Waterman Moylan
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Engineering Assessment Report

Proposed Strategic Housing Development at Auburn, Malahide Road

April 2022

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This document has been prepared and checked in accordance with
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Issue	Date	Prepared by	Checked by	Approved by
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Comments

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1. Introduction

1.1 Background of Report

This engineering assessment report has been prepared by Waterman Moylan as part of the planning documentation for a proposed residential development in lands around Auburn House in Malahide, Co. Dublin.

This report assesses wastewater and surface water drainage, water supply infrastructure and the road and transportation network in the vicinity of the site, and details the criteria used to design the proposed wastewater and surface water drainage, water supply and road networks.

1.2 Planning History

A previous planning submission to develop the site was made by the Applicant in 2021 under An Bord Pleanála reference no. ABP-309907-21. A decision to refuse planning permission was made by An Bord Pleanála on 14 July 2021.

The primary reasons for refusal are summarised below:

1. The proposed development, including the proposed entrance road, would negatively impact Auburn House, a Protected Structure (RPS No. 448).
2. The proposed development would result in the loss of a significant number of trees; and
3. The submission did not include a comprehensive assessment of daylight and sunlight.

The subject application seeks to address the previous reasons for refusal.

1.3 Site Location and Description

The site is located between the existing Abington residential development and the Malahide Road. The site entrance is from the Malahide Road, adjacent to the Malahide Road/Back Road junction.

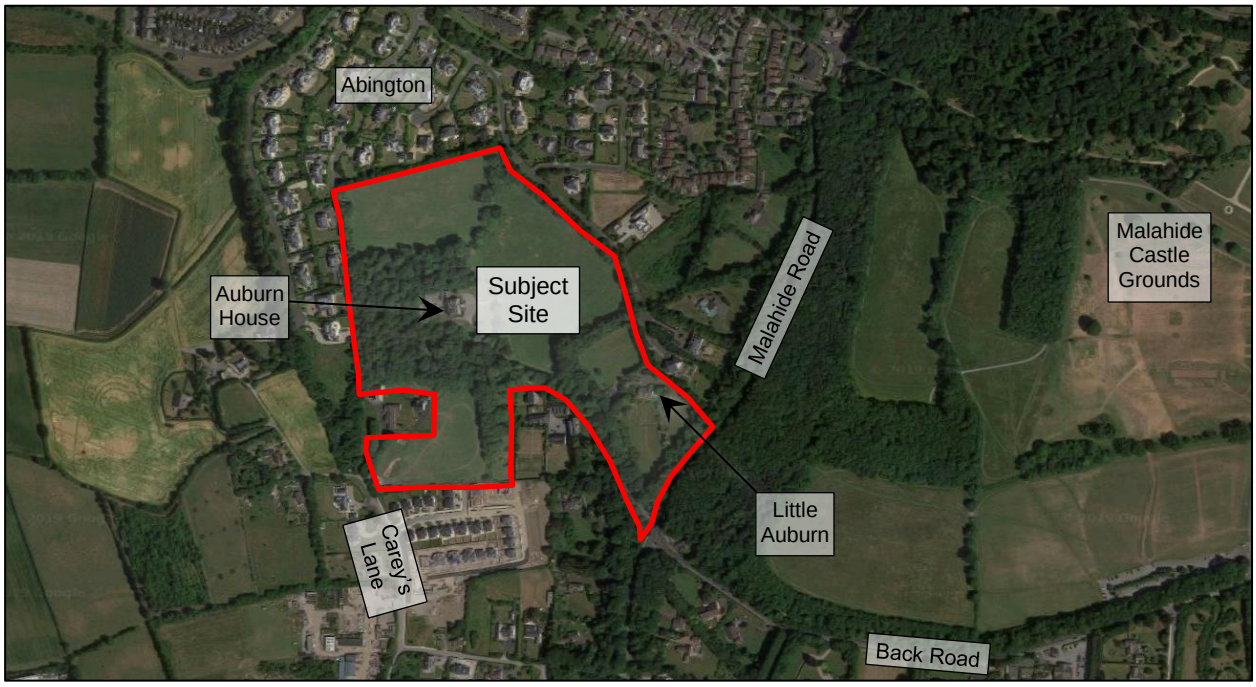

Figure 1 | *Site Location (Source: Google Maps)*

The subject lands form the western, northern and eastern boundaries of Auburn House, an eighteenth century three-storey mansion located within a wooded demesne. Malahide Castle is approximately 900m north-east of the site.

A topographic survey of the area indicated that the site is very flat with only local high points. The site lies generally at a level of between 9m and 11m OD Malin, with a local high point near the north-east of the site of 12.45m OD Malin.

There is an existing surface water drain along the northern and eastern boundary of the site (within the Abington development) which discharges to an existing culvert under the Malahide Road close to the entrance to the site at the junction with Back Road. This drain is very flat at an estimated average gradient of 1/1,000 over its 700-metre length along the north-eastern boundary and through the lands to the entrance of the site.

1.4 Proposed Development

The proposed development will consist of the preservation and protection of the existing Protected Structure of Auburn House and its stables as 1 no. residential dwelling; the conversion of the existing stables of Auburn House to provide for storage space for the main Auburn House and the construction of 368 no. new residential dwelling units (comprising 87 no. houses, 239 no. apartments & 42 no. duplex units) for an overall total of 369 no. residential units, including Auburn House.

The development shall consist of 135 no. 1-bedroom apartments and duplex apartments, 138 no. 2-bedroom apartments and duplex apartments, 8 no. 3-bedroom apartments and duplex apartments, 47 no. 3-bedroom houses, 34 no. 4-bedroom houses, 6 no. 5-bedroom houses and the existing 11-bedroom Auburn House along with 1 no. childcare facility and 1 no. ancillary resident facility.

The breakdown of the proposed development is set out in the Schedule of Accommodation below:

Description		1-Bed	2-Bed	3-Bed	4-Bed	5-Bed or more	Total	
Houses *(including Auburn House)*		-	-	47	34	7	88 Houses	
Apartments	Block 1	26	20	-	-	-	46	239 Apartments
	Block 2	26	21	2	-	-	49	
	Block 3	22	20	-	-	-	42	
	Block 4	10	17	1	-	-	28	
	Block 5	6	22	-	-	-	28	
	Block 6	5	14	2	-	-	21	
	Block 7	14	10	1	-	-	25	
Duplexes	Block 1	1	3	2	-	-	6	42 Duplexes
	Block 2A	6	2	-	-	-	8	
	Block 2B	8	3	-	-	-	11	
	Block 2C	7	2	-	-	-	9	
	Block 2D	4	4	-	-	-	8	
Total		**135**	**138**	**55**	**34**	**7**	**369 Units**	

Table 1 | *Schedule of Accommodation*

The proposed development shall also provide landscaped public open space, car parking and all associated ancillary site development infrastructure including foul and surface water drainage, internal roads, cycle paths and footpaths, and boundary walls and fences. Vehicular access to the proposed development is to be via a new entrance at the R107 Malahide Road/Dublin Road entrance, with the existing entrance to Auburn House acting as a pedestrian/cyclist entrance and access to existing properties outside the application site, there will be a secondary entrance comprising modifications of the existing vehicular entrance off Carey's Lane to the south west of the development, the closure of the existing vehicular entrance to Little Auburn, the provision of 4 no. ESB substations, 1 no. new foul pumping station, public lighting; proposed foul sewer works along Back Road and Kinsealy Lane and all associated engineering and site works necessary to facilitate the development. The building heights range from 2 storey to 5 storey buildings with balconies or terraces being provided to the apartments and duplex units.

Figure 2 | *Proposed Site Layout*

2. Foul Water Network

2.1 Existing Foul Water Network

There is no gravity sewer within the Malahide Road in front of the subject site. The closest gravity sewer is located in the Swords Road, approximately 670m north of the proposed access onto the Malahide Road. This gravity sewer drains to the Malahide Wastewater Treatment Plant.

There are three existing pumping stations in the vicinity of the site:

1. Connolly Avenue Pumping Station (Irish Water)

   This pumping station drains:

   a) Broomfield LAP and Kinsealy Lane developments

   b) Housing in Streamstown

   This pumping station also previously drained Kinsealy Village via a pumping station known as Floraville. However, the Floraville pumping station has recently been decommissioned following completion of a Local Network Reinforcement Project by Irish Water. This project comprised of a new pumping station on Chapel Road discharging via a new rising main to the existing North Fringe Interceptor Sewer. As part of the project, the Floraville pumping station was decommissioned and diverted by a new gravity sewer to the new Chapel Road pumping station. Refer also to Section 2.2, below, which provides further details of these recent upgrade works.

2. Abington / Gaybrook Stream Pumping Station

   a) Abington is drained via a private pumping station

   b) Gaybrook pumping station drains developments along the Swords Road

3. Carey's Lane Pumping Station

   Draining the Carey's Lane development up the Malahide Road to the junction with the Swords Road known as McAlister's Garage.

Both the Abington and Carey's Lane pumping stations are private and have not been designed for any significant additional development flows. Carey's Lane pumping station discharges to the existing sewers on Swords Road, where some spare capacity has previously been identified. However, there is no longer capacity in the Swords Road foul sewer as advised by Irish Water.

Although the Local Network Reinforcement Project has reduced the flows discharging to the Connolly Avenue pumping station, Irish Water have advised that it still has capacity constraints and is not suitable for significant additional development.

Refer to Figure 2, overleaf, which shows the location of existing pumping stations, rising mains and the new gravity main from Floraville to the Chapel Road Pumping Station.

2.2 Foul Water Network Upgrades

On 3 March 2020, Waterman Moylan met with John O'Shaughnessy, Dermot Phelan, Keith Kirwan and Fergal Broderick of Irish Water to discuss the foul drainage options available to service the subject development and to establish the scope of any upgrades that might be required to accommodate the proposed development. The meeting was also for the purpose of understanding what upgrades Irish Water proposed for this area and the current status of any such upgrades.

As noted above, Irish Water have recently completed a Local Network Reinforcement Project, which comprises of a new pumping station on Chapel Road discharging via a new rising main to the existing North Fringe Interceptor Sewer, south of the site in Marrsfield Avenue, Clongriffin. The Floraville pumping station

at Kinsealy was decommissioned and diverted by a new gravity sewer to the new Chapel Road pumping station. These works were completed and commissioned in the last quarter of 2021.

In November 2021 Irish Water advised of a future new pumping station on Kinsealy Lane, which would pump wastewater south to the new Chapel Road Pumping Station. This is intended to relieve capacity constraints at Connolly Avenue Pumping Station and is referred to as the Castleway Pumping Station.

A Pre-Connection Enquiry was submitted to Irish Water and a new Confirmation of Feasibility (CoF) Letter was issued, 29 November 2021 – a copy of the letter is included in Appendix A. The confirmation of feasibility letter states that connection to the Irish Water network is feasible for the proposed Auburn development via a new rising main from the Auburn site to the new gravity sewer at Floraville Pumping Station in Kinsealy, which in turn drains to the new Chapel Road pumping station. It was agreed with Irish Water that the proposed rising main along Kinsealy Lane would need to be designed and constructed to allow the future Castleway Pumping Station to utilise the rising main so as to avoid multiple rising mains along Kinsealy Lane.

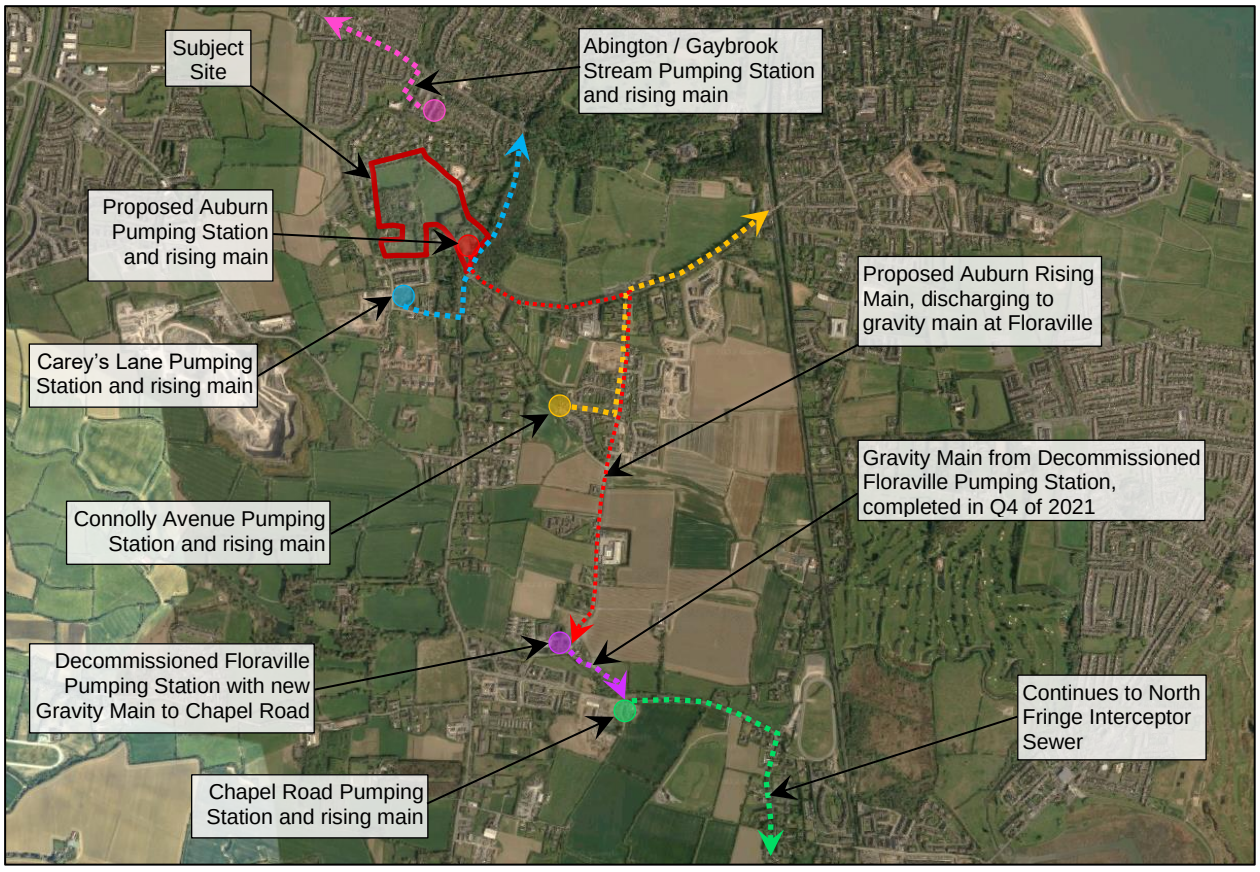

Figure 3 | *Existing Pumping Stations and Proposed Auburn Pumping Station*

A Statement of Design Acceptance has also been issued by Irish Water for the proposed development, dated 28 March 2022, and is included in Appendix B. The letter states that Irish Water has no objection to the proposals.

2.3 Proposed Foul Water Network

It is proposed to drain wastewater in a south-easterly direction through a series of 150mm and 225mm sewers to a proposed new pumping station near the site entrance, as shown on Waterman Moylan drawings 19-020-P200 to P203.

The majority of this proposed pumping station will be below ground and will not be visible to those visiting the site, with only the kiosk above ground. The above ground control kiosk will be 2.0 wide by 1.2m deep by 1.8m high. The pumping station will be secured and screened with a 1.8m high black twin wire fence and landscaping as outlined in the accompany Landscape Architects drawings.

The wastewater pumping station will have a 24-hour storage tank (c.169m^3 of storage for 369 units) and will be designed in accordance with Irish Water requirements. In order to minimise the risk of odour, noise and vibration nuisance, a buffer zone of 35m is proposed between the pumping station and the nearest property, in accordance with Fingal County Council's Development Plan, Objective WT12. There are no existing or proposed buildings within this 35m buffer zone.

As agreed with Irish Water and confirmed in their CoF, wastewater will be pumped from the development site via Back Road and Kinsealy Lane to outfall via a stand-off manhole to the new gravity sewer, where it will drain by gravity to the new Chapel Road pumping station (as described in Section 2.2 above) and ultimately to the North Fringe Interceptor Sewer, all as shown on Waterman Moylan drawing number 19-020-P205.

It was agreed with Irish Water that the proposed rising main along Kinsealy Lane would be designed and constructed to allow the future Castleway Pumping Station to utilise the rising main and therefore avoid multiple rising mains along Kinsealy Lane. This proposed rising main is designed to accommodate flows from the Kinsealy Lane Pumping Station and to ensure that there are no septicity issues arising. The detailed rising main design will form part of the Connection Agreement with Irish Water for the Auburn Pumping Station prior to any construction on site.

Fingal County Council have issued a letter of consent, which accompanies this submission, for the necessary works on public roads / lands to facilitate the proposed rising main.

2.4 Foul Water Drainage Calculations

The calculated foul water flows at the subject development are set out in the Table overleaf. Domestic wastewater loads have been calculated based on 2.7 persons per unit with a daily per capita wastewater flow of 150 litres with a 10% unit consumption allowance, in line with Section 3.6 of the Irish Water Code of Practice for Wastewater Infrastructure. A peak flow multiplier of 3 has been used, as per Section 2.2.5 of Appendix B of the Code of Practice.

It is estimated that the crèche will generate flow for 50 people (8 staff and 42 children), with a wastewater volume of 90 litres per head per day, based on the figure for the most similar type of usage: a non-residential school with canteen facilities, also as per Appendix C of the Code of Practice.

Description	Total Population	Load per Capita	Daily Load	Total DWF	Peak Flow
	No. People	*l/day*	*l/day*	*l/s*	*l/s*
88 Houses	237.6	150	39,204.0	0.454	1.361
42 Duplexes	113.4	150	18,711.0	0.217	0.650
239 Apartments	645.3	150	106,474.5	1.232	3.697
Crèche	50	90	4,950.0	0.057	0.172
Total	**1,046.3**	**-**	**169,339.5**	**1.960**	**5.880**

Table 2 | *Calculation of Total Foul Water Flow from the Development*

The total dry weather flow from the development is 1.96 l/s, with a peak flow of 5.88 l/s. This wastewater flow will come online as the development is built out and occupied.

2.5 Proposed Pumping Station & Rising Main

As noted above, a new pumping station is proposed near the site entrance. This pumping station will pump wastewater approximately 835m eastwards along Back Road, before turning southwards along Kinsealy Lane for approximately 1,540m and discharging to a public foul water gravity sewer via a stand-off manhole. This gravity sewer in turn discharges to the Chapel Road Pumping Station under development by Irish Water.

The proposed pumping station will be sized to accommodate the fully developed site. The total length of the proposed rising main is c.2,375m. The size of the proposed rising main for the development will be 110mmOD/90mmID. This section provides relevant information in respect of hydraulic and storage calculations and septicity. The capacity of the pumps to be provided have been based on the following design criteria:

Rising Main diameter	90mm
Length of Rising Main which is pumped	2,375m
Dry Weather Flow	1.960l/s

Table 3 | *Pumping Station Design Criteria*

It is proposed to provide a minimum of 24-hour emergency storage as required by Irish Water. The 24-hour storage requirement, at a flow rate of 1.96l/s, is 169m^3.

The pump station is designed to deliver a minimum peak flow of 3 times the Dry Weather Flow.

Dry Weather Flow	**Peak Flow** *(3xDWF)*	**Design Flow** *(Peak Flow in m³/hr)*
1.960l/s	5.880l/s	21.167m³/hr

Table 4 | *Design Flow Rate*

Velocities have been calculated for the 90mm rising main to achieve the minimum pump rate required to achieve self-cleansing velocity. The Irish Water Code of Practice states that discharge velocities should be in the range of between 0.75m/s to 1.8m/s to achieve self-cleansing velocity.

Velocity	**Required Flow Rate**	**DWF Factor**
0.818m/s	5.20l/s	2.66

Table 5 | *Pump Flow Rate*

It is proposed to introduce chemical dosing to address the septicity issues until the self-cleansing velocity is achieved. The retention time has been determined as follows:

Flow Rate	**Volume Rising Main**	**Retention Time**
169.3m³/day	15.109m³	2.14 Hours

Table 6 | *Retention Time*

Based on these calculations, there will be no septicity in the rising main with the development fully occupied. Chemical dosing will only be required when the retention time exceeds 6 hours, which occurs when the daily flow rate is below approximately 60.5m^3, equivalent to 45 dwellings or fewer occupied. Once 46 of the proposed dwellings are occupied, chemical dosing will no longer be required.

The Foul Rising Main Outfall Layout is shown on Waterman Moylan Drawing No. 19-020-P205, and construction details for the Pumping Station are shown on Drawing No. 19-020-P206. Rising Main Longitudinal Sections are shown on Drawing No.'s 19-020-P208 to P211.

2.6 Foul Water Drainage – General

Foul water sewers will be constructed strictly in accordance with Irish Water requirements. No private drainage will be located within public areas.

Drains will be laid to comply with the requirements of the latest Building Regulations, and in accordance with the recommendations contained in the Technical Guidance Document H.

3. Surface Water Network

3.1 Existing Surface Water Network

The subject site is generally flat with gentle slope from west to east. The existing drain along the northern and eastern boundary of the site (within the Abington development) discharges to an existing culvert under the Malahide Road close to the entrance to the site at the junction with Back Road. This drain is very flat at an estimated average gradient of 1/1000 over its 700-metre length along the north-eastern boundary and through the lands to the entrance of the site.

Surface water from the site discharges into a series of ditches on-site. The ditches drain eastwards and merge with the Hazelbrook Stream, east of the Malahide Road, which is a tributary of the Sluice River that ultimately outfalls to Baldoyle Bay at Portmarnock.

3.2 Proposed Surface Water Network and SuDS Strategy

For storm water management purposes, it is proposed to divide the site into three separate sub-catchments, as indicated in the Figure below:

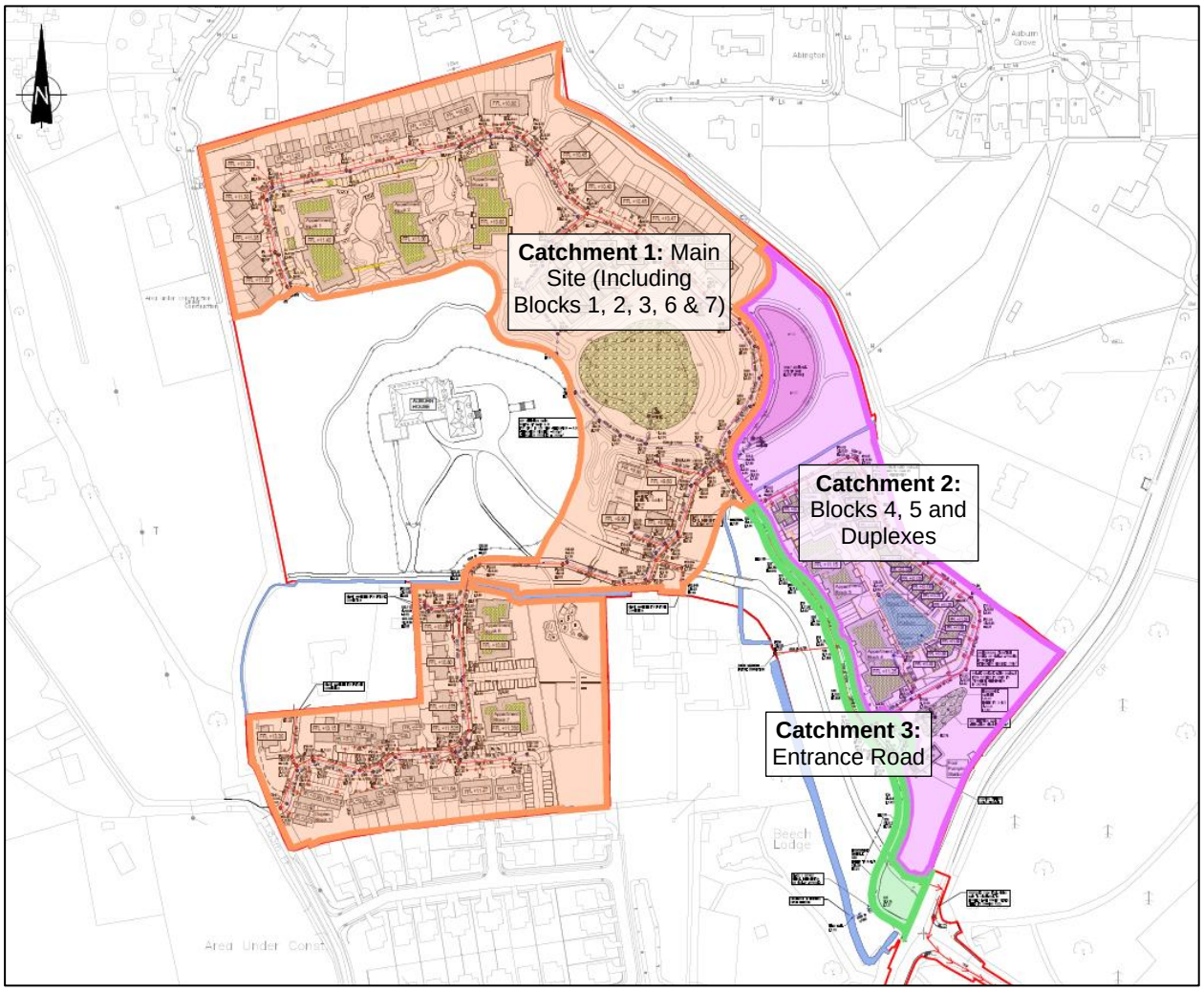

Figure 4 | *Proposed Sub-Catchments*

Catchment 1, which comprises the main portion of the site including the houses and Blocks 1, 2, 3, 6 and 7, is approximately 71,330m^2. It will be attenuated in a proposed dry detention basin in the open space at the centre of the site.

Catchment 2, which includes Blocks 4 and 5 and the duplex units, is approximately 22,770m^2. It will utilise a private on-site attenuation tank / system beneath the courtyard area. This tank is to be privately managed and maintained. The location and level of these Blocks relative to the outfall surface water pipe does not allow for above ground attenuation.

Catchment 3, the entrance road, is approximately 3,040m^2 and will be attenuated in a dry detention basin near the site entrance.

Storm water from each catchment will discharge at a controlled rate, limited to the greenfield equivalent runoff, to the existing streams on the site. The proposed development will be designed to incorporate best drainage practice. Section 3.3, below, sets out the methodology used in determining the existing greenfield runoff rates and calculating attenuation storage requirements for the site. The relevant calculations are included in full in Appendix C.

It is proposed to incorporate a Storm Water Management Plan through the use of various SuDS techniques to treat and minimise surface water runoff from the site. The methodology involved in developing a Storm Water Management Plan for the subject site is based on recommendations set out in the Greater Dublin Strategic Drainage Study (GDSDS) and in the SuDS Manual. Based on three key elements – Water Quantity, Water Quality and Amenity – the targets of the SuDS train concept have been implemented in the design, providing SuDS devices for each of the following (refer also to the SuDS Selection Checklist included in Appendix D):

- Source Control
- Site Control
- Regional Control

3.2.1 Source Control

Permeable Paving:

It is proposed to introduce permeable paving at all private driveways and parking courts throughout the development. Downpipes from the front of the houses and apartments will drain to filter drains beneath the permeable paving to facilitate maximum infiltration of surface water from driveways and roof areas.

The goal of permeable paving is to control stormwater at the source to reduce runoff. In addition to reducing surface runoff, permeable paving has the dual benefit of improving water quality by trapping suspended solids and filtering pollutants in the substrata layers.

Filter Drains:

It is proposed to install 225mm diameter filter drains, consisting of perforated pipes surrounded in filter stone around the perimeter of each apartment block. The filter drains will provide infiltration, optimise the retention time and provide quality improvement to the storm water runoff, in particular the first flush from hardstanding areas. The proposed perforated pipes connect to the proposed surface water sewer network.

Green Roof:

It is proposed to introduce green roofing as a source control device. The green roofing is proposed to cover a cumulative area of 4,646m^2 across the apartment and duplex blocks. The green roofing shall consist of 75mm substrate with a sedum blanket. This is in line with FCC's document titled: Green/Blue Infrastructure for Development – Guidance notes, which stipulates that a green roof should be provided where a roof surface area exceeds 300m^2.

The substrate and the plant layers in a green roof absorb large amounts of rainwater and release it back into the atmosphere by transpiration and evaporation. They also filter water as it passes through the layers, so the run-off, when it is produced, has fewer pollutants. Rainfall not retained by green roofs is detained, effectively increasing the time to peak and slowing peak flows.

A green roof can reduce annual percentage runoff by between 40% and 80% through this retention and evapotranspiration, with the impact dependent on a range of factors including the depth of substrate, the saturation of substrate at the onset of a rain event, the angle of the roof, the range of vegetation growing, intensity of rainfall and the time of year.

Bio-retention Systems:

Bio-retention planted areas will be provided within the private domain around apartment blocks. Planted boxes will intercept down pipes from the apartment blocks.

3.2.2 Site Control

Roadside Trees:

It is proposed to provide roadside trees throughout the development. Trees can help control storm water runoff because their leaves, stems, and roots slow rain from reaching the ground and capture and store rainfall to be released later. Trees help to attenuate flows, trap silts and pollutants, promote infiltration and prevent erosion. Incorporating tree planting offers multiple benefits, including attractive planting features, improved air quality and increased biodiversity whilst helping to ensure adaptation to climate change.

Excess Out-of-Bank Storage:

As part of the previous submission, it was agreed with Fingal County Council that additional out of bank flood storage would be provided for the existing ditch to facilitate out-of-bank flow for the 30-year storm return period. This will minimise further any risk of any possible downstream flooding. Note that this out-of-bank storage is over and above the required attenuation storage provided.

A portion of the open space at the east of the site, north of the existing ditch/stream, is proposed to be lowered by 300mm to provide 600m^3 of additional storage for out-of-bank flows from the existing ditch/stream. The location of this additional storage has been changed since the previous application in order to avoid removal of hedgerows. Refer to drainage drawing no. 19-020-P203 for the location of this out-of-bank storage.

3.2.3 Regional Control

Dry Detention Basins:

A dry detention basin is proposed in the open space at the centre of the site, designed to store surface excess surface water Catchment 1. It has been sized to accommodate excess surface water for up to the 1-in-100 year storm event, accounting for a 20% increase due to climate change. The detention basin will typically remain dry but will act as a storage pond during extreme rainfall events.

A second dry detention basin is also proposed to cater for surface water discharge from the entrance road.

Attenuation Storage Tanks:

As noted above, Catchment 2 will be attenuated in privately managed and maintained in an underground attenuation tank / system.

Flow Control:

A flow control device is proposed at the outfall from the detention basins and tanks, with flows limited to the greenfield equivalent runoff rate.

Petrol Interceptor:

A Petrol interceptor is to be installed before each surface water outfall to the existing network. These Interceptors will remove hydrocarbons from surface flows before they outfall to natural watercourses.

3.3 Interception or Treatment Storage and Attenuation Storage

As noted above, the methodology involved in developing the Storm Water Management Plan for the subject site is based on recommendations set out in the Greater Dublin Strategic Drainage Study (GDSDS) and in the SuDS Manual. Appendix E of the Greater Dublin Strategic Drainage Study (GDSDS) sets out criteria for determining the provision of interception or treatment storage, attenuation storage and long-term storage at a development site. These calculations are included in full in Appendix C and are summarised below:

3.3.1 Criterion 1: River Water Quality Protection

Criterion 1.1: Interception

The Greater Dublin Strategic Drainage Study (GDSDS) states that approximately 30% to 40% of rainfall events are sufficiently small that there is no measurable runoff from greenfield areas into the receiving waters. These events are generally considered as the first 5mm of rainfall. Assuming 80% runoff from paved surfaces and 0% from pervious surfaces for the first 5mm of rainfall yields the following:

Catchment 1	Paved surfaces connected to drainage system	*71330m² x 0.49 x 1 =* 34,951.70m²	*71,330m² site area* *49% of the site is paved* *100% of the paved area*
	Volume of Interception Storage	*34951.7m² x 5mm x 0.8 =* **139.81m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*
Catchment 2	Paved surfaces connected to drainage system	*22770m² x 0.3 x 1 =* 6,831.00m²	*22,770m² site area* *30% of the site is paved* *100% of the paved area*
	Volume of Interception Storage	*6831m² x 5mm x 0.8 =* **27.32m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*
Catchment 3	Paved surfaces connected to drainage system	*3040m² x 0.86 x 1 =* 2,614.40m²	*3,040m² site area* *86% of the site is paved* *100% of the paved area*
	Volume of Interception Storage	*2614.4m² x 5mm x 0.8 =* **10.46m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

Table 7 | *Interception Calculation*

The required interception volume is 139.81m³ for Catchment 1, 27.32m³ for Catchment 2 and 10.46m³ for Catchment 3.

Criterion 1.2: Treatment Volume

For events larger than 5mm, and in situations where interception storage cannot be provided, surface water runoff treatment is provided using the detention basin or wetland in accordance with the CIRIA design manual C521.

Assuming 80% runoff from paved surfaces and 0% from pervious surfaces for the first 15mm of rainfall:

Catchment 1	Paved surfaces draining to river	*71330m² x 0.49 x 1 =* 34,951.70m²	*71,330m² site area* *49% of the site is paved* *100% of the paved area*
	Volume of Treatment Storage	*34951.7m² x 15mm x 0.8 =* **419.42m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*
Catchment 2	Paved surfaces draining to river	*22770m² x 0.3 x 1 =* 6,831.00m²	*22,770m² site area* *30% of the site is paved* *100% of the paved area*
	Volume of Treatment Storage	*6831m² x 15mm x 0.8 =* **81.97m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*
Catchment 3	Paved surfaces draining to river	*3040m² x 0.86 x 1 =* 2,614.40m²	*3,040m² site area* *86% of the site is paved* *100% of the paved area*
	Volume of Treatment Storage	*2614.4m² x 15mm x 0.8 =* **31.37m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

Table 8 | *Treatment Volume Calculation*

The required treatment volume is 419.42m³ for Catchment 1, 81.97m³ for Catchment 2 and 31.37m³ for Catchment 3.

The required interception and treatment volumes are provided through the use of various SuDS features as described in Section 3.2.1, above.

3.3.2 Criterion 2: River Regime Protection

Attenuation storage is provided to limit the discharge rate from the site into receiving waters. As per the GDSDS, the required attenuation volume is calculated assuming 100% runoff from paved areas, and has been calculated for the 1-year, 30-year and 100-year return periods, identifying the critical storm for each – refer to the calculations included in Appendix C.

As noted above, the site has been divided into four sub-catchments which will be attenuated separately. Based on the calculations included in Appendix C, the required attenuation storage volume for each sub-catchment is set out in the table below:

Catchment		Area	Allowable Discharge Rate	Required Attenuation Volume
		m^2	m^3/s	m^3
Catchment 1:	Main Site	71,330	17.83	2,376.66
Catchment 2:	Blocks 4 & 5 and Duplexes	22,770	5.69	377.30
Catchment 3:	Entrance Road	3,040	2.00	148.58
Total		**97,140**	**25.52**	**2,902.54**

Table 9 | *Attenuation Volume for Each Sub-Catchment*

Catchment 1 will be attenuated in the regional detention basin proposed in the open space at the centre of the site. The proposed basin will normally remain dry except in extreme weather events and will have a storm water storage capacity of 2,406m³. This provides a storage capacity in excess of the required storage volume of 2,377m³, and will accommodate the 1-in-100-year storm volume from the main site, accounting for a 20% increase due to climate change. Water will discharge from the basin to the existing ditch network via a Hydrobrake or similar approved flow control device at a controlled discharge rate limited to 18l/s.

Catchment 2 will be attenuated in a privately managed and maintained StormTech or similar approved underground attenuation tank / system. Surface water will be stored in the attenuation tank / system during storm events, discharging to the public surface water network via a flow control device limited to the greenfield equivalent runoff rate as shown in the Table above, and on the accompanying drainage drawings.

Catchment 3 is to be attenuated in a dry detention basin located near the site entrance. The basin will typically be dry, and water will only accumulate during storm events, discharging at a controlled rate of 2l/s.

The proposed attenuation for each catchment provides sufficient storage to accommodate the 1-in-100-year storm volume, accounting for a 20% increase due to climate change.

3.3.3 Criterion 3: Levels of Service

There are four criteria for levels of service. These are:

Criterion 3.1: No external flooding except where specifically planned (30-year high intensity rainfall event).

Criterion 3.2: No internal flooding (100-year high intensity rainfall event).

Criterion 3.3: No internal flooding (100-year river event and critical duration for site storage).

Criterion 3.4: No flood routing off site except where specifically planned (100-year high intensity rainfall event).

Both internal and external flooding have been assessed in the Flood Risk Assessment report which accompanies this Engineering Assessment report. The Flood Risk Assessment has been carried out in accordance with the *DEHLG/OPW Guidelines on the Planning Process and Flood Risk Management* published in November 2009.

The assessment identifies the risk of both internal and external flooding at the site from various sources and sets out mitigation measures against the potential risks of flooding. The sources of possible flooding assessed in the report include coastal, fluvial, pluvial (direct heavy rain), groundwater and human/mechanical errors.

As a result of the flood risk management and mitigation measures proposed, the residual risk of internal or external flooding for the 30-year and 100-year flood events is low, and accordingly all four of the above

criteria have been met. Please refer to the accompanying Flood Risk Assessment report for the full analysis of the flood risk at the subject site.

3.3.4 Criterion 4: River Flood Protection

The long-term storage volume is a comparison of pre- and post-development runoff volumes. The objective is to limit the runoff discharged after development to the same as that which occurred prior to development.

Of the three methods described in the GDSDS for establishing River Flood Protection by comparison of the pre- and post-development runoff volumes, (Criteria 4.1, 4.2 and 4.3 respectively), Criteria 4.3 is selected for use as the most practical criteria at this stage in the design.

The Criteria 4.3 approach is for all runoff to be limited to either Q_{BAR} or to 2 l/s/Ha, whichever is the greater. The proposed drainage system includes flow control devices at the outfall for each catchment to ensure that the discharge rate is limited to the greenfield equivalent and ample attenuation is provided for the 1-in-100 year storm, accounting for a 20% increase due to climate change.

The extra runoff volume of the development runoff over greenfield runoff, Vol_{xs}, is calculated in Appendix C for each of the four sub-catchments. Note that as stated in the GDSDS, this volume is not additional to the attenuation storage volume but is effectively an element of it.

3.4 Surface Water – General

Surface water sewers will generally consist of PVC (to IS 123) or concrete socket and spigot pipes (to IS 6) and laid strictly in accordance with Fingal County Council requirements for taking in charge. It is intended that all sewers within the public domain will be handed over to Fingal County Council for taking in charge.

All private outfall manholes will be built in accordance with the Greater Dublin Regional Code of Practice for Drainage Works. No private drainage will be located within public areas.

Drains will be laid in accordance with the requirements of the Building Regulations, Technical Guidance Document H.

3.5 Flood Risk Assessment

A site-specific Flood Risk Assessment has been carried out by JBA Consulting for the proposed development and an overall Flood Risk Assessment has been prepared by Waterman Moylan. Both reports accompany this submission under separate cover.

4. Water Supply

4.1 Existing Water Supply

Irish Water records for the surrounding area have been provided by Fingal County Council and are extracted below.

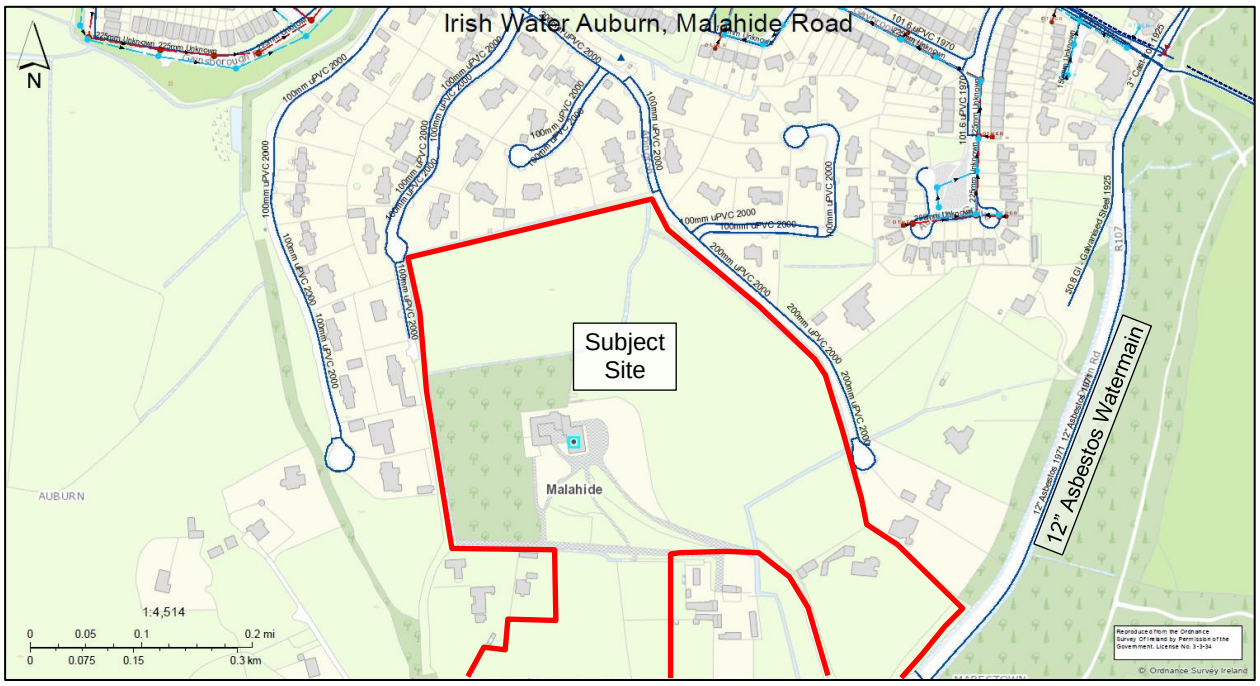

Figure 5 | *Extract of Irish Water's Water Supply Service Records (provided by FCC)*

There is a 12" (c. 300mm) diameter water supply main in the R107 Malahide Road and a 100mm watermain to the south west of the site in Carey's Lane.

4.2 Proposed Water Supply

It is proposed to connect to the 12" (c.300mm) watermain in the Malahide Road and the 100mm watermain in Carey's Lane.

The proposed network consists of a 150mm diameter watermain running along the Main Access Road, with a series of 100mm diameter branches. Refer to watermain drawings 19-020-P300 to P303 for the proposed watermain layout.

As noted in Section 2.2 above, a pre-connection enquiry was submitted to Irish Water; the response letter from Irish Water, dated 13 September 2021, is included in Appendix A. In this letter, Irish Water state that a new connection to the existing network is feasible without upgrades.

A Statement of Design Acceptance has also been issued by Irish Water for the proposed development, dated 28 March 2022, and is included in Appendix B. The letter states that Irish Water has no objection to the proposals.

4.3 Water Supply Calculations

The calculated water demand at the subject development is set out in the Table below. The average domestic demand has been established based on an average occupancy ratio of 2.7 persons per dwelling

with a daily domestic per capita consumption of 150 litres and with a 10% allowance factor. The average day/peak week demand has been taken as 1.25 times the average daily domestic demand, while the peak demand has been taken as 5 times the average day/peak week demand, as per Section 3.7.2 of the Irish Water Code of Practice for Water Infrastructure. The water demand for the crèche is based on a per capita daily consumption rate of 90 litres.

Description	Total Population	Water Demand	Average Demand	Average Peak Demand	Peak Demand
	No. People	*l/day*	*l/s*	*l/s*	*l/s*
88 Houses	237.6	39,204	0.454	0.567	2.836
42 Duplexes	113.4	18,711	0.217	0.271	1.354
239 Apartments	645.3	106,475	1.232	1.540	7.702
Crèche	50	4,950	0.057	0.072	0.358
Total	**1,046.3**	**169,340**	**1.960**	**2.450**	**12.250**

Table 10 | *Calculation of Water Demand for the Development*

The average demand for the development is 1.96l/s, with a peak demand of 12.25l/s. This water demand will come online as the development is built out and occupied.

4.4 Water Supply – General

All watermains will be laid strictly in accordance with Irish Water requirements for taking in charge.

Valves, hydrants, scour and sluice valves and bulk water meters will be provided in accordance with the requirements of Irish Water.

5. Roads and Transport Network

This section provides an overview of the existing and proposed road and transportation network in the vicinity of the site. A comprehensive Traffic and Transport Assessment and a Travel Plan have also been prepared by Waterman Moylan in accordance with the requirements of the Traffic and Transport Assessment Guidelines published by National Roads Authority in May 2014, and accompany this submission under separate cover. A DMURS Statement of Design consistency has also been prepared by Waterman Moylan, in collaboration with other members of the multi-disciplinary design team, and accompanies this submission under separate cover

5.1 Existing Road Layout

The existing site entrance is from the Malahide Road, approximately 20m north of the Malahide Road/Back Road junction. The Malahide Road has a posted speed limit of 60km/hr and extends from Malahide to Dublin City Centre.

The Swords Road is approximately 500m north of the subject site and can be accessed from the Malahide Road. This road continues in a westerly direction to Swords, crossing the M1 motorway approximately 1.6km west of the site. The Feltrim Road, approximately 1km south of the site, can also be accessed from the Malahide Road, and provides a connection in a north-westerly direction towards Swords.

5.2 Proposed Road Layout

Various access options for the site have been assessed by the multi-disciplinary design team. Of particular concern was the retention of as many trees as possible while providing a safe and suitably sized access to the development. The full assessment of these options accompanies this submission under separate cover by Downey Planning. The main options assessed were:

- Option 1: Providing a new access adjacent to Back Road, to form a new 4-arm signalised junction.
- Option 2: Utilising the existing access to Auburn House as the primary site access, to form a new staggered signalised T-junction.
- Option 3: Utilising both the existing access to Auburn House and the existing access to Little Auburn, with one serving as the vehicular entrance and the other as the exit from the site, forming a staggered priority crossroads with Back Road and the Auburn House entrance, and a priority T-junction at the Little Auburn exit.
- Option 4: Utilising the existing access to Little Auburn as the primary site access in the form of a new priority T-junction.

The assessment determined that Option 1, a new 4-arm signalised junction adjacent to Back Road, is preferable from a roads and transportation viewpoint. During the pre-planning process Fingal County Council Roads and Transportation department noted that this was their preferred option and the only feasible option.

Refer to the Proposed Malahide Road Junction Upgrade Layout drawing 19-020-P110. This proposed junction drawing was discussed and agreed in principle with Fingal County Council Roads and Transportation Department in February 2022.

A secondary site entrance is proposed from Carey's Lane, at the south-west of the site.

The internal road network includes local access roads and "home-zone" / shared surfaces, as shown on Waterman Moylan's site layout drawings 19-020-P002, 19-020-P100 to P103 and road cross sections drawing 19-020-P130. The location and design of the Homezone in the northwest of the site has been

agreed in principle with Fingal County Council Roads and Transportation Department in February 2022. This is now the only homezone in the proposed development.

The proposed road hierarchy is shown in the Figure below:

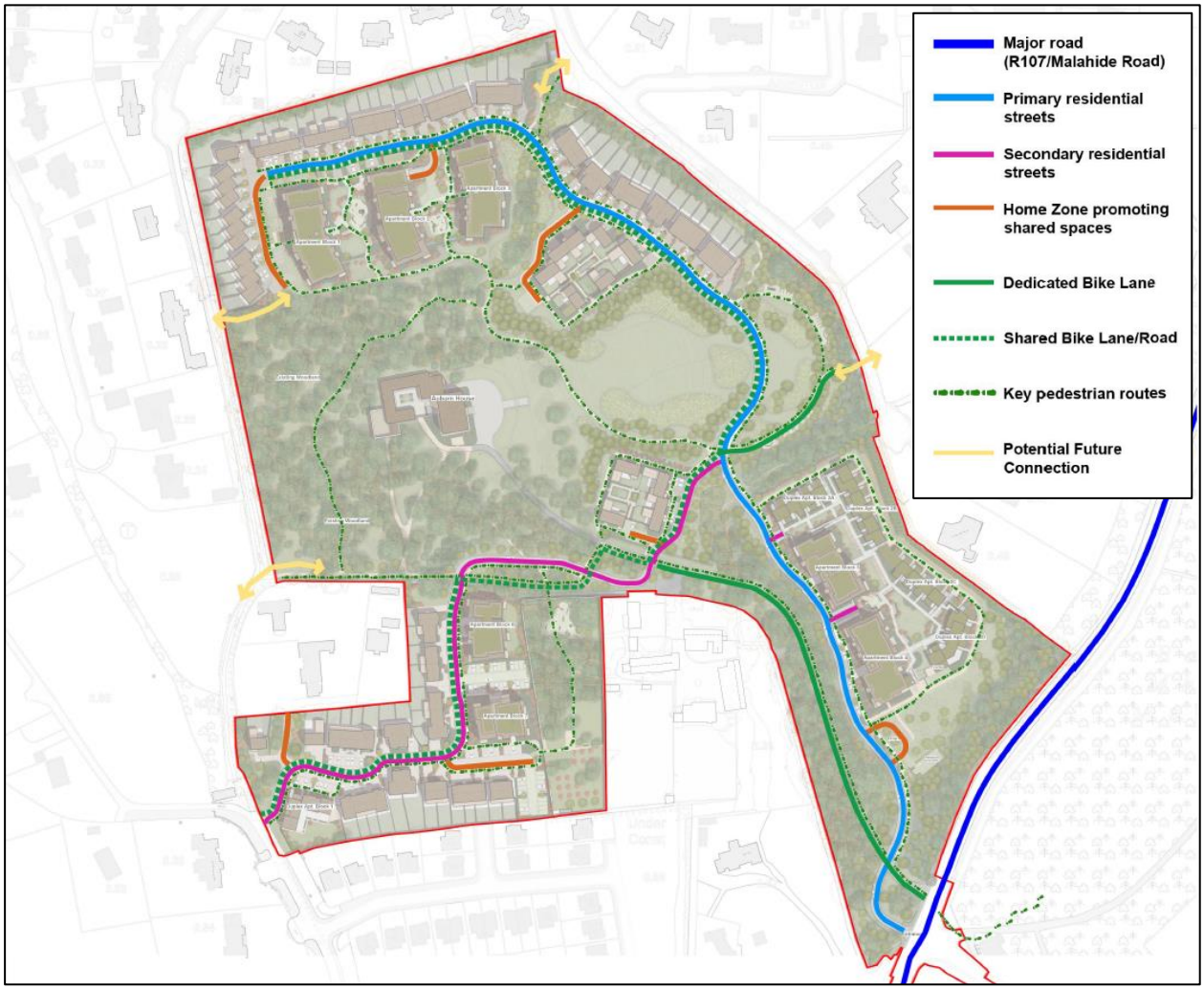

Figure 6 | *Road Hierarchy*

5.2.1 Design Manual for Urban Roads and Streets

The proposed development has been designed by the multi-disciplinary design team to comply with the objectives of the Design Manual for Urban Roads and Streets (DMURS). In this regard, a separate DMURS Statement of Design Consistency report has been prepared and accompanies this report under separate cover.

5.2.2 Quality Audit

A Quality Audit, including a Stage 1 Road Safety Audit, has been carried out by Bruton Consulting Engineers. For further information on the Quality Audit, refer to the DMURS Statement of Design Consistency which accompanies this submission under separate cover.

5.3 Related Reports

5.3.1 Traffic and Transport Assessment

As noted above, a comprehensive Traffic and Transport Assessment has been prepared by Waterman Moylan and accompanies this submission under separate cover. The Traffic and Transport Assessment provides a comprehensive review of all the potential transport impacts of the development, including a detailed assessment of the transportation systems provided and the impact of the proposed development on the surrounding environment and transportation network.

5.3.2 Travel Plan

A Travel Plan has been prepared by Waterman Moylan and accompanies this submission under separate cover. This Travel Plan is intended to deal with the typical day-to-day operational conditions at the site to assess, examine and manage the typical traffic that will be generated by the residential units during the operational phase of the development, and to propose measures to encourage residents to avail of public transport by improving awareness of public transport options and providing information on bus and train routes and frequencies.

5.3.3 DMURS Statement of Design Consistency

As noted above, a DMURS Statement of Design Consistency has been prepared by Waterman Moylan, in collaboration with other members of the multi-disciplinary design team, and accompanies this submission under separate cover. This report outlines specific design features that have been incorporated within the proposed scheme with the objective of delivering a design that is in compliance with the Design Manual for Urban Roads and Streets (DMURS).

5.3.4 Site Access Options

Downey Planning, in collaboration with other members of the multi-disciplinary design team including Waterman Moylan, have prepared a report assessing the various site access options. This assessment was used to determine the optimal option accounting for the requirements of the various disciplines.

Appendices

A. Irish Water Confirmation of Feasibility Letter

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Waterman Moylan
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Eastpoint Business Park,
Block S, Alfie Byrne Road
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Co. Dublin
D03H3F4

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

13 September 2021

Re: CDS20005975 pre-connection enquiry - Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 440 unit(s) at Malahide Road, Fingal, Co. Dublin

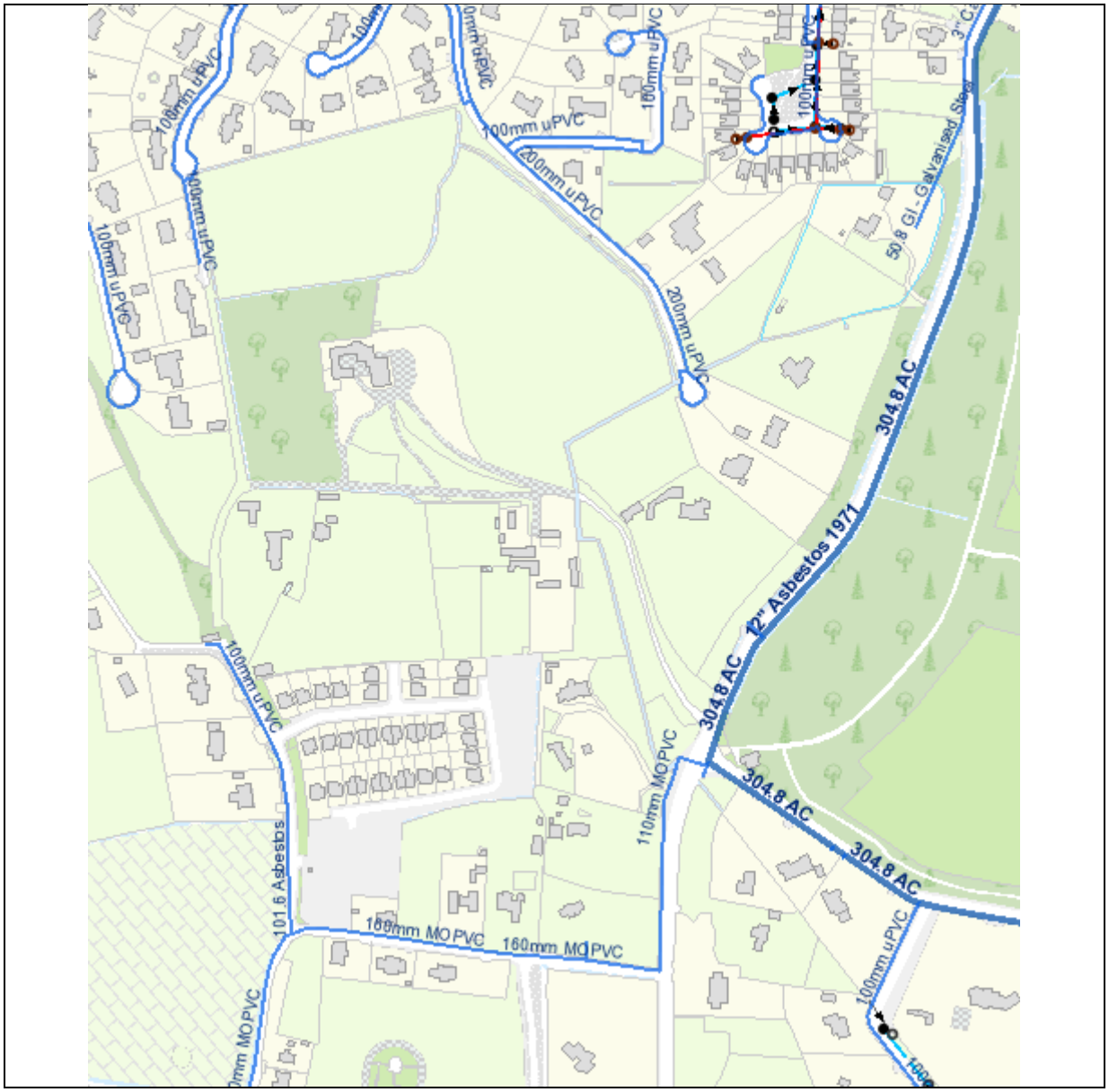
Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Malahide Road, Fingal, Co. 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 subject to upgrades
SITE SPECIFIC COMMENTS	
Water Connection	New connection to the existing network is feasible without upgrade
Wastewater Connection	Feasible subject to the delivery of the following: A new Kinsealy Lane Pumping Station (Castleway Pumping Station): a) Delivery of a new pumping station to serve the existing and future Connolly Avenue pumping station catchment. b) Procurement of additional lands to facilitate the provision of a total storage volume of 530m3. This includes 362m3of existing storage at the site. An additional 168m3 storage volume and associated area is required. c) Identification of the required changes to the Malahide discharge licence. d) All environmental (assimilative capacity of receiving water), archaeological and statutory assessments.

	e) Increase the capacity of the new Chapel Lane pumping station (Capital Investment Plan project) from 53l/s to 94l/s. f) Upgrade to the gravity network to the new Castleway Pumping Station. g) Upgrade the foul network downstream of the new Castleway Pumping Station to connect to the new Chapel Lane Pumping Station. h) Provision of Mechanical Electrical and Instrumentation, Control and Automation (MEICA). i) Scope of works requirements to incorporate existing MEICA operational requirements (FCC/Irish Water). **Interim Solution:** • New Rising Main from the proposed site to the Floraville Pumping Station bypass (subject to the delivery of the Chapel Lane Pumping Station (CIP, Local Network Reinforcement Project) • The overall design to allow the proposed Rising Main on Kinsealy Lane to be transferred to a new Kinsealy Lane Pumping Station (Castleway Pumping Station) upon its completion • Rising Main design to provide for flows from the Castleway Pumping Station and also septicity issues. Irish Water does not have any plans, in the current Capital Investment Programme (CIP), to undertake these upgrades to facilitate this connection. Should you wish to progress upgrades and associated works, Irish Water may require you to provide a contribution of a relevant portion of the costs for the required upgrades. Engagement with Irish Water will be required to agree the delivery mechanism for the upgrades Completion of the Chapel Lane Pumping Station (CIP, Local Network Reinforcement Project) and rising main to the North Fringe Sewer. This upgrade project is currently in progress and scheduled to be completed by Q4 2021 (this may be subject to change).
The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.	

The map included below outlines the current Irish Water infrastructure adjacent to your site:



Reproduced from the Ordnance Survey of Ireland by Permission of the Government. License No. 3-3-34

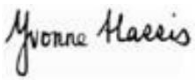
Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

General Notes:

1) The initial assessment referred to above is carried out taking into account water demand and wastewater discharge volumes and infrastructure details on the date of the assessment. **The availability of capacity may change at any date after this assessment.**
2) This feedback does not constitute a contract in whole or in part to provide a connection to any Irish Water infrastructure. All feasibility assessments are subject to the constraints of the Irish Water Capital Investment Plan.
3) The feedback provided is subject to a Connection Agreement/contract being signed at a later date.
4) A Connection Agreement will be required to commencing the connection works associated with the enquiry this can be applied for at https://www.water.ie/connections/get-connected/
5) A Connection Agreement cannot be issued until all statutory approvals are successfully in place.
6) Irish Water Connection Policy/ Charges can be found at https://www.water.ie/connections/information/connection-charges/
7) Please note the Confirmation of Feasibility does not extend to your fire flow requirements.
8) Irish Water is not responsible for the management or disposal of storm water or ground waters. You are advised to contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges
9) To access Irish Water Maps email datarequests@water.ie
10) All works to the Irish Water infrastructure, including works in the Public Space, shall have to be carried out by Irish Water.

If you have any further questions, please contact James O'Sullivan from the design team on 022 52269 or email jameosull@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,



Yvonne Harris

Head of Customer Operations

B. Irish Water 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

Robert Walpole
Block S Eastpoint Business Park
Alfie Byrne Road
East Wall, Dublin 3
Dublin D03H3F4

28 March 2022

Re: Design Submission for Malahide Road, Dublin, Co Dublin (the "Development") (the "Design Submission") / Connection Reference No: CDS20001740

Dear Robert Walpole,

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: James O'Sullivan
Phone: 022 52269
Email: jameosull@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

19-020-P200 Drainage General Arrangement
19-020-P201 Drainage Layout Sheet 1 of 3

19-020-P202 Drainage Layout Sheet 2 of 3

19-020-P203 Drainage Layout Sheet 3 of 3

19-020-P300 Watermain General Arrangement

19-020-P301 Watermain Layout Sheet 1of 3

19-020-P302 Watermain Layout Sheet 2 of 3

19-020-P303 Watermain Layout Sheet 3 of 3

Additional Comments

The design submission will be subject to further technical review at connection application stage

*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.

C. GDSDS Attenuation Calculations

Waterman Moylan
Engineering Consultants

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Alfie Byrne Road, Dublin D03 H3F4
t 01 664 8900 f 01 661 3618 e info@waterman-moylan.ie

Calculation By:	SDN
Approved by:	MD

Project Data

Catchment	1 - Main Site
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

Description		%	Area
Total Site Area		-	71,330m²
Paved Area	Total	49%	34,952m²
	Drained	100%	34,952m²
Soil Area	Total	51%	36,378m²
	Drained	0%	0m²

Soil Type:	Type 2
SPR Index (from FSR):	0.30
SAAR:	917mm
Rain Data:	Dublin Airport
Climate Change Factor:	20%

Greenfield Runoff:

$Q_{BARrural} = 0.00108 \times Area^{0.89} \times SAAR^{1.17} \times Soil^{2.17}$

Area = 0.07133km² … *Total site area in km²*
SAAR = 917mm … *Standard Average Annual Rainfall in mm*
SOIL = 0.30 … *The "SPR" index from FSR*

Note: Where a site is <0.5km², the $Q_{BARrural}$ formula should be applied for 0.5km² and the result factored based on the ratio of the actual site area and the applied area.

$Q_{BARrural}$ = 0.018m³/s
$Q_{BARrural}$ = 17.829 l/s
$Q_{BARrural}$ = 2.500 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	15.15	37.44	46.36
Q_{BAR} (l/s/Ha)	2.12	5.25	6.50
Allowable Discharge	17.83	17.83	17.83

Rainfall Data:

Rain Data From: Dublin Airport
Climate Change Factor: 20%

Duration	**Return Period** *(Years)*						
(Hours)	**1**	**5**	**10**	**20**	**30**	**50**	**100**
0.5	9.0	14.4	17.9	22.0	24.2	28.8	33.6
1	12.0	18.6	22.9	27.6	30.4	36.0	42.0
2	15.7	23.8	28.8	34.8	37.6	43.2	50.4
4	21.2	31.2	37.2	43.2	46.4	52.8	61.2
6	25.6	37.2	43.2	50.4	54.4	62.4	70.8
12	32.4	46.8	18.0	63.6	68.0	76.8	86.4

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Calculation By:	SDN
Approved by:	MD

Summary

Catchment	1 - Main Site
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**139.81m³**
Treatment Volume	**419.42m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	635.32m³
1-in-30-Year Storm	1,098.38m³
1-in-100-Year Storm	642.97m³
Reduction of Long-Term Storage	-928.22m³
Volume Required	**1,448.44m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**928.22m³**
Long Term Storage *(Interception provided)*	**788.41m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	635.32m³
1-in-30-Year Storm	1,098.38m³
1-in-100-Year Storm	642.97m³
Total	**2,376.66m³**

The maximum attenuation volume required is 2,376.66m³

Waterman Moylan
Engineering Consultants

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Calculation By:	SDN
Approved by:	MD

Criterion 1
River Protection Volume

Catchment	1 - Main Site
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

1.1 Interception

Paved surfaces connected to drainage system	*71330m² x 0.49 x 1 =* 34,951.70m²	*71,330m² site area* *49% of the site is paved* *100% of the paved area*
Volume of Interception Storage	*34951.7m² x 5mm x 0.8 =* **139.81m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*71330m² x 0.49 x 1 =* 34,951.70m²	*71,330m² site area* *49% of the site is paved* *100% of the paved area*
Volume of Treatment Storage	*34951.7m² x 15mm x 0.8 =* **419.42m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

Waterman Moylan
Engineering Consultants

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Calculation By:	SDN
Approved by:	MD

Criterion 2
River Regime Protection

Catchment	1 - Main Site
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

1-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	50.00	174.76	0.00	174.76	314.6	17.83	32.1	156.93	282.5
1	33.33	116.51	0.00	116.51	419.4	17.83	64.2	98.68	355.2
2	21.83	76.31	0.00	76.31	549.4	17.83	128.4	58.48	421.1
4	14.75	51.55	0.00	51.55	742.4	17.83	256.7	33.72	485.6
6	11.83	41.36	0.00	41.36	893.4	17.83	385.1	23.53	508.3
12	7.50	26.21	0.00	26.21	1,132.4	17.83	770.2	8.38	362.2

30-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	134.67	470.68	0.00	470.68	847.2	17.83	12.1	452.85	306.9
1	84.43	295.11	0.00	295.11	1,062.4	17.83	31.5	277.28	490.0
2	52.22	182.51	0.00	182.51	1,314.0	17.83	73.3	164.68	677.4
4	32.23	112.63	0.00	112.63	1,621.9	17.83	161.2	94.80	856.9
6	25.18	88.02	0.00	88.02	1,901.2	17.83	256.0	70.19	1,007.9
12	15.74	55.02	0.00	55.02	2,376.9	17.83	526.6	37.19	1,098.4

100-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	186.67	652.43	0.00	652.43	1,174.4	17.83	-13.0	634.60	-464.3
1	116.67	407.77	0.00	407.77	1,468.0	17.83	-9.3	389.94	-202.8
2	70.00	244.66	0.00	244.66	1,761.6	17.83	2.1	226.83	26.6
4	42.50	148.54	0.00	148.54	2,139.0	17.83	37.6	130.72	275.7
6	32.78	114.56	0.00	114.56	2,474.6	17.83	89.0	96.73	482.8
12	20.00	69.90	0.00	69.90	3,019.8	17.83	220.1	52.07	643.0

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Calculation By:	SDN
Approved by:	MD

Criterion 4
River Flood Protection

Catchment	1 - Main Site
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

Vol_{XS} = RD x A x 10 [(PIMP/100 x α0.8) + (1 - (PIMP/100))(β x Soil) - Soil]

Vol_{XS}			*… Extra runoff volume of development over Greenfield runoff*
RD	=	71 mm	*… Rainfall depth of the 100 year, 6 hour event mm*
A	=	7.133 Ha	*… Area of site*
PIMP	=	49%	*… Impermeable area of total site*
α0.8	=	100%	*… Proportion of paved area drained to drainage network or river with 80% runoff*
β	=	60%	*… Proportion of pervious area drained to the network or river*
Soil	=	0.30	*… SPR index*

Vol_{XS} = 928.22m³

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Calculation By:	SDN
Approved by:	MD

Project Data

Catchment	2 - Blocks 4 & 5 and Duplexes
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

Description		%	Area
Total Site Area		-	22,770m²
Paved Area	Total	30%	6,831m²
	Drained	100%	6,831m²
Soil Area	Total	70%	15,939m²
	Drained	0%	0m²

Soil Type:	Type 2
SPR Index (from FSR):	0.30
SAAR:	917mm
Rain Data:	Dublin Airport
Climate Change Factor:	20%

Greenfield Runoff:

$Q_{BARrural} = 0.00108 \times Area^{0.89} \times SAAR^{1.17} \times Soil^{2.17}$

Area = 0.02277km² … *Total site area in km²*
SAAR = 917mm … *Standard Average Annual Rainfall in mm*
SOIL = 0.30 … *The "SPR" index from FSR*

Note: Where a site is <0.5km², the $Q_{BARrural}$ formula should be applied for 0.5km² and the result factored based on the ratio of the actual site area and the applied area.

$Q_{BARrural}$ = 0.006m³/s
$Q_{BARrural}$ = 5.691 l/s
$Q_{BARrural}$ = 2.500 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	4.84	11.95	14.80
Q_{BAR} (l/s/Ha)	2.12	5.25	6.50
Allowable Discharge	5.69	5.69	5.69

Rainfall Data:

Rain Data From: Dublin Airport
Climate Change Factor: 20%

Duration	Return Period *(Years)*						
(Hours)	1	5	10	20	30	50	100
0.5	9.0	14.4	17.9	22.0	24.2	28.8	33.6
1	12.0	18.6	22.9	27.6	30.4	36.0	42.0
2	15.7	23.8	28.8	34.8	37.6	43.2	50.4
4	21.2	31.2	37.2	43.2	46.4	52.8	61.2
6	25.6	37.2	43.2	50.4	54.4	62.4	70.8
12	32.4	46.8	18.0	63.6	68.0	76.8	86.4

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Summary

Catchment	2 - Blocks 4 & 5 and Duplexes
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**27.32m³**
Treatment Volume	**81.97m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	83.01m³
1-in-30-Year Storm	182.24m³
1-in-100-Year Storm	112.06m³
Reduction of Long-Term Storage	-106.40m³
Volume Required	**270.90m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**106.40m³**
Long Term Storage *(Interception provided)*	**79.08m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	83.01m³
1-in-30-Year Storm	182.24m³
1-in-100-Year Storm	112.06m³
Total	**377.30m³**

The maximum attenuation volume required is 377.30m³

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Calculation By:	SDN
Approved by:	MD

Criterion 1
River Protection Volume

Catchment	2 - Blocks 4 & 5 and Duplexes
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

1.1 Interception

Paved surfaces connected to drainage system	*22770m² x 0.3 x 1 =* 6,831.00m²	*22,770m² site area* *30% of the site is paved* *100% of the paved area*
Volume of Interception Storage	*6831m² x 5mm x 0.8 =* **27.32m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*22770m² x 0.3 x 1 =* 6,831.00m²	*22,770m² site area* *30% of the site is paved* *100% of the paved area*
Volume of Treatment Storage	*6831m² x 15mm x 0.8 =* **81.97m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Criterion 2
River Regime Protection

Catchment	2 - Blocks 4 & 5 and Duplexes
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

1-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	50.00	34.16	0.00	34.16	61.5	5.69	10.2	28.46	51.2
1	33.33	22.77	0.00	22.77	82.0	5.69	20.5	17.08	61.5
2	21.83	14.91	0.00	14.91	107.4	5.69	41.0	9.22	66.4
4	14.75	10.08	0.00	10.08	145.1	5.69	82.0	4.38	63.1
6	11.83	8.08	0.00	8.08	174.6	5.69	122.9	2.39	51.7
12	7.50	5.12	0.00	5.12	221.3	5.12	221.3	0.00	0.0

30-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	134.67	91.99	0.00	91.99	165.6	5.69	5.9	86.30	88.9
1	84.43	57.68	0.00	57.68	207.6	5.69	13.2	51.98	120.7
2	52.22	35.67	0.00	35.67	256.8	5.69	28.4	29.98	149.4
4	32.23	22.01	0.00	22.01	317.0	5.69	58.8	16.32	168.6
6	25.18	17.20	0.00	17.20	371.6	5.69	90.1	11.51	182.2
12	15.74	10.75	0.00	10.75	464.5	5.69	171.2	5.06	152.3

100-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	186.67	127.51	0.00	127.51	229.5	5.69	-1.4	121.82	-29.4
1	116.67	79.70	0.00	79.70	286.9	5.69	1.4	74.00	17.8
2	70.00	47.82	0.00	47.82	344.3	5.69	7.4	42.13	54.7
4	42.50	29.03	0.00	29.03	418.1	5.69	21.3	23.34	87.5
6	32.78	22.39	0.00	22.39	483.6	5.69	38.2	16.70	112.1
12	20.00	13.66	0.00	13.66	590.2	5.69	68.3	7.97	95.7

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Calculation By:	SDN
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Criterion 4
River Flood Protection

Catchment	2 - Blocks 4 & 5 and Duplexes
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

Vol_{XS} = RD x A x 10 [(PIMP/100 x α0.8) + (1 - (PIMP/100))(β x Soil) - Soil]

Vol_{XS}			*… Extra runoff volume of development over Greenfield runoff*
RD	=	71 mm	*… Rainfall depth of the 100 year, 6 hour event mm*
A	=	2.277 Ha	*… Area of site*
PIMP	=	30%	*… Impermeable area of total site*
α0.8	=	100%	*… Proportion of paved area drained to drainage network or river with 80% runoff*
β	=	60%	*… Proportion of pervious area drained to the network or river*
Soil	=	0.30	*… SPR index*

Vol_{XS} = 106.40m³

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Calculation By:	SDN
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Project Data

Catchment	3 - Entrance Road
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

Description		%	Area
Total Site Area		-	3,040m²
Paved Area	Total	86%	2,614m²
	Drained	100%	2,614m²
Soil Area	Total	14%	426m²
	Drained	0%	0m²

Soil Type:	Type 2
SPR Index (from FSR):	0.30
SAAR:	917mm
Rain Data:	Dublin Airport
Climate Change Factor:	20%

Greenfield Runoff:

$Q_{BARrural} = 0.00108 \times Area^{0.89} \times SAAR^{1.17} \times Soil^{2.17}$

Area = 0.00304km² … *Total site area in km²*
SAAR = 917mm … *Standard Average Annual Rainfall in mm*
SOIL = 0.30 … *The "SPR" index from FSR*

Note: Where a site is <0.5km², the $Q_{BARrural}$ formula should be applied for 0.5km² and the result factored based on the ratio of the actual site area and the applied area.

$Q_{BARrural}$ = 0.001m³/s
$Q_{BARrural}$ = 0.760 l/s … *Note: where greenfield runoff value is <2l/s, a value of 2l/s shall be taken*
$Q_{BARrural}$ = 6.579 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	1.70	4.20	5.20
Q_{BAR} (l/s/Ha)	5.59	13.82	17.11
Allowable Discharge	2.00	2.00	2.00

Rainfall Data:

Rain Data From: Dublin Airport
Climate Change Factor: 20%

Duration	**Return Period** *(Years)*						
(Hours)	**1**	**5**	**10**	**20**	**30**	**50**	**100**
0.5	9.0	14.4	17.9	22.0	24.2	28.8	33.6
1	12.0	18.6	22.9	27.6	30.4	36.0	42.0
2	15.7	23.8	28.8	34.8	37.6	43.2	50.4
4	21.2	31.2	37.2	43.2	46.4	52.8	61.2
6	25.6	37.2	43.2	50.4	54.4	62.4	70.8
12	32.4	46.8	18.0	63.6	68.0	76.8	86.4

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Calculation By:	SDN
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Summary

Catchment	3 - Entrance Road
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**10.46m³**
Treatment Volume	**31.37m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	33.41m³
1-in-30-Year Storm	72.28m³
1-in-100-Year Storm	42.89m³
Reduction of Long-Term Storage	-88.93m³
Volume Required	**59.65m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**88.93m³**
Long Term Storage *(Interception provided)*	**78.48m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	33.41m³
1-in-30-Year Storm	72.28m³
1-in-100-Year Storm	42.89m³
Total	**148.58m³**

The maximum attenuation volume required is 148.58m³

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Calculation By:	SDN
Approved by:	MD

Criterion 1
River Protection Volume

Catchment	3 - Entrance Road
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

1.1 Interception

Paved surfaces connected to drainage system	*3040m² x 0.86 x 1 =* 2,614.40m²	*3,040m² site area* *86% of the site is paved* *100% of the paved area*
Volume of Interception Storage	*2614.4m² x 5mm x 0.8 =* **10.46m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*3040m² x 0.86 x 1 =* 2,614.40m²	*3,040m² site area* *86% of the site is paved* *100% of the paved area*
Volume of Treatment Storage	*2614.4m² x 15mm x 0.8 =* **31.37m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Criterion 2
River Regime Protection

Catchment	3 - Entrance Road
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

1-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	50.00	13.07	0.00	13.07	23.5	2.00	3.6	11.07	19.9
1	33.33	8.71	0.00	8.71	31.4	2.00	7.2	6.71	24.2
2	21.83	5.71	0.00	5.71	41.1	2.00	14.4	3.71	26.7
4	14.75	3.86	0.00	3.86	55.5	2.00	28.8	1.86	26.7
6	11.83	3.09	0.00	3.09	66.8	2.00	43.2	1.09	23.6
12	7.50	1.96	0.00	1.96	84.7	1.96	84.7	0.00	0.0

30-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	134.67	35.21	0.00	35.21	63.4	2.00	2.0	33.21	33.0
1	84.43	22.07	0.00	22.07	79.5	2.00	4.5	20.07	45.5
2	52.22	13.65	0.00	13.65	98.3	2.00	9.8	11.65	57.2
4	32.23	8.42	0.00	8.42	121.3	2.00	20.5	6.42	65.8
6	25.18	6.58	0.00	6.58	142.2	2.00	31.5	4.58	72.3
12	15.74	4.12	0.00	4.12	177.8	2.00	61.1	2.12	64.7

100-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	186.67	48.80	0.00	48.80	87.8	2.00	-0.6	46.80	-14.8
1	116.67	30.50	0.00	30.50	109.8	2.00	0.3	28.50	3.6
2	70.00	18.30	0.00	18.30	131.8	2.00	2.3	16.30	18.4
4	42.50	11.11	0.00	11.11	160.0	2.00	7.1	9.11	32.2
6	32.78	8.57	0.00	8.57	185.1	2.00	13.1	6.57	42.9
12	20.00	5.23	0.00	5.23	225.9	2.00	25.1	3.23	40.5

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Criterion 4
River Flood Protection

Catchment	3 - Entrance Road
Project Name	Auburn, Malahide, Co. Dublin
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	07/04/2022

Vol_{XS} = RD x A x 10 [(PIMP/100 x α0.8) + (1 - (PIMP/100))(β x Soil) - Soil]

Vol_{XS}			*… Extra runoff volume of development over Greenfield runoff*
RD	=	71 mm	*… Rainfall depth of the 100 year, 6 hour event mm*
A	=	0.304 Ha	*… Area of site*
PIMP	=	86%	*… Impermeable area of total site*
α0.8	=	100%	*… Proportion of paved area drained to drainage network or river with 80% runoff*
β	=	60%	*… Proportion of pervious area drained to the network or river*
Soil	=	0.30	*… SPR index*

Vol_{XS} = 88.93m³

D. SuDS Selection Checklist

SUDS/Green Infrastructure selection checklist –To be submitted in planning submission

Suds Measures	Measures to be used on this site	Rationale for selecting/not selecting measure	Checklist submitted? See no. 8 below
Source Control			
Swales			
Tree Pits	✓	Roadside tree pits are to be provided throughout the development. Trees help to attenuate flows, trap silts and pollutants, promote infiltration and prevent erosion.	
Rainwater Butts			
Rainwater harvesting			
Soakaways			
Infiltration trenches			
Permeable pavement (Grasscrete, Block paving, Porous Asphalt etc.)	✓	All private driveways are to be permeable paving with underlying filter drains. Downpipes from the front of the houses will also drain to the filter drain under the permeable paving to facilitate maximum infiltration of surface water from driveways and roof areas.	
Green Roofs	✓	Areas of green roof are to be provided on the apartment buildings and Duplex Blocks. This is in line with the FCC document Green/Blue Infrastructure for Developments. Roofs with an area over 300m² will be provided with at least 60% green roof coverage.	
Filter strips			
Bio-retention systems/Raingardens	✓	Rain gardens are proposed at open spaces around the site. Rain gardens are gardens of native shrubs, perennials, and flowers planted in a small depression, designed to temporarily hold and soak in rainwater runoff that flows from roofs, driveways, patios or lawns.	
Blue Roofs			
Filter Drain	✓	Filter drains are to be incorporated around the perimeter of each apartment block to allow for infiltration of surface water.	
Site Control			
Detention Basins	✓	A large detention basin is to be utilised for the main catchment within the development, with a secondary detention basin to cater for the main entrance road. Excess Out-of-Bank Storage is also provided for the existing ditch to facilitate out-of-bank flow for the 30-year storm return period. This out-of-bank storage is over and above the required attenuation storage already provided.	
Retention basins			
Regional Control			
Ponds			

Wetlands			
Other			
Petrol/Oil interceptor	✓	A Class 1 petrol interceptor will be provided before the surface water outfall to the public surface water network.	
Attenuation tank – only as a last resort where other measures are not feasible	✓	An attenuation tank (StormTech or similar approved) is to be utilised within the development for apartment block to the east of the entrance road only, where detention basins are not suitable. The tank will be privately managed and maintained. Storage for the tank is designed to have capacity for greater than the 1-in-100-year storm plus 20% for climate change. The outfall will be fitted with a Hydrobrake or similar approved flow control device to limit flows to the greenfield equivalent rate.	
Oversized pipes– only as a last resort where other measures are not feasible			

Note:

1. Fingal has a preference for above ground Green Infrastructure rather than tanks or over sized pipes . Above ground flows through swales, basins etc are encouraged.
2. Demonstrate SUDS system will have sufficient Pollutant removal efficiency in accordance with Ciria Suds Manual C753
3. Basins sides should be no steeper than 1:4 and no deeper than 1.2m in the 1%AEP
4. Culverting shall be avoided where possible
5. De-culverting is encouraged.
6. Please submit evidence of infiltration rates
7. To account for climate change in the design of the drainage system rainfall intensities should be factored up by 20%
8. The Applicant must provide Suds checklists in accordance with the Appendix B of the Ciria Suds manual C753

UK and Ireland Office Locations