30+20% Climate Change** storm water storage volume for total site is **c.3,078m^3** as determined from the MicroDrainage simulation modelling software. This volume will be stored below ground within the 6No. voided arch MC 4500 systems.

3.13.4 The **required volume for the Q100 +20% Climate Change event** is **c.3,972m^3** as determined from the MicroDrainage simulation modelling software results.

3.13.5 The freeboard achieved in the S/W design exceeds the minimum 500mm requirement as specified in the GDRS as noted in Section 6.36 of the main Engineering Infrastructure & Stormwater Impact Assessment report.

3.13.6 In reference to Tables 5 & 6 Section 6.39, of the main infrastructural report accompanying the application, it is noted that there is additional **interception storage** volume of **c.1,102m^3** has not been subtracted from the required attenuation volume nor has it been added to the available storage volume and is therefore considered to be a safer and more conservative approach to attenuation storage estimation.

3.13.7 SuDS elements included in the pluvial design include rear garden filter drains, roadside filter swales, house rainwater butts, permeable paving systems, catchpits, filter drains, roadside swales, tree pits, bio-retention areas, void arch attenuation storage and petrol interceptors.

3.13.8 An overflow flood route map was prepared (Dwg.No.2104/12) and is included in the appendix of this assessment report. These extreme event overflow follow the natural grassland ground contours overland to a low point grasslands on the subject site.

3.14 Conclusion of the Detailed Pluvial Flood Risk Assessment

3.14.1 In accordance with the sequential assessment approach as per the Guidelines flowchart (section 2.10 above) it is concluded that the requirements have been met and no further assessment is required regarding pluvial flood risk.

3.15 Groundwater Flood Risk

3.15.1 Groundwater flooding occurs when the level of water stored in the ground, the water table, rises because of prolonged rainfall. Groundwater flooding tends to be very local and result from interactions of site specific factors such as tidal variations.

3.15.2 A Hydrological and Hydrological Risk Assessment report prepared by Enviroguide Consulting has been completed and is included with the planning application – refer to that report for further detail.

3.16 Groundwater Flood Risk Indicators

3.16.1 Site investigations have revealed that sub surface soil conditions on this site are known to be sandy gravelly CLAY and SILTs overlying broken granite and bedrock. Soakaway testing & site investigations reports are included in the Appendix 12.8 of the main infrastructure report.

3.16.2 Reference was also made to the online web portal provided by the Geological Survey of Ireland (GSI) as well as the alluvial maps provided by the Teagasc link on the GSI website. Reference is also made to the Hydrological and Hydrological Risk Assessment included with the planning application – refer to that report for further detail.

3.16.3 No ground water was noted as encountered during the soakaway trial holes investigations but it is noted that ground water levels can vary depending on the time of year. Borehole testing carried out in 2006 noted ground water encountered between c.2.6-2.8m. Refer to soakaway report in Appendix 12.8 of the main infrastructure report for more detail.

3.16.4 There were no recorded groundwater issues for the subject site/area on the Geological Survey of Ireland online datasets and reference can be made to the summary groundwater map report included in the appendix of this report.

3.16.5 Site walkovers were carried out in varying weather conditions and the water table was not evident during the visits.

3.16.6 In reference to the Road and Block Levels drawings 2104/01 & 02 it is noted that all finished floor levels of buildings on the site are to be constructed above the ground level and above the adjacent roads.

3.16.7 In reference to the architectural design layouts it is noted that there are 2No. covered/undercroft car-parking areas but these are at ground level and are not deemed as basement construction.

3.17 Initial Groundwater Flood Risk Assessment

3.17.1 The indicators described above suggest that the site is not at risk of flooding from groundwater and accordingly a detailed assessment of the flooding mechanism is not required and, in our opinion, there is a low risk of groundwater flooding onto the site

3.18 Human/Mechanical Error Flood Risk

3.18.1 There are flood risks associated with misuse, neglect, damage, intervention of or lack of intervention attributable to mechanical failure or human error. Such a risk can be caused by blockages in piped systems or lack of maintenance of mechanical devices.

3.19 Human/Mechanical Error Flood Risk Indicators

3.19.1 Based on the experienced professional judgement of the engineering designer and in consultation with the Drainage Department of DLRCC, it has been considered that blockages can occur with systems for many reasons.

3.20 Initial Human/Mechanical Error Flood Risk Assessment

3.20.1 As there is some risk of pluvial flooding from human/mechanical error, the new infrastructure is not deemed as a low risk occurrence and the vulnerability of residential development is classified as high (refer to

Section 2.12 of this report), it is seen as appropriate that a more detailed human/mechanical error flood risk assessment be reviewed.

3.21 Detailed Human/Mechanical Error Flood Risk Assessment

3.21.1 As part of the assessment for blockages in the system, the MicroDrainage design model was run on the basis that there was a near 100% blockage of the outfall vortex control devices for a 30minute period. Therefore, the model was run with a reduction in the outfall rates from each of the 6No. Hydrobrakes down to 0.1 l/s for a 30min duration in the Q100 + 20% event. These resulting volumes and top water level are contained beneath the ground level and no flooding was noted. Refer to the appendix of this report of the for these calculation results.

3.22 Conclusion of the Detailed Human/Mechanical Error Risk Assessment

3.22.1 In accordance with the sequential assessment approach as per the Guidelines flowchart (section 2.10 above) it is concluded that the requirements have been met and no further assessment is required regarding human/mechanical error flood risk.

4.0 Source Pathway Receptor Model

4.1 A source-pathway-receptor model as per the Appendix A 1.3 of the Technical Appendices accompanying *the Guidelines* was created and is shown in the Table 2 below. This model indicates the possible sources of flood water and the pathway to the receptors (the buildings/people) and the risks associated based on the findings of the FRA research.

Source	Pathway	Receptor	Likelihood	Consequence	Risk
Tidal	>5.5km from coast and elevated >142m above sea level	People/ property	Remote	N/A	Very Low
Fluvial	Overtopping of drainage channel on Glenamuck Road	People/ property	Remote	N/A	Low
Pluvial (Surface water)	Flooding from drainage systems	People/ property	Possible	Low	Low
Groundwater	Rising water table	People/ property	Possible	Low	Low
Human/ Mechanical Error	Blockage of drainage	People/ property	Possible	Moderate	Low

Table 2

5.0 SSFRA Conclusion

5.1 As is required under the Dun Laoghaire Rathdown County Development Plan 2022 – 2028 Appendix 15 – Strategic Flood Risk assessment and in accordance with the requirements set out in the DoEHLG and OPW published guidelines *The Planning System and Flood Risk Management 2009* (the Guidelines), a Site Specific Flood Risk Assessment (SSFRA) has been carried out for this application.

5.2 In accordance with the above noted Guidelines, as sequential staged approach was adopted in assessing the flood risk for the subject development.

5.3 It was determined in accordance with the Guidelines that the lands on which the subject development is located is within a **flood Zone C** as defined in the Guidelines.

5.4 It is concluded that a mixed residential and commercial development is appropriate on the subject lands.

5.5 It is concluded that the above level of assessment is sufficient given the nature of the development and the level of flood risk identified for the site.

5.6 Based on the information available it is concluded that this site is suitable for development and has an overall low risk of being affected by flooding.

6.0 APPENDIX

Contents:

Appendix 6.1

Micro Drainage Calculations – Blocked Outfalls

BLOCKED
OUTFALLS
SIMULATION

```
                  STORM SEWER DESIGN by the Modified Rational Meth

                            Design Criteria for Storm

                   Pipe Sizes STANDARD Manhole Sizes STANDARD

                    FSR Rainfall Model - Scotland and Ireland
            Return Period (years)       2                      PIMP (%)    100
                      M5-60 (mm) 18.000        Add Flow / Climate Change (%)      0
                         Ratio R  0.271         Minimum Backdrop Height (m) 0.200
         Maximum Rainfall (mm/hr)      90        Maximum Backdrop Height (m) 3.000
 Maximum Time of Concentration (mins)      30 Min Design Depth for Optimisation (m) 1.500
             Foul Sewage (l/s/ha)  0.000    Min Vel for Auto Design only (m/s)  0.75
         Volumetric Runoff Coeff.  1.000      Min Slope for Optimisation (1:X)   180

                          Designed with Level Soffits

                      Free Flowing Outfall Details for Storm

               Outfall       Outfall     C. Level I. Level    Min    D,L    W
             Pipe Number      Name          (m)       (m)   I. Level (mm)  (mm)
                                                               (m)

                S1.018  SExisting Mh   123.210   122.267   122.180 1200     0

                      Free Flowing Outfall Details for Storm

               Outfall       Outfall      C. Level I. Level    Min    D,L    W
             Pipe Number      Name           (m)       (m)   I. Level (mm)  (mm)
                                                                (m)

               S17.004  SGlenamuck Rd  132.800   131.186   130.150    0     0

                          Simulation Criteria for Storm

         Volumetric Runoff Coeff 1.000    Additional Flow - % of Total Flow 0.000
          Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
                 Hot Start (mins)     0                Inlet Coeffiecient 0.800
             Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
    Manhole Headloss Coeff (Global) 0.500                     Run Time (mins)    60
     Foul Sewage per hectare (l/s) 0.000              Output Interval (mins)     1

  Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
   Number of Online Controls 6 Number of Storage Structures 6 Number of Real Time Controls 0

                           Synthetic Rainfall Details

            Rainfall Model                   FSR          Profile Type Summer
        Return Period (years)                100            Cv (Summer)  1.000
                       Region Scotland and Ireland          Cv (Winter)  1.000
                  M5-60 (mm)              18.000 Storm Duration (mins)     30
                     Ratio R               0.271
```

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S44, DS/PN: S9.003, Volume (m³): 8.7

Unit Reference	MD-SHE-0012-1000-1450-1000
Design Head (m)	1.450
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	139.920
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.450	0.1	Kick-Flo®	0.110	0.0
Flush-Flo™	0.048	0.0	Mean Flow over Head Range	-	0.1

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)
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.2	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.2	7.500	0.2
0.300	0.1	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Hydro-Brake® Optimum Manhole: S48, DS/PN: S6.005, Volume (m³): 17.9

Unit Reference	MD-SHE-0012-1000-1850-1000
Design Head (m)	1.850
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	138.708
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.850	0.1	Kick-Flo®	0.105	0.0
Flush-Flo™	0.040	0.0	Mean Flow over Head Range	-	0.1

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)
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.1	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.1	7.500	0.2
0.300	0.0	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Hydro-Brake® Optimum Manhole: S57, DS/PN: S12.004, Volume (m^3): 5.8

Unit Reference	MD-SHE-0012-1000-1850-1000
Design Head (m)	1.850
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	139.532
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	0.1	Kick-Flo®	0.105	0.0
Flush-Flo™	0.040	0.0	Mean Flow over Head Range	-	0.1

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)**
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.1	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.1	7.500	0.2
0.300	0.0	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Hydro-Brake® Optimum Manhole: S72, DS/PN: S12.012, Volume (m^3): 26.0

Unit Reference	MD-SHE-0012-1000-1850-1000
Design Head (m)	1.850
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	134.897
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	0.1	Kick-Flo®	0.105	0.0
Flush-Flo™	0.040	0.0	Mean Flow over Head Range	-	0.1

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)**
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.1	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.1	7.500	0.2
0.300	0.0	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Hydro-Brake® Optimum Manhole: S77, DS/PN: S1.012, Volume (m³): 21.9

Unit Reference	MD-SHE-0012-1000-1850-1000
Design Head (m)	1.850
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	131.650
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	0.1	Kick-Flo®	0.105	0.0
Flush-Flo™	0.040	0.0	Mean Flow over Head Range	-	0.1

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)**
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.1	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.1	7.500	0.2
0.300	0.0	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Hydro-Brake® Optimum Manhole: S89, DS/PN: S17.004, Volume (m³): 5.5

Unit Reference	MD-SHE-0012-1000-1850-1000
Design Head (m)	1.850
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	131.350
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	0.1	Kick-Flo®	0.105	0.0
Flush-Flo™	0.040	0.0	Mean Flow over Head Range	-	0.1

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)**
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.1	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.1	7.500	0.2
0.300	0.0	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Storage Structures for Storm

Cellular Storage Manhole: S44, DS/PN: S9.003

Invert Level (m) 139.950 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	250.0	0.0	1.850	250.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S48, DS/PN: S6.005

Invert Level (m) 138.750 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	350.0	0.0	1.850	350.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S57, DS/PN: S12.004

Invert Level (m) 139.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	80.0	0.0	1.850	80.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S72, DS/PN: S12.012

Invert Level (m) 134.950 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	750.0	0.0	1.850	750.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S77, DS/PN: S1.012

Invert Level (m) 131.750 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1000.0	0.0	1.850	1000.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S89, DS/PN: S17.004

Invert Level (m) 131.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	72.0	0.0	1.850	72.0	0.0	1.851	0.0	0.0

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	6	Number of Storage Structures	6	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	18.000	Cv (Summer)	1.000
Region	Scotland and Ireland	Ratio R	0.271	Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	30
Return Period(s) (years)	2, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S1	30 minute 2 year Summer I+20%	142.350	141.003	0.21	0.100	21.7	OK
S1.001	S2	30 minute 2 year Summer I+20%	142.020	140.632	0.46	0.368	43.8	OK
S1.002	S3	30 minute 2 year Summer I+20%	141.630	140.246	0.34	0.300	66.5	OK
S1.003	S4	30 minute 2 year Summer I+20%	139.700	138.347	0.47	0.222	84.8	OK
S2.000	S5	30 minute 2 year Summer I+20%	140.710	139.291	0.27	0.086	17.9	OK
S2.001	S6	30 minute 2 year Summer I+20%	139.880	138.475	0.22	0.106	34.2	OK
S2.002	S7	30 minute 2 year Summer I+20%	139.160	137.657	0.54	0.175	56.5	OK
S1.004	S8	30 minute 2 year Summer I+20%	138.950	136.899	0.55	0.278	153.0	OK
S1.005	S9	30 minute 2 year Summer I+20%	137.580	136.098	0.54	0.423	174.2	OK
S3.000	S10	30 minute 2 year Summer I+20%	136.510	135.141	0.09	0.063	7.7	OK
S3.001	S11	30 minute 2 year Summer I+20%	137.730	134.863	0.12	0.141	9.1	OK
S3.002	S12	30 minute 2 year Summer I+20%	137.800	134.828	0.38	0.316	30.1	OK
S3.003	S13	30 minute 2 year Summer I+20%	137.330	134.618	0.29	0.272	41.9	OK
S3.004	S14	30 minute 2 year Summer I+20%	136.650	134.427	0.45	0.688	56.4	OK
S3.005	S15	30 minute 2 year Summer I+20%	136.500	134.321	0.42	0.957	56.4	OK
S1.006	S16	30 minute 2 year Summer I+20%	136.880	134.287	0.61	1.466	234.9	OK
S1.007	S17	30 minute 2 year Summer I+20%	136.650	134.158	0.66	3.110	239.6	OK
S1.008	S18	30 minute 2 year Summer I+20%	136.530	133.974	0.56	2.378	270.8	OK
S4.000	S19	30 minute 2 year Summer I+20%	138.100	136.141	0.08	0.041	8.3	OK
S1.009	S20	30 minute 2 year Summer I+20%	135.920	133.609	0.63	4.766	302.5	OK
S5.000	S21	30 minute 2 year Summer I+20%	140.610	139.190	0.33	0.096	26.8	OK
S5.001	S22	30 minute 2 year Summer I+20%	139.230	136.944	0.36	0.101	34.9	OK
S5.002	S23	30 minute 2 year Summer I+20%	137.520	136.132	0.29	0.122	46.9	OK
S1.010	S24	30 minute 2 year Summer I+20%	136.850	133.278	0.49	2.960	352.4	OK
S1.011	S25	30 minute 2 year Summer I+20%	136.550	132.851	1.02	1.500	354.1	SURCHARGED
S6.000	S26	30 minute 2 year Summer I+20%	142.240	140.805	0.26	0.143	28.4	OK
S7.000	S27	30 minute 2 year Summer I+20%	142.000	140.891	0.20	0.097	15.8	OK
S7.001	S28	30 minute 2 year Summer I+20%	142.350	140.762	0.29	0.274	28.1	OK
S8.000	S29	30 minute 2 year Summer I+20%	142.000	140.663	0.17	0.088	15.8	OK
S8.001	S30	30 minute 2 year Summer I+20%	142.500	140.381	0.22	0.192	17.8	OK
S6.001	S31	30 minute 2 year Summer I+20%	142.810	140.226	0.37	0.378	98.4	OK
S6.002	S32	30 minute 2 year Summer I+20%	142.810	139.883	0.66	1.717	170.9	OK
S6.003	S33	30 minute 2 year Summer I+20%	142.500	139.634	0.90	2.609	180.9	OK

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status	
S6.004	S34	30 minute 2 year Summer I+20%	142.400	139.321	1.07	0.955	181.4	SURCHARGED	
S9.000	S35	30 minute 2 year Summer I+20%	141.960	140.720	0.12	0.074	12.1	OK	
S9.001	S36	30 minute 2 year Summer I+20%	142.200	140.474	0.14	0.137	14.8	OK	
S9.002	S37	30 minute 2 year Winter I+20%	142.390	140.302	0.16	0.449	26.4	OK	
S10.000	S38	30 minute 2 year Summer I+20%	143.000	141.606	0.26	0.114	26.8	OK	
S10.001	S39	30 minute 2 year Summer I+20%	142.730	141.304	0.61	0.490	56.9	OK	
S10.002	S40	30 minute 2 year Winter I+20%	142.750	140.302	0.31	0.339	60.1	OK	
S11.000	S41	30 minute 2 year Summer I+20%	142.630	141.220	0.33	0.096	16.1	OK	
S11.001	S42	30 minute 2 year Summer I+20%	142.380	140.830	0.39	0.153	26.1	OK	
S11.002	S43	30 minute 2 year Winter I+20%	142.600	140.302	0.16	0.282	21.9	OK	
S9.003	S44	30 minute 2 year Winter I+20%	142.350	140.302	0.00	87.566	0.1	SURCHARGED	TANK 4
S9.004	S45	30 minute 2 year Summer I+20%	141.940	139.893	0.25	0.193	24.0	OK	
S9.005	S46	30 minute 2 year Summer I+20%	141.350	139.399	0.15	0.201	36.9	OK	
S9.006	S47	30 minute 2 year Winter I+20%	142.000	139.242	0.22	2.540	43.3	OK	
S6.005	S48	30 minute 2 year Winter I+20%	142.100	139.242	0.00	176.518	0.1	SURCHARGED	TANK 3
S6.006	S49	30 minute 2 year Summer I+20%	142.030	138.685	0.37	0.185	14.8	OK	
S6.007	S50	30 minute 2 year Summer I+20%	141.290	138.531	0.59	0.313	34.8	OK	
S6.008	S51	30 minute 2 year Summer I+20%	139.150	137.783	0.49	0.183	52.5	OK	
S6.009	S52	30 minute 2 year Summer I+20%	138.060	136.384	0.59	0.136	56.4	OK	
S12.000	S53	30 minute 2 year Summer I+20%	141.650	140.417	0.22	0.104	23.6	OK	
S12.001	S54	30 minute 2 year Summer I+20%	141.640	140.022	0.27	0.199	28.3	OK	
S12.002	S55	30 minute 2 year Winter I+20%	142.080	139.923	0.43	0.500	29.8	OK	
S12.003	S56	30 minute 2 year Winter I+20%	142.110	139.923	0.15	0.867	29.6	OK	
S12.004	S57	30 minute 2 year Winter I+20%	141.750	139.923	0.00	27.183	0.1	SURCHARGED	TANK 5
S13.000	S58	30 minute 2 year Summer I+20%	142.650	141.126	0.59	0.137	36.1	OK	
S12.005	S59	30 minute 2 year Summer I+20%	141.700	139.544	0.48	0.206	48.2	OK	
S12.006	S60	30 minute 2 year Summer I+20%	141.500	139.318	0.55	0.526	56.0	OK	
S12.007	S61	30 minute 2 year Summer I+20%	141.000	138.905	0.46	0.412	82.3	OK	
S14.000	S62	30 minute 2 year Summer I+20%	141.530	140.115	0.30	0.090	26.0	OK	
S12.008	S63	30 minute 2 year Summer I+20%	140.500	138.600	0.69	1.086	138.7	OK	
S12.009	S64	30 minute 2 year Summer I+20%	139.520	138.080	0.63	0.853	165.9	OK	
S12.010	S65	30 minute 2 year Summer I+20%	138.600	137.246	0.60	0.612	173.9	OK	
S12.011	S66	30 minute 2 year Summer I+20%	138.250	135.687	1.00	0.799	164.4	SURCHARGED	
S15.000	S67	30 minute 2 year Summer I+20%	142.680	141.175	0.58	0.136	27.8	OK	
S15.001	S68	30 minute 2 year Summer I+20%	142.440	140.813	0.29	0.129	52.4	OK	
S15.002	S69	30 minute 2 year Summer I+20%	141.180	139.605	0.39	0.196	72.8	OK	
S15.003	S70	30 minute 2 year Summer I+20%	140.230	138.679	0.47	0.218	89.5	OK	
S15.004	S71	30 minute 2 year Summer I+20%	138.780	135.396	0.53	0.331	108.5	OK	
S12.012	S72	30 minute 2 year Winter I+20%	137.250	135.227	0.00	204.912	0.1	SURCHARGE	TANK 2
S6.010	S73	30 minute 2 year Summer I+20%	137.750	134.957	0.65	0.608	59.8	OK	
S6.011	S74	30 minute 2 year Summer I+20%	136.750	132.696	0.40	0.274	67.4	OK	
S16.000	S75	30 minute 2 year Summer I+20%	134.250	133.141	0.09	0.123	21.1	OK	
S16.001	S76	30 minute 2 year Summer I+20%	134.250	132.828	0.13	0.332	26.1	OK	
S1.012	S77	30 minute 2 year Summer I+20%	134.500	132.114	0.00	346.826	0.1	SURCHARGED	TANK 1
S1.013	S78	30 minute 2 year Summer I+20%	132.500	130.530	0.00	0.000	0.1	OK	
S1.014	S79	30 minute 2 year Summer I+20%	130.850	128.400	0.00	0.000	0.1	OK	
S1.015	S80	30 minute 2 year Summer I+20%	127.750	126.150	0.00	0.000	0.1	OK	
S1.016	S81	30 minute 2 year Summer I+20%	127.000	125.390	0.00	0.000	0.1	OK	
S1.017	S82	30 minute 2 year Summer I+20%	125.700	122.711	0.00	0.000	0.1	OK	
S1.018	S83	30 minute 2 year Summer I+20%	123.500	122.321	0.00	0.000	0.1	OK	
S17.000	S84	30 minute 2 year Summer I+20%	136.750	135.250	0.00	0.000	0.0	OK	
S17.001	S85	30 minute 2 year Summer I+20%	136.750	134.836	0.01	0.002	0.4	OK	
S17.002	S86	30 minute 2 year Summer I+20%	135.750	132.257	0.54	0.172	33.0	OK	
S17.003	S87	30 minute 2 year Winter I+20%	134.750	131.904	0.45	0.451	27.4	SURCHARGED	
S18.000	S88	30 minute 2 year Summer I+20%	135.500	134.065	0.18	0.068	7.0	OK	
S17.004	S89	30 minute 2 year Winter I+20%	134.750	131.904	0.00	28.879	0.1	SURCHARGED	TANK 6

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Offline Controls 0
Number of Time/Area Diagrams 0
Number of Online Controls 6
Number of Storage Structures 6
Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR
M5-60 (mm) 18.000
Cv (Summer) 1.000
Region Scotland and Ireland
Ratio R 0.271
Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 150.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 30
Return Period(s) (years) 2, 30, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S1	30 minute 30 year Summer I+20%	142.350	141.040	0.38	0.141	39.9	OK
S1.001	S2	30 minute 30 year Summer I+20%	142.020	140.722	0.95	0.847	89.7	OK
S1.002	S3	30 minute 30 year Summer I+20%	141.630	140.314	0.71	0.659	139.8	OK
S1.003	S4	30 minute 30 year Summer I+20%	139.700	138.441	0.99	0.449	179.8	OK
S2.000	S5	30 minute 30 year Summer I+20%	140.710	139.325	0.50	0.124	33.0	OK
S2.001	S6	30 minute 30 year Summer I+20%	139.880	138.521	0.44	0.189	68.6	OK
S2.002	S7	30 minute 30 year Summer I+20%	139.160	137.935	1.08	0.863	113.7	SURCHARGED
S1.004	S8	30 minute 30 year Summer I+20%	138.950	137.323	1.09	2.397	304.9	SURCHARGED
S1.005	S9	30 minute 30 year Summer I+20%	137.580	136.398	1.06	1.932	342.1	SURCHARGED
S3.000	S10	30 minute 30 year Summer I+20%	136.510	135.184	0.16	0.112	14.2	OK
S3.001	S11	30 minute 30 year Summer I+20%	137.730	135.172	0.31	2.352	22.8	SURCHARGED
S3.002	S12	30 minute 30 year Summer I+20%	137.800	135.163	0.77	1.342	61.2	SURCHARGED
S3.003	S13	30 minute 30 year Summer I+20%	137.330	135.062	0.52	2.341	75.3	SURCHARGED
S3.004	S14	30 minute 30 year Summer I+20%	136.650	134.939	0.83	4.319	103.6	SURCHARGED
S3.005	S15	30 minute 30 year Summer I+20%	136.500	134.831	0.80	3.267	107.5	SURCHARGED
S1.006	S16	30 minute 30 year Summer I+20%	136.880	134.718	1.12	2.888	433.5	SURCHARGED
S1.007	S17	30 minute 30 year Summer I+20%	136.650	134.536	1.21	6.736	441.3	SURCHARGED
S1.008	S18	30 minute 30 year Summer I+20%	136.530	134.342	1.01	6.104	492.1	SURCHARGED
S4.000	S19	30 minute 30 year Summer I+20%	138.100	136.156	0.14	0.058	15.3	OK
S1.009	S20	30 minute 30 year Summer I+20%	135.920	133.922	1.14	15.031	546.2	SURCHARGED
S5.000	S21	30 minute 30 year Summer I+20%	140.610	139.228	0.60	0.139	49.4	OK
S5.001	S22	30 minute 30 year Summer I+20%	139.230	136.991	0.69	0.154	66.9	OK
S5.002	S23	30 minute 30 year Summer I+20%	137.520	136.189	0.58	0.202	93.0	OK
S1.010	S24	30 minute 30 year Summer I+20%	136.850	133.498	0.87	8.266	625.6	OK
S1.011	S25	30 minute 30 year Summer I+20%	136.550	133.103	1.82	2.798	632.4	SURCHARGED
S6.000	S26	30 minute 30 year Summer I+20%	142.240	140.848	0.47	0.205	52.3	OK
S7.000	S27	30 minute 30 year Summer I+20%	142.000	140.926	0.37	0.137	29.0	OK
S7.001	S28	30 minute 30 year Summer I+20%	142.350	140.817	0.57	0.590	55.1	OK
S8.000	S29	30 minute 30 year Summer I+20%	142.000	140.701	0.31	0.131	28.9	OK
S8.001	S30	30 minute 30 year Summer I+20%	142.500	140.650	0.52	2.048	42.2	SURCHARGED
S6.001	S31	30 minute 30 year Summer I+20%	142.810	140.546	0.63	4.871	169.0	SURCHARGED
S6.002	S32	30 minute 30 year Summer I+20%	142.810	140.401	1.14	8.788	297.8	SURCHARGED
S6.003	S33	30 minute 30 year Summer I+20%	142.500	139.975	1.59	6.606	318.9	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status	
S6.004	S34	30 minute 30 year Winter I+20%	142.400	139.736	1.66	3.412	282.4	SURCHARGED	
S9.000	S35	30 minute 30 year Summer I+20%	141.960	140.747	0.22	0.104	22.3	OK	
S9.001	S36	30 minute 30 year Winter I+20%	142.200	140.596	0.21	0.607	22.0	OK	
S9.002	S37	30 minute 30 year Winter I+20%	142.390	140.596	0.30	1.491	50.8	SURCHARGED	
S10.000	S38	30 minute 30 year Summer I+20%	143.000	141.649	0.48	0.163	49.4	OK	
S10.001	S39	30 minute 30 year Summer I+20%	142.730	141.513	1.22	1.949	112.9	SURCHARGED	
S10.002	S40	30 minute 30 year Winter I+20%	142.750	140.640	0.60	0.823	117.4	SURCHARGED	
S11.000	S41	30 minute 30 year Summer I+20%	142.630	141.259	0.60	0.140	29.4	OK	
S11.001	S42	30 minute 30 year Summer I+20%	142.380	140.901	0.76	0.268	51.2	OK	
S11.002	S43	30 minute 30 year Summer I+20%	142.600	140.596	0.39	0.702	52.9	SURCHARGED	
S9.003	S44	30 minute 30 year Winter I+20%	142.350	140.596	0.00	159.491	0.1	SURCHARGED	TANK 4
S9.004	S45	30 minute 30 year Summer I+20%	141.940	139.955	0.57	0.434	54.1	OK	
S9.005	S46	30 minute 30 year Summer I+20%	141.350	139.649	0.34	1.809	82.0	OK	
S9.006	S47	30 minute 30 year Summer I+20%	142.000	139.649	0.53	8.783	105.1	SURCHARGED	
S6.005	S48	30 minute 30 year Summer I+20%	142.100	139.649	0.00	313.378	0.1	SURCHARGED	TANK 3
S6.006	S49	30 minute 30 year Summer I+20%	142.030	139.016	0.72	1.074	28.9	SURCHARGED	
S6.007	S50	30 minute 30 year Summer I+20%	141.290	138.916	1.16	1.577	68.7	SURCHARGED	
S6.008	S51	30 minute 30 year Summer I+20%	139.150	137.853	0.99	0.394	105.4	OK	
S6.009	S52	30 minute 30 year Summer I+20%	138.060	136.693	1.19	0.514	113.1	SURCHARGED	
S12.000	S53	30 minute 30 year Summer I+20%	141.650	140.456	0.41	0.148	43.5	OK	
S12.001	S54	30 minute 30 year Winter I+20%	141.640	140.259	0.40	1.606	41.8	SURCHARGED	
S12.002	S55	30 minute 30 year Winter I+20%	142.080	140.241	0.80	1.526	55.3	SURCHARGED	
S12.003	S56	30 minute 30 year Summer I+20%	142.110	140.192	0.34	1.382	66.7	SURCHARGED	
S12.004	S57	30 minute 30 year Winter I+20%	141.750	140.192	0.00	48.558	0.1	SURCHARGED	TANK 5
S13.000	S58	30 minute 30 year Summer I+20%	142.650	141.303	1.05	0.337	63.8	SURCHARGED	
S12.005	S59	30 minute 30 year Summer I+20%	141.700	139.791	0.87	0.696	86.9	SURCHARGED	
S12.006	S60	30 minute 30 year Summer I+20%	141.500	139.629	0.96	2.291	98.0	SURCHARGED	
S12.007	S61	30 minute 30 year Summer I+20%	141.000	139.300	0.81	3.126	146.1	SURCHARGED	
S14.000	S62	30 minute 30 year Summer I+20%	141.530	140.150	0.55	0.131	47.9	OK	
S12.008	S63	30 minute 30 year Summer I+20%	140.500	139.104	1.19	5.094	239.4	SURCHARGED	
S12.009	S64	30 minute 30 year Summer I+20%	139.520	138.387	1.08	3.796	285.1	SURCHARGED	
S12.010	S65	30 minute 30 year Summer I+20%	138.600	137.428	1.02	1.692	295.4	SURCHARGED	
S12.011	S66	30 minute 30 year Summer I+20%	138.250	136.225	1.76	1.750	289.5	SURCHARGED	
S15.000	S67	30 minute 30 year Summer I+20%	142.680	141.308	1.06	0.286	51.1	SURCHARGED	
S15.001	S68	30 minute 30 year Summer I+20%	142.440	140.869	0.59	0.256	104.2	OK	
S15.002	S69	30 minute 30 year Summer I+20%	141.180	139.682	0.79	0.371	148.8	OK	
S15.003	S70	30 minute 30 year Summer I+20%	140.230	138.773	0.97	0.438	186.3	OK	
S15.004	S71	30 minute 30 year Summer I+20%	138.780	135.672	1.11	0.726	227.2	SURCHARGED	
S12.012	S72	30 minute 30 year Winter I+20%	137.250	135.452	0.00	376.430	0.1	SURCHARGED	TANK 2
S6.010	S73	30 minute 30 year Summer I+20%	137.750	135.191	1.30	1.105	119.7	SURCHARGED	
S6.011	S74	30 minute 30 year Summer I+20%	136.750	132.809	0.81	0.435	137.2	OK	
S16.000	S75	30 minute 30 year Summer I+20%	134.250	133.173	0.16	0.168	38.8	OK	
S16.001	S76	30 minute 30 year Summer I+20%	134.250	132.874	0.26	0.712	49.8	OK	
S1.012	S77	30 minute 30 year Summer I+20%	134.500	132.418	0.00	638.117	0.1	SURCHARGED	TANK 1
S1.013	S78	30 minute 30 year Summer I+20%	132.500	130.531	0.00	0.000	0.1	OK	
S1.014	S79	30 minute 30 year Summer I+20%	130.850	128.400	0.00	0.000	0.1	OK	
S1.015	S80	30 minute 30 year Summer I+20%	127.750	126.151	0.00	0.000	0.1	OK	
S1.016	S81	30 minute 30 year Summer I+20%	127.000	125.390	0.00	0.000	0.1	OK	
S1.017	S82	30 minute 30 year Summer I+20%	125.700	122.711	0.00	0.000	0.1	OK	
S1.018	S83	30 minute 30 year Summer I+20%	123.500	122.322	0.00	0.000	0.1	OK	
S17.000	S84	30 minute 30 year Summer I+20%	136.750	135.250	0.00	0.000	0.0	OK	
S17.001	S85	30 minute 30 year Summer I+20%	136.750	134.844	0.01	0.014	0.8	OK	
S17.002	S86	30 minute 30 year Summer I+20%	135.750	132.416	1.21	0.351	74.3	SURCHARGED	
S17.003	S87	30 minute 30 year Summer I+20%	134.750	132.245	1.18	1.209	72.5	SURCHARGED	
S18.000	S88	30 minute 30 year Summer I+20%	135.500	134.090	0.33	0.096	12.9	OK	
S17.004	S89	30 minute 30 year Winter I+20%	134.750	132.244	0.00	52.559	0.1	SURCHARGED	TANK 6

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Offline Controls 0
Number of Time/Area Diagrams 0
Number of Online Controls 6
Number of Storage Structures 6
Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR
M5-60 (mm) 18.000
Cv (Summer) 1.000
Region Scotland and Ireland
Ratio R 0.271
Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 150.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 30
Return Period(s) (years) 2, 30, 100
Climate Change (%) 20, 20, 20

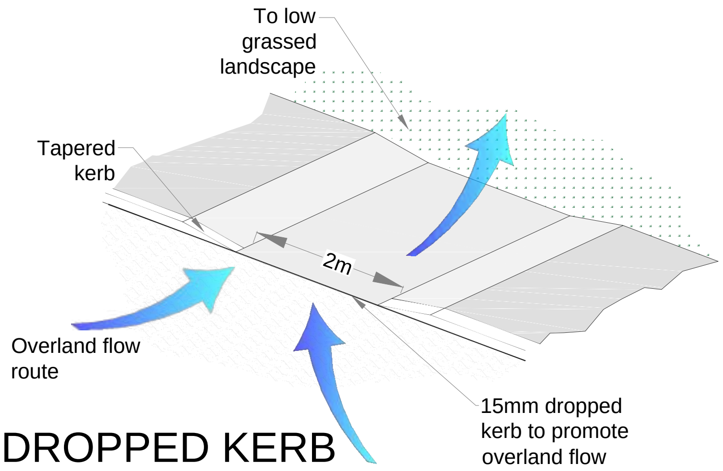
PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S1	30 minute 100 year Summer I+20%	142.350	141.062	0.49	0.166	52.1	OK
S1.001	S2	30 minute 100 year Summer I+20%	142.020	140.929	1.17	2.370	110.8	SURCHARGED
S1.002	S3	30 minute 100 year Summer I+20%	141.630	140.357	0.87	0.974	171.0	OK
S1.003	S4	30 minute 100 year Summer I+20%	139.700	138.996	1.17	2.172	211.4	SURCHARGED
S2.000	S5	30 minute 100 year Summer I+20%	140.710	139.346	0.65	0.148	43.0	OK
S2.001	S6	30 minute 100 year Summer I+20%	139.880	138.889	0.57	1.299	88.9	SURCHARGED
S2.002	S7	30 minute 100 year Summer I+20%	139.160	138.686	1.17	3.426	123.0	SURCHARGED
S1.004	S8	30 minute 100 year Summer I+20%	138.950	138.020	1.25	6.515	348.8	SURCHARGED
S1.005	S9	30 minute 100 year Summer I+20%	137.580	136.854	1.19	4.420	384.9	SURCHARGED
S3.000	S10	30 minute 100 year Summer I+20%	136.510	135.885	0.20	0.904	17.4	SURCHARGED
S3.001	S11	30 minute 100 year Summer I+20%	137.730	135.865	0.47	3.829	34.4	SURCHARGED
S3.002	S12	30 minute 100 year Summer I+20%	137.800	135.849	0.83	2.119	66.0	SURCHARGED
S3.003	S13	30 minute 100 year Summer I+20%	137.330	135.733	0.54	3.303	78.9	SURCHARGED
S3.004	S14	30 minute 100 year Summer I+20%	136.650	135.623	0.83	5.299	103.8	SURCHARGED
S3.005	S15	30 minute 100 year Summer I+20%	136.500	135.524	0.82	4.259	110.8	SURCHARGED
S1.006	S16	30 minute 100 year Summer I+20%	136.880	135.413	1.28	5.267	496.7	SURCHARGED
S1.007	S17	30 minute 100 year Summer I+20%	136.650	135.181	1.40	7.897	510.5	SURCHARGED
S1.008	S18	30 minute 100 year Summer I+20%	136.530	134.938	1.16	7.241	563.7	SURCHARGED
S4.000	S19	30 minute 100 year Summer I+20%	138.100	136.165	0.18	0.068	20.0	OK
S1.009	S20	30 minute 100 year Summer I+20%	135.920	134.410	1.33	19.627	634.0	SURCHARGED
S5.000	S21	30 minute 100 year Summer I+20%	140.610	139.254	0.79	0.168	64.5	OK
S5.001	S22	30 minute 100 year Summer I+20%	139.230	137.021	0.90	0.188	87.3	OK
S5.002	S23	30 minute 100 year Summer I+20%	137.520	136.222	0.76	0.248	121.5	OK
S1.010	S24	30 minute 100 year Summer I+20%	136.850	133.908	1.06	13.088	759.4	SURCHARGED
S1.011	S25	30 minute 100 year Summer I+20%	136.550	133.311	2.23	3.690	774.2	SURCHARGED
S6.000	S26	30 minute 100 year Summer I+20%	142.240	141.357	0.59	0.934	64.8	SURCHARGED
S7.000	S27	30 minute 100 year Summer I+20%	142.000	141.478	0.46	0.761	36.8	SURCHARGED
S7.001	S28	30 minute 100 year Summer I+20%	142.350	141.398	0.64	2.452	61.4	SURCHARGED
S8.000	S29	30 minute 100 year Summer I+20%	142.000	141.457	0.41	0.986	37.9	SURCHARGED
S8.001	S30	30 minute 100 year Summer I+20%	142.500	141.348	0.55	3.601	44.8	SURCHARGED
S6.001	S31	30 minute 100 year Summer I+20%	142.810	141.231	0.73	9.921	197.1	SURCHARGED
S6.002	S32	30 minute 100 year Summer I+20%	142.810	141.008	1.36	9.789	353.4	SURCHARGED
S6.003	S33	30 minute 100 year Summer I+20%	142.500	140.434	1.89	7.419	378.8	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S6.004	S34	30 minute 100 year Winter I+20%	142.400	140.005	1.94	3.823	329.8	SURCHARGED
S9.000	S35	30 minute 100 year Summer I+20%	141.960	140.792	0.29	0.155	29.1	OK
S9.001	S36	30 minute 100 year Summer I+20%	142.200	140.792	0.35	1.855	36.7	SURCHARGED
S9.002	S37	30 minute 100 year Summer I+20%	142.390	140.792	0.50	1.839	84.1	SURCHARGED
S10.000	S38	30 minute 100 year Summer I+20%	143.000	141.838	0.61	0.377	62.1	SURCHARGED
S10.001	S39	30 minute 100 year Summer I+20%	142.730	141.699	1.56	3.007	144.4	SURCHARGED
S10.002	S40	30 minute 100 year Winter I+20%	142.750	140.847	0.76	1.119	148.6	SURCHARGED
S11.000	S41	30 minute 100 year Summer I+20%	142.630	141.285	0.79	0.170	38.4	OK
S11.001	S42	30 minute 100 year Summer I+20%	142.380	140.950	1.00	0.432	67.1	OK
S11.002	S43	30 minute 100 year Summer I+20%	142.600	140.792	0.50	1.160	68.0	SURCHARGED
S9.003	S44	30 minute 100 year Summer I+20%	142.350	140.792	0.00	206.389	0.1	SURCHARGED TANK 4
S9.004	S45	30 minute 100 year Summer I+20%	141.940	139.987	0.74	0.560	70.5	OK
S9.005	S46	30 minute 100 year Winter I+20%	141.350	139.919	0.35	4.234	84.6	SURCHARGED
S9.006	S47	30 minute 100 year Winter I+20%	142.000	139.919	0.50	9.308	100.0	SURCHARGED
S6.005	S48	30 minute 100 year Winter I+20%	142.100	139.919	0.00	403.448	0.1	SURCHARGED TANK 3
S6.006	S49	30 minute 100 year Summer I+20%	142.030	139.863	0.86	2.033	34.7	SURCHARGED
S6.007	S50	30 minute 100 year Summer I+20%	141.290	139.725	1.39	2.492	82.5	SURCHARGED
S6.008	S51	30 minute 100 year Summer I+20%	139.150	138.311	1.13	2.158	120.1	SURCHARGED
S6.009	S52	30 minute 100 year Summer I+20%	138.060	136.890	1.34	0.868	128.2	SURCHARGED
S12.000	S53	30 minute 100 year Winter I+20%	141.650	140.492	0.42	0.189	44.5	OK
S12.001	S54	30 minute 100 year Winter I+20%	141.640	140.455	0.48	2.918	50.4	SURCHARGED
S12.002	S55	30 minute 100 year Winter I+20%	142.080	140.427	0.92	1.736	64.2	SURCHARGED
S12.003	S56	30 minute 100 year Summer I+20%	142.110	140.374	0.41	1.643	81.6	SURCHARGED
S12.004	S57	30 minute 100 year Summer I+20%	141.750	140.374	0.00	62.633	0.1	SURCHARGED TANK 5
S13.000	S58	30 minute 100 year Summer I+20%	142.650	141.846	1.27	0.951	77.4	SURCHARGED
S12.005	S59	30 minute 100 year Summer I+20%	141.700	140.837	0.94	3.258	94.4	SURCHARGED
S12.006	S60	30 minute 100 year Summer I+20%	141.500	140.643	1.13	4.147	116.0	SURCHARGED
S12.007	S61	30 minute 100 year Summer I+20%	141.000	140.264	0.90	5.119	162.8	SURCHARGED
S14.000	S62	30 minute 100 year Summer I+20%	141.530	140.270	0.72	0.265	62.5	SURCHARGED
S12.008	S63	30 minute 100 year Summer I+20%	140.500	139.989	1.35	7.727	272.2	SURCHARGED
S12.009	S64	30 minute 100 year Summer I+20%	139.520	139.065	1.26	6.526	331.0	SURCHARGED
S12.010	S65	30 minute 100 year Summer I+20%	138.600	137.753	1.19	3.910	346.7	SURCHARGED
S12.011	S66	30 minute 100 year Summer I+20%	138.250	136.526	2.04	2.807	336.2	SURCHARGED
S15.000	S67	30 minute 100 year Summer I+20%	142.680	141.521	1.37	0.527	66.3	SURCHARGED
S15.001	S68	30 minute 100 year Summer I+20%	142.440	140.901	0.76	0.329	135.4	OK
S15.002	S69	30 minute 100 year Summer I+20%	141.180	140.165	0.96	2.020	180.8	SURCHARGED
S15.003	S70	30 minute 100 year Summer I+20%	140.230	139.278	1.16	1.963	221.6	SURCHARGED
S15.004	S71	30 minute 100 year Summer I+20%	138.780	135.806	1.33	0.917	271.3	SURCHARGED
S12.012	S72	30 minute 100 year Winter I+20%	137.250	135.607	0.00	490.973	0.1	SURCHARGED TANK 2
S6.010	S73	30 minute 100 year Summer I+20%	137.750	135.269	1.47	1.194	135.3	SURCHARGED
S6.011	S74	30 minute 100 year Summer I+20%	136.750	132.839	0.91	0.479	155.5	OK
S16.000	S75	30 minute 100 year Summer I+20%	134.250	133.192	0.21	0.196	50.6	OK
S16.001	S76	30 minute 100 year Summer I+20%	134.250	132.899	0.33	0.921	65.0	OK
S1.012	S77	30 minute 100 year Winter I+20%	134.500	132.615	0.00	832.259	0.1	SURCHARGED TANK 1
S1.013	S78	30 minute 100 year Winter I+20%	132.500	130.531	0.00	0.000	0.1	OK
S1.014	S79	30 minute 100 year Winter I+20%	130.850	128.400	0.00	0.000	0.1	OK
S1.015	S80	30 minute 100 year Summer I+20%	127.750	126.151	0.00	0.000	0.1	OK
S1.016	S81	30 minute 100 year Summer I+20%	127.000	125.390	0.00	0.000	0.1	OK
S1.017	S82	30 minute 100 year Summer I+20%	125.700	122.711	0.00	0.000	0.1	OK
S1.018	S83	30 minute 100 year Summer I+20%	123.500	122.322	0.00	0.000	0.1	OK
S17.000	S84	30 minute 100 year Summer I+20%	136.750	135.250	0.00	0.000	0.0	OK
S17.001	S85	30 minute 100 year Summer I+20%	136.750	134.849	0.02	0.021	1.1	OK
S17.002	S86	30 minute 100 year Summer I+20%	135.750	132.480	1.58	0.424	96.7	SURCHARGED
S17.003	S87	30 minute 100 year Summer I+20%	134.750	132.468	1.52	1.739	93.1	SURCHARGED
S18.000	S88	30 minute 100 year Summer I+20%	135.500	134.104	0.43	0.112	16.8	OK
S17.004	S89	30 minute 100 year Winter I+20%	134.750	132.467	0.00	68.045	0.1	SURCHARGED TANK 6

Appendix 6.2

RMA Exceedance Flow Route Map Dwg.No.2104/12

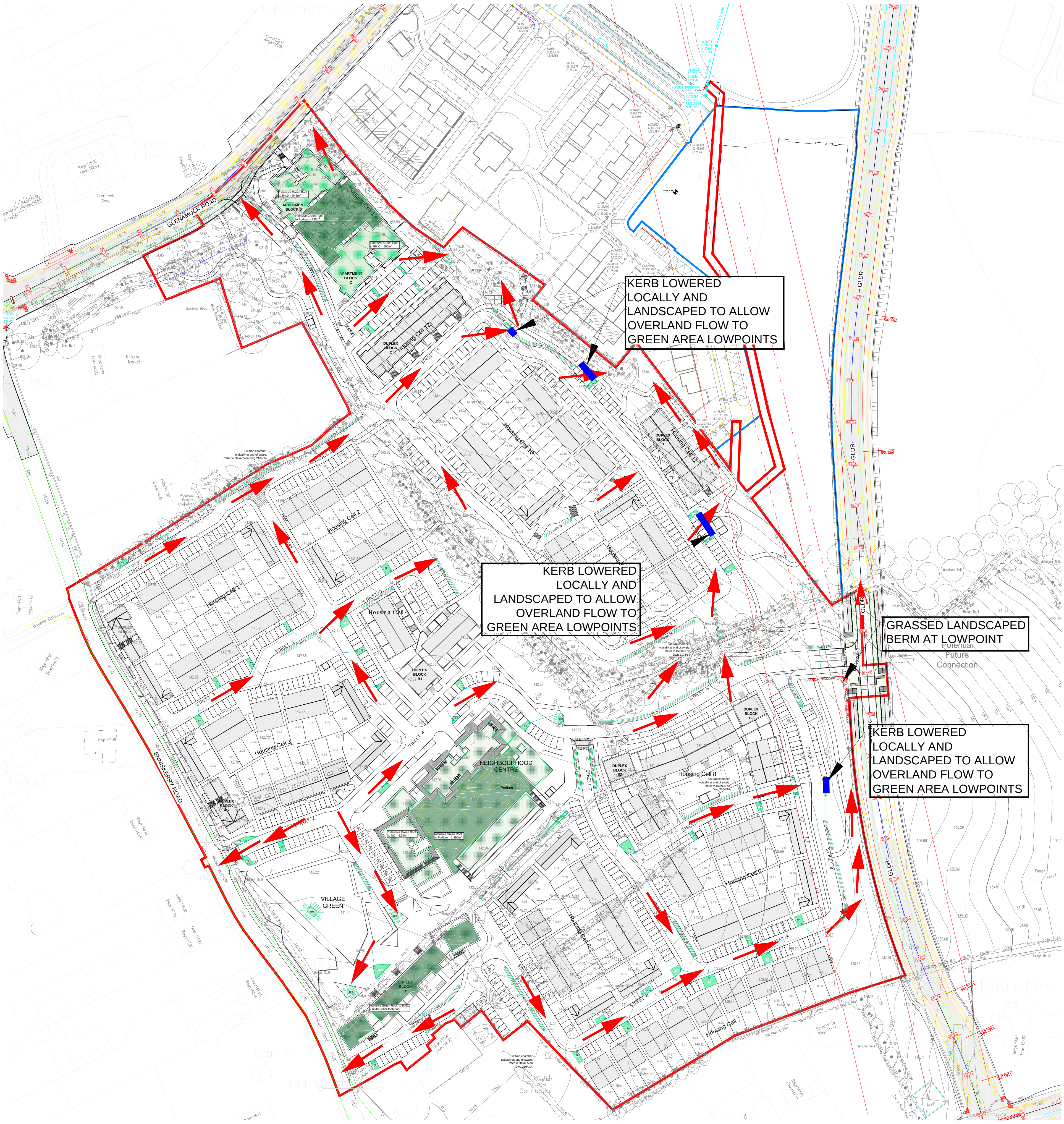


DROPPED KERB

Scale 1:100

Notes:

1. Read this drawing in conjunction with all other relevant Engineers and Architects drawings.
2. Do not scale this drawing, use only written dimensions.
3. This drawing is relevant to flood exceedence routing of storm events greater than the Q100 + 20% climate change as outlined in the RMA Drainage Infrastructure Report prepared as part of the planning application - refer to that document for further information.



KERB LOWERED LOCALLY AND LANDSCAPED TO ALLOW OVERLAND FLOW TO GREEN AREA LOWPOINTS

KERB LOWERED LOCALLY AND LANDSCAPED TO ALLOW OVERLAND FLOW TO GREEN AREA LOWPOINTS

GRASSED LANDSCAPED BERM AT LOWPOINT

KERB LOWERED LOCALLY AND LANDSCAPED TO ALLOW OVERLAND FLOW TO GREEN AREA LOWPOINTS

Overland Flow Routing

Scale 1:2000

A3 Scale 1:2000 0m 50m 100m 150m 200m

REV	DATE	DESCRIPTION

ROGER MULLARKEY & ASSOCIATES
Consulting Structural and Civil Engineers

Duncreevan, Kilcock, Co.Kildare
Tel: +353 1 610 3755 Mob: +353 87 232 4917
E-mail. info@rmullarkey.ie www.rmullarkey.ie

Project
KILTERNAN VILLAGE SHD

Drawing Title
EXCEEDANCE OVERFLOW ROUTE

Architect
MCORM Architects

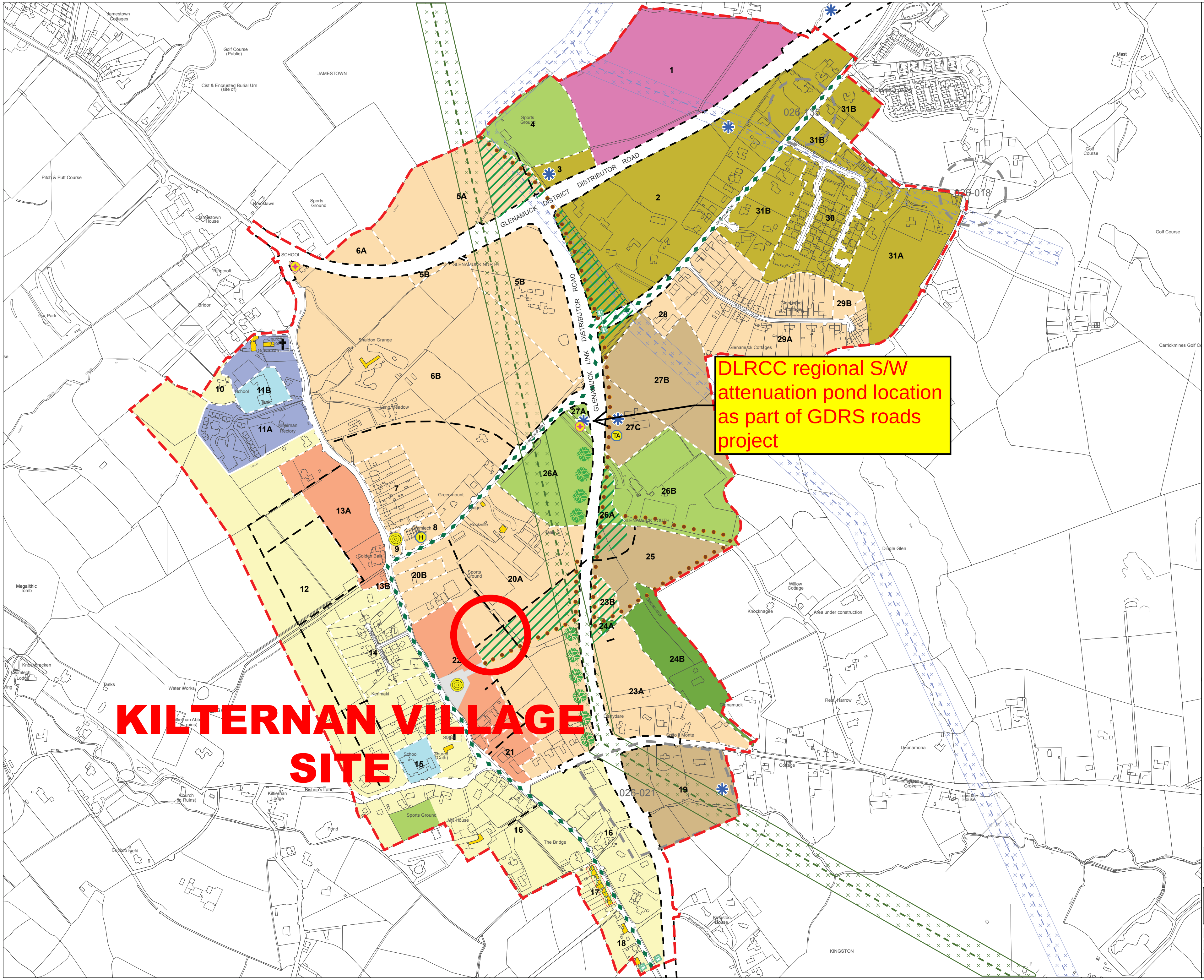
Stage
PLANNING

Date	Drawn By	Scales	Dwg.No.	Rev.
May'22	RM	1:2000 @A3	2104/12	

Appendix 6.3

DLRCC Local Area Plan Map Np. PL-13-402

(Not to scale at A4)



DLRCC regional S/W attenuation pond location as part of GDRS roads project

KILTERNAN VILLAGE SITE

LEGEND

▭	Boundary of Local Area Plan
🟨	Medium/Higher Density Residential
🟧	Medium Density Residential
🟨	Lower Density Residential
🟧	Neighbourhood Centre
🟪	Employment Use
🟫	Agriculture
🟩	High Amenity
🟩	Open Space/Recreational Amenity
🟦	Parish/Community Centre Node
🟦	Existing Primary School
▨	Indicative Greenway Link
▥	Architectural Conservation Area
🟨	Protected Structures
▭	Record of Monuments and Places
H	County Council Housing Programme Site
TA	Traveller Accommodation
✱	Surface Water Attenuation Pond
✦	Gateway Feature
◎	Artistic Feature
• • • •	Walkway/Cycleway
⬜	Civic Space
✝	Church
- - - -	ESB 220KV Overhead Line
× × × ×	Restriction Corridor 220KV
- - - -	ESB 110KV Overhead Line
× × × ×	Restriction Corridor 110KV
◆ ◆ ◆	Primary Bus Corridor
▬ ▬ ▬	Indicative Proposed Access Road
▣—▣	Proposed Bus Gate
✿	Trees (Avenue Planting)
▭	Dashed White Lines Indicate Land Parcel Boundary
25A	Land Parcel Number

NOTE: The lines of road proposals and surface water attenuation ponds on this map are diagrammatic only and are subject to change during the detailed design stage.

0 45 90 180 270
Metres

Planning and Enterprise Department

G.Hayden
Director of Planning

dlr
Comhairle Contae County Council

Adopted Kiltiernan / Glenamuck Local Area Plan 2013

Senior Planner: D.Irvine	**Chief Technician:** M. Hevehan
Prepared By: C. Fulcher	**Drawn By:** M.Hennessy

Date:	**Scale:**	**Drawing No:**
October 2013	1:2500	PL - 13 - 402

Appendix 6.4

DLRCC Flood Zone Map No.9

(Not to scale at A4)

Mapping Notes

1. The lines of the Road Proposals shown are diagrammatic only and may be subject to change.
2. Wave Overtopping layer is relevant to the following maps only: Map No's. 2, 3, 4, 7, 10 & 14 unless noted otherwise.
3. These flood maps contain Land Use Zonings & Flooding information only. Please refer to the Land Use Zoning maps for more detailed land use objectives.

Flood Zone Map

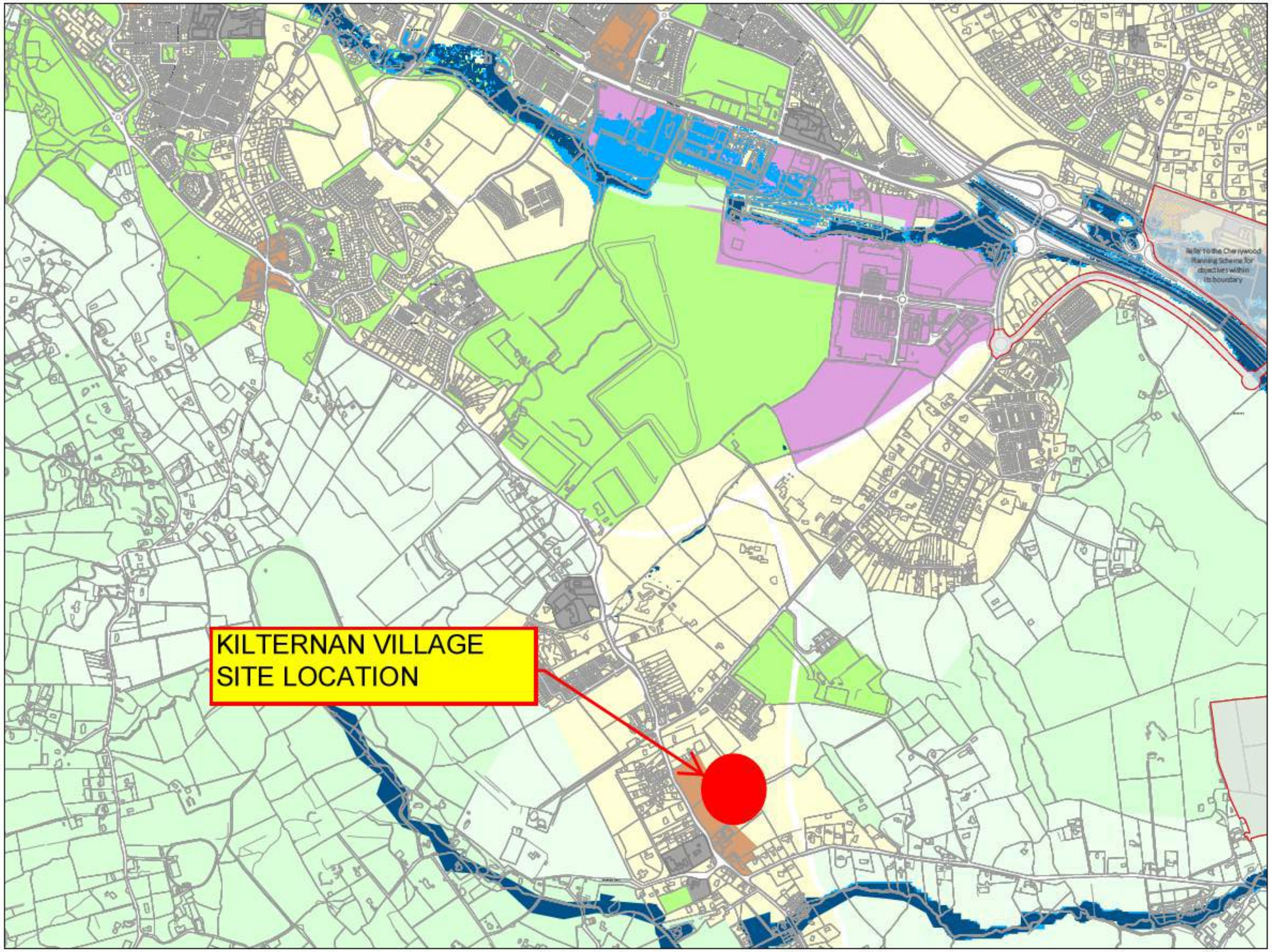
COMHAIRLE CHONTAE DHÚN LAOGHAIRE-RÁTH AN DÚIN

DÚN LAOGHAIRE-RATHDOWN COUNTY COUNCIL

COUNTY DEVELOPMENT PLAN 2022-2028

Adopted March 2022

INDEX


Refer to the Cherrywood Planning Scheme for objectives within its boundary

KILTERNAN VILLAGE SITE LOCATION

Land Use Zonings

Objective A	To provide residential development and improve residential amenity while protecting the existing residential amenities.	🟨
Objective A1	To provide for new residential communities and Sustainable Neighbourhood Infrastructure in accordance with approved local area plans.	🟨
Objective A2	To provide for the creation of sustainable residential neighbourhoods and preserve and protect residential amenity.	🟨
Objective B	To protect and improve rural amenity and to provide for the development of agriculture.	🟩
Objective DC	To protect, provide for and-or improve mixed-use district centre facilities.	🟥
Objective E	To provide for economic development and employment.	🟪
Objective F	To preserve and provide for open space with ancillary active recreational amenities.	🟩
Objective G	To protect and improve high amenity areas.	🟩
Objective GB	To protect and enhance the open nature of lands between urban areas.	▨
Objective LIW	To improve and provide for low density warehousing/light industrial warehousing uses.	🟦
Objective MIC	To consolidate and complete the development of the mixed use inner core to enhance and reinforce sustainable development.	🟧
Objective MOC	To provide for a mix of uses which complements the inner core, but with less retail and residential and more emphasis on employment and services.	🟥
Objective MTC	To protect, provide for and-or improve major town centre facilities.	🟦
Objective NC	To protect, provide for and-or improve mixed-use neighbourhood centre facilities.	🟫
Objective OE	To provide for office and enterprise development.	🟦
Objective TLI	To facilitate, support and enhance the development of third level education institutions.	⬜
Objective W	To provide for waterfront development and harbour related uses.	🟩
Objective SNI	To protect, improve and encourage the provision of sustainable neighbourhood infrastructure.	⬛

Areas of Flood Risk Concern

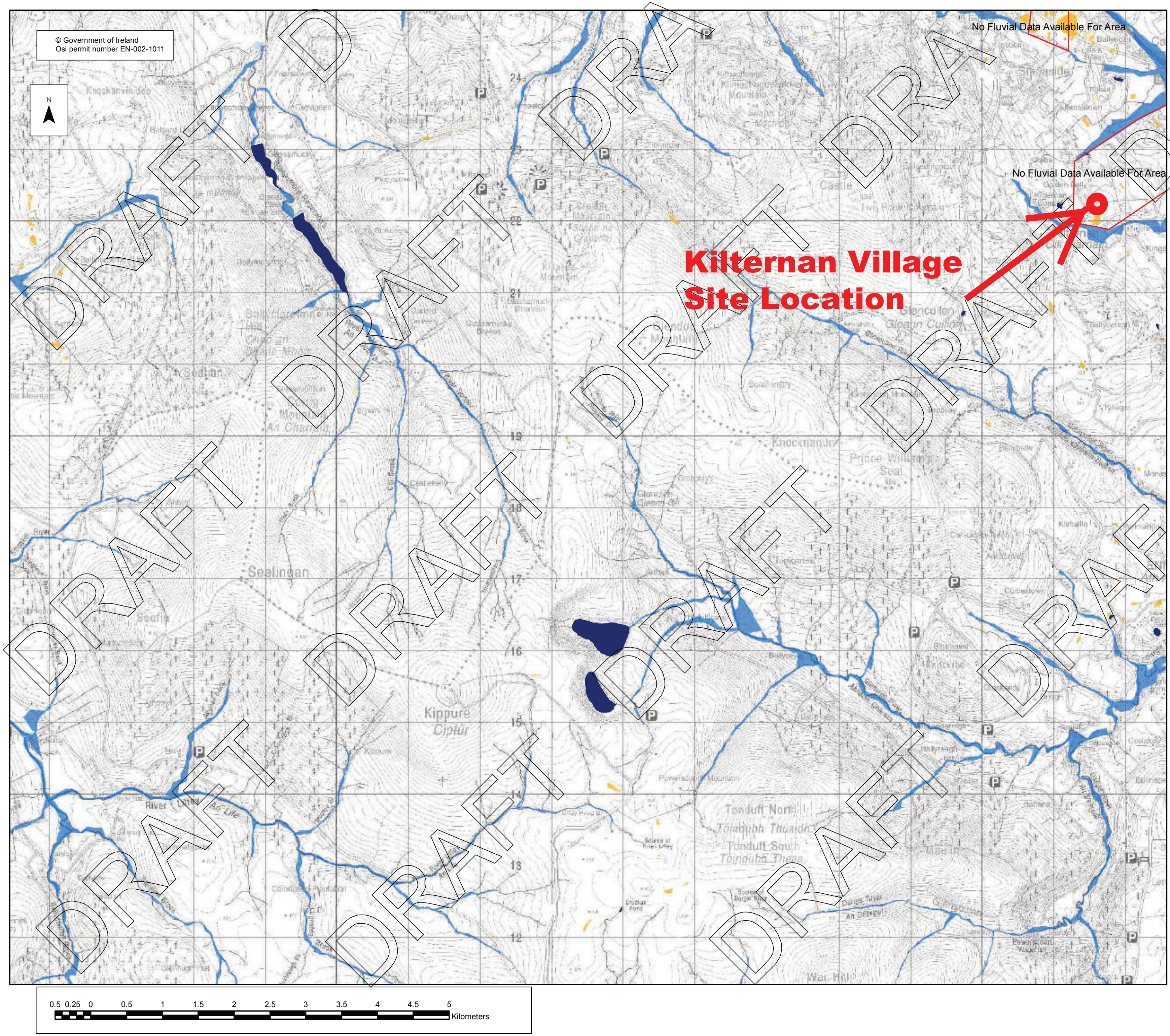
Fluvial - Surface Water	▲ F
Pluvial - Surface Water	▲ P
Pluvial - Foul	▲ P
Flood Zone A	🟦
Flood Zone B	🟦
Wave Overtopping	▨
County Boundary	■ ■ ■
Boundary of Adopted Cherrywood Planning Scheme	▭

Director of Planning: M Henchy
Senior Planner: L McGauran

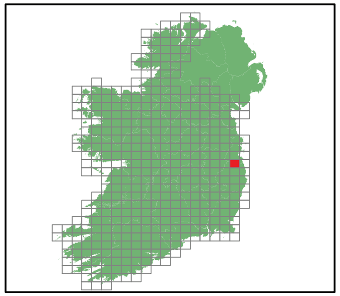
Appendix 6.5

OPW PRFA map No.2019/MAP/221A

(Not to scale at A4)



Location Plan :



Legend:

Flood Extents

🟦	Fluvial - Indicative 1% AEP (100-yr) Event
▢	Fluvial - Extreme Event
🟩	Coastal - Indicative 0.5% AEP (200-yr) Event
▢	Coastal - Extreme Event
🟨	Pluvial - Indicative 1% AEP (100-yr) Event
▢	Pluvial - Extreme Event
🟫	Groundwater Flood Extents
■	Lakes / Turloughs

PFRA Outcomes

✳	Probable Area for Further Assesment
✳	Possible Area for Further Assesment

Important User Note:

The flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location. Information on the purpose, development and limitations of these maps is available in the relevant reports (see www.cfram.ie). Users should seek professional advice if they intend to rely on the maps in any way.

If you believe that the maps are inaccurate in some way please forward full details by contacting the OPW (refer to PFRA Information leaflets or 'Have Your Say' on www.cfram.ie).

Office of Public Works
Jonathon Swift Street
Trim
Co Meath
Ireland

Project :
PRELIMINARY FLOOD RISK ASSESMENT (PFRA)

Map :
PFRA Indicative extents and outcomes
- Draft for Consultation

Figure By : PJW
Date : July2011
Checked By : MA
Date : July 2011

Figure No. : 2019 / MAP / 221 / A
Revision 0

Drawing Scale : 1:50,000
Plot Scale : 1:1 @ A3

Appendix 6.6

OPW National Flood Hazard Mapping – Summary Report

OPW *National Flood Hazard Mapping*

Summary Local Area Report

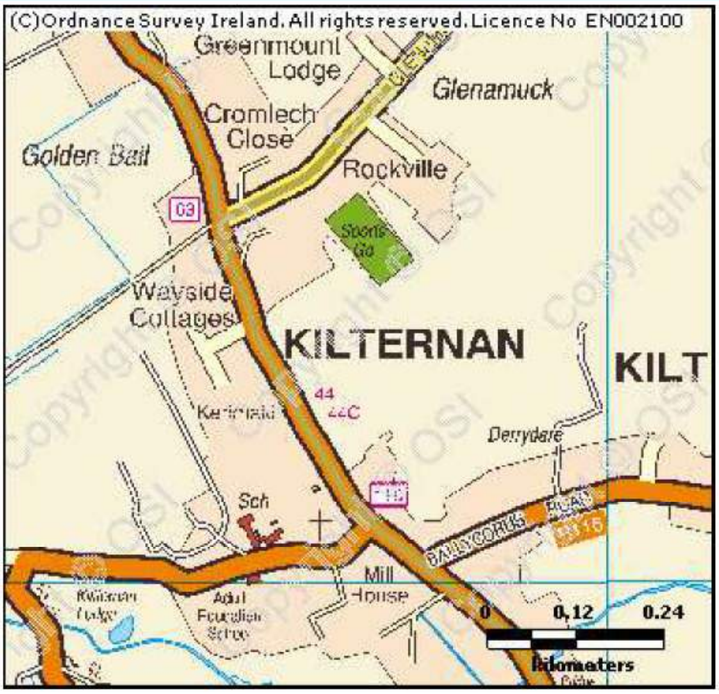
This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:

County: Dublin

NGR: O 206 223

This Flood Report has been downloaded from the Web site www.floodmaps.ie. The users should take account of the restrictions and limitations relating to the content and use of this Web site that are explained in the Disclaimer box when entering the site. It is a condition of use of the Web site that you accept the User Declaration and the Disclaimer.



Map Scale 1:10,112

Map Legend	
⚠	Flood Points
⚠	Multiple / Recurring Flood Points
▦	Areas Flooded
📍	Hydrometric Stations
╱	Rivers
🟦	Lakes
□	River Catchment Areas
▨	Land Commission *
▤	Drainage Districts *
▥	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Thier purpose and scope is explained in the Glossary.

7 Results

⚠ 1. Shanganagh Carrickmines Nov 2002 — Start Date: 26/Nov/2002

County: Dublin — Flood Quality Code: 3

Additional Information: Reports (1) More Mapped Information

⚠ 2. Shanganagh Carrickmines Dec 1997 — Start Date: 18/Dec/1997

County: Dublin — Flood Quality Code: 3

Additional Information: Reports (1) More Mapped Information

⚠ 3. Shanganagh Carrickmines May 1993 — Start Date: 26/May/1993

County: Dublin — Flood Quality Code: 1

Additional Information: Photos (3) Reports (4) More Mapped Information

---

⚠ 4. Shanganagh Carrickmines Nov 1982 — Start Date: 06/Nov/1982

County: Dublin — Flood Quality Code: 3

Additional Information: Reports (3) More Mapped Information

⚠ 5. Kilternan Glencullen Road Nov 1982 — Start Date: 05/Nov/1982

County: Dublin — Flood Quality Code: 3

Additional Information: Reports (1) More Mapped Information

---

6. Glenamuck Stream Glenamuck Road Recurring
County: Dublin
Additional Information: Reports (2) More Mapped Information

Start Date:
Flood Quality Code:4

---

7. Enniskerry Road Recurring
County: Dublin
Additional Information: Reports (2) More Mapped Information

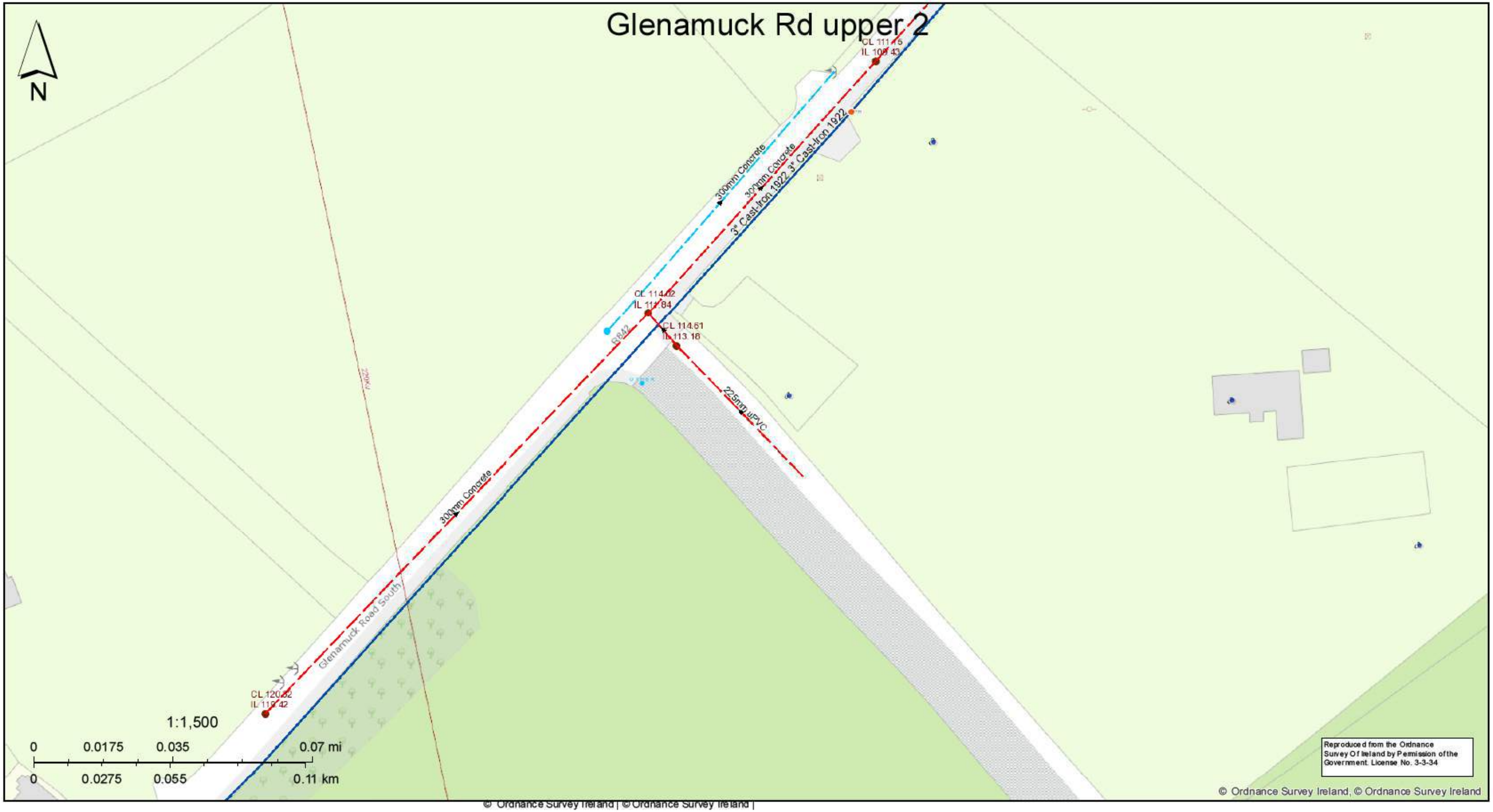
Start Date:
Flood Quality Code:4

Appendix 6.7

IW/DLRCC Drainage Records drawings

(Not to scale at A4)

Glenamuck Rd upper 2



© Ordnance Survey Ireland | © Ordnance Survey Ireland |

July 11, 2017

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown

- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

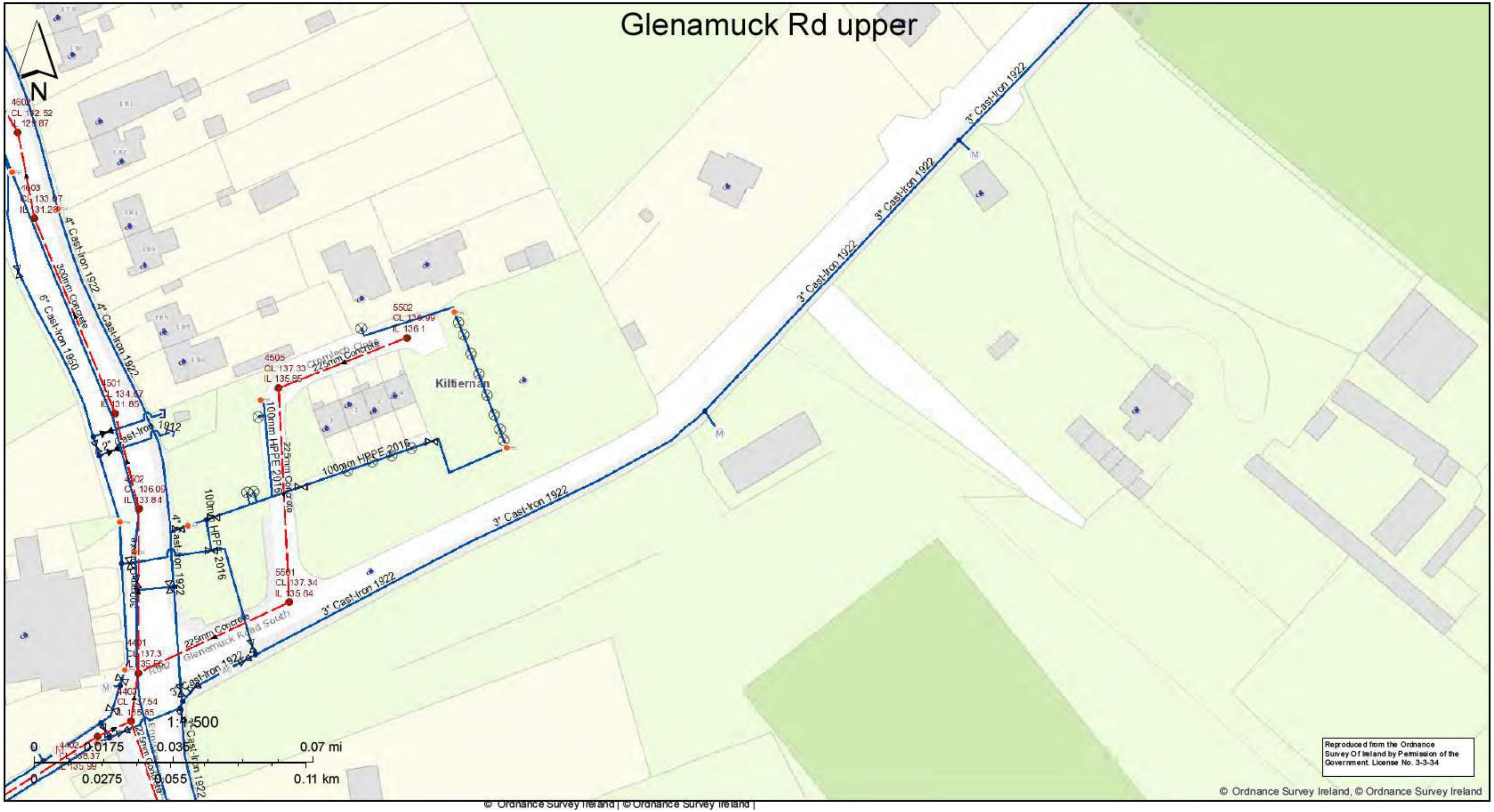
Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

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. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

UISCE ÉIREANN : IRISH WATER

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the Information (including maps or mapping data). NOTE: DIAL BEFORE YOU DIG Phone 1850 427 747 or e-mail dig@gasnetworks.ie – The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of the gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication, 'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Glenamuck Rd upper



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July 11, 2017

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

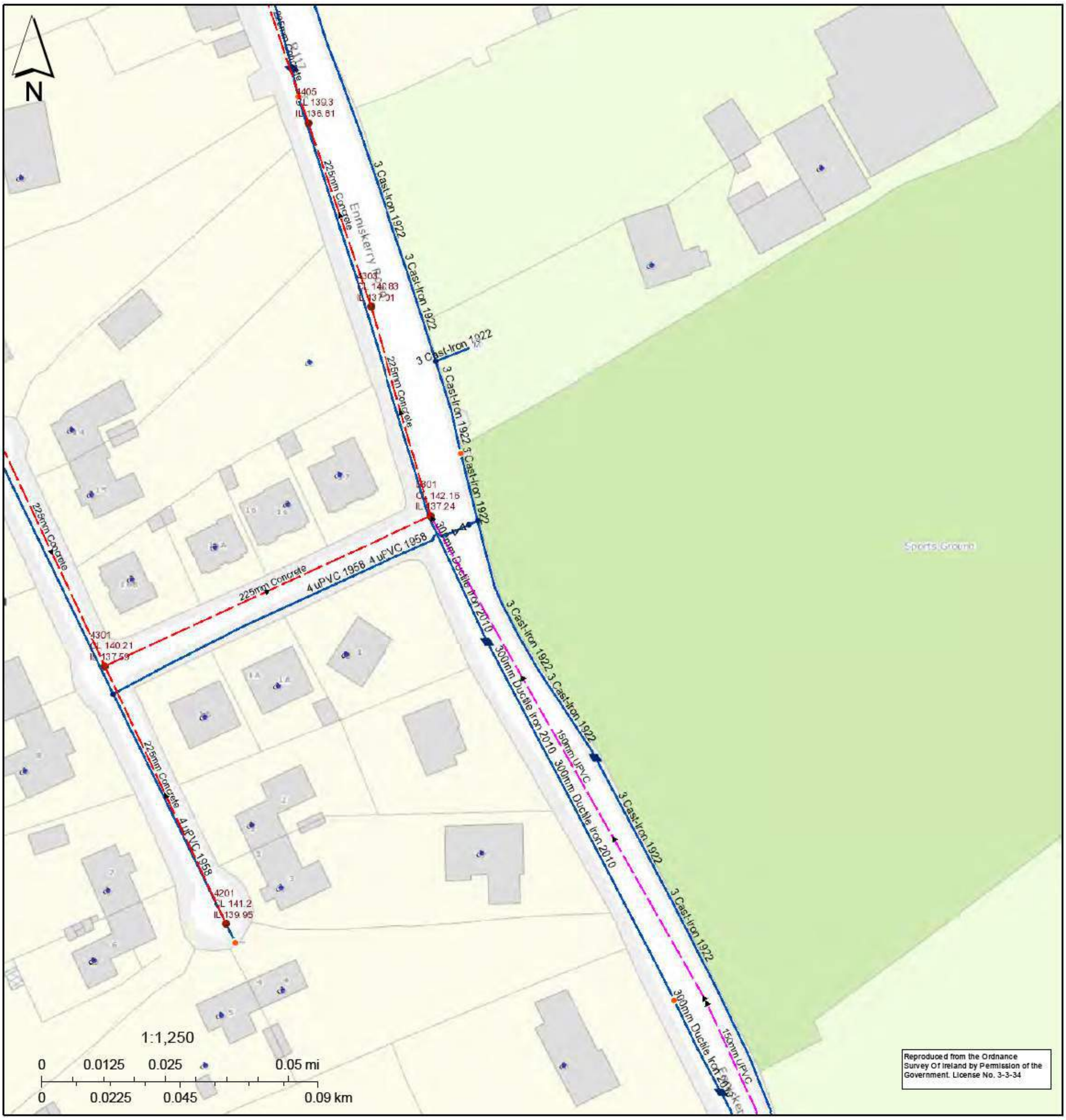
Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown

- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Kilternan Village



5/29/2018 9:45:34 AM

© Ordnance Survey Ireland | © Ordnance Survey Ireland |

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown
- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Pressurized Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Pressurized Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

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. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated.

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Appendix D

Appendix D1: The Qualifying Interests (QIs) and Special Conservation Interests (SCIs) of the European and National sites in the vicinity of the proposed development site

European Site Name [Code] and its Qualifying interest(s) / Special Conservation Interest(s) **(*Priority Annex I Habitats)**	**Location Relative to the Proposed Development Site**
Special Area of Conservation (SAC)	
Knocksink Wood SAC [000725] [7220] Petrifying springs with tufa formation (Cratoneurion)* [91E0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)* [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles NPWS (2021) *Conservation objectives for Knocksink Wood SAC [000725]. Generic Version 1.0.* Department of Housing, Local Government and Heritage.	Located *c.* 2.7km south of the proposed development site.
Ballyman Glen SAC [000713] [7220] Petrifying springs with tufa formation (Cratoneurion)* [7230] Alkaline fens NPWS (2019) *Conservation Objectives: Ballyman Glen SAC 000713.* Version 1. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht.	Located *c.* 3.5km south of the proposed development site.
Wicklow Mountains SAC [002122] [3110] Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) [3160] Natural dystrophic lakes and ponds [4010] Northern Atlantic wet heaths with *Erica tetralix* [4030] European dry heaths [4060] Alpine and Boreal heaths [6130] Calaminarian grasslands of the Violetalia calaminariae [6230] Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)* [7130] Blanket bogs (* if active bog) [8110] Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani) [8210] Calcareous rocky slopes with chasmophytic vegetation [8220] Siliceous rocky slopes with chasmophytic vegetation [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [1355] *Lutra lutra* (Otter) NPWS (2017) *Conservation Objectives: Wicklow Mountains SAC 002122.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.	Located *c. 4.3*km south west of the proposed development site.
South Dublin Bay SAC [000210] [1140] Mudflats and sandflats not covered by seawater at low tide [1210] Annual vegetation of drift lines [1310] *Salicornia* and other annuals colonising mud and sand [2110] Embryonic shifting dunes NPWS (2013b) *Conservation Objectives: South Dublin Bay SAC 000210.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	Located *c.* 6.6km north of the proposed development site.

Rockabill to Dalkey Island SAC [003000] [1170] Reefs [1351] Harbour porpoise *Phocoena phocoena* NPWS (2013) *Conservation Objectives: Rockabill to Dalkey Island SAC 003000.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht[1]	Located *c*.6.7km east of the proposed development site. Located *c.* 1.5km north east of the Shanganagh WWTP outfall.
Bray Head SAC (000714) [1230] Vegetated sea cliffs of the Atlantic and Baltic coasts [4030] European dry heaths NPWS (2017) *Conservation Objectives: Bray Head SAC 000714*. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.	Located *c.* 8.1km south east of the proposed development site.
Glenasmole Valley SAC [001209] [6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) [6410] *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) [7220] Petrifying springs with tufa formation (Cratoneurion)* NPWS (2021) *Conservation objectives: Glenasmole Valley SAC [001209]. Version 1.0*. Department of Housing, Local Government and Heritage.	Located *c.* 10.4km west of the proposed development site.
Glen of the Downs SAC (000719) [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles NPWS (2020) *Conservation objectives: Glen of the Downs SAC [000719].* Version 1.0. Department of Housing, Local Government and Heritage.	Located *c.* 11.3km south east of the proposed development site.
North Dublin Bay SAC [000206] [1140] Mudflats and sandflats not covered by seawater at low tide [1210] Annual vegetation of drift lines [1310] *Salicornia* and other annuals colonising mud and sand [1330] Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1395] Petalwort *Petalophyllum ralfsii* [1410] Mediterranean salt meadows (Juncetalia maritimi) [2110] Embryonic shifting dunes [2120] Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2130] Fixed coastal dunes with herbaceous vegetation (grey dunes)* [2190] Humid dune slacks NPWS (2013a) *Conservation Objectives: North Dublin Bay SAC 000206.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	Located *c.* 12km north of the proposed development site.
Carriggower Bog SAC [000202] [7140] Transition mires and quaking bogs NPWS (2019) Conservation Objectives: Carriggower Bog SAC 000716. Version 1. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht.	Located *c.* 14.2km south of the proposed development site.

---

[1] The versions of the conservation objectives documents referenced in this table are the most recent published versions at the time of writing

Howth Head SAC [000202] [1230] Vegetated sea cliffs of the Atlantic and Baltic coasts [4030] European dry heaths NPWS (2016) *Conservation Objectives: Howth Head SAC 000202.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.	Located *c.* 15.3km north east of the proposed development site.
The Murrough Wetlands SAC [002249] [1210] Annual vegetation of drift lines [1220] Perennial vegetation of stony banks [1330] Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1410] Mediterranean salt meadows (Juncetalia maritimi) [7210] Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae* [7230] Alkaline fens NPWS (2021) Conservation Objectives: The Murrough Wetlands SAC 002249. Version 1. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage.	Located *c.* 16.6km south east of the proposed development site.
Special Protection Area (SPA)	
Wicklow Mountains SPA [004040] [A098] Merlin *Falco columbarius* [A103] Peregrine *Falco peregrinus* NPWS (2022) *Conservation objectives for Wicklow Mountains SPA [004040]. Generic Version 9.0.* Department of Housing, Local Government and Heritage.	Located *c.* 4.3km south west of the proposed development site.
South Dublin Bay and River Tolka Estuary SPA [004024] [A046] Light-bellied Brent Goose *Branta bernicla hrota* [A130] Oystercatcher *Haematopus ostralegus* [A137] Ringed Plover *Charadrius hiaticula* [A141] Grey Plover *Pluvialis squatarola* [A143] Knot *Calidris canutus* [A144] Sanderling *Calidris alba* [A149] Dunlin *Calidris alpina* [A157] Bar-tailed Godwit *Limosa lapponica* [A162] Redshank *Tringa totanus* [A179] Black-headed Gull *Chroicocephalus ridibundus* [A192] Roseate Tern *Sterna dougallii* [A193] Common Tern *Sterna hirundo* [A194] Arctic Tern *Sterna paradisaea* [A999] Wetland and Waterbirds NPWS (2015) *Conservation Objectives: South Dublin Bay and River Tolka Estuary SPA 004024*. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	Located *c.* 6.6km north of the proposed development site.

Dalkey Islands SPA [004172] [A192] Roseate Tern *Sterna dougallii* [A193] Common Tern *Sterna hirundo* [A194] Arctic Tern *Sterna paradisaea* NPWS (2022) *Conservation objectives for Dalkey Islands SPA [004172]. Generic Version 9.0.* Department of Housing, Local Government and Heritage.	Located *c.* 7.6km north east of the proposed development site. Located *c.* 3.2km north east of the Shanganagh WWTP outfall.
North Bull Island SPA [004006] [A046] Light-bellied Brent Goose *Branta bernicla hrota* [A048] Shelduck *Tadorna tadorna* [A052] Teal *Anas crecca* [A054] Pintail *Anas acuta* [A056] Shoveler *Anas clypeata* [A130] Oystercatcher *Haematopus ostralegus* [A140] Golden Plover *Pluvialis apricaria* [A141] Grey Plover *Pluvialis squatarola* [A143] Knot *Calidris canutus* [A144] Sanderling *Calidris alba* [A149] Dunlin *Calidris alpina* [A156] Black-tailed Godwit *Limosa limosa* [A157] Bar-tailed Godwit *Limosa lapponica* [A160] Curlew *Numenius arquata* [A162] Redshank *Tringa totanus* [A169] Turnstone *Arenaria interpres* [A179] Black-headed Gull *Chroicocephalus ridibundus* [A999] Wetlands & Waterbirds NPWS (2015) *Conservation Objectives: North Bull Island SPA 004006.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	Located *c.* 12km northeast of the proposed development site.
Howth Head Coast SPA [004113] [A188] Kittiwake (Rissa tridactyla) NPWS (2022) *Conservation objectives for Howth Head Coast SPA [004113].* Generic Version 9.0. Department of Housing, Local Government and Heritage.	Located *c.* 16.3km north east of the proposed development site.
The Murrough SPA [004113] [A001] Red-throated Diver *Gavia stellata* [A043] Greylag Goose *Anser anser* [A046] Light-bellied Brent Goose *Branta bernicla hrota* [A050]Wigeon *Anas penelope* [A052] Teal *Anas crecca* [A179] Black-headed Gull *Chroicocephalus ridibundus* [A184] Herring Gull *Larus argentatus* [A195] Little Tern *Sterna albifrons* [A999] Wetland and Waterbirds NPWS (2022) *Conservation objectives for The Murrough SPA [004186].* Generic Version 9.0. Department of Housing, Local Government and Heritage.	Located *c.* 14.2km north east of the proposed development site.
Proposed National Heritage Areas (pNHA)	

Dingle Glen pNHA 001207 The importance in this site lies in the variety of habitats within a relatively small area, mainly for its woodland regeneration structure. The site is secluded and not subject to much disturbance	Located 1 km east of proposed development site
Fitzimon's Wood pNHA 001753 Intact basic woodland structure and birch woodland is very rare in Co. Dublin, Fitzsimon's Wood continues to be of ecological importance.	Located 4 km northwest of proposed development site
Loughlinstown Wood pNHA 001211 This site is a good example of demesne-type mixed woodland. It is now used chiefly for amenity purposes.	Located 4 km east of proposed development site
Ballybetagh Bog pNHA 001202 Although the site contains samples of fen and marsh vegetation, the main interest lies in its historical value. Ballybetagh Bog has become a classical site of quaternary studies due to the intensity of research. The bones of Giant Irish Deer have been found in upwards of 150 sites in the country, but nowhere else have their surroundings been subjected to such intense investigation.	Located 1.8 km southwest of proposed development site
Ballyman Glen pNHA 000713 Listed under similar conservation objectives as it's SAC designation.	Located 4.5 km southeast of proposed development site
Knocksink Wood pNHA 000725 Listed under similar conservation objectives as it's SAC designation.	Located 3.6 km south of proposed development site
Dalkey Coastal Zone and Killiney Hill pNHA 001206 This site represents a fine example of a coastal system with habitats ranging from the sub-littoral to coastal heath. The flora is well developed and includes some scarce species. The islands are important bird sites. The site also has geological importance	Located 5.8 km northeast of proposed development site

Appendix D2: Criteria for Ecological Evaluation

Ecological Valuation Criteria

International Importance:

- ‘European Site’ including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation.
- Proposed Special Protection Area (pSPA).
- Site that fulfils the criteria for designation as a ‘European Site’ (see Annex III of the Habitats Directive, as amended).
- Features essential to maintaining the coherence of the Natura 2000 Network.[2]
- Site containing ‘best examples’ of the habitat types listed in Annex I of the Habitats Directive.
- Resident or regularly occurring populations (assessed to be important at the national level)[3] of the following:
    - Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and / or
    - Species of animal and plants listed in Annex II and/or IV of the Habitats Directive.
- Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971).
- World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972).
- Biosphere Reserve (UNESCO Man & The Biosphere Programme).
- Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979).
- Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979).
- Biogenetic Reserve under the Council of Europe.
- European Diploma Site under the Council of Europe.
- Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).[4]

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[2] See Articles 3 and 10 of the Habitats Directive.

[3] It is suggested that, in general, 1% of the national population of such species qualifies as an internationally important population. However, a smaller population may qualify as internationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

[4] Note that such waters are designated based on these waters’ capabilities of supporting salmon (*Salmo salar*), trout (*Salmo trutta*), char (*Salvelinus*) and whitefish (*Coregonus*).

Ecological Valuation Criteria

National Importance:

- Site designated or proposed as a Natural Heritage Area (NHA).
- Statutory Nature Reserve.
- Refuge for Fauna and Flora protected under the Wildlife Acts.
- National Park.
- Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park.
- Resident or regularly occurring populations (assessed to be important at the national level)[5] of the following:
    - Species protected under the Wildlife Acts; and/or
    - Species listed on the relevant Red Data list.
- Site containing 'viable areas'[6] of the habitat types listed in Annex I of the Habitats Directive.

County Importance:

- Area of Special Amenity.[7]
- Area subject to a Tree Preservation Order.
- Area of High Amenity, or equivalent, designated under the County Development Plan.
- Resident or regularly occurring populations (assessed to be important at the County level)[8] of the following:
    - Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
    - Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;
    - Species protected under the Wildlife Acts; and/or
    - Species listed on the relevant Red Data list.
- Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance.
- County important populations of species, or viable areas of semi-natural habitats or natural heritage features identified in the National or Local Biodiversity Action Plan (BAP) if this has been prepared.
- Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county.
- Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.

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[5] It is suggested that, in general, 1% of the national population of such species qualifies as a nationally important population. However, a smaller population may qualify as nationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

[6] A 'viable area' is defined as an area of a habitat that, given the particular characteristics of that habitat, was of a sufficient size and shape, such that its integrity (in terms of species composition, and ecological processes and function) would be maintained in the face of stochastic change (for example, as a result of climatic variation).

[7] It should be noted that whilst areas such as Areas of Special Amenity, areas subject to a Tree Preservation Order and Areas of High Amenity are often designated on the basis of their ecological value, they may also be designated for other reasons, such as their amenity or recreational value. Therefore, it should not be automatically assumed that such sites are of County importance from an ecological perspective.

[8] It is suggested that, in general, 1% of the County population of such species qualifies as a County important population. However, a smaller population may qualify as County importance where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

Ecological Valuation Criteria

Local Importance (higher value):

- Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared;
- Resident or regularly occurring populations (assessed to be important at the Local level)[9] of the following:
    - Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
    - Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;
    - Species protected under the Wildlife Acts; and/or
    - Species listed on the relevant Red Data list.
- Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality;
- Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.

Local Importance (lower value):

- Sites containing small areas of semi-natural habitat that are of some local importance for wildlife;
- Sites or features containing non-native species that are of some importance in maintaining habitat links.

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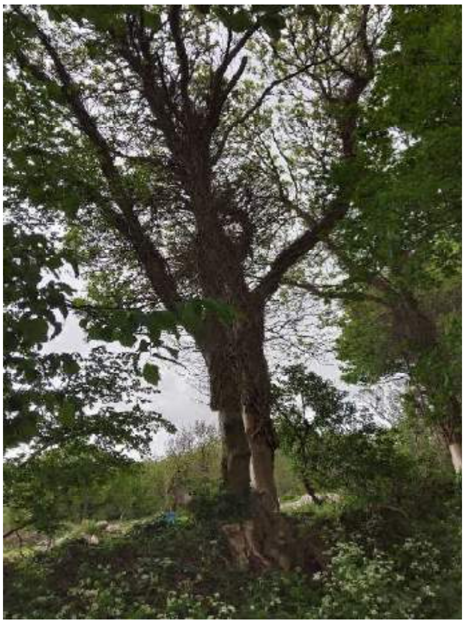
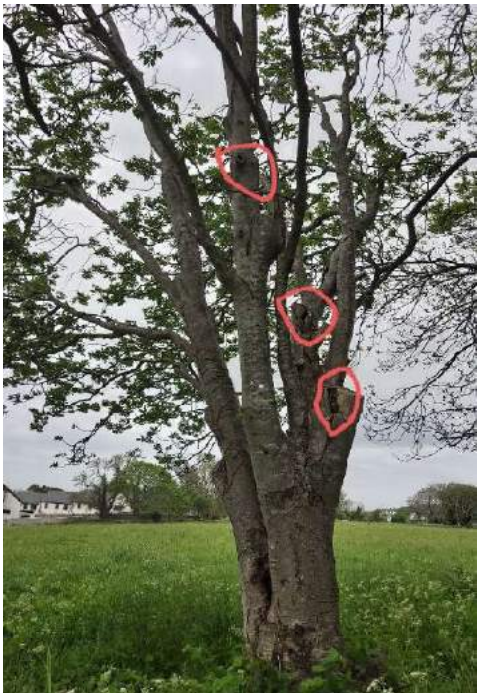
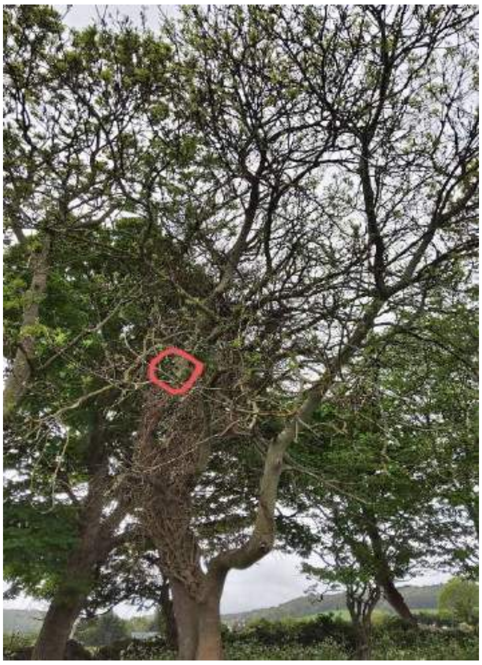
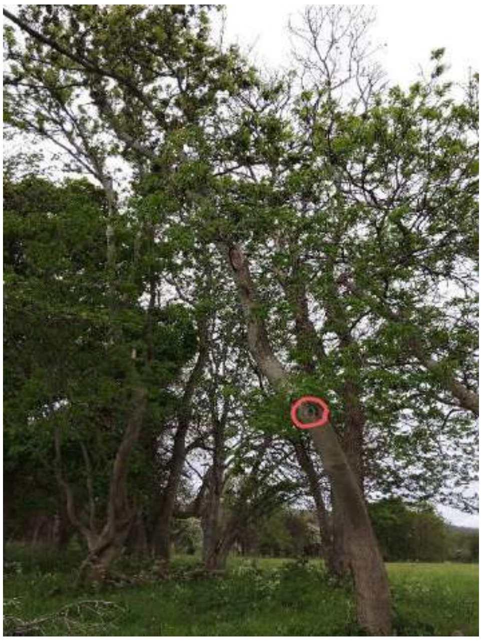
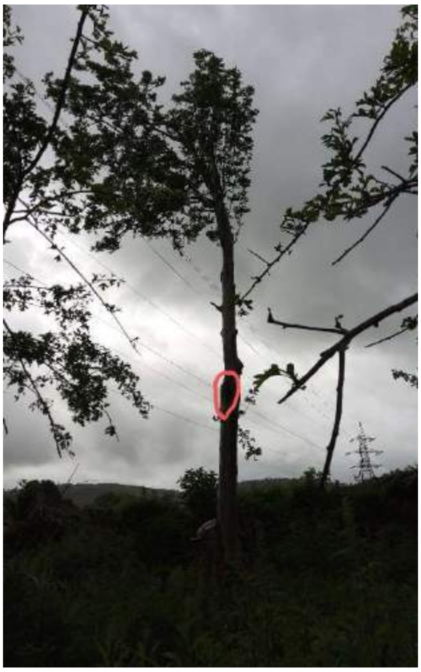
[9] It is suggested that, in general, 1%of the local population of such species qualifies as a locally important population. However, a smaller population may qualify as locally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

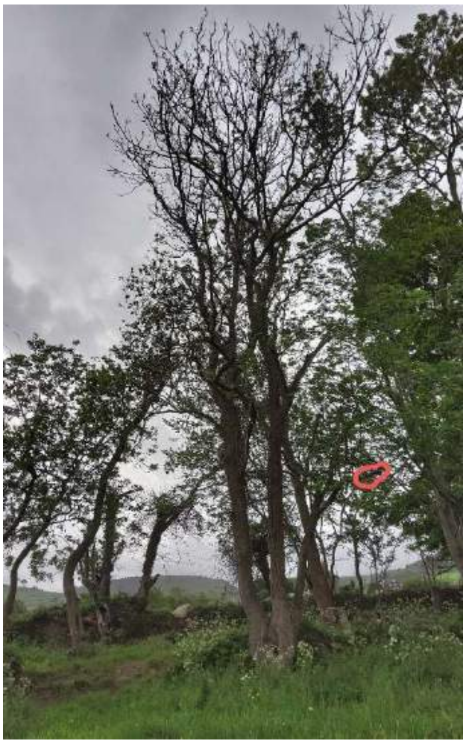
Appendix D3: Potential Roost Feature (PRF) photos of tree PRFs identified

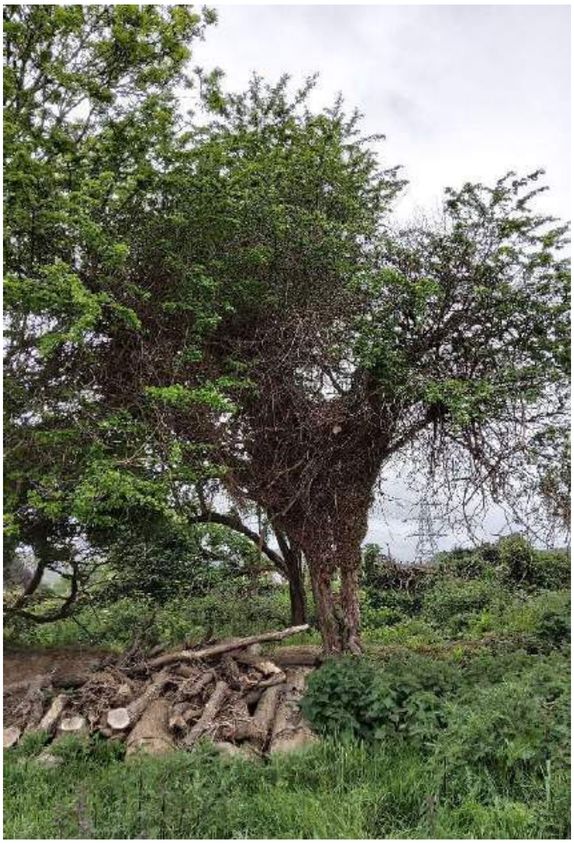
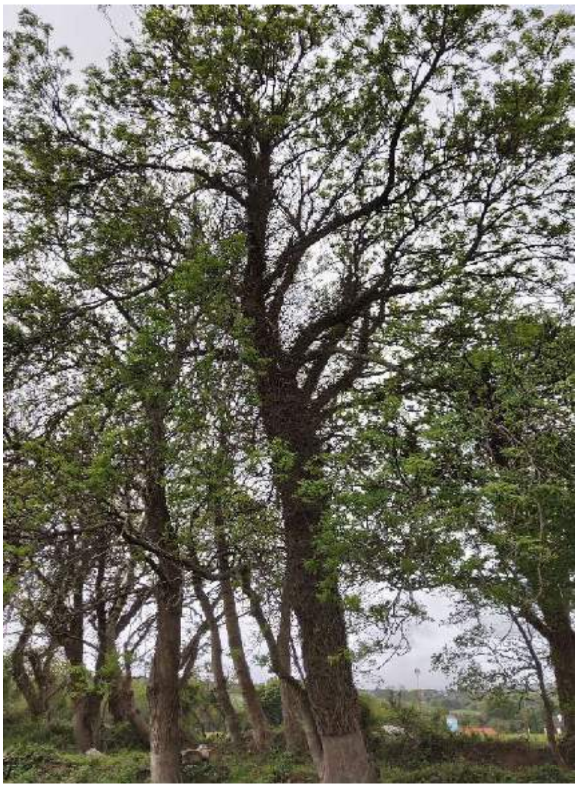
Tree	PRFs (with indicative heights)	Photograph
Tree 1 Mature Ash	Knothole 8m	
Tree 2 Ash Tag no. 0872	Peeling Bark 7 m	No corresponding photo
Tree 3 - Sycamore	Mat of dead ivy around tops of main trunks 8 – 9 m	

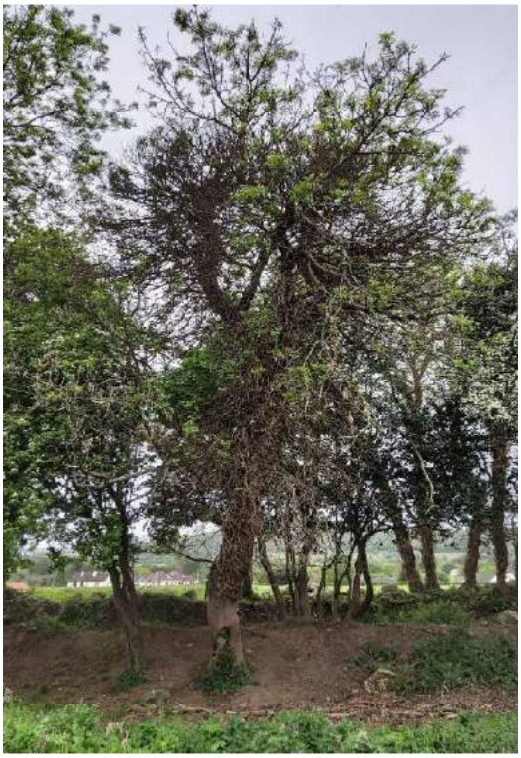
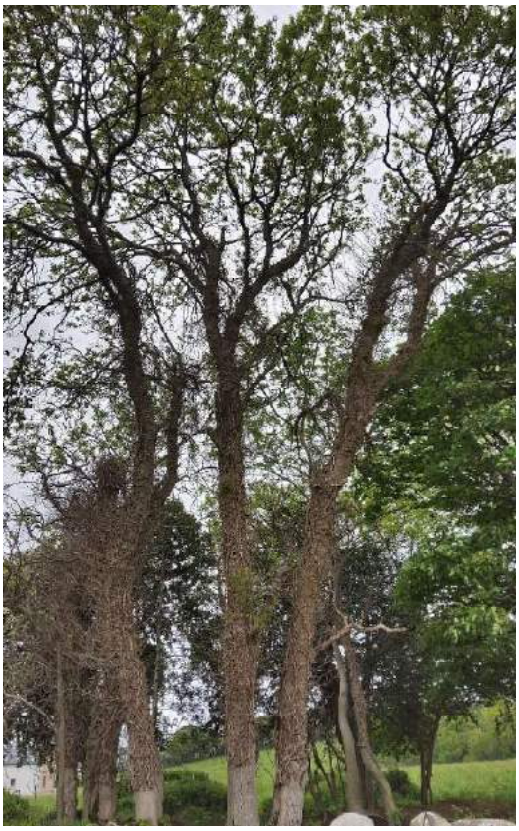
Tree 4 – Ash Tag no. 0808	Dense mat of ivy around main trunk (see photo) 3 – 10 m	
Tree 5 – Rowan Tag no. 0695	Set of Knotholes 3 m	

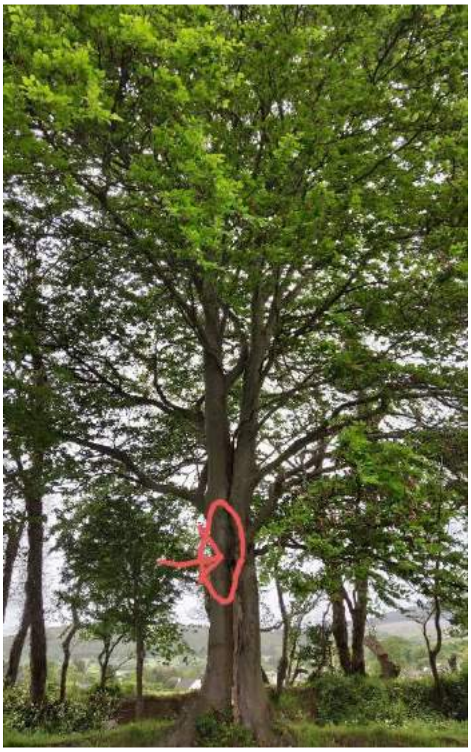
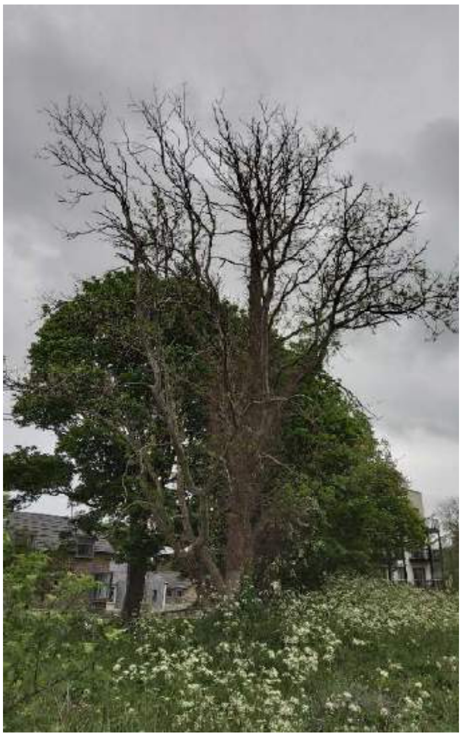
Tree 6 – Mature Ash Tag no. 0698	Knothole 6 -7 m	
Tree 7 – Ash Tag no. 1113	Knothole – 3m	

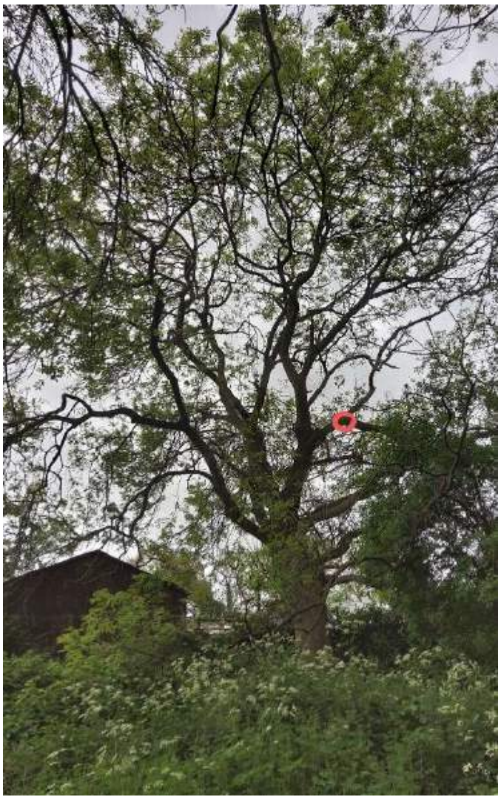
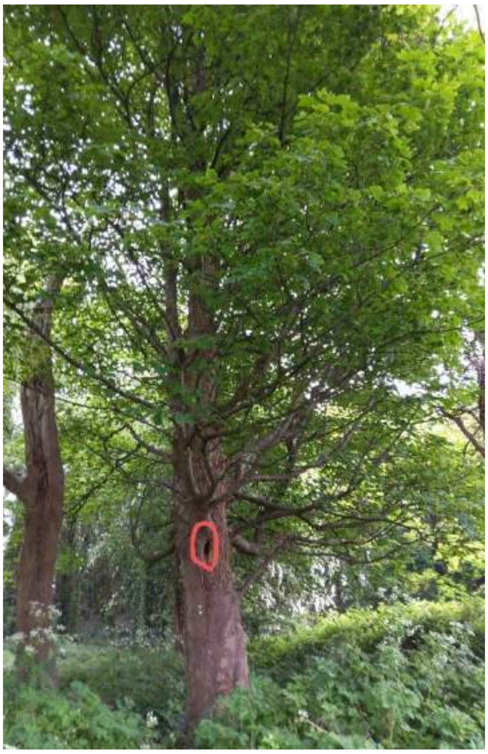
Tree 8 – Rowan Tag no. 0690	Tear Out 3 m	

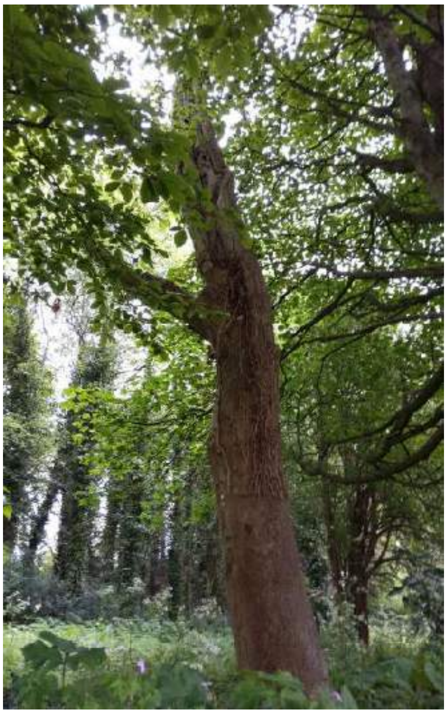
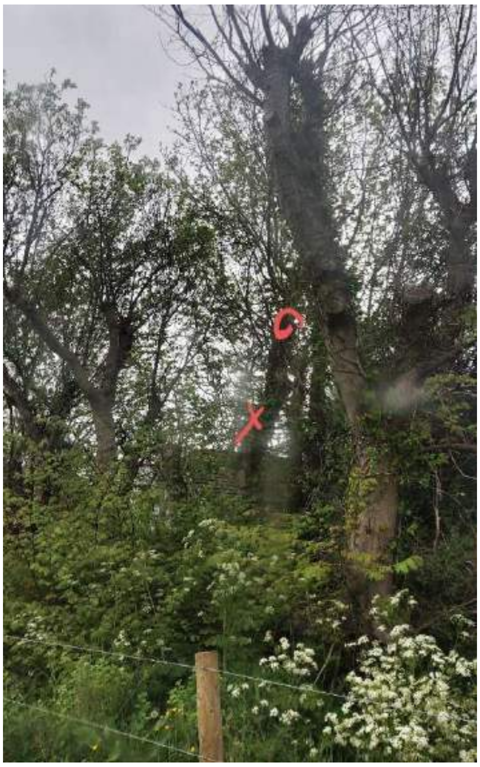
Tree 9 – Ash Tag no. 0693	Wound 4 m	

Tree 10 – Hawthorn Tag no. 0688	Dense mat of ivy 1 – 5 m	
Tree 11 – Mature Ash Tag no. 1155	Dense mat of ivy 1 – 10 m	

Tree 12 - Ash 1161	Dense dead mat of ivy around trunk 1 – 6 m	
Tree 13 – Ash Tag no. 1158	Knotholes 3 – 7 m	

Tree 14 – Beech Tag no. 1165	Split from Base 4m	
Tree 15 – Mature Ash Tag no. 1048	Peeling Bark decaying tree with peeling bark on multiple limbs - at least one limb with gap under bark	

Tree 16 – Mature Ash Tag no. 0629	Knothole 7 m	
Tree 17 – Mature Sycamore Tag no. 0787	Large Cavity/Wound 3 m	

Tree 18 – Ash Tag no. 0644	Collapse of trunk 4 – 5 m	
Tree 19 - Ash	Canker 5 m	

Tree 20 – Ash 0614	Knothole 2m	

Appendix D4: Relevant projects in the vicinity of the proposed development site with regard the in-combination assessment (projects granted permission within the last five years included)

Planning/Project Reference	Developer / Applicant	Grant of permission	Description
D17A/0793	Frederick Jason	25/01/2018	Large residential development Northeast of and abutting Kilternan SHD
ABP30397819	Victoria Homes Ltd.	26/06/2019	Strategic Housing Development Northeast of Kilternan SHD
D17A/1022	Calerotech Ltd	05/03/2018	Demolition of structures and houses, and landscaping and car park alterations Northwest of Kilternan SHD
ABP-303945-19	Dun Laoghaire Rathdown County Council	18/12/2019	Glenamuck District Roads Scheme which will connect the existing R117 Enniskerry Road with the Glenamuck Road and new link distributor road which will connect to the Ballycorus Road and the R117 Enniskerry Road
D18A/1191	Goodrock Project Management Ltd.	19/02/2018	Change to house type in Rockville
D17A/0364	Claire Moran	11/01/2018	One new dwelling being developed to west of Kilternan SHD
D15A/0466	Robert Patrick Glanville	04/05/2016	Construction of a new two storey house, vehicular entrance, and waste treatment system along south border of Kilternan SHD

Appendix E

ROGER MULLARKEY & ASSOCIATES
CONSULTING STRUCTURAL and CIVIL ENGINEERS

ENGINEERING INFRASTRUCTURE REPORT & STORMWATER IMPACT ASSESSMENT for a Residential/Commercial Development at Kilternan Village, Kilternan, Dublin 18.

PROJECT:	**KILTERNAN VILLAGE SHD - 2104**
CLIENT:	**LISCOVE LTD**
DATE:	**JUNE 2022**
ISSUE NO:	**PLANNING**
ISSUED BY:	**ROGER MULLARKEY**

DUNCREEVAN,
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Co.KILDARE
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12.7 GSI Data
12.8 Site Investigations Reports
12.9 DLRCC Flood Zone Map No.9
12.10 DLRCC Local Area Plan Map.NoPL-13-402
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12.17 DLRCC GDRS Project Correspondence
12.18 Water and Wastewater Calculations

1.0 Introduction

1.1 This document relates to the Drainage & Water Infrastructure design, including the Storm Water Impact Assessment, for a proposed mixed residential/commercial development located on lands at Wayside, Enniskerry Road, Kilternan, Dublin 18.

1.2 We, Roger Mullarkey & Associates, were appointed by Liscove Ltd. to carry out the drainage and water supply infrastructure report to accompany the suite of other drawings and documentation relating to a proposed residential and commercial development at the above noted address.

1.3 The site development area is c.10.8Ha, is currently predominately greenfield and includes a derelict house & outbuildings.

1.4 The development will principally consist of a mixed-use development consisting of 383 No. residential units and a Neighbourhood Centre (NC) incorporating a creche/office/medical/retail/community use. Please refer to Thornton O'Connor Planning Consultants for a full development description.

2.0 Key Objectives

2.1 This document relates to the Drainage and Water Infrastructure engineering that incorporates the design, background, and detail of the following aspects;

- Road & Block Levels
- Sustainable Drainage Systems (SuDS)
- Storm Water Impact Assessment
- Attenuation
- Foul Water
- Potable Drinking Water Infrastructure

2.2 Aspects relating to the Flood Risk Assessment are detailed in a separate document entitled the Site-Specific Flood Risk Assessment and the reader is referred to that report for further information in that regards.

2.3 Roads access and traffic/transportation assessments are contained in the separate submission documentation by Atkins Consulting Engineers included in the overall planning submission.

2.4 Reference should be made to all drainage drawings and designs included in the appendix of this report and all other consultant's reports and drawings as part of the overall application documentation.

3.0 Site Location & Topography

3.1 The lands are located just east of the Enniskerry Road and south of the Glenamuck Road in Kilternan, Dublin18.

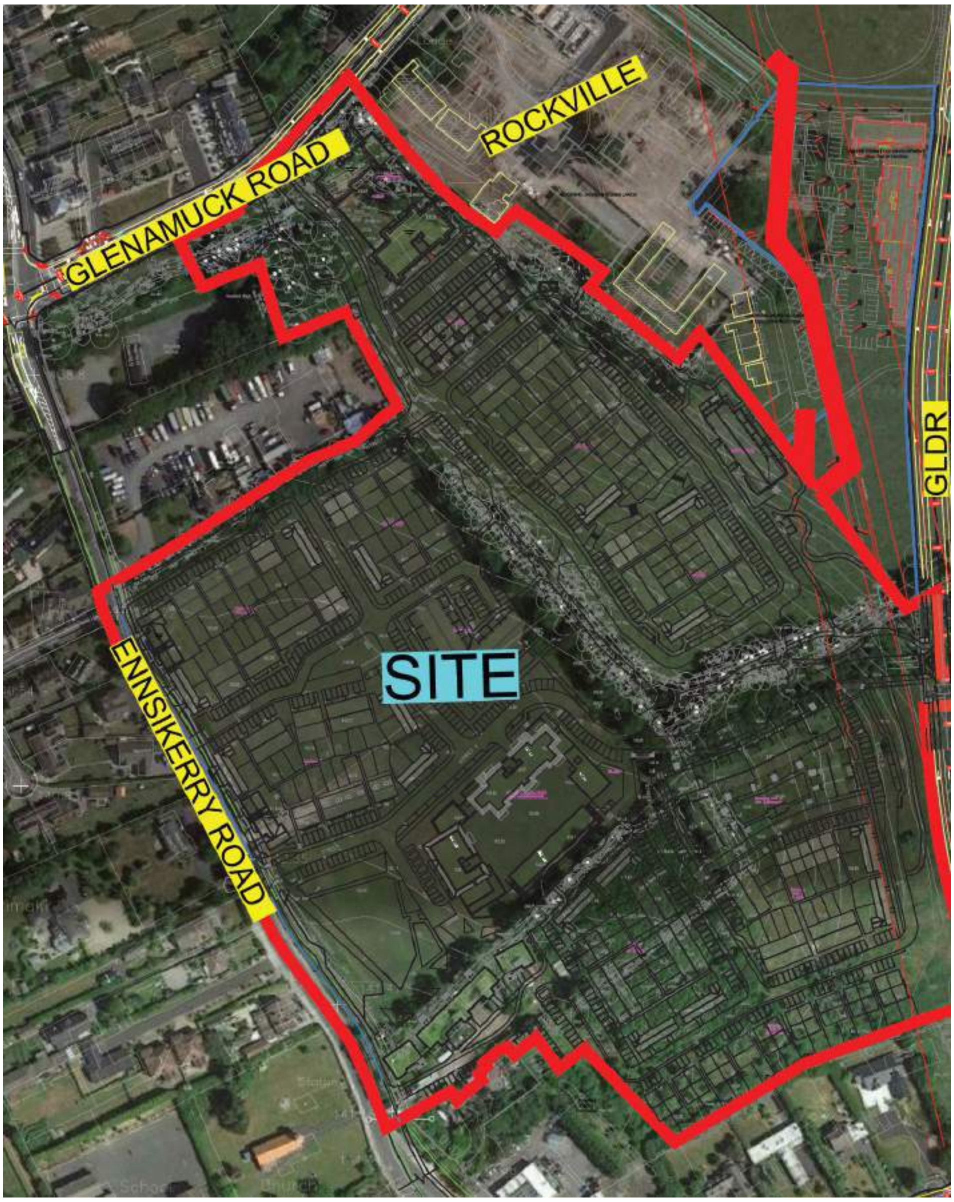


Fig. 1 – Site Location

3.2 The site development area is c.10.8Ha, is currently predominately greenfield and includes a derelict house & outbuildings. It is noted that the surface water drained area is c.9.92Ha and is used for the Qbar and drainage calculations.

3.3 The topography is generally a gradually increasing slope downwards from the Enniskerry Road (western boundary) in a North-easterly direction and then falls off sharply (c 1/10 gradient) towards the eastern boundary. A site survey drawing is included in the application and can be viewed as background on the drawing RMA Dwg.No.2104/01 & 02.

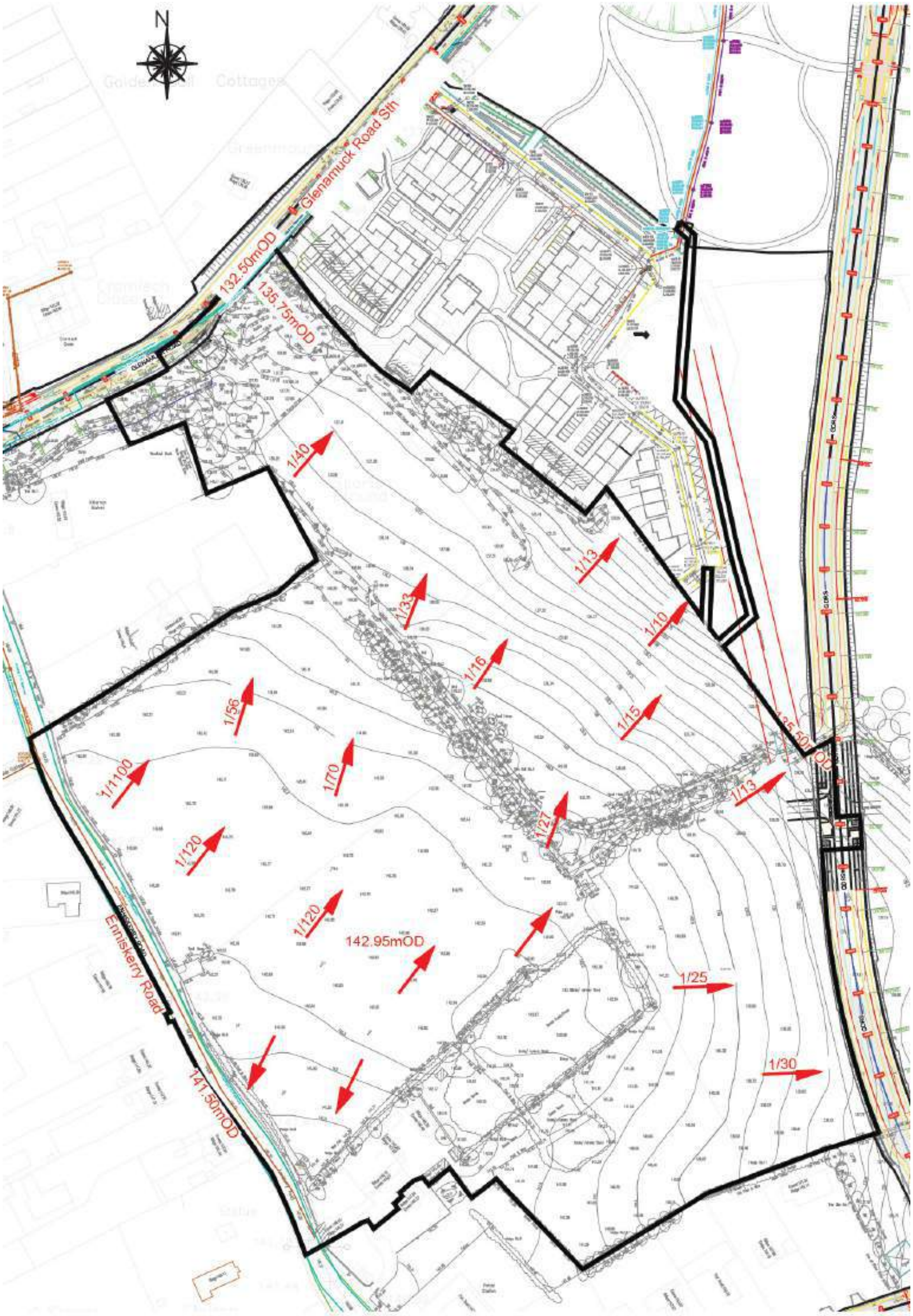


Fig.2 - Topography

3.4 The site is bounded by a c.1.2m high existing stone wall to the west (Enniskerry Rd), by hedgerows/trees to the northwest and north, by the Glenamuck Road to the far north, by an existing stone wall onto the Rockville development (Reg.Ref.D17A/0793 & D18A/0566 & D20A/0015) to the northeast, by open green field and the future Glenamuck Link Distributor Road (GLDR) as part of the Glenamuck District Roads Scheme (GDRS) to the east and by hedgerow and a petrol station and detached house rear gardens along the southern boundary.

3.5 The GLDR as part of the GDRS will bound the subject lands to the east and along the upgraded Glenamuck Road to the north of the site.

3.6 Consultations between the applicants and their agents with the Dun Laoghaire Rathdown County Councils (DLRCC) GDRS project team have taken place over several years. The interface between the GDRS and the proposed Kilternan Village development has been identified on the application drawings and land transfers between the applicant and DLRCC have been agreed to facilitate the GDRS project.

3.7 Road access from the Kilternan Village land and the GLDR has been facilitated in the contract documents of the GDRS, the detail of which is the included in this planning application and is subject to a successful grant of planning under the SHD process. Refer to the MCORM Architects and Atkins Ireland Traffic & Transportation consultants' drawings and documentation included in this application for more detail.

3.8 Drainage and water supply infrastructure included in the GDRS project have been designed by DLRCC to facilitate future connections to the subject Kilternan Village lands subject to a successful grant of planning for this subject sites proposed development.

3.9 A Road & Block levels drawing has been prepared as part of this application and reference should be made to Dwg.No.2014/01 & 02 in this regards. Generally, the proposed road levels and house levels follow the existing contours of the site topography.

3.10 Proposed road gradients vary between 1/120 (0.83%) and 1/20 (5.0%) which are in accordance with the DOELG Recommendations for Site Development Works for Housing Areas and the Dept. Of Transport's Design Manual for Urban Roads and Streets (DMURS) documentation.

3.11 Private house surface water drainage is limited to 8No.units per pipe run and is to be in accordance with the DOELG Recommendations for Site Development Works for Housing Areas.

3.12 Private foul water drainage is to be in accordance with the Irish Water Code of Practice for wastewater Infrastructure 2020 which requires individual house connections to each dwelling.

3.13 The site zoning is classified as Zoning Objective NC (Mixed Use/Neighbourhood Centre) along the Enniskerry frontage and as Zoning Objective A (Residential Protect/Improve) on the remainder of the lands.

4.0 Existing Drainage & Water Services

4.1 Records drawings were obtained from Irish Water(IW)/DLRCC in preparation for this planning application and are included in the appendix of this document.

4.2 There are no known public drainage services on the subject lands. There are 2No.derlicit/unused old septic tanks on the site to be removed.

4.3 The proposed development will have 2No.surface water and 2No.foul water connection outfall points.

4.4 Approximately 9.63 Ha of the proposed developments drained S/W drainage will outfall the attenuated flow into the existing piped infrastructure constructed as part of the existing Rockville development (D17A/0793) to the NE of the subject site. This connection point of the attenuated flow will be downstream of the existing Rockville attenuation system into the existing 300mm S/W pipe. This existing pipe currently outfalls into the Glenamuck Road roadside watercourse. Refer to Dwg.2104/05 for further detail.

4.5 Located in the north corner of the subject site (apartment Blocks C & D), approximately 0.29Ha of the proposed developments drained S/W area will outfall the localised attenuated flow into the S/W drainage infrastructure to be provided as part of the GDRS project in Glenamuck road. The S/W drainage connection spur into the GDRS infrastructure has been agreed with the DLRCC GDRS project office and is incorporated into that road project. Refer to Dwg.2104/03 for further detail.

4.6 The main (324No.units and the NC) proposed foul outfall from of the subject site will be via the existing piped foul drainage system constructed as part of the Rockville schemes (D17A/0793 and D18A/0566). This existing infrastructure in turn outfalls downstream into the existing Irish Water owned 300mm foul drainage piped infrastructure on Glenamuck Road. Refer to Dwg.2104/07 for further detail. As this connection portion of the existing foul sewer is not yet in the charge of

Irish Water, a letter of consent for the connection has been provided and is included in the appendix of this report.

4.7 Located in the north corner of the subject site, 59No.units (apartment Blocks C & D) of the proposed development will outfall the localised foul flow into the foul drainage infrastructure to be provided as part of the GDRS project in Glenamuck Road. The foul drainage connection spur from the GDRS infrastructure has been agreed with the DLRCC GDRS project office and is incorporated into that road project. Connection into the spur is subject to a successful planning permission and has been agreed with Irish Water. Refer to Dwg.2104/07 for further detail.

4.8 The proposed developments potable drinking water supply connections will be into the existing 300mm Irish Water watermain in Enniskerry Road fronting the site and the existing 250mm watermain in the Glenamuck Road as requested by Irish Water. Refer to Dwg.2104/09 & 10 for further detail.

5.0 Key Design Reference Documents

5.1 As part of the design of the storm water network and SuDS components, the following documentation were the principal references;

- Dun Laoghaire Rathdown County Development Plan 2022 – 2028
- Kilternan/Glenamuck Local Area Plan 2013
- CIRIA Report c753 "The SuDS Manual" 2015
- Greater Dublin Strategic Drainage Study (GDSDS) 2005
- DLRCC Stormwater management Policy
- The Greater Dublin Regional Code of Practice for Drainage Works
- DOELG Recommendations for Site Development Works for Housing Areas.
- DLRCC Drainage Records maps
- Available OPW flood maps and reports (from *floodmaps.ie*)
- DLRCC Carrickmines/Shanganagh River Catchment Study
- OPW Eastern CFRAM study
- OPW PFRM mapping
- Geological Survey of Ireland (GSI) website
- Teagasc soils data sets
- Ordnance Survey mapping
- Topographical survey
- Site Investigation reports
- Site walkover visits
- Discussions with DLRCC Drainage Department

6.0 STORMWATER IMPACT ASSESSMENT

6.1 The design of the storm water network has been carried out in accordance with and in conjunction with the requirements of Dun Laoghaire Rathdown County Councils Drainage Department as were ascertained in meetings, phone calls and email communications as part of the pre-planning process. During the Pre-App Stage 2 process, a full set of RMA documentation and drawings were submitted to the Drainage Department of DLRCC for their review. The Stage 2 pre-application review carried out by the DLRCC Drainage Department noted their observations as published in Appendix B (dated 07/12/21) of the DLRCC "*Report of Chief Executive Strategic Housing Development*" submission to An Bord Pleanala. The following is a summary of the observations and response to same;

Drainage Planning Report

Surface Water Drainage

1 *.There are significant areas of the site that do not undergo any level of interception/treatment via SuDS measures at source. There is an overreliance on gullies, pipes and cellular storage. Given the size of this site, there is ample opportunity to provide soft SuDS measures. The applicant should note that over-provision in one location does not compensate for under provision elsewhere and that attenuation systems and bypass interceptors are not considered SuDS features. The applicant is requested to revisit their SuDS proposals and maximise the use of SuDS across the site, utilising the existing vegetated areas in their design and incorporating more significant SuDS features than those currently proposed. The applicant must show the options being proposed for interception and treatment with contributing areas on a drawing together with the accompanying text and tabular submission to demonstrate that the entire site is in compliance with GDSDS requirements.*

Applicants Response

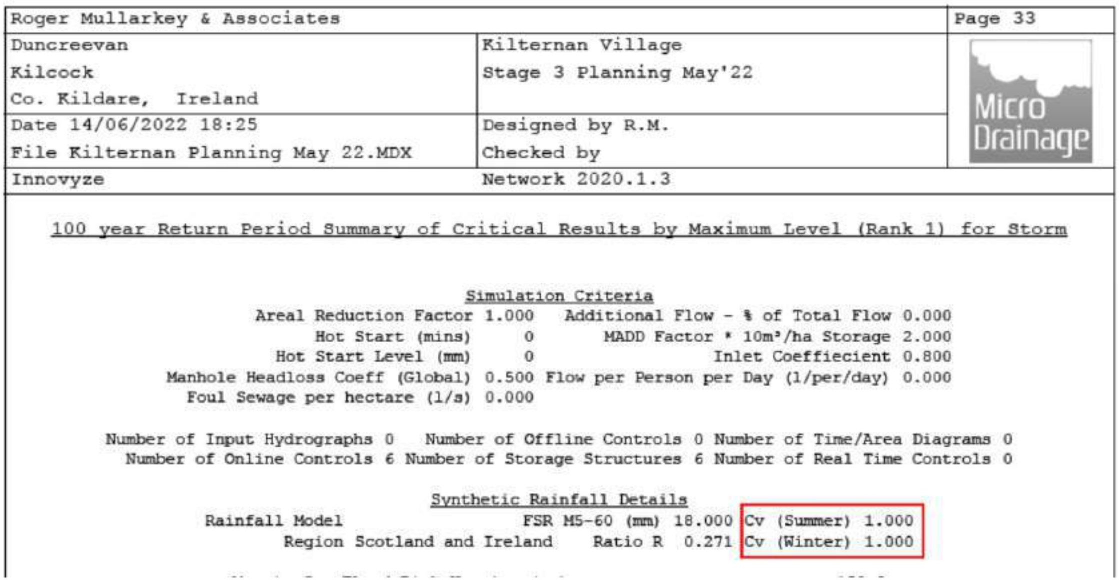
The quantity of the SuDS elements have been increased significantly and are highlighted on Dwg.No.2104/14 included in the submission. In summary there are 41No.tree pit elements, 29No.swales, 4No.bio-retention areas, 2,703m^2 of Extensive Green Roof, 2,849m^2 of Intensive Green Roof, c.1,136m of filter drains,c.10,900m^2 of permeable paving and 172No.200l rainwater butts. Sections/Details of these SuDS elements are illustrated on Dwg.2104/14 and the design of same is included in the appendix of this report. Interception volumes greater than that required in accordance with the GDSDS have been achieved and are identified/summarised on

Dwg.No.2104/13. Interception to the overall drained area catchment and sub-catchment areas are identified on that drawing and typical calculations for same are included in the appendix of this report.

2. *It should be noted that Microdrainage has default Cv values of 0.84 for Winter and 0.75 for Summer. These should be amended to a value of 1.0, particularly where applicants are proposing reduced PIMP (%) values. Maintaining the default Cv values reduces run-off in simulations of rainfall events, giving inaccurate simulation results which may lead to under sizing of the drainage system and attenuation storage. The applicant is requested to resub it their Microdrainage results with Cv values set to 1.0. The applicant shall confirm the suitability of the proposed reduced run-off rates (PIMP values) and SAAR prior to submission. The applicant shall also identify in the Microdrainage report where the outflow values from upstream catchments input into the downstream attenuation storage volume calculations.*

Applicants Response

The Cv values are set to 1.0 in Microdrainage and are visible in the calculations included in the appendix of this report, as per below;



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Roger Mullarkey & Associates                                           Page 33
Duncreevan                          Kilternan Village
Kilcock                             Stage 3 Planning May'22
Co. Kildare,  Ireland
Date 14/06/2022 18:25               Designed by R.M.
File Kiltnernan Planning May 22.MDX Checked by
Innovyze                            Network 2020.1.3

  100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

                                   Simulation Criteria
            Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                  Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
               Hot Start Level (mm)    0                   Inlet Coeffiecient 0.800
      Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
          Foul Sewage per hectare (l/s) 0.000

    Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
      Number of Online Controls 6 Number of Storage Structures 6 Number of Real Time Controls 0

                                  Synthetic Rainfall Details
        Rainfall Model                   FSR M5-60 (mm) 18.000 Cv (Summer) 1.000
                 Region Scotland and Ireland     Ratio R  0.271 Cv (Winter) 1.000
```

3. *The applicant is requested to confirm if bypass separators are required, as interception/treatment should be provided via SuDS across the site prior to discharge to attenuation systems. If they are deemed necessary, they should be provided prior to the attenuation system.*

Applicants Response

Notwithstanding the inclusion of the substantial quantity of the SuDS features in the design (Section 7 of this report), it is considered infeasible to capture 100% of every surface runoff prior to entering the final attenuation system on the site. Consequently, it is proposed to include a bypass separator upstream of SMh25 & SMh87 as a prudent measure to capture any possible deleterious elements prior to outfall from the site. This is a somewhat conservative effort and is the interests of safe best practice.

4. *The applicant is dependant on a lengthy connection through third party lands to connect their outfall to the watercourse. The applicant will need to prove that this connection is technically feasible. The applicant will also be required to submit a draft wayleave agreement in favour of Dun Laoghaire-Rathdown County Council for any section of the proposed public surface water infrastructure that is to be located in lands not to be taken in charge or not in the applicants' ownership. Any such proposed wayleave agreement should be accompanied by a supporting drawing showing the dimensioned route of the sewer, which shall not be less than 6.0m in width.*

Applicants Response

The main S/W outfall route proposed to the NE of the site is 216m long containing 6No. offsite manholes and is detailed on dwg.2104/05. Longitudinal sections of same are shown on Dwg.2104/23 with gradients ranging between 1/20 – 1/60. There will be a limited attenuated flowrate of 42.4l/s into this 300mm diameter outfall pipe. Standard hydraulic tables note the capacity of a 300mm diameter pipe to be c.150l/s at a gradient of 1/60 and therefore the limited maximum flowrate of 42.4l/s is less than 30% of the pipe capacity. Approximately 203m (or 94%) of this S/W outfall pipe is contained within lands in the ownership of the applicant and c.13m (c.6%) and 1No.Mh are in lands outside the applicant's ownership. Letters of consent/wayleave from the current owner of the land in which the 13m section of pipe is to be laid are included in the appendix of this report.

The existing 300mm diameter pipe is the main S/W outfall for the existing and permitted Rockville schemes. The capacity of this existing 300mm diameter pipe is primarily governed by the gradient at which it is laid and it can be seen from the as-constructed level survey (refer to Dwg.2104/05) that the existing pipe gradients are generally 1/40 and 1/60 but with one portion near the end of the pipe into the public road (Glenamuck Rd.) at a gradient of 1/300.The capacity of the pipe @ 1/60 gradient is c.150l/s and @ 1/300 is c.60l/s.

This existing 300mm diameter S/W outfall pipe from Rockville Ph1 currently drains the already attenuated flows from the substantially completed Rockville 1 & Rockville 2 (Reg.Ref. D18A/0566) projects at a total restricted flowrate of c.4.5 l/s. There is also a permitted Rockville apartment development (Reg.Ref.D20A/0015), which is in the ownership of the Applicant, yet to be commenced that has an additional attenuated flowrate of c.2.5 l/s to be drained into the existing 300mm pipe. Therefore, there is an already allowed maximum c.7l/s flowrate into this existing 300mm outfall pipe.

Upon completion of all development serviced by this pipe, the maximum possible flowrate from the Kilternan Village site plus the existing /permitted Rockville sites will be 42.4+7= 49.4l/s which is less than the localised c.60l/s capacity.

It is important to note that this existing 300mm S/W pipe flows through open parkland that is to become part of the approved DLRCC *Glenamuck Park* Part 8 scheme which incorporates the GLDR/GDRS regional attenuation pond and does include the diverting of the existing S/W pipe into that pond as part of that project. This will remove both the 1/60 and the 1/300 gradient sections of the existing pipe therefore leaving the existing 1/40 gradient as the predominant capacity governor. Using standard hydraulic tables, a 300mm diameter S/W pipe at a gradient 1/40 has a capacity of c.180l/s which is far greater than the 49.4l/s maximum possible flow coming from all the upstream fully developed sites, including the subject application lands.

For clarity the applicant has full rights of access over/under this strip of land and can confirm that should a planning permission be granted the Applicant has the ability to deliver the services and ancillary works required to implement the designed scheme in full. Letters of consent relating to connection to services and crossing lands not in the Applicants ownership are included in the Appendix 12.15 of this report.

5. *The applicant is requested to submit the complete Site Investigation Report and results, including Infiltration tests, and a plan showing the trial pits/soakaway test locations across the site. The report should address instances where ground water, if any, were encountered during testing and its impact.*

Applicants Response

SI reports are included in the appendix of this report and include locations of the trial pits/soakaway testing. No ground water above c.2.5m was encountered during the testing which was carried out in different time periods.

6. *As standard, the applicant is requested to provide details of maintenance access to the green roofs and should note that, it the absence of a stairwell type access to the roof, provision should be made for alternative maintenance and access arrangements such as external mobile access that will be centrally managed. A detailed cross section of the proposed build-up of the green roof should be provided, including dimensions. The applicant should comment on the compatibility of the green roof with PV panels if they are to be incorporated into the design.*

Applicants response

Access for maintenance of the green roofs will be via the internal building stairwells and a roof hatch over. Detailed cross sections of the proposed roof build-up are included in the main body and the appendix of this report as well as shown on Dwg.No.2104/14 included in the submission. PV panels do not form part of this application.

7. *As standard, the applicant is requested to provide a penstock in each flow control device chamber.*

Applicants Response

A penstock is provided in each flow control device chamber as detailed on Dwg.No.'s 2104/14 & 20.

8. *As standard, the applicant is requested to submit supporting standard details including cross-sections and long-sections, and commentary that demonstrates that all proposed SuDS measures have been designed in accordance with the recommendations of CIRIA 753 (The SuDS manual), specifically Section 36 regarding Health and Safety.*

Applicants Response

A full suite of sections/details of the SuDS components in accordance with the SuDS manual are included in the man body of this report and on Dwg.2104/14. Calculations for same are included in Appendix 12.3 of this report. Longitudinal sections of the S/W infrastructure are shown on Dwg.No.'s 2104/23-26.

9. *If the applicant proposes SuDS measures that incorporate the use of infiltration, the applicant is requested to provide details of each SuDS measure and confirm weather it will be lined/tanked or not. If lined/tanked systems are to be used, the applicant will be requested to explain the rationale behind this. If unlined systems are to be used then the applicant is requested to demonstrate on a drawing that all infiltration SuDS proposals, including the attenuation systems have a 5m separation distance from building foundations and 3m separation from site boundaries.*

Applicants Response

The SuDS measures proposed do not rely on infiltration due to the unsuitable infiltration results obtained from the soakaway tests. Separation above noted separations distances of 3 and 5m respectively are achieved and are demonstrated on Dwg.No.'s 2104/03 & 04.

10. *As standard, the applicant is requested to confirm that a utilities clash check has been carried out ensuring all utilities' vertical and horizontal separation distances can be provided throughout the scheme. The applicant should demonstrate this with cross-sections at critical locations such as junctions, site thresholds and connection points to public utilities. Minimum separation distances shall be in accordance with applicable Code of Practice.*

Applicants Response

Cross sections of the proposed utilities are shown on Dwg.No.2104/16 & 17 and crossing separation distances have been achieved as demonstrated on Dwg.No.'s 2104/23-30 inclusive.

11. *A Stormwater Audit will be requested for this application. In accordance with the Stormwater Audit policy, the audit shall be forwarded to DLRCC prior to lodging the planning application. All recommendations shall be complied with, unless agreed in writing otherwise with DLRCC.*

Applicants Response

In advance of submission of the main planning application and in accordance with the requirements of the Stormwater Management Policy of the DLRCC County Development Plan 2022-2028, a Stormwater Audit has been carried out by Punch Consulting Engineers for the proposed development, was submitted to DLRCC Drainage Department and is included in Appendix 12.6 of this report.

Site Specific Flood Risk Assessment 1. *The applicant has submitted a drawing identifying overland flow routes both within and without the site. The applicant is requested to provide further detail on this drawing of any drop kerbs/ramps/boundary treatments required at significant locations and should detail how properties, both within the development and on adjacent lands, will be protected in the event of excessive overland flows.*
Applicants Response Details relating to excessive overland flows are shown on drawing No.2104/12 including details of dropped kerbs as requested. All house floor levels on the site are greater than 500mm above the top water flood levels for the 100 year plus 20% climate event in compliance with the GDSDS.

6.2 The existing site topography generally slopes from the Southwest towards the Northeast. That is, the ground falls away from the Enniskerry Road towards the Glenamuck Road South. There is an existing open roadside ditch along the northern edge of Glenamuck Road.

6.3 There is a drop in level across the land by c.10.2m from the highest point on the site (143.07mOD) to the lowest (c.132.85mOD).

6.4 The general topography outside the application site and the surrounding lands is downwards towards the Glenamuck Road and the adjacent roadside ditch.

6.5 Replicating the natural characteristics and providing amenity/biodiversity has been achieved in the SuDS elements included in this application. A full SuDS treatment train approach has been implemented in accordance with the CIRIA SuDS Manual as described in detail in Chapter 7 of this report, summarised as follows;

- Filter drains to the rear of the housing (c.1,135m)
- Permeable paving to all parking spaces (c.10,900m^2)
- Rainwater butts (200l) to the rear downpipes (172No.)
- Swales adjacent to roadways where practically feasible (29No.)
- Tree pits where practically feasible (41No.)
- Extensive Green Roof (2,703m^2)

- Intensive Green Roof (2,849m^2)
- Bio-Retention area (4No.)
- Silt-trap/catchpit manholes (6No.)
- Hydrobrakes limiting flow to the drained area Qbar greenfield rate
- Petrol interceptor upstream of SMh25 & Smh87
- Stone lined voided arch retention storage devices

6.6 Due to the site topography on the site there are 2No.seperate surface water outfalls proposed for the development, namely 1 and 2. Outfall 1 flows into the existing piped infrastructure constructed as part of the recent Rockville development (D17A/0793) to the NE of the subject site. Outfall 2 (Phase 3 of the proposed development) is located in the north corner of the subject site towards the Glenamuck Road into the S/W drainage infrastructure to be provided as part of the GDRS project in Glenamuck Road. Subject to a successful planning application, the S/W drainage connection spur into the GDRS infrastructure has been agreed with the DLRCC GDRS project office and is incorporated into that road project.

6.7 The Outfall 1 pipe will pass through the adjacent lands to the northeast, the vast majority of which (203m of 216m) is in the ownership of the applicant. The final 13m of Outfall 1 lies outside the applicants ownership but consent from the current landowner has been obtained and letters of consent to connect into the infrastructure and cross over the lands are included in Appendix 12.15 of this report. For clarity the Applicant has full rights of access over/under this strip of land and can confirm that should a planning permission be granted the Applicant has the ability to deliver the services and ancillary works required to implement the designed scheme in full. Letters of consent relating to connection to services and crossing these lands are included in the Appendix 12.15 of this report.

6.8 This connection point of the attenuated flow will be downstream of the existing Rockville attenuation system into the existing 300mm S/W pipe. This existing pipe currently outfalls into the Glenamuck Road roadside watercourse and is to be diverted into the regional attenuation pond located beside the Glenamuck Road/GDRS junction as part of the DLRCC GLDR/GDRS roads project and will in effect be in the ownership of DLRCC. Refer to Dwg.2104/05 for layout of the 300mm Outfall 1 pipe and longitudinal sections of same on Dwg.2104/23 for further detail.

6.9 Outfall 1 caters for the vast majority, 9.63Ha of the total 9.92Ha of the developments drained area, while Outfall 2 caters for 0.29Ha of the drained area.

6.10 There have been pre-planning consultations with DLRCC in relation to the GDRS project as well as meetings/discussions with the GRDS consultant engineers (DBFL) to discuss any interface between the roads project and this subject application, with specific attention to drainage services and access arrangements.

6.11 It was confirmed by DLRCC consultants that GDRS infrastructure has been designed to cater for the attenuated run-off from the Kilternan Village lands and that the regional pond in that project has capacity to intercept and store the S/W outfall from the subject site. All drainage connections to the upcoming GDRS project are subject to a successful grant of this subject planning application.

6.12 Correspondence relating to the above interface is included in Appendix 12.17 of this report.

6.13 The surface water drainage design has been carried out in accordance with the Greater Dublin Regional Code of Practice, the GDSDS and the CIRIA Report c753 “The SuDS Manual” 2015. A SuDS treatment train and attenuation are included in the design. A Stage 1 SuDS audit has been completed by Punch Consulting Engineers and submitted to DLRCC Drainage Department in accordance with the Stormwater Management Policy. The audit also included the Surface Cover Type table from Section 7.1.5 of the DLRCC County Development Plan 2022-2028. Refer to Appendix 12.6 for the SuDS audit report.

6.14 As is recommended in the DLRCC Stormwater Management Policy, the HR Wallingford UKSuDS Greenfield runoff rate estimation tool was used to calculate the Qbar for the site. The overall S/W outfall rate from the proposed development has been calculated using the drained site area of 9.92Ha (not the application “*redline*” area). **Qbar** was determined to be **= 44.2l/s** . The HR Wallingford Qbar calculations are included in Appendix 12.5 of this report. The soil type used in the calculation has been determined to be Type 3 as is discussed in detail in Chapter 8 of this report. Refer to Appendix 12.5 for a copy of the Qbar calculation. Refer also to Dwg.2104/13 for a summary of the catchment and drained paved areas.

6.15 The surface water drainage infrastructure for the development will collect the rainfall on the site and convey the storm water run-off via roadside swales, rear garden filter drains, tree pits, bio retention areas, gullies, underground pipes, manholes, silt -traps and direct the flows via void arched attenuation systems and a petrol interceptor towards vortex flow restricting devices, Hydrobrake or similar.

6.16 As outlined above, the S/W infrastructure has been divided into 2 catchment areas, namely 1 & 2. Catchment 1 is large (c.9.63Ha drained area) draining to Outfall 1 and Catchment 2 is small (c.0.29Ha drained area) draining to Outfall 2. Refer to Dwg.No.2104/13 for further detail and to Fig.3 below for an extract of same;

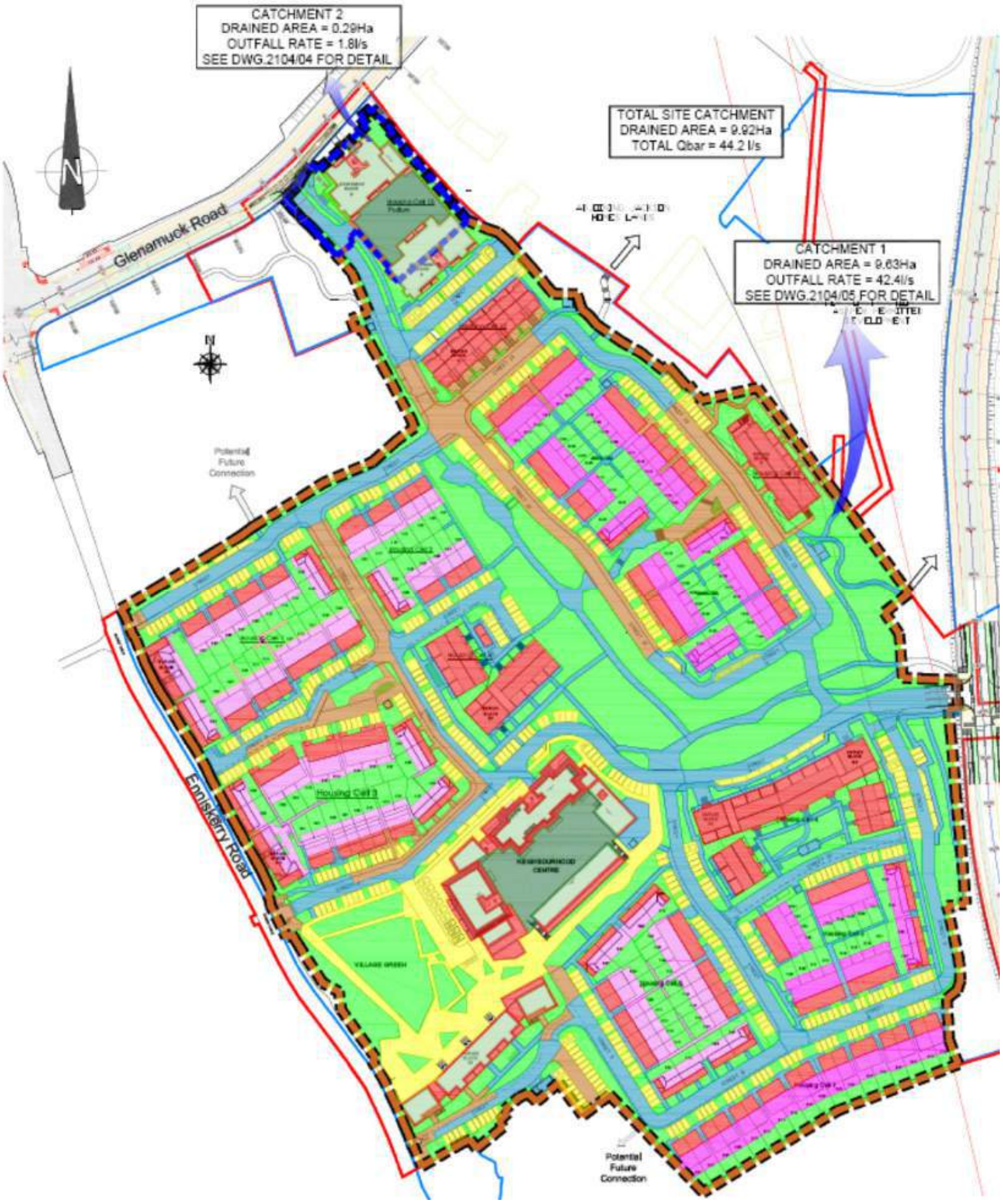


Fig.3 – Catchment Locations – ex.Dwg.2104/13

6.17 The larger Catchment 1 contains 5No.sub-catchments (A/B/C/D/E) each with an attenuation tank that connect in series, each of which has the flowrates restricted as shown in Table 2 before discharging to Outfall 1 in Rockville. The smaller Catchment 2 contains 1No.privately maintained attenuation tank upstream of outfalling into the Glenamuck Road upgraded S/W system as part of the GDRS project. The total site Qbar is divided between the 2No. site outfalls as per Table 1 below. The attenuated outfall rates from the sub-catchments A to E are divided to suit the drainage design and available space for attenuation tanks and separate the larger Catchment 1 into manageable interception zones.

CATCHMENT 1 & 2 SUMMARY				
	GROSS SITE AREA (Ha)	**Catchment No.**	**DRAINED AREA (Ha)**	**Outfall rate Applied (l/s)**
	10.8	1	9.63	42.4
		2	0.29	1.8
TOTALS	**10.8 Ha**		**9.92 Ha**	**44.2 l/s**

Table 1 – Catchment Summary

SUB-CATCHMENTS OF 1		
Sub-Catchment	**DRAINED AREA (Ha)**	**Outfall rate Applied (l/s)**
Main Outfall A	4.20	**42.4**
B	2.16	3
C	2.07	19
D	0.80	4
E	0.4	2
TOTALS	**9.63**	

Table 2 – Sub-Catchments Summary

6.18 Catchment 1 has 5No. attenuation tanks in total arranged as follows;

Tanks 4 & 3 are connected in series and in turn drain down to the main tank No.1.

Tanks 5 & 2 are connected in series and in turn drain down to the main tank No.1.

Attenuated flow from Tank 1 drains through the applicants lands and then outfalls into the into the existing Rockville Ph1 (Reg.Ref.D17A/0793) 300mm diameter outfall pipe across parkland. Noting that the existing S/W pipe is to be diverted into the regional attenuation pond as part of the GRDS project. This area is under the approved DLRCC Part 8 scheme known as as *Glenamuck Park*.

6.19 The outfall pipe from Catchment 1 proposed to the Northeast of the site is 216m long containing 6No. offsite manholes and is detailed on Dwg.2104/05. Longitudinal sections of same are shown on Dwg.2104/23 with gradients ranging between 1/20 – 1/60. There will be a limited attenuated flowrate of 42.4l/s into this 300mm diameter outfall pipe. Standard hydraulic tables note the capacity of a 300mm diameter pipe to be c.150l/s at a gradient of 1/60 and therefore the limited maximum flowrate of 42.4l/s is less than 30% of the pipe capacity.

6.20 Approximately 203m (or 94%) of this S/W outfall pipe is contained within lands in the ownership of the applicant and c.13m (c.6%) and 1No.Mh are in lands outside the applicants ownership. A wayleave agreement is in place between the Applicant and the current owner of the land in which the 13m section of pipe is to be laid and copies of the letters of consent are included in the appendix of this report. It is important to note that this existing 300mm S/W pipe flows through open parkland that is to become part of the approved DLRCC Part 8 *Glenamuck Park* and the GLDR/GDRS open space, will be in the ownership of DLRCC, and is to be diverted into the regional attenuation pond as part of that project. Discussions with DLRCC's consultant engineers for the GDRS have confirmed that capacity to drain the Kilternan Village lands have been included in regional ponds.

6.21 This existing 300mm diameter S/W outfall pipe from Rockville Ph1 currently drains the already attenuated flows from the substantially completed Rockville 1 & Rockville 2 (Reg.Ref. D18A/0566) projects at a total restricted flowrate of c.4.5 l/s. There is also a permitted Rockville apartment development (Reg.Ref.D20A/0015 in the ownership of the Applicant) yet to be commenced that has will have additional attenuated flowrate of c.2.5 l/s to be drained into the existing 300mm pipe. Therefore, there is an already allowed maximum c.7l/s flowrate into this existing 300mm outfall pipe.

6.22 The proposed Kilternan Village Catchment 1 maximum outfall is proposed at 42.4 l/s. Upon completion of all development serviced by the existing Rockville 300mm pipe, the maximum possible flowrate from the Kilternan Village site plus the existing /permitted Rockville sites will be 42.4+7= 49.4l/s.

6.23 The capacity of the existing Rockville outfall 300mm diameter pipe is primarily governed by the gradient at which it is laid and it can be seen from the as-constructed level survey (refer to Dwg.2104/05) that the existing pipe gradients are generally 1/40 and 1/60 but with one portion near the end of the pipe into the public road (Glenamuck Rd.) at a gradient of 1/300.The capacity of the pipe @ 1/60 gradient is c.150l/s and @ 1/300 is c.60l/s.

6.24 Therefore, the maximum flowrate from the Kilternan Village site and the existing/permitted Rockville sites of 49.4l/s is less than the localised c.60l/s capacity.

6.25 It is relevant to note that this existing 300mm S/W pipe flows through open parkland that is to become part of the GLDR/GDRS open space (DLRCC *Glenamuck Park* Part 8), in the ownership of DLRCC, and is to be diverted into the regional attenuation pond as part of that project. This will remove both the 1/60 and the 1/300 gradient sections of the existing pipe therefore leaving the existing 1/40 gradient as the predominant capacity governor. Using standard hydraulic tables, a 300mm diameter S/W pipe at a gradient 1/40 has a capacity of c.180l/s which is far greater than the 49.4l/s maximum possible flow coming from all the upstream fully developed sites, including the subject application lands.

6.26 Catchment 2 for the proposed Kilternan Village site has a drained area of 0.29Ha and is contained within the apartment Blocks C & D bounding onto the Glenamuck Road to the north of the proposed development. Flowrate from this catchment is to be attenuated and outfall into the new S/W infrastructure to be constructed as part of the GDRS. A spur connection from the GDRS S/W drainage is to be provided by DLRCC to facilitate Phase 3 of this application of these Kilternan Village lands and connection into same is subject to a successful planning permission. Refer to Appendix 12.15 for letters of consent relating to lands not in the Applicants ownership.

6.27 Correspondence relating to the above interface is included in Appendix 12.17 of this report.

6.28 The proposed development is to be phased as 1, 2, 2A, 3, 4 & 5. The extent of each phase and the main water/drainage infrastructure associated with each phase is identified on Dwg.No.2104/18. All main drainage/water services necessary to serve each phase are to be completed in full in each area from the head of the system to outfall.

6.29 The SuDS management train approach to designing the storm water network has been applied for this development and is specifically discussed in Chapter 7.

6.30 Downstream of the SuDS elements, the retained storm water flows will be stored in a combination of an underground systems, such as the StormTech MC4500 system. As part of the pre-planning process, these proposals have been discussed and submitted to DLRCC Drainage

Department and have been agreed with in principle. Refer to Dwg.No.'s 2104/14 & 15 for SuDS and attenuation Storage details.

6.31 The MicroDrainage software was used to generate drainage simulation models for storm events for 1 year, 30 year and 100 year return events over multiple time periods. In accordance with the DLRCC Stormwater management Policy, an allowance for an increased rainfall due to climate change of 20% was applied in the drainage design model. Furthermore, the Cv values are set to 1.0 in Microdrainage software model and are visible in the calculations included in Appendix 12.1 of this report.

6.32 As part of the assessment for blockages in the system, the MicroDrainage design model was run on the basis that there was a near 100% blockage of the outfall vortex control devices for a 30 minute period. Therefore, the model was run with a reduction in the outfall rates from each of the 6No. Hydrobrakes down to 0.1 l/s for a 30min duration in the Q100 + 20% event. These resulting volumes and top water level are contained beneath the ground level and no flooding was noted. Refer to Appendix 12.1 for these calculation results.

6.33 As noted in the DLRCC Stormwater Management Policy document, an allowance for 10% Urban Creep is required in the drainage calculations. This allowance has been applied in the model by increasing the drained paved area to the rear of the houses by more than 20% of the roof area draining to the rear of the houses. This additional area has been applied across all houses in the scheme to take account for possible house extensions in the future. Refer to Dwg.No.2104/13 for details of same.

6.34 In accordance with the Greater Dublin Regional Code of Practice for Drainage Works (GDSDS) and in consultation with DLRCC drainage Department and in accordance with the DLRCC Stormwater Management Policy, the surface water drainage infrastructure was designed to the parameters as outlined in Table 3 below;

Time of entry	**4mins**
Return periods for pipework	2 years- no surcharge
	Q30 15min no flooding
	Q100 15min – storage in designated areas only
Climate Change	20%
Allowance for Urban Creep	10%
Min.velocity	0.75m/s
Max.velocity	3m/s
Min.sewer size for TIC	225mm diameter
Pipe friction (Ks)	0.6mm
Minimum pipe depth	1.2m below roads 0.9m in open/grassed spaces
Standard Annual Average Rainfall (SAAR)	1003mm (Met Eireann data)
M5-60	18mm
Ratio r (M5-60/M5-2Day)	0.271
SPR Value	0.37
Total Site Outfall Rate	**Qbar = 44.2 l/s** (based on HR Wallingford Qbar – refer Chapter 8) and split between Outfall 1 = 42.4 l/s & Outfall 2 = 1.8 l/s
Attenuation storage	Q30 – no flooding on site Q100 – flooding on site, 500mm freeboard to FFLs of houses, flood routing plan.
Paved Area Runoff percentage	100% from roofs to drains 95% from roads and paths not drained to SuDS features 92% from Extensive Green Roofs 85% from Intensive Green roofs 71% from roads and paths drained to SuDS filter swales 70% roof runoff and private path drained via rear garden filter drains 60% parking permeable paving areas and locally drained paths 37% grassland

Table 3 – S/W Design Parameters

6.35 In accordance with best practice, the internal drainage system has been designed as a completely separate foul and surface water system.

6.36 The freeboard between each separate storage tank top water level (TWL) and the lowest level house floor slab draining to that tank is greater than the GDSDS minimum of 0.5m. A summary of the freeboards is given in Table 4 below;

FREEBOARD SUMMARY				
Tank No.	TWL (mOD)	FFL (mOD)	Freeboard (m)	Pass/Fail
1	133.44	134.25	0.81	PASS
2	136.47	139.35	2.88	PASS
3	140.48	142.25	1.77	PASS
4	141.60	142.45	0.85	PASS
5	141.06	141.75	0.69	PASS
6	133.13	136.00	2.87	PASS

Table 4 - Freeboard Summary

6.37 In accordance with the GDSDS, the four principal design criteria as set out in section 6.3.4 of Volume 2 are summarized as follows;

- ○ **Criterion 1** - River water quality protection
- ○ **Criterion 2** – River regime protection
- ○ **Criterion 3** – Level of service (flooding) for the site
- ○ **Criterion 4** – River Flood protection

6.38 **Criterion 1** has been complied with by inclusion of **Interception** of at least 5mm of rainfall to prevent runoff to the receiving water. Interception has been calculated for each sub-catchment A-E of Catchment 1 as well as Catchment 2. As per the GDSDS guidelines, the interception is to capture the first 5mm of rainfall from 80% of Paved Drained Area.

6.39 Interception will achieved be within the voids of the stone base of the permeable paving, in the stone below the filter drain pipework, in the tree pits, swales, bio-retention areas, in the green roof systems and in the stone base of the attenuation storage. As per the parameters laid out in the GDSDS the interception volume was calculated and is summarised in the following tables 5 & 6. Refer to Appendix 12.2 for detailed calculations.

INTERCEPTION SUMMARY TABLE*															
MAIN CATCHMENT REFERENCE	SUB-CATCHMENT REFERENCE	DRAINED PAVED AREA (Ha)	INTERCEPTION REQUIRED (m³) *Area x 0.8 x 5mm	VOIDS IN STONE BELOW SuDS ELEMENT (m³)			TREE PITS (m³)	SWALES (m³)	BIO-RETENTION (m³)	GREEN ROOF (m³)		Rainwater Butts (200l) (m3)	SUB-CATCHMENT INTERCEPTION PROVIDED (m³)	SUB-CATCHMENT INTERCEPTION REQUIRED (m³)	PASS/FAIL
				TANK	PERMEABLE PAVING	FILTER DRAINS				EXTENSIVE	INTENSIVE				
1	A	2.92	116.80	180.00	127.13	30.96	12.50	7.43	0.00	0.00	0.00	12.20	370.2	116.80	PASS
	B	1.57	62.64	135.00	105.57	30.02	17.50	2.11	0.00	0.00	0.00	12.60	302.8	62.64	PASS
	C	1.84	73.48	69.84	178.83	6.62	15.00	1.38	5.00	43.90	97.30	5.00	422.9	73.48	PASS
	D	0.69	27.52	45.00	30.38	14.18	5.00	0.51	0.00	0.00	0.00	4.20	99.3	27.52	PASS
	E	0.37	14.80	11.52	48.60	0.00	1.25	0.76	0.00	0.00	46.48	0.40	109.0	14.80	PASS
2		0.21	8.52	14.04	0.00	0.00	0.00	0.51	0.00	31.78	55.65	0.00	102.0	8.52	PASS

*Refer to detailed calculation tables for each sub-catchment in main report appendix

Table 5 – Sub-Catchment Interception Summary

INTERCEPTION SUMMARY		
MAIN CATCHMENT REFERENCE	REQUIRED	PROVIDED
1	295	1,304
2	9	102
TOTAL	**304**	**1,406**

Table 6 – Main Catchment Interception Summary

6.40 **Criterion 2** is complied with in applying the total Qbar outfall rate of 44.2 l /s and providing more than the required volume of attenuation storage (Q100+20% = 3,973m^3) in the MC4500 StormTech systems.

6.41 **Criterion 3** is satisfied with as each of the 4No.sub-criterion design objectives have been met as per Table 7 the below;

Sub-criterion	*Design objective*	*Satisfied*
3.1	No flooding on site for the Q30 except where specifically planned	**OK**
3.2	No internal property flooding for site critical duration storm event.	**OK**
3.3	No internal property flooding satisfied as 500mm freeboard to house FFL's is achieved.	**OK**
3.4	No flooding of adjacent areas unless specific routing planned for the Q100 + 20% climate change	**OK**
Refer to the MicroDrainage surface water model results (Q1-Q100+20%) included in the appendix of this report for further detail		

Table 7 – Sub-criterion

6.42 **Criterion 4** River flood protection is satisfied under sub-criterion 4.3 in accordance with the application of the maximum Qbar (44.2 l/s) and therefore long-term storage is not required.

6.43 An exceedance flow routing plan can be viewed on Dwg.No.2104/12 included with this submission.

6.44 Based on the drained area Qbar and the paved area factors identified in Table 3 above and using the MicroDrainage software, a drainage model was generated for multiple storm events and return periods of 2, 30 and 100 years were simulated. The attenuated storage provided is a combination of the interception volume provided below each tank plus the tank volume itself. Full model simulation results for the network and storage units are included in Appendix 12.1 of this report but are summarised in Table 8 below;

ATTENUATION STORAGE SUMMARY					
	Flow control limit (l/s)	**Volume Required (m^3)**		**Volume Provided (m^3) and Top Water Level**	
Catchment 1					
		Q30	**Q100 +20% CC**	**Tank Storage Volume Provided (m^3)**	**TWL**
Tank 1 (Outfall)	42.4	1,263	1,629	**1638**	133.45mOD
Tank 2	3.0	878	1,110	**1122**	136.49mOD
Tank 3	19.0	444	591	**611**	140.53mOD
Tank 4	4.0	308	399	**406**	141.60mOD
Tank 5	2.0	88	116	**118**	141.06mOD
Catchment 2					
Tank 6 (Outfall)	1.8	97	127	**129**	133.15mOD
TotalMax.Storage Required		3,078m^3	3,972m^3		
Total Storage PROVIDED				**4,024m^3**	
The total storage provided > required					

Table 8 - Storage Volume Summary

6.45 It is noted that there is additional **interception storage** volume of c.1,406-304= **1,102m^3** (refer to Table 6 above) that has not been subtracted from the required attenuation volume nor has it been added to the available storage volume and is therefore considered to be a safer and more conservative approach to attenuation storage estimation.

6.46 Refer to Dwg.No.'s 2104/03 & 04 for layout of the attenuation systems and to Dwg.No.2104/15 for details of same.

6.47 In accordance with the requirements of the DLRCC Stormwater Management Policy, a Stage 1 SuDS audit has been completed by Punch Consulting Engineers and submitted to DLRCC Drainage Department. The audit also included the Surface Cover Type table from Section 7.1.5 of the DLRCC County Development Plan 2022-2028. Refer to Appendix 12.6 for details of the SuDS audit.

6.48 A Hydrological and Hydrological Risk Assessment report prepared by Enviroguide Consulting has been completed and is included with the planning application – refer to that report for further detail.

7.0 Sustainable Drainage Systems - SuDS

7.0.1 SuDS addresses the water quality, water quantity, amenity, and biodiversity by the management of surface water run off in a sequence of treatment processes along the drainage infrastructure network.

7.0.2 The SuDS philosophy is illustrated in the GDSDS Volume 3 Section 6.3 as the “SuDS triangle”, shown below. The principle is to reduce the storm water run-off through managed processes, improve the quality of the run-off and to replicate the natural characteristics of the rainfall run off.

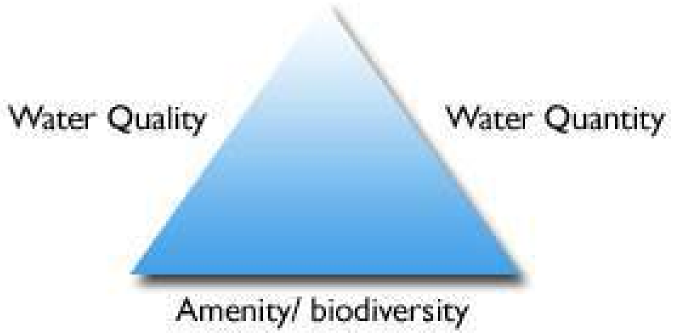


Fig.4 – The SuDS Triangle

7.0.3 Replicating the natural characteristics and providing amenity/biodiversity has been achieved in the SuDS elements included in this application. A full SuDS treatment train approach has been implemented in accordance with the CIRIA SuDS Manual, summarised as follows;

- Filter drains to the rear of the housing (c.1,135m)
- Permeable paving to all parking spaces (c.10,900m^2)
- Rainwater butts (200l) to the rear downpipes (172No.)
- Swales adjacent to roadways where practically feasible (29No.)
- Tree pits where practically feasible (41No.)
- Extensive Green Roof (2,703m^2)
- Intensive Green Roof (2,849m^2)
- Bio-Retention area (4No.)
- Silt-trap/catchpit manholes (6No.)

- Hydrobrakes limiting flow to the drained area Qbar greenfield rate
- Petrol interceptor upstream of SMh25 & Smh87
- Stone lined voided arch retention storage devices

With the inclusion of these measures, it is proposed that the SuDS treatment of the run-off has been adequately addressed.

7.0.4 The SuDS management train approach to designing the storm water network has been applied in this proposed developments design, similar in principle to Fig.5 below

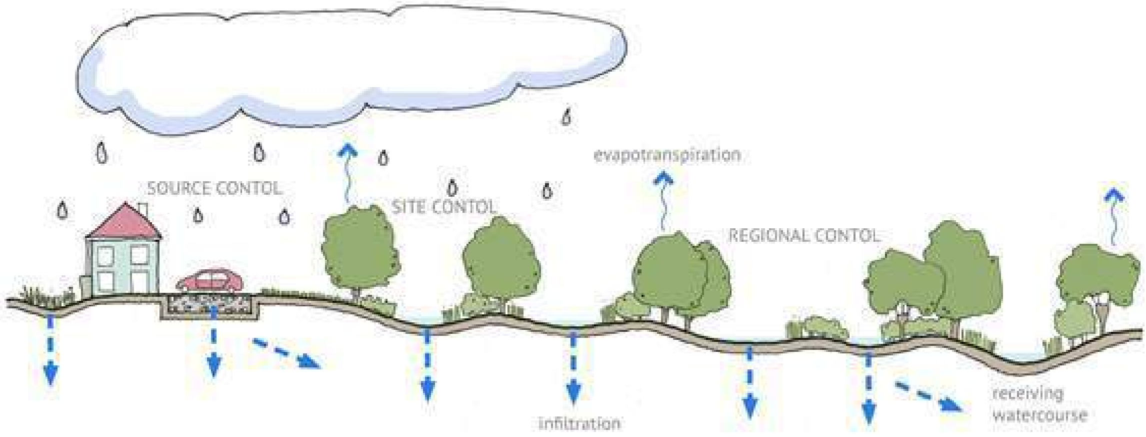


Fig.5 – Treatment Train

7.1 Source control

7.1.1 Source Control aims to detain or infiltrate runoff as close as possible to the point of origin.

7.1.2 The site investigation results (see appendix) suggest that there is some, but limited, ($9.32x10^{-6}$ m/s) scope for infiltration of surface water flows. Even if the infiltration is limited there is still scope to provide some level of storage, time delay and treatment as the surface water flows through the stone medium.

7.1.3 It is proposed to use **filter drains** in the rear gardens of the house to cater for run off from the rear roofs and patios. The use of these filter drains will encourage run off to infiltrate directly to ground and will also provide interception storage in the c.40% voids ratio stone below the high-level drain. Any run-off that cannot infiltrate to ground will overflow to the high-level drain and connect to the main drainage system. The surface water runoff rate is also attenuated using these filter drains. A PAF of 0.70 (70%) will apply to these areas as was agreed in principle with the DLRCC Water Services Department as part of the pre-planning discussions. A silt-trap inspection chamber is included downstream of each filter drain. Refer to Dwg.2104/14 for further detail.

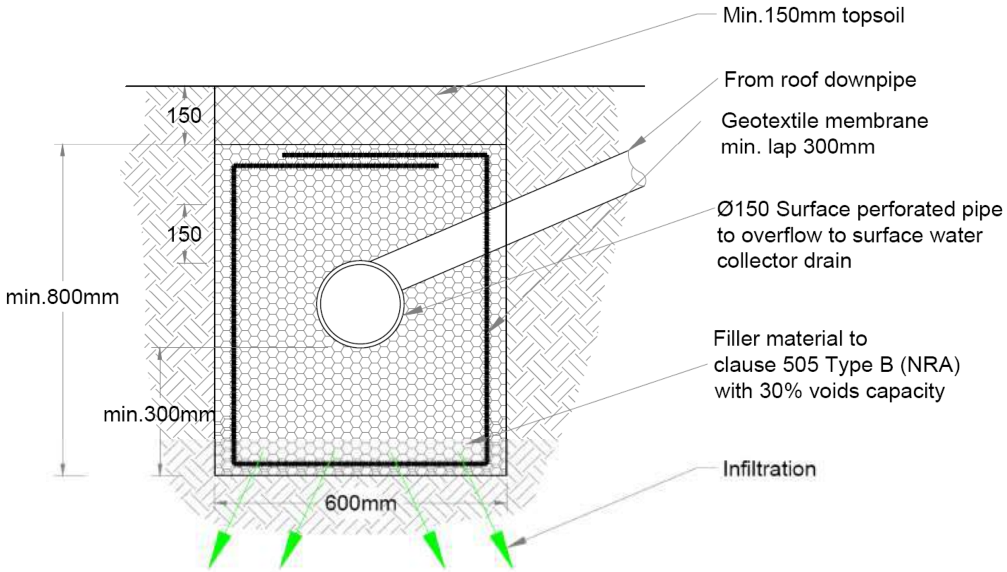


Fig.6 – Filter Drain

7.1.4 It is proposed to use **tree pits (41No.)** and a **bio-retention (4No.)** areas where possible to collect run-off from the cambered road surface. The use of these tree pits will provide treatment of the run-off, will encourage run off to infiltrate directly to ground and will also provide interception storage below the high-level connection to the main S/W drainage. Any run-off that cannot infiltrate to ground will overflow to the high-level drain and connect to the main drainage system. The surface water runoff rate is also attenuated using these tree pits.

7.1.5 The road cambers roads are to be constructed to drain flow into these tree pits and bio retention areas to maximize the drained area into SuDS treatment & interception. The road cambers are shown on Dwg.No.'s 2104/01 & 02 and further illustrated on Dwg.No.2104/13.

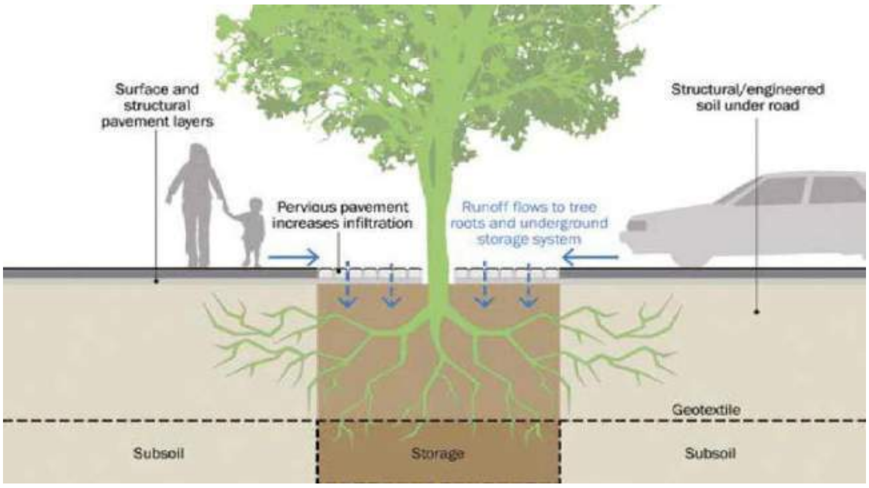

Surface and structural pavement layers
Structural/engineered soil under road
Pervious pavement increases infiltration
Runoff flows to tree roots and underground storage system
Geotextile
Subsoil
Storage
Subsoil

Fig.7 – Tree Pit (ex. SuDS Manual fig.19.3)

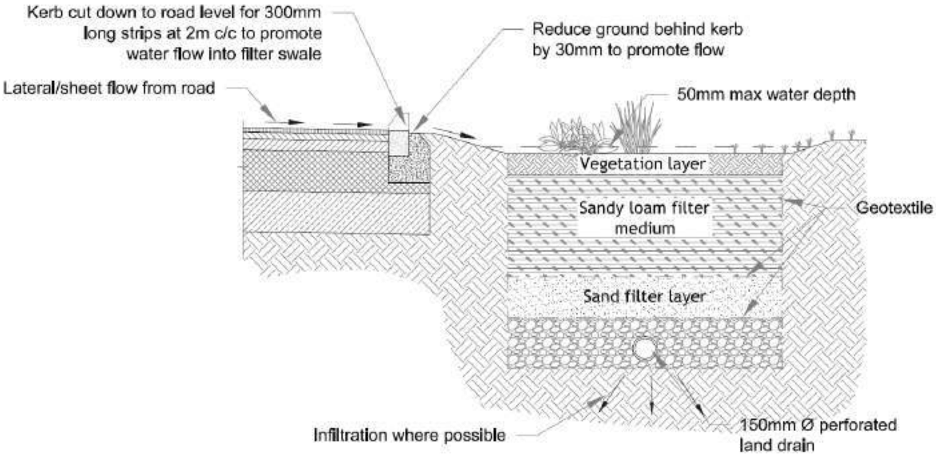

Kerb cut down to road level for 300mm long strips at 2m c/c to promote water flow into filter swale
Reduce ground behind kerb by 30mm to promote flow
Lateral/sheet flow from road
50mm max water depth
Vegetation layer
Sandy loam filter medium
Geotextile
Sand filter layer
Infiltration where possible
150mm Ø perforated land drain

Fig.8 – Bio-Retention (ex.Dwg.2104/14)

7.1.6 A PAF of 0.71 (71%) will apply to areas or paths/roads draining to these tree pits and bio-retention areas as was agreed in principle with the DLRCC Water Services Department as part of the pre-planning discussions. Refer Dwg.No.'s 2104/03 & 04 for location and to Dwg.No.2104/14 for details.

7.1.7 It is proposed to use **permeable paving** surfacing to the private driveways of the houses and in the car parking spaces of the duplex units and the road/paths remaining in control of a management company around/west of the Neighbourhood Centre. This allows for the rainfall to percolate through open joints in the pavement and be strained through the unwoven geo-textile membrane beneath the paved surface. This method of surface water collection will improve water quality and prevent excessive sedimentation. There is a natural interception, attenuation and storage of surface waters flowing through the permeable paving system and an outfall pipe is provided 150mm above the bottom of the system to drain the overflow filtered/attenuated run off into the main drainage system.

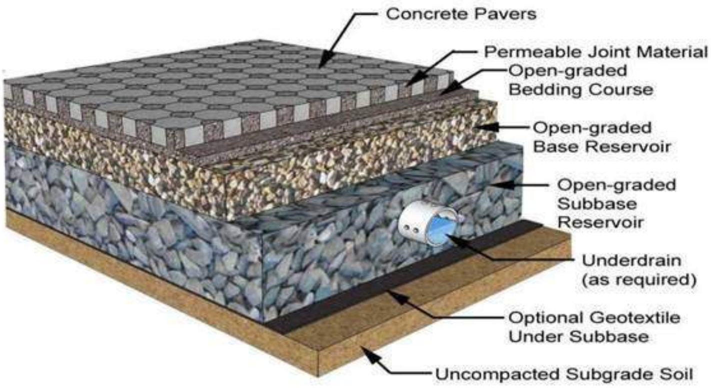

Concrete Pavers
Permeable Joint Material
Open-graded Bedding Course
Open-graded Base Reservoir
Open-graded Subbase Reservoir
Underdrain (as required)
Optional Geotextile Under Subbase
Uncompacted Subgrade Soil

Fig.9 – Permeable Paving

7.1.8 In providing permeable paving systems on the site, a run-off rate of 60% (0.60 paved area factor applied) has been applied in the surface water calculations. Refer to Dwg.No.2104/14 for details.

7.1.9 In accordance with the CIRIA SuDS Manual 2015, **green roofs** can be used to treat and attenuate runoff in their substrate and support root uptake of water with appropriate planting and are an integral part of source control on a site. Green roofs can increase the indigenous biodiversity and is an encouraging environmentally design strategy, which is in accordance with the objectives as specified in the Greater Dublin Strategic Drainage Strategy (GDSDS) and in Appendix 7.2 of the DLRCC County Development Plan 2022-2028.

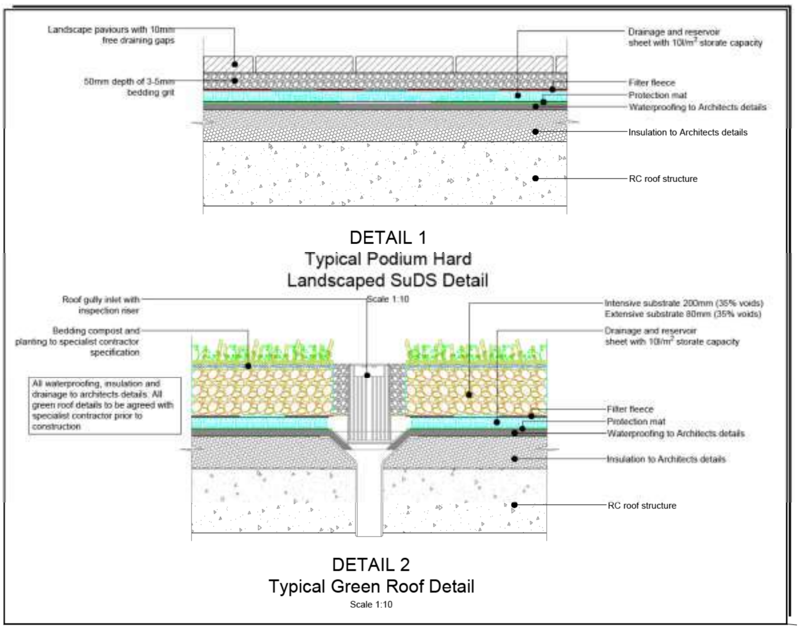

Landscape paviours with 10mm free draining gaps
50mm depth of 3-5mm bedding grit
Drainage and reservoir sheet with 10l/m² storate capacity
Filter fleece
Protection mat
Waterproofing to Architects details
Insulation to Architects details
RC roof structure
DETAIL 1
Typical Podium Hard Landscaped SuDS Detail
Scale 1:10
Roof gully inlet with inspection riser
Bedding compost and planting to specialist contractor specification
All waterproofing, insulation and drainage to architects details. All green roof details to be agreed with specialist contractor prior to construction
Intensive substrate 200mm (35% voids)
Extensive substrate 80mm (35% voids)
Drainage and reservoir sheet with 10l/m² storate capacity
Filter fleece
Protection mat
Waterproofing to Architects details
Insulation to Architects details
RC roof structure
DETAIL 2
Typical Green Roof Detail
Scale 1:10

Fig.10 – Intensive & Extensive Green Roof (ex.Dwg.2104/14)

7.1.10 Both Intensive and extensive Green roofs are proposed to Apartment Block C/D and the Neighbourhood Centre (NC). Duplex Block D1 is to have Intensive Green Roof only. The minimum percentage coverage required in Appendix 7.2 of the DLRCC County Development Plan is 50% if extensive and 70% if intensive. Each green roof proposed passes the DLRCC minimum requirement % and is summarised in Table 9 below; plan.

GREEN ROOF COVERAGE SUMMARY							
BLOCK REFERENCE	Extensive	Intensive	Total	Building Footprint	% Coverage of Green Roof	Min.% Reqd.	Pass/Fail DLRCC Min. %
NC	1,568	1,390	2958	4,089	72%	60%*	PASS
Duplex D1		664	664	996	66%	50%	PASS
Apt.Block C/D	1,135	795	1,930	2266	85%	60%*	PASS
*The 60% coverage is an average between the Min.50% if Intensive and 70% if Extensive. Each of the NC and Apt. Blk C/D contain both Intensive & Extensive Green Roofs and therefore the average is taken as the minimum percentage requirement.							

Table 9 – Green Roof Coverage Summary

7.1.11 In providing the green roof system, a run-off rate of 85% (0.85 paved area factor applied) has been applied in the surface water calculations for the intensive Green Roof area and 92% for the Extensive Green Roof area in accordance with appendix 7.2 Green Roof Policy of the DLRCC County Development Plan 2022-2028.

7.1.12 Access for maintenance of the green roofs will be via the internal building stairwells and a roof hatch over or using a cherry picker where stairs access is not feasible. Detailed cross sections of the proposed roof build-up are shown on Dwg.No.2104/14 included in the submission. PV panels to these roofs of the do not form part of this application.

7.1.13 The use of **rainwater butts** is another source control method in the SuDS treatment train process. It is proposed to provide c.172No. 200l rainwater butts to collect rainwater from the house roofs for use as garden irrigation, therefore reducing drinking water demand and decreasing run-off from the site.

Fig 11 – Rainwater Butt

7.1.14 Bypass oil separators are important SuDS devices that significantly reduce any potential hydrocarbons and suspended solids from surface water run-off. and are included upstream of each of the 2No. S/W outfalls from the site. Sizing of the interceptors are based on the Microdrainage calculated flowrates and manufacturers details tables and can be viewed in Appendix 12.6 of this report as part of the SuDS audit procedure.

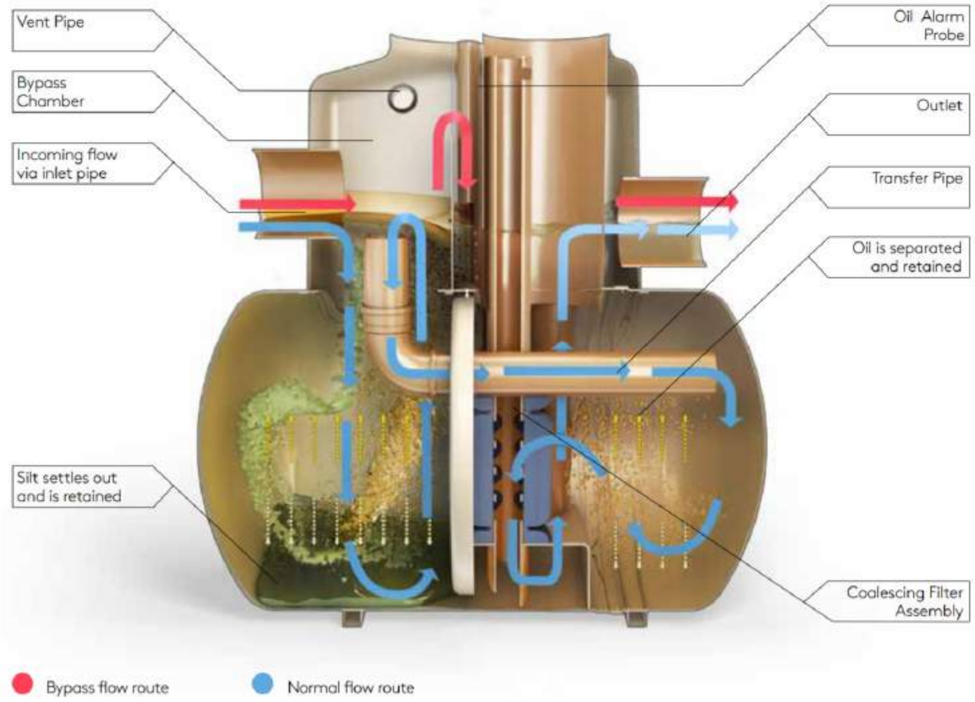

Vent Pipe
Bypass Chamber
Incoming flow via inlet pipe
Silt settles out and is retained
Oil Alarm Probe
Outlet
Transfer Pipe
Oil is separated and retained
Coalescing Filter Assembly
Bypass flow route
Normal flow route

Fig 12 – Bypass Separator

7.1.15 An important aspect of Source Control is reducing pollution by prevention of chemicals and other pollutants from coming into contact with rainfall runoff. In this respect, it is proposed that the homeowner will be provided with information regarding the appropriate usage of the proposed drainage system.

7.2 Site Control

7.2.1 Site control in the treatment train process involves the reduction in volume and rate of surface runoff run off and provide some treatment of the runoff.

7.2.2 Roadside **filter swales** are a method of site control that reduces harmful chemical pollutants and sediment reaching the piped network. These pollutants are trapped in the grassed areas leading to the filter strip. Filter swales reduce the surface water runoff rate and attenuate flows locally, therefore reducing stress on downstream facilities. Filter swales also facilitate interception of the “first flush” of rainfall. Fig.13 below from the CIRIA SuDS Manual illustrates the principle.

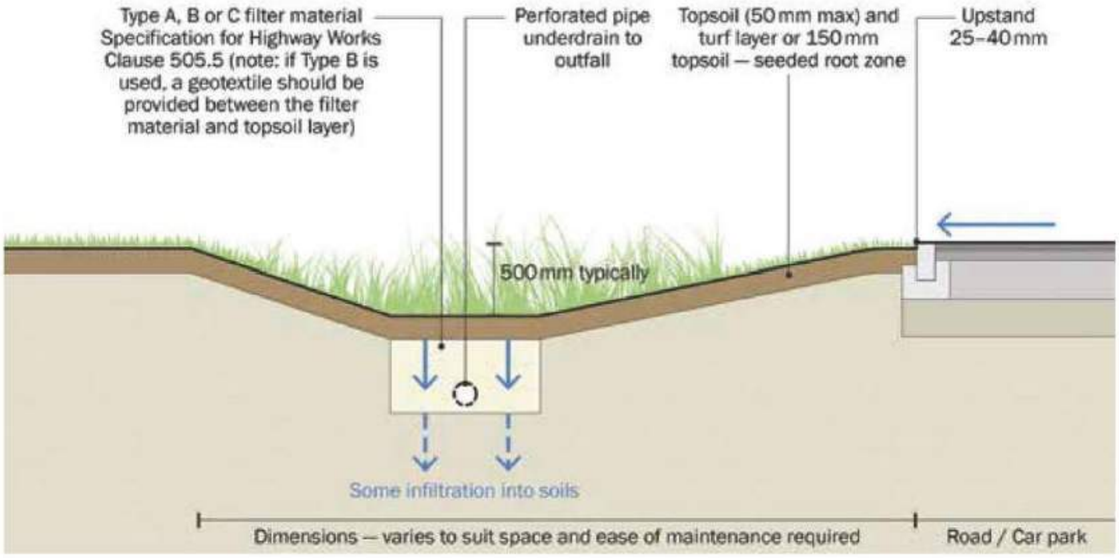

Type A, B or C filter material Specification for Highway Works Clause 505.5 (note: if Type B is used, a geotextile should be provided between the filter material and topsoil layer)
Perforated pipe underdrain to outfall
Topsoil (50 mm max) and turf layer or 150 mm topsoil — seeded root zone
Upstand 25–40 mm
500 mm typically
Some infiltration into soils
Dimensions — varies to suit space and ease of maintenance required
Road / Car park

Fig.13 – Filter Swale

7.2.3 As part of the site control it is proposed to construct 29 No. **filter swales** along the site roads at specified locations which will allow surface water runoff from roads to be intercepted and infiltrate to ground. In the event the ground is saturated, there are also positive drainage connections from the filter swales into the piped network. Refer to Dwg.No.'s 2104/03 & 04 for proposed locations of the filter swales and to Dwg.2104/14 for details of this proposal.

7.2.4 In providing the filter swales, a run-off rate of 71% (0.71 paved area factor applied) has been applied in the surface water calculations as was agreed in principle with the DLRCC Drainage Department as part of the pre-planning discussions. Typical calculations for these SuDS features are included in Appendix 12.2 of this report.

7.2.5 The road cambers roads are to be constructed to drain flow into these filter swales where appropriate to maximize the drained area into SuDS treatment & interception. The road cambers are shown on Dwg.No.'s 2104/01 & 02 and further illustrated on Dwg.No.2104/13.

7.2.6 A key landscape/bio-diversity feature of the proposed development is the embankment of existing trees forming the open space to the centre of the site. These trees provide an important role of intercepting rainfall run-off and managing same through evapotranspiration as well as infiltration to roots. The addition of landscaping and planting throughout the development is also an important aspect of site control in providing biodiversity, run-off reduction, interception, infiltration, and amenity. The project Arborist specialist has advised of the critical root zone constraints relating to this tree belt and as a result excavation withing the to the root zone prohibited. Refer to the landscape architects and arborist drawings/reports for more information. Refer also to the SuDS audit report (Appendix 12.6) relating to an illustration of tree root protection zone.

7.2.7 Silt-trap/catchpit manholes are provided upstream of the underground attenuation storage systems which will remove sediments and silts and forms part of the site control methodology used in the proposed development. Furthermore, silt-trap inspection chambers are included downstream of each filter drain and swale as recommended in the SuDS audit. Refer to Dwg.2104/14 for further detail.

7.3 Regional Control

7.3.1 Regional control comprises of treatment facilities to reduce pollutants from runoff and control the surface water runoff rate to pre-development rates.

7.3.2 As part of the overall regional control for the site it is proposed to use a 6No.void arched **attenuation systems**, such as the StormTech MC4500 system (Fig.14).

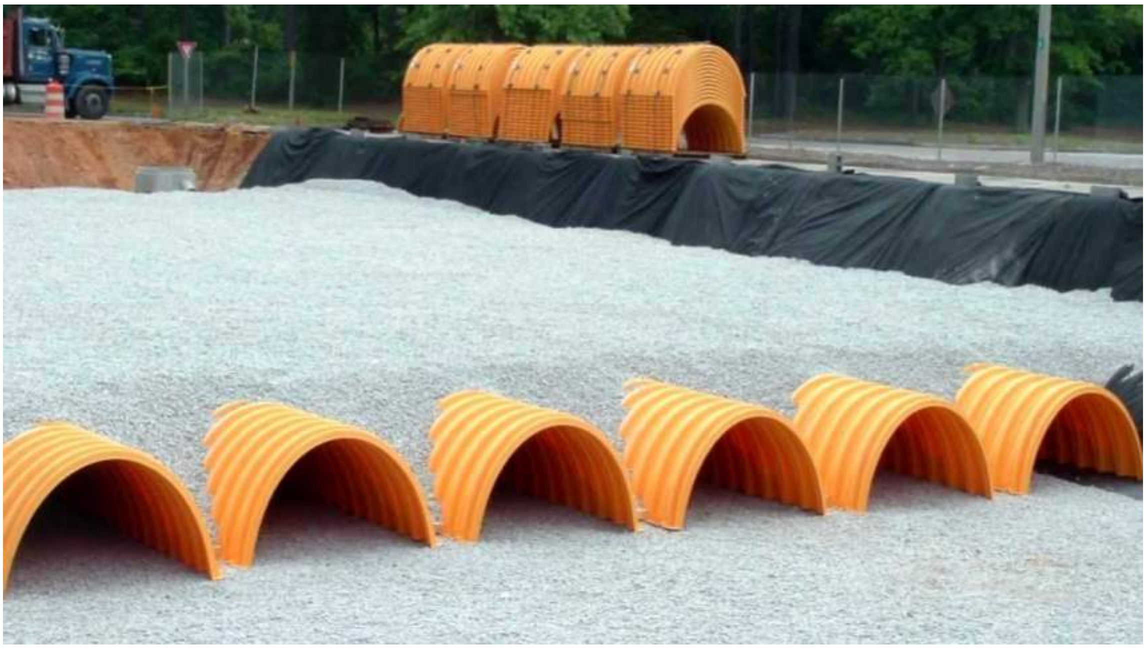


Fig.14 – StormTech Attenuation System

7.3.3 The flow rate of the run-off outfalling from the attenuation systems is to be controlled using vortex control devices such as Hydrobrake vortex control devices.

7.3.4 Interception of the "*first flush*" of rainfall is captured upstream of the outfalls and can infiltrate to ground where possible. The interception storage will be within the stone base of the permeable paving, in the stone below the filter drain pipework and swales, in the sub-strata of the green roof systems and in the stone base of the attenuation storage areas. As per the parameters laid out in the GDSDS the interception volume was calculated for the total site as per Tables 4 & 5.

7.3.5 A class 1 petrol interceptor (PI) is to be provided upstream of inlets to attenuation Tanks 1 & 6. These PI's will further remove any pollutants not already captured in the above noted interception and treatment train elements. Sizing of the interceptors are based on the Microdrainage calculated flowrates and manufacturers details tables and can be viewed in Appendix 12.6 of this report as part of the SuDS audit procedure.

7.3.6 Prevention of pollutants and sediments entering the receiving watercourse has been achieved in providing Interception Storage throughout the proposed development. The interception will take place from the head of the catchment right down to the Hydrobrake manhole on the application lands. Refer to paragraphs 6.37 & 6.38 above and to Dwg.2104/13 & 15 for further detail.

7.4 SuDS Summary

7.4.1 Interception will achieved be within the voids of the stone base of the permeable paving, in the stone below the filter drain pipework, in the tree pits, swales, bio-retention areas, in the green roof systems and in the stone base of the attenuation storage. As per the parameters laid out in the GDSDS the interception volume was calculated and is summarised in the Tables 4 & 5. Refer to Appendix 12.2 for detailed calculations.

7.4.2 Replicating the natural characteristics and providing amenity/biodiversity will be encouraged by creating the roadside grassed swales, tree pits, bio-retention areas, green roofs, and filter drains.

7.4.3 The overall site surface water runoff rate has been restricted to the greenfield runoff rate, Qbar (44.2 l/s) and the DLRCC recommended HR Wallingford UK SuDS calculations for same can be viewed in Appendix 12.5 of this report. Refer also to Chapter 8 for background on the determination of the soil type used in the Qbar calculation.

7.4.4 Refer to the appendix and to Dwg. No's 2104/03-05 and 13-14 for the drainage layout and SuDS features details.

7.4.5 In providing the above noted rear garden filter drains, roadside filter swales, house rainwater butts, permeable paving systems, catchpits, tree pits, bio-retention areas, green roofs, attenuation storage, greenfield run off vortex control and petrol interceptors it is proposed that the SuDS treatment of the run-off has been adequately addressed. The above noted proposals have been discussed and agreed in principle with DLRCC Drainage Department as during the pre-planning application meetings.

7.4.6 In advance of submission of the main planning application and in accordance with the requirements of the Stormwater Management Policy of the DLRCC County Development Plan 2022-2028, a Stormwater Audit has been carried out by Punch Consulting Engineers for the proposed development, was submitted to DLRCC Drainage Department and is included in Appendix 12.6 of this report.

8.0 Determination of Qbar

8.1 The allowable surface water outfall rate Qbar is based on the greenfield run off rate of the drained site area, as specified in the GDSDS section 6.6.1.2. As recommended in the DLRCC Stormwater Management Policy document, the Wallingford UKSuDS Greenfield runoff rate estimation tool was used to calculate the Qbar for the site, refer to Appendix 12.5.

8.2 While the development area of the site is c.10.8Ha in this application, the actual positive drained area is c.9.92Ha. This is the area used in the calculation of Qbar.

8.3 The Standard Annual Average Rainfall for the Kilternan Site is 1003mm as determined from Met Eireann 1km^2 grid dataset. Refer to Appendix 12.14 for the Met Eireann data.

8.4 The value for SOIL used in the IH 124 Qbar formula noted above is derived from the pervious surface runoff factor (SPR) using the formula

$$SOIL = \frac{(0.1S1 + 0.3S2 + 0.4S3 + 0.45S4 + 0.5S5)}{S1 + S2 + S3 + S4 + S5}$$

Where the soil type S1-S5 is determined in accordance with the following paragraphs.

8.5 In determination of the SOIL value for this Kilternan site, a number of different sources of data were reviewed such as the site specific site investigation trial holes, the soakaway tests, the Winter Rainfall Acceptance Potential (WRAP) – the Wallingford Procedure Volume 3 Maps, the Flood Studies Report (FSR - NERC, 1975), Transport Infrastructure Ireland (TII, formerly NRA) – Drainage of Runoff from Natural Catchments 2015, HR Wallingford website, the site specific topographical survey as well as site visits by the design engineer. The following paragraphs provide context and detail behind the choosing of the SOIL Type 3 for the Qbar calculation.

8.6 As part of the preparation for the planning application, research into the existing site ground conditions were undertaken. Furthermore, a Hydrological and Hydrological Risk Assessment report prepared by Enviroguide Consulting has been completed and is included with the planning application – refer to that report for further detail.

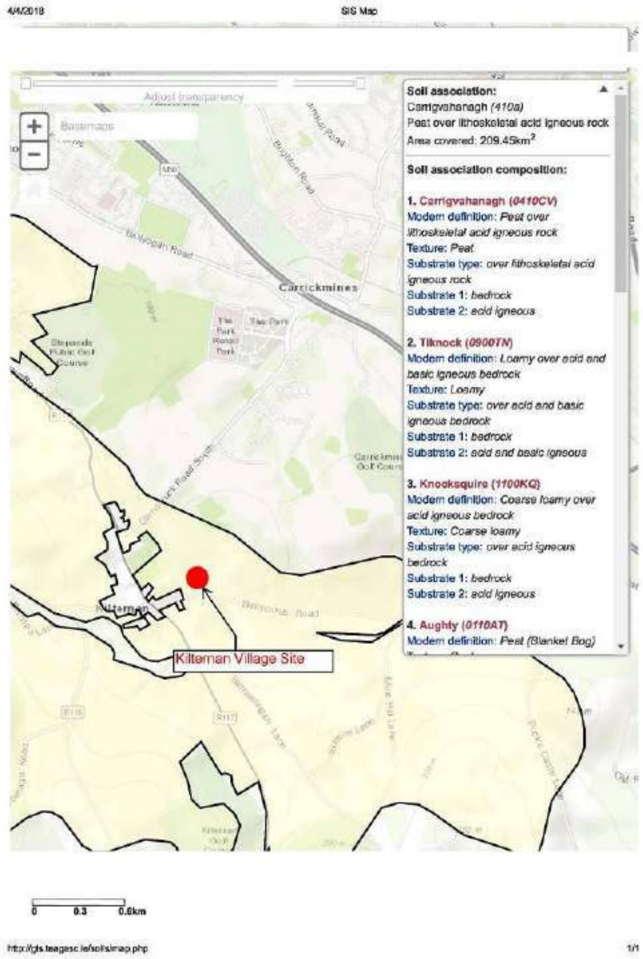
8.7 Site investigations were undertaken including trial hole opening and soakaway testing. Refer to Appendix 12.8 of this report for the SI results.

8.8 In total 6No. soakaway tests were carried out in accordance with BRE Digest 365 and the results indicated infiltration rates varied between unobtainable f values up to 9.3x10^{-6} m/s. These results indicate limited but some availability for infiltration across the site. Refer to the soakaway test results in Appendix 12.8 of this report for further information.

8.9 The sub-soil conditions as determined by trial hole opening noted topsoil over cohesive clay overlying silt above broken granite.

8.10 A review of the Geological Survey of Ireland website http://www.gsi.ie and that of the Teagasc sub specific http://gis.teagasc.ie/soils/map.php websites both of which provide publicly available soils and bedrock datasets.

8.11 The soil association composition as determined from the Teagasc data is noted as Carrigvahanagh peat over lithoskeletal acid igneous rock on most of the site. Refer Fig.15 below and to Appendix 12.7 of this report for the summary extracts from the GSI/Teagasc datasets.


4/4/2018 GIS Map

Soil association:
Carrigvahanagh *(410a)*
Peat over lithoskeletal acid igneous rock
Area covered: 209.45km²

Soil association composition:

1. Carrigvahanagh *(0410CV)*
Modern definition: *Peat over lithoskeletal acid igneous rock*
Texture: *Peat*
Substrate type: *over lithoskeletal acid igneous rock*
Substrate 1: *bedrock*
Substrate 2: *acid igneous*

2. Tiknock *(0900TN)*
Modern definition: *Loamy over acid and basic igneous bedrock*
Texture: *Loamy*
Substrate type: *over acid and basic igneous bedrock*
Substrate 1: *bedrock*
Substrate 2: *acid and basic igneous*

3. Knocksquire *(1100KQ)*
Modern definition: *Coarse loamy over acid igneous bedrock*
Texture: *Coarse loamy*
Substrate type: *over acid igneous bedrock*
Substrate 1: *bedrock*
Substrate 2: *acid igneous*

4. Aughty *(0110AT)*
Modern definition: *Peat (Blanket Bog)*

http://gis.teagasc.ie/soils/map.php 1/1

Fig.15 – GSI/Teagasc Soil Data

8.12 SOIL indices (1 to 5) are defined in the Flood Studies Report (NERC, 1975). The index broadly describes the maximum runoff potential and was derived by a consideration of soil permeability and topographic slope, see Table 10 below;

FSR Soil Indices	
Soil Type 1	Well drained permeable sandy or loamy soils and shallower analogues over highly permeable limestone, chalk, sandstone, and related drifts. Earth peat soils drained by dykes and pumps Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys
Soil Type 2	Very permeable soils with shallow ground water Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils. Moderately permeable soils, some with slowly permeable sub-soils
Soil Type 3	Relatively impermeable soils in boulder and sedimentary clays, and in alluvium. Permeable soils with shallow ground water in low lying areas. Mixed areas of impermeable and permeable soils in approximately equal proportions.
Soil Type 4	Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.
Soil Type 5	Soils of wet uplands with peaty or humose surface horizons and impermeable layers at shallow depth Deep raw peat associated with gentle upland slopes or basin sites Bare rock cliffs and screes (iv) shallow, permeable rocky soils on steep slopes.
Based on the above definitions a SOIL Type 3 or 4 could be chosen for the Kilternan Village site	

Table 10 – FSR Soil Indices

8.13 The WRAP map gives a broad-spectrum overview of the soil type location across the entire country as per Fig.16 below;

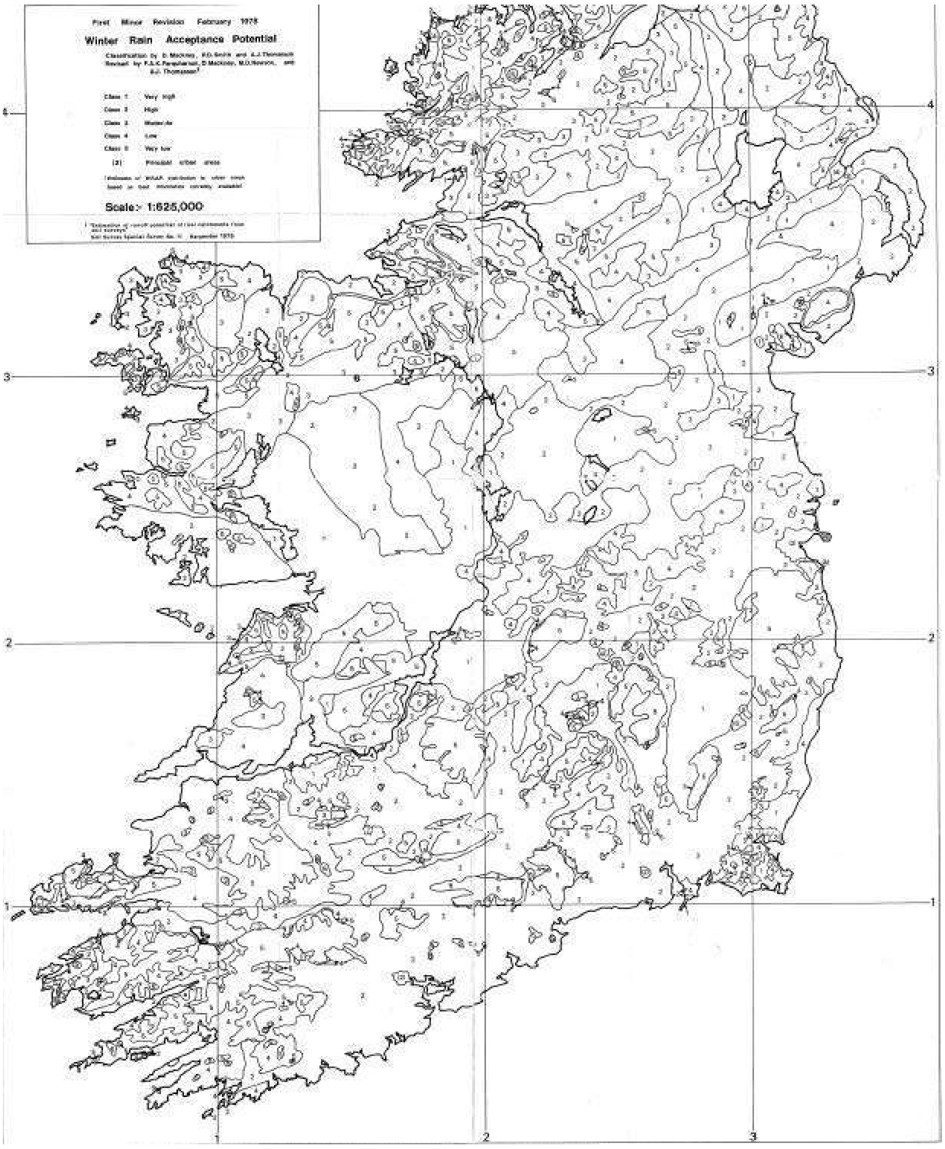


Fig.16 – WRAP Map - Full

8.14 At an expanded scale and overlaid with the Kilternan site specific location the WRAP map and Soil index is as Fig.17 below;

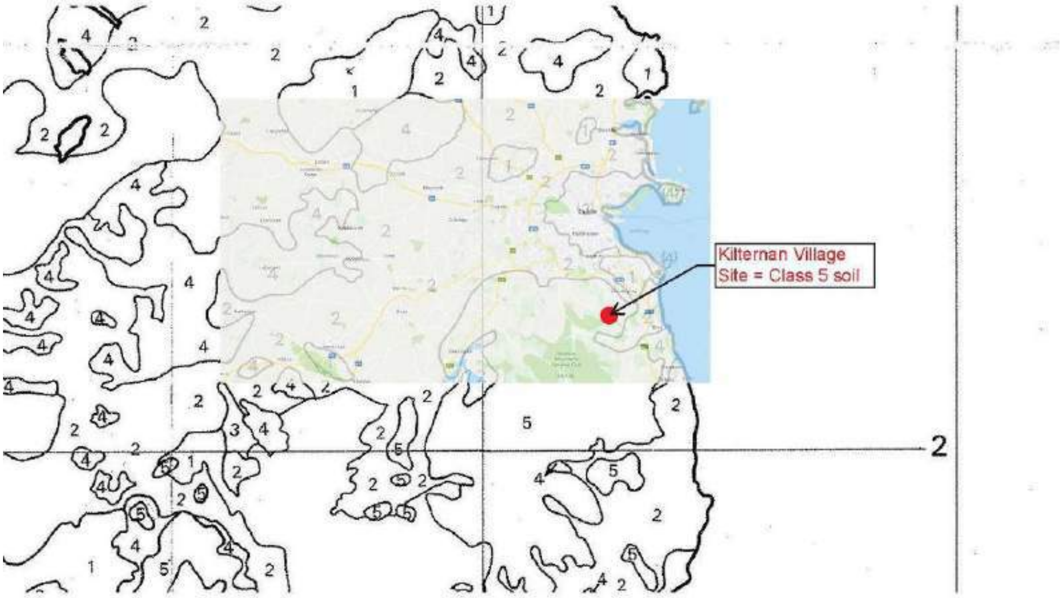
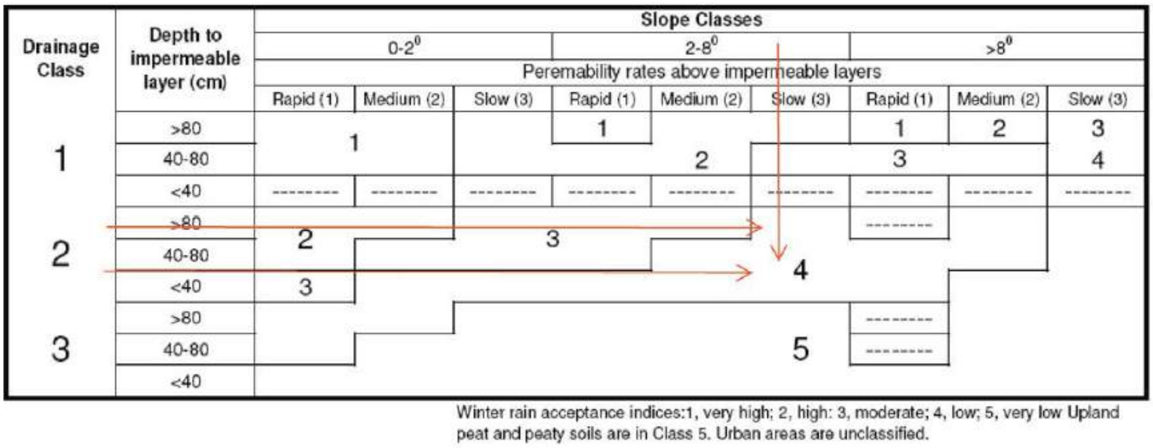


Fig.17 – WRAP Map - Local

8.15 Based on the WRAP map a **SOIL value of 5** could be interpreted but is not applied for this site. It is noted that SOIL type 5 is rarely applied and is more associated with exposed rock or peat wetlands.

8.16 From the FSR table, reproduced in in Fig.18 below, showing the noted drainage and slope classes, the **Soil type could be interpolated between a type 4 and a type 3**.

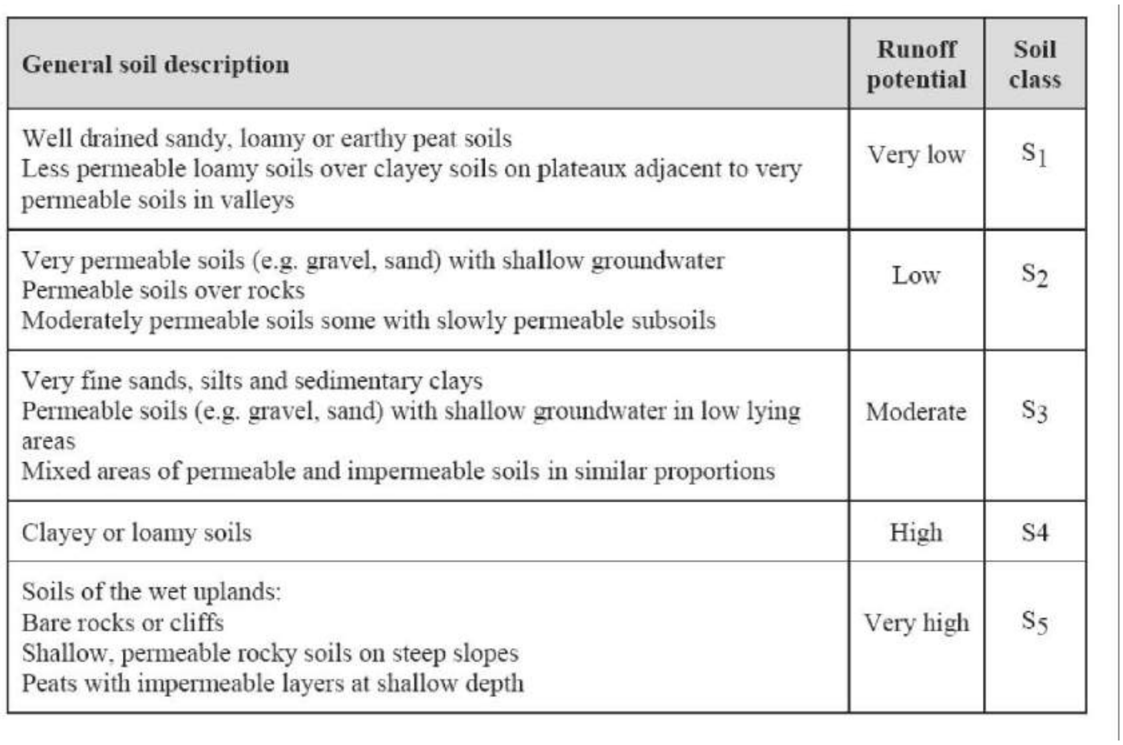


Drainage Class	Depth to impermeable layer (cm)	Slope Classes								
		0-2^0			2-8^0			>8^0		
		Peremability rates above impermeable layers								
		Rapid (1)	Medium (2)	Slow (3)	Rapid (1)	Medium (2)	Slow (3)	Rapid (1)	Medium (2)	Slow (3)
1	>80	1			1			1	2	3
	40-80					2		3		4
	<40	--------	--------	--------	--------	--------	--------	--------	--------	--------
2	>80							--------		
	40-80	2			3					
	<40	3					4			
3	>80							--------		
	40-80						5	--------		
	<40									

Winter rain acceptance indices:1, very high; 2, high: 3, moderate; 4, low; 5, very low Upland peat and peaty soils are in Class 5. Urban areas are unclassified.

Fig.18 – Soil Type Table

8.17 Reference to the Transport Infrastructure Ireland -TII (formerly the National Roads Authority – NRA) publication Drainage of Runoff from Natural Catchments 2015, Volume 4 Sections 2 of the Design Manual for Roads and Bridges (DMRB) the following table was noted (Fig.19);



General soil description	Runoff potential	Soil class
Well drained sandy, loamy or earthy peat soils Less permeable loamy soils over clayey soils on plateaux adjacent to very permeable soils in valleys	Very low	S_1
Very permeable soils (e.g. gravel, sand) with shallow groundwater Permeable soils over rocks Moderately permeable soils some with slowly permeable subsoils	Low	S_2
Very fine sands, silts and sedimentary clays Permeable soils (e.g. gravel, sand) with shallow groundwater in low lying areas Mixed areas of permeable and impermeable soils in similar proportions	Moderate	S_3
Clayey or loamy soils	High	S4
Soils of the wet uplands: Bare rocks or cliffs Shallow, permeable rocky soils on steep slopes Peats with impermeable layers at shallow depth	Very high	S_5

Fig.19 – TII Soil Class

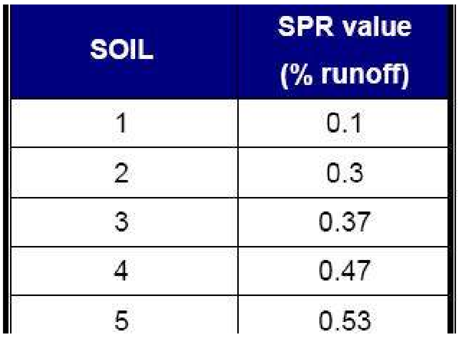
8.18 Using the results of the site investigation trial holes as well as the Teagasc data sets noted previously, a **Soil class of S4** could be interpolated from the TII Fig.16 above but is not applied for this Kilternan Village site.

8.19 In reference to the HR Wallingford online design tool, it is noted that a **SOIL type 5** was the default value given for the input site coordinates. but is not applied for this site. It is noted that SOIL type 5 is rarely applied and is more associated with exposed rock or peat wetlands.

8.20 The site is generally flat in the western side and is more steeply sloped on the eastern side but the underlying soil type evidenced from the trial hole logs is consistent in that the strata are topsoil over clays over silts over broken granite. Refer to Appendix 12.8 for the trial hole and soakaway test results.

8.21 Based on interpretation of each of the above data sets a Soil Type 3 or 4 could be reasonably be interpreted. As part of the pre-planning consultations, agreement in principle was reached with the DLRCC Drainage Department and a **Type 3 soil** was chosen as appropriate for this site. The decision to choose a type 3 is deemed as conservative and yields a lower outfall rate than of a soil type 4.

8.22 From the GDSDS Table 6.7, shown in Fig.20 below, using a Soil value of 3 equates to an SPR value of 0.37. The SPR value of 0.37 was used in the HR Wallingford Qbar calculator to override the default higher SPR value of 0.53.



SOIL	SPR value (% runoff)
1	0.1
2	0.3
3	0.37
4	0.47
5	0.53

Fig.20 – GDSDS SPR Values

8.23 Using the DLRCC recommended HR Wallingford UK SuDS calculation tool the resultant **Qbar = 44.2 l/s**. Refer to Appendix 12.5 for the calculation sheet.

9.0 S/W Design Conclusion

9.1 The S/W outfalls are described in detail in Section 6 of this report.

9.2 Full SuDS treatment train approach has been implemented in accordance with the CIRIA SuDS Manual as described in Section 7 above.

9.3 A thorough examination of the site characteristics were undertaken in determination of the soil type and greenfield run off rate as described in Section 8 above.

9.4 The drainage design and attenuation storage volumes have been determined using an industry standard computer modelling software program MicroDrainage, for designing drainage networks as described in Section 6 above and are included in Appendix 12.1 of this report. Climate change of 20% and Urban Creep of 10% has been applied in the design and is detailed in Section 6 above.

9.5 A Site-Specific Flood Risk Assessment was completed and is included in the application as a separate report.

9.6 A Hydrological and Hydrological Risk Assessment report prepared by Enviroguide Consulting has been completed and is included with the planning application – refer to that report for further detail.

9.7 Pre-planning consultations were held with the DLRCC Drainage Department and their requirements were ascertained and complied with in this document and the accompanying drawings.

9.8 In accordance with the requirements of the Stormwater Management Policy of the DLRCC County Development Plan 2022-2028, in advance of submission of the main planning application, a Storm Water Audit has been carried out for the proposed development, submitted to the Drainage Department of DLRCC and is included in Appendix 12.6 of this report.

9.9 Should planning permission be granted the Applicant has the ability to deliver the services and ancillary works required to implement the designed scheme in full. Letters of consent relating to connection to services and crossing lands not in the Applicants ownership are included in the Appendix 12.15 of this report.

10.0 Wastewater Infrastructure

10.1 Foul drainage records drawings were obtained from Irish Water/DLRCC in preparation for this planning application and are included in Appendix 12.11 of this document.

10.2 A Pre-Connection Enquiry Form application (PCEA) was submitted to Irish Water (IW) and a Confirmation of Feasibility (CoF) was received from IW (ref.CDS21006509) noting that a foul connection is "*feasible without infrastructure upgrade*". A copy of the IW Confirmation of Feasibility letter can be viewed in the appendix of this report. Further to the CoF from IW, a full design submission was made for the wastewater infrastructure. Subsequently IW have issued the Statement of Design acceptance letter (Ref.CDS20006509) issued on 01/06/22. A copy of the IW design acceptance letter and correspondence can be viewed in Appendix 12.16 of this report.

10.3 The minimum public sewer diameter is to be 225mm and the foul drains/sewer are to be in accordance with the Irish Water Code of Practice for Wastewater Infrastructure 2020.

Foul Sewer Design Criteria	
Min.velocity	0.75m/s
Max.velocity	3m/s
Min.sewer size for TIC	225mm diameter
Pipe friction (Ks)	1.5mm
Minimum pipe depth	1.2m below roads 0.9m in open/grassed spaces
Ave.Occupancy	2.7 persons/unit
Residential loading/person/day	150 l/day
Commercial loading/person/day	50 l/d

Table 11 - Foul Sewer Design Criteria

10.4 Each individual house is to be connected to the main public foul sewer using a 100mm diameter drain with a minimum gradient of 1/60 in any one drainage connection.

10.5 The proposed foul outfall from c.10.5 Ha the subject site will be via the existing piped foul drainage system constructed as part of the Rockville schemes (D17A/0793 and D18A/0566). This existing infrastructure in turn outfalls downstream into the existing Irish Water owned 300mm foul drainage piped infrastructure on Glenamuck Road. Refer to Dwg.2104/07 for further detail. The existing foul sewer has been submitted by the

Rockville developer for taking-in-charge by Irish Water and a letter of consent for the connection into this foul pipe has been provided the sewer owner and is included in Appendix 12.15 of this report.

10.6 Located in the north corner of the subject site, apartment Blocks C & D (59No. units) will outfall the localised foul flow from into the foul drainage infrastructure to be provided as part of the GDRS project in Glenamuck road. The foul drainage connection spur from the GDRS infrastructure has been agreed with the DLRCC GDRS project office and is incorporated into that road project. Connection into same is subject to a successful planning permission and agreement with Irish Water. Refer to Dwg.2104/07 & 30 and Appendix 12.17 for further detail.

10.7 Refer to Dwg.No.2104/06 & 07 for the alignment and levels of the proposed foul network.

10.8 The proposed development is to be phased as 1, 2, 2A, 3, 4 & 5. The extent of each phase and the main wastewater drainage infrastructure associated with each phase is identified on Dwg.No.2104/18. All main wastewater services necessary to serve each phase are to be completed in full in each area from the head of the system to outfall. Final connection dates to be agreed with IW at connection application stage subject to a successful planning approval.

10.9 Design estimates for the foul water loading are as per Table's 12 and 13 below and refer to Appendix 12.18 for more calculations;

Foul Wastewater Calculations for TOTAL SITE

<table>
<tr><th colspan="7"><i>New Network - DOMESTIC Wastewater Flows</i></th></tr>
<tr><th>Usage</th><th>Quantity</th><th>Occupancy (h)</th><th>Population (P)</th><th>Consumption (G) (l/h/day)</th><th colspan="2">Loading (PxG)(l/day)</th></tr>
<tr><td>Residential</td><td>383 Units</td><td>2.7No./Unit</td><td>1034</td><td>150</td><td colspan="2">155,100</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="5"><b>Total =</b></td><td colspan="2"><b>155,100 l/day</b></td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="5"><b>Flowrate per day (l/s)</b></td><td></td><td><b>1.80l/s</b></td></tr>
<tr><td colspan="5">Growth Rate</td><td>1</td><td>1</td></tr>
<tr><td colspan="5">Infiltration (I)</td><td>10%</td><td>0.18</td></tr>
<tr><td colspan="5"><b>Dry Weather Flow</b></td><td><b>PG + I</b></td><td><b>1.97 l/s</b></td></tr>
<tr><td colspan="5">Peaking Factor (Pf_{Dom})</td><td>3</td><td></td></tr>
<tr><td colspan="5"><b>Design Foul Flow (l/s)</b></td><td><b>Pf_{Dom} x PG</b></td><td><b>5.91 l/s</b></td></tr>
<tr><td colspan="5">Misconnection Allowance (SW)</td><td>1.5%</td><td>0.09l/s</td></tr>
<tr><td colspan="5"><b>Design Flow (l/s)</b></td><td></td><td><b>6.00 l/s</b></td></tr>
</table>

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

Table 12 - Residential Wastewater Calculations

<table>
<tr><th colspan="7"><em>New Network - COMMERCIAL Wastewater Flows</em></th></tr>
<tr><th>Usage</th><th>Quantity</th><th>Occupancy (h)</th><th>Population (P)</th><th>Consumption (G) (l/h/day)</th><th colspan="2">Loading (PxG)(l/day)</th></tr>
<tr><td>Retail/Comm</td><td>2,975m^2</td><td>1per 5m^2</td><td>595</td><td>50</td><td colspan="2">29,750</td></tr>
<tr><td>Crèche</td><td>439m^2</td><td>1child/8m^2 + Staff (20%) + support accommodation</td><td>65</td><td>50</td><td colspan="2">3,250</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="5"><strong>Total =</strong></td><td colspan="2"><strong>33,000 l/day</strong></td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="5"><strong>Flowrate per 12hr day (l/s)</strong></td><td></td><td><strong>0.76l/s</strong></td></tr>
<tr><td colspan="5">Growth Rate</td><td>1</td><td>1</td></tr>
<tr><td colspan="5">Infiltration (I)</td><td>10%</td><td>0.08</td></tr>
<tr><td colspan="5"><strong>Dry Weather Flow</strong></td><td><strong>PG + I</strong></td><td><strong>0.83 l/s</strong></td></tr>
<tr><td colspan="5">Peaking Factor (Pf_{Dom})</td><td>6</td><td></td></tr>
<tr><td colspan="5"><strong>Design Foul Flow (l/s)</strong></td><td><strong>Pf_{Dom} x PG</strong></td><td><strong>5.02 l/s</strong></td></tr>
<tr><td colspan="5">Misconnection Allowance (SW)</td><td>1.5%</td><td>0.08l/s</td></tr>
<tr><td colspan="5"><strong>Design Flow (l/s)</strong></td><td></td><td><strong>5.1 l/s</strong></td></tr>
</table>

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

Table 13 – Commercial Wastewater Calculations

10.10 As the development of the site is to be phased, calculations for the phased wastewater flows are included in Appendix 12.18 of this report. A summary of the phasing wastewater calculations are shown in Table 14 below and Final connection dates to be agreed with IW at connection application stage subject to a successful planning approval;

Usage	Residential Design Flow (l/s)	Commercial Design Flow (l/s)
Phase 1	2.8	
Phase 2	2.3	
Phase 2A	0.9	3.8
Phase 3	1.8	
Phase 4	3.1	
Phase 5	0.3	1.4

Table 14 – Wastewater Phased Flowrates

10.11 Details of manholes are to be as per Dwg.No.2104/20 and in accordance with the Irish Water Code of Practice for Wastewater Infrastructure 2020.

11.0 Site Potable Watermain

11.1 Water infrastructure records drawings were obtained from Irish Water/DLRCC in preparation for this planning application and are included in Appendix 12.11 of this document.

11.2 A Pre-Connection Enquiry Form application (PCEA) was submitted to Irish Water and a confirmation of available service was received from IW (ref.CDS21006509) noting that the water connection was "*feasible without infrastructure upgrade*". A copy of the IW Confirmation of Feasibility (CoF) letter can be viewed in Appendix 12.16 of this report.

11.3 Further to the CoF from IW, a full design submission was made for the water infrastructure. Subsequently IW have issued the Statement of Design acceptance letter (Ref.CDS20006509) issued on 01/06/22. A copy of the IW design acceptance letter can be viewed in Appendix 12.16 of this report.

11.4 There is an existing 300mmØ diameter water supply main located along the Enniskerry Road passing in front of the proposed development and likewise a 250mm diameter main along Glenamuck Road. It is proposed to make a new connections into these watermains main to supply the development as confirmed by the IW CoF and Statement of Design Acceptance letters.

11.5 The applicant has enclosed (Appendix 12.5) copies of letters of consent from Ken Fennell (Statutory Receiver) over the portion of lands that sits outside the applicants ownership on the Glenamuck Rd. For clarity the applicant has full rights of access over/under this strip of land and can confirm that should a planning permission be granted the Applicant has the ability to deliver the services and ancillary works required to implement the designed scheme in full.

11.6 Refer to Dwg.No.'s 2104/09-11 for the watermain layout.

11.7 The proposed development is to be phased as 1, 2, 2A, 3, 4 & 5. The extent of each phase and the main water infrastructure associated with each phase is identified on Dwg.No.2104/18. All main water services necessary to serve each phase are to be completed in full in each area from the head of the system to outfall. Final connection dates to be agreed with IW at connection application stage subject to a successful planning approval.

11.8 Each individual residential dwelling within the development is to be provided with a boundary box for a separate domestic water meter. The type and configuration of the water meter is to be agreed with Irish Water in advance of construction commencing at the development.

11.9 Each dwelling will be fitted with a cold-water storage tank to provide 24 hours of supply.

11.10 In accordance with best practice, the use of water conservation appliances in the buildings are to be employed as part of this scheme to reduce the water demand. Although the consumption of treated water depends a lot on the behaviour of consumers, demand on the network is limited in the scheme by incorporating water saving tap valves, eco-flush toilet system and water saving appliances.

11.11 As a further measure of demand reduction, it is proposed to provide c.172No. 200l **rainwater butts** to the rear of each gabling property. This will collect rainwater from the house roofs for use in garden irrigation, therefore reducing drinking water demand and decreasing run-off from the site. Refer to Appendix 12.5 for more information.

11.12 All watermain layout and details are to be in accordance with the Irish Water Code of Practice for Water Infrastructure 2020 and the Water Infrastructure Standard details 2020.

11.13 Estimates of the water demand for the site were carried out using the guidelines in accordance with the IW COP for Water Infrastructure 2020 publication and are shown in Table's 15 and 16 below and in Appendix 12.18;

Water Demand Calculations for TOTAL SITE

New Network – DOMESTIC Water Demand								
Usage	**Quantity**	**Occupancy**	**Population**	**Consumption (l//h/day)**	**Ave. Daily Domestic Demand (l/day)**	**Ave. Daily Domestic Demand (l/s)**	**Ave. Day/Peak Week (l/s)**	**Peak Hour Water Demand (l/s)**
Resi'	383 Units	2.7 No./Unit	1034	150	155,115	1.80	2.24	**11.2 l/s**
Peak Hour Water Demand (Domestic)								**11.2 /s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

Table 15 – Residential Water Demand Calculations

New Network – COMMERCIAL Water Demand								
Usage	Quantity	Occupancy	Population	Consumption (l//h/day)	Ave. Daily Domestic Demand (l/day)	Ave. Daily(12hr) Domestic Demand (l/s)	Ave. Day/Peak Week (l/s)	Peak Hour Water Demand (l/s)
Retail/ Comm	2,975m^2	1per 5m^2	595	50	29,750	0.69	0.86	4.3
Crèche	439m^2	1child/8m^2 + Staff (20%) + support accommodation	66	50	3,293	0.08	0.09	0.47
Peak Hour Water Demand (Commercial)								4.8l/s

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

Table 16 – Commercial Water Demand Calculations

11.14 As the development of the site is to be phased, calculations for the phased water demand are included in the appendix of this report. A summary of the phasing wastewater calculations are shown in Table 17 below;

Usage	Residential Design Flow (l/s)	Commercial Design Flow (l/s)
Phase 1	2.7	
Phase 2	2.1	
Phase 2A	1.6	2.4
Phase 3	1.7	
Phase 4	2.8	
Phase 5	0.3	1.5

Table 17 – Commercial Water Demand Calculations

12.0 APPENDIX

12.1 MicroDrainage Drainage Calculations
12.2 Interception and Sample Swale Calculations
12.3 StormTech System Calculations & Details
12.4 OPW PFRA Map No.2019/MAP/221/A
12.5 HR Wallingford/UK SuDS Report
12.6 SuDS Audit Report
12.7 GSI Data
12.8 Site Investigations Reports
12.9 DLRCC Flood Zone Map No.9
12.10 DLRCC Local Area Plan Map.NoPL-13-402
12.11 IW/DLRCC Records Drawings
12.12 OPW Flood Hazard Mapping Report
12.13 Green Roof Information
12.14 Met Eireann Data Sheet
12.15 Letters of Consent
12.16 Irish Water CoF/Design Acceptance Letters
12.17 DLRCC GDRS Project Correspondence
12.18 Water and Wastewater Calculations

Appendix 12.1

Micro Drainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.271	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	90	Maximum Backdrop Height (m)	3.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.500
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	1.000	Min Slope for Optimisation (1:X)	180

Designed with Level Soffits

Time Area Diagram for Storm at outfall SExisting Mh (pipe S1.018)

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**	**Time (mins)**	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.836	4-8	4.416	8-12	1.025	12-16	0.000

Total Area Contributing (ha) = 6.276

Total Pipe Volume (m³) = 268.031

Time Area Diagram at outfall SGlenamuck Rd (pipe S17.004)

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.195	4-8	0.023

Total Area Contributing (ha) = 0.218

Total Pipe Volume (m³) = 5.187

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	**Length (m)**	**Fall (m)**	**Slope (1:X)**	**I.Area (ha)**	**T.E. (mins)**	**Base Flow (l/s)**	**k (mm)**	**HYD SECT**	**DIA (mm)**	**Section Type**	**Auto Design**
S1.000	40.678	0.423	96.2	0.097	4.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S1.001	43.770	0.362	120.9	0.121	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S1.002	55.734	1.922	29.0	0.125	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S1.003	22.349	0.757	29.5	0.100	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒

Network Results Table

PN	**Rain (mm/hr)**	**T.C. (mins)**	**US/IL (m)**	**Σ I.Area (ha)**	**Σ Base Flow (l/s)**	**Foul (l/s)**	**Add Flow (l/s)**	**Vel (m/s)**	**Cap (l/s)**	**Flow (l/s)**
S1.000	56.10	4.42	140.910	0.097	0.0	0.0	0.0	1.60	113.3	19.6
S1.001	53.97	4.93	140.487	0.218	0.0	0.0	0.0	1.43	101.0	42.4
S1.002	52.74	5.25	140.125	0.342	0.0	0.0	0.0	2.93	207.2	65.2
S1.003	52.27	5.38	138.201	0.442	0.0	0.0	0.0	2.90	205.3	83.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.000	43.680	0.771	56.7	0.080	4.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S2.001	30.954	0.729	42.5	0.086	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S2.002	55.087	0.551	100.0	0.121	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S1.004	31.603	0.781	40.5	0.063	0.00	0.0	0.600	o	375	Pipe/Conduit	🔒
S1.005	31.723	1.035	30.7	0.115	0.00	0.0	0.600	o	375	Pipe/Conduit	🔒
S3.000	38.235	0.283	135.0	0.034	4.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S3.001	12.862	0.086	149.6	0.007	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S3.002	22.723	0.151	150.5	0.114	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S3.003	31.593	0.211	149.7	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	🔒
S3.004	21.926	0.119	184.3	0.080	0.00	0.0	0.600	o	375	Pipe/Conduit	🔒
S3.005	15.359	0.119	129.1	0.001	0.00	0.0	0.600	o	375	Pipe/Conduit	🔓
S1.006	20.829	0.150	138.9	0.027	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
S1.007	19.092	0.133	144.0	0.038	0.00	0.0	0.600	o	600	Pipe/Conduit	🔓
S1.008	63.723	0.394	161.7	0.189	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
S4.000	34.163	1.708	20.0	0.036	4.00	0.0	0.600	o	225	Pipe/Conduit	🔓
S1.009	42.021	0.276	152.3	0.190	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
S5.000	44.747	1.217	36.8	0.119	4.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S5.001	17.701	0.754	23.5	0.042	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S5.002	28.564	0.712	40.1	0.062	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S1.010	8.793	0.516	17.0	0.102	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
S1.011	23.747	0.118	201.2	0.021	0.00	0.0	0.600	o	600	Pipe/Conduit	🔓

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	56.12	4.42	139.210	0.080	0.0	0.0	0.0	1.74	69.2	16.2
S2.001	55.21	4.63	138.380	0.166	0.0	0.0	0.0	2.42	171.0	33.1
S2.002	52.88	5.22	137.500	0.287	0.0	0.0	0.0	1.57	111.2	54.8
S1.004	51.60	5.56	136.700	0.792	0.0	0.0	0.0	2.86	315.4	147.5
S1.005	51.04	5.72	135.900	0.907	0.0	0.0	0.0	3.28	362.6	167.1
S3.000	55.89	4.47	135.080	0.034	0.0	0.0	0.0	1.35	95.5	7.0
S3.001	55.17	4.64	134.790	0.041	0.0	0.0	0.0	1.28	90.7	8.2
S3.002	53.96	4.93	134.700	0.155	0.0	0.0	0.0	1.28	90.4	30.2
S3.003	52.59	5.29	134.480	0.220	0.0	0.0	0.0	1.48	163.3	41.7
S3.004	51.59	5.57	134.250	0.299	0.0	0.0	0.0	1.33	147.1	55.8
S3.005	51.03	5.73	134.131	0.301	0.0	0.0	0.0	1.59	176.0	55.8
S1.006	50.46	5.89	133.950	1.234	0.0	0.0	0.0	2.06	583.8	224.9
S1.007	49.94	6.05	133.800	1.272	0.0	0.0	0.0	2.03	573.2	229.4
S1.008	48.20	6.61	133.650	1.461	0.0	0.0	0.0	1.91	540.7	254.3
S4.000	57.13	4.19	136.100	0.036	0.0	0.0	0.0	2.94	116.9	7.5
S1.009	47.17	6.96	133.260	1.688	0.0	0.0	0.0	1.97	557.4	287.4
S5.000	56.45	4.34	139.100	0.119	0.0	0.0	0.0	2.16	86.1	24.2
S5.001	55.97	4.45	136.850	0.161	0.0	0.0	0.0	2.71	107.8	32.6
S5.002	55.15	4.64	136.021	0.224	0.0	0.0	0.0	2.49	176.0	44.5
S1.010	47.10	6.99	132.980	2.013	0.0	0.0	0.0	5.92	1673.1	342.4
S1.011	46.46	7.22	132.250	2.034	0.0	0.0	0.0	1.71	484.3	342.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S6.000	51.580	0.572	90.2	0.127	4.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S7.000	20.919	0.139	150.0	0.079	6.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S7.001	56.030	0.467	120.0	0.068	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S8.000	35.234	0.294	119.8	0.079	6.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S8.001	12.620	0.105	120.0	0.011	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S6.001	50.405	0.421	119.7	0.142	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S6.002	37.839	0.315	120.1	0.397	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S6.003	15.215	0.127	119.8	0.063	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S6.004	37.471	0.134	279.6	0.013	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S9.000	25.127	0.251	100.1	0.053	4.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S9.001	11.348	0.174	65.2	0.015	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S9.002	7.707	0.053	145.4	0.095	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S10.000	36.604	0.366	100.0	0.119	4.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S10.001	21.049	0.191	110.2	0.159	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S10.002	22.929	0.124	184.9	0.086	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S11.000	31.625	0.316	100.0	0.071	4.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S11.001	7.621	0.072	105.8	0.052	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S11.002	5.767	0.029	198.9	0.005	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S9.003	15.123	0.105	144.0	0.002	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S9.004	54.407	0.448	121.4	0.131	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S6.000	55.68	4.52	140.700	0.127	0.0	0.0	0.0	1.66	117.1	25.4
S7.000	49.23	6.27	140.800	0.079	0.0	0.0	0.0	1.28	90.6	14.0
S7.001	47.28	6.92	140.650	0.147	0.0	0.0	0.0	1.43	101.4	25.1
S8.000	48.80	6.41	140.580	0.079	0.0	0.0	0.0	1.44	101.4	14.0
S8.001	48.35	6.56	140.286	0.090	0.0	0.0	0.0	1.43	101.4	15.7
S6.001	46.03	7.38	140.036	0.505	0.0	0.0	0.0	1.86	295.3	84.0
S6.002	45.15	7.72	139.615	0.903	0.0	0.0	0.0	1.85	294.9	147.1
S6.003	44.80	7.85	139.300	0.965	0.0	0.0	0.0	1.86	295.2	156.1
S6.004	43.56	8.37	138.870	0.978	0.0	0.0	0.0	1.21	192.6	156.1
S9.000	56.80	4.27	140.650	0.053	0.0	0.0	0.0	1.57	111.1	10.9
S9.001	56.36	4.36	140.399	0.068	0.0	0.0	0.0	1.95	137.8	13.8
S9.002	56.03	4.44	140.000	0.163	0.0	0.0	0.0	1.68	267.8	33.0
S10.000	56.25	4.39	141.500	0.119	0.0	0.0	0.0	1.57	111.1	24.3
S10.001	55.24	4.62	141.134	0.279	0.0	0.0	0.0	1.50	105.8	55.6
S10.002	54.19	4.88	140.060	0.365	0.0	0.0	0.0	1.49	237.3	71.4
S11.000	56.19	4.40	141.130	0.071	0.0	0.0	0.0	1.31	52.0	14.5
S11.001	55.82	4.49	140.700	0.124	0.0	0.0	0.0	1.53	108.0	24.9
S11.002	55.54	4.55	140.100	0.129	0.0	0.0	0.0	1.44	228.7	25.8
S9.003	53.28	5.11	139.900	0.659	0.0	0.0	0.0	1.09	43.2«	126.7
S9.004	50.96	5.75	139.790	0.790	0.0	0.0	0.0	1.43	100.8«	145.3

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S9.005	50.995	0.336	151.8	0.071	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S9.006	47.205	0.219	215.7	0.078	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S6.005	16.306	0.119	137.0	0.072	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S6.006	26.450	0.185	143.0	0.079	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S6.007	51.993	0.732	71.0	0.110	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S6.008	22.172	1.109	20.0	0.098	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S6.009	10.726	0.505	21.2	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S12.000	38.228	0.405	94.4	0.105	4.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S12.001	14.710	0.184	79.9	0.024	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S12.002	9.963	0.077	129.4	0.046	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S12.003	17.943	0.122	147.1	0.004	0.00	0.0	0.600	o	450	Pipe/Conduit	🔓
S12.004	7.788	0.060	129.8	0.034	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S13.000	54.291	0.804	67.5	0.158	4.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S12.005	23.014	0.239	96.3	0.062	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S12.006	35.596	0.357	99.7	0.048	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S12.007	35.464	0.358	99.1	0.142	0.00	0.0	0.600	o	375	Pipe/Conduit	🔓
S14.000	34.562	1.069	32.3	0.114	4.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S12.008	41.437	0.505	82.1	0.181	0.00	0.0	0.600	o	375	Pipe/Conduit	🔓
S12.009	39.425	0.826	47.7	0.149	0.00	0.0	0.600	o	375	Pipe/Conduit	🔓
S12.010	30.682	0.822	37.3	0.045	0.00	0.0	0.600	o	375	Pipe/Conduit	🔓
S12.011	86.979	0.256	339.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S9.005	49.26	6.26	139.280	0.860	0.0	0.0	0.0	1.65	262.1	153.0
S9.006	47.54	6.83	138.927	0.938	0.0	0.0	0.0	1.38	219.5	161.0
S6.005	43.01	8.61	138.708	1.988	0.0	0.0	0.0	1.12	44.3«	308.8
S6.006	42.12	9.02	138.590	2.068	0.0	0.0	0.0	1.09	43.4«	314.5
S6.007	40.98	9.57	138.405	2.177	0.0	0.0	0.0	1.55	61.8«	322.2
S6.008	40.73	9.70	137.670	2.275	0.0	0.0	0.0	2.94	116.9«	334.6
S6.009	40.61	9.76	136.258	2.296	0.0	0.0	0.0	2.85	113.4«	336.7
S12.000	56.23	4.39	140.320	0.105	0.0	0.0	0.0	1.62	114.4	21.4
S12.001	55.62	4.53	139.915	0.129	0.0	0.0	0.0	1.76	124.4	25.9
S12.002	55.11	4.65	139.731	0.175	0.0	0.0	0.0	1.38	97.6	34.9
S12.003	54.38	4.83	139.650	0.180	0.0	0.0	0.0	1.67	266.3	35.3
S12.004	53.92	4.95	139.532	0.213	0.0	0.0	0.0	1.15	45.6	41.5
S13.000	55.47	4.57	141.000	0.158	0.0	0.0	0.0	1.59	63.4	31.7
S12.005	52.99	5.18	139.397	0.434	0.0	0.0	0.0	1.60	113.3	83.0
S12.006	51.61	5.56	139.158	0.482	0.0	0.0	0.0	1.57	111.3	89.9
S12.007	50.49	5.89	138.726	0.625	0.0	0.0	0.0	1.82	201.1	113.9
S14.000	56.87	4.25	140.030	0.114	0.0	0.0	0.0	2.31	91.8	23.3
S12.008	49.36	6.23	138.368	0.919	0.0	0.0	0.0	2.00	221.1	163.9
S12.009	48.58	6.48	137.863	1.068	0.0	0.0	0.0	2.63	290.3	187.4
S12.010	48.06	6.65	137.037	1.113	0.0	0.0	0.0	2.97	328.5	193.2
S12.011	44.50	7.97	135.230	1.113	0.0	0.0	0.0	1.10	174.5«	193.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S15.000	27.335	0.273	100.0	0.124	4.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S15.001	41.735	1.225	34.1	0.130	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S15.002	26.771	0.942	28.4	0.109	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S15.003	38.123	1.315	29.0	0.091	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S15.004	53.574	0.257	208.5	0.110	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S12.012	16.181	0.167	96.9	0.051	0.00	0.0	0.600	o	225	Pipe/Conduit	🔐
S6.010	18.505	0.171	108.2	0.018	0.00	0.0	0.600	o	300	Pipe/Conduit	🔐
S6.011	56.227	0.187	300.7	0.043	0.00	0.0	0.600	o	450	Pipe/Conduit	🔐
S16.000	49.592	0.331	149.8	0.094	4.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S16.001	12.266	0.119	103.1	0.026	0.00	0.0	0.600	o	450	Pipe/Conduit	🔓
S1.012	21.327	1.066	20.0	0.037	0.00	0.0	0.600	o	300	Pipe/Conduit	🔐
S1.013	42.270	1.431	29.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔐
S1.014	42.351	2.241	18.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔐
S1.015	24.294	0.759	32.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔐
S1.016	53.448	2.672	20.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔐
S1.017	22.677	0.344	66.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔐
S1.018	8.163	0.053	154.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔐
S17.000	25.190	0.420	60.0	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S17.001	35.233	0.573	61.5	0.002	0.00	0.0	0.600	o	225	Pipe/Conduit	🔓
S17.002	10.401	0.059	176.3	0.174	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S17.003	8.526	0.057	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S18.000	26.725	0.178	150.1	0.031	4.00	0.0	0.600	o	225	Pipe/Conduit	🔐

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S15.000	56.43	4.35	141.050	0.124	0.0	0.0	0.0	1.31	52.0	25.2
S15.001	55.31	4.61	140.702	0.254	0.0	0.0	0.0	2.70	191.0	50.7
S15.002	54.68	4.76	139.477	0.363	0.0	0.0	0.0	2.96	209.3	71.6
S15.003	53.81	4.97	138.535	0.453	0.0	0.0	0.0	2.93	207.2	88.1
S15.004	51.44	5.61	135.160	0.564	0.0	0.0	0.0	1.40	223.3	104.7
S12.012	44.01	8.18	134.897	1.728	0.0	0.0	0.0	1.33	52.8«	274.6
S6.010	40.21	9.97	134.780	4.042	0.0	0.0	0.0	1.51	106.8«	586.9
S6.011	38.76	10.77	132.500	4.085	0.0	0.0	0.0	1.17	185.6«	586.9
S16.000	55.77	4.50	133.050	0.094	0.0	0.0	0.0	1.66	263.8	18.9
S16.001	55.34	4.60	132.719	0.120	0.0	0.0	0.0	2.00	318.5	23.9
S1.012	38.59	10.87	131.600	6.276	0.0	0.0	0.0	3.53	249.6«	874.6
S1.013	38.18	11.11	130.530	6.276	0.0	0.0	0.0	2.90	205.2«	874.6
S1.014	37.86	11.31	128.400	6.276	0.0	0.0	0.0	3.63	256.8«	874.6
S1.015	37.62	11.45	126.150	6.276	0.0	0.0	0.0	2.79	197.2«	874.6
S1.016	37.23	11.70	125.390	6.276	0.0	0.0	0.0	3.53	249.6«	874.6
S1.017	36.92	11.90	122.710	6.276	0.0	0.0	0.0	1.94	137.0«	874.6
S1.018	36.76	12.01	122.320	6.276	0.0	0.0	0.0	1.26	89.4«	874.6
S17.000	56.88	4.25	135.250	0.000	0.0	0.0	0.0	1.69	67.3	0.0
S17.001	55.34	4.60	134.830	0.002	0.0	0.0	0.0	1.67	66.4	0.4
S17.002	54.73	4.75	132.100	0.176	0.0	0.0	0.0	1.18	83.5	34.8
S17.003	54.27	4.86	131.500	0.176	0.0	0.0	0.0	1.28	90.6	34.8
S18.000	56.12	4.42	134.000	0.031	0.0	0.0	0.0	1.06	42.3	6.3

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S17.004	9.658	0.064	150.9	0.011	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S17.004	53.67	5.01	131.250	0.218	0.0	0.0	0.0	1.06	42.2	42.2

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	70	0.025	0.017	0.017
	User	-	60	0.006	0.004	0.021
	User	-	60	0.005	0.003	0.024
	User	-	60	0.005	0.003	0.027
	User	-	70	0.025	0.017	0.044
	User	-	37	0.001	0.000	0.045
	User	-	37	0.002	0.001	0.045
	User	-	95	0.007	0.006	0.051
	User	-	37	0.006	0.002	0.054
	User	-	37	0.003	0.001	0.055
	User	-	100	0.001	0.001	0.056
	User	-	100	0.000	0.000	0.056
	User	-	100	0.017	0.017	0.073
	User	-	70	0.017	0.012	0.085
	User	-	71	0.003	0.002	0.087
	User	-	71	0.003	0.002	0.089
	User	-	37	0.002	0.001	0.090
	User	-	37	0.001	0.000	0.091
	User	-	37	0.016	0.006	0.097
1.001	User	-	60	0.005	0.003	0.003
	User	-	69	0.005	0.003	0.006
	User	-	70	0.015	0.011	0.017
	User	-	60	0.010	0.006	0.023
	User	-	37	0.002	0.001	0.024
	User	-	37	0.002	0.001	0.024
	User	-	37	0.008	0.003	0.027
	User	-	37	0.025	0.009	0.036
	User	-	71	0.047	0.034	0.070
	User	-	71	0.002	0.002	0.072
	User	-	71	0.003	0.002	0.073
	User	-	71	0.003	0.002	0.075
	User	-	37	0.001	0.001	0.076
	User	-	37	0.001	0.000	0.076
	User	-	37	0.002	0.001	0.077
	User	-	37	0.045	0.017	0.094
	User	-	100	0.014	0.014	0.107
	User	-	100	0.007	0.007	0.114
	User	-	100	0.007	0.007	0.121
1.002	User	-	60	0.005	0.003	0.003
	User	-	71	0.023	0.016	0.019
	User	-	71	0.012	0.009	0.028
	User	-	37	0.014	0.005	0.033
	User	-	37	0.004	0.001	0.034
	User	-	100	0.006	0.006	0.040
	User	-	95	0.000	0.000	0.041
	User	-	95	0.000	0.000	0.041
	User	-	37	0.001	0.000	0.041
	User	-	37	0.011	0.004	0.045
	User	-	71	0.004	0.003	0.048
	User	-	95	0.029	0.028	0.076
	User	-	60	0.005	0.003	0.079
	User	-	60	0.005	0.003	0.082
	User	-	37	0.001	0.000	0.082
	User	-	37	0.006	0.002	0.084
	User	-	37	0.003	0.001	0.085
	User	-	37	0.002	0.001	0.086
	User	-	37	0.002	0.001	0.087
	User	-	37	0.013	0.005	0.091
	User	-	100	0.015	0.015	0.107
	User	-	70	0.026	0.018	0.125
1.003	User	-	37	0.010	0.004	0.004
	User	-	71	0.011	0.008	0.012

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	37	0.006	0.002	0.014
	User	-	71	0.023	0.016	0.030
	User	-	71	0.011	0.007	0.037
	User	-	71	0.018	0.013	0.050
	User	-	37	0.033	0.012	0.062
	User	-	71	0.002	0.002	0.064
	User	-	60	0.005	0.003	0.067
	User	-	60	0.003	0.002	0.069
	User	-	37	0.001	0.000	0.069
	User	-	100	0.010	0.010	0.079
	User	-	70	0.015	0.011	0.090
	User	-	37	0.027	0.010	0.100
2.000	User	-	69	0.003	0.002	0.002
	User	-	69	0.005	0.004	0.005
	User	-	69	0.002	0.002	0.007
	User	-	69	0.005	0.003	0.010
	User	-	37	0.001	0.000	0.011
	User	-	37	0.000	0.000	0.011
	User	-	37	0.002	0.001	0.012
	User	-	95	0.026	0.025	0.037
	User	-	37	0.038	0.014	0.051
	User	-	71	0.011	0.007	0.058
	User	-	37	0.039	0.015	0.073
	User	-	95	0.002	0.002	0.075
	User	-	95	0.003	0.003	0.078
	User	-	37	0.001	0.001	0.078
	User	-	95	0.002	0.002	0.080
2.001	User	-	37	0.001	0.000	0.000
	User	-	95	0.028	0.026	0.026
	User	-	37	0.039	0.015	0.041
	User	-	37	0.050	0.018	0.059
	User	-	71	0.025	0.018	0.077
	User	-	37	0.001	0.000	0.077
	User	-	37	0.002	0.001	0.078
	User	-	37	0.001	0.000	0.079
	User	-	37	0.005	0.002	0.080
	User	-	60	0.002	0.001	0.082
	User	-	60	0.002	0.001	0.083
	User	-	60	0.003	0.002	0.085
	User	-	95	0.001	0.001	0.086
2.002	User	-	37	0.001	0.000	0.000
	User	-	37	0.000	0.000	0.001
	User	-	71	0.017	0.012	0.012
	User	-	37	0.030	0.011	0.023
	User	-	37	0.006	0.002	0.026
	User	-	37	0.001	0.000	0.026
	User	-	37	0.001	0.000	0.026
	User	-	60	0.003	0.002	0.028
	User	-	60	0.002	0.001	0.029
	User	-	60	0.002	0.001	0.031
	User	-	60	0.003	0.002	0.032
	User	-	60	0.001	0.001	0.033
	User	-	60	0.001	0.001	0.034
	User	-	60	0.004	0.002	0.036
	User	-	60	0.005	0.003	0.039
	User	-	60	0.005	0.003	0.042
	User	-	60	0.005	0.003	0.045
	User	-	95	0.038	0.036	0.081
	User	-	95	0.007	0.007	0.088
	User	-	100	0.014	0.014	0.102
	User	-	100	0.008	0.008	0.110
	User	-	71	0.009	0.006	0.116

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	95	0.001	0.001	0.117
	User	-	95	0.001	0.001	0.118
	User	-	95	0.001	0.001	0.119
	User	-	71	0.002	0.002	0.121
	User	-	37	0.001	0.000	0.121
	User	-	37	0.000	0.000	0.121
1.004	User	-	60	0.013	0.008	0.008
	User	-	37	0.001	0.000	0.008
	User	-	37	0.001	0.000	0.008
	User	-	37	0.001	0.000	0.009
	User	-	95	0.001	0.001	0.009
	User	-	37	0.013	0.005	0.014
	User	-	37	0.006	0.002	0.016
	User	-	37	0.001	0.000	0.017
	User	-	37	0.001	0.000	0.017
	User	-	95	0.001	0.001	0.018
	User	-	95	0.002	0.001	0.020
	User	-	100	0.014	0.014	0.033
	User	-	95	0.005	0.005	0.038
	User	-	37	0.006	0.002	0.040
	User	-	95	0.024	0.022	0.063
1.005	User	-	60	0.005	0.003	0.003
	User	-	37	0.001	0.000	0.003
	User	-	37	0.001	0.000	0.004
	User	-	95	0.044	0.042	0.045
	User	-	37	0.001	0.000	0.046
	User	-	37	0.001	0.000	0.046
	User	-	37	0.001	0.000	0.047
	User	-	37	0.001	0.000	0.047
	User	-	95	0.006	0.005	0.052
	User	-	100	0.013	0.013	0.066
	User	-	70	0.023	0.016	0.082
	User	-	70	0.023	0.016	0.098
	User	-	37	0.017	0.006	0.104
	User	-	95	0.002	0.001	0.105
	User	-	95	0.005	0.005	0.110
	User	-	95	0.005	0.005	0.115
	User	-	95	0.001	0.001	0.115
3.000	User	-	71	0.003	0.002	0.002
	User	-	37	0.007	0.002	0.005
	User	-	37	0.015	0.006	0.010
	User	-	37	0.012	0.004	0.014
	User	-	71	0.028	0.020	0.034
3.001	User	-	71	0.007	0.005	0.005
	User	-	37	0.001	0.001	0.006
	User	-	37	0.004	0.001	0.007
3.002	User	-	100	0.041	0.041	0.041
	User	-	60	0.005	0.003	0.044
	User	-	60	0.007	0.004	0.049
	User	-	37	0.001	0.000	0.049
	User	-	71	0.032	0.022	0.072
	User	-	37	0.007	0.003	0.074
	User	-	71	0.006	0.004	0.079
	User	-	71	0.003	0.002	0.081
	User	-	60	0.010	0.006	0.087
	User	-	37	0.001	0.000	0.087
	User	-	37	0.015	0.005	0.093
	User	-	95	0.022	0.021	0.114
3.003	User	-	37	0.001	0.000	0.000
	User	-	100	0.050	0.050	0.051
	User	-	60	0.006	0.004	0.054
	User	-	37	0.001	0.000	0.054

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	37	0.001	0.000	0.055
	User	-	71	0.004	0.003	0.058
	User	-	60	0.008	0.005	0.062
	User	-	37	0.004	0.001	0.064
	User	-	37	0.002	0.001	0.065
3.004	User	-	37	0.001	0.000	0.000
	User	-	37	0.003	0.001	0.001
	User	-	60	0.006	0.004	0.005
	User	-	60	0.003	0.002	0.007
	User	-	71	0.007	0.005	0.011
	User	-	71	0.024	0.017	0.029
	User	-	71	0.007	0.005	0.033
	User	-	60	0.007	0.004	0.038
	User	-	37	0.008	0.003	0.041
	User	-	92	0.015	0.014	0.055
	User	-	92	0.012	0.011	0.066
	User	-	100	0.005	0.005	0.071
	User	-	100	0.009	0.009	0.080
3.005	User	-	37	0.004	0.001	0.001
1.006	User	-	60	0.002	0.001	0.001
	User	-	37	0.001	0.000	0.002
	User	-	37	0.001	0.000	0.002
	User	-	37	0.011	0.004	0.006
	User	-	71	0.014	0.010	0.016
	User	-	37	0.003	0.001	0.017
	User	-	71	0.000	0.000	0.018
	User	-	71	0.008	0.005	0.023
	User	-	71	0.005	0.004	0.027
1.007	User	-	71	0.015	0.011	0.011
	User	-	37	0.005	0.002	0.012
	User	-	37	0.017	0.006	0.019
	User	-	71	0.013	0.009	0.028
	User	-	71	0.001	0.000	0.028
	User	-	37	0.010	0.004	0.032
	User	-	71	0.009	0.006	0.038
1.008	User	-	60	0.003	0.002	0.002
	User	-	60	0.007	0.004	0.006
	User	-	60	0.005	0.003	0.009
	User	-	60	0.009	0.006	0.015
	User	-	37	0.000	0.000	0.015
	User	-	37	0.001	0.000	0.015
	User	-	37	0.000	0.000	0.015
	User	-	37	0.000	0.000	0.015
	User	-	71	0.030	0.021	0.036
	User	-	37	0.002	0.001	0.037
	User	-	37	0.002	0.001	0.038
	User	-	37	0.000	0.000	0.038
	User	-	37	0.001	0.001	0.039
	User	-	37	0.001	0.000	0.039
	User	-	95	0.004	0.004	0.042
	User	-	95	0.004	0.004	0.047
	User	-	100	0.014	0.014	0.060
	User	-	100	0.010	0.010	0.071
	User	-	70	0.022	0.015	0.086
	User	-	70	0.018	0.012	0.099
	User	-	37	0.018	0.007	0.105
	User	-	37	0.015	0.005	0.111
	User	-	37	0.018	0.007	0.117
	User	-	37	0.011	0.004	0.121
	User	-	70	0.022	0.015	0.136
	User	-	70	0.015	0.011	0.147
	User	-	71	0.004	0.003	0.150

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	71	0.002	0.001	0.151
	User	-	37	0.001	0.000	0.152
	User	-	95	0.001	0.000	0.152
	User	-	60	0.003	0.002	0.154
	User	-	60	0.003	0.002	0.155
	User	-	60	0.002	0.001	0.157
	User	-	60	0.002	0.001	0.158
	User	-	60	0.002	0.001	0.160
	User	-	71	0.003	0.002	0.162
	User	-	37	0.014	0.005	0.167
	User	-	70	0.024	0.017	0.184
	User	-	37	0.005	0.002	0.186
	User	-	71	0.004	0.003	0.189
	User	-	37	0.001	0.000	0.189
4.000	User	-	71	0.017	0.012	0.012
	User	-	70	0.024	0.017	0.029
	User	-	70	0.001	0.001	0.029
	User	-	37	0.013	0.005	0.034
	User	-	37	0.003	0.001	0.035
	User	-	37	0.000	0.000	0.035
	User	-	37	0.001	0.000	0.035
	User	-	71	0.000	0.000	0.036
	User	-	71	0.000	0.000	0.036
	User	-	37	0.000	0.000	0.036
	User	-	37	0.001	0.000	0.036
	User	-	37	0.000	0.000	0.036
1.009	User	-	60	0.005	0.003	0.003
	User	-	60	0.002	0.001	0.004
	User	-	37	0.001	0.000	0.005
	User	-	95	0.031	0.030	0.035
	User	-	71	0.058	0.041	0.076
	User	-	37	0.001	0.000	0.076
	User	-	37	0.000	0.000	0.077
	User	-	37	0.001	0.001	0.077
	User	-	95	0.000	0.000	0.078
	User	-	95	0.002	0.002	0.080
	User	-	100	0.010	0.010	0.090
	User	-	70	0.018	0.012	0.102
	User	-	37	0.017	0.006	0.109
	User	-	70	0.000	0.000	0.109
	User	-	60	0.002	0.001	0.110
	User	-	95	0.013	0.013	0.123
	User	-	37	0.001	0.000	0.123
	User	-	37	0.002	0.001	0.124
	User	-	37	0.008	0.003	0.127
	User	-	70	0.015	0.011	0.138
	User	-	100	0.008	0.008	0.145
	User	-	37	0.023	0.009	0.154
	User	-	95	0.020	0.019	0.173
	User	-	37	0.000	0.000	0.173
	User	-	37	0.000	0.000	0.173
	User	-	95	0.001	0.001	0.174
	User	-	95	0.001	0.001	0.175
	User	-	95	0.005	0.004	0.180
	User	-	95	0.005	0.004	0.184
	User	-	95	0.007	0.007	0.190
5.000	User	-	60	0.005	0.003	0.003
	User	-	71	0.024	0.017	0.020
	User	-	71	0.015	0.011	0.031
	User	-	37	0.062	0.023	0.054
	User	-	37	0.038	0.014	0.068
	User	-	71	0.012	0.008	0.076

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	37	0.031	0.012	0.088
	User	-	95	0.014	0.013	0.101
	User	-	95	0.005	0.005	0.106
	User	-	71	0.007	0.005	0.111
	User	-	60	0.002	0.001	0.112
	User	-	71	0.002	0.002	0.114
	User	-	71	0.001	0.000	0.114
	User	-	71	0.001	0.001	0.115
	User	-	37	0.006	0.002	0.117
	User	-	37	0.002	0.001	0.118
	User	-	37	0.002	0.001	0.119
5.001	User	-	71	0.014	0.010	0.010
	User	-	71	0.019	0.014	0.024
	User	-	71	0.010	0.007	0.031
	User	-	37	0.030	0.011	0.042
	User	-	37	0.001	0.000	0.042
5.002	User	-	37	0.001	0.000	0.000
	User	-	37	0.000	0.000	0.000
	User	-	37	0.045	0.017	0.017
	User	-	60	0.002	0.001	0.018
	User	-	60	0.002	0.001	0.020
	User	-	71	0.002	0.002	0.022
	User	-	71	0.000	0.000	0.022
	User	-	71	0.000	0.000	0.022
	User	-	37	0.003	0.001	0.023
	User	-	37	0.001	0.000	0.023
	User	-	37	0.001	0.000	0.024
	User	-	70	0.023	0.016	0.040
	User	-	70	0.018	0.013	0.053
	User	-	100	0.010	0.010	0.062
1.010	User	-	60	0.002	0.001	0.001
	User	-	60	0.002	0.001	0.003
	User	-	37	0.001	0.000	0.003
	User	-	37	0.000	0.000	0.003
	User	-	37	0.001	0.000	0.004
	User	-	37	0.001	0.000	0.004
	User	-	70	0.025	0.017	0.021
	User	-	60	0.002	0.001	0.023
	User	-	60	0.002	0.001	0.024
	User	-	37	0.000	0.000	0.024
	User	-	71	0.010	0.007	0.031
	User	-	71	0.001	0.000	0.032
	User	-	95	0.001	0.001	0.033
	User	-	95	0.003	0.002	0.036
	User	-	37	0.001	0.000	0.036
	User	-	37	0.001	0.000	0.036
	User	-	37	0.001	0.000	0.036
	User	-	70	0.022	0.015	0.052
	User	-	100	0.013	0.013	0.065
	User	-	70	0.013	0.009	0.074
	User	-	37	0.031	0.011	0.086
	User	-	37	0.019	0.007	0.093
	User	-	37	0.019	0.007	0.100
	User	-	71	0.003	0.002	0.102
	User	-	37	0.001	0.000	0.102
1.011	User	-	37	0.010	0.004	0.004
	User	-	37	0.001	0.000	0.004
	User	-	60	0.008	0.005	0.009
	User	-	60	0.006	0.004	0.012
	User	-	71	0.011	0.008	0.020
	User	-	71	0.001	0.001	0.021
6.000	User	-	95	0.008	0.008	0.008

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	60	0.035	0.021	0.029
	User	-	71	0.002	0.002	0.031
	User	-	71	0.003	0.002	0.033
	User	-	60	0.010	0.006	0.039
	User	-	60	0.005	0.003	0.042
	User	-	60	0.005	0.003	0.045
	User	-	60	0.005	0.003	0.048
	User	-	37	0.001	0.000	0.048
	User	-	37	0.001	0.000	0.049
	User	-	37	0.001	0.000	0.049
	User	-	37	0.002	0.001	0.050
	User	-	37	0.006	0.002	0.052
	User	-	37	0.002	0.001	0.053
	User	-	37	0.003	0.001	0.054
	User	-	37	0.001	0.000	0.054
	User	-	70	0.014	0.010	0.064
	User	-	70	0.017	0.012	0.076
	User	-	100	0.015	0.015	0.090
	User	-	100	0.006	0.006	0.096
	User	-	37	0.010	0.004	0.100
	User	-	37	0.025	0.009	0.109
	User	-	95	0.003	0.003	0.112
	User	-	95	0.001	0.001	0.113
	User	-	37	0.021	0.008	0.120
	User	-	37	0.003	0.001	0.122
	User	-	37	0.001	0.000	0.122
	User	-	95	0.005	0.004	0.127
7.000	User	-	71	0.021	0.015	0.015
	User	-	60	0.046	0.027	0.042
	User	-	60	0.038	0.023	0.065
	User	-	37	0.006	0.002	0.068
	User	-	37	0.003	0.001	0.069
	User	-	37	0.015	0.005	0.074
	User	-	60	0.004	0.002	0.077
	User	-	100	0.002	0.002	0.079
7.001	User	-	60	0.008	0.005	0.005
	User	-	60	0.007	0.004	0.009
	User	-	37	0.006	0.002	0.012
	User	-	37	0.001	0.001	0.012
	User	-	37	0.003	0.001	0.013
	User	-	37	0.001	0.000	0.014
	User	-	37	0.007	0.003	0.016
	User	-	60	0.018	0.011	0.027
	User	-	60	0.016	0.009	0.036
	User	-	60	0.030	0.018	0.054
	User	-	37	0.004	0.001	0.056
	User	-	60	0.017	0.010	0.066
	User	-	71	0.003	0.002	0.068
8.000	User	-	60	0.031	0.019	0.019
	User	-	37	0.042	0.015	0.034
	User	-	37	0.122	0.045	0.079
8.001	User	-	37	0.030	0.011	0.011
6.001	User	-	95	0.027	0.026	0.026
	User	-	71	0.018	0.013	0.038
	User	-	71	0.002	0.002	0.040
	User	-	60	0.005	0.003	0.043
	User	-	60	0.004	0.002	0.045
	User	-	60	0.008	0.005	0.050
	User	-	37	0.004	0.001	0.051
	User	-	37	0.002	0.001	0.052
	User	-	37	0.001	0.000	0.052
	User	-	100	0.002	0.002	0.054

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	95	0.001	0.001	0.055
	User	-	70	0.038	0.027	0.081
	User	-	100	0.012	0.012	0.093
	User	-	100	0.006	0.006	0.100
	User	-	37	0.012	0.004	0.104
	User	-	37	0.013	0.005	0.109
	User	-	95	0.001	0.001	0.110
	User	-	37	0.001	0.000	0.110
	User	-	37	0.001	0.000	0.111
	User	-	60	0.004	0.003	0.114
	User	-	37	0.001	0.001	0.114
	User	-	37	0.001	0.000	0.115
	User	-	71	0.037	0.026	0.141
	User	-	37	0.001	0.001	0.142
6.002	User	-	37	0.002	0.001	0.001
	User	-	95	0.012	0.011	0.012
	User	-	71	0.010	0.007	0.019
	User	-	100	0.001	0.001	0.019
	User	-	37	0.004	0.001	0.021
	User	-	37	0.004	0.001	0.022
	User	-	95	0.001	0.001	0.023
	User	-	100	0.008	0.008	0.031
	User	-	37	0.001	0.000	0.031
	User	-	71	0.005	0.004	0.035
	User	-	71	0.002	0.001	0.036
	User	-	71	0.001	0.001	0.037
	User	-	60	0.007	0.004	0.041
	User	-	60	0.002	0.001	0.042
	User	-	71	0.010	0.007	0.049
	User	-	37	0.001	0.000	0.049
	User	-	92	0.047	0.043	0.092
	User	-	92	0.036	0.033	0.125
	User	-	92	0.021	0.019	0.144
	User	-	92	0.004	0.004	0.148
	User	-	92	0.011	0.011	0.159
	User	-	92	0.032	0.029	0.188
	User	-	92	0.008	0.007	0.196
	User	-	100	0.021	0.021	0.217
	User	-	100	0.043	0.043	0.260
	User	-	100	0.000	0.000	0.261
	User	-	100	0.000	0.000	0.261
	User	-	85	0.141	0.120	0.381
	User	-	100	0.016	0.016	0.397
6.003	User	-	37	0.009	0.003	0.003
	User	-	37	0.002	0.001	0.004
	User	-	37	0.001	0.001	0.005
	User	-	71	0.001	0.001	0.005
	User	-	71	0.001	0.001	0.006
	User	-	60	0.002	0.001	0.007
	User	-	60	0.003	0.002	0.009
	User	-	37	0.010	0.004	0.013
	User	-	60	0.003	0.002	0.015
	User	-	95	0.005	0.005	0.020
	User	-	71	0.023	0.016	0.036
	User	-	60	0.002	0.001	0.037
	User	-	71	0.001	0.001	0.038
	User	-	37	0.011	0.004	0.042
	User	-	100	0.011	0.011	0.053
	User	-	100	0.002	0.002	0.055
	User	-	100	0.001	0.001	0.057
	User	-	100	0.006	0.006	0.063
6.004	User	-	71	0.004	0.003	0.003

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	71	0.008	0.006	0.009
	User	-	60	0.005	0.003	0.012
	User	-	37	0.003	0.001	0.013
9.000	User	-	37	0.014	0.005	0.005
	User	-	37	0.003	0.001	0.006
	User	-	37	0.004	0.002	0.008
	User	-	95	0.000	0.000	0.008
	User	-	95	0.028	0.026	0.034
	User	-	37	0.001	0.000	0.035
	User	-	100	0.008	0.008	0.043
	User	-	70	0.014	0.010	0.053
	User	-	95	0.001	0.001	0.053
9.001	User	-	37	0.003	0.001	0.001
	User	-	95	0.014	0.014	0.015
9.002	User	-	60	0.005	0.003	0.003
	User	-	70	0.028	0.019	0.022
	User	-	37	0.001	0.000	0.023
	User	-	37	0.001	0.001	0.023
	User	-	60	0.005	0.003	0.026
	User	-	95	0.006	0.005	0.032
	User	-	37	0.002	0.001	0.032
	User	-	37	0.001	0.000	0.033
	User	-	37	0.002	0.001	0.033
	User	-	71	0.003	0.002	0.036
	User	-	71	0.001	0.001	0.036
	User	-	100	0.021	0.021	0.058
	User	-	37	0.020	0.007	0.065
	User	-	70	0.005	0.003	0.068
	User	-	95	0.009	0.009	0.077
	User	-	100	0.016	0.016	0.093
	User	-	100	0.002	0.002	0.095
10.000	User	-	70	0.015	0.010	0.010
	User	-	70	0.031	0.022	0.032
	User	-	37	0.001	0.000	0.033
	User	-	37	0.002	0.001	0.033
	User	-	37	0.002	0.001	0.034
	User	-	37	0.009	0.003	0.038
	User	-	100	0.008	0.008	0.046
	User	-	95	0.002	0.002	0.048
	User	-	37	0.002	0.001	0.048
	User	-	95	0.001	0.001	0.049
	User	-	37	0.007	0.003	0.052
	User	-	37	0.001	0.000	0.052
	User	-	71	0.021	0.015	0.066
	User	-	60	0.009	0.005	0.072
	User	-	71	0.002	0.001	0.073
	User	-	100	0.006	0.006	0.079
	User	-	100	0.007	0.007	0.087
	User	-	37	0.016	0.006	0.092
	User	-	37	0.002	0.001	0.093
	User	-	37	0.003	0.001	0.094
	User	-	37	0.001	0.001	0.095
	User	-	37	0.001	0.000	0.095
	User	-	37	0.001	0.001	0.096
	User	-	37	0.007	0.003	0.098
	User	-	70	0.013	0.009	0.107
	User	-	70	0.000	0.000	0.107
	User	-	100	0.008	0.008	0.115
	User	-	71	0.002	0.001	0.116
	User	-	95	0.000	0.000	0.117
	User	-	95	0.003	0.003	0.119
10.001	User	-	100	0.009	0.009	0.009

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	100	0.010	0.010	0.019
	User	-	70	0.001	0.001	0.020
	User	-	70	0.005	0.004	0.023
	User	-	60	0.006	0.003	0.027
	User	-	60	0.010	0.006	0.033
	User	-	95	0.032	0.031	0.064
	User	-	37	0.000	0.000	0.064
	User	-	71	0.011	0.007	0.071
	User	-	37	0.001	0.001	0.072
	User	-	37	0.002	0.001	0.072
	User	-	37	0.013	0.005	0.077
	User	-	37	0.015	0.006	0.083
	User	-	100	0.005	0.005	0.088
	User	-	37	0.001	0.000	0.088
	User	-	70	0.026	0.018	0.106
	User	-	70	0.016	0.011	0.117
	User	-	100	0.009	0.009	0.127
	User	-	100	0.012	0.012	0.139
	User	-	95	0.002	0.002	0.141
	User	-	95	0.001	0.001	0.142
	User	-	100	0.017	0.017	0.159
10.002	User	-	71	0.020	0.014	0.014
	User	-	37	0.001	0.000	0.014
	User	-	100	0.007	0.007	0.022
	User	-	37	0.003	0.001	0.023
	User	-	37	0.002	0.001	0.023
	User	-	70	0.021	0.015	0.038
	User	-	100	0.014	0.014	0.052
	User	-	95	0.003	0.003	0.055
	User	-	95	0.002	0.002	0.057
	User	-	37	0.001	0.000	0.058
	User	-	100	0.029	0.029	0.086
11.000	User	-	37	0.003	0.001	0.001
	User	-	37	0.001	0.000	0.002
	User	-	37	0.014	0.005	0.007
	User	-	37	0.002	0.001	0.007
	User	-	60	0.003	0.002	0.009
	User	-	60	0.002	0.001	0.010
	User	-	95	0.021	0.020	0.030
	User	-	71	0.012	0.008	0.038
	User	-	70	0.013	0.009	0.047
	User	-	100	0.008	0.008	0.055
	User	-	37	0.013	0.005	0.060
	User	-	71	0.005	0.003	0.064
	User	-	60	0.001	0.001	0.064
	User	-	60	0.011	0.007	0.071
	User	-	37	0.001	0.000	0.071
11.001	User	-	37	0.002	0.001	0.001
	User	-	60	0.005	0.003	0.004
	User	-	95	0.007	0.007	0.011
	User	-	71	0.003	0.002	0.013
	User	-	100	0.005	0.005	0.018
	User	-	37	0.001	0.000	0.018
	User	-	37	0.000	0.000	0.018
	User	-	70	0.014	0.010	0.028
	User	-	100	0.012	0.012	0.040
	User	-	37	0.007	0.003	0.042
	User	-	71	0.003	0.002	0.044
	User	-	71	0.004	0.003	0.047
	User	-	60	0.001	0.001	0.048
	User	-	60	0.007	0.004	0.052
	User	-	37	0.001	0.000	0.052

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
11.002	User	-	37	0.007	0.002	0.002
	User	-	37	0.003	0.001	0.004
	User	-	37	0.000	0.000	0.004
	User	-	100	0.002	0.002	0.005
9.003	User	-	95	0.002	0.002	0.002
9.004	User	-	60	0.005	0.003	0.003
	User	-	37	0.008	0.003	0.006
	User	-	37	0.002	0.001	0.006
	User	-	37	0.003	0.001	0.008
	User	-	71	0.010	0.007	0.014
	User	-	71	0.017	0.012	0.027
	User	-	71	0.011	0.008	0.034
	User	-	60	0.013	0.008	0.042
	User	-	37	0.007	0.002	0.044
	User	-	37	0.002	0.001	0.045
	User	-	100	0.007	0.007	0.052
	User	-	70	0.029	0.020	0.072
	User	-	37	0.010	0.004	0.076
	User	-	37	0.004	0.001	0.077
	User	-	37	0.002	0.001	0.078
	User	-	37	0.003	0.001	0.079
	User	-	37	0.001	0.000	0.079
	User	-	71	0.004	0.003	0.082
	User	-	71	0.001	0.001	0.083
	User	-	71	0.001	0.001	0.084
	User	-	71	0.006	0.004	0.088
	User	-	100	0.043	0.043	0.131
9.005	User	-	60	0.009	0.006	0.006
	User	-	60	0.009	0.005	0.011
	User	-	71	0.023	0.016	0.027
	User	-	71	0.003	0.002	0.029
	User	-	37	0.001	0.000	0.029
	User	-	37	0.006	0.002	0.031
	User	-	100	0.010	0.010	0.042
	User	-	37	0.025	0.009	0.051
	User	-	37	0.002	0.001	0.052
	User	-	37	0.002	0.001	0.053
	User	-	37	0.003	0.001	0.054
	User	-	37	0.001	0.001	0.054
	User	-	71	0.014	0.010	0.064
	User	-	100	0.004	0.004	0.068
	User	-	37	0.006	0.002	0.071
9.006	User	-	37	0.014	0.005	0.005
	User	-	100	0.073	0.073	0.078
6.005	User	-	71	0.010	0.007	0.007
	User	-	71	0.016	0.011	0.018
	User	-	37	0.006	0.002	0.021
	User	-	37	0.041	0.015	0.036
	User	-	60	0.010	0.006	0.042
	User	-	71	0.026	0.019	0.060
	User	-	60	0.006	0.004	0.064
	User	-	60	0.010	0.006	0.070
	User	-	37	0.001	0.000	0.070
	User	-	37	0.004	0.001	0.072
6.006	User	-	60	0.021	0.013	0.013
	User	-	71	0.016	0.012	0.024
	User	-	37	0.006	0.002	0.027
	User	-	37	0.007	0.002	0.029
	User	-	71	0.014	0.010	0.039
	User	-	71	0.057	0.041	0.079
6.007	User	-	60	0.008	0.005	0.005
	User	-	37	0.006	0.002	0.007

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	37	0.004	0.001	0.008
	User	-	37	0.002	0.001	0.009
	User	-	37	0.001	0.000	0.009
	User	-	37	0.002	0.001	0.010
	User	-	100	0.059	0.059	0.069
	User	-	71	0.005	0.004	0.073
	User	-	71	0.013	0.009	0.082
	User	-	71	0.005	0.004	0.085
	User	-	71	0.008	0.005	0.091
	User	-	37	0.052	0.019	0.110
6.008	User	-	60	0.005	0.003	0.003
	User	-	37	0.005	0.002	0.005
	User	-	37	0.008	0.003	0.008
	User	-	37	0.006	0.002	0.010
	User	-	100	0.069	0.069	0.079
	User	-	71	0.006	0.005	0.084
	User	-	37	0.037	0.014	0.098
6.009	User	-	37	0.004	0.001	0.001
	User	-	60	0.005	0.003	0.004
	User	-	37	0.002	0.001	0.005
	User	-	37	0.004	0.001	0.007
	User	-	71	0.017	0.012	0.018
	User	-	37	0.007	0.003	0.021
12.000	User	-	95	0.025	0.023	0.023
	User	-	71	0.016	0.012	0.035
	User	-	37	0.007	0.003	0.038
	User	-	37	0.009	0.003	0.041
	User	-	60	0.005	0.003	0.044
	User	-	60	0.008	0.005	0.049
	User	-	37	0.022	0.008	0.057
	User	-	92	0.014	0.013	0.069
	User	-	92	0.039	0.036	0.105
12.001	User	-	71	0.017	0.012	0.012
	User	-	37	0.007	0.003	0.015
	User	-	37	0.007	0.003	0.017
	User	-	37	0.002	0.001	0.018
	User	-	71	0.008	0.006	0.024
12.002	User	-	95	0.007	0.007	0.007
	User	-	71	0.010	0.007	0.014
	User	-	95	0.004	0.003	0.017
	User	-	37	0.008	0.003	0.020
	User	-	37	0.012	0.004	0.024
	User	-	60	0.005	0.003	0.027
	User	-	37	0.003	0.001	0.028
	User	-	100	0.017	0.017	0.045
	User	-	100	0.002	0.002	0.046
12.003	User	-	60	0.007	0.004	0.004
12.004	User	-	95	0.018	0.017	0.017
	User	-	60	0.008	0.005	0.022
	User	-	60	0.009	0.005	0.027
	User	-	37	0.019	0.007	0.034
13.000	User	-	37	0.001	0.000	0.000
	User	-	37	0.002	0.001	0.001
	User	-	60	0.005	0.003	0.004
	User	-	60	0.005	0.003	0.007
	User	-	60	0.002	0.001	0.009
	User	-	60	0.033	0.020	0.029
	User	-	95	0.010	0.010	0.038
	User	-	37	0.010	0.004	0.042
	User	-	71	0.009	0.006	0.048
	User	-	100	0.008	0.008	0.056
	User	-	100	0.017	0.017	0.073

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	70	0.015	0.011	0.084
	User	-	70	0.016	0.011	0.095
	User	-	70	0.028	0.019	0.114
	User	-	37	0.015	0.006	0.120
	User	-	37	0.001	0.001	0.120
	User	-	37	0.001	0.001	0.121
	User	-	37	0.013	0.005	0.126
	User	-	37	0.011	0.004	0.130
	User	-	37	0.000	0.000	0.130
	User	-	92	0.014	0.013	0.142
	User	-	100	0.012	0.012	0.155
	User	-	100	0.002	0.002	0.156
	User	-	100	0.002	0.002	0.158
12.005	User	-	37	0.003	0.001	0.001
	User	-	60	0.010	0.006	0.007
	User	-	37	0.000	0.000	0.007
	User	-	37	0.001	0.000	0.008
	User	-	71	0.034	0.024	0.031
	User	-	71	0.007	0.005	0.036
	User	-	100	0.008	0.008	0.044
	User	-	70	0.015	0.010	0.054
	User	-	37	0.021	0.008	0.062
12.006	User	-	37	0.002	0.001	0.001
	User	-	60	0.005	0.003	0.004
	User	-	37	0.016	0.006	0.010
	User	-	71	0.044	0.031	0.041
	User	-	37	0.010	0.004	0.045
	User	-	37	0.009	0.004	0.048
12.007	User	-	71	0.024	0.017	0.017
	User	-	100	0.008	0.008	0.025
	User	-	70	0.015	0.010	0.036
	User	-	37	0.010	0.004	0.039
	User	-	37	0.007	0.003	0.042
	User	-	37	0.045	0.017	0.058
	User	-	100	0.025	0.025	0.083
	User	-	70	0.047	0.033	0.116
	User	-	60	0.010	0.006	0.122
	User	-	60	0.010	0.006	0.128
	User	-	37	0.005	0.002	0.130
	User	-	37	0.002	0.001	0.130
	User	-	37	0.001	0.000	0.131
	User	-	37	0.001	0.000	0.131
	User	-	37	0.001	0.000	0.131
	User	-	71	0.002	0.001	0.133
	User	-	71	0.003	0.002	0.135
	User	-	71	0.004	0.003	0.138
	User	-	71	0.003	0.002	0.140
	User	-	71	0.004	0.003	0.142
14.000	User	-	71	0.037	0.026	0.026
	User	-	71	0.002	0.002	0.028
	User	-	71	0.003	0.002	0.030
	User	-	100	0.017	0.017	0.047
	User	-	70	0.053	0.037	0.084
	User	-	37	0.002	0.001	0.084
	User	-	37	0.002	0.001	0.085
	User	-	37	0.019	0.007	0.092
	User	-	60	0.003	0.002	0.094
	User	-	60	0.002	0.001	0.095
	User	-	60	0.002	0.001	0.096
	User	-	60	0.005	0.003	0.099
	User	-	60	0.002	0.001	0.101
	User	-	60	0.010	0.006	0.107

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	37	0.001	0.000	0.107
	User	-	37	0.000	0.000	0.107
	User	-	71	0.002	0.001	0.109
	User	-	71	0.001	0.001	0.110
	User	-	37	0.001	0.001	0.110
	User	-	37	0.000	0.000	0.110
	User	-	37	0.004	0.001	0.112
	User	-	37	0.005	0.002	0.113
	User	-	37	0.001	0.000	0.114
12.008	User	-	71	0.036	0.025	0.025
	User	-	37	0.011	0.004	0.029
	User	-	60	0.005	0.003	0.032
	User	-	71	0.038	0.027	0.059
	User	-	71	0.001	0.001	0.060
	User	-	71	0.006	0.004	0.064
	User	-	60	0.002	0.001	0.065
	User	-	60	0.007	0.004	0.070
	User	-	100	0.014	0.014	0.083
	User	-	70	0.023	0.016	0.099
	User	-	37	0.001	0.000	0.099
	User	-	37	0.001	0.000	0.100
	User	-	37	0.001	0.000	0.100
	User	-	37	0.000	0.000	0.100
	User	-	37	0.001	0.001	0.101
	User	-	37	0.001	0.000	0.101
	User	-	37	0.019	0.007	0.108
	User	-	37	0.032	0.012	0.120
	User	-	100	0.015	0.015	0.135
	User	-	70	0.045	0.032	0.167
	User	-	60	0.010	0.006	0.173
	User	-	37	0.002	0.001	0.174
	User	-	37	0.003	0.001	0.175
	User	-	37	0.001	0.000	0.175
	User	-	37	0.001	0.000	0.176
	User	-	37	0.001	0.000	0.176
	User	-	71	0.004	0.003	0.179
	User	-	71	0.003	0.002	0.181
12.009	User	-	71	0.001	0.001	0.001
	User	-	71	0.005	0.004	0.004
	User	-	71	0.002	0.001	0.006
	User	-	60	0.015	0.009	0.014
	User	-	100	0.014	0.014	0.028
	User	-	70	0.023	0.016	0.044
	User	-	37	0.001	0.001	0.045
	User	-	37	0.000	0.000	0.045
	User	-	37	0.001	0.000	0.046
	User	-	37	0.002	0.001	0.046
	User	-	37	0.029	0.011	0.057
	User	-	37	0.021	0.008	0.065
	User	-	100	0.015	0.015	0.080
	User	-	100	0.017	0.017	0.097
	User	-	70	0.045	0.031	0.128
	User	-	60	0.015	0.009	0.137
	User	-	37	0.002	0.001	0.138
	User	-	37	0.002	0.001	0.139
	User	-	37	0.002	0.001	0.139
	User	-	37	0.008	0.003	0.142
	User	-	37	0.001	0.000	0.143
	User	-	37	0.001	0.000	0.143
	User	-	37	0.001	0.000	0.143
	User	-	71	0.003	0.002	0.145
	User	-	71	0.003	0.002	0.147

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	71	0.002	0.001	0.149
12.010	User	-	71	0.009	0.006	0.006
	User	-	71	0.019	0.014	0.020
	User	-	100	0.008	0.008	0.028
	User	-	70	0.016	0.011	0.039
	User	-	37	0.001	0.000	0.039
	User	-	37	0.004	0.001	0.041
	User	-	37	0.003	0.001	0.042
	User	-	37	0.010	0.004	0.045
12.011	-	-	100	0.000	0.000	0.000
15.000	User	-	60	0.078	0.047	0.047
	User	-	71	0.009	0.007	0.054
	User	-	71	0.006	0.004	0.058
	User	-	100	0.008	0.008	0.066
	User	-	100	0.008	0.008	0.074
	User	-	70	0.015	0.011	0.085
	User	-	37	0.030	0.011	0.096
	User	-	37	0.008	0.003	0.098
	User	-	37	0.007	0.003	0.101
	User	-	60	0.005	0.003	0.104
	User	-	60	0.008	0.005	0.109
	User	-	60	0.005	0.003	0.112
	User	-	37	0.001	0.000	0.112
	User	-	37	0.003	0.001	0.113
	User	-	37	0.009	0.004	0.117
	User	-	71	0.010	0.007	0.124
15.001	User	-	71	0.025	0.018	0.018
	User	-	71	0.004	0.003	0.021
	User	-	71	0.002	0.001	0.022
	User	-	71	0.007	0.005	0.026
	User	-	100	0.013	0.013	0.040
	User	-	70	0.013	0.009	0.049
	User	-	37	0.001	0.001	0.050
	User	-	37	0.000	0.000	0.050
	User	-	37	0.001	0.000	0.050
	User	-	37	0.016	0.006	0.056
	User	-	60	0.003	0.002	0.057
	User	-	60	0.003	0.002	0.059
	User	-	60	0.002	0.001	0.060
	User	-	60	0.002	0.001	0.062
	User	-	71	0.001	0.001	0.062
	User	-	100	0.013	0.013	0.076
	User	-	70	0.024	0.017	0.092
	User	-	37	0.003	0.001	0.093
	User	-	37	0.007	0.002	0.096
	User	-	37	0.002	0.001	0.097
	User	-	37	0.003	0.001	0.098
	User	-	37	0.002	0.001	0.098
	User	-	100	0.031	0.031	0.129
	User	-	71	0.001	0.001	0.130
15.002	User	-	71	0.029	0.021	0.021
	User	-	71	0.003	0.002	0.023
	User	-	60	0.003	0.002	0.024
	User	-	60	0.008	0.005	0.029
	User	-	100	0.017	0.017	0.046
	User	-	70	0.028	0.019	0.065
	User	-	37	0.017	0.006	0.071
	User	-	37	0.000	0.000	0.072
	User	-	37	0.001	0.000	0.072
	User	-	37	0.012	0.005	0.077
	User	-	37	0.010	0.004	0.080
	User	-	37	0.002	0.001	0.081

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	100	0.012	0.012	0.092
	User	-	37	0.005	0.002	0.094
	User	-	37	0.004	0.001	0.096
	User	-	37	0.001	0.000	0.096
	User	-	37	0.002	0.001	0.097
	User	-	71	0.012	0.008	0.105
	User	-	71	0.005	0.004	0.109
15.003	User	-	71	0.021	0.015	0.015
	User	-	71	0.007	0.005	0.020
	User	-	71	0.010	0.007	0.027
	User	-	71	0.003	0.002	0.029
	User	-	60	0.003	0.002	0.031
	User	-	60	0.002	0.001	0.032
	User	-	60	0.005	0.003	0.035
	User	-	100	0.008	0.008	0.043
	User	-	70	0.014	0.010	0.053
	User	-	37	0.004	0.001	0.055
	User	-	37	0.002	0.001	0.055
	User	-	37	0.001	0.000	0.056
	User	-	37	0.001	0.000	0.056
	User	-	37	0.001	0.000	0.056
	User	-	37	0.001	0.000	0.057
	User	-	37	0.001	0.000	0.057
	User	-	37	0.021	0.008	0.065
	User	-	37	0.013	0.005	0.070
	User	-	37	0.002	0.001	0.070
	User	-	37	0.004	0.002	0.072
	User	-	37	0.015	0.006	0.077
	User	-	37	0.005	0.002	0.079
	User	-	71	0.016	0.011	0.091
15.004	User	-	71	0.020	0.014	0.014
	User	-	71	0.008	0.005	0.020
	User	-	37	0.006	0.002	0.022
	User	-	37	0.044	0.016	0.038
	User	-	37	0.001	0.000	0.039
	User	-	37	0.023	0.008	0.047
	User	-	71	0.015	0.010	0.058
	User	-	60	0.007	0.004	0.062
	User	-	60	0.004	0.002	0.064
	User	-	60	0.005	0.003	0.067
	User	-	37	0.004	0.001	0.068
	User	-	37	0.008	0.003	0.071
	User	-	37	0.001	0.000	0.071
	User	-	37	0.001	0.000	0.072
	User	-	100	0.032	0.032	0.103
	User	-	71	0.007	0.005	0.108
	User	-	71	0.003	0.002	0.110
12.012	User	-	71	0.033	0.023	0.023
	User	-	37	0.011	0.004	0.028
	User	-	71	0.017	0.012	0.040
	User	-	60	0.011	0.006	0.046
	User	-	37	0.001	0.000	0.047
	User	-	95	0.005	0.004	0.051
6.010	User	-	71	0.019	0.014	0.014
	User	-	37	0.011	0.004	0.018
6.011	User	-	71	0.007	0.005	0.005
	User	-	71	0.007	0.005	0.010
	User	-	71	0.006	0.005	0.015
	User	-	37	0.023	0.009	0.024
	User	-	37	0.053	0.020	0.043
16.000	User	-	100	0.063	0.063	0.063
	User	-	95	0.012	0.011	0.075

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	95	0.005	0.005	0.079
	User	-	37	0.009	0.003	0.083
	User	-	37	0.019	0.007	0.090
	User	-	37	0.007	0.002	0.092
	User	-	37	0.001	0.000	0.093
	User	-	37	0.000	0.000	0.093
	User	-	37	0.002	0.001	0.094
16.001	User	-	100	0.012	0.012	0.012
	User	-	95	0.004	0.004	0.015
	User	-	95	0.002	0.001	0.017
	User	-	95	0.004	0.003	0.020
	User	-	37	0.000	0.000	0.020
	User	-	37	0.005	0.002	0.022
	User	-	37	0.011	0.004	0.026
1.012	User	-	37	0.053	0.019	0.019
	User	-	37	0.014	0.005	0.025
	User	-	71	0.015	0.011	0.036
	User	-	37	0.002	0.001	0.036
	User	-	37	0.002	0.001	0.037
1.013	-	-	100	0.000	0.000	0.000
1.014	-	-	100	0.000	0.000	0.000
1.015	-	-	100	0.000	0.000	0.000
1.016	-	-	100	0.000	0.000	0.000
1.017	-	-	100	0.000	0.000	0.000
1.018	-	-	100	0.000	0.000	0.000
17.000	-	-	100	0.000	0.000	0.000
17.001	User	-	37	0.005	0.002	0.002
17.002	User	-	37	0.010	0.004	0.004
	User	-	92	0.008	0.008	0.011
	User	-	92	0.051	0.047	0.059
	User	-	100	0.006	0.006	0.065
	User	-	100	0.003	0.003	0.067
	User	-	92	0.031	0.029	0.096
	User	-	85	0.092	0.078	0.174
17.003	-	-	100	0.000	0.000	0.000
18.000	User	-	37	0.005	0.002	0.002
	User	-	37	0.005	0.002	0.004
	User	-	71	0.022	0.016	0.019
	User	-	71	0.007	0.005	0.024
	User	-	71	0.002	0.001	0.026
	User	-	37	0.000	0.000	0.026
	User	-	37	0.001	0.000	0.026
	User	-	37	0.011	0.004	0.030
	User	-	37	0.002	0.001	0.031
17.004	User	-	71	0.004	0.003	0.003
	User	-	37	0.001	0.000	0.003
	User	-	37	0.019	0.007	0.011
				Total	Total	Total
				9.895	6.494	6.494

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.018	SExisting Mh	123.210	122.267	122.180	1200	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	**Outfall Name**	**C. Level (m)**	**I. Level (m)**	**Min I. Level (m)**	**D,L (mm)**	**W (mm)**
S17.004	SGlenamuck Rd	132.800	131.186	130.150	0	0

Simulation Criteria for Storm

```
     Volumetric Runoff Coeff 1.000   Additional Flow - % of Total Flow 0.000
     Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
            Hot Start (mins)     0               Inlet Coeffiecient 0.800
        Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
Manhole Headloss Coeff (Global) 0.500                    Run Time (mins)    60
   Foul Sewage per hectare (l/s) 0.000             Output Interval (mins)     1

Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
  Number of Online Controls 6 Number of Storage Structures 6 Number of Real Time Controls 0
```

Synthetic Rainfall Details

```
        Rainfall Model                 FSR          Profile Type Winter
 Return Period (years)                   2           Cv (Summer)   1.000
                Region Scotland and Ireland          Cv (Winter)   1.000
           M5-60 (mm)               18.000 Storm Duration (mins)      30
               Ratio R               0.271
```

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S44, DS/PN: S9.003, Volume (m³): 8.7

Unit Reference	MD-SHE-0088-4000-1450-4000
Design Head (m)	1.450
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	88
Invert Level (m)	139.920
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.450	4.0	Kick-Flo®	0.786	3.0
Flush-Flo™	0.385	3.8	Mean Flow over Head Range	-	3.4

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)**
0.100	2.7	0.800	3.0	2.000	4.6	4.000	6.4	7.000	8.4
0.200	3.5	1.000	3.4	2.200	4.9	4.500	6.8	7.500	8.6
0.300	3.7	1.200	3.7	2.400	5.1	5.000	7.1	8.000	8.9
0.400	3.8	1.400	3.9	2.600	5.2	5.500	7.5	8.500	9.2
0.500	3.7	1.600	4.2	3.000	5.6	6.000	7.8	9.000	9.4
0.600	3.6	1.800	4.4	3.500	6.0	6.500	8.1	9.500	9.7

Hydro-Brake® Optimum Manhole: S48, DS/PN: S6.005, Volume (m³): 17.9

Unit Reference	MD-SHE-0207-2500-1850-2500
Design Head (m)	1.850
Design Flow (l/s)	25.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	207
Invert Level (m)	138.708
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	25.0	Kick-Flo®	1.178	20.2
Flush-Flo™	0.546	25.0	Mean Flow over Head Range	-	21.7

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)**
0.100	7.1	0.800	24.4	2.000	25.9	4.000	36.2	7.000	47.4
0.200	19.8	1.000	23.0	2.200	27.1	4.500	38.3	7.500	49.0
0.300	23.5	1.200	20.3	2.400	28.3	5.000	40.3	8.000	50.6
0.400	24.6	1.400	21.9	2.600	29.4	5.500	42.2	8.500	52.1
0.500	25.0	1.600	23.3	3.000	31.5	6.000	44.0	9.000	53.5
0.600	25.0	1.800	24.7	3.500	33.9	6.500	45.7	9.500	55.0

Hydro-Brake® Optimum Manhole: S57, DS/PN: S12.004, Volume (m^3): 5.8

Unit Reference	MD-SHE-0058-2000-1850-2000
Design Head (m)	1.850
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	58
Invert Level (m)	139.532
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.850	2.0	Kick-Flo®	0.519	1.1
Flush-Flo™	0.255	1.4	Mean Flow over Head Range	-	1.5

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)
0.100	1.2	0.800	1.4	2.000	2.1	4.000	2.8	7.000	3.7
0.200	1.4	1.000	1.5	2.200	2.2	4.500	3.0	7.500	3.8
0.300	1.4	1.200	1.6	2.400	2.3	5.000	3.2	8.000	3.9
0.400	1.3	1.400	1.8	2.600	2.3	5.500	3.3	8.500	4.1
0.500	1.2	1.600	1.9	3.000	2.5	6.000	3.4	9.000	4.2
0.600	1.2	1.800	2.0	3.500	2.7	6.500	3.6	9.500	4.3

Hydro-Brake® Optimum Manhole: S72, DS/PN: S12.012, Volume (m^3): 26.0

Unit Reference	MD-SHE-0072-3000-1850-3000
Design Head (m)	1.850
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	72
Invert Level (m)	134.897
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.850	3.0	Kick-Flo®	0.637	1.8
Flush-Flo™	0.312	2.3	Mean Flow over Head Range	-	2.3

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)
0.100	1.9	0.800	2.0	2.000	3.1	4.000	4.3	7.000	5.6
0.200	2.2	1.000	2.3	2.200	3.2	4.500	4.5	7.500	5.8
0.300	2.3	1.200	2.5	2.400	3.4	5.000	4.8	8.000	5.9
0.400	2.3	1.400	2.6	2.600	3.5	5.500	5.0	8.500	6.1
0.500	2.2	1.600	2.8	3.000	3.7	6.000	5.2	9.000	6.3
0.600	2.0	1.800	3.0	3.500	4.0	6.500	5.4	9.500	6.4

Hydro-Brake® Optimum Manhole: S77, DS/PN: S1.012, Volume (m³): 21.9

Unit Reference	MD-SHE-0263-4240-1850-4240
Design Head (m)	1.850
Design Flow (l/s)	42.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	263
Invert Level (m)	131.650
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	42.2	Kick-Flo®	1.233	34.8
Flush-Flo™	0.564	42.2	Mean Flow over Head Range	-	36.3

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)**
0.100	8.4	0.800	41.4	2.000	43.9	4.000	61.3	7.000	80.4
0.200	27.1	1.000	39.8	2.200	45.9	4.500	64.9	7.500	83.2
0.300	39.5	1.200	35.9	2.400	47.9	5.000	68.3	8.000	85.9
0.400	41.4	1.400	37.0	2.600	49.8	5.500	71.5	8.500	88.4
0.500	42.1	1.600	39.4	3.000	53.3	6.000	74.6	9.000	90.9
0.600	42.2	1.800	41.7	3.500	57.5	6.500	77.6	9.500	93.4

Hydro-Brake® Optimum Manhole: S89, DS/PN: S17.004, Volume (m³): 5.5

Unit Reference	MD-SHE-0055-1800-1850-1800
Design Head (m)	1.850
Design Flow (l/s)	1.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	55
Invert Level (m)	131.350
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	1.8	Kick-Flo®	0.489	1.0
Flush-Flo™	0.238	1.2	Mean Flow over Head Range	-	1.3

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)**
0.100	1.1	0.800	1.2	2.000	1.9	4.000	2.6	7.000	3.3
0.200	1.2	1.000	1.4	2.200	1.9	4.500	2.7	7.500	3.4
0.300	1.2	1.200	1.5	2.400	2.0	5.000	2.8	8.000	3.5
0.400	1.1	1.400	1.6	2.600	2.1	5.500	3.0	8.500	3.6
0.500	1.0	1.600	1.7	3.000	2.2	6.000	3.1	9.000	3.7
0.600	1.1	1.800	1.8	3.500	2.4	6.500	3.2	9.500	3.8

Storage Structures for Storm

Cellular Storage Manhole: S44, DS/PN: S9.003

Invert Level (m) 139.950 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	250.0	0.0	1.850	250.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S48, DS/PN: S6.005

Invert Level (m) 138.750 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	350.0	0.0	1.850	350.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S57, DS/PN: S12.004

Invert Level (m) 139.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	80.0	0.0	1.850	80.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S72, DS/PN: S12.012

Invert Level (m) 134.950 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	750.0	0.0	1.850	750.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S77, DS/PN: S1.012

Invert Level (m) 131.750 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1000.0	0.0	1.850	1000.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S89, DS/PN: S17.004

Invert Level (m) 131.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	72.0	0.0	1.850	72.0	0.0	1.851	0.0	0.0

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

```
                            Simulation Criteria
         Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
               Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
             Hot Start Level (mm)     0               Inlet Coeffiecient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
      Foul Sewage per hectare (l/s) 0.000

 Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
   Number of Online Controls 6 Number of Storage Structures 6 Number of Real Time Controls 0

                          Synthetic Rainfall Details
          Rainfall Model                 FSR M5-60 (mm) 18.000 Cv (Summer) 1.000
                  Region Scotland and Ireland     Ratio R  0.271 Cv (Winter) 1.000

             Margin for Flood Risk Warning (mm)                       150.0
                             Analysis Timestep 2.5 Second Increment (Extended)
                                     DTS Status                         OFF
                                     DVD Status                          ON
                                 Inertia Status                          ON

                             Profile(s)            Summer and Winter
                       Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360
                    Return Period(s) (years)                  2, 30, 100
                       Climate Change (%)                     20, 20, 20

                                                 Water                 Pipe
         US/MH                             US/CL Level  Flow / Maximum Flow
  PN      Name           Event               (m)   (m)   Cap.  Vol (m³) (l/s)    Status

S1.000    S1 15 minute 2 year Summer I+20% 142.350 141.007  0.23   0.105  24.2         OK
S1.001    S2 15 minute 2 year Summer I+20% 142.020 140.638  0.49   0.396  46.2         OK
S1.002    S3 15 minute 2 year Summer I+20% 141.630 140.249  0.35   0.313  69.3         OK
S1.003    S4 15 minute 2 year Summer I+20% 139.700 138.349  0.48   0.227  87.5         OK
S2.000    S5 15 minute 2 year Summer I+20% 140.710 139.295  0.30   0.090  20.0         OK
S2.001    S6 15 minute 2 year Summer I+20% 139.880 138.478  0.23   0.110  36.4         OK
S2.002    S7 15 minute 2 year Summer I+20% 139.160 137.662  0.56   0.181  59.2         OK
S1.004    S8 15 minute 2 year Summer I+20% 138.950 136.903  0.57   0.283 158.3         OK
S1.005    S9 15 minute 2 year Summer I+20% 137.580 136.100  0.56   0.430 179.0         OK
S3.000   S10 15 minute 2 year Summer I+20% 136.510 135.143  0.10   0.065   8.6         OK
S3.001   S11 15 minute 2 year Summer I+20% 137.730 134.867  0.13   0.149   9.8         OK
S3.002   S12 15 minute 2 year Summer I+20% 137.800 134.831  0.39   0.330  31.0         OK
S3.003   S13 15 minute 2 year Summer I+20% 137.330 134.620  0.30   0.281  43.1         OK
S3.004   S14 15 minute 2 year Summer I+20% 136.650 134.428  0.46   0.695  57.1         OK
S3.005   S15 15 minute 2 year Summer I+20% 136.500 134.326  0.43   0.998  57.8         OK
S1.006   S16 15 minute 2 year Summer I+20% 136.880 134.294  0.61   1.511 237.3         OK
S1.007   S17 15 minute 2 year Summer I+20% 136.650 134.164  0.67   3.186 246.1         OK
S1.008   S18 15 minute 2 year Summer I+20% 136.530 133.976  0.56   2.405 271.1         OK
S4.000   S19 15 minute 2 year Summer I+20% 138.100 136.143  0.08   0.043   9.2         OK
S1.009   S20 15 minute 2 year Summer I+20% 135.920 133.610  0.63   4.771 302.7         OK
S5.000   S21 15 minute 2 year Summer I+20% 140.610 139.194  0.37   0.101  30.0         OK
S5.001   S22 15 minute 2 year Summer I+20% 139.230 136.948  0.40   0.105  38.1         OK
S5.002   S23 15 minute 2 year Summer I+20% 137.520 136.137  0.31   0.128  50.0         OK
S1.010   S24 30 minute 2 year Summer I+20% 136.850 133.278  0.49   2.960 352.4         OK
S1.011   S25 30 minute 2 year Summer I+20% 136.550 132.851  1.02   1.500 354.1 SURCHARGED
S6.000   S26 15 minute 2 year Summer I+20% 142.240 140.810  0.28   0.150  31.5         OK
S7.000   S27 30 minute 2 year Summer I+20% 142.000 140.891  0.20   0.097  15.8         OK
S7.001   S28 15 minute 2 year Summer I+20% 142.350 140.762  0.29   0.276  28.1         OK
S8.000   S29 30 minute 2 year Summer I+20% 142.000 140.663  0.17   0.088  15.8         OK
S8.001   S30 30 minute 2 year Summer I+20% 142.500 140.381  0.22   0.192  17.8         OK
S6.001   S31 15 minute 2 year Summer I+20% 142.810 140.230  0.38   0.390 101.8         OK
S6.002   S32 15 minute 2 year Summer I+20% 142.810 139.886  0.67   1.746 173.3         OK
S6.003   S33 15 minute 2 year Summer I+20% 142.500 139.639  0.91   2.687 182.5         OK
```

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status	
S6.004	S34	240 minute 2 year Summer I+20%	142.400	139.452	0.46	1.846	78.0	SURCHARGED	
S9.000	S35	15 minute 2 year Summer I+20%	141.960	140.723	0.14	0.077	13.5	OK	
S9.001	S36	360 minute 2 year Winter I+20%	142.200	140.622	0.03	0.771	2.8	OK	
S9.002	S37	360 minute 2 year Winter I+20%	142.390	140.622	0.04	1.555	6.5	SURCHARGED	
S10.000	S38	15 minute 2 year Summer I+20%	143.000	141.611	0.29	0.120	30.0	OK	
S10.001	S39	15 minute 2 year Summer I+20%	142.730	141.311	0.64	0.525	59.4	OK	
S10.002	S40	360 minute 2 year Winter I+20%	142.750	140.623	0.08	0.798	14.8	SURCHARGED	
S11.000	S41	15 minute 2 year Summer I+20%	142.630	141.224	0.37	0.101	18.0	OK	
S11.001	S42	15 minute 2 year Summer I+20%	142.380	140.835	0.42	0.162	28.0	OK	
S11.002	S43	360 minute 2 year Winter I+20%	142.600	140.622	0.04	0.746	5.2	SURCHARGED	
S9.003	S44	360 minute 2 year Winter I+20%	142.350	140.622	0.10	165.745	3.8	SURCHARGED	TANK 4
S9.004	S45	15 minute 2 year Summer I+20%	141.940	139.901	0.29	0.220	27.3	OK	
S9.005	S46	30 minute 2 year Summer I+20%	141.350	139.404	0.17	0.221	40.2	OK	
S9.006	S47	240 minute 2 year Summer I+20%	142.000	139.380	0.12	5.300	23.5	SURCHARGED	
S6.005	S48	240 minute 2 year Summer I+20%	142.100	139.376	0.63	221.946	24.9	SURCHARGED	TANK 3
S6.006	S49	60 minute 2 year Summer I+20%	142.030	138.749	0.84	0.428	33.6	OK	
S6.007	S50	30 minute 2 year Summer I+20%	141.290	138.564	0.83	0.480	49.5	OK	
S6.008	S51	30 minute 2 year Summer I+20%	139.150	137.799	0.62	0.232	65.6	OK	
S6.009	S52	30 minute 2 year Summer I+20%	138.060	136.402	0.73	0.157	69.2	OK	
S12.000	S53	15 minute 2 year Summer I+20%	141.650	140.422	0.25	0.109	26.4	OK	
S12.001	S54	360 minute 2 year Winter I+20%	141.640	140.162	0.05	0.916	5.3	OK	
S12.002	S55	360 minute 2 year Winter I+20%	142.080	140.162	0.10	1.406	6.9	SURCHARGED	
S12.003	S56	360 minute 2 year Winter I+20%	142.110	140.161	0.03	1.338	6.8	SURCHARGED	
S12.004	S57	360 minute 2 year Winter I+20%	141.750	140.161	0.04	46.141	1.4	SURCHARGED	TANK 5
S13.000	S58	15 minute 2 year Summer I+20%	142.650	141.133	0.66	0.145	40.0	OK	
S12.005	S59	15 minute 2 year Summer I+20%	141.700	139.553	0.53	0.226	52.8	OK	
S12.006	S60	15 minute 2 year Summer I+20%	141.500	139.327	0.60	0.574	61.6	OK	
S12.007	S61	15 minute 2 year Summer I+20%	141.000	138.911	0.48	0.431	87.3	OK	
S14.000	S62	15 minute 2 year Summer I+20%	141.530	140.119	0.33	0.095	28.7	OK	
S12.008	S63	15 minute 2 year Summer I+20%	140.500	138.607	0.72	1.154	145.1	OK	
S12.009	S64	15 minute 2 year Summer I+20%	139.520	138.084	0.65	0.886	170.9	OK	
S12.010	S65	15 minute 2 year Summer I+20%	138.600	137.252	0.61	0.639	177.3	OK	
S12.011	S66	15 minute 2 year Summer I+20%	138.250	135.710	1.05	0.839	172.9	SURCHARGED	
S15.000	S67	15 minute 2 year Summer I+20%	142.680	141.182	0.65	0.144	31.2	OK	
S15.001	S68	15 minute 2 year Summer I+20%	142.440	140.817	0.31	0.139	55.4	OK	
S15.002	S69	15 minute 2 year Summer I+20%	141.180	139.610	0.40	0.207	75.6	OK	
S15.003	S70	15 minute 2 year Summer I+20%	140.230	138.683	0.48	0.228	92.3	OK	
S15.004	S71	360 minute 2 year Winter I+20%	138.780	135.640	0.11	0.680	23.1	SURCHARGED	
S12.012	S72	360 minute 2 year Winter I+20%	137.250	135.640	0.05	514.777	2.3	SURCHARGED	TANK 2
S6.010	S73	30 minute 2 year Summer I+20%	137.750	134.985	0.80	0.704	73.9	OK	
S6.011	S74	30 minute 2 year Summer I+20%	136.750	132.719	0.48	0.307	81.0	OK	
S16.000	S75	15 minute 2 year Summer I+20%	134.250	133.144	0.10	0.128	23.3	OK	
S16.001	S76	15 minute 2 year Summer I+20%	134.250	132.833	0.14	0.376	27.8	OK	
S1.012	S77	360 minute 2 year Winter I+20%	134.500	132.428	0.19	648.539	41.8	SURCHARGED	TANK 1
S1.013	S78	240 minute 2 year Summer I+20%	132.500	130.625	0.22	0.114	41.8	OK	
S1.014	S79	240 minute 2 year Summer I+20%	130.850	128.484	0.17	0.089	41.8	OK	
S1.015	S80	240 minute 2 year Winter I+20%	127.750	126.249	0.24	0.118	41.8	OK	
S1.016	S81	240 minute 2 year Winter I+20%	127.000	125.475	0.18	0.110	41.8	OK	
S1.017	S82	240 minute 2 year Winter I+20%	125.700	122.831	0.35	0.156	41.8	OK	
S1.018	S83	240 minute 2 year Summer I+20%	123.500	122.502	0.68	0.318	41.8	OK	
S17.000	S84	15 minute 2 year Summer I+20%	136.750	135.250	0.00	0.000	0.0	OK	
S17.001	S85	15 minute 2 year Summer I+20%	136.750	134.837	0.01	0.002	0.4	OK	
S17.002	S86	15 minute 2 year Summer I+20%	135.750	132.259	0.55	0.174	33.5	OK	
S17.003	S87	360 minute 2 year Winter I+20%	134.750	132.221	0.12	1.120	7.1	SURCHARGED	
S18.000	S88	15 minute 2 year Summer I+20%	135.500	134.068	0.20	0.071	7.8	OK	
S17.004	S89	360 minute 2 year Winter I+20%	134.750	132.221	0.04	50.896	1.3	SURCHARGED	TANK 6

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Offline Controls 0
Number of Time/Area Diagrams 0
Number of Online Controls 6
Number of Storage Structures 6
Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR
M5-60 (mm) 18.000
Cv (Summer) 1.000
Region Scotland and Ireland
Ratio R 0.271
Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 150.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360
Return Period(s) (years) 2, 30, 100
Climate Change (%) 20, 20, 20

PN	**US/MH Name**	**Event**	**US/CL (m)**	**Water Level (m)**	**Flow / Cap.**	**Maximum Vol (m³)**	**Pipe Flow (l/s)**	**Status**
S1.000	S1	15 minute 30 year Summer I+20%	142.350	141.047	0.42	0.149	44.7	OK
S1.001	S2	15 minute 30 year Summer I+20%	142.020	140.787	1.00	1.294	94.2	OK
S1.002	S3	15 minute 30 year Summer I+20%	141.630	140.324	0.75	0.710	146.6	OK
S1.003	S4	15 minute 30 year Summer I+20%	139.700	138.578	1.05	0.861	189.3	SURCHARGED
S2.000	S5	15 minute 30 year Summer I+20%	140.710	139.331	0.56	0.131	36.9	OK
S2.001	S6	15 minute 30 year Summer I+20%	139.880	138.529	0.49	0.205	76.9	OK
S2.002	S7	15 minute 30 year Summer I+20%	139.160	138.102	1.11	1.528	117.0	SURCHARGED
S1.004	S8	15 minute 30 year Summer I+20%	138.950	137.497	1.13	3.853	317.9	SURCHARGED
S1.005	S9	15 minute 30 year Summer I+20%	137.580	136.483	1.09	2.413	352.5	SURCHARGED
S3.000	S10	15 minute 30 year Summer I+20%	136.510	135.221	0.18	0.154	15.9	OK
S3.001	S11	15 minute 30 year Summer I+20%	137.730	135.209	0.28	2.632	20.3	SURCHARGED
S3.002	S12	15 minute 30 year Summer I+20%	137.800	135.195	0.76	1.378	60.7	SURCHARGED
S3.003	S13	15 minute 30 year Summer I+20%	137.330	135.083	0.55	2.371	79.8	SURCHARGED
S3.004	S14	15 minute 30 year Summer I+20%	136.650	134.967	0.78	4.359	97.2	SURCHARGED
S3.005	S15	15 minute 30 year Summer I+20%	136.500	134.867	0.72	3.320	97.6	SURCHARGED
S1.006	S16	15 minute 30 year Summer I+20%	136.880	134.773	1.14	2.984	444.3	SURCHARGED
S1.007	S17	15 minute 30 year Summer I+20%	136.650	134.577	1.25	6.822	454.6	SURCHARGED
S1.008	S18	15 minute 30 year Summer I+20%	136.530	134.370	1.03	6.213	501.0	SURCHARGED
S4.000	S19	15 minute 30 year Summer I+20%	138.100	136.158	0.15	0.061	16.9	OK
S1.009	S20	15 minute 30 year Summer I+20%	135.920	133.926	1.15	15.118	547.7	SURCHARGED
S5.000	S21	15 minute 30 year Summer I+20%	140.610	139.236	0.67	0.148	55.4	OK
S5.001	S22	15 minute 30 year Summer I+20%	139.230	137.000	0.78	0.164	75.2	OK
S5.002	S23	15 minute 30 year Summer I+20%	137.520	136.200	0.66	0.217	104.3	OK
S1.010	S24	30 minute 30 year Summer I+20%	136.850	133.498	0.87	8.266	625.6	OK
S1.011	S25	30 minute 30 year Summer I+20%	136.550	133.103	1.82	2.798	632.4	SURCHARGED
S6.000	S26	15 minute 30 year Summer I+20%	142.240	140.856	0.53	0.216	58.1	OK
S7.000	S27	30 minute 30 year Summer I+20%	142.000	140.926	0.37	0.137	29.0	OK
S7.001	S28	15 minute 30 year Summer I+20%	142.350	140.824	0.60	0.630	58.0	OK
S8.000	S29	15 minute 30 year Summer I+20%	142.000	140.742	0.31	0.177	28.8	OK
S8.001	S30	15 minute 30 year Summer I+20%	142.500	140.703	0.60	2.443	48.8	SURCHARGED
S6.001	S31	15 minute 30 year Summer I+20%	142.810	140.635	0.65	6.298	175.5	SURCHARGED
S6.002	S32	15 minute 30 year Summer I+20%	142.810	140.477	1.18	9.006	306.2	SURCHARGED
S6.003	S33	360 minute 30 year Summer I+20%	142.500	140.192	0.50	7.073	99.5	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m^3)	Pipe Flow (l/s)	Status	
S6.004	S34	360 minute 30 year Summer I+20%	142.400	140.103	0.58	3.963	98.4	SURCHARGED	
S9.000	S35	360 minute 30 year Winter I+20%	141.960	141.218	0.04	0.636	3.7	SURCHARGED	
S9.001	S36	360 minute 30 year Winter I+20%	142.200	141.218	0.04	2.611	4.3	SURCHARGED	
S9.002	S37	360 minute 30 year Winter I+20%	142.390	141.217	0.06	2.447	10.3	SURCHARGED	
S10.000	S38	15 minute 30 year Summer I+20%	143.000	141.681	0.53	0.199	54.8	OK	
S10.001	S39	15 minute 30 year Summer I+20%	142.730	141.578	1.33	2.408	122.9	SURCHARGED	
S10.002	S40	360 minute 30 year Winter I+20%	142.750	141.218	0.13	2.498	25.0	SURCHARGED	
S11.000	S41	15 minute 30 year Summer I+20%	142.630	141.267	0.68	0.149	33.0	OK	
S11.001	S42	360 minute 30 year Winter I+20%	142.380	141.218	0.13	1.620	8.6	SURCHARGED	
S11.002	S43	360 minute 30 year Winter I+20%	142.600	141.217	0.07	2.041	8.8	SURCHARGED	
S9.003	S44	360 minute 30 year Winter I+20%	142.350	141.217	0.10	307.958	3.8	SURCHARGED	TANK 4
S9.004	S45	360 minute 30 year Summer I+20%	141.940	140.058	0.18	0.776	17.6	OK	
S9.005	S46	360 minute 30 year Summer I+20%	141.350	140.050	0.10	4.804	24.1	SURCHARGED	
S9.006	S47	360 minute 30 year Summer I+20%	142.000	140.046	0.14	9.490	28.5	SURCHARGED	
S6.005	S48	360 minute 30 year Summer I+20%	142.100	140.042	0.63	444.649	25.0	SURCHARGED	TANK 3
S6.006	S49	15 minute 30 year Summer I+20%	142.030	139.128	0.92	1.202	37.0	SURCHARGED	
S6.007	S50	15 minute 30 year Summer I+20%	141.290	139.058	1.20	1.737	71.5	SURCHARGED	
S6.008	S51	15 minute 30 year Summer I+20%	139.150	137.954	1.03	0.768	109.7	SURCHARGED	
S6.009	S52	15 minute 30 year Summer I+20%	138.060	136.740	1.23	0.592	117.7	SURCHARGED	
S12.000	S53	360 minute 30 year Winter I+20%	141.650	140.702	0.07	0.427	7.3	SURCHARGED	
S12.001	S54	360 minute 30 year Winter I+20%	141.640	140.701	0.08	3.501	8.8	SURCHARGED	
S12.002	S55	360 minute 30 year Winter I+20%	142.080	140.700	0.17	2.046	12.0	SURCHARGED	
S12.003	S56	360 minute 30 year Winter I+20%	142.110	140.699	0.06	2.109	12.3	SURCHARGED	
S12.004	S57	360 minute 30 year Winter I+20%	141.750	140.699	0.05	87.817	1.6	SURCHARGED	TANK 5
S13.000	S58	15 minute 30 year Summer I+20%	142.650	141.459	1.13	0.514	68.8	SURCHARGED	
S12.005	S59	15 minute 30 year Summer I+20%	141.700	140.018	0.88	0.956	88.7	SURCHARGED	
S12.006	S60	15 minute 30 year Summer I+20%	141.500	139.832	1.00	2.714	102.6	SURCHARGED	
S12.007	S61	15 minute 30 year Summer I+20%	141.000	139.480	0.84	3.731	151.9	SURCHARGED	
S14.000	S62	15 minute 30 year Summer I+20%	141.530	140.157	0.61	0.138	53.0	OK	
S12.008	S63	15 minute 30 year Summer I+20%	140.500	139.241	1.23	5.485	247.8	SURCHARGED	
S12.009	S64	15 minute 30 year Summer I+20%	139.520	138.470	1.10	4.610	289.5	SURCHARGED	
S12.010	S65	15 minute 30 year Summer I+20%	138.600	137.460	1.03	1.909	300.8	SURCHARGED	
S12.011	S66	15 minute 30 year Summer I+20%	138.250	136.260	1.78	1.838	293.1	SURCHARGED	
S15.000	S67	15 minute 30 year Summer I+20%	142.680	141.376	1.14	0.363	55.2	SURCHARGED	
S15.001	S68	15 minute 30 year Summer I+20%	142.440	140.880	0.64	0.281	114.1	OK	
S15.002	S69	15 minute 30 year Summer I+20%	141.180	139.699	0.87	0.426	163.4	OK	
S15.003	S70	15 minute 30 year Summer I+20%	140.230	138.972	1.05	1.031	200.4	SURCHARGED	
S15.004	S71	360 minute 30 year Winter I+20%	138.780	136.149	0.19	1.408	38.9	SURCHARGED	
S12.012	S72	360 minute 30 year Winter I+20%	137.250	136.149	0.05	878.371	2.5	SURCHARGED	TANK 2
S6.010	S73	15 minute 30 year Summer I+20%	137.750	135.204	1.34	1.120	123.0	SURCHARGED	
S6.011	S74	360 minute 30 year Winter I+20%	136.750	133.155	0.31	0.931	52.7	SURCHARGED	
S16.000	S75	15 minute 30 year Summer I+20%	134.250	133.179	0.18	0.178	43.1	OK	
S16.001	S76	360 minute 30 year Winter I+20%	134.250	133.060	0.04	3.306	8.3	OK	
S1.012	S77	360 minute 30 year Winter I+20%	134.500	133.060	0.19	1263.359	41.8	SURCHARGED	TANK 1
S1.013	S78	30 minute 30 year Summer I+20%	132.500	130.625	0.22	0.114	41.8	OK	
S1.014	S79	30 minute 30 year Summer I+20%	130.850	128.484	0.17	0.089	41.8	OK	
S1.015	S80	30 minute 30 year Summer I+20%	127.750	126.249	0.24	0.118	41.8	OK	
S1.016	S81	30 minute 30 year Winter I+20%	127.000	125.475	0.18	0.110	41.8	OK	
S1.017	S82	30 minute 30 year Winter I+20%	125.700	122.831	0.35	0.156	41.8	OK	
S1.018	S83	30 minute 30 year Winter I+20%	123.500	122.502	0.68	0.318	41.8	OK	
S17.000	S84	15 minute 30 year Summer I+20%	136.750	135.250	0.00	0.000	0.0	OK	
S17.001	S85	15 minute 30 year Summer I+20%	136.750	134.846	0.01	0.016	0.9	OK	
S17.002	S86	360 minute 30 year Winter I+20%	135.750	132.884	0.19	0.881	12.0	SURCHARGED	
S17.003	S87	360 minute 30 year Winter I+20%	134.750	132.883	0.18	2.209	11.3	SURCHARGED	
S18.000	S88	15 minute 30 year Summer I+20%	135.500	134.094	0.37	0.101	14.5	OK	
S17.004	S89	360 minute 30 year Winter I+20%	134.750	132.882	0.05	96.911	1.7	SURCHARGED	TANK 6

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	6	Number of Storage Structures	6	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	18.000	Cv (Summer)	1.000
Region	Scotland and Ireland	Ratio R	0.271	Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360
Return Period(s) (years)	2, 30, 100
Climate Change (%)	20, 20, 20

PN	**US/MH Name**	**Event**	**US/CL (m)**	**Water Level (m)**	**Flow / Cap.**	**Maximum Vol (m³)**	**Pipe Flow (l/s)**	**Status**
S1.000	S1	15 minute 100 year Summer I+20%	142.350	141.120	0.54	0.232	57.0	OK
S1.001	S2	15 minute 100 year Summer I+20%	142.020	141.006	1.24	2.903	116.8	SURCHARGED
S1.002	S3	15 minute 100 year Summer I+20%	141.630	140.479	0.88	2.040	172.1	SURCHARGED
S1.003	S4	15 minute 100 year Summer I+20%	139.700	139.118	1.18	2.559	213.3	SURCHARGED
S2.000	S5	15 minute 100 year Summer I+20%	140.710	139.354	0.73	0.157	48.0	OK
S2.001	S6	15 minute 100 year Summer I+20%	139.880	139.059	0.59	1.864	91.8	SURCHARGED
S2.002	S7	15 minute 100 year Summer I+20%	139.160	138.878	1.22	3.656	128.7	SURCHARGED
S1.004	S8	15 minute 100 year Summer I+20%	138.950	138.120	1.26	6.853	353.9	SURCHARGED
S1.005	S9	15 minute 100 year Summer I+20%	137.580	136.894	1.21	4.580	389.3	SURCHARGED
S3.000	S10	15 minute 100 year Summer I+20%	136.510	135.897	0.21	0.919	18.7	SURCHARGED
S3.001	S11	15 minute 100 year Summer I+20%	137.730	135.878	0.44	3.843	32.0	SURCHARGED
S3.002	S12	15 minute 100 year Summer I+20%	137.800	135.864	0.86	2.135	69.0	SURCHARGED
S3.003	S13	30 minute 100 year Summer I+20%	137.330	135.733	0.54	3.303	78.9	SURCHARGED
S3.004	S14	30 minute 100 year Summer I+20%	136.650	135.623	0.83	5.299	103.8	SURCHARGED
S3.005	S15	30 minute 100 year Summer I+20%	136.500	135.524	0.82	4.259	110.8	SURCHARGED
S1.006	S16	30 minute 100 year Summer I+20%	136.880	135.413	1.28	5.267	496.7	SURCHARGED
S1.007	S17	30 minute 100 year Summer I+20%	136.650	135.181	1.40	7.897	510.5	SURCHARGED
S1.008	S18	30 minute 100 year Summer I+20%	136.530	134.938	1.16	7.241	563.7	SURCHARGED
S4.000	S19	15 minute 100 year Summer I+20%	138.100	136.168	0.20	0.071	21.9	OK
S1.009	S20	15 minute 100 year Summer I+20%	135.920	134.423	1.32	19.651	631.3	SURCHARGED
S5.000	S21	15 minute 100 year Summer I+20%	140.610	139.263	0.88	0.179	72.0	OK
S5.001	S22	15 minute 100 year Summer I+20%	139.230	137.087	1.01	0.262	97.3	SURCHARGED
S5.002	S23	15 minute 100 year Summer I+20%	137.520	136.235	0.84	0.269	134.4	OK
S1.010	S24	15 minute 100 year Summer I+20%	136.850	133.916	1.06	13.103	763.7	SURCHARGED
S1.011	S25	360 minute 100 year Winter I+20%	136.550	133.447	0.51	4.121	177.5	SURCHARGED
S6.000	S26	15 minute 100 year Summer I+20%	142.240	141.449	0.61	1.066	67.3	SURCHARGED
S7.000	S27	15 minute 100 year Summer I+20%	142.000	141.551	0.53	0.844	41.7	SURCHARGED
S7.001	S28	15 minute 100 year Summer I+20%	142.350	141.476	0.70	2.564	66.8	SURCHARGED
S8.000	S29	15 minute 100 year Summer I+20%	142.000	141.515	0.47	1.051	44.2	SURCHARGED
S8.001	S30	15 minute 100 year Summer I+20%	142.500	141.428	0.64	3.691	52.1	SURCHARGED
S6.001	S31	15 minute 100 year Summer I+20%	142.810	141.319	0.81	10.047	216.5	SURCHARGED
S6.002	S32	15 minute 100 year Summer I+20%	142.810	141.087	1.40	9.901	365.1	SURCHARGED
S6.003	S33	360 minute 100 year Winter I+20%	142.500	140.632	0.39	7.703	77.7	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status	
S6.004	S34	360 minute 100 year Winter I+20%	142.400	140.552	0.46	4.605	78.1	SURCHARGED	
S9.000	S35	360 minute 100 year Winter I+20%	141.960	141.599	0.04	1.068	4.4	SURCHARGED	
S9.001	S36	360 minute 100 year Winter I+20%	142.200	141.599	0.05	3.043	5.0	SURCHARGED	
S9.002	S37	360 minute 100 year Winter I+20%	142.390	141.599	0.07	2.993	12.6	SURCHARGED	
S10.000	S38	15 minute 100 year Summer I+20%	143.000	141.969	0.65	0.524	66.6	SURCHARGED	
S10.001	S39	15 minute 100 year Summer I+20%	142.730	141.802	1.68	3.241	155.8	SURCHARGED	
S10.002	S40	360 minute 100 year Winter I+20%	142.750	141.599	0.16	3.594	31.5	SURCHARGED	
S11.000	S41	360 minute 100 year Winter I+20%	142.630	141.600	0.13	0.526	6.2	SURCHARGED	
S11.001	S42	360 minute 100 year Winter I+20%	142.380	141.599	0.16	2.221	10.8	SURCHARGED	
S11.002	S43	360 minute 100 year Winter I+20%	142.600	141.599	0.08	2.587	10.6	SURCHARGED	
S9.003	S44	360 minute 100 year Winter I+20%	142.350	141.599	0.11	399.096	4.1	SURCHARGED	TANK 4
S9.004	S45	360 minute 100 year Summer I+20%	141.940	140.498	0.22	1.346	20.9	SURCHARGED	
S9.005	S46	360 minute 100 year Summer I+20%	141.350	140.489	0.11	5.479	26.4	SURCHARGED	
S9.006	S47	360 minute 100 year Summer I+20%	142.000	140.486	0.18	10.119	35.8	SURCHARGED	
S6.005	S48	360 minute 100 year Summer I+20%	142.100	140.481	0.63	591.253	25.0	SURCHARGED	TANK 3
S6.006	S49	15 minute 100 year Summer I+20%	142.030	139.600	0.97	1.735	38.9	SURCHARGED	
S6.007	S50	15 minute 100 year Summer I+20%	141.290	139.557	1.30	2.302	76.8	SURCHARGED	
S6.008	S51	15 minute 100 year Summer I+20%	139.150	138.353	1.12	2.323	120.1	SURCHARGED	
S6.009	S52	15 minute 100 year Summer I+20%	138.060	136.920	1.36	0.924	129.4	SURCHARGED	
S12.000	S53	360 minute 100 year Winter I+20%	141.650	141.061	0.09	0.833	9.1	SURCHARGED	
S12.001	S54	360 minute 100 year Winter I+20%	141.640	141.060	0.09	3.907	9.8	SURCHARGED	
S12.002	S55	360 minute 100 year Winter I+20%	142.080	141.059	0.19	2.451	13.5	SURCHARGED	
S12.003	S56	360 minute 100 year Winter I+20%	142.110	141.058	0.07	2.622	13.7	SURCHARGED	
S12.004	S57	360 minute 100 year Winter I+20%	141.750	141.057	0.05	115.573	1.8	SURCHARGED	TANK 5
S13.000	S58	15 minute 100 year Summer I+20%	142.650	142.073	1.31	1.208	79.6	SURCHARGED	
S12.005	S59	15 minute 100 year Summer I+20%	141.700	140.933	0.97	3.619	97.1	SURCHARGED	
S12.006	S60	15 minute 100 year Summer I+20%	141.500	140.747	1.17	4.330	120.1	SURCHARGED	
S12.007	S61	15 minute 100 year Summer I+20%	141.000	140.397	0.91	5.353	165.3	SURCHARGED	
S14.000	S62	15 minute 100 year Summer I+20%	141.530	140.415	0.76	0.430	66.1	SURCHARGED	
S12.008	S63	15 minute 100 year Summer I+20%	140.500	140.122	1.37	8.094	276.2	SURCHARGED	
S12.009	S64	15 minute 100 year Summer I+20%	139.520	139.163	1.27	6.700	334.3	SURCHARGED	
S12.010	S65	15 minute 100 year Summer I+20%	138.600	137.783	1.21	4.115	350.6	SURCHARGED	
S12.011	S66	15 minute 100 year Summer I+20%	138.250	136.549	2.05	2.925	337.1	SURCHARGED	
S15.000	S67	15 minute 100 year Summer I+20%	142.680	141.630	1.46	0.650	70.6	SURCHARGED	
S15.001	S68	15 minute 100 year Summer I+20%	142.440	141.022	0.80	0.842	141.6	SURCHARGED	
S15.002	S69	15 minute 100 year Summer I+20%	141.180	140.340	0.99	2.629	186.4	SURCHARGED	
S15.003	S70	15 minute 100 year Summer I+20%	140.230	139.415	1.19	2.384	228.3	SURCHARGED	
S15.004	S71	360 minute 100 year Winter I+20%	138.780	136.474	0.24	1.873	49.0	SURCHARGED	
S12.012	S72	360 minute 100 year Winter I+20%	137.250	136.474	0.06	1110.237	2.8	SURCHARGED	TANK 2
S6.010	S73	15 minute 100 year Summer I+20%	137.750	135.277	1.47	1.203	135.8	SURCHARGED	
S6.011	S74	360 minute 100 year Winter I+20%	136.750	133.547	0.35	1.492	59.2	SURCHARGED	
S16.000	S75	360 minute 100 year Winter I+20%	134.250	133.444	0.03	0.557	8.2	OK	
S16.001	S76	360 minute 100 year Winter I+20%	134.250	133.444	0.05	8.627	10.5	SURCHARGED	
S1.012	S77	360 minute 100 year Winter I+20%	134.500	133.444	0.19	1629.210	41.8	SURCHARGED	TANK 1
S1.013	S78	360 minute 100 year Winter I+20%	132.500	130.625	0.22	0.114	41.8	OK	
S1.014	S79	360 minute 100 year Winter I+20%	130.850	128.484	0.17	0.089	41.8	OK	
S1.015	S80	360 minute 100 year Summer I+20%	127.750	126.249	0.24	0.118	41.8	OK	
S1.016	S81	240 minute 100 year Winter I+20%	127.000	125.475	0.18	0.110	41.8	OK	
S1.017	S82	180 minute 100 year Winter I+20%	125.700	122.831	0.35	0.156	41.8	OK	
S1.018	S83	360 minute 100 year Winter I+20%	123.500	122.502	0.68	0.317	41.8	OK	
S17.000	S84	15 minute 100 year Summer I+20%	136.750	135.250	0.00	0.000	0.0	OK	
S17.001	S85	15 minute 100 year Summer I+20%	136.750	134.850	0.02	0.023	1.2	OK	
S17.002	S86	360 minute 100 year Winter I+20%	135.750	133.315	0.25	1.369	15.2	SURCHARGED	
S17.003	S87	360 minute 100 year Winter I+20%	134.750	133.314	0.24	2.696	14.7	SURCHARGED	
S18.000	S88	15 minute 100 year Summer I+20%	135.500	134.110	0.48	0.118	18.8	OK	
S17.004	S89	360 minute 100 year Winter I+20%	134.750	133.313	0.05	126.864	1.8	SURCHARGED	TANK 6

BLOCKED OUTFALLS SIMULATION

STORM SEWER DESIGN by the Modified Rational Meth

Design Criteria for Storm

```
                 Pipe Sizes STANDARD Manhole Sizes STANDARD

                  FSR Rainfall Model - Scotland and Ireland
          Return Period (years)       2                   PIMP (%)    100
                    M5-60 (mm)   18.000      Add Flow / Climate Change (%)      0
                       Ratio R    0.271        Minimum Backdrop Height (m)  0.200
       Maximum Rainfall (mm/hr)      90        Maximum Backdrop Height (m)  3.000
Maximum Time of Concentration (mins)    30 Min Design Depth for Optimisation (m)  1.500
         Foul Sewage (l/s/ha)    0.000     Min Vel for Auto Design only (m/s)   0.75
       Volumetric Runoff Coeff.  1.000      Min Slope for Optimisation (1:X)    180

                        Designed with Level Soffits
```

Free Flowing Outfall Details for Storm

```
   Outfall      Outfall    C. Level I. Level    Min    D,L   W
 Pipe Number     Name        (m)      (m)    I. Level (mm)  (mm)
                                               (m)

     S1.018  SExisting Mh  123.210  122.267  122.180 1200     0
```

Free Flowing Outfall Details for Storm

```
   Outfall       Outfall     C. Level I. Level    Min    D,L   W
 Pipe Number      Name         (m)      (m)    I. Level (mm)  (mm)
                                                 (m)

     S17.004 SGlenamuck Rd  132.800  131.186  130.150    0     0
```

Simulation Criteria for Storm

```
     Volumetric Runoff Coeff 1.000   Additional Flow - % of Total Flow 0.000
     Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
             Hot Start (mins)     0              Inlet Coeffiecient 0.800
         Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
Manhole Headloss Coeff (Global) 0.500                  Run Time (mins)    60
   Foul Sewage per hectare (l/s) 0.000            Output Interval (mins)     1

Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
  Number of Online Controls 6 Number of Storage Structures 6 Number of Real Time Controls 0
```

Synthetic Rainfall Details

```
          Rainfall Model                FSR        Profile Type Summer
     Return Period (years)              100          Cv (Summer)   1.000
                   Region Scotland and Ireland       Cv (Winter)   1.000
               M5-60 (mm)            18.000 Storm Duration (mins)     30
                  Ratio R             0.271
```

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S44, DS/PN: S9.003, Volume (m³): 8.7

Unit Reference	MD-SHE-0012-1000-1450-1000
Design Head (m)	1.450
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	139.920
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.450	0.1	Kick-Flo®	0.110	0.0
Flush-Flo™	0.048	0.0	Mean Flow over Head Range	-	0.1

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)**
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.2	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.2	7.500	0.2
0.300	0.1	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Hydro-Brake® Optimum Manhole: S48, DS/PN: S6.005, Volume (m³): 17.9

Unit Reference	MD-SHE-0012-1000-1850-1000
Design Head (m)	1.850
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	138.708
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	0.1	Kick-Flo®	0.105	0.0
Flush-Flo™	0.040	0.0	Mean Flow over Head Range	-	0.1

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)**
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.1	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.1	7.500	0.2
0.300	0.0	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Hydro-Brake® Optimum Manhole: S57, DS/PN: S12.004, Volume (m^3): 5.8

Unit Reference	MD-SHE-0012-1000-1850-1000
Design Head (m)	1.850
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	139.532
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	0.1	Kick-Flo®	0.105	0.0
Flush-Flo™	0.040	0.0	Mean Flow over Head Range	-	0.1

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)**
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.1	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.1	7.500	0.2
0.300	0.0	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Hydro-Brake® Optimum Manhole: S72, DS/PN: S12.012, Volume (m^3): 26.0

Unit Reference	MD-SHE-0012-1000-1850-1000
Design Head (m)	1.850
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	134.897
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	0.1	Kick-Flo®	0.105	0.0
Flush-Flo™	0.040	0.0	Mean Flow over Head Range	-	0.1

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)**
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.1	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.1	7.500	0.2
0.300	0.0	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Hydro-Brake® Optimum Manhole: S77, DS/PN: S1.012, Volume (m³): 21.9

Unit Reference	MD-SHE-0012-1000-1850-1000
Design Head (m)	1.850
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	131.650
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	0.1	Kick-Flo®	0.105	0.0
Flush-Flo™	0.040	0.0	Mean Flow over Head Range	-	0.1

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)**
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.1	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.1	7.500	0.2
0.300	0.0	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Hydro-Brake® Optimum Manhole: S89, DS/PN: S17.004, Volume (m³): 5.5

Unit Reference	MD-SHE-0012-1000-1850-1000
Design Head (m)	1.850
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12
Invert Level (m)	131.350
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	0.1	Kick-Flo®	0.105	0.0
Flush-Flo™	0.040	0.0	Mean Flow over Head Range	-	0.1

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)**
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.1	7.000	0.2
0.200	0.0	1.000	0.1	2.200	0.1	4.500	0.1	7.500	0.2
0.300	0.0	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.1	6.000	0.2	9.000	0.2
0.600	0.1	1.800	0.1	3.500	0.1	6.500	0.2	9.500	0.2

Storage Structures for Storm

Cellular Storage Manhole: S44, DS/PN: S9.003

Invert Level (m) 139.950 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	250.0	0.0	1.850	250.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S48, DS/PN: S6.005

Invert Level (m) 138.750 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	350.0	0.0	1.850	350.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S57, DS/PN: S12.004

Invert Level (m) 139.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	80.0	0.0	1.850	80.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S72, DS/PN: S12.012

Invert Level (m) 134.950 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	750.0	0.0	1.850	750.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S77, DS/PN: S1.012

Invert Level (m) 131.750 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	1000.0	0.0	1.850	1000.0	0.0	1.851	0.0	0.0

Cellular Storage Manhole: S89, DS/PN: S17.004

Invert Level (m) 131.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	72.0	0.0	1.850	72.0	0.0	1.851	0.0	0.0

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 6 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.271 Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 150.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 30
Return Period(s) (years) 2, 30, 100
Climate Change (%) 20, 20, 20

PN	**US/MH Name**	**Event**	**US/CL (m)**	**Water Level (m)**	**Flow / Cap.**	**Maximum Vol (m³)**	**Pipe Flow (l/s)**	**Status**
S1.000	S1	30 minute 2 year Summer I+20%	142.350	141.003	0.21	0.100	21.7	OK
S1.001	S2	30 minute 2 year Summer I+20%	142.020	140.632	0.46	0.368	43.8	OK
S1.002	S3	30 minute 2 year Summer I+20%	141.630	140.246	0.34	0.300	66.5	OK
S1.003	S4	30 minute 2 year Summer I+20%	139.700	138.347	0.47	0.222	84.8	OK
S2.000	S5	30 minute 2 year Summer I+20%	140.710	139.291	0.27	0.086	17.9	OK
S2.001	S6	30 minute 2 year Summer I+20%	139.880	138.475	0.22	0.106	34.2	OK
S2.002	S7	30 minute 2 year Summer I+20%	139.160	137.657	0.54	0.175	56.5	OK
S1.004	S8	30 minute 2 year Summer I+20%	138.950	136.899	0.55	0.278	153.0	OK
S1.005	S9	30 minute 2 year Summer I+20%	137.580	136.098	0.54	0.423	174.2	OK
S3.000	S10	30 minute 2 year Summer I+20%	136.510	135.141	0.09	0.063	7.7	OK
S3.001	S11	30 minute 2 year Summer I+20%	137.730	134.863	0.12	0.141	9.1	OK
S3.002	S12	30 minute 2 year Summer I+20%	137.800	134.828	0.38	0.316	30.1	OK
S3.003	S13	30 minute 2 year Summer I+20%	137.330	134.618	0.29	0.272	41.9	OK
S3.004	S14	30 minute 2 year Summer I+20%	136.650	134.427	0.45	0.688	56.4	OK
S3.005	S15	30 minute 2 year Summer I+20%	136.500	134.321	0.42	0.957	56.4	OK
S1.006	S16	30 minute 2 year Summer I+20%	136.880	134.287	0.61	1.466	234.9	OK
S1.007	S17	30 minute 2 year Summer I+20%	136.650	134.158	0.66	3.110	239.6	OK
S1.008	S18	30 minute 2 year Summer I+20%	136.530	133.974	0.56	2.378	270.8	OK
S4.000	S19	30 minute 2 year Summer I+20%	138.100	136.141	0.08	0.041	8.3	OK
S1.009	S20	30 minute 2 year Summer I+20%	135.920	133.609	0.63	4.766	302.5	OK
S5.000	S21	30 minute 2 year Summer I+20%	140.610	139.190	0.33	0.096	26.8	OK
S5.001	S22	30 minute 2 year Summer I+20%	139.230	136.944	0.36	0.101	34.9	OK
S5.002	S23	30 minute 2 year Summer I+20%	137.520	136.132	0.29	0.122	46.9	OK
S1.010	S24	30 minute 2 year Summer I+20%	136.850	133.278	0.49	2.960	352.4	OK
S1.011	S25	30 minute 2 year Summer I+20%	136.550	132.851	1.02	1.500	354.1	SURCHARGED
S6.000	S26	30 minute 2 year Summer I+20%	142.240	140.805	0.26	0.143	28.4	OK
S7.000	S27	30 minute 2 year Summer I+20%	142.000	140.891	0.20	0.097	15.8	OK
S7.001	S28	30 minute 2 year Summer I+20%	142.350	140.762	0.29	0.274	28.1	OK
S8.000	S29	30 minute 2 year Summer I+20%	142.000	140.663	0.17	0.088	15.8	OK
S8.001	S30	30 minute 2 year Summer I+20%	142.500	140.381	0.22	0.192	17.8	OK
S6.001	S31	30 minute 2 year Summer I+20%	142.810	140.226	0.37	0.378	98.4	OK
S6.002	S32	30 minute 2 year Summer I+20%	142.810	139.883	0.66	1.717	170.9	OK
S6.003	S33	30 minute 2 year Summer I+20%	142.500	139.634	0.90	2.609	180.9	OK

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S6.004	S34	30 minute 2 year Summer I+20%	142.400	139.321	1.07	0.955	181.4	SURCHARGED
S9.000	S35	30 minute 2 year Summer I+20%	141.960	140.720	0.12	0.074	12.1	OK
S9.001	S36	30 minute 2 year Summer I+20%	142.200	140.474	0.14	0.137	14.8	OK
S9.002	S37	30 minute 2 year Winter I+20%	142.390	140.302	0.16	0.449	26.4	OK
S10.000	S38	30 minute 2 year Summer I+20%	143.000	141.606	0.26	0.114	26.8	OK
S10.001	S39	30 minute 2 year Summer I+20%	142.730	141.304	0.61	0.490	56.9	OK
S10.002	S40	30 minute 2 year Winter I+20%	142.750	140.302	0.31	0.339	60.1	OK
S11.000	S41	30 minute 2 year Summer I+20%	142.630	141.220	0.33	0.096	16.1	OK
S11.001	S42	30 minute 2 year Summer I+20%	142.380	140.830	0.39	0.153	26.1	OK
S11.002	S43	30 minute 2 year Winter I+20%	142.600	140.302	0.16	0.282	21.9	OK
S9.003	S44	30 minute 2 year Winter I+20%	142.350	140.302	0.00	87.566	0.1	SURCHARGED
S9.004	S45	30 minute 2 year Summer I+20%	141.940	139.893	0.25	0.193	24.0	OK
S9.005	S46	30 minute 2 year Summer I+20%	141.350	139.399	0.15	0.201	36.9	OK
S9.006	S47	30 minute 2 year Winter I+20%	142.000	139.242	0.22	2.540	43.3	OK
S6.005	S48	30 minute 2 year Winter I+20%	142.100	139.242	0.00	176.518	0.1	SURCHARGED
S6.006	S49	30 minute 2 year Summer I+20%	142.030	138.685	0.37	0.185	14.8	OK
S6.007	S50	30 minute 2 year Summer I+20%	141.290	138.531	0.59	0.313	34.8	OK
S6.008	S51	30 minute 2 year Summer I+20%	139.150	137.783	0.49	0.183	52.5	OK
S6.009	S52	30 minute 2 year Summer I+20%	138.060	136.384	0.59	0.136	56.4	OK
S12.000	S53	30 minute 2 year Summer I+20%	141.650	140.417	0.22	0.104	23.6	OK
S12.001	S54	30 minute 2 year Summer I+20%	141.640	140.022	0.27	0.199	28.3	OK
S12.002	S55	30 minute 2 year Winter I+20%	142.080	139.923	0.43	0.500	29.8	OK
S12.003	S56	30 minute 2 year Winter I+20%	142.110	139.923	0.15	0.867	29.6	OK
S12.004	S57	30 minute 2 year Winter I+20%	141.750	139.923	0.00	27.183	0.1	SURCHARGED
S13.000	S58	30 minute 2 year Summer I+20%	142.650	141.126	0.59	0.137	36.1	OK
S12.005	S59	30 minute 2 year Summer I+20%	141.700	139.544	0.48	0.206	48.2	OK
S12.006	S60	30 minute 2 year Summer I+20%	141.500	139.318	0.55	0.526	56.0	OK
S12.007	S61	30 minute 2 year Summer I+20%	141.000	138.905	0.46	0.412	82.3	OK
S14.000	S62	30 minute 2 year Summer I+20%	141.530	140.115	0.30	0.090	26.0	OK
S12.008	S63	30 minute 2 year Summer I+20%	140.500	138.600	0.69	1.086	138.7	OK
S12.009	S64	30 minute 2 year Summer I+20%	139.520	138.080	0.63	0.853	165.9	OK
S12.010	S65	30 minute 2 year Summer I+20%	138.600	137.246	0.60	0.612	173.9	OK
S12.011	S66	30 minute 2 year Summer I+20%	138.250	135.687	1.00	0.799	164.4	SURCHARGED
S15.000	S67	30 minute 2 year Summer I+20%	142.680	141.175	0.58	0.136	27.8	OK
S15.001	S68	30 minute 2 year Summer I+20%	142.440	140.813	0.29	0.129	52.4	OK
S15.002	S69	30 minute 2 year Summer I+20%	141.180	139.605	0.39	0.196	72.8	OK
S15.003	S70	30 minute 2 year Summer I+20%	140.230	138.679	0.47	0.218	89.5	OK
S15.004	S71	30 minute 2 year Summer I+20%	138.780	135.396	0.53	0.331	108.5	OK
S12.012	S72	30 minute 2 year Winter I+20%	137.250	135.227	0.00	204.912	0.1	SURCHARGED
S6.010	S73	30 minute 2 year Summer I+20%	137.750	134.957	0.65	0.608	59.8	OK
S6.011	S74	30 minute 2 year Summer I+20%	136.750	132.696	0.40	0.274	67.4	OK
S16.000	S75	30 minute 2 year Summer I+20%	134.250	133.141	0.09	0.123	21.1	OK
S16.001	S76	30 minute 2 year Summer I+20%	134.250	132.828	0.13	0.332	26.1	OK
S1.012	S77	30 minute 2 year Summer I+20%	134.500	132.114	0.00	346.826	0.1	SURCHARGED
S1.013	S78	30 minute 2 year Summer I+20%	132.500	130.530	0.00	0.000	0.1	OK
S1.014	S79	30 minute 2 year Summer I+20%	130.850	128.400	0.00	0.000	0.1	OK
S1.015	S80	30 minute 2 year Summer I+20%	127.750	126.150	0.00	0.000	0.1	OK
S1.016	S81	30 minute 2 year Summer I+20%	127.000	125.390	0.00	0.000	0.1	OK
S1.017	S82	30 minute 2 year Summer I+20%	125.700	122.711	0.00	0.000	0.1	OK
S1.018	S83	30 minute 2 year Summer I+20%	123.500	122.321	0.00	0.000	0.1	OK
S17.000	S84	30 minute 2 year Summer I+20%	136.750	135.250	0.00	0.000	0.0	OK
S17.001	S85	30 minute 2 year Summer I+20%	136.750	134.836	0.01	0.002	0.4	OK
S17.002	S86	30 minute 2 year Summer I+20%	135.750	132.257	0.54	0.172	33.0	OK
S17.003	S87	30 minute 2 year Winter I+20%	134.750	131.904	0.45	0.451	27.4	SURCHARGED
S18.000	S88	30 minute 2 year Summer I+20%	135.500	134.065	0.18	0.068	7.0	OK
S17.004	S89	30 minute 2 year Winter I+20%	134.750	131.904	0.00	28.879	0.1	SURCHARGED

TANK 4

TANK 3

TANK 5

TANK 2

TANK 1

TANK 6

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 6 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.271 Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 150.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 30
Return Period(s) (years) 2, 30, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S1	30 minute 30 year Summer I+20%	142.350	141.040	0.38	0.141	39.9	OK
S1.001	S2	30 minute 30 year Summer I+20%	142.020	140.722	0.95	0.847	89.7	OK
S1.002	S3	30 minute 30 year Summer I+20%	141.630	140.314	0.71	0.659	139.8	OK
S1.003	S4	30 minute 30 year Summer I+20%	139.700	138.441	0.99	0.449	179.8	OK
S2.000	S5	30 minute 30 year Summer I+20%	140.710	139.325	0.50	0.124	33.0	OK
S2.001	S6	30 minute 30 year Summer I+20%	139.880	138.521	0.44	0.189	68.6	OK
S2.002	S7	30 minute 30 year Summer I+20%	139.160	137.935	1.08	0.863	113.7	SURCHARGED
S1.004	S8	30 minute 30 year Summer I+20%	138.950	137.323	1.09	2.397	304.9	SURCHARGED
S1.005	S9	30 minute 30 year Summer I+20%	137.580	136.398	1.06	1.932	342.1	SURCHARGED
S3.000	S10	30 minute 30 year Summer I+20%	136.510	135.184	0.16	0.112	14.2	OK
S3.001	S11	30 minute 30 year Summer I+20%	137.730	135.172	0.31	2.352	22.8	SURCHARGED
S3.002	S12	30 minute 30 year Summer I+20%	137.800	135.163	0.77	1.342	61.2	SURCHARGED
S3.003	S13	30 minute 30 year Summer I+20%	137.330	135.062	0.52	2.341	75.3	SURCHARGED
S3.004	S14	30 minute 30 year Summer I+20%	136.650	134.939	0.83	4.319	103.6	SURCHARGED
S3.005	S15	30 minute 30 year Summer I+20%	136.500	134.831	0.80	3.267	107.5	SURCHARGED
S1.006	S16	30 minute 30 year Summer I+20%	136.880	134.718	1.12	2.888	433.5	SURCHARGED
S1.007	S17	30 minute 30 year Summer I+20%	136.650	134.536	1.21	6.736	441.3	SURCHARGED
S1.008	S18	30 minute 30 year Summer I+20%	136.530	134.342	1.01	6.104	492.1	SURCHARGED
S4.000	S19	30 minute 30 year Summer I+20%	138.100	136.156	0.14	0.058	15.3	OK
S1.009	S20	30 minute 30 year Summer I+20%	135.920	133.922	1.14	15.031	546.2	SURCHARGED
S5.000	S21	30 minute 30 year Summer I+20%	140.610	139.228	0.60	0.139	49.4	OK
S5.001	S22	30 minute 30 year Summer I+20%	139.230	136.991	0.69	0.154	66.9	OK
S5.002	S23	30 minute 30 year Summer I+20%	137.520	136.189	0.58	0.202	93.0	OK
S1.010	S24	30 minute 30 year Summer I+20%	136.850	133.498	0.87	8.266	625.6	OK
S1.011	S25	30 minute 30 year Summer I+20%	136.550	133.103	1.82	2.798	632.4	SURCHARGED
S6.000	S26	30 minute 30 year Summer I+20%	142.240	140.848	0.47	0.205	52.3	OK
S7.000	S27	30 minute 30 year Summer I+20%	142.000	140.926	0.37	0.137	29.0	OK
S7.001	S28	30 minute 30 year Summer I+20%	142.350	140.817	0.57	0.590	55.1	OK
S8.000	S29	30 minute 30 year Summer I+20%	142.000	140.701	0.31	0.131	28.9	OK
S8.001	S30	30 minute 30 year Summer I+20%	142.500	140.650	0.52	2.048	42.2	SURCHARGED
S6.001	S31	30 minute 30 year Summer I+20%	142.810	140.546	0.63	4.871	169.0	SURCHARGED
S6.002	S32	30 minute 30 year Summer I+20%	142.810	140.401	1.14	8.788	297.8	SURCHARGED
S6.003	S33	30 minute 30 year Summer I+20%	142.500	139.975	1.59	6.606	318.9	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status	
S6.004	S34	30 minute 30 year Winter I+20%	142.400	139.736	1.66	3.412	282.4	SURCHARGED	
S9.000	S35	30 minute 30 year Summer I+20%	141.960	140.747	0.22	0.104	22.3	OK	
S9.001	S36	30 minute 30 year Winter I+20%	142.200	140.596	0.21	0.607	22.0	OK	
S9.002	S37	30 minute 30 year Winter I+20%	142.390	140.596	0.30	1.491	50.8	SURCHARGED	
S10.000	S38	30 minute 30 year Summer I+20%	143.000	141.649	0.48	0.163	49.4	OK	
S10.001	S39	30 minute 30 year Summer I+20%	142.730	141.513	1.22	1.949	112.9	SURCHARGED	
S10.002	S40	30 minute 30 year Winter I+20%	142.750	140.640	0.60	0.823	117.4	SURCHARGED	
S11.000	S41	30 minute 30 year Summer I+20%	142.630	141.259	0.60	0.140	29.4	OK	
S11.001	S42	30 minute 30 year Summer I+20%	142.380	140.901	0.76	0.268	51.2	OK	
S11.002	S43	30 minute 30 year Summer I+20%	142.600	140.596	0.39	0.702	52.9	SURCHARGED	
S9.003	S44	30 minute 30 year Winter I+20%	142.350	140.596	0.00	159.491	0.1	SURCHARGED	TANK 4
S9.004	S45	30 minute 30 year Summer I+20%	141.940	139.955	0.57	0.434	54.1	OK	
S9.005	S46	30 minute 30 year Summer I+20%	141.350	139.649	0.34	1.809	82.0	OK	
S9.006	S47	30 minute 30 year Summer I+20%	142.000	139.649	0.53	8.783	105.1	SURCHARGED	
S6.005	S48	30 minute 30 year Summer I+20%	142.100	139.649	0.00	313.378	0.1	SURCHARGED	TANK 3
S6.006	S49	30 minute 30 year Summer I+20%	142.030	139.016	0.72	1.074	28.9	SURCHARGED	
S6.007	S50	30 minute 30 year Summer I+20%	141.290	138.916	1.16	1.577	68.7	SURCHARGED	
S6.008	S51	30 minute 30 year Summer I+20%	139.150	137.853	0.99	0.394	105.4	OK	
S6.009	S52	30 minute 30 year Summer I+20%	138.060	136.693	1.19	0.514	113.1	SURCHARGED	
S12.000	S53	30 minute 30 year Summer I+20%	141.650	140.456	0.41	0.148	43.5	OK	
S12.001	S54	30 minute 30 year Winter I+20%	141.640	140.259	0.40	1.606	41.8	SURCHARGED	
S12.002	S55	30 minute 30 year Winter I+20%	142.080	140.241	0.80	1.526	55.3	SURCHARGED	
S12.003	S56	30 minute 30 year Summer I+20%	142.110	140.192	0.34	1.382	66.7	SURCHARGED	
S12.004	S57	30 minute 30 year Winter I+20%	141.750	140.192	0.00	48.558	0.1	SURCHARGED	TANK 5
S13.000	S58	30 minute 30 year Summer I+20%	142.650	141.303	1.05	0.337	63.8	SURCHARGED	
S12.005	S59	30 minute 30 year Summer I+20%	141.700	139.791	0.87	0.696	86.9	SURCHARGED	
S12.006	S60	30 minute 30 year Summer I+20%	141.500	139.629	0.96	2.291	98.0	SURCHARGED	
S12.007	S61	30 minute 30 year Summer I+20%	141.000	139.300	0.81	3.126	146.1	SURCHARGED	
S14.000	S62	30 minute 30 year Summer I+20%	141.530	140.150	0.55	0.131	47.9	OK	
S12.008	S63	30 minute 30 year Summer I+20%	140.500	139.104	1.19	5.094	239.4	SURCHARGED	
S12.009	S64	30 minute 30 year Summer I+20%	139.520	138.387	1.08	3.796	285.1	SURCHARGED	
S12.010	S65	30 minute 30 year Summer I+20%	138.600	137.428	1.02	1.692	295.4	SURCHARGED	
S12.011	S66	30 minute 30 year Summer I+20%	138.250	136.225	1.76	1.750	289.5	SURCHARGED	
S15.000	S67	30 minute 30 year Summer I+20%	142.680	141.308	1.06	0.286	51.1	SURCHARGED	
S15.001	S68	30 minute 30 year Summer I+20%	142.440	140.869	0.59	0.256	104.2	OK	
S15.002	S69	30 minute 30 year Summer I+20%	141.180	139.682	0.79	0.371	148.8	OK	
S15.003	S70	30 minute 30 year Summer I+20%	140.230	138.773	0.97	0.438	186.3	OK	
S15.004	S71	30 minute 30 year Summer I+20%	138.780	135.672	1.11	0.726	227.2	SURCHARGED	
S12.012	S72	30 minute 30 year Winter I+20%	137.250	135.452	0.00	376.430	0.1	SURCHARGED	TANK 2
S6.010	S73	30 minute 30 year Summer I+20%	137.750	135.191	1.30	1.105	119.7	SURCHARGED	
S6.011	S74	30 minute 30 year Summer I+20%	136.750	132.809	0.81	0.435	137.2	OK	
S16.000	S75	30 minute 30 year Summer I+20%	134.250	133.173	0.16	0.168	38.8	OK	
S16.001	S76	30 minute 30 year Summer I+20%	134.250	132.874	0.26	0.712	49.8	OK	
S1.012	S77	30 minute 30 year Summer I+20%	134.500	132.418	0.00	638.117	0.1	SURCHARGED	TANK 1
S1.013	S78	30 minute 30 year Summer I+20%	132.500	130.531	0.00	0.000	0.1	OK	
S1.014	S79	30 minute 30 year Summer I+20%	130.850	128.400	0.00	0.000	0.1	OK	
S1.015	S80	30 minute 30 year Summer I+20%	127.750	126.151	0.00	0.000	0.1	OK	
S1.016	S81	30 minute 30 year Summer I+20%	127.000	125.390	0.00	0.000	0.1	OK	
S1.017	S82	30 minute 30 year Summer I+20%	125.700	122.711	0.00	0.000	0.1	OK	
S1.018	S83	30 minute 30 year Summer I+20%	123.500	122.322	0.00	0.000	0.1	OK	
S17.000	S84	30 minute 30 year Summer I+20%	136.750	135.250	0.00	0.000	0.0	OK	
S17.001	S85	30 minute 30 year Summer I+20%	136.750	134.844	0.01	0.014	0.8	OK	
S17.002	S86	30 minute 30 year Summer I+20%	135.750	132.416	1.21	0.351	74.3	SURCHARGED	
S17.003	S87	30 minute 30 year Summer I+20%	134.750	132.245	1.18	1.209	72.5	SURCHARGED	
S18.000	S88	30 minute 30 year Summer I+20%	135.500	134.090	0.33	0.096	12.9	OK	
S17.004	S89	30 minute 30 year Winter I+20%	134.750	132.244	0.00	52.559	0.1	SURCHARGED	TANK 6

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 6 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.271 Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 150.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 30
Return Period(s) (years) 2, 30, 100
Climate Change (%) 20, 20, 20

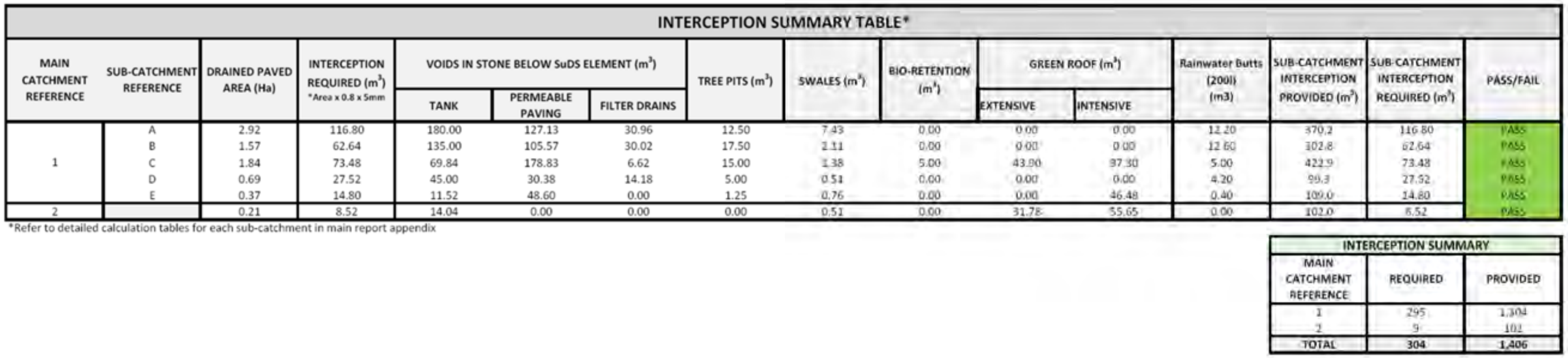
PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S1	30 minute 100 year Summer I+20%	142.350	141.062	0.49	0.166	52.1	OK
S1.001	S2	30 minute 100 year Summer I+20%	142.020	140.929	1.17	2.370	110.8	SURCHARGED
S1.002	S3	30 minute 100 year Summer I+20%	141.630	140.357	0.87	0.974	171.0	OK
S1.003	S4	30 minute 100 year Summer I+20%	139.700	138.996	1.17	2.172	211.4	SURCHARGED
S2.000	S5	30 minute 100 year Summer I+20%	140.710	139.346	0.65	0.148	43.0	OK
S2.001	S6	30 minute 100 year Summer I+20%	139.880	138.889	0.57	1.299	88.9	SURCHARGED
S2.002	S7	30 minute 100 year Summer I+20%	139.160	138.686	1.17	3.426	123.0	SURCHARGED
S1.004	S8	30 minute 100 year Summer I+20%	138.950	138.020	1.25	6.515	348.8	SURCHARGED
S1.005	S9	30 minute 100 year Summer I+20%	137.580	136.854	1.19	4.420	384.9	SURCHARGED
S3.000	S10	30 minute 100 year Summer I+20%	136.510	135.885	0.20	0.904	17.4	SURCHARGED
S3.001	S11	30 minute 100 year Summer I+20%	137.730	135.865	0.47	3.829	34.4	SURCHARGED
S3.002	S12	30 minute 100 year Summer I+20%	137.800	135.849	0.83	2.119	66.0	SURCHARGED
S3.003	S13	30 minute 100 year Summer I+20%	137.330	135.733	0.54	3.303	78.9	SURCHARGED
S3.004	S14	30 minute 100 year Summer I+20%	136.650	135.623	0.83	5.299	103.8	SURCHARGED
S3.005	S15	30 minute 100 year Summer I+20%	136.500	135.524	0.82	4.259	110.8	SURCHARGED
S1.006	S16	30 minute 100 year Summer I+20%	136.880	135.413	1.28	5.267	496.7	SURCHARGED
S1.007	S17	30 minute 100 year Summer I+20%	136.650	135.181	1.40	7.897	510.5	SURCHARGED
S1.008	S18	30 minute 100 year Summer I+20%	136.530	134.938	1.16	7.241	563.7	SURCHARGED
S4.000	S19	30 minute 100 year Summer I+20%	138.100	136.165	0.18	0.068	20.0	OK
S1.009	S20	30 minute 100 year Summer I+20%	135.920	134.410	1.33	19.627	634.0	SURCHARGED
S5.000	S21	30 minute 100 year Summer I+20%	140.610	139.254	0.79	0.168	64.5	OK
S5.001	S22	30 minute 100 year Summer I+20%	139.230	137.021	0.90	0.188	87.3	OK
S5.002	S23	30 minute 100 year Summer I+20%	137.520	136.222	0.76	0.248	121.5	OK
S1.010	S24	30 minute 100 year Summer I+20%	136.850	133.908	1.06	13.088	759.4	SURCHARGED
S1.011	S25	30 minute 100 year Summer I+20%	136.550	133.311	2.23	3.690	774.2	SURCHARGED
S6.000	S26	30 minute 100 year Summer I+20%	142.240	141.357	0.59	0.934	64.8	SURCHARGED
S7.000	S27	30 minute 100 year Summer I+20%	142.000	141.478	0.46	0.761	36.8	SURCHARGED
S7.001	S28	30 minute 100 year Summer I+20%	142.350	141.398	0.64	2.452	61.4	SURCHARGED
S8.000	S29	30 minute 100 year Summer I+20%	142.000	141.457	0.41	0.986	37.9	SURCHARGED
S8.001	S30	30 minute 100 year Summer I+20%	142.500	141.348	0.55	3.601	44.8	SURCHARGED
S6.001	S31	30 minute 100 year Summer I+20%	142.810	141.231	0.73	9.921	197.1	SURCHARGED
S6.002	S32	30 minute 100 year Summer I+20%	142.810	141.008	1.36	9.789	353.4	SURCHARGED
S6.003	S33	30 minute 100 year Summer I+20%	142.500	140.434	1.89	7.419	378.8	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status	
S6.004	S34	30 minute 100 year Winter I+20%	142.400	140.005	1.94	3.823	329.8	SURCHARGED	
S9.000	S35	30 minute 100 year Summer I+20%	141.960	140.792	0.29	0.155	29.1	OK	
S9.001	S36	30 minute 100 year Summer I+20%	142.200	140.792	0.35	1.855	36.7	SURCHARGED	
S9.002	S37	30 minute 100 year Summer I+20%	142.390	140.792	0.50	1.839	84.1	SURCHARGED	
S10.000	S38	30 minute 100 year Summer I+20%	143.000	141.838	0.61	0.377	62.1	SURCHARGED	
S10.001	S39	30 minute 100 year Summer I+20%	142.730	141.699	1.56	3.007	144.4	SURCHARGED	
S10.002	S40	30 minute 100 year Winter I+20%	142.750	140.847	0.76	1.119	148.6	SURCHARGED	
S11.000	S41	30 minute 100 year Summer I+20%	142.630	141.285	0.79	0.170	38.4	OK	
S11.001	S42	30 minute 100 year Summer I+20%	142.380	140.950	1.00	0.432	67.1	OK	
S11.002	S43	30 minute 100 year Summer I+20%	142.600	140.792	0.50	1.160	68.0	SURCHARGED	
S9.003	S44	30 minute 100 year Summer I+20%	142.350	140.792	0.00	206.389	0.1	SURCHARGED	TANK 4
S9.004	S45	30 minute 100 year Summer I+20%	141.940	139.987	0.74	0.560	70.5	OK	
S9.005	S46	30 minute 100 year Winter I+20%	141.350	139.919	0.35	4.234	84.6	SURCHARGED	
S9.006	S47	30 minute 100 year Winter I+20%	142.000	139.919	0.50	9.308	100.0	SURCHARGED	
S6.005	S48	30 minute 100 year Winter I+20%	142.100	139.919	0.00	403.448	0.1	SURCHARGED	TANK 3
S6.006	S49	30 minute 100 year Summer I+20%	142.030	139.863	0.86	2.033	34.7	SURCHARGED	
S6.007	S50	30 minute 100 year Summer I+20%	141.290	139.725	1.39	2.492	82.5	SURCHARGED	
S6.008	S51	30 minute 100 year Summer I+20%	139.150	138.311	1.13	2.158	120.1	SURCHARGED	
S6.009	S52	30 minute 100 year Summer I+20%	138.060	136.890	1.34	0.868	128.2	SURCHARGED	
S12.000	S53	30 minute 100 year Winter I+20%	141.650	140.492	0.42	0.189	44.5	OK	
S12.001	S54	30 minute 100 year Winter I+20%	141.640	140.455	0.48	2.918	50.4	SURCHARGED	
S12.002	S55	30 minute 100 year Winter I+20%	142.080	140.427	0.92	1.736	64.2	SURCHARGED	
S12.003	S56	30 minute 100 year Summer I+20%	142.110	140.374	0.41	1.643	81.6	SURCHARGED	
S12.004	S57	30 minute 100 year Summer I+20%	141.750	140.374	0.00	62.633	0.1	SURCHARGED	TANK 5
S13.000	S58	30 minute 100 year Summer I+20%	142.650	141.846	1.27	0.951	77.4	SURCHARGED	
S12.005	S59	30 minute 100 year Summer I+20%	141.700	140.837	0.94	3.258	94.4	SURCHARGED	
S12.006	S60	30 minute 100 year Summer I+20%	141.500	140.643	1.13	4.147	116.0	SURCHARGED	
S12.007	S61	30 minute 100 year Summer I+20%	141.000	140.264	0.90	5.119	162.8	SURCHARGED	
S14.000	S62	30 minute 100 year Summer I+20%	141.530	140.270	0.72	0.265	62.5	SURCHARGED	
S12.008	S63	30 minute 100 year Summer I+20%	140.500	139.989	1.35	7.727	272.2	SURCHARGED	
S12.009	S64	30 minute 100 year Summer I+20%	139.520	139.065	1.26	6.526	331.0	SURCHARGED	
S12.010	S65	30 minute 100 year Summer I+20%	138.600	137.753	1.19	3.910	346.7	SURCHARGED	
S12.011	S66	30 minute 100 year Summer I+20%	138.250	136.526	2.04	2.807	336.2	SURCHARGED	
S15.000	S67	30 minute 100 year Summer I+20%	142.680	141.521	1.37	0.527	66.3	SURCHARGED	
S15.001	S68	30 minute 100 year Summer I+20%	142.440	140.901	0.76	0.329	135.4	OK	
S15.002	S69	30 minute 100 year Summer I+20%	141.180	140.165	0.96	2.020	180.8	SURCHARGED	
S15.003	S70	30 minute 100 year Summer I+20%	140.230	139.278	1.16	1.963	221.6	SURCHARGED	
S15.004	S71	30 minute 100 year Summer I+20%	138.780	135.806	1.33	0.917	271.3	SURCHARGED	
S12.012	S72	30 minute 100 year Winter I+20%	137.250	135.607	0.00	490.973	0.1	SURCHARGED	TANK 2
S6.010	S73	30 minute 100 year Summer I+20%	137.750	135.269	1.47	1.194	135.3	SURCHARGED	
S6.011	S74	30 minute 100 year Summer I+20%	136.750	132.839	0.91	0.479	155.5	OK	
S16.000	S75	30 minute 100 year Summer I+20%	134.250	133.192	0.21	0.196	50.6	OK	
S16.001	S76	30 minute 100 year Summer I+20%	134.250	132.899	0.33	0.921	65.0	OK	
S1.012	S77	30 minute 100 year Winter I+20%	134.500	132.615	0.00	832.259	0.1	SURCHARGED	TANK 1
S1.013	S78	30 minute 100 year Winter I+20%	132.500	130.531	0.00	0.000	0.1	OK	
S1.014	S79	30 minute 100 year Winter I+20%	130.850	128.400	0.00	0.000	0.1	OK	
S1.015	S80	30 minute 100 year Summer I+20%	127.750	126.151	0.00	0.000	0.1	OK	
S1.016	S81	30 minute 100 year Summer I+20%	127.000	125.390	0.00	0.000	0.1	OK	
S1.017	S82	30 minute 100 year Summer I+20%	125.700	122.711	0.00	0.000	0.1	OK	
S1.018	S83	30 minute 100 year Summer I+20%	123.500	122.322	0.00	0.000	0.1	OK	
S17.000	S84	30 minute 100 year Summer I+20%	136.750	135.250	0.00	0.000	0.0	OK	
S17.001	S85	30 minute 100 year Summer I+20%	136.750	134.849	0.02	0.021	1.1	OK	
S17.002	S86	30 minute 100 year Summer I+20%	135.750	132.480	1.58	0.424	96.7	SURCHARGED	
S17.003	S87	30 minute 100 year Summer I+20%	134.750	132.468	1.52	1.739	93.1	SURCHARGED	
S18.000	S88	30 minute 100 year Summer I+20%	135.500	134.104	0.43	0.112	16.8	OK	
S17.004	S89	30 minute 100 year Winter I+20%	134.750	132.467	0.00	68.045	0.1	SURCHARGED	TANK 6

Appendix 12.2

Interception & Sample of Swale Calculations



INTERCEPTION SUMMARY TABLE*

MAIN CATCHMENT REFERENCE	SUB-CATCHMENT REFERENCE	DRAINED PAVED AREA (Ha)	INTERCEPTION REQUIRED (m^3) *Area x 0.8 x 5mm	VOIDS IN STONE BELOW SuDS ELEMENT (m^3)			TREE PITS (m^3)	SWALES (m^3)	BIO-RETENTION (m^3)	GREEN ROOF (m^3)		Rainwater Butts (200l) (m3)	SUB-CATCHMENT INTERCEPTION PROVIDED (m^3)	SUB-CATCHMENT INTERCEPTION REQUIRED (m^3)	PASS/FAIL
				TANK	PERMEABLE PAVING	FILTER DRAINS				EXTENSIVE	INTENSIVE				
1	A	2.92	116.80	180.00	127.13	30.96	12.50	7.43	0.00	0.00	0.00	12.20	370.2	116.80	PASS
	B	1.57	62.64	135.00	105.57	30.02	17.50	2.11	0.00	0.00	0.00	12.60	102.8	62.64	PASS
	C	1.84	73.48	69.84	178.83	6.62	15.00	1.38	5.00	43.00	97.30	5.00	422.9	73.48	PASS
	D	0.69	27.52	45.00	30.38	14.18	5.00	0.51	0.00	0.00	0.00	4.20	99.3	27.52	PASS
	E	0.37	14.80	11.52	48.60	0.00	1.25	0.76	0.00	0.00	46.48	0.40	109.0	14.80	PASS
2		0.21	8.52	14.04	0.00	0.00	0.00	0.51	0.00	31.78	55.65	0.00	102.0	8.52	PASS

*Refer to detailed calculation tables for each sub-catchment in main report appendix

INTERCEPTION SUMMARY		
MAIN CATCHMENT REFERENCE	REQUIRED	PROVIDED
1	295	1,304
2	9	102
TOTAL	304	1,406

INTERCEPTION - Catchment A

Paved Surfaces connected to the drainage system (Ha) =	2.92	Volume of Interception Required (m³)	116.8	Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)

Volume of Interception Provided (m³)	Length	Width (m)	Area (m²)	Quantity	Stone Depth (m)	Void Ratio	Volume (m³)
Voids of stone below Attenuation Tank			1,000		0.45	0.4	180.0
Voids of stone below Permeable Paving overflow			2,825		0.15	0.3	127.1
Voids of stone below Filter Drain overflow	430	0.6			0.3	0.4	31.0
Rainwater Butts (200l) @ 2No.per block	1		0.2	61		1	12.2
Voids of stone below Swale overflow	275	0.45			0.15	0.4	7.4
Tree Pit			12.5	10	0.1	1	12.5
Bio-Retention			12.5	0	0.1	1	0.0
Green Roof Intensive			0		0.2	0.35	0.0
Green Roof Extensive			0		0.08	0.35	0.0

Volume of Interception Provided (m³) =	370.2
Volume of Interception Required (m³) =	116.8
Interception provided > Required	OK

INTERCEPTION - Catchment B

Paved Surfaces connected to the drainage system (Ha) =	1.57	Volume of Interception Required (m³)	62.6	Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)

Volume of Interception Provided (m³)	Length	Width (m)	Area (m²)	Quantity	Stone Depth (m)	Void Ratio	Volume (m³)
Voids of stone below Attenuation Tank			750		0.45	0.4	135.0
Voids of stone below Permeable Paving overflow			2,346		0.15	0.3	105.6
Voids of stone below Filter Drain overflow	417	0.6			0.3	0.4	30.0
Rainwater Butts (200l) @ 2No.per block	1		0.2	63		1	12.6
Voids of stone below Swale overflow	78	0.45			0.15	0.4	2.1
Tree Pit			12.5	14	0.1	1	17.5
Bio-Retention			12.5	0	0.1	1	0.0
Green Roof Intensive			0		0.2	0.35	0.0
Green Roof Extensive			0		0.08	0.35	0.0

Volume of Interception Provided (m³) =	302.8
Volume of Interception Required (m³) =	62.6
Interception provided > Required	OK

INTERCEPTION - Catchment C

Paved Surfaces connected to the drainage system (Ha) =	1.84	Volume of Interception Required (m³)	73.5	Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)

Volume of Interception Provided (m³)	Length	Width (m)	Area (m²)	Quantity	Stone Depth (m)	Void Ratio	Volume (m³)
Voids of stone below Attenuation Tank			388		0.45	0.4	69.8
Voids of stone below Permeable Paving overflow			3,974		0.15	0.3	178.8
Voids of stone below Filter Drain overflow	92	0.6			0.3	0.4	6.6
Rainwater Butts (200l) @ 2No.per block	1		0.2	25		1	5.0
Voids of stone below Swale overflow	51	0.45			0.15	0.4	1.4
Tree Pit			12.5	12	0.1	1	15.0
Bio-Retention			12.5	4	0.1	1	5.0
Green Roof Intensive			1,390		0.2	0.35	97.3
Green Roof Extensive			1,568		0.08	0.35	43.9

Volume of Interception Provided (m³) =	422.9
Volume of Interception Required (m³) =	73.5
Interception provided > Required	OK

INTERCEPTION - Catchment D

Paved Surfaces connected to the drainage system (Ha) = 0.69

Volume of Interception Required (m^3) 27.5 Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)

Volume of Interception Provided (m^3)	**Length**	**Width (m)**	**Area (m^2)**	**Quantity**	**Stone Depth (m)**	**Void Ratio**	**Volume (m^3)**
Voids of stone below Attenuation Tank			250		0.45	0.4	45.0
Voids of stone below Permeable Paving overflow			675		0.15	0.3	30.4
Voids of stone below Filter Drain overflow	197	0.6			0.3	0.4	14.2
Rainwater Butts (200l) @ 2No.per block	1		0.2	21		1	4.2
Voids of stone below Swale overflow	19	0.45			0.15	0.4	0.5
Tree Pit			12.5	4	0.1	1	5.0
Bio-Retention			12.5	0	0.1	1	0.0
Green Roof Intensive			0		0.2	0.35	0.0
Green Roof Extensive			0		0.08	0.35	0.0

Volume of Interception Provided (m^3) = 99.3

Volume of Interception Required (m^3) = 27.5

Interception provided > Required **OK**

INTERCEPTION - Catchment E

Paved Surfaces connected to the drainage system (Ha) = 0.37

Volume of Interception Required (m^3) 14.8 Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)

Volume of Interception Provided (m^3)	**Length**	**Width (m)**	**Area (m^2)**	**Quantity**	**Stone Depth (m)**	**Void Ratio**	**Volume (m^3)**
Voids of stone below Attenuation Tank			64		0.45	0.4	11.5
Voids of stone below Permeable Paving overflow			1,080		0.15	0.3	48.6
Voids of stone below Filter Drain overflow	0	0.6			0.3	0.4	0.0
Rainwater Butts (200l) @ 2No.per block	1		0.2	2		1	0.4
Voids of stone below Swale overflow	28	0.45			0.15	0.4	0.8
Tree Pit			12.5	1	0.1	1	1.3
Bio-Retention			12.5	0	0.1	1	0.0
Green Roof Intensive			664		0.2	0.35	46.5
Green Roof Extensive			0		0.08	0.35	0.0

Volume of Interception Provided (m^3) = 109.0

Volume of Interception Required (m^3) = 14.8

Interception provided > Required **OK**

INTERCEPTION - Catchment 2

Paved Surfaces connected to the drainage system (Ha) = 0.21

Volume of Interception Required (m^3) 8.5 Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)

Volume of Interception Provided (m^3)	**Length**	**Width (m)**	**Area (m^2)**	**Quantity**	**Stone Depth (m)**	**Void Ratio**	**Volume (m^3)**
Voids of stone below Attenuation Tank			78		0.45	0.4	14.0
Voids of stone below Permeable Paving overflow			0		0.15	0.3	0.0
Voids of stone below Filter Drain overflow	0	0.6			0.3	0.4	0.0
Rainwater Butts (200l) @ 2No.per block	1		0.2	0		1	0.0
Voids of stone below Swale overflow	19	0.45			0.15	0.4	0.5
Tree Pit			12.5	0	0.1	1	0.0
Bio-Retention			12.5	0	0.1	1	0.0
Green Roof Intensive			795		0.2	0.35	55.7
Green Roof Extensive			1,135		0.08	0.35	31.8

Volume of Interception Provided (m^3) = 102.0

Volume of Interception Required (m^3) = 8.5

Interception provided > Required **OK**

Roger Mullarkey & Associates Duncreevan Kilcock Co.Kildare	Project Kilternan Vilage				Job Ref. 2104	
	Section Swale 1				Sheet no./rev. 1	
	Calc. by RM	Date 22/05/2022	Chk'd by	Date	App'd by	Date

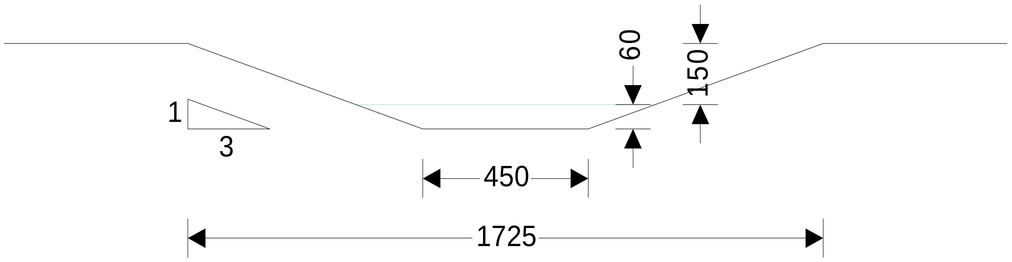
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	w = **0.450** m
Longitudinal gradient of swale	S = **0.020**
Side slope gradient of swale	s = **0.330**
Manning number	n = **0.25**
Length of swale	L = **20** m



Cross section of swale

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **1** hr
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.271**
5-year return period rainfall of 60 minutes duration	M5_60min = **18.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **20** %
Factor Z1 (Wallingford procedure)	Z1 = **1.00**
Rainfall for 1hr storm with 5 year return period	$M5\_1hr_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **21.6** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.92**
Rainfall for 1hr storm with 100 year return period	$M100\_1hr = Z2 \times M5\_1hr_i$ = **41.4** mm
Design rainfall intensity	$I_{max} = M100\_1hr / D$ = **41.4** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **297** m^2
Percentage of area that is impermeable	p = **80** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **2.7** l/s

Calculate depth of flow using iteration of Manning’s formula

Minimum depth of flow	x = **60** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow	$A = (w + x / s) \times x$ = **0.038** m^2
Perimeter of flow	$P = w + 2 \times \sqrt{(x^2 + (x / s)^2)}$ = **0.836** m
Hydraulic radius	$R = A / P$ = **0.046** m
Check flow using Manning equation	$Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n$ = **2.8** l/s
Maximum velocity of flow	$V_{max} = Q_{max} / A$ = **0.071** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

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Minimum width

Freeboard $d_{free} = \mathbf{150}$ mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w = \mathbf{1.725}$ m

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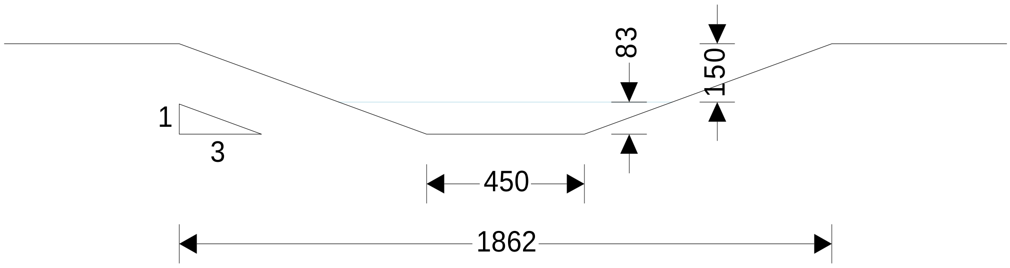
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	w = **0.450** m
Longitudinal gradient of swale	S = **0.020**
Side slope gradient of swale	s = **0.330**
Manning number	n = **0.25**
Length of swale	L = **30** m



Cross section of swale

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **1** hr
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.271**
5-year return period rainfall of 60 minutes duration	M5_60min = **18.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **20** %
Factor Z1 (Wallingford procedure)	Z1 = **1.00**
Rainfall for 1hr storm with 5 year return period	$M5\_1hr_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **21.6** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.92**
Rainfall for 1hr storm with 100 year return period	$M100\_1hr = Z2 \times M5\_1hr_i$ = **41.4** mm
Design rainfall intensity	$I_{max} = M100\_1hr / D$ = **41.4** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **540** m^2
Percentage of area that is impermeable	p = **80** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **5.0** l/s

Calculate depth of flow using iteration of Manning’s formula

Minimum depth of flow	x = **83** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow	$A = (w + x / s) \times x$ = **0.058** m^2
Perimeter of flow	$P = w + 2 \times \sqrt{(x^2 + (x / s)^2)}$ = **0.980** m
Hydraulic radius	$R = A / P$ = **0.059** m
Check flow using Manning equation	$Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n$ = **5.0** l/s
Maximum velocity of flow	$V_{max} = Q_{max} / A$ = **0.085** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard d_{free} = **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w = \mathbf{1.862}$ m

SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

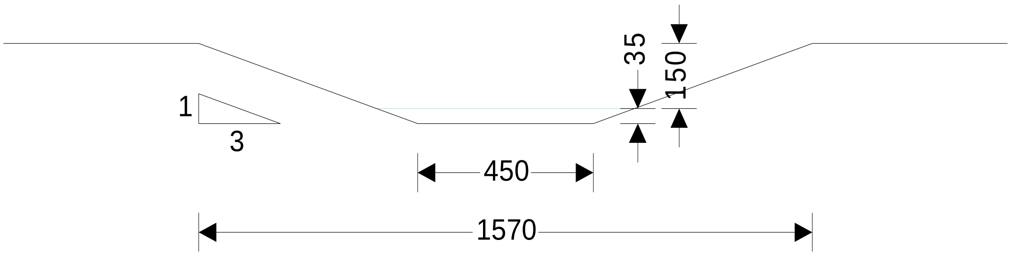
Width of swale base — w = **0.450** m

Longitudinal gradient of swale — S = **0.010**

Side slope gradient of swale — s = **0.330**

Manning number — n = **0.25**

Length of swale — L = **11** m



Cross section of swale

Design rainfall intensity

Location of catchment area — Other

Storm duration — D = **1** hr

Return period — Period = **2** yr

Ratio 60 min to 2 day rainfall of 5 yr return period — r = **0.271**

5-year return period rainfall of 60 minutes duration — M5_60min = **18.0** mm

Increase of rainfall intensity due to global warming — $p_{climate}$ = **20** %

Factor Z1 (Wallingford procedure) — Z1 = **1.00**

Rainfall for 1hr storm with 5 year return period — $M5\_1hr_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **21.6** mm

Factor Z2 (Wallingford procedure) — Z2 = **0.84**

Rainfall for 1hr storm with 2 year return period — $M2\_1hr = Z2 \times M5\_1hr_i$ = **18.1** mm

Design rainfall intensity — $I_{max} = M2\_1hr / D$ = **18.1** mm/hr

Maximum surface water runoff

Catchment area — A_{catch} = **140** m^2

Percentage of area that is impermeable — p = **95** %

Maximum surface water runoff — $Q_{max} = A_{catch} \times p \times I_{max}$ = **0.7** l/s

Calculate depth of flow using iteration of Manning’s formula

Minimum depth of flow — x = **35** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow — $A = (w + x / s) \times x$ = **0.019** m^2

Perimeter of flow — $P = w + 2 \times \sqrt{(x^2 + (x / s)^2)}$ = **0.673** m

Hydraulic radius — $R = A / P$ = **0.029** m

Check flow using Manning equation — $Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n$ = **0.7** l/s

Maximum velocity of flow — $V_{max} = Q_{max} / A$ = **0.035** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

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Minimum width

Freeboard d_{free} = **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **1.570** m

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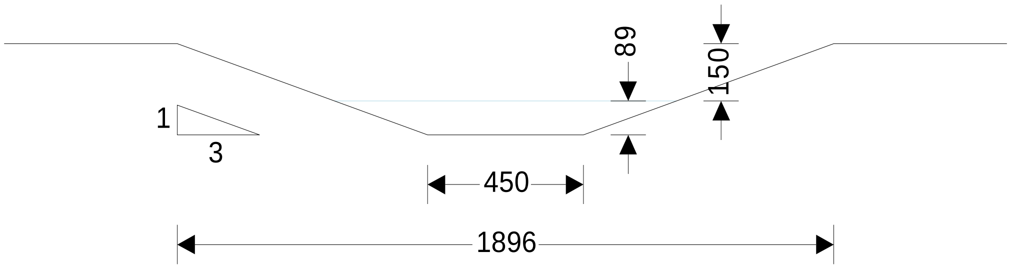
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	$w = \mathbf{0.450}$ m
Longitudinal gradient of swale	$S = \mathbf{0.008}$
Side slope gradient of swale	$s = \mathbf{0.330}$
Manning number	$n = \mathbf{0.25}$
Length of swale	$L = \mathbf{35}$ m



Cross section of swale

Design rainfall intensity

Location of catchment area	Other
Storm duration	$D = \mathbf{30}$ min
Return period	Period = **2** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	$r = \mathbf{0.271}$
5-year return period rainfall of 60 minutes duration	M5_60min = **18.0** mm
Increase of rainfall intensity due to global warming	$p_{climate} = \mathbf{20}$ %
Factor Z1 (Wallingford procedure)	$Z1 = \mathbf{0.76}$
Rainfall for 30min storm with 5 year return period	$M5\_30min_i = Z1 \times M5\_60min \times (1 + p_{climate}) = \mathbf{16.4}$ mm
Factor Z2 (Wallingford procedure)	$Z2 = \mathbf{0.83}$
Rainfall for 30min storm with 2 year return period	$M2\_30min = Z2 \times M5\_30min_i = \mathbf{13.7}$ mm
Design rainfall intensity	$I_{max} = M2\_30min / D = \mathbf{27.4}$ mm/hr

Maximum surface water runoff

Catchment area	$A_{catch} = \mathbf{493}$ m^2
Percentage of area that is impermeable	$p = \mathbf{95}$ %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max} = \mathbf{3.6}$ l/s

Calculate depth of flow using iteration of Manning’s formula

Minimum depth of flow	$x = \mathbf{89}$ mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow	$A = (w + x / s) \times x = \mathbf{0.064}$ m^2
Perimeter of flow	$P = w + 2 \times \sqrt{(x^2 + (x / s)^2)} = \mathbf{1.015}$ m
Hydraulic radius	$R = A / P = \mathbf{0.063}$ m
Check flow using Manning equation	$Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n = \mathbf{3.6}$ l/s
Maximum velocity of flow	$V_{max} = Q_{max} / A = \mathbf{0.056}$ m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard	d_{free} = **150** mm
Minimum required swale width	$w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **1.896** m

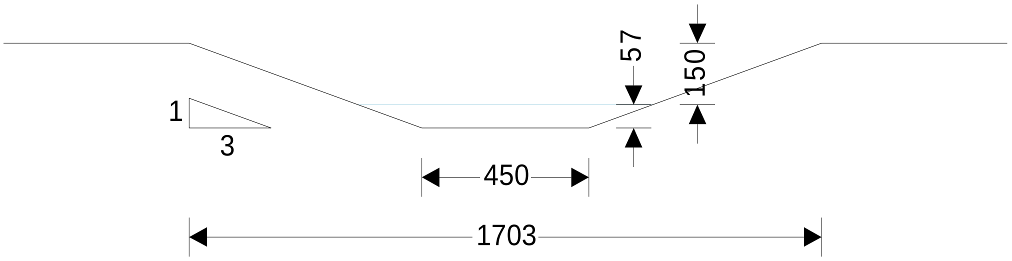
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	w = **0.450** m
Longitudinal gradient of swale	S = **0.020**
Side slope gradient of swale	s = **0.330**
Manning number	n = **0.25**
Length of swale	L = **26** m



Cross section of swale

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **30** min
Return period	Period = **2** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.271**
5-year return period rainfall of 60 minutes duration	M5_60min = **18.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **20** %
Factor Z1 (Wallingford procedure)	Z1 = **0.76**
Rainfall for 30min storm with 5 year return period	$M5\_30min_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **16.4** mm
Factor Z2 (Wallingford procedure)	Z2 = **0.83**
Rainfall for 30min storm with 2 year return period	$M2\_30min = Z2 \times M5\_30min_i$ = **13.7** mm
Design rainfall intensity	$I_{max} = M2\_30min / D$ = **27.4** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **338** m^2
Percentage of area that is impermeable	p = **95** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **2.4** l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow	x = **57** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow	$A = (w + x / s) \times x$ = **0.035** m^2
Perimeter of flow	$P = w + 2 \times \sqrt{(x^2 + (x / s)^2)}$ = **0.812** m
Hydraulic radius	$R = A / P$ = **0.043** m
Check flow using Manning equation	$Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n$ = **2.5** l/s
Maximum velocity of flow	$V_{max} = Q_{max} / A$ = **0.069** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard d_{free} = **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **1.703** m

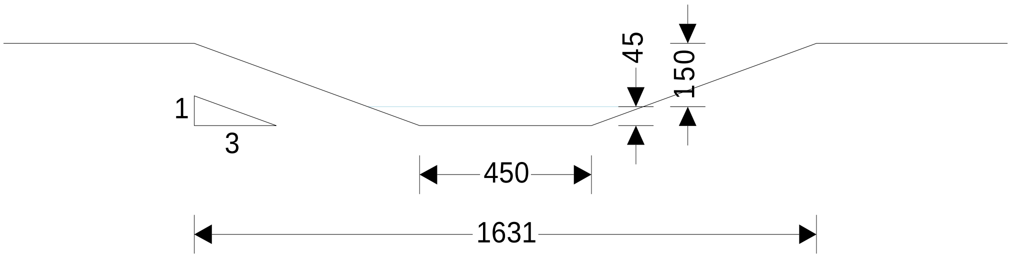
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	w = **0.450** m
Longitudinal gradient of swale	S = **0.020**
Side slope gradient of swale	s = **0.330**
Manning number	n = **0.25**
Length of swale	L = **11** m



Cross section of swale

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **30** min
Return period	Period = **2** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.271**
5-year return period rainfall of 60 minutes duration	M5_60min = **18.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **20** %
Factor Z1 (Wallingford procedure)	Z1 = **0.76**
Rainfall for 30min storm with 5 year return period	$M5\_30min_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **16.4** mm
Factor Z2 (Wallingford procedure)	Z2 = **0.83**
Rainfall for 30min storm with 2 year return period	$M2\_30min = Z2 \times M5\_30min_i$ = **13.7** mm
Design rainfall intensity	$I_{max} = M2\_30min / D$ = **27.4** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **220** m^2
Percentage of area that is impermeable	p = **95** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **1.6** l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow	x = **45** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow	$A = (w + x / s) \times x$ = **0.026** m^2
Perimeter of flow	$P = w + 2 \times \sqrt{(x^2 + (x / s)^2)}$ = **0.736** m
Hydraulic radius	$R = A / P$ = **0.036** m
Check flow using Manning equation	$Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n$ = **1.6** l/s
Maximum velocity of flow	$V_{max} = Q_{max} / A$ = **0.061** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard d_{free} = **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **1.631** m

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SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

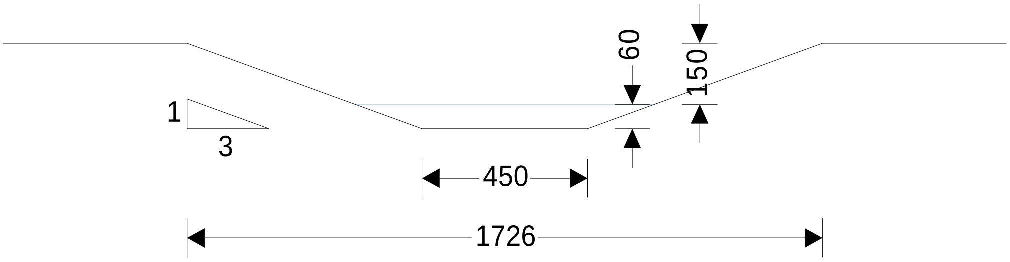
Width of swale base $w = \mathbf{0.450}$ m

Longitudinal gradient of swale $S = \mathbf{0.008}$

Side slope gradient of swale $s = \mathbf{0.330}$

Manning number $n = \mathbf{0.25}$

Length of swale $L = \mathbf{33}$ m



Cross section of swale

Design rainfall intensity

Location of catchment area Other

Storm duration $D = \mathbf{30}$ min

Return period Period = **2** yr

Ratio 60 min to 2 day rainfall of 5 yr return period $r = \mathbf{0.271}$

5-year return period rainfall of 60 minutes duration $M5\_60min = \mathbf{18.0}$ mm

Increase of rainfall intensity due to global warming $p_{climate} = \mathbf{20}$ %

Factor Z1 (Wallingford procedure) $Z1 = \mathbf{0.76}$

Rainfall for 30min storm with 5 year return period $M5\_30min_i = Z1 \times M5\_60min \times (1 + p_{climate}) = \mathbf{16.4}$ mm

Factor Z2 (Wallingford procedure) $Z2 = \mathbf{0.83}$

Rainfall for 30min storm with 2 year return period $M2\_30min = Z2 \times M5\_30min_i = \mathbf{13.7}$ mm

Design rainfall intensity $I_{max} = M2\_30min / D = \mathbf{27.4}$ mm/hr

Maximum surface water runoff

Catchment area $A_{catch} = \mathbf{240}$ m^2

Percentage of area that is impermeable $p = \mathbf{95}$ %

Maximum surface water runoff $Q_{max} = A_{catch} \times p \times I_{max} = \mathbf{1.7}$ l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow $x = \mathbf{60}$ mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow $A = (w + x / s) \times x = \mathbf{0.038}$ m^2

Perimeter of flow $P = w + 2 \times \sqrt{(x^2 + (x / s)^2)} = \mathbf{0.836}$ m

Hydraulic radius $R = A / P = \mathbf{0.046}$ m

Check flow using Manning equation $Q_{check} = A \times (R / 1\text{ m})^{2/3} \times S^{1/2} \times 1\text{ m/s} / n = \mathbf{1.8}$ l/s

Maximum velocity of flow $V_{max} = Q_{max} / A = \mathbf{0.045}$ m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard	d_{free} = **150** mm
Minimum required swale width	$w_{total,min} = 2 \times (x + d_{free}) / s + w = \mathbf{1.726}$ m

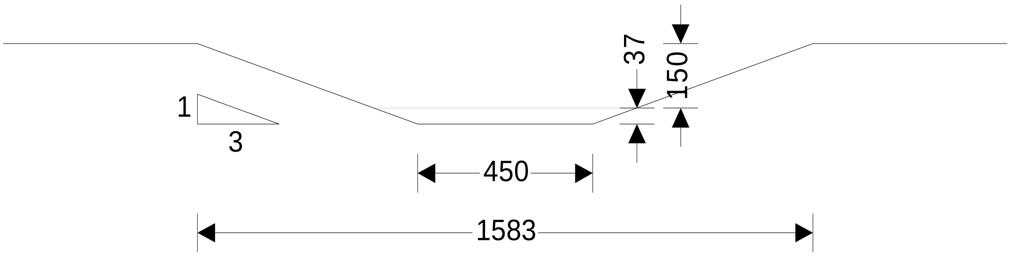
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	w = **0.450** m
Longitudinal gradient of swale	S = **0.016**
Side slope gradient of swale	s = **0.330**
Manning number	n = **0.25**
Length of swale	L = **19** m



Cross section of swale

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **30** min
Return period	Period = **2** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.271**
5-year return period rainfall of 60 minutes duration	M5_60min = **18.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **20** %
Factor Z1 (Wallingford procedure)	Z1 = **0.76**
Rainfall for 30min storm with 5 year return period	$M5\_30min_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **16.4** mm
Factor Z2 (Wallingford procedure)	Z2 = **0.83**
Rainfall for 30min storm with 2 year return period	$M2\_30min = Z2 \times M5\_30min_i$ = **13.7** mm
Design rainfall intensity	$I_{max} = M2\_30min / D$ = **27.4** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **140** m^2
Percentage of area that is impermeable	p = **95** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **1.0** l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow x = **37** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow	$A = (w + x / s) \times x$ = **0.021** m^2
Perimeter of flow	$P = w + 2 \times \sqrt{(x^2 + (x / s)^2)}$ = **0.686** m
Hydraulic radius	R = A / P = **0.030** m
Check flow using Manning equation	$Q_{check} = A \times (R / 1 m)^{2/3} \times S^{1/2} \times 1 m/s / n$ = **1.0** l/s
Maximum velocity of flow	$V_{max} = Q_{max} / A$ = **0.049** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

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Minimum width

Freeboard $d_{free} = \mathbf{150}$ mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w = \mathbf{1.583}$ m

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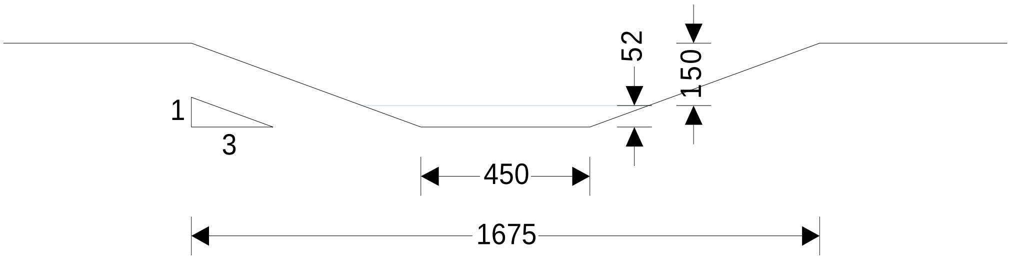
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	w = **0.450** m
Longitudinal gradient of swale	S = **0.015**
Side slope gradient of swale	s = **0.330**
Manning number	n = **0.25**
Length of swale	L = **17** m



Cross section of swale

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **30** min
Return period	Period = **2** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.271**
5-year return period rainfall of 60 minutes duration	M5_60min = **18.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **20** %
Factor Z1 (Wallingford procedure)	Z1 = **0.76**
Rainfall for 30min storm with 5 year return period	$M5\_30min_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **16.4** mm
Factor Z2 (Wallingford procedure)	Z2 = **0.83**
Rainfall for 30min storm with 2 year return period	$M2\_30min = Z2 \times M5\_30min_i$ = **13.7** mm
Design rainfall intensity	$I_{max} = M2\_30min / D$ = **27.4** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **250** m^2
Percentage of area that is impermeable	p = **95** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **1.8** l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow	x = **52** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow	$A = (w + x / s) \times x$ = **0.032** m^2
Perimeter of flow	$P = w + 2 \times \sqrt{(x^2 + (x / s)^2)}$ = **0.782** m
Hydraulic radius	R = A / P = **0.040** m
Check flow using Manning equation	$Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n$ = **1.8** l/s
Maximum velocity of flow	$V_{max} = Q_{max} / A$ = **0.057** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Roger Mullarkey & Associates Duncreevan Kilcock Co.Kildare	Project Kilternan Vilage				Job Ref. 2104	
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	Calc. by RM	Date 22/05/2022	Chk'd by	Date	App'd by	Date

Minimum width

Freeboard d_{free} = **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w = \mathbf{1.675}$ m

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	Section Swale 10				Sheet no./rev. 1	
	Calc. by RM	Date 22/05/2022	Chk'd by	Date	App'd by	Date

SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

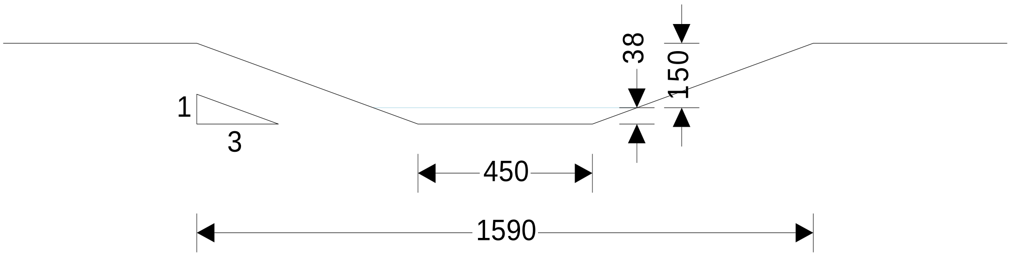
Width of swale base — $w = \mathbf{0.450}$ m

Longitudinal gradient of swale — $S = \mathbf{0.020}$

Side slope gradient of swale — $s = \mathbf{0.330}$

Manning number — $n = \mathbf{0.25}$

Length of swale — $L = \mathbf{21}$ m



Cross section of swale

Design rainfall intensity

Location of catchment area — Other

Storm duration — $D = \mathbf{30}$ min

Return period — Period = **2** yr

Ratio 60 min to 2 day rainfall of 5 yr return period — $r = \mathbf{0.271}$

5-year return period rainfall of 60 minutes duration — $M5\_60min = \mathbf{18.0}$ mm

Increase of rainfall intensity due to global warming — $p_{climate} = \mathbf{20}$ %

Factor Z1 (Wallingford procedure) — $Z1 = \mathbf{0.76}$

Rainfall for 30min storm with 5 year return period — $M5\_30min_i = Z1 \times M5\_60min \times (1 + p_{climate}) = \mathbf{16.4}$ mm

Factor Z2 (Wallingford procedure) — $Z2 = \mathbf{0.83}$

Rainfall for 30min storm with 2 year return period — $M2\_30min = Z2 \times M5\_30min_i = \mathbf{13.7}$ mm

Design rainfall intensity — $I_{max} = M2\_30min / D = \mathbf{27.4}$ mm/hr

Maximum surface water runoff

Catchment area — $A_{catch} = \mathbf{165}$ m^2

Percentage of area that is impermeable — $p = \mathbf{95}$ %

Maximum surface water runoff — $Q_{max} = A_{catch} \times p \times I_{max} = \mathbf{1.2}$ l/s

Calculate depth of flow using iteration of Manning’s formula

Minimum depth of flow — $x = \mathbf{38}$ mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow — $A = (w + x / s) \times x = \mathbf{0.022}$ m^2

Perimeter of flow — $P = w + 2 \times \sqrt{(x^2 + (x / s)^2)} = \mathbf{0.693}$ m

Hydraulic radius — $R = A / P = \mathbf{0.031}$ m

Check flow using Manning equation — $Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n = \mathbf{1.2}$ l/s

Maximum velocity of flow — $V_{max} = Q_{max} / A = \mathbf{0.055}$ m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard d_{free} = **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **1.590** m

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	Section Swale 11				Sheet no./rev. 1	
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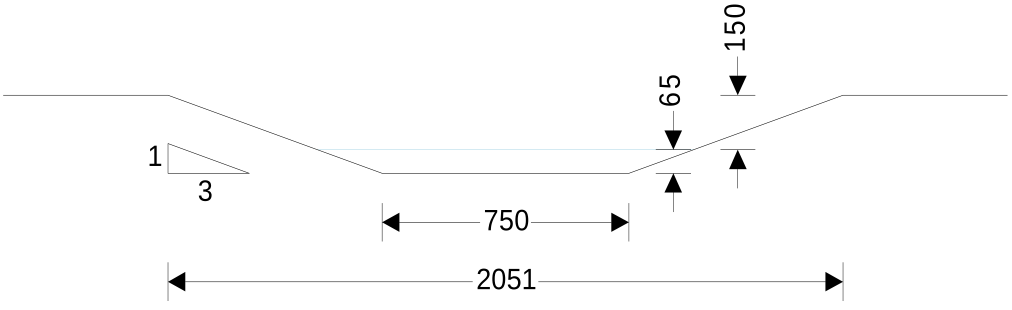
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	$w = \mathbf{0.750}$ m
Longitudinal gradient of swale	$S = \mathbf{0.008}$
Side slope gradient of swale	$s = \mathbf{0.330}$
Manning number	$n = \mathbf{0.25}$
Length of swale	$L = \mathbf{14}$ m



Cross section of swale

Design rainfall intensity

Location of catchment area	Other
Storm duration	$D = \mathbf{30}$ min
Return period	Period = **2** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	$r = \mathbf{0.271}$
5-year return period rainfall of 60 minutes duration	$M5\_60min = \mathbf{18.0}$ mm
Increase of rainfall intensity due to global warming	$p_{climate} = \mathbf{20}$ %
Factor Z1 (Wallingford procedure)	$Z1 = \mathbf{0.76}$
Rainfall for 30min storm with 5 year return period	$M5\_30min_i = Z1 \times M5\_60min \times (1 + p_{climate}) = \mathbf{16.4}$ mm
Factor Z2 (Wallingford procedure)	$Z2 = \mathbf{0.83}$
Rainfall for 30min storm with 2 year return period	$M2\_30min = Z2 \times M5\_30min_i = \mathbf{13.7}$ mm
Design rainfall intensity	$I_{max} = M2\_30min / D = \mathbf{27.4}$ mm/hr

Maximum surface water runoff

Catchment area	$A_{catch} = \mathbf{500}$ m^2
Percentage of area that is impermeable	$p = \mathbf{80}$ %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max} = \mathbf{3.0}$ l/s

Calculate depth of flow using iteration of Manning’s formula

Minimum depth of flow	$x = \mathbf{65}$ mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow	$A = (w + x / s) \times x = \mathbf{0.061}$ m^2
Perimeter of flow	$P = w + 2 \times \sqrt{(x^2 + (x / s)^2)} = \mathbf{1.163}$ m
Hydraulic radius	$R = A / P = \mathbf{0.053}$ m
Check flow using Manning equation	$Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n = \mathbf{3.1}$ l/s
Maximum velocity of flow	$V_{max} = Q_{max} / A = \mathbf{0.050}$ m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard d_{free} = **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **2.051** m

Roger Mullarkey & Associates Duncreevan Kilcock Co.Kildare	Project Kilternan Vilage				Job Ref. 2104	
	Section Swale 12				Sheet no./rev. 1	
	Calc. by RM	Date 22/05/2022	Chk'd by	Date	App'd by	Date

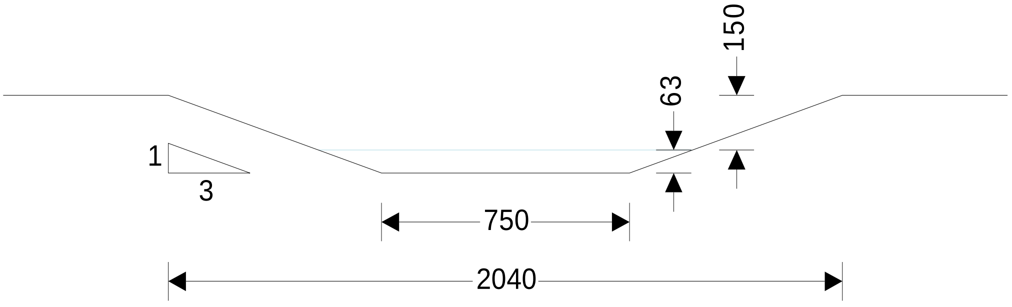
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	$w = \mathbf{0.750}$ m
Longitudinal gradient of swale	$S = \mathbf{0.020}$
Side slope gradient of swale	$s = \mathbf{0.330}$
Manning number	$n = \mathbf{0.25}$
Length of swale	$L = \mathbf{65}$ m



Cross section of swale

Design rainfall intensity

Location of catchment area	Other
Storm duration	$D = \mathbf{30}$ min
Return period	Period = **2** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	$r = \mathbf{0.271}$
5-year return period rainfall of 60 minutes duration	M5_60min = **18.0** mm
Increase of rainfall intensity due to global warming	$p_{climate} = \mathbf{20}$ %
Factor Z1 (Wallingford procedure)	$Z1 = \mathbf{0.76}$
Rainfall for 30min storm with 5 year return period	$M5\_30min_i = Z1 \times M5\_60min \times (1 + p_{climate}) = \mathbf{16.4}$ mm
Factor Z2 (Wallingford procedure)	$Z2 = \mathbf{0.83}$
Rainfall for 30min storm with 2 year return period	$M2\_30min = Z2 \times M5\_30min_i = \mathbf{13.7}$ mm
Design rainfall intensity	$I_{max} = M2\_30min / D = \mathbf{27.4}$ mm/hr

Maximum surface water runoff

Catchment area	$A_{catch} = \mathbf{750}$ m^2
Percentage of area that is impermeable	$p = \mathbf{80}$ %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max} = \mathbf{4.6}$ l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow	$x = \mathbf{63}$ mm
	Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)
Area of flow	$A = (w + x / s) \times x = \mathbf{0.059}$ m^2
Perimeter of flow	$P = w + 2 \times \sqrt{(x^2 + (x / s)^2)} = \mathbf{1.151}$ m
Hydraulic radius	$R = A / P = \mathbf{0.051}$ m
Check flow using Manning equation	$Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n = \mathbf{4.6}$ l/s
Maximum velocity of flow	$V_{max} = Q_{max} / A = \mathbf{0.077}$ m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard d_{free} = **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **2.040** m

Roger Mullarkey & Associates Duncreevan Kilcock Co.Kildare	Project Kilternan Vilage			Job Ref. 2104	
	Section Swale 13			Sheet no./rev. 1	
	Calc. by RM	Date 22/05/2022	Chk'd by	Date	App'd by	Date

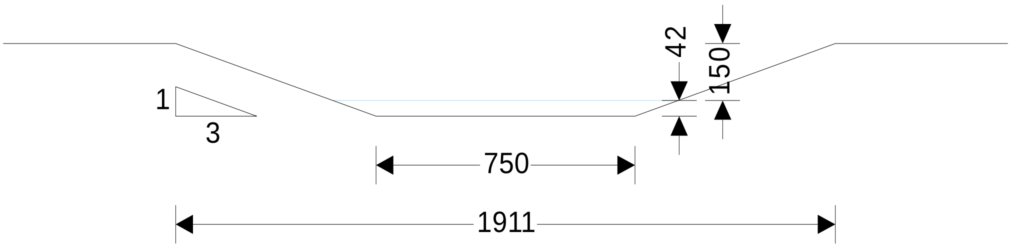
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	w = **0.750** m
Longitudinal gradient of swale	S = **0.020**
Side slope gradient of swale	s = **0.330**
Manning number	n = **0.25**
Length of swale	L = **16** m



Cross section of swale

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **30** min
Return period	Period = **2** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.271**
5-year return period rainfall of 60 minutes duration	M5_60min = **18.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **20** %
Factor Z1 (Wallingford procedure)	Z1 = **0.76**
Rainfall for 30min storm with 5 year return period	$M5\_30min_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **16.4** mm
Factor Z2 (Wallingford procedure)	Z2 = **0.83**
Rainfall for 30min storm with 2 year return period	$M2\_30min = Z2 \times M5\_30min_i$ = **13.7** mm
Design rainfall intensity	$I_{max} = M2\_30min / D$ = **27.4** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **365** m^2
Percentage of area that is impermeable	p = **80** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **2.2** l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow x = **42** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow	$A = (w + x / s) \times x$ = **0.036** m^2
Perimeter of flow	$P = w + 2 \times \sqrt{(x^2 + (x / s)^2)}$ = **1.015** m
Hydraulic radius	$R = A / P$ = **0.036** m
Check flow using Manning equation	$Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n$ = **2.2** l/s
Maximum velocity of flow	$V_{max} = Q_{max} / A$ = **0.061** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Roger Mullarkey & Associates Duncreevan Kilcock Co.Kildare	Project Kilternan Vilage				Job Ref. 2104	
	Section Swale 13				Sheet no./rev. 2	
	Calc. by RM	Date 22/05/2022	Chk'd by	Date	App'd by	Date

Minimum width

Freeboard $d_{free} = \mathbf{150}$ mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w = \mathbf{1.911}$ m

Appendix 12.3

StormTech Calculations and Information

StormTech® Subsurface Stormwater Management

The advanced design of StormTech's chambers allows stormwater professionals to create more profitable, environmentally sound installations. Compared with other subsurface systems, StormTech's innovative chambers offer lower overall installed costs, superior design flexibility and enhanced long-term performance.

Superior Design Flexibility for Optimal Land Use

StormTech chambers are ideal for commercial, municipal and residential applications. One of the key advantages of the StormTech chamber system is design flexibility. StormTech chambers can be configured into beds or trenches, in centralized or decentralized layouts to fit on nearly any site.

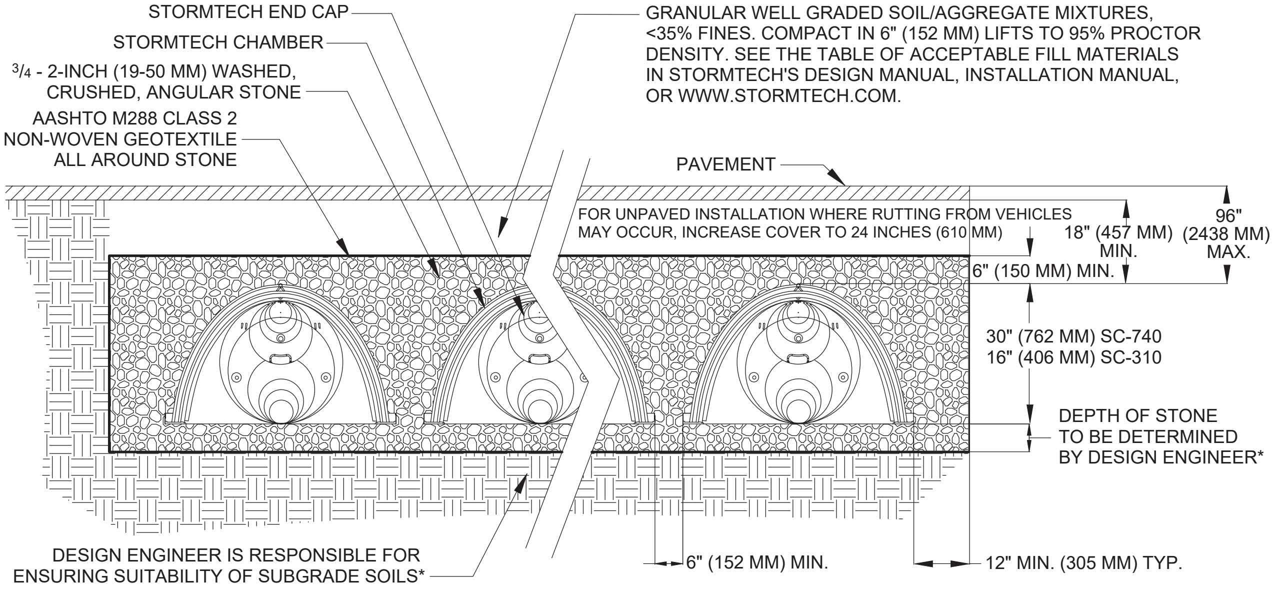
L to R: SC-310 chamber and SC-740 chamber

Product Features and Benefits

The advanced features and innovative technology of StormTech chambers streamline installations while lowering overall installed costs. StormTech chambers offer these unique advantages:

- Lightweight, two people can install chambers quickly and easily, saving time and money
- Extensive product research & development and rigorous testing ensure long term reliability and performance
- Versatile product design accommodates a wide range of site constraints with cost-effective system designs
- The chamber length can be cut in 6.5" (165 mm) increments – reducing waste and optimizing the use of available space
- Injection molded polypropylene ensures precise control of wall thickness and product consistency
- Isolator Row – a patent pending technique to inexpensively enhance total suspended solids (TSS) removal and provide easy access for inspection and maintenance
- Corrugated Arch Design – a proven geometry for structural integrity under H-20 live loads and deep burial loads, also provides high storage capacity

Typical Cross Section Detail (not to scale)


STORMTECH END CAP
STORMTECH CHAMBER
3/4 - 2-INCH (19-50 MM) WASHED, CRUSHED, ANGULAR STONE
AASHTO M288 CLASS 2 NON-WOVEN GEOTEXTILE ALL AROUND STONE
GRANULAR WELL GRADED SOIL/AGGREGATE MIXTURES, <35% FINES. COMPACT IN 6" (152 MM) LIFTS TO 95% PROCTOR DENSITY. SEE THE TABLE OF ACCEPTABLE FILL MATERIALS IN STORMTECH'S DESIGN MANUAL, INSTALLATION MANUAL, OR WWW.STORMTECH.COM.
PAVEMENT
FOR UNPAVED INSTALLATION WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24 INCHES (610 MM)
18" (457 MM) MIN.
96" (2438 MM) MAX.
6" (150 MM) MIN.
30" (762 MM) SC-740
16" (406 MM) SC-310
DEPTH OF STONE TO BE DETERMINED BY DESIGN ENGINEER*
DESIGN ENGINEER IS RESPONSIBLE FOR ENSURING SUITABILITY OF SUBGRADE SOILS*
6" (152 MM) MIN.
12" MIN. (305 MM) TYP.

Detention-Retention-Recharge

The StormTech SC-740 chamber optimizes storage volumes in relatively small footprints by providing 2.2 ft^3/ft^2 (0.67 m^3/m^2) (minimum) of storage. This can decrease excavation, backfill and associated costs. The StormTech SC-310 chamber is ideal for systems requiring low-rise and wide-span solutions. The chamber allows the storage of large volumes, 1.3 ft^3/ft^2 (0.4 m^3/m^2) (minimum), at minimum depths.

StormTech SC-740 Chamber
(not to scale)

Nominal Chamber
Specifications

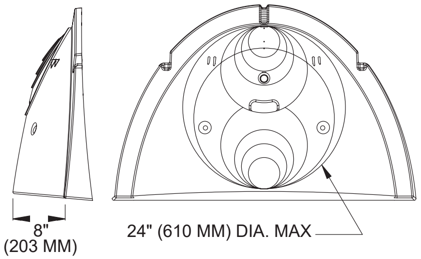
Size (L x W x H)
85.4" x 51.0" x 30.0"
(2169 x 1295 x 762 mm)

Chamber Storage
45.9 ft^3 (1.30 m^3)

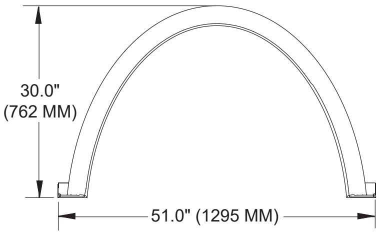
Minimum Installed Storage*
74.9 ft^3 (2.12 m^3)

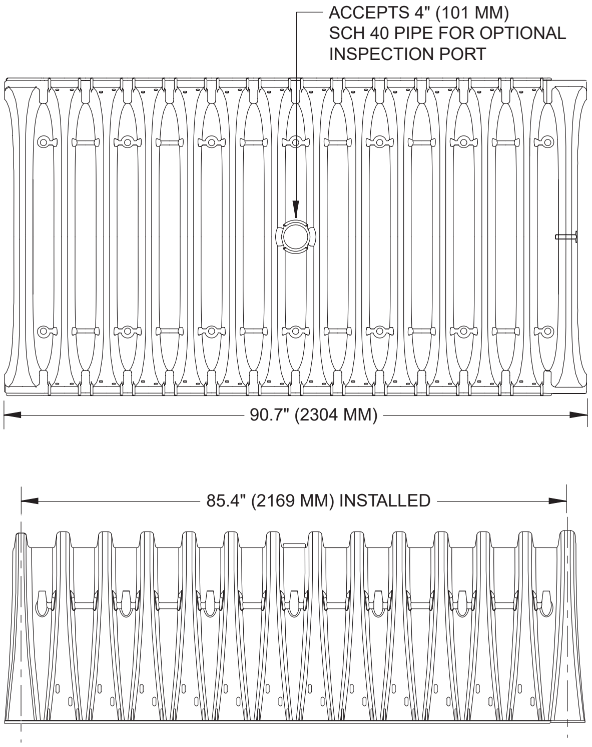
Weight
74.0 lbs (33.6 kg)

Shipping
30 chambers/pallet
60 end caps/pallet
12 pallets/truck



SC-740 end cap





SC-740 chamber

StormTech SC-310 Chamber
(not to scale)

Nominal Chamber
Specifications

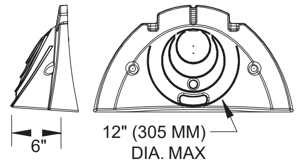
Size (L x W x H)
85.4" x 34.0" x 16.0"
(2169 x 864 x 406 mm)

Chamber Storage
14.7 ft^3 (0.42 m^3)

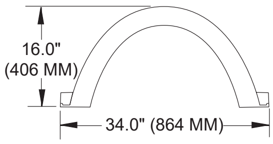
Minimum Installed Storage*
31.0 ft^3 (0.88 m^3)

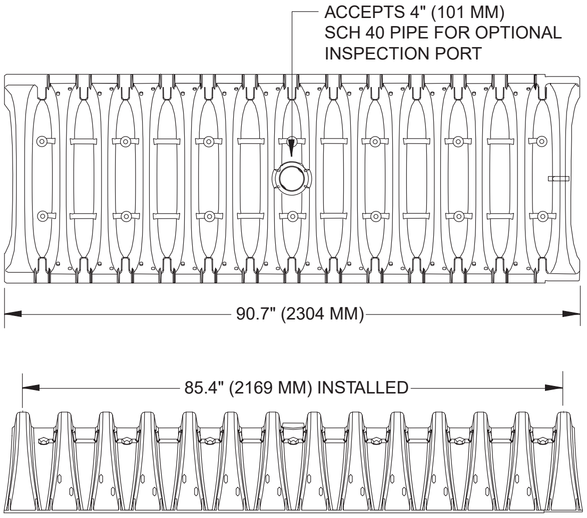
Weight
37.0 lbs (16.8 kg)

Shipping
41 chambers/pallet
108 end caps/pallet
18 pallets/truck



SC-310 end cap





SC-310 chamber

*This assumes a minimum of 6 inches (152 mm) of stone below, above and between chamber rows.

Advanced Structural Performance for Greater Long-Term Reliability

StormTech developed a state of the art chamber design through:

- Collaboration with world-renowned experts of buried drainage structures to develop and evaluate the structural testing program and product design
- Designing chambers to exceed AASHTO LRFD design specifications for HS-20 live loads and deep burial earth loads
- Subjecting the chambers to rigorous full scale testing, under severe loading conditions to verify the AASHTO safety factors for live load and deep burial applications

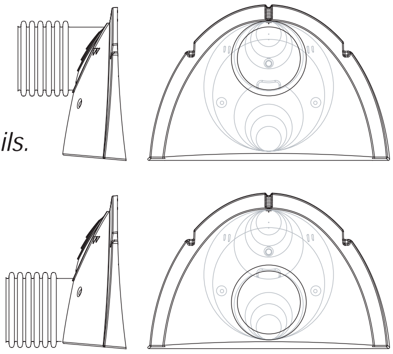
StormTech continues to conduct research and consult with outside experts to meet customer needs for alternative backfill materials, designs for special loadings and other technical solutions.

Technical Assistance

StormTech's technical support staff is available to provide assistance to engineers, contractors and developers. Please contact one of our engineers or product managers to discuss your particular application. A wide variety of technical support material is available in print, electronic media or from our website at www.stormtech.com. For any questions, please call StormTech at 888-892-2694.

Fabricated End Caps

Contact StormTech for details.



StormTech®
Detention • Retention • Recharge
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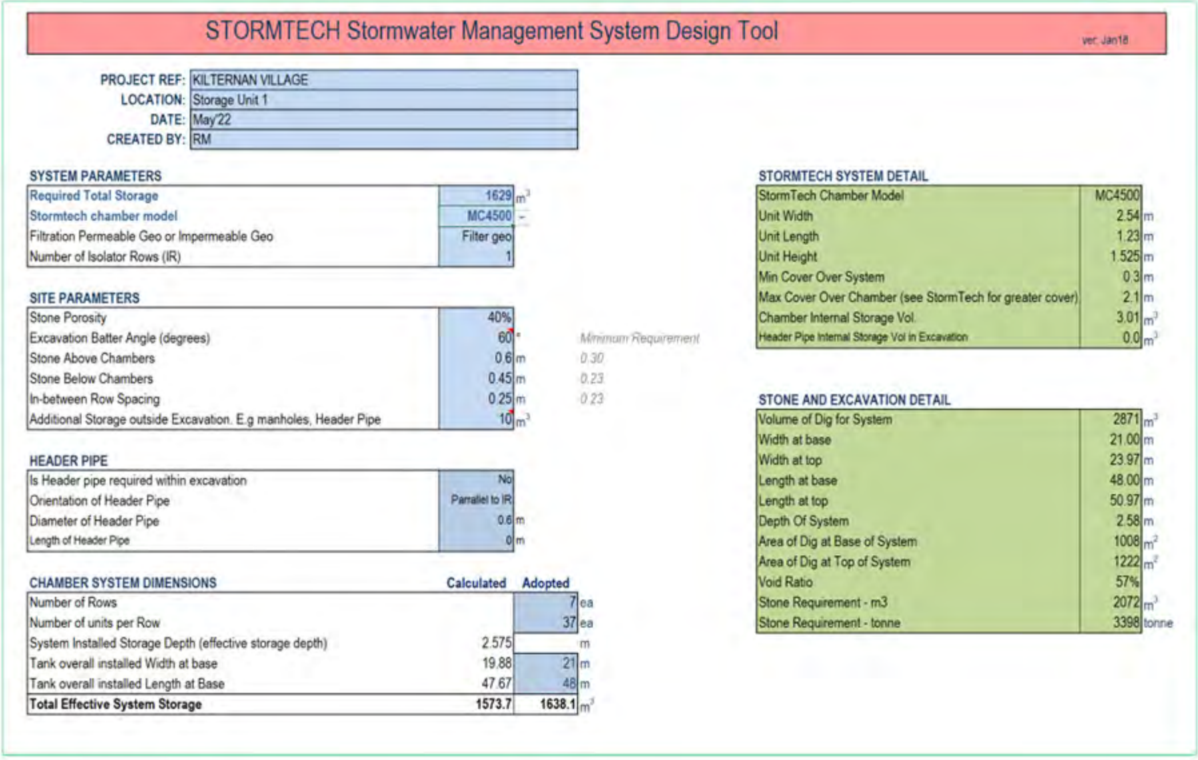


STORMTECH Stormwater Management System Design Tool

ver. Jan18

PROJECT REF: KILTERNAN VILLAGE
LOCATION: Storage Unit 1
DATE: May'22
CREATED BY: RM

SYSTEM PARAMETERS

Required Total Storage	1629	m^3
Stormtech chamber model	MC4500	-
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

			Minimum Requirement
Stone Porosity	40%		
Excavation Batter Angle (degrees)	60	°	
Stone Above Chambers	0.6	m	0.30
Stone Below Chambers	0.45	m	0.23
In-between Row Spacing	0.25	m	0.23
Additional Storage outside Excavation. E.g manholes, Header Pipe	10	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Parralel to IR	
Diameter of Header Pipe	0.6	m
Length of Header Pipe	0	m

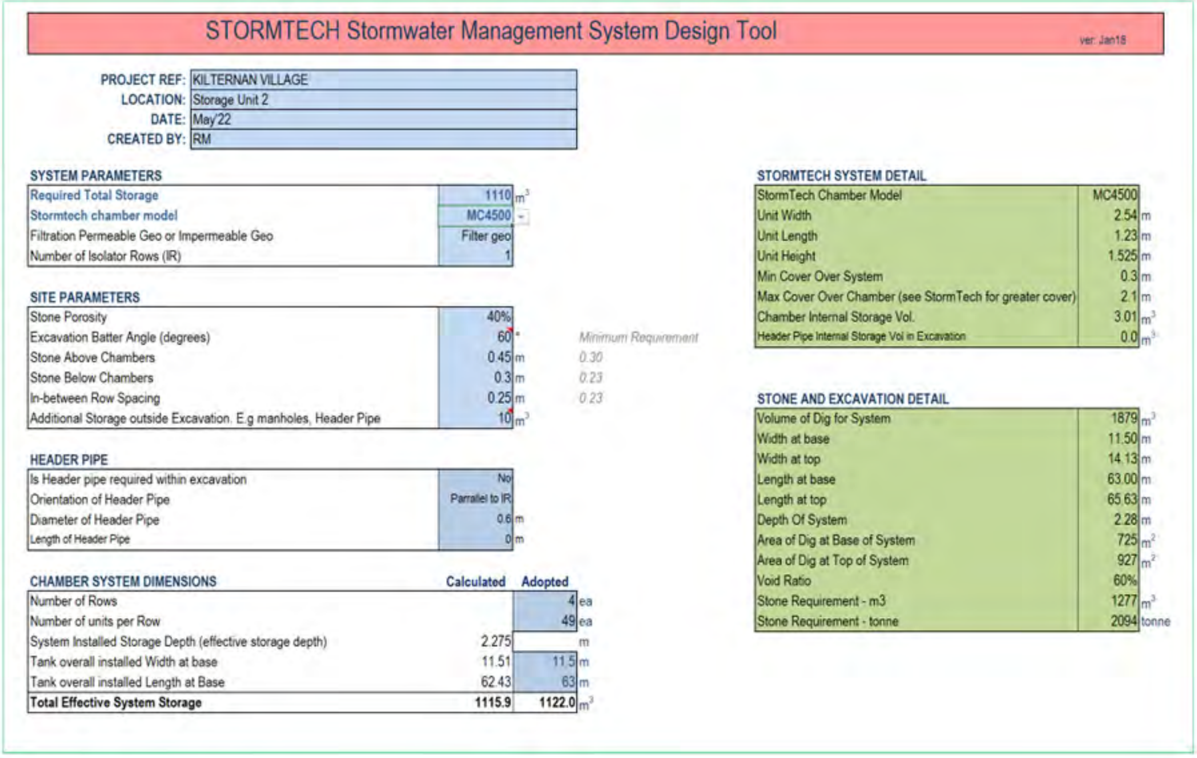
CHAMBER SYSTEM DIMENSIONS	Calculated	Adopted	
Number of Rows		7	ea
Number of units per Row		37	ea
System Installed Storage Depth (effective storage depth)	2.575		m
Tank overall installed Width at base	19.88	21	m
Tank overall installed Length at Base	47.67	48	m
Total Effective System Storage	**1573.7**	**1638.1**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	MC4500	
Unit Width	2.54	m
Unit Length	1.23	m
Unit Height	1.525	m
Min Cover Over System	0.3	m
Max Cover Over Chamber (see StormTech for greater cover)	2.1	m
Chamber Internal Storage Vol.	3.01	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	2871	m^3
Width at base	21.00	m
Width at top	23.97	m
Length at base	48.00	m
Length at top	50.97	m
Depth Of System	2.58	m
Area of Dig at Base of System	1008	m^2
Area of Dig at Top of System	1222	m^2
Void Ratio	57%	
Stone Requirement - m3	2072	m^3
Stone Requirement - tonne	3398	tonne



STORMTECH Stormwater Management System Design Tool

ver. Jan18

PROJECT REF: KILTERNAN VILLAGE
LOCATION: Storage Unit 2
DATE: May'22
CREATED BY: RM

SYSTEM PARAMETERS

Required Total Storage	1110	m^3
Stormtech chamber model	MC4500	-
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

			Minimum Requirement
Stone Porosity	40%		
Excavation Batter Angle (degrees)	60	°	
Stone Above Chambers	0.45	m	0.30
Stone Below Chambers	0.3	m	0.23
In-between Row Spacing	0.25	m	0.23
Additional Storage outside Excavation. E.g manholes, Header Pipe	10	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Parralel to IR	
Diameter of Header Pipe	0.6	m
Length of Header Pipe	0	m

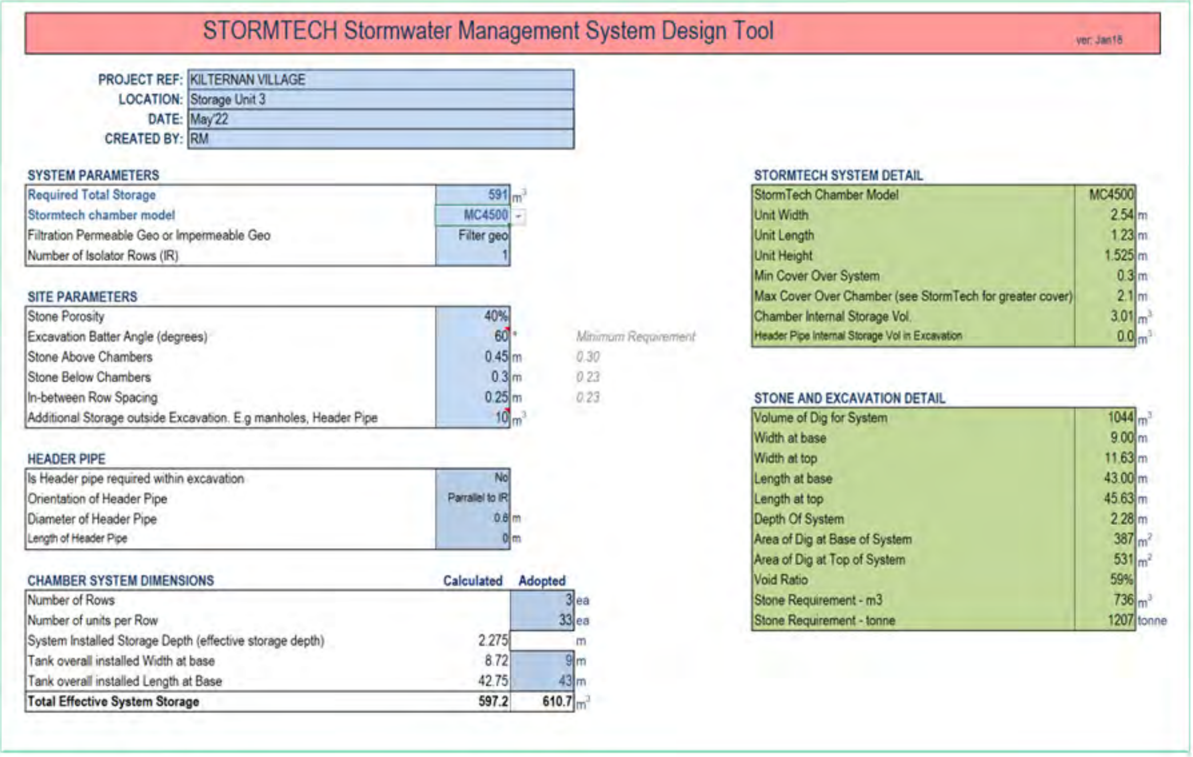
CHAMBER SYSTEM DIMENSIONS	Calculated	Adopted	
Number of Rows		4	ea
Number of units per Row		49	ea
System Installed Storage Depth (effective storage depth)	2.275		m
Tank overall installed Width at base	11.51	11.5	m
Tank overall installed Length at Base	62.43	63	m
Total Effective System Storage	**1115.9**	**1122.0**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	MC4500	
Unit Width	2.54	m
Unit Length	1.23	m
Unit Height	1.525	m
Min Cover Over System	0.3	m
Max Cover Over Chamber (see StormTech for greater cover)	2.1	m
Chamber Internal Storage Vol.	3.01	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	1879	m^3
Width at base	11.50	m
Width at top	14.13	m
Length at base	63.00	m
Length at top	65.63	m
Depth Of System	2.28	m
Area of Dig at Base of System	725	m^2
Area of Dig at Top of System	927	m^2
Void Ratio	60%	
Stone Requirement - m3	1277	m^3
Stone Requirement - tonne	2094	tonne



STORMTECH Stormwater Management System Design Tool

ver. Jan18

PROJECT REF: KILTERNAN VILLAGE
LOCATION: Storage Unit 3
DATE: May'22
CREATED BY: RM

SYSTEM PARAMETERS

Required Total Storage	591	m^3
Stormtech chamber model	MC4500	-
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

			Minimum Requirement
Stone Porosity	40%		
Excavation Batter Angle (degrees)	60	°	
Stone Above Chambers	0.45	m	0.30
Stone Below Chambers	0.3	m	0.23
In-between Row Spacing	0.25	m	0.23
Additional Storage outside Excavation. E.g manholes, Header Pipe	10	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Parrallel to IR	
Diameter of Header Pipe	0.6	m
Length of Header Pipe	0	m

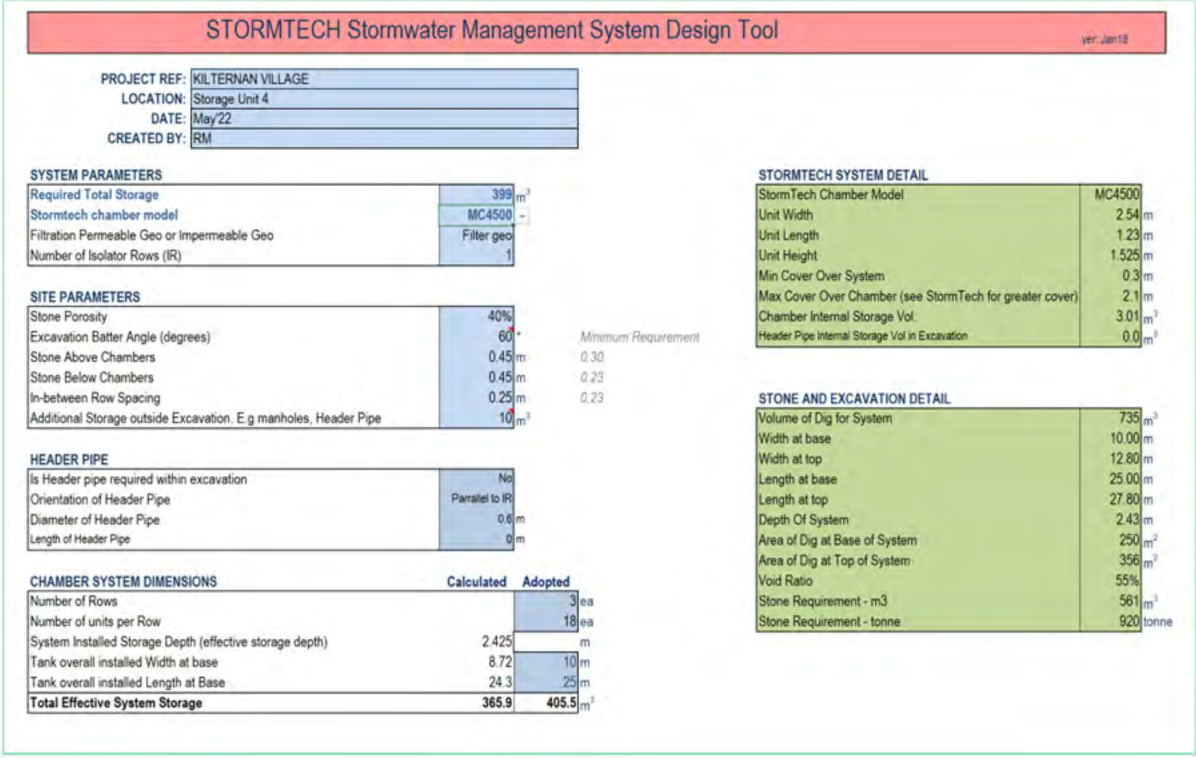
CHAMBER SYSTEM DIMENSIONS	Calculated	Adopted	
Number of Rows		3	ea
Number of units per Row		33	ea
System Installed Storage Depth (effective storage depth)	2.275		m
Tank overall installed Width at base	8.72	9	m
Tank overall installed Length at Base	42.75	43	m
Total Effective System Storage	**597.2**	**610.7**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	MC4500	
Unit Width	2.54	m
Unit Length	1.23	m
Unit Height	1.525	m
Min Cover Over System	0.3	m
Max Cover Over Chamber (see StormTech for greater cover)	2.1	m
Chamber Internal Storage Vol.	3.01	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	1044	m^3
Width at base	9.00	m
Width at top	11.63	m
Length at base	43.00	m
Length at top	45.63	m
Depth Of System	2.28	m
Area of Dig at Base of System	387	m^2
Area of Dig at Top of System	531	m^2
Void Ratio	59%	
Stone Requirement - m3	736	m^3
Stone Requirement - tonne	1207	tonne



STORMTECH Stormwater Management System Design Tool

ver. Jan18

PROJECT REF: KILTERNAN VILLAGE
LOCATION: Storage Unit 4
DATE: May'22
CREATED BY: RM

SYSTEM PARAMETERS

Required Total Storage	399	m^3
Stormtech chamber model	MC4500	-
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

			Minimum Requirement
Stone Porosity	40%		
Excavation Batter Angle (degrees)	60	°	
Stone Above Chambers	0.45	m	0.30
Stone Below Chambers	0.45	m	0.23
In-between Row Spacing	0.25	m	0.23
Additional Storage outside Excavation. E.g manholes, Header Pipe	10	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Parrallel to IR	
Diameter of Header Pipe	0.6	m
Length of Header Pipe	0	m

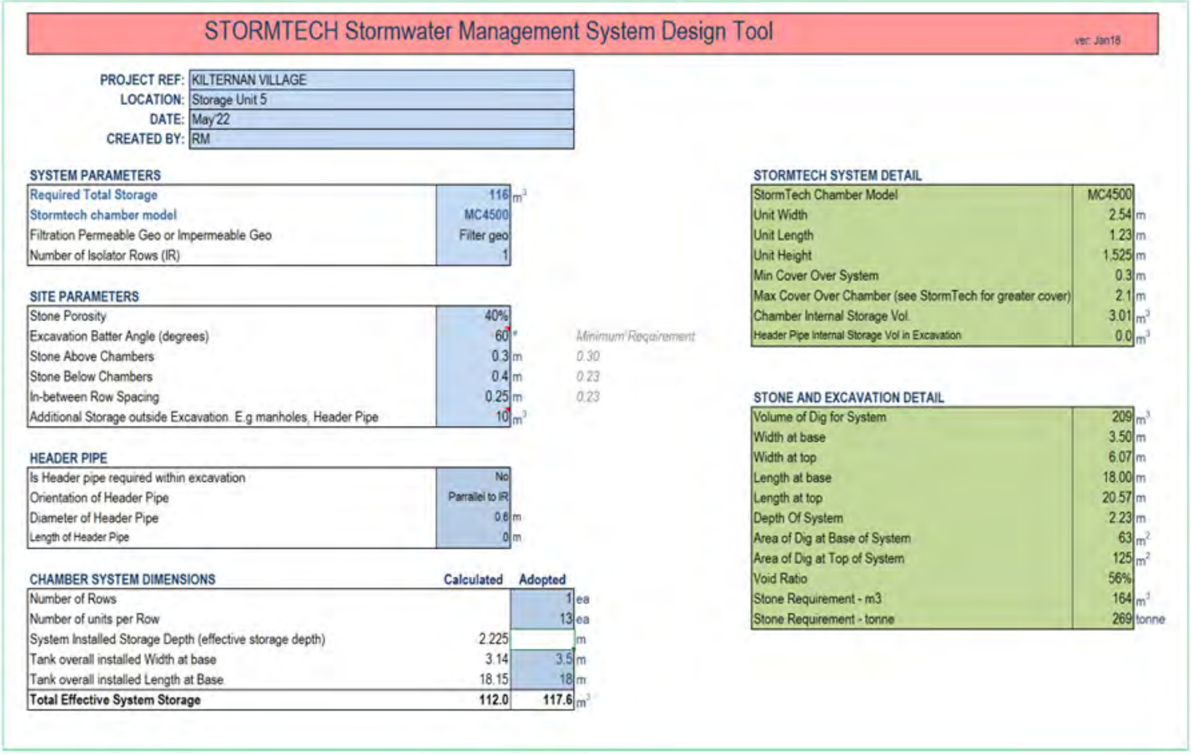
CHAMBER SYSTEM DIMENSIONS	Calculated	Adopted	
Number of Rows		3	ea
Number of units per Row		18	ea
System Installed Storage Depth (effective storage depth)	2.425		m
Tank overall installed Width at base	8.72	10	m
Tank overall installed Length at Base	24.3	25	m
Total Effective System Storage	**365.9**	**405.5**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	MC4500	
Unit Width	2.54	m
Unit Length	1.23	m
Unit Height	1.525	m
Min Cover Over System	0.3	m
Max Cover Over Chamber (see StormTech for greater cover)	2.1	m
Chamber Internal Storage Vol.	3.01	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	735	m^3
Width at base	10.00	m
Width at top	12.80	m
Length at base	25.00	m
Length at top	27.80	m
Depth Of System	2.43	m
Area of Dig at Base of System	250	m^2
Area of Dig at Top of System	356	m^2
Void Ratio	55%	
Stone Requirement - m3	561	m^3
Stone Requirement - tonne	920	tonne



STORMTECH Stormwater Management System Design Tool

ver: Jan18

PROJECT REF:	KILTERNAN VILLAGE
LOCATION:	Storage Unit 5
DATE:	May'22
CREATED BY:	RM

SYSTEM PARAMETERS

Required Total Storage	116	m^3
Stormtech chamber model	MC4500	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

			Minimum Requirement
Stone Porosity	40%		
Excavation Batter Angle (degrees)	60	°	
Stone Above Chambers	0.3	m	0.30
Stone Below Chambers	0.4	m	0.23
In-between Row Spacing	0.25	m	0.23
Additional Storage outside Excavation. E.g manholes, Header Pipe	10	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Parralel to IR	
Diameter of Header Pipe	0.6	m
Length of Header Pipe	0	m

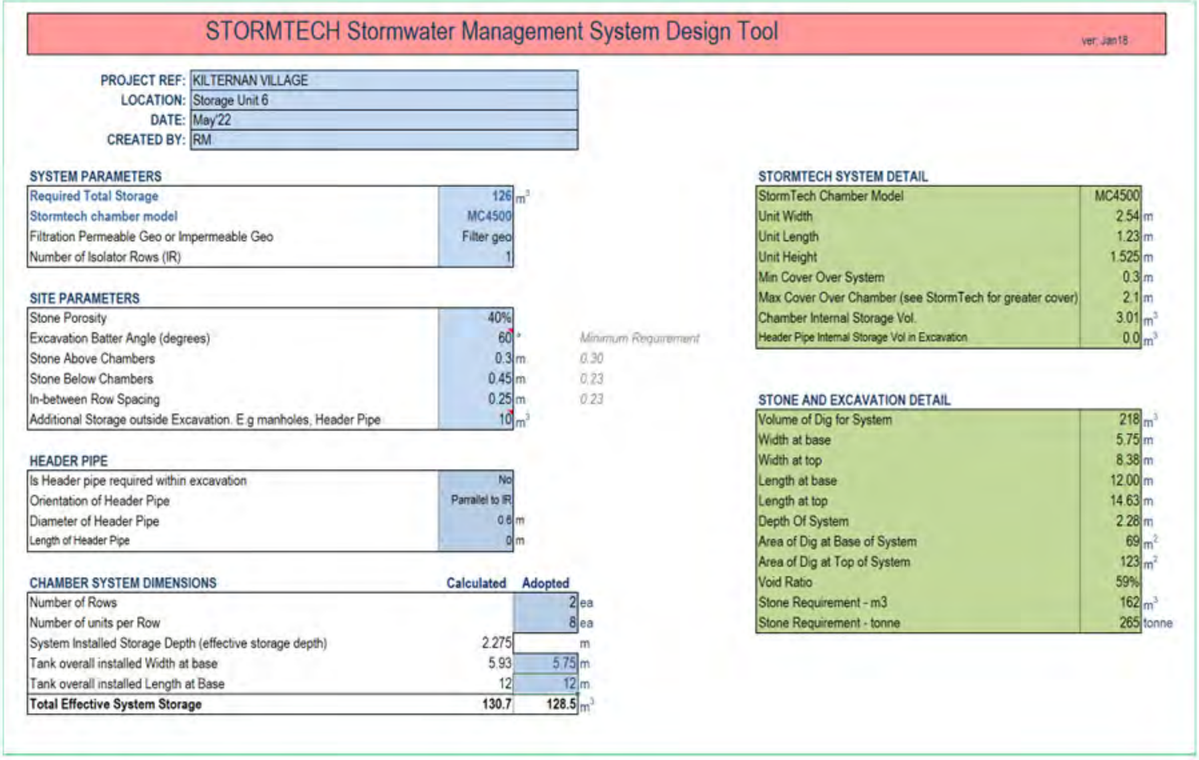
CHAMBER SYSTEM DIMENSIONS	**Calculated**	**Adopted**	
Number of Rows		1	ea
Number of units per Row		13	ea
System Installed Storage Depth (effective storage depth)	2.225		m
Tank overall installed Width at base	3.14	3.5	m
Tank overall installed Length at Base	18.15	18	m
Total Effective System Storage	**112.0**	**117.6**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	MC4500	
Unit Width	2.54	m
Unit Length	1.23	m
Unit Height	1,525	m
Min Cover Over System	0.3	m
Max Cover Over Chamber (see StormTech for greater cover)	2.1	m
Chamber Internal Storage Vol.	3.01	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	209	m^3
Width at base	3.50	m
Width at top	6.07	m
Length at base	18.00	m
Length at top	20.57	m
Depth Of System	2.23	m
Area of Dig at Base of System	63	m^2
Area of Dig at Top of System	125	m^2
Void Ratio	56%	
Stone Requirement - m3	164	m^3
Stone Requirement - tonne	269	tonne



STORMTECH Stormwater Management System Design Tool

ver: Jan18

PROJECT REF:	KILTERNAN VILLAGE
LOCATION:	Storage Unit 6
DATE:	May'22
CREATED BY:	RM

SYSTEM PARAMETERS

Required Total Storage	126	m^3
Stormtech chamber model	MC4500	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

			Minimum Requirement
Stone Porosity	40%		
Excavation Batter Angle (degrees)	60	°	
Stone Above Chambers	0.3	m	0.30
Stone Below Chambers	0.45	m	0.23
In-between Row Spacing	0.25	m	0.23
Additional Storage outside Excavation. E.g manholes, Header Pipe	10	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Parralel to IR	
Diameter of Header Pipe	0.6	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS	**Calculated**	**Adopted**	
Number of Rows		2	ea
Number of units per Row		8	ea
System Installed Storage Depth (effective storage depth)	2.275		m
Tank overall installed Width at base	5.93	5.75	m
Tank overall installed Length at Base	12	12	m
Total Effective System Storage	**130.7**	**128.5**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	MC4500	
Unit Width	2.54	m
Unit Length	1.23	m
Unit Height	1.525	m
Min Cover Over System	0.3	m
Max Cover Over Chamber (see StormTech for greater cover)	2.1	m
Chamber Internal Storage Vol.	3.01	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

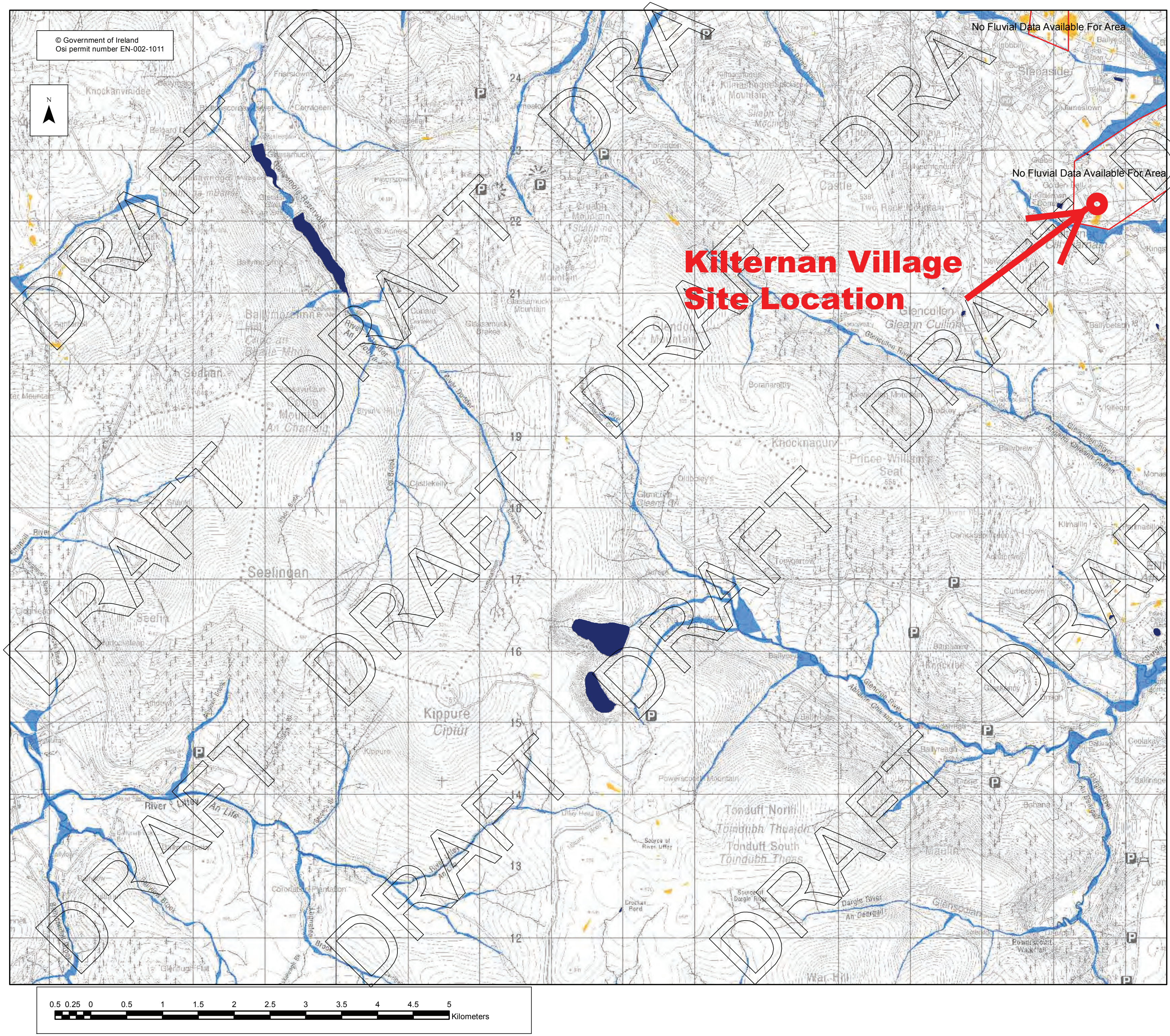
STONE AND EXCAVATION DETAIL

Volume of Dig for System	218	m^3
Width at base	5.75	m
Width at top	8.38	m
Length at base	12.00	m
Length at top	14.63	m
Depth Of System	2.28	m
Area of Dig at Base of System	69	m^2
Area of Dig at Top of System	123	m^2
Void Ratio	59%	
Stone Requirement - m3	162	m^3
Stone Requirement - tonne	265	tonne

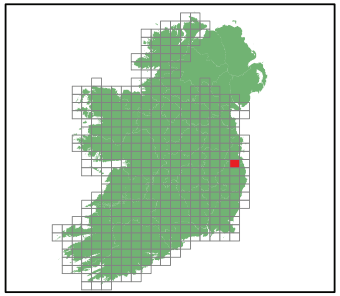
Appendix 12.4

OPW PFRA Map.No.2019/MAP/221/A

(Not to scale at A3)



Location Plan :



Legend:

Flood Extents

🟦 Fluvial - Indicative 1% AEP (100-yr) Event

▢ Fluvial - Extreme Event

🟩 Coastal - Indicative 0.5% AEP (200-yr) Event

▢ Coastal - Extreme Event

🟧 Pluvial - Indicative 1% AEP (100-yr) Event

▢ Pluvial - Extreme Event

🟫 Groundwater Flood Extents

■ Lakes / Turloughs

PFRA Outcomes

✳ Probable Area for Further Assesment

✳ Possible Area for Further Assesment

Important User Note:

The flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location. Information on the purpose, development and limitations of these maps is available in the relevant reports (see www.cfram.ie). Users should seek professional advice if they intend to rely on the maps in any way.

If you believe that the maps are inaccurate in some way please forward full details by contacting the OPW (refer to PFRA Information leaflets or 'Have Your Say' on www.cfram.ie).

Office of Public Works
Jonathon Swift Street
Trim
Co Meath
Ireland

Project :
PRELIMINARY FLOOD RISK ASSESMENT (PFRA)

Map :
PFRA Indicative extents and outcomes
- Draft for Consultation

Figure By : PJW
Date : July2011
Checked By : MA
Date : July 2011
Figure No. : 2019 / MAP / 221 / A
Revision 0
Drawing Scale : 1:50,000
Plot Scale : 1:1 @ A3

Appendix 12.5

UK SuDS.com Report

Print Close Report

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by: Roger Mullarkey

Site name: Kilternan Village

Site location: Kilternan

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude: 53.23799° N

Longitude: 6.19357° W

Reference: 1600766165

Date: May 16 2022 12:42

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 9.92

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	5	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.53	0.37

Hydrological characteristics

	Default	Edited
SAAR (mm):	1019	1019
Hydrological region:	12	12
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.13	2.13
Growth curve factor 100 years:	2.61	2.61
Growth curve factor 200 years:	2.86	2.86

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	96.45	44.22
1 in 1 year (l/s):	81.98	37.59
1 in 30 years (l/s):	205.43	94.19
1 in 100 year (l/s):	251.73	115.41
1 in 200 years (l/s):	275.84	126.47

Appendix 12.6

S/W Audit Report

Residential/Commercial Development at Kilternan Village, Kilternan, Dublin 18

Stage 1 Storm Water Audit

222181-PUNCH-XX-XX-RP-C-0001

May 2022

Document Control

Document Number: **222181-PUNCH-XX-XX-RP-C-0001**

Status	Revision	Description	Date	Prepared	Checked	Approved
S3	P01	Draft SWA	25-May-2022	J Fennell	MC Daly	MC Daly
A0	C01	SWA	30-May-2022	J Fennell	MC Daly	MC Daly

Report by: ________________ Date: 30 May 2022

Jamie Fennell
Design Engineer
PUNCH Consulting Engineers

Checked by: ________________ Date: 30 May 2022

Marie-Claire Daly
Technical Director
PUNCH Consulting Engineers

Approved by: ________________ Date: 30 May 2022

Marie-Claire Daly
Technical Director
PUNCH Consulting Engineers

Table of Contents

1 Introduction

1.1 Purpose of Report

This report presents a Stage 1 Storm Water Audit carried out for a proposed Strategic Housing Development (SHD) and associated infrastructure at Kilternan Village, Kilternan, Dublin 18.

1.2 Site Details

The site is located at Wayside, Enniskerry Road, Kilternan, Dublin 18 and is approximately 10.7 hectares in area. The proposed development comprises a mixed-use development consisting of 383 no. residential units and a neighbourhood centre incorporating c.2,512 sqm of creche, office, medical, retail and community use. The site is bordered by a fuel station and residential developments to the south, Enniskerry road to the West, a mix of commercial and residential to the north, and residential / greenfield sites to the east. The land generally falls from southwest to northeast, with the slope increasing to c.1/10 gradient on the eastern boundary. The proposed road levels within the area range from 135m (site entrance) to 143m (western boundary) OD Malin and the proposed dwellings on site range from 136m to 143m OD Malin.

1.3 Report Details

The audit was carried out by PUNCH Consulting Engineers between the dates of 23 May 2022 and 25 May 2022.

This Stage 1 Audit has been carried out in accordance with the Dún Laoghaire-Rathdown County Council (DLRCC) Stormwater Audit Procedure as per the Dún Laoghaire-Rathdown County Development Plan 2022-2028 Appendix 7. The auditor has examined only those issues within the design relating to storm water drainage implications of the scheme and has therefore not examined or verified the compliance of the design to any other criteria.

Appendix A contains copies of drawings examined by the auditor. The drawings in Appendix B correspond to the Stage 1 Audit findings outlined in Section 2 of this report. Appendix C contains the Surface Water Audit Feedback form.

All of the findings outlined in Section 2 of this report are considered by the auditor to require action in order to improve the stormwater credentials of the scheme.

1.4 Documents Reviewed

The following documents were reviewed as part of this audit;

1. RMA 2104-01 Road and Block Levels Sheet 1 D1
2. RMA 2104-02 Road and Block Levels Sheet 2 D1
3. RMA 2104-03 SW Drainage Sheet 1 D1
4. RMA 2104-04 SW Drainage Sheet 2 D1
5. RMA 2104-05 Drainage Connections D1
6. RMA 2104-08 Drainage Masterplan D1
7. RMA 2104-12 Exceedance Overflow Route D1
8. RMA 2104-13 Catchment Interception and Paved Areas D1
9. RMA 2104-14 SuDS Details Sheet 1 D1
10. RMA 2104-15 Attenuation Tank Details D1
11. RMA 2104-16 Road Details D1
12. RMA 2104-17 Manhole Details D1
13. RMA 2104-18 Water and Drainage Phasing D1
14. RMA 2104-23 SW Longitudinal Sections - Sheet 1 D1
15. RMA 2104-24 SW Longitudinal Sections - Sheet 2 D1
16. RMA 2104-25 SW Longitudinal Sections - Sheet 3 D1
17. RMA 2104-26 SW Longitudinal Sections - Sheet 4 D1

2 Stage 1 Audit Findings

2.1 General Requirements as per DLRCC County Development Plan 2022-2028 Stormwater Audit Procedure

Table 2-1 below outlines the result of a review of the scheme designer's proposals against the general requirements outlined in the DLRCC County Development Plan 2022-2028, Appendix 7, section 7.1.1.

Table 2-1: General requirements for all developments greater than a single house

	Requirements as per DLRCC 2022-2028 Development Plan	Addressed by Scheme Designer?
2.1.1	Climate Change All developments must apply a minimum factor of 1.2 to their drainage design and attenuation volumes to accommodate climate change.	Y
2.1.2	Urban Creep All developments must apply a factor of 1.1 to their drainage design and attenuation volumes to accommodate urban creep.	Y
2.1.3	Blockage Analysis Scheme Designers must submit details of the proposed surface water drainage system in the event of blockage or partial blockage of the system, commenting on any surcharging or flood risk that may be identified, particularly in relation to freeboard used in the simulation analysis. The proposal must include a drawing confirming that safe overland flow routes do not negatively impact properties both within and without the site. The overland flow route plan should identify drop kerbs or ramps required for channelling the flow and address low point areas in the site and detail how properties, both within the development and on adjacent lands, will be protected in the event of excessive overland flows.	Y
2.1.4	Utility Clash Check The Scheme Designer must undertake a utilities clash check to ensure all utilities' vertical and horizontal separation distances can be provided throughout the scheme. The Scheme Designer should demonstrate this with cross-sections at critical locations such as junctions, site thresholds and connection points to public utilities. Minimum separation distances must be in accordance with applicable Codes of Practice.	Scheme designer to confirm.
2.1.5	Private Drains Where an applicant's land is crossed by a private drain, the applicant is responsible for acquiring any rights or permissions necessary to connect to, or to increase the discharge into, or to build over, or divert, or to ensure thSS2.3e adequate capacity is not exceeded, or otherwise alter any private drains not in their exclusive ownership or control, and for ensuring their adequacy.	Scheme design to confirm connection is to a public sewer.
2.1.6	Pumping of Surface Water	N/A - pumping of surface water is not proposed

2.1.7	**Sustainable Drainage Systems (SuDS):** The proposal must demonstrate that they meet the requirements of the Greater Dublin Strategic Drainage Study (GDSDS) policies in relation to Sustainable Drainage Systems (SuDS). The design must incorporate SuDS measures appropriate to the scale of the proposed development such as green roofs, bioretention areas, permeable paving, rainwater harvesting, swales, etc. that minimise flows to the public drainage system and maximises local infiltration potential. The Scheme Designer should provide cross-sections and long-sections, and commentary that demonstrates all proposed SuDS measures have been designed in accordance with the relevant industry standards and the recommendations of The SuDS Manual (CIRIA C753)	Highlighted as part of this audit
2.1.8	**Infiltration:** The Scheme Designer should submit Site Investigation Report and results, including infiltration tests, and a plan showing the trial pits/soakaway test locations across the site. The report should address instances where groundwater, if any, was encountered during testing and its impact.	Y
2.1.9	**Hardstanding/Parking Areas:** All proposed parking and hardstanding areas should maximise local infiltration before discharge to the surface water drainage system, via a specifically designed permeable paving/porous asphalt system, in accordance with the requirements of Section 12.4.8 of the County Development Plan 2022-2028.	Highlighted as part of this audit
2.1.10	**Basement:** If basement carparking is provided, then all incidental run-off from the basement should be shown to drain to the foul system and not the surface water system	N/A - basement carparking not provided
2.1.11	**Run-off Factors:** Where Scheme Designers propose to use reduced run-off factors (or reduced impermeable contributing areas) for areas of their site that drain to SuDS measures these factors must be agreed with Municipal Services, preferable during the pre-planning process. It should be noted that standard surface water simulation software uses default Cv values of 0.84 for Winter and 0.75 for Summer. If the Scheme Designer proposes to use their own reduced run-off rates, then the default Cv values should be amended to a value of 1.0. Maintaining the default Cv values in conjunction with the Scheme Designers proposed rates reduces the run-off in simulations of rainfall events, giving inaccurate simulation results which may lead to under sizing of the drainage system and attenuation storage required.	Y
2.1.12	**Hydrological Parameters** Scheme Designers must use site specific or local data in their Qbar, attenuation volume and surface water system design such as: • SAAR • Soil Type • Rainfall Return Period Table (available from MET Eireann) • Rainfall intensity • Other hydrological parameters	Y
2.1.13	**Discharge Rate:** Surface Water discharge from a development must be restricted to 2 l/s/ha or the calculated Qbar, whichever is greater. The Qbar should be calculated using the net area drained and not the gross area of the site (i.e. red line boundary). This discharge rate should be marked on the drainage drawing on the manhole in which the flow restricting device if located. The manhole in which the flow restricting device is located should not have a bypass pipe and, a penstock and silt trap should be provided. Flow restricting devices with an orifice of less than 50mm in diameter should be avoided. Where this is not possible then the Scheme Designer must submit a robust maintenance regime to ensure blockages are avoided, to the satisfaction of dlr. Scheme Designers are recommended to use the HR	Highlighted as part of this audit

	Wallingford UK SuDS Greenfield runoff rate estimation tool to estimate Qbar for their site: https://www.uksuds.com/drainage-calculation-tools/greenfield-runoff-rate-estimation	
2.1.14	**Attenuation:** If an attenuation system is proposed it should, where possible, not be located under the internal roads but in/under open space or parking areas. Attenuation systems must be inline. The preference is for attenuation systems that allow for infiltration and/or treatment within the site. The Scheme Designer should note that certain landscaping items, such as trees, may not be compatible with attenuation systems. The Scheme Designer must provide fully dimensioned plans and sections of the attenuation storage system. All relevant inlet and outlet levels, dimensioned clearances between other utilities, and actual depths of cover to the system should be provided. Details of the proposed inlet and outlet manholes and arrangements to facilitate draw down and maintenance should also be provided. Scheme Designers are recommended to use the HR Wallingford UK SuDS Surface water storage volume estimation tool to estimate the attenuation storage required for their site: https://www.uksuds.com/drainage-calculation-tools/surface-water-storage.	Y
2.1.15	**Green Roof:** The proposal must meet the requirements of Appendix 7.2: Green Roof Policy of the County Development Plan 2022-2028.	Y
2.1.16	**Interception and Treatment:** The Scheme Designer must demonstrate that required interception and/or treatment of surface water run-off is achieved in accordance with GDSDS policy. To be in compliance with GDSDS Volume 2 Section 6.3.3 Table 6.3 Criterion 1, interception of the first 5-10mm is required. If interception of first 5-10mm can't be achieved, then treatment of first 15mm is required.	Y
2.1.17	**Maintenance:** Scheme Designers must submit a post-construction maintenance specification and schedule for the drainage system, including SuDS measures and attenuation system to dlrcc for approval. This maintenance specification and schedule must be included in the Safety File.	To be addressed by the Scheme Designer at Construction Stage
2.1.18	**New Connections:** Prior to submission of the planning application, the Scheme Designer must obtain the sewer network records from DLRCC and assess if a new connection to the public sewer is technically feasible.	Y

2.2 DLRCC 2022 Development Plan – Stormwater Audit Procedure Table

Table 2-2: Stormwater Audit Procedure Table - Completed by Scheme Designer

Surface Cover Type	Area (m²)
Wetland or open water (semi-natural; not chlorinated) maintained or established on site.	-
Semi-natural vegetation (e.g. hedgerows, trees, woodland, species-rich grassland) maintained or established on site.	**(30m² per tree)** **13,870m²**
Reuse of existing soils and seed source to develop vegetation cover	-
Standard trees planted in connected tree pits with a minimum soil volume equivalent to at least two thirds of the projected canopy area of the mature tree.	**(20m² per tree)** **6,870m²**
Standard trees planted in pits with soil volumes less than two thirds of the projected canopy area of the mature tree.	**7,800m²**
Intensive green roof or vegetation over structure. Substrate minimum settled depth of 150mm.	**2,849m²**
Non intensive Brown Roof (Biodiversity Roof). Substrate minimum settled depth of 150mm. Design will be site specific and developed by a suitably qualified ecologist.	-
Extensive green roof with substrate of minimum settled depth of 80mm (or 60mm beneath vegetation blanket)	**2,703m²**
Extensive green roof of sedum mat or other lightweight systems	-
Green wall -modular system or climbers rooted in soil.	-
Rain gardens and other vegetated sustainable drainage elements.	-
Flower-rich perennial planting.	**6,072m²**
Hedges (line of mature shrubs one or two shrubs wide).	**(238+1,000m (Native Hedge))** **1,238m²**
Hedgerows or double hedgerow of native species (may have an associated ditch and bank)	
Groundcover planting.	**(30% of flower rich perennials)** **2,024m²**
Amenity grassland entire area or sections managed for lesser mowing frequencies for pollinators (e.g. six week meadow)	-
Amenity grassland (species-poor, regularly mown lawn).	**17,689m²**

Water features (chlorinated) or unplanted detention basins.	-
Permeable paving.	7,200m^2
Sealed surfaces (e.g. concrete, asphalt, waterproofing, stone)	29,700m^2

2.3 Roads, Carparks & Landscaping

2.3.1 Permeable Paving

Problem: Although permeable paving is located in some private driveways, it should be considered in greater quantity. Impermeable surfaces do not allow water to infiltrate to the ground.

Recommendation: Consider inclusion of permeable paving along footpaths, bicycle parking, plazas, and other pedestrian areas within the development.

2.3.2 Roads surfacing/Porous Asphalt

Problem: The proposed roads' surfacing has potential to increase the surface water runoff from the development.

Recommendation: It is noted that a significant portion of the roads and paved areas discharge via SuDs measures, with only a small area discharging directly to drains. Consider utilising porous asphalt or porous concrete surfacing throughout the development as a roads surfacing. This would allow surface water runoff from all areas subject to vehicular traffic to achieve an enhanced environmental quality level as well as a greater opportunity for infiltration.

2.3.3 Use of Detention Basins

Problem: Detention Basins have not been utilised within the development despite the large extent of landscaping to the south-west and centre of the site.

Recommendation: Considering the extent of landscaping, it may be feasible to adopt detention basins in these areas, which would promote greater amenity and biodiversity within the development and encourage infiltration of surface water. These also have the potential to reduce the size of the underground storage required.

2.3.4 Bypass Interceptors - Specification

Problem: Bypass Interceptor details have not been included in the documents provided.

Recommendation: Details of bypass interceptors are to be provided to ensure appropriate sizing.

2.3.5 Silt Trap Sump Chambers

Problem: Silt traps (or catch-pit manholes) should be included downstream of swales or filter drains to prevent silt build-up in the carrier drains and attenuation tank downstream of the SuDS elements.

Recommendation: Consider including silt traps (or catch-pit manholes) downstream of swales and filter drains.

2.3.6 CBR Values - Permeable Paving

Problem: Californian bearing ration (CBR) varies inversely with moisture content (as the latter increases the CBR value decreases). The equilibrium CBR value is the long-term value that occurs once the pavement is constructed and the moisture content of the subgrade soil comes in to equilibrium with the suction forces within the subgrade air spaces. Carrying out CBR tests will allow for appropriate permeable paving design including capping material if and where required. This capping is typically quite impermeable when compacted.

Recommendation: CBR tests to be performed on site at detailed design stage to allow for appropriate permeable paving design. These CBR tests are to be carried out in accordance with BS 1377-4:1990. Where Plate Bearing Tests provide very low results, which would typically warrant additional capping material as a result, consider incorporating an alternative strengthening system such layers of geogrid to ensure permeability is not compromised.

2.3.7 Hydrobrake

Problem: The proposed Hydrobrake orifice is not defined.

Recommendation: The orifice size of the Hydrobrake required is not defined. We recommend the use of a flow control device with an orifice no less than 50mm diameter for maintenance purposes and to ensure timely drain down time.

2.3.8 Tree Root Structural Cell Systems/ Podium Landscaping

Problem: There is potential to increase the amount of landscaping, including tree root structured cell systems, within the paving areas.

Recommendation: There are large open spaces that are proposed to be surfaced with paving. These areas could be broken up with planters, in line with the landscaping/SuDS proposals. The surrounding paving areas could be drained to these proposed planters.

2.3.9 Manhole SW Mh26

Problem: The manhole chamber and lid appear to clash with a raised table ramp.

Recommendation: Consider revising the drainage layout at detailed design stage so that all manholes take into the account the surrounding infrastructure and landscape proposals.

2.4 Buildings/Residential Units

2.4.1 Green Roof Co-ordination

Problem: It is unclear if the greenroof layout has been co-ordinated with M&E plant and access points to roof level.

Recommendation: Confirm co-ordination has been carried out.

2.4.2 Rainwater Harvesting Tanks

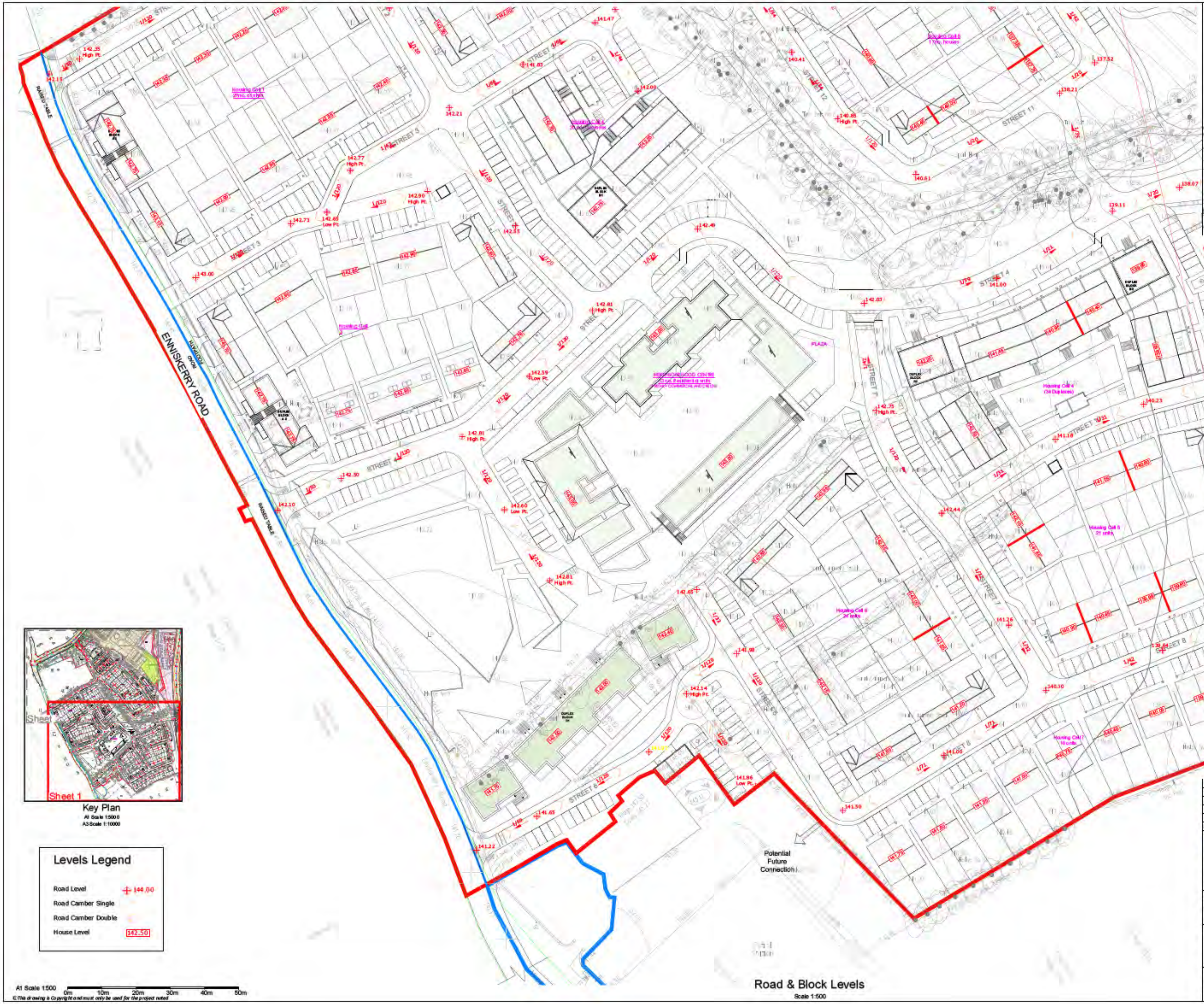
Problem: There is potential to install a rainwater harvesting facilities for the proposed duplex units. The rainwater collected can be used for toilet flushing within the new units and irrigation of the landscaping.

Recommendation: Consider incorporating rainwater harvesting tanks.

Appendix A Drawings and Documents Examined by the Auditor

Notes:

1. Read in conjunction with all relevent Architects and Engineer's drawings and specification. All setting out to be done from the Architect's drawings.Do not scale the drawing.
2. Refer to Dwg.No.2104/22 for full specification notes relating to the roads details.
3. The contractor shall prepare a traffic management plan and agree it with the Local Authority, prior to commencement of work on site.
4. Road gullies must be placed at low points to eliminate ponding. Close gullies in the direction of the traffic flow. Place double gullies at upstream side of table ramps.



Key Plan
At Scale 1:5000
A3 Scale 1:10000

Levels Legend

Road Level	✛ 144.00
Road Camber Single	
Road Camber Double	
House Level	142.50

A1 Scale 1:500 0m 10m 20m 30m 40m 50m

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Road & Block Levels

Scale 1:500

REV	DATE	DESCRIPTION

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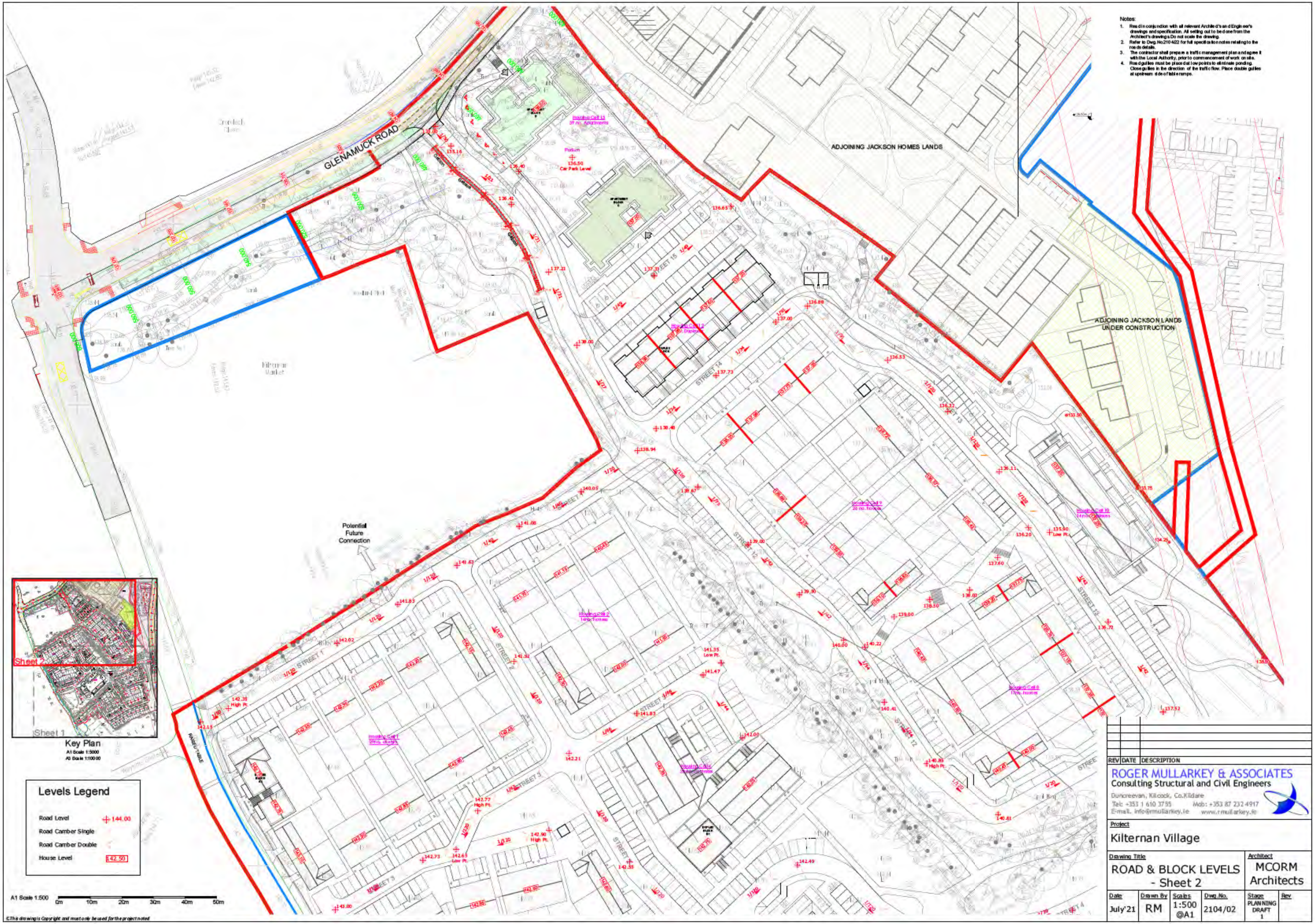
Project
Kilternan Village

Drawing Title	Architect
ROAD & BLOCK LEVELS - Sheet 1	MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
July'21	RM	1:500 @A1	2104/01	PLANNING DRAFT 1	



Notes:
1. Read in conjunction with all relevent Architect's and Engineer's drawings and specification. All setting out to be done from the Architect's drawings. Do not scale the drawing.
2. Refer to Dwg. No.210 422 for full specification notes relating to the roads details.
3. The contractor shall prepare a traffic management plan and agree it with the Local Authority, prior to commencement of work on site.
4. Road gullies must be placed at low points to eliminate ponding. Close gullies in the direction of the traffic flow. Place double gullies at upstream side of table ramps.

Levels Legend

Road Level	+ 144.00
Road Camber Single	
Road Camber Double	
House Level	142.50

REV	DATE	DESCRIPTION

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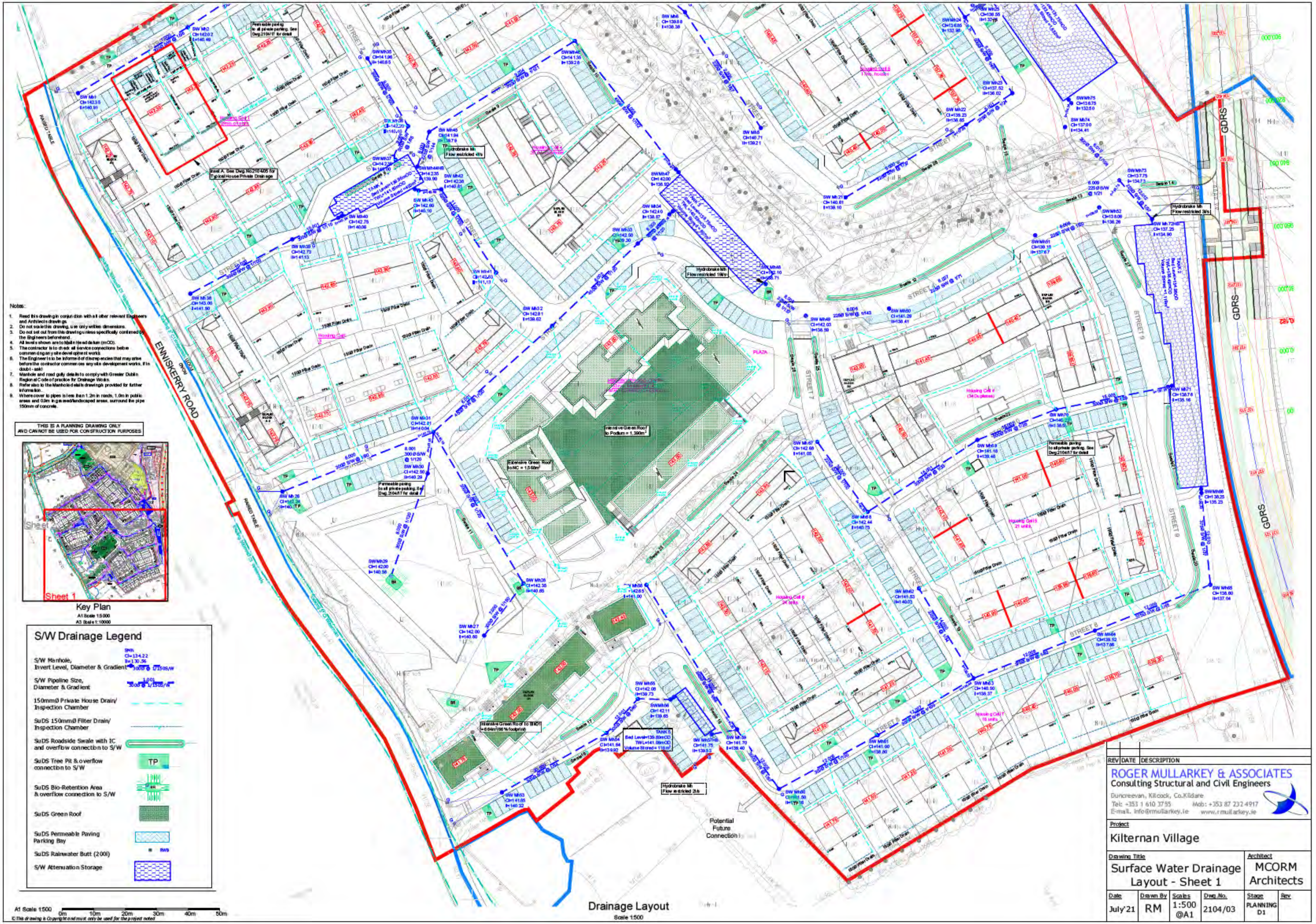
Project
Kilternan Village

Drawing Title
ROAD & BLOCK LEVELS
- Sheet 2

Architect
MCORM
Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
July'21	RM	1:500 @A1	2104/02	PLANNING DRAFT 1	


ENNISKERRY ROAD
GDRS
STREET 2
STREET 6
STREET 7
STREET 8
STREET 9
STREET 12
PLAZA
Intensive Green Roof to Podium = 1,390m²
Extensive Green Roof to NC = 1,050m²
Intensive Green Roof to SHD1 = 684m² (66% footprint)
Hydrobrake Mh Flow restricted 4l/s
Hydrobrake Mh Flow restricted 19l/s
Hydrobrake Mh Flow restricted 3l/s
Hydrobrake Mh Flow restricted 2l/s
TANK 5 Bed Level=139.00mOD TWL=141.05mOD Volume Stored = 116m³
Permeable paving to all private parking. See Dwg.2104/17 for detail
Inset A. See Dwg.No.2104/05 for Typical House Private Drainage
Potential Future Connection
RAISED TABLE
1500 Filter Drain
Housing Cell 7 18 units
Housing Cell 8 24 units
Housing Cell 15 21 units
Housing Cell 4 (34 Duplexes)
Sheet 1

Drainage Layout

Scale 1:500

Notes:

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4. All levels shown are to Malin Head datum (mOD).
5. The contractor is to check all service connections before commending any site development works.
6. The Engineer is to be informed of discrepencies that may arise before the contractor commences any site development works, if in doubt - ask!
7. Manhole and road gully details to comply with Greater Dublin Regional Code of practice for Drainage Works.
8. Refer also to the Manhole details drawings provided for further information.
9. Where cover to pipes is less than 1.2m in roads, 1.0m in public areas and 0.9m in grassed/landscaped areas, surround the pipe 150mm of concrete.

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AND CANNOT BE USED FOR CONSTRUCTION PURPOSES

Key Plan

A1 Scale 1:5000
A3 Scale 1:10000

S/W Drainage Legend

S/W Manhole, Invert Level, Diameter & Gradient	SMh
	Cl=134.22
	Il=130.56
	300Ø @ 1/150S/W

S/W Pipeline Size, Diameter & Gradient	1.001 300Ø @ 1/150S/W
150mmØ Private House Drain/ Inspection Chamber	
SuDS 150mmØ Filter Drain/ Inspection Chamber	
SuDS Roadside Swale with IC and overflow connection to S/W	
SuDS Tree Pit & overflow connection to S/W	TP
SuDS Bio-Retention Area & overflow connection to S/W	BR
SuDS Green Roof	▩
SuDS Permeable Paving Parking Bay	▨
SuDS Rainwater Butt (200l)	● RWB
S/W Attenuation Storage	▦

A1 Scale 1:500 0m 10m 20m 30m 40m 50m

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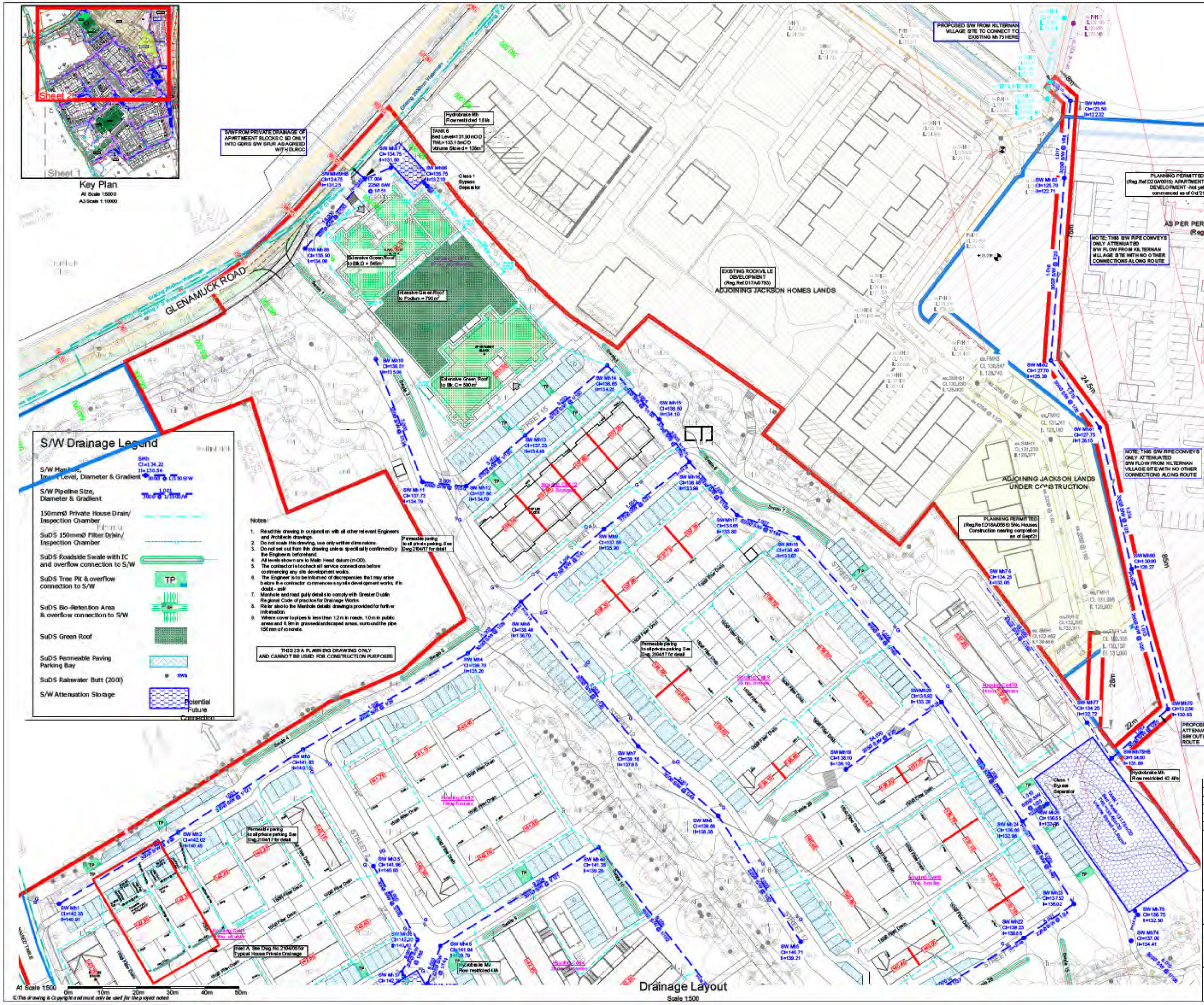
Project
Kilternan Village

Drawing Title
Surface Water Drainage Layout - Sheet 1

Architect
MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
July'21	RM	1:500 @A1	2104/03	PLANNING D1	


Key Plan
A1 Scale 1:5000
A3 Scale 1:10000
Sheet 1
Sheet 2
GLENAMUCK ROAD
GDRS
S/W FROM PRIVATE DRAINAGE OF APARTMEENT BLOCKS C &D ONLY INTO GDRS S/W SPUR AS AGREED WITH DLRCC
Hydrobrake Mh Flow restricted 1.8l/s
TANK 6 Bed Level=131.50mOD TWL=133.15mOD Volume Stored = 126m³
SW Mh67 Cl=134.75 Il=131.50
SW Mh66 Cl=135.75 Il=132.10
SW Mh65HB Cl=134.75 Il=131.25
17.004 225Ø SW @ 1/151
Class 1 Bypass Separator
SW Mh68 Cl=135.50 Il=134.00
Extensive Green Roof to Blk D = 545m²
Intensive Green Roof to Podium = 755m²
Extensive Green Roof to Blk C = 590m²
EXISTING ROCKVILLE DEVELOPMENT (Reg.Ref D17A0793)
ADJOINING JACKSON HOMES LANDS
PROPOSED S/W FROM KILTERNAN VILLAGE SITE TO CONNECT TO EXISTING Mh73 HERE
SW Mh84 Cl=123.50 Il=122.32
SW Mh83 Cl=125.70 Il=122.71
8m
76m
24.5m
85m
28m
22m
PLANNING PERMITTED (Reg.Ref.D20A/0015) APARTMENT DEVELOPMENT -Not yet commenced as of Oct'21
AS PER PERMITTED DEVELOPMENT (Reg. Ref D17A/0793)
NOTE; THIS S/W PIPE CONVEYS ONLY ATTENUATED S/W FLOW FROM KILTERNAN VILLAGE SITE WITH NO OTHER CONNECTIONS ALONG ROUTE
SW Mh82 Cl=127.70 Il=125.39
SW Mh81 Cl=127.75 Il=126.15
ADJOINING JACKSON LANDS UNDER CONSTRUCTION
PLANNING PERMITTED (Reg.Ref.D16A/0566) 5No. Houses Construction nearing completion as of Sept'21
SW Mh80 Cl=130.00 Il=128.27
SW Mh76 Cl=134.25 Il=133.05
SW Mh77 Cl=134.25 Il=132.72
SW Mh79 Cl=132.50 Il=130.53
PROPOSED ATTENUATED S/W OUTFALL ROUTE
SW Mh78HB Cl=134.50 Il=131.60
Hydrobrake Mh Flow restricted 42.4l/s
Class 1 Bypass Separator
TANK 1
Permeable paving to all private parking. See Dwg 2104/17 for detail
Hydrobrake Mh Flow restricted 4l/s
Inset A: See Dwg No.2104/06 for Typical House Private Drainage
STREET 12
STREET 13
STREET 15
Drainage Layout
Scale 1:500
A1 Scale 1:500
0m
10m
20m
30m
40m
50m
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S/W Drainage Legend

S/W Manhole, Invert Level, Diameter & Gradient	SMh
	Cl=134.22
	Il=130.56
	300Ø @ 1/130S/W

S/W Pipeline Size, Diameter & Gradient	1.001 300Ø @ 1/150S/W
150mmØ Private House Drain/ Inspection Chamber	
SuDS 150mmØ Filter Drain/ Inspection Chamber	
SuDS Roadside Swale with IC and overflow connection to S/W	
SuDS Tree Pit & overflow connection to S/W	TP
SuDS Bio-Retention Area & overflow connection to S/W	
SuDS Green Roof	▩
SuDS Permeable Paving Parking Bay	
SuDS Rainwater Butt (200l)	● RWB
S/W Attenuation Storage	

Potential Future Connection

Notes:

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6. The Engineer is to be informed of discrepancies that may arise before the contractor commences any site development works; if in doubt - ask!
7. Manhole and road gully details to comply with Greater Dublin Regional Code of practice for Drainage Works.
8. Refer also to the Manhole details drawing's provided for further information.
9. Where cover to pipes is less than 1.2m in roads, 1.0m in public areas and 0.9m in grassed/landscaped areas, surround the pipe 150mm of concrete.

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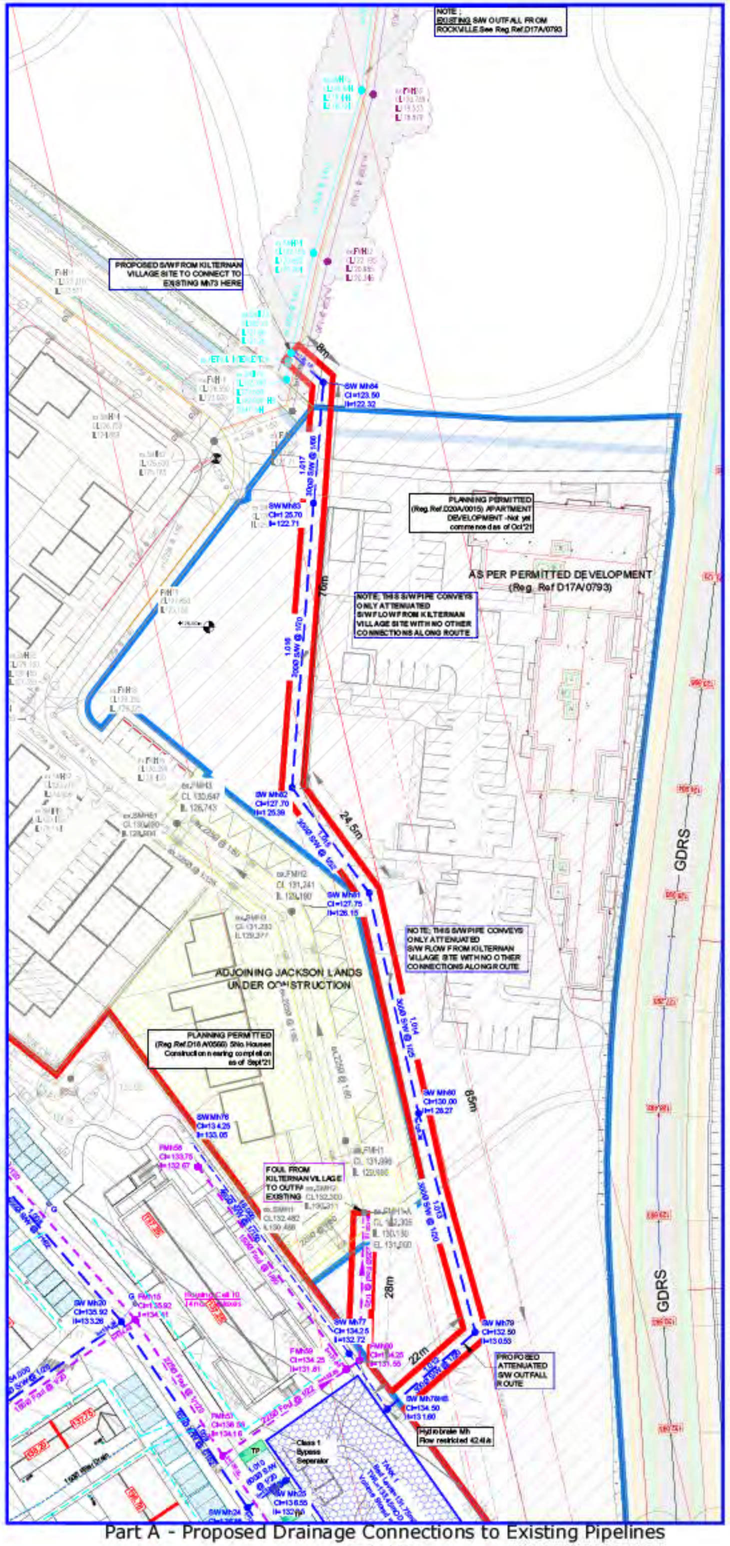
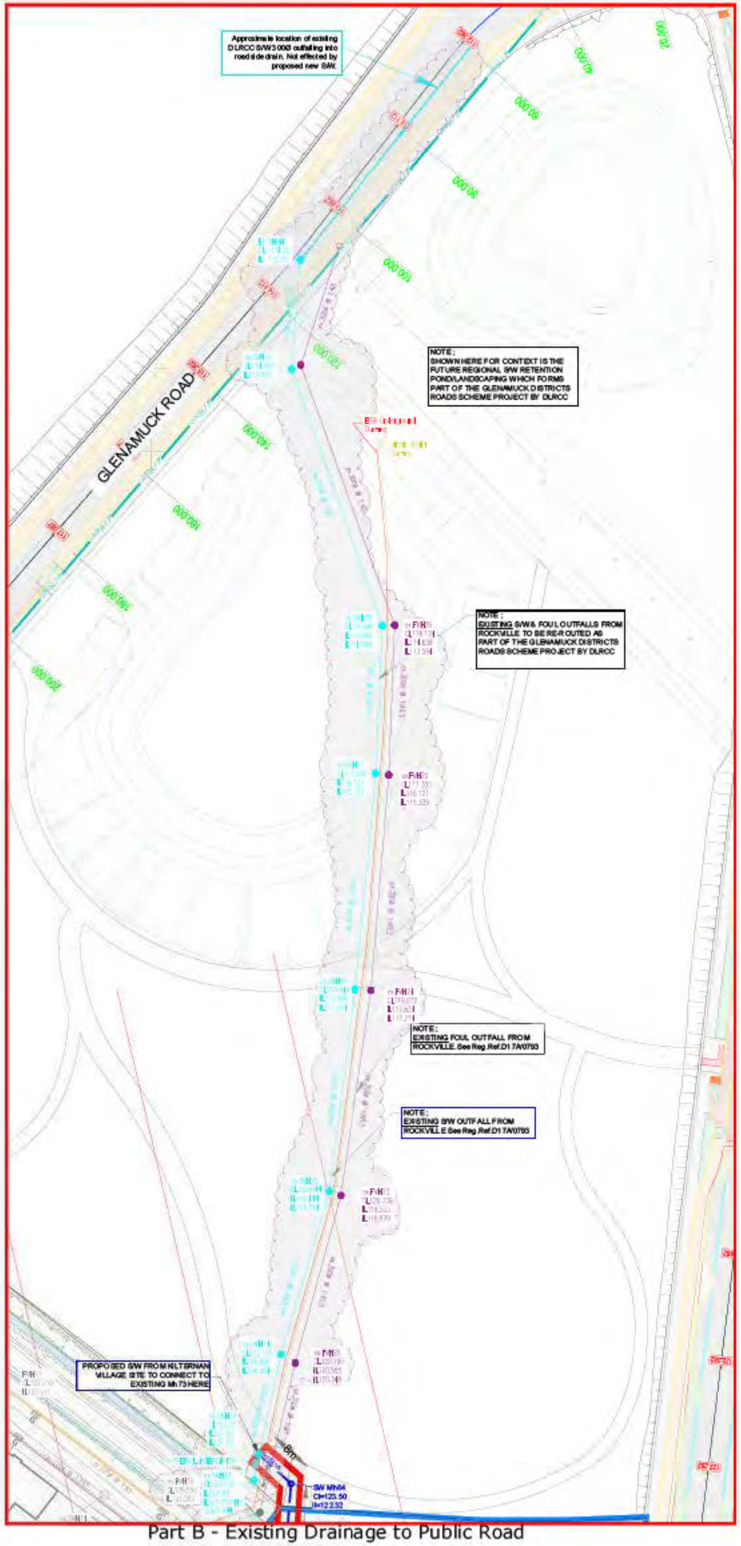
Project
Kilternan Village

Drawing Title	Architect
Surface Water Drainage Layout - Sheet 2	MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
July'21	RM	1:500 @A1	2104/04	PLANNING D1	

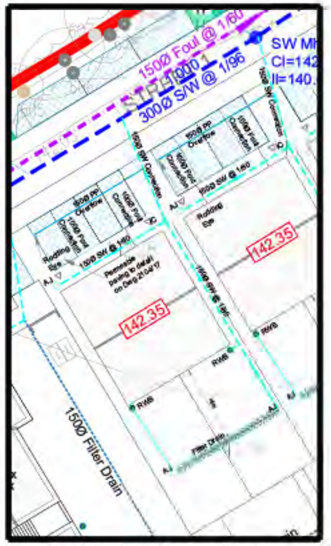


Part A - Proposed Drainage Connections to Existing Pipelines
Scale 1:500


Approximate location of existing DLRCC S/W300Ø outfalling into roadside drain. Not effected by proposed new S/W.
GLENAMUCK ROAD
20.000
40.000
60.000
80.000
100.000
120.000
140.000
160.000
180.000
NOTE ;
SHOWN HERE FOR CONTEXT IS THE FUTURE REGIONAL S/W RETENTION POND/LANDSCAPING WHICH FORMS PART OF THE GLENAMUCK DISTRICTS ROADS SCHEME PROJECT BY DLRCC
ESB Underground
NOTE ;
EXISTING S/W& FOUL OUTFALLS FROM ROCKVILLE TO BE RE-ROUTED AS PART OF THE GLENAMUCK DISTRICTS ROADS SCHEME PROJECT BY DLRCC
NOTE ;
EXISTING FOUL OUTFALL FROM ROCKVILLE. See Reg.Ref.D17A/0793
NOTE ;
EXISTING S/W OUTFALL FROM ROCKVILLE See Reg.Ref.D17A/0793
PROPOSED S/W FROM KILTERNAN VILLAGE SITE TO CONNECT TO EXISTING Mh73 HERE
8m
SW Mh64
CI=123.50
IL=122.32

Part B - Existing Drainage to Public Road
Scale 1:500

Part B
Part A
Key Plan
At Scale 1:5000
A3 Scale 1:10000



Inset A- Typical House Drainage
(Refer to Dwg.No.2104/03 for location)
Scale 1:250

A1 Scale 1:500 0m 10m 20m 30m 40m 50m

Drainage Legend

S/W Manhole/Pipe, Invert Level, Diameter & Gradient	SMH CI=142.35 IL=140.00 225Ø S/W @ 1/150
150mmØ House Drain /Armstrong Jtn.	AJ
150mmØ Filter Drain/AJ	AJ Filter Drain AJ
Roadside Swale with IC and overflow connection to S/W	
Permeable Paving Parking Bay	▨
Rainwater Butt (200l)	● RWB
Proposed Foul Sewer/MH/ Cover Level/Invert Level Diameter/Gradient/Pipe No.	FMh24 CI=127.60 IL=126.16 4,001 225Ø F W @ 1/35
Proposed connection and inspection chamber	
Existing Foul Sewer	
Existing Watermain	

Notes:

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8. Refer also to the Manhole details drawings provided for further information.
9. Where cover to pipes is less than 1.2m in roads, 1.0m in public areas and 0.9m in grassed/landscaped areas, surround the pipe 150mm of concrete.

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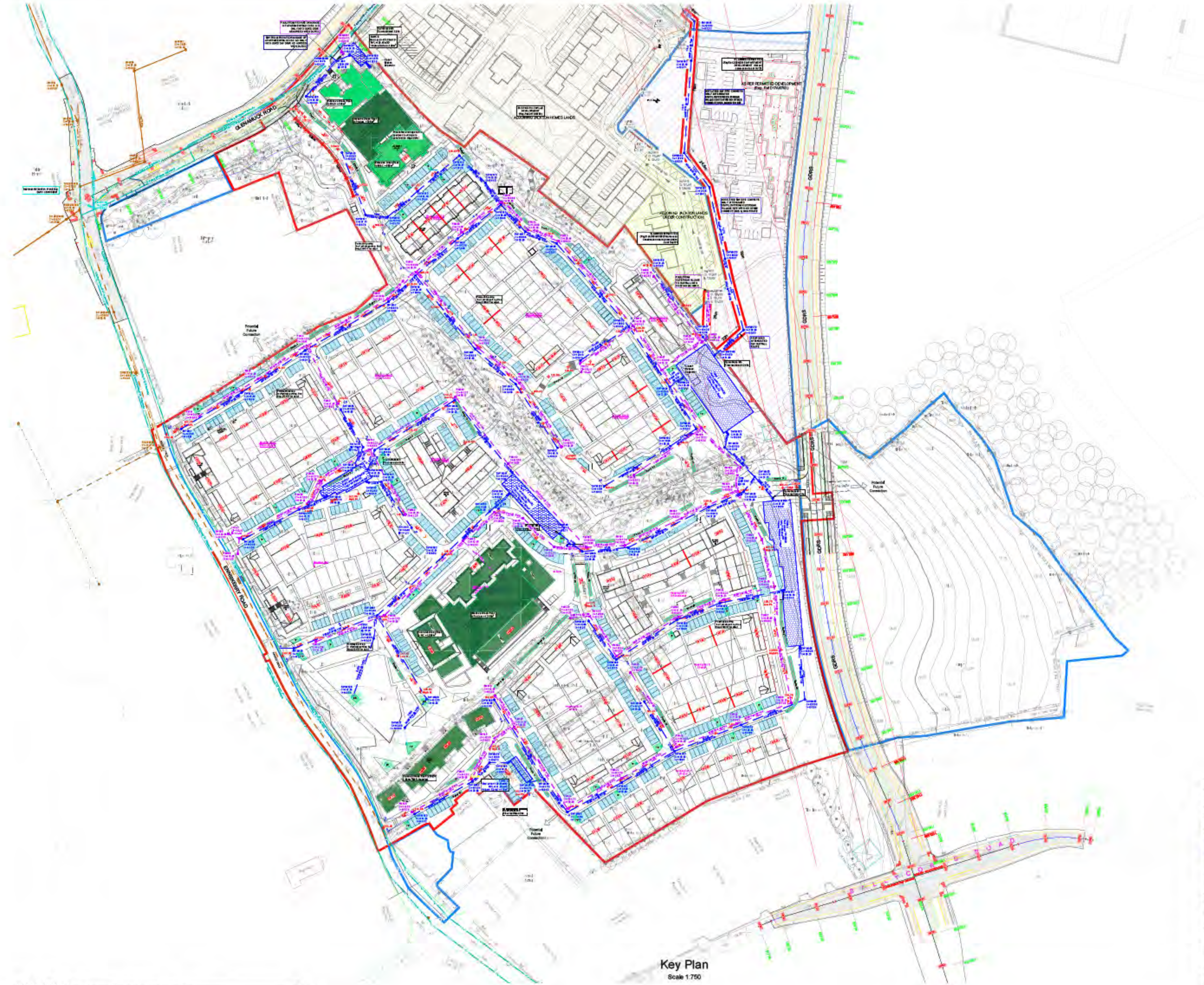
Project
Kilternan Village

Drawing Title
Drainage Outfalls

Architect
MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
July'21	RM	1:500 @A1	2104/05	PLANNING D1	


GLENAMUCK ROAD
ENNISKERRY ROAD
GDRS
AS PER PERMITTED DEVELOPMENT
ADJOINING JACKSON HOMES LANDS
ADJOINING JACKSON LANDS UNDER CONSTRUCTION
Potential Future Connection
BALLYCORUS ROAD

Key Plan
Scale 1:750

A1 Scale 1:750 0m 10m 20m 30m 40m 50m 100m

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NOTES:

Notes:

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6. The Engineer is to be informed of discrepencies that may arise before the contractor commences any site development works. If in doubt - ask
7. Refer to individual S/W & Foul drainage sheets (No.'s 2104/03-07) for greater detail of general arrangements at 1:500 scale.

REV	DATE	DESCRIPTION

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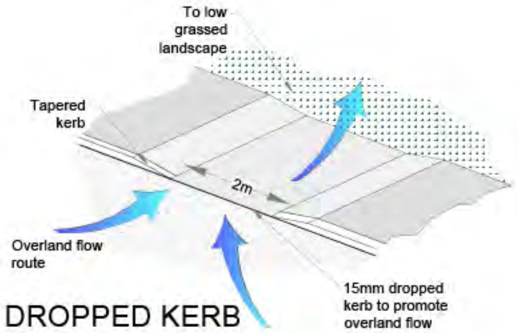
Project
Kilternan Village

Drawing Title
Drainage Masterplan

Architect
MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
May'22	RM	1:1000 @A1	2104/08	PLANNING D1	

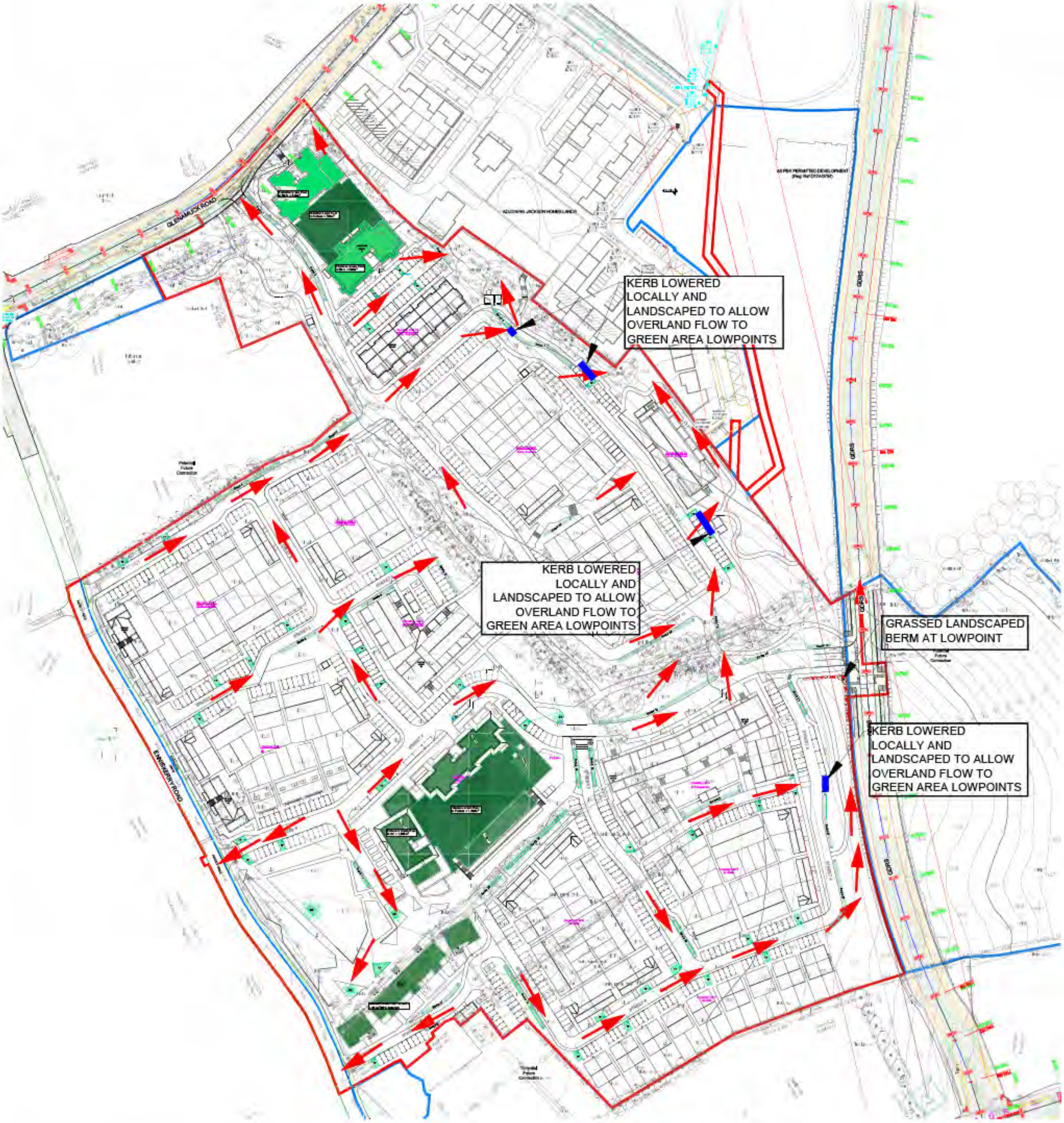


DROPPED KERB

Scale 1:100

Notes:

1. Read this drawing in conjunction with all other relevant Engineers and Architects drawings.
2. Do not scale this drawing, use only written dimensions.
3. This drawing is relevant to flood exceedence routing of storm events greater than the Q100 + 20% climate change as outlined in the RMA Drainage Infrastructure Report prepared as part of the planning application - refer to that document for further information.


GLENAMUCK ROAD
ADJOINING JACKSON HOMES LANDS
KERB LOWERED LOCALLY AND LANDSCAPED TO ALLOW OVERLAND FLOW TO GREEN AREA LOWPOINTS
KERB LOWERED LOCALLY AND LANDSCAPED TO ALLOW OVERLAND FLOW TO GREEN AREA LOWPOINTS
GRASSED LANDSCAPED BERM AT LOWPOINT
KERB LOWERED LOCALLY AND LANDSCAPED TO ALLOW OVERLAND FLOW TO GREEN AREA LOWPOINTS
ENNISKERRY ROAD
GDRS

Overland Flow Routing

Scale 1:2000

A3 Scale 1:2000
0m 50m 100m 150m 200m

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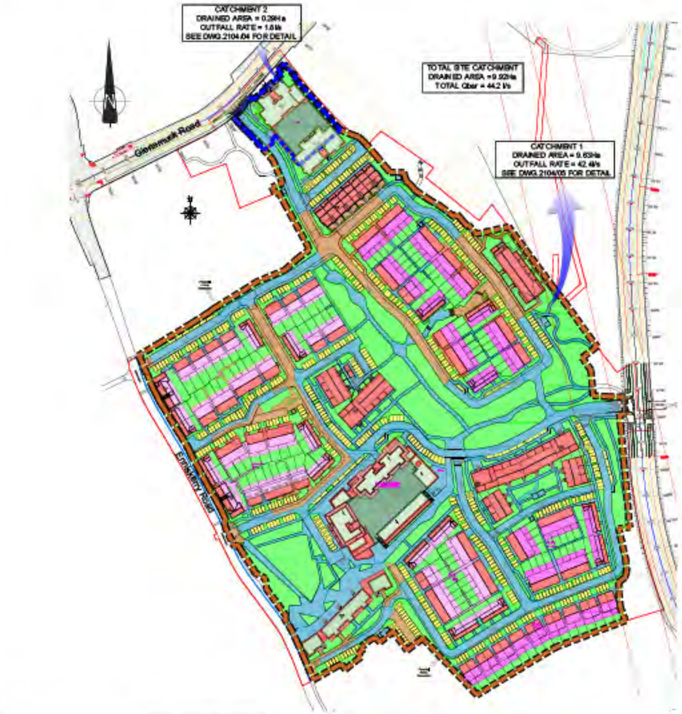
KILTERNAN VILLAGE

Exceedance Overflow Route

MCORM Architects

PLANNING D1

May'22
RM
1:2000 @A3
2104/12

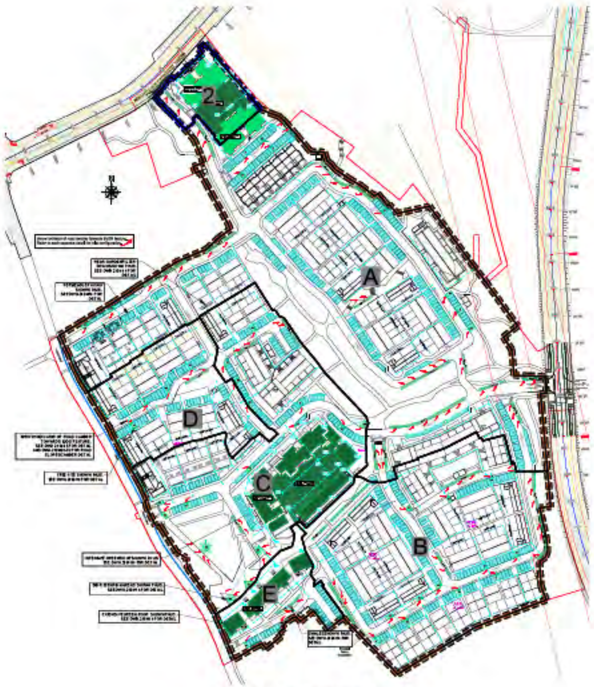


Paved Areas
Scale 1:2000

Paved Areas Summary	Impermeability Percentage (%)	Gross Area (Ha)	Net Area (Ha)
🟥 Roofs to drains	100%	1.36	1.36
🟫 Roads/Paths to drains	95%	0.68	0.65
⬜ Green Roof - Extensive	92%	0.34	0.32
▨ Green Roof - Intensive	85%	0.23	0.20
🟦 Roads/Paths via SuDS	71%	2.29	1.63
🟪 Rear Roofs via SuDS	70%	1.16	0.82
🟨 Permeable Paving	60%	0.72	0.43
🟩 Grassland	37%	3.13	1.16
		Total 9.92	6.55
		Net Impermeable Area	6.6

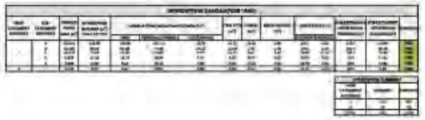
Qbar & Attenuation Storage Summary

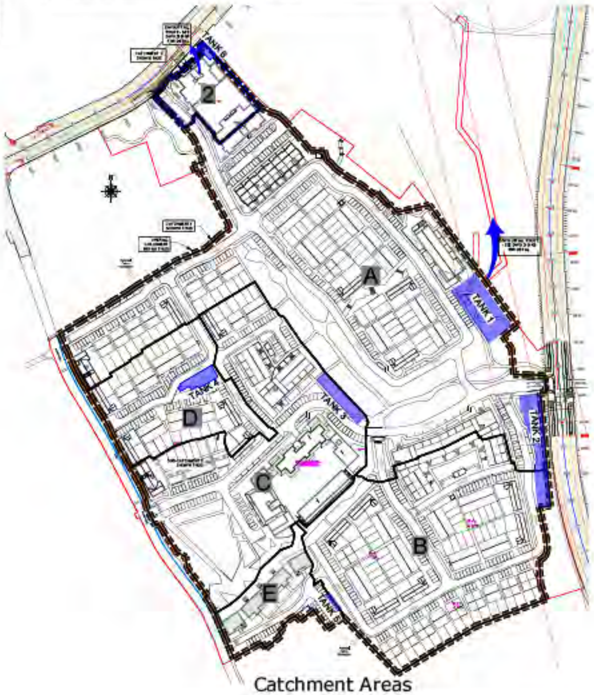
CATCHMENT	GROSS AREA	NET DRAINED AREA	APPLIED QBar	Q100+10% STORAGE PROVIDED
TOTAL	10.7Ha	9.92 Ha	44.2 l/s	4,001m³
1		9.63Ha	42.4 l/s	3,873m³
2		0.29Ha	1.85 l/s	128m³



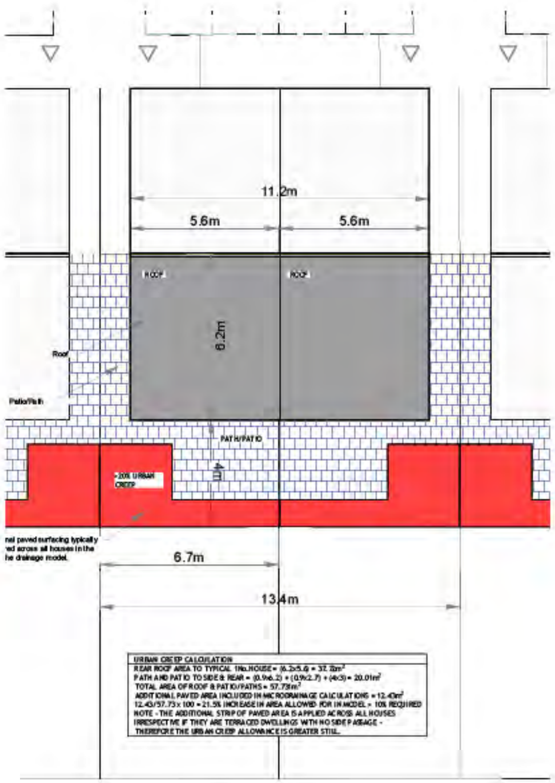
SuDS Interception
Scale 1:2000

	AREA	Qbar
TOTAL DRAINED SITE AREA	9.92Ha	44.2 l/s
CATCHMENT 1 DRAINED AREA	9.63Ha	42.4 l/s
CATCHMENT 2 DRAINED AREA	0.29Ha	1.8l/s





Catchment Areas
Scale 1:2000



URBAN CREEP CALCULATION
REAR ROOF AREA TO TYPICAL 1No.HOUSE = (6.2x5.6) = 37.72m²
PATH AND PATIO TO SIDE & REAR = (0.9x6.2) + (0.9x2.7) + (4x3) = 20.01m²
TOTAL AREA OF ROOF & PATIO/PATHS = 57.73m²
ADDITIONAL PAVED AREA INCLUDED IN MICRODRAINAGE CALCULATIONS = 12.43m²
12.43/57.73 x 100 = 21.5% INCREASE IN AREA ALLOWED FOR IN MODEL > 10% REQUIRED
NOTE - THE ADDITIONAL STRIP OF PAVED AREA IS APPLIED ACROSS ALL HOUSES IRRESPECTIVE IF THEY ARE TERRACED DWELLINGS WITH NO SIDE PASSAGE - THEREFORE THE URBAN CREEP ALLOWANCE IS GREATER STILL.

Urban Creep
Scale 1:100

REV	DATE	DESCRIPTION

ROGER MULLARKEY & ASSOCIATES
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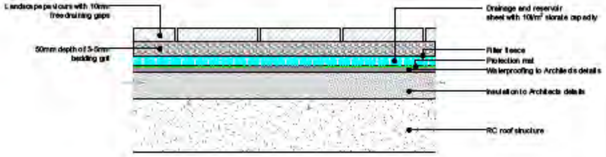
Project
KILTERNAN VILLAGE

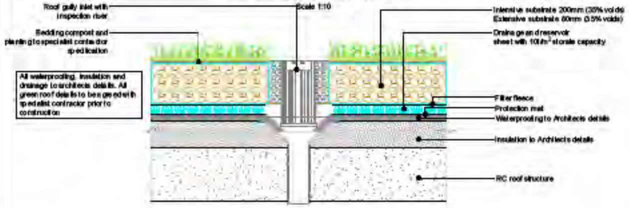
Drawing Title
CATCHMENT,
INTERCEPTION,
PAVED AREAS

Architect
MCORM
Architects

Date	Drawn By	Scales	Dwg No.	Stage	Rev
May'22	RM	As Shown	2104/13	PLANNING D1	


Landscape paviours with 10mm free draining gaps
50mm depth of 3-5mm bedding grit
Drainage and reservoir sheet with 10l/m² storage capacity
Filter fleece
Protection mat
Waterproofing to Architects details
Insulation to Architects details
RC roof structure

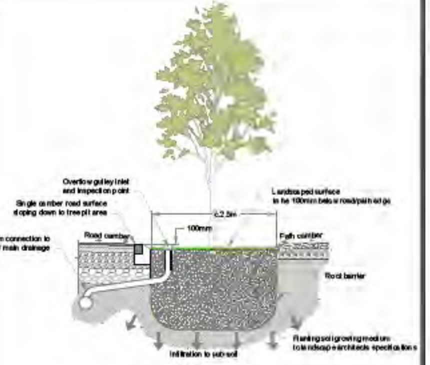
DETAIL 1
Typical Podium Hard Landscaped SuDS Detail
Scale 1:10


Roof gully inlet with inspection riser
Bedding compost and planting to specialist contractor specification
All waterproofing, insulation and drainage to architects details. All green roof details to be agreed with specialist contractor prior to construction
Intensive substrate 200mm (30% voids) Extensive substrate 80mm (35% voids)
Drainage and reservoir sheet with 10l/m² storage capacity
Filter fleece
Protection mat
Waterproofing to Architects details
Insulation to Architects details
RC roof structure

DETAIL 2
Typical Green Roof Detail
Scale 1:10

DETAIL 9
Typical 200l Rainwater Butt
NTS

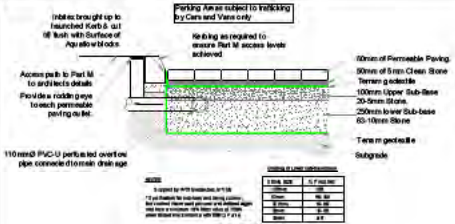
DETAIL 8
ByPass Interceptor
NTS


Overflow gulley inlet and inspection point
Single camber road surface sloping down to tree pit area
150mm connection to SW main drainage
Road camber
100mm
c.2.5m
Landscaped surface to be 100mm below road/path edge
Path camber
Root barrier
Planting soil growing medium to landscape architects specifications
Infiltration to sub-soil

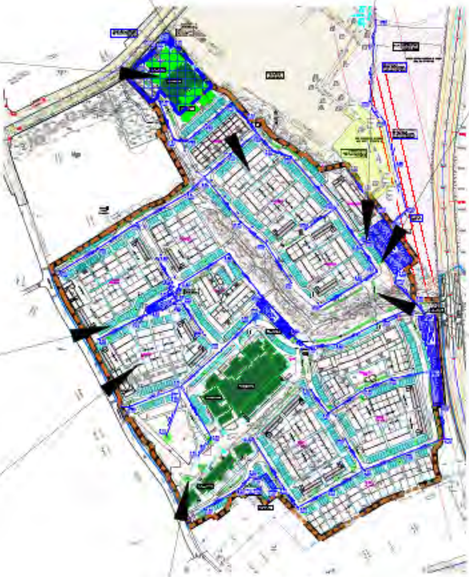
DETAIL 7
Typical Tree Pit Detail
Scale 1:50

1. Read in conjunction with all relevant Architect's and Engineer's drawings.
2. Do not set out from this drawing. Setting out to be done from Architect's drawings.
3. Manhole and road gully details to comply with Greater Dublin Regional Code of practice for Drainage Works.
4. All pipes up to and including 150mm to be Wavin 'Titec' laid in accordance with IAB building products certification. Minimum fall 1/60 UNO. House drains to be laid a minimum of 5m from rear of house, UNO.
5. All pipes 225mm and over to be S&S concrete with rubber rings, laid on a 150mm concrete bed and haunched or surrounded.
6. Where cover to pipes is less than 1.2m in roads, 1.0m in public areas and 0.6m in grassed landscaped areas, surround the pipe up to 150mm with 100mm concrete and larger pipes with 150mm Concrete.
7. Back-fill trenches in roads to detail.
8. Adjust foundation depths, as necessary, adjacent to sewers to avoid undermining of the foundations.
9. Manhole covers and frames shall comply with the LA standard pattern with min opening of 600mm & with closed keyways. all Manholes covers to comply with IS EN 124:1994. Group 4 (min. class D400) manholes in all trafficked areas; Minimum Group 2 (min. class B125) to be used in footways, pedestrian areas and comparable areas. Class D400 should be used in footpaths where heavy vehicles have the potential to access or mount footpaths and these covers should be free of trip hazards, removable parts and be lockable, an example of suitable cover type is a Cavanagh Bromal, supplied by Cavanagh Foundry Ltd. Group 1 (min. class A15) may be used in enclosed private gardens only.
10. Manholes on house drains to be in private property. House drains shall not pass through property they do not serve.
11. Double gullies, with separate connections to main, to be provided at low points and at the ends of Cul de Sacs. Maximum run of pipe 15m Minimum pipe diameter 150mm. Maximum gully spacing for roads up to 7m wide to be 50m UNO.
12. All Road gullies to be placed in the direction of traffic flow.
13. All Gully tops shall comply with the LA standard, Group 3 (min. class C250) where gullys are located in the kerbside channels of roads which when measured from the kerb, extends a maximum of 0.5m into the carriageway and a maximum of 0.2m into the footway. Group 4 (min Class D400) to be used elsewhere. All gully covers to comply with IS EN 124:1994
14. Record drawings of the as constructed work shall be made available to RMA at the end of the project.
15. All connections to existing public services must be determined by the main contractor prior to any construction on site. All existing invert levels to be confirmed to the engineers and all discrepancies notified to RMA before any construction commences.

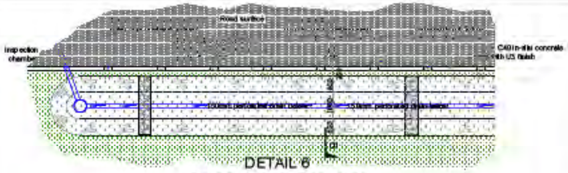
REFER TO DWG No. 2104/17 FOR MANHOLE DETAILS and DWG. 2104/15 FOR ATTENUATION STORAGE DETAILS


Parking Areas subject to trafficking by Cars and Vans only
Inbloc brought up to haunched Kerb & cut off flush with Surface of Aquaflow blocks
Kerbing as required to ensure Part M access levels achieved
Access path to Part M to architects details
Provide a rodding eye to each permeable paving outlet.
110mmØ PVC-U perforated overflow pipe connected to main drainage
80mm of Permeable Paving
50mm of 5mm Clean Stone
Terram geotextile
100mm Upper Sub-Base 20-5mm Stone.
250mm lower Sub-base 63-10mm Stone
Terram geotextile
Subgrade

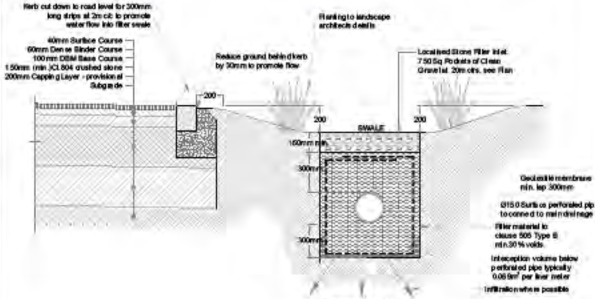
DETAIL 3
Typical Peremable Paving System
Scale: 1:20



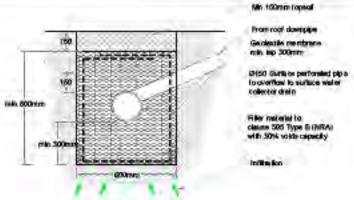
SuDS Location Plan
Scale 1:2500


Road surface
Inspection chamber
C40 in-situ concrete with U3 finish
150mm perforated drain below
GI

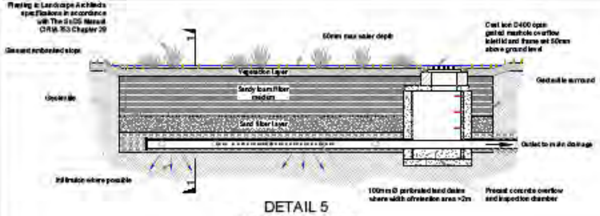
DETAIL 6
Typical Plan of Filter Swale
Scale 1:100


Kerb cut down to road level for 300mm long strips at 2m c/c to promote water flow into filter swale
40mm Surface Course
60mm Dense Binder Course
100mm DBM Base Course
150mm min 3CL804 crushed stone
200mm Capping Layer - provisional
Subgrade
Planting to landscape architects details
Reduce ground behind kerb by 30mm to promote flow
Localised Stone Filter Inlet 750Sq Pockets of Clean Gravel at 20m ctrs. see Plan
200
SWALE
150mm min
300mm
Geotextile membrane min. lap 300mm
Ø150 Surface perforated pipe to connect to main drainage
Filter material to clause 505 Type B min.30% voids.
Interception volume below perforated pipe typically 0.059m³ per liner meter
Infiltration where possible

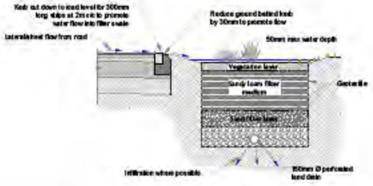
Section B-B
Typical Roadside Filter Swale
Scale 1:20


Min 150mm topsoil
From roof downpipe
Geotextile membrane min. lap 300mm
Ø150 Surface perforated pipe to overflow to surface water collector drain
Filter material to clause 505 Type B (NRA) with 30% voids capacity
Infiltration
150
150
Min. 600mm
min. 300mm
600mm

DETAIL 4
Typical Rear Garden Filter Trench
Scale 1:20


Planting to Landscape Architects specifications in accordance with The SuDS Manual CIRIA 753 Chapter 29
Ground embanked slope
Geotextile
50mm max water depth
Vegetation layer
Sandy loam filter medium
Sand filter layer
Cast iron D400 open grated manhole overflow inlet lid and frame set 50mm above ground level
Geotextile surround
Outlet to main drainage
Infiltration where possible
100mmØ perforated land drains where width of retention area >2m
Precast concrete overflow and inspection chamber

DETAIL 5
BioRetention Area
Long' Section
Scale 1:50


Kerb cut down to road level for 300mm long strips at 2m c/c to promote water flow into filter swale
Laterally inlet flow from road
Reduce ground behind kerb by 30mm to promote flow
50mm max water depth
Vegetation layer
Sandy loam filter medium
Sand filter layer
Geotextile
Infiltration where possible
150mm Ø perforated land drain

Section 1-1
Scale 1:50

REV	DATE	DESCRIPTION

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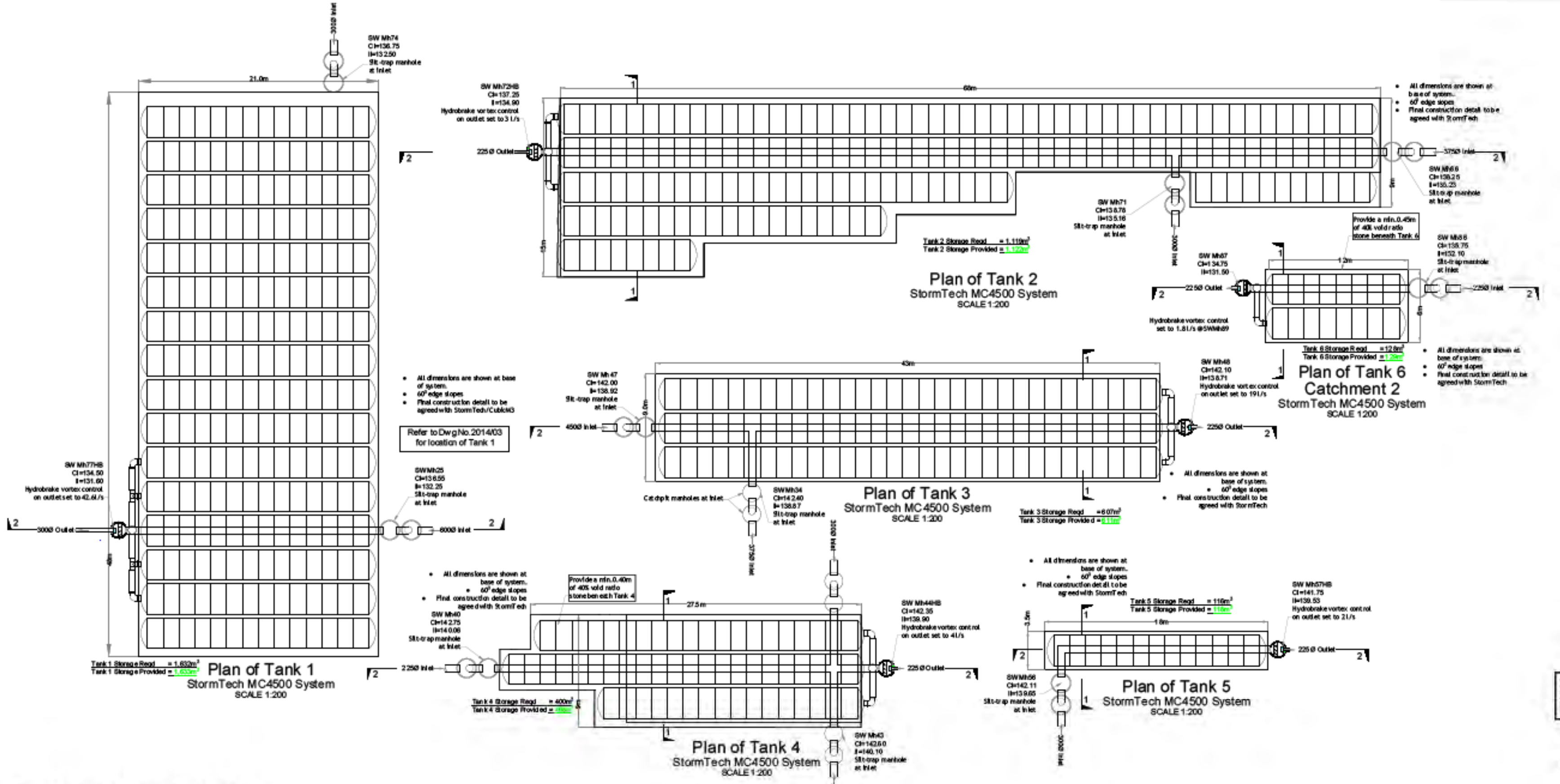
Project
KILTERNAN VILLAGE

Drawing Title
SuDS DETAILS - Sheet 1

Architect
MCORM Architects

Date	Drawn By	Scales	Dwg No.	Stage	Rev
May'22	RM	As Shown	2104/14	PLANNING D1	



Tank 1 Storage Reqd = 1,632m^3
Tank 1 Storage Provided = 1,632m^3

Plan of Tank 1
StormTech MC4500 System
SCALE 1:200

- All dimensions are shown at base of system.
- 60° edge slopes
- Final construction detail to be agreed with StormTech/CubicM3

Refer to Dwg No.2014/03 for location of Tank 1

Tank 2 Storage Reqd = 1,119m^3
Tank 2 Storage Provided = 1,122m^3

Plan of Tank 2
StormTech MC4500 System
SCALE 1:200

- All dimensions are shown at base of system.
- 60° edge slopes
- Final construction detail to be agreed with StormTech

Tank 3 Storage Reqd = 607m^3
Tank 3 Storage Provided = 611m^3

Plan of Tank 3
StormTech MC4500 System
SCALE 1:200

- All dimensions are shown at base of system.
- 60° edge slopes
- Final construction detail to be agreed with StormTech

Provide a min.0.40m of 40% void ratio stone beneath Tank 4

Tank 4 Storage Reqd = 400m^3
Tank 4 Storage Provided = [illegible]

Plan of Tank 4
StormTech MC4500 System
SCALE 1:200

- All dimensions are shown at base of system.
- 60° edge slopes
- Final construction detail to be agreed with StormTech

Tank 5 Storage Reqd = 116m^3
Tank 5 Storage Provided = 118m^3

Plan of Tank 5
StormTech MC4500 System
SCALE 1:200

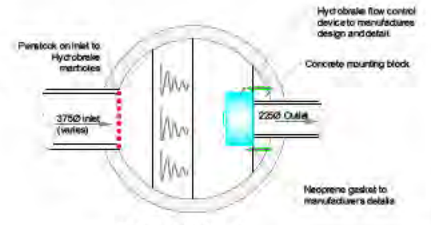
- All dimensions are shown at base of system.
- 60° edge slopes
- Final construction detail to be agreed with StormTech

Provide a min.0.45m of 40% void ratio stone beneath Tank 6

Tank 6 Storage Reqd = 128m^3
Tank 6 Storage Provided = 129m^3

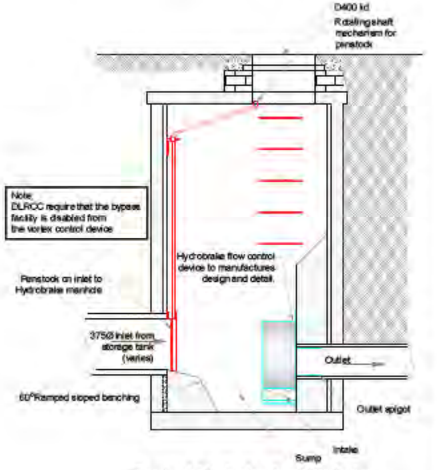
Plan of Tank 6
Catchment 2
StormTech MC4500 System
SCALE 1:200

- All dimensions are shown at base of system.
- 60° edge slopes
- Final construction detail to be agreed with StormTech


Penstock on inlet to Hydrobrake manholes
375Ø inlet (varies)
Hydrobrake flow control device to manufactures design and detail
Concrete mounting block
225Ø Outlet
Neoprene gasket to manufacturers details

Typical Plan of Hydrobrake Manhole
Scale 1:20

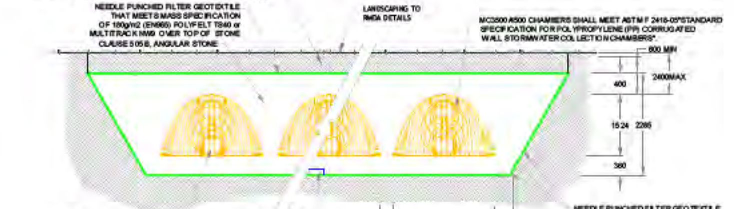
Note;
DLRCC require that the bypass facility is disabled from the vortext control device


D400 lid
Rotating shaft mechanism for penstock
Hydrobrake flow control device to manufactures design and detail.
Penstock on inlet to Hydrobrake manhole
375Ø Inlet from storage tank (varies)
60°Ramped sloped benching
Outlet
Outlet spigot
Intake
Sump

Note;
DLRCC require that the bypass facility is disabled from the vortex control device

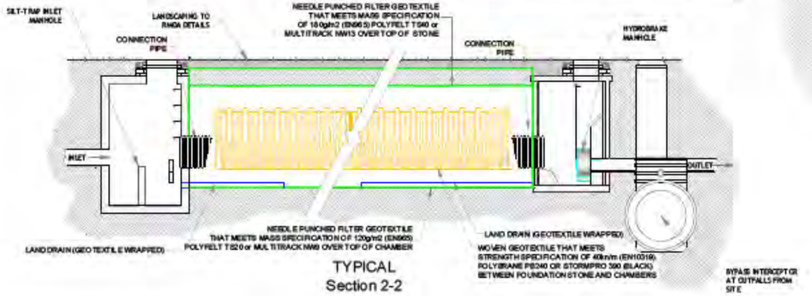
Typical Hydrobrake Manhole
Scale1:20

Tank 1 **SWMh78** to be restricted to 42.6l/s
Tank 2 SWMh72 to be restricted to 3.0l/s
Tank 3 SWMh48 to be restricted to 19.0l
Tank 4 SWMh44 to be restricted to 4.0l/s
Tank 5 SWMh57 to be restricted to 2.0l/s
Tank 6 **SWMh89** to be restricted to 1.8l/s
TOTAL SITE OUTAFALL RATE = 44.2l/s

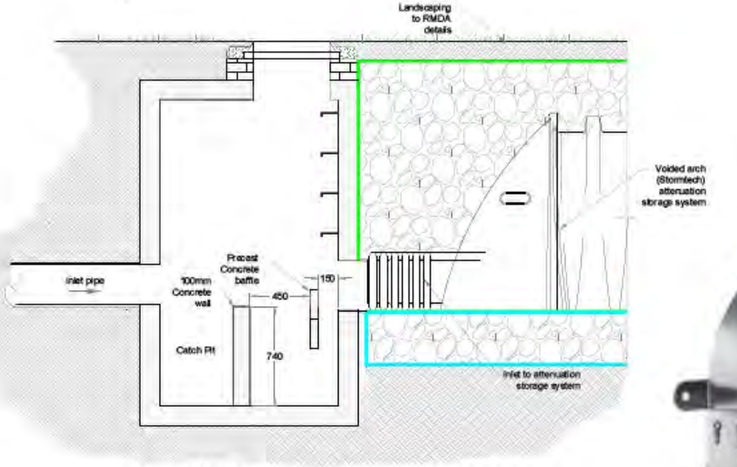

GRANULAR WELL GRADED SOIL/AGGREGATE MIXTURES, <35% FINES. COMPACT IN 15CM LIFTS TO 95% PROCTOR DENSITY. SEE THE TABLE OF ACCEPTABLE FILL MATERIALS IN STORMTECH'S DESIGN MANUAL INSTALLATION MANUAL, OR WWW.STORMTECH.COM.
NEEDLE PUNCHED FILTER GEOTEXTILE THAT MEETS MASS SPECIFICATION OF 180g/m2 (EN965) POLYFELT TS40 or MULTITRACK NW9 OVER TOP OF STONE
CLAUSE 505B, ANGULAR STONE
LANDSCAPING TO RMDA DETAILS
MC3500 A500 CHAMBERS SHALL MEET ASTM F 2418-05"STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
600 MIN
2400MAX
400
1524
2286
380
MC3500/MC4500 END CAP
LAND DRAIN GEOTEXTILE WRAPPED
230 Min
1956 MM
300 Min
NEEDLE PUNCHED FILTER GEOTEXTILE THAT MEETS MASS SPECIFICATION OF 180g/m2 (EN965) POLYFELT TS40 or MULTITRACK NW13 AROUND BASE AND SIDES OF EXCAVATION

TYPICAL
Section 1-1
Scale 1:50

ALL ATTENUATION STORAGE DEATILS TO BE AGREED WITH SPECIALIST CONTRACTOR BEFORE CONSTRUCTION COMMENCES AND BE STRICTLY IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS.


SILT-TRAP INLET MANHOLE
LANDSCAPING TO RMDA DETAILS
CONNECTION PIPE
NEEDLE PUNCHED FILTER GEOTEXTILE THAT MEETS MASS SPECIFICATION OF 180g/m2 (EN965) POLYFELT TS40 or MULTITRACK NW13 OVER TOP OF STONE
CONNECTION PIPE
HYDROBRAKE MANHOLE
INLET
OUTLET
LAND DRAIN (GEOTEXTILE WRAPPED)
NEEDLE PUNCHED FILTER GEOTEXTILE THAT MEETS MASS SPECIFICATION OF 120g/m2 (EN965) POLYFELT TS20 or MULTITRACK NW9 OVER TOP OF CHAMBER
LAND DRAIN (GEOTEXTILE WRAPPED)
WOVEN GEOTEXTILE THAT MEETS STRENGTH SPECIFICATION OF 40kn/m (EN10319) POLYBRANE PB240 OR STORMPRO 390 (BLACK) BETWEEN FOUNDATION STONE AND CHAMBERS
BYPASS INTERCEPTOR AT OUTFALLS FROM SITE

TYPICAL
Section 2-2
Scale 1:50


Landscaping to RMDA details
Voided arch (Stormtech) attenuation storage system
Inlet pipe
100mm Concrete wall
Precast Concrete baffle
150
450
740
Catch Pit
Inlet to attenuation storage system

Typical Silt-Trap Mh Inlet to Attenuation Storage
Scale1:20

Typical View of
Hydrobrake Vortex Control
NTS

REV	DATE	DESCRIPTION

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Project
KILTERNAN VILLAGE

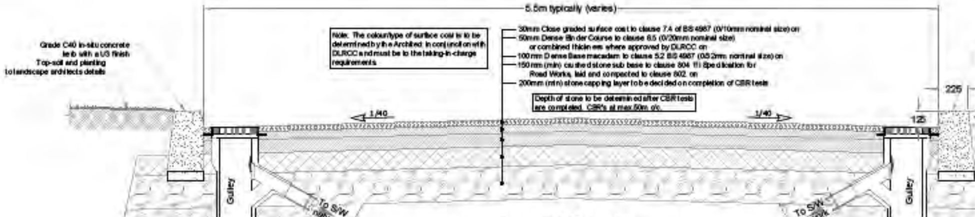
Drawing Title
ATTENUATUION
TANK DETAILS

Architect
MCORM
Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
May'22	RM	As Shown	2104/15	PLANNING D1	

NOTES:
1. Read in conjunction with all relevant Architect's and Engineer's drawings.
2. Do not set out from this drawing. Setting out to be done from Architect's drawings.
3. Manhole and road gully details to comply with Greater Dublin Regional Code of practice for Drainage Works.
4. All attenuation storage details to be agreed with specialist contractor before construction commences and be strictly in accordance with the manufacturers specifications.

THIS IS A PLANNING DRAWING ONLY


5.5m typically (varies)
Grade C40 in-situ concrete kerb with a U3 finish
Top-soil and planting to landscape architects details
1/40
1/40
225
125
Gulley
Gulley
To S/W network
To S/W network

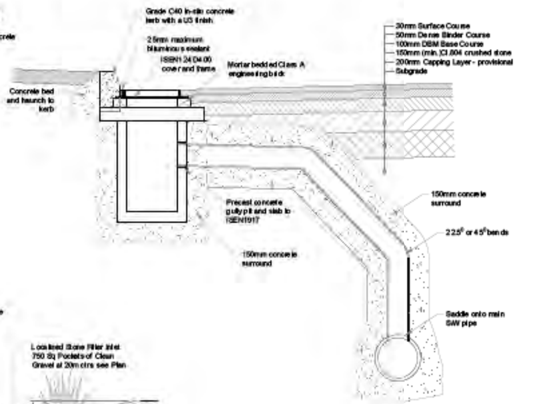
Note: The colour/type of surface coat is to be determined by the Architect in conjunction with DLRCC and must be to the taking-in-charge requirements.

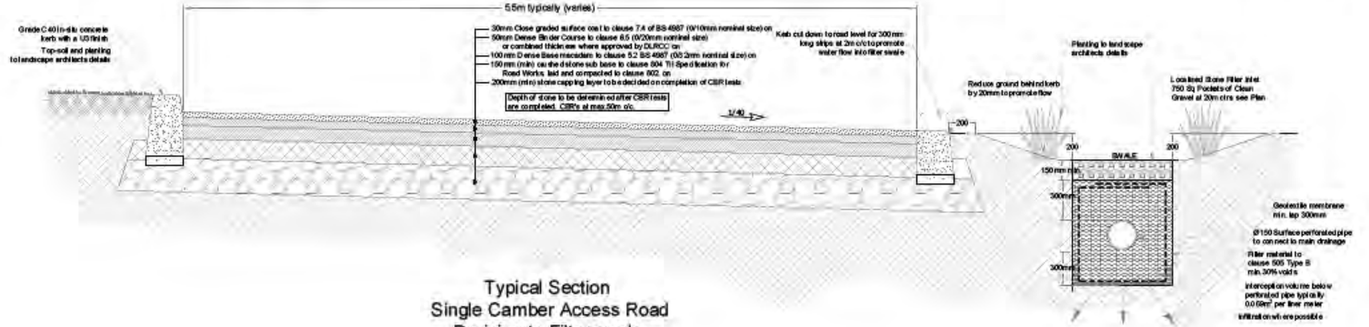
- 30mm Close graded surface coat to clause 7.4 of BS 4987 (0/10mm nominal size) on
- 50mm Dense Binder Course to clause 6.5 (0/20mm nominal size) or combined thickness where approved by DLRCC on
- 100mm Dense Base macadam to clause 5.2 BS 4987 (0/32mm nominal size) on
- 150mm (min) crushed stone sub base to clause 804 TII Specification for Road Works, laid and compacted to clause 802. on
- 200mm (min) stone capping layer to be decided on completion of CBR tests

Depth of stone to be determined after CBR tests are completed. CBR's at max.50m c/c.

Typical Section
Double Camber Access Road

Scale 1:20


Grade C40 in-situ concrete kerb with a U3 finish
100mm concrete path on min. 150mm Cl808 compacted stone. Use 150mm deep concrete at vehicle entrances.
225
Grade C40 in-situ concrete kerb with a U3 finish
25mm maximum bituminous sealant
ISEN124 D400 cover and frame
Mortar bedded Class A engineering brick
Concrete bed and haunch to kerb
Precast concrete gully pit and slab to ISEN1917
150mm concrete surround
150mm concrete surround
22.5° or 45° bends
Saddle onto main SW pipe
30mm Surface Course
50mm Dense Binder Course
100mm DBM Base Course
150mm (min.)Cl.804 crushed stone
200mm Capping Layer - provisional
Subgrade

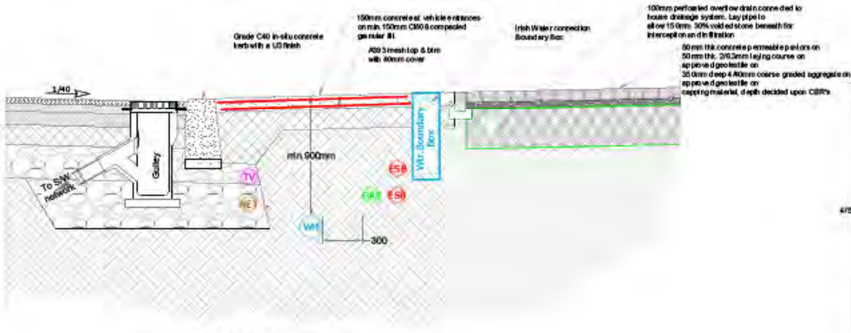

5.5m typically (varies)
Grade C40 in-situ concrete kerb with a U3 finish
Top-soil and planting to landscape architects details
Kerb cut down to road level for 300mm long strips at 2m c/c to promote water flow into filter swale
1/40
200
Planting to landscape architects details
Reduce ground behind kerb by 20mm to promote flow
Localised Stone Filter inlet 750 Sq Pockets of Clean Gravel at 20m ctrs see Plan
200
200
SWALE
150mm min.
300mm
300mm
Geotextile membrane min. lap 300mm
Ø150 Surface perforated pipe to connect to main drainage
Filter material to clause 505 Type B min.30% voids
Interception volume below perforated pipe typically 0.069m² per liner meter
Infiltration where possible

- 30mm Close graded surface coat to clause 7.4 of BS 4987 (0/10mm nominal size) on
- 50mm Dense Binder Course to clause 6.5 (0/20mm nominal size) or combined thickness where approved by DLRCC on
- 100mm Dense Base macadam to clause 5.2 BS 4987 (0/32mm nominal size) on
- 150mm (min) crushed stone sub base to clause 804 TII Specification for Road Works, laid and compacted to clause 802. on
- 200mm (min) stone capping layer to be decided on completion of CBR tests

Depth of stone to be determined after CBR tests are completed. CBR's at max.50m c/c.

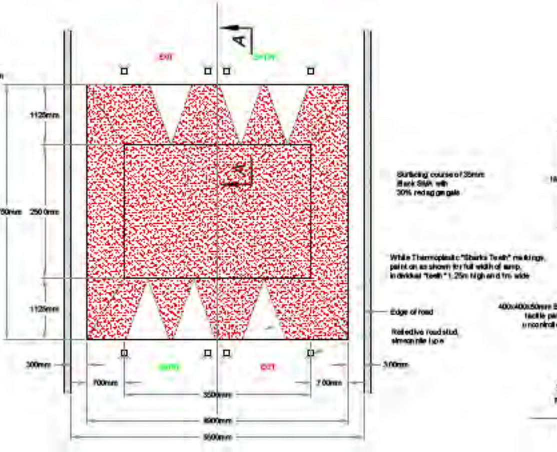
Typical Section
Single Camber Access Road
Draining to Filter swale

Scale 1:20


1/40
Grade C40 in-situ concrete kerb with a U3 finish
150mm concrete at vehicle entrances on min. 150mm Cl808 compacted granular fill.
A393 mesh top & btm with 40mm cover
Irish Water connection Boundary Box
Wtr. Boundary Box
100mm perforated overflow drain connected to house drainage system. Lay pipe to allow 150mm 30% voided stone beneath for interception and infiltration
80mm thk concrete permeable paviors on 50mm thk. 2/6.3mm laying course on approved geotextile on 350mm deep 4/40mm coarse graded aggregate on approved geotextile on capping material, depth decided upon CBR's
min.900mm
Gulley
To S/W network
TV
NET
WM
GAS
ESB
ESB
300

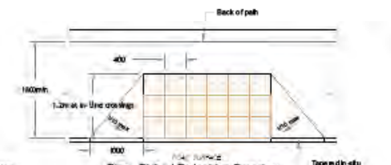
Typical Section
Dropped Kerb to Vehicular Entrance

Scale 1:20


A
A
EXIT
ENTRY
ENTRY
EXIT
1125mm
2500mm
1125mm
4750mm
300mm
700mm
3500mm
700mm
4900mm
5500mm
300mm
Surfacing course of 35mm Black SMA with 30% red aggregate
White Thermoplastic "Sharks Teeth" markings, paint on as shown for full width of ramp, individual "teeth" 1.25m high and 1m wide
Edge of road
Reflective road stud, simonite type

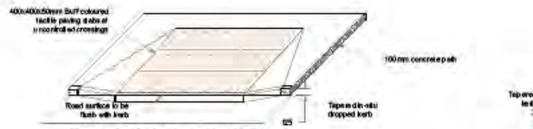
Plan of Traffic Platform

Scale 1:50



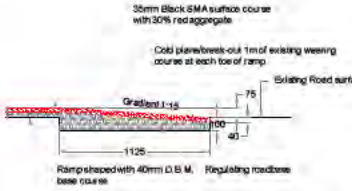
Plan - Dished Pedestrian Crossings

Scale 1:50


400x400x50mm Buff coloured tactile paving slabs at uncontrolled crossings
100mm concrete path
Road surface to be flush with kerb
Tapered in-situ dropped kerb
125

Uncontroled Dished Pedestrian Crossing

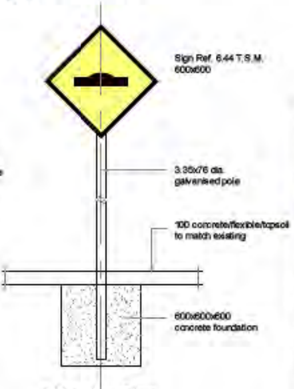
Scale 1:50


35mm Black SMA surface course with 30% red aggregate
Cold plane/break-out 1m of existing wearing course at each toe of ramp
Existing Road surface
Gradient 1:15
75
100
40
1125
Ramp shaped with 40mm D.B.M. base course
Regulating roadbase

Section A-A

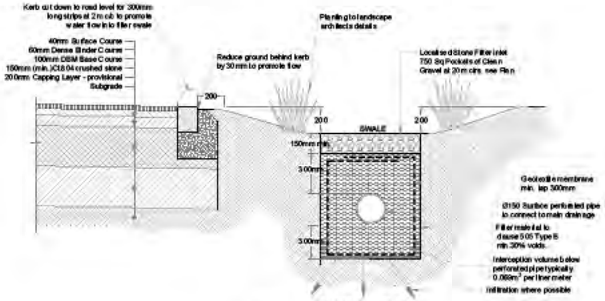
Scale: 1:20

Notes
1. Place 4No. Road Studs on each approach to the ramp, 2 at 700mm from the kerb and 2 at 125mm from the centre line.
2. 1No. warning sign (6.44 TSM) on each approach to ramp located 15m aprox. from platform on left hand side


Sign Ref. 6.44 T.S.M. 600x600
3.35x76 dia. galvanised pole
100 concrete/flexible/topsoil to match existing
600x600x600 concrete foundation

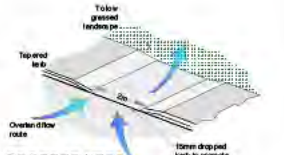
Warning Sign

Scale: 1:20


Kerb cut down to road level for 300mm long strips at 2m c/c to promote water flow into filter swale
40mm Surface Course
60mm Dense Binder Course
100mm DBM Base Course
150mm (min.)Cl.804 crushed stone
200mm Capping Layer - provisional
Subgrade
200
Planting to landscape architects details
Reduce ground behind kerb by 30mm to promote flow
Localised Stone Filter inlet 750 Sq Pockets of Clean Gravel at 20m ctrs. see Plan
200
200
SWALE
150mm min.
300mm
300mm
Geotextile membrane min. lap 300mm
Ø150 Surface perforated pipe to connect to main drainage
Filter material to clause 505 Type B min.30% voids.
Interception volume below perforated pipe typically 0.069m² per liner meter
Infiltration where possible

Section B-B
Typical Roadside Filter Swale

Scale 1:20



DROPPED KERB

Scale 1:100

NOTES:

1. Read in conjunction with all relevant Architects and Engineer's drawings and specification. All setting out to be done from the Architects drawings. Do not scale the drawing.
2. The contractor shall establish, by slit trenches, by liaison with the various utilities and by scanning, the location of the existing services, so that the work can be carried out in a safe and efficient manner.
3. The contractor shall prepare a traffic management plan and agree it with the Local Authority, prior to commencement of work on site.
4. Soft areas and loose uncompacted areas to be excavated and replaced with stone capping layer, Class 6F1 or 2 to the TII Specification for Road Works, as amended by the specification, compacted in layers to clause 612.
5. All services, including manhole covers and gullies must be installed before the wearing course is placed. No patch work permitted.
6. Concrete in footpaths to be Mix E to specification and Mix F in kerb beds and haunch. Form A should be giv to the concrete supplier.
7. Sub base to be blinded with a thin layer of non plastic quarry screenings, where necessary, maximum thickness to be 20mm.
8. Double road gullies must be placed at low points to eliminate ponding. Close gullies in the direction of the traffic flow.

THIS IS A PLANNING DRAWING ONLY
AND CANNOT BE USED FOR CONSTRUCTION
PURPOSES

ROAD SPECIFICATION FOR SPINE ROAD:

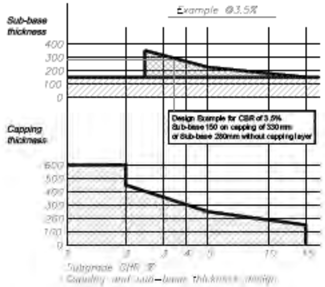
1. Surface Course - One of following;
   A- 30mm HRA in accordance with Cl.911,915,943 of SWR laid and compacted in accordance with Cl.903, or
   B- 30mm PMSMA in accordance with Cl.942 of SRW laid and compacted in accordance with Cl.903. Mixture resignation/material SMA 10 surf PMB 65/105-60 des, min.polishead stone value PSV 55,min.agg.abrasion value AAV12, binder penetration 40/60
2. Binder Course; 50mm in accordance with Cl.. 929,930,937,943 of SRW laid and compacted in accordance with C.903. AC20 HDM bin 40/60 des.
3. Base; 100mm in accordance with Cl.906,907,929,930 of SRW laid and compacted in accordance with Cl.903. AC HDM base 60/60 des.
4. Sub-Base -200mm (min) crushed stone sub base to be to clause 804 and grading to be in accordance with the TII Specification for Road Works, Class 6F2 and laid and compacted to clause 802. All stone to be certified for the end use for additional properties as per the requirements of SR21:2014 Annex E. Where no capping layer is required the depth shall be increased to 225mm minimum.
5. Stone capping layer to be decided on completion of CBR tests. Capping layer should be to Class 6F 2 to the TII Specification for Road Works,compacted in layers to clause 612. Capping layer may be omitted, for CBR values between >5%.
6. Granular filling material, to Class 6F2 certified for end use to the requirements of SR21 as above. It shall be used to make up levels below the hardcore. Each layer shall be compacted with approved mechanical equipment in accordance with clause 612 of the TII Specification. Generally the layers shall not exceed 150mm thick.
7. Hardcore and granular fill shall be obtained from a independently tested and approved quarry. The stone shall be certified as being not subject to swelling and in accordance with SR21:2014 Annex E. Samples of Granular Fill to be taken from site and to be tested at a frequency to be agreed but minimum of 1 No.sample per 125m² for roads/paths.
8. CBR tests to be carried out at a maximum of 50m c/c.
9. Terram is required generally in low CBR and wet areas.
10. Tensar Geogrid required where CBR<2%.

Macadam Car park construction:

1. 30mm of close graded surface coat macadam to ISEN 13108-5 (10mm nominal size) on
2. 60mm Dense Binder Course to ISEN 13108-1 (AC 20 dense bin)
3. 150mm (min) crushed stone sub base to clause 804 TII Specification for Road Works, laid and compacted to clause 802. Increase to 225mm where no capping layer is required, on
4. 200 mm (min) stone capping layer to be decided on completion of CBR tests

CBR%	<2	2	3	4-15	16+
Depth	350	250	200	150	0

NOTE:
Use Terram geotextile generally where formation is wet. Use Tensar Geogrid in road at locations where CBR <2%. Refer to SI report for locations of CBR's.



Design Example for CBR of 3.5%
Sub-base 150 on capping of 330mm
or Sub-base 280mm without capping layer

REV	DATE	DESCRIPTION

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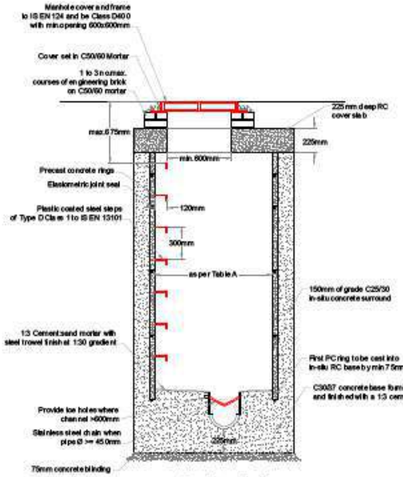
Project
KILTERNAN VILLAGE

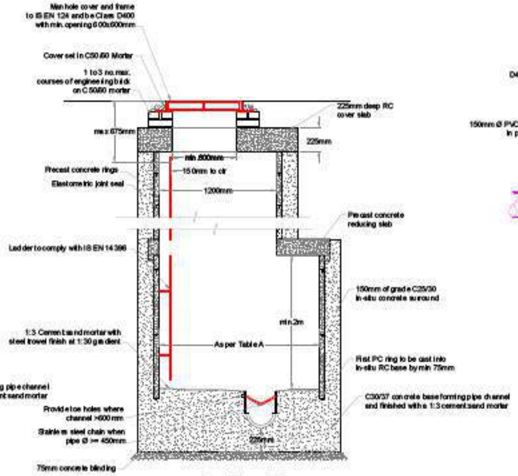
Drawing Title
ROAD DETAILS

Architect
MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
Oct'21	RM	As Shown	2104/16	PLANNING D1	

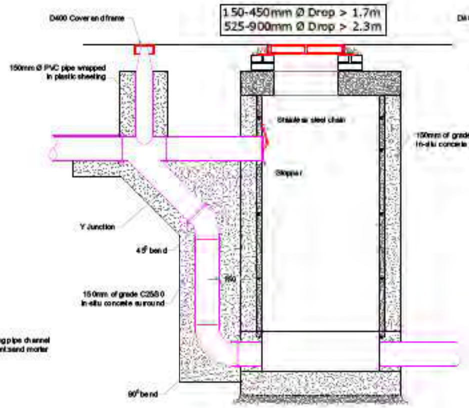

Manhole cover and frame to IS EN 124 and be Class D400 with min.opening 600x600mm
Cover set in C50/60 Mortar
1 to 3 no.max. courses of engineering brick on C50/60 mortar
225mm deep RC cover slab
max.675mm
225mm
min.600mm
Precast concrete rings
Elastomeric joint seal
120mm
Plastic coated steel steps of Type D Class 1 to IS EN 13101
300mm
as per Table A
150mm of grade C25/30 in-situ concrete surround
1:3 Cement:sand mortar with steel trowel finish at 1:30 gradient
First PC ring to be cast into in-situ RC base by min 75mm
C30/37 concrete base forming pipe channel and finished with a 1:3 cement sand mortar
Provide toe holes where channel >600mm
Stainless steel chain when pipe Ø >= 450mm
225mm
75mm concrete blinding

Section A-A
Type A <3m depth
Scale 1:20


Manhole cover and frame to IS EN 124 and be Class D400 with min. opening 600x600mm
Cover set in C50/60 Mortar
1 to 3 no. max. courses of engineering brick on C50/60 mortar
225mm deep RC cover slab
max 675mm
225mm
min.600mm
150mm to clr
1200mm
Precast concrete rings
Elastomeric joint seal
Precast concrete reducing slab
Ladder to comply with IS EN 14396
150mm of grade C25/30 in-situ concrete surround
min.2m
1:3 Cement:sand mortar with steel trowel finish at 1:30 gradient
As per Table A
First PC ring to be cast into in-situ RC base by min 75mm
C30/37 concrete base forming pipe channel and finished with a 1:3 cement:sand mortar
Provide toe holes where channel >600mm
Stainless steel chain when pipe Ø >= 450mm
225mm
75mm concrete blinding

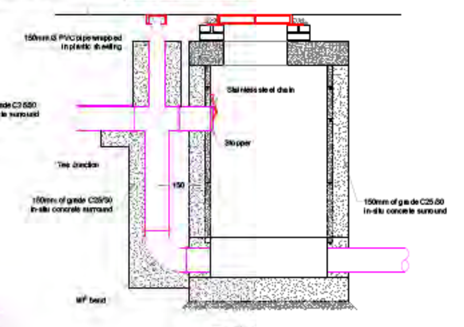
Section A-A
Type B 3-6m depth
Scale 1:20

150-450mm Ø Drop > 1.7m
525-900mm Ø Drop > 2.3m


D400 Cover and frame
150mm Ø PVC pipe wrapped in plastic sheeting
Stainless steel chain
Stopper
150mm of grade C25/30 in-situ concrete surround
Y Junction
45° bend
150
150mm of grade C25/30 in-situ concrete surround
90° bend

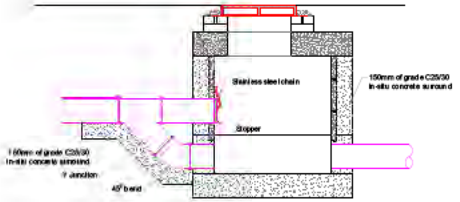
Backdrop Manhole
Type 1
Scale 1:20

150-450mm Ø Drop > 0.9m and < 1.7m
525-900mm Ø Drop > 1.3m and < 2.3m

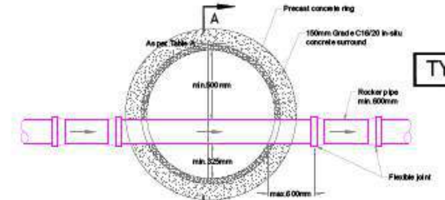

D400 Cover and frame
150mm Ø PVC pipe wrapped in plastic sheeting
150mm of grade C25/30 in-situ concrete surround
Stainless steel chain
Stopper
Tee Junction
150
150mm of grade C25/30 in-situ concrete surround
150mm of grade C25/30 in-situ concrete surround
90° bend

Backdrop Manhole
Type 2
Scale 1:20

150-450mm Ø Drop > 0.6m and < 0.9m
525-900mm Ø Drop > 0.6m and < 1.3m


Stainless steel chain
150mm of grade C25/30 in-situ concrete surround
Stopper
150mm of grade C25/30 in-situ concrete surround
Y Junction
45° bend

Backdrop Manhole
Type 3
Scale 1:20

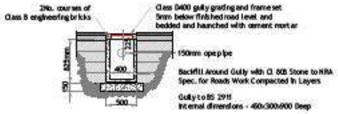


Plan on Precast
Concrete Manhole
<3m depth
Scale 1:20

TYPICAL MANHOLE DETAIL

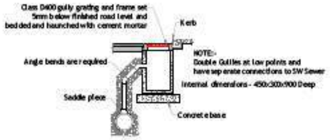
TABLE A

DEPTH (m)	TYPE	PIPE DIAMETER (mm)				
		150	225	300	375	450
0-1	PRECAST	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1-3	PRECAST	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3-6	PRECAST	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]


2No. courses of Class B engineering bricks
Class D400 gully grating and frame set 5mm below finished road level and bedded and haunched with cement mortar
125
150mm ope pipe
625mm
400
150
500
Backfill Around Gully with Cl. 808 Stone to NRA Spec. for Roads Work Compacted in Layers
Gully to BS 2911
Internal dimensions - 450x300x900 Deep

Precast Concrete
Gully Pit
SCALE 1:50

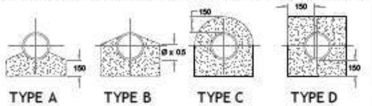
NB.
All gullies to be positioned at low points and no ponding of S/W is acceptable. Adjustment to suit site conditions to be discussed with RMA where variation to drawings occurs


Class D400 gully grating and frame set 5mm below finished road level and bedded and haunched with cement mortar
Kerb
Angle bends are required
Saddle piece
Concrete base

NOTE:-
Double Gullies at low points and have seperate connections to SW Sewer
Internal dimensions - 450x300x900 Deep

Gulley Connection
SCALE 1:50

CONCRETE BED/HAUNCH/SURROUND DETAILS



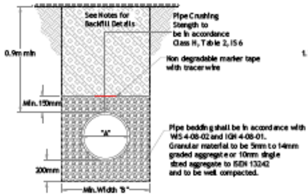
TYPE A
Scale 1:25

TYPE B
Scale 1:25

TYPE C
Scale 1:25

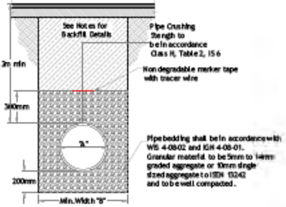
TYPE D
Scale 1:25

Pipe Diameter "A" (mm) <80 Rising Main	Trench Width "B" (mm)
100	<500 TBC with Eng.
150	600
200	600
250	750
300	750
350	750
400	900
450	900


See Notes for Backfill Details
Pipe Crushing Strength to be in accordance Class H, Table 2, IS6
0.9m min
Non degradable marker tape with tracer wire
Min.150mm
"A"
200mm
Min.Width "B"

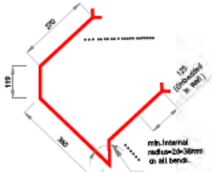
Pipe bedding shall be in accordance with WIS 4-08-02 and IGN 4-08-01. Granular material to be 5mm to 14mm graded aggregate or 10mm single sized aggregate to ISEN 13242 and to be well compacted.

CROSS SECTION
GRASSED AREA
Granular Bed & Surround
Scale 1:25


See Notes for Backfill Details
Pipe Crushing Strength to be in accordance Class H, Table 2, IS6
1.2m min
Non degradable marker tape with tracer wire
300mm
"A"
200mm
Min.Width "B"

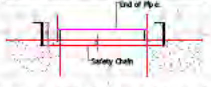
Pipe bedding shall be in accordance with WIS 4-08-02 and IGN 4-08-01. Granular material to be 5mm to 14mm graded aggregate or 10mm single sized aggregate to ISEN 13242 and to be well compacted.

CROSS SECTION ROADS
Granular Bed & Surround
Scale 1:25

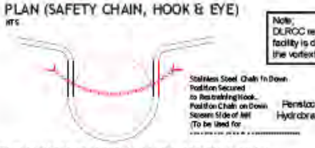


Galvanised Standard Rung
Scale 1:10

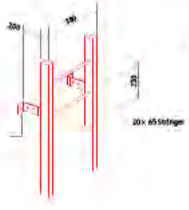
LADDER & CHAIN DETAILS



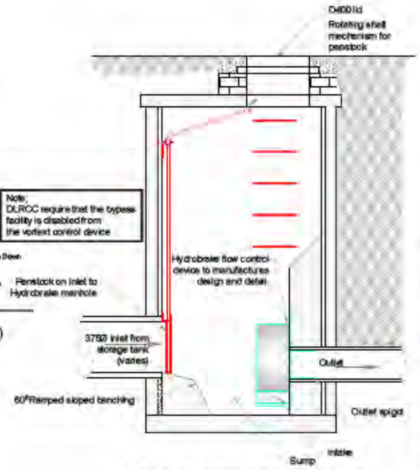
PLAN (SAFETY CHAIN, HOOK & EYE)
NTS


Stainless Steel Chain In Down Position Secured to Restraining Hook. Position Chain on Down Stream Side of MH (To be Used for

ELEVATION (SAFETY CHAIN, HOOK & EYE)
NTS



Note;
DLRCC require that the bypass facility is disabled from the vortext control device


D400 lid
Rotating shaft mechanism for penstock
Penstock on inlet to Hydrobrake manhole
Hydrobrake flow control device to manufactures design and detail
375Ø inlet from storage tank (varies)
Outlet
60° Ramped sloped benching
Outlet spigot
Intake
Sump

Typical Hydrobrake Manhole
Scale 1:20

NOTES:

1. Read in conjunction with all relevant Architect's & Engineer's drawings and cross read the detailed notes on the various manholes.
2. The minimum diameter of manholes are as shown in Table A, but this may need be increased subject to the number of branches, this is made up as follows:
[illegible]
=1525mm (subject to minimum length)
3. Access rungs shall be provided in manholes greater than 1m to the invert level of the pipe.
4. A 200mm concrete surround, 100mm deep, shall be provided around manhole covers in grassed areas.
5. Class U2 finish to the top of slabs. Reinforcement in the slabs to details or as directed by the Engineer.
6. Manhole foundations to be 225mm C30/37 mass concrete with 75mm lean mix concrete blinding if required by site conditions.
7. Use pre-formed half circle channel pipes through manholes but the pipeline may be laid through the manhole and the crown cut out to half diameter ensuring that flexible joints are located either side of manhole at max.600mm as measured from the inner face of manhole wall.
8. Use Cl. 20N/20 concrete for benching and pipe channel pipe surround.
9. Benching to be finished in 1:3 cement-sand mortar with a smooth trowel finish, at 1 in 30 slope towards channel. Form a 25mm radius nosing on benching, level with crown of the pipe.
10. Standard galvanised (BS 729) rungs to be positioned @ 300c/c vertically.
11. Roof slab to have a min. 600mm square ope.
12. 225thk. Precast R.C Roof Slab in C30/37 Concrete. Cover to steel shall be 40mm.
13. MH cover frame to be laid on 1 No.min to 3 No. max. courses of engineering bricks Cl.B to I.S.91:1983 set in C50/60 mortar
14. MH cover and frames to be Class D400 to IS/EN 124.150mm deep frame for roads, 100mm deep for footpaths and green areas. Class B250 manhole covers may be used in private areas accessible to light vehicular traffic. Non-rock design, closed keyways, manufactured from spheroidal graphite cast iron (ductile cast iron), 600x600 (or 600diam.) clear opening, cover and frame coated in bitumen or other approved material, cover to have a minimum mass of 140Kg/m², frame bearing area shall be 80,000mm² min., frames shall be designed to prevent covers falling into manhole. Frames shall be bedded on C50/60 mortar to manufacturers instructions.
15. Galvanised steel safety railings to be provided in benching of sewers greater than [illegible] to be provided where channel >600mm.
16. [illegible] chain shall be 10mm nominal size graded M(H) non calibrated chain, type 1. complying with B.S.4942 Part 2.
17. When depth of Manholes to invert is greater than 3.0m. ladders shall be used, instead of rungs 25mm in diam. B.S.4211 except that stringers should be not less than 65x20mm. in section and rungs 25mm in diam. Fixed Ladders should meet the dimensional requirements of B.S.4211.
18. Ladder stringers should be adequately supported from the Manhole wall at intervals of not more than 2.0m. Stringers should be bolted to cleats to allow renewal.
19. Socket of pipe to be cut flush with the inside surface of the manhole wall.
20. Where manhole diameter changes in deep manholes, provide a 910mm square ope in the intermediate roof slab.
21. All Manholes shall be watertight to the satisfaction of the Engineer. Formwork to reinforced concrete and mass concrete shall comply comply to Class 2, Section 6.2.7 BS8110:Part 1:1997. Finish to the top of slabs shall comply to Type A, Section 6.2.7 BS8110: Part 1: 1997. Manholes are designed to BS 8005 and wall thicknesses to I.S325.
22. Precast Manholes, Chamber walls and cover slab to be constructed to IS EN 1917 and IS 420 2004.
23. Manhole opes to be situated furthest from the nearest carriageway. Manhole steps/access to be positioned to allow viewing of oncoming traffic.
24. For bedding and sealing of chamber rings, the top ring below PC slab and bottom ring to be bedded with cement mortar, For intermediate rings, joints to be sealed with approved pre-formed jointing strip.
25. Pre cast Manholes to be surrounded with a minimum of 150mm thick Grade C25/30 concrete.

PIPE BEDDING & BACK FILLING NOTES:-

1. Pipe backfill to be granular material to Cl.804/808 in accordance with the NRA Specification for Road Works. Use only CL808 material when within 500mm of cement bound materials such as concrete kerbs/paths/haunching.
2. Backfill material to be well compacted in accordance with CL802 of the NRA specification compacted in layers of not greater than 150mm.
3. Back filling in open spaces shall consist of suitable selected excavated material, shall be free from stones greater than 25mm in size, builders rubbish, vegetable matter and lumps of clay greater than 75mm in size and shall be compacted in 150mm layers. It shall meet the requirements of "Acceptable material" as defined in Clause 601 of the NRA Specification for Road Works.
4. Pipe bedding shall be in accordance with WIS 4-08-02 and IGN 4-08-01. Granular material to be 5mm to 14mm graded aggregate or 10mm single sized aggregate to ISEN 13242.
5. All pipes to have a 150mm Concrete surround where the cover is less than 900mm in landscaped/Pedestrian areas. Use concrete bed & surround details if cover is <1.2m trafficked areas. All other pipework to be to bedding details as shown.
6. Concrete for pipe bedding, haunching and surrounds shall be grade C16/20 and have expansion joints at all pipe joints using 18mm filler board.
7. Formwork to Reinforced Concrete and mass concrete shall be class F2.
8. Wrap PE pipes in plastic sheeting before casting into concrete

All pipe/manhole details to be compliant with Irish Water's Wastewater Infrastructure Standard Details document July'20 (Rev'04)

THIS IS A PLANNING DRAWING AND IS FOR THE APPROVAL OF IRISH WATER

REV	DATE	DESCRIPTION

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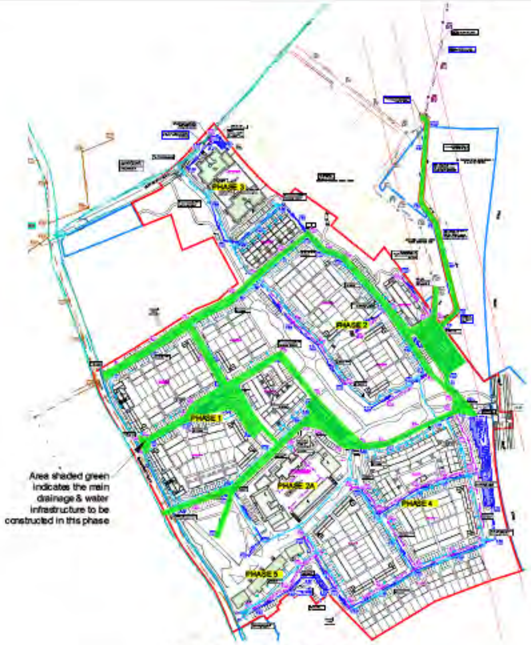
Project
KILTERNAN VILLAGE

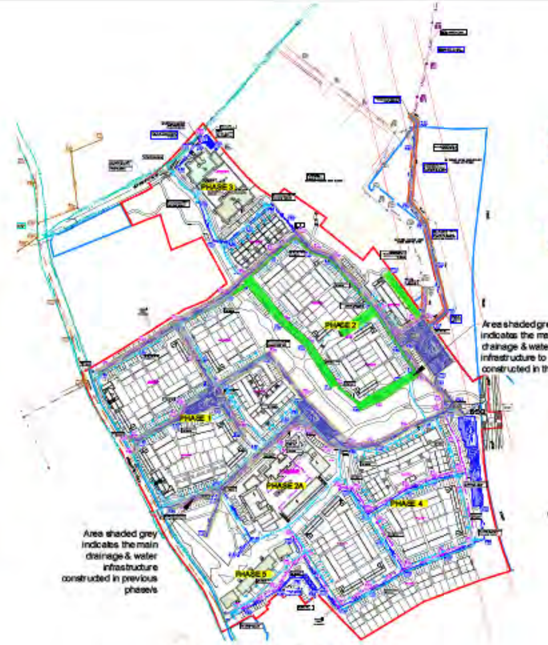
Drawing Title				Architect	
MANHOLE DETAILS				MCORM Architects	
Date	Drawn By	Scales	Dwg.No.	Stage	Rev
May'22	RM	As Shown	2104/17	PLANNING D1	



PHASE 1
PHASE 2
PHASE 2A
PHASE 3
PHASE 4
PHASE 5
Area shaded green indicates the main drainage & water infrastructure to be constructed in this phase

Phase 1 Main Infrastructure

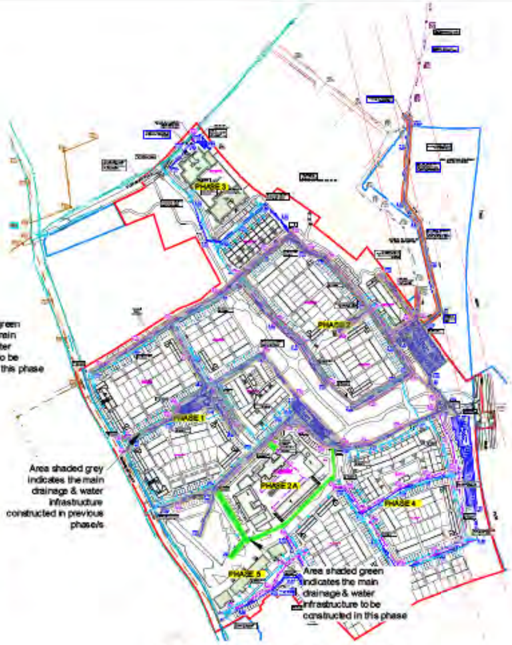
Scale 1:2500



PHASE 1
PHASE 2
PHASE 2A
PHASE 3
PHASE 4
PHASE 5
Area shaded green indicates the main drainage & water infrastructure to be constructed in this phase
Area shaded grey indicates the main drainage & water infrastructure constructed in previous phase/s

Phase 2 Main Infrastructure

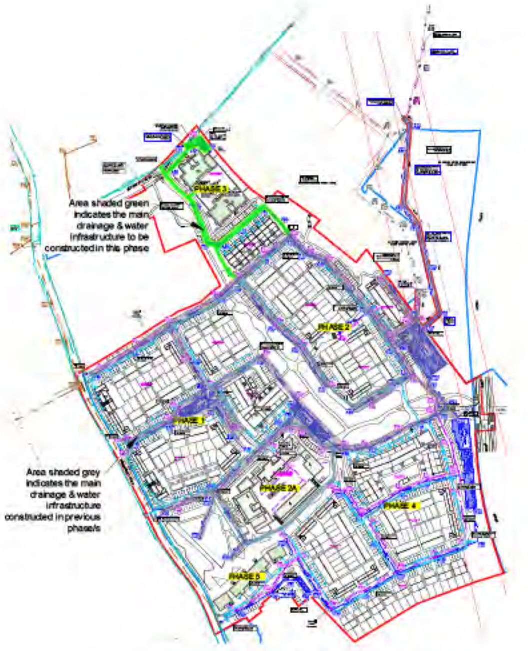
Scale 1:2500



PHASE 1
PHASE 2
PHASE 2A
PHASE 3
PHASE 4
PHASE 5
Area shaded grey indicates the main drainage & water infrastructure constructed in previous phase/s
Area shaded green indicates the main drainage & water infrastructure to be constructed in this phase

Phase 2A Main Infrastructure

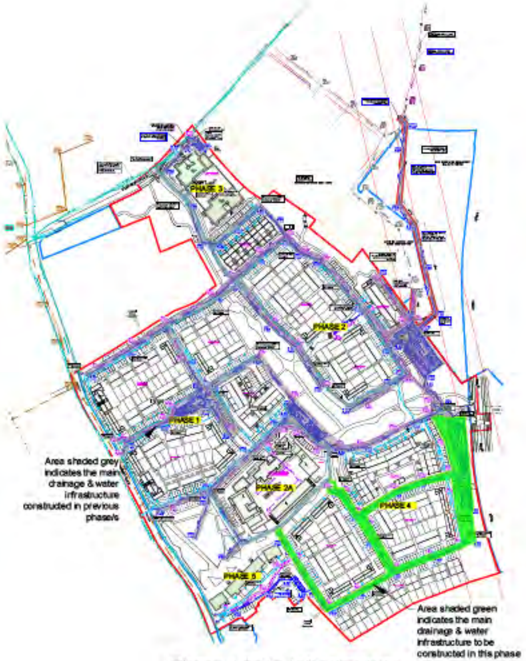
Scale 1:2500



PHASE 1
PHASE 2
PHASE 2A
PHASE 3
PHASE 4
PHASE 5
Area shaded green indicates the main drainage & water infrastructure to be constructed in this phase
Area shaded grey indicates the main drainage & water infrastructure constructed in previous phase/s

Phase 3 Main Infrastructure

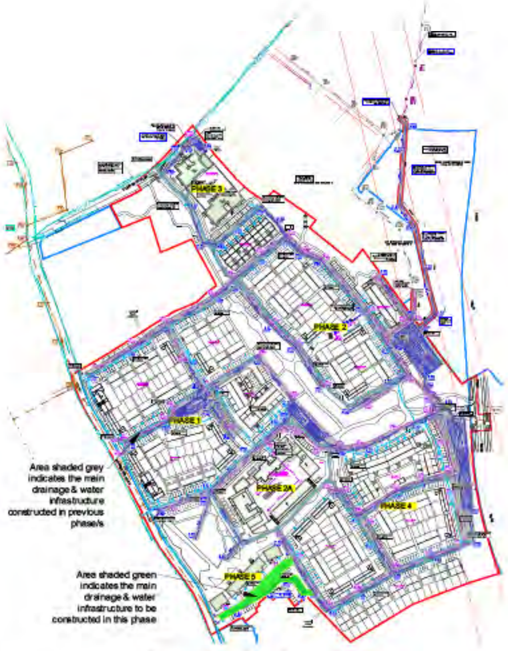
Scale 1:2500



PHASE 1
PHASE 2
PHASE 2A
PHASE 3
PHASE 4
PHASE 5
Area shaded grey indicates the main drainage & water infrastructure constructed in previous phase/s
Area shaded green indicates the main drainage & water infrastructure to be constructed in this phase

Phase 4 Main Infrastructure

Scale 1:2500



PHASE 1
PHASE 2
PHASE 2A
PHASE 3
PHASE 4
PHASE 5
Area shaded grey indicates the main drainage & water infrastructure constructed in previous phase/s
Area shaded green indicates the main drainage & water infrastructure to be constructed in this phase

Phase 5 Main Infrastructure

Scale 1:2500

A1 Scale 1:750 0m 10m 20m 30m 40m 50m 100m

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NOTES:

Notes:

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6. The Engineer is to be informed of discrepancies that may arise before the contractor commences any site development works. If in doubt - ask
7. Refer to individual SW & Foul drainage sheets (No.'s 2104/03-07) for greater detail of general arrangements at 1:500 scale.

REV	DATE	DESCRIPTION

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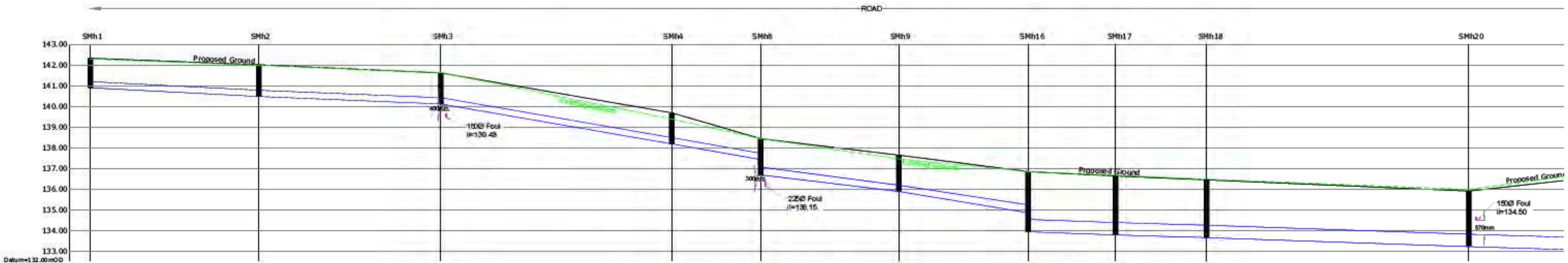
Project

Kilternan Village

Drawing Title				Architect	
Water & Drainage Phasing				MCORM Architects	
Date	**Drawn By**	**Scales**	**Dwg.No.**	**Stage**	**Rev**
May'22	RM	1:1000 @A1	2104/18	PLANNING D1	



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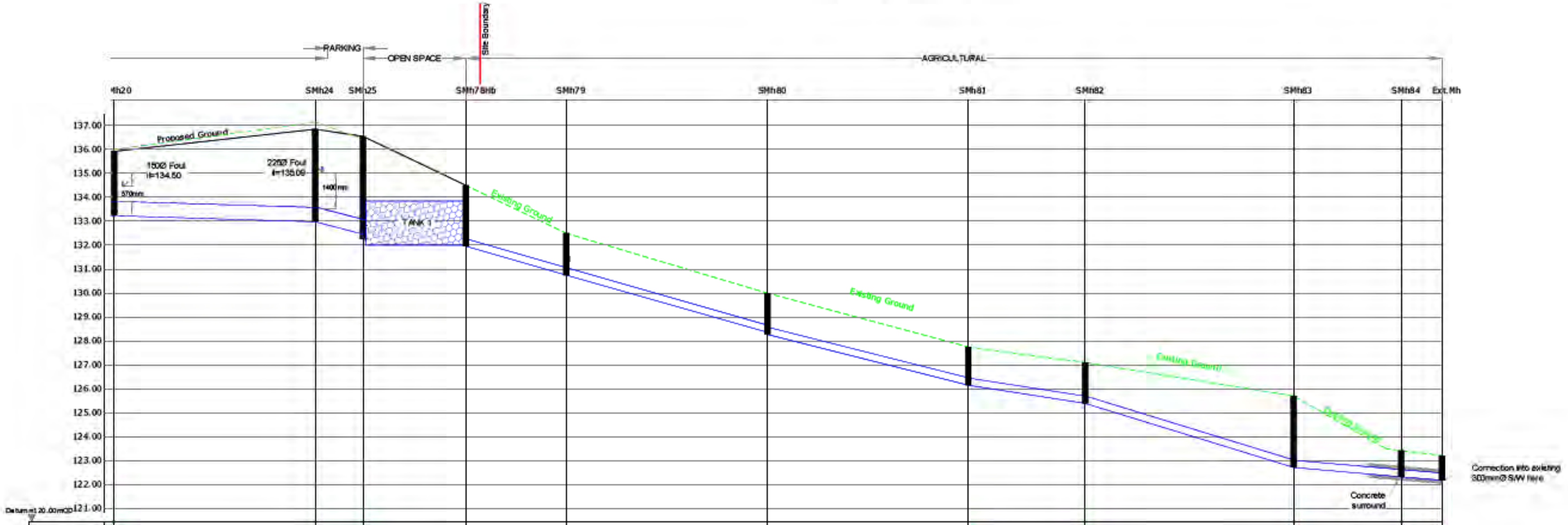
Proposed Cover Levels	142.35		142.02		141.63		139.70		138.48		137.78		136.86		136.65		136.46		135.92	
Proposed Invert Levels	140.91	1.000	140.49	1.001	140.13	1.002	138.20	1.003	137.44 136.70	1.004	135.90	1.005	134.87 133.96	1.006	133.80	1.007	133.67	1.008	133.26	1.0
Pipe Length		40.7m		44.0m		55.60m		21.5m		33.5m		32.0m		21.0m		21.0m		63.5m		42.
Pipe Size & Gradient		300Ø @ 1/96		300Ø @ 1/121		300Ø @ 1/29		300Ø @ 1/29		375Ø @ 1/41		375Ø @ 1/31		600Ø @ 1/139		600Ø @ 1/144		600Ø @ 1/162		600Ø @ 1/15

S/W Longitudinal Section
SMh1 to SMh20

Vertical Scale 1:100
Horizontal Scale 1: 500



Existing Levels	[illegible]		[illegible]		[illegible]		134.50		132.50		130.00		127.75		127.70		125.70		123.50		123.21
Proposed Cover Levels	135.92		136.85		136.55		134.50		132.50		130.00		127.75		127.70		125.70		123.50		123.21
Proposed Invert Levels	133.26	1.009	132.98	1.010	132.46 132.25		131.60	1.012	130.53	1.013	128.36 128.27	1.014	126.15	1.015	125.39	1.016	122.71	1.017	122.32	1.018	122.18 121.26
Pipe Length		42.0m		10.0m				22.0m		42.0m		42.0m		24.5m		48.5m		22.5m		8.5m	
Pipe Size & Gradient		600Ø @ 1/152		600Ø @ 1/20		TANK 1		300Ø @ 1/20		300Ø @ 1/20		300Ø @ 1/25		300Ø @ 1/32		300Ø @ 1/20		300Ø @ 1/56		300Ø @ 1/60	

S/W Longitudinal Section
SMh20 to Outfall

Vertical Scale 1:100
Horizontal Scale 1: 500

Notes

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7. Manholes and road gully details to comply with Greater Dublin Regional Code of practice for Drainage Works.
8. Refer also to the Manhole details drawing/s provided for further information.
9. Where cover to pipes is less than 1.2m in roads, 1.0m in public areas and 0.9m in grassed/landscaped areas surround the pipe 150mm of concrete.

THIS IS A PLANNING DRAWING ONLY
AND CANNOT BE USED FOR CONSTRUCTION PURPOSES

REFER TO Dwg.No.2104/03-05 FOR
PLAN ALIGNMENT OF S/W SEWER
SHOWN ON THIS DRAWING

REV	DATE	DESCRIPTION

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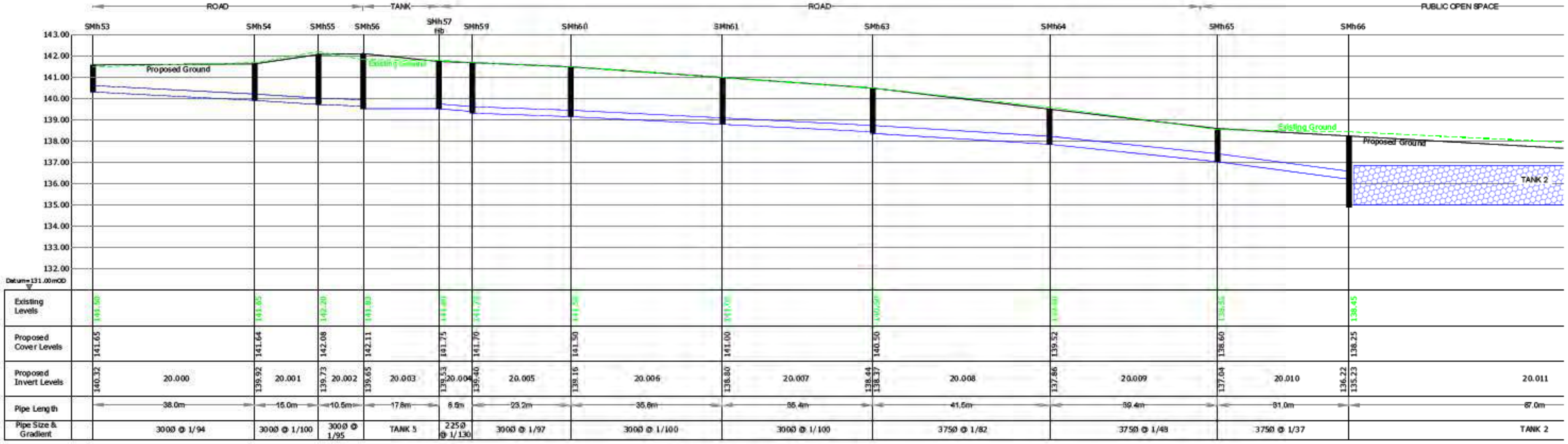
Project
Kilternan Village

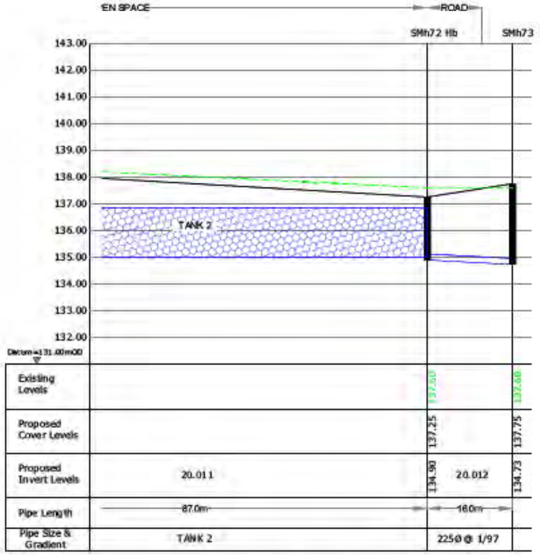
Drawing Title
S/W LONGITUDINAL SECTIONS- Sheet 1

Architect
MCORM Architects

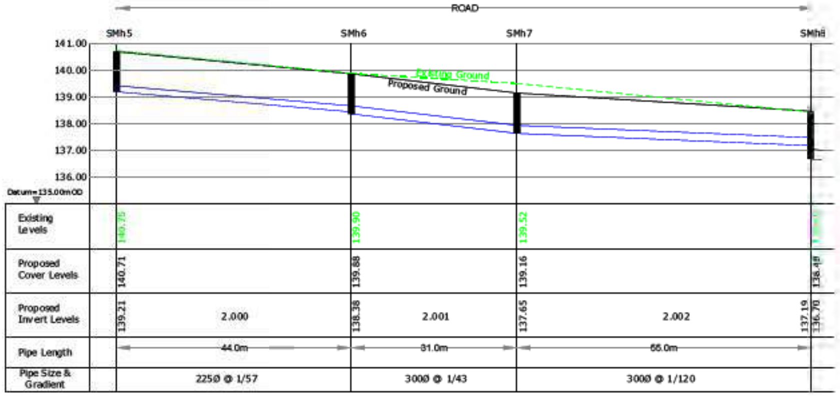
Date	Drawn By	Scales	Dwg No.	Stage	Rev
Oct'21	RM	As Shown @A1	2104/23	PLANNING D1	



S/W Longitudinal Section
SMh53 to SMh66/Tank 2
Vertical Scale 1:100
Horizontal Scale 1:500



S/W Longitudinal Section
Tank 2 to SMh73
Vertical Scale 1:100
Horizontal Scale 1:500



S/W Longitudinal Section
SMh5 to SMh8
Vertical Scale 1:100
Horizontal Scale 1:500

Notes

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8. Refer also to the Manhole details drawing/s provided for further information.
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PLAN ALIGNMENT OF S/W SEWER
SHOWN ON THIS DRAWING

REV	DATE	DESCRIPTION

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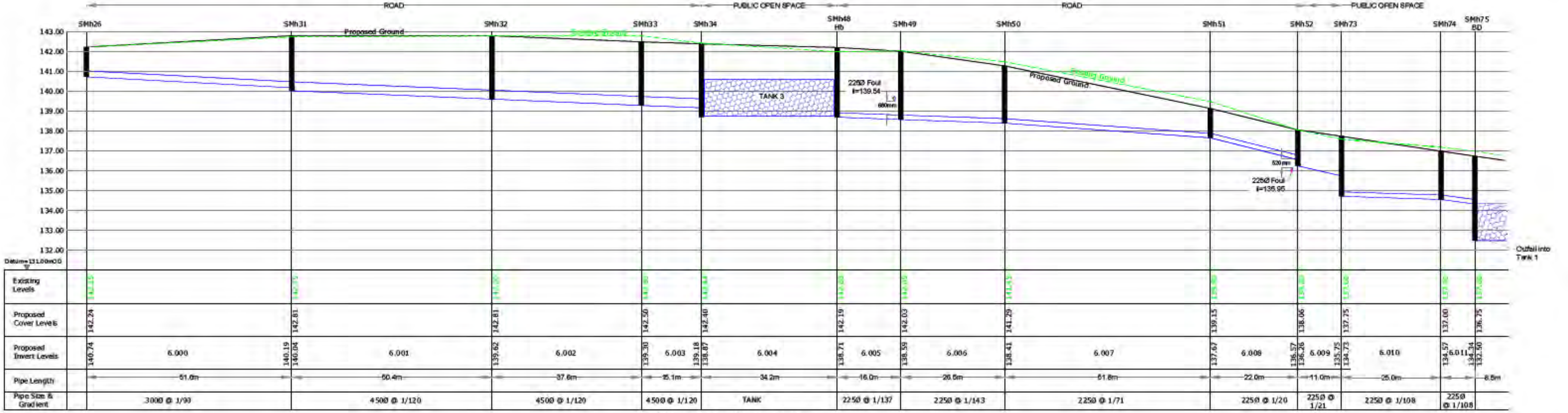
Project
Kilternan Village

Drawing Title
S/W LONGITUDINAL SECTIONS- Sheet 2

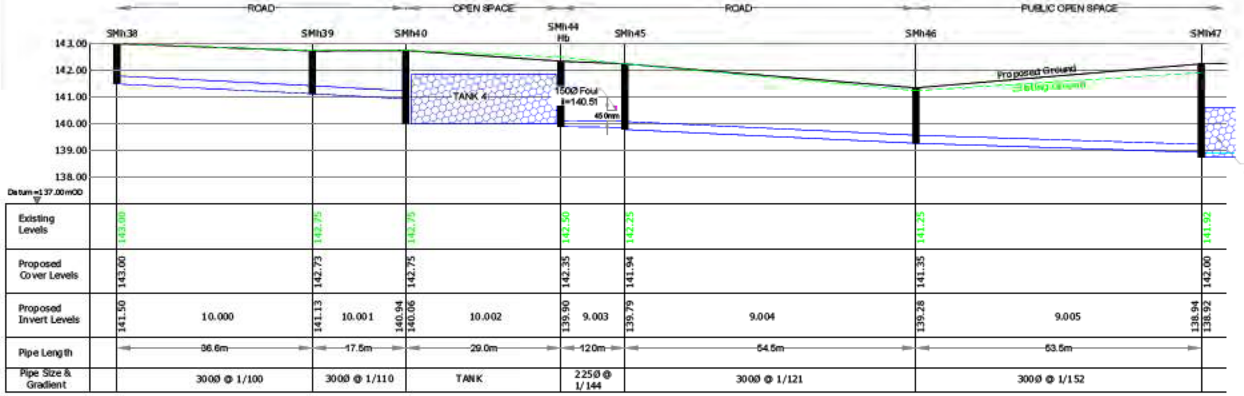
Architect
MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
Oct'21	RM	As Shown @A1		PLANNING D1	



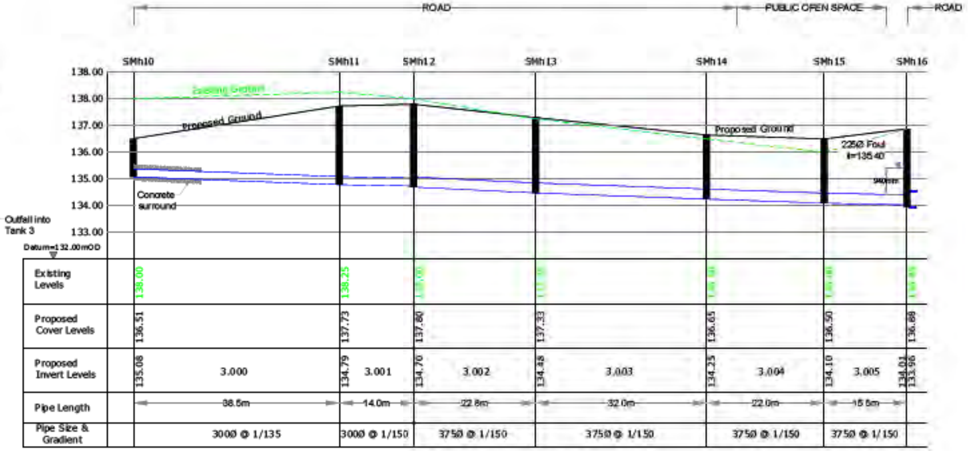
S/W Longitudinal Section
SMh26 to SMh75

Vertical Scale 1:100
Horizontal Scale 1:500



S/W Longitudinal Section
SMh38 to SMh47

Vertical Scale 1:100
Horizontal Scale 1:500



S/W Longitudinal Section
SMh10 to SMh16

Vertical Scale 1:100
Horizontal Scale 1:500

REFER TO Dwg.No.2104/03-05 FOR PLAN ALIGNMENT OF S/W SEWER SHOWN ON THIS DRAWING

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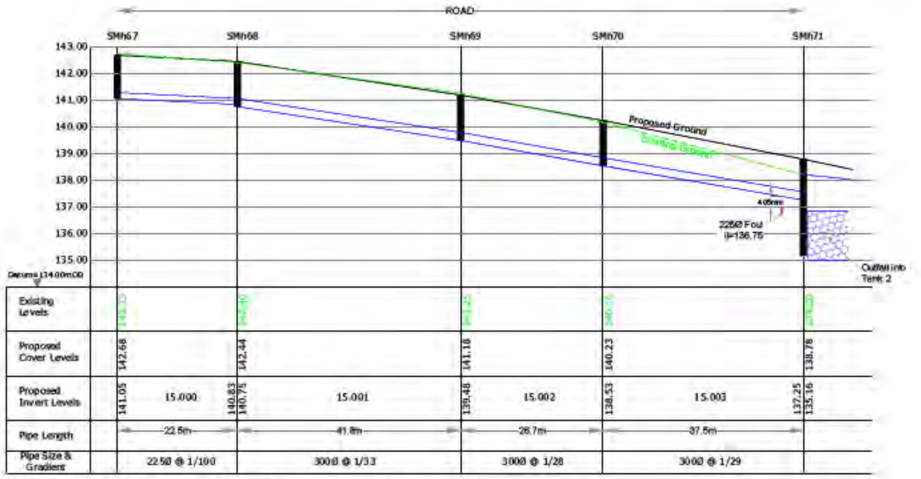
Project
Kilternan Village

Drawing Title
S/W LONGITUDINAL SECTIONS- Sheet 3

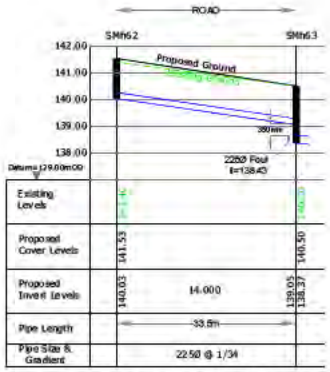
Architect
MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
Oct'21	RM	As Shown @A1	2104/25	PLANNING D1	



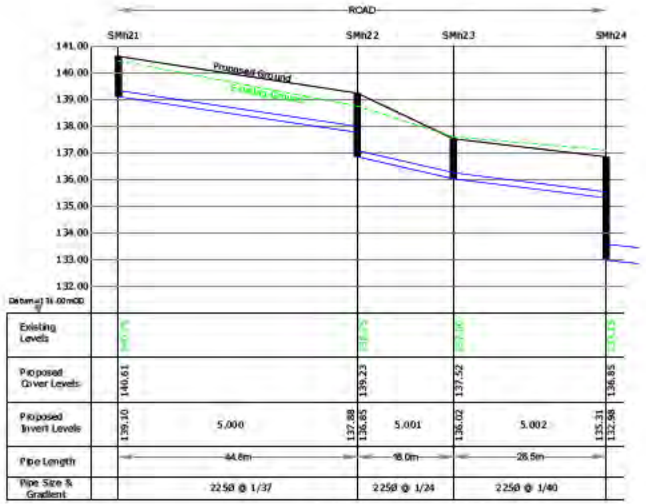
S/W Longitudinal Section SMh67 to SMh71

Vertical Scale 1:100
Horizontal Scale 1:500



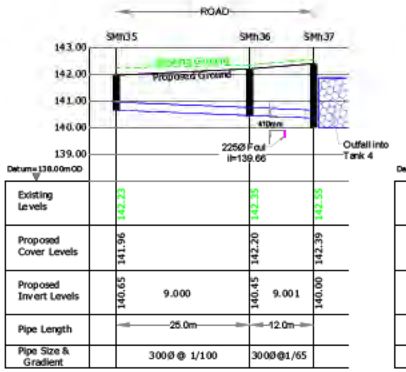
S/W Longitudinal Section SMh62 to SMh63

Vertical Scale 1:100
Horizontal Scale 1:500



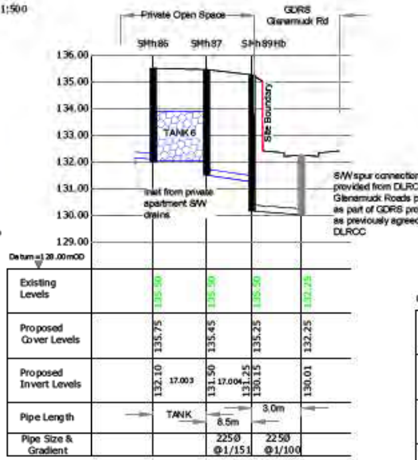
S/W Longitudinal Section SMh21 to SMh24

Vertical Scale 1:100
Horizontal Scale 1:500



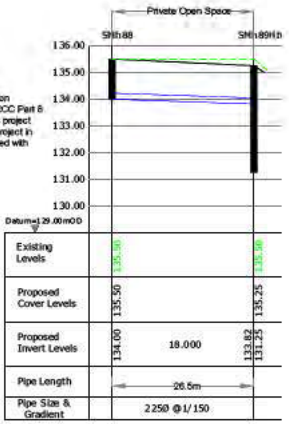
S/W Longitudinal Section SMh35 to SMh37

Vertical Scale 1:100
Horizontal Scale 1:500



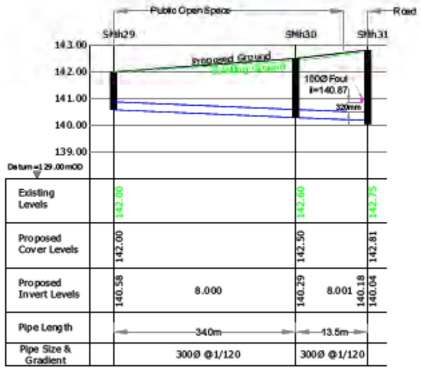
S/W Longitudinal Section SMh86 to Outfall

Vertical Scale 1:100
Horizontal Scale 1:500



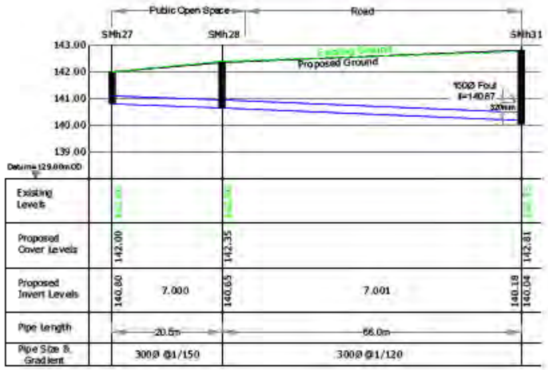
S/W Longitudinal Section SMh88 to SMh89Hb

Vertical Scale 1:100
Horizontal Scale 1:500



S/W Longitudinal Section SMh29 to SMh31

Vertical Scale 1:100
Horizontal Scale 1:500



S/W Longitudinal Section SMh27 to SMh31

Vertical Scale 1:100
Horizontal Scale 1:500

REFER TO Dwg.No.2104/03-05 FOR
PLAN ALIGNMENT OF S/W SEWER
SHOWN ON THIS DRAWING

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REV	DATE	DESCRIPTION

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Project
Kilternan Village

Drawing Title				Architect	
S/W LONGITUDINAL SECTIONS- Sheet 4				MCORM Architects	
Date	Drawn By	Scales	Dwg.No.	Stage	Rev
Oct'21	RM	As Shown @A1	2104/26	PLANNING D1	

Appendix B Site Layout with Stage 1 Audit Findings

NOTES:

Notes:

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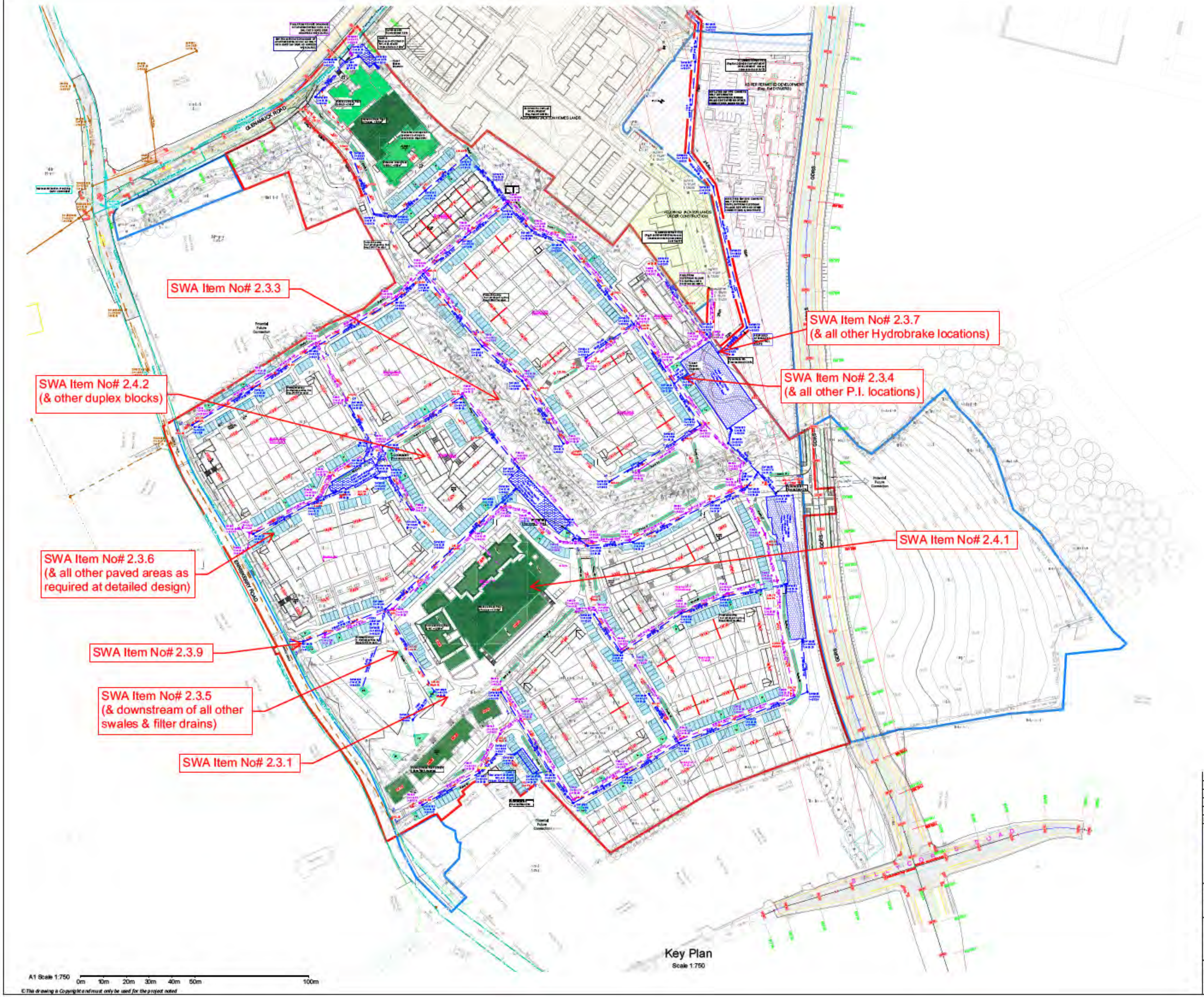

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REV	DATE	DESCRIPTION

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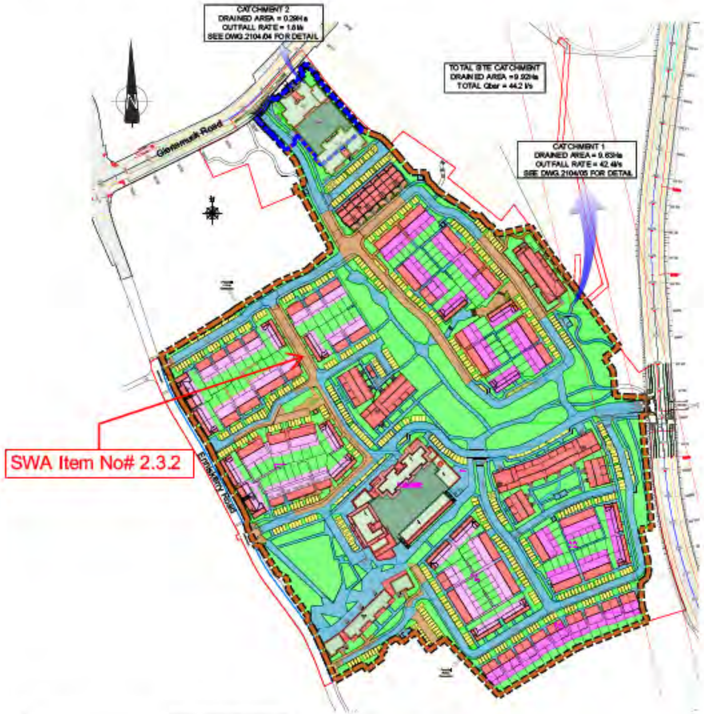
Project
Kilternan Village

Drawing Title
Drainage Masterplan

Architect
MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
May'22	RM	1:1000 @A1	2104/08	PLANNING D1	

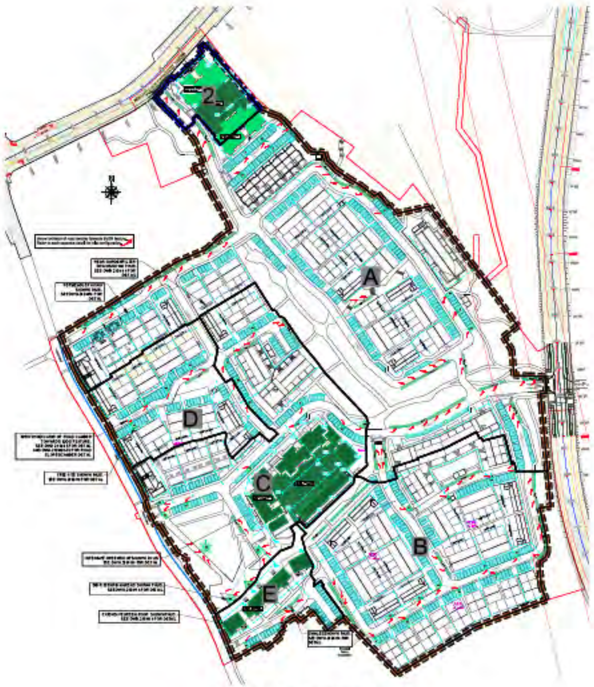


Paved Areas
Scale 1:2000

Paved Areas Summary	Impermeability Percentage (%)	Gross Area (Ha)	Net Area (Ha)
🟥 Roofs to drains	100%	1.36	1.36
🟧 Roads/Paths to drains	95%	0.68	0.65
▭ Green Roof - Extensive	92%	0.34	0.32
🟩 Green Roof - Intensive	85%	0.23	0.20
🟦 Roads/Paths via SuDS	71%	2.29	1.63
🟪 Rear Roofs via SuDS	70%	1.16	0.82
🟨 Permeable Paving	60%	0.72	0.43
🟩 Grassland	37%	3.13	1.16
	Total	9.92	6.55
	Net Impermeable Area		6.6

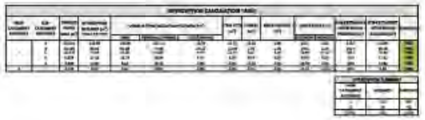
Qbar & Attenuation Storage Summary

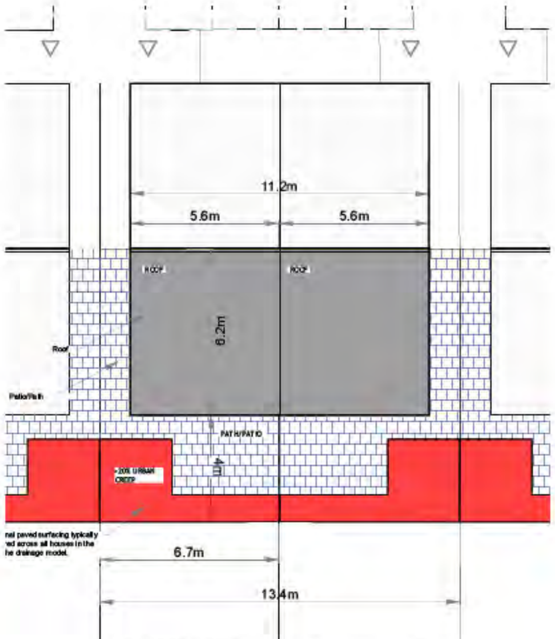
CATCHMENT	GROSS AREA	NET DRAINED AREA	APPLIED QBar	Q100+10% STORAGE PROVIDED
TOTAL	10.7Ha	9.92 Ha	44.2 l/s	4,000m³
1		9.63Ha	42.4 l/s	3,873m³
2		0.29Ha	1.85 l/s	128m³



SuDS Interception
Scale 1:2000

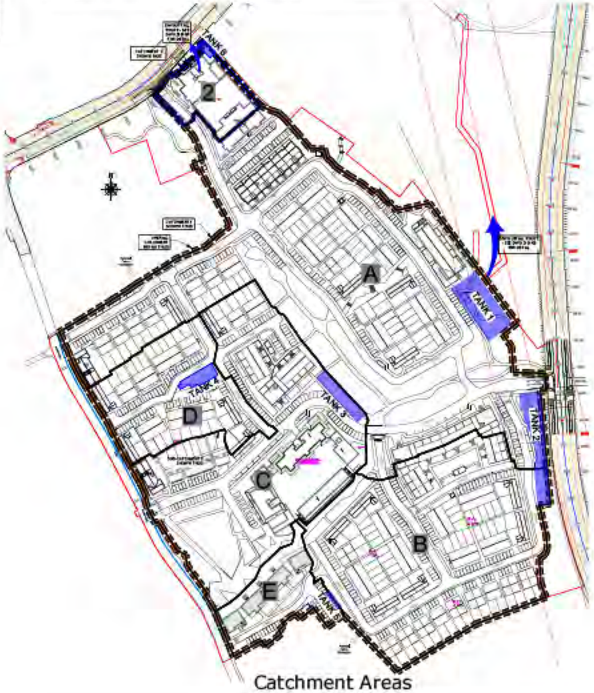
	AREA	Qbar
TOTAL DRAINED SITE AREA	9.92Ha	44.2 l/s
CATCHMENT 1 DRAINED AREA	9.63 Ha	42.4 l/s
CATCHMENT 2 DRAINED AREA	0.29 Ha	1.8l/s





URBAN CREEP CALCULATION
REAR ROOF AREA TO TYPICAL 1No.HOUSE = (6.2x5.6) = 37.72m²
PATH AND PATIO TO SIDE & REAR = (0.9x6.2) + (0.9x2.7) + (4x3) = 20.01m²
TOTAL AREA OF ROOF & PATIO/PATHS = 57.73m²
ADDITIONAL PAVED AREA INCLUDED IN MICRODRAINAGE CALCULATIONS = 12.43m²
12.43/57.73 x 100 = 21.5% INCREASE IN AREA ALLOWED FOR IN MODEL > 10% REQUIRED
NOTE - THE ADDITIONAL STRIP OF PAVED AREA IS APPLIED ACROSS ALL HOUSES IRRESPECTIVE IF THEY ARE TERRACED DWELLINGS WITH NO SIDE PASSAGE - THEREFORE THE URBAN CREEP ALLOWANCE IS GREATER STILL.

Urban Creep
Scale 1:100



Catchment Areas
Scale 1:2000

REV	DATE	DESCRIPTION

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Consulting Structural and Civil Engineers
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Project
KILTERNAN VILLAGE

Drawing Title
CATCHMENT,
INTERCEPTION,
PAVED AREAS

Architect
MCORM
Architects

Date	Drawn By	Scales	Dwg No.	Stage	Rev
May'22	RM	As Shown	2104/13	PLANNING D1	

Appendix C Storm Water Audit Feedback Form

STORM WATER AUDIT FEEDBACK FORM

Scheme: Proposed Residential Development at: Kilternan Village

Area: Residential

Audit Stage: 1 **Date Audit Completed:** 25/05/2022 **Our Ref:** 222181

Paragraph No. in Audit Report	Problem Accepted (Yes/No)	Recommended Measure Accepted (Yes/No)	Alternative Measures (described) [or reason problem not accepted]	Alternative Measures Accepted by Auditors (Yes/No)
2.1.4	YES		Crossings have been checked and sections of same are visible on Dwg.No.'s 2104/23-30	
2.1.5	YES		The S/W outfall pipe passes through lands in the applicants ownership, but where they are not in the applicants ownership letters of consent from the 3rd party landowner and a wayleave through same.	
2.3.1	YES		Permeable paved surfacing has been increased to the road west of the Neighbourhood Centre and the paving surrounding same. Refer to the attached Sk1 highlighting same. Noting also that the Village Green paving is also permeable surfacing. The paths through the parklands are gravel surfaces. Refer to the landscape architects drawing No.RMDA 1609-DwgNo.1 included with this response for further clarification.	
2.3.2	YES		The surface area of permeable paving has been increased as described in 2.3.1 above.	

STORM WATER AUDIT FEEDBACK FORM

Paragraph No. in Audit Report	Problem Accepted (Yes/No)	Recommended Measure Accepted (Yes/No)	Alternative Measures (described) [or reason problem not accepted]	Alternative Measures Accepted by Auditors (Yes/No)
2.3.3		NO	The use of detention basin/s in the central tree belt is not feasible due to the limited space available outside the arborist specified tree root constraint zone and the prohibition of excavations within same – refer to Sk2 included in this response for illustration of same. The depth of the incoming drainage below the road surface doe not permit a open detention basin for reasons of safety or viability. The central tree belt is a strong bio-diversity benefit to the scheme and promotion of minimal intervention in this area is recommended by both the project landscape architect and arborist. The use of detention basins elsewhere are constrained virtue of the steep topography to the east. It is noted that the Village Green to the west of the site is at the head of the catchment and is therefore an inappropriate location.	Yes
2.3.4	YES		The Bypass Interceptors proposed are in accordance with the manufacturers recommendations based on the calculated flowrates from the drainage model results. Refer to Sk3 included in this response submission for greater detail of same.	
2.3.5	YES		Silt trap chambers are to included on the downstream end of swales and filter drains as recommended.	
2.3.6	YES		CBR testing to be carried out as part of the at the detailed design for construction stage.	
2.3.7	YES		The Hydrobrake orifices are noted in the Microdrainage calculations and highlighted on Sk4 included in this response submission. The orifice diameters range from 72mm to 262mm	
2.3.8	YES		Both podium areas have a detailed landscaping plan which are compatible as Intensive Green Roofs. Refer to the attached landscape architect drawing No.RMDA 1609-Dwg.No.1.	

STORM WATER AUDIT FEEDBACK FORM

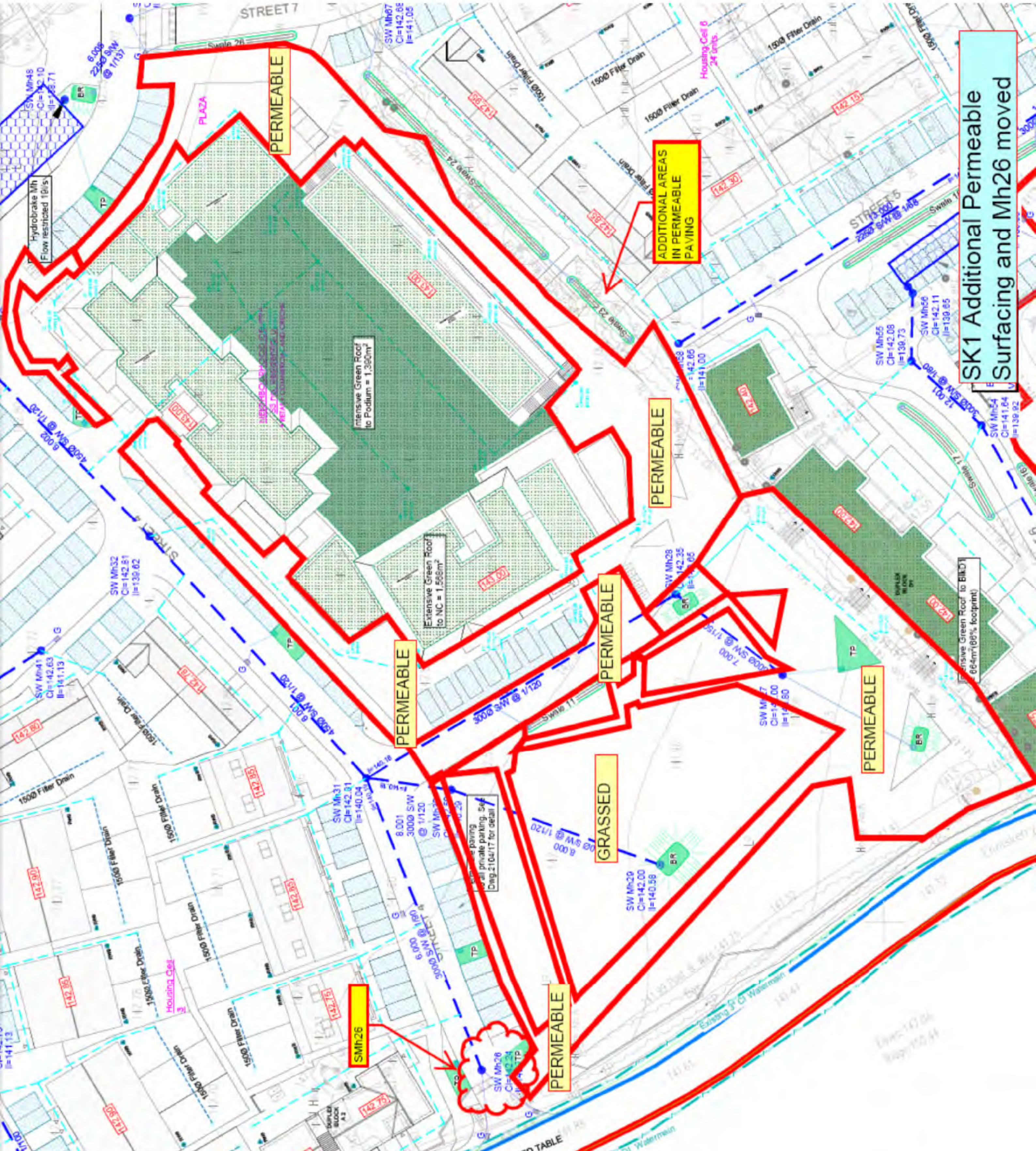
Paragraph No. in Audit Report	Problem Accepted (Yes/No)	Recommended Measure Accepted (Yes/No)	Alternative Measures (described) [or reason problem not accepted]	Alternative Measures Accepted by Auditors (Yes/No)
2.3.9	YES		SMh26 has been moved as noted. See Sk4 included in this response submission. Refer to Sk1 included in this response submission for greater detail of same.	
2.4.1	YES		The green roof is to be set back from roof over-runs/access points and there is no M+E plant/solar designed/intended for the roof areas.	
2.4.2		NO	Rainwater harvesting is not proposed for duplex units due to the applicants concerns relating to a lack of management and maintenance responsibility relating to same and the limited public space available to include such. Given that the residential units are to be fitted with water saving tap valves, eco-flush toilet systems, water saving appliances and as there are already c.170No.rainwater butts included in the design, it is proposed that there is more that sufficient amount of water saving features in the scheme.	Yes

Signed: **Design Team Project Manager** **Date:25/05/22**

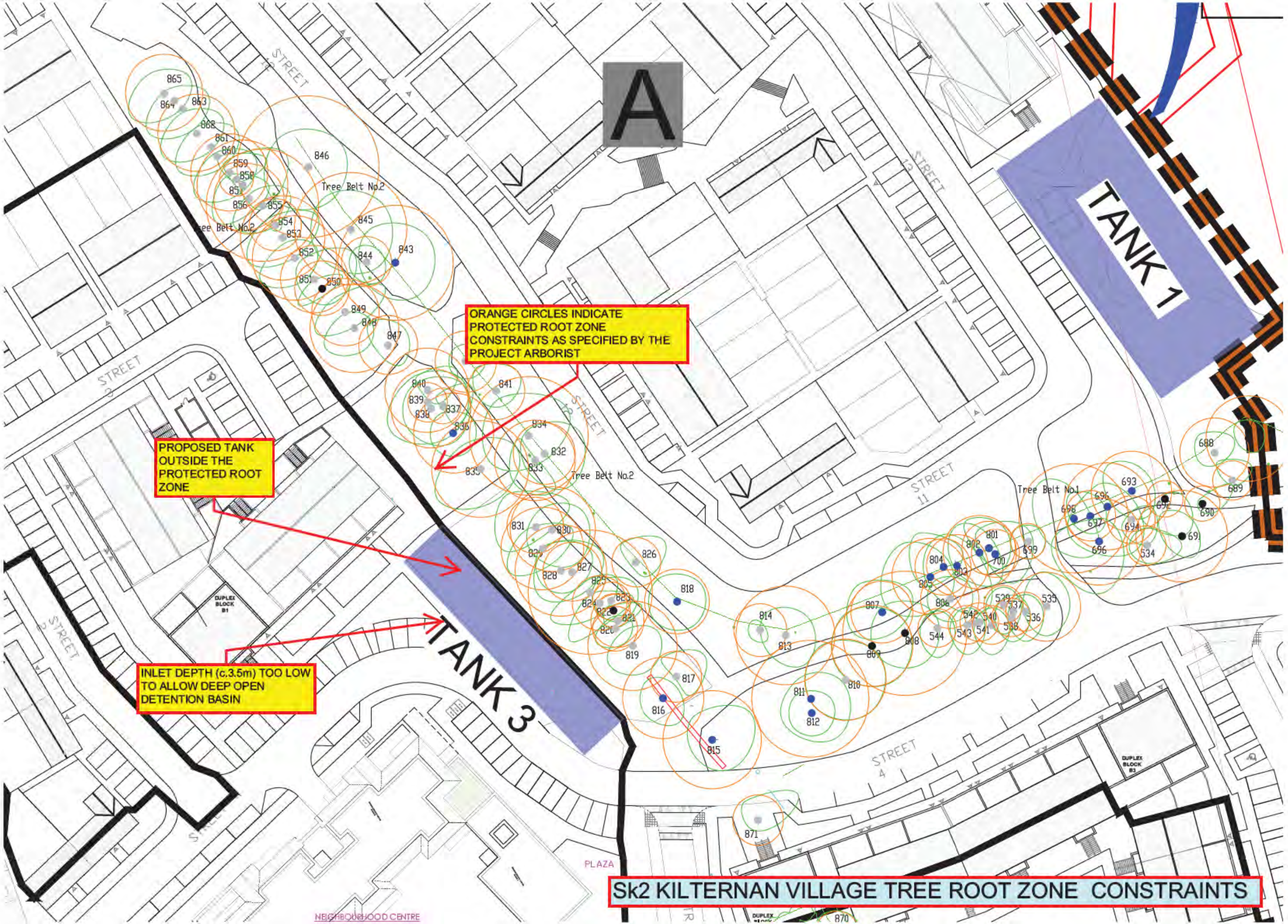
Please complete and return to the auditor

Auditor Signed Off: **Date:** 30/05/22

SK1 Additional Permeable Surfacing and Mh26 moved



Sk2 KILTERNAN VILLAGE TREE ROOT ZONE CONSTRAINTS

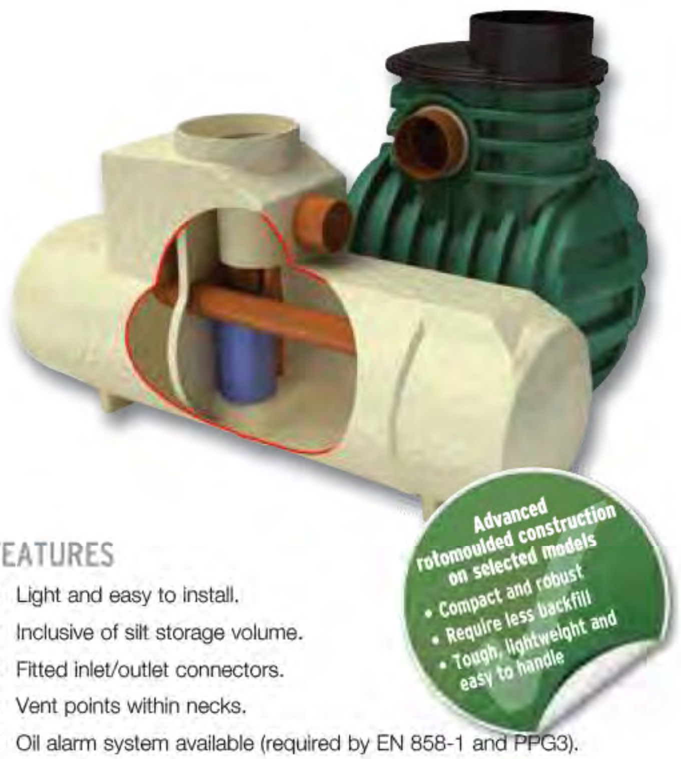


ORANGE CIRCLES INDICATE PROTECTED ROOT ZONE CONSTRAINTS AS SPECIFIED BY THE PROJECT ARBORIST

PROPOSED TANK OUTSIDE THE PROTECTED ROOT ZONE

INLET DEPTH (c.3.5m) TOO LOW TO ALLOW DEEP OPEN DETENTION BASIN

Bypass NSB RANGE


Advanced rotomoulded construction on selected models
• Compact and robust
• Require less backfill
• Tough, lightweight and easy to handle

APPLICATION

Bypass separators are used when it is considered an acceptable risk not to provide full treatment, for very high flows, and are used, for example, where the risk of a large spillage and heavy rainfall occurring at the same time is small, e.g.

- Surface car parks.
- Roadways.
- Lightly contaminated commercial areas.

PERFORMANCE

Klargester were one of the first UK manufacturers to have separators tested to EN 858-1. Klargester have now added the NSB bypass range to their portfolio of certified and tested models. The NSB number denotes the maximum flow at which the separator treats liquids. The British Standards Institute (BSI) tested the required range of Kingspan Klargester Bypass separators and certified their performance in relation to their flow and process performance assessing the effluent qualities to the requirements of EN 858-1. Klargester bypass separator designs follow the parameters determined during the testing of the required range of bypass separators.

Each bypass separator design includes the necessary volume requirements for:

- Oil separation capacity.
- Silt storage capacity.
- Oil storage volume.
- Coalescer.

The unit is designed to treat 10% of peak flow. The calculated drainage areas served by each separator are indicated according to the formula given by PPG3 NSB = 0.0018A(m2). Flows generated by higher rainfall rates will pass through part of the separator and bypass the main separation chamber.

Class I separators are designed to achieve a concentration of 5mg/litre of oil under standard test conditions.

FEATURES

- Light and easy to install.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.
- Vent points within necks.
- Oil alarm system available (required by EN 858-1 and PPG3).
- Extension access shafts for deep inverts.
- Maintenance from ground level.
- GRP or rotomoulded construction (subject to model).

To specify a nominal size bypass separator, the following information is needed:-

- The calculated flow rate for the drainage area served. Our designs are based on the assumption that any interconnecting pipework fitted elsewhere on site does not impede flow into or out of the separator and that the flow is not pumped.
- The drain invert inlet depth.
- Pipework type, size and orientation.

Catchment Area "2"-Tank 6

SIZES AND SPECIFICATIONS

UNIT NOMINAL SIZE	FLOW (l/s)	PEAK FLOW RATE (l/s)	DRAINAGE AREA (m²)	STORAGE CAPACITY (litres) SILT	OIL	UNIT LENGTH (mm)	UNIT DIA. (mm)	ACCESS SHAFT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT	STANDARD FALL ACROSS (mm)	MIN. INLET INVERT (mm)	STANDARD PIPEWORK DIA.
NSBP003	3	30	1670	300	45	1700	1350	600	1420	1320	100	500	160
NSBP004	4.5	45	2500	450	60	1700	1350	600	1420	1320	100	500	160
NSBP006	6	60	3335	600	90	1700	1350	600	1420	1320	100	500	160
NSBE010	10	100	5560	1000	150	2069	1220	750	1450	1350	100	700	315
NSBE015	15	150	8335	1500	225	2947	1220	750	1450	1350	100	700	315
NSBE020	20	200	11111	2000	300	3893	1220	750	1450	1350	100	700	375
NSBE025	25	250	13890	2500	375	3575	1420	750	1680	1580	100	700	375
NSBE030	30	300	16670	3000	450	4265	1420	750	1680	1580	100	700	450
NSBE040	40	400	22222	4000	600	3230	1920	600	2185	2035	150	1000	500
NSBE050	50	500	27778	5000	750	3960	1920	600	2185	2035	150	1000	600
NSBE075	75	750	41667	7500	1125	5841	1920	600	2235	2035	200	950	675
NSBE100	100	1000	55556	10000	1500	7661	1920	600	2235	2035	200	950	750
NSBE125	125	1250	69444	12500	1875	9548	1920	600	2235	2035	200	950	750

Catchment Area "A"-Tank 1

🟩 Rotomoulded chamber construction ☐ GRP chamber construction * Some units have more than one access shaft – diameter of largest shown.

SK3 - Bypass Inteceptors

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S44, DS/PN: S9.003, Volume (m³): 8.7

Unit Reference	MD-SHE-0088-4000-1450-4000
Design Head (m)	1.450
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	88
Invert Level (m)	139.920
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.450	4.0	Kick-Flo®	0.786	3.0
Flush-Flo™	0.385	3.8	Mean Flow over Head Range	-	3.4

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)
0.100	2.7	1.200	3.7	3.000	5.6	7.000	8.4
0.200	3.5	1.400	3.9	3.500	6.0	7.500	8.6
0.300	3.7	1.600	4.2	4.000	6.4	8.000	8.9
0.400	3.8	1.800	4.4	4.500	6.8	8.500	9.2
0.500	3.7	2.000	4.6	5.000	7.1	9.000	9.4
0.600	3.6	2.200	4.9	5.500	7.5	9.500	9.7
0.800	3.0	2.400	5.1	6.000	7.8		
1.000	3.4	2.600	5.2	6.500	8.1		

Hydro-Brake® Optimum Manhole: S48, DS/PN: S6.005, Volume (m³): 17.9

Unit Reference	MD-SHE-0207-2500-1850-2500
Design Head (m)	1.850
Design Flow (l/s)	25.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	207
Invert Level (m)	138.708
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.850	25.0	Kick-Flo®	1.178	20.2
Flush-Flo™	0.546	25.0	Mean Flow over Head Range	-	21.7

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

SK4/1 - Orifice Diameters

Hydro-Brake® Optimum Manhole: S48, DS/PN: S6.005, Volume (m³): 17.9

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.1	1.200	20.3	3.000	31.5	7.000	47.4
0.200	19.8	1.400	21.9	3.500	33.9	7.500	49.0
0.300	23.5	1.600	23.3	4.000	36.2	8.000	50.6
0.400	24.6	1.800	24.7	4.500	38.3	8.500	52.1
0.500	25.0	2.000	25.9	5.000	40.3	9.000	53.5
0.600	25.0	2.200	27.1	5.500	42.2	9.500	55.0
0.800	24.4	2.400	28.3	6.000	44.0		
1.000	23.0	2.600	29.4	6.500	45.7		

Hydro-Brake® Optimum Manhole: S57, DS/PN: S12.004, Volume (m³): 5.8

Unit Reference	MD-SHE-0058-2000-1850-2000
Design Head (m)	1.850
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	58
Invert Level (m)	139.532
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.850	2.0	Kick-Flo®	0.519	1.1
Flush-Flo™	0.255	1.4	Mean Flow over Head Range	-	1.5

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)
0.100	1.2	1.200	1.6	3.000	2.5	7.000	3.7
0.200	1.4	1.400	1.8	3.500	2.7	7.500	3.8
0.300	1.4	1.600	1.9	4.000	2.8	8.000	3.9
0.400	1.3	1.800	2.0	4.500	3.0	8.500	4.1
0.500	1.2	2.000	2.1	5.000	3.2	9.000	4.2
0.600	1.2	2.200	2.2	5.500	3.3	9.500	4.3
0.800	1.4	2.400	2.3	6.000	3.4		
1.000	1.5	2.600	2.3	6.500	3.6		

Hydro-Brake® Optimum Manhole: S72, DS/PN: S12.012, Volume (m³): 26.0

Unit Reference	MD-SHE-0072-3000-1850-3000
Design Head (m)	1.850
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	72
Invert Level (m)	134.897
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

SK4/2 - Orifice Diameters

Hydro-Brake® Optimum Manhole: S72, DS/PN: S12.012, Volume (m³): 26.0

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.850	3.0	Kick-Flo®	0.637	1.8
Flush-Flo™	0.312	2.3	Mean Flow over Head Range	-	2.3

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)
0.100	1.9	1.200	2.5	3.000	3.7	7.000	5.6
0.200	2.2	1.400	2.6	3.500	4.0	7.500	5.8
0.300	2.3	1.600	2.8	4.000	4.3	8.000	5.9
0.400	2.3	1.800	3.0	4.500	4.5	8.500	6.1
0.500	2.2	2.000	3.1	5.000	4.8	9.000	6.3
0.600	2.0	2.200	3.2	5.500	5.0	9.500	6.4
0.800	2.0	2.400	3.4	6.000	5.2		
1.000	2.3	2.600	3.5	6.500	5.4		

Hydro-Brake® Optimum Manhole: S77, DS/PN: S1.012, Volume (m³): 21.9

Unit Reference	MD-SHE-0263-4240-1850-4240
Design Head (m)	1.850
Design Flow (l/s)	42.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	263
Invert Level (m)	131.650
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.850	42.2	Kick-Flo®	1.233	34.8
Flush-Flo™	0.564	42.2	Mean Flow over Head Range	-	36.3

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)
0.100	8.4	1.200	35.9	3.000	53.3	7.000	80.4
0.200	27.1	1.400	37.0	3.500	57.5	7.500	83.2
0.300	39.5	1.600	39.4	4.000	61.3	8.000	85.9
0.400	41.4	1.800	41.7	4.500	64.9	8.500	88.4
0.500	42.1	2.000	43.9	5.000	68.3	9.000	90.9
0.600	42.2	2.200	45.9	5.500	71.5	9.500	93.4
0.800	41.4	2.400	47.9	6.000	74.6		
1.000	39.8	2.600	49.8	6.500	77.6		

Hydro-Brake® Optimum Manhole: S89, DS/PN: S17.004, Volume (m³): 5.5

Unit Reference	MD-SHE-0055-1800-1850-1800
Design Head (m)	1.850
Design Flow (l/s)	1.8

SK4/3 - Orifice Diameters

Hydro-Brake® Optimum Manhole: S89, DS/PN: S17.004, Volume (m³): 5.5

Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 55
Invert Level (m) 131.350
Minimum Outlet Pipe Diameter (mm) 75
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.850	1.8	Kick-Flo®	0.489	1.0
Flush-Flo™	0.238	1.2	Mean Flow over Head Range	-	1.3

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)
0.100	1.1	1.200	1.5	3.000	2.2	7.000	3.3
0.200	1.2	1.400	1.6	3.500	2.4	7.500	3.4
0.300	1.2	1.600	1.7	4.000	2.6	8.000	3.5
0.400	1.1	1.800	1.8	4.500	2.7	8.500	3.6
0.500	1.0	2.000	1.9	5.000	2.8	9.000	3.7
0.600	1.1	2.200	1.9	5.500	3.0	9.500	3.8
0.800	1.2	2.400	2.0	6.000	3.1		
1.000	1.4	2.600	2.1	6.500	3.2		

SK4/4 - Orifice Diameters

All Stormwater Audits must include the following table completed by the scheme designers.

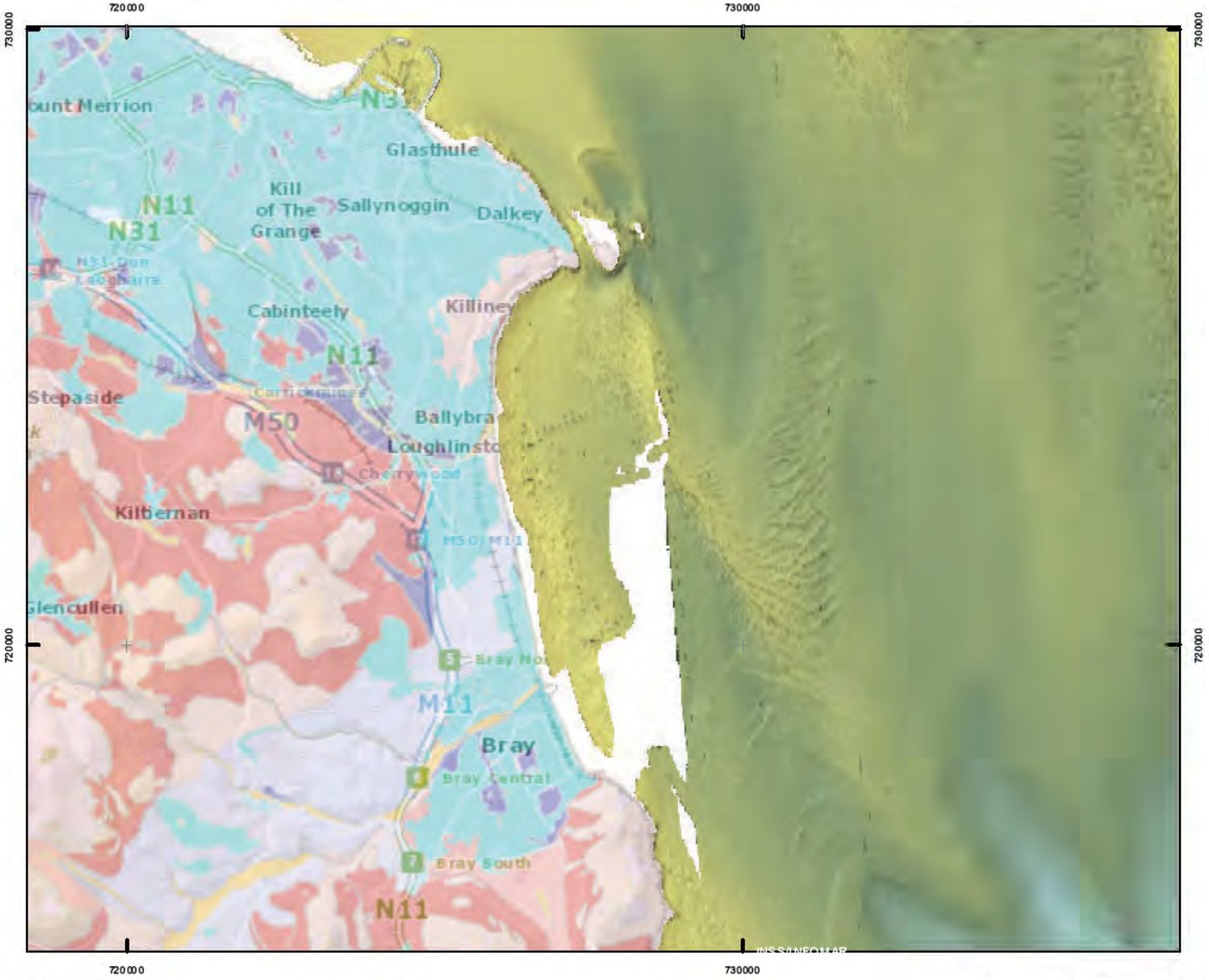
Surface Cover Type	Area (m²)
Wetland or open water (semi-natural; not chlorinated) maintained or established on site.	
Semi-natural vegetation (e.g. trees, woodland, species-rich grassland) maintained or established on site. *30sqm per tree	13,870sqm
Standard trees planted in connected tree pits with a minimum soil volume equivalent to at least two thirds of the projected canopy area of the mature tree. *20sqm per tree	6,870sqm
Standard trees planted in pits with soil volumes less than two thirds of the projected canopy area of the mature tree.	7,800sqm
Intensive green roof or vegetation over structure. Substrate minimum settled depth of 150mm.	2,849sqm
Extensive green roof with substrate of minimum settled depth of 80mm (or 60mm beneath vegetation blanket)	2,703sqm
Extensive green roof of sedum mat or other lightweight systems	
Green wall –modular system or climbers rooted in soil.	
Rain gardens and other vegetated sustainable drainage elements.	
Flower-rich perennial planting.	6,072sqm
Hedges (line of mature shrubs one or two shrubs wide). *238+1,000m (Native Hedge)	1,238sqm
Groundcover planting. *30% of flower rich perennuals	2,024sqm
Amenity grassland (species-poor, regularly mown lawn).	17,689sqm
Water features (chlorinated) or unplanted detention basins.	
Permeable paving.	7,200sqm
Sealed surfaces (e.g. concrete, asphalt, waterproofing, stone). *includes 22,900sqm to SuDS features	29,700sqm

Any assumptions (e.g. how expected tree canopy has been calculated) and which features (e.g. the type of semi-natural habitat) have been included should be noted.

Appendix 12.7

Geological Survey of Ireland & Teagasc Datasets

Geological Survey Ireland Public Data



Scale: 1:100,000

Geological Survey Ireland

PSI Licence

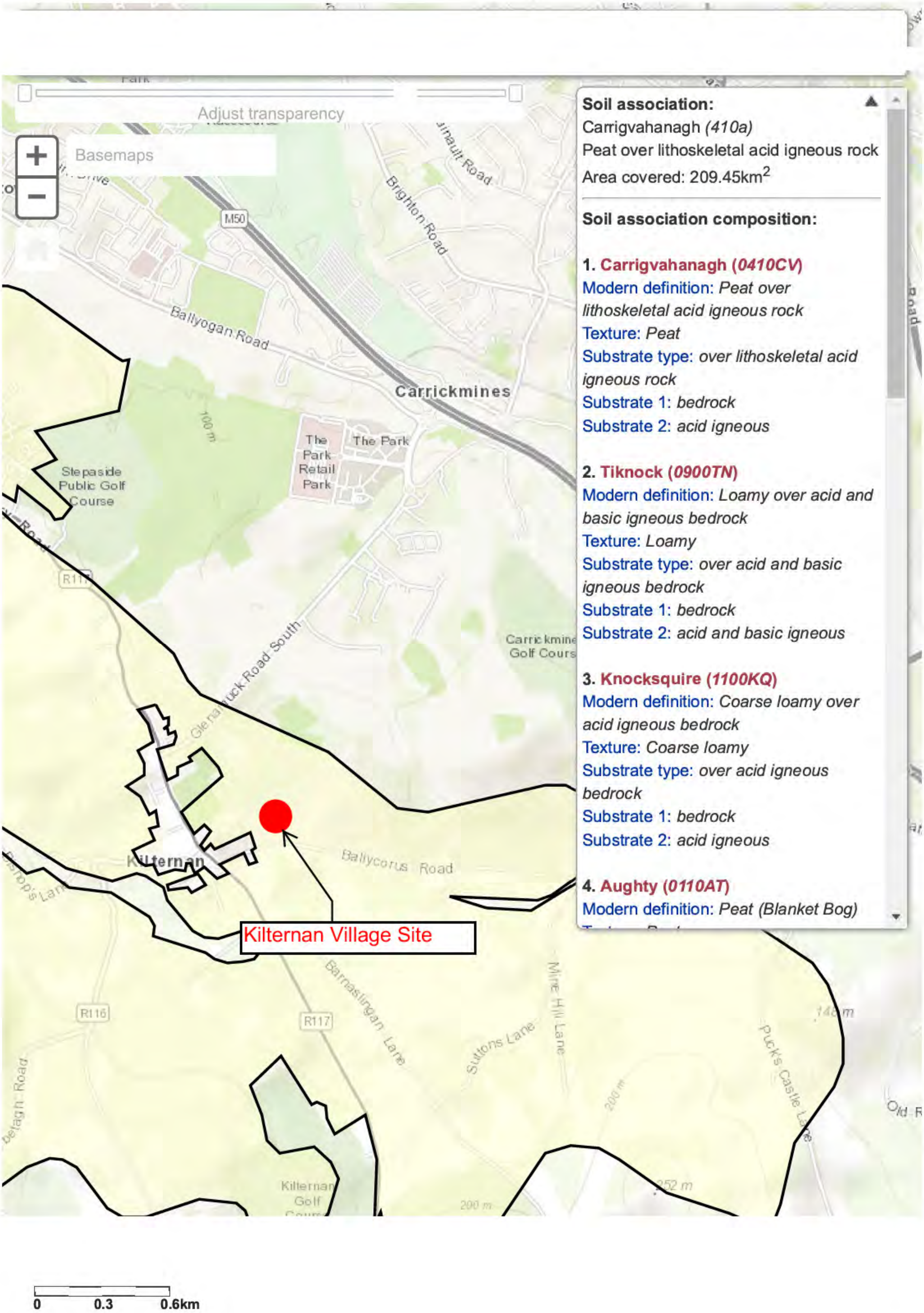
0 0.5 1 2 mi
0 1 2 4 km

Map Centre Coordinates (ITM) 727,739 722,537
4/9/2018 11:24:51 AM

Legend

Teagasc Soils

- ▨ AminDW - Deep well drained mineral (Mainly acidic)
- ▨ AminPD - Mineral poorly drained (Mainly acidic)
- ▨ AminPDPT - Peaty poorly drained mineral (Mainly acidic)
- ▨ AminSW - Shallow well drained mineral (Mainly acidic)
- ▨ AminSP - Shallow poorly drained mineral (Mainly acidic)
- ▨ AminSPPT - Shallow peaty poorly drained mineral (Mainly acidic)
- ▨ AminSRPT - Shallow, rocky, peaty/non-peatymi... complexes (Mainly acidic)
- ▨ BminDW - Deep well drained mineral (Mainly basic)
- ▨ BminPD - Mineral poorly drained (Mainly basic)
- ▨ BminPDPT - Peaty poorly drained mineral (Mainly basic)
- ▨ BminSW - Shallow well drained mineral (Mainly basic)
- ▨ BminSP - Shallow poorly drained mineral (Mainly basic)
- ▨ BminSPPT - Shallow peaty poorly drained mineral (Mainly basic)
- ▨ BminSRPT - Shallow, rocky, peaty/non-peatymi... complexes (Mainly basic)
- ▨ BktPt - Blanket peat
- ▨ FenPt - Fen peat
- ▨ RsPt - Raised Peat
- ▨ Cut - Cutover/cutaway peat
- ▨ AlluvMIN - Alluvial (mineral)
- ▨ AlluvMRL - Alluvial (marl)
- ▨ Lac - Lacustrine type soils
- ☐ Scree - Scree
- ▨ AeoUND - Aeolian undifferentiated
- ▨ MarSands - Marine sand and gravel
- ▨ MarSed - Marine/estuarine sediments
- ▨ Made - Made ground
- ☐ Water - Water
- ☐ Unclass



Soil association:
Carrigvahanagh *(410a)*
Peat over lithoskeletal acid igneous rock
Area covered: 209.45km^2

Soil association composition:

1. **Carrigvahanagh (*0410CV*)**
Modern definition: *Peat over lithoskeletal acid igneous rock*
Texture: *Peat*
Substrate type: *over lithoskeletal acid igneous rock*
Substrate 1: *bedrock*
Substrate 2: *acid igneous*

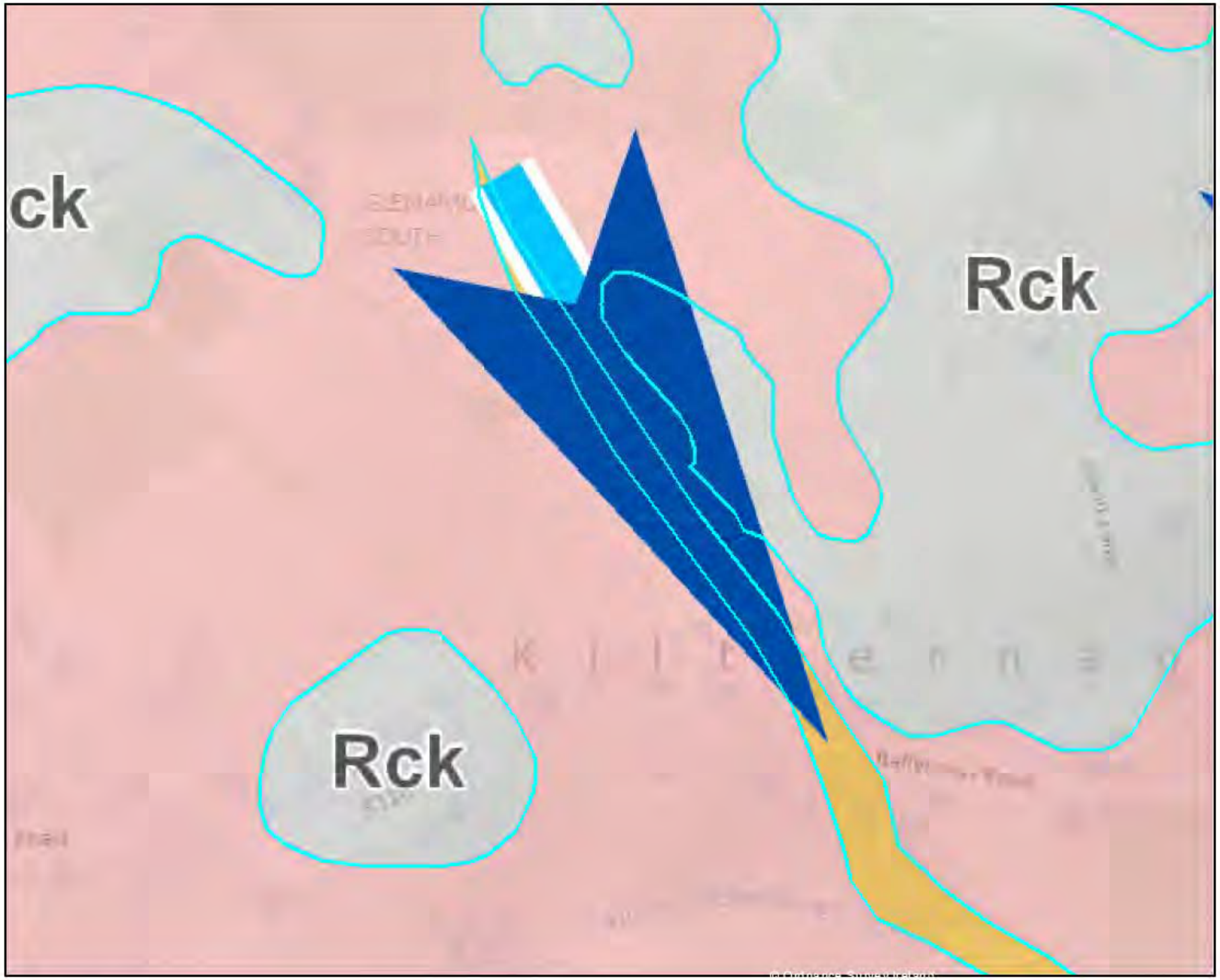
2. **Tiknock (*0900TN*)**
Modern definition: *Loamy over acid and basic igneous bedrock*
Texture: *Loamy*
Substrate type: *over acid and basic igneous bedrock*
Substrate 1: *bedrock*
Substrate 2: *acid and basic igneous*

3. **Knocksquire (*1100KQ*)**
Modern definition: *Coarse loamy over acid igneous bedrock*
Texture: *Coarse loamy*
Substrate type: *over acid igneous bedrock*
Substrate 1: *bedrock*
Substrate 2: *acid igneous*

4. **Aughty (*0110AT*)**
Modern definition: *Peat (Blanket Bog)*

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

GSI Quaternary



Legend

- Subglacial Striae

Subglacial Lineations

- Crag-and-Tail
- Drumlin
- Mega scale glacial lineation
- Streamlined Bedrock

Subglacial Moraines

- ☐ Composite Thrust Block Moraine
- ☐ Minor Ribbed Moraine
- ☐ Non-oriented Bedform
- ☐ Ribbed Moraine
- ☐ Submarine Ribbed Moraine

Meltwater Landforms

- Esker ridge
- Meltwater channel

Deglacial Landforms

- ☐ Delta
- ▨ Fan
- ▨ Glaciofluvial Terrace
- ▨ Hummocky Moraine
- ☐ Hummocky Sand and Gravel
- ☐ Kame Terrace
- ☐ Moraine Ridge

Mountain Glaciation Corries

- Corries

Mountain Glaciation Trimlines

- ▨ Trimlines

Scale: 1:5,000

Geological Survey Ireland

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Map Centre Coordinates (ITM) 720,934 722,336

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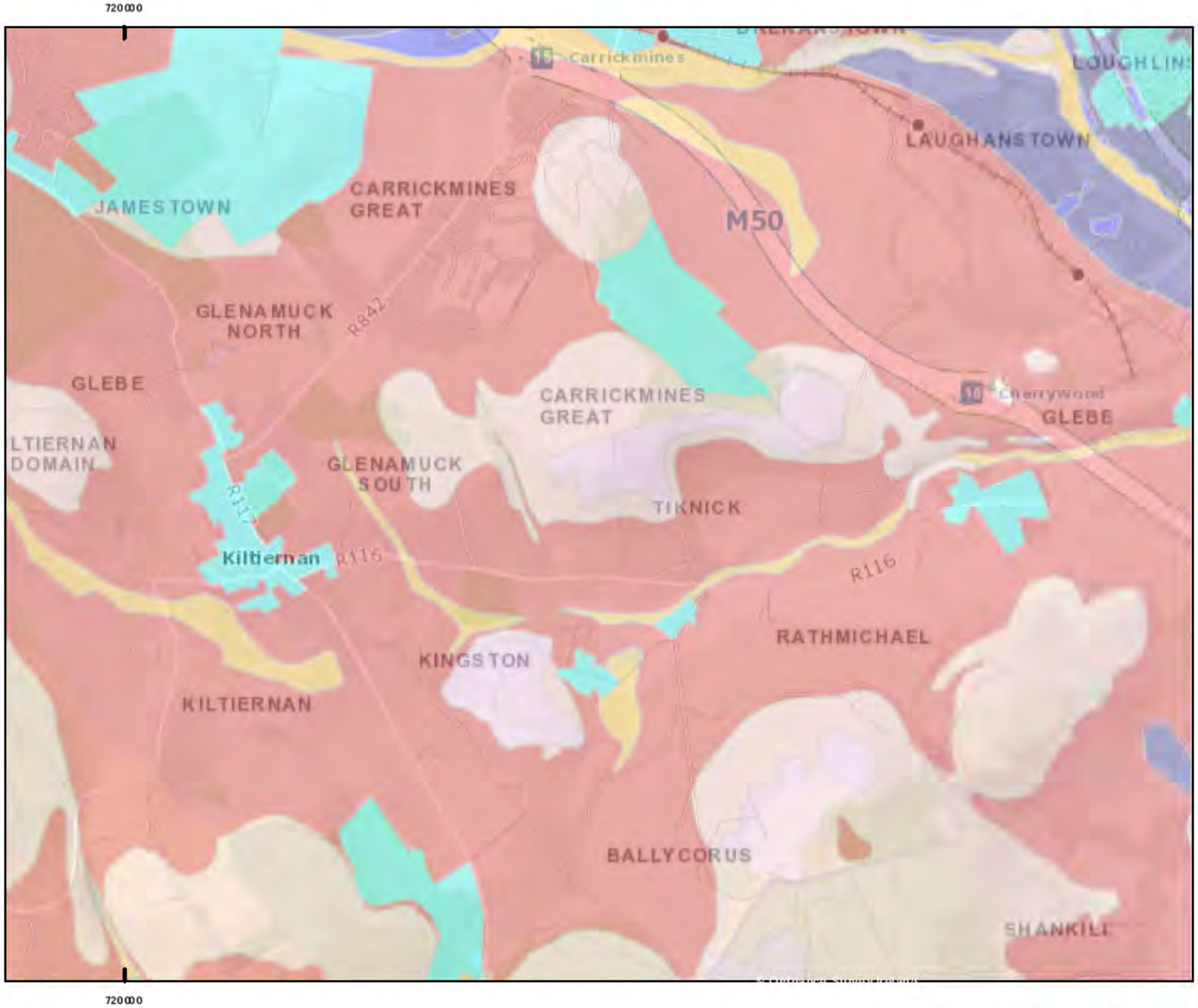
Geological Survey Ireland Public Data



Legend

Teagasc Soils

- ■ AminDW - Deep well drained mineral (Mainly acidic)
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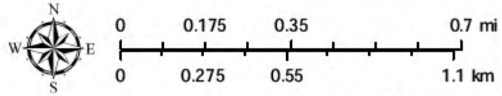
- ■ AminPDPT - Peaty poorly drained mineral (Mainly acidic)
- ■ AminSW - Shallow well drained mineral (Mainly acidic)
- ■ AminSP - Shallow poorly drained mineral (Mainly acidic)
- ■ AminSPPT - Shallow peaty poorly drained mineral (Mainly acidic)
- ■ AminSRPT - Shallow, rocky, peaty/non-peatymi... complexes (Mainly acidic)
- ■ BminDW - Deep well drained mineral (Mainly basic)
- ■ BminPD - Mineral poorly drained (Mainly basic)
- ■ BminPDPT - Peaty poorly drained mineral (Mainly basic)
- ■ BminSW - Shallow well drained mineral (Mainly basic)
- ■ BminSP - Shallow poorly drained mineral (Mainly basic)
- ■ BminSPPT - Shallow peaty poorly drained mineral (Mainly basic)
- ■ BminSRPT - Shallow, rocky, peaty/non-peatymi... complexes (Mainly basic)
- ■ BktPt - Blanket peat
- ■ FenPt - Fen peat
- ■ RsPt - Raised Peat
- ■ Cut - Cutover/cutaway peat
- ■ AlluvMIN - Alluvial (mineral)
- ■ AlluvMRL - Alluvial (marl)
- ■ Lac - Lacustrine type soils
- □ Scree - Scree
- ■ AeoUND - Aeolian undifferentiated
- ■ MarSands - Marine sand and gravel
- ■ MarSed - Marine/estuarine sediments
- ■ Made - Made ground
- □ Water - Water
- □ Unclass

Scale: 1:25,000

Geological Survey Ireland

PSI Licence



Map Centre Coordinates (ITM) 721,867 722,350

4/9/2018 11:26:47 AM

SERIES: TIKNOCK (0900TN) - REPRESENTATIVE PROFILE DESCRIPTION - PDF version available

Reference profile: RPO12BR01
Weather: Rain

TOPOGRAPHY
Position: Upper slope
Form: Convex
Aspect: N

PARENT MATERIAL
Substrate type: Bedrock
Substrate subgroup: Igneous acid

TEXTURAL CRITERIA
Texture 1: Fine loamy
Texture 2: -

LAND USE
Land use: Forestry
Human technologies: Clearing

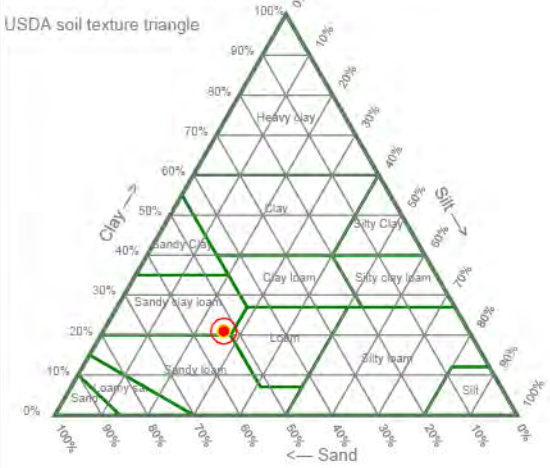
ROCK OUTCROPS - (-)

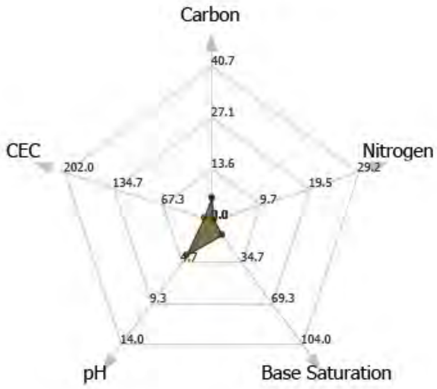
SURFACE STONE - (-)

IRISH CLASSIFICATION (2013)
Soil subgroup: 900 Typical Brown Podzolics
National Soil Series: Tiknock
Definition: Loamy over acid and basic igneous bedrock

Download a PDF version of this profile description here

TOPSOIL ATTRIBUTES (*Horizon 1*)





Horizon 1: 0 - 20 cm

Humose: Yes
Matrix colour (moist): 10YR22
Texture: Fine loamy

Stones (% total): Few (2-5 %)
Stones details: Boulders (20-60 cm)
Stickiness: -

HCL reaction: -
Packing density: Low
Plasticity: -

TOTAL %
Nitrogen: 0.42
Carbon: 6.04
Organic carbon: 4.13
Loss on ignition: -

PARTICLE SIZE %
Sand: 53%
Silt: 26%
Clay: 21%

Textural Class (USDA): Sandy Clay Loam
Bulk density: -
pH: 3.90

EXCHANGEABLE COMPLEX
Exchangeable Bases (cmol kg^{-1})
Na: 0.11
K: 0.12
Mg: 0.37
Ca: 0.66

CEC (cmol kg^{-1}): 10.57
Base saturation: 12%

Horizon 2: 20 - 40 cm

Humose: Yes
Matrix colour (moist): 10YR36
Texture: Fine loamy

Stones (% total): Abundant (40-80 %)
Stones details: Boulders (20-60 cm)
Stickiness: -

HCL reaction: -
Packing density: Low
Plasticity: -

TOTAL %
Nitrogen: 0.33
Carbon: 4.77
Organic carbon: 2.53
Loss on ignition: -

PARTICLE SIZE %
Sand: 49%
Silt: 27%
Clay: 24%

Textural Class (USDA): Sandy Clay Loam
Bulk density: -
pH: 4.33

EXCHANGEABLE COMPLEX
Exchangeable Bases (cmol kg^{-1})
Na: 0.10

CEC (cmol kg^{-1}): 9.32
Base saturation: 6%

K: 0.04
Mg: 0.09
Ca: 0.31

Horizon 3: 40 - 60 cm

Humose: No
Matrix colour (moist): 10YR46
Texture: Coarse loamy

Stones (% total): Abundant (40-80 %)
Stones details: Boulders (20-60 cm)
Stickiness: -

HCL reaction: -
Packing density: Medium
Plasticity: -

TOTAL %
Nitrogen: 0.18
Carbon: 2.77
Organic carbon: 1.49
Loss on ignition: -

PARTICLE SIZE %
Sand: 47%
Silt: 33%
Clay: 20%

Textural Class (USDA): Loam
Bulk density: -
pH: 4.55

EXCHANGEABLE COMPLEX
Exchangeable Bases (cmol kg^{-1})
Na: 0.12
K: 0.04
Mg: 0.07
Ca: 0.22

CEC (cmol kg^{-1}): 6.78
Base saturation: 7%

Horizon 4: 60 - - cm

Humose: No
Matrix colour (moist):
Texture: -

Stones (% total): - (-)
Stones details: - (-)
Stickiness: -

HCL reaction: -
Packing density: -
Plasticity: -

TOTAL %
Nitrogen: -
Carbon: -
Organic carbon: -
Loss on ignition: -

PARTICLE SIZE %
Sand: -%
Silt: -%
Clay: -%

Textural Class (USDA): -
Bulk density: -
pH: -

EXCHANGEABLE COMPLEX
Exchangeable Bases (cmol kg^{-1})
Na: -
K: -
Mg: -
Ca: -

CEC (cmol kg^{-1}): -
Base saturation: -%

Contact us | Terms | Teagasc | Cranfield University

SERIES: CARRIGVAHANAGH (0410CV) - REPRESENTATIVE PROFILE DESCRIPTION - **PDF version available**

Reference profile: RPO21BR01
Weather: Partly cloudy

TOPOGRAPHY
Position: Middle slope
Form: Straight
Aspect: N

PARENT MATERIAL
Substrate type: Bedrock
Substrate subgroup: Igneous acid

TEXTURAL CRITERIA
Texture 1: -
Texture 2: Coarse loamy

LAND USE
Land use: Scrub
Human technologies: Clearing

ROCK OUTCROPS None (0 %)

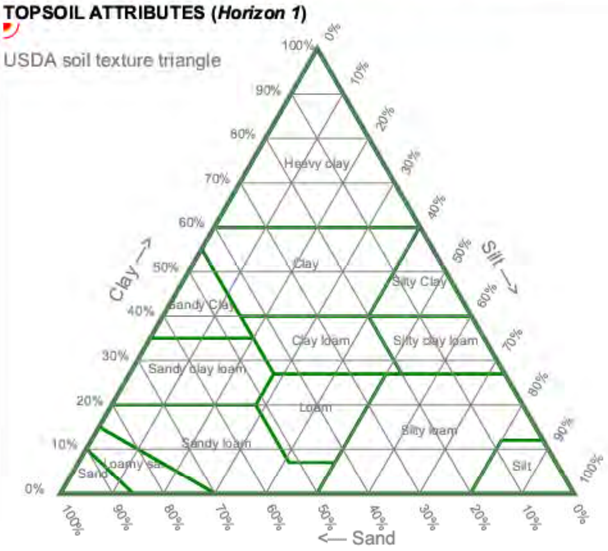
SURFACE STONE Few (2-5 %)

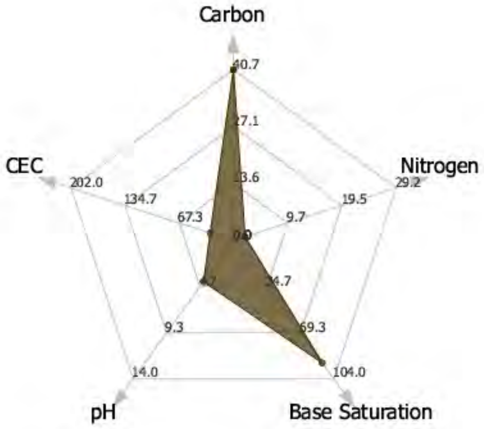
IRISH CLASSIFICATION (2013)
Soil subgroup: 410 Histic Lithosols
National Soil Series: Carrigvahanagh
Definition: Peat over lithoskeletal acid igneous rock

Download a PDF version of this profile description here

TOPSOIL ATTRIBUTES (*Horizon 1*)

USDA soil texture triangle





Horizon 1: 0 - 4 cm

Humose: Yes
Matrix colour (moist): 75YR32
Texture: -

Stones (% total): None (0 %)
Stones details: - (-)
Stickiness: -

HCL reaction: -
Packing density: Low
Plasticity: -

TOTAL %
Nitrogen: 2.09
Carbon: 40.67
Organic carbon: 40.67
Loss on ignition: 85.68

PARTICLE SIZE %
Sand: -%
Silt: -%
Clay: -%

Textural Class (USDA):
Bulk density: -
pH: 4.16

EXCHANGEABLE COMPLEX

Exchangeable Bases (cmol kg^{-1})
Na: 0.08
K: 3.29
Mg: 6.70
Ca: 16.60

CEC (cmol kg^{-1}): 28.99
Base saturation: 92%

Horizon 2: 4 - 20 cm

Humose: Yes
Matrix colour (moist): 10YR21
Texture: -

Stones (% total): Common (5-15 %)
Stones details: Medium gravels (6mm -2 cm)
Stickiness: -

HCL reaction: -
Packing density: Low
Plasticity: -

TOTAL %
Nitrogen: 1.40
Carbon: 28.77
Organic carbon: 28.77
Loss on ignition: 51.52

PARTICLE SIZE %
Sand: -%
Silt: -%
Clay: -%

Textural Class (USDA):
Bulk density: -
pH: 3.71

EXCHANGEABLE COMPLEX

Exchangeable Bases (cmol kg^{-1})

Na:	0.08
K:	1.65
Mg:	3.78
Ca:	4.43

CEC (cmol kg^{-1}): 22.73
Base saturation: 44%

Horizon 3: 20 - 999 cm

Humose:	No	**Stones (% total):**	Abundant (40-80 %)	**HCL reaction:**	-
Matrix colour (moist):	10YR43	**Stones details:**	Medium gravels (6mm -2 cm)	**Packing density:**	High
Texture:	Coarse loamy	**Stickiness:**	-	**Plasticity:**	-

TOTAL %		**PARTICLE SIZE %**			
Nitrogen:	0.07	**Sand:**	68%	**Textural Class (USDA):**	Sandy Loam
Carbon:	1.39	**Silt:**	26%	**Bulk density:**	-
Organic carbon:	1.12	**Clay:**	6%	**pH:**	3.80
Loss on ignition:	-				

EXCHANGEABLE COMPLEX

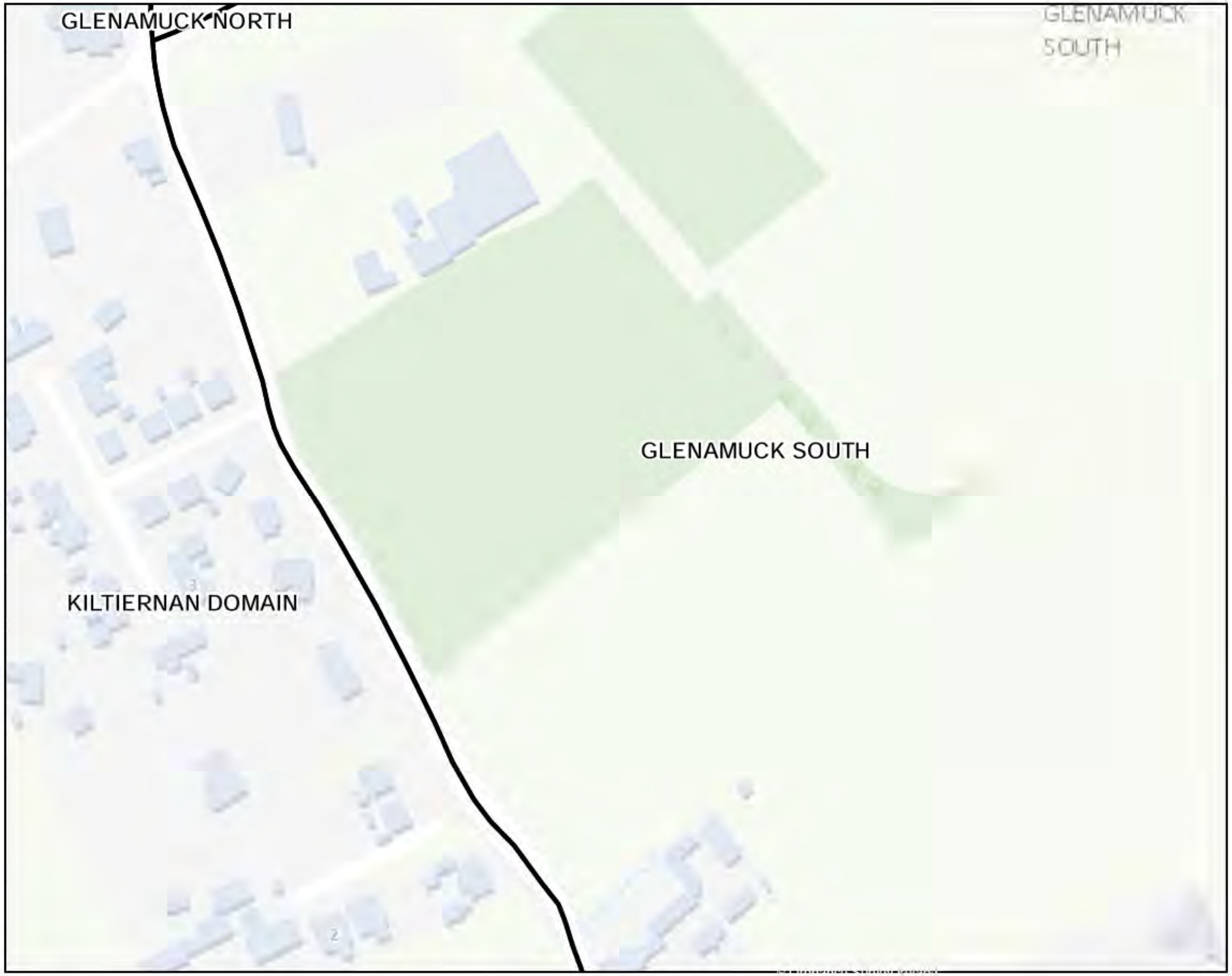
Exchangeable Bases (cmol kg^{-1})

Na:	0.08
K:	0.06
Mg:	0.08
Ca:	0.09

CEC (cmol kg^{-1}): 2.95
Base saturation: 11%

Groundwater Data

Legend



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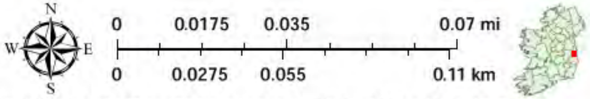
Geological Survey Ireland



Map Centre Coordinates (ITM) 720,574 722,352
5/29/2018, 6:24:49 PM

Geological Survey Ireland Public Data

Legend

☐ Groundwater Wells and Springs

GLENAMUCK
SOUTH

Scale: 1:2,500

Geological Survey Ireland

PSI Licence

0 0.0175 0.035 0.07 mi

0 0.0275 0.055 0.11 km

Map Centre Coordinates (ITM) 720,714 722,403

5/29/2018, 6:22:04 PM

Appendix 12.8

Ground Investigations Soakaway Reports

Ground Investigations Ireland Ltd.,
Catherinestown House,
Hazelhatch Road,
Newcastle, Co Dublin.
Tel: 01 601 5175 / 5176 | Fax: 01 601 5173
Email: info@gii.ie | Web: gii.ie

Ground Investigations Ireland

Kilternan Village

Ground Investigation Report

DOCUMENT CONTROL SHEET

Project Title	Kilternan Village
Engineer	Roger Mullarkey & Associates
Client	Deloitte
Project No	7121-09-17
Document Title	Ground Investigation Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
A	Final	N Sheehan	F McNamara	F McNamara	Dublin	24 October 2017

CONTENTS

APPENDICES

Appendix 1	**Site Location Plan**
Appendix 2	**Trial Pit Records**
Appendix 3	**Soakaway Records**
Appendix 4	**Trial Pit Photographs**

1.0 Preamble

On the instructions of Roger Mullarkey & Associates Consulting Engineers, a site investigation was carried out by Ground Investigations Ireland Ltd on 3rd October 2017 at the site of a proposed residential housing development in Kilternan Village, Kilternan, Dublin 18.

2.0 Overview

2.1. Background

It is proposed to construct a new residential housing development with associated services, access roads and car parking at the proposed site. The site is currently an open greenfield with playing pitches thereon situated in the centre of Kilternan Village. The proposed construction is envisaged to consist of conventional foundations and pavement make up with some local excavations for services and plant.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 3 No. Trial Pits to a maximum depth of 2.00m BGL
- Carry out 3 No. Soakaways to determine a soil infiltration value to BRE digest 365
- Report with recommendations

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.
The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Trial Pits

The trial pits were excavated using a 3.50 Tonne tracked excavator at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering services during the excavation. The trial pits were sampled, logged and photographed by a Geotechnical Engineer/Engineering Geologist prior to backfilling with arisings. Notes were made of any services, inclusions, pit stability, groundwater encountered and the characteristics of the strata encountered and are presented on the trial pit logs which are provided in Appendix 2 of this Report.

3.3. Soakaway Testing

The soakaway testing was carried out in each trial pit at the locations shown in the exploratory hole location plan in Appendix 1. These pits were carefully excavated and filled with water to assess the infiltration characteristics of the proposed site. The pits were allowed to drain and the drop in water level was recorded over time as required by BRE Digest 365. The pits were logged prior to completing the soakaway test and were backfilled with arising's upon completion. The soakaway test results are provided in Appendix 3 of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were consistent across the site and are generally comprised;

- Topsoil
- Cohesive Deposits

TOPSOIL: Topsoil was encountered in all the exploratory holes and was present to a maximum depth of 0.20m BGL.

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Topsoil and were described typically as *light brown sandy slightly gravelly CLAY* overlying a *light yellowish brown sandy slightly gravelly SILT (recovered as possible weathered GRANITE)*. The strength of the cohesive deposits typically increased with depth and was firm and firm to stiff below 1.50m BGL in the majority of the exploratory holes.

4.2. Groundwater

No groundwater was noted during the investigation however we would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the time of year, rainfall, nearby construction and other factors.

5.0 Recommendations & Conclusions

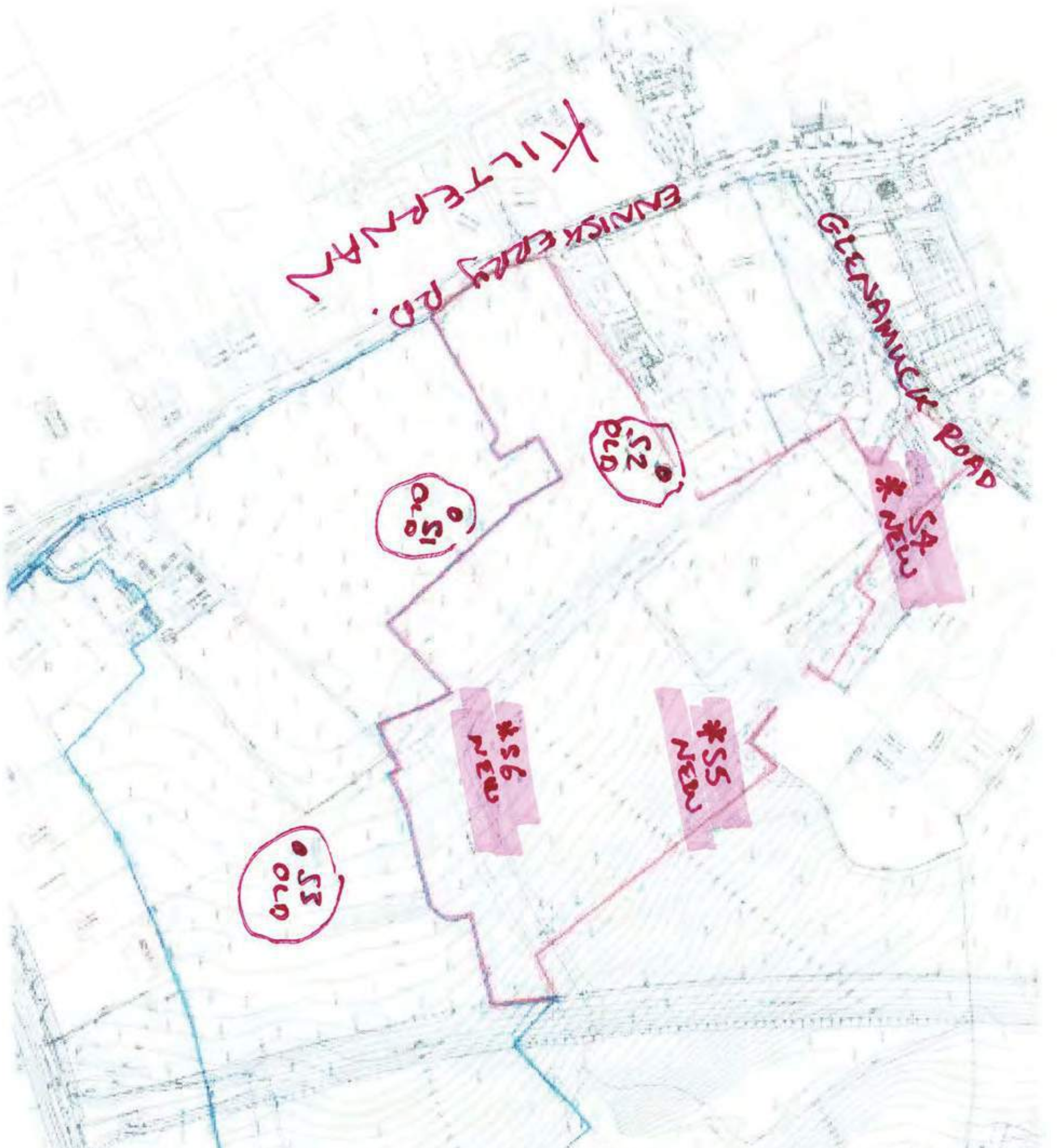
5.1. General

The recommendations given, and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided at the ground investigation stage and any designs based on the recommendations or conclusions should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory hole logs.

5.2. Soakaway Design

Infiltration rates of 9.325×10^{-6} , 5.702×10^{-6} and 5.007×10^{-6} m/s respectively were calculated for the soakaway locations S04, S05 and S06.

APPENDIX 1 - Site Location Plan


KILTERNAN
ENNISKERRY RD.
GLENAMUCK ROAD
S2 OLD
S1 OLD
S3 OLD
*S4 NEW
*S5 NEW
*S6 NEW

APPENDIX 2 – Trial Pit Records

Ground Investigations Ireland Ltd
www.gii.ie

Site Kilternan Village, Dublin 18				**Trial Pit Number** S 04
Machine : 3.5T Tracked Excavator **Method** : Trial Pit	**Dimensions** 2.50 x 0.70 x 2.00 L x W X D	**Ground Level (mOD)**	**Client**	**Job Number** 7121-09-17
	Location (Handheld GPS) 720570 E 722565 N	**Dates** 03/10/2017	**Engineer** Roger Mullarkey & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	TOPSOIL	▨	
					(0.20) 0.40	Firm light brown sandy slightly gravelly CLAY	⁘	
					(1.60) 2.00	Light yellowish brown sandy slightly gravelly SILT (recovered as possible weathered GRANITE)	⁘	
						Complete at 2.00m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Trial pit used for soakaway test, backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	N. Sheehan	7121-09-17

Ground Investigations Ireland Ltd
www.gii.ie

Site Kilternan Village, Dublin 18				**Trial Pit Number** **S 05**
Machine : 3.5T Tracked Excavator **Method :** Trial Pit	**Dimensions** 2.50 x 0.70 x 1.90 L x W X D	**Ground Level (mOD)**	**Client**	**Job Number** 7121-09-17
	Location (Handheld GPS) 720687 E 722490 N	**Dates** 03/10/2017	**Engineer** Roger Mullarkey & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	TOPSOIL	▨	
					(0.50) 0.70	Firm light brown sandy slightly gravelly CLAY	▒	
					(1.10) 1.80	Light yellowish brown sandy slightly gravelly SILT (recovered as possible weathered GRANITE)	░	
					(0.10) 1.90	Light yellowish brown medium grained GRANITE	⁚	
						Complete at 1.90m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Trial pit used for soakaway test, backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	N. Sheehan	7121-09-17

Ground Investigations Ireland Ltd
www.gii.ie

Site	Kilternan Village, Dublin 18			**Trial Pit Number** S 06
Machine : 3.5T Tracked Excavator **Method :** Trial Pit	**Dimensions** 2.50 x 0.70 x 1.90 L x W X D	**Ground Level (mOD)**	**Client**	**Job Number** 7121-09-17
	Location (Handheld GPS) 720668 E 722394 N	**Dates** 03/10/2017	**Engineer** Roger Mullarkey & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	TOPSOIL	▨	
					(1.40) 1.60	Firm to stiff light brown sandy slightly gravelly CLAY	▨	
					(0.20) 1.80	Light yellowish brown sandy slightly gravelly SILT (recovered as possible weathered GRANITE)	▨	
					(0.10) 1.90	Light yellowish brown medium grained GRANITE	▨	
						Complete at 1.90m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Trial pit used for soakaway test, backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	N. Sheehan	7121-09-17

APPENDIX 3 – Soakaway Records

S 04

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.50m x 0.70m x 2.00m (L x W x D)

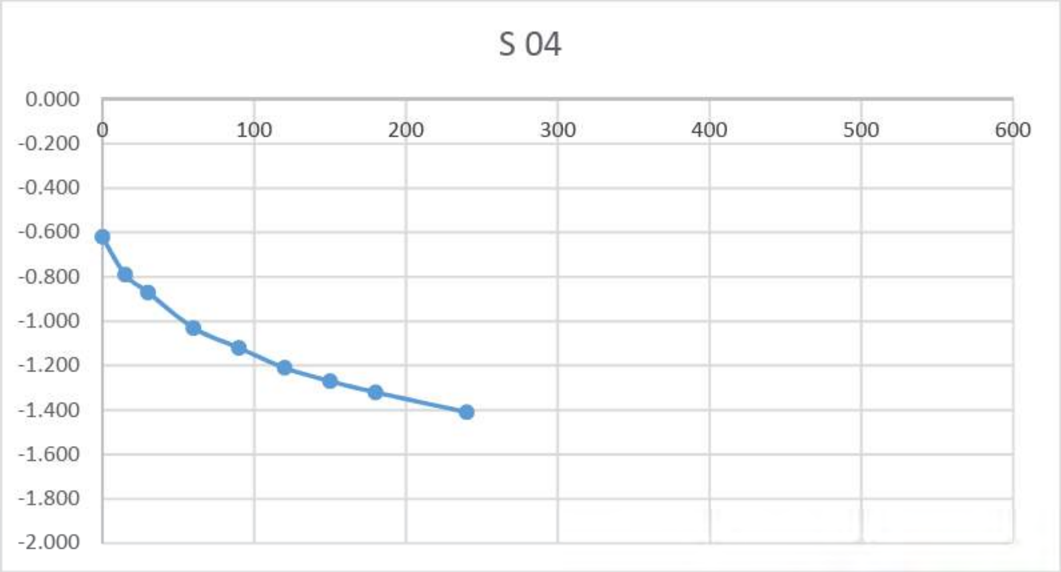
Date	Time	Water level (m bgl)
03/10/2017	0	-0.620
03/10/2017	15	-0.790
03/10/2017	30	-0.870
03/10/2017	60	-1.030
03/10/2017	90	-1.120
03/10/2017	120	-1.210
03/10/2017	150	-1.270
03/10/2017	180	-1.320
03/10/2017	240	-1.410

Start depth	Depth of Pit	Diff	75% full	25%full
0.62	**2.000**	**1.380**	**0.965**	**1.655**

Length of pit (m)	Width of pit (m)	75-25Ht (m)	Vp75-25 (m3)
2.500	0.700	0.690	1.21

Tp75-25 (from graph) (s)		50% Eff Depth	ap50 (m2)
	21000	0.690	6.166

f = 9.325E-06 m/s



GROUND
INVESTIGATIONS
IRELAND

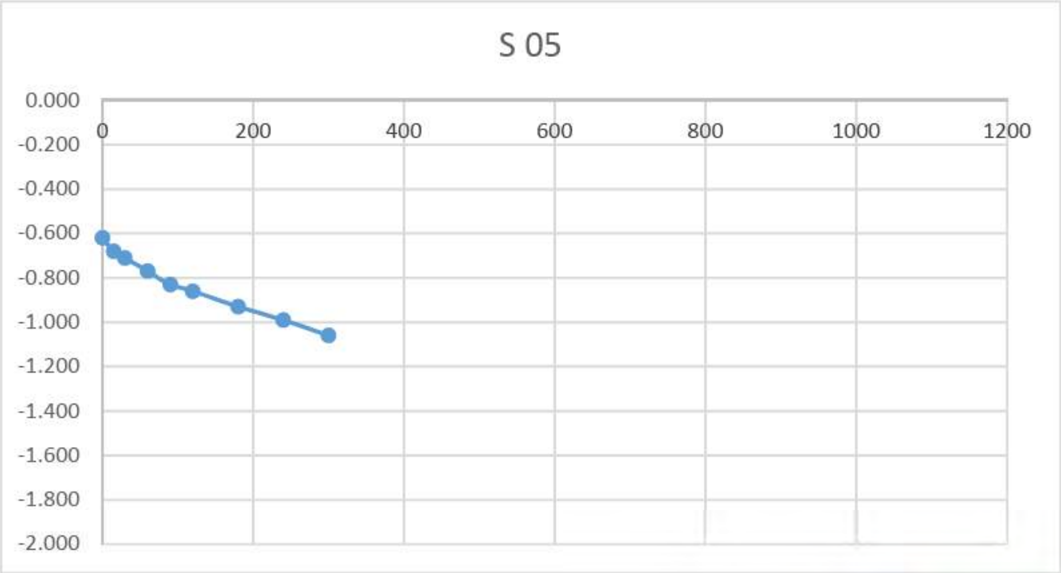
S 05

Soakaway Test to BRE Digest 365

Trial Pit Dimensions: 2.50m x 0.70m x 1.90m (L x W x D)

Date	Time	Water level (m bgl)
03/10/2017	0	-0.620
03/10/2017	15	-0.680
03/10/2017	30	-0.710
03/10/2017	60	-0.770
03/10/2017	90	-0.830
03/10/2017	120	-0.860
03/10/2017	180	-0.930
03/10/2017	240	-0.990
03/10/2017	300	-1.060

Start depth	**Depth of Pit**		**Diff**	**75% full**	**25%full**
0.62	**1.900**		**1.280**	**0.94**	**1.58**
Length of pit (m)	Width of pit (m)			75-25Ht (m)	Vp75-25 (m3)
2.500	0.700			0.640	1.12
Tp75-25 (from graph) (s)		**33600**		50% Eff Depth	ap50 (m2)
				0.640	5.846
f =	**5.702E-06**	**m/s**			



S 06

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.50m x 0.70m x 1.90m (L x W x D)

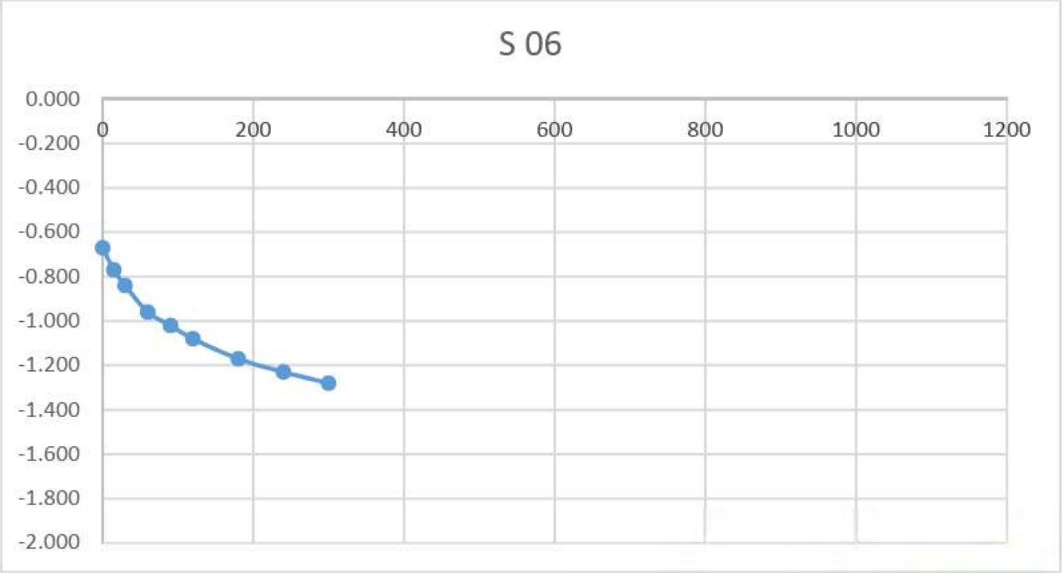
Date	Time	Water level (m bgl)
03/10/2017	0	-0.670
03/10/2017	15	-0.770
03/10/2017	30	-0.840
03/10/2017	60	-0.960
03/10/2017	90	-1.020
03/10/2017	120	-1.080
03/10/2017	180	-1.170
03/10/2017	240	-1.230
03/10/2017	300	-1.280

Start depth	Depth of Pit	Diff	75% full	25%full
0.67	1.900	1.230	0.9775	1.5925

Length of pit (m)	Width of pit (m)	75-25Ht (m)	Vp75-25 (m3)
2.500	0.700	0.615	1.08

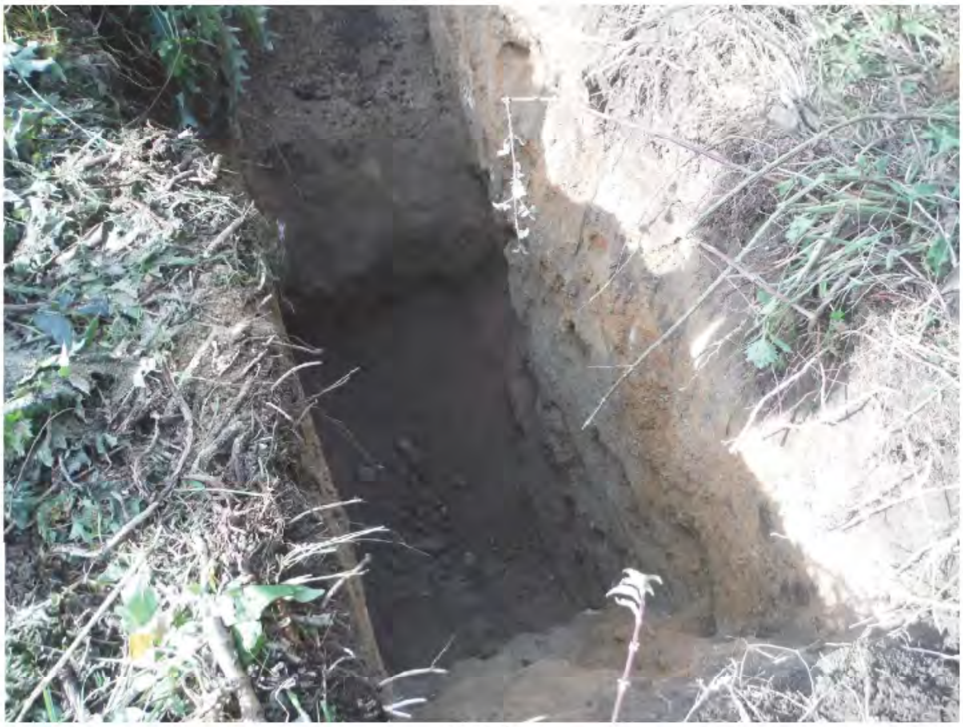
Tp75-25 (from graph) (s)		50% Eff Depth	ap50 (m2)
	37800	0.615	5.686

f = 5.007E-06 m/s



APPENDIX 4 – Trial Pit Photographs

Kilternan Village – Soakaway Trial Pit Photos



S 01

S 01

S 02

S 02

S 03

S 03

REPORT ON SOIL INFILTRATION TESTS

FOR

SOAKAWAY DESIGN

AT

KILTERNAN VILLAGE SITE

CO. DUBLIN

Prepared by: James Lombard BE MIEI

Signed.. **Date:** 23rd February 2010

File no: 2430-02-10

Contents

1.0 Preamble

On the instructions of Mr P. Moran of Pat O'Gorman & Associates Consulting Engineers, three soil infiltration tests were carried out by Ground Investigations Ireland Ltd., at the above site on the 16th of February 2010 to determine the suitability of the subsoil for the construction of a soakaway for surface water run-off.

2.0 Overview

2.1 Background

The site in question is at Kilternan Co. Dublin.

3.0 Soil Infiltration tests.

3.1 General

Three no. Trial Pits were excavated to depths of 1.80 to 2.50metres below ground level (mBGL) at locations indicated by the Consulting Engineers. A Trial Pit Record representing the subsurface conditions encountered in the pits is included in Appendix 1. A site map showing the locations of the trial pits is displayed in Appendix 3. Soakaway tests were carried out in accordance with the *BRE Digest 365, Soakaway Design.*

3.2 Soakaway test 1

At location S1 a trial pit was excavated to 2.50mBGL (metres below ground level) and filled with water to a nominal invert level of 1.00mBGL and allowed to drain. The fall in water level was monitored over time. Details of the trial pit excavated and the fall of water over time can be found in appendix 1 and 2 of this report. The water level dropped to 1.49mBGL in 5¼ hours.

3.3 Soakaway test 2

At location S2 a trial pit was excavated to 2.50mBGL (metres below ground level) and filled with water to a nominal invert level of 1.00mBGL and allowed to drain. The fall in water level was monitored over time. Details of the trial pit excavated and the fall of water over time can be found in appendix 1 and 2 of this report. The water level dropped to 1.13mBGL in 4¼ hours.

3.4 Soakaway test 3

At location S3 a trial pit was excavated to 1.80mBGL (metres below ground level) and filled with water to a nominal invert level of 1.00mBGL and allowed to drain. The fall in water level was monitored over time. Details of the trial pit excavated and the fall of water over time can be found in appendix 1 and 2 of this report. The water level dropped to 1.06mBGL in 3½ hours.

4.0 Recommendations and Conclusions

4.1 General

The recommendations given and opinions expressed in this Report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations or below the final level of excavation, this is for guidance only and no liability can be accepted from its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. It is further recommended that all excavations when excavated should be inspected to verify the information given in this Report.

4.2 Soakaway design

There was insufficient soakage in S1, S2 and S3 to enable calculation of the soil infiltration rate **f.** Some limited soakage was noted however in S1. We would therefore recommend that the surface water be disposed off site.

****

TRIAL PIT RECORD

Project Name: Kilternan Village

Hole ID: SI

Client: Durkan
Consultant: Pat O'Gorman & Associates
Location: Co. Dublin
Date: 16/02/2010
Excavator used: Atlas

Co-ordinates: -
-
Elevation: -
Project no. 2430-02-10
Logged by: J.Lombard

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Samples / tests Depth	Samples / tests Result	Water Depth	Date
TOPSOIL	▒	0.25						
Brown slightly gravelly sandy CLAY	┅	0.70						
Light brown slightly gravelly sandy SILT (Possible weathered granite)	░	2.10						
Broken weathered GRANITE	✚	2.50						

End of Trial pit at 2.50 m

Remarks:

Stability: Slight fall in of trial pit sides
Water: Seepage at 2.4mBGL
Remarks: See report for soakaway test

KEY
B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 2.60
Depth: 0.75
2.50

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TRIAL PIT RECORD

Project Name: Kilternan Village

Hole ID: S2

Client: Durkan
Consultant: Pat O'Gorman & Associates
Location: Co. Dublin
Date: 16/02/2010
Excavator used: Atlas

Co-ordinates: -
-
Elevation: -
Project no. 2430-02-10
Logged by: J.Lombard

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Samples / tests Depth	Samples / tests Result	Water Depth	Date
TOPSOIL		0.20						
Brown slightly gravelly sandy CLAY		0.90						
Light brown slightly gravelly sandy SILT (Possible weathered granite)		2.40						
Broken GRANITE		2.50						
End of Trial pit at 2.50 m								

Remarks:

Stability: Slight fall in of trial pit sides
Water: No groundwater encountered
Remarks: See report for soakaway test

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: 2.80
0.65
Depth:
2.50

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TRIAL PIT RECORD

Project Name: Kilternan Village Hole ID: S3

Client: Durkan
Consultant: Pat O'Gorman & Associates
Location: Co. Dublin
Date: 16/02/2010
Excavator used: Atlas

Co-ordinates: -
-
Elevation: -
Project no. 2430-02-10
Logged by: J.Lombard

Strata Description	Legend	Depth	Level (mOD)	Samples / tests			Water Depth	Date
				Type	Depth	Result		
TOPSOIL		0.20						
Brown slightly gravelly sandy CLAY		0.70						
Light brown slightly gravelly sandy SILT (Possible weathered granite)		1.70						
Broken GRANITE		1.80						

End of Trial pit at 1.80 m

Remarks:

Stability: Slight fall in of trial pit sides
Water: No groundwater encountered
Remarks: See report for soakaway test

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: 2.70 × 0.70
Depth: 1.80

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Kilternan Soakaway 1

Soakaway Test to BRE Digest 365

The Trial pit was filled with water to 0.95mBGL and the drop in water level with time was recorded below.

Elapsed Time Minutes	Water Level mBGL	Remarks
0	0.95	Hole filled with water after initial presoak
60	1.12	
130	1.25	
250	1.40	
315	1.49	Test complete

Kilternan Soakaway 2

Soakaway Test to BRE Digest 365

The Trial pit was filled with water to 1.00mBGL and the drop in water level with time was recorded below.

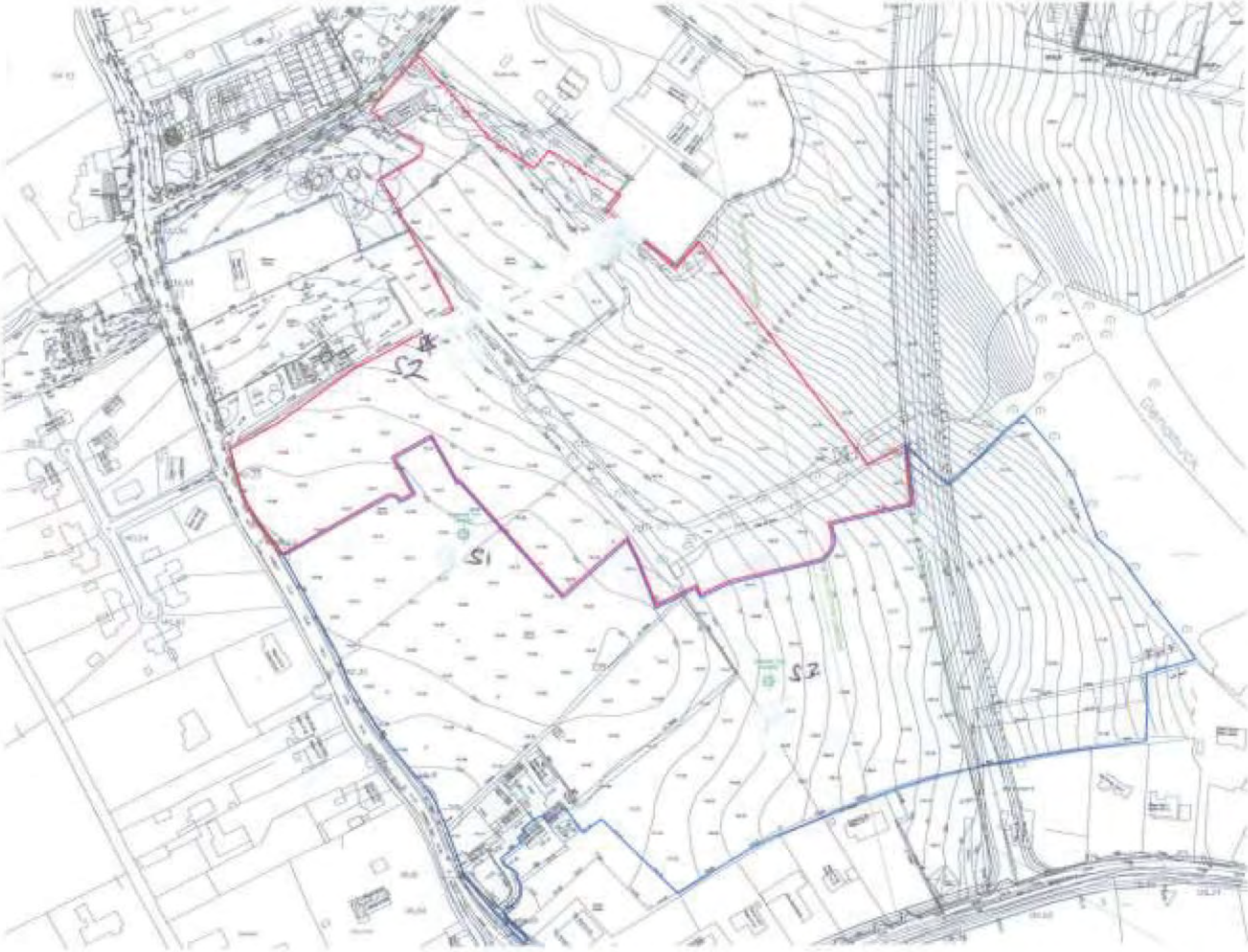
Elapsed Time Minutes	Water Level mBGL	Remarks
0	1.00	Hole filled with water after initial presoak
70	1.06	
120	1.10	
255	1.14	Test Complete

Kilternan Soakaway 3

Soakaway Test to BRE Digest 365

The Trial pit was filled with water to 1.00mBGL and the drop in water level with time was recorded below.

Elapsed Time Minutes	**Water Level mBGL**	**Remarks**
0	1.00	Hole filled with water after initial presoak
60	1.03	
120	1.045	
210	1.06	Test Complete


S3*
S1
S2

1.0 Preamble

On the instructions of Mr Pat O' Gorman of Pat O' Gorman & Associates Consulting Engineers, a ground investigation was carried out by "Site Investigations Ltd" over the period 24/02/2006 to 09/05/2006 for proposed residential development at Kiltiernan GAA, Kiltiernan, County Dublin.

2.0 Scope

The scope of the site investigation was to investigate subsurface ground conditions by means of cable percussion and rotary cored boreholes with associated 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 locations of all the site works are shown on the Exploratory Hole Location Plan in Appendix I.

3.2 Boreholes

Twelve number cable percussion boreholes were sunk. Boreholes BH7, BH12 and BH13 were subsequently cancelled due to access problems. Standpipes for groundwater monitoring were installed in boreholes BH6, BH8 and BH10.

In addition, eight number rotary cored boreholes were carried out adjacent to the relevant cable percussion boreholes to prove rockhead levels across the site.

The borehole records are presented in Appendix II.

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

3.3 Groundwater Monitoring

The results of the groundwater monitoring in the installations in the boreholes are presented in Appendix III.

3.4 Survey

The locations and ground levels of the boreholes were surveyed and the tabulated results are presented in Appendix II along with the borehole logs.

4.0 Lab Testing

The following testing was carried out on selected samples from the boreholes:

- One number chemical test suite for material disposal purposes

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 IV.

5.0 Revealed Ground Conditions

A generalised summary of the ground profile is given below. Reference should be made to the individual borehole records in Appendix II for the full strata information at specific locations.

- Firm (locally stiff)brown sandy gravelly CLAY/SILT with some cobbles.
- Medium dense sandy GRAVEL with some cobbles
  (completely weathered granite with corestones)
- GRANITE.

6.0 Groundwater Conditions

Groundwater levels and/or seepage into the boreholes at the time of excavation are noted on the logs in Appendix II. Groundwater monitoring results from the installations in the boreholes are presented in Appendix III.

It should be noted that waterlevels and waterstrikes recorded 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. (Perforated standpipe or piezometer installations and associated waterlevel monitoring are required to provide more accurate information regarding groundwater conditions).

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

7.0 Recommendations and Conclusions

7.1 General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between the exploratory hole locations or below the final level of excavation, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. It is further recommended that all bearing surfaces when excavated should be inspected to verify the information given in this report.

Excavated surfaces in clay strata should be kept dry to avoid softening prior to foundation placement. Foundations should always be taken to a minimum depth of 0.50mBGL to avoid the effects of frost action and possible seasonal shrinkage/swelling.

If it is intended that on-site materials are to be used as fill, then the necessary laboratory testing should specified by the Client to confirm the suitability. Also, relevant lab testing should be specified where stability of side slopes to excavations is a concern.

7.2 Foundations

The following allowable bearing capacities are recommended for the soil and rock strata encountered at the site:

For the firm light brown sandy gravelly CLAY/SILT with some cobbles we would recommend an allowable bearing capacity of 75kN/m^2. The general depth to the top of this stratum is 0.3mBGL with the depth to the base varying generally between 0.9m and 1.9mBGL, although deeper (3.0m) at BH5.

For the completely weathered granite we would recommend an allowable bearing capacity of 750kN/m^2. which will exist generally as a medium dense sandy GRAVEL with cobbles, although the grading of this material will vary greatly depending on the degree of weathering. The depth to the top of this stratum varies generally from 0.9m to 1.9mBGL, although deeper (3.0m) at BH5.

For the rock itself we would recommend an allowable bearing capacity of 750kN/m^2, provided refusal is met with heavy duty ripping when excavating to the level of unproved rock. Depth to rock of this strength varies between 2.8m and 9.9mBGL across the site.

It is not advisable to place foundations partly on soil and partly on rock due to the possibility of excessive differential settlement.

7.3 Rippability

It is considered that the quality of the rock revealed in the boreholes is such that rock breaking will be required, at least off and on, for the following ***approximate*** depth ranges at the location of each rotary cored borehole:

RC2	4.0mBGL to base of hole
RC4	3.3mBGL to base of hole
RC5	8.2mBGL to base of hole
RC6	2.8mBGL to base of hole
RC8	9.9mBGL to base of hole
RC9	5.7mBGL to base of hole
RC10	(no good rock to base of hole at 7mBGL)
RC11	1.6m to base of hole

7.4 Aggressive Ground Considerations

The results of the chemical testing(Appendix IV) indicate that the pH is near neutral and that the sulphate content is relatively low. The ground is therefore not considered to be aggressive towards concrete.

7.5 Chemical/Contamination Testing

When dealing with potential contamination, the Irish Building Regulations call for the use of the Code of Practice for the Identification of Potentially Contaminated Sites (ref 1) which in turn cites the use of the ICRCL UK Standard (ref 2). However, the ICRCL UK Standard has been withdrawn and superseded by CLEA 2002 (ref 3) which currently covers only a few substances. Therefore the action levels of the Dutch Standard (ref 4) are generally being used.

The results (Appendix IV) indicate that under the Dutch Standard none of the substances tested showed concentrations exceeding the trigger levels requiring action. Furthermore, none of the trigger levels in the old ICRCL UK Standard or the CLEA 2002 Soil Guideline Values have been exceeded for commercial/industrial land-use.

Each individual landfill site will have it's own criteria for acceptability of waste. The suite of chemical tests carried out covers a broad range of substances and in particular meets the testing requirements of the Murphy environmental suite and the KTK environmental suite, along with much of groups A,B and C of the ICRCL list.

References

1. DD175: Code of Practice for the Identification of Potentially Contaminated Sites, 1985.
2. Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL 59/83)
3. Contaminated Land Exposure Assessment (CLEA 2002)
4. "New" Dutch List

BOREHOLE RECORD

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

CONTRACT: Development at Kiltiernan for Durkan new homes **HOLE ID:** **BH1**

Client:		**Elevation:**	m.O.D.
Consultant:	Pat O' Gorman & Associates	**Co-ordinates**	E N
Site Address:	Kiltiernan	**Hole Diameter:**	200 mm
Boring Commenced:	25/02/2006	**Drilled by:**	E. Blacoe
Boring Completed:	25/02/2006	**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	0.00								
Firm to stiff brown sandy gravelly CLAY/SILT with some cobbles	0.30			B	0.50	1292			
				B C(50)	1.00 1.00	1293			
ROCK or BOULDER	1.90			C(50)	2.00		2.00	25/02/2006	dry(pm)
	2.00	Hole End							

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 1.30 to 1.40m: 30 mins.
Chiselling from 1.90 to 2.00m: 1.0 hrs (refusal).

CPT at 1.0m: 2/3/4/7/39 for 10mm
CPT at 2.0m: 25 for 5mm/50 for 5mm

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: Development at Kiltiernan for Durkan new homes **HOLE ID:** **BH2**

Client:		**Elevation:**	m.O.D.
Consultant:	Pat O' Gorman & Associates	**Co-ordinates**	E N
Site Address:	Kiltiernan	**Hole Diameter:**	200 mm
Boring Commenced:	24/02/2006	**Drilled by:**	E. Blacoe
Boring Completed:	24/02/2006	**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	Depth (m)	Ref No.	Progress/Water Hole Depth (m)	Date	Water Depth (m)
TOPSOIL	0.00								
Firm light brown sandy gravelly CLAY/SILT with granite cobbles	0.30			B	0.40	T1280			
Medium dense silty sandy GRAVEL with some cobbles (completely weathered granite)	0.90			B C(17)	1.00 1.00	T1281			
				B C(27)	2.00 2.00	T1282			
								24/02/2006 24/02/2006	2.90(20) 3.00
				B C(50)	3.00 3.00	T1283			
BOULDER	3.30								
	3.40	Hole End					3.40	24/02/2006	3.00(pm)

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 2.70 to 2.80m: 45 mins.
Chiselling from 3.30 to 3.40m: 1 hr (refusal)

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: Development at Kiltiernan for Durkan new homes **HOLE ID:** **BH3**

Client:		**Elevation:**	m.O.D.
Consultant:	Pat O' Gorman & Associates	**Co-ordinates**	E N
Site Address:	Kiltiernan	**Hole Diameter:**	200 mm
Boring Commenced:	25/02/2006	**Drilled by:**	E. Blacoe
Boring Completed:	25/02/2006	**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			Progress/Water		
				Type	Depth (m)	Ref No.	Hole Depth (m)	Date	Water Depth (m)
TOPSOIL	0.00								
Firm brown sandy gravelly CLAY/SILT	0.30			B	0.50	1284			
				B C(12)	1.00 1.00	1285			
Medium dense silty very sandy GRAVEL with some cobbles (completely weathered granite)	1.30								
				B C(22)	2.00 2.00	1286			
								25/02/2006	2.50(20)
								25/02/2006	2.80
				B C(32)	3.00 3.00	1287			
ROCK or BOULDER	3.50								
	3.70	Hole End					3.70	25/02/2006	2.30(pm)

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 3.60 to 3.70m: 1hr (refusal)

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: Development at Kiltiernan for Durkan new homes **HOLE ID:** **BH4**

Client:		**Elevation:**	**m.O.D.**
Consultant:	**Pat O' Gorman & Associates**	**Co-ordinates**	**E N**
Site Address:	**Kiltiernan**	**Hole Diameter:**	**200 mm**
Boring Commenced:	**25/02/2006**	**Drilled by:**	**E. Blacoe**
Boring Completed:	**25/02/2006**	**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	0.00								
Firm brown sandy gravelly CLAY/SILT	0.30			B	0.40	T1288			
				B C(10)	1.00 1.00	T1289			
Medium dense silty very sandy GRAVEL with some cobbles (completely weathered granite)	1.70			B C(24)	2.00 2.00	T1290			
								25/02/2006	▽ 2.50(20)
								25/02/2006	▼ 2.80
				B C(50)	3.00 3.00	T1291			
GRANITE	3.40								
	3.50	Hole End							
							3.70	25/02/2006	2.30(pm)

Remarks:- *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 3.40 to 3.50m: 1 hr (refusal)

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

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BOREHOLE RECORD

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

CONTRACT:	Development at Kiltiernan for Durkan new homes	**HOLE ID:**	**BH5**
Client:		**Elevation:**	m.O.D.
Consultant:	Pat O' Gorman & Associates	**Co-ordinates**	E N
Site Address:	Kiltiernan	**Hole Diameter:**	200 mm
Boring Commenced:	24/02/2006	**Drilled by:**	E. Blacoe
Boring Completed:	24/02/2006	**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	0.00								
Firm light brown sandy gravelly CLAY/SILT with granite cobbles	0.30			B	0.50	T1276			
				B C(11)	1.00 1.00	T1277			
Stiff light brown sandy gravelly CLAY/SILT with granite cobbles	1.50			B C(20)	2.00 2.00	T1278			
								24/02/2006 24/02/2006	2.80(20) 2.90
BOULDER	3.00			B C(50)	3.00 3.00	T1279	3.10	24/02/2006	2.90(pm)
	3.10	Hole End							

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 2.70 to 2.80m: 45 mins.
Chiselling from 3.00 to 3.10m: 1 hr (refusal)

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

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BOREHOLE RECORD

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

CONTRACT: Development at Kiltiernan for Durkan new homes

HOLE ID: **BH6**

Client:		**Elevation:**	m.O.D.
Consultant:	Pat O' Gorman & Associates	**Co-ordinates**	E N
Site Address:	Kiltiernan	**Hole Diameter:**	200 mm
Boring Commenced:	28/02/2006	**Drilled by:**	E. Blacoe
Boring Completed:	28/02/2006	**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	Depth (m)	Ref No.	Progress/Water Hole Depth (m)	Date	Water Depth (m)
TOPSOIL	0.00								
Firm brown sandy gravelly CLAY/SILT	0.30			B	0.50	U0305			
				B C(10)	1.00 1.00	U0306			
Medium dense silty very sandy GRAVEL with some cobbles (completely weathered granite)	1.10								
				B C(27)	2.00 2.00	U0307			
								28/02/2006 28/02/2006	2.80(20) 2.90
				B C(50)	3.00 3.00	U0308			
GRANITE	3.30								
	3.40	Hole End					3.40	28/02/2006	2.90(pm)

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 3.30 to 3.40m: 1 hr (refusal)
19mm pipe installed (slotted from 3.40 to 2.00m, plain from 2.00 to G.L.).
Backfilled with gravel surround from 3.40 to 2.00m, bentonite seal from 2.00m to G.L. Raised steel cover installed.

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

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BOREHOLE RECORD

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

CONTRACT: Development at Kiltiernan for Durkan new homes   HOLE ID: **BH8**

Client:		Elevation:	m.O.D.
Consultant:	Pat O' Gorman & Associates	Co-ordinates	E N
Site Address:	Kiltiernan	Hole Diameter:	200 mm
Boring Commenced:	**28/02/2006**	**Drilled by:**	**E. Blacoe**
Boring Completed:	**28/02/2006**	**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	Depth (m)	Ref No.	Progress/Water Hole Depth (m)	Date	Water Depth (m)
TOPSOIL	0.00								
Firm brown sandy gravelly CLAY/SILT	0.20			B	0.50	U0301			
				B C(12)	1.00 1.00	U0302			
Medium dense silty very sandy GRAVEL with some cobbles (completely weathered granite)	1.30			B C(27)	2.00 2.00	U0303			
								28/02/2006	2.60(20)
								28/02/2006	2.80
				B C(50)	3.00 3.00	U0304			
BOULDER	3.40								
	3.50	Hole End					3.50	28/02/2006	3.00(pm)

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 2.80 to 2.90m: 30 mins.
Chiselling from 3.40 to 3.50m: 1 hr (refusal)

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 4278BH.GPJ COREHOLE.GDT 11/07/06

BOREHOLE RECORD

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

CONTRACT: Development at Kiltiernan for Durkan new homes **HOLE ID:** **BH9**

Client:		**Elevation:**	m.O.D.
Consultant:	Pat O' Gorman & Associates	**Co-ordinates**	E N
Site Address:	Kiltiernan	**Hole Diameter:**	200 mm
Boring Commenced:	26/02/2006	**Drilled by:**	E. Blacoe
Boring Completed:	26/02/2006	**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	0.00								
Firm brown sandy gravelly CLAY/SILT	0.30			B	0.50	T1297			
				B C(11)	1.00 1.00	T1298			
Medium dense silty very sandy GRAVEL with some cobbles (completely weathered granite)	1.40								
				B C(50)	2.00 2.00	T1299			
BOULDER	2.10								
	2.30	Hole End					2.30	26/02/2006	dry(pm)

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

Chiselling from 1.70 to 1.80m: 45 mins.

Chiselling from 2.10 to 2.30m: 1.5 hrs (refusal)

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: Development at Kiltiernan for Durkan new homes — HOLE ID: **BH10**

Client:		**Elevation:**	m.O.D.
Consultant:	Pat O' Gorman & Associates	**Co-ordinates**	E N
Site Address:	Kiltiernan	**Hole Diameter:**	200 mm
Boring Commenced:	26/02/2006	**Drilled by:**	E. Blacoe
Boring Completed:	26/02/2006	**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	0.00								
Firm brown sandy gravelly CLAY/SILT	0.30			B B C(14)	0.50 1.00 1.00	T1294 T1295			
Medium dense silty very sandy GRAVEL with some cobbles (completely weathered granite)	1.20			B C(50)	2.00 2.00	T1296			
Highly weathered GRANITE	2.30						2.40	26/02/2006	dry(pm)
	2.40	**Hole End**							

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 1.60 to 1.70m: 45 mins.
Chiselling from 2.30 to 2.40m: 1 hr (refusal)

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:	Development at Kiltiernan for Durkan new homes	HOLE ID:	**BH11**

Client:		**Elevation:**	m.O.D.
Consultant:	**Pat O' Gorman & Associates**	**Co-ordinates**	E N
Site Address:	Kiltiernan	**Hole Diameter:**	**200 mm**
Boring Commenced:	**28/02/2006**	**Drilled by:**	**E. Blacoe**
Boring Completed:	**28/02/2006**	**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	0.0 0.00								
Firm brown sandy gravelly CLAY/SILT	0.20			B	0.40	U0309			
	1.0			B C(9)	1.00 1.00	U0310			
Medium dense silty very sandy GRAVEL with some cobbles (completely weathered granite)	1.20								
	2.0			B C(21)	2.00 2.00	U0311			
								28/02/2006 28/02/2006	2.80(20) 3.00
	3.0			B C(50)	3.00 3.00	U0312			
GRANITE	3.50								
	3.60	Hole End					3.60	28/02/2006	3.10(pm)
	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 3.30 to 3.60m: 1 hr (refusal)

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: Development at Kiltiernan for Durkan new homes   HOLE ID: **BH14**

Client:		**Elevation:**	m.O.D.
Consultant:	Pat O' Gorman & Associates	**Co-ordinates**	E N
Site Address:	Kiltiernan	**Hole Diameter:**	200 mm
Boring Commenced:	29/02/2006	**Drilled by:**	E. Blacoe
Boring Completed:	29/02/2006	**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	0.00								
Stiff brown sandy gravelly CLAY/SILT	0.20			B	0.20	U0315			
				C(17)	1.00				
Medium dense silty very sandy GRAVEL with some cobbles (completely weathered granite)	1.20			B	1.20	U0316			
				C(30)	2.00				
								29/02/2006	2.80(20)
								29/02/2006	2.90
GRANITE (presumed bedrock, possible boulder)	2.95 3.00	Hole End		B	2.95	U0317	3.00	29/02/2006	2.85(pm)
				C(50)	3.00				

Remarks: *(Note: Stratum bands <200mm are not indicated pictorially)*
Chiselling from 2.80 to 2.90m: 45 mins.
Chiselling from 2.95 to 3.00m: 1 hr (refusal)

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: Development at Kiltiernan for Durkan new homes

HOLE ID: **BH15**

Client:		**Elevation:**	m.O.D.
Consultant:	Pat O' Gorman & Associates	**Co-ordinates**	E N
Site Address:	Kiltiernan	**Hole Diameter:**	200 mm
Boring Commenced:	29/02/2006	**Drilled by:**	E. Blacoe
Boring Completed:	29/02/2006	**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	0.00								
Brown sandy gravelly CLAY/SILT	0.20			B	0.50	U0316			
				B C(11)	1.00 1.00	U0319			
Medium dense to dense silty very sandy GRAVEL with some cobbles (completely weathered granite)	1.10								
				B C(38)	2.00 2.00	U0320			
								29/02/2006 29/02/2006	2.75(20) 2.80
GRANITE (presumed bedrock, possible boulder)	2.90						3.00	29/02/2006	2.90(pm)
	3.00	Hole End		C(50)	3.00				

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

Chiselling from 2.30 to 2.50m: 45 mins.
Chiselling from 2.90 to 3.00m: 1 hr (refusal)

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

REF: AGL07380_01

REPORT
ON THE
GEOPHYSICAL SURVEY
FOR THE
PROPOSED DEVELOPMENT AT
KILTERNAN VILLAGE, CO. WICKLOW
FOR
DURKAN NEW HOMES.

3RD JULY 2008

PRIVATE AND CONFIDENTIAL

THE FINDINGS OF THIS REPORT ARE THE RESULT OF A GEOPHYSICAL SURVEY USING NON-INVASIVE SURVEY TECHNIQUES CARRIED OUT AT THE GROUND SURFACE. INTERPRETATIONS CONTAINED IN THIS REPORT ARE DERIVED FROM A KNOWLEDGE OF THE GROUND CONDITIONS, THE GEOPHYSICAL RESPONSES OF GROUND MATERIALS AND THE EXPERIENCE OF THE AUTHOR. APEX GEOSERVICES LTD. HAS PREPARED THIS REPORT IN LINE WITH BEST CURRENT PRACTICE AND WITH ALL REASONABLE SKILL, CARE AND DILIGENCE IN CONSIDERATION OF THE LIMITS IMPOSED BY THE SURVEY TECHNIQUES USED AND THE RESOURCES DEVOTED TO IT BY AGREEMENT WITH THE CLIENT. THE INTERPRETATIVE BASIS OF THE CONCLUSIONS CONTAINED IN THIS REPORT SHOULD BE TAKEN INTO ACCOUNT IN ANY FUTURE USE OF THIS REPORT.

Project Number	AGL07380		
Author	**Checked**	**Report Status**	**Date**
EurGeol yvonne O'Connell P.Geo., M.Sc (geophysics)	EurGeol Peter O'Connor P.Geo., M.Sc (geophysics), Dip EIA Mgt.	V.1	3rd July 2008

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INTERPRETED SECTIONS

APPENDICES

1. INTRODUCTION

APEX Geoservices Ltd. was requested by Pat O'Gorman & Associates on behalf of their client Durkan New Homes to carry out a geophysical survey at a proposed development site in Kilternan, Co. Dublin.

1.1 Survey Objectives

The objectives of the survey were to assess the sub-surface conditions across the site including type and thickness of overburden and the depth to bedrock.

1.2 Survey Methodology

- Electromagnetic conductivity mapping to outline zones of shallow rock and to map lateral variations in overburden type & thickness.
- 2D Resistivity to determine overburden and bedrock resistivity and investigate variations in depth to bedrock, overburden material and bedrock type including possible faults and other structural features.
- Seismic Refraction profiles were recorded to map overburden thickness, depth to bedrock and to indicate overburden stiffness and to assess rock quality and excavatability.

1.3 Site Background

The site is located on the eastern side of Enniskerry Road in Kilternan Village and is approximately 5.6ha in size. The site is bounded to the north and south by developed property including houses and a petrol station. The site is open to the east. The topography across the site ranges from 147.9mOD in the centre of the sites, sloping gently to 141.5mOD in the north and to 139.5mOD in the southeast of the site.

The Geological Survey of Ireland 1:100,000 Bedrock Map Series for the area (GSI, Online Geological Map) indicates that the site is underlain by Type Nt3 Granite of the Leinster Granite which comprises granite with muscovite phenocrysts.

The Geological Survey of Ireland 6 inch to 1 mile historic bedrock geology field sheets for the area (mapped in the nineteenth century) indicate some limestone gravel across the site, underlain by granite.

The Geological Survey of Ireland Teagasc subsoils map for the area indicates that the soil type across the site comprises till derived from granite. Made ground is indicated directly north, south and west of the site and outcrop/subcrop is indicated to both the northwest and northeast of the site.

1.4 Report Outline

- ❖ The survey results are discussed in Part 2.
- ❖ Conclusions and recommendations are given in Part 3.
- ❖ The conductivity values are plotted on Map 2.
- ❖ The interpreted resistivity data are shown on Sections 1 to 5.
- ❖ Summary results and proposed drilling locations are shown on Map 3.
- ❖ The survey methodology is contained in Appendix I.
- ❖ The seismic refraction data is contained in Appendix II.
- ❖ An excavatability rating chart is contained in Appendix III.

2. INTERPRETED RESULTS

2.1 Electromagnetic Conductivity

The results of the EM31 Conductivity Survey were contoured and plotted on Map 2. The conductivity data values ranged from 10 to 20 mS/m and were interpreted on the following basis:

Conductivity (mS/m)	Interpretation of 0 – 6m Below Ground Level
10.0 – 11.25	Near surface (approx. 1m BGL) Granite Bedrock
11.25 – 16.0	Near surface (approx. 1m BGL) Granite Bedrock with open water-filled joints
16.0 – 20.0	Probable interference from Metal Fences, Cultural Noise, etc…

Note: Some spurious conductivity values were recorded in the vicinity of cultural noise such as the goal posts and metal fencing and these points have been removed from the dataset and are not included on Map 2.

2.2 2D Resistivity Profiling

Five 2D resistivity profiles (R1-R5) were recorded across the site (Map 1). The resistivity data have been interpreted on the following basis:

Apparent Resistivity (ohm-m)	Interpretation
300-500	Clayey SAND/GRAVEL
500-1000	Silty SAND/GRAVEL
1000-3000	SAND/GRAVEL
300-800	GRANITE with open water-filled joints
800-3500	GRANITE

The overburden materials across the site have been subdivided into three types based on typical resistivity ranges. The lowest resistivities from 300-500 Ohm-m have been interpreted as indicating clayey sand/gravel. As the sand/gravel content increases the resistivity values increase with a maximum range of 1000-3000 Ohm-m for clean sand/gravel.

Granite bedrock has been interpreted as having resistivities in the range 800-3500 Ohm-m with low bedrock resistivies (300-800 Ohm-m) interpreted as granite with open joints that are water-filled. These low values may also indicate a fault zone through the site.

2.3 Seismic Refraction

Eight seismic refraction spreads (S1-S8) were recorded across the survey area at the locations shown on Map 1. The seismic data indicate 4 velocity layers which have been interpreted on the following basis:

Layer	Seismic Velocity (m/s)	Average Velocity (m/s)	Interpretation	Estimated Stiffness/ Rock Quality	Excavatability
1	178-324	227	Overburden Material	Soft-Firm/ Loose	Diggable
2	343-857	496	Completely to Highly Weathered Granite	Poor	Diggable
3	706-1500	1048	Highly to Moderately Weathered Granite	Poor-Fair	Diggable – Heavy Breaking
4	3161-3963	3527	Slightly Weathered to Fresh Granite	Good/Very good	Break/ blast

Layer 1 velocities would be typical of soft to firm or loose overburden material. Layer 2 velocities would be typical of completely to highly weathered granite. Layer 3 velocities would be typical of highly to moderately weathered granite and Layer 4 velocities would be typical of slightly weathered to fresh granite bedrock.

2.4 Integrated Results

The results of the 2D Resistivity and seismic data have been combined with the available borehole information to produce Sections 1 to 5. The combined interpretation has been summarised as follows:

Layer	Velocity (m/s)	Average Velocity (m/sec)	Resistivity (ohm-m)	Thickness Range (m)	Average Thickness (m)	Interpretation	Estimated Stiffness/ Rock Quality	Excavatability/ Rippability
1	178-324	227	300-500	0.6-1.2	0.9	Clayey SAND/GRAVEL	Loose	Diggable
			500-1000			Silty SAND/GRAVEL		
			1000-3000			SAND/GRAVEL		
2	343-857	496	300-3500	0.8-3.0	1.6	Completely to Highly Weathered Granite	Poor	Diggable
3	706-1500	1048	300-3500	0.0-4.6	2.5	Highly to Moderately Weathered Granite	Poor-Fair	Diggable – Heavy Breaking
4	3161-3963	3527	300-800			Slightly Weathered to Fresh Granite with open water-filled joints	Good/Very good	Break/ Blast
			800-3500			Slightly Weathered to Fresh Granite		

Overburden:
The geophysical data indicate a thin layer of sandy/gravelly overburden across the site. The thickness of this layer varies locally but is typically 0.9m thick. This overburden material will be diggable.

Bedrock:
The geophysical data indicate three layers within the granite bedrock; an upper layer of completely to highly weathered granite that has an average thickness of 1.6m across the site, underlain by a layer of highly to moderately weathered granite with corestones of unweathered rock that has an average thickness of 2.5m across the site, over slightly weathered to fresh granite bedrock at depths ranging from 2m to 6.9m below ground level.

The low velocities of the completely to highly weathered granite layer indicate that this material will be diggable. The highly to moderately weathered granite layer includes corestones of unweathered granite and any excavation of this layer will range from diggable where the granite is highly weathered to heavy breaking. Any excavation of the slightly weathered to fresh granite will require heavy breaking and blasting.

Low bedrock resistivies (300-800 Ohm-m) and high conductivities predominantly along the western and sourthern parts of the site have been interpreted as indicating granite with open joints that are water-filled. The extent of this low resistivity bedrock is indicated on Map 3. The contact between the two rock types may be faulted.

The conductivity data in conjunction with the 2D Resistivity data have been combined to produce Summary Map 3, indicating variations in the bedrock across the site. The western part of the site is dominated by lower resistivity granite with open water-filled joints while the eastern part of the site is dominated by the higher resistivity granite bedrock. A possible fault line has been interpreted between the two rock types.

3. CONCLUSIONS AND RECOMMENDATIONS

The geophysical data agreed well with the borehole data.

The geophysical survey indicated 4 subsurface layers across the site as follows:

1. An upper layer, on average 0.9m thick, of diggable sandy/gravelly overburden material.
2. A second layer, on average 1.6m thick, of diggable completely to highly weathered granite.
3. A third layer, on average 2.5m thick, of highly to moderately weathered granite with corestones of unweathered rock. Excavation of this layer will range from diggable where the granite is highly weathered to heavy breaking.
4. A fourth layer comprising slightly weathered to fresh granite bedrock at depths ranging from 2m to 6.9m below ground level. Any excavation of the slightly weathered to fresh granite will require heavy breaking and blasting.

In addition, variations in bedrock resistivies have been interpreted as indicating a change in bedrock type along the western and southern boundaries of the site, from granite to granite with open joints that are water-filled. The contact between the two rock types may be faulted.

If bedrock excavation were proposed, a detailed assessment of excavatability should be carried out combining the results of the geophysical survey, rotary core drilling, strength testing, and trial excavation pits using a high powered excavator. Trial excavations should be attempted down to formation level using a high powered excavator of similar rating to that to be used during construction.

A more detailed discussion of velocity and excavatability is contained in Appendix III.

The geophysical interpretation should be reviewed based on the findings of any further direct investigation.

4. REFERENCES

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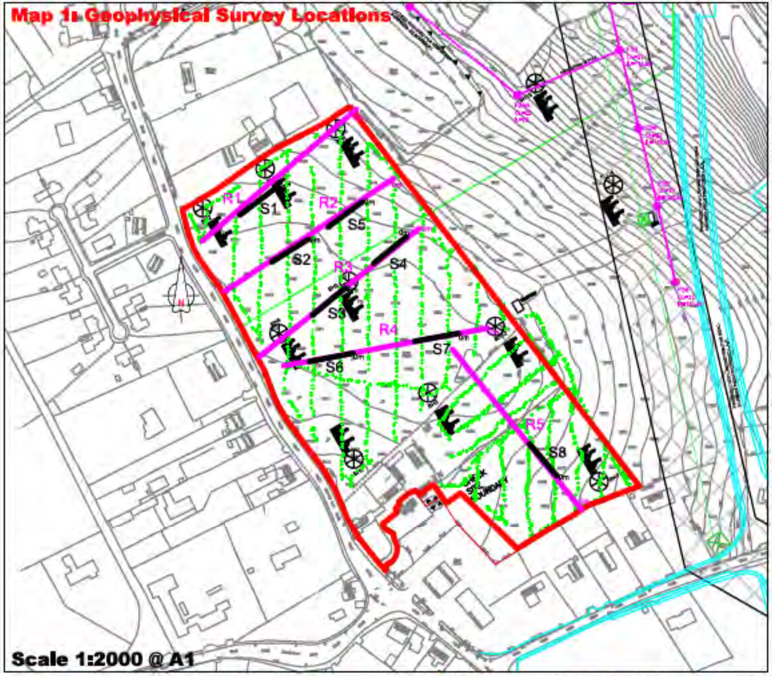
MAPS & SECTIONS

Map 1: Geophysical Survey Locations



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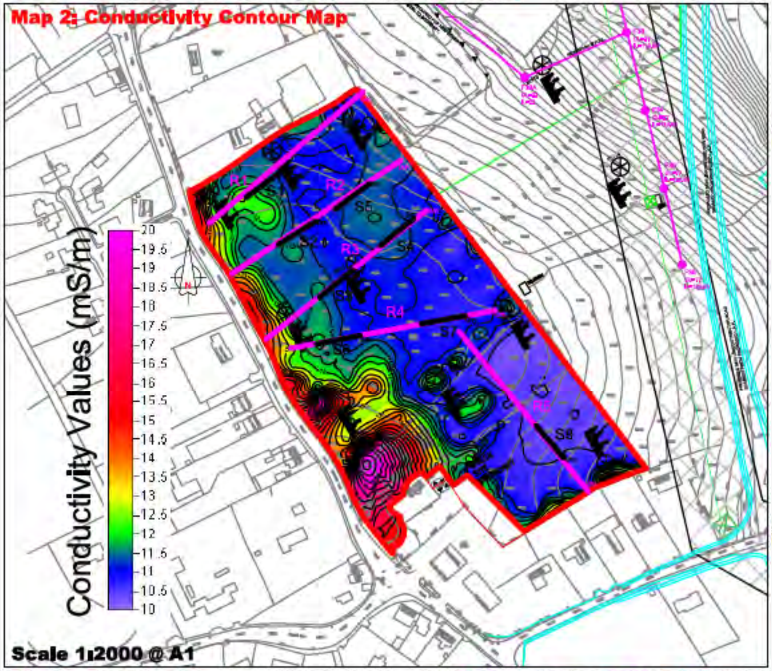
Map 2: Conductivity Contour Map



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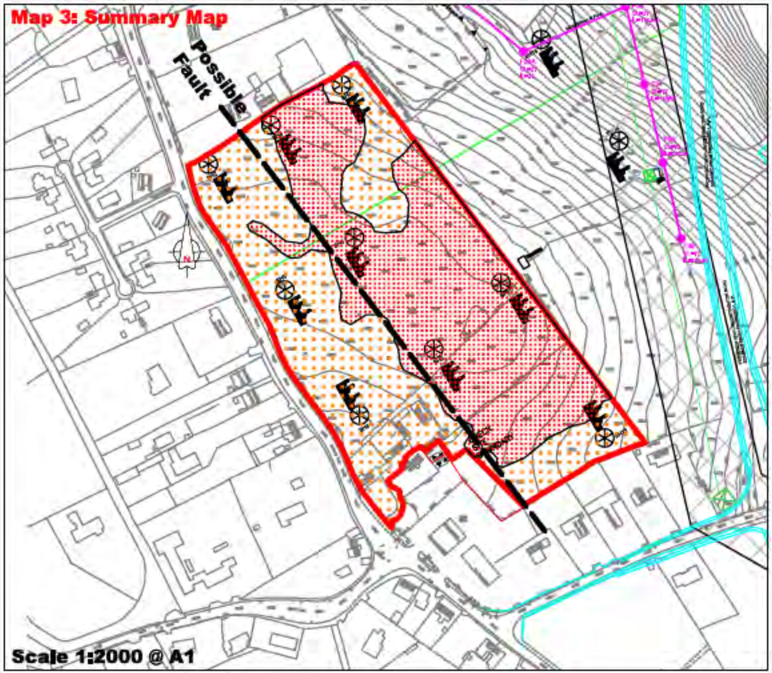
Map 3: Summary Map



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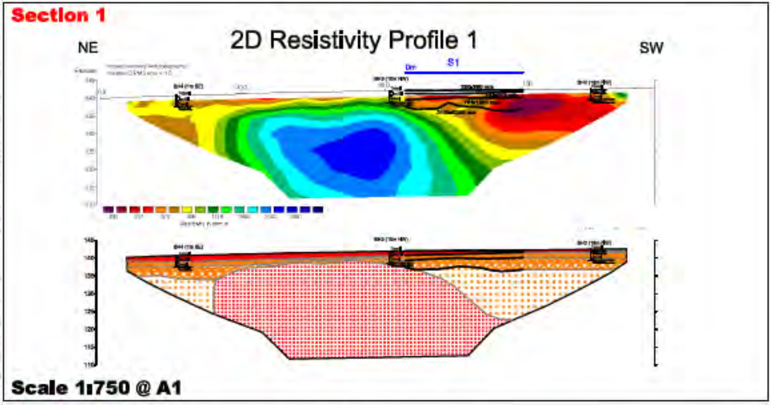
Section 1



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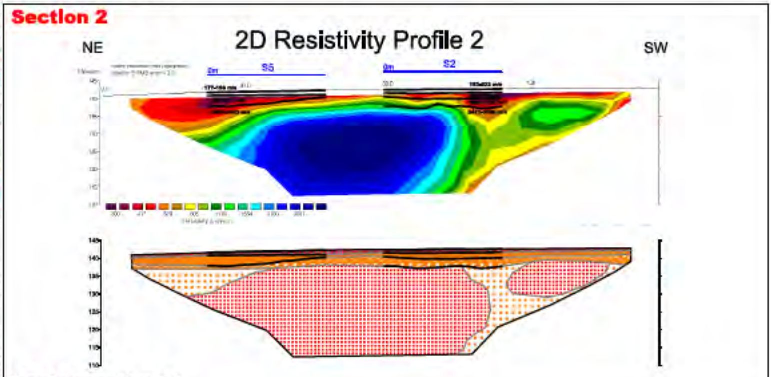

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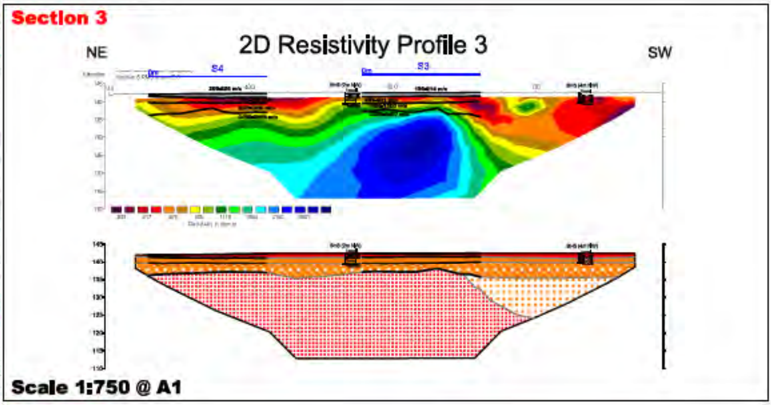

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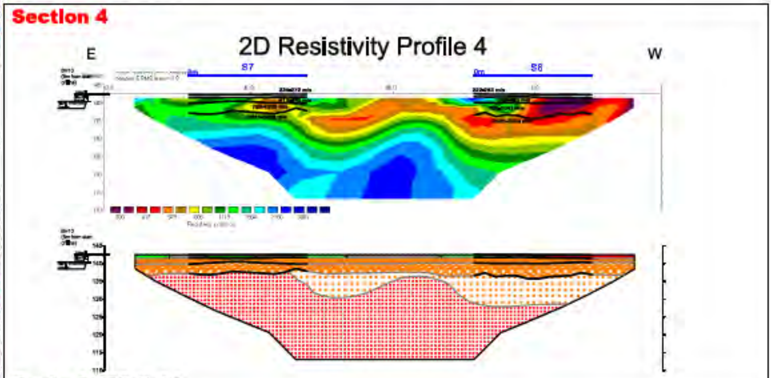

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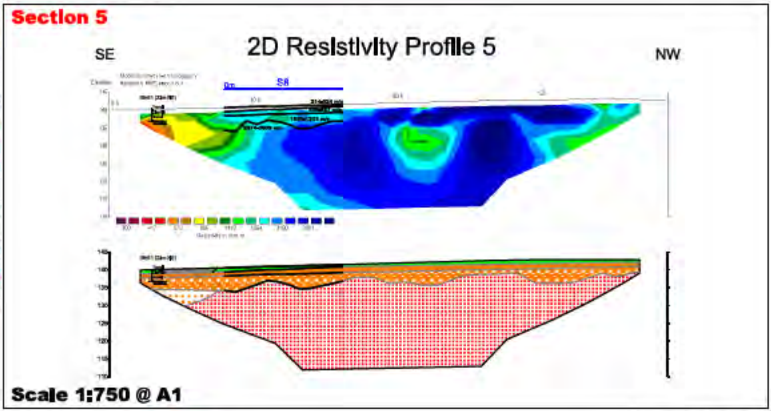

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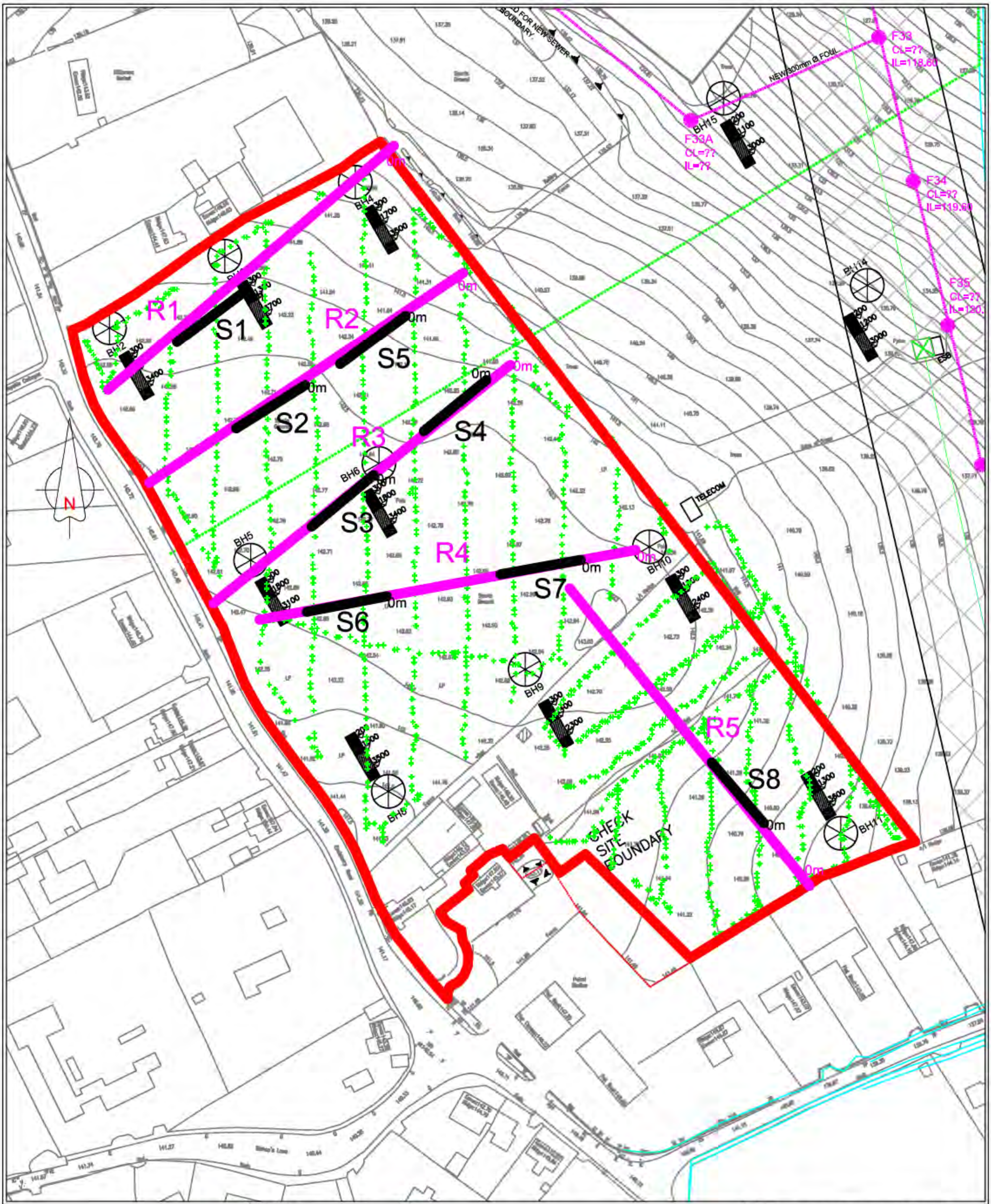
apex

LEGEND

- 🟥 Site Boundary
- ✚ Electromagnetic Conductivity Station
- 2D Resistivity Profile
- Seismic Refraction Profile
- 🟥 GRANITE
- ▨ GRANITE with Water-filled Open Joints
- Possible Fault
- Layer Boundary from Seismic Data
- Interpreted Layer Boundary
- ▨ Clayey SAND/GRAVEL
- ▨ Silty SAND/GRAVEL
- 🟩 SAND/GRAVEL
- 🟧 Completely to Highly Weathered GRANITE
- 🟧 Highly to Moderately Weathered GRANITE
- ▨ Slightly Weathered to Fresh GRANITE with open water-filled joints
- 🟥 Slightly Weathered to Fresh GRANITE

Geophysical Maps & Sections

3rd July 2008



INDEX MAP:

LEGEND:

🟥 Site Boundary

+ Electromagnetic Conductivity Station

— 2D Resistivity Profile

— Seismic Refraction Profile

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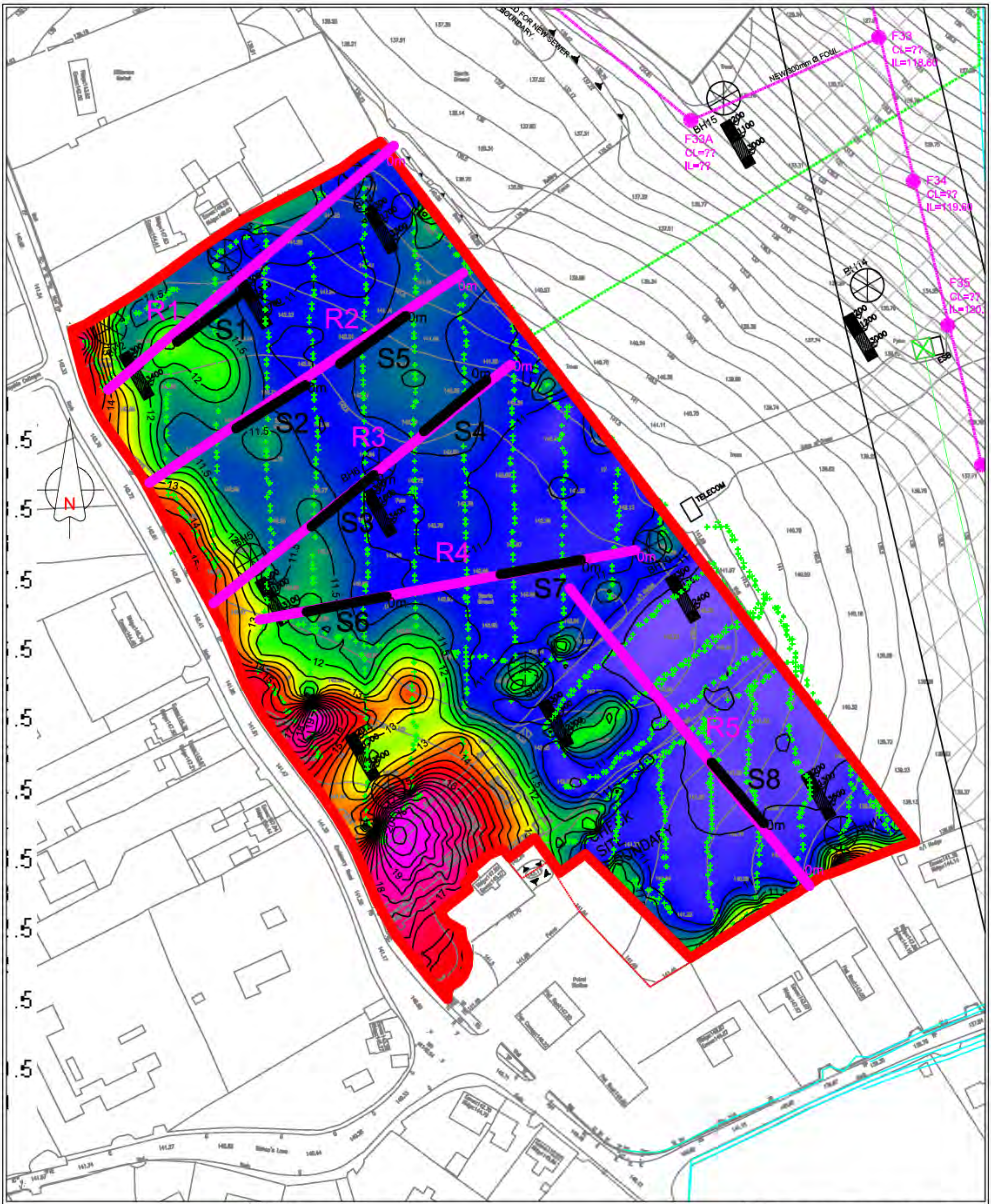
PROJECT:	AGL07380 Kilternan, Co. Dublin
DRAWING No:	Map 1 - Geophysical Survey Locations
DATE:	June 2008
CLIENT:	Durkan New Homes
SCALE:	1:2000 @A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials



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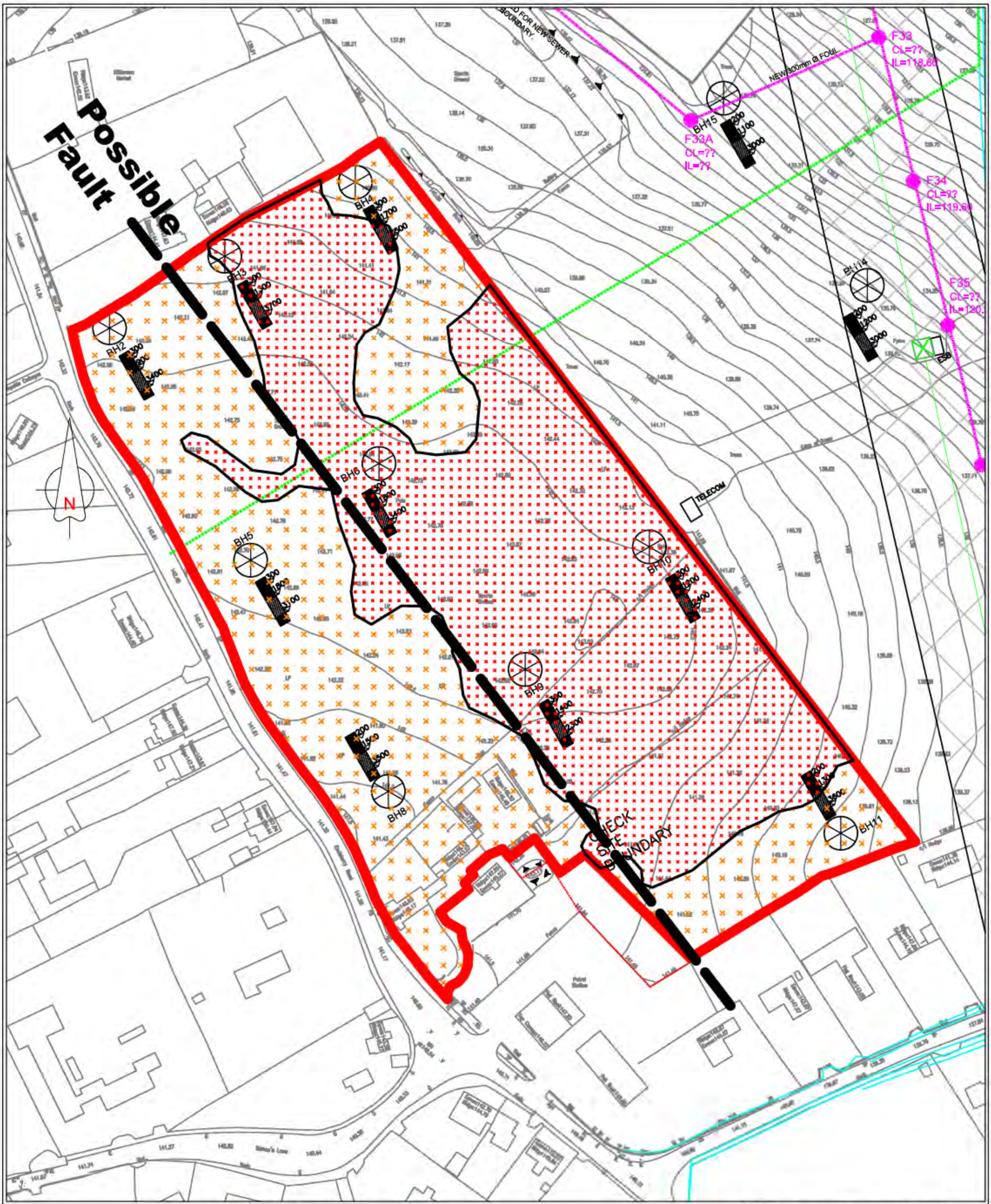
www.apexgeoservices.ie

INDEX MAP:

LEGEND:

PROJECT:	AGL07380 Kilternan, Co. Dublin
DRAWING No:	Map 2 - Conductivity Contour Map
DATE:	June 2008
CLIENT:	Durkan New Homes
SCALE:	1:2000 @A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials



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E: info@apexgeoservices.ie
www.apexgeoservices.ie

INDEX MAP:

LEGEND:

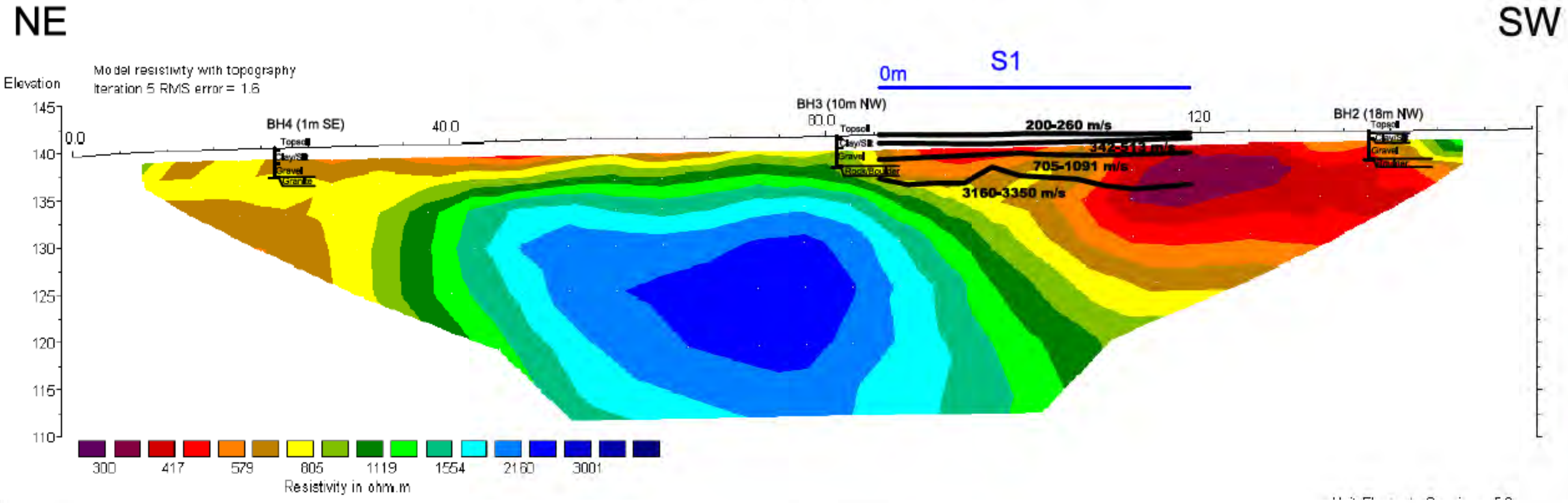
🟥 GRANITE

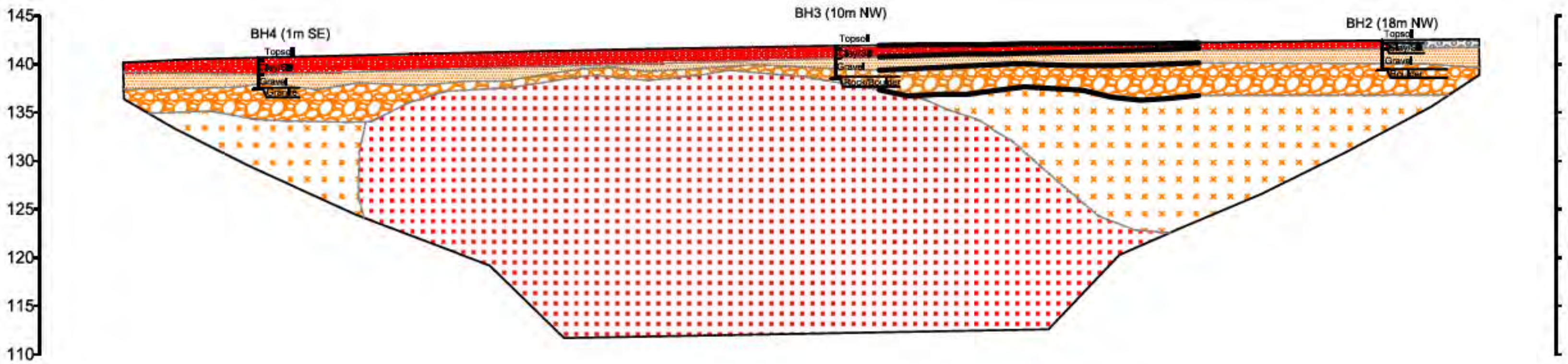
▨ GRANITE with Water-Filled Open Joints

— — Possible Fault

PROJECT:	AGL07380 Kilternan, Co. Dublin		
DRAWING No.:	Map 3 - Summary Map		
DATE:	June 2008		
CLIENT:	Durkan New Homes		
SCALE:	1:2000 @A4		
Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials

2D Resistivity Profile 1





INDEX MAP:

LEGEND:

- ∼ Layer Boundary from Seismic Data
- ∼ Interpreted Layer Boundary
- ▨ Clayey SAND/GRAVEL
- ▨ Silty SAND/GRAVEL
- ▨ SAND/GRAVEL
- ▨ Completely to Highly Weathered GRANITE
- ▨ Highly to Moderately Weathered GRANITE
- ▨ Slightly Weathered to Fresh GRANITE with open water-filled joints
- ▨ Slightly Weathered to Fresh GRANITE

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PROJECT:	AGL07380 Kilternan, Co. Dublin
DRAWING No.:	Section 1
DATE:	June 2008
CLIENT:	Durkan New Homes
SCALE:	1:750 @A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials

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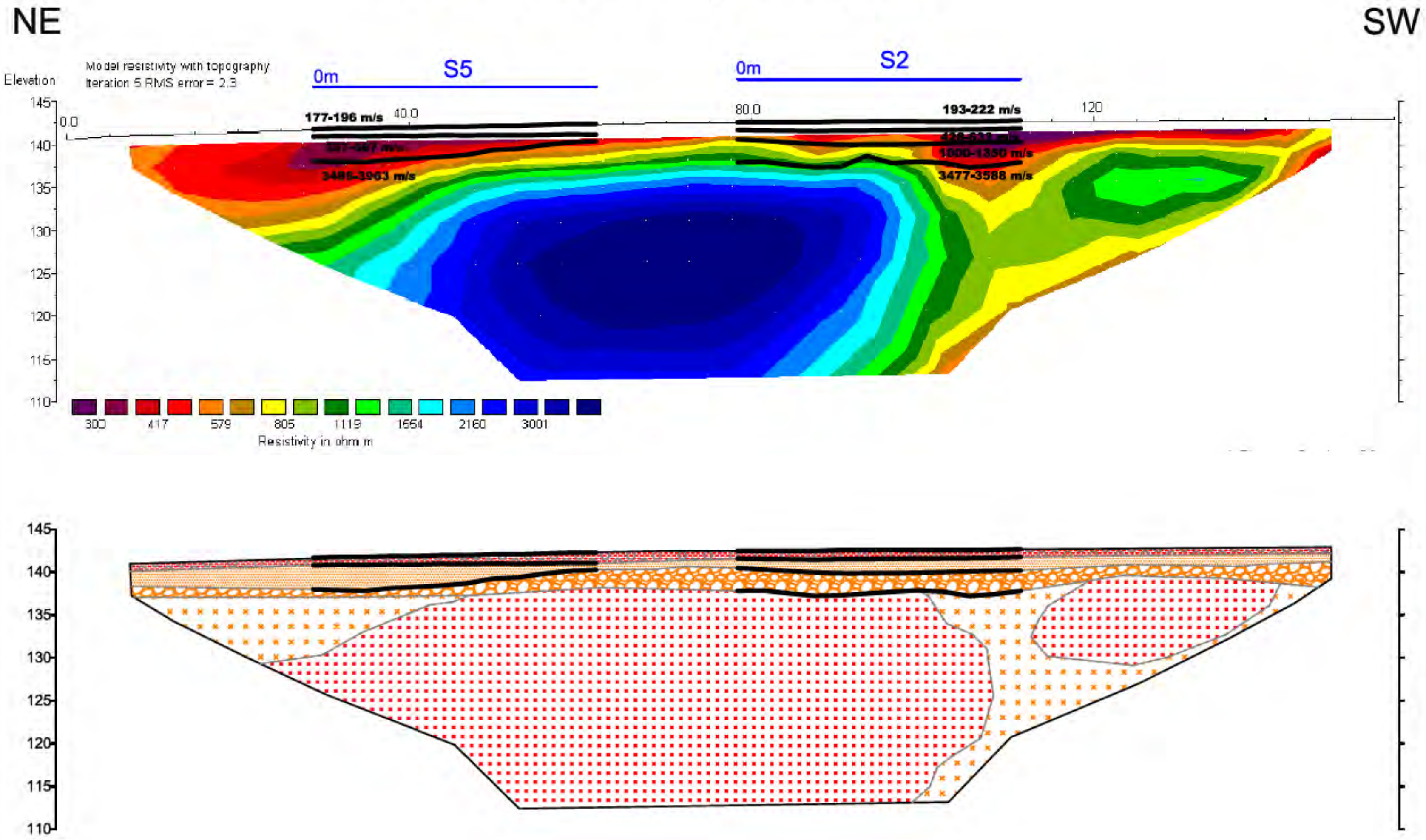

INDEX MAP:

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PROJECT:	AGL07380 Kilternan, Co. Dublin
DRAWING No.:	Section 2
DATE:	June 2008
CLIENT:	Durkan New Homes
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Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials

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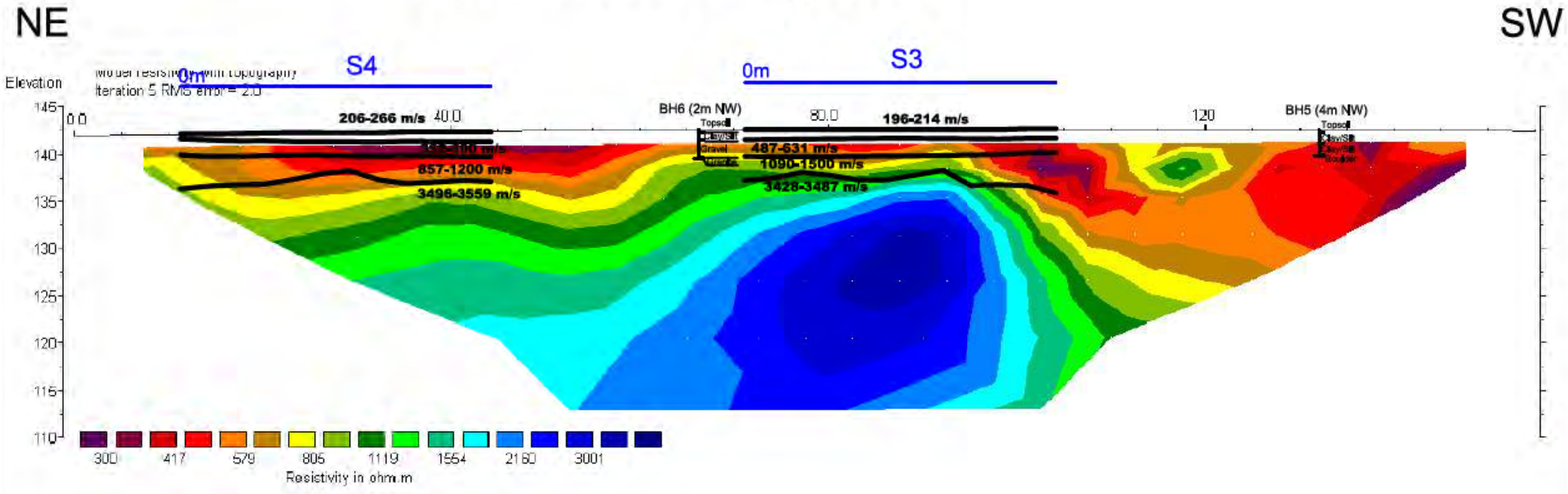

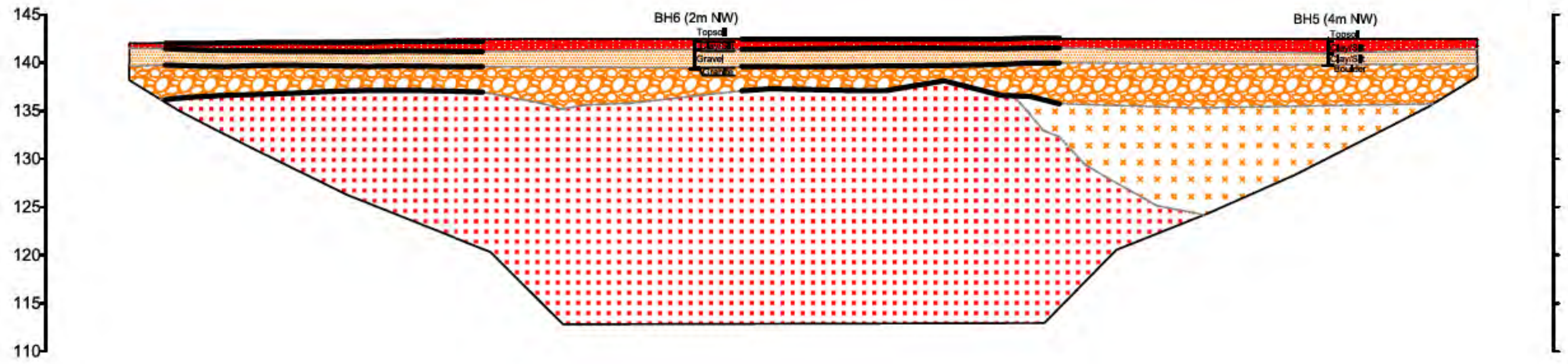

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PROJECT: AGL07380 Kilternan, Co. Dublin
DRAWING No.: Section 3
DATE: June 2008
CLIENT: Durkan New Homes
SCALE: 1:750 @A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials

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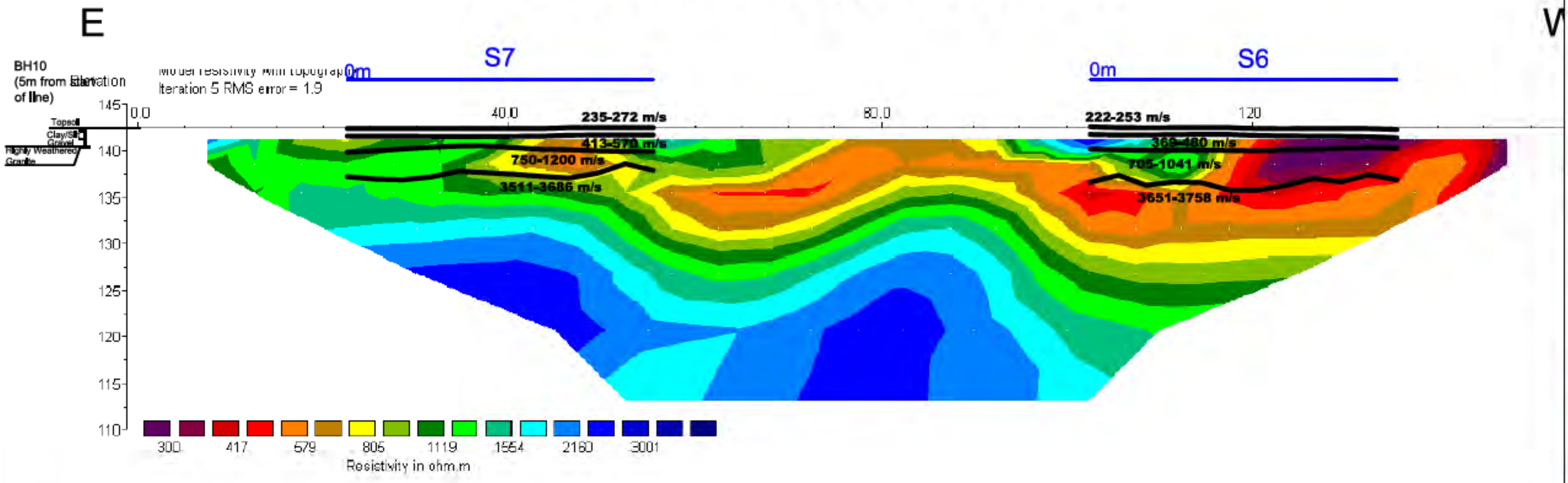

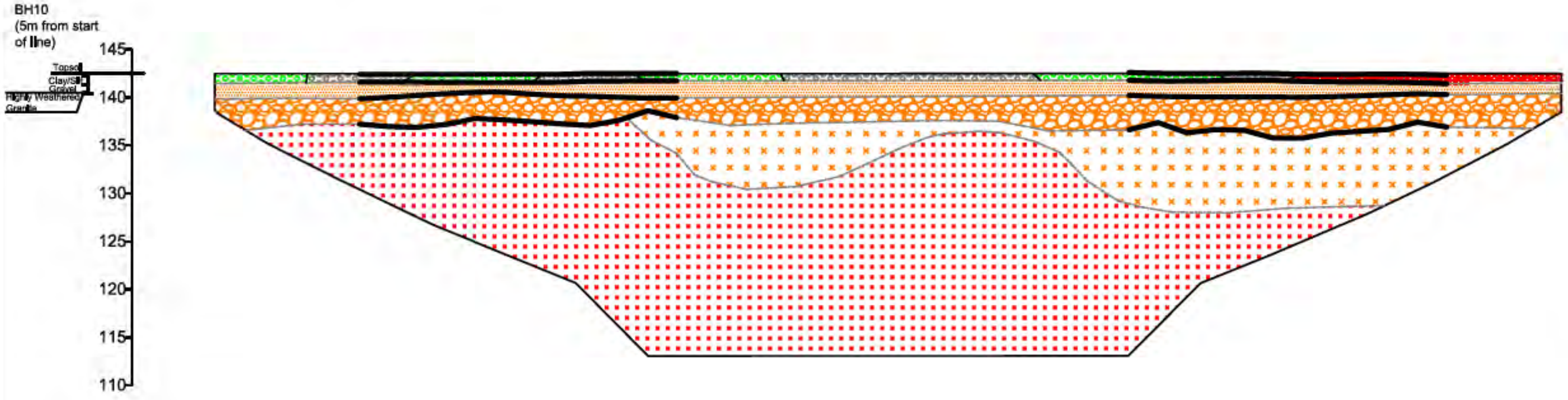

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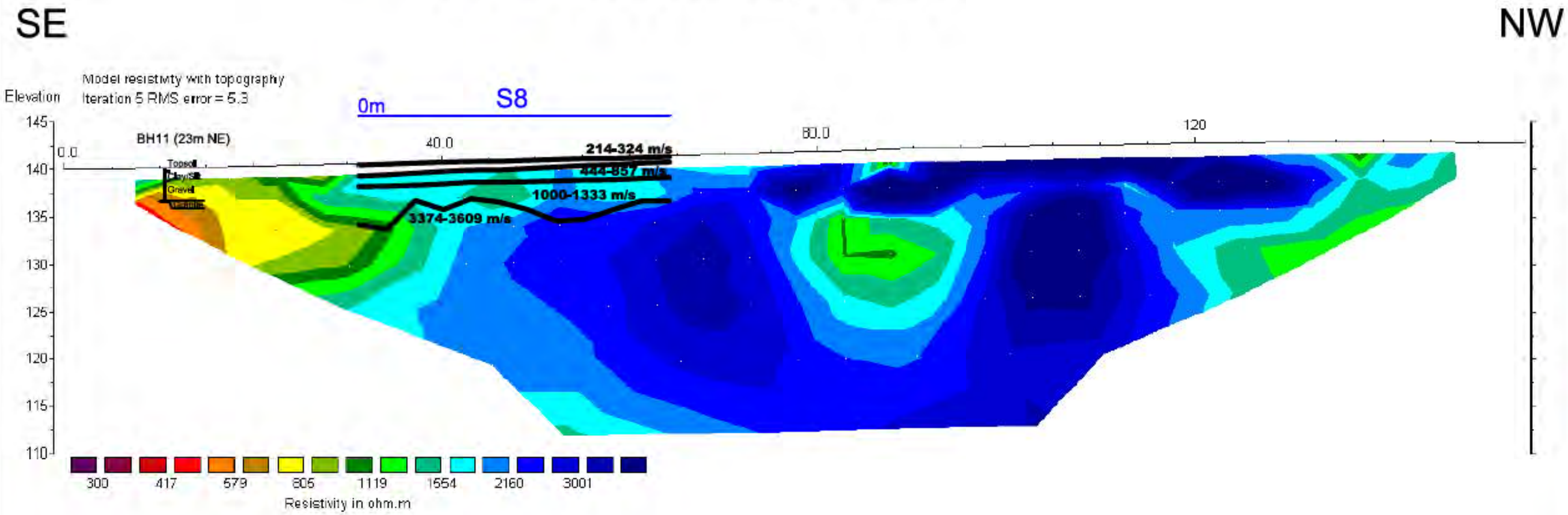
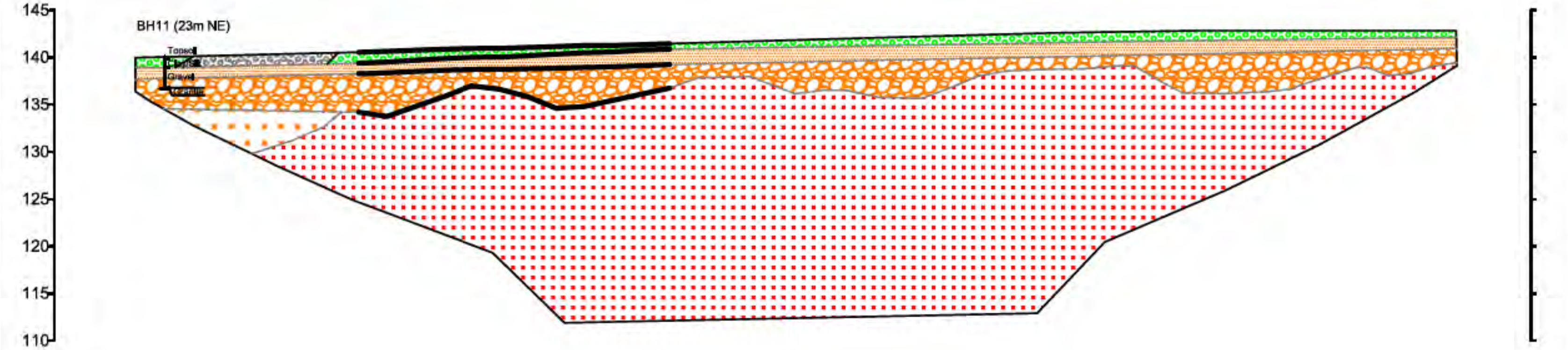
PROJECT:	AGL07380 Kilternan, Co. Dublin
DRAWING No.:	Section 4
DATE:	June 2008
CLIENT:	Durkan New Homes
SCALE:	1:750 @A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials

2D Resistivity Profile 5





INDEX MAP:

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PROJECT:	AGL07380 Kilternan, Co. Dublin
DRAWING No:	Section 5
DATE:	June 2008
CLIENT:	Durkan New Homes
SCALE:	1:750 @A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials

APPENDIX I GEOPHYSICAL METHODOLOGY

M1. Methods Used

1.1 EM Conductivity

This method operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/metre (mS/m). As the effective penetration of this method is around 6m below ground level the measured conductivity is a function of the different overburden layers and/or rock from 0 to 6m below ground level.

1.2 2D-Resistivity Profiling

The resistivity surveying technique makes use of the Wenner resistivity array whereby four electrodes are placed in a line in the ground and a current is passed through the two outer electrodes. The potential difference is measured across the two inner electrodes. The measured potential is divided by the current value to obtain the resistance. The resistivity is determined from the resistance using the following formula:

Resistivity = Resistance* 2 * Pi * Spacing.

The 2D-resistivity profiling method records a large number of resistivity readings in order to map lateral and vertical changes in material types. The 2D-resistivity profiling method involves the use of 32 electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

1.3 Seismic Refraction Profiling

This method measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph.

M2. Equipment Used

2.1 EM Conductivity

The equipment used was a GF CM31 Conductivity meter equipped with data logger. This instrument features a real time graphic display of the previous 20 measurement points to monitor data quality and results.

2.2 2D-Resistivity Profiling

A Campus instrument with a 32 take-out multicore cable (5 m spacing) and 32 stainless steel electrodes were used. Equipment was carried in a 4WD. A two-person crew was employed.

2.3 Seismic Refraction Profiling

A RAS-24 high resolution 24 channel digital seismograph, 12 10HZ vertical geophones and a 10 kg hammer were used to provide first break information, with two 12 take-out cables (5m spacing) and a trigger geophone. Equipment was carried in a 4WD vehicle with a two-person crew.

M3. Field Procedure

3.1 EM Conductivity

1660 conductivity readings were recorded on the 11th and 12th December 2007.Conductivity and in-phase values were recorded on an approximate 3m x 25m grid over an approximate area of 5.6 hectares. Local conditions and variations were recorded.

3.2 2D-Resistivity Profiling

Five profiles were recorded on the 11th and 12th December 2007. An electrode spacing of 5 m investigating to a maximum depth of 30 m below ground level was used. The profiles were 155 m in length. 2 cycles were recorded to 3% repeatability. Saline solution was added around electrodes in areas of high contact resistance. Local conditions and variations were recorded. QC inversion of each profile was carried out before removal of electrodes.

3.3 Seismic Refraction Profiling

Eight spreads were recorded on the 11th and 12th December 2007. Each seismic spread consisted of 12 collinear geophones at spacings of 3m, and were 33m in length. Records from up to five different positions were taken on each spread (2 x off-end, 2 x end, 1 x middle) to ensure optimum coverage of all refractors.

M4. Data Processing

4.1 EM31 Conductivity Mapping

The data were downloaded and plotted. Assignation of material types and possible anomaly sources was carried out, with cross-reference to other data. A scaled plot of conductivity against distance was prepared (Map 2) with annotated interpretation (Map 3).

4.2 2D-Resistivity Profiling

The field readings were stored in computer files and inverted using the RES2DINV package (Campus Geophysical Instruments, 1997) with up to 5 iterations of the measured data carried out for each profile to obtain a 2D-Depth model of the resistivities. The readings were edited to remove any noisy reading. Topographic corrections were applied.

The inverted 2D-Resistivity models and corresponding interpreted geology are displayed on Sections 1 to 5. The distance from the first electrode is indicated along the horizontal axis of the profile and the depth below ground level is indicated on the vertical axis. The resistivity profiles have been contoured using the same contour intervals and colour codes.

It is important to note that the data displayed on the 2D-Resistivity profiles is real physical data however interpretation of the geophysical results is required to transform the resistivities directly into geological layers.

4.3 Seismic Refraction Profiling

First break picking in digital format was carried out using the FIRSTPIX software program to construct traveltime plots for each spread. Velocity phases were selected from these plots using the GREMIX software program and were used to calculate the thickness of individual velocity units. Topographic data were input. Material types were assigned and estimation made of material properties, cross-referenced to the 2D Resistivity and borehole data. The processed seismic data are displayed in Appendix II and on Sections 1 to 5.

Approximate errors for velocities are estimated to be +/- 10%. Errors for the calculated layer thicknesses are of the order of +/-20%. Possible errors due to the "hidden layer" and "velocity inversion" effects may also occur (Soske, 1959).

APPENDIX II SEISMIC REFRACTION DATA

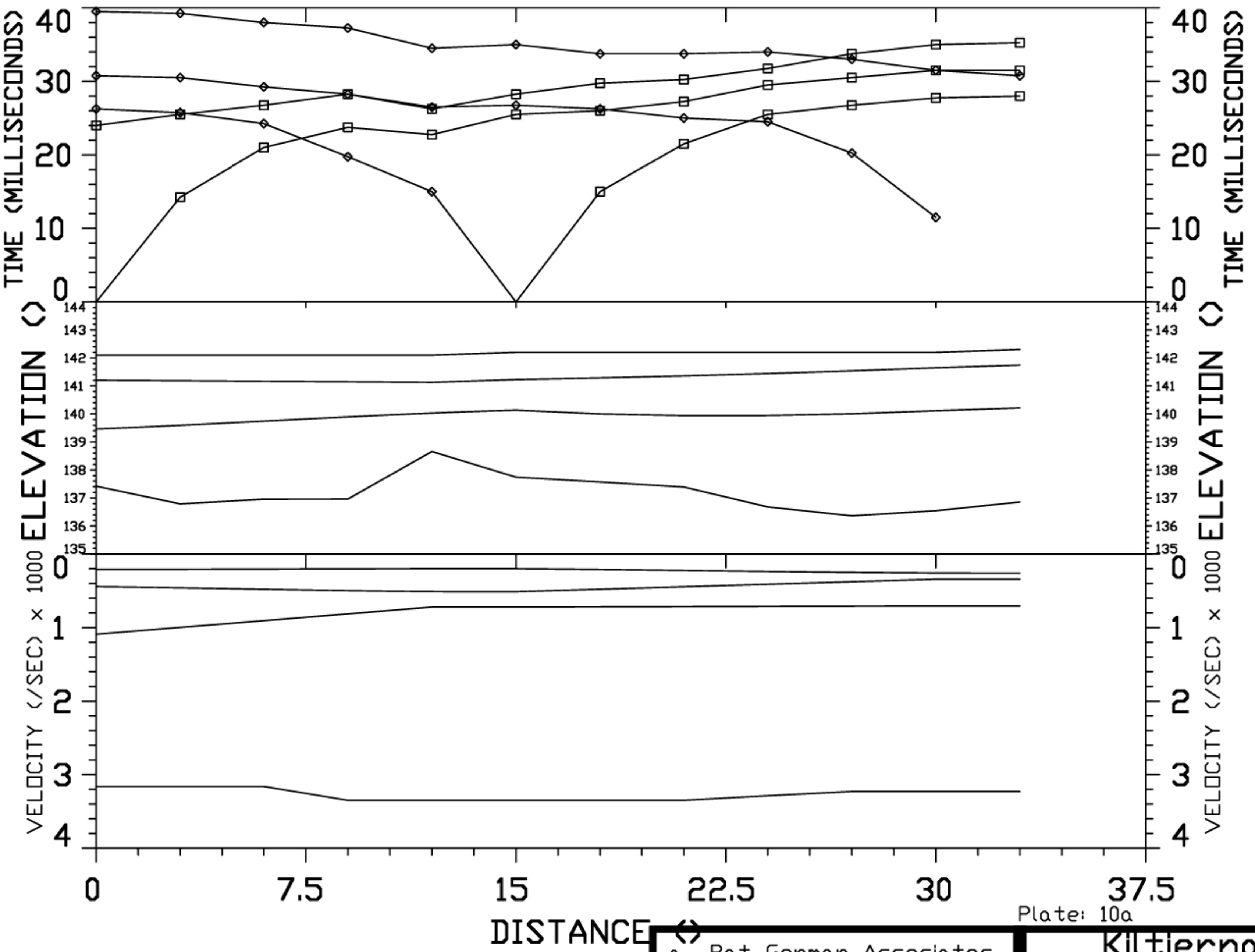

Plate: 10a

for: Pat Gorman Associates

by: APEX Geoservices Ltd.

Data SetS1

Date: 11/DEC/200

Equipment: GEOMETRICS Sma

Spread: S1

Kiltiernan

Kiltiernan
Co. Dublin

Azimuth:

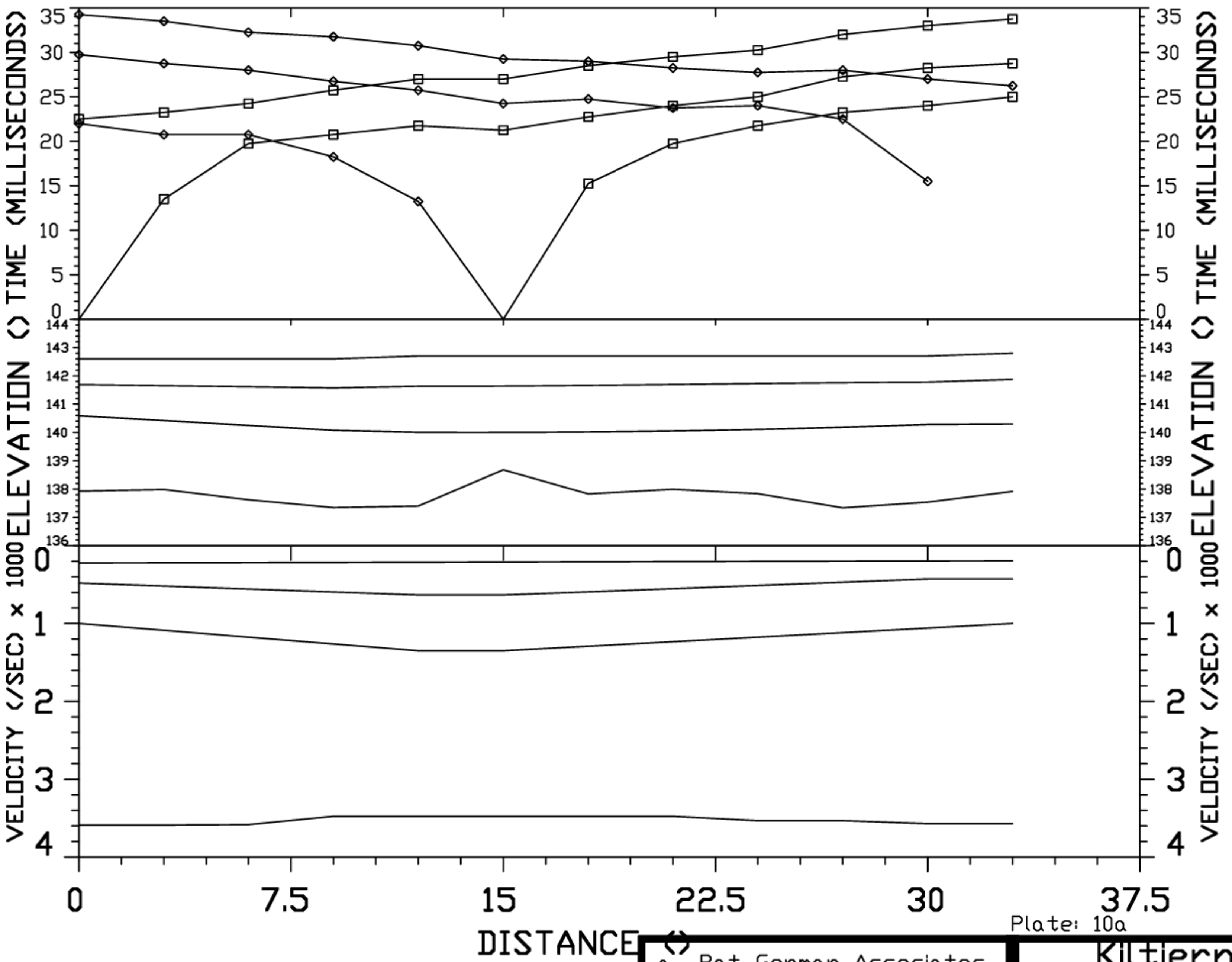

Plate: 10a

for: Pat Gorman Associates

by: APEX Geoservices Ltd.

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Date: 11/DEC/200

Equipment: GEOMETRICS Sma

Spread: S2

Kiltiernan

Kiltiernan
Co. Dublin

Azimuth:

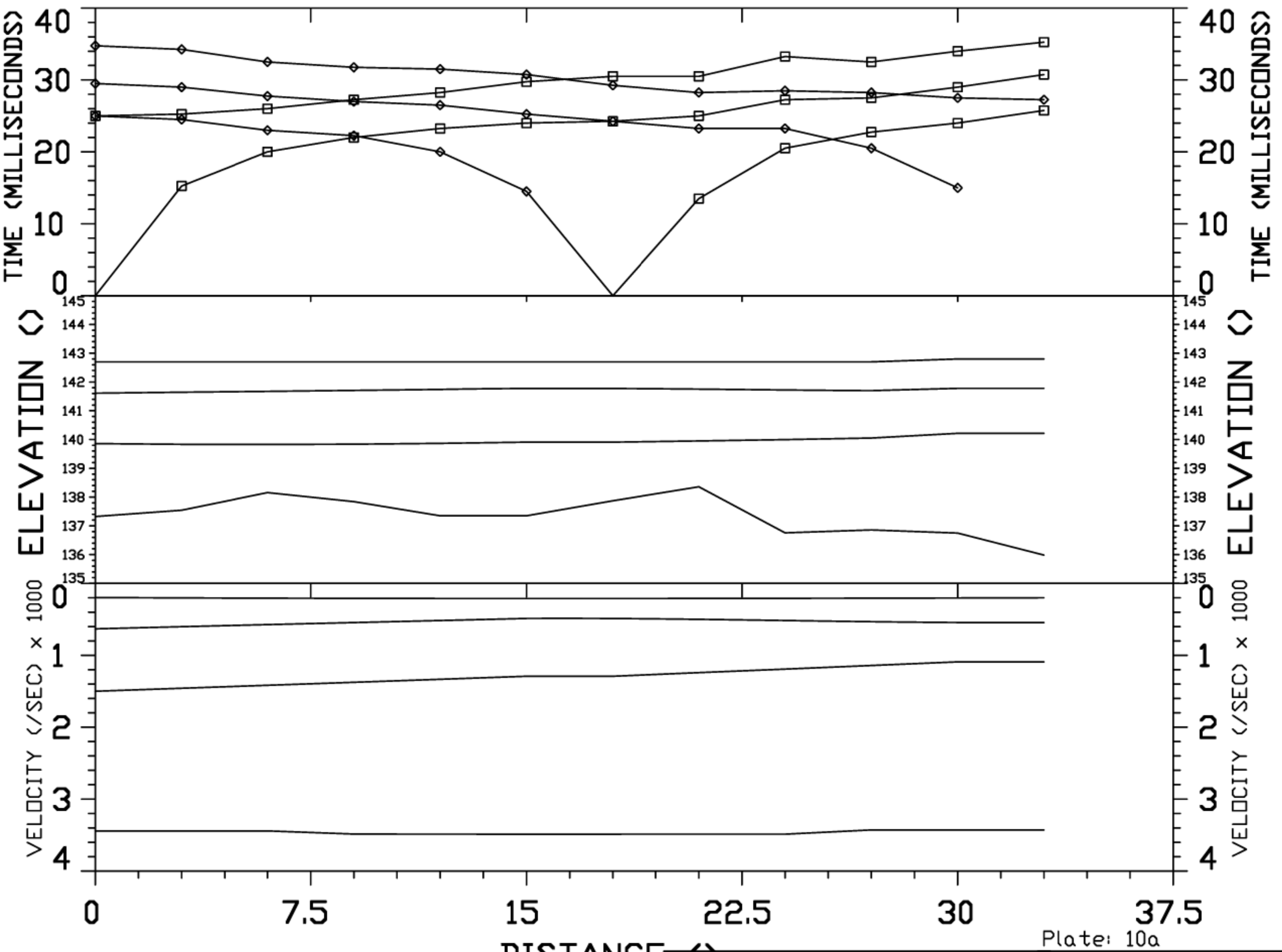

Plate: 10a

for: Pat Gorman Associates

by: APEX Geoservices Ltd.

Data SetS3

Date: 11/DEC/200

Equipment: GEOMETRICS Sma

Spread: S3

Kiltiernan

Kiltiernan
Co. Dublin

Azimuth:

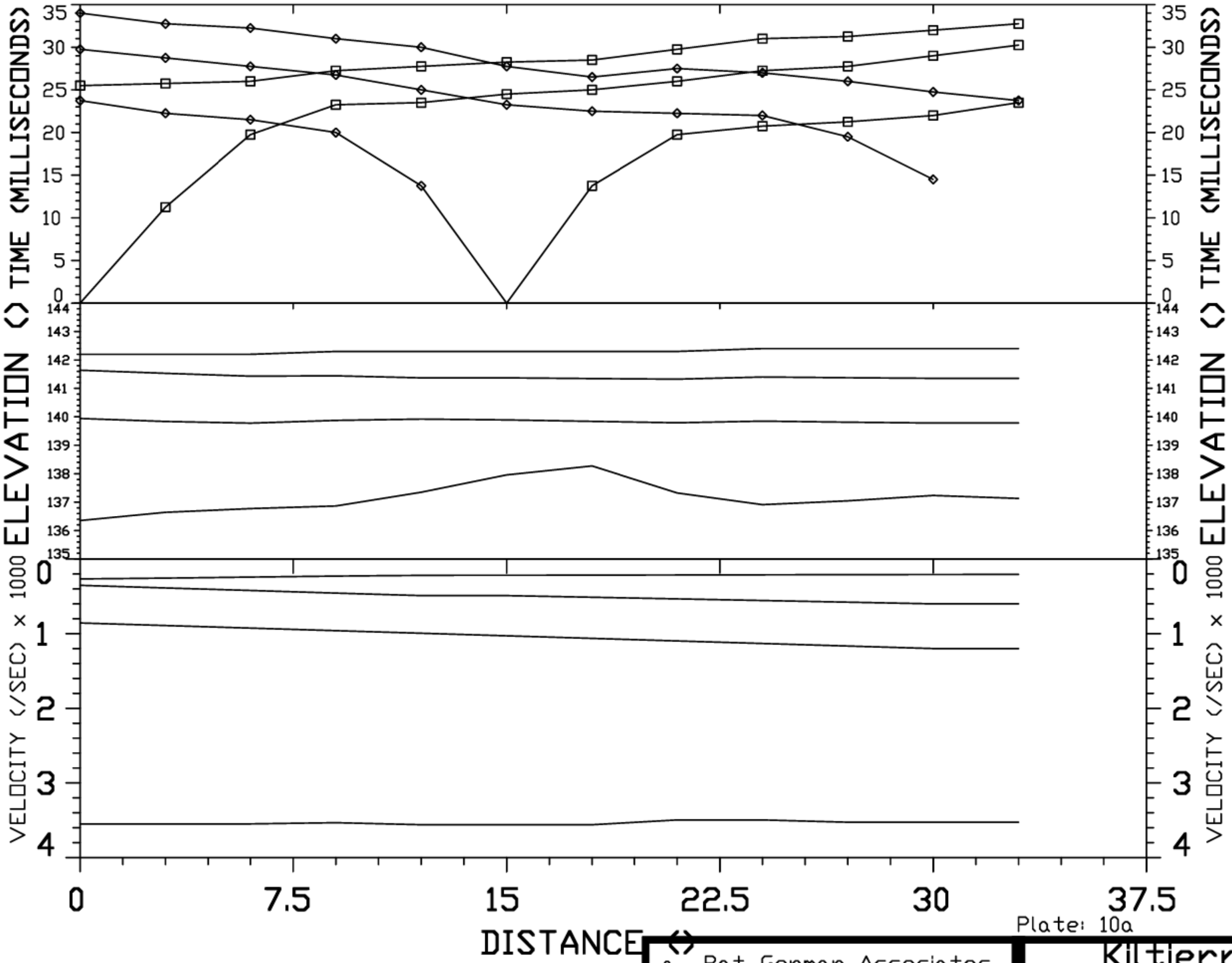

Plate: 10a

for: Pat Gorman Associates

by: APEX Geoservices Ltd.

Data SetS4

Date: 11/DEC/200

Equipment: GEOMETRICS Sma

Spread: S4

Kiltiernan

Kiltiernan
Co. Dublin

Azimuth:

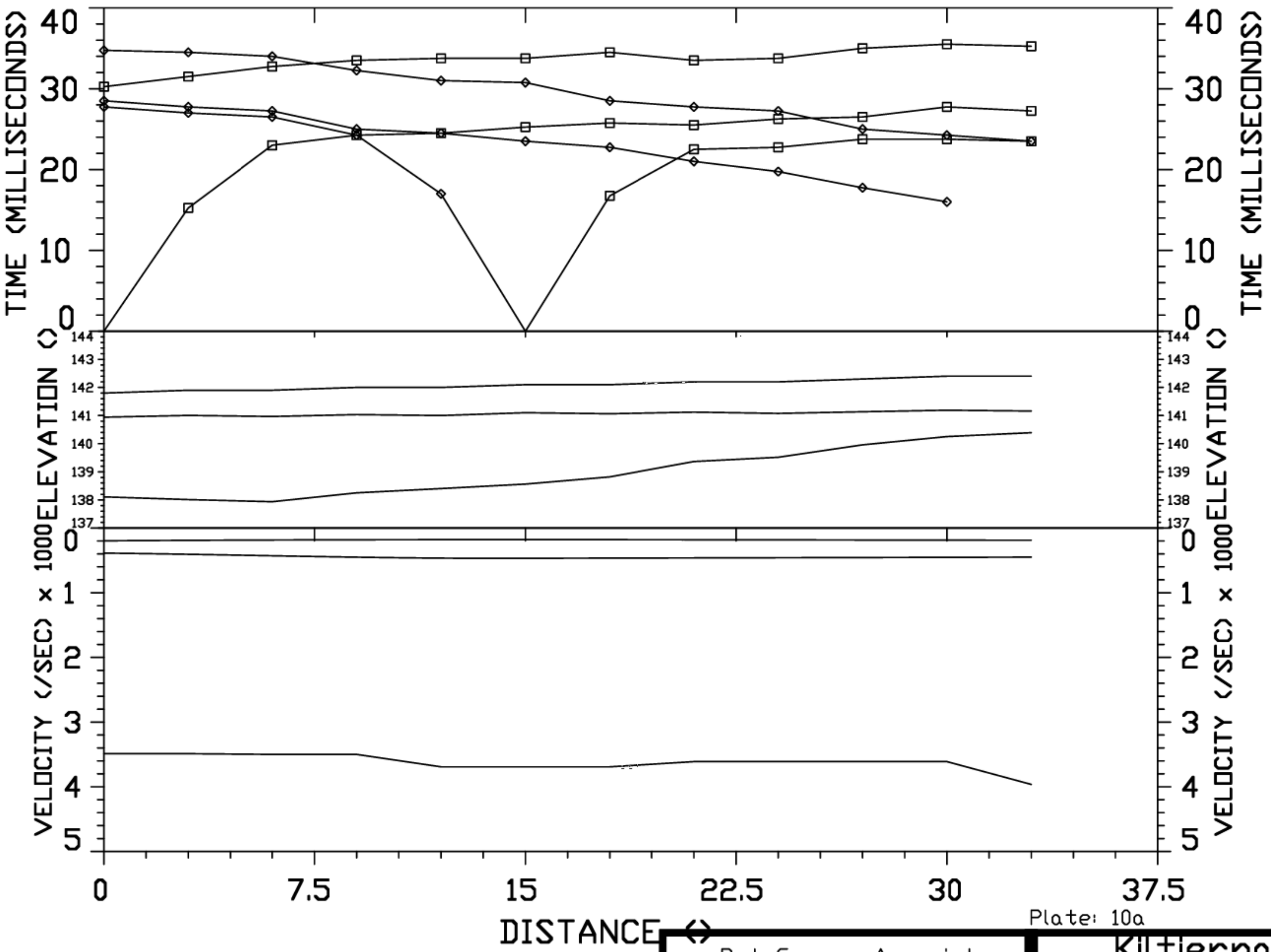

Plate: 10a

for: Pat Gorman Associates

by: APEX Geoservices Ltd.

Data SetS5

Date: 11/DEC/200

Equipment: GEOMETRICS Sma

Spread: S5

Kiltiernan

Kiltiernan
Co. Dublin

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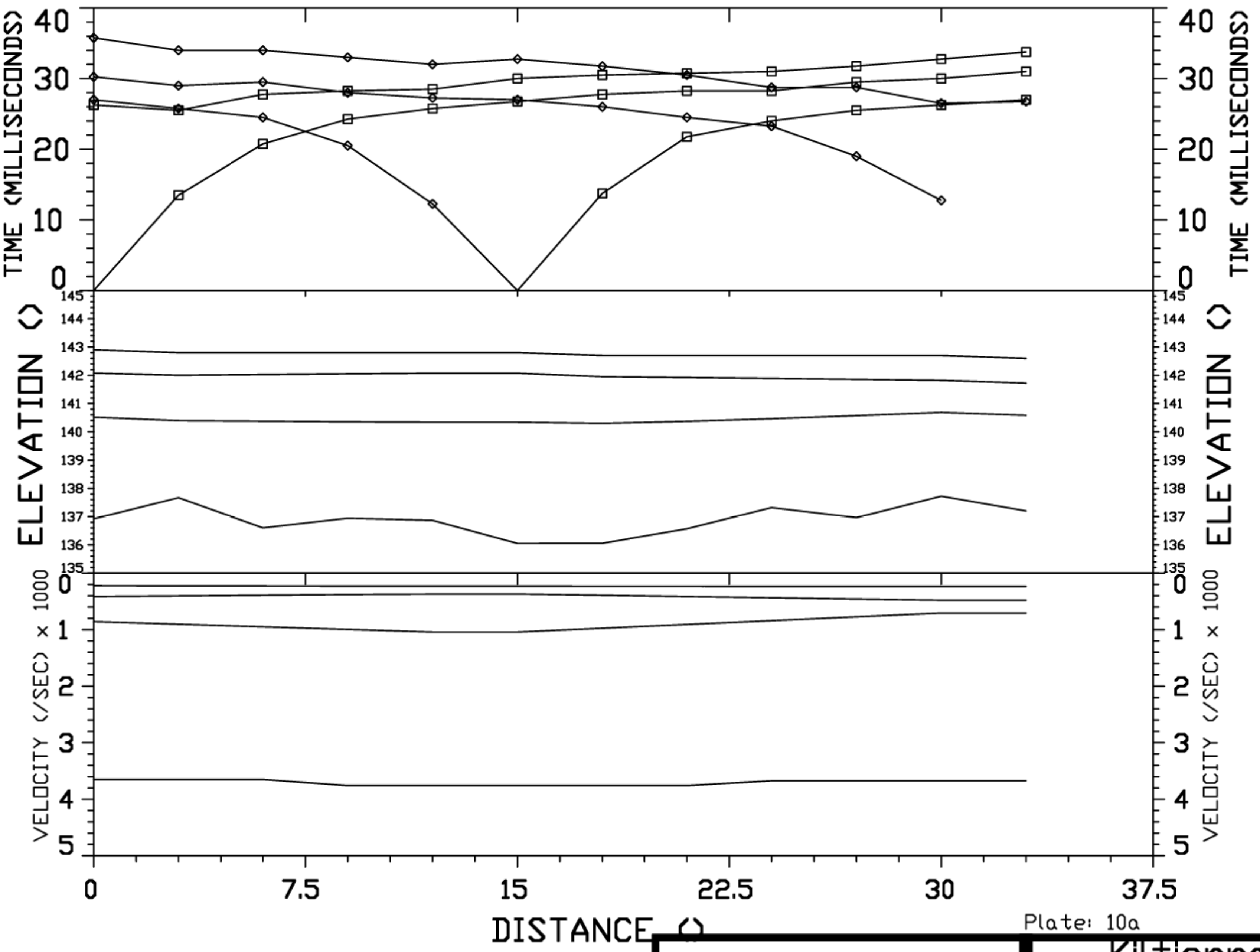


Plate: 10a

for: Pat Gorman Associates	Kiltiernan
by: APEX Geoservices Ltd.	Kiltiernan Co. Dublin
Data SetS6	Date: 11/DEC/200
Equipment: GEOMETRICS Sma	Spread: S6
	Azimuth:

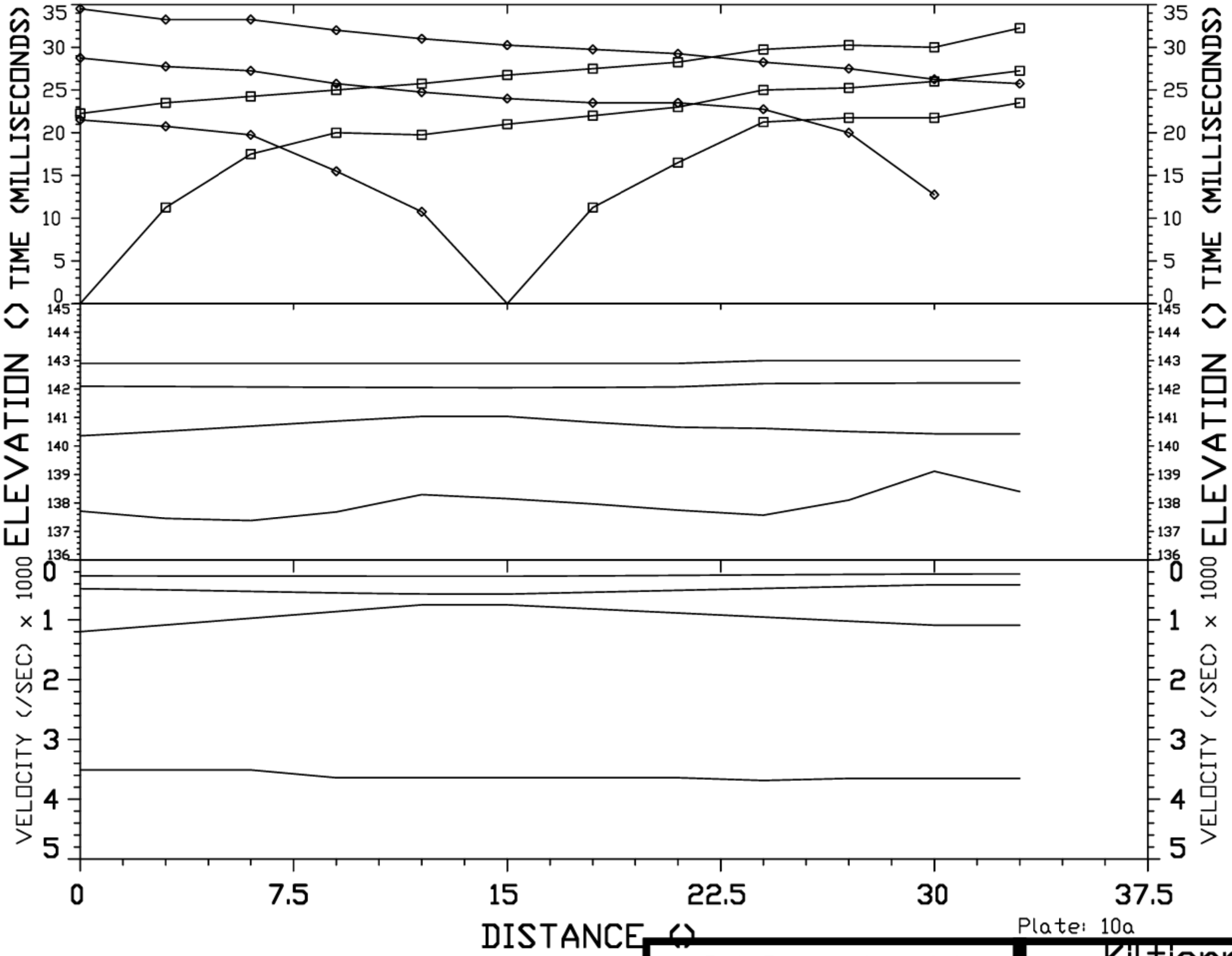


Plate: 10a

for: Pat Gorman Associates	
by: APEX Geoservices Ltd.	
Data SetS7	Date: 11/DEC/200
Equipment: GEOMETRICS Sma	Spread: S7

Kiltiernan

Kiltiernan
Co. Dublin

Azimuth:

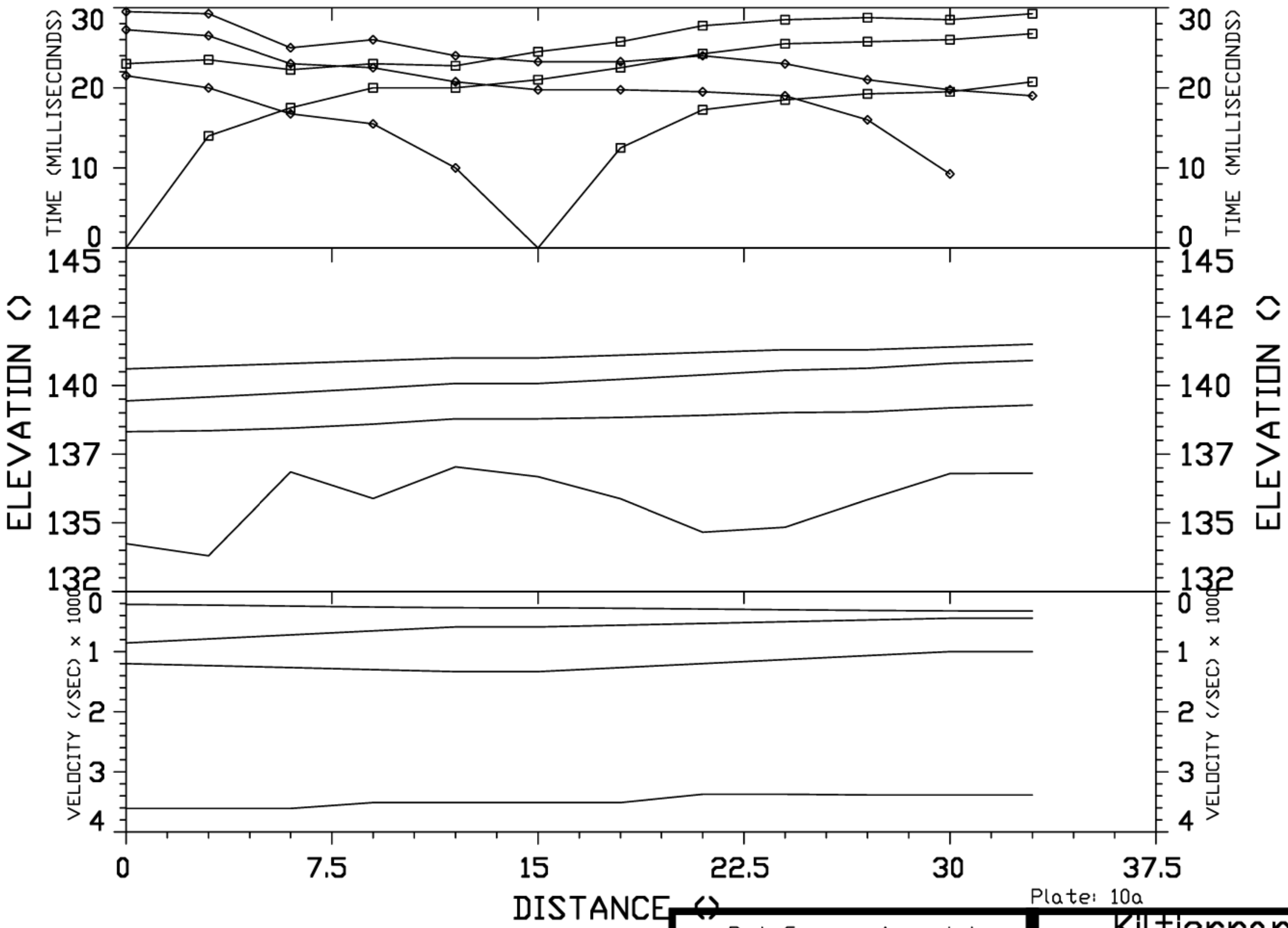


Plate: 10a

for: Pat Gorman Associates	
by: APEX Geoservices Ltd.	
Data SetS8	Date: 11/DEC/200
Equipment: GEOMETRICS Sma	Spread: S8

Kiltiernan

Kiltiernan
Co. Dublin

Azimuth:

APPENDIX III EXCAVATABILITY

The seismic velocity of a rock formation is related to characteristics of the rock mass which include rock hardness and strength, degree of weathering and discontinuities. Usually the velocity is just one of several parameters used in the assessment of excavatability. The excavatability of a rock formation is favoured by the following factors:

- Open fractures, faults and other planes of weakness of any kind
- Weathering
- Brittleness and crystalline nature
- High degree of stratification or lamination
- Large grain size
- Low compressive strength

Weaver (1975) presented a comprehensive rippability rating chart (Fig.1) in which the p-wave velocity value and the relevant geological factors could be entered and assigned appropriate weightings. The total weighted index was found to correlate very well with actual rippability.

Fig.1 Rippability Rating Chart

Rock class	I	II	III	IV	V
Description	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock
Seismic velocity (m/s)	>2150	2150-1850	1850-1500	1500-1200	1200-450
Rating	26	24	20	12	5
Rock hardness	Extremely hard rock	Very hard rock	Hard rock	Soft rock	Very soft rock
Rating	10	5	2	1	0
Rock weathering	Unweathered	Slightly weathered	Weathered	Highly weathered	Completely weathered
Rating	9	7	5	3	1
Joint spacing (mm)	>3000	3000-1000	1000-300	300-50	<50
Rating	30	25	20	10	5
Joint continuity	Non continuous	Slightly continuous	Continuous-no gouge	Continuous-some gouge	Continuous-with gouge
Rating	5	5	3	0	0
Joint gouge	No separation	Slight separation	Separation <1mm	Gouge <5mm	Gouge >5mm
Rating	5	5	4	3	1
Strike and dip orientation	Very unfavourable	Unfavourable	Slightly unfavourable	Favourable	Very favourable
Rating	15	13	10	5	3
Total rating	100-90	90-70*	70-50	50-25	<25
Rippability assessment	Blasting	Extremely hard ripping and blasting	Very hard ripping	Hard ripping	Easy ripping
Tractor horsepower		770/385	385/270	270/180	180
Tractor kilowatts		575/290	290/200	200/135	135

Appendix 12.9

DLRCC Flood Zone Map No.9

(Not to scale at A4)

Mapping Notes

1. The lines of the Road Proposals shown are diagrammatic only and may be subject to change.
2. Wave Overtopping layer is relevant to the following maps only: Map No's. 2, 3, 4, 7, 10 & 14 unless noted otherwise.
3. These flood maps contain Land Use Zonings & Flooding information only. Please refer to the Land Use Zoning maps for more detailed land use objectives.

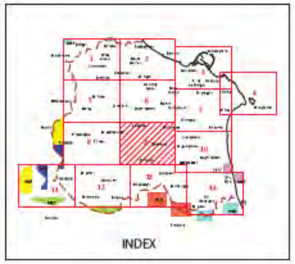
Flood Zone Map

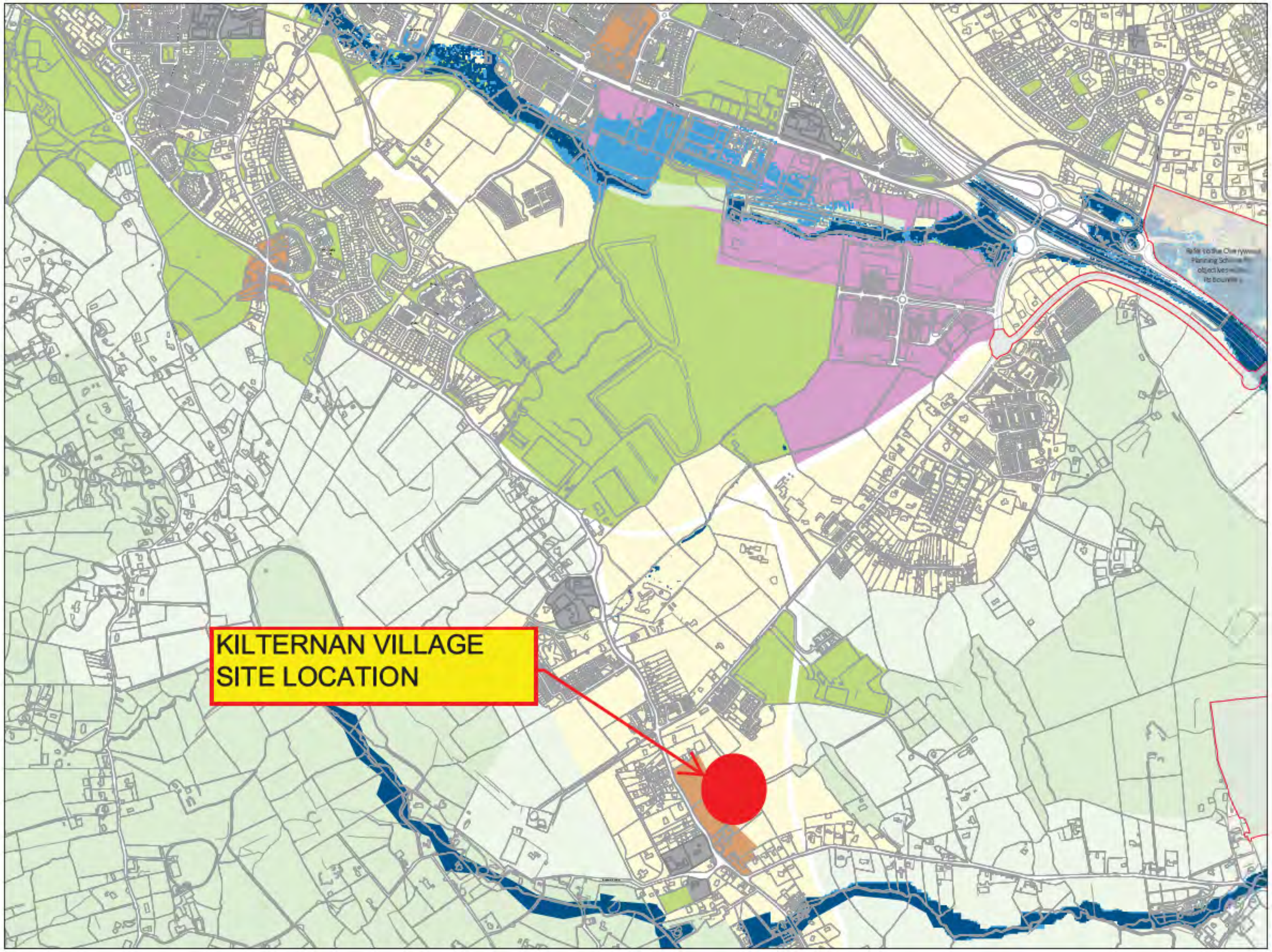
COMHAIRLE CHONTAE DHÚN LAOGHAIRE-RÁTH AN DÚIN

DÚN LAOGHAIRE-RATHDOWN COUNTY COUNCIL

COUNTY DEVELOPMENT PLAN 2022-2028

Adopted March 2022




Refer to the Cherrywood Planning Scheme for objectives within its boundary
KILTERNAN VILLAGE
SITE LOCATION

Land Use Zonings

Objective A	To provide residential development and improve residential amenity while protecting the existing residential amenities.	🟨
Objective A1	To provide for new residential communities and Sustainable Neighbourhood Infrastructure in accordance with approved local area plans.	🟨
Objective A2	To provide for the creation of sustainable residential neighbourhoods and preserve and protect residential amenity.	🟨
Objective B	To protect and improve rural amenity and to provide for the development of agriculture.	🟩
Objective DC	To protect, provide for and-or improve mixed-use district centre facilities.	🟥
Objective E	To provide for economic development and employment.	🟪
Objective F	To preserve and provide for open space with ancillary active recreational amenities.	🟩
Objective G	To protect and improve high amenity areas.	🟩
Objective GB	To protect and enhance the open nature of lands between urban areas.	▨
Objective LIW	To improve and provide for low density warehousing/light industrial/warehousing uses.	🟦
Objective MIC	To consolidate and complete the development of the mixed use inner core to enhance and reinforce sustainable development.	🟧
Objective MOC	To provide for a mix of uses which complements the inner core, but with less retail and residential and more emphasis on employment and services.	🟥
Objective MTC	To protect, provide for and-or improve major town centre facilities.	🟦
Objective NC	To protect, provide for and-or improve mixed-use neighbourhood centre facilities.	🟫
Objective OE	To provide for office and enterprise development.	🟩
Objective TLI	To facilitate, support and enhance the development of third level education institutions.	⬜
Objective W	To provide for waterfront development and harbour related uses.	🟩
Objective SNI	To protect, improve and encourage the provision of sustainable neighbourhood infrastructure.	⬛

Areas of Flood Risk Concern

Fluvial - Surface Water	▲
Pluvial - Surface Water	▲
Pluvial - Foul	▲
Flood Zone A	🟦
Flood Zone B	🟦
Wave Overtopping	⬜
County Boundary	■■■■
Boundary of Adopted Cherrywood Planning Scheme	▭

0 50 100 200 300 400 500 Meters

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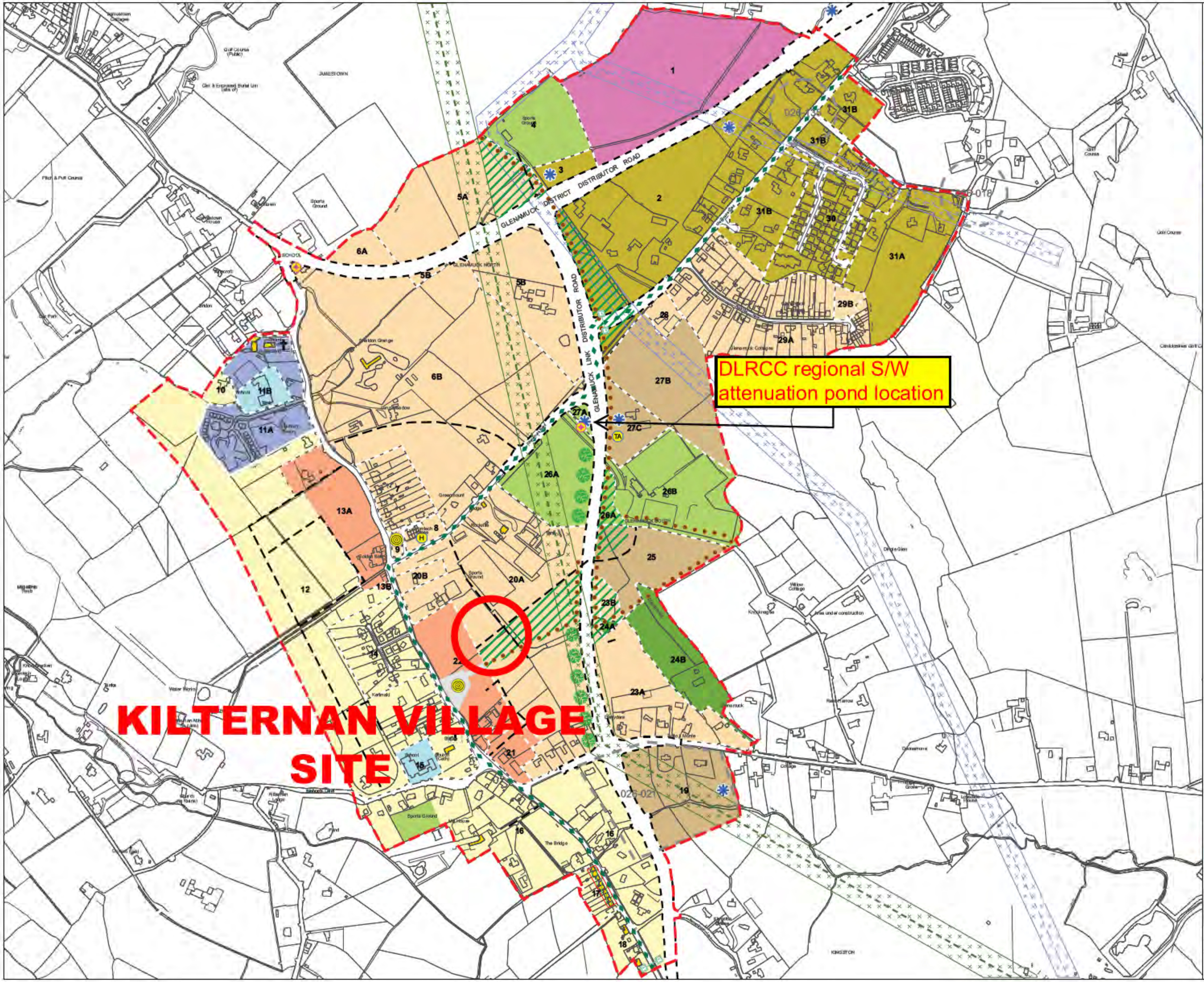
Director of Planning: [illegible]
Senior Planner: L. [illegible]

9

Appendix 12.10

DLRCC LAP Map No.PL-13-402

(Not to scale at A4)



DLRCC regional S/W attenuation pond location

KILTERNAN VILLAGE SITE

LEGEND

🟥	Boundary of Local Area Plan
🟫	Medium/Higher Density Residential
🟧	Medium Density Residential
🟨	Lower Density Residential
🟧	Neighbourhood Centre
🟪	Employment Use
🟫	Agriculture
🟩	High Amenity
🟩	Open Space/Recreational Amenity
🟦	Parish/Community Centre Node
🟦	Existing Primary School
▨	Indicative Greenway Link
▥	Architectural Conservation Area
🟨	Protected Structures
☐	Record of Monuments and Places
H	County Council Housing Programme Site
TA	Traveller Accommodation
✱	Surface Water Attenuation Pond
●	Gateway Feature
●	Artistic Feature
• • • •	Walkway/Cycleway
⬜	Civic Space
✝	Church
- - - -	ESB 220KV Overhead Line
☐	Restriction Corridor 220KV
- - - -	ESB 110KV Overhead Line
☐	Restriction Corridor 110KV
◆ ◆ ◆	Primary Bus Corridor
▬ ▬ ▬	Indicative Proposed Access Road
☐-☐	Proposed Bus Gate
●	Trees (Avenue Planting)
☐	Dashed White Lines Indicate Land Parcel Boundary
25A	Land Parcel Number

NOTE: The lines of road proposals and surface water attenuation ponds on this map are diagrammatic only and are subject to change during the detailed design stage.

0 45 90 180 270
Metres

Planning and Enterprise Department
G Haydon
Director of Planning

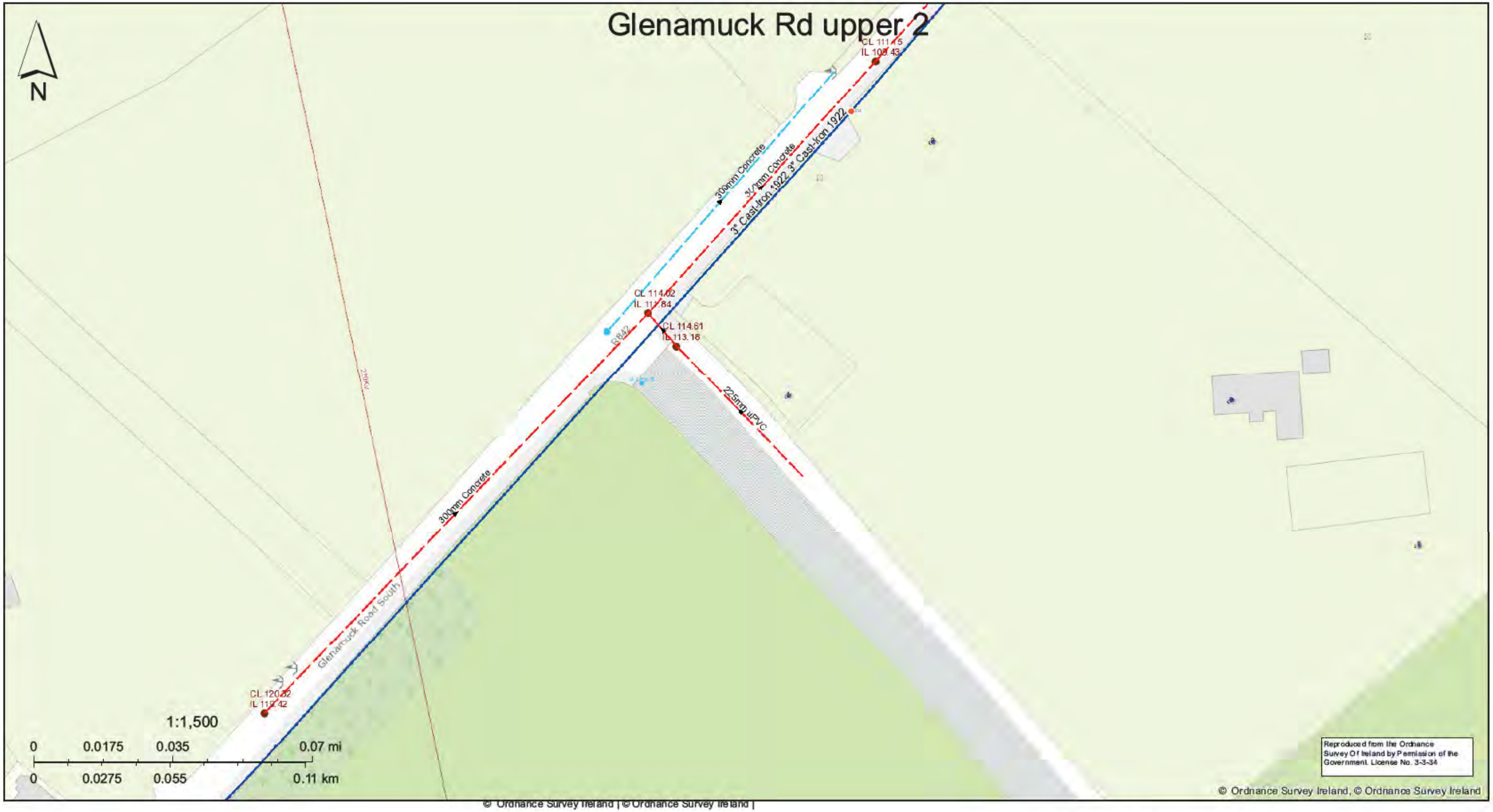
Adopted Kiltiernan / Glenamuck Local Area Plan 2013

Senior Planner: D.Irvine
Chief Technician: M. Hovahan
Prepared By: C. Fulcher
Drawn By: M.Hennessy
Date: October 2013
Scale: 1:2500
Drawing No: PL - 13 - 402

Appendix 12.11

IW/DLRCC Drainage Records drawings

Glenamuck Rd upper 2



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July 11, 2017

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown

- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

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. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

UISCE ÉIREANN : IRISH WATER

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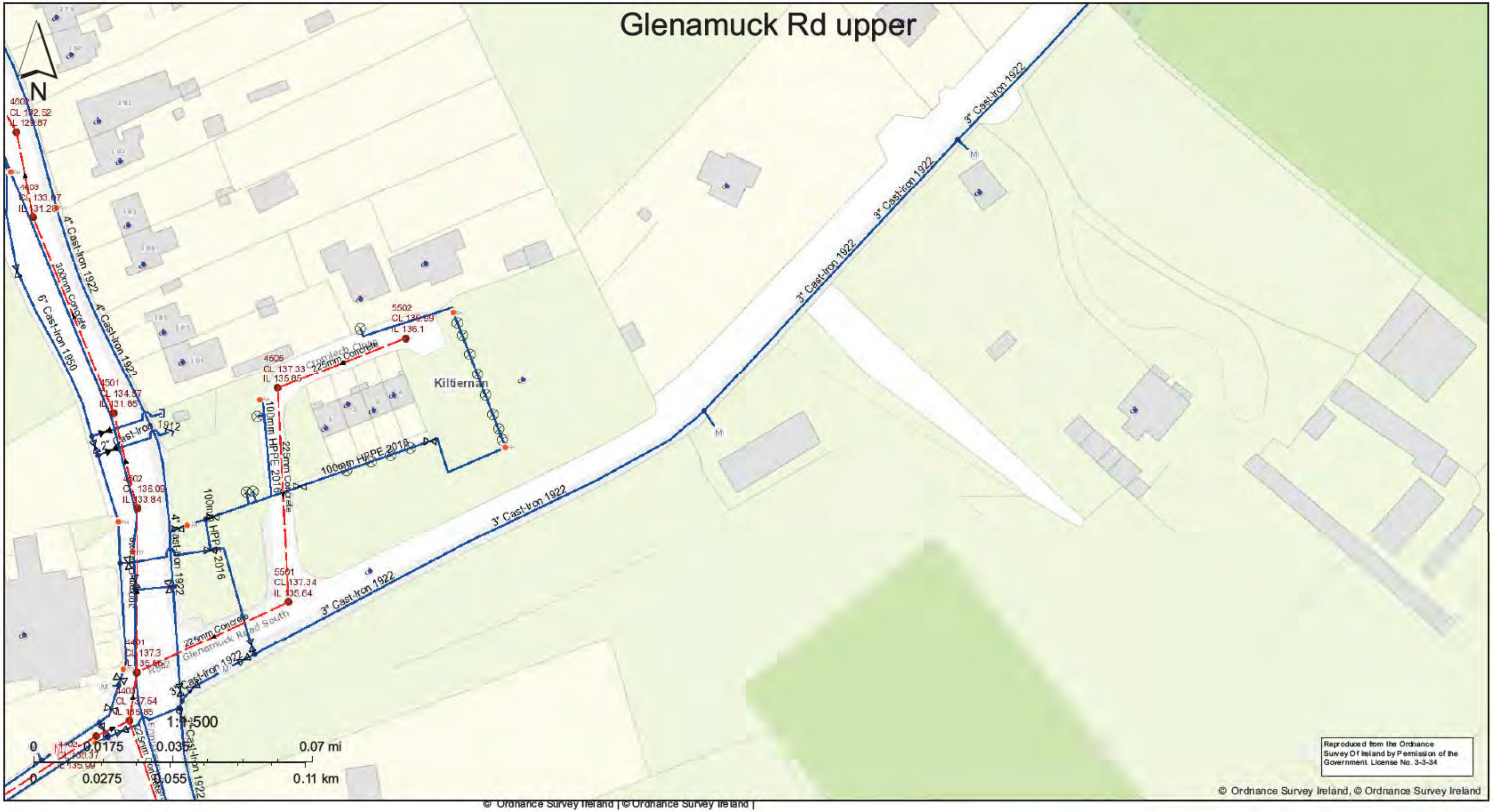
Glenamuck Rd upper



July 11, 2017

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown

- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

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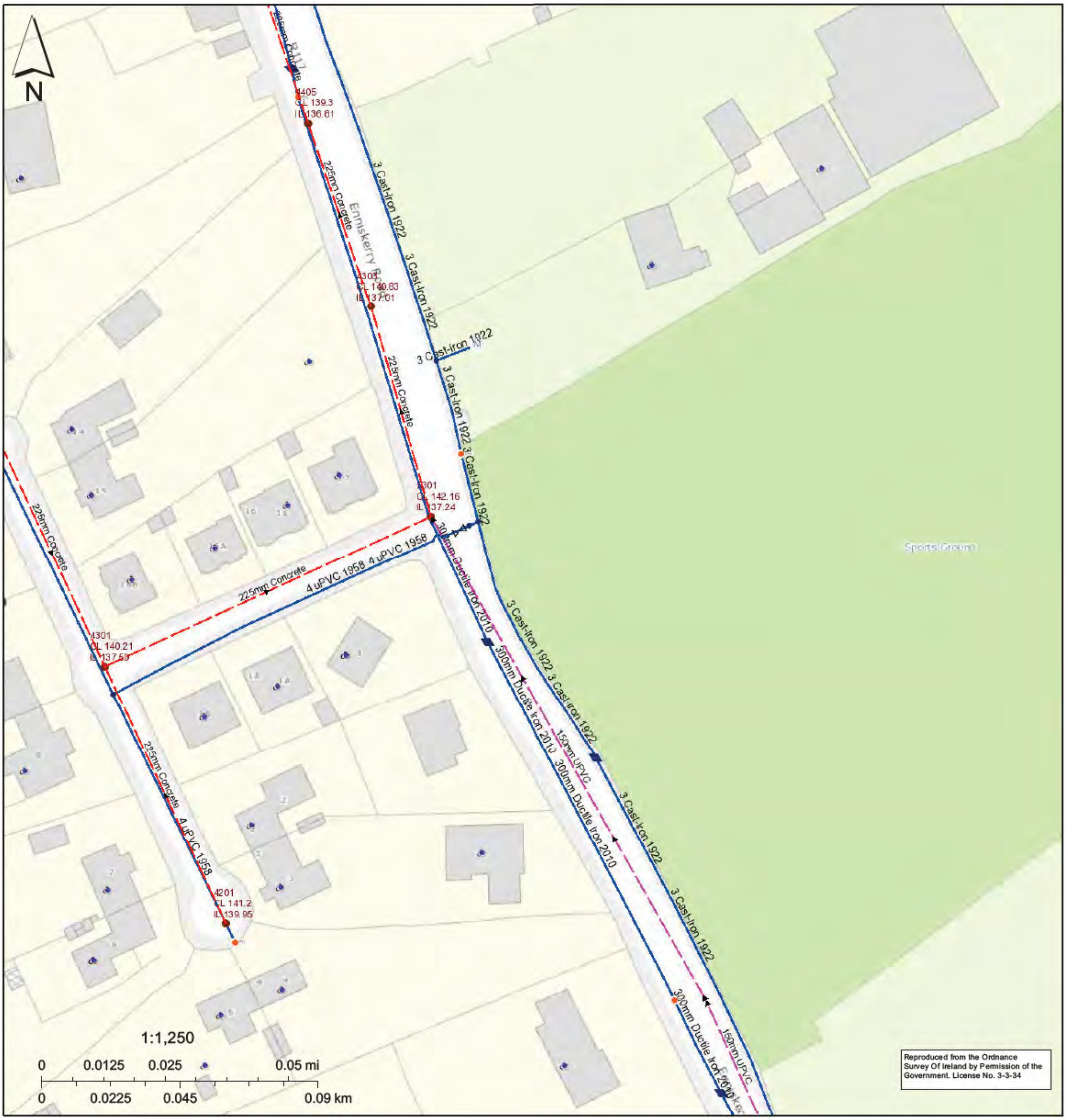
Kilternan Village



5/29/2018 9:45:34 AM

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown
- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Pressurized Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Pressurized Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

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. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated.

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Appendix 12.12

OPW Flood Hazard Report

OPW *National Flood Hazard Mapping*

Summary Local Area Report

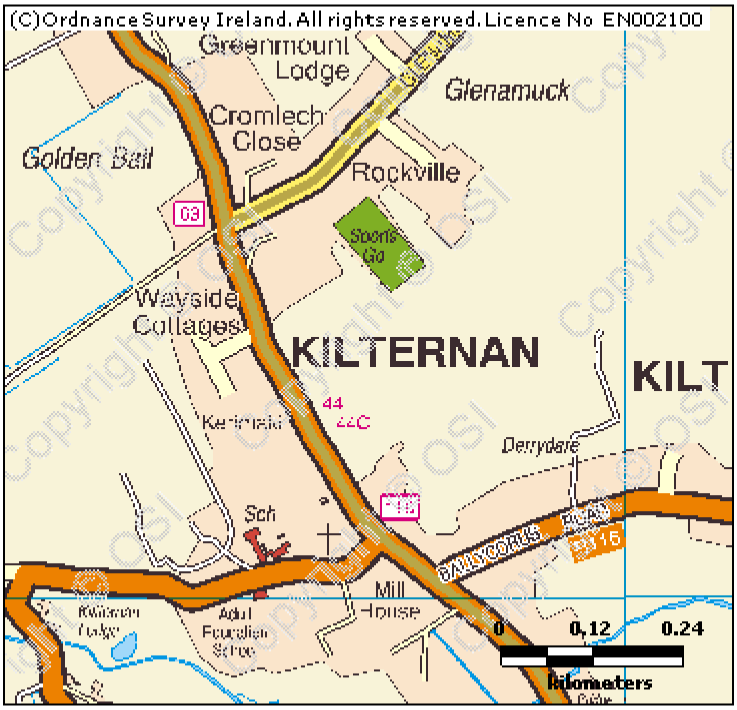
This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:

County: Dublin

NGR: O 206 223

This Flood Report has been downloaded from the Web site www.floodmaps.ie. The users should take account of the restrictions and limitations relating to the content and use of this Web site that are explained in the Disclaimer box when entering the site. It is a condition of use of the Web site that you accept the User Declaration and the Disclaimer.



Map Scale 1:10,112

Map Legend	
⚠	Flood Points
⚠	Multiple / Recurring Flood Points
▦	Areas Flooded
●	Hydrometric Stations
╱	Rivers
🟦	Lakes
☐	River Catchment Areas
▨	Land Commission *
▤	Drainage Districts *
▥	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Thier purpose and scope is explained in the Glossary.

7 Results

⚠ 1. Shanganagh Carrickmines Nov 2002 — Start Date: 26/Nov/2002

County: Dublin — Flood Quality Code:3

Additional Information: Reports (1) More Mapped Information

⚠ 2. Shanganagh Carrickmines Dec 1997 — Start Date: 18/Dec/1997

County: Dublin — Flood Quality Code:3

Additional Information: Reports (1) More Mapped Information

⚠ 3. Shanganagh Carrickmines May 1993 — Start Date: 26/May/1993

County: Dublin — Flood Quality Code:1

Additional Information: Photos (3) Reports (4) More Mapped Information

⚠ 4. Shanganagh Carrickmines Nov 1982 — Start Date: 06/Nov/1982

County: Dublin — Flood Quality Code:3

Additional Information: Reports (3) More Mapped Information

⚠ 5. Kilternan Glencullen Road Nov 1982 — Start Date: 05/Nov/1982

County: Dublin — Flood Quality Code:3

Report Produced: 29-May-2018 17:19

Additional Information: Reports (1) More Mapped Information

---

6. Glenamuck Stream Glenamuck Road Recurring

Start Date:

County: Dublin

Flood Quality Code:4

Additional Information: Reports (2) More Mapped Information

---

7. Enniskerry Road Recurring

Start Date:

County: Dublin

Flood Quality Code:4

Additional Information: Reports (2) More Mapped Information

Appendix 12.13

Green Roofs Information

MOY TOTAL EXTENSIVE GREEN ROOF SYSTEM.

Intended Use.

The Moy Total Extensive Green Roof System is a robust waterproofing assembly finished with a native Irish Sedum mix species extensive green roof assembly, designed to provide a self-sustaining low maintenance green roof which provides substantial rainwater attenuation benefits and provides habitat for bees and invertebrates. The Moy Extensive Green roof may be installed in "Blue Roof" configuration, whereby drainage of the roof is delayed, or may be installed on roofs where free drainage takes place.

Green Roof Assembly and Key Data.

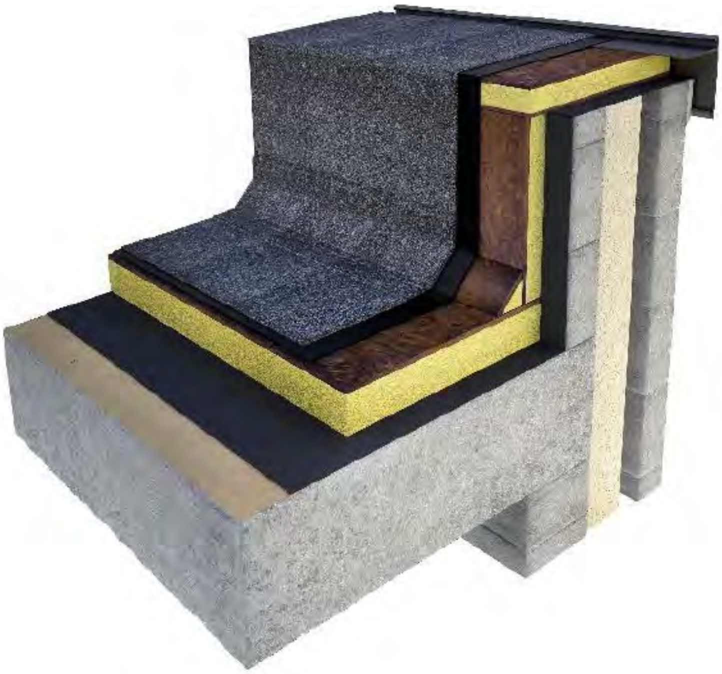
Element	Key Characteristics	Notes
Moy Sedum Mix Blanket	30mm Thickness	Native Irish Species Mix.
Moy Growing Media	50mmThickness	Recycled Brick & Organic Materials
Filtration Fleece VLF150	1mm Thickness	Recycled fibres.
DE25H Reservoir Layer	25mm Thickness	Recycled Plastics.
Protection Fleece VLU300	2mm Thickness	Recycled fibres.
System PH Value	PH 7.1	-

Weight & Water Attenuation Data.

Total Mass per M2 – Dry Condition.	C. 70 Kg / M2.
Total Mass per M2 – Saturated Condition	C. 125 Kg / M2.
Rainwater Attenuation Capacity	C. 44 litres / M2. (Dynamic Value).

Moy Extensive Green Roofs provide a substantial rainwater attenuation capacity and may be incorporated in site specific SUDs Design.

Moy Warm Roof Waterproofing & Insulation Assembly.



Paralon System Assembly.

1. Vapour Controlling Layer, Parabase modified bitumen.

2. Thermal Insulation, Paratherm T, PIR foam core by Kingspan Insulation, available as a flat or tapered layer. High Efficiency of 0.024 W/mK.

3. Paralon TOP/S polyester reinforced base layer, modified bitumen, torch applied membrane.

4. Paralon NT4 polyester reinforced cap layer, root resistant, modified bitumen, torch applied membrane.

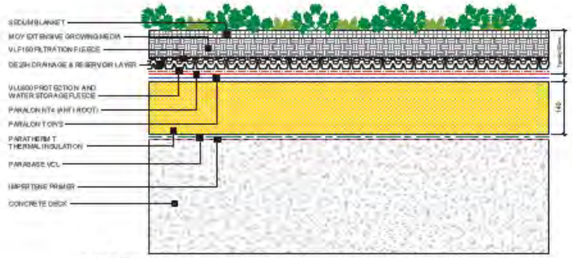
Approvals, Compliance & Certification.

- BBA Certified Certificate No. 09/4688 (Life Expectancy in Excess of 40 Years).
- FM Global Insurance Corporation Approved.
- Compliant with FLL (Germany) and GRO (UK) Green Roof Design Guidelines.

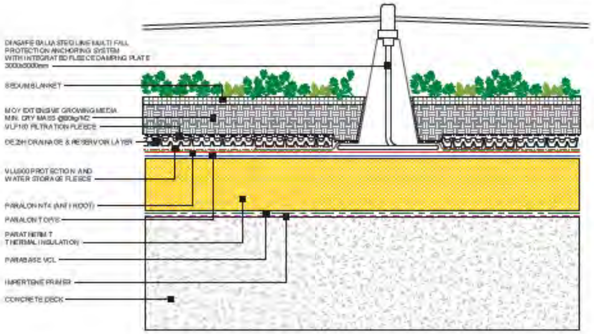
LEED & BREEAM CREDITS.

Moy Extensive Green Roofs are locally sourced where possible, with over 80% of the bulk mass material being produced or grown in Ireland, reducing the carbon footprint and promoting sustainability.

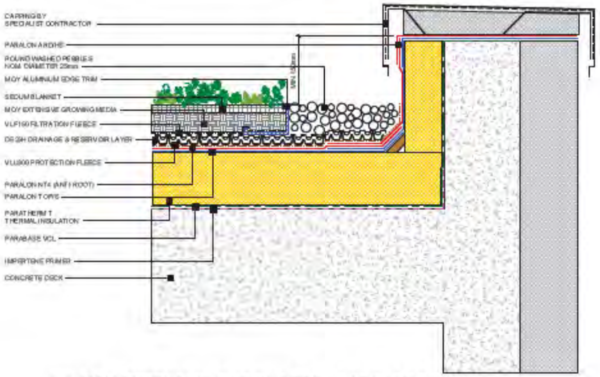
Ver. April 2020.


SEDUM BLANKET
MOY EXTENSIVE GROWING MEDIA
VLF150 FILTRATION FLEECE
DE25H DRAINAGE & RESERVOIR LAYER
VLU500 PROTECTION AND WATER STORAGE FLEECE
PARALON NT4 (ANTI ROOT)
PARALON TOP/S
PARATHERM T THERMAL INSULATION
PARABASE VCL
IMPERTENE PRIMER
CONCRETE DECK
140

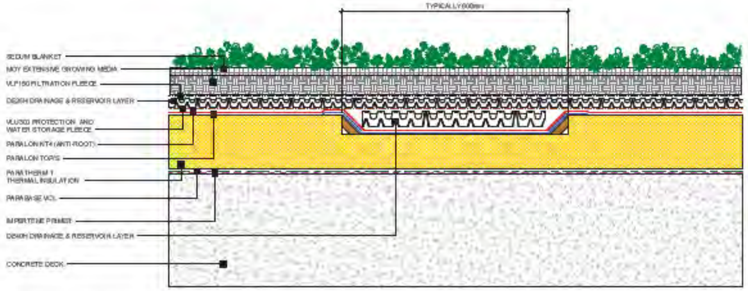
① **MOY EXTENSIVE GREEN ROOF SYSTEM (CONCRETE DECK)**
1 : 5


DIASAFE BALLASTED LINE MULTI FALL PROTECTION ANCHORING SYSTEM WITH INTEGRATED FLEECE DAMPING PLATE 3000x3000mm
SEDUM BLANKET
MOY EXTENSIVE GROWING MEDIA MIN. DRY MASS @80kg/M2
VLF150 FILTRATION FLEECE
DE25H DRAINAGE & RESERVOIR LAYER
VLU500 PROTECTION AND WATER STORAGE FLEECE
PARALON NT4 (ANTI ROOT)
PARALON TOP/S
PARATHERM T THERMAL INSULATION
PARABASE VCL
IMPERTENE PRIMER
CONCRETE DECK

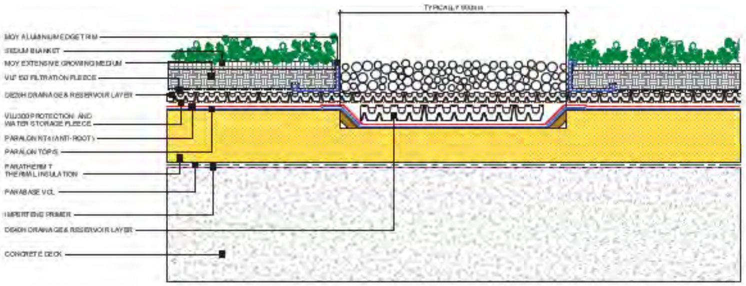
② **MOY EXTENSIVE GREEN ROOF SYSTEM - PROTECTION ANCHORING SYSTEM DETAIL**
1 : 5



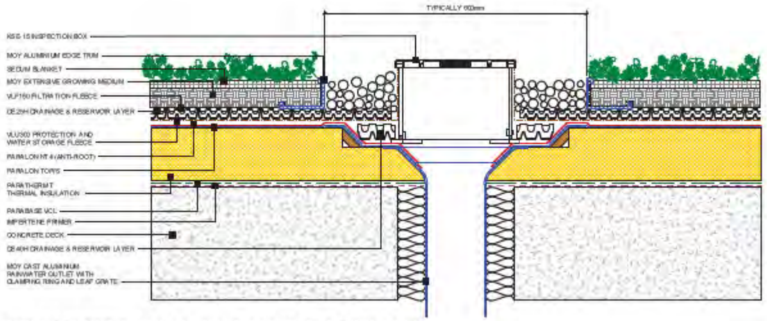
③ **MOY EXTENSIVE GREEN ROOF - PARAPET DETAIL**
1 : 5


TYPICALLY 600mm
SEDUM BLANKET
MOY EXTENSIVE GROWING MEDIA
VLF150 FILTRATION FLEECE
DE25H DRAINAGE & RESERVOIR LAYER
VLU300 PROTECTION AND WATER STORAGE FLEECE
PARALON NT4 (ANTI-ROOT)
PARALON TOP/S
PARATHERM T THERMAL INSULATION
PARABASE VCL
IMPERTENE PRIMER
DE40H DRAINAGE & RESERVOIR LAYER
CONCRETE DECK

④ **MOY EXTENSIVE GREEN ROOF SYSTEM - GUTTER CHANNEL WITH SEDUM COVERING DETAIL**
1 : 5


TYPICALLY 600mm
MOY ALUMINIUM EDGE TRIM
SEDUM BLANKET
MOY EXTENSIVE GROWING MEDIUM
VLF 150 FILTRATION FLEECE
DE25H DRAINAGE & RESERVOIR LAYER
VLU300 PROTECTION AND WATER STORAGE FLEECE
PARALON NT4 (ANTI-ROOT)
PARALON TOP/S
PARATHERM T THERMAL INSULATION
PARABASE VCL
IMPERTENE PRIMER
DE40H DRAINAGE & RESERVOIR LAYER
CONCRETE DECK

⑤ **MOY EXTENSIVE GREEN ROOF SYSTEM - GUTTER CHANNEL WITH PEBBLES DETAIL**
1 : 5


TYPICALLY 600mm
RSS-15 INSPECTION BOX
MOY ALUMINIUM EDGE TRIM
SEDUM BLANKET
MOY EXTENSIVE GROWING MEDIUM
VLF150 FILTRATION FLEECE
DE25H DRAINAGE & RESERVOIR LAYER
VLU300 PROTECTION AND WATER STORAGE FLEECE
PARALON NT4 (ANTI-ROOT)
PARALON TOP/S
PARATHERM T THERMAL INSULATION
PARABASE VCL
IMPERTENE PRIMER
CONCRETE DECK
DE40H DRAINAGE & RESERVOIR LAYER
MOY CAST ALUMINIUM RAINWATER OUTLET WITH CLAMPING RING AND LEAF GRATE

⑥ **MOY EXTENSIVE GREEN ROOF SYSTEM - RAINWATER OUTLET INSPECTION BOX DETAIL**
1 : 5

Detail:
EXTENSIVE GREEN ROOF TYPICAL DETAILS

System Ref: [illegible]
DWG. NO: GR-E-01

Scale: 1 : 5
Date: MAY 2021

MOY
DUBLIN - LONDON - GLASGOW - FRANKFURT
WWW.MOYMATERIALS.COM
INFO@MOYMATERIALS.COM

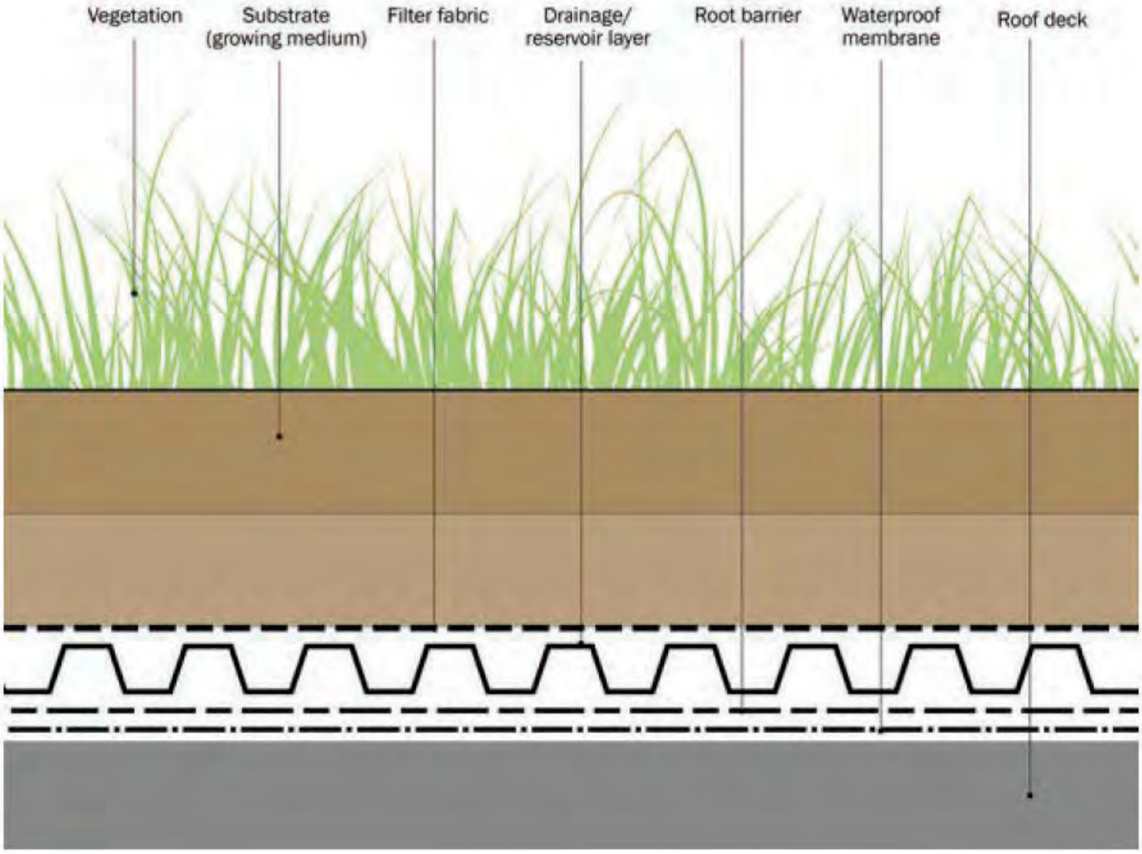


Figure 12.1 Section showing typical extensive green roof components

As mentioned earlier, there are two main types of green roof:

Extensive green roofs – These systems cover the entire roof area with hardy, slow growing, drought tolerant, low maintenance plants (eg mosses, succulents, herbs, grasses) often enhanced with wildflowers. Planting often establishes more slowly, but the long-term biodiversity can be of high value. They are only accessed for maintenance and can be flat or sloping. Extensive green roofs typically comprise a 20–150 mm thick growing medium and can be further divided into "single-layer" systems (which consist of a single medium designed to be free-draining and support plant growth), and "multi-layer" systems that include both a growing medium layer and a separate underlying drainage layer. They are lightweight and low cost to maintain, and can be used in a wide variety of locations with minimal intervention. They are often suitable for retrofit on existing structures due to their light weight. Biodiverse extensive green roofs are often planted with a mix of species supported by a range of soil depths.

Intensive green roofs (or roof gardens) – These are designed to sustain more complex landscaped environments that can provide high amenity or biodiversity benefits. They are planted with a range of plants including grasses, shrubs and/or trees, either as ground cover or within planters, and may also include water features and storage of rainwater for irrigation (ie blue roof elements). They are usually easily accessible, as they normally require a fairly high level of regular maintenance, and in some cases they are made accessible to the public. Intensive roofs have a deeper substrate, with >150 mm growing medium, and therefore impose greater loads on the roof structure.

Green roofs with substrate depths of 100–200 mm tend to be semi-intensive roofs, and can include characteristics of both extensive and intensive roofs, with plants that include shrubs and woody plants. Irrigation and maintenance requirements of this type of roof will be dependent upon the plant species chosen for the roof. There are also various combinations of green roof that combine both types in a single roof system.

A comparison of the main differences between extensive and intensive green roof systems is given in **Table 12.1**.

Extensive Green Roof

Blackdown extensive green roofs provide a lightweight, drought tolerant and low maintenance planting solution. They are suitable for lightweight roof decks, inaccessible roofs, flat or sloping roofs. Ongoing maintenance will keep extensive green roofs looking healthy and attractive

Vegetation

Extensive green roofs rely on hardy, drought tolerant sedum plants to form the majority of the planting. The sedums that Blackdown select and grow at the nursery in Somerset represent years of experience and horticultural knowledge.

There are three planting options to choose from – sedum NatureMat®, plugs or hydroplant (sedum cuttings).

Key Features

Substrate

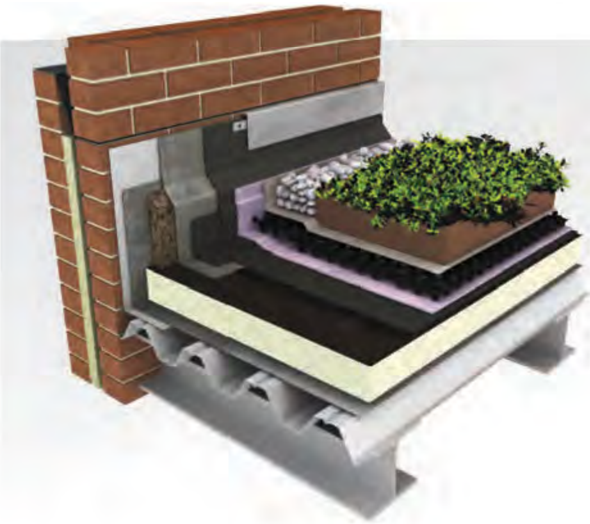
Blackdown extensive substrates are made from carefully selected organic and inorganic materials. These materials are then blended to very specific proportions which enables plant material to establish as quickly as possible.

Waterproofing

Typical waterproofing options include suitable root-resistant bituminous membranes from the Derbigum and Euroroof ranges along with standing seam metal roofing.

Warranty

Warranties are available for the Alumasc waterproofing system used in the green roof build-up.



Build-up height	100mm
Drainage layer	25mm
Saturated weight	95-100 kg per m²
Plant coverage at installation	<5 to 90%
Maximum pitch	45 degrees
Irrigation requirements	Not required once plant material is established
Maintenance requirements	Twice a year

Appendix 12.14

Met Eireann Data

Met Eireann

Return Period Rainfall Depths for sliding Durations

Irish Grid: Easting: 320619, Northing: 222316,

	Interval		Years													
DURATION	6months	1year	2	3	4	5	10	20	30	50	75	100	150	200	250	500
5 mins	2.6	3.8	4.4	5.5	6.2	6.7	8.6	10.7	12.2	14.3	16.2	17.6	19.9	21.7	23.2	N/A
10 mins	3.6	5.3	6.2	7.6	8.6	9.4	12.0	15.0	17.0	19.9	22.5	24.6	27.8	30.3	32.4	N/A
15 mins	4.2	6.2	7.3	9.0	10.1	11.0	14.1	17.6	20.0	23.4	26.5	28.9	32.7	35.6	38.1	N/A
30 mins	5.6	8.1	9.5	11.6	13.0	14.1	17.9	22.2	25.0	29.2	32.8	35.7	40.2	43.7	46.7	N/A
1 hours	7.4	10.5	12.3	14.9	16.7	18.0	22.6	27.9	31.4	36.3	40.7	44.2	49.5	53.7	57.1	N/A
2 hours	9.7	13.7	15.9	19.2	21.4	23.1	28.7	35.1	39.3	45.2	50.5	54.6	61.0	65.9	70.0	N/A
3 hours	11.4	16.0	18.5	22.2	24.7	26.6	33.0	40.1	44.8	51.4	57.3	61.8	68.8	74.3	78.8	N/A
4 hours	12.8	17.9	20.6	24.7	27.4	29.5	36.4	44.1	49.2	56.3	62.6	67.5	75.1	80.9	85.7	N/A
6 hours	15.1	20.9	24.0	28.6	31.7	34.0	41.8	50.4	56.1	64.0	71.0	76.5	84.8	91.2	96.5	N/A
9 hours	17.8	24.4	27.9	33.1	36.6	39.3	48.0	57.7	64.0	72.8	80.6	86.6	95.7	102.8	108.6	N/A
12 hours	20.0	27.3	31.1	36.8	40.6	43.5	52.9	63.4	70.3	79.7	88.1	94.5	104.3	111.9	118.1	N/A
18 hours	23.5	31.9	36.2	42.7	47.0	50.2	60.8	72.5	80.1	90.7	99.9	107.0	117.8	126.2	133.0	N/A
24 hours	26.4	35.6	40.4	47.4	52.1	55.6	67.1	79.8	88.0	99.3	109.3	116.9	128.5	137.3	144.7	169.9
2 days	33.2	43.8	49.2	57.2	62.4	66.4	79.0	92.8	101.7	113.8	124.4	132.4	144.6	153.9	161.5	187.6
3 days	38.7	50.4	56.4	65.1	70.7	75.1	88.7	103.5	112.9	125.7	136.9	145.3	158.1	167.8	175.7	202.8
4 days	43.5	56.3	62.7	72.0	78.1	82.7	97.2	112.8	122.7	136.2	147.8	156.7	170.0	180.1	188.3	216.2
6 days	52.0	66.5	73.7	84.1	90.8	95.9	111.9	128.9	139.7	154.3	166.9	176.4	190.6	201.4	210.1	239.8
8 days	59.6	75.5	83.4	94.7	102.0	107.5	124.7	143.0	154.6	170.2	183.5	193.6	208.6	220.0	229.2	260.4
10 days	66.6	83.7	92.3	104.4	112.2	118.1	136.4	155.9	168.1	184.5	198.6	209.1	224.9	236.8	246.5	279.0
12 days	73.1	91.4	100.5	113.4	121.7	127.9	147.3	167.7	180.5	197.8	212.5	223.5	240.0	252.4	262.4	296.1
16 days	85.3	105.7	115.8	130.1	139.2	146.0	167.3	189.5	203.4	222.1	237.9	249.8	267.4	280.7	291.4	327.4
20 days	96.5	119.0	129.9	145.4	155.3	162.7	185.5	209.4	224.3	244.2	261.0	273.6	292.4	306.4	317.8	355.7
25 days	109.8	134.4	146.4	163.2	174.0	182.0	206.7	232.4	248.4	269.7	287.7	301.1	321.1	336.0	348.0	388.1

NOTES:

N/A Data not available

These values are derived from a Depth Duration Frequency (DDF) Model

For details refer to:

'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

Kilternan Village
320619E 222316N
SAAR = 1003mm
M5/60 = 18.0
r= 0.271

Appendix 12.15

Land Owner Agreements

Liscove Limited
First Floor,
Maple House,
Lower Kilmacud Road,
Stillorgan,
Co. Dublin

- 2 JUN 2022

25th May 2022

Re: Letter of Consent to Planning Application

Strategic Housing Development Application for 383 Residential Dwellings and a Neighbourhood Centre on lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18

To Whom It May Concern,

I refer to the above intended planning application, the site of which includes lands in the ownership of the Jackson Family (Fredrick, Brendan, Damien & Aine Jackson), specifically lands annotated in Green on the attached drawing.

I confirm that the Jackson Family has no objection to the inclusion of these lands for the purpose of making the planning application.

Yours faithfully

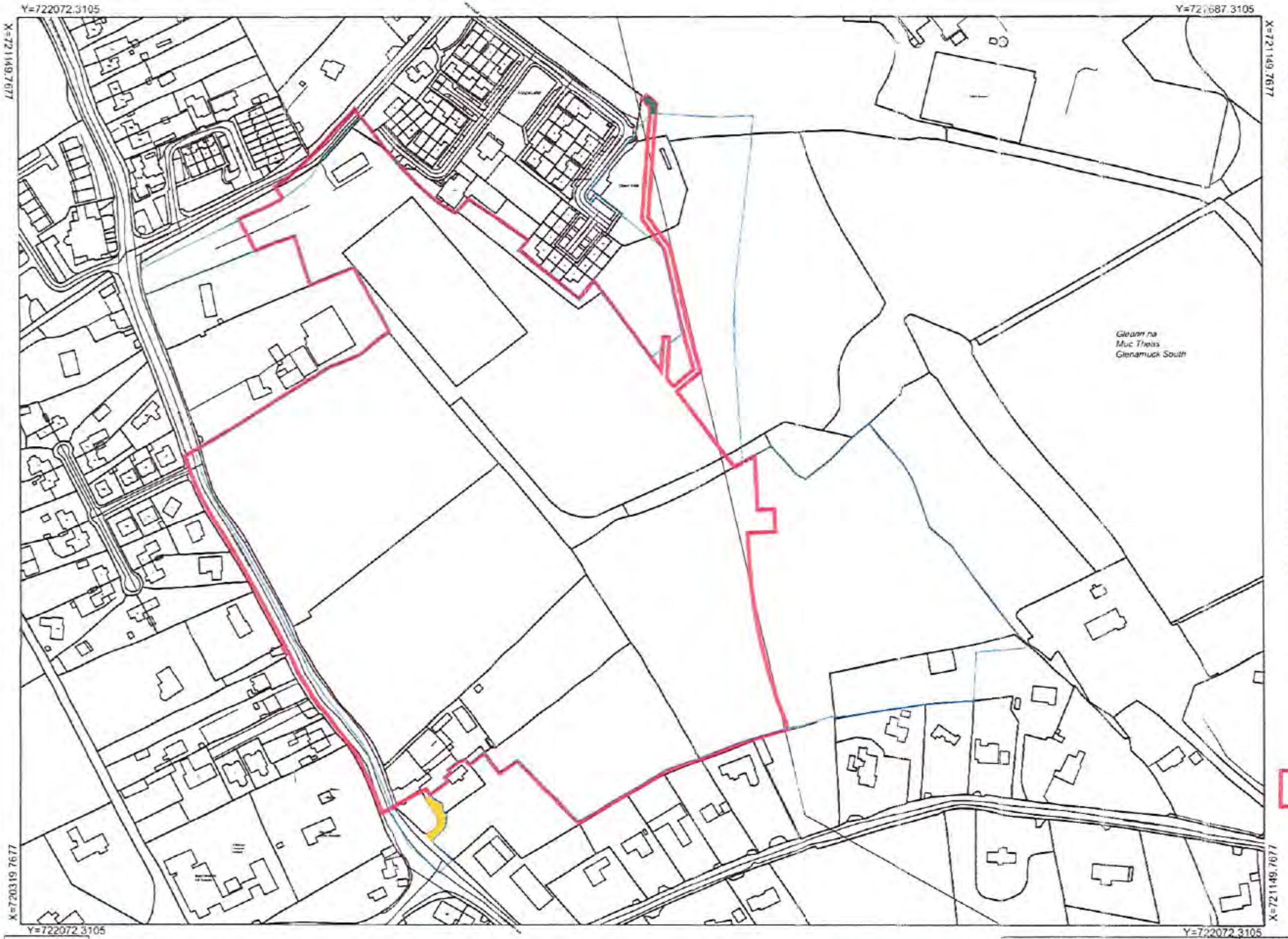
Fredrick Jackson

Brendan Jackson

Damien Jackson

Aine Jackson

Newtown House, Newtown, Eadestown, Naas, Co. Kildare



REPRODUCED UNDER LICENCE NO.
CYAL50171770

Description:
Digital Cartographic Model (DCM)

Publisher / Source:
Ordnance Survey Ireland (OSi)

Data Source / Reference:
PRIME2

File Format:
Autodesk AutoCAD (DWG_R2013)

File Name:
[illegible]

Client Extent / Area of Interest (AOI):
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LRX,LRY= 721149.7677,722072.3105
ULX,ULY= 720319.7677,722687.3105
URX,URY= 721149.7677,722687.3105

Projection / Spatial Reference:
Projection= IRENET95_Irish_Transverse_Mercator

Centre Point Coordinates:
X,Y= 720734.7677,722379.8105

Reference Index:
Map Series | Map Sheets
[illegible]

Data Extraction Date:
Date= [illegible]

Source Data Release:
DCMTS Release V1.140.112

Product Version:
Version= 1.3

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'SITE MAP 5'

NOTE:
DO NOT SCALE FROM DRAWINGS. WORK TO FIGURED DIMENSIONS ONLY. ARCHITECT TO BE NOTIFIED OF ALL DESCREPENCIES.

LEGEND

🟥 SITE BOUNDARY OF PLANNING APPLICATION
🟦 LANDS UNDER CONTROL OF THE APPLICANT
🟨 WAYLEAVE
🟩 WORKS TO LANDS OWNED BY OTHERS

SHD STAGE 3

MCORM
MCCROSSAN O'ROURKE MANNING ARCHITECTS

PROJECT TITLE: RESIDENTIAL DEVELOPMENT KILTERNAN VILLAGE, DUBLIN 18	DATE: MAY '22	DRAWN BY: LOMD	
DRAWING TITLE: LAND OWNERSHIP MAP	SCALE: 1:2500@A3	REVISION: -	
1 Grantham Street, Dublin 8, D08 A0X7, Ireland Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com	JOB NO: 21009	DRAWING NO: PL100.5	

CANNONS
SOLICITORS

(Incorporating THOMAS P. O'CONNOR)

First Floor,
Maple House,
Lower Stillorgan Road,
Stillorgan,
Co. Dublin
Telephone 01 278 5016
(From UK 00-353-1-278 5016)
Fax 01 2784503

DX 103 004 Stillorgan
e-mail: cannons@securemail.ie

Joseph P. Kelly

Suhaila Othman

Our ref: JK/PD/ your ref: Date: 8th June 2022

The Directors,
Liscove Limited,
First Floor,
Maple House,
Stillorgan,
Co. Dublin

RE: Liscove Limited – Strategic Housing Development Application for 383 residential dwellings and Neighbourhood Centre on lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18

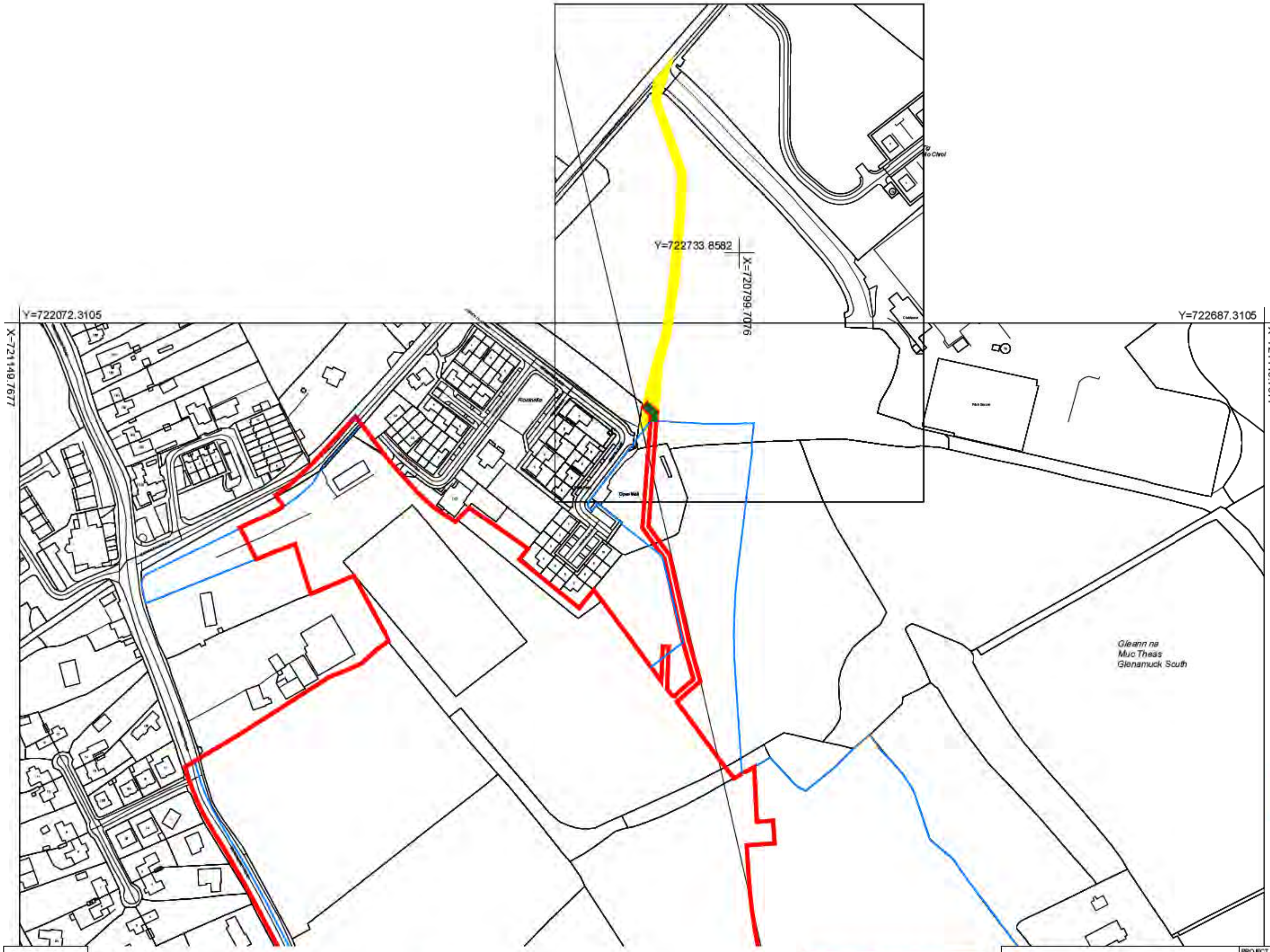
Dear Sirs,

I refer to the above intended planning application. I refer also to letter of 25th May 2022 from Frederick, Brendan, Damien and Aine Jackson consenting to the inclusion of their lands notated in green on the drawing attached to their letter which lands are also shown notated in green on the drawing attached to this letter.

I confirm that Liscove Limited has the benefit of an easement over the area shown coloured yellow on the attached drawing which easement is for the benefit of the entire of its lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18 and which easement includes a right to connect to all existing services running through the lands shown coloured yellow on the said drawing.

Yours faithfully,

Joseph P Kelly
Principal
CANNONS



REPRODUCED UNDER LICENCE NO.
CYAL50171770

Description:
Digital Cartographic Model (DCM)

Publisher / Source:
Ordnance Survey Ireland (OSI)

Data Source / Reference:
PRIME2

File Format:
Autodesk AutoCAD (DWG_R2013)

File Name:
v_50195626_1.dwg

Clip Extent / Area of Interest (AOI):
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ULX,ULY= 720319.7677,722687.3105
URX,URY= 721149.7677,722687.3105

Projection / Spatial Reference:
Projection= IRENET95_Irish_Transverse_Mercator

Centre Point Coordinates:
X,Y= 720734.7677,722379.8105

Reference Index:
Map Series | Map Sheets
1:2,500 | 3517-A

Data Extraction Date:
Date= 26-May-2021

Source Data Release:
DCLMS Release V1.140.112

Product Version:
Version= 1.3

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'SITE MAP 8'

N

NOTE:
DO NOT SCALE FROM DRAWINGS. WORK TO FIGURED DIMENSIONS ONLY. ARCHITECT TO BE NOTIFIED OF ALL DESCREPENCIES.

LEGEND
🟥 SITE BOUNDARY OF PLANNING APPLICATION
🟦 LANDS UNDER CONTROL OF THE APPLICANT
🟨 WAYLEAVE
🟩 WORKS TO LANDS OWNED BY OTHERS - LAND REG: DN197564F

SHD STAGE 3

MCORM
MᶜCROSSAN O'ROURKE MANNING ARCHITECTS

PROJECT TITLE:
RESIDENTIAL DEVELOPMENT
KILTERNAN VILLAGE, DUBLIN 18

DRAWING TITLE:
LAND OWNERSHIP MAP

1 Grantham Street, Dublin 8, D08 A49Y Ireland.
Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com

DATE:	DRAWN BY:
MAY '22	LQMD
SCALE:	REVISION:
1:2500@A3	*
JOB NO:	DRAWING NO:
21009	PL100.8

Liscove Limited
First Floor,
Maple House,
Lower Kilmacud Road,
Stillorgan,
Co. Dublin

25th May 2022

Re: Letter of Consent to Planning Application

Strategic Housing Development Application for 383 Residential Dwellings and a Neighbourhood Centre on lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18

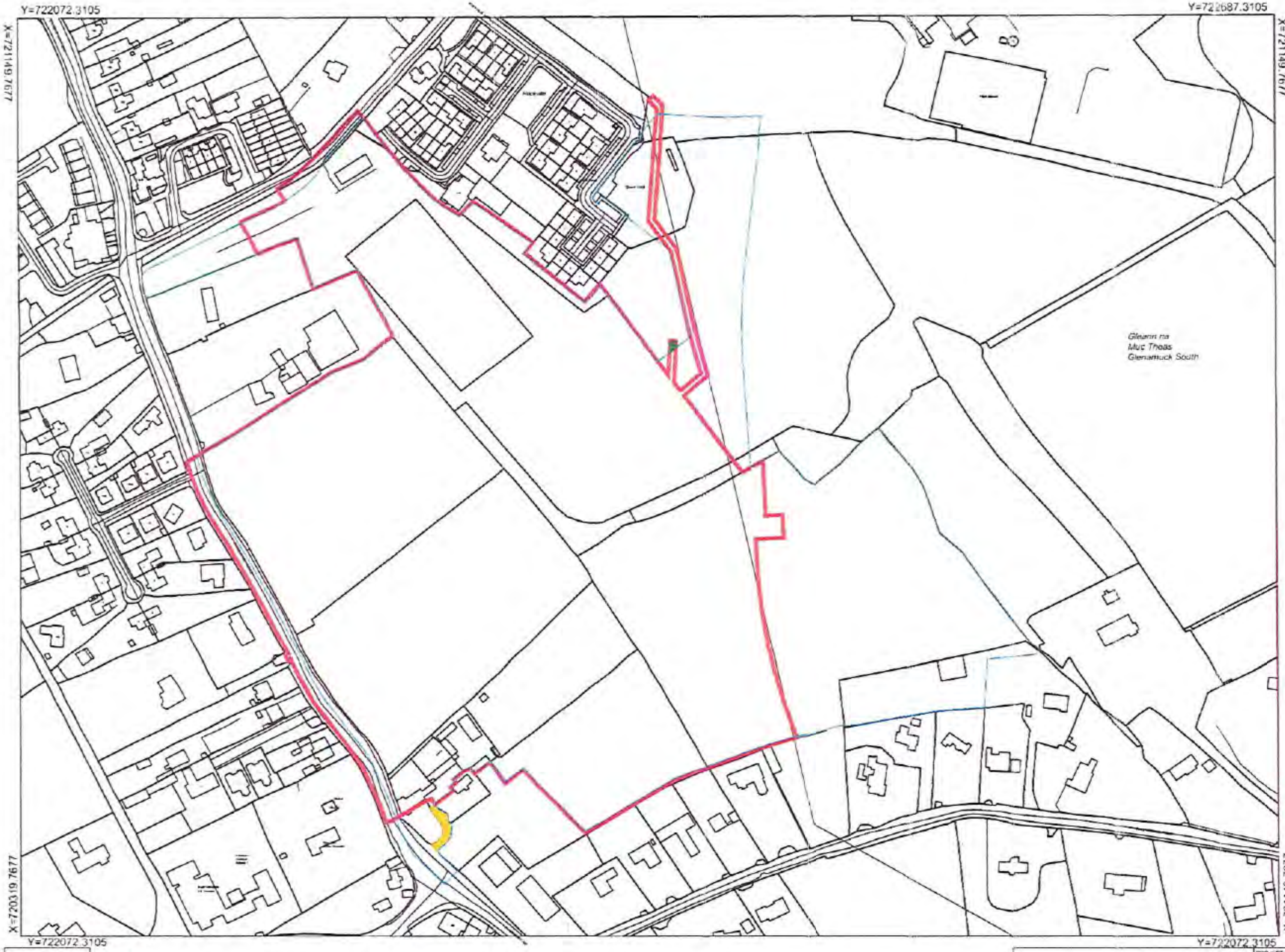
To Whom It May Concern,

I refer to the above intended planning application, the site of which includes lands in the ownership of Goodrock Project Management Limited specifically lands annotated in Green on the attached drawing.

I confirm that Goodrock Project Management Limited has no objection to the inclusion of these lands for the purpose of making the planning application.

Yours faithfully

Brendan Jackson
Director
Goodrock Project Management Limited
Newtown House, Newtown, Eadestown, Naas, Co. Kildare



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File Format:
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Site Location / Area of Interest (AOI)
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LRX_LRY= 721149.7677,722072.3105
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URX_URY= 721149.7677,722687.3105

Projection / Spatial Reference:
Projection= IRENET95_Irish_Transverse_Mercator

Centre Point Coordinates:
X,Y= 720734.7677,722379.8105

Reference Index:
Map Series | Map Sheets
1:2500 | 3817-A

Data Extraction Date:
Date= [illegible]-May-2021

Source Data Release:
DCMTS Release [illegible]

Product Version:
Version [illegible]

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The representation on this map of a road, track or footpath is not evidence of the existence of a right of way.

'SITE MAP 6'

N

NOTE:
DO NOT SCALE FROM
DRAWINGS, WORK
TO FIGURED
DIMENSIONS ONLY
ARCHITECT TO BE
NOTIFIED OF ALL
DESCREPENCIES

LEGEND
🟥 SITE BOUNDARY OF PLANNING APPLICATION
🟦 LANDS UNDER CONTROL OF THE APPLICANT
🟨 WAYLEAVE
🟩 WORKS TO LANDS OWNED BY OTHERS

SHD STAGE 3

MCORM
MCCROSSAN O'ROURKE MANNING ARCHITECTS

PROJECT TITLE	DATE	DRAWN BY
RESIDENTIAL DEVELOPMENT KILTERNAN VILLAGE, DUBLIN 18	MAY '22	LOMD
DRAWING TITLE LAND OWNERSHIP MAP	SCALE 1:2500@A3	REVISION -
1 Grantham Street, Dublin 8, D08 A4W? Ireland. Tel 01-4788700 Fax 01-4788711 E-Mail: arch@mcorm.com	JOB NO. 21009	DRAWING NO. PL100.6

Deloitte Ireland LLP
Deloitte & Touche House
29 Earlsfort Terrace
Dublin 2
D02 AY28
Ireland

Tel: +353 (1) 417 2200
Fax: +353 (1) 417 2300
Deloitte.ie

10th June 2022

Liscove Limited
First Floor,
Maple House,
Lower Kilmacud Road,
Stillorgan,
Co. Dublin

Our Ref: THEX0113-01/KF/BOR/AC

Re: <u>Letter of Consent to Planning Application</u>

Strategic Housing Development Application for 383 Residential Dwellings and a Neighbourhood Centre on lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18

To Whom It May Concern,

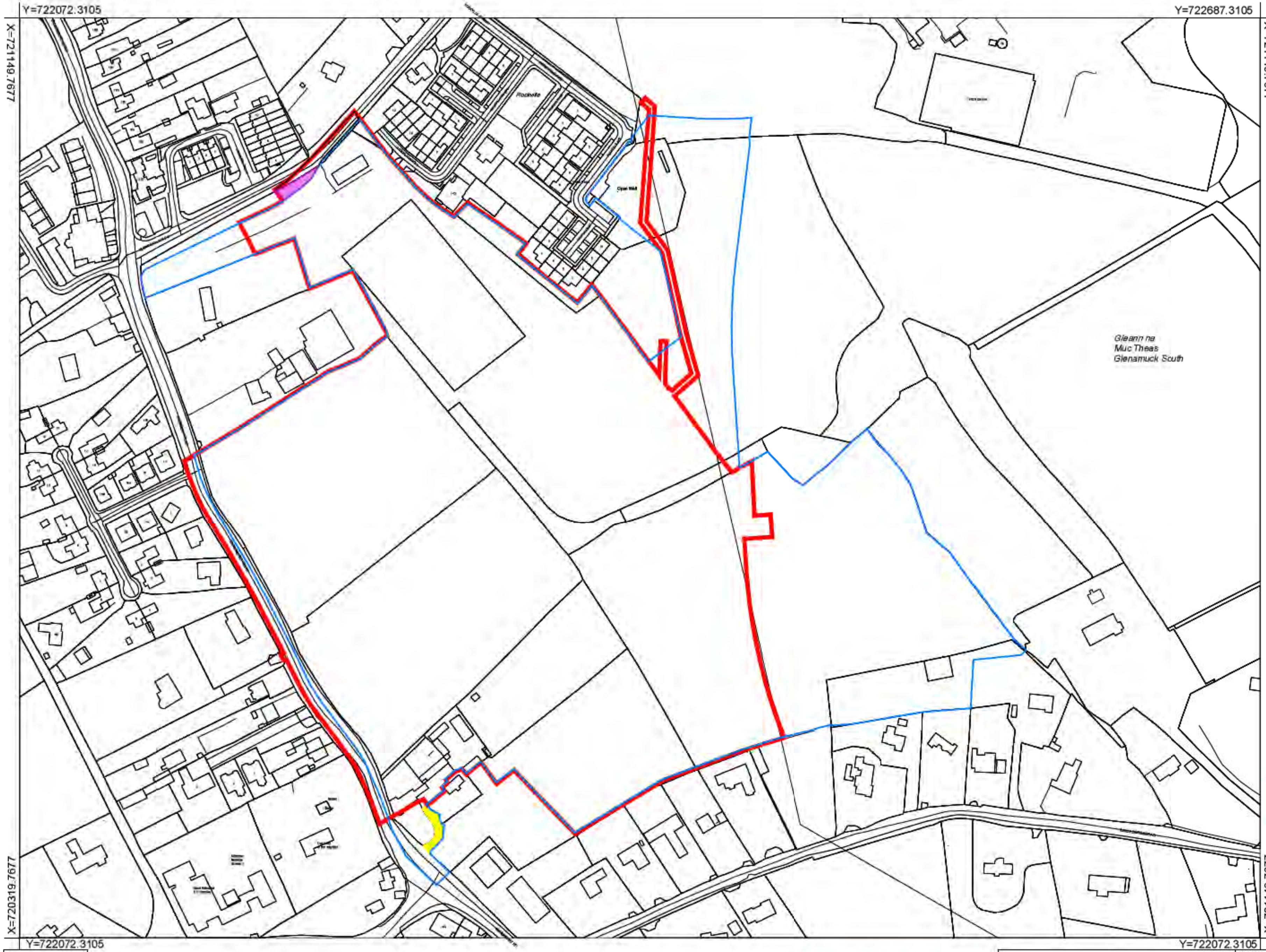
I refer to the above intended planning application, the site of which includes lands in the ownership of Ken Fennell as Statutory Receiver over the assets of Carrickmines Partnership specifically lands annotated in Pink/Purple on the attached drawing.

I confirm that Ken Fennell as Statutory Receiver over the assets of Carrickmines Partnership has no objection to the inclusion of these lands for the purpose of making the planning application.

Yours faithfully
For and on behalf of
Certain assets of the Carrickmines Partnership
(In Receivership)

Ken Fennell
Statutory Receiver

Note: The Receiver contracts only as an agent of the mortgagor(s) and without personal liability



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ULX,ULY= 720319.7677,722687.3105
URX,URY= 721149.7677,722687.3105

Projection / Spatial Reference:
Projection= IRENET95_Irish_Transverse_Mercator

Centre Point Coordinates:
X,Y= 720734.7677,722379.8105

Reference Index:
Map Series | Map Sheets
1:2,500 | 3517-A

Data Extraction Date:
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Source Data Release:
DCLMS Release V1.140.112

Product Version:
Version= 1.3

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'SITE MAP 7'

N

NOTE:
DO NOT SCALE FROM DRAWINGS. WORK TO FIGURED DIMENSIONS ONLY. ARCHITECT TO BE NOTIFIED OF ALL DESCREPENCIES.

LEGEND

🟥	SITE BOUNDARY OF PLANNING APPLICATION
🟦	LANDS UNDER CONTROL OF THE APPLICANT
🟨	WAYLEAVE
🟪	WORKS TO LANDS OWNED BY OTHERS

SHD STAGE 3

M C O R M
McCROSSAN O'ROURKE MANNING ARCHITECTS

PROJECT TITLE:
RESIDENTIAL DEVELOPMENT
KILTERNAN VILLAGE, DUBLIN 18

DRAWING TITLE:
LAND OWNERSHIP MAP

1 Grantham Street, Dublin 8, D08 A49Y Ireland.
Tel: 01-4788700 Fax: 01-4788711 E-Mail: arch@mcorm.com

DATE: MAY '22	DRAWN BY: LQMD
SCALE: 1:2500@A3	REVISION: *
JOB NO: 21009	DRAWING NO: PL100.7

Appendix 12.16

Irish Water Confirmation Of Feasibility (CoF) Letter

& 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

Neil Durkan

1st Floor, Maple House
Lower Kilmacud Road, Stillorgan
Co. Dublin
A94E3F2

30 May 2022

Re: CDS21006509 pre-connection enquiry - Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 444 units at Enniskerry Road, Kilternan, Dublin

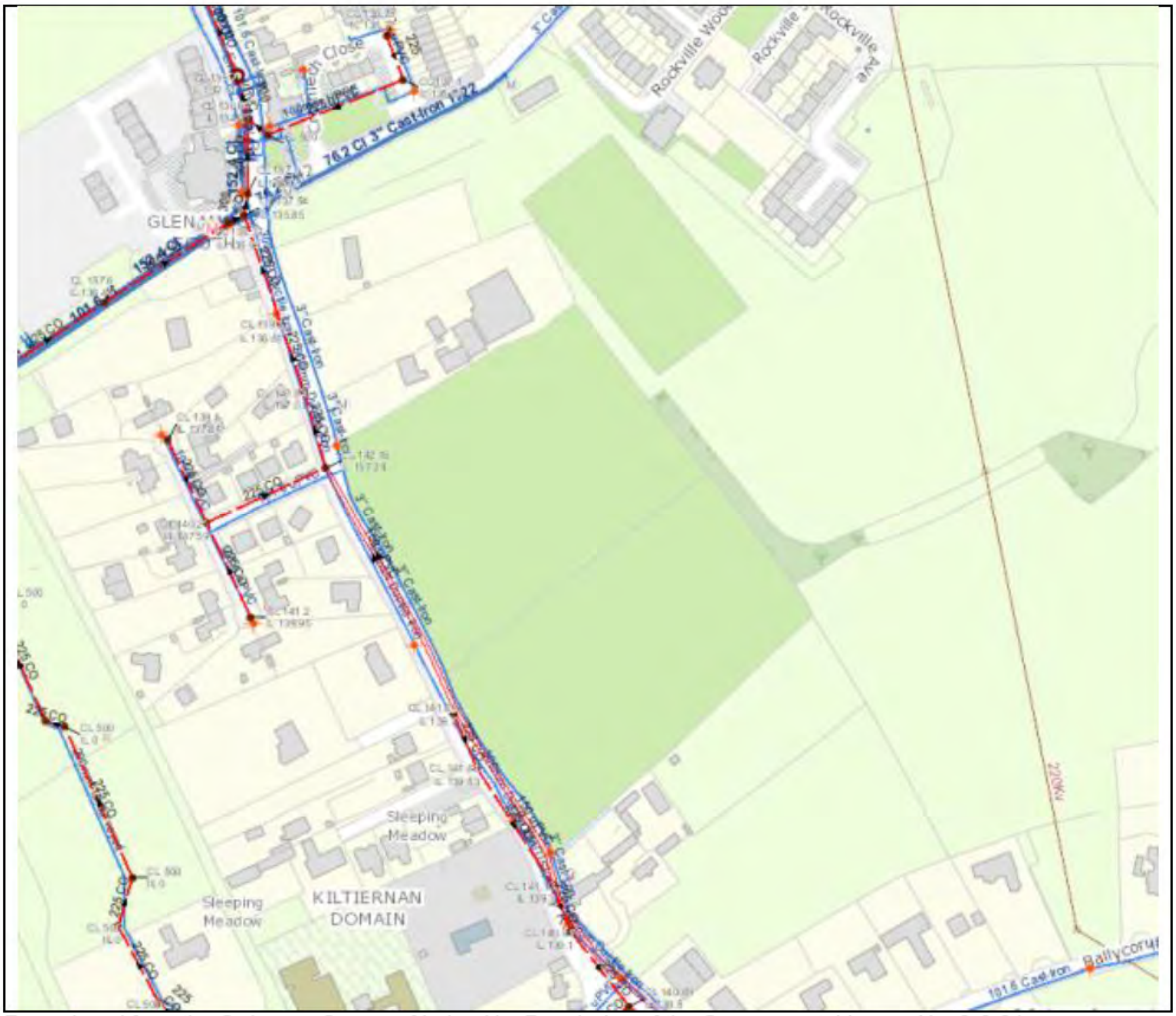
Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Enniskerry Road, Kilternan, Dublin (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	
Wastewater Connection	The proposed wastewater connection for this development connects to the Irish Water network via infrastructure that has not been taken in charge by Irish Water (Third Party Infrastructure). Please be advised that at connection application stage and prior to the commencement of any Self-Lay Works, you have to: • identify and procure transfer to Irish Water of the arterial infrastructure within the Third-Party Infrastructure • demonstrate that the arterial infrastructure is in compliance with requirements of Irish Water Code of Practice and Standard Details and in adequate condition and capacity to cater for the additional load from the Development.

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:



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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 Marina Byrne from the design team via email mzbyrne@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,

Yvonne Harris

Yvonne Harris

Head of Customer Operations

UISCE
ÉIREANN : IRISH
WATER

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

Neil Durkan
1st Floor, Maple House
Lower Kilmacud Road, Stillorgan
Co. Dublin A94E3F2

1 June 2022

Re: Design Submission for Enniskerry Road, Kilternan, Dublin (the "Development") (the "Design Submission") / Connection Reference No: CDS21006509

Dear Neil Durkan,

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: Marina Byrne
Phone: 01 89 25991/ 087619321
Email: mzbyrne@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

- RMA 2104-06 Foul Drainage Sheet 1
- RMA 2104-07 Foul Drainage Sheet 2
- RMA 2104-27 Foul Longitudinal Sections - Sheet 1
- RMA 2104-28 Foul Longitudinal Sections - Sheet 2
- RMA 2104-29 Foul Longitudinal Sections - Sheet 3
- RMA 2104-30 Foul Longitudinal Sections - Sheet 4
- RMA 2104-09 Watermain Layout Sheet 1
- RMA 2104-10 Watermain Layout Sheet 2

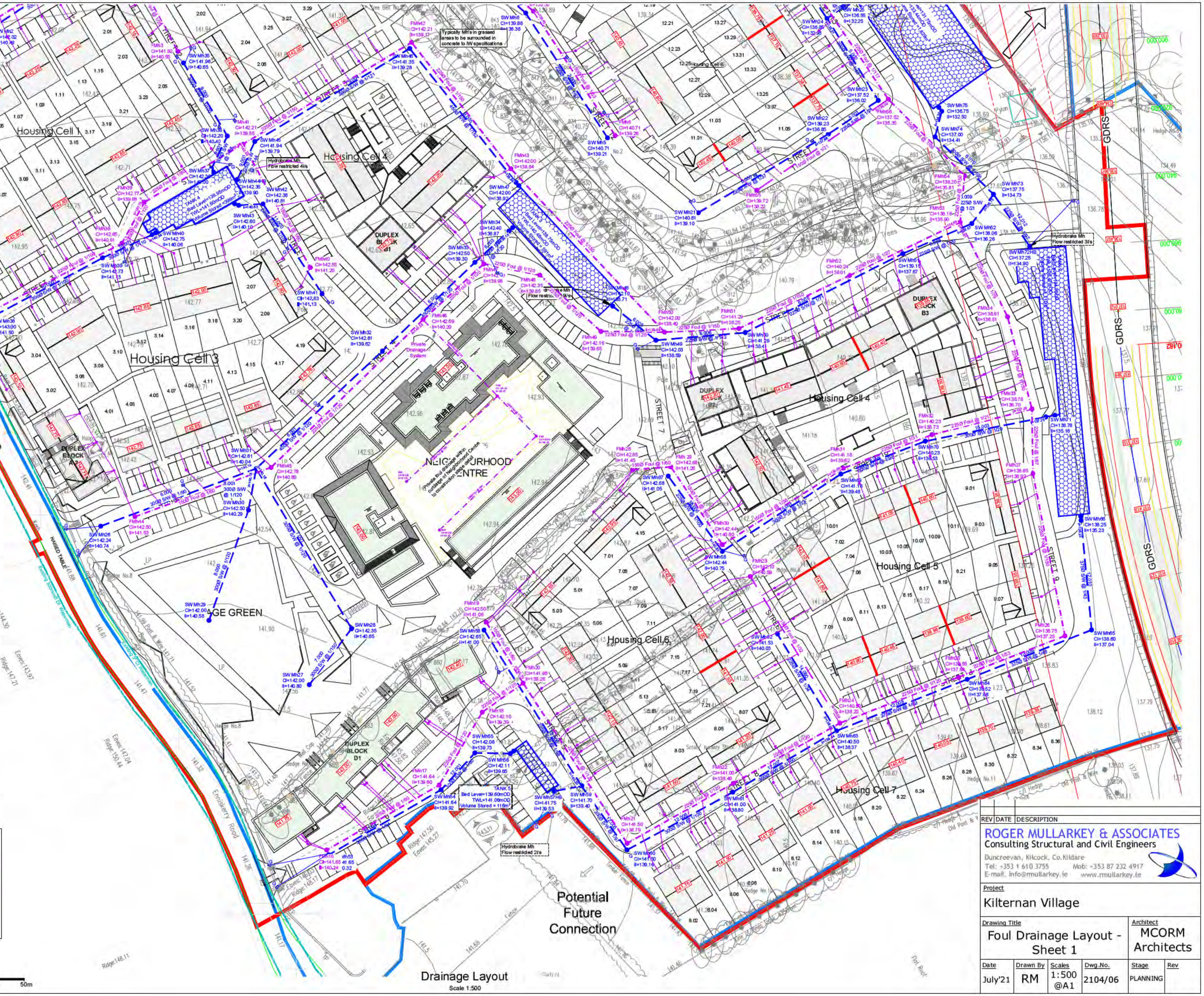
Additional Comments

The design submission will be subject to further technical review at connection application stage.

While Irish Water notes that the water and wastewater services infrastructure for the Housing Cell 13 (Apartment Blocks C&D) and the Neighbourhood Centre will remain private and not be vested, we have the following comments: It is recommended that the foul sewer should have 3 m clearance from the proposed building.

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.



Drainage Layout
Scale 1:500

Notes:

1. Read this drawing in conjunction with all other relevant Engineers and Architects drawings.
2. Do not scale this drawing, use only written dimensions.
3. Do not set out from this drawing unless specifically confirmed by the Engineers beforehand.
4. All levels shown are to Malin Head datum (mOD).
5. The contractor is to check all service connections before commencing any site development works.
6. The Engineer is to be informed of discrepancies that may arise before the contractor commences any site development works, if in doubt - ask!
7. Manhole and road gully details to comply with Greater Dublin Regional Code of practice for Drainage Works.
8. Refer also to the Manhole details drawing/s provided for futher information.
9. Where cover to pipes is less than 1.2m in roads, 1.0m in public areas and 0.9m in grassed/landscaped areas, surround the pipe 150mm of concrete.

THIS IS A PLANNING DRAWING ONLY
AND CANNOT BE USED FOR CONSTRUCTION PURPOSES

Key Plan
A1 Scale 1:5000

Foul Drainage Legend

Proposed Foul Sewer/MH/ Cover Level/Invert Level Diameter/Gradient/Pipe No.	FMh24 Cl=127.60 Il=126.16 4.001 225Ø FW@1/35
Proposed connection and inspection chamber	

S/W Manhole, Invert Level, Diameter & Gradient	SMh
	Cl=134.22
	Il=130.56
	300Ø @ 1/150S/W

A1 Scale 1:500 0m 10m 20m 30m 40m 50m

REV	DATE	DESCRIPTION

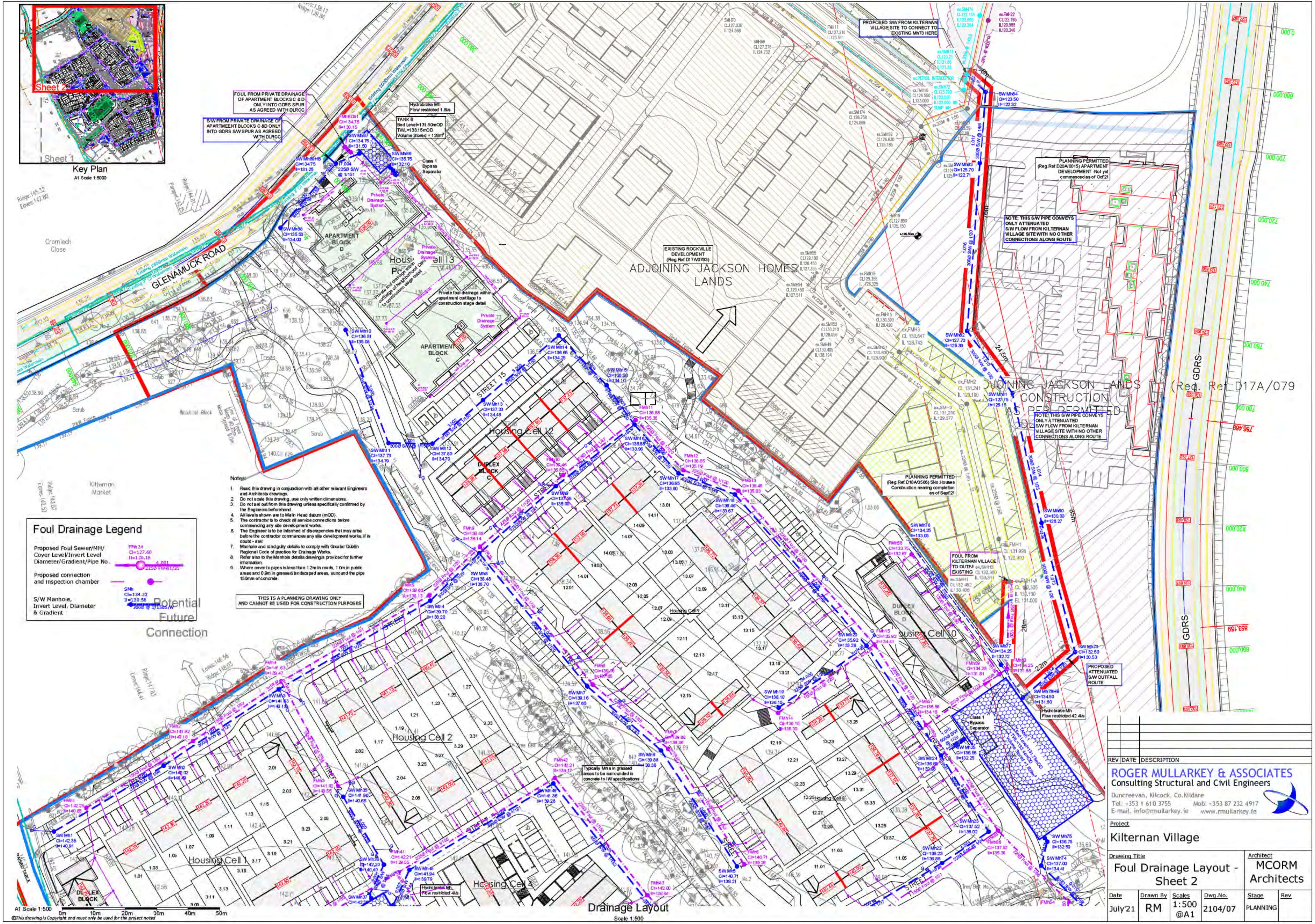
ROGER MULLARKEY & ASSOCIATES
Consulting Structural and Civil Engineers
Duncreevan, Kilcock, Co.Kildare
Tel: +353 1 610 3755 Mob: +353 87 232 4917
E-mail. info@rmullarkey.ie www.rmullarkey.ie

Project
Kilternan Village

Drawing Title
Foul Drainage Layout - Sheet 1

Architect
MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
July'21	RM	1:500 @A1	2104/06	PLANNING	


Key Plan
A1 Scale 1:5000
Sheet 2
Sheet 1
GLENAMUCK ROAD
Cromlech Close
Kilternan Market
ADJOINING JACKSON HOMES LANDS
EXISTING ROCKVILLE DEVELOPMENT (Reg.Ref.D17A0793)
ADJOINING JACKSON LANDS CONSTRUCTION AS PER PERMITTED DE
(Reg. Ref D17A/079
GDRS
PLANNING PERMITTED (Reg.Ref.D20A/0015) APARTMENT DEVELOPMENT -Not yet commenced as of Oct'21
PLANNING PERMITTED (Reg.Ref.D18A/0566) 5No.Houses Construction nearing completion as of Sept'21
NOTE; THIS S/W PIPE CONVEYS ONLY ATTENUATED S/W FLOW FROM KILTERNAN VILLAGE SITE WITH NO OTHER CONNECTIONS ALONG ROUTE
PROPOSED S/W FROM KILTERNAN VILLAGE SITE TO CONNECT TO EXISTING Mh73 HERE
FOUL FROM KILTERNAN VILLAGE TO OUTFA EXISTING
PROPOSED ATTENUATED S/W OUTFALL ROUTE
FOUL FROM PRIVATE DRAINAGE OF APARTMENT BLOCKS C & D ONLY INTO GDRS SPUR AS AGREED WITH DLRCC
S/W FROM PRIVATE DRAINAGE OF APARTMEENT BLOCKS C &D ONLY INTO GDRS S/W SPUR AS AGREED WITH DLRCC
Hydrobrake Mh Flow restricted 1.8l/s
TANK 6
Bed Level=131.50mOD
TWL=133.15mOD
Volume Stored = 128m³
Class 1 Bypass Separator
Hydrobrake Mh Flow restricted 42.4l/s
Hydrobrake Mh Flow restricted 4l/s
Typically MH's in grassed areas to be surrounded in concrete to IW specifications
Private Drainage System
Private foul drainage within apartment curtilage to construction stage detail
APARTMENT BLOCK C
APARTMENT BLOCK D
DUPLEX BLOCK C
DUPLEX BLOCK D
DUPLEX BLOCK
Housing Cell 1
Housing Cell 2
Housing Cell 4
Housing Cell 8
Housing Cell 9
Housing Cell 10
Housing Cell 12
Housing Cell 13
STREET 15
Potential Future Connection
85m
28m
22m
24.5m
8m
Drainage Layout
Scale 1:500
A1 Scale 1:500
0m 10m 20m 30m 40m 50m
©This drawing is Copyright and must only be used for the project noted

Notes:

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6. The Engineer is to be informed of discrepencies that may arise before the contractor commences any site development works, if in doubt - ask!
7. Manhole and road gully details to comply with Greater Dublin Regional Code of practice for Drainage Works.
8. Refer also to the Manhole details drawing/s provided for further information.
9. Where cover to pipes is less than 1.2m in roads, 1.0m in public areas and 0.9m in grassed/landscaped areas, surround the pipe 150mm of concrete.

THIS IS A PLANNING DRAWING ONLY
AND CANNOT BE USED FOR CONSTRUCTION PURPOSES

Foul Drainage Legend

Proposed Foul Sewer/MH/ Cover Level/Invert Level Diameter/Gradient/Pipe No.	FMh24 Cl=127.60 Il=126.16 4.001 225Ø FW@1/35
Proposed connection and inspection chamber	

S/W Manhole, Invert Level, Diameter & Gradient	SMh
	Cl=134.22
	Il=130.56
	300Ø @ 1/150S/W

REV	DATE	DESCRIPTION

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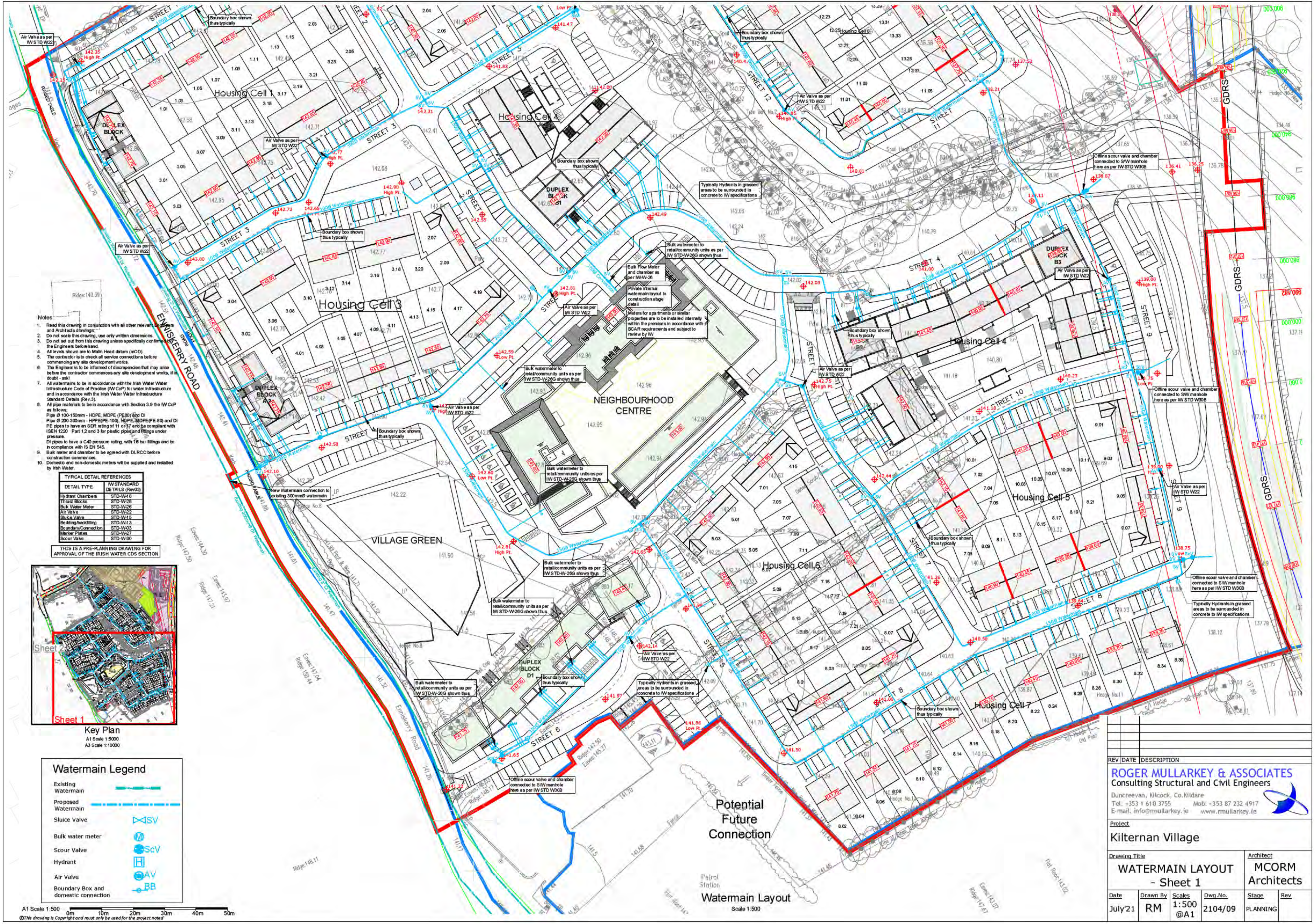
Project
Kilternan Village

Drawing Title
Foul Drainage Layout - Sheet 2

Architect
MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
July'21	RM	1:500 @A1	2104/07	PLANNING	


ENNISKERRY ROAD
Enniskerry Road
Housing Cell 1
Housing Cell 3
Housing Cell 4
Housing Cell 5
Housing Cell 6
Housing Cell 7
NEIGHBOURHOOD CENTRE
VILLAGE GREEN
DUPLEX BLOCK A1
DUPLEX BLOCK B1
DUPLEX BLOCK B3
DUPLEX BLOCK D1
STREET 2
STREET 3
STREET 4
STREET 5
STREET 6
STREET 7
STREET 8
STREET 9
STREET 10
STREET 11
STREET 12
GDRS
Potential Future Connection
Petrol Station
Air Valve as per IW STD W22
Boundary box shown thus typically
Typically Hydrants in grassed areas to be surrounded in concrete to IW specifications
Offline scour valve and chamber connected to S/W manhole here as per IW STD W30B
Bulk watermeter to retail/community units as per IW STD-W-26G shown thus
Bulk Flow Meter and chamber as per IW-W-26
Private internal watermain layout to construction stage detail
Meters for apartments or similar properties are to be installed internally within the premises in accordance with BCAR requirements and subject to review by IW
New Watermain connection to existing 300mmØ watermain
High Pt.
Low Pt.
RAISED TABLE
Sheet 1
Sheet 2
Watermain Layout
Scale 1:500

Notes:

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2. Do not scale this drawing, use only written dimensions.
3. Do not set out from this drawing unless specifically confirmed by the Engineers beforehand.
4. All levels shown are to Malin Head datum (mOD).
5. The contractor is to check all service connections before commencing any site development works.
6. The Engineer is to be informed of discrepencies that may arise before the contractor commences any site development works, if in doubt - ask!
7. All watermains to be in accordance with the Irish Water Water Infrastructure Code of Practice (IW CoP) for water Infrastructure and in accordance with the Irish Water Water Infrastructure Standard Details (Rev.3).
8. All pipe materials to be in accordance with Section 3.9 the IW CoP as follows;
   Pipe Ø 100-150mm - HDPE, MDPE (PE80) and DI
   Pipe Ø 200-300mm - HPPE(PE-100), HDPE, MDPE(PE-80) and DI
   PE pipes to have an SDR rating of 11 or 17 and be compliant with ISEN 1220 Part 1,2 and 3 for plastic pipes and fittings under pressure.
   DI pipes to have a C40 pressure rating, with 16 bar fittings and be in compliance with IS EN 545.
9. Bulk meter and chamber to be agreed with DLRCC before construction commences.
10. Domestic and non-domestic meters will be supplied and installed by Irish Water.

TYPICAL DETAIL REFERENCES	
DETAIL TYPE	IW STANDARD DETAILS (Rev03)
Hydrant Chambers	STD-W-18
Thrust Blocks	STD-W-28
Bulk Water Meter	STD-W-26
Air Valve	STD-W-22
Sluice Valve	STD-W-15
Bedding/backfilling	STD-W-13
Boundary/Connection	STD-W-03
Marker Plates	STD-W-27
Scour Valve	STD-W-30

THIS IS A PRE-PLANNING DRAWING FOR
APPROVAL OF THE IRISH WATER CDS SECTION

Key Plan
A1 Scale 1:5000
A3 Scale 1:10000

Watermain Legend

Existing Watermain
Proposed Watermain
Sluice Valve ⋈ISV
Bulk water meter Ⓜ
Scour Valve ●ScV
Hydrant 🄷
Air Valve ◉AV
Boundary Box and domestic connection BB

A1 Scale 1:500 0m 10m 20m 30m 40m 50m

REV	DATE	DESCRIPTION

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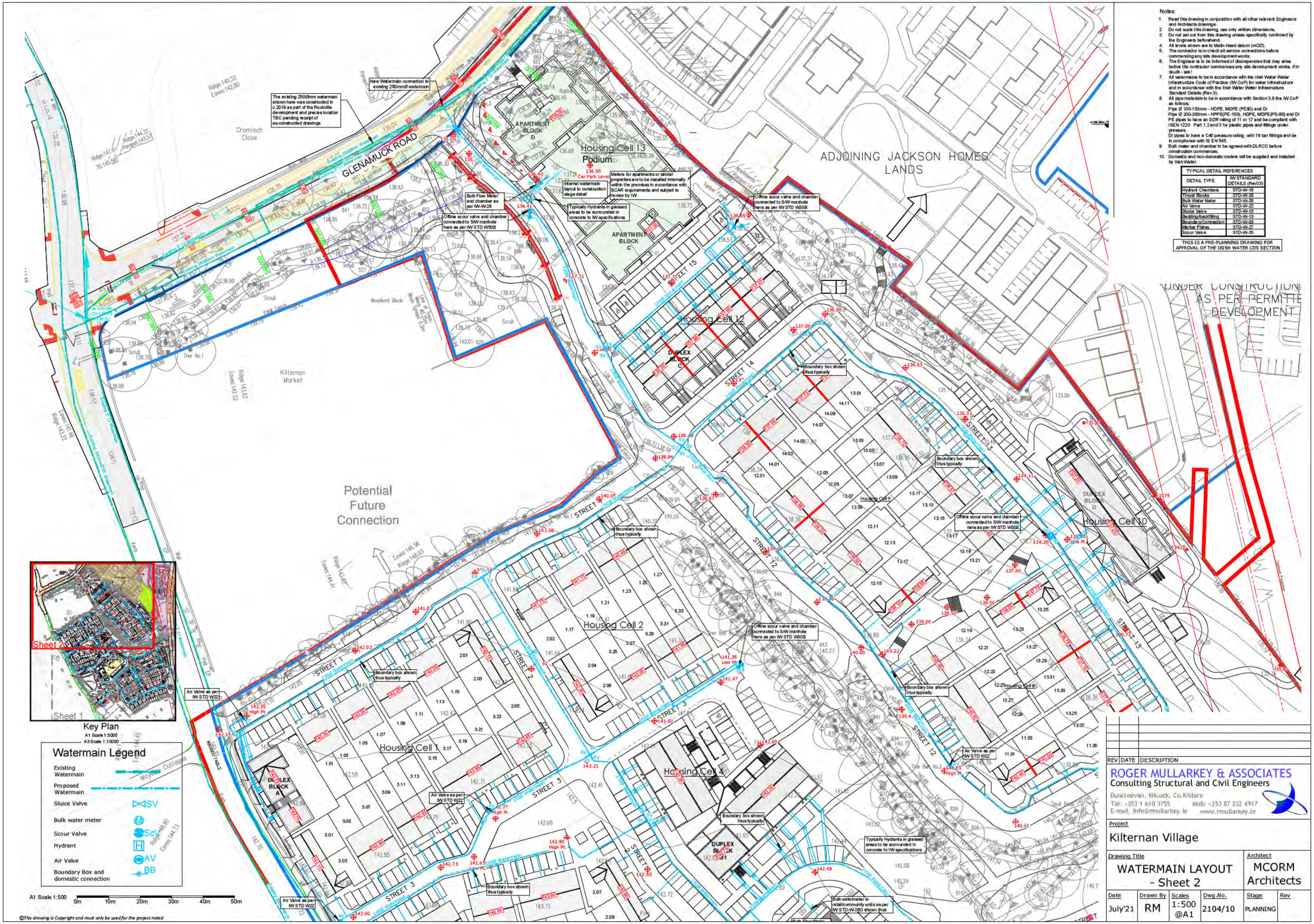
Project
Kilternan Village

Drawing Title
WATERMAIN LAYOUT
- Sheet 1

Architect
MCORM
Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
July'21	RM	1:500 @A1	2104/09	PLANNING	


GLENAMUCK ROAD
ADJOINING JACKSON HOMES LANDS
UNDER CONSTRUCTION AS PER PERMITTED DEVELOPMENT
Cromlech Close
Kilternan Market
Potential Future Connection
Woodland Block
Housing Cell 13
Podium
APARTMENT BLOCK D
APARTMENT BLOCK C
Housing Cell 12
DUPLEX BLOCK C
Housing Cell 9
Housing Cell 10
DUPLEX BLOCK D
Housing Cell 8
Housing Cell 2
Housing Cell 1
Housing Cell 4
DUPLEX BLOCK A1
DUPLEX BLOCK B1
STREET 1
STREET 2
STREET 3
STREET 5
STREET 12
STREET 13
STREET 14
STREET 15
RAISED TABLE
Wayside Cottages
The existing 250Ømm watermain shown here was constructed in c.2019 as part of the Rockville development and precise location TBC pending receipt of as-constructed drawings
New Watermain connection to existing 250mmØ watermain
Bulk Flow Meter and chamber as per IW-W-26
Offline scour valve and chamber connected to S/W manhole here as per IW STD W30B
Internal watermain layout to construction stage detail
Meters for apartments or similar properties are to be installed internally within the premises in accordance with BCAR requirements and subject to review by IW
Typically Hydrants in grassed areas to be surrounded in concrete to IW specifications
Boundary box shown thus typically
Air Valve as per IW STD W22
Bulk watermeter to retail/community units as per IW STD-W-26G shown thus
136.50 Car Park Level
Key Plan
A1 Scale 1:5000
A3 Scale 1:10000
Sheet 1
Sheet 2
A1 Scale 1:500
0m
10m
20m
30m
40m
50m

Watermain Legend

Existing Watermain	▬
Proposed Watermain	─ · ─
Sluice Valve	⋈SV
Bulk water meter	Ⓜ
Scour Valve	●ScV
Hydrant	H
Air Valve	◉AV
Boundary Box and domestic connection	●BB

Notes:

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3. Do not set out from this drawing unless specifically confirmed by the Engineers beforehand.
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6. The Engineer is to be informed of discrepencies that may arise before the contractor commences any site development works, if in doubt - ask!
7. All watermains to be in accordance with the Irish Water Water Infrastructure Code of Practice (IW CoP) for water Infrastructure and in accordance with the Irish Water Water Infrastructure Standard Details (Rev.3).
8. All pipe materials to be in accordance with Section 3.9 the IW CoP as follows;
   Pipe Ø 100-150mm - HDPE, MDPE (PE80) and DI
   Pipe Ø 200-300mm - HPPE(PE-100), HDPE, MDPE(PE-80) and DI
   PE pipes to have an SDR rating of 11 or 17 and be compliant with ISEN 1220 Part 1,2 and 3 for plastic pipes and fittings under pressure.
   DI pipes to have a C40 pressure rating, with 16 bar fittings and be in compliance with IS EN 545.
9. Bulk meter and chamber to be agreed with DLRCC before construction commences.
10. Domestic and non-domestic meters will be supplied and installed by Irish Water.

TYPICAL DETAIL REFERENCES	
DETAIL TYPE	IW STANDARD DETAILS (Rev03)
Hydrant Chambers	STD-W-16
Thrust Blocks	STD-W-28
Bulk Water Meter	STD-W-26
Air Valve	STD-W-22
Sluice Valve	STD-W-15
Bedding/backfilling	STD-W-13
Boundary/Connection	STD-W-03
Marker Plates	STD-W-27
Scour Valve	STD-W-30

THIS IS A PRE-PLANNING DRAWING FOR APPROVAL OF THE IRISH WATER CDS SECTION

REV	DATE	DESCRIPTION

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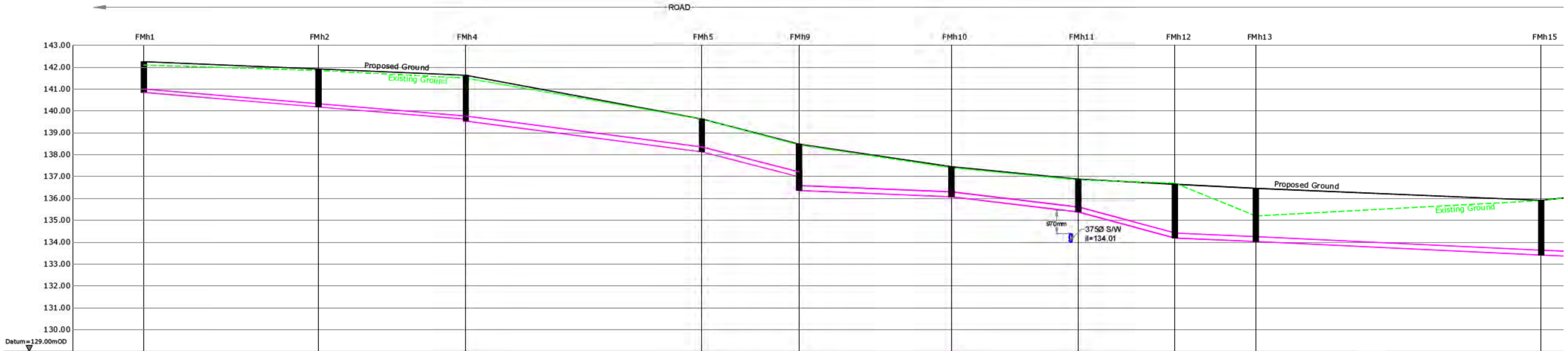
Project
Kilternan Village

Drawing Title
WATERMAIN LAYOUT
- Sheet 2

Architect
MCORM
Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
July'21	RM	1:500 @A1	2104/10	PLANNING	



	FMh1		FMh2		FMh4		FMh5		FMh9		FMh10		FMh11		FMh12		FMh13		FMh15
Existing Levels	142.10		141.85		141.50		140.40		138.45		137.40		136.85		136.70		135.20		135.90
Proposed Cover Levels	142.25		141.92		141.63		139.63		138.48		137.46		136.88		136.65		136.46		135.92
Proposed Invert Levels	140.85		140.18		139.62 139.47		138.13		136.98 136.14		135.85		135.38		135.19		135.03		134.41
Pipe Length		40.0m		33.7m		54.4m		22.2m		34.9m		29.0m		22.2m		18.5m		65.30m	
Pipe Size & Gradient		150Ø @ 1/60		150Ø @ 1/60		225Ø @ 1/41		225Ø @ 1/20		225Ø @ 1/120		225Ø @ 1/47		225Ø @ 1/120		225Ø @ 1/120		225Ø @ 1/120	

Foul Longitudinal Section
FMh1 to FMh15

Vertical Scale 1:100
Horizontal Scale 1:500

Notes:

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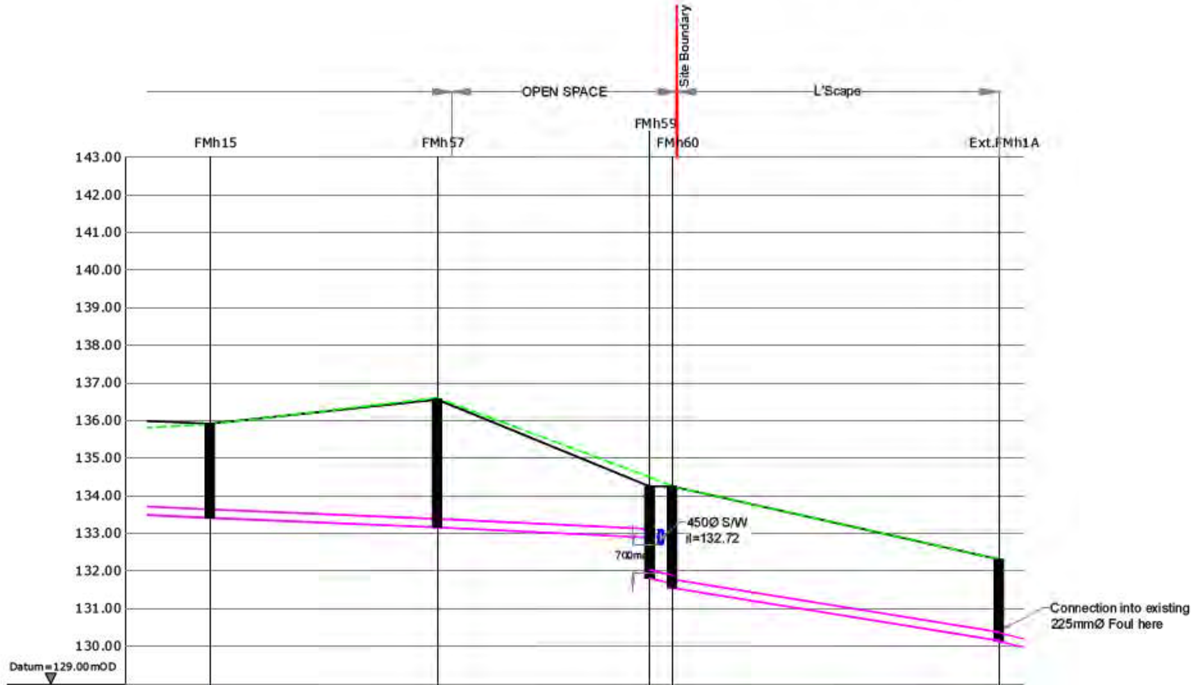
5. The contractor is to check all service connections before commencing any site development works.
6. The Engineer is to be informed of discrepencies that may arise before the contractor commences any site development works, if in doubt - ask!
7. Manhole details and materials specification to comply Irish Water Wastewater Infrastructure Standard Details document and Code of Practice.
8. Foul gravity sewers to be concrete in accordance with IW CoP section 3.13.
9. Refer also to the Manhole details drawing provided for further information.
10. Where cover to pipes is less than 1.2m in roads, 1.0m in public areas and 0.9m in grassed/landscaped areas, surround the pipe 150mm of concrete.

THIS IS A PRE-PLANNING DRAWING FOR
APPROVAL OF THE IRISH WATER CDS SECTION

REFER TO Dwg.No.2104/06-07 FOR
PLAN ALIGNMENT OF FOUL SEWER
SHOWN ON THIS DRAWING



	FMh15		FMh57		FMh59		FMh60		Ext.FMh1A
Existing Levels	135.90		135.60		134.50		134.25		132.30
Proposed Cover Levels	135.92		136.56		134.25		134.25		132.30
Proposed Invert Levels	134.41		134.16		132.89 131.81		131.66 131.55		130.15 131.13
Pipe Length		30.3m		28.2m		3.0m		27.8m	
Pipe Size & Gradient		225Ø @ 1/120		225Ø @ 1/22				225Ø @ 1/20	

225mmØ @ 1/20

Foul Longitudinal Section
FMh15 to Outfall

Vertical Scale 1:100
Horizontal Scale 1:500

REV	DATE	DESCRIPTION

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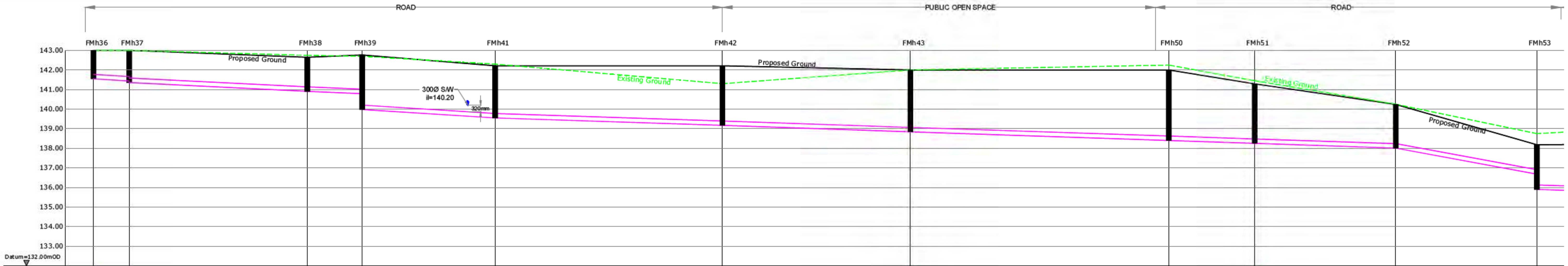
Project
Kilternan Village

Drawing Title
FOUL LONGITUDINAL SECTIONS- Sheet 1

Architect
MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
Oct'21	RM	As Shown @A1	2104/27	PLANNING	

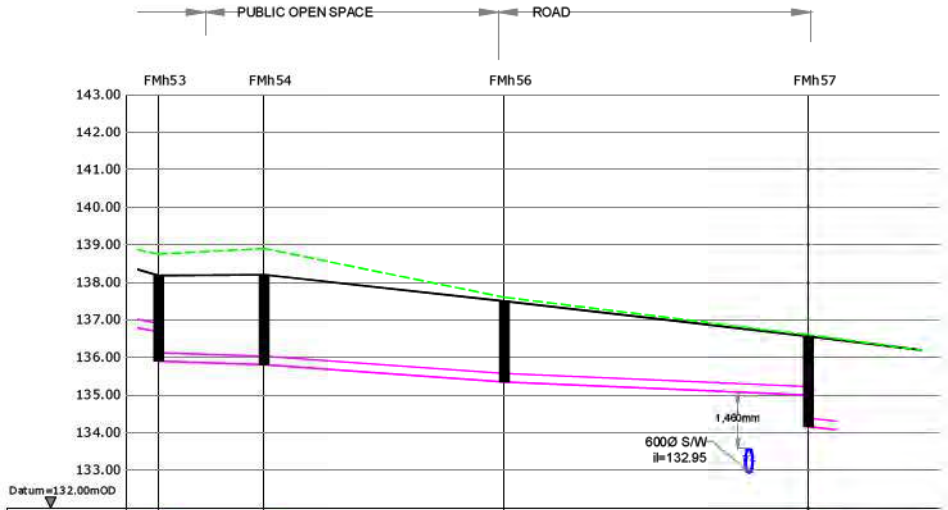


	FMh36	FMh37	FMh38	FMh39	FMh41	FMh42	FMh43	FMh50	FMh51	FMh52	FMh53
Existing Levels	143.00	143.00	142.75	142.70	142.30	141.30	142.00	142.25	141.45	140.25	138.75
Proposed Cover Levels	143.05	143.00	142.65	142.77	142.21	142.21	142.00	142.00	141.29	140.24	138.18
Proposed Invert Levels	141.55	141.36	140.91	140.79 139.98	139.55	139.17	138.84	138.40	138.25	138.01	136.68 135.90
Pipe Length	9.1m	45.5m	14.0m	34.0m	58.0m	48.0m	66.0m	22.0m	36.0m	36.0m	14.
Pipe Size & Gradient	150Ø @ 1/60	225Ø @ 1/100	225Ø @ 1/120	225Ø @ 1/80	225Ø @ 1/150	225Ø @ 1/150	225Ø @ 1/140	225Ø @ 1/150	225Ø @ 1/150	225Ø @ 1/27	225Ø @

Foul Longitudinal Section
FMh36 to FMh53

Vertical Scale 1:100
Horizontal Scale 1:500

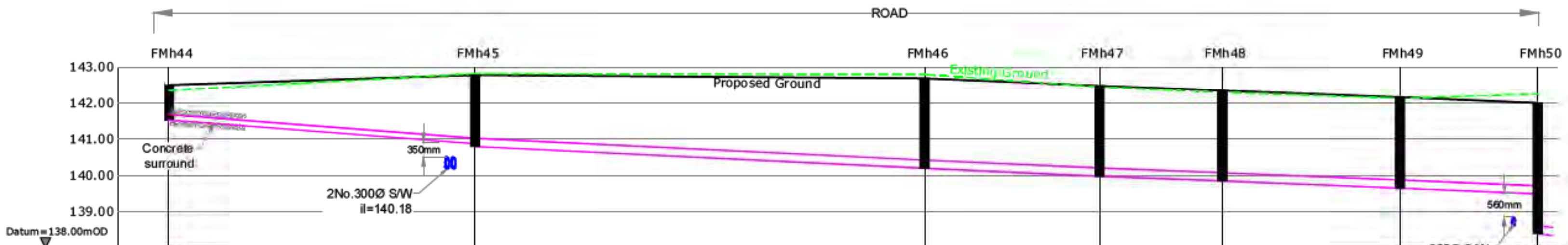
Horizontal Scale 1:500



	FMh53	FMh54	FMh56	FMh57
Existing Levels	138.75	138.90	137.60	136.60
Proposed Cover Levels	138.18	138.20	137.52	136.56
Proposed Invert Levels	136.68 135.90	135.81	135.35	135.00 134.16
Pipe Length	14.0m	32.0m	40.50m	
Pipe Size & Gradient	225Ø @ 1/150	225Ø @ 1/68	225Ø @ 1/117	

Foul Longitudinal Section
FMh53 to FMh57

Vertical Scale 1:100
Horizontal Scale 1:500



	FMh44	FMh45	FMh46	FMh47	FMh48	FMh49	FMh50
Existing Levels	142.35	142.82	142.80	142.45	142.30	142.13	142.25
Proposed Cover Levels	142.50	142.78	142.69	142.49	142.35	142.16	142.00
Proposed Invert Levels	141.53	140.80	140.20	139.98	139.85	139.65	139.49 138.40
Pipe Length	42.20m	62.0m	24.2m	17.0m	24.5m	19.0m	
Pipe Size & Gradient	150Ø @ 1/60	225Ø @ 1/120	225Ø @ 1/120	225Ø @ 1/120	225Ø @ 1/120	225Ø @ 1/120	

Foul Longitudinal Section
FMh44 to FMh50

Vertical Scale 1:100
Horizontal Scale 1:500

Notes:

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6. The Engineer is to be informed of discrepencies that may arise before the contractor commences any site development works, if in doubt - ask!
7. Manhole details and materials specification to comply Irish Water Wastewater Infrastructure Standard Details document and Code of Practice.
8. Foul gravity sewers to be concrete in accordance with IW CoP section 3.13.
9. Refer also to the Manhole details drawing provided for further information.
10. Where cover to pipes is less than 1.2m in roads, 1.0m in public areas and 0.9m in grassed/landscaped areas, surround the pipe 150mm of concrete.

THIS IS A PRE-PLANNING DRAWING FOR
APPROVAL OF THE IRISH WATER CDS SECTION

REFER TO Dwg.No.2104/06-07 FOR
PLAN ALIGNMENT OF FOUL SEWER
SHOWN ON THIS DRAWING

REV	DATE	DESCRIPTION

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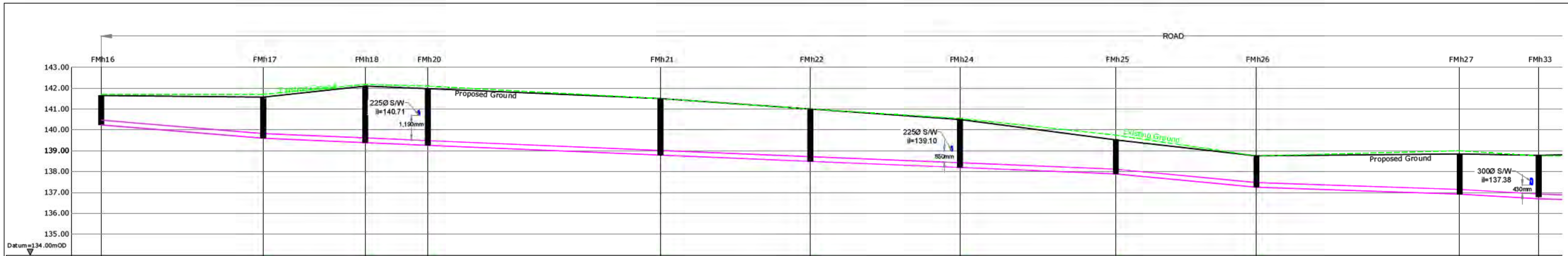
Project
Kilternan Village

Drawing Title
FOUL LONGITUDINAL
SECTIONS- Sheet 2

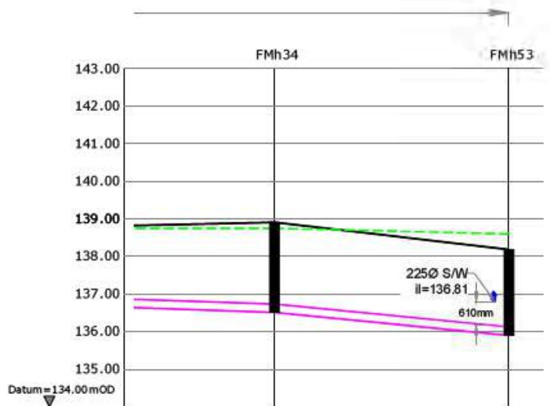
Architect
MCORM
Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
Oct'21	RM	As Shown @A1	2104/28	PLANNING	



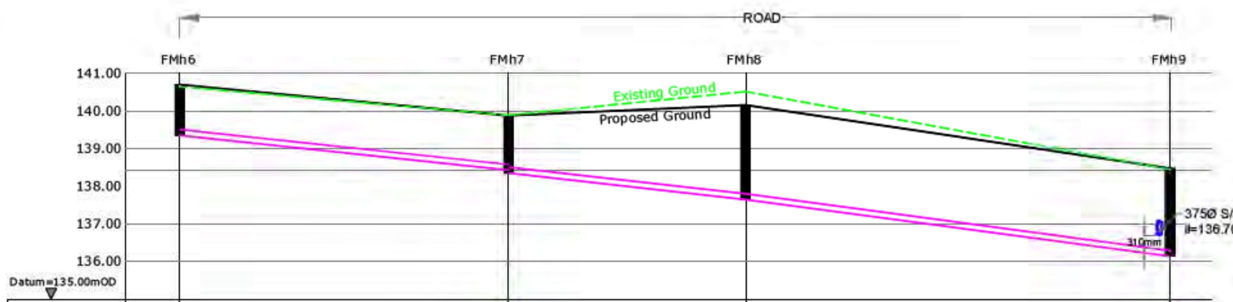
	FMh16		FMh17		FMh18		FMh20		FMh21		FMh22		FMh24		FMh25		FMh26		FMh27		FMh33
Existing Levels	141.70		141.70		142.18		142.10		141.50		141.00		140.55		139.75		138.75		139.00		138.75
Proposed Cover Levels	141.65		141.64		142.10		141.98		141.50		141.00		140.50		139.55		138.75		138.85		138.78
Proposed Invert Levels	140.24		139.60		139.39		139.26		138.79		138.49		138.20		137.89		137.25		136.92		136.70
Pipe Length		39.0m		24.5m		15.0m		56.0m		36.0m		36.0m		37.5m		33.8m		48.9m		19.0m	
Pipe Size & Gradient		225Ø @ 1/60		225Ø @ 1/120		225Ø @ 1/120		225Ø @ 1/120		225Ø @ 1/120		225Ø @ 1/120		225Ø @ 1/120		225Ø @ 1/53		225Ø @ 1/150		225Ø @ 1/87	

Foul Longitudinal Section
FMh16 to FMh33
Vertical Scale 1:100
Horizontal Scale 1:500



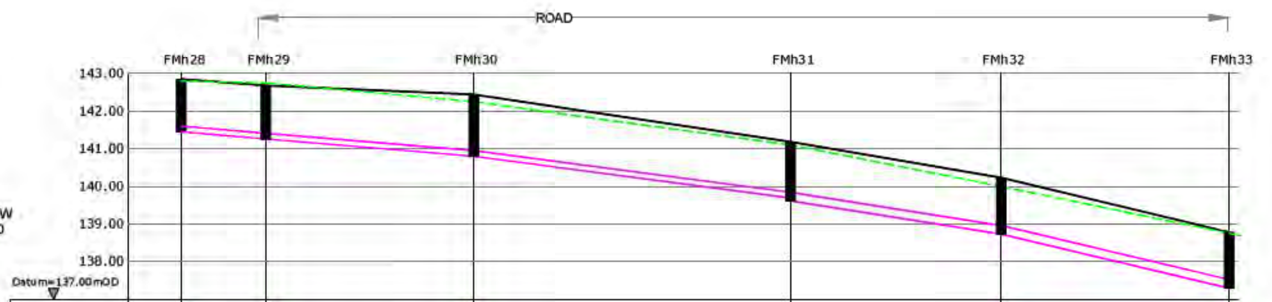
		FMh34		FMh53
Existing Levels		138.75		138.60
Proposed Cover Levels		138.91		138.18
Proposed Invert Levels		136.51		135.90
Pipe Length	28.0m		31.2m	
Pipe Size & Gradient	250 @ 1/150		225Ø @ 1/79	

Foul Longitudinal Section
FMh33 to FMh53
Vertical Scale 1:100
Horizontal Scale 1:500



	FMh6		FMh7		FMh8		FMh9
Existing Levels	140.65		139.89		139.52		138.45
Proposed Cover Levels	140.71		139.88		139.16		138.48
Proposed Invert Levels	139.26		138.43 138.36		137.65		136.14
Pipe Length		43.8m		31.5m		56.5m	
Pipe Size & Gradient		150Ø @ 1/53		225Ø @ 1/45		225Ø @ 1/38	

Foul Longitudinal Section
FMh6 to FMh9
Vertical Scale 1:100
Horizontal Scale 1:500



	FMh28		FMh29		FMh30		FMh31		FMh32		FMh33
Existing Levels	142.80		142.73		142.23		141.10		140.80		136.75
Proposed Cover Levels	142.85		142.68		142.44		141.18		140.23		138.78
Proposed Invert Levels	141.45		141.26		140.80		139.69 139.62		138.73		137.29 136.70
Pipe Length		11.3m		27.6m		42.2m		28.0m		30.3m	
Pipe Size & Gradient		150Ø @ 1/60		150Ø @ 1/60		225Ø @ 1/38		225Ø @ 1/31		225Ø @ 1/21	

Foul Longitudinal Section
FMh28 to FMh33
Vertical Scale 1:100
Horizontal Scale 1:500

Notes:
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7. Manhole details and materials specification to comply Irish Water Wastewater Infrastructure Standard Details document and Code of Practice.
8. Foul gravity sewers to be concrete in accordance with IW CoP section 3.13.
9. Refer also to the Manhole details drawing provided for further information.
10. Where cover to pipes is less than 1.2m in roads, 1.0m in public areas and 0.9m in grassed/landscaped areas, surround the pipe 150mm of concrete.

THIS IS A PRE-PLANNING DRAWING FOR APPROVAL OF THE IRISH WATER CDS SECTION

REFER TO Dwg.No.2104/06-07 FOR PLAN ALIGNMENT OF FOUL SEWER SHOWN ON THIS DRAWING

REV	DATE	DESCRIPTION

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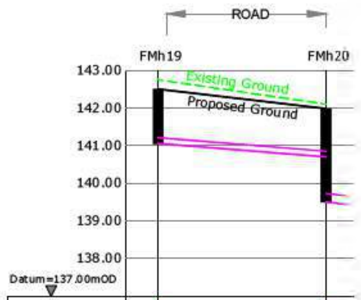
Project
Kilternan Village

Drawing Title	Architect
FOUL LONGITUDINAL SECTIONS- Sheet 3	MCORM Architects

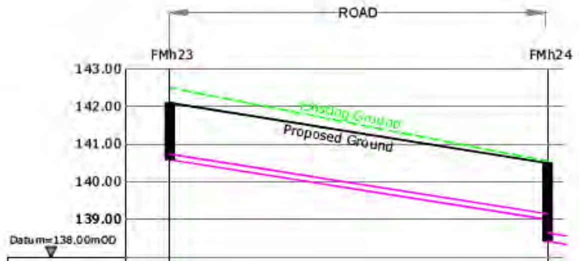
Date	Drawn By	Scales	Dwg.No.	Stage	Rev
Oct'21	RM	As Shown @A1	2104/29	PLANNING	



Existing Levels	142.75	142.10
Proposed Cover Levels	142.50	141.98
Proposed Invert Levels	141.06	140.70 139.52
Pipe Length	22.3m	
Pipe Size & Gradient	150Ø @ 1/60	

Foul Longitudinal Section FMh19 to FMh20

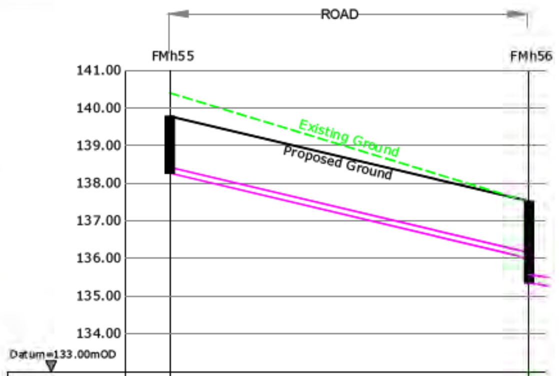
Vertical Scale 1:100
Horizontal Scale 1:500



Existing Levels	142.30	140.35
Proposed Cover Levels	142.10	140.50
Proposed Invert Levels	140.59	139.00 138.42
Pipe Length	50.3m	
Pipe Size & Gradient	150Ø @ 1/32	

Foul Longitudinal Section FMh23 to FMh24

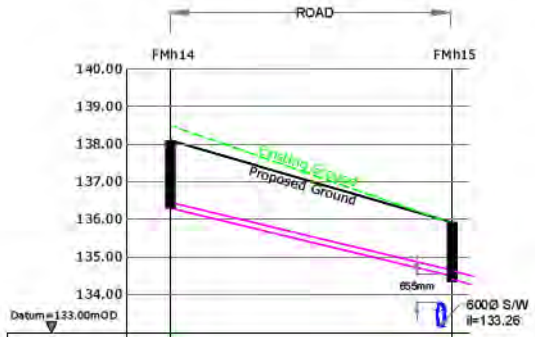
Vertical Scale 1:100
Horizontal Scale 1:500



Existing Levels	140.40	137.50
Proposed Cover Levels	139.72	137.52
Proposed Invert Levels	138.22	136.00 135.35
Pipe Length	47.8m	
Pipe Size & Gradient	150Ø @ 1/21	

Foul Longitudinal Section FMh55 to FMh56

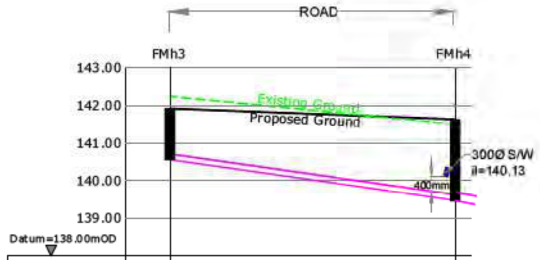
Vertical Scale 1:100
Horizontal Scale 1:500



Existing Levels	136.50	135.90
Proposed Cover Levels	138.10	135.92
Proposed Invert Levels	136.30	134.49 134.41
Pipe Length	37.5m	
Pipe Size & Gradient	150Ø @ 1/20	

Foul Longitudinal Section FMh14 to FMh15

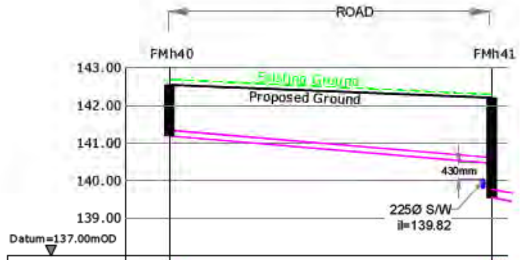
Vertical Scale 1:100
Horizontal Scale 1:500



Existing Levels	142.25	141.50
Proposed Cover Levels	141.92	141.63
Proposed Invert Levels	140.55	139.48 139.47
Pipe Length	38.0m	
Pipe Size & Gradient	150Ø @ 1/35	

Foul Longitudinal Section FMh3 to FMh4

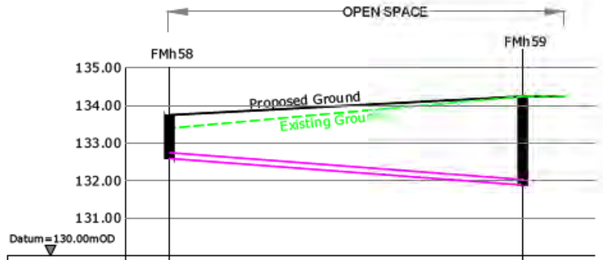
Vertical Scale 1:100
Horizontal Scale 1:500



Existing Levels	142.70	142.30
Proposed Cover Levels	142.55	142.21
Proposed Invert Levels	141.20	140.49 139.55
Pipe Length	42.8m	
Pipe Size & Gradient	150Ø @ 1/60	

Foul Longitudinal Section FMh40 to FMh41

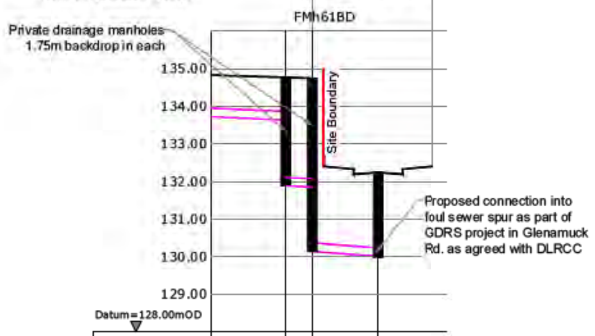
Vertical Scale 1:100
Horizontal Scale 1:500



Existing Levels	133.40	134.30
Proposed Cover Levels	133.75	134.25
Proposed Invert Levels	132.60	131.89 131.81
Pipe Length	47.0m	
Pipe Size & Gradient	150Ø @ 1/60	

Foul Longitudinal Section FMh58 to FMh59

Vertical Scale 1:100
Horizontal Scale 1:500


GDRS
Glenamuck Rd
FMh61BD
Private drainage manholes
1.75m backdrop in each
135.00
134.00
133.00
132.00
131.00
130.00
129.00
Site Boundary
Proposed connection into foul sewer spur as part of GDRS project in Glenamuck Rd. as agreed with DLRCC
Datum=128.00mOD

Existing Levels	135.50	135.50	132.25
Proposed Cover Levels	134.75	134.75	132.25
Proposed Invert Levels	133.64 131.89	130.15	130.01
Pipe Length			
Pipe Size & Gradient		225Ø @1/100	

Foul Longitudinal Section FMh61BD to Outfall

Vertical Scale 1:100
Horizontal Scale 1:500

Notes:

1. Read this drawing in conjunction with all other relevant Engineers and Architects drawings.
2. Do not scale this drawing, use only written dimensions.
3. Do not set out from this drawing unless specifically confirmed by the Engineers beforehand.
4. All levels shown are to Malin Head datum (mOD).
5. The contractor is to check all service connections before commencing any site development works.
6. The Engineer is to be informed of discrepencies that may arise before the contractor commences any site development works, if in doubt - ask!
7. Manhole details and materials specification to comply Irish Water Wastewater Infrastructure Standard Details document and Code of Practice.
8. Foul gravity sewers to be concrete in accordance with IW CoP section 3.13.
9. Refer also to the Manhole details drawing provided for further information.
10. Where cover to pipes is less than 1.2m in roads, 1.0m in public areas and 0.9m in grassed/landscaped areas, surround the pipe 150mm of concrete.

THIS IS A PRE-PLANNING DRAWING FOR APPROVAL OF THE IRISH WATER CDS SECTION

REFER TO Dwg.No.2104/06-07 FOR PLAN ALIGNMENT OF FOUL SEWER SHOWN ON THIS DRAWING

REV	DATE	DESCRIPTION

ROGER MULLARKEY & ASSOCIATES
Consulting Structural and Civil Engineers
Duncreevan, Kilcock, Co.Kildare
Tel: +353 1 610 3755 Mob: +353 87 232 4917
E-mail. info@rmullarkey.ie www.rmullarkey.ie

Project
Kilternan Village

Drawing Title	Architect
FOUL LONGITUDINAL SECTIONS- Sheet 4	MCORM Architects

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
Oct'21	RM	As Shown @A1	2104/30	PLANNING	

Roger Mullarkey

From: Antonio Garzon Mielgo <Antonio.Garzon@water.ie>
Sent: Wednesday 1 June 2022 11:06
To: Roger Mullarkey
Cc: CDS Design QA; Marina Zivanovic Byrne
Subject: Re: CDS21006509 Kilternan Co. Dublin - SoDA
Attachments: Statement of Design Acceptance - PCE 01-06-2022 10-35-30.pdf

Hi Roger,

Please find attached the Statement of Design Acceptance for the above project.

Please let me know if you need any clarification.

Regards,
Antonio

From: Roger Mullarkey <info@rmullarkey.ie>
Sent: 31 May 2022 11:55
To: Antonio Garzon Mielgo
Cc: CDS Design QA; Marina Zivanovic Byrne
Subject: Re: CDS21006509 Kilternan Co. Dublin - Email 1 of 3

Thanks Antonio.
We will update those few notes and issue to you later today.
Thanks for the quick response.

Kind Regards,
Roger Mullarkey

From: Antonio Garzon Mielgo <Antonio.Garzon@water.ie>
Sent: Tuesday, May 31, 2022 11:51:51 AM
To: Roger Mullarkey <info@rmullarkey.ie>
Cc: CDS Design QA <cdsdesignqa@water.ie>; Marina Zivanovic Byrne <mzbyrne@water.ie>
Subject: Re: CDS21006509 Kilternan Co. Dublin - Email 1 of 3

Hi Roger,

Please see additional comments below:

- The Duplex D1 arrangement is clearer now. For the commercial units, please indicate a bulk meter flow meters in accordance with STD-W-26G and Section 3.15.3 of the Water Code of Practice. (The service connections for the domestic units is correct as it is shown).

- I note that the 100mm dia. connection to the Neighbourhood Centre is to remain as private. However, I would like to make some clarifications. As the daily demand exceeds the equivalent of 40 domestic units I would include a similar note as follows: "meters for apartments or similar properties will be installed internally within the premises in accordance with the Building Controls Authority Requirements and subject to review by Irish Water". Also include a note indicating the need of bulk flow meters in accordance with STD-W-26G and Section 3.15.3 of the Water Code of Practice for the commercial units. (No need to show the internal arrangement, but a note may suffice)
Additionally, I would include the same note if the Housing Cell no. 13 has a daily demand over 40 units.

Let me know if you need further clarification.

Regards,
Antonio

From: Roger Mullarkey <info@rmullarkey.ie>
Sent: 31 May 2022 09:34
To: Antonio Garzon Mielgo
Cc: CDS Design QA; Marina Zivanovic Byrne
Subject: RE: CDS21006509 Kilternan Co. Dublin - Email 1 of 3

CAUTION: This email originated from outside of your organisation. Do not click links or open attachments unless you recognise the sender and are sure that the content is safe.

Many thanks Antonio

Kind Regards,

Roger Mullarkey
BScEng, DipEng, CEng, EurIng, MIEI, FConsEI

Roger Mullarkey & Associates

Consulting Engineers
Structural & Civil
Duncreevan, Kilcock, Co.Kildare
Ph: 01 6103755
Mob: 087 2324917
Email: info@rmullarkey.ie
Web: www.rmullarkey.ie

From: Antonio Garzon Mielgo <Antonio.Garzon@water.ie>
Sent: Tuesday 31 May 2022 09:28
To: Roger Mullarkey <info@rmullarkey.ie>
Cc: CDS Design QA <cdsdesignqa@water.ie>; Marina Zivanovic Byrne <mzbyrne@water.ie>
Subject: Re: CDS21006509 Kilternan Co. Dublin - Email 1 of 3

Hi Roger,

We have received the 3 emails. Thanks for the feedback and clarifications. Let me have a look on this and come back to you during the day.

Regards,
Antonio

From: Roger Mullarkey <info@rmullarkey.ie>
Sent: 30 May 2022 20:38
To: Antonio Garzon Mielgo
Cc: CDS Design QA; Marina Zivanovic Byrne
Subject: RE: CDS21006509 Kilternan Co. Dublin - Email 1 of 3

Email 1 of 3
Antonio – thank you for your email.

I have broken down this response/submission into three separate emails due to the size of the file attachments as follows;
This email No.1 - Foul Layout Dwg.No.'s 2104/05-07 and the Water/Wastewater Demand Calculations
Email No.2 – Watermain Drawings No's 2104/09-11
Email No.3 - Foul Long Sections Dwg.No.'s 2104/27-30 and Water & Drainage Phasing Dwg.No.2104/18

In response to your observations noted below;
Watermain

1. The water connection to the Neighbourhood Centre (NC) is a single point connection into the private internal water system that will contain an internal distribution system to a construction stage design by the mechanical/electrical consultant. Therefore there are no individual commercial connections from he public main as all will be supplied from the internal centralised system. This will all remain as private under the control of a management company. The 100mm diameter connection is to remain as private.
2. Loops have been amended to make sure a min. of 4No.units are connected to the loop as requested.
3. The hydrants noted have been moved into non-private locations – apologies for the previously positioned in error.
4. Hydrants/Valves where located in grassed areas are now noted as typically surrounded in concrete to Irish Water specifications.

Foul Drainage

1. Any manhole and specifically FMh42 & FMh43, located in grassed areas are now noted as typically surrounded in concrete to Irish Water specifications.
2. The connection from Apartment Blocks C/D will be a private drainage (and water) system and further detail can be agreed at connection stage if required. I have amended the outfall to include

2No.backdrop manholes (see section on Dwg.2104/30) limiting the backdrop to 1.75m in each. Gradients are not to exceed 1:20.

3. The gradient between FMh59 to FMh60 has been amended and is illustrated in section on Dwg.No.2104/27
4. The gradient between FMh16 to FMh17 has been amended to 1:60 as requested – and noting also that there are 12No.units connected onto this pipe as the ground floor is commercial and the upper floors are residential duplexes which would not have been apparent from the previously issued drawings. Hopefully this is now better illustrated and apologies for any confusion.

Ground Conditions have been considered as noted and the appropriate safe construction methods will be employed as the scheme progresses, subject to the successful grant of planning of course.

Hopefully the above narrative and the attachments in this and the following 2No.emails address your observations and you will now be in a position to issue the Statement of Design Acceptance at your earliest convenience please.
Appreciating that you are likely very busy, the issuing of a Statement of Design Acceptance is very urgent for the Applicant as the SHD process is ceasing shortly and our application must go to print nd be submitted as soon as possible.

Antonio, we would greatly appreciate if you could acknowledge receipt of these 3 emails please, thank you.

Kind Regards,

Roger Mullarkey
BScEng, DipEng, CEng, EurIng, MIEI, FConsEI

Roger Mullarkey & Associates
Consulting Engineers
Structural & Civil
Duncreevan, Kilcock, Co.Kildare
Ph: 01 6103755
Mob: 087 2324917
Email: info@rmullarkey.ie
Web: www.rmullarkey.ie

From: Antonio Garzon Mielgo <Antonio.Garzon@water.ie>
Sent: Monday 30 May 2022 15:59
To: Roger Mullarkey <info@rmullarkey.ie>

Cc: CDS Design QA <cdsdesignqa@water.ie>; Marina Zivanovic Byrne <mzbyrne@water.ie>
Subject: CDS21006509 Kilternan Co. Dublin

Customer Number: CDS21006509

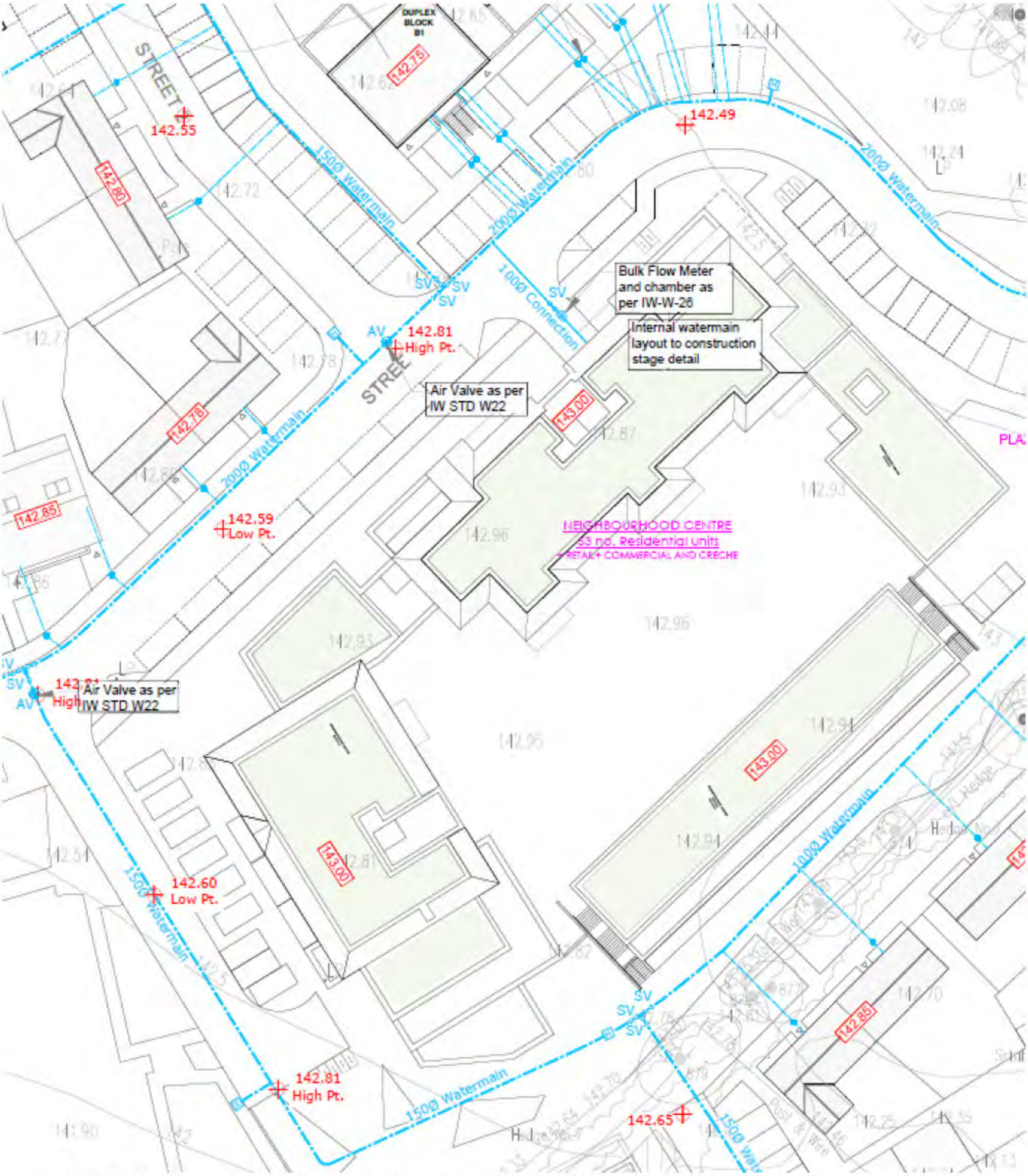
Dear Roger,

Irish Water has carried out a review of the design submission for a proposed development at the above address. Please see below comments that require further clarification or amendment in order to ensure compliance with Irish Water's Codes of Practice and Standard Details.

Refer to the Irish Water's Codes of Practice; Sections 2.3, 2.4 and 3.5 and the suite of Standard Details to ensure the expected minimum standards of drawings required to carry out design vetting as part of a submission. Digital copies of the Codes of Practice and Standard Details can be downloaded at the following address: https://www.water.ie/connections/developer-services/.

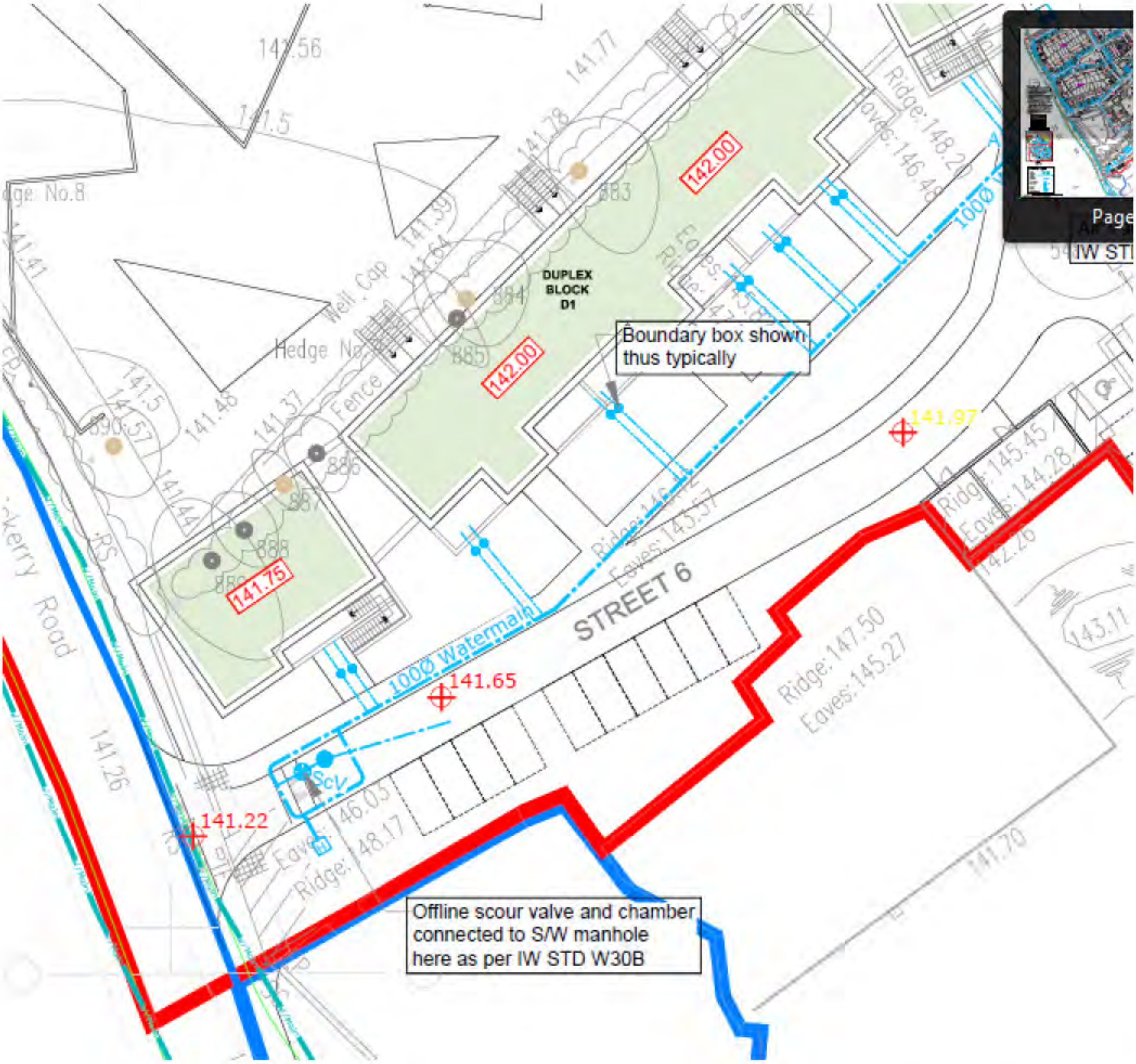
Proposed Watermain Layout

- *Please note that all commercial premises require an individual service connection and external bulk flow meter. Please indicate all commercial service connections and bulk flow meters in accordance with STD-W-26G (for 25-32mm diam. pipe) and Section 3.15.3 of the Water Code of Practice. The meter is to be selected, supplied, and fitted by Irish Water. (See snap below from drawing 2104/09). Please update accordingly.*



- *Also, in the snap above, please confirm that 100mm dia. watermain is in compliance as no new watermain up to and including 150mm in diameter shall be laid within* ***3m*** *of an existing or proposed structure. See section 3.5.9 of Water Code of Practice.*

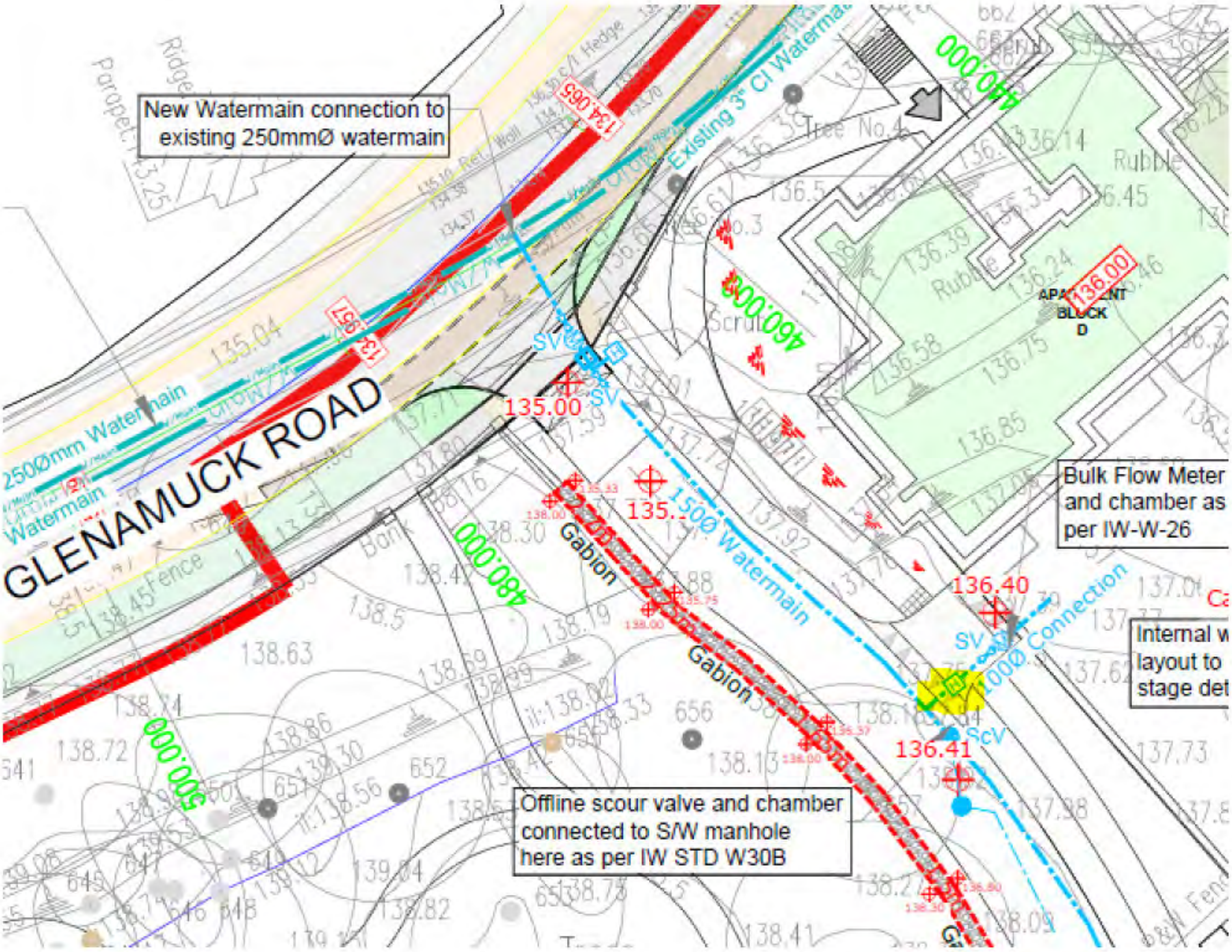
- *Please note that loops shall have a minimum of four connected houses and one hydrant. See Section 3.5.14 of the Water Code of Practice. See snap below from drawing 2104/09*



Boundary box shown thus typically

Offline scour valve and chamber connected to S/W manhole here as per IW STD W30B

- The hydrants indicated in the parking space / road / shared space as per snaps below from drawing 2104/10 are not permitted. Hydrants shall not be located in trafficked areas. See Section 3.5.23 of the Water Code of Practice.

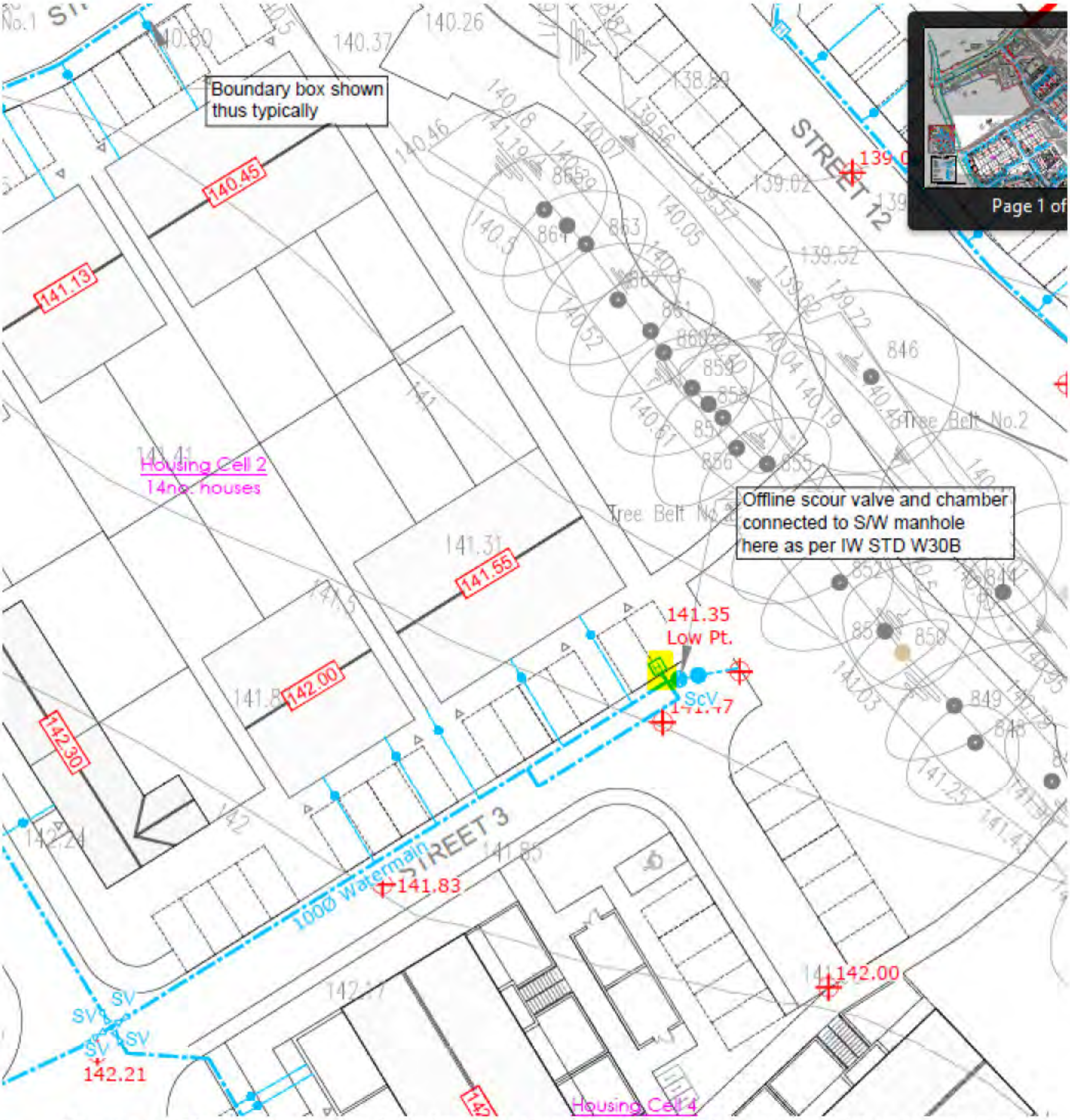


New Watermain connection to existing 250mmØ watermain

Bulk Flow Meter and chamber as per IW-W-26

Internal w layout to stage det

Offline scour valve and chamber connected to S/W manhole here as per IW STD W30B



Boundary box shown thus typically

Offline scour valve and chamber connected to S/W manhole here as per IW STD W30B

· *Air valve and hydrants covers, where located in grass areas, shall be surrounded by a concrete plinth, 200mm all round and 100mm deep, formed with C20/25 concrete, 20mm aggregate size, and bedded in Clause 804 material. The plinth shall incorporate mild steel reinforcement links and shall have a bull-nose finish around its external perimeter. See Section 3.18 of Water Code of Practice. An additional general may suffice.*

Proposed Foul Drainage Layout

· Please note that, where manhole covers are to be located in soft landscaped/grass areas; to ensure that 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. (Applicable to FMh42 & FMh43.). An additional general note may suffice.

- The connection point from the private drainage from Apartment blocks C&D is subject to review at Connection Application Stage. Please note, that for pipes less that 450mm diameter, the maximum permissible vertical backdrop is 2.5m. In cases where this vertical drop is exceeded, multiple backdrop manholes should be utilised, with connecting pipes at a 1:20 gradient to mitigate the vertical drop required. Refer to Section 3.6 of the Wastewater Code of Practice and standard details STD-WW-12 for guidance. Please amend accordingly.
- Please note a maximum permissible gradient of a 225mm diameter sewer is 1:20. Gradient of the line FMh59 to FMh60 is currently too steep. Please review and resubmit an alternative proposal for this area. Refer to Section 3.6 of the Wastewater Code of Practice and standard details STD-WW-12 for guidance.
- Please note a 150mm (or 225mm) gravity sewer should be laid at a gradient not flatter than 1:60 where there are less than 10 dwelling units connected. See Section 3.6.5 of the Wastewater Code of Practice. The following sewer lines are not in compliance: FMh16 to FMh17 (8 no. dwellings). Please amend.

Ground Conditions

- Please ensure you have accounted for site specific ground conditions and taken appropriate design measures if applicable.

Once the above items have been addressed to the satisfaction of Irish Water, a Statement of Design Acceptance for this development will be issued.

Design Responsibility
You, the applicant/applicant’s agent (including any designers/contractors or other related parties appointed by the applicant), are 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 or any associated errors or omissions.

If you have any further queries, please don’t hesitate to get in touch.

Kind Regards,
Antonio Garzón
Connections & Developer Services - Design Engineer

Appendix 12.17

Glenamuck Distributor Road Scheme (GDRS) Correspondence

From: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Sent: Tuesday 13 April 2021 16:48
To: Roger Mullarkey
Cc: Thompson Adrian
Subject: RE: GDRS Kilternan
Attachments: 170172-DBFL-0500-SP-DR-C-1008-P01-Surface Water, Foul Sewer & Wa.pdf; 170172-DBFL-RD-SP-M2-C-0001_Road2d.dwg; 170172-DBFL-0500-SP-DR-C-1009-P02-Surface Water, Foul Sewer & Wa.pdf

Hi Roger,

The work in progress services drawings are attached for reference – service provision to your site is unchanged from what was provided 16/10/20 and is not intended to be changed.

The attached scheme Cad should be suitable for your needs. There's a couple of design tweaks still ongoing but none would have any significant impact on the landholding in question or would affect your CPO extents.

Thanks
John

John Carr

Associate Civils

+ 353 1 4004000

+353 851264411

John.Carr@dbfl.ie

?Cork ?Dublin ?Waterford

www.dbfl.ie

Civil, Structural & Transportation Engineering

From: Roger Mullarkey <info@rmullarkey.ie>
Sent: Tuesday 13 April 2021 10:40
To: Thompson Adrian <athompson@DLRCOCO.IE>
Cc: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Subject: RE: GDRS Kilternan

Adrian/John – just a reminder on the below request for drawings/info please?

Kind Regards,

Roger Mullarkey
BScEng, DipEng, CEng, EurIng, MIEI, FConsEI

Roger Mullarkey & Associates
Consulting Engineers
Structural & Civil
Duncreevan, Kilcock, Co.Kildare
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Email: info@rmullarkey.ie
Web: www.rmullarkey.ie

From: Roger Mullarkey
Sent: Tuesday 30 March 2021 11:36
To: Thompson Adrian <athompson@DLRCOCO.IE>
Cc: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Subject: GDRS Kilternan

Hi Adrian & John and I hope all is well with you both.
As you may be aware the Kilternan Village lands are now in new ownership and we are representing this new Client in finalising discussions relating to the interface between the GDRS and our Clients site. In order to complete the CPO's we need the latest version of the overall GDRS scheme drawings in both dwg and pdf format please. We have currently have two differing draft versions on file and would like to make sure we are all on the same page. If you could include the previously discussed service connection locations on those drawings would be great too please.

Give me a call anytime to discuss the above if needed guys, thank you.

Kind Regards,

Roger Mullarkey
BScEng, DipEng, CEng, EurIng, MIEI, FConsEI

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Email: info@rmullarkey.ie
Web: www.rmullarkey.ie

From: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Sent: Friday 16 October 2020 11:23
To: Roger Mullarkey
Cc: Thompson Adrian; boreilly@deloitte.ie; Tom Kirby
Subject: RE: 170172 - Glenamuck District Roads Scheme
Attachments: 170172-DBFL-0100-SP-DR-C-1008-DRAFT.pdf; 170172-DBFL-0100-SP-DR-C-1009-DRAFT.pdf; 170172-DBFL-2700-SP-SK-C-0020A-DRAFT.pdf; 170172-DBFL-0500-SP-DR-C-1009-DRAFT.pdf; 170172-DBFL-0500-SP-DR-C-1008-DRAFT.pdf; 170172-DBFL-0300-SP-DR-C-1008-DRAFT.pdf; 170172-DBFL-0300-SP-DR-C-1009-DRAFT.pdf

Hi Roger,

See attached drawings as requested.

Thanks
John

From: Roger Mullarkey <info@rmullarkey.ie>
Sent: Monday 5 October 2020 12:09
To: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Cc: Thompson Adrian <athompson@DLRCOCO.IE>; boreilly@deloitte.ie; Tom Kirby <tkirby@dob.ie>; Kevin Sturgeon-DBFL Consulting Engineers <Kevin.Sturgeon@dbfl.ie>
Subject: RE: 170172 - Glenamuck District Roads Scheme

Hi John – just wondering if you had made any progress in completing a final agreement drawing incorporating all the CP lands access/servicing agreements yet please?

Kind Regards,

Roger Mullarkey
BScEng, DipEng, CEng, EurIng, MIEI, FConsEI

Roger Mullarkey & Associates
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Structural & Civil
Duncreevan, Kilcock, Co.Kildare
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Email: info@rmullarkey.ie
Web: www.rmullarkey.ie

From: Roger Mullarkey
Sent: Wednesday 23 September 2020 12:47
To: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Cc: Thompson Adrian <athompson@DLRCOCO.IE>; boreilly@deloitte.ie; Tom Kirby <tkirby@dob.ie>;
Kevin Sturgeon-DBFL Consulting Engineers <Kevin.Sturgeon@dbfl.ie>
Subject: RE: 170172 - Glenamuck District Roads Scheme

John – I think that all the comments we have and our Clients are OK with the outcome.
Can we now get the final agreed drawings for the Glenamuck Road end and the GDRS as it crosses the CMP lands showing all the piped services, gates, walls, fences, temp land take, etc. please?

Kind Regards,

Roger Mullarkey
BScEng, DipEng, CEng, EurIng, MIEI, FConsEI

Roger Mullarkey & Associates
Consulting Engineers
Structural & Civil
Duncreevan, Kilcock, Co.Kildare
Ph: 01 6103755
Mob: 087 2324917
Email: info@rmullarkey.ie
Web: www.rmullarkey.ie

From: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Sent: Wednesday 23 September 2020 11:31
To: Roger Mullarkey <info@rmullarkey.ie>
Cc: Thompson Adrian <athompson@DLRCOCO.IE>; boreilly@deloitte.ie; Tom Kirby <tkirby@dob.ie>;
Kevin Sturgeon-DBFL Consulting Engineers <Kevin.Sturgeon@dbfl.ie>
Subject: RE: 170172 - Glenamuck District Roads Scheme

Thanks Roger – That looks like basically everything closed out. Comments below

From: Roger Mullarkey <info@rmullarkey.ie>
Sent: Tuesday 22 September 2020 18:21
To: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Cc: Thompson Adrian <athompson@DLRCOCO.IE>; boreilly@deloitte.ie; Tom Kirby <tkirby@dob.ie>;
Kevin Sturgeon-DBFL Consulting Engineers <Kevin.Sturgeon@dbfl.ie>
Subject: RE: 170172 - Glenamuck District Roads Scheme

Hi John, hope you had a decent break away from the joys of work !
Thanks for your response comments and I amend our additional comments following the same numbering below;

1(a) – Our Client accepts that any access will be part of a planning permission in the future and they also accept your proposal to allow for a agricultural gate here for now, thank you. We wanted you to make sure that whatever the Glenamuck Road alignment/lanes/margins/cycle tracks are designed will not prevent our Client from getting a new road entrance in the future. Therefore, can you indicate on your drawings that the potential kerb radii (as per the AutoCAD drawing I sent you on the 4th last) can be achieved and are as such are "reserved" for future development? A small pocket of sloped ground behind the gate is acceptable
Great - See attached sketch. Agricultural entry will have simple drop kerb and concrete apron facilitating access across verge. I've also shown a potential kerb returned future entry with 6m kerb radii for reference. There is a verge available to allow deflections of the cycle track and raised entry treatment if needed for future entrance. I've made the overall wall opening wide enough to accommodate road plus footpaths including the path to the apartments shown in your plan. Ignore the earthworks slopes shown – these will be updated to take account of wall, pocket etc
.

1(b) - The pipe levels are important to us so I attached a revised location for the outfalls and if achieve 2m below the finished GR road level here then the inverts will lower than we need and are therefore acceptable (will be c.130mOD) – let me know if this is OK please.
We'll accommodate pipes here at approx. 130mOD

2 – The retaining wall is acceptable to our Client in a similar manner to that shown on your cross section and noting that the wall would have to begin around chainage c.420m (was noted as Ch500 on your drawing) – please confirm this is so. Temp working space is acceptable also John but the ground is to reinstated to similar condition and at a level no lower than 1m below existing.
Noted – Wall starts at approx. CH 455 per sketch attached, beyond this we are matching the existing back of kerb location and level so the existing can be retained

3 – OK

4 – OK, reluctantly.

Also John, our Client would like to be able to show any potential site purchasers the GLDR/GDRS/Glenamuck Rd impacts on their landholding, is it OK to use what you have sent us today before for that purpose?
Unless DLRCC have an issue I thinks its reasonable to share the design intent agreed once it is caveated as such

Cheers.

Kind Regards,

Roger Mullarkey
BScEng, DipEng, CEng, EurIng, MIEI, FConsEI

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From: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Sent: Tuesday 22 September 2020 14:47
To: Roger Mullarkey <info@rmullarkey.ie>
Cc: Thompson Adrian <athompson@DLRCOCO.IE>; boreilly@deloitte.ie; Tom Kirby <tkirby@dob.ie>; Kevin Sturgeon-DBFL Consulting Engineers <Kevin.Sturgeon@dbfl.ie>
Subject: RE: 170172 - Glenamuck District Roads Scheme

Hi Roger,

I was on leave so just working my way through emails.

See responses below

Thanks
John

From: Roger Mullarkey <info@rmullarkey.ie>
Sent: Friday 4 September 2020 17:29
To: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Cc: Thompson Adrian <athompson@DLRCOCO.IE>; boreilly@deloitte.ie; Tom Kirby <tkirby@dob.ie>; Kevin Sturgeon-DBFL Consulting Engineers <Kevin.Sturgeon@dbfl.ie>
Subject: RE: 170172 - Glenamuck District Roads Scheme

John,
Apologies for just getting back now and just following up on previous discussions as follows;
1. Dwg. of the Glenamuck Road end of the site with preferred location of road access, watermain and drainage attached.
* There is currently no vehicular access from Glenamuck Road and the existing vehicle access to this plot is not affected by the scheme. No development entrances are being provided without planning permission across the scheme. DLRCC are however open to accommodating an opening in the boundary and agricultural gate. Given the very significant level differences the access road will not be formed – a cut slope and possibly a small pocket would be left behind the gate and any further earthworks associated with a development access road would be the responsibility of the landowner.
* The pipe levels proposed are approx. 4m deep in Glenamuck road which is far deeper than our proposed pipe levels (typ max 2m depth). It is anticipated that bedrock is present at shallow depths in Glenamuck road. Therefore we would propose that your levels are revisited or alternatively we could provide the stubs at the lower end of the site where provision of

pipework at the approximate levels requested would not result in excessive excavation – you could potentially then route your gravity pipework past the proposed apartments to this connection point?

2. The section at the Glenamuck Rd end is important John as our site had intended an apartment block sitting just at the boundary at a FFL of c.137.50mOD so we would need to protect the existing levels at boundary here. The levels local to the proposed access road were to be graded down to c.134.50mOD onto the Glenamuck Rd but the apartment block and surrounding ground was to remain at or above existing ground. Therefore, a retaining wall would be required east and west from the access point. There was no intention to lower the ground levels in the wooded area to the NW of the site (approaching the Enniskerry Rd junction) and the preference would be to leave the site levels at they are John. A retaining wall perhaps?
DLRCC are open to providing a retaining wall here to replace the existing wall. Retained height will be up to 2.5m so we may propose some minor ground lowering directly behind the wall to limit retained height. We anticipate a railing will be required on the top of wall to ensure it is safe from the high side – See attached some concept sections of the typical arrangement and arrangement at access. We would require a temporary working area of approx 7.5m behind the wall for construction

3. The proposed access and levels onto Glenamuck Rd were intended as per below extract image;

4. Our Client is insistent that stone faced walls be constructed along the GLDR section of the GDRS.
DLRCC have advised that the provision of a post and rail fence on the boundary of the GDRS was one of the items agreed with the six major landowners in the area (including the Carrickmines Partnership) following discussions over an eighteen month period. Each landowner will provide their own boundary treatment as developed through the planning process. These discussions and agreements culminated in an agreed 'Heads of Terms' that will form the basis of the Council's purchase of these lands for the GDRS.

5. John – the S/W from the Eastern portion of the CP lands, Plot B, can drain northwards towards the regional attenuation pond along the c.127mOD contour and our Client would like to make sure that his c.2.1Ha lands are not prohibited access into the drainage catchment. These are development zoned lands and given that the GLDR/GDRS is a significant change to the area, the infrastructure should be able to service the affected/divided land owned by our Client. We request again that at the very least these Plot B lands have some capacity reserved (2Ha @ 2l/s/Ha = c.4l/s) in the new infrastructure notwithstanding the fact that the GLDR cannot put a pipe onto the lands directly. We just don't want the new road to preclude the possibility of accessing a S/W outfall in a north-westerly direction from Plot B.
Refer to previous response on this (10. Below).

Kind Regards,

Roger Mullarkey
BScEng, DipEng, CEng, EurIng, MIEI, FConsEI

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From: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Sent: Thursday 20 August 2020 15:56
To: Roger Mullarkey <info@rmullarkey.ie>
Cc: Thompson Adrian <athompson@DLRCOCO.IE>; boreilly@deloitte.ie; Tom Kirby <tkirby@dob.ie>; Kevin Sturgeon-DBFL Consulting Engineers <Kevin.Sturgeon@dbfl.ie>
Subject: RE: 170172 - Glenamuck District Roads Scheme

Hi Roger,

I've added some responses below. I can also arrange a quick teams call if needed.

Thanks
John

From: Roger Mullarkey <info@rmullarkey.ie>
Sent: Friday 14 August 2020 14:58
To: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Cc: Thompson Adrian <athompson@DLRCOCO.IE>; boreilly@deloitte.ie; Tom Kirby <tkirby@dob.ie>
Subject: RE: 170172 - Glenamuck District Roads Scheme

Hi John.
On review of the document you kindly issued on 28/07/20 last has provided most of the servicing request and our Client is appreciative of your cooperation in that regards.
However, there are a few comments arising from your document as follows;

1. The proposed access location onto the Glenamuck Road is not where our Clients had previously required. You may remember that last year we had submitted a Pre-App to AnBP after protracted discussions/meetings with DLRCC that included agreement in principle for the access point onto the Glenamuck Road. It would appear that your current proposed access from Glenamuck Rd. is c.10m further north than our sites advanced design, as per below screenshot.
Happy to move the entrance to suitable location – please provide info on preference here. We were not involved in pre app discussions . We have only recently been appointed on the Golden ball upgrade section of the works so had included an extract from DLRCC drawings for reference until our own were prepared. As is the case across the scheme, development accesses are not being provided without approved planning permissions however we can provide an agricultural access here.

2. While our Client is grateful for your cooperation in the provision of the service spurs

from the Glenamuck Road, we would appreciate that the precise location is agreed between us so that there is a smooth interface between our sites advanced design and your projects design intentions. We can provide an AutoCAD drawing of the main drainage including invert levels if you need it – just let me know.
Yes please provide intended design and we will endeavour to suit
3. Your drawing extract (above) indicates a Section A-A is available – may we have a copy please?
Again this is from the DLRCC drawings. See attached however this is likely out of date as a result of updated design and these discussions
4. Can you confirm that the lands taken up by the sloped embankment indicated above are included in the agreement with our Client? That is, any change in level/embankment on our Clients lands will result in sterile development ground and therefore must be accounted for in the "land-take" agreement.
The land take agreements are a matter for the landowner and DLRCC but we will try resolve technical issues to get clarity here. Refer to point 7
5. Appreciating that the recent works at Rockville included a new watermain along the Glenamuck Road, we wish to make sure that access to this watermain is not hindered by the Glenamuck Road upgrade works. To that end, we request that a 200mm diameter spur connection from the new watermain be brought into the public footpath at a precise location to be agreed between us but coincidental with the proposed roads access onto our Clients lands.
I note that the watermain is lad under the proposed footpath so there should be no issues with access. If a spur is still essential please provide preferred location and we will include subject to IW approval
6. In regards to Gas Networks Ireland, we discussed this in detail with Declan Reale of GNI and he has agreed to deal with you specifically regarding the provision of a gas main spur from the existing main in the Glenamuck Road into the public footpath. You might let me know that this requirement will be included in your Tender documents too please John.
Declan is due to update the gas design drawing – Ideally have him show this spur in this updated drawing and we will then include the relevant trenching in our tender
7. The boundary fencing is not agreed by our Client. The lands currently enjoy a stone wall as the site boundary in this location and our Client wishes to maintain a similar principle along the new boundary. Fencing won't do John, walls are needed.
Along the Glenamuck Road frontage there is an existing wall and DLRCC are happy to provide a wall here if desired as it is like for like. Some items to consider
* There will be a level difference between the road and site here. How is it intended to manage this level difference with regard to development levels and access road gradients etc. Are levels to be lowered?
* If so we could just provide a wall at back of footpath and excavate a slope out behind and your development could come along after and finish the ground lowering
* Alternatively we can provide a retaining wall here at back of path
* In either case we would propose the permanent land take to be at the pack of path and would require a temporary land take to facilitate construction.
8. Similar to point 7, our Client requires that DLRCC provide a more sturdy and robust form of boundary along both sides of the GDRS as it divides his lands. A stone faced wall and railing is acceptable to our Client but a post and rail fence is not.
I understand there have been protracted discussions on this item and the agreed site wide approach here is to provide a suitable stockproof fence at the land take line across the development land frontages. The final and permanent boundaries frontages would then be provided along with future development when an appropriate boundary to the development and urban design can be selected. We can look at other types of fence if desired however the indication to date is that walls are not to be provided.
9. Can you move the location of the field gate into the East lands (Plot B) up to the pedestrian crossing please, or as close as?

Yes we will move it to just south of the pedestrian crossing – obviously it cannot be right at the crossing
10. Notwithstanding the topographical constraints of Plot B gaining access into the adjacent
GDRS S/W network, our Client needs to be reassured that there will be some form of
piped culvert beneath the GDRS included downstream of Plot B that will access into the
proposed attenuation pond surface water drainage network.
The SW network is based on the natural topography draining towards the road network and many
parcels in the areas are therefore excluded from the catchment. Allowing for an area which currently
drains elsewhere would undermine the drainage philopsopy adopted. The pond sizing and associated
land take has also been fixed from planning stage and cannot be increased. What we can offer is
providing a crossing from plot B back into plot A at the northern end. You would then have the option of
selecting an appropriate overall attenuated discharge rate from the combined parcels which is in
keeping with the regional pond design or could seek any other discharge measure as per normal practice
– in any case SW measures would need to be approved by DLRCC drainage. I note the road network is
not what is causing the issue with the storm discharge here and in fact provides significant benefits to
the overall lands
Trusting the above is all clear John, we await your response to our Clients reasonable requests.

Kind Regards,

Roger Mullarkey
BScEng, DipEng, CEng, EurIng, MIEI, FConsEI

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Web: www.rmullarkey.ie

From: John Carr - DBFL Consulting Engineers <John.Carr@dbfl.ie>
Sent: Tuesday 28 July 2020 13:03
To: Roger Mullarkey <info@rmullarkey.ie>
Cc: Thompson Adrian <athompson@DLRCOCO.IE>; boreilly@deloitte.ie; Tom Kirby <tkirby@dob.ie>
Subject: 170172 - Glenamuck District Roads Scheme

Roger,

As we near completion of the tender documents for the Glenamuck District Roads scheme we have
prepared a brief summary of items related to your clients landholding in order to flush out any
remaining items to resolve. This addresses items such as access, boundaries, servicing, construction

stage implications.

Please advise any comments you may have. Happy to have a call/ meeting as needed. The other servicing considerations discussed in separate email (attached) are also noted.

Thanks
John

John Carr

Associate Civils

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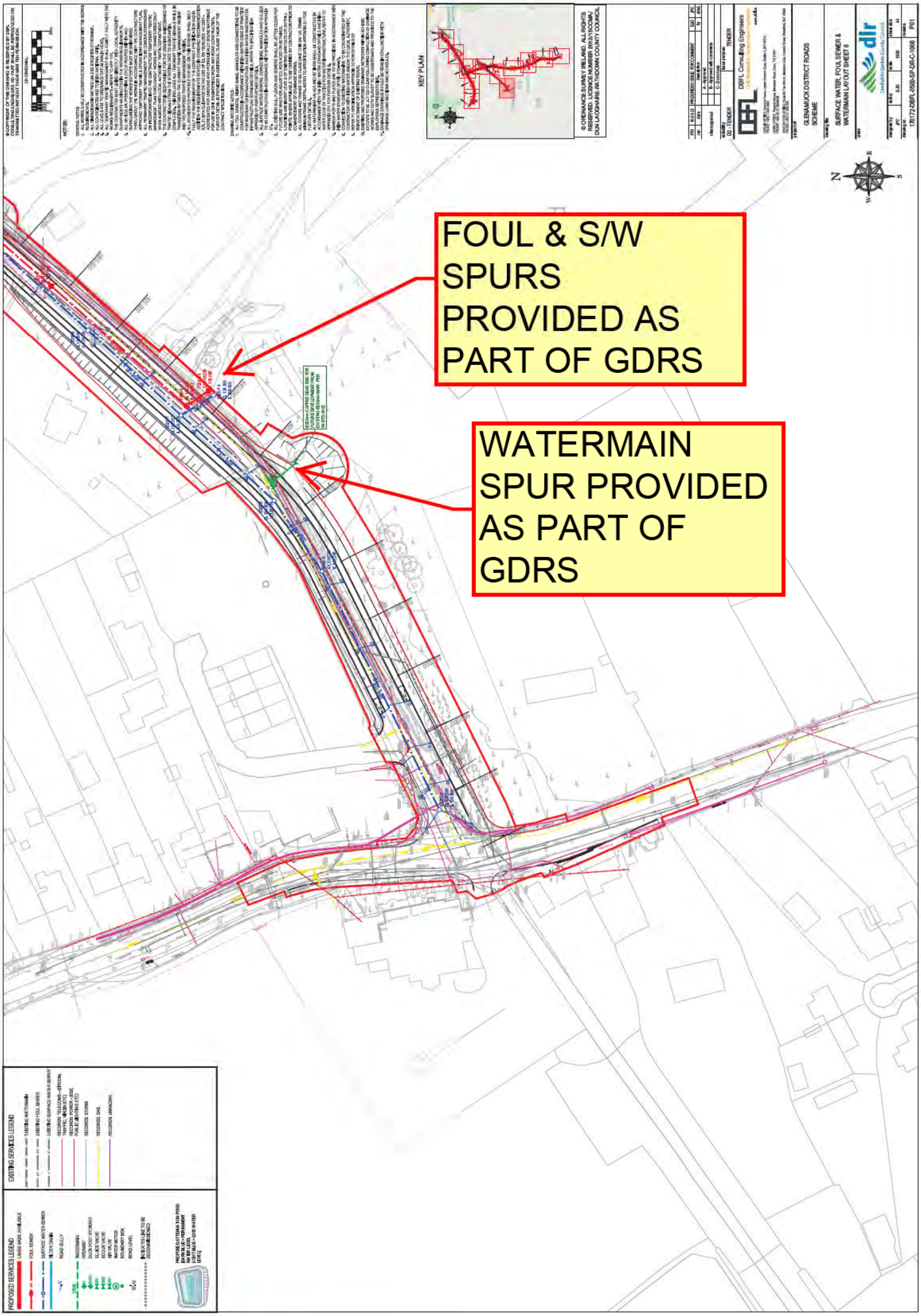
Civil, Structural & Transportation Engineering


GLENAMUCK DISTRICT ROADS SCHEME
SURFACE WATER, FOUL SEWER & WATERMAIN LAYOUT SHEET 8
DBFL Consulting Engineers
D2 - TENDER
TENDER
P01
170172-DBFL-0500-SP-DR-C-1006
KEY PLAN
PROPOSED SERVICES LEGEND
EXISTING SERVICES LEGEND
N
E
S
W

FOUL & S/W SPURS PROVIDED AS PART OF GDRS

WATERMAIN SPUR PROVIDED AS PART OF GDRS

Appendix 12.18

Water and Wastewater Calculations

Foul Wastewater Calculations for TOTAL SITE

New Network - DOMESTIC Wastewater Flows

Usage	Quantity	Occupancy (h)	Population (P)	Consumption (G) (l/h/day)	Loading (PxG)(l/day)
Residential	383 Units	2.7No./Unit	1034	150	155,100
				Total =	**155,100 l/day**

Flowrate per day (l/s)		**1.80l/s**
Growth Rate	1	1
Infiltration (I)	10%	0.18
Dry Weather Flow	**PG + I**	**1.97 l/s**
Peaking Factor (Pf_{Dom})	3	
Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**5.91 l/s**
Misconnection Allowance (SW)	1.5%	0.09l/s
Design Flow (l/s)		**6.00 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

New Network - COMMERCIAL Wastewater Flows

Usage	Quantity	Occupancy (h)	Population (P)	Consumption (G) (l/h/day)	Loading (PxG)(l/day)
Retail/Comm	2,975m^2	1per 5m^2	595	50	29,750
Crèche	439m^2	1child/8m^2 + Staff (20%) + support accommodation	65	50	3,250
				Total =	**33,000 l/day**

Flowrate per 12hr day (l/s)		**0.76l/s**
Growth Rate	1	1
Infiltration (I)	10%	0.08
Dry Weather Flow	**PG + I**	**0.83 l/s**
Peaking Factor (Pf_{Dom})	6	
Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**5.02 l/s**
Misconnection Allowance (SW)	1.5%	0.08l/s
Design Flow (l/s)		**5.1 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

Foul Wastewater Calculations for PHASE 1

<table>
<tr><th colspan="7"><i>New Network - DOMESTIC Wastewater Flows</i></th></tr>
<tr><th>Usage</th><th>Quantity</th><th>Occupancy (h)</th><th>Population (P)</th><th>Consumption (G) (l/h/day)</th><th colspan="2">Loading (PxG)(l/day)</th></tr>
<tr><td>Residential</td><td>91 Units</td><td>2.7No./Unit</td><td>246</td><td>150</td><td colspan="2">36,855</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="5"><b>Total =</b></td><td colspan="2"><b>36,855 l/day</b></td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="5"><b>Flowrate per day (l/s)</b></td><td></td><td><b>0.43l/s</b></td></tr>
<tr><td colspan="5">Growth Rate</td><td>1</td><td>1</td></tr>
<tr><td colspan="5">Infiltration (I)</td><td>10%</td><td>0.04</td></tr>
<tr><td colspan="5"><b>Dry Weather Flow</b></td><td><b>PG + I</b></td><td><b>0.47 l/s</b></td></tr>
<tr><td colspan="5">Peaking Factor (Pf_{Dom})</td><td>6</td><td></td></tr>
<tr><td colspan="5"><b>Design Foul Flow (l/s)</b></td><td><b>Pf_{Dom} x PG</b></td><td><b>2.8 l/s</b></td></tr>
<tr><td colspan="5">Misconnection Allowance (SW)</td><td>1.5%</td><td>0.05l/s</td></tr>
<tr><td colspan="5"><b>Design Flow (l/s)</b></td><td></td><td><b>2.84 l/s</b></td></tr>
</table>

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

Foul Wastewater Calculations for PHASE 2

<table>
<tr><th colspan="7"><i>New Network - DOMESTIC Wastewater Flows</i></th></tr>
<tr><th>Usage</th><th>Quantity</th><th>Occupancy (h)</th><th>Population (P)</th><th>Consumption (G) (l/h/day)</th><th colspan="2">Loading (PxG)(l/day)</th></tr>
<tr><td>Residential</td><td>73 Units</td><td>2.7No./Unit</td><td>197</td><td>150</td><td colspan="2">29,565</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="5"><b>Total =</b></td><td colspan="2"><b>29,565 l/day</b></td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="5"><b>Flowrate per day (l/s)</b></td><td></td><td><b>0.34l/s</b></td></tr>
<tr><td colspan="5">Growth Rate</td><td>1</td><td>1</td></tr>
<tr><td colspan="5">Infiltration (I)</td><td>10%</td><td>0.03</td></tr>
<tr><td colspan="5"><b>Dry Weather Flow</b></td><td><b>PG + I</b></td><td><b>0.37 l/s</b></td></tr>
<tr><td colspan="5">Peaking Factor (Pf_{Dom})</td><td>6</td><td></td></tr>
<tr><td colspan="5"><b>Design Foul Flow (l/s)</b></td><td><b>Pf_{Dom} x PG</b></td><td><b>2.25 l/s</b></td></tr>
<tr><td colspan="5">Misconnection Allowance (SW)</td><td>1.5%</td><td>0.07l/s</td></tr>
<tr><td colspan="5"><b>Design Flow (l/s)</b></td><td></td><td><b>2.28 l/s</b></td></tr>
</table>

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

Foul Wastewater Calculations for PHASE 2A

New Network - DOMESTIC Wastewater Flows

Usage	Quantity	Occupancy (h)	Population (P)	Consumption (G) (l/h/day)	Loading (PxG)(l/day)
Residential	53 Units	2.7No./Unit	80	150	11,925
				Total =	**11,925 l/day**

Flowrate per day (l/s)		**0.14l/s**
Growth Rate	1	1
Infiltration (I)	10%	0.01
Dry Weather Flow	**PG + I**	**0.15 l/s**
Peaking Factor ($Pf_{Dom)}$	6	
Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**0.92 l/s**
Misconnection Allowance (SW)	1.5%	0.07l/s
Design Flow (l/s)		**0.94 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

New Network - COMMERCIAL Wastewater Flows

Usage	Quantity	Occupancy (h)	Population (P)	Consumption (G) (l/h/day)	Loading (PxG)(l/day)
Retail/Comm	2,073m^2	1per 5m^2	415	50	20,750
Crèche	439m^2	1child/8m^2 + Staff (20%) + support accommodation	65	50	3,250
				Total =	**24,000 l/day**

Flowrate per 12hr day (l/s)		**0.56l/s**
Growth Rate	1	1
Infiltration (I)	10%	0.06
Dry Weather Flow	**PG + I**	**0.62 l/s**
Peaking Factor ($Pf_{Dom)}$	6	
Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**3.70 l/s**
Misconnection Allowance (SW)	1.5%	0.06l/s
Design Flow (l/s)		**3.8 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

Foul Wastewater Calculations for PHASE 3

New Network - DOMESTIC Wastewater Flows						
Usage	Quantity	Occupancy (h)	Population (P)	Consumption (G) (l/h/day)	Loading (PxG)(l/day)	
Residential	59 Units	2.7No./Unit	154	150	23,028	
				Total =	**23,028 l/day**	
				Flowrate per day (l/s)		**0.27l/s**
				Growth Rate	1	1
				Infiltration (I)	10%	0.03
				Dry Weather Flow	**PG + I**	**0.30 l/s**
				Peaking Factor (Pf_{Dom})	6	
				Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**1.8 l/s**
				Misconnection Allowance (SW)	1.5%	0.04l/s
				Design Flow (l/s)		**1.81 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

Foul Wastewater Calculations for PHASE 4

New Network - DOMESTIC Wastewater Flows						
Usage	Quantity	Occupancy (h)	Population (P)	Consumption (G) (l/h/day)	Loading (PxG)(l/day)	
Residential	97 Units	2.7No./Unit	262	150	39,285	
				Total =	**39,285 l/day**	
				Flowrate per day (l/s)		**0.46l/s**
				Growth Rate	1	1
				Infiltration (I)	10%	0.05
				Dry Weather Flow	**PG + I**	**0.51 l/s**
				Peaking Factor (Pf_{Dom})	6	
				Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**3.03 l/s**
				Misconnection Allowance (SW)	1.5%	0.04l/s
				Design Flow (l/s)		**3.08 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

Foul Wastewater Calculations for PHASE 5

New Network - DOMESTIC Wastewater Flows

Usage	Quantity	Occupancy (h)	Population (P)	Consumption (G) (l/h/day)	Loading (PxG)(l/day)
Residential	10 Units	2.7No./Unit	27	150	4,050
				Total =	**4,050 l/day**

Flowrate per day (l/s)		**0.05l/s**
Growth Rate	1	1
Infiltration (I)	10%	0.01
Dry Weather Flow	**PG + I**	**0.05 l/s**
Peaking Factor (Pf_{Dom})	6	
Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**0.3 l/s**
Misconnection Allowance (SW)	1.5%	0.01l/s
Design Flow (l/s)		**0.31 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

New Network - COMMERCIAL Wastewater Flows

Usage	Quantity	Occupancy (h)	Population (P)	Consumption (G) (l/h/day)	Loading (PxG)(l/day)
Retail/Comm	$902m^2$	1per $5m^2$	180	50	9,020
				Total =	**9,020 l/day**

Flowrate per 12hr day (l/s)		**0.21l/s**
Growth Rate	1	1
Infiltration (I)	10%	0.02
Dry Weather Flow	**PG + I**	**0.23 l/s**
Peaking Factor (Pf_{Dom})	6	
Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**1.38 l/s**
Misconnection Allowance (SW)	1.5%	0.02l/s
Design Flow (l/s)		**1.4 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

Foul Wastewater Calculations -PHASING SUMMARY

Usage	Resedential Design Flow (l/s)	Commercial Design Flow (l/s)
Phase 1	2.8	
Phase 2	2.3	
Phase 2A	0.9	3.8
Phase 3	1.8	
Phase 4	3.1	
Phase 5	0.3	1.4

Water Demand Calculations for TOTAL SITE

New Network - DOMESTIC Water Demand

Usage	Quantity	Occupancy	Population	Consumption (l//h/day)	Ave. Daily Domestic Demand (l/day)	Ave. Daily Domestic Demand (l/s)	Ave. Day/Peak Week (l/s)	Peak Hour Water Demand (l/s)
Resi'	383 Units	2.7 No./Unit	1034	150	155,115	1.80	2.24	**11.2 l/s**
Peak Hour Water Demand (Domestic)								**11.2 /s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

New Network - COMMERCIAL Water Demand

Usage	Quantity	Occupancy	Population	Consumption (l//h/day)	Ave. Daily Domestic Demand (l/day)	Ave. Daily(12hr) Domestic Demand (l/s)	Ave. Day/Peak Week (l/s)	Peak Hour Water Demand (l/s)
Retail/ Comm	2,975m^2	1per 5m^2	595	50	29,750	0.69	0.86	4.3
Crèche	439m^2	1child/8m^2 + Staff (20%) + support accommodation	66	50	3,293	0.08	0.09	0.47
Peak Hour Water Demand (Commercial)								**4.8l/s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

Water Demand Calculations for PHASE 1

New Network - DOMESTIC Water Demand								
Usage	Quantity	Occupancy	Population	Consumption (l//h/day)	Ave. Daily Domestic Demand (l/day)	Ave. Daily Domestic Demand (l/s)	Ave. Day/Peak Week (l/s)	Peak Hour Water Demand (l/s)
Resi'	91 Units	2.7 No./Unit	246	150	36,855	0.43	0.53	**2.7 l/s**
Peak Hour Water Demand (Domestic)								**2.7 /s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

Water Demand Calculations for PHASE 2

New Network - DOMESTIC Water Demand								
Usage	Quantity	Occupancy	Population	Consumption (l//h/day)	Ave. Daily Domestic Demand (l/day)	Ave. Daily Domestic Demand (l/s)	Ave. Day/Peak Week (l/s)	Peak Hour Water Demand (l/s)
Resi'	73 Units	2.7 No./Unit	197	150	29,565	0.347	0.43	**2.1 l/s**
Peak Hour Water Demand (Domestic)								**2.1 /s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

Water Demand Calculations for PHASE 2A

New Network - DOMESTIC Water Demand								
Usage	Quantity	Occupancy	Population	Consumption (l//h/day)	Ave. Daily Domestic Demand (l/day)	Ave. Daily Domestic Demand (l/s)	Ave. Day/Peak Week (l/s)	Peak Hour Water Demand (l/s)
Resi'	53 Units	2.7 No./Unit	143	150	21,465	0.25	0.31	**1.55 l/s**
Peak Hour Water Demand (Domestic)								**1.6 /s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

New Network - COMMERCIAL Water Demand								
Usage	Quantity	Occupancy	Population	Consumption (l//h/day)	Ave. Daily Domestic Demand (l/day)	Ave. Daily(12hr) Domestic Demand (l/s)	Ave. Day/Peak Week (l/s)	Peak Hour Water Demand (l/s)
Retail/ Comm	2,073m^2	1per 5m^2	415	50	20,730	0.48	0.6	3.0
Crèche	439m^2	1child/8m^2 + Staff (20%) + support accommodation	66	50	3,293	0.08	0.09	0.47
Peak Hour Water Demand (Commercial)								2.4l/s

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

Water Demand Calculations for PHASE 3

New Network - DOMESTIC Water Demand								
Usage	Quantity	Occupancy	Population	Consumption (l//h/day)	Ave. Daily Domestic Demand (l/day)	Ave. Daily Domestic Demand (l/s)	Ave. Day/Peak Week (l/s)	Peak Hour Water Demand (l/s)
Resi’	59 Units	2.7 No./Unit	159	150	23,895	0.27	0.35	**1.73l/s**
Peak Hour Water Demand (Domestic)								**1.7 /s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

Water Demand Calculations for PHASE 4

New Network - DOMESTIC Water Demand								
Usage	Quantity	Occupancy	Population	Consumption (l//h/day)	Ave. Daily Domestic Demand (l/day)	Ave. Daily Domestic Demand (l/s)	Ave. Day/Peak Week (l/s)	Peak Hour Water Demand (l/s)
Resi’	97 Units	2.7 No./Unit	262	150	39,285	0.46	0.57	**2.84l/s**
Peak Hour Water Demand (Domestic)								**2.8 /s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

Water Demand Calculations for PHASE 5

New Network - DOMESTIC Water Demand

Usage	Quantity	Occupancy	Population	Consumption (l//h/day)	Ave. Daily Domestic Demand (l/day)	Ave. Daily Domestic Demand (l/s)	Ave. Day/Peak Week (l/s)	Peak Hour Water Demand (l/s)
Resi'	10 Units	2.7 No./Unit	27	150	4,050	0.05	0.06	**0.29 l/s**
Peak Hour Water Demand (Domestic)								**0.3 /s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

New Network - COMMERCIAL Water Demand

Usage	Quantity	Occupancy	Population	Consumption (l//h/day)	Ave. Daily Domestic Demand (l/day)	Ave. Daily(12hr) Domestic Demand (l/s)	Ave. Day/Peak Week (l/s)	Peak Hour Water Demand (l/s)
Retail/ Comm	902m^2	1per 5m^2	180	50	902	0.02	0.3	1.5
Peak Hour Water Demand (Commercial)								**1.5l/s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

Water Demand Calculations -PHASING SUMMARY

Usage	Resedential Design Flow (l/s)	Commercial Design Flow (l/s)
Phase 1	2.7	
Phase 2	2.1	
Phase 2A	1.6	2.4
Phase 3	1.7	
Phase 4	2.8	
Phase 5	0.3	1.5

Appendix F

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iSM INDEPENDENT SITE MANAGEMENT

Telecommunications Report - Section 3.2 of the Building Height Guidelines (2018)

DEVELOPMENT
KILTERNAN VILLAGE SHD

15 June 2022

Prepared by
Independent Site Management Limited
Christopher Plockelman
Director
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Table of Contents

DEFINITIONS

Author:	Independent Site Management Limited (hereinafter referred to as "ISM")
Mitigation Measures:	means the allowances made for the retention of important Telecommunication Channels (hereinafter referred to as "Mitigation Measures")
Planning Body:	means An Bord Pleanála (hereinafter referred to as the "Planning Body")
Radio Frequency:	means a frequency or band of frequencies in the range 104 to 1011 or 1012 Hz, of the electromagnetic spectrum suitable for use in telecommunications.
Microwave Links:	means the transmission of information by electromagnetic waves with wavelengths in the microwave range (1 m - 1 mm) of the electromagnetic spectrum suitable for use in telecommunications.
Telecommunication Channels:	means Radio Frequency links & Microwave Transmission links (hereinafter referred to as "Telecommunication Channels")
Report Date:	means the date which the assessment was carried out (hereinafter referred to as "Report Date")
The Applicant:	means Liscove Limited (hereinafter referred to as the "Applicant")
The Development:	means the proposed development situated at lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18 (hereinafter referred to as the "Development")

EXECUTIVE SUMMARY

Independent Site Management ('ISM') has been engaged to provide a specific assessment that the proposal being made by Liscove Limited (the "Applicant") within its submission to An Bord Pleanála (the 'Planning Body'), allows for the retention of important Telecommunication Channels ("Telecommunication Channels") such as microwave links, to satisfy the criteria of Section 3.2 of the Building Height Guidelines (2018).

To provide this assessment, ISM reviewed the Applicant's proposed development (the "Development"), together with their proposed allowances to retain relevant Telecommunication Channels in the context of the immediate surrounding registered and documented telecommunication sites.

Pursuant to our review, ISM can conclude based on the findings outlined herein that the proposal being made by the Applicant within its submission to the Planning Body allows for the retention of important Telecommunication Channels, such as Microwave links, and therefore satisfies the criteria of Section 3.2 of the Building Height Guidelines (2018).

ABOUT THE AUTHOR

ISM is a consultancy firm and asset management company that provides telecommunication consultancy and services to developers and property owners.

ISM works closely with all providers of wireless and fixed line telecommunication services to bridge their infrastructure requirements with that of private and public development. ISM has successfully been providing this service in Ireland for 20 years.

ISM is a multidiscipline firm proficient in the 3 main areas in the delivery of telecommunication services:

(1) Radio Frequency technology;
(2) Microwave Transmission technology; &
(3) Fixed Line fiber optic & copper technologies.

ISM has had an integral part in procuring, designing, building and subsequently managing over 300 mobile base station and/or fixed wireless sites, the vast majority of which originated in densely populated, urban environments.

ISM has designed, built and now operates 6 in-building distributed antenna systems, and 2 large area managed fibre optic networks.

DEVELOPMENT DESCRIPTION

Liscove Limited intend to apply to An Bord Pleanála for permission for a strategic housing development at this c. 10.8 Ha site at lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18, which include a derelict dwelling known as 'Rockville' and associated derelict outbuildings, Enniskerry Road, Kilternan, Dublin 18, D18 Y199. The site is generally bounded by the Glenamuck Road to the north; Kilternan Country Market and the Sancta Maria property to the north and west; a recently constructed residential development named "Rockville" to the north-east; the Enniskerry Road to the south-west; dwellings to the south; and lands that will facilitate the future Glenamuck Link Distributor Road to the east.

Road works are also proposed to facilitate access to the development from the Enniskerry Road; to the approved Part 8 Enniskerry Road/Glenamuck Road Junction Upgrade Scheme on Glenamuck Road (DLRCC Part 8 Ref PC/IC/01/17); and to the approved Glenamuck District Roads Scheme (GDRS) (ABP Ref:HA06D.303945) on the Glenamuck Link Distributor Road (GLDR). Drainage and water works are also proposed to connect to services on the Glenamuck Road and Enniskerry Road.

At the Glenamuck Road access point, this will include works, inclusive of any necessary tie-ins, to the footpath and cycle track to create a side road access junction incorporating the provision of an uncontrolled pedestrian crossing across the side road junction on a raised table and the changing of the cycle track to a cycle lane at road level as the cycle facility passes the side road junction. Surface water and foul drainage infrastructure is proposed towards the north of the site into the drainage infrastructure to be constructed as part of the Part 8 scheme. Potable water is to be provided from the existing piped infrastructure adjacent to the site along Glenamuck Road. These interfacing works are proposed on an area measuring c. 0.05 Ha.

At the GLDR access point, this will include works, inclusive of any necessary tie-ins, to the footpath and cycle track to create a side road access junction incorporating the provision of short section of shared path and an uncontrolled shared pedestrian and cyclist crossing across the side road junction on a raised table. The works will also include the provision of a toucan crossing, inclusive of the necessary traffic signal equipment, immediately south of the access point to facilitate pedestrian and cyclist movement across the mainline road. All works at the GLDR access point will include the provision of the necessary tactile paving layouts and are provided on an area measuring c. 0.06 Ha.

At the Enniskerry Road, works are proposed to facilitate 3 No. new accesses for the development along with modifications to Enniskerry Road. The 3 No. side road priority access junctions incorporate the provision of an uncontrolled pedestrian crossing across the side road junction on a raised table. The modifications to Enniskerry Road fronting the development (circa 320 metres) includes the narrowing of the carriageway down to 6.5 metres (i.e. a 3.25 metres running lane in each direction) from the front of the kerb on western side of Enniskerry Road. The remaining former carriageway, which varies in width of c. 2 metres, will be reallocated for other road users and will include the introduction of a widened pedestrian footpath and landscaped buffer on the eastern side of the road adjoining the proposed development. The above works are inclusive of all necessary tie-in works such as new kerb along eastern side of Enniskerry Road, drainage details, road marking, signage and public lighting. Potable water is to be provided from the existing piped infrastructure adjacent to the site along the Enniskerry Road. The interface works on Enniskerry Road measures c. 0.19 Ha.

Surface water and foul drainage infrastructure is proposed to connect into and through the existing/permitted Rockville developments (DLR Reg. Refs. D17A/0793, D18A/0566 and D20A/0015) on a total area measuring c. 0.09 ha. The development site area and drainage and roads works areas will provide a total application site area of c. 11.2 Ha.

The development will principally consist of: the demolition of c. 573.2 sq m of existing structures on site comprising a derelict dwelling known as 'Rockville' and associated derelict outbuildings; and the provision of a mixed use development consisting of 383 No. residential units (165 No. houses, 118 No. duplex units and 100 No. apartments) and a Neighbourhood Centre, which will provide a creche (439 sq m), office (317 sq m), medical (147 sq m), retail (857 sq m), convenience retail (431 sq m) and a community facility (321 sq m). The 383 No. residential units will consist of 27 No. 1 bedroom units (19 No. apartments and 8 No. duplexes), 128 No. 2 bedroom units (78 No. apartments and 50 No. duplexes), 171 No. 3 bedroom units (108 No. houses, 3 No. apartments and

60 No. duplexes) and 57 No. 4 bedroom units (57 No. houses). The proposed development will range in height from 2 No. to 5 No. storeys (including podium/undercroft level in Apartment Blocks C and D and in the Neighbourhood Centre).

The development also provides: pedestrian links from Enniskerry Road and within the site to the neighbouring "Rockville" development to the north-east and a pedestrian/cycle route through the Dingle Way from Enniskerry Road to the future Glenamuck Link Distributor Road; 678 No. car parking spaces (110 No. in the undercroft of Blocks C and D and the Neighbourhood Centre and 568 No. at surface level) including 16 No. mobility impaired spaces, 73 No. electric vehicle spaces, 1 No. car share space, 4 No. drop-off spaces/loading bays; motorcycle parking; bicycle parking; bin storage; the decommissioning of the existing telecommunications mast at ground level and provision of new telecommunications infrastructure at roof level of the Neighbourhood Centre including shrouds, antennas and microwave link dishes (18 No. antennas and 6 No. transmission dishes, all enclosed in 9 No. shrouds together with all associated equipment); private balconies, terraces and gardens; hard and soft landscaping; sedum roofs; solar panels; boundary treatments; lighting; substations; plant; and all other associated site works above and below ground. The proposed development has a gross floor space of c. 43,120 sq m in addition to undercroft levels (under Apartment Blocks C and D measuring c. 1,347 sq m and under the Neighbourhood Centre measuring c. 2,183 sq m, which includes parking spaces, external storage, bin storage, bike storage and plant).

SITE LOCATION/LAYOUT MAP

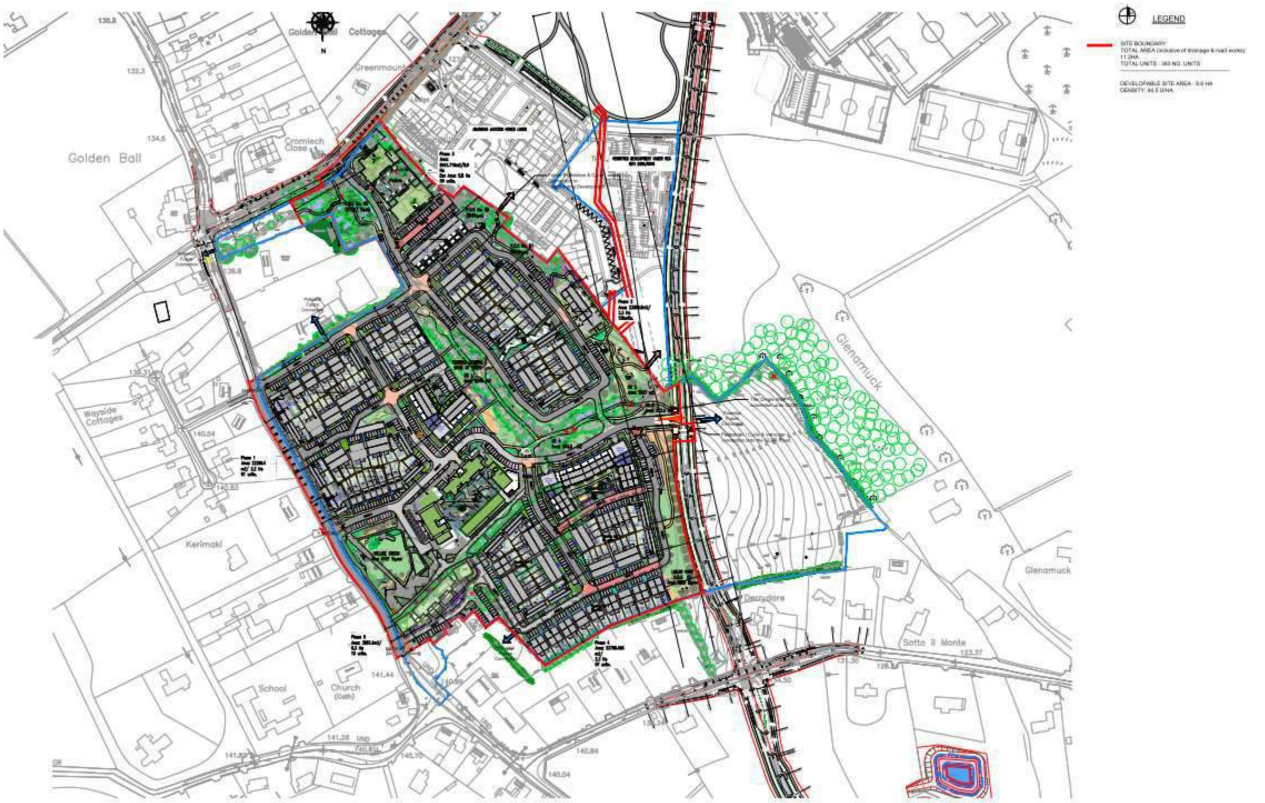


Figure 1

TELECOMMUNICATION CHANNELS

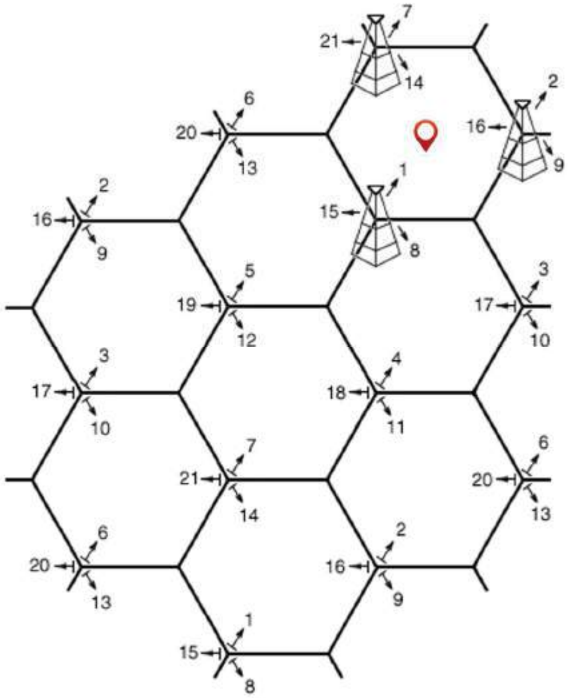
This report assesses the two wireless Telecommunication Channels or networks of Telecommunication Channels that may be affected by the height and scale of a new development, Radio Frequency links & Microwave Transmission links.

Radio Frequency links & Microwave Transmission Links are used in Ireland's mobile phone and fixed wireless networks and disseminate at an average above ground level height of 20m, making them the most relevant Telecommunication Channels to be assessed in relation to the height and scale of a new development and to that end what allowance the Applicant needs to make for their retention.

Mobile phones send and receive signals via links from nearby antenna sites or cellular towers, technically known as base stations, using Radio Frequency waves. Microwave Transmission links use microwave dishes to "transmit" from these base stations to other base stations forming a network. Radio Frequency waves operate at a lower power within lower frequencies of the radio spectrum, whereas Microwave Transmission operates at higher power within higher frequencies of the radio spectrum.

Radio Frequency waves are distributed over land areas in "cells", each served by at least one fixed-location transceiver (base station), but more normally by three cell sites or base stations. These base stations provide the cell with the network coverage, which can then be used for voice, data, and other types of content. A cell typically uses a different set of frequencies from neighbouring cells to avoid interference and provide guaranteed service quality within each cell.

When joined together, these cells provide Radio Frequency coverage over a wide geographic area (Cellular network). This enables numerous portable transceivers (e.g., mobile phones, tablets and laptops equipped with mobile broadband modems, pagers, etc.) to communicate with each other and with fixed transceivers and telephones anywhere in the network, via base stations, even if some of the transceivers are moving through more than one cell during transmission.



As demonstrated on this cell map illustrating Radio Frequency coverage, each Radio Frequency "cell" is supported by at least 3No. base stations sites. This means that should an obstacle occur between an area and a base station site, such as a new development, the affected area will be covered by other base stations from other locations.

📍 = a given location

✳ = base station site

Figure 2

Cellular networks offer a number of desirable features, but most notably, additional cell towers can be added indefinitely and are not limited by the horizon, therefore it can be considered **indeterminable** as to whether a new development affects the Radio Frequency coverage of a geographical area which is being served by multiple base stations, not necessarily the closest.

Conversely, Microwave Transmission links are point-to-point links, which are easily determined to be affected, or not, by the height and scale of a new development. In point-to-point wireless communications, it is important for the line of sight between two base stations to be free from any obstruction (terrain, vegetation, buildings, wind farms and a host of other obstructions). As any interference or obstruction in the line of sight can result in a loss of signal.

While installing Microwave links, it is important to keep an elliptical region between the transmitting Microwave link and the receiving Microwave link free from any obstruction for the proper functioning of the system. This 3D elliptical region between the transmit antenna and the receive antenna is called the **Fresnel Zone**. The size of the ellipse is determined by the frequency of operation and the distance between the two sites.

Fresnel Zone

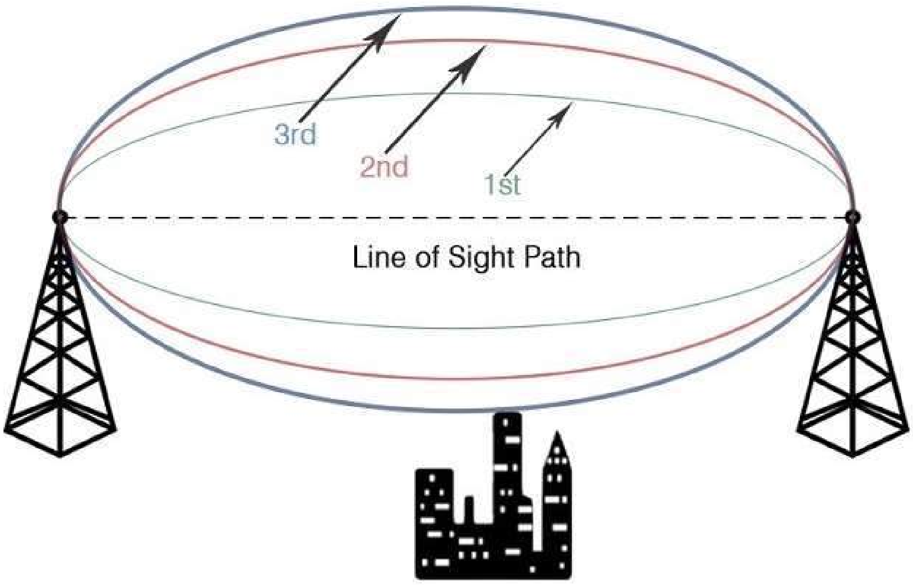


Figure 3

Essentially, if there is an obstacle in the Fresnel zone, part of the radio signal will be diffracted or bent away from the straight-line path. The practical effect is that on a point-to-point Microwave link, referred to herein, the refraction will reduce the amount of energy reaching the receiving microwave dish. The thickness or radius of the Fresnel zone depends on the frequency of the signal – the higher the frequency, the smaller the Fresnel zone. Microwave links are high frequency radio links used for point-to-point transmission.

FINDINGS

ISM's assessment identified 2 No. Microwave links that will require the Applicant to make specific allowances for their retention ("Mitigation Measures").

Our assessment also identified 6 No. Radio Frequency links that will require the Applicant to make allowances for their retention.

ISM carried out a full assessment of neighbouring registered and documented telecommunication sites to assess what Microwave links would be impacted by the height and scale of the Development. Refer to Figure 5 & 6 of the appendices for full analysis. The assessment of Microwave Transmission links entailed both a visual survey of each identified neighbouring telecommunication site within a reasonable geographic proximity to the Development and a request for information from telecommunication providers where the visual survey was inconclusive.

Impacted Microwave links

(1) 1 No. is a Microwave link installed by Eir Mobile (Meteor) oriented at 43°
(2) 1 No. is a Microwave link installed by Three Ireland. oriented at 300° (approximately)

Impacted Radio Frequency links

(1) 3 No. Radio Frequency links installed by Eir Mobile (Meteor)
(2) 3 No. Radio Frequency links installed by Three Ireland

The azimuths for both Eir and Three are 80° 200° & 320° azimuth respectively

The 2 No. Microwave links are installed on a telecommunication mast site located within the site boundary of the proposed development site. This mast is providing cellular coverage for the businesses and residential neighborhood in the wider local Kilternan area. Refer to Figure 4

These Microwave links are situated at an above ground level height of 17.2m (AGL) and therefore the Fresnel zone of each will be diffracted by the height of the Development. The proposed heights sought within the Development will cause significant diffraction to these Microwave links.

Existing Mast on development site

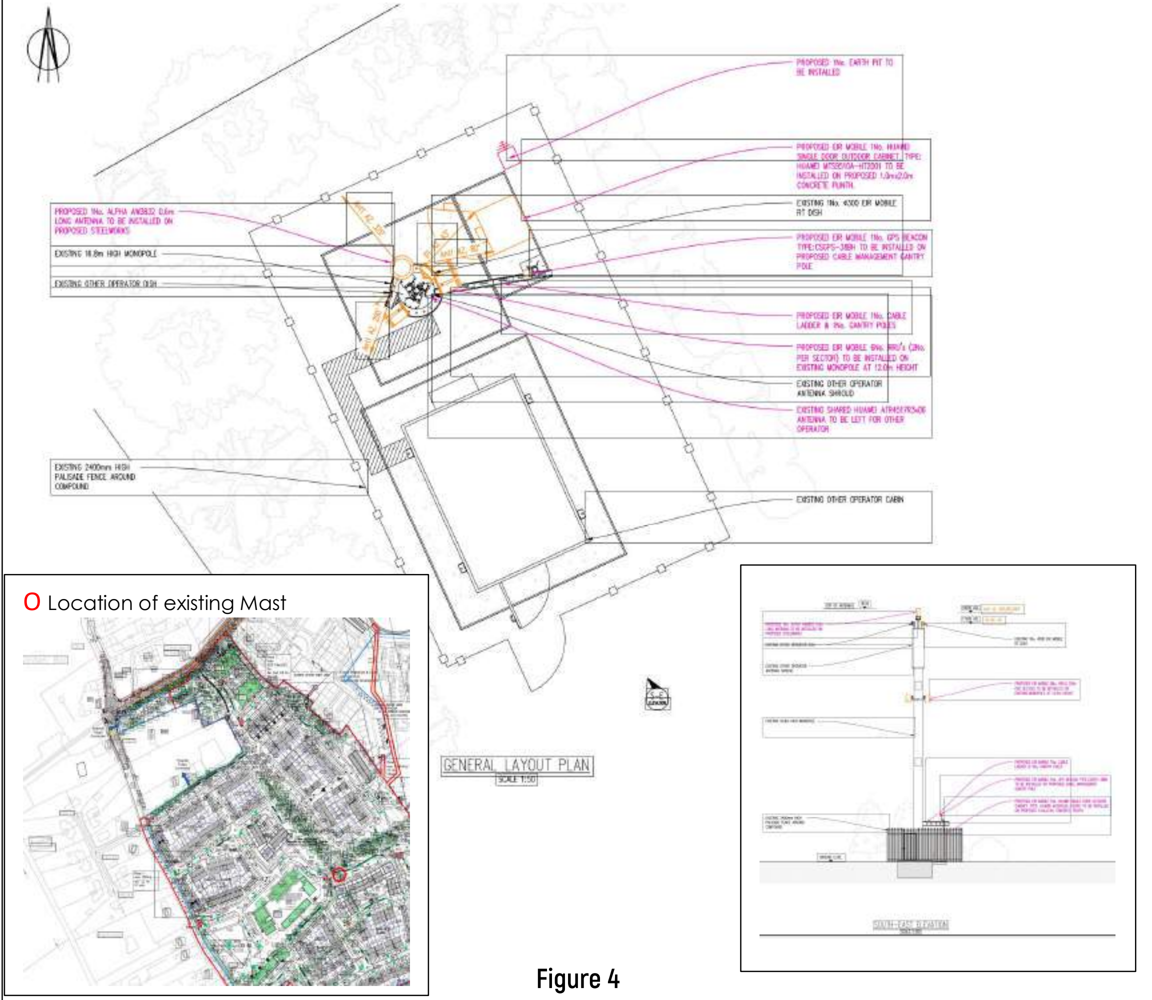

PROPOSED 1No. EARTH PIT TO BE INSTALLED
PROPOSED EIR MOBILE 1No. HUAWEI SINGLE DOOR OUTDOOR CABINET, TYPE: HUAWEI MTS9510A-HT2001 TO BE INSTALLED ON PROPOSED 1.0mx2.0m CONCRETE PLINTH.
EXISTING 1No. 300 EIR MOBILE RT DISH
PROPOSED EIR MOBILE 1No. GPS BEACON TYPE:CSGPS-38BH TO BE INSTALLED ON PROPOSED CABLE MANAGEMENT GANTRY POLE
PROPOSED EIR MOBILE 1No. CABLE LADDER & 1No. GANTRY POLES
PROPOSED EIR MOBILE 6No. RRU's (2No. PER SECTOR) TO BE INSTALLED ON EXISTING MONOPOLE AT 12.0m HEIGHT
EXISTING OTHER OPERATOR ANTENNA SHROUD
EXISTING SHARED HUAWEI ATR4518R5406 ANTENNA TO BE LEFT FOR OTHER OPERATOR
EXISTING OTHER OPERATOR CABIN
PROPOSED 1No. ALPHA AW3832 0.6m LONG ANTENNA TO BE INSTALLED ON PROPOSED STEELWORKS
EXISTING 18.8m HIGH MONOPOLE
EXISTING OTHER OPERATOR DISH
EXISTING 2400mm HIGH PALISADE FENCE AROUND COMPOUND
GENERAL LAYOUT PLAN
SCALE 1:50
O Location of existing Mast
SOUTH-EAST ELEVATION

Figure 4

ISM carried out a full assessment of neighbouring registered and document telecommunication sites to assess what Radio Frequency links might be impacted by the height and scale of the Development. To assess this, we carried out a walk test throughout the surrounding areas to ascertain what cells were serving the neighbourhoods and business districts to the north, south, east & west of the Development site. Refer to Figure 7 of the appendices for full analysis.

Our assessment identified Radio Frequency coverage for the local geographic area is served by several cells at a range of distances to the development site on a 360° basis, which is a typical cell pattern for urban/semi-rural Radio Frequency coverage. However, the walk test data determined that most local business, residential, and the public road areas to the north, south east and west of the development site receive signal from Radio Frequency links emanating from a telecommunication mast hosting Three Ireland and Eir Mobile which is located within the development site boundary.

It is therefore our finding that the proposed heights sought by the Applicant will impact the identified Radio Frequency links. We have set out the impacted areas within Figure 7.

Please note the following that telecommunication networks are always evolving, and as such, these findings remain subject to change.

MITIGATION MEASURES

To provide an adequate allowance for the retention of the 2No. identified Microwave links that will be impacted by the Development, the Applicant is seeking planning permission to install 3No, support poles, affixed to the lift shaft overrun on the Development's neighbourhood centre block B, rising 3metres above roof level.

These support poles are sufficient to accommodate 2No. Ø0.3m Microwave links each (*together with associated telecommunications equipment*), which provides an adequate solution for the Applicant to mitigate the impact the Development will have on the existing Microwave links emanating from the existing mast currently within the development site boundary, as well as providing some capacity for future links that may or may not be required.

To provide an adequate allowance for the retention of the 6No. identified Radio Frequency links that will be impacted by the Development, the Applicant is seeking planning permission to install 9No. support poles, affixed to ballast mounts on neighbourhood centre block B rising 2.5 metres above parapet level.

These support poles are sufficient to each accommodate 1No. 2m 2G/3G/4G antenna & 1No. 5G antenna each (*together with associated telecommunications equipment*), which creates the ability for the Applicant to mitigate the impact the Development will have on the existing Radio Frequency links emanating from the mast within the development site, as well as providing some capacity for future links that may or may not be required.

To adequately screen the infrastructure, the support poles used for the antennae will be installed within Radio friendly GRP shrouds.

Refer to Figures 8 & 9 of the appendices for full analysis and installation parameters for all the proposed replacement telecommunication infrastructure set out herein.

ISM can therefore conclude that the proposal being made by the Applicant within its submission to An Bord Pleanála allows for the retention of important Telecommunication Channels, such as Microwave links, to satisfy the criteria of Section 3.2 of the Building Height Guidelines (2018).

APPENDICIES

Figure 5: Identification of neighbouring registered and documented telecommunication sites (Area Telecommunication Analysis)

Figure 6: Identification of Microwave links disseminating from neighbouring registered and documented telecommunication sites (Microwave Link Analysis)

Figure 7: Identification of local area Cells by Cell ID (Cell Identification Analysis)

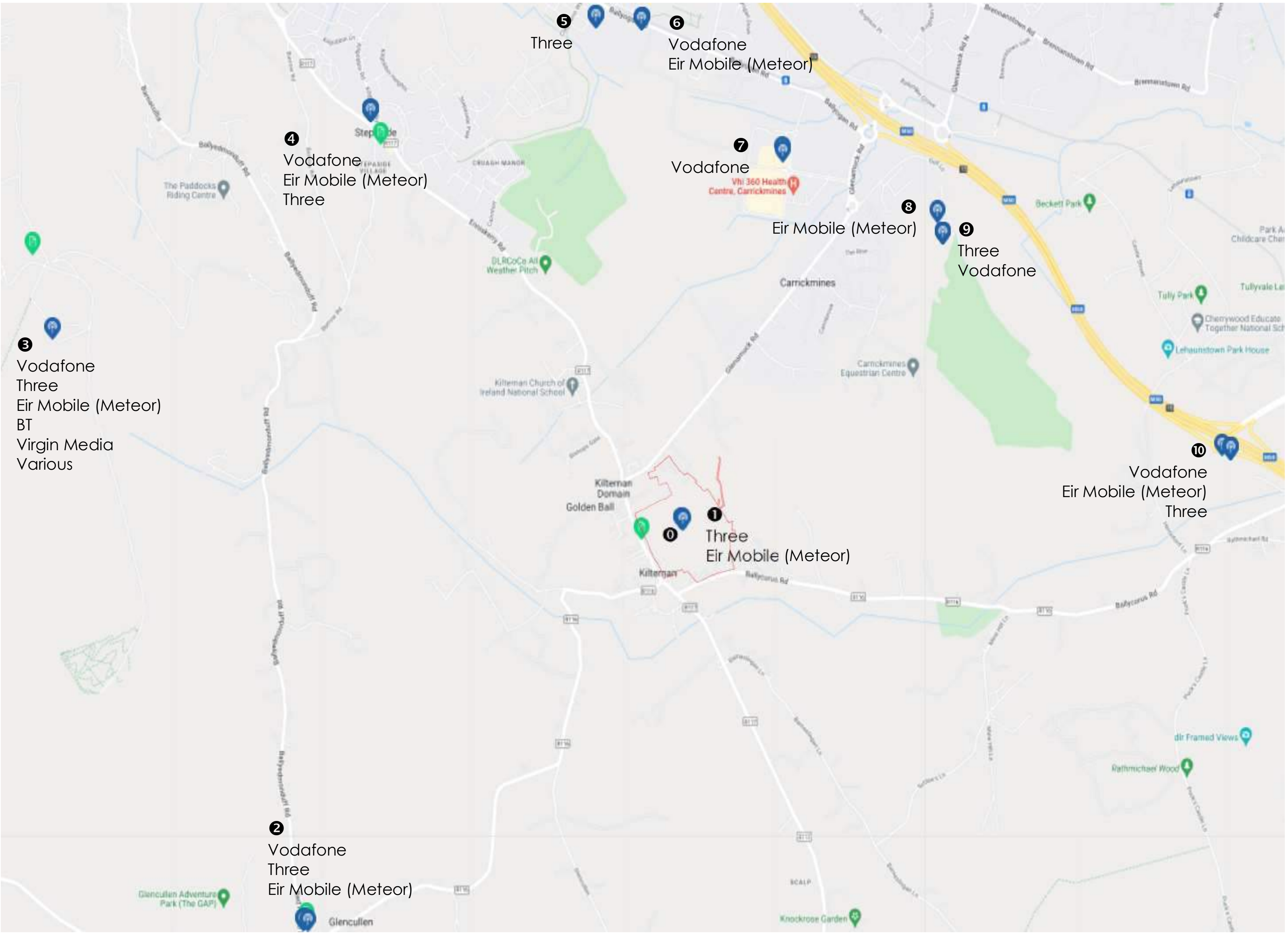
Figure 8: Mitigation Measures

Figure 9: Mitigation Measures

Figure 5

Area Telecommunication Analysis

Source: Comreg



Note
All Dimensions to be checked on site
No Dimensions to be scaled from this Drawing
This drawing to be read with relevant Consultant Drawings

- ⓿ Proposed Development
- ❶ Kilternan
- ❷ Johnny Foxes
- ❸ Three Rock*
- ❹ Stepaside Garda St
- ❺ Carrickmines Bird Cage
- ❻ Carrickmines ESB
- ❼ Vodafone Sales Office
- ❽ Golf Lane 1
- ❾ Golf Lane 2
- ❿ Brides Glen

*Three Rock Mountain hosts a high concentration of telecommunication channels.

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iSM INDEPENDENT SITE MANAGEMENT

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Client
Liscove Limited

Project
Kilternan Village SHD

Option	1
Report Date	06/05/22
File Name	Kilternan Village SHD

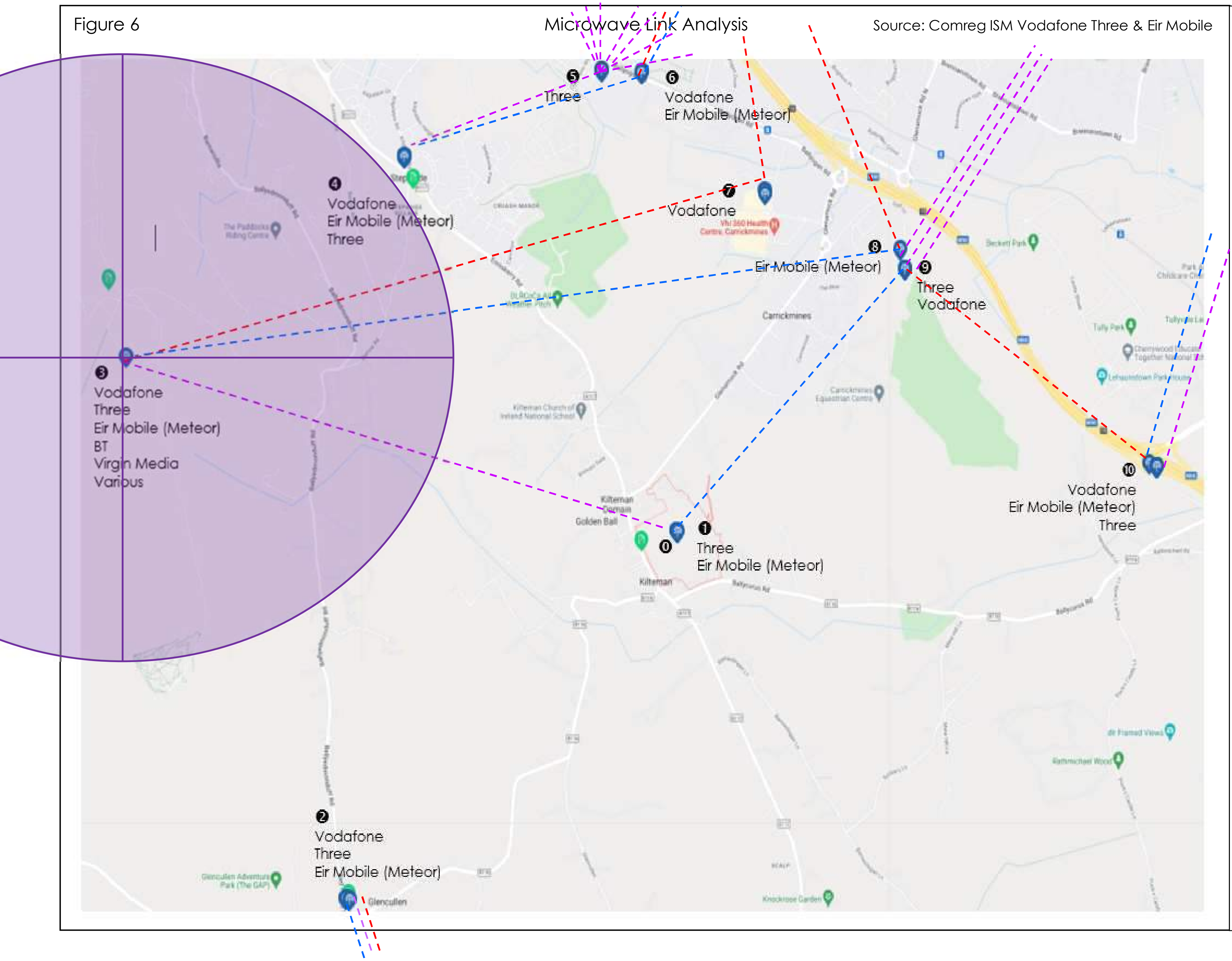
Drawing:
Area Site Analysis

Building	Drawing No.	Zone	Rev
SPN	E 0622		1

Figure 6

Microwave Link Analysis

Source: Comreg ISM Vodafone Three & Eir Mobile



Note
All Dimensions to be checked on site
No Dimensions to be scaled from this Drawing
This drawing to be read with relevant Consultant Drawings

---- Three Transmission Link
---- Vodafone Transmission Link
---- Eir Transmission Link

Three Rock Mountain hosts a high concentration of telecommunication channels. It is not impacted by the development because of its height which far exceeds those sought by the applicant

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Client
Liscove Limited

Project
Kilternan Village SHD

Option	1
Report Date	06/05/22
File Name	Kilternan Village SHD

Drawing:

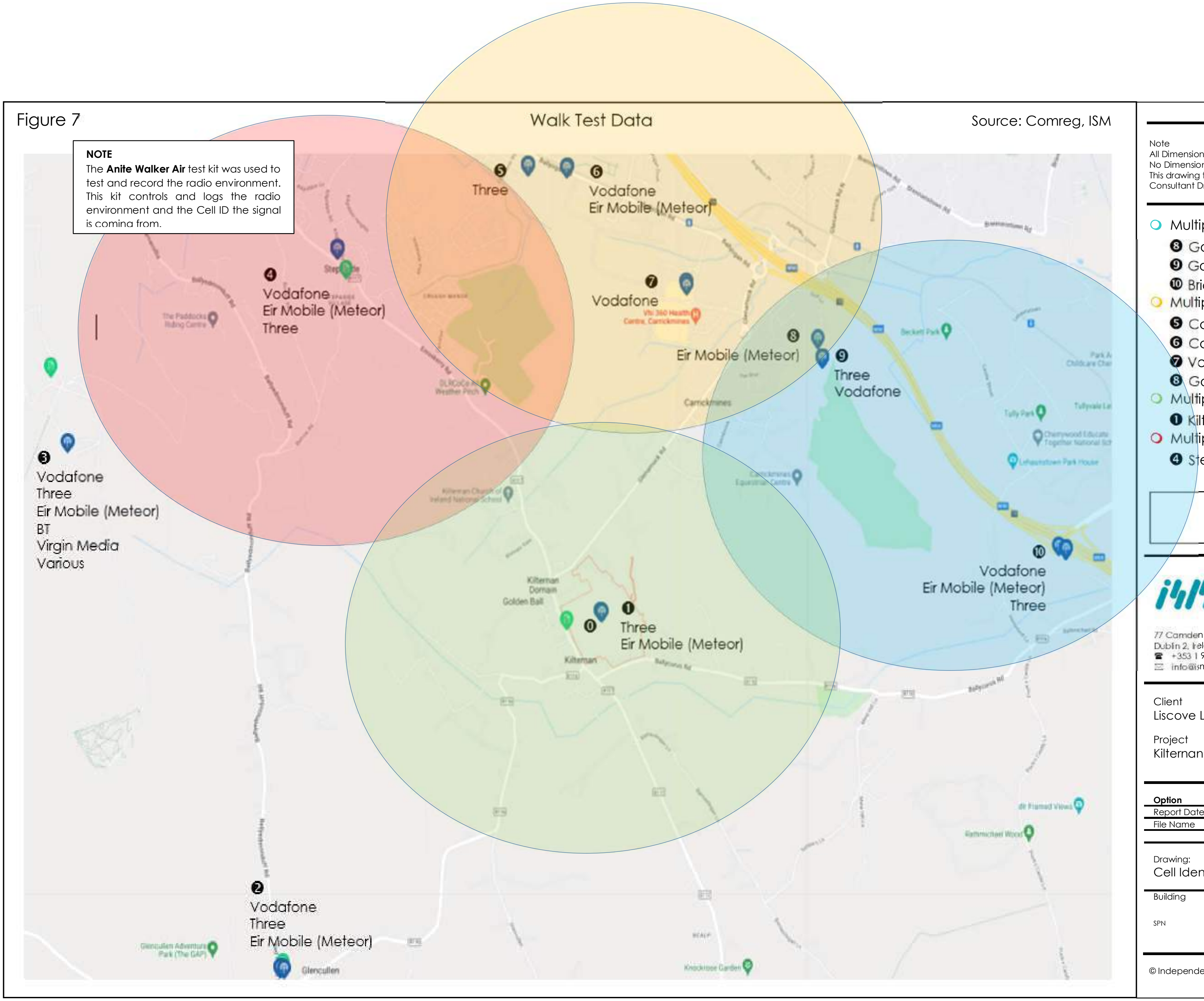
Link Analysis

Building	Drawing No.	Zone	Rev
SPN	E 0622		1

Figure 7

Walk Test Data

Source: Comreg, ISM



NOTE
The **Anite Walker Air** test kit was used to test and record the radio environment. This kit controls and logs the radio environment and the Cell ID the signal is coming from.

Note
All Dimensions to be checked on site
No Dimensions to be scaled from this Drawing
This drawing to be read with relevant Consultant Drawings

- ○ Multiple Cell IDs
  - ❽ Golf Lane 1
  - ❾ Golf Lane 2
  - ❿ Brides Glen
- ○ Multiple Cell IDs
  - ❺ Carrickmines Bird C.
  - ❻ Carrickmines ESB
  - ❼ Vodafone Sales Office
  - ❽ Golf Lane 1
- ○ Multiple Cell IDs
  - ❶ Kilternan
- ○ Multiple Cell IDs
  - ❹ Stepaside Garda St

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Client
Liscove Limited

Project
Kilternan Village SHD

Option	**1**
Report Date	06/05/22
File Name	Kilternan Village SHD

Drawing:
Cell Identification Analysis

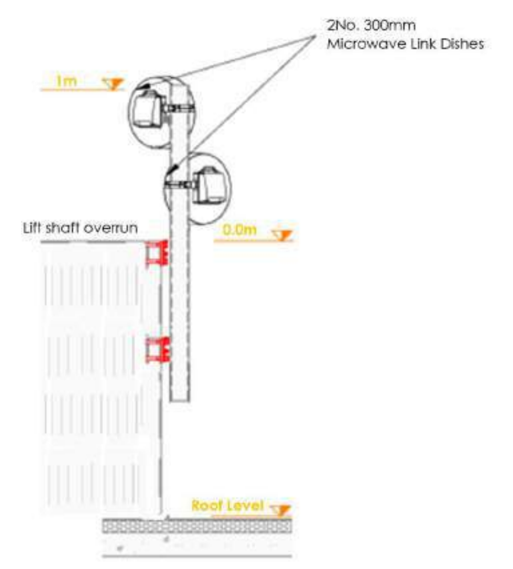
Building	Drawing No.	Zone	Rev
SPN	E 0622		1

Figure 8

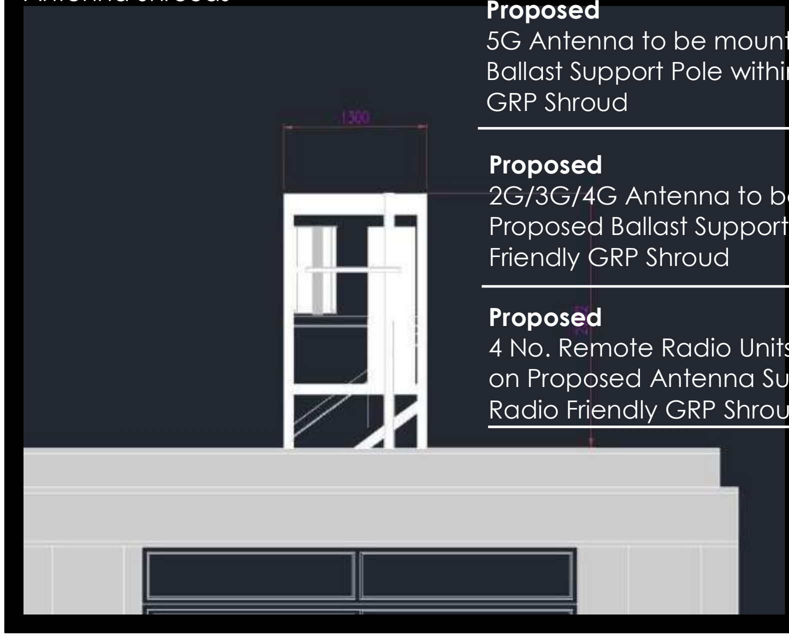
Mitigation Measure Design

Source: Comreg ISM

Microwave Links Lift Shaft (see left)



Antenna Shrouds



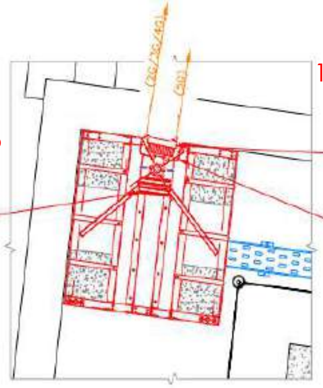
Proposed
5G Antenna to be mounted on Proposed Ballast Support Pole within Radio Friendly GRP Shroud

Proposed
2G/3G/4G Antenna to be mounted on Proposed Ballast Support Pole within Radio Friendly GRP Shroud

Proposed
4 No. Remote Radio Units to be mounted on Proposed Antenna Support Pole within Radio Friendly GRP Shroud

Ballast Mount

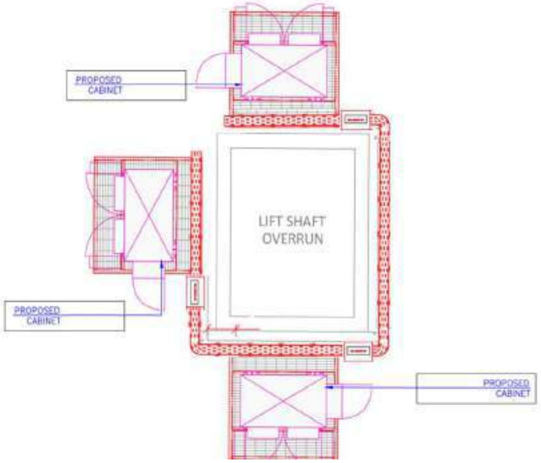
Proposed
4 No. Remote Radio Units to be mounted on Proposed Antenna Support Pole



Proposed
1 No. 5G Antenna mounted on Proposed Antenna Support Pole

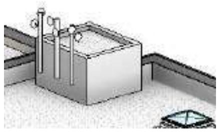
Proposed
1 No. 2G/3G/4G Hexaband Antenna mounted on Proposed Antenna Support Pole

Equipment Cabinets



Note
All Dimensions to be checked on site
No Dimensions to be scaled from this Drawing
This drawing to be read with relevant Consultant Drawings

Typical Installation



FINAL

iSM INDEPENDENT SITE MANAGEMENT

77 Camden Street Lower
Dublin 2, Ireland D02 XE80
☎ +353 1 905 8800
✉ info@ismireland.com

Client
Liscove Limited

Project
Kilternan Village SHD

Option	1
Report Date	06/02/22
File Name	Kilternan Village SHD

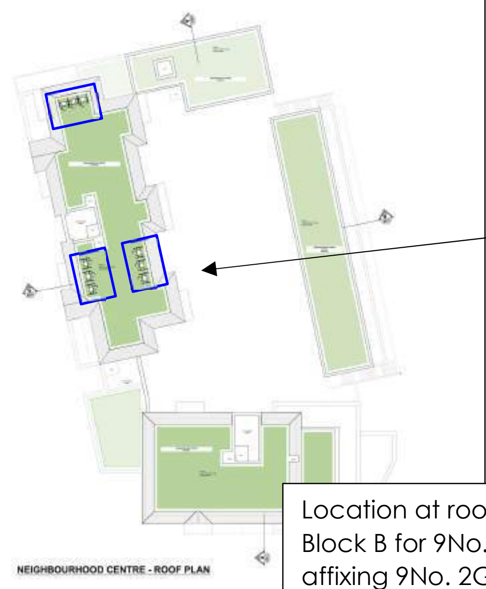
Drawing:
Mitigation Measure

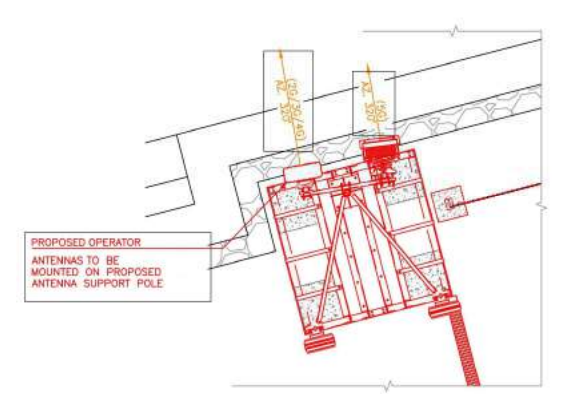
Building	Drawing No.	Zone	Rev
SPN	E 0622		1

Figure 9

Mitigation Measure Design

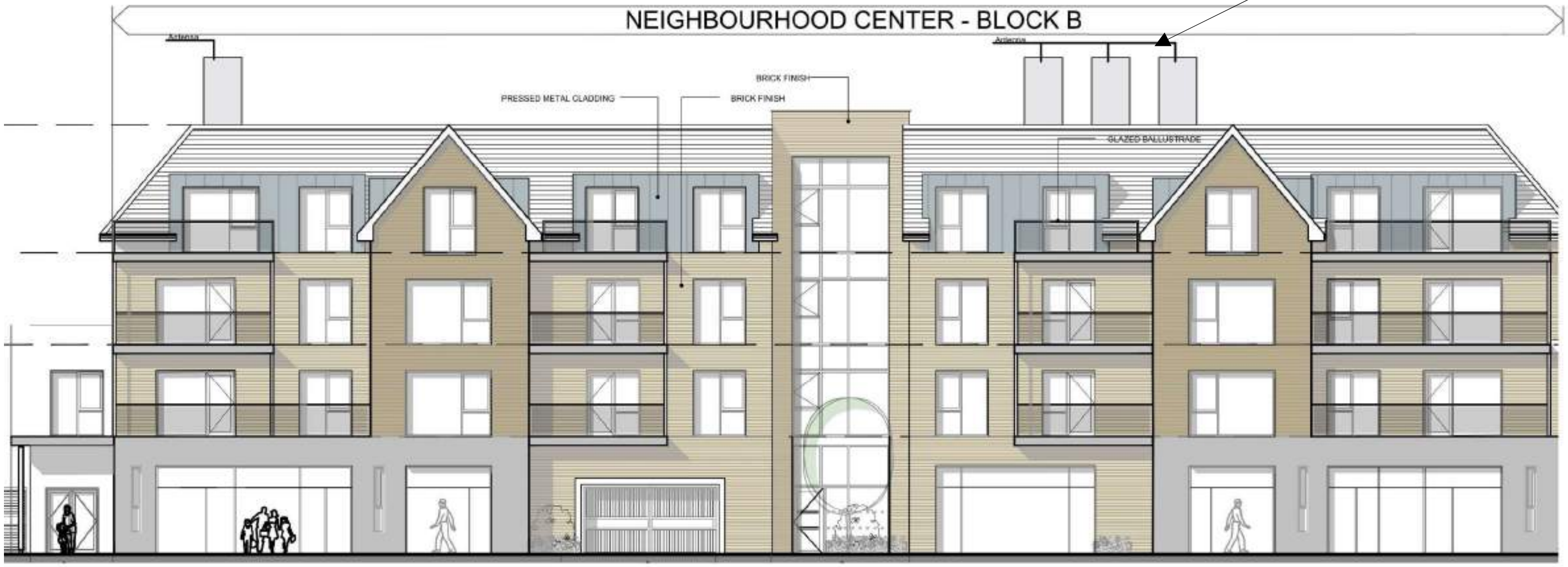
Source: Comreg ISM





Location at roof level of Neigbiorehood Centre Block B for 9No. Ballast Mounts with steel poles affixing 9No. 2G/3G/4G Antennas (2mL) & 9No 5G Antennas (0.8mL) ☐ **Locations**

2G/3G/4G Antennas (2mL) & 5G Antennas (0.8mL) to be mounted on Proposed Ballast Support Pole within Radio Friendly GRP Shroud



Note
All Dimensions to be checked on site
No Dimensions to be scaled from this Drawing
This drawing to be read with relevant Consultant Drawings

Typical Installation

---- Transmission Link

☐ Location of Steel support Poles

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iSM INDEPENDENT SITE MANAGEMENT

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Client
Liscove Limited

Project
Kilternan Village SHD

Option	1
Report Date	06/02/22
File Name	Kilternan Village SHD

Drawing:
Mitigation Measure

Building	Drawing No.	Zone	Rev
SPN	E 0622		1

Appendix G

3D DESIGN BUREAU

Creative & Technical 3D Solutions
Design | Planning | Marketing

Kilternan Village SHD

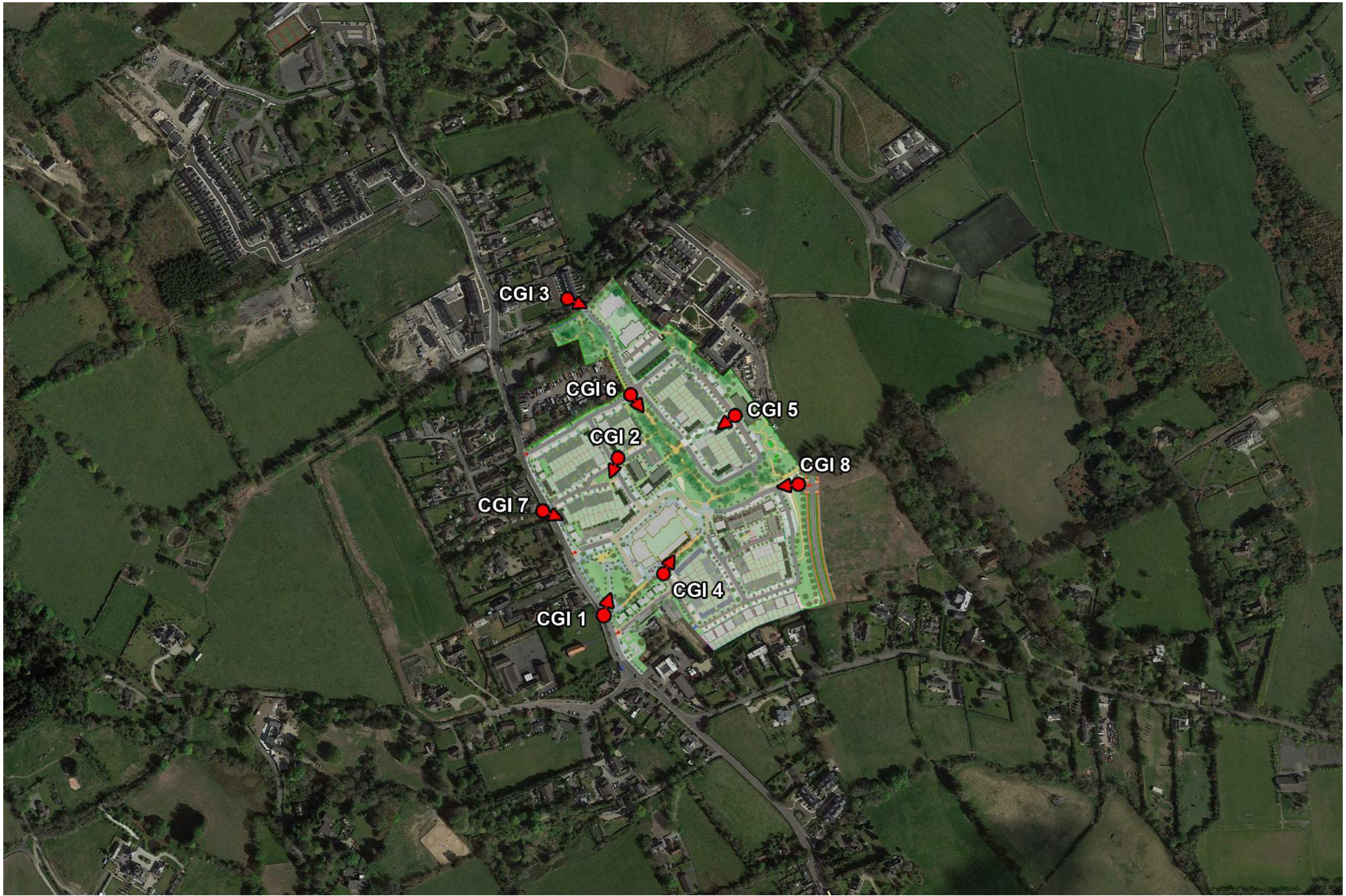
Photomontages and CGI

Applicant: Liscove Limited

☎ +353 (0) 1 2880186
✉ info@3ddesignbureau.com

www.3ddesignbureau.com

June 2022



Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: CGI Map

Planning Imagery by 3D DESIGN BUREAU

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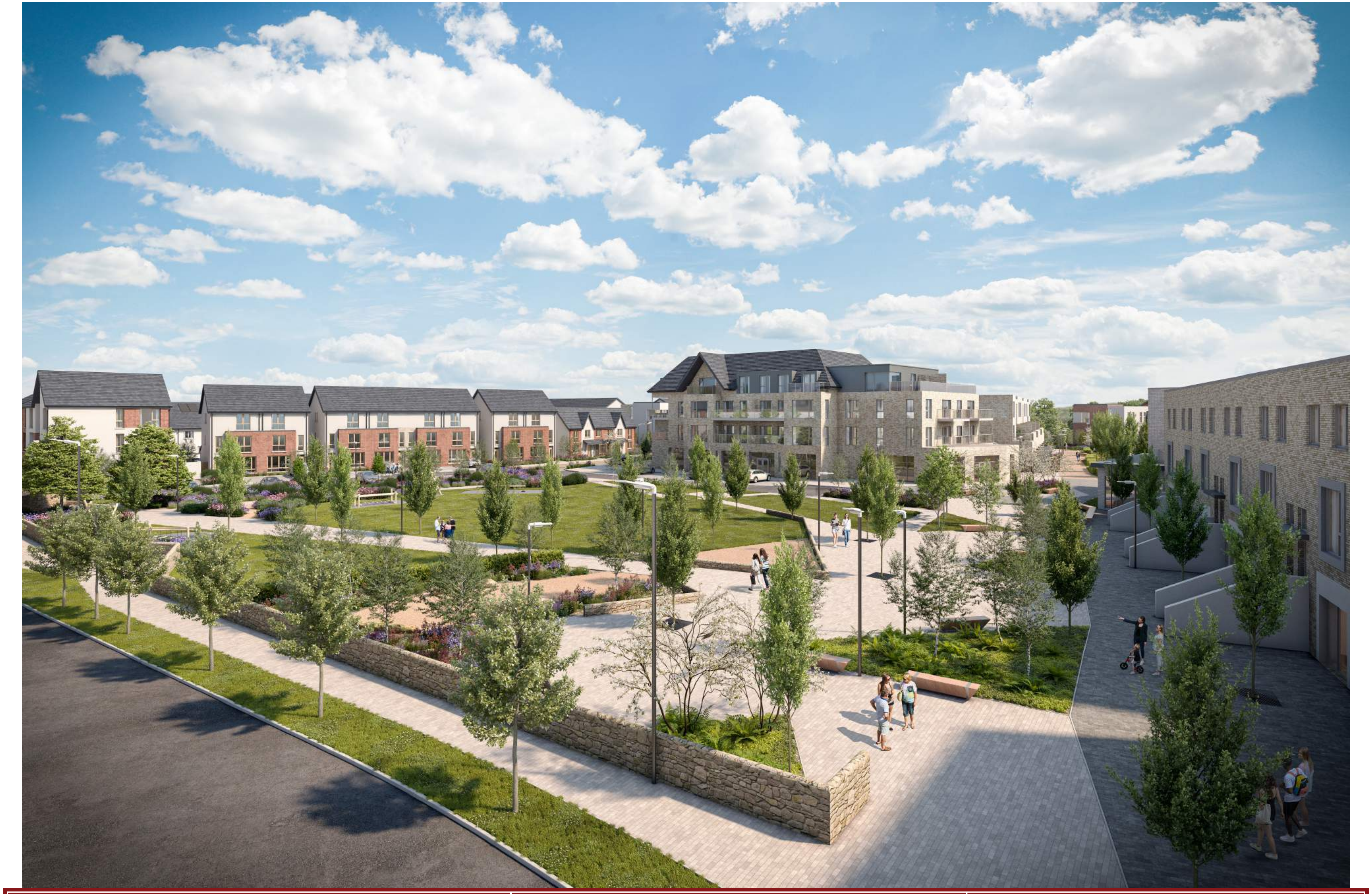
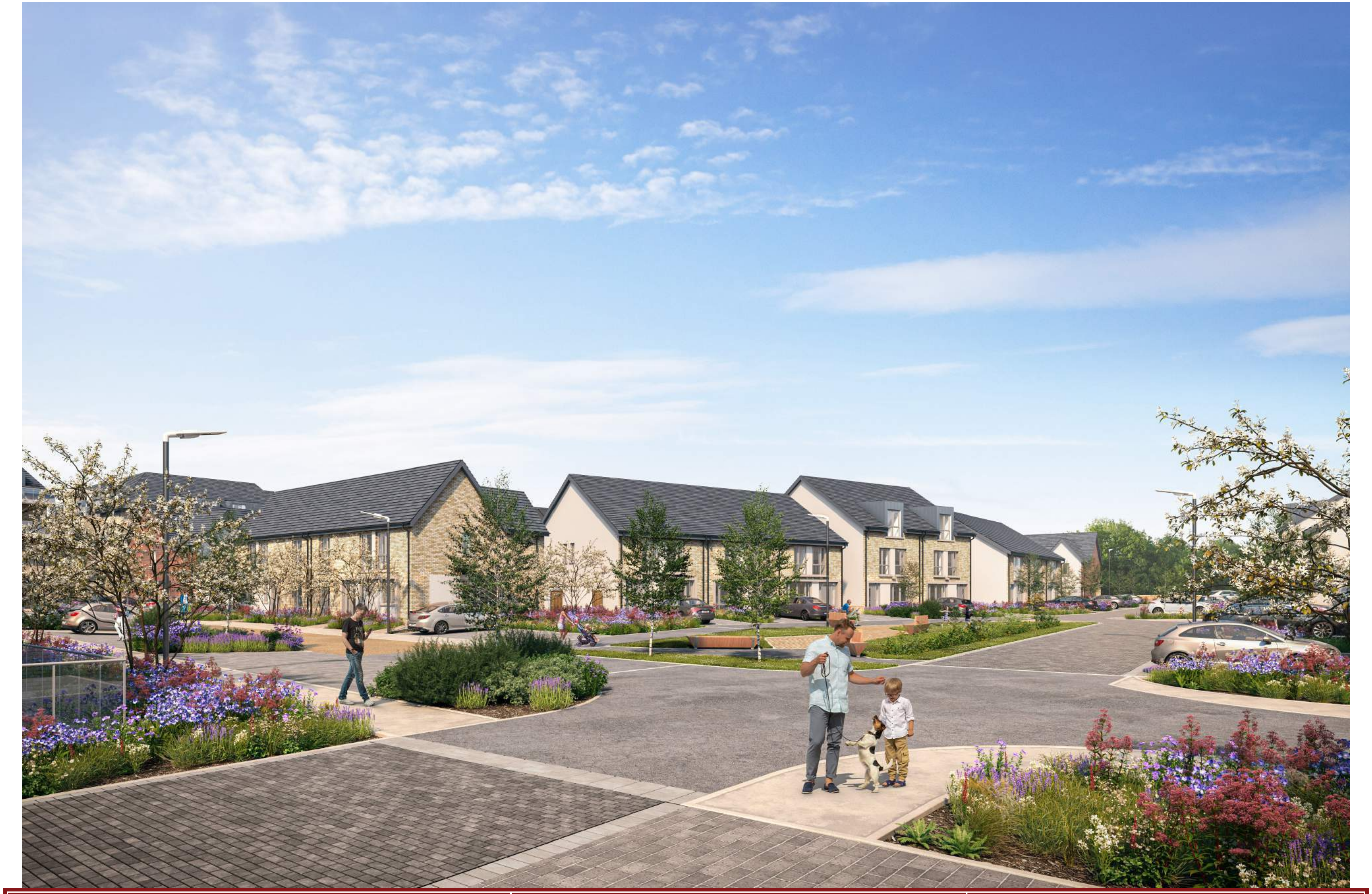
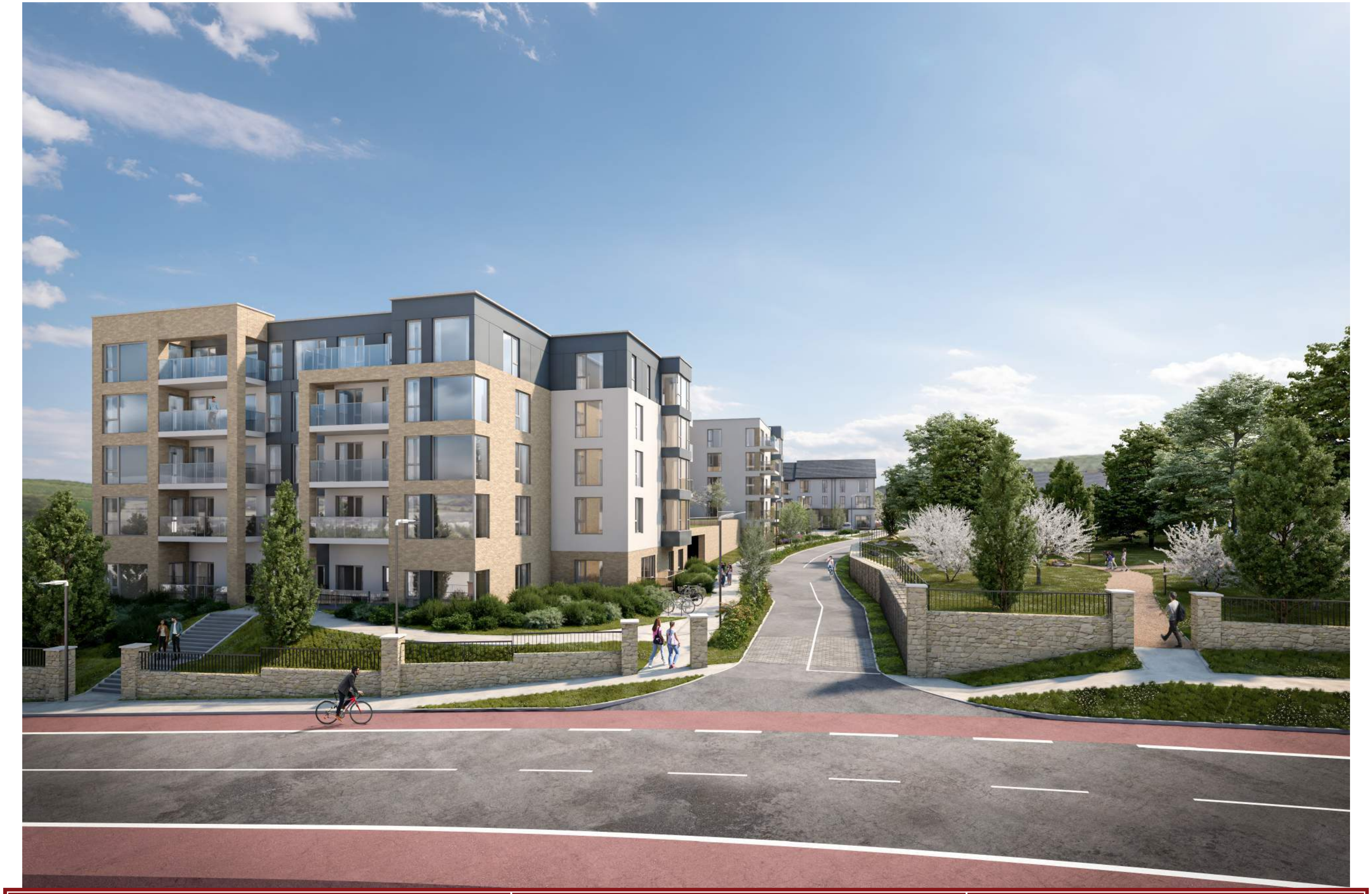


Project Title: Kilternan Village SHD	**Applicant Name: Liscove Limited**	**Image Title: CGI 1**
	Presentation Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com



Project Title: Kilternan Village SHD	**Applicant Name: Liscove Limited**	**Image Title: CGI 2**
	Presentation Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com



Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: CGI 3

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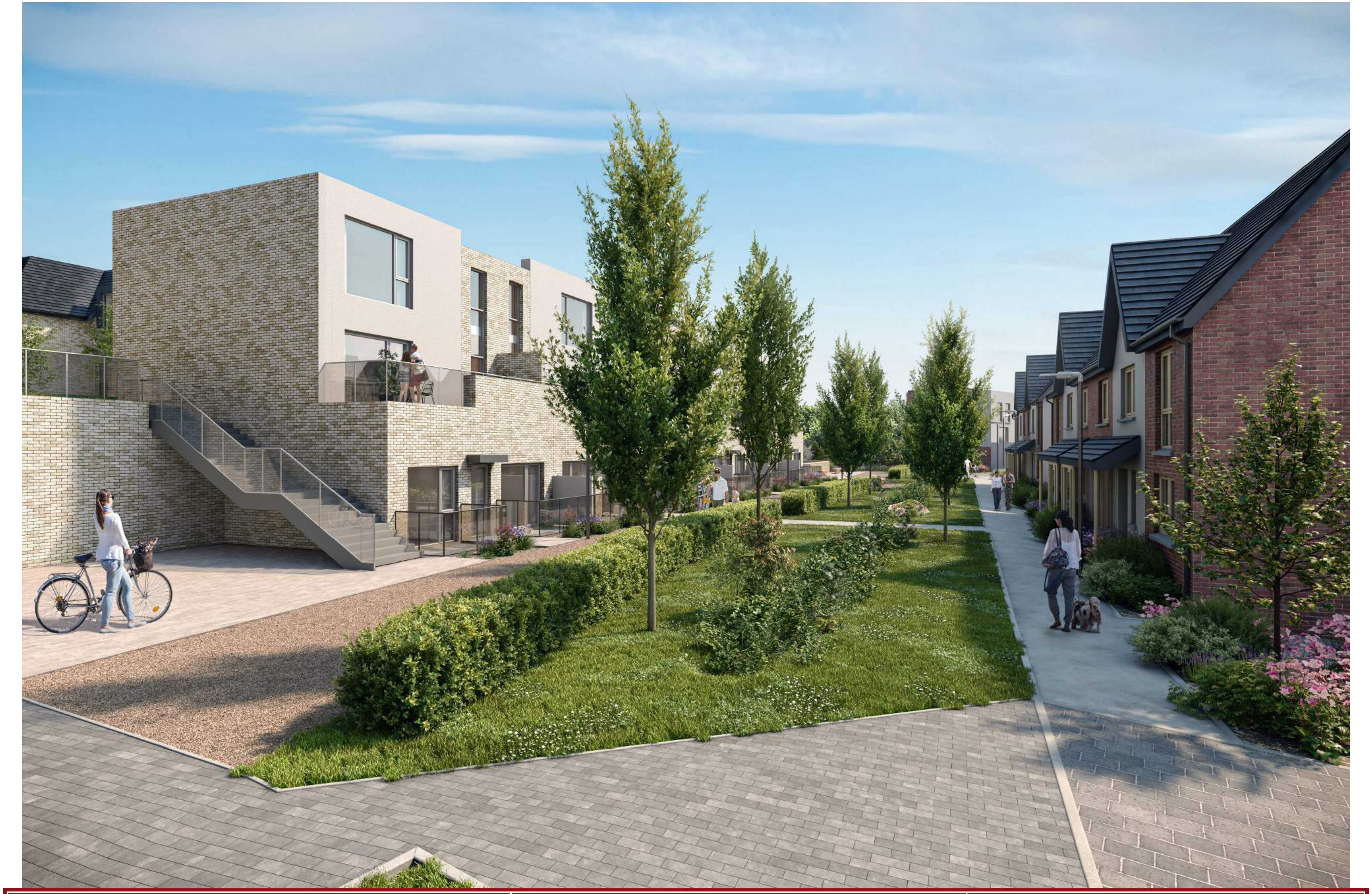

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: CGI 4

Presentation Imagery by 3D DESIGN BUREAU

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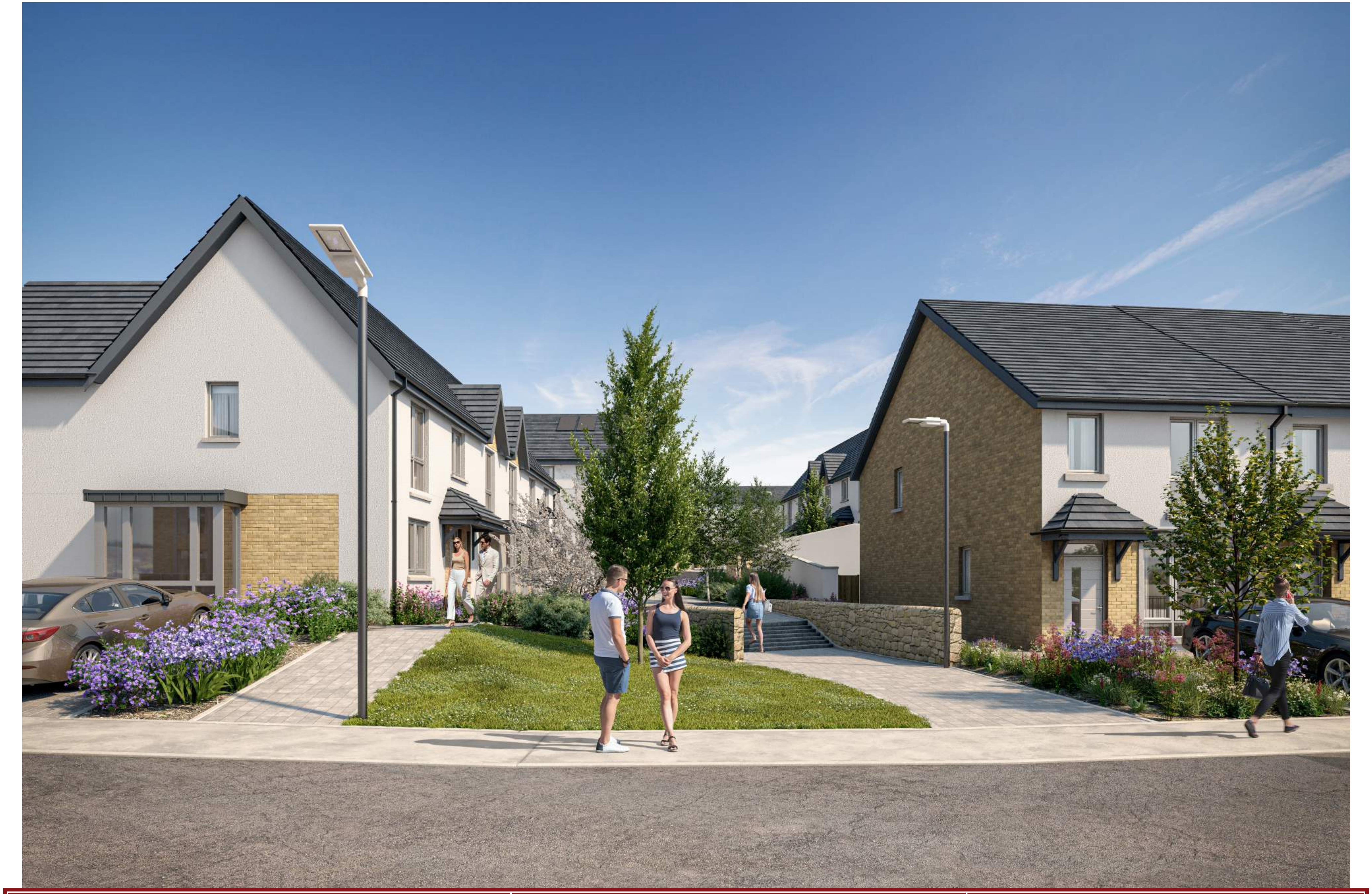

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: CGI 5

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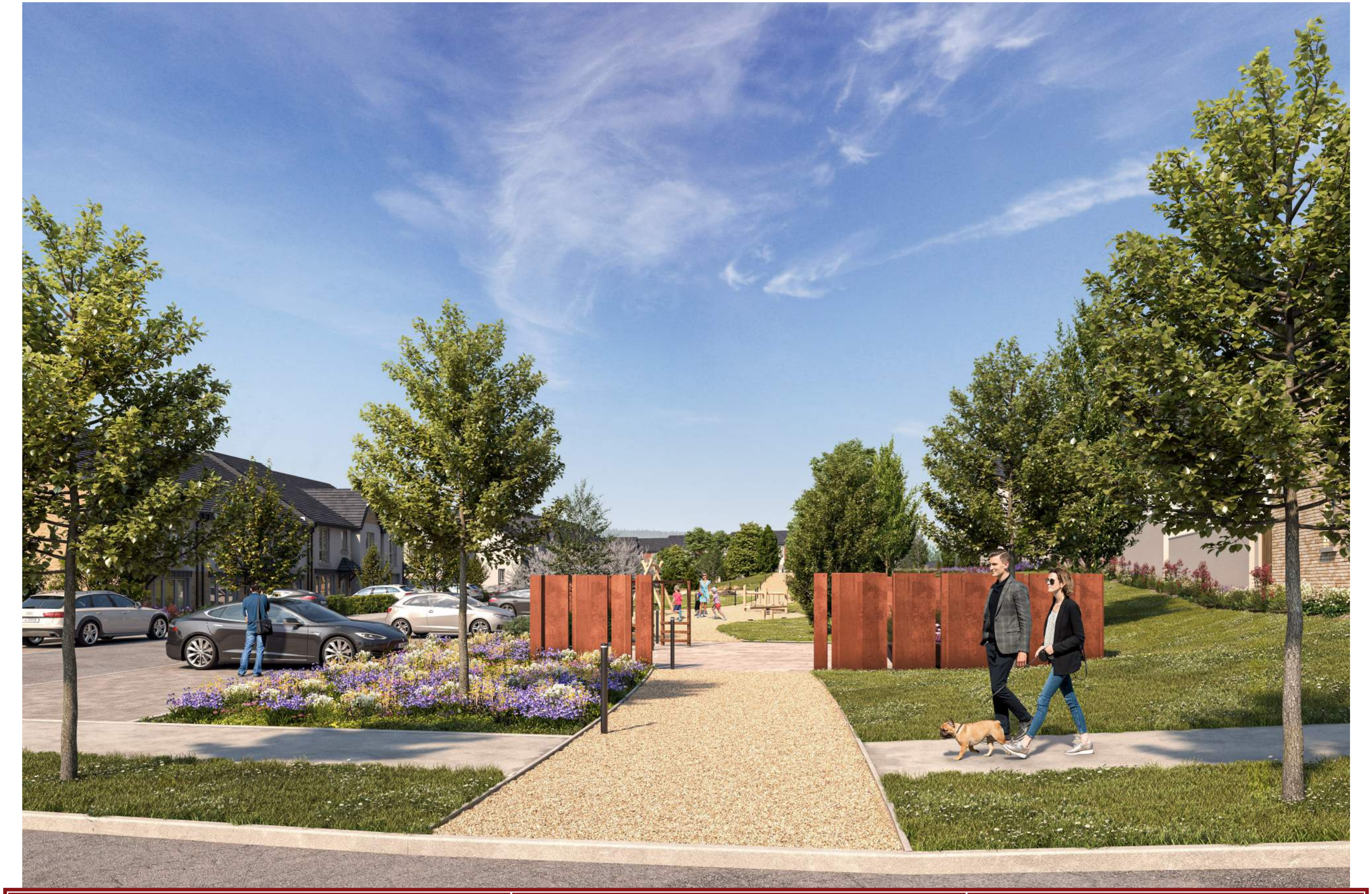
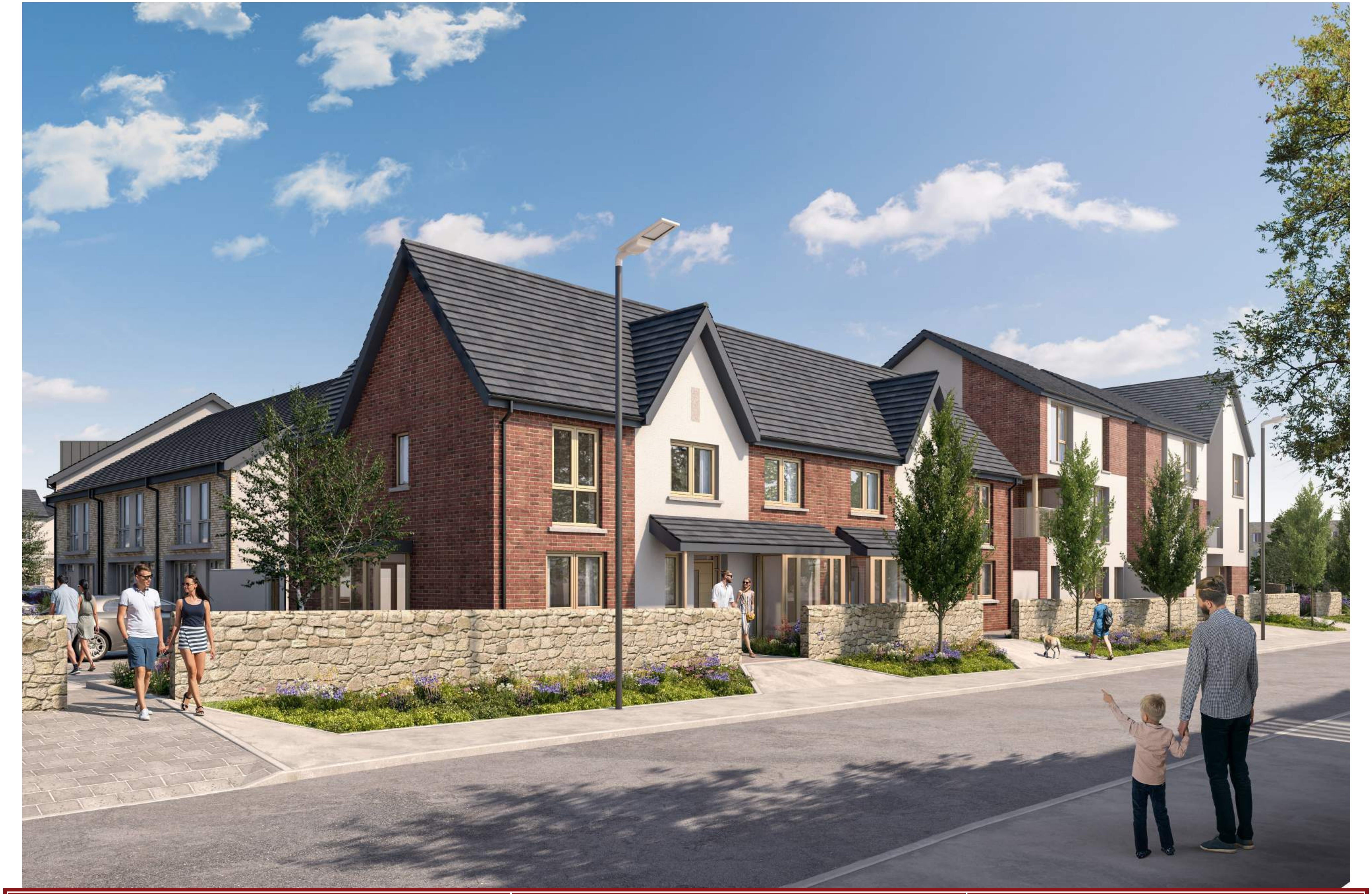
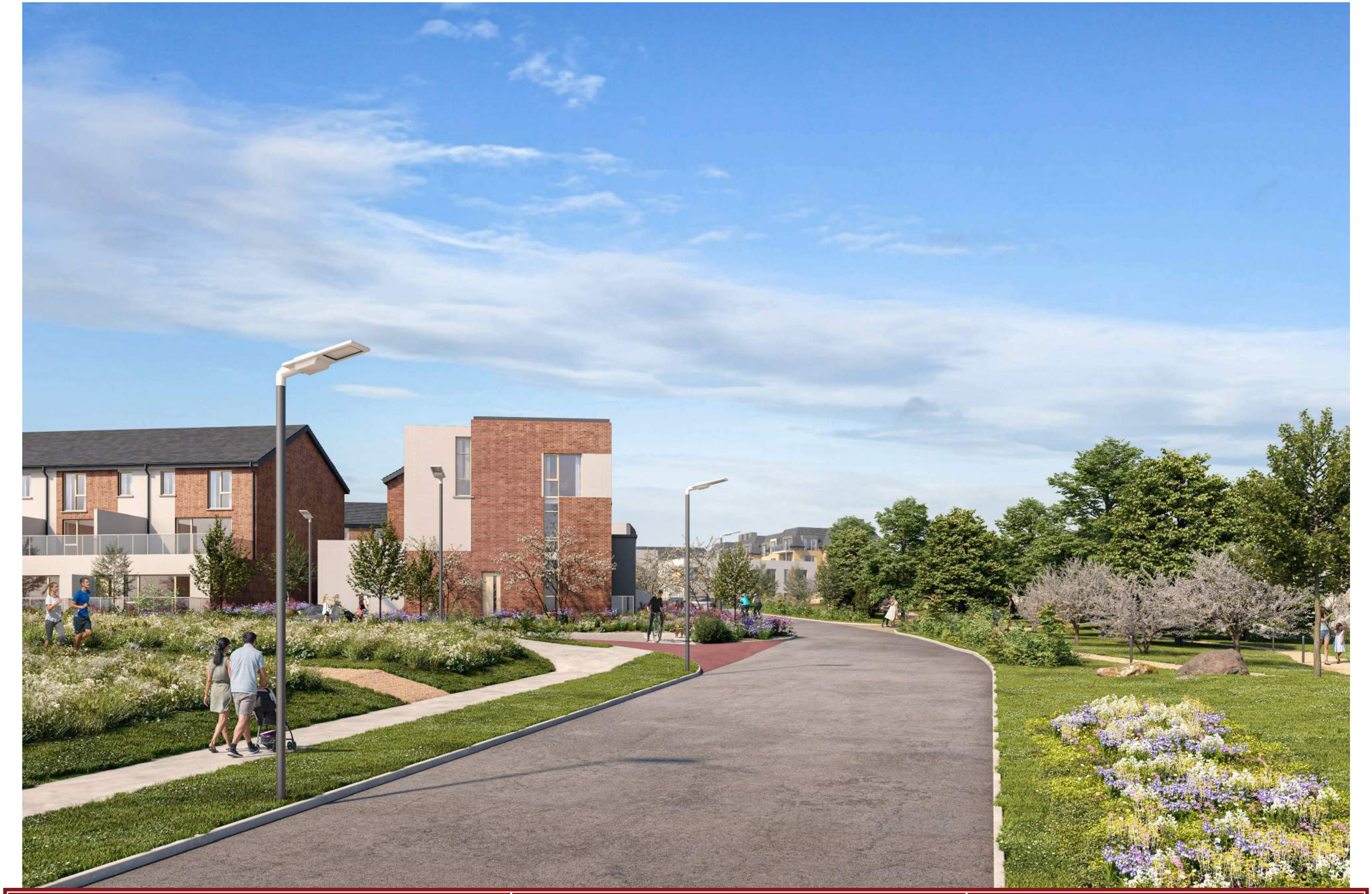


Project Title: Kilternan Village SHD	**Applicant Name: Liscove Limited**	**Image Title: CGI 6**
	Presentation Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com



Project Title: Kilternan Village SHD	**Applicant Name: Liscove Limited**	**Image Title: CGI 7**
	Presentation Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com



Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: CGI 8

Presentation Imagery by 3D DESIGN BUREAU

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Methodology for Verified View Montages

1. Overview.
This summarised methodology has been prepared by 3D Design Bureau Ltd (3DDB) to explain the production of Verified View Montages (VVM). The preparation and presentation of reliable verifiable visual information is a key component to the writing of Landscape Visual Impact Assessment reports. It should be noted that VVMs are technical images and should be produced and used in a technically appropriate manner. Please see full details of this methodology below.

2. What Is A Verified View Montage (Vvm)?
Verified View Montages work by using the correct geospatial insertion of accurate 3D models in the existing landscape (photo) allowing for a photorealistic view of the planned model in its intended location.

3. Methodology

3.1 Project Planning
Following appointment a full list of suggested views are drawn up for review prior to visiting site between 3DDB, the client and the planning consultant. Note: If a LVIA report is being written by a 3rd Party planning consultant, the medium to long range views will be guided by them. After obtaining a full list, it is analysed and a plan for the taking of baseline photographs is put in place. Note: 3D modelling of the proposed scheme can, and usually is, commenced prior to the photographic site visit.

3.2 High resolution Baseline Photography
Every baseline photograph is captured in raw settings using a high-resolution digital SLR camera. This allows for the maximum possible information to be retained in the digital file. It also avoids the file from being altered by any internal camera processing definitions, allowing us to retain the maximum control and fidelity on the end results.
The focal lengths used depend on the surrounding context and proximity to the desired area. We use high quality lenses with focal lengths that allow us to capture enough surrounding context without compromising quality and fidelity, by avoiding excessive barrelling, distortion or aberrations. All shots are taken horizontally with the use of a 50mm lens (where possible). Note: Although the 50mm focal length represents the perceived scale of the human eye, it does NOT represent the human field of view and therefore should not necessarily be used to show the proposed development in its context.
On site and back in the studio, each photo location is correctly recorded and marked as follows
On-Site:

- The tripod location on site is paint marked and photographed in relation to existing elements.
- The location of each photo is manually marked on a printed map while on site.
- The camera height is recorded.

Upon completion of the baseline photo site visit all photographs go through post processing back in the studio. The full set of photos along with a viewpoint location map are issued to the client for review and to choose the best shots that will demonstrate the visual impact that the proposed scheme may/may not have**.**

3.3 Baseline Photo Surveying
When all baseline photos for the VVMs are chosen, each one is marked up in studio. The fixed reference points within each photo are coloured coded and all ‘marked up’ baseline photos are issued to our qualified topographical surveyor for surveying purposes.
The survey team records the camera/tripod position using GPS & Total Station to an accuracy of +-1cm Northing & Easting and to an accuracy of 2cm Elevation. The ‘marked up’ fixed reference points identified in each photo are then surveyed to establish exact orientation of the view and to verify the photomontage process.

Methodology for Verified View Montages

3.4 3D Modelling & Visualisation.

Modelling

An accurate digital 3D model of the 'proposed' development is produced in Revit. This is carried out from a combination of the 3rd Party architectural, engineering and landscape drawings. All proposed model information is contained in the one file and it is ALWAYS positioned relative to the existing survey information.

The 'marked up' fixed reference points which have been surveyed, are also modelled along with any other relevant survey information from the supplied topo survey drawing/s. As stated above, the proposed model and survey model information are geospatially positioned relative to one another. This is imperative to ensure the accurate positioning / camera matching of the proposed digital 3D model within each chosen photo.

Visualisation

Once the digital 3D Revit model is complete, our 3D visualisation team take over the project for the visualisation process. This involves the matching of textures, lighting conditions and asset population. This ensures that the 3D model is visually as close as possible to the intended future 'As Built' development.

Software used for the visualisation process is called 3D Studio Max. This is accepted as the industry standard for architectural visualisation work and production of VVMs.

3.5 Camera Matching / Rendering / Post Production

Following the completion the 3D visualisation process (but in some instances prior to this) the following methodology is applied in order for views to be verifiable.

Camera Matching

All of the information recorded at the time of the baseline photographic site visit, that is, camera co-ordinates, angle of view, and direction of view, is programmed into the virtual camera within our 3D software package of choice - 3D studio Max. Insertion of digital cameras within the software with matching attributes of the physical camera is carried out. This careful method ensures that the size, position and height, of the proposed development in each VVM is correct to an accuracy of 0.33% i.e. +/- 1mm on an A3 print.

Rendering

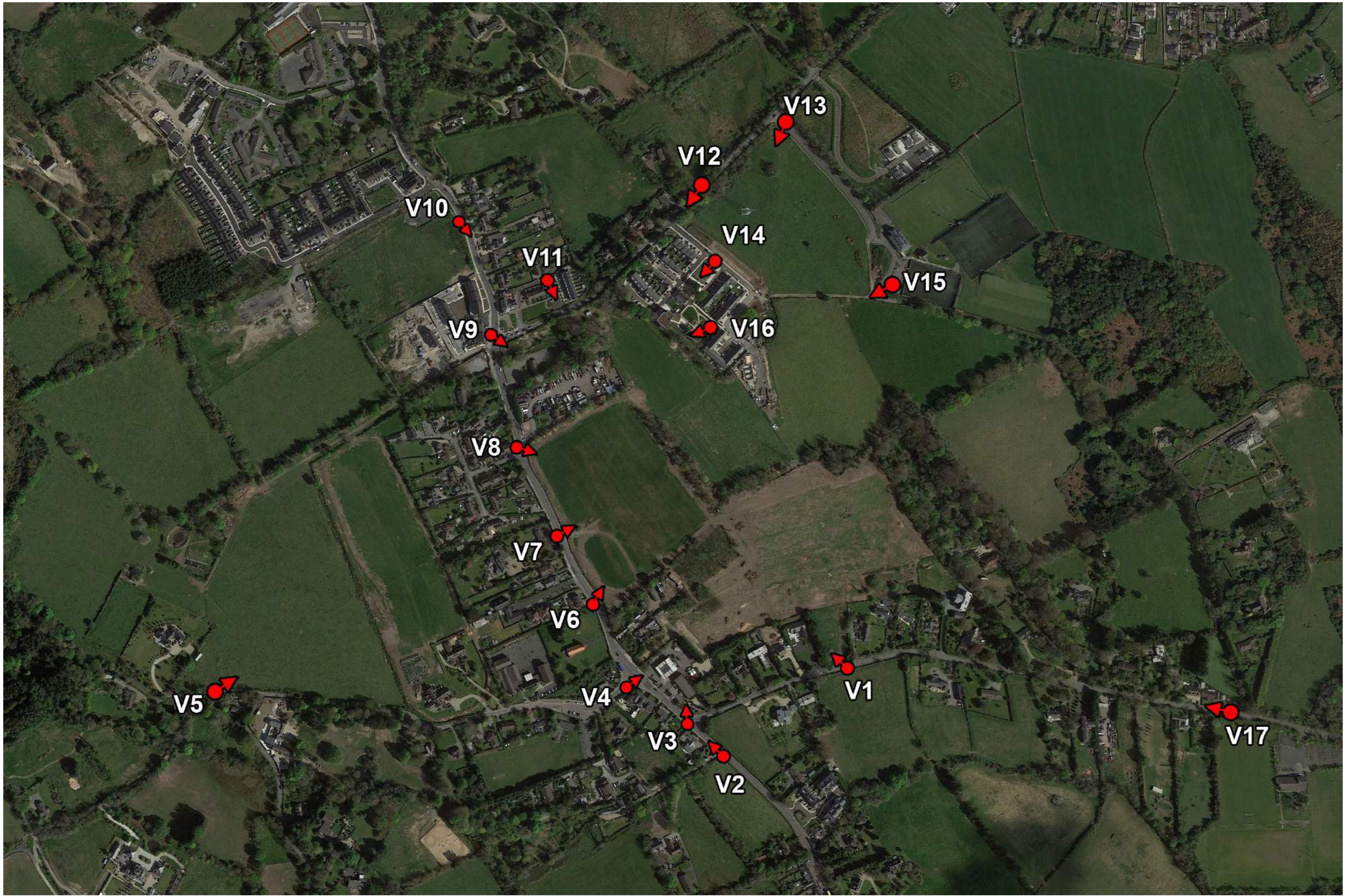
Following the camera matching and visualisation process the view is 'rendered' at high resolution and is superimposed onto its matching baseline photograph using Adobe Photoshop software. The mathematical accuracy is then double checked and verified by ensuring that existing 'marked up' fixed reference point features which were also rendered line up exactly in the photo.

Post Production

Next, the VVM specialist establishes, which existing features, such as buildings, landscape and trees, are in the foreground of the proposed development and those that are in the background, i.e. which features will mask the development and which ones will appear behind the development. When it is found that the development is not visible due to foreground features, its extremities will be indicated with a red outline.

4. RESULTS

The resulting VVM having gone through this extensive procedure is an accurate and verifiable representation of the proposed development as viewed from the selected camera positions. This shows as closely as possible any future impact the proposed development may have on the surrounding environment and existing buildings, presenting a truly valuable tool for planning purposes.



Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Viewpoint Location Map-Close Range

Planning Imagery by 3D DESIGN BUREAU

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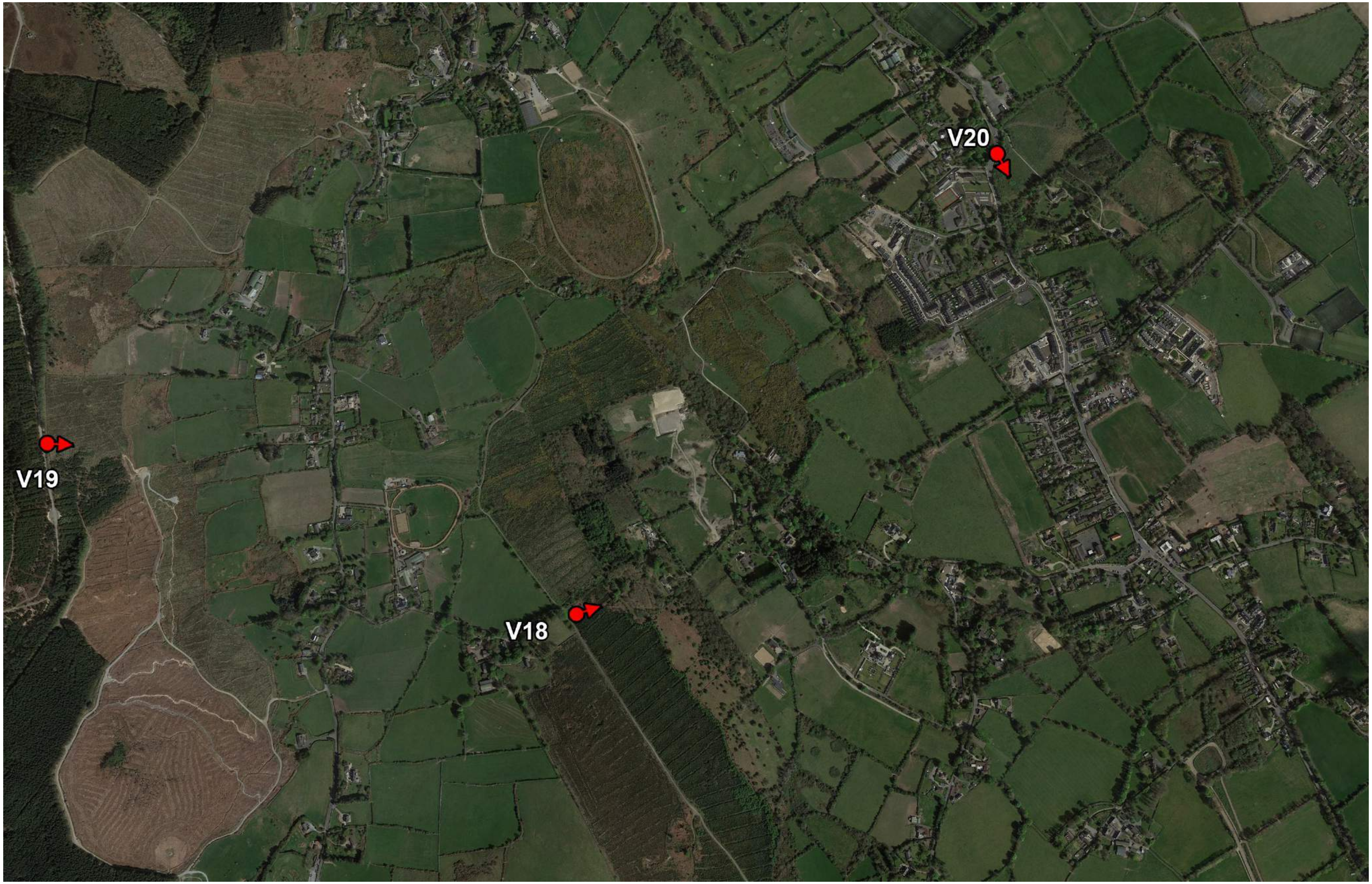


Project Title: Kilternan Village SHD

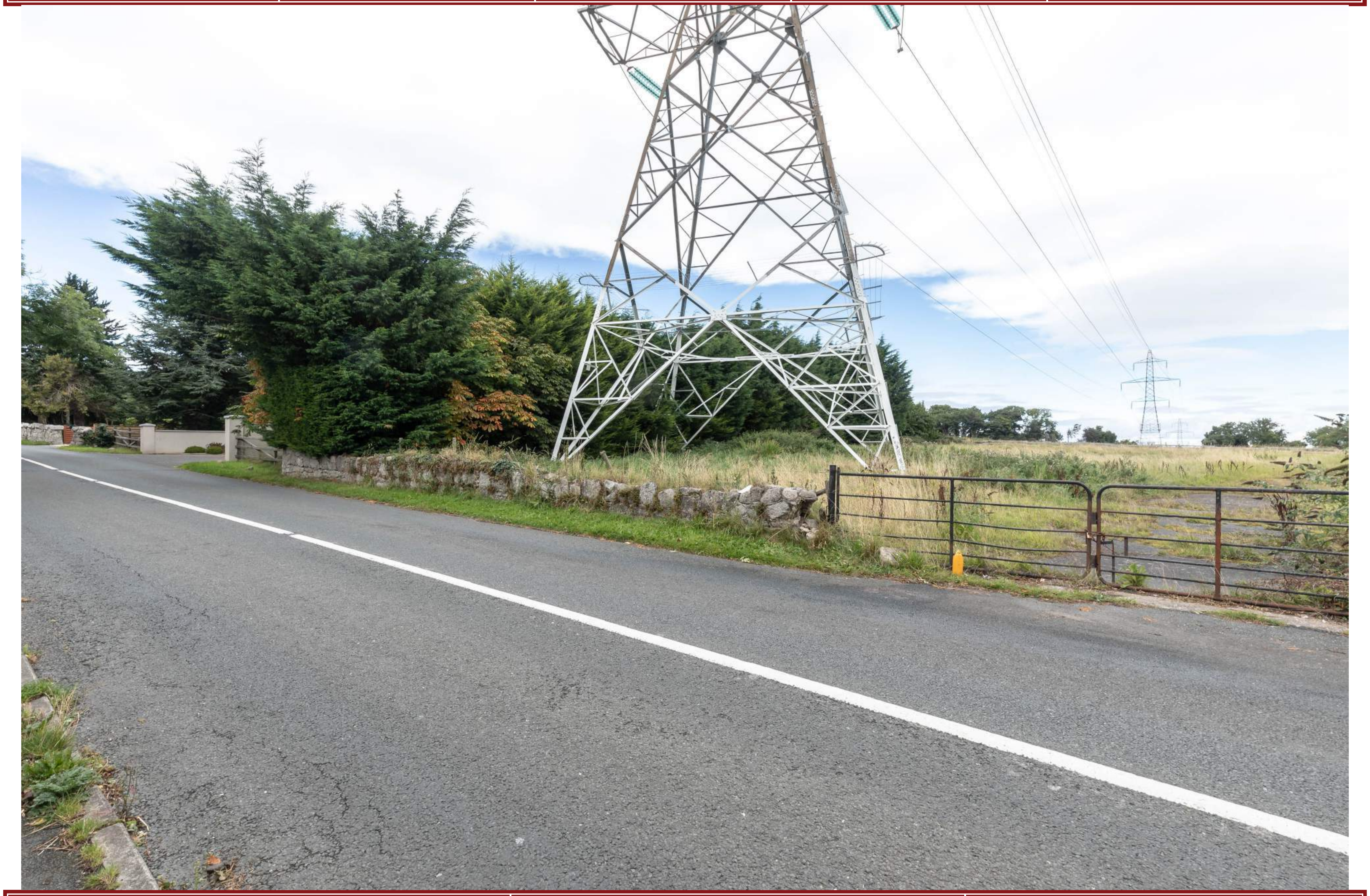
Applicant Name: Liscove Limited

Image Title: Viewpoint Location Map-Long Range

Planning Imagery by 3D DESIGN BUREAU

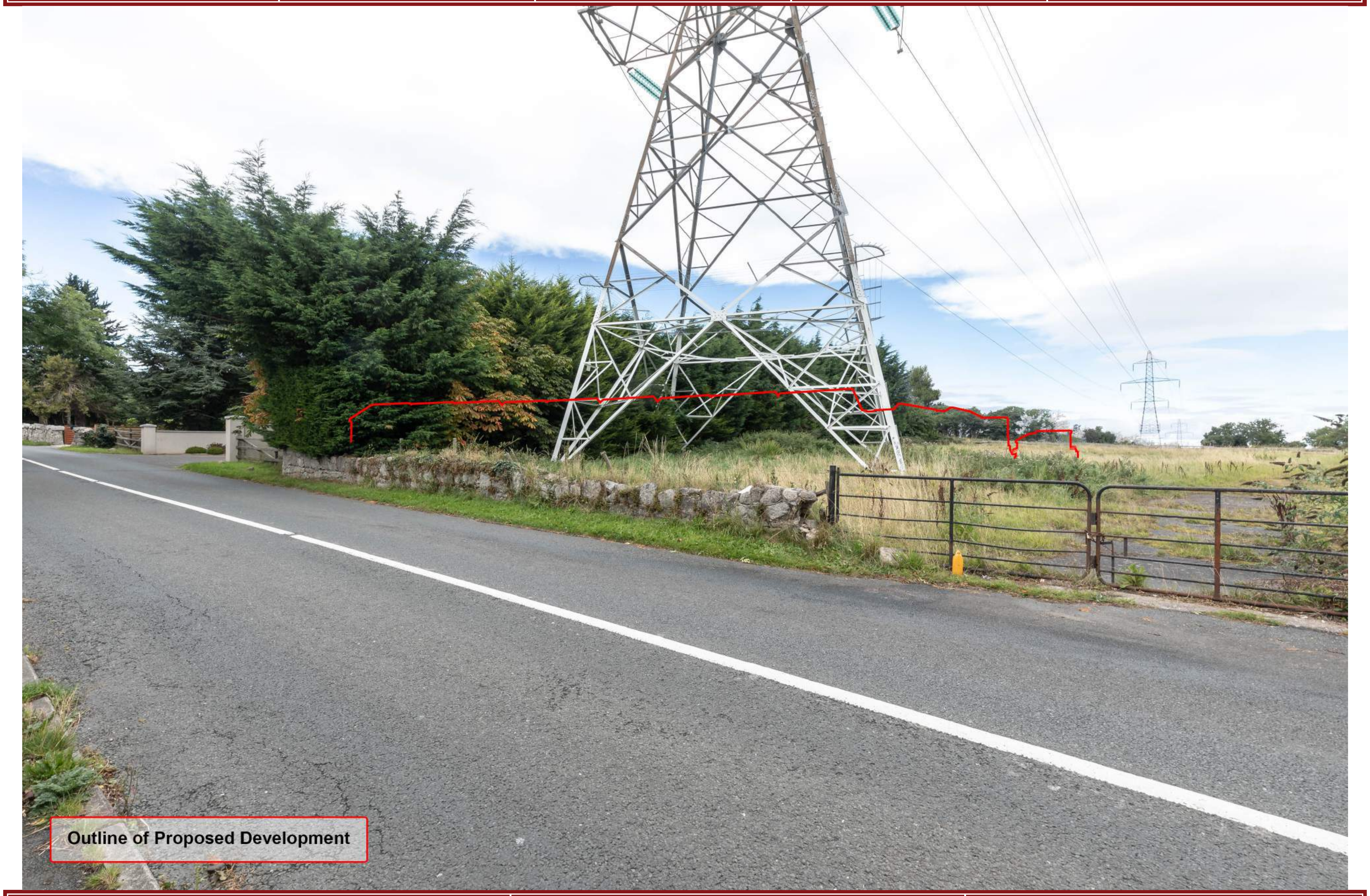
Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

Camera Type: Canon EOS 5D Mark IV	Lens Type: EF16-35mm f/4L IS USM	Focal Length: 16 mm	Approx Dist: 82.00 m	Date & Time: 28/09/2021, 12:32:34



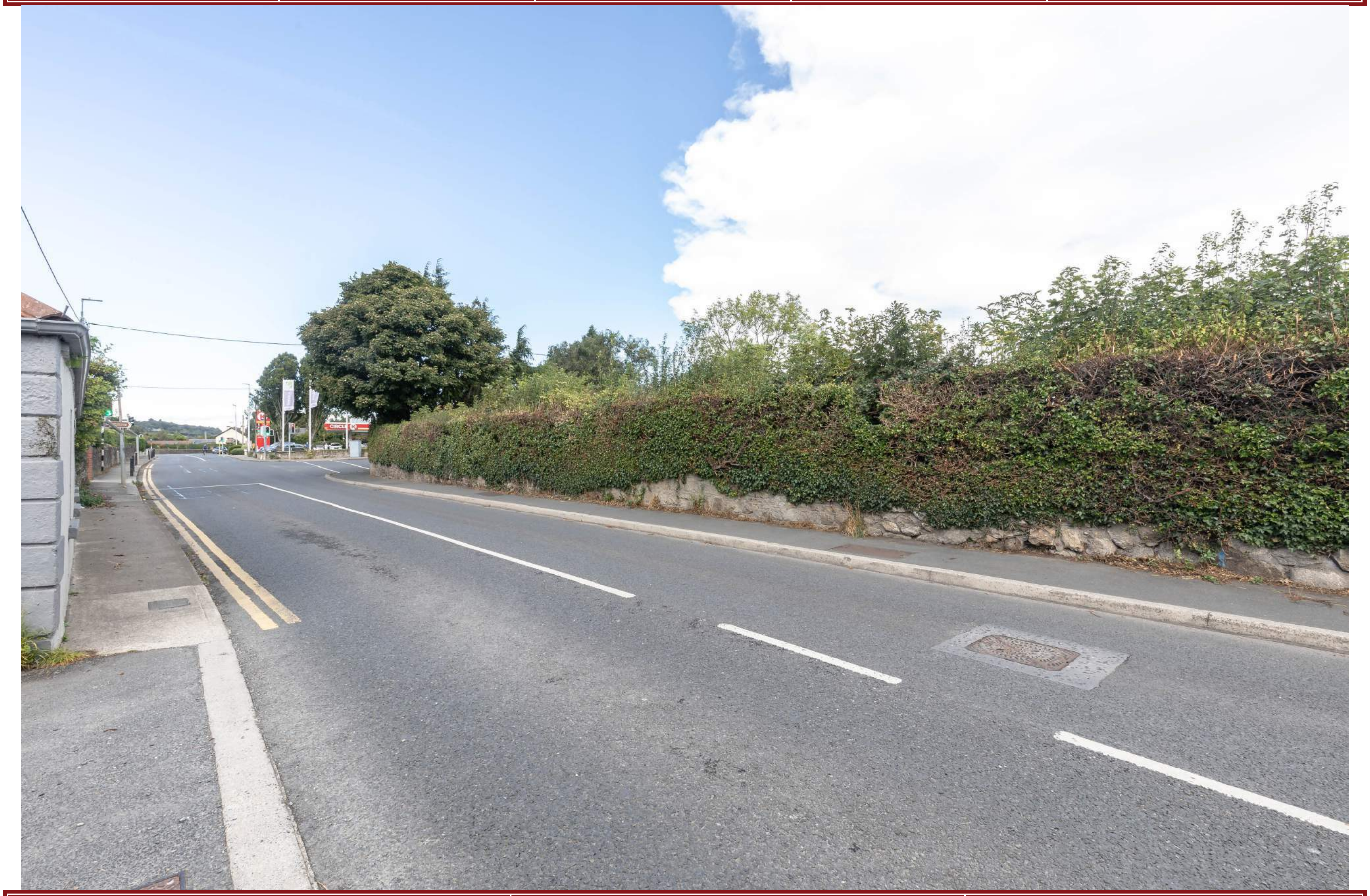
Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Baseline VVM 1
	Planning Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com

Camera Type: Canon EOS 5D Mark IV	Lens Type: EF16-35mm f/4L IS USM	Focal Length: 16 mm	Approx Dist: 82.00 m	Date & Time: 28/09/2021, 12:32:34



Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Proposed VVM 1
	Planning Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com

Camera Type: Canon EOS 5D Mark IV	Lens Type: EF16-35mm f/4L IS USM	Focal Length: 16 mm	Approx Dist: 128.00 m	Date & Time: 28/09/2021, 12:53:38

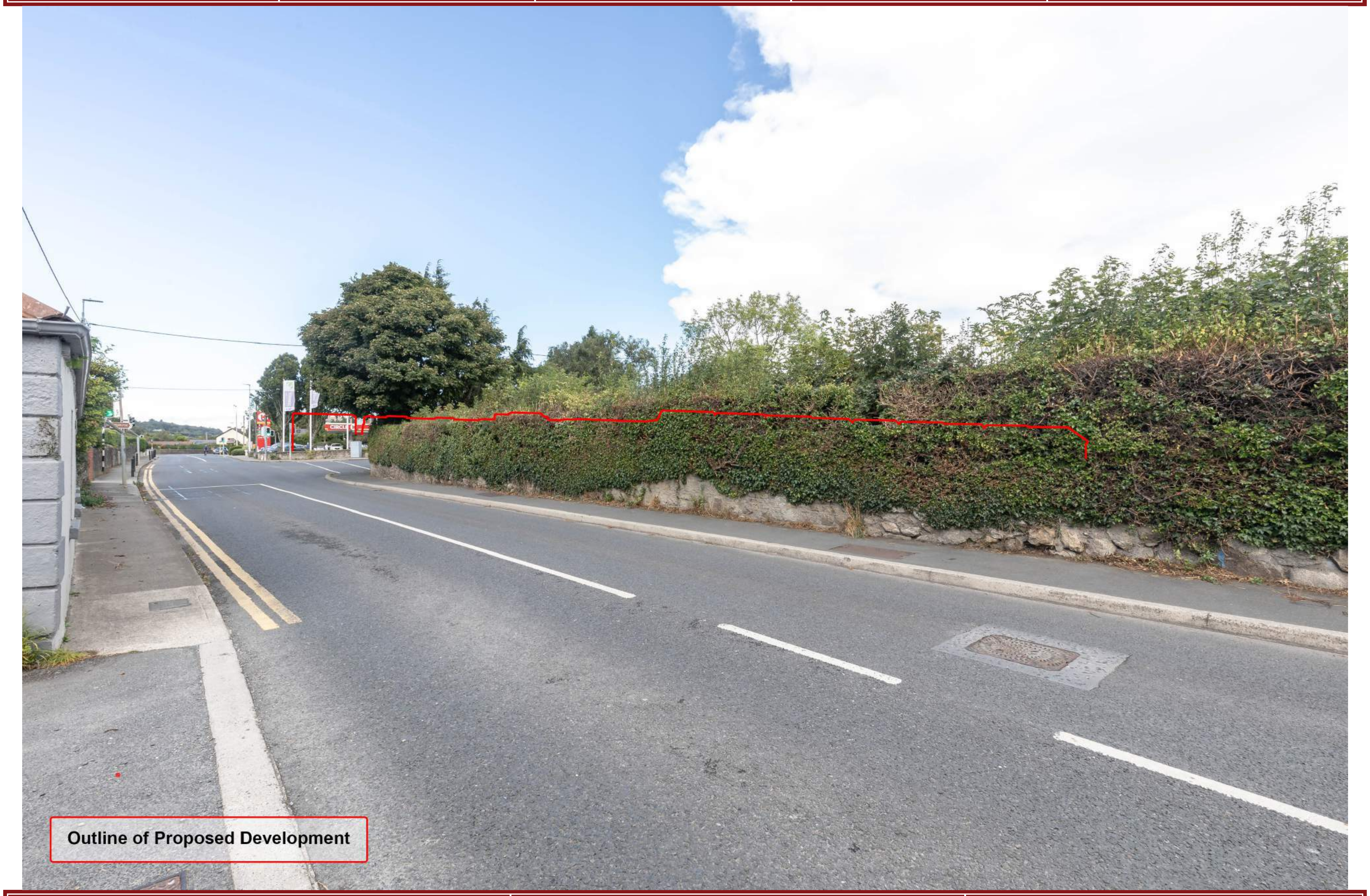


Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Baseline VVM 2

Planning Imagery by 3D DESIGN BUREAU

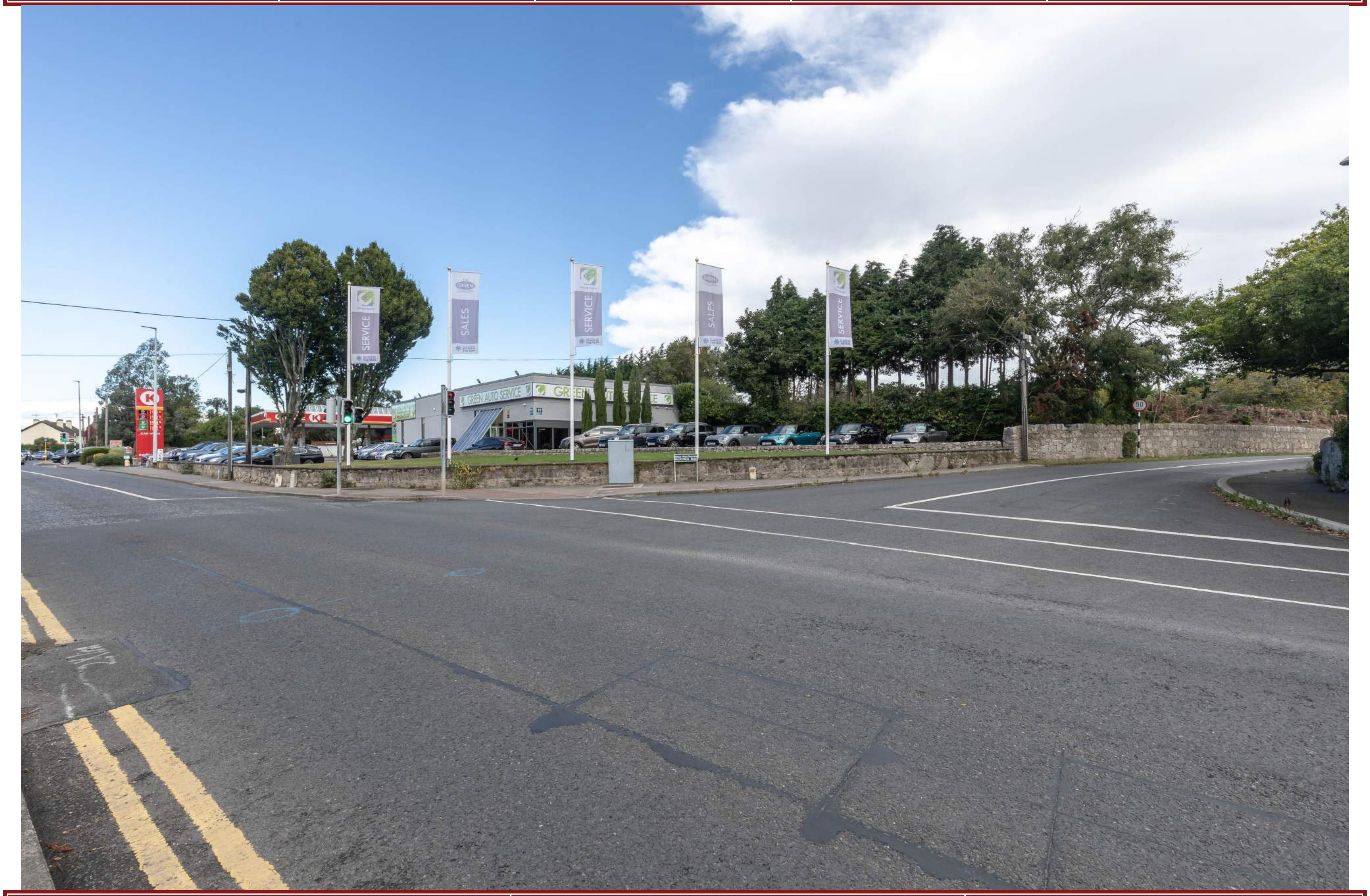
Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

Camera Type: Canon EOS 5D Mark IV	**Lens Type: EF16-35mm f/4L IS USM**	**Focal Length: 16 mm**	**Approx Dist: 128.00 m**	**Date & Time: 28/09/2021, 12:53:38**



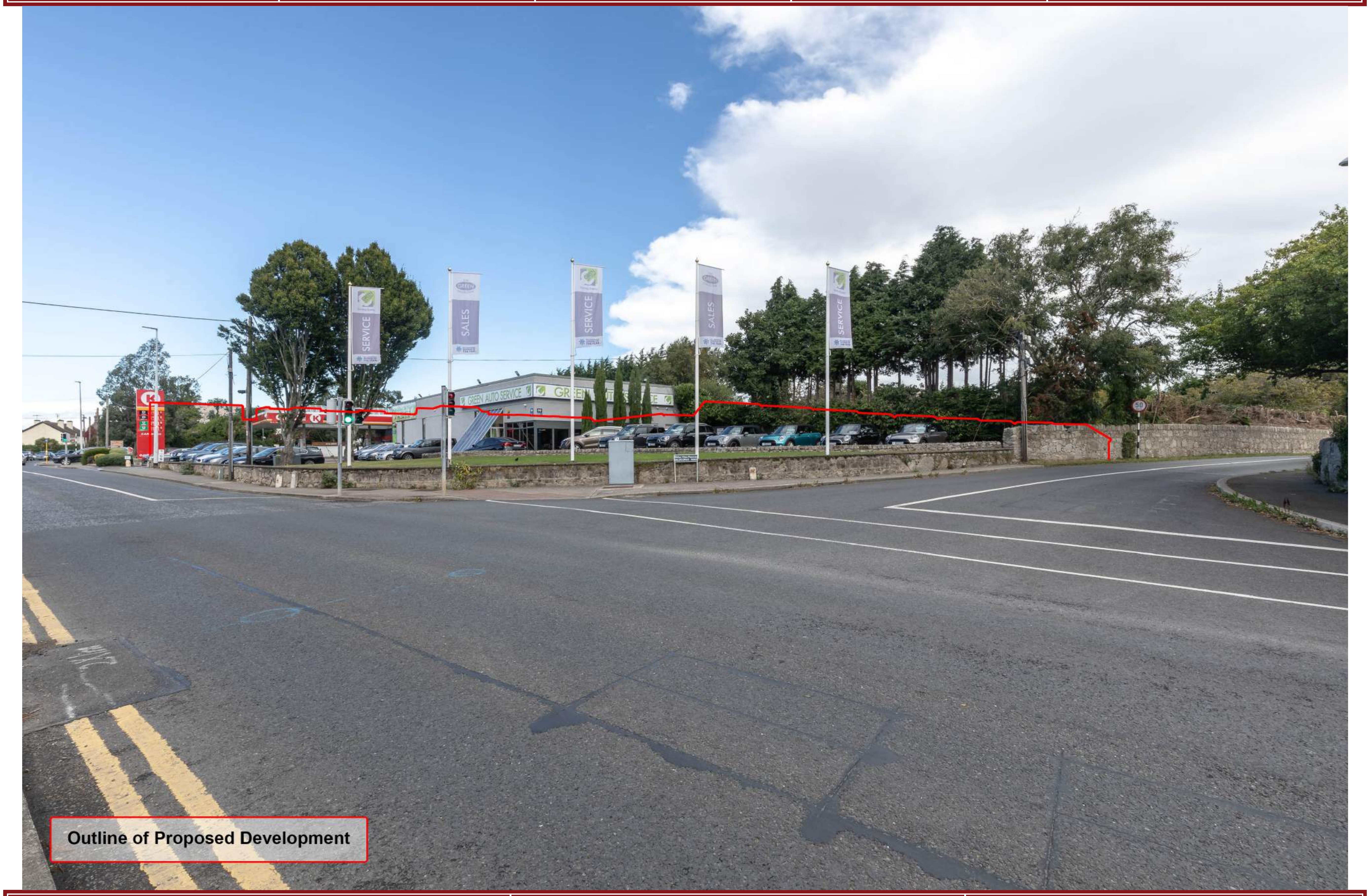
Project Title: Kilternan Village SHD	**Applicant Name: Liscove Limited**	**Image Title: Proposed VVM 2**
	Planning Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com

Camera Type: Canon EOS 5D Mark IV	Lens Type: EF16-35mm f/4L IS USM	Focal Length: 16 mm	Approx Dist: 100.00 m	Date & Time: 28/09/2021, 12:56:33



Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Baseline VVM 3
	Planning Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com

Camera Type: Canon EOS 5D Mark IV	Lens Type: EF16-35mm f/4L IS USM	Focal Length: 16 mm	Approx Dist: 100.00 m	Date & Time: 28/09/2021, 12:56:33



Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 3

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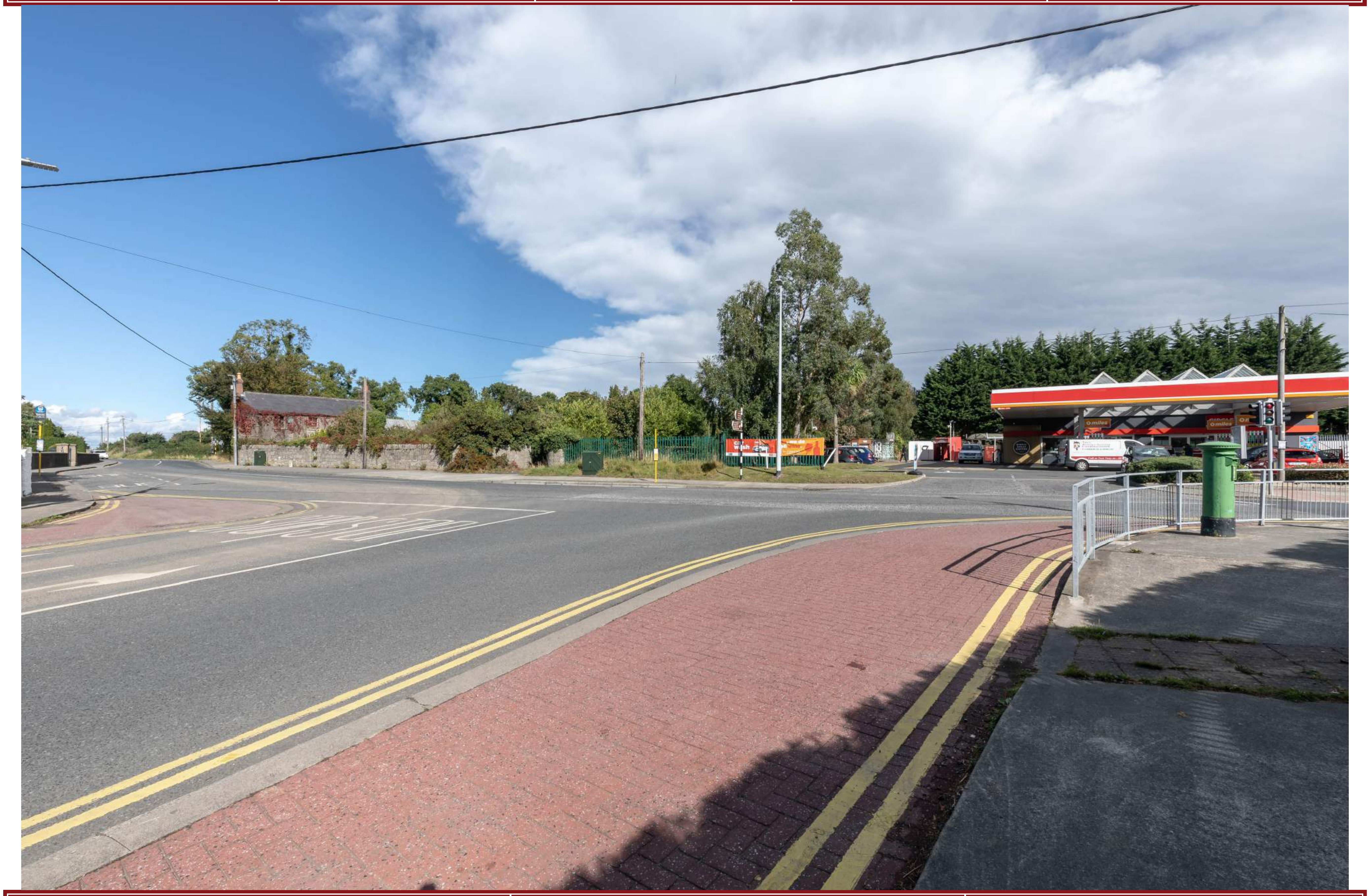
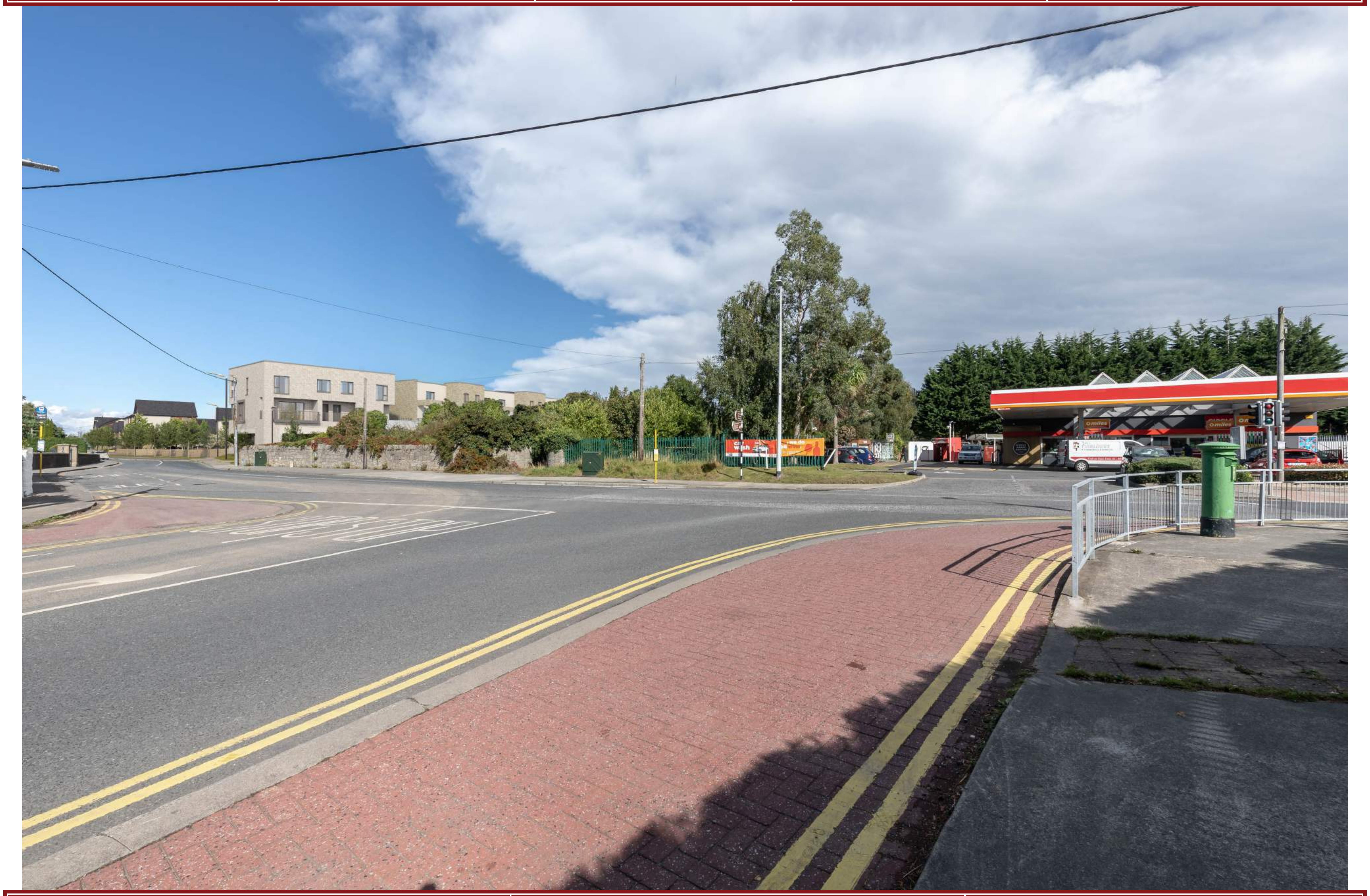
Camera Type: Canon EOS 5D Mark IV	Lens Type: EF16-35mm f/4L IS USM	Focal Length: 16 mm	Approx Dist: 20.00 m	Date & Time: 28/09/2021, 13:04:47



Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Baseline VVM 4
	Planning Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com

Camera Type: Canon EOS 5D Mark IV	Lens Type: EF16-35mm f/4L IS USM	Focal Length: 16 mm	Approx Dist: 20.00 m	Date & Time: 28/09/2021, 13:04:47



Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 4

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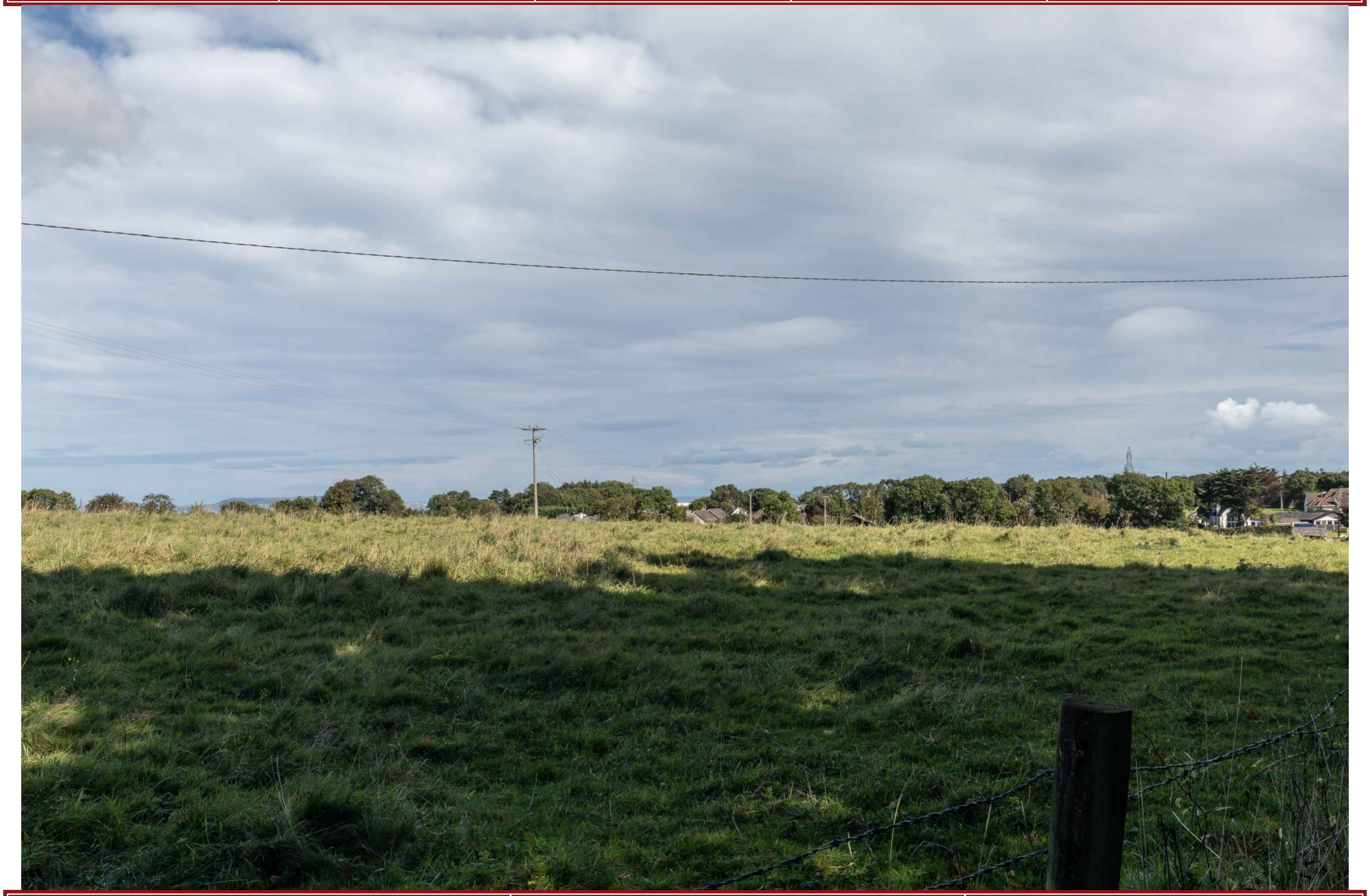
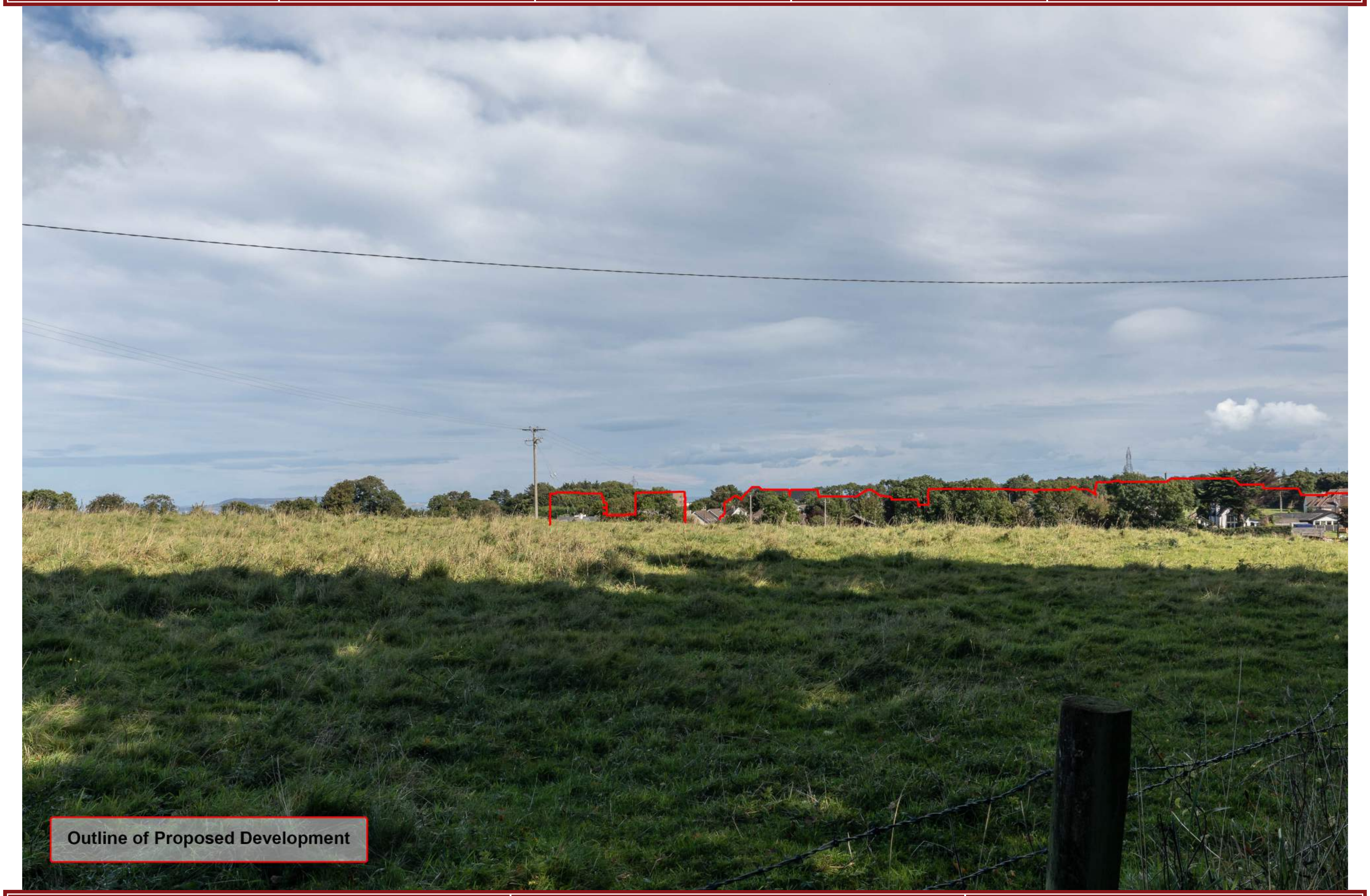
Camera Type: Canon EOS 5D Mark IV	Lens Type: EF16-35mm f/4L IS USM	Focal Length: 35 mm	Approx Dist: 443.00 m	Date & Time: 28/09/2021, 13:14:56



Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Baseline VVM 5
	Planning Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com

Camera Type: Canon EOS 5D Mark IV	Lens Type: EF16-35mm f/4L IS USM	Focal Length: 35 mm	Approx Dist: 443.00 m	Date & Time: 28/09/2021, 13:14:56



Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 5

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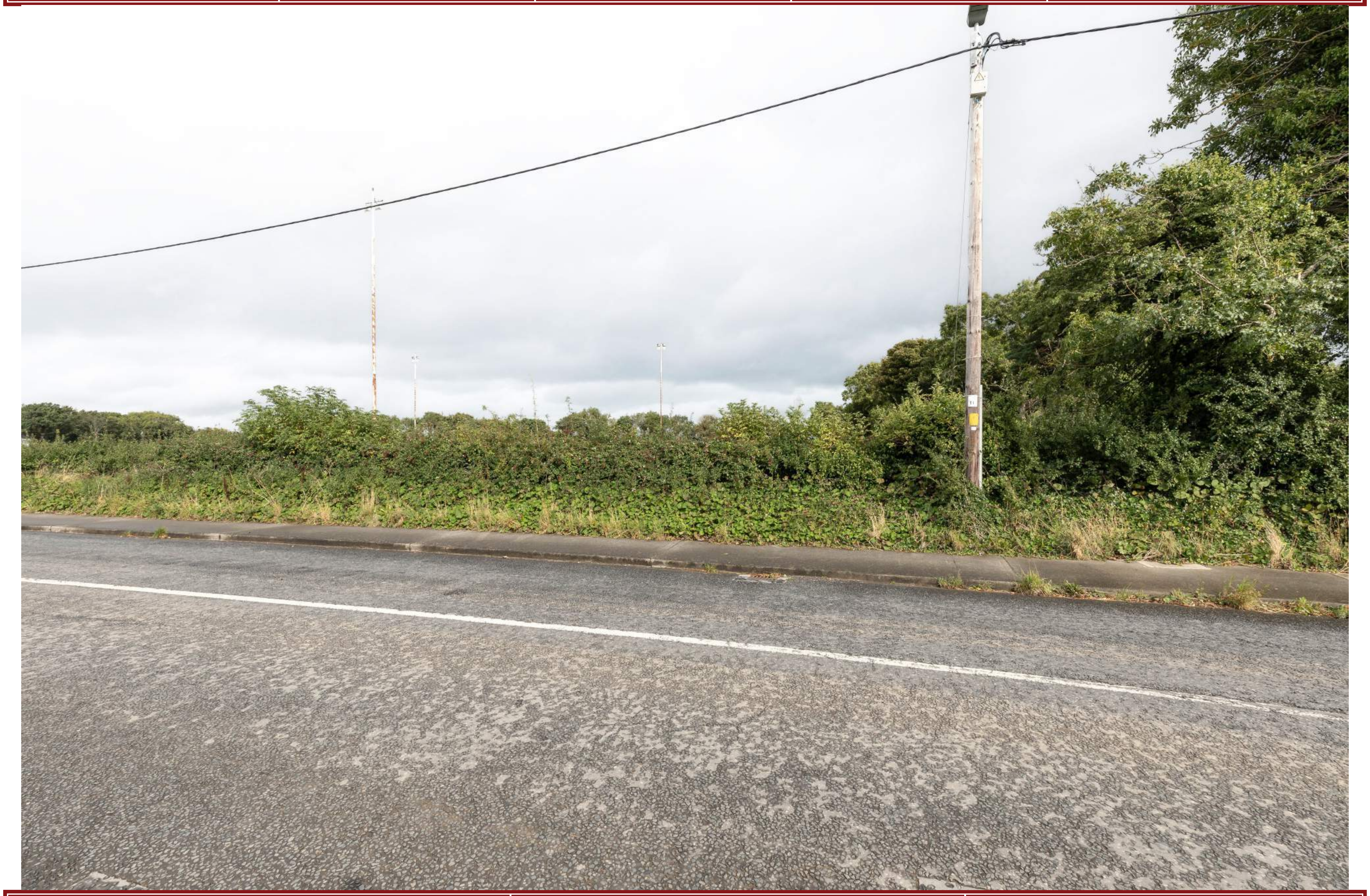
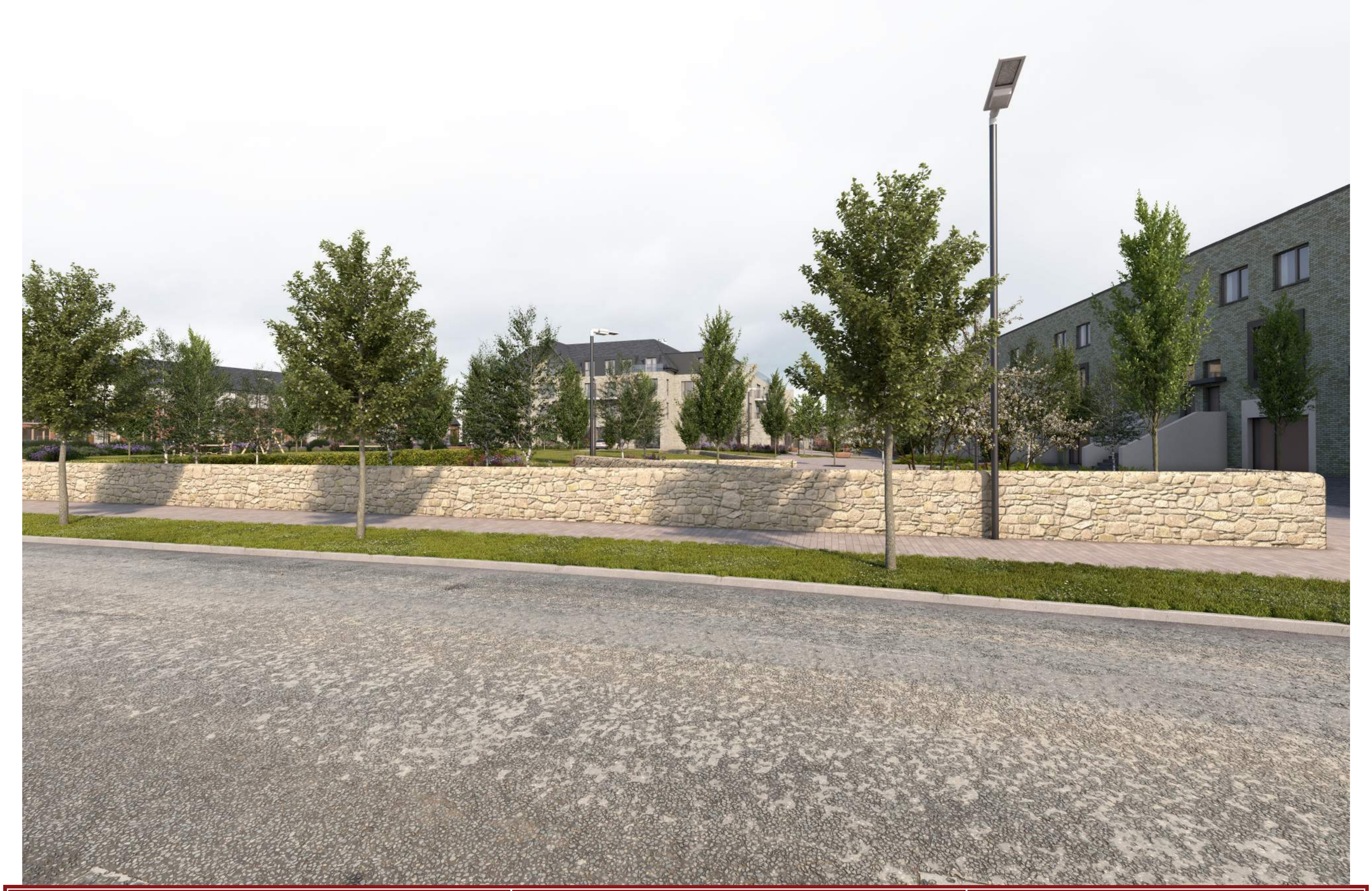
Camera Type: Canon EOS 5D Mark IV	**Lens Type: EF16-35mm f/4L IS USM**	**Focal Length: 16 mm**	**Approx Dist: 6.60 m**	**Date & Time: 30/09/2021, 13:55:51**



Project Title: Kilternan Village SHD	**Applicant Name: Liscove Limited**	**Image Title: Baseline VVM 6**
	Planning Imagery by	3D DESIGN BUREAU Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com

Camera Type: Canon EOS 5D Mark IV	Lens Type: EF16-35mm f/4L IS USM	Focal Length: 16 mm	Approx Dist: 6.60 m	Date & Time: 30/09/2021, 13:55:51



Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Proposed VVM 6
	Planning Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com

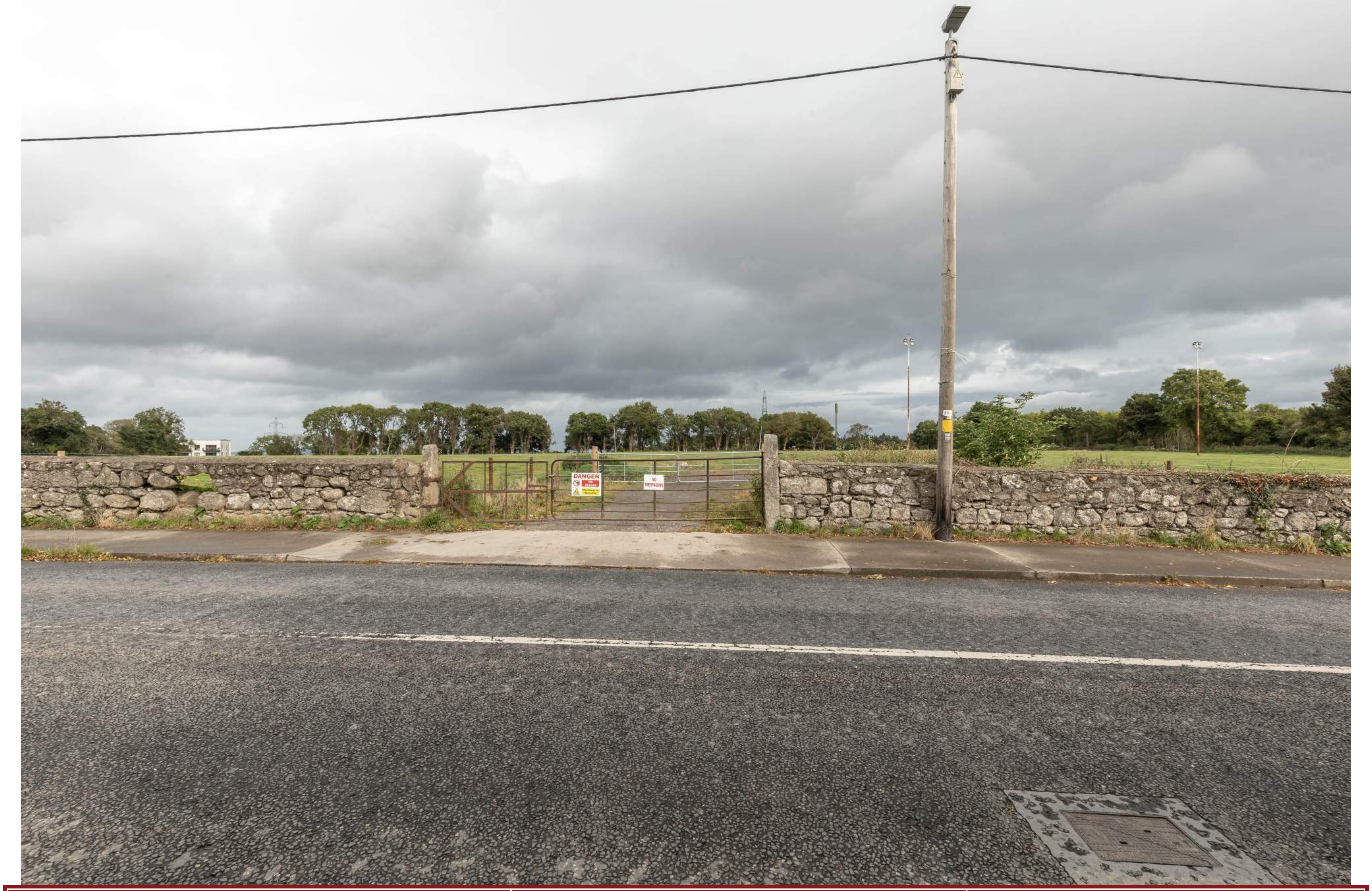
Camera Type: Canon EOS 5D Mark IV

Lens Type: EF16-35mm f/4L IS USM

Focal Length: 16 mm

Approx Dist: 5.20m

Date & Time: 30/09/2021, 13:58:30



Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Baseline VVM 7

Planning Imagery by 3D DESIGN BUREAU

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www.3ddesignbureau.com
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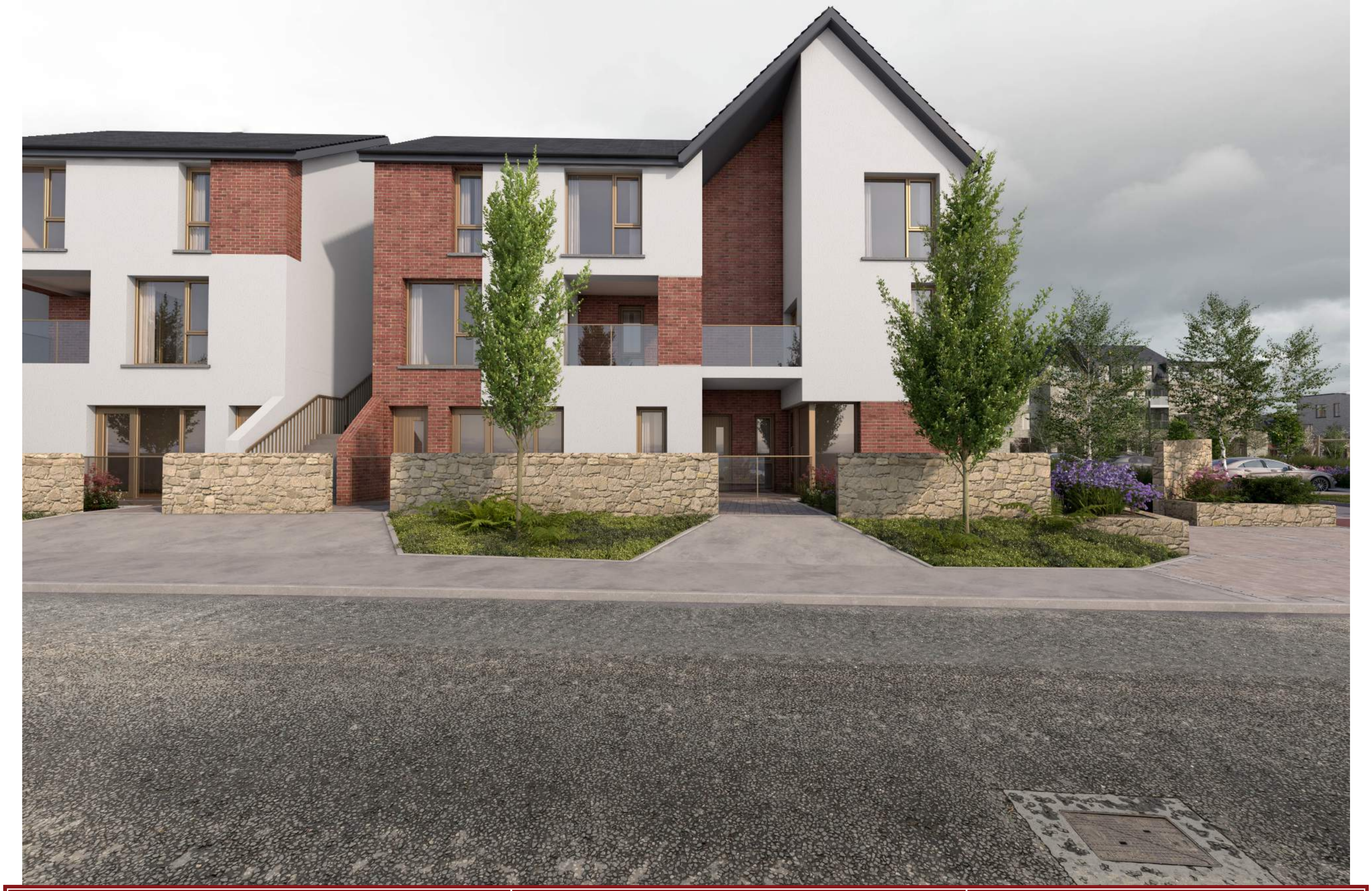
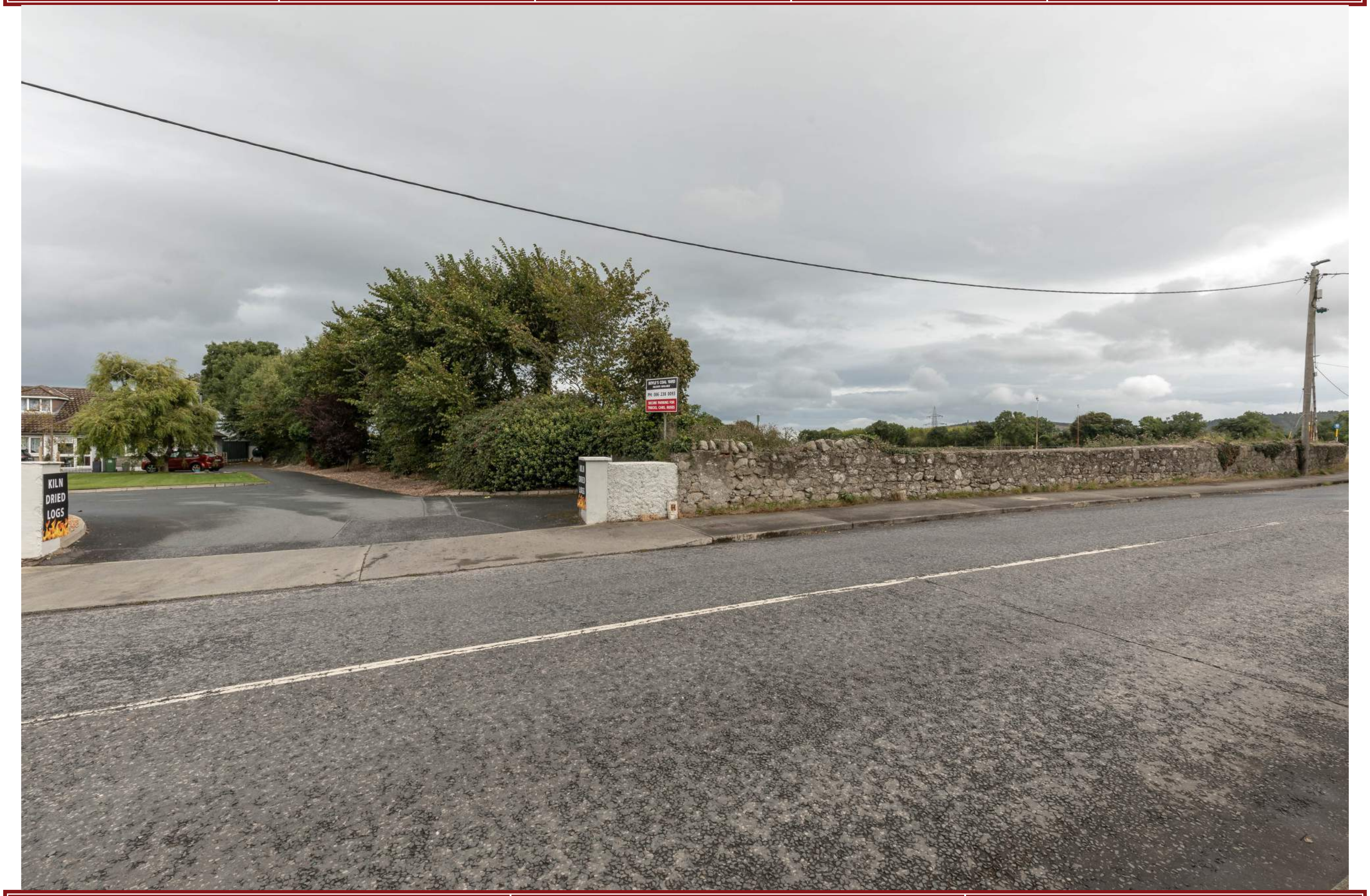


Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Proposed VVM 7

Planning Imagery by 3D DESIGN BUREAU

Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

Camera Type: Canon EOS 5D Mark IV | Lens Type: EF16-35mm f/4L IS USM | Focal Length: 16 mm | Approx Dist: 9.30m | Date & Time: 30/09/2021, 14:01:57



Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Baseline VVM 8

Planning Imagery by 3D DESIGN BUREAU
Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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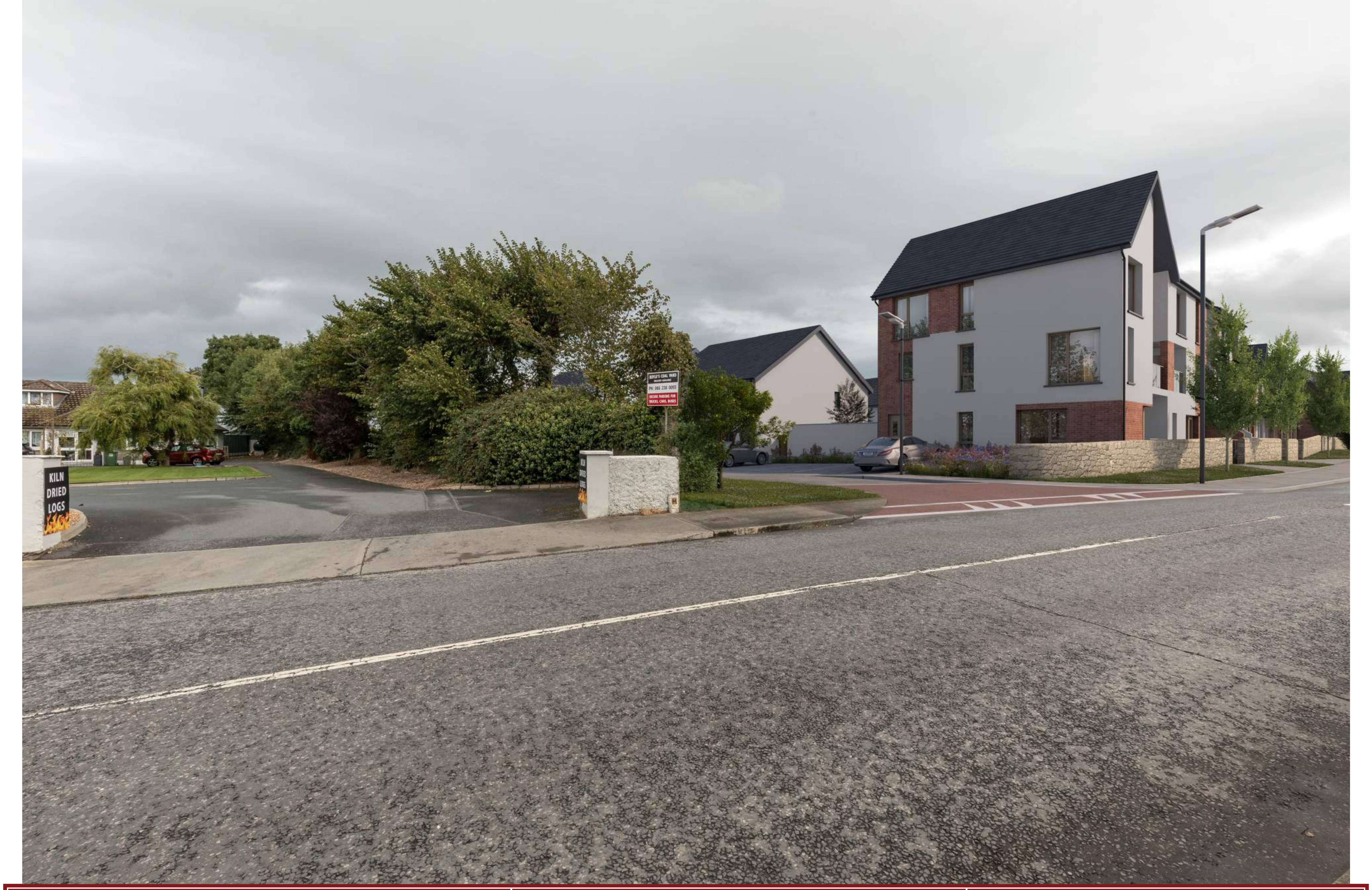

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 8

Planning Imagery by 3D DESIGN BUREAU
Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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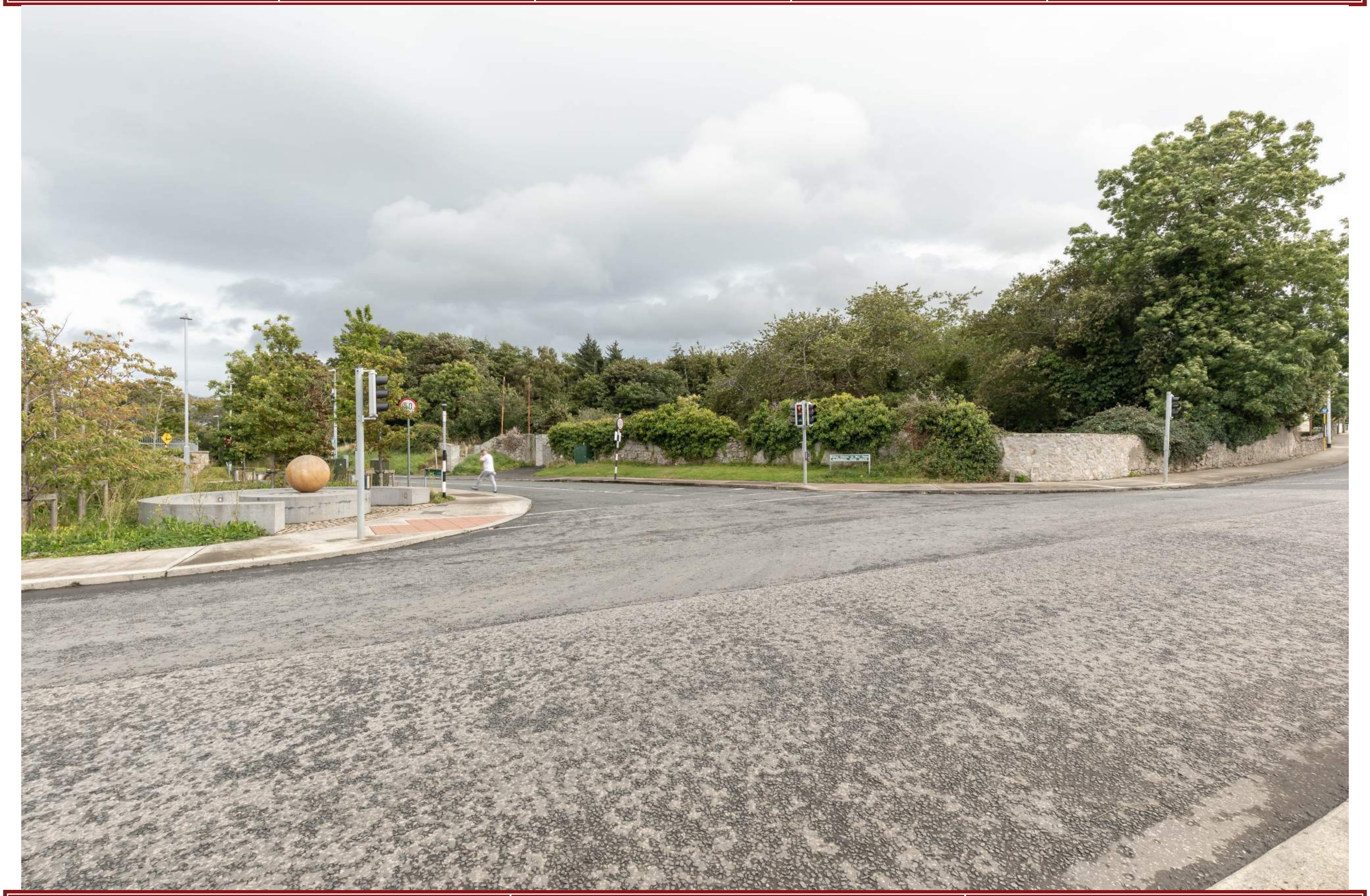

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Baseline VVM 9

Planning Imagery by 3D DESIGN BUREAU

Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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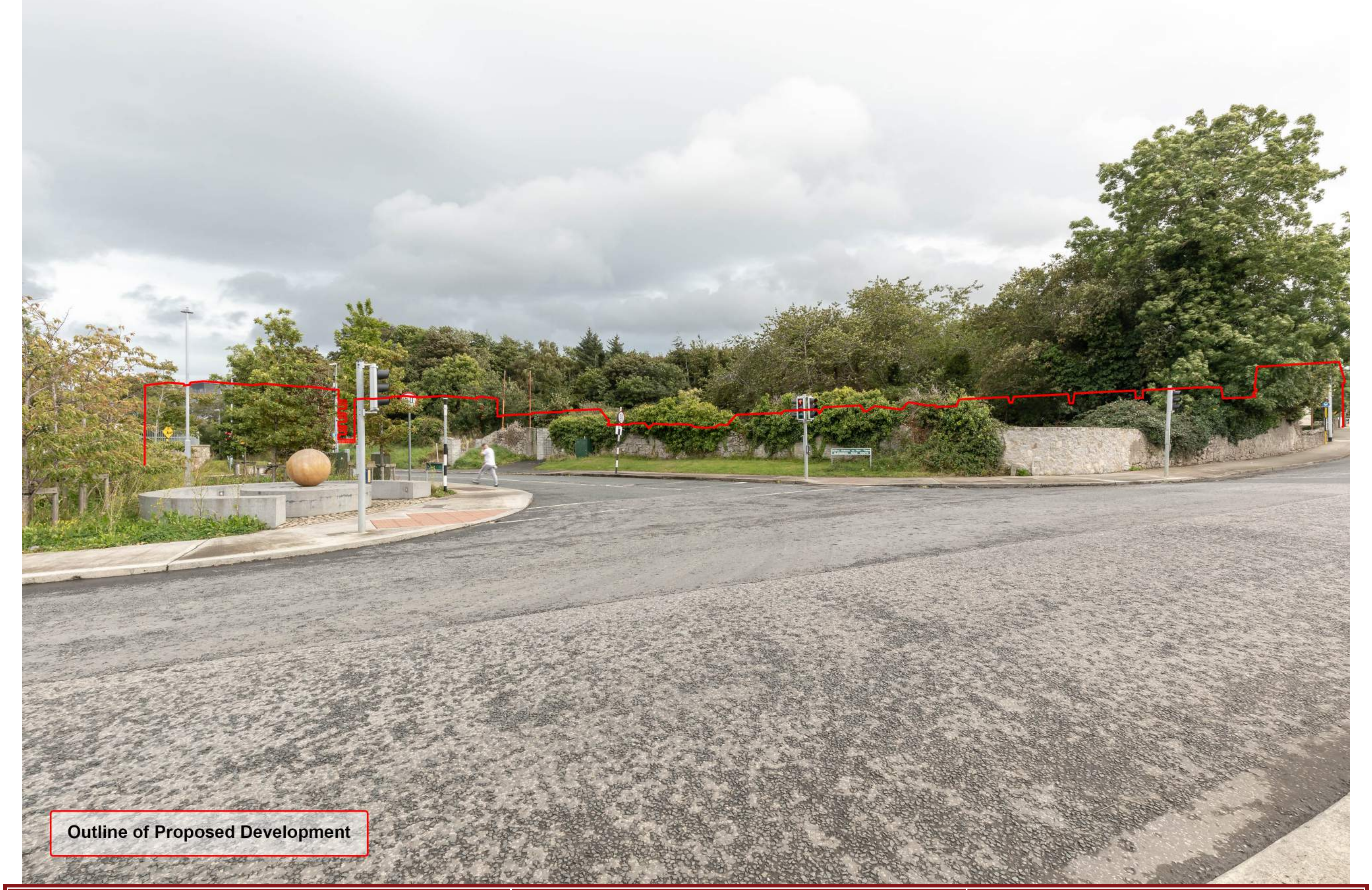

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 9

Planning Imagery by 3D DESIGN BUREAU

Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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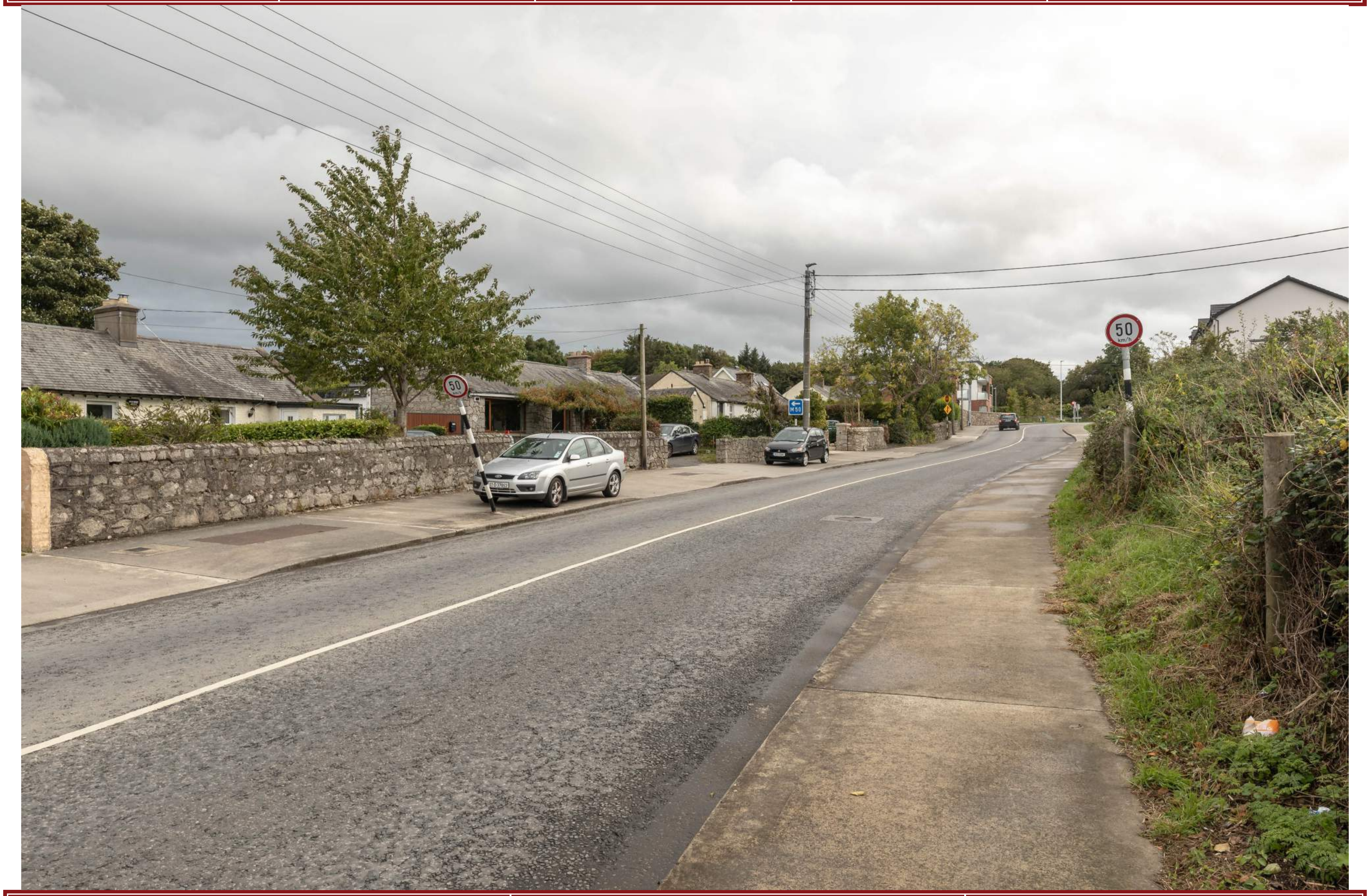

Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Baseline VVM 10
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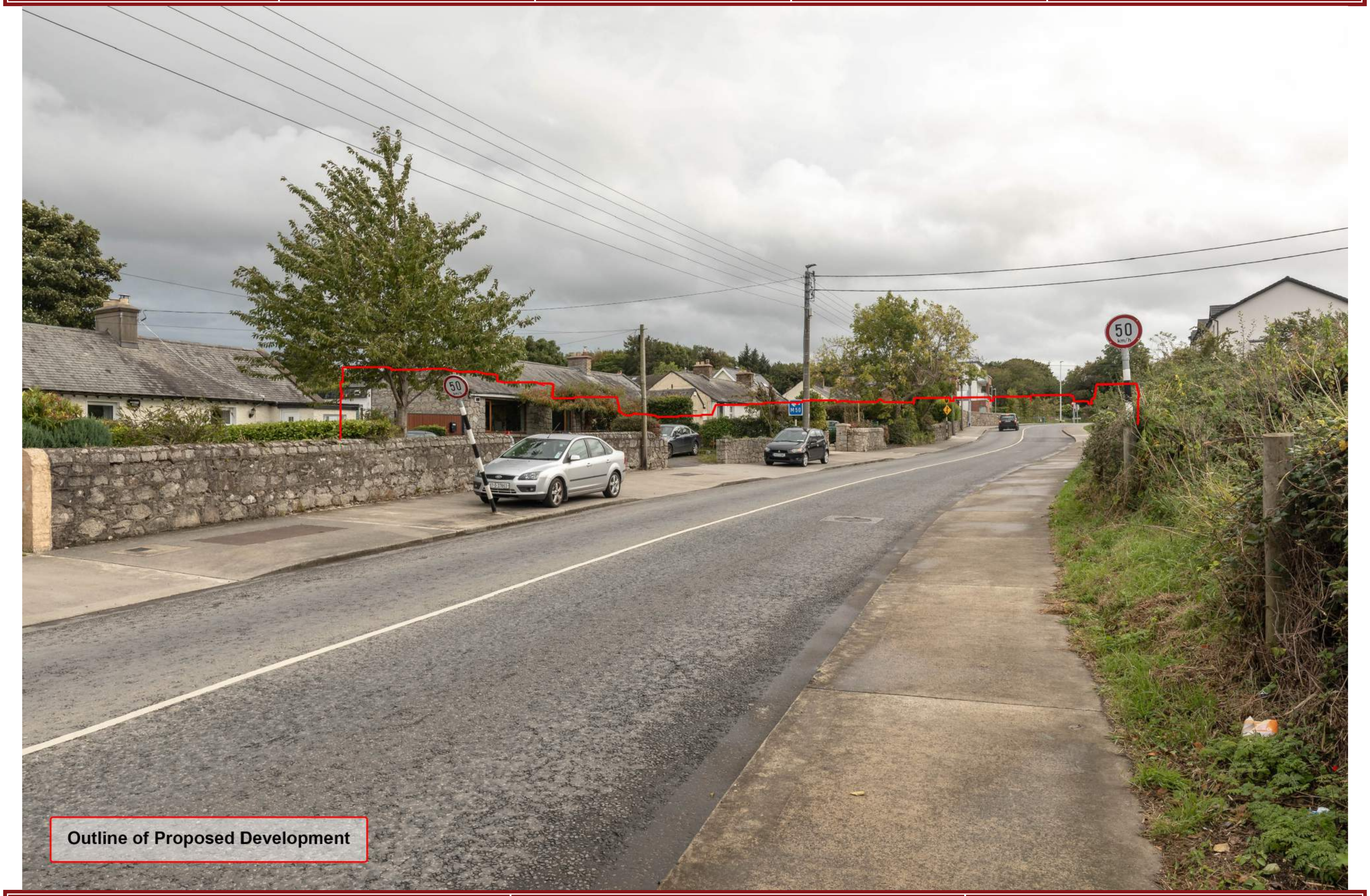

Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Proposed VVM 10
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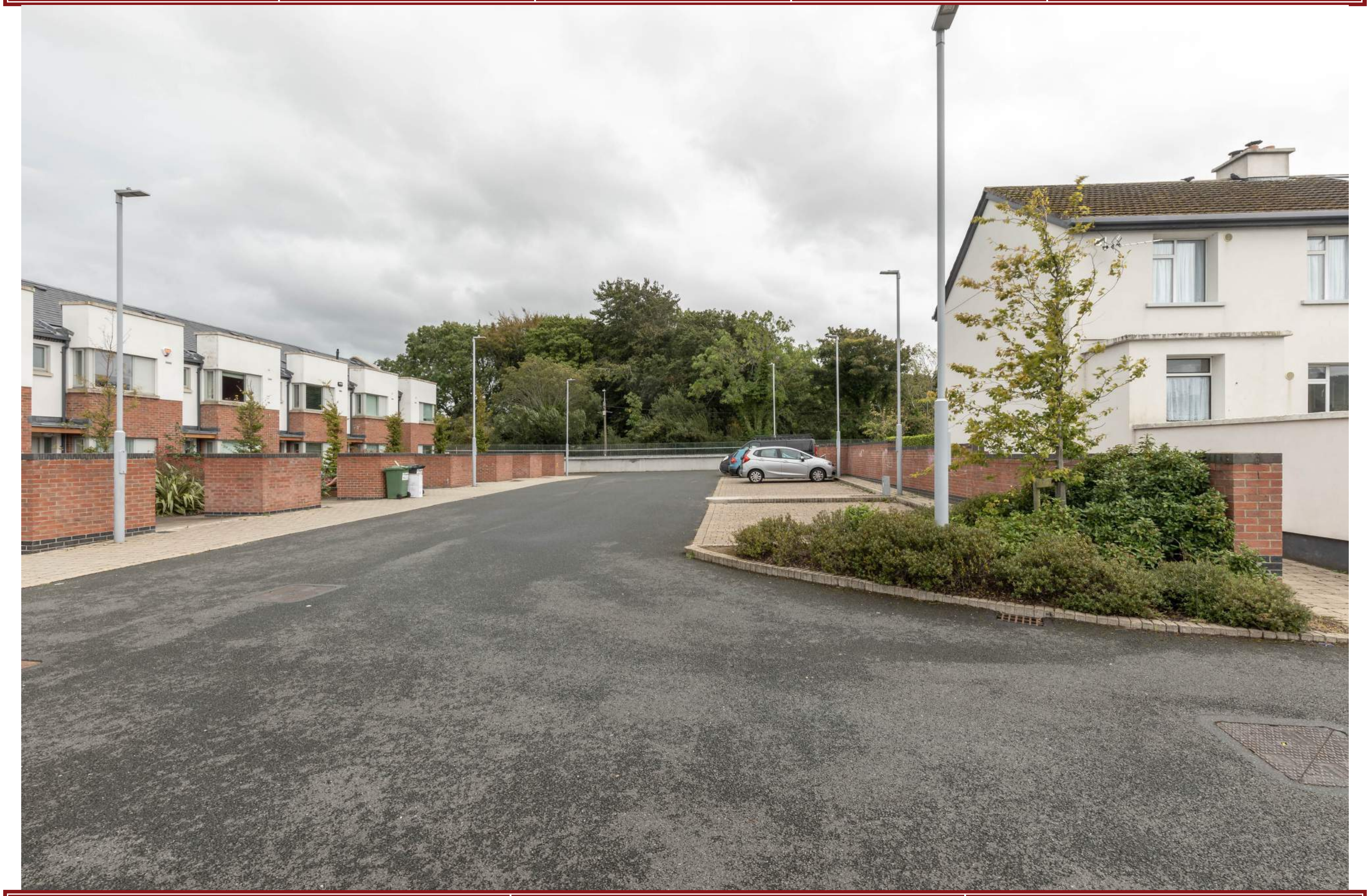


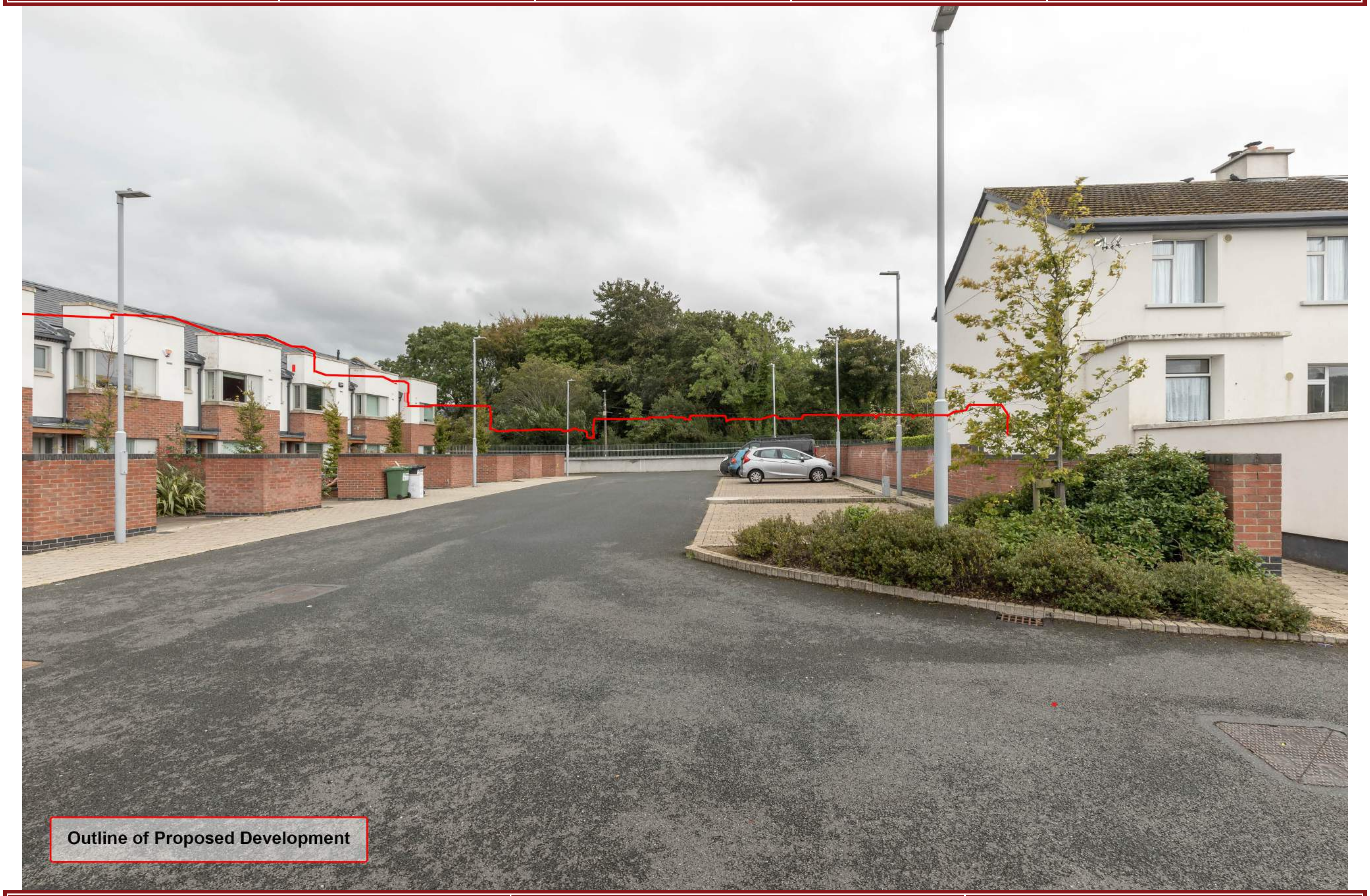
Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Baseline VVM 11

Planning Imagery by 3D DESIGN BUREAU
Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

Camera Type: Canon EOS 5D Mark IV	Lens Type: EF16-35mm f/4L IS USM	Focal Length: 16 mm	Approx Dist: 65.00m	Date & Time: 30/09/2021, 14:20:27



Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 11

Planning Imagery by 3D DESIGN BUREAU

Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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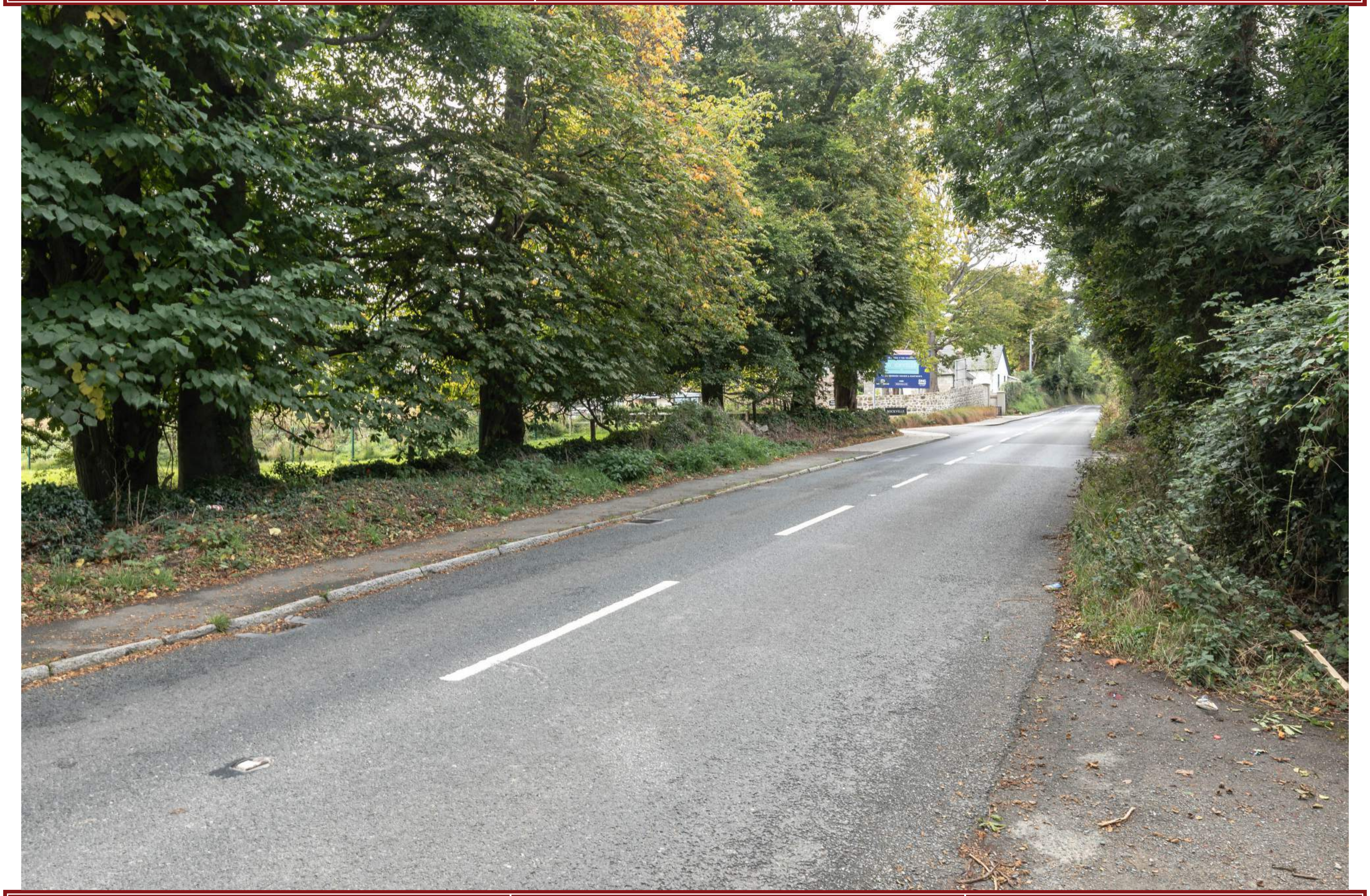

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Baseline VVM 12

Planning Imagery by 3D DESIGN BUREAU

Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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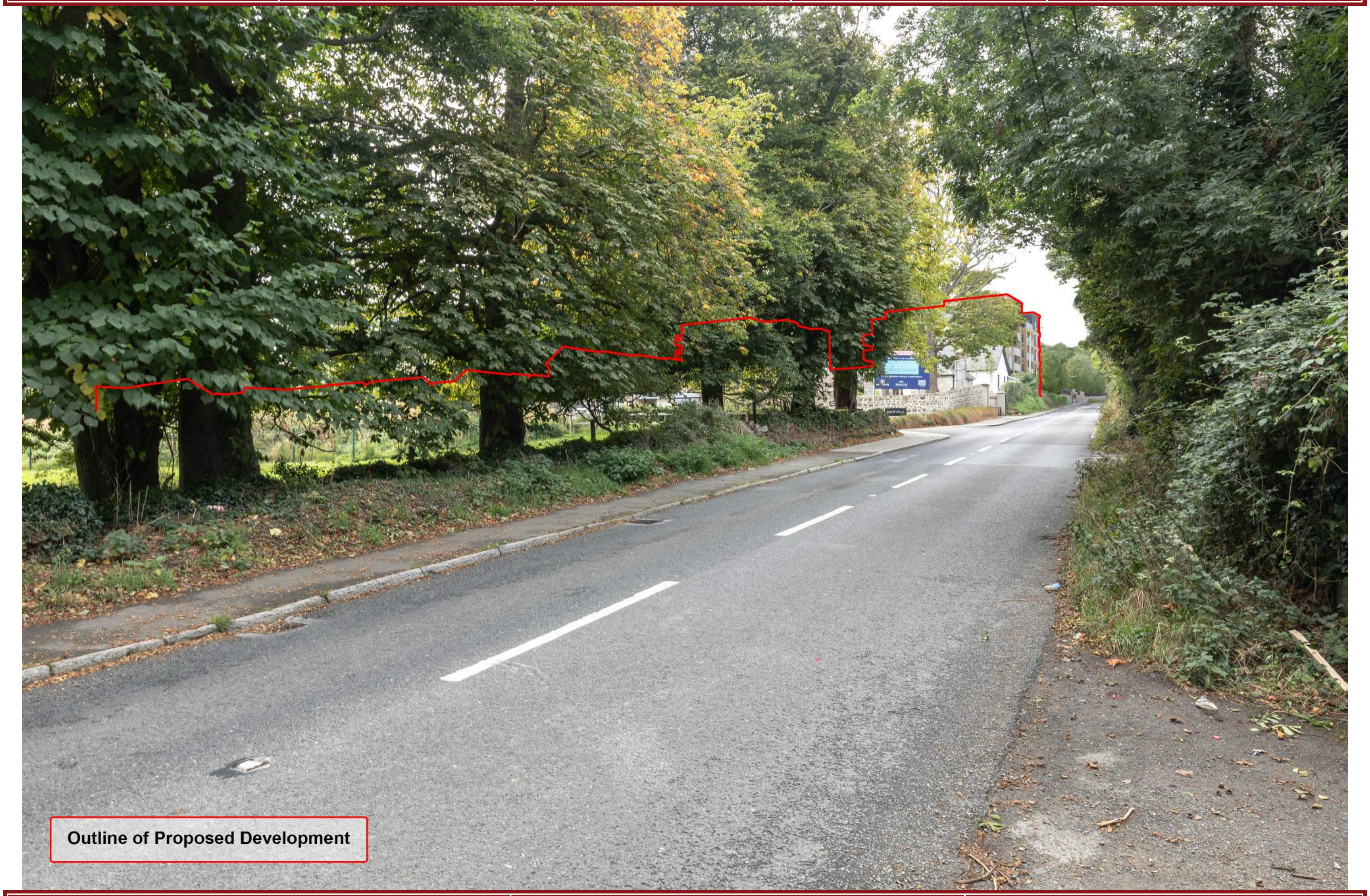

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 12

Planning Imagery by 3D DESIGN BUREAU
Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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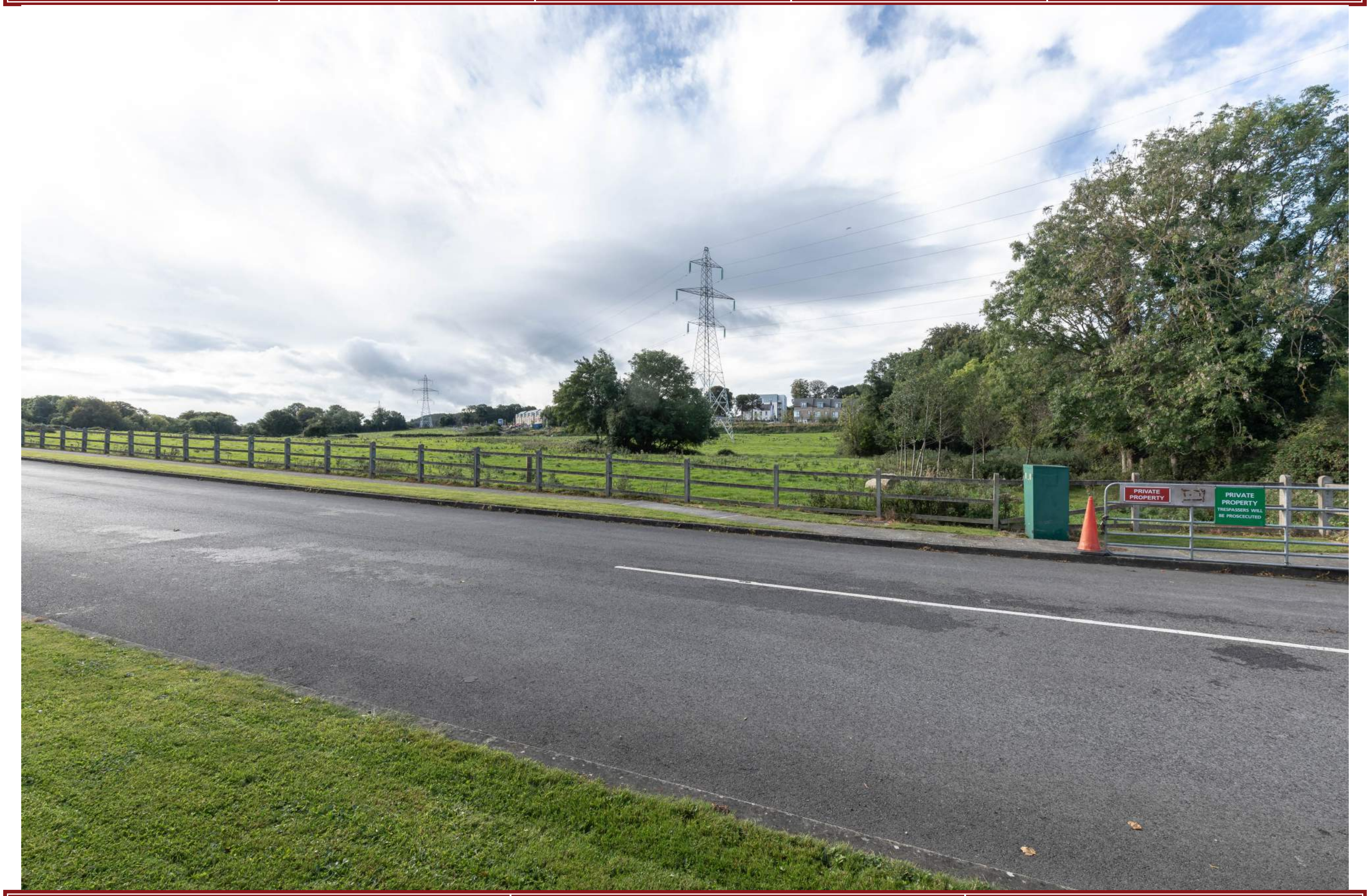

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Baseline VVM 13

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Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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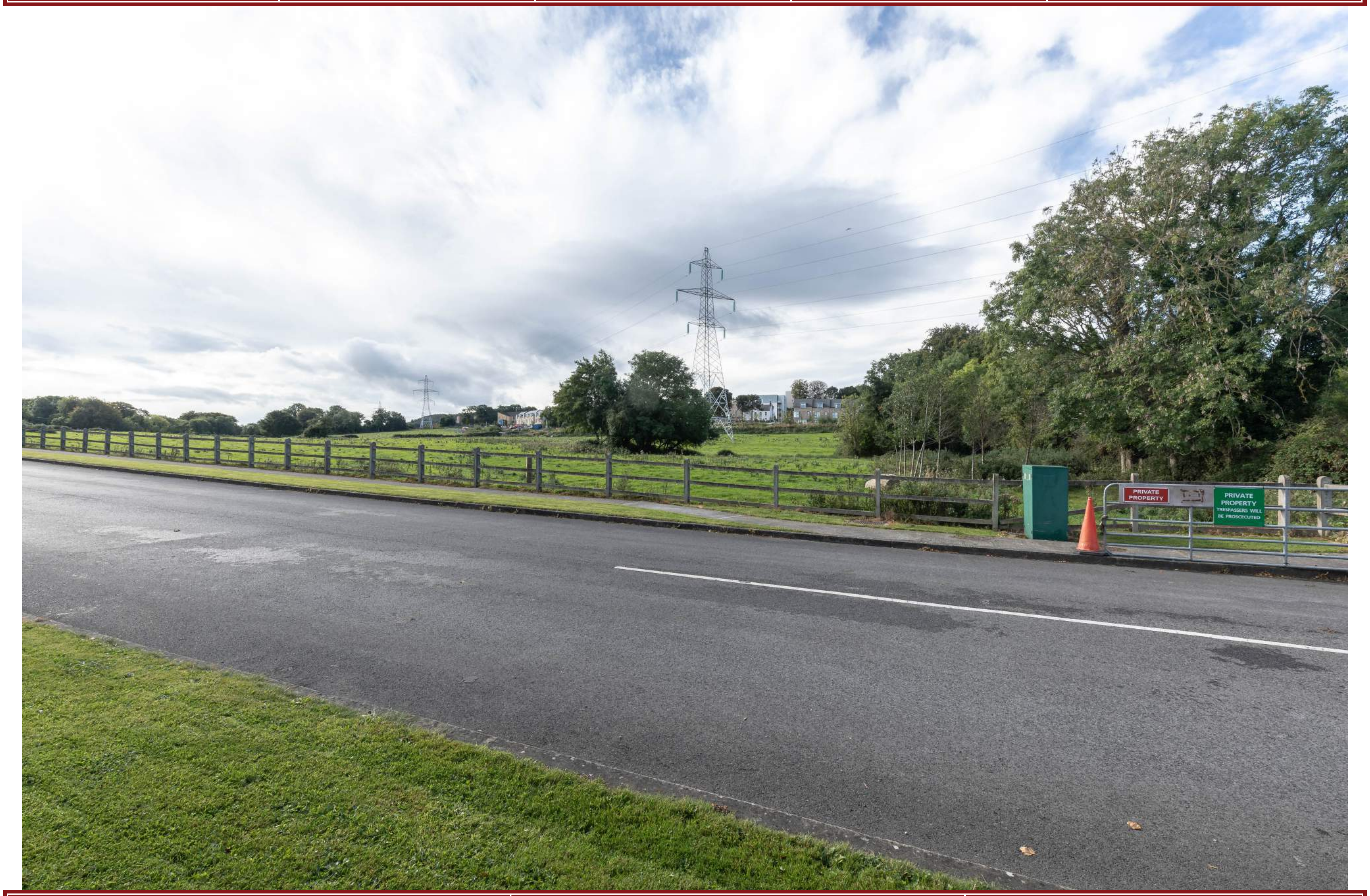

Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Proposed VVM 13
	Planning Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com

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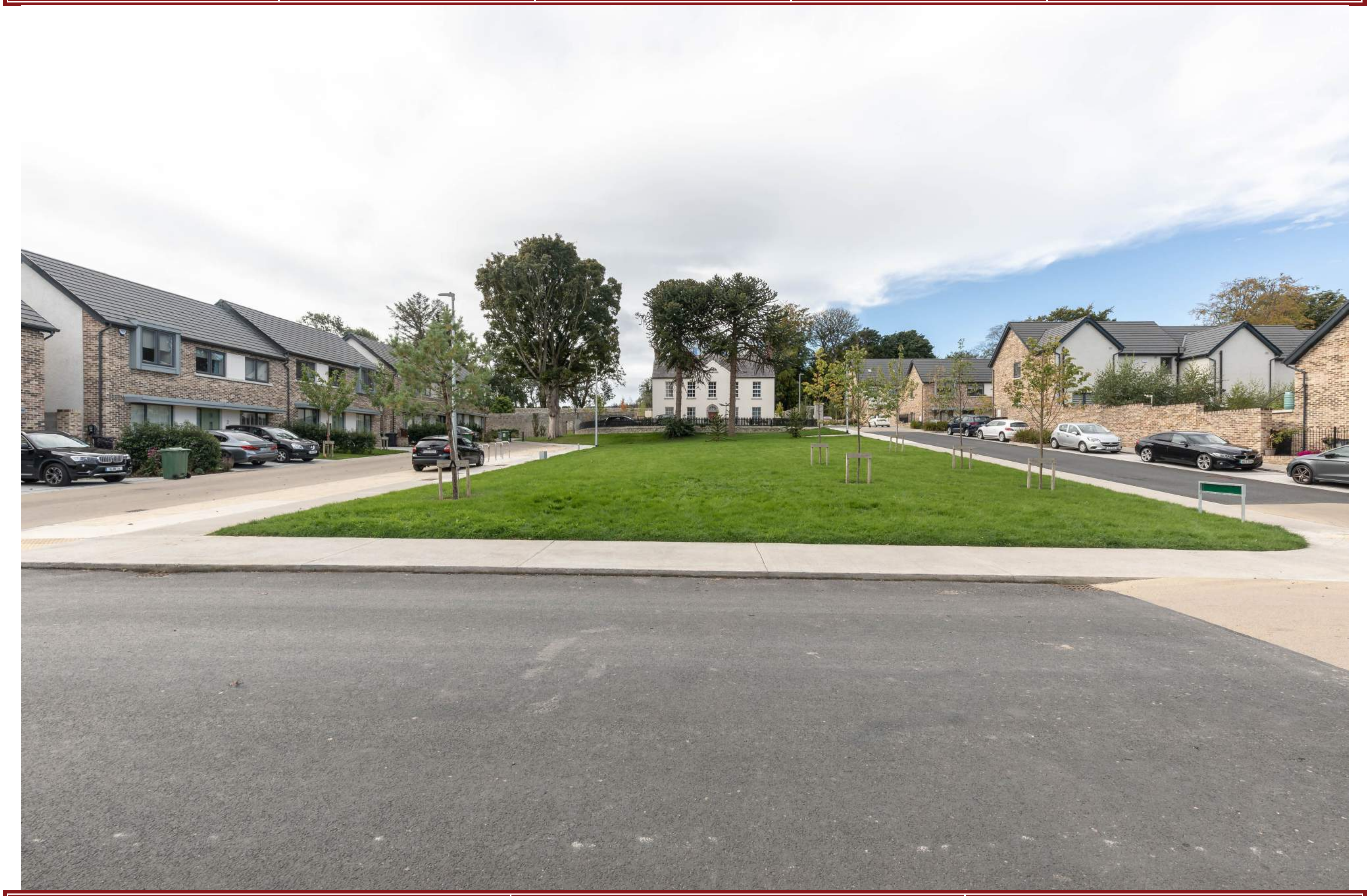

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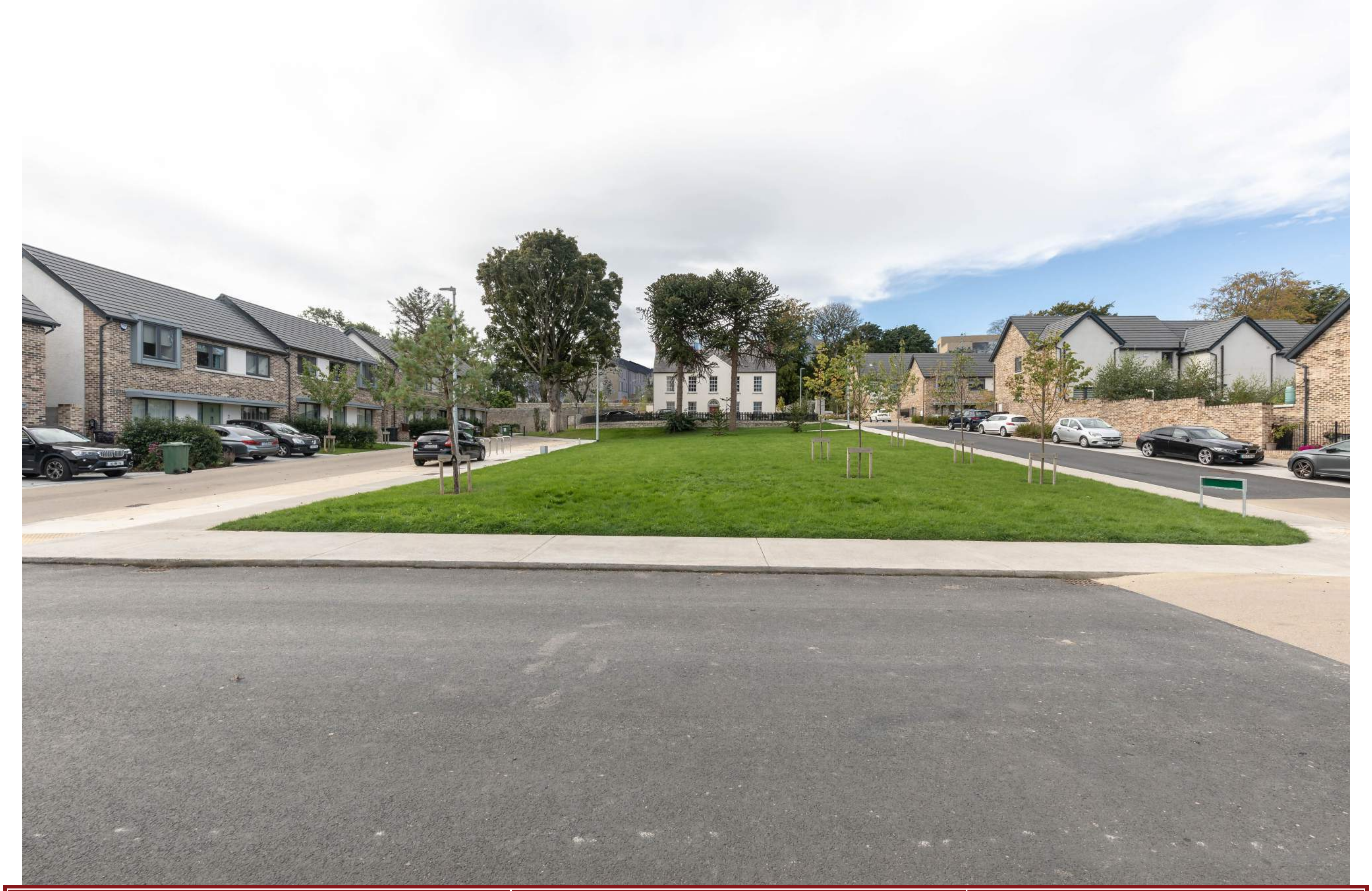

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 14

Planning Imagery by 3D DESIGN BUREAU
Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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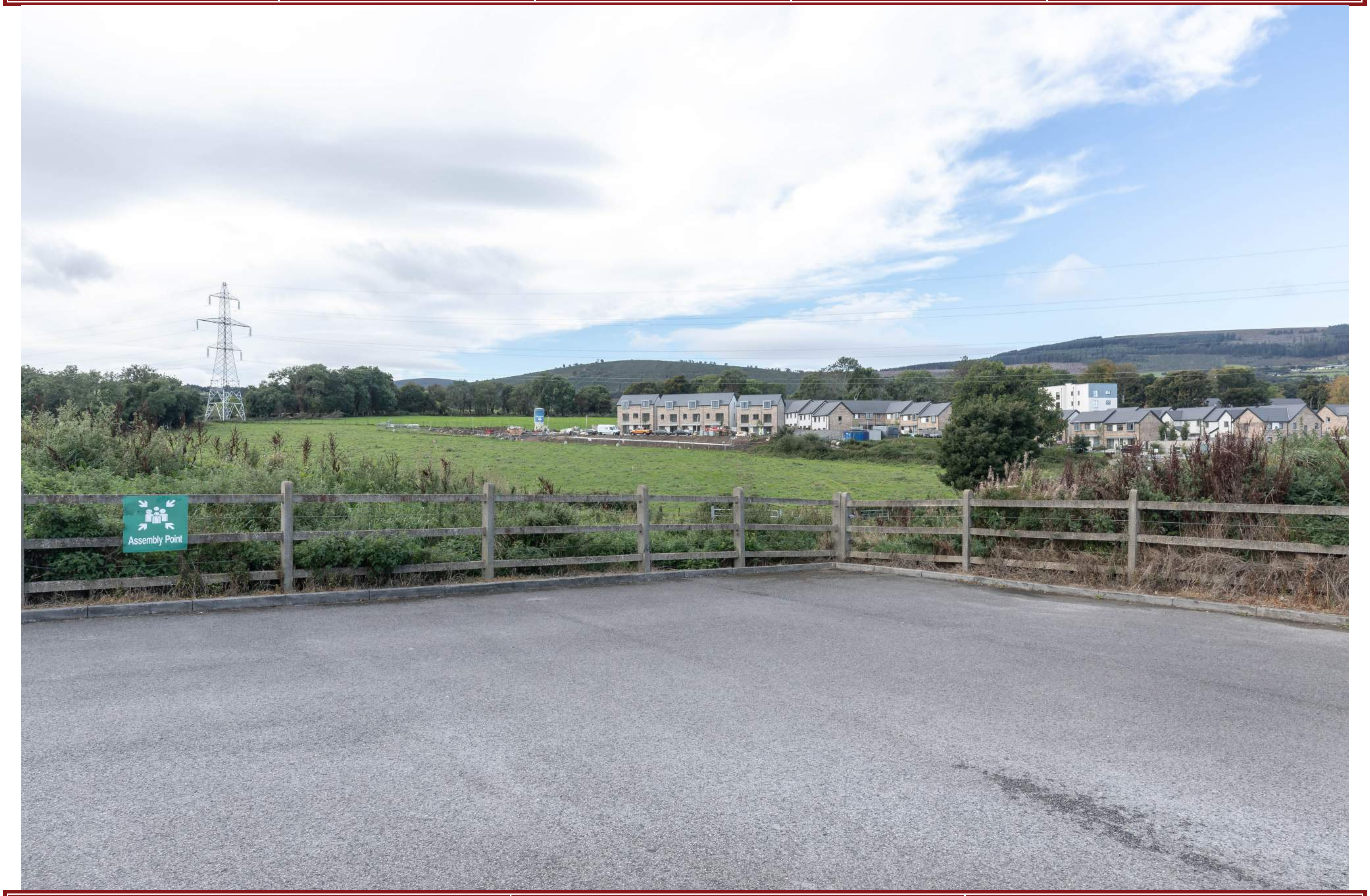

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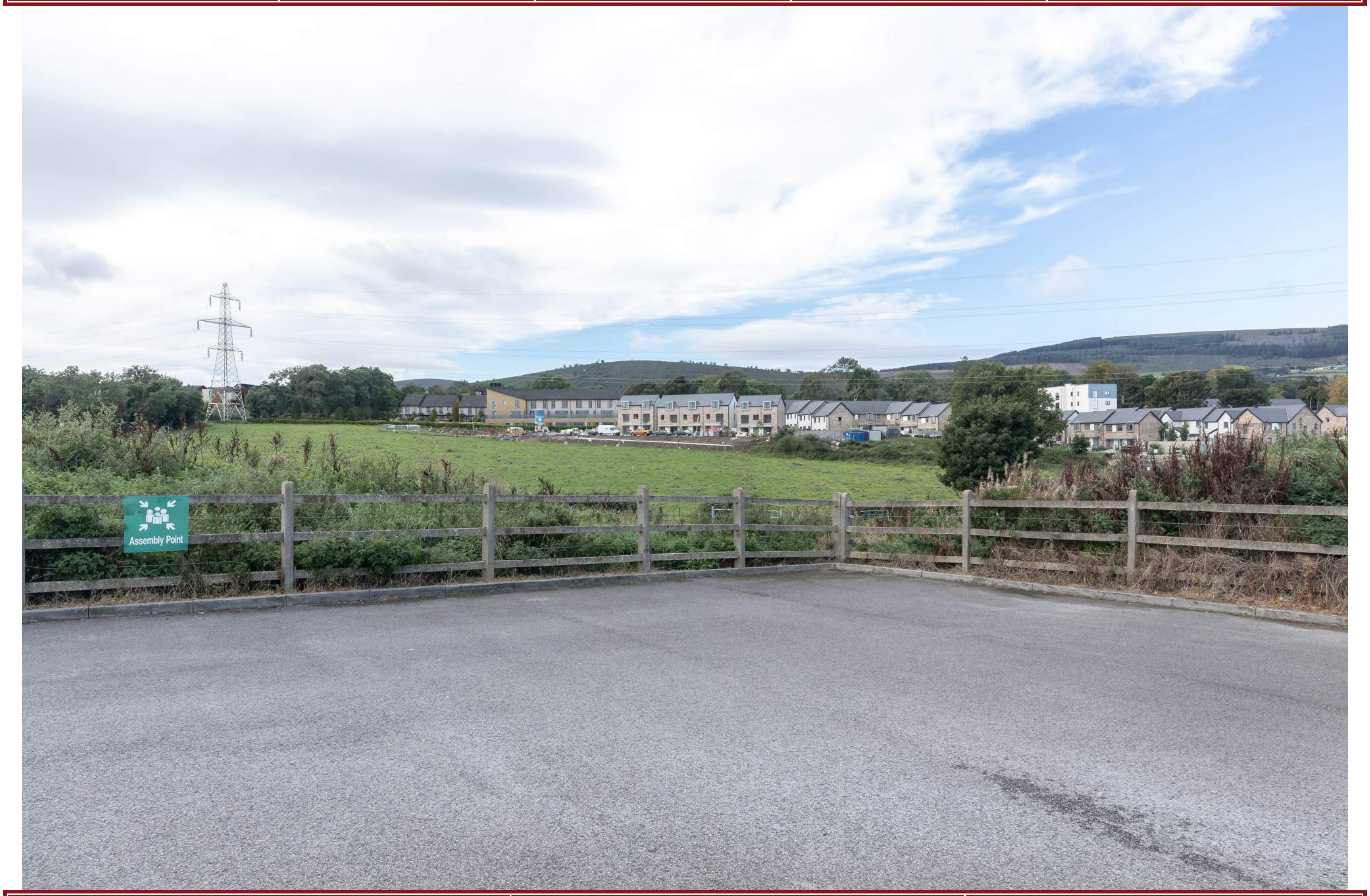

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 15

Planning Imagery by 3D DESIGN BUREAU

Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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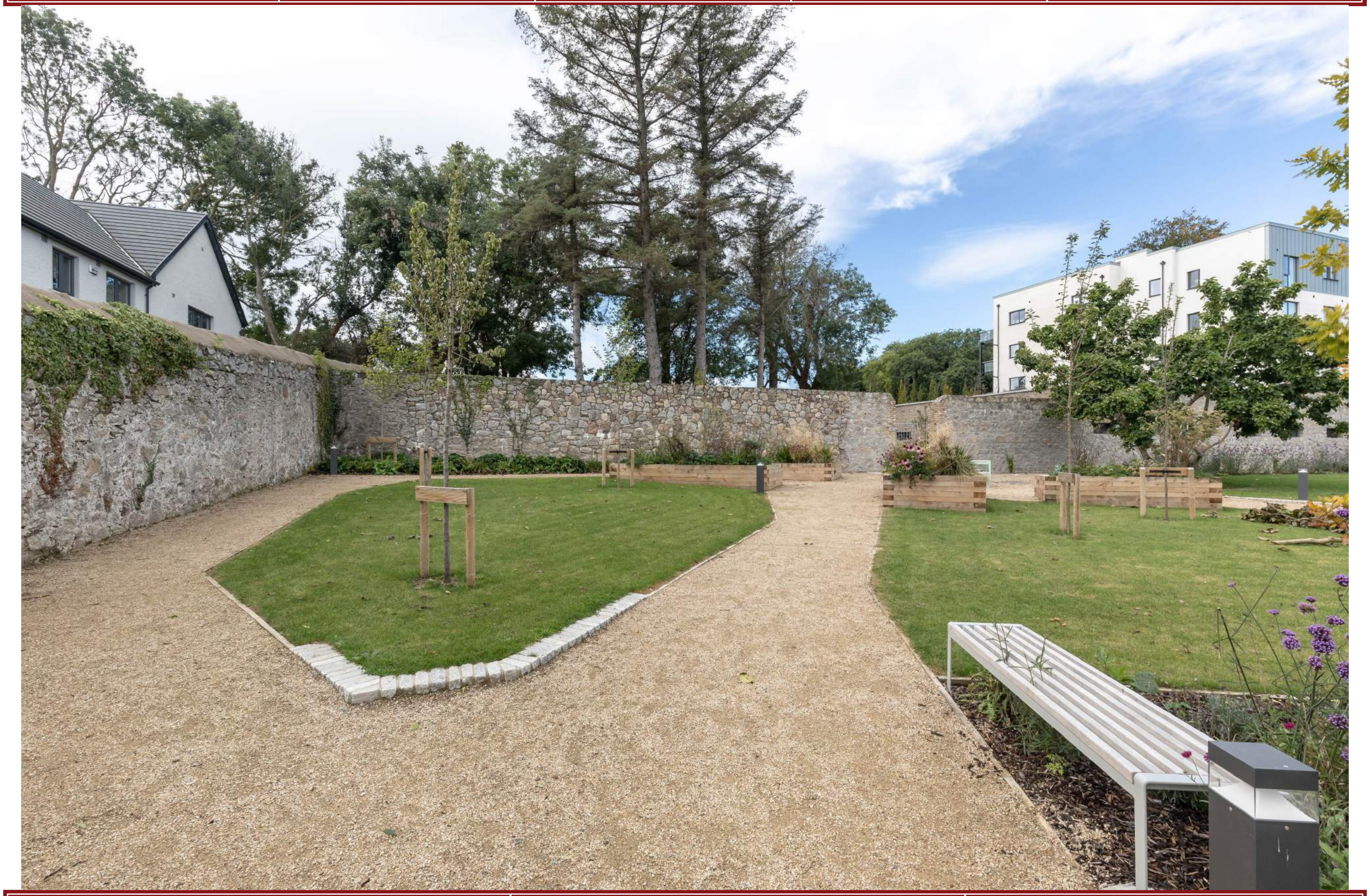

Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Baseline VVM 16
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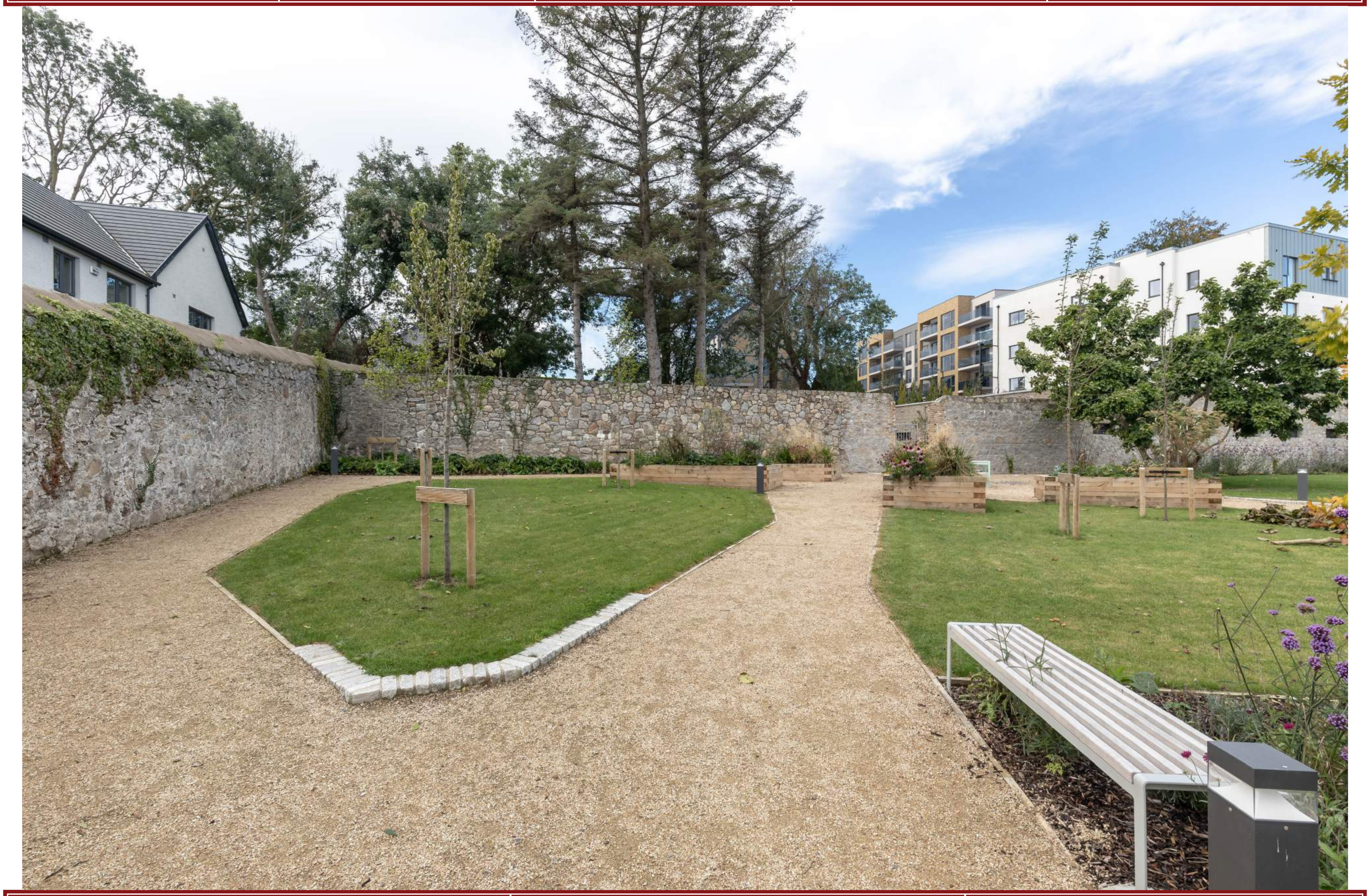

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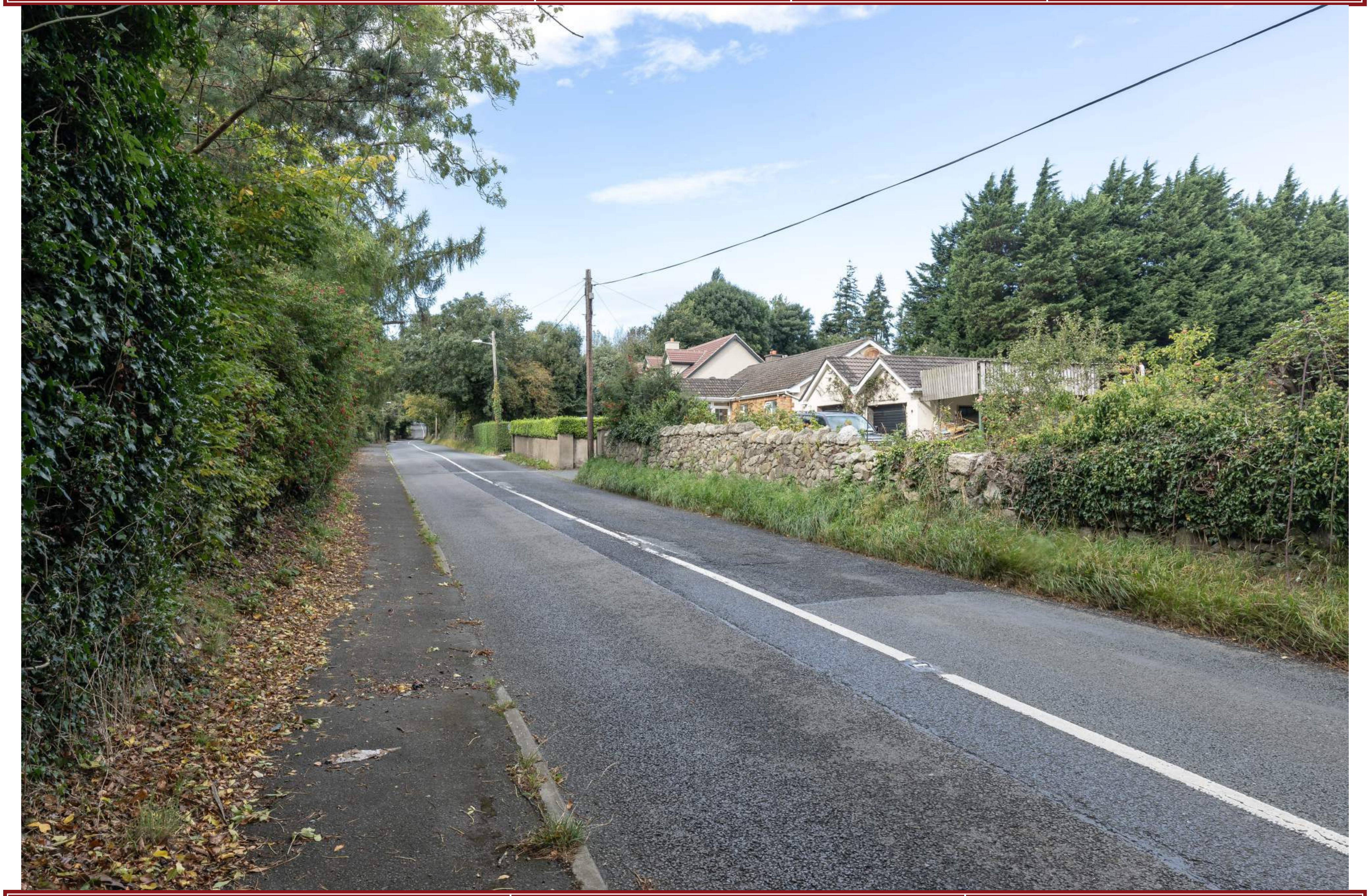

Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Baseline VVM 17
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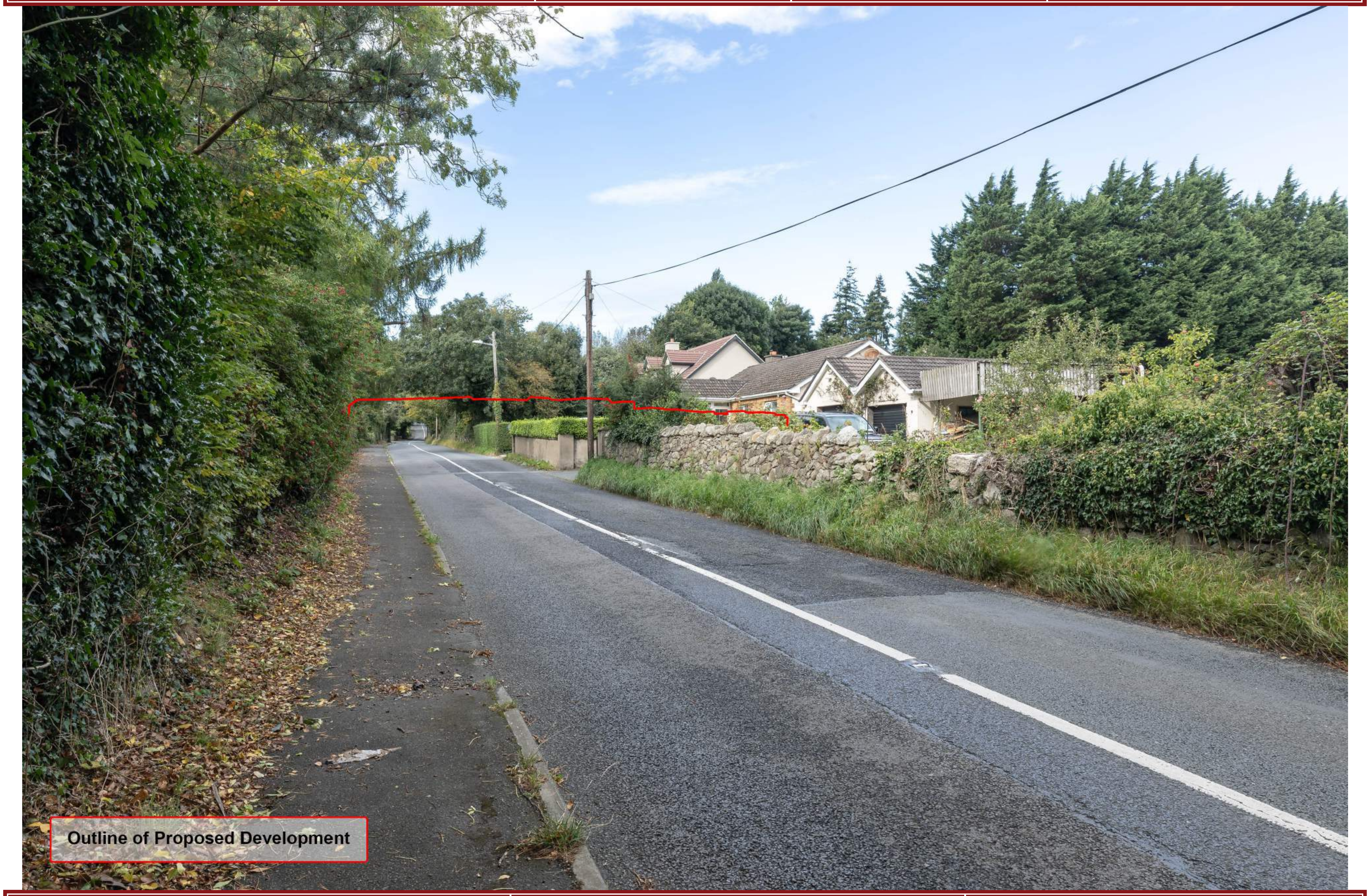

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 17

Planning Imagery by 3D DESIGN BUREAU

Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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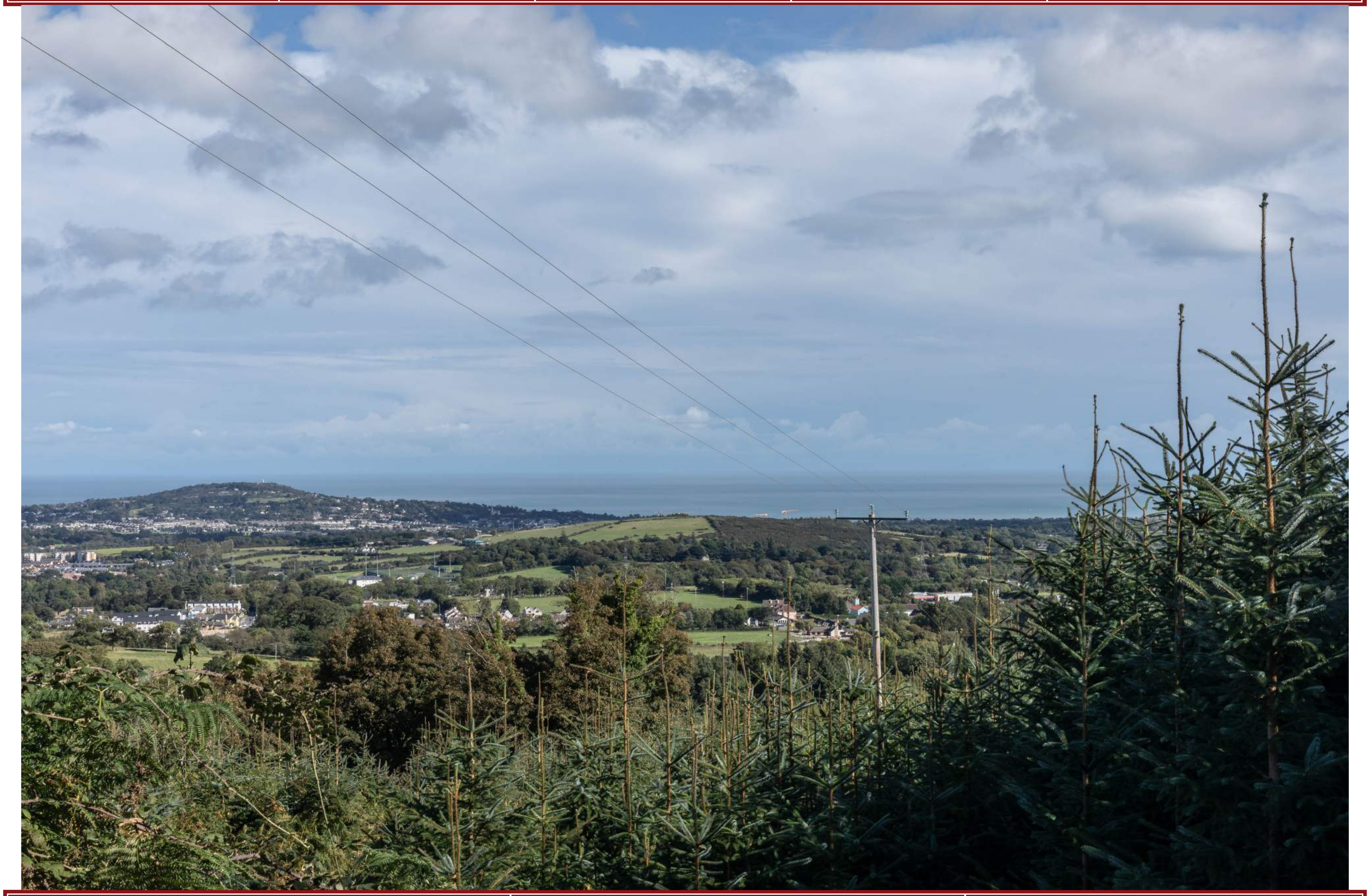

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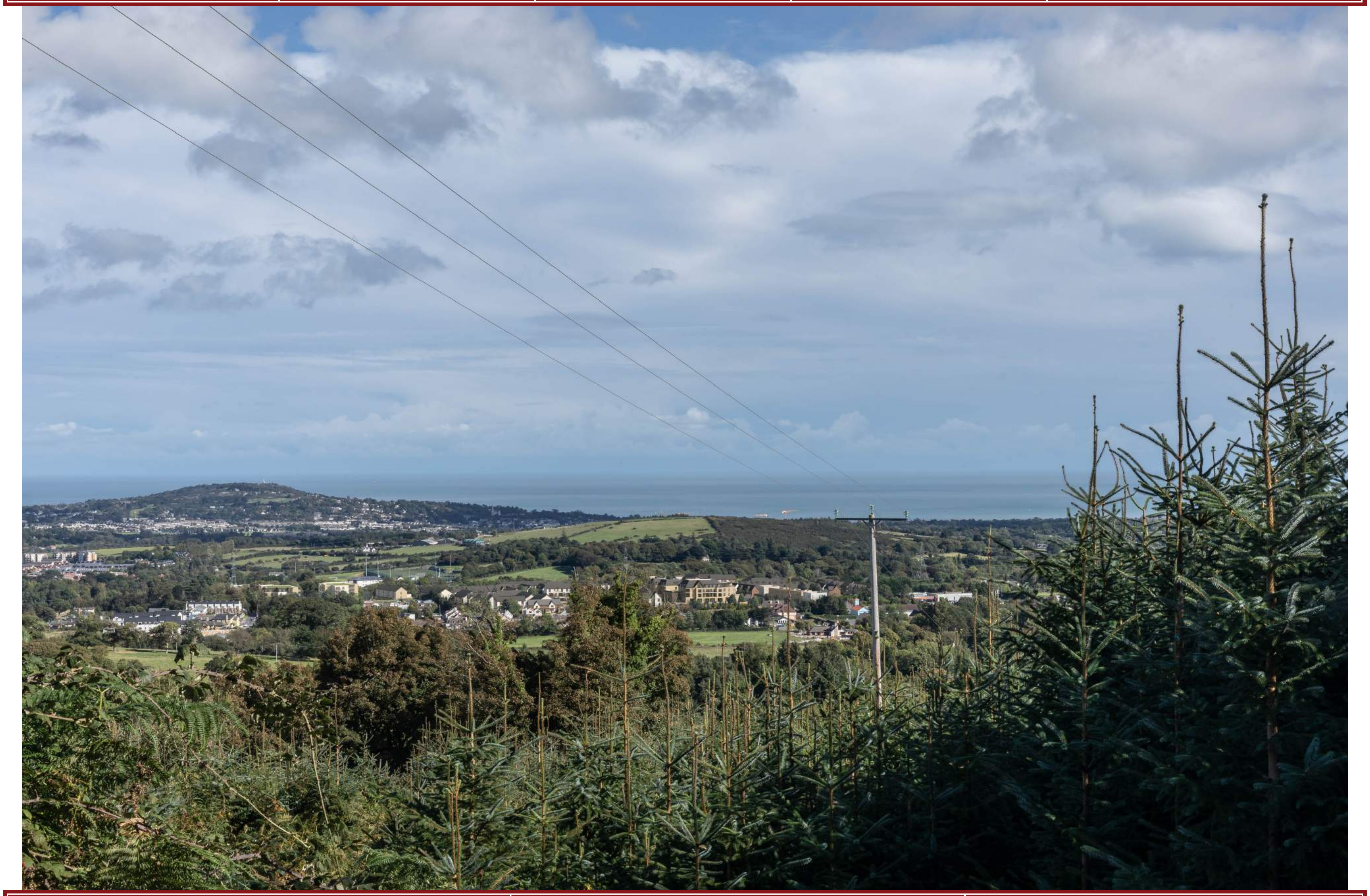

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 18

Planning Imagery by 3D DESIGN BUREAU

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www.3ddesignbureau.com
info@3ddesignbureau.com

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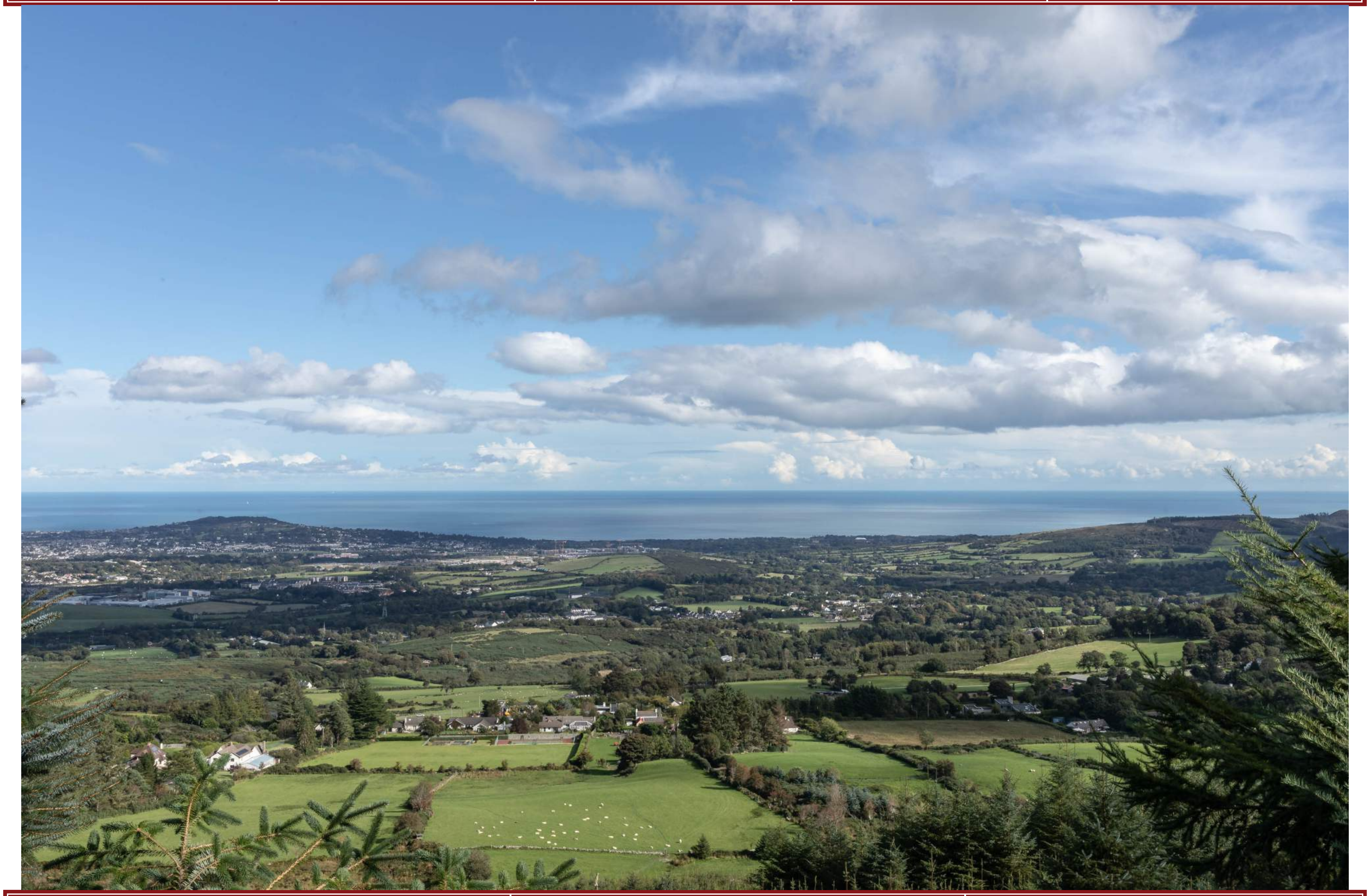

Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Baseline VVM 19

Planning Imagery by **3D DESIGN BUREAU**

Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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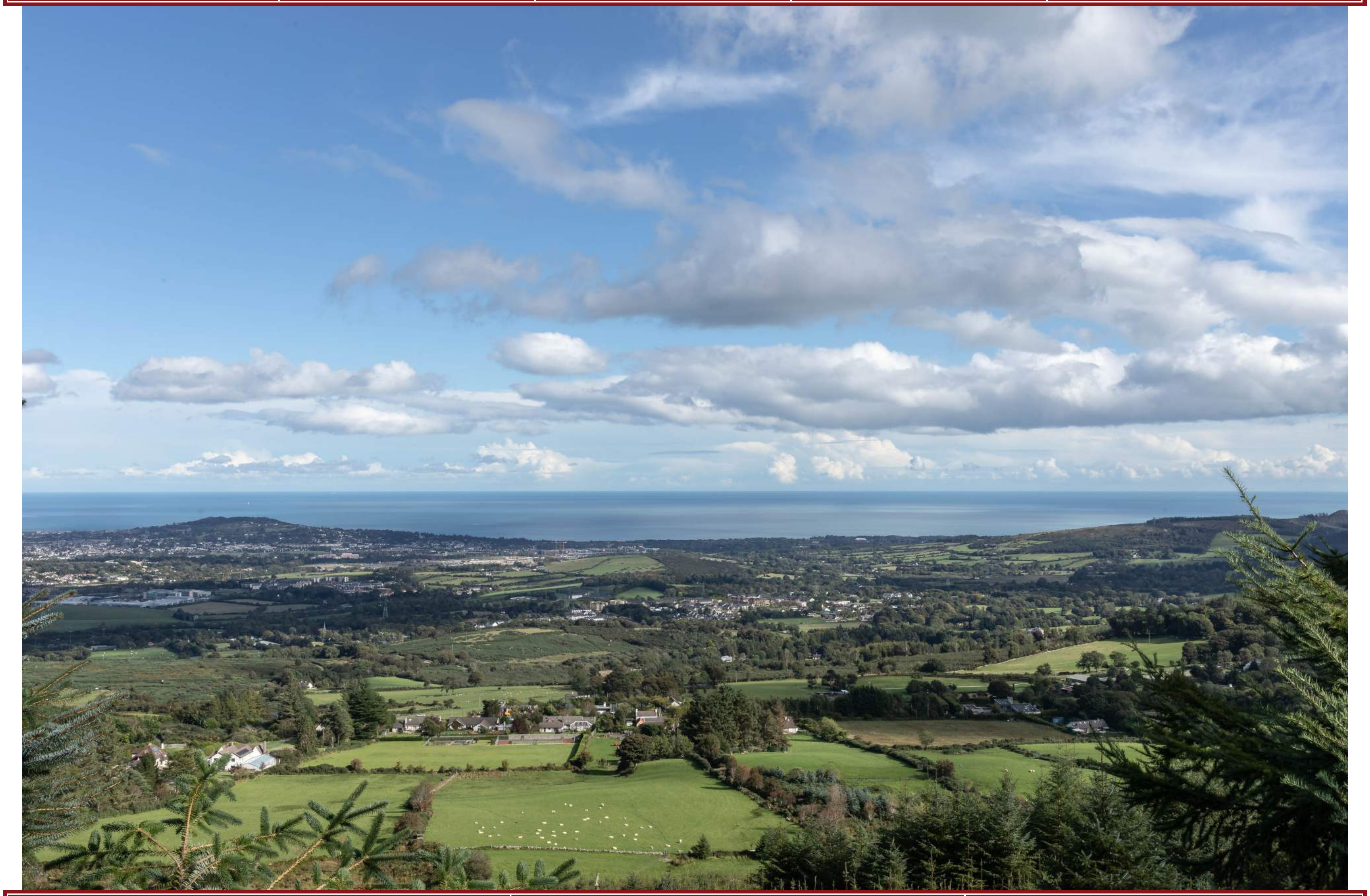

Project Title: Kilternan Village SHD	**Applicant Name: Liscove Limited**	**Image Title: Proposed VVM 19**
	Planning Imagery by 3D DESIGN BUREAU	Tel: 01 288 0186 www.3ddesignbureau.com info@3ddesignbureau.com

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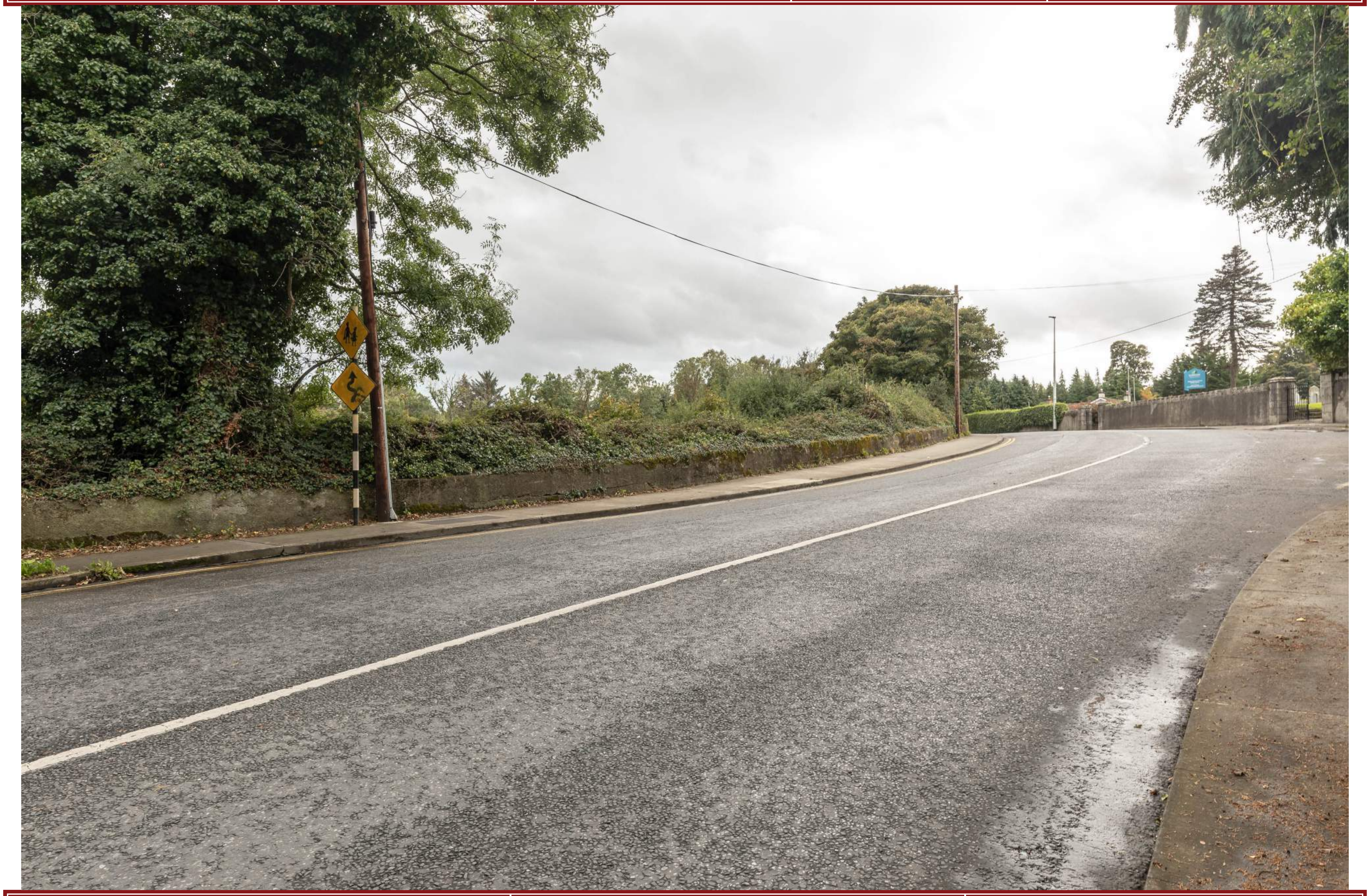

Project Title: Kilternan Village SHD	Applicant Name: Liscove Limited	Image Title: Baseline VVM 20

Planning Imagery by 3D DESIGN BUREAU

Tel: 01 288 0186
www.3ddesignbureau.com
info@3ddesignbureau.com

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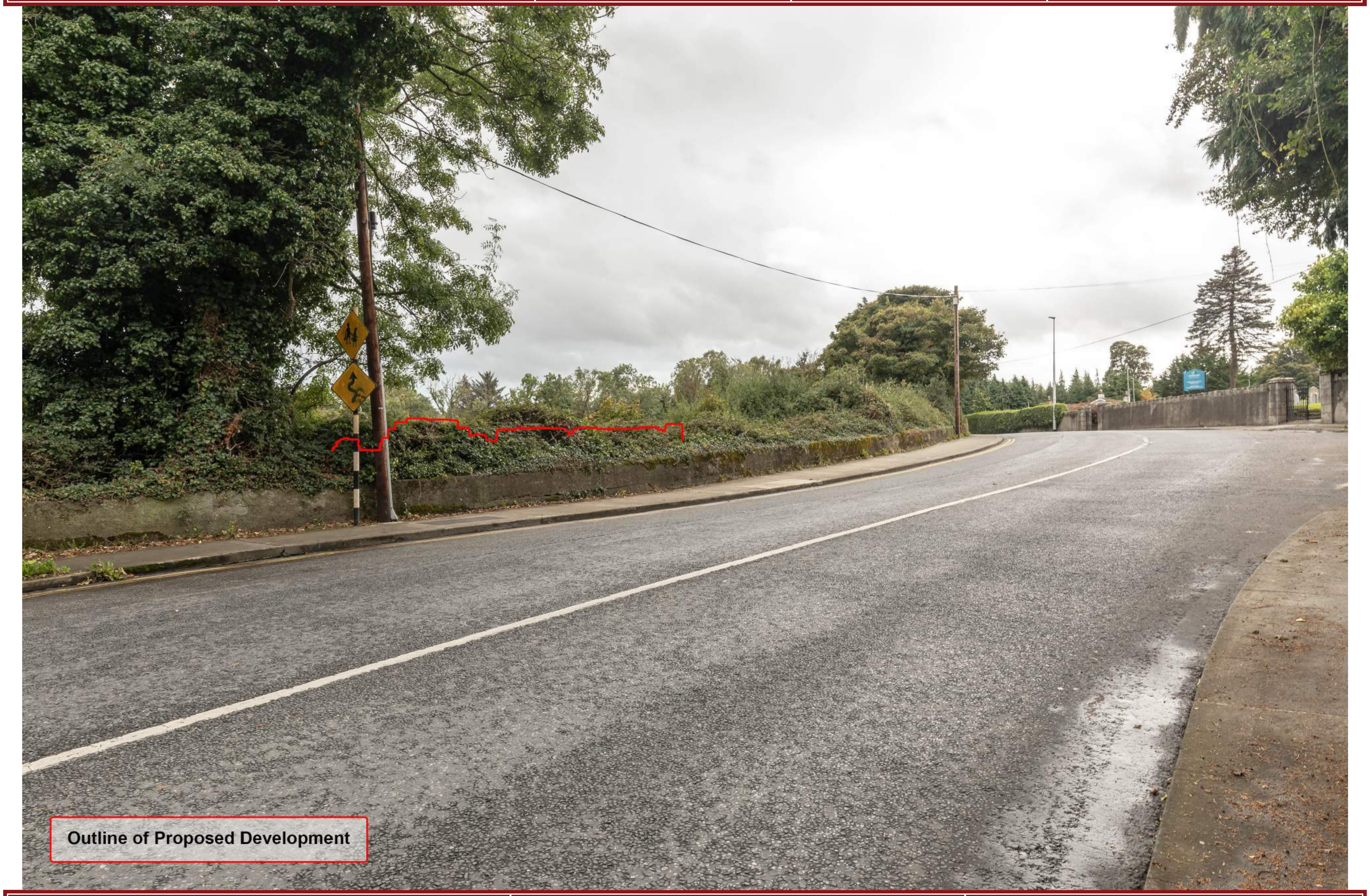

Project Title: Kilternan Village SHD

Applicant Name: Liscove Limited

Image Title: Proposed VVM 20

Planning Imagery by 3D DESIGN BUREAU
Tel: 01 288 0186
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info@3ddesignbureau.com

Appendix H

Liscove Limited

LANDS AT WAYSIDE, KILTERNAN DUBLIN 18, KILTERNAN VILLAGE SHD

ProPG: Acoustic Design Statement

603552 (02)

JUNE 2022

EXECUTIVE SUMMARY

RSK Ireland Limited (RSK) was instructed by Liscove Limited to conduct a noise impact assessment in respect of a proposed SHD at lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18.

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 between 13th and 14th May and on 20th May 2022.

This report considers the potential impact of existing traffic and future Glenamuck District Roads Scheme (GDRS) 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 **Negligible** to **Medium** for daytime and **Negligible** 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.

In the developments operational phase, criteria have also been set for any new building services plant items plant (i.e. such as may be required to service the retail/commercial elements of the proposed neighbourhood centre), to both existing and future residents, 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.: 603552 (01)

Title: Lands at Wayside, Kilternan Dublin 18. Noise Impact Assessment

Client: Liscove Limited

Date: 16th June 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:	17th June 2022	Date:	17th June 2022

RSK Ireland Ltd. Bluebell Business Centre, Old Naas Road, Bluebell, Dublin 12

CONTENTS

List of Appendices

1 INTRODUCTION

Liscove Limited instructed RSK to conduct an assessment of the potential noise impact associated with the proposed residential development. The potential inward noise impact of existing and future traffic noise on the proposed development has 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 dwelling 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 buildings façades to control road traffic noise ingress to the proposed dwellings.

2 THE PROPOSED DEVELOPMENT

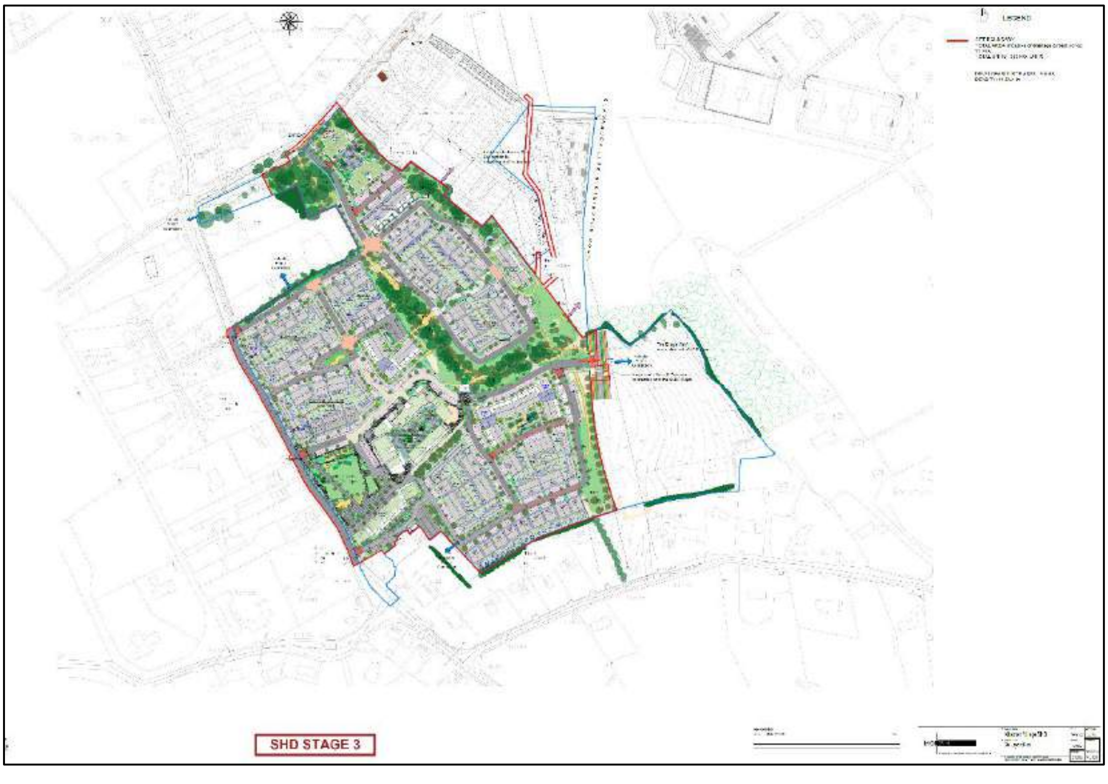
Liscove Limited intend to apply to An Bord Pleanála for permission for a strategic housing development at this c. 10.8 Ha site at lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18.

The development will principally consist of: the demolition of c. 573.2 sq m of existing structures on site comprising a derelict dwelling known as 'Rockville' and associated derelict outbuildings; and the provision of a mixed use development consisting of 383 No. residential units (165 No. houses, 118 No. duplex units and 100 No. apartments) and a Neighbourhood Centre, which will provide a creche (439 sq m), office (317 sq m), medical (147 sq m), retail (857 sq m), convenience retail (431 sq m) and a community facility (321 sq m). The 383 No. residential units will consist of 27 No. 1 bedroom units (19 No. apartments and 8 No. duplexes), 128 No. 2 bedroom units (78 No. apartments and 50 No. duplexes), 171 No. 3 bedroom units (108 No. houses, 3 No. apartments and 60 No. duplexes) and 57 No. 4 bedroom units (57 No. houses). The proposed development will range in height from 2 No. to 5 No. storeys (including podium/undercroft level in Apartment Blocks C and D and in the Neighbourhood Centre).

The site setting is predominately in a mixed residential area with nearby dwellings to the north, east, south and west of the site. The R117 runs along the site's western boundary and the proposed new Glenamuck District Roads Scheme (GDRS) adjoins part of the development's eastern boundary. The north-western corner of the site adjoins a site that currently appears to operate as a car dealership and solid fuel depot, which includes some commercial/industrial use.

Figure 1 shows the proposed site location in the context of the surrounding environment.

Figure 1: Proposed Site Layout Plan (inc. proposed GDRS)



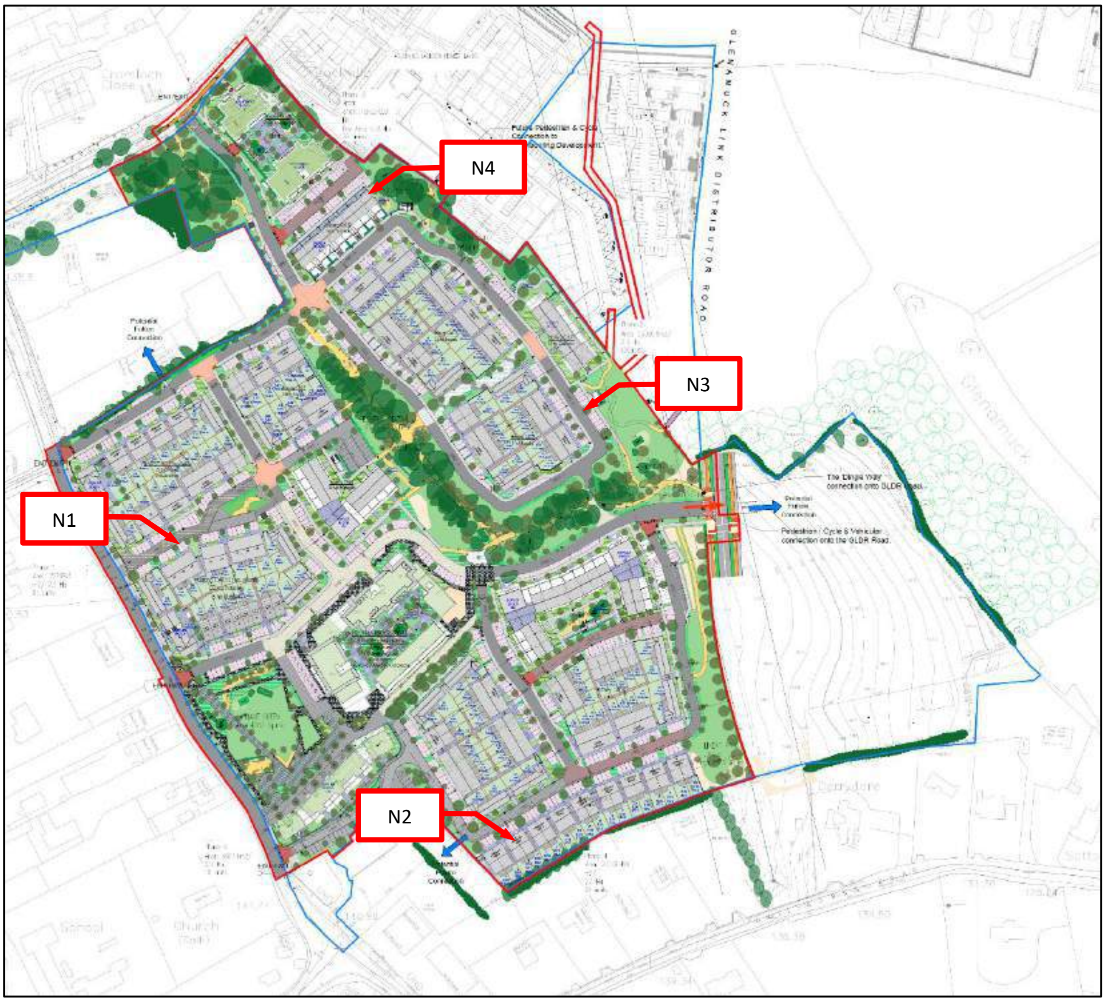
3 BASELINE NOISE SURVEY

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 location is 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 southwest of the site with the microphone positioned at a location representative of the proposed development facade that is closest to the R117 Road. This noise survey position comprised of unattended monitoring for an approximate 24-hr period. Noise data 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 south of the site with the microphone positioned at ground floor level at a location representative of a proposed development facade. This noise survey position comprised attended daytime monitoring.

Location N3 to the north east 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 new proposed road and nearby existing residents. This noise survey position comprised attended daytime monitoring.

Location N4 to the north 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	13 - 14 May 2022	13 May at 15:07	14 May at 15:00
	N2 – N4	20 May 2022	20 May at 12:30	12 May at 19:05
Night-time 23:00 – 07:00hrs	N1	13 - 14 May 2022	13 May at 23:00	14 May at 07:00

3.3 Weather

The weather during the surveys of 13th -14th and 20th May 2022 is summarised as follows (ref. https://www.met.ie/climate/available-data/daily-data) from the Casement met station.

Table 2: Weather Conditions

Date	Period	Temperature Degrees Celsius	Precipitation	Wind Speed m/s	Wind Direction
13/05	Daytime	10 – 18	No	8 – 11	WSW
13-14/05	Night- time	9 – 10	No	8 – 9	SW
14/05	Daytime	10 – 18	No	4 – 11	W
20/05	Daytime	17 - 18	No	3 - 4	SW

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
Class 1 Sound Level Meter	LXT 831	0006263

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 included in Appendix B.

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	13/05	15:00 - 16:00	65	84	65	51	Local and distant road traffic dominant
		16:00 - 17:00	63	78	67	52	
		17:00 - 18:00	62	76	66	49	
		18:00 - 19:00	61	76	66	48	
		19:00 - 20:00	60	76	64	46	
		20:00 - 21:00	60	80	64	43	
		21:00 - 22:00	59	77	62	40	
		22:00 – 23:00	56	76	60	35	
	14/05	07:00 – 08:00	58	78	61	38	

Period	Date	Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)				Notes
			L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}	
		08:00 – 09:00	60	84	64	42	
		09:00 – 10:00	60	80	64	46	
		10:00 – 11:00	60	86	64	48	
		11:00 – 12:00	60	75	64	48	
		12:00 – 13:00	60	76	64	47	
		13:00 – 14:00	61	96	64	44	
		14:00 – 15:00	61	87	64	44	

The daily daytime ambient noise levels were in the range 56 to 65 dB $L_{Aeq,1hr}$. 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.

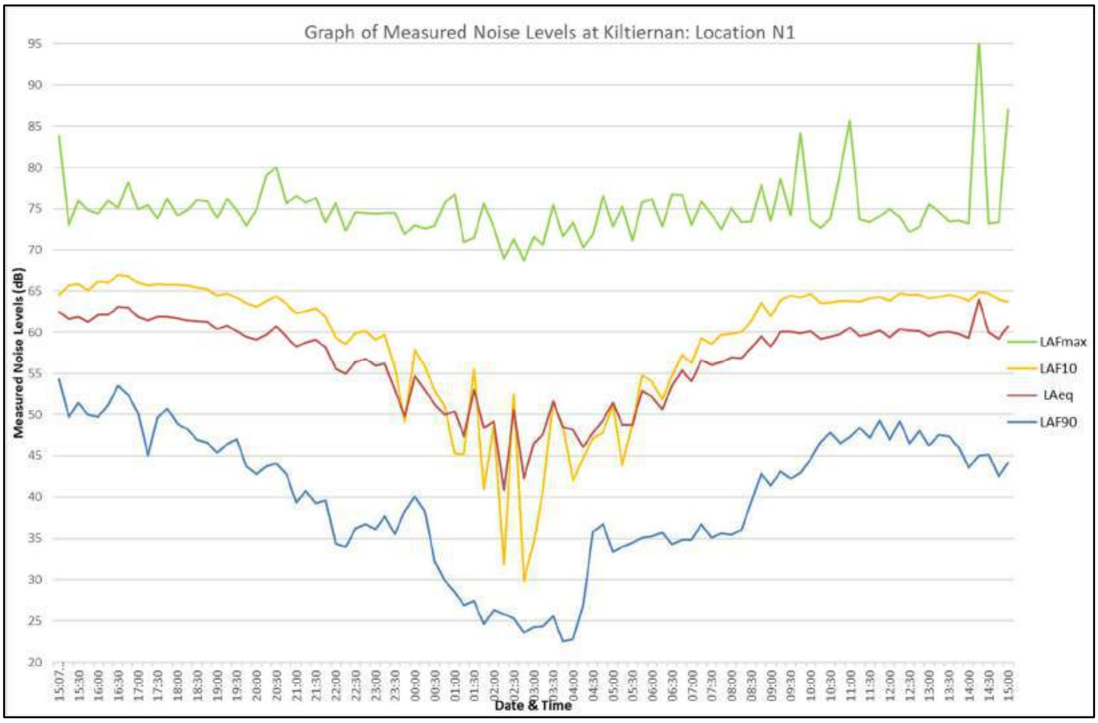
Table 5: Measured Night-time Noise Levels at Location N1

Period	Date	Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)				Notes
			L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}	
Night-time	13/05	23:00 - 00:00	54	75	56	37	Local and distant road traffic dominant
	14/05	01:00 – 02:00	53	76	54	35	
		02:00 – 03:00	50	77	47	27	
		03:00 – 04:00	48	73	41	25	
		04:00 – 05:00	49	75	44	24	
		05:00 – 06:00	48	77	45	31	
		06:00 – 07:00	51	76	50	34	

The night-time ambient noise levels were in the range 48 to 54 dB $L_{Aeq,1hr}$. 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 13th and 14th May 2022 at Location N1. Raw data for the unattended noise survey conducted at Location N1 is included in Appendix C.

Figure 3: Profile of Baseline Noise Monitoring Results at Location N1 (13 – 14 May 2022)



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	20/05	11:34	61	84	59	47	Distant and local road traffic dominant.
		11:49	54	62	57	45	
		12:04	56	75	59	48	

The daytime ambient noise levels were in the range 54 to 61 dB $L_{Aeq,15min}$. Road traffic was the dominant source of noise. Construction noise, birdsong, treesong, cows and children playing nearby 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	20/05	10:21	53	57	55	48	Distant and local road traffic dominant
		10:36	53	68	56	49	
		10:51	54	72	56	49	

The daytime ambient noise levels were in the range 53 to 54 dB $L_{Aeq,15min}$. Road traffic was the dominant source of noise. Construction noise, birdsong, treesong and children playing nearby 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	20/05	10:11	53	67	55	49	Distant and local road traffic dominant
		10:26	55	65	58	51	
		10:41	55	64	57	51	

The daytime ambient noise levels were in the range 53 to 55 dB $L_{Aeq,15min}$. Road traffic was the dominant source of noise. Construction noise, birdsong, treesong and children playing nearby were also audible as secondary sources.

4 NOISE CRITERIA

In deriving noise criteria for the development, consideration has been given to the following documents:

- *Dublin Agglomeration Environmental Noise Action Plan (2018 – 2023): Volume 2, Dun Laoghaire – Rathdown County Council*.
- Dún Laoghaire-Rathdown County Development Plan 2022-2028
- *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 Local Authority Guidelines

4.1.1 Dublin Agglomeration Environmental Noise Action Plan (2018 – 2023): Volume 2, Dun Laoghaire – Rathdown County Council

With regard to inward noise impact on the proposed dwellings reference is made to The *Dublin Agglomeration Environmental Noise Action Plan, December 2018 – July 2023, Volume 2, Dún Laoghaire-Rathdown County Council* (NAP) provides guidance for the scenario whereby a residential development is proposed in an area exposed to pre-existing levels of environmental noise. Section 8.2.3 discusses *Noise in the Planning Process*, and this section is reproduced below:

> ***"8.2.3 Noise in the Planning Process***
>
> *The planning system has the potential to exercise a significant influence on the control of future exposure to environmental noise and can play a key role in the improvement of amenity. The appropriate use of the planning system can help avoid, or minimise, the adverse impacts of noise without placing unreasonable restrictions on development. Scope exists within the planning and development management process to manage increased levels of noise arising from new development where exposure levels can be harmful to health.*
>
> *There are two main scenarios in development where noise could be considered as being a material issue, namely:*
>
> *1) Introducing people into potentially noisy areas through the provision new residential housing, hospital, schools nursing homes etc in the vicinity of existing road rail industrial or airport noise, or where there are potential high levels of noise with buildings or in adjoining gardens or public open spaces.*
>
> *2) Introducing potentially noisy developments such as new or altered roads, railways, industrial sites, and airports, commercial or large sporting recreational developments into the vicinity of noise sensitive locations.*
>
> *In the scenario where new residential development or other noise sensitive development is proposed in an area with an existing climate of environmental noise, there is currently no clear national guidance on appropriate noise exposure levels. The EPA has suggested that in the interim that Action Planning Authorities should examine the planning policy guidance notes issued in England titled, „ProPG Planning and Noise: Professional Practice Guidance on Planning and Noise‟. This has been produced to provide practitioners with guidance on*

> *a recommended approach to the management of noise within the planning system in England".*

The noise levels measured 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).

4.1.2 Dún Laoghaire-Rathdown County Development Plan 2022-2028

Section 12.9.2 *Noise Pollution and Noise Nuisance* of the Dún Laoghaire-Rathdown County Development Plan 2022-2028 states the following in relation to a scenario where a residential development is located in an area potentially exposed to environmental noise sources.

> *"To require developers to produce an Acoustic Design Assessment (informed by guidance such as is set out in 'ProPG Planning and Noise', 2018, as referenced in the 'Dublin Agglomeration Noise Action Plan 2018 – 2023'), where a noise-sensitive use is proposed in an area that may have high pre-existing environmental sound levels".*

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:

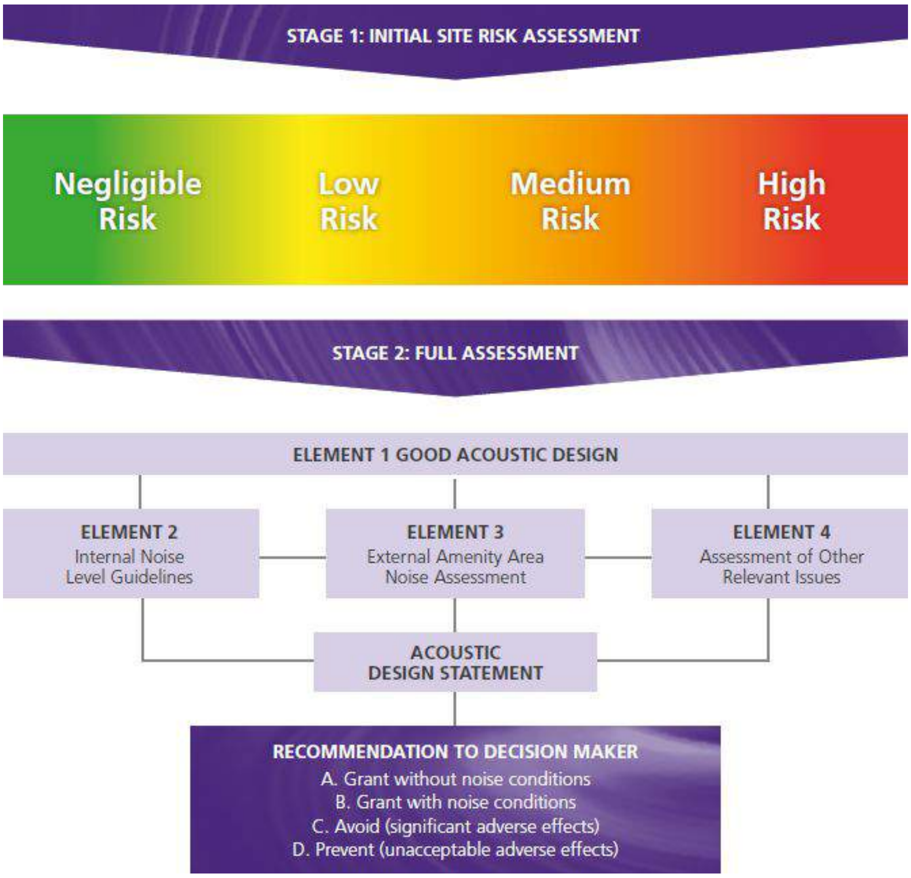
A. Planning consent may be granted without any need for noise conditions;
B. Planning consent may be granted subject to the inclusion of suitable noise conditions;

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)


STAGE 1: INITIAL SITE RISK ASSESSMENT
Negligible Risk
Low Risk
Medium Risk
High Risk
STAGE 2: FULL ASSESSMENT
ELEMENT 1 GOOD ACOUSTIC DESIGN
ELEMENT 2 Internal Noise Level Guidelines
ELEMENT 3 External Amenity Area Noise Assessment
ELEMENT 4 Assessment of Other Relevant Issues
ACOUSTIC DESIGN STATEMENT
RECOMMENDATION TO DECISION MAKER
A. Grant without noise conditions
B. Grant with noise conditions
C. Avoid (significant adverse effects)
D. Prevent (unacceptable adverse effects)

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	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

Activity	Location	Daytime (07:00 to 23:00hrs)	Night-time (23:00 to 07:00hrs)
(daytime resting)			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 there are commercial buildings and used in the vicinity, 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 *Southside Autolink* car dealership and *Boyle's Solid Fuel* in the Sancta Maria property adjoins the developments north-western boundary. This site includes some industrial/commercial use. The baseline noise survey included surveys and site inspections/observations along this boundary. The dominant noise sources observed were road traffic from the surrounding public road network. There were occasional sounds from the adjacent site which included primarily the movement of vehicles. 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 Glenamuck District Roads Scheme (GDRS) which runs to the north and east of the site and adjoins part of the sites eastern boundary.

In order to assess the potential noise impact of the proposed GDRS, 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 GDRS, 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

Atkins have provided the traffic data in relation to the GDRS for the following scenarios:

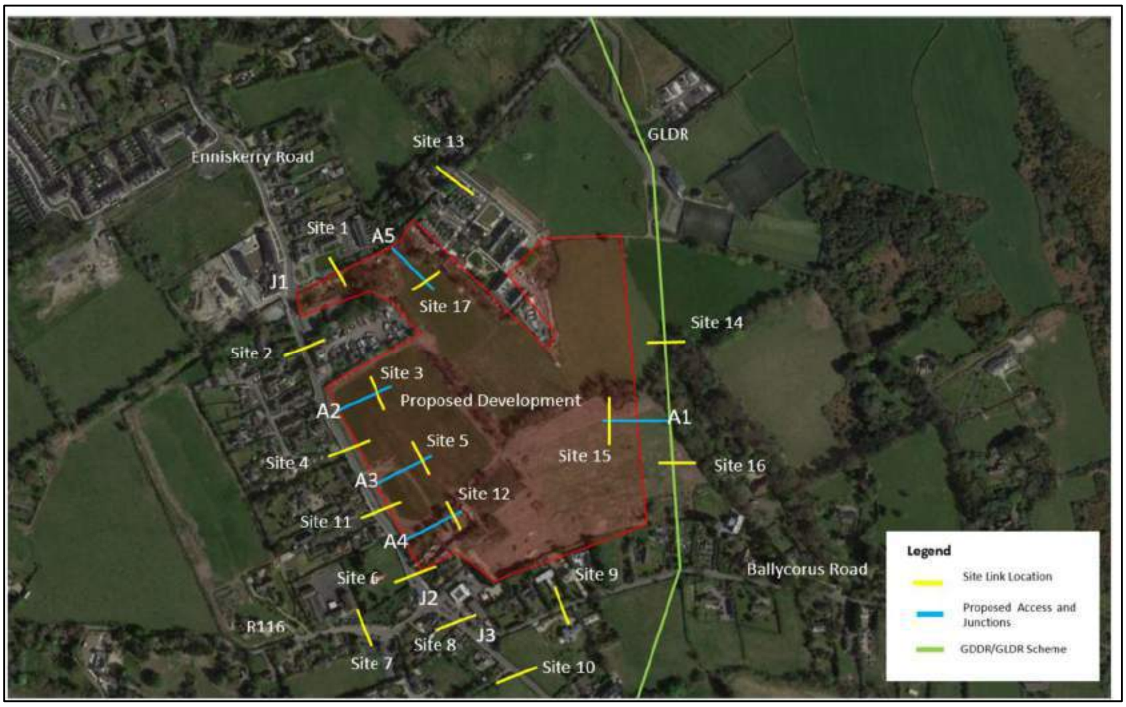
- Base scenario for the year 2021 (i.e. the estimated current traffic flows along the existing roads).
- Do Something for the year 2039 (i.e. all surrounding roads including the Development of GDRS).

Table 10 presents the provided Annual Average Daily Traffic (AADT) traffic flows for the Roads under consideration which are indicated in Figure 5.

Table 10: Traffic Flow Projections

Road	Description	Location	Year 2039 "Do Something" Scenario (AADT)
Site1	Between J1 and A5	Along Glenamuck Rd	8,990
Site2	Between J1 and A2	Along R117 Enniskerry Rd	5,954
Site3	Between R117 Enniskerry Rd and Proposed Access Junction 2	Along Proposed Access Road A2	286
Site4	Between A2 and A3	Along R117 Enniskerry Rd	6,053
Site5	Between R117 Enniskerry Rd and Proposed Access Junction 3	Along Proposed Access Road A3	286
Site6	Between A4 and J2	Along R117 Enniskerry Rd	5,816
Site7	Between R117 Enniskerry Rd and R116	Along R116 Rd	4,370
Site8	Between J2 and J3	Along R117 Enniskerry Rd	3,318
Site9	Between R117 Enniskerry Rd and Ballycorus Rd	Along R116 Ballycorus Rd	2,797
Site10	After Junction 3	Along R117 Enniskerry Rd	0
Site11	Between A3 and A4	Along Enniskerry Rd	6,240
Site12	Between R117 Enniskerry Rd and Proposed Access Junction 4	Along Proposed Access Rd A4	286
Site13	Between A5 and GDRS road	Along Glenamuck Rd (After A5)	9,262
Site14	North of Access Junction 1	Along GDRS Rd (North)	7,372
Site15	Between GDRS and Access Junction 5	Along Proposed Access Rd A1	1,567
Site16	South of Access Junction 1	Along GDRS Rd (South)	7,520
Site17	Between Glenamuck Rd and A5	Along Proposed Access Rd A5	709

Figure 5: Key to Traffic Link Locations (Source: Atkins)



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 6 and 7 present the traffic noise prediction contours for daytime and night-time scenarios to the proposed building façades.

Figure 6: Do Something Noise Contour Plot (2039 inc. GDRS): Daytime

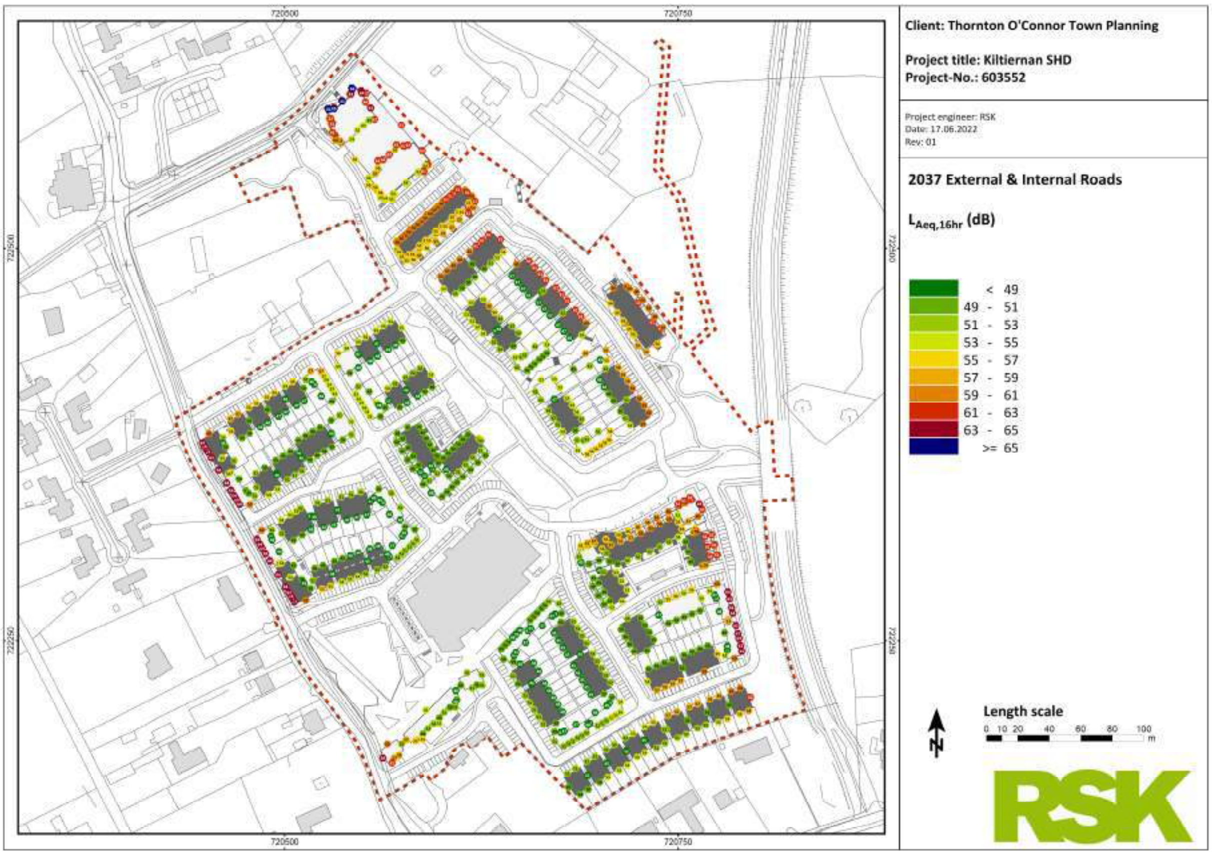


Figure 7: Do Something Noise Contour Plot (2039 inc. GDRS): Night-time

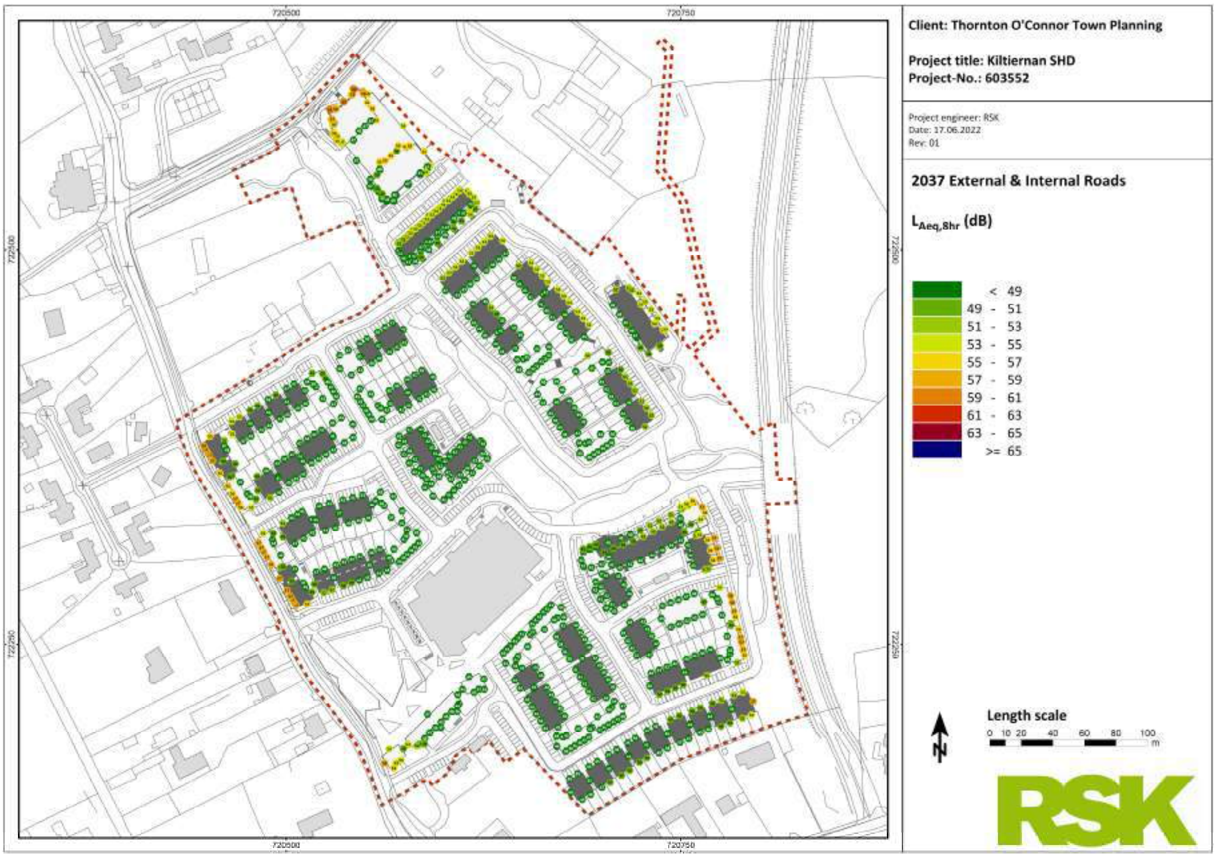
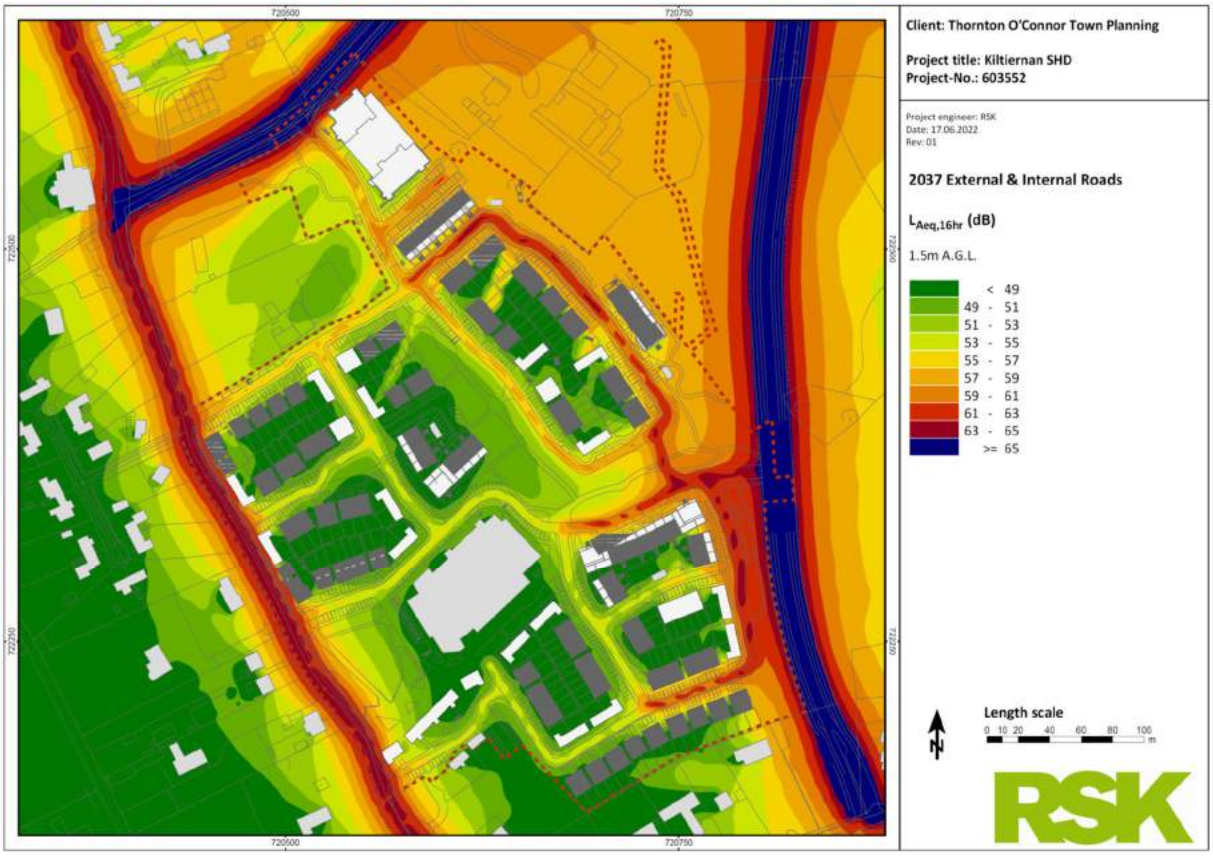


Figure 8 present the traffic noise prediction contours for the daytime scenarios to the proposed development lands for the purposes of the analysis of noise levels in external amenity spaces.

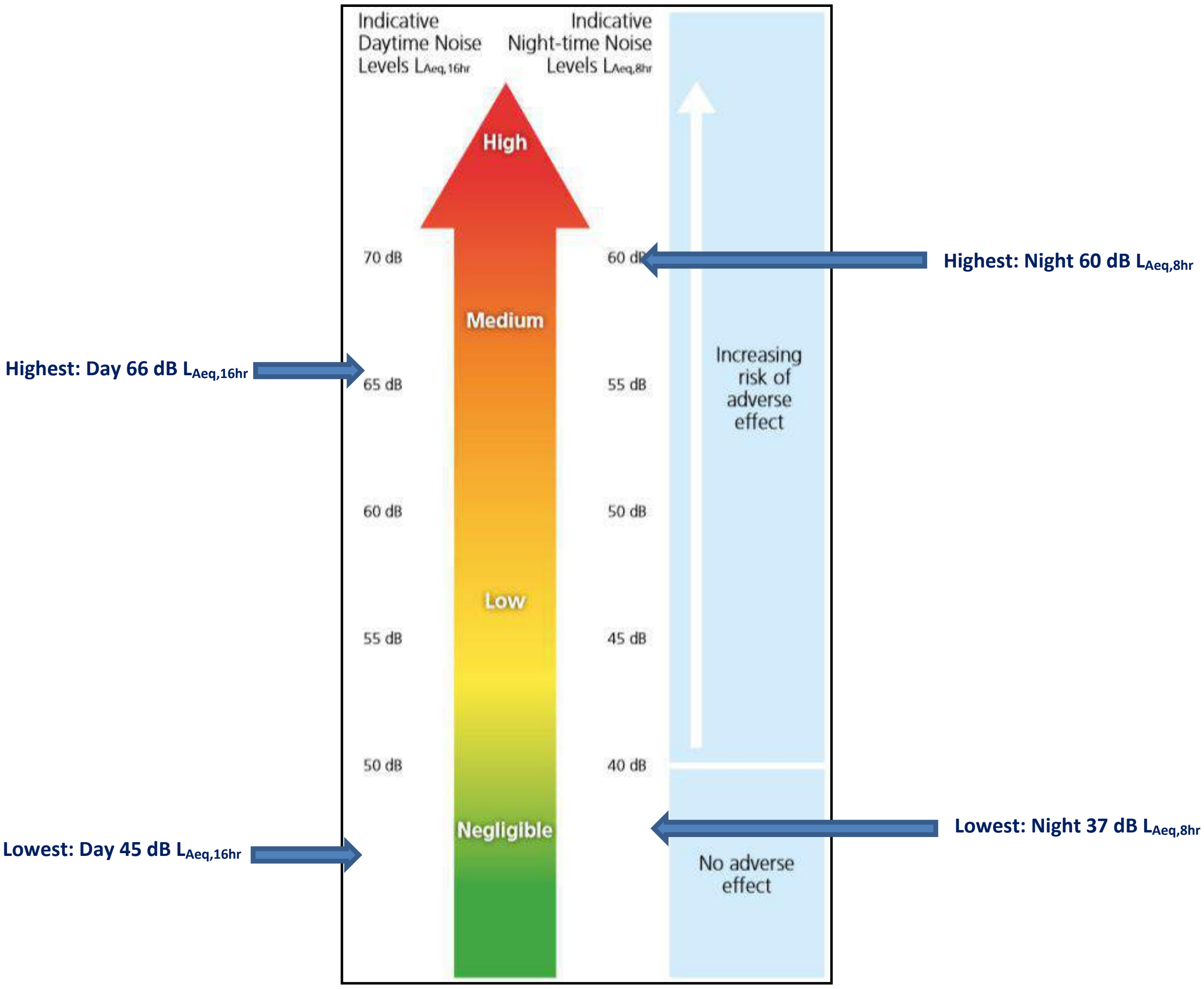
Figure 8: Site Plan indicating Communal Amenity Areas



5.1.3 ProPG Stage 1 Noise Risk Categories

Figure 9 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 GDRS) on the site are indicated on Figure 9.

Figure 9 **ProPG Stage 1 - Noise Risk Assessment Categories (Highest expected Site Noise Levels Indicated)**


Indicative Daytime Noise Levels $L_{Aeq,16hr}$
Indicative Night-time Noise Levels $L_{Aeq,8hr}$
High
Medium
Low
Negligible
70 dB
65 dB
60 dB
55 dB
50 dB
60 dB
55 dB
50 dB
45 dB
40 dB
Increasing risk of adverse effect
No adverse effect

Highest: Night 60 dB $L_{Aeq,8hr}$

Highest: Day 66 dB $L_{Aeq,16hr}$

Lowest: Night 37 dB $L_{Aeq,8hr}$

Lowest: Day 45 dB $L_{Aeq,16hr}$

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 night-time noise 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 9.

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:	**Negligible** to **Medium**
Night-time	**Negligible** 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 GDRS. Given that the roads are largely 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 perimeter barrier screens. However, the height and location of the proposed development in relation to surrounding noise sources is such that the effectiveness of a noise barrier will be limited.

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*

Masonry (i.e. blockwork/concrete) constructions will be used for external walls of dwellings. These 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.

Calculations indicate that it will be 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

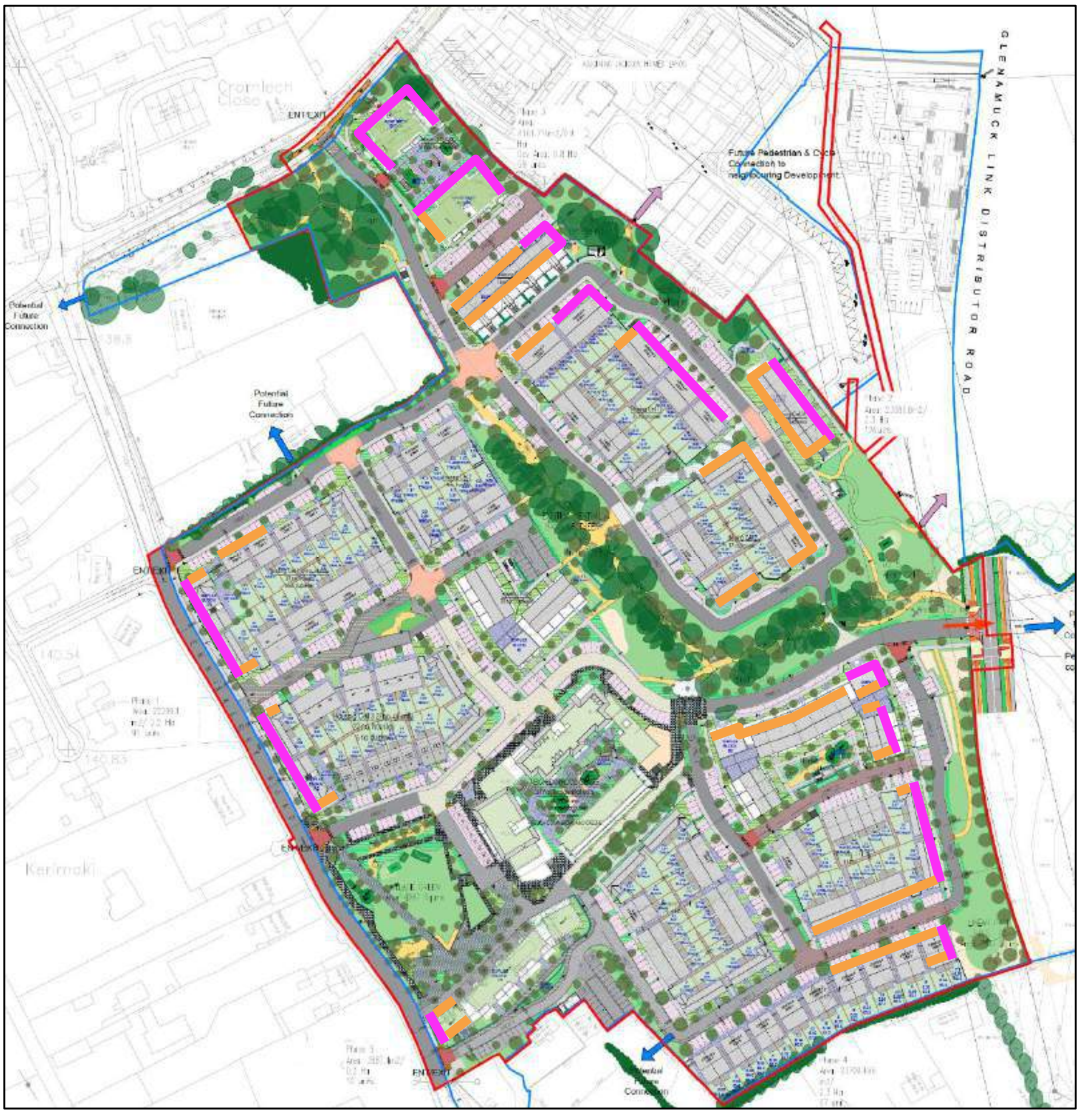
Noise surveys and calculations have been conducted across the site in order to establish the range and magnitude of noise levels at various positions on-site. Table 11 presents the free-field noise levels used for assessment purposes.

Table 11: Projected Traffic Noise Levels at Development Facades

Development Zone (Ref. Figure 10)	Period	Assessment Level (dB $L_{Aeq,T}$)
Zone A (Magenta) 🟪	Daytime (07:00 to 23:00)	61 – 66
Zone B (Orange) 🟧		56 – 60
Zone C (All Other Dwellings)		45 – 55
Zone A (Magenta) 🟪	Night-time (23:00 to 07:00)	56 - 60
Zone B (Orange) 🟧		51 – 55
Zone C (All Other Dwellings)		37 – 50

Figure 10 indicates the how the noise level zones described above relate to the proposed development façades.

Figure 10: Façade Noise Level Designation


GLENAMUCK LINK DISTRIBUTOR ROAD
Cromlech Close
ENT/EXIT
Future Pedestrian & Cycle Connection to neighbouring Development
Potential Future Connection
Potential Future Connection
ENT/EXIT
Kerimoki
ENT/EXIT
ENT/EXIT
Potential Future Connection

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.

Glazing

Facades shall be provided with glazing that achieves the following minimum sound insulation performance.

Table 12: Glazing Acoustic Specification (Ref. Figure 10)

Specification (Ref Figure 10)	Sound Reduction Performance Requirements (dB) in Octave Frequency Bands (Hz)						Typical Overall dB R_w
	125	250	500	1k	2k	4k	
Zone A (Magenta)	27	28	36	45	53	59	41
Zone B (Orange)	25	22	33	40	43	44	36
Zone C (All Other Dwellings)	24	20	25	35	38	35	31

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 10)

Specification (Ref Figure 10)	Room Type	Required Overall dB $D_{n, e, w}$
Zone A (Magenta)	Living Room, Dining Rooms and Bedrooms	41
Zone B (Orange)	Living Room, Dining Rooms and Bedrooms	36
Zone C (All Other)	Not Required	Not Required

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:

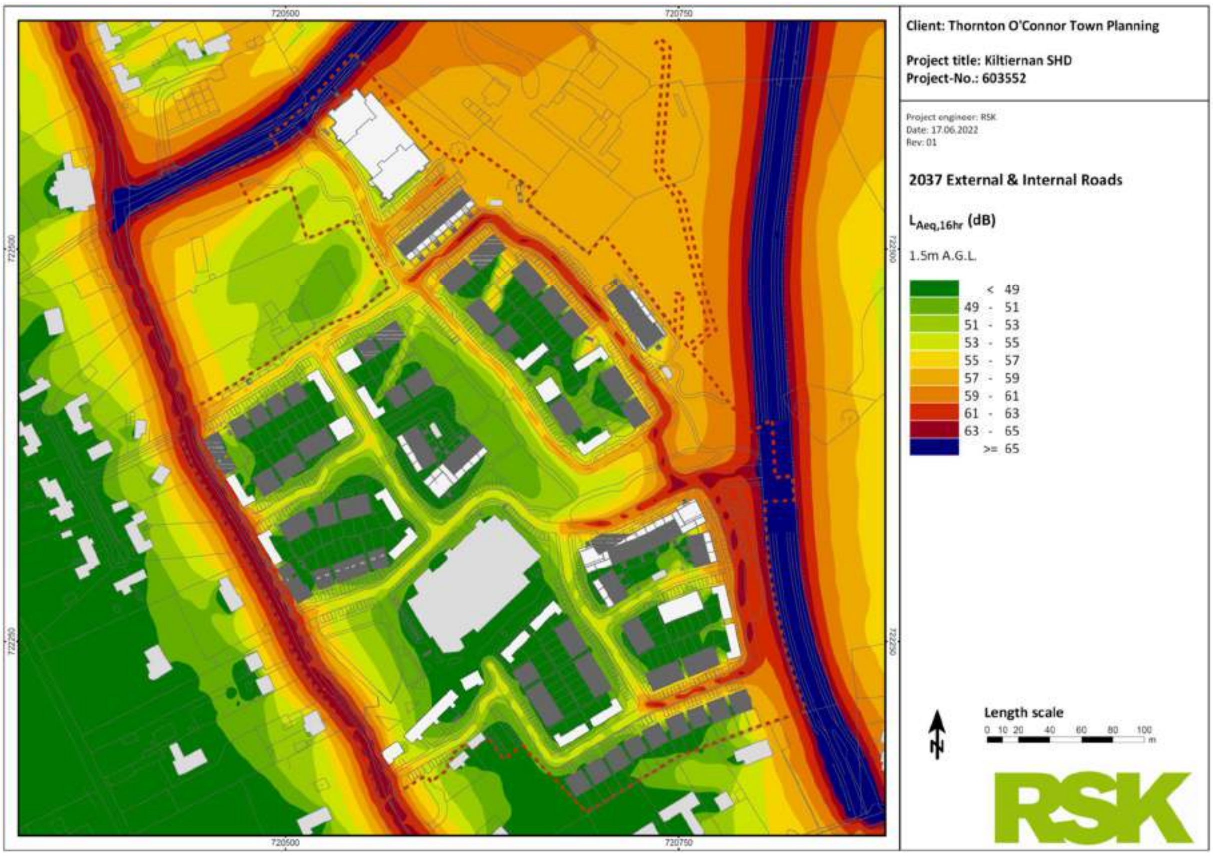
> *"Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, 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 are number of public open amenity spaces proposed as part of the development, as well as private gardens to dwellings and apartment balconies, and courtyard areas. The external noise levels in these amenity areas are indicated in Figure 11.

Figure 11: Site Plan indicating Expected Noise Levels in External Amenity Areas



The majority of private amenity spaces have noise levels that achieve 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* $L_{Aeq,T}$. In addition, there are various public amenity spaces throughout the development, that have noise levels that achieve the recommended range. 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 8.2.3 of the Dublin Agglomeration Environmental Noise Action Plan, December 2018 – July 2023, Volume 2, Dún Laoghaire-Rathdown County Council (NAP), along with Section 12.9.2 *Noise Pollution and Noise Nuisance* of the Dún Laoghaire-Rathdown County Development Plan 2022-2028 all refer 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 are external amenity spaces available for use by residents that have been assessed and are 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, duplexes and houses and is designed primarily for the purpose of residential accommodation, along with and a new neighborhood centre with retail, offices, medical, a community centre etc.

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. such as may be required to service the retail/commercial elements of the proposed neighborhood centre). Such plant items may include 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 (including existing and proposed new dwelling) 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 Liscove Limited to conduct a noise impact assessment and Acoustic Design Statement (ADS) in respect of a Lands at Wayside, Kilternan Dublin 18.

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 Glenamuck District Roads Scheme (GDRS) 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 **Negligible** to **Medium** for daytime and **Negligible** 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 any new building services plant (i.e. such as may be required to service the retail/commercial elements of the proposed neighbourhood centre), to both existing and future residents, 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 Liscove Limited . (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.

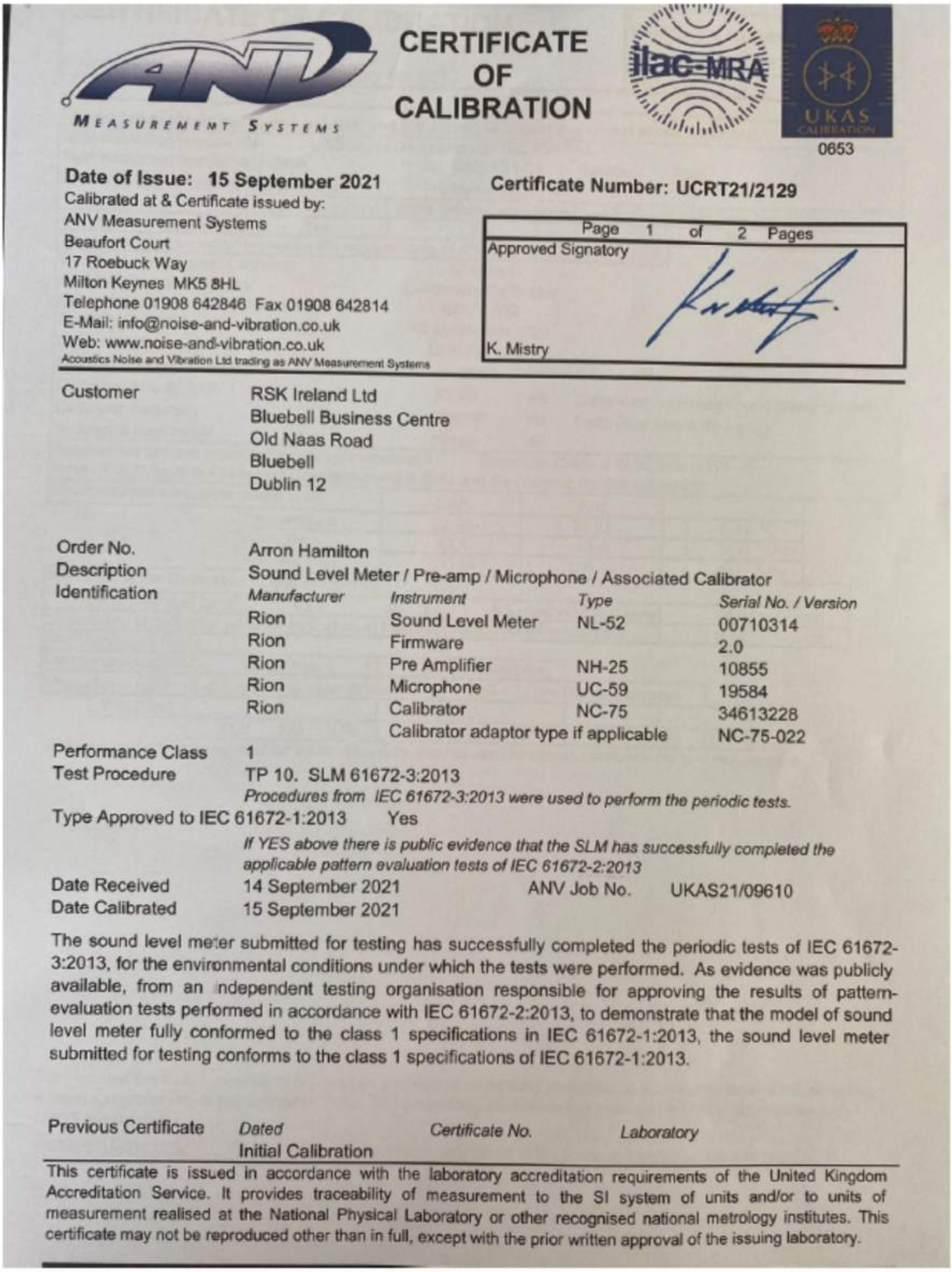
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the 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.

APPENDIX B
CALIBRATION CERTIFICATES



MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

0653

Date of Issue: 15 September 2021

Certificate Number: UCRT21/2129

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

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Approved Signatory

K. Mistry

Customer
RSK Ireland Ltd
Bluebell Business Centre
Old Naas Road
Bluebell
Dublin 12

Order No. Arron Hamilton

Description Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification

Manufacturer	*Instrument*	*Type*	*Serial No. / Version*
Rion	Sound Level Meter	NL-52	00710314
Rion	Firmware		2.0
Rion	Pre Amplifier	NH-25	10855
Rion	Microphone	UC-59	19584
Rion	Calibrator	NC-75	34613228
	Calibrator adaptor type if applicable		NC-75-022

Performance Class 1

Test Procedure TP 10. SLM 61672-3:2013

Procedures from IEC 61672-3:2013 were used to perform the periodic tests.

Type Approved to IEC 61672-1:2013 Yes

If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2013

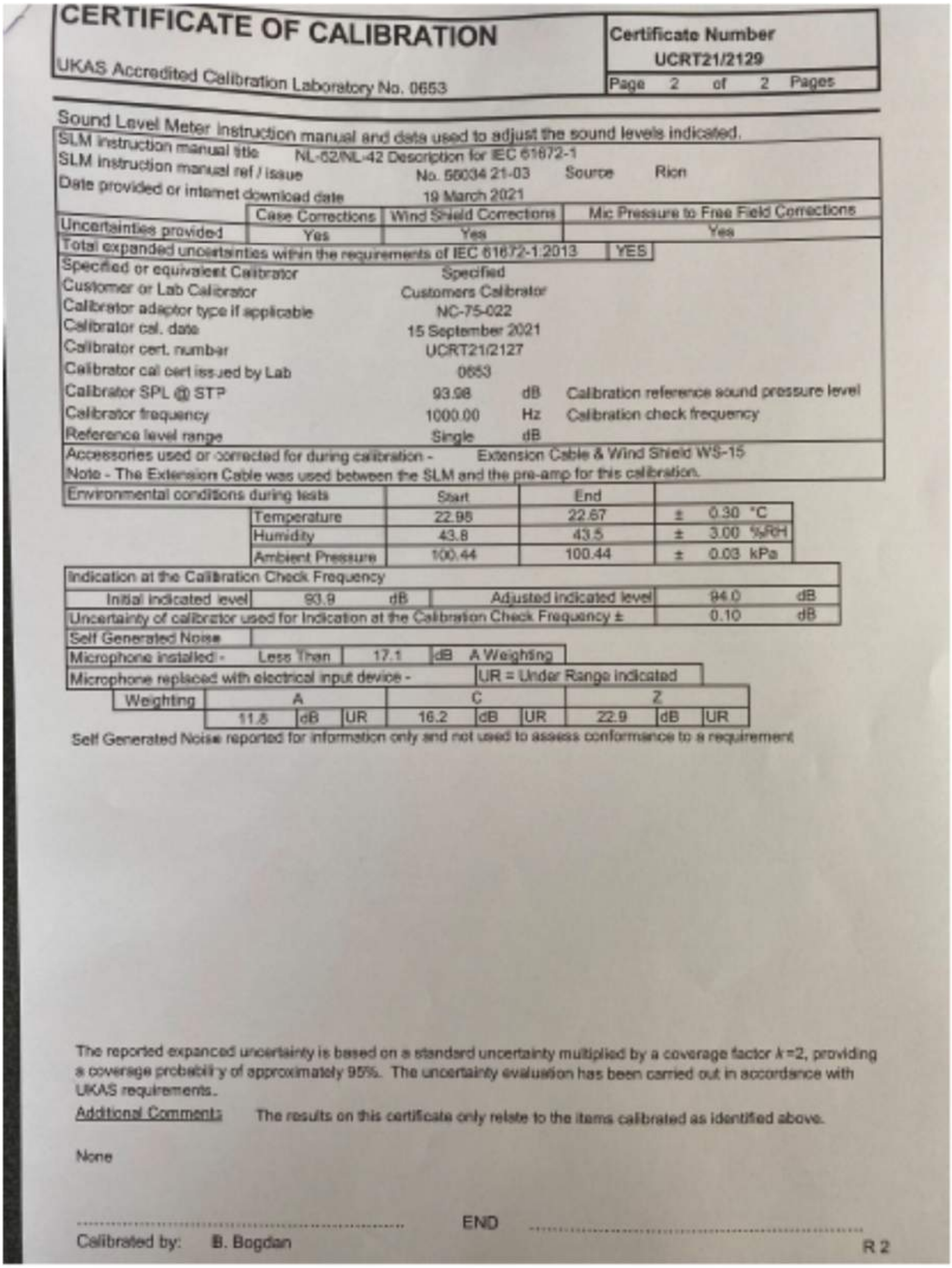
Date Received 14 September 2021 ANV Job No. UKAS21/09610

Date Calibrated 15 September 2021

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 specifications of IEC 61672-1:2013.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	Initial Calibration		

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.



CERTIFICATE OF CALIBRATION

UKAS Accredited Calibration Laboratory No. 0653

Certificate Number
UCRT21/2129
Page 2 of 2 Pages

Sound Level Meter instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	NL-52/NL-42 Description for IEC 61672-1		
SLM instruction manual ref / issue	No. 56034 21-03	Source	Rion
Date provided or internet download date	19 March 2021		

	Case Corrections	Wind Shield Corrections	Mic Pressure to Free Field Corrections
Uncertainties provided	Yes	Yes	Yes

Total expanded uncertainties within the requirements of IEC 61672-1:2013 YES

Specified or equivalent Calibrator	Specified		
Customer or Lab Calibrator	Customers Calibrator		
Calibrator adaptor type if applicable	NC-75-022		
Calibrator cal. date	15 September 2021		
Calibrator cert. number	UCRT21/2127		
Calibrator cal cert issued by Lab	0653		
Calibrator SPL @ STP	93.98	dB	Calibration reference sound pressure level
Calibrator frequency	1000.00	Hz	Calibration check frequency
Reference level range	Single	dB	

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
Note - The Extension Cable was used between the SLM and the pre-amp for this calibration.

Environmental conditions during tests	Start	End			
Temperature	22.98	22.67	±	0.30	°C
Humidity	43.8	43.5	±	3.00	%RH
Ambient Pressure	100.44	100.44	±	0.03	kPa

Indication at the Calibration Check Frequency

Initial indicated level	93.9	dB	Adjusted indicated level	94.0	dB
Uncertainty of calibrator used for Indication at the Calibration Check Frequency ±				0.10	dB

Self Generated Noise

Microphone installed -	Less Than	17.1	dB	A Weighting

Microphone replaced with electrical input device - UR = Under Range indicated

Weighting	A			C			Z		
	11.8	dB	UR	16.2	dB	UR	22.9	dB	UR

Self Generated Noise reported for information only and not used to assess conformance to a requirement

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

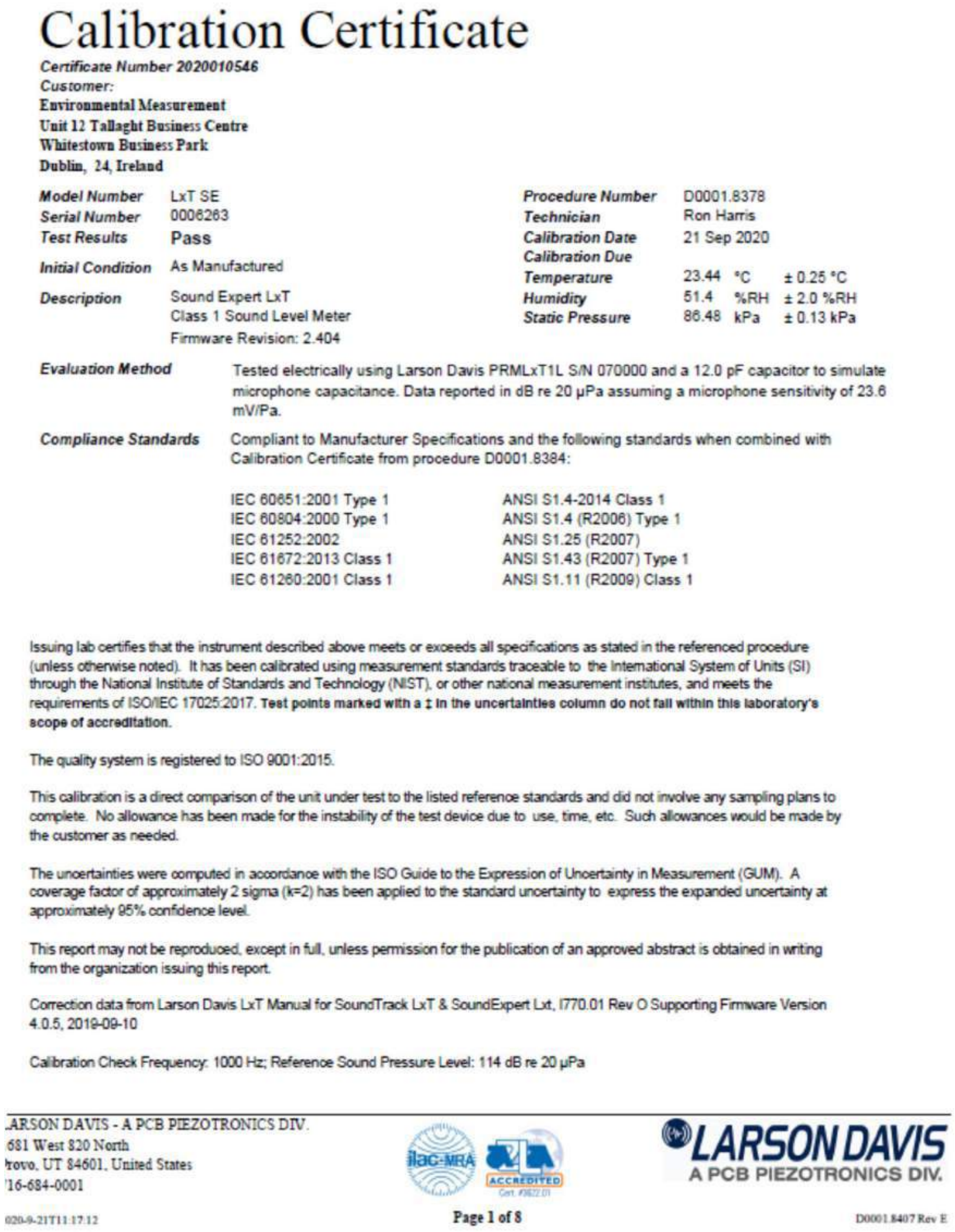
Additional Comments The results on this certificate only relate to the items calibrated as identified above.

None

END

Calibrated by: B. Bogdan

R 2



Calibration Certificate

Certificate Number 2020010546
Customer:
Environmental Measurement
Unit 12 Tallaght Business Centre
Whitestown Business Park
Dublin, 24, Ireland

Model Number	LxT SE
Serial Number	0006263
Test Results	Pass
Initial Condition	As Manufactured
Description	Sound Expert LxT Class 1 Sound Level Meter Firmware Revision: 2.404

Procedure Number	D0001.8378		
Technician	Ron Harris		
Calibration Date	21 Sep 2020		
Calibration Due			
Temperature	23.44	°C	± 0.25 °C
Humidity	51.4	%RH	± 2.0 %RH
Static Pressure	86.48	kPa	± 0.13 kPa

Evaluation Method	Tested electrically using Larson Davis PRMLxT1L S/N 070000 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 23.6 mV/Pa.
Compliance Standards	Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Lxt, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

ARSON DAVIS - A PCB PIEZOTRONICS DIV.
681 West 820 North
rovo, UT 84601, United States
16-684-0001

ACCREDITED
Cert. #3622.01

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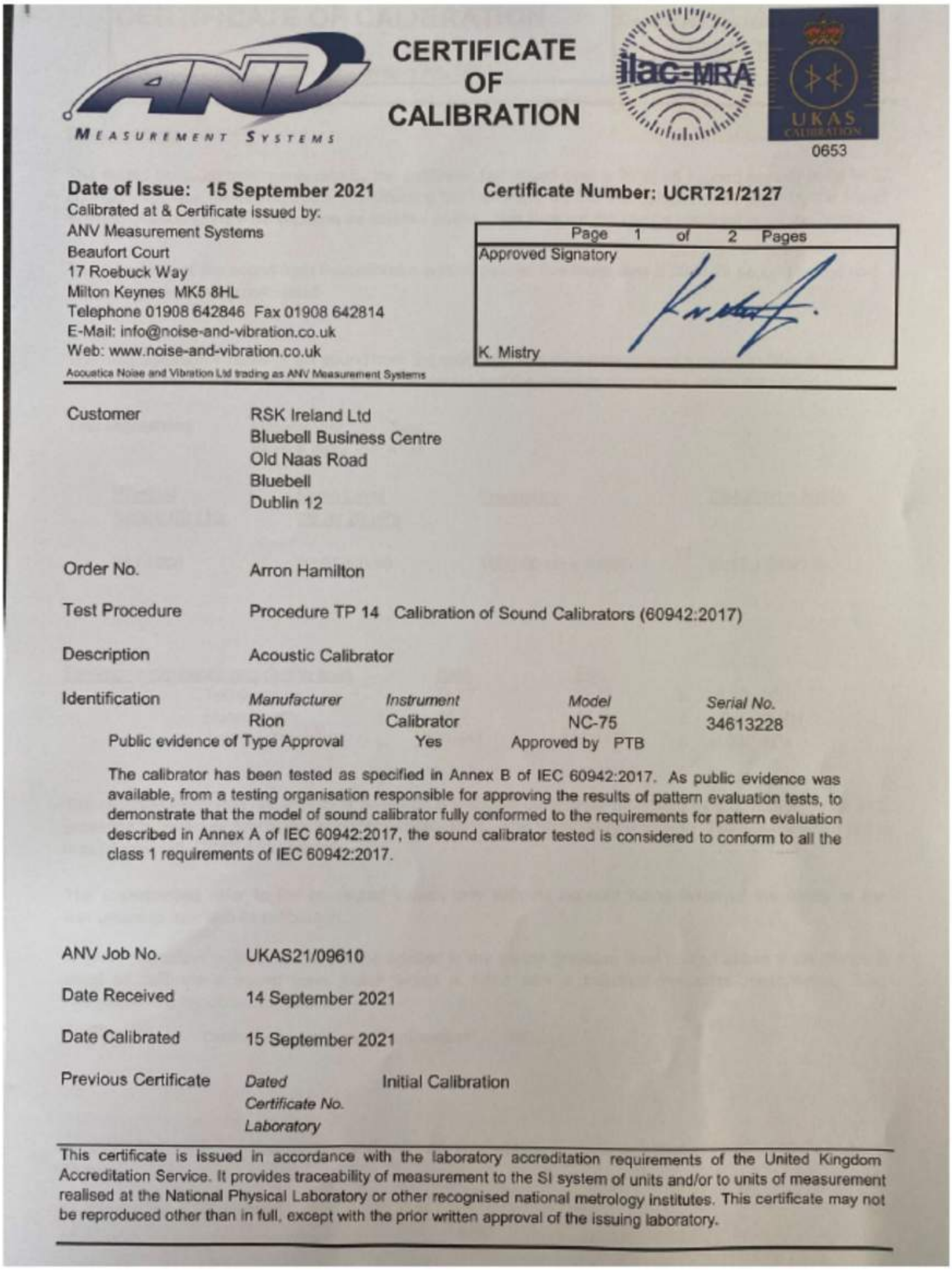
D0001.8407 Rev E



ANV MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

ilac-MRA

UKAS CALIBRATION 0653

Date of Issue: 15 September 2021

Certificate Number: UCRT21/2127

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustica Noise and Vibration Ltd trading as ANV Measurement Systems

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Approved Signatory

K. Mistry

Customer	RSK Ireland Ltd Bluebell Business Centre Old Naas Road Bluebell Dublin 12
Order No.	Arron Hamilton
Test Procedure	Procedure TP 14 Calibration of Sound Calibrators (60942:2017)
Description	Acoustic Calibrator

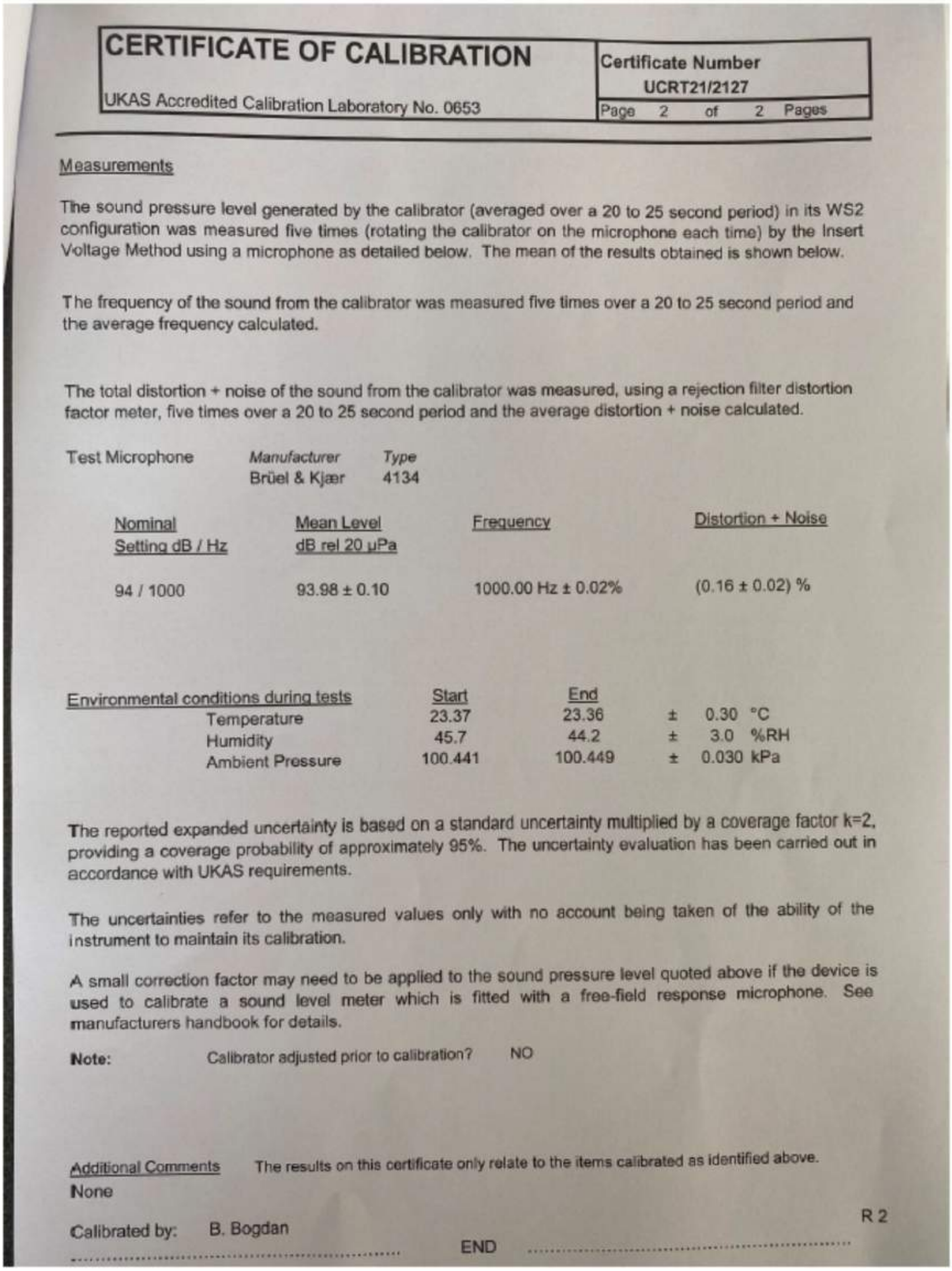
Identification	*Manufacturer*	*Instrument*	*Model*	*Serial No.*
	Rion	Calibrator	NC-75	34613228

Public evidence of Type Approval Yes Approved by PTB

The calibrator has been tested as specified in Annex B of IEC 60942:2017. As public evidence was available, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2017.

ANV Job No.	UKAS21/09610
Date Received	14 September 2021
Date Calibrated	15 September 2021
Previous Certificate	*Dated* Initial Calibration *Certificate No.* *Laboratory*

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.



CERTIFICATE OF CALIBRATION

UKAS Accredited Calibration Laboratory No. 0653

Certificate Number
UCRT21/2127
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Measurements

The sound pressure level generated by the calibrator (averaged over a 20 to 25 second period) in its WS2 configuration was measured five times (rotating the calibrator on the microphone each time) by the Insert Voltage Method using a microphone as detailed below. The mean of the results obtained is shown below.

The frequency of the sound from the calibrator was measured five times over a 20 to 25 second period and the average frequency calculated.

The total distortion + noise of the sound from the calibrator was measured, using a rejection filter distortion factor meter, five times over a 20 to 25 second period and the average distortion + noise calculated.

Test Microphone	*Manufacturer*	*Type*
	Brüel & Kjær	4134

Nominal Setting dB / Hz	Mean Level dB rel 20 µPa	Frequency	Distortion + Noise
94 / 1000	93.98 ± 0.10	1000.00 Hz ± 0.02%	(0.16 ± 0.02) %

Environmental conditions during tests	Start	End		
Temperature	23.37	23.36	±	0.30 °C
Humidity	45.7	44.2	±	3.0 %RH
Ambient Pressure	100.441	100.449	±	0.030 kPa

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The uncertainties refer to the measured values only with no account being taken of the ability of the instrument to maintain its calibration.

A small correction factor may need to be applied to the sound pressure level quoted above if the device is used to calibrate a sound level meter which is fitted with a free-field response microphone. See manufacturers handbook for details.

Note: Calibrator adjusted prior to calibration? NO

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
None

Calibrated by: B. Bogdan

R 2

END

APPENDIX C
RAW NOISE MONITORING DATA

Raw Data from Baseline Noise Survey

Date	Time	Measured Noise Levels (dB re. 2x10^{-5} Pa)			
		L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
2022-05-13	15:07:45	62.5	83.9	64.6	54.3
2022-05-13	15:15:00	61.7	73.0	65.7	49.7
2022-05-13	15:30:00	61.9	76.0	65.9	51.4
2022-05-13	15:45:00	61.3	74.9	65.1	50.0
2022-05-13	16:00:00	62.1	74.5	66.2	49.7
2022-05-13	16:15:00	62.1	75.9	66.0	51.2
2022-05-13	16:30:00	63.1	75.1	67.0	53.5
2022-05-13	16:45:00	63.0	78.2	66.8	52.4
2022-05-13	17:00:00	61.9	74.9	66.0	50.2
2022-05-13	17:15:00	61.5	75.5	65.7	45.0
2022-05-13	17:30:00	61.8	73.8	65.9	49.6
2022-05-13	17:45:00	61.9	76.2	65.8	50.7
2022-05-13	18:00:00	61.7	74.2	65.8	48.9
2022-05-13	18:15:00	61.4	74.9	65.7	48.2
2022-05-13	18:30:00	61.3	76.0	65.4	46.9
2022-05-13	18:45:00	61.2	75.9	65.3	46.6
2022-05-13	19:00:00	60.4	73.9	64.5	45.4
2022-05-13	19:15:00	60.9	76.3	64.7	46.4
2022-05-13	19:30:00	60.2	74.9	64.2	47.0
2022-05-13	19:45:00	59.5	72.9	63.5	43.7
2022-05-13	20:00:00	59.1	74.9	63.1	42.8
2022-05-13	20:15:00	59.8	79.1	63.8	43.7
2022-05-13	20:30:00	60.7	80.0	64.4	44.1
2022-05-13	20:45:00	59.5	75.6	63.4	42.8
2022-05-13	21:00:00	58.2	76.6	62.3	39.3
2022-05-13	21:15:00	58.8	75.7	62.6	40.8
2022-05-13	21:30:00	59.1	76.3	62.9	39.2
2022-05-13	21:45:00	58.1	73.4	61.9	39.6
2022-05-13	22:00:00	55.6	75.7	59.4	34.4

Date	Time	Measured Noise Levels (dB re. 2x10^{-5} Pa)			
		L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
2022-05-13	22:15:00	55.0	72.3	58.6	34.0
2022-05-13	22:30:00	56.4	74.6	59.9	36.2
2022-05-13	22:45:00	56.8	74.5	60.2	36.7
2022-05-13	23:00:00	55.9	74.4	59.1	36.1
2022-05-13	23:15:00	56.2	74.5	59.7	37.7
2022-05-13	23:30:00	53.0	74.5	55.7	35.5
2022-05-13	23:45:00	49.8	72.0	49.2	38.3
2022-05-14	00:00:00	54.8	73.0	57.9	40.1
2022-05-14	00:15:00	53.0	72.6	55.8	38.3
2022-05-14	00:30:00	51.3	72.9	52.9	32.2
2022-05-14	00:45:00	50.0	75.8	51.0	29.9
2022-05-14	01:00:00	50.4	76.8	45.3	28.5
2022-05-14	01:15:00	47.4	70.9	45.2	26.9
2022-05-14	01:30:00	52.9	71.4	55.5	27.4
2022-05-14	01:45:00	48.4	75.6	41.0	24.6
2022-05-14	02:00:00	49.2	72.7	49.0	26.4
2022-05-14	02:15:00	40.9	68.9	31.9	25.8
2022-05-14	02:30:00	50.6	71.3	52.5	25.3
2022-05-14	02:45:00	42.2	68.7	29.8	23.6
2022-05-14	03:00:00	46.5	71.6	34.6	24.3
2022-05-14	03:15:00	47.6	70.6	41.0	24.4
2022-05-14	03:30:00	51.6	75.5	51.6	25.6
2022-05-14	03:45:00	48.5	71.7	48.4	22.6
2022-05-14	04:00:00	48.1	73.4	42.0	22.8
2022-05-14	04:15:00	46.1	70.3	44.7	26.9
2022-05-14	04:30:00	47.8	71.8	47.1	35.8
2022-05-14	04:45:00	49.4	76.6	47.9	36.7
2022-05-14	05:00:00	51.5	72.9	51.1	33.4
2022-05-14	05:15:00	48.8	75.3	43.9	34.0
2022-05-14	05:30:00	48.7	71.1	48.8	34.5
2022-05-14	05:45:00	52.9	75.8	54.8	35.1
2022-05-14	06:00:00	52.1	76.2	53.9	35.3
2022-05-14	06:15:00	50.6	72.9	51.9	35.7
2022-05-14	06:30:00	53.5	76.7	54.7	34.3

Date	Time	Measured Noise Levels (dB re. 2x10^{-5} Pa)			
		L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
2022-05-14	06:45:00	55.4	76.7	57.3	34.8
2022-05-14	07:00:00	54.0	73.0	56.3	34.8
2022-05-14	07:15:00	56.6	75.9	59.3	36.7
2022-05-14	07:30:00	56.0	74.4	58.6	35.1
2022-05-14	07:45:00	56.4	72.5	59.7	35.6
2022-05-14	08:00:00	57.0	75.1	59.8	35.4
2022-05-14	08:15:00	56.9	73.4	60.1	36.0
2022-05-14	08:30:00	58.1	73.5	61.4	39.4
2022-05-14	08:45:00	59.5	77.8	63.6	42.9
2022-05-14	09:00:00	58.3	73.6	62.0	41.4
2022-05-14	09:15:00	60.1	78.7	63.9	43.1
2022-05-14	09:30:00	60.0	74.1	64.5	42.3
2022-05-14	09:45:00	59.9	84.2	64.2	43.0
2022-05-14	10:00:00	60.2	73.7	64.7	44.6
2022-05-14	10:15:00	59.2	72.7	63.5	46.7
2022-05-14	10:30:00	59.5	73.8	63.6	47.8
2022-05-14	10:45:00	59.8	79.6	63.8	46.5
2022-05-14	11:00:00	60.6	85.6	63.8	47.3
2022-05-14	11:15:00	59.6	73.7	63.7	48.4
2022-05-14	11:30:00	59.8	73.4	64.1	47.2
2022-05-14	11:45:00	60.3	74.1	64.3	49.3
2022-05-14	12:00:00	59.4	75.0	63.8	46.9
2022-05-14	12:15:00	60.4	74.0	64.7	49.2
2022-05-14	12:30:00	60.2	72.2	64.6	46.5
2022-05-14	12:45:00	60.1	72.9	64.6	48.1
2022-05-14	13:00:00	59.6	75.6	64.1	46.2
2022-05-14	13:15:00	60.0	74.7	64.3	47.5
2022-05-14	13:30:00	60.1	73.5	64.6	47.4
2022-05-14	13:45:00	59.8	73.6	64.3	46.0
2022-05-14	14:00:00	59.3	73.2	63.8	43.6
2022-05-14	14:15:00	64.0	95.6	64.9	45.0
2022-05-14	14:30:00	60.0	73.2	64.7	45.1

Date	Time	Measured Noise Levels (dB re. 2x10^{-5} Pa)			
		L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
2022-05-14	14:45:00	59.2	73.4	64.0	42.5
2022-05-14	15:00:00	60.8	87.0	63.7	44.2
2022-05-14	15:15:00	58.0	79.0	62.3	5.6