Waterman Moylan
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Engineering Assessment Report

Residential Development at Auburn, Malahide Road

March 2021

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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 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.

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.

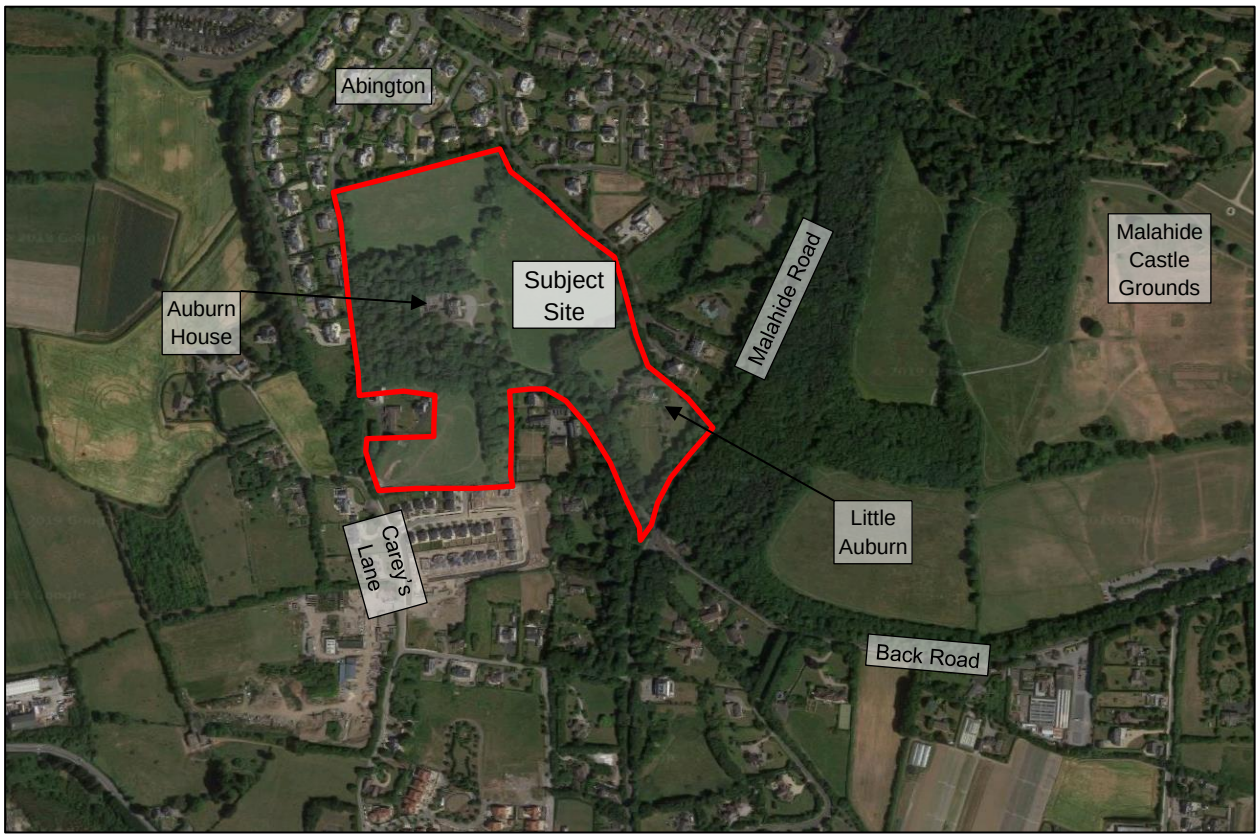

Figure 1 | *Site Location (Source: Google Maps)*

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.

1.3 Proposed Development

The proposed development will consist of the preservation and protection of the existing Protected Structure of Auburn House as 1 no. residential dwelling, the conversion of the existing stables of Auburn House to accommodate 4 no. dwellings, and the construction of 406 no. residential dwellings, comprised of houses, apartments and duplexes, providing for an overall total of 411 no. residential units. A crèche (173m²) will be constructed as part of the development.

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 converted stables)*		1	2	46	39	14	102 Houses	
Apartments	Block 1	27	22	2	-	-	51	266 Apartments
	Block 2	29	27	1	-	-	57	
	Block 3	27	22	2	-	-	51	
	Block 4	9	17	1	-	-	27	
	Block 5	6	22	-	-	-	28	
	Block 6	5	14	2	-	-	21	
	Block 7	-	6	-	-	-	6	
	Block 8	6	17	2	-	-	25	
Duplexes	Block 1	1	3	2	-	-	6	43 Duplexes
	Block 2A	6	2	-	-	-	8	
	Block 2B	8	3	-	-	-	11	
	Block 2C	7	2	-	-	-	9	
	Block 2D	5	4	-	-	-	9	
Total		**137**	**163**	**58**	**39**	**13**	**411**	

Table 1 | *Schedule of Accommodation*

A Community building (178m²) is also proposed, to be constructed in the "walled garden" part of the site.

A new vehicular entrance is to be constructed off Malahide Road, providing for a new signalised junction with Back Road and Malahide Road, and a secondary vehicular entrance is to be provided off Carey's Lane. The existing vehicular entrance access is to be utilised as a pedestrian and cycle route only, with vehicular access retained solely for existing residential use.

The development includes all associated site works, boundary treatments, drainage and service connections.

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) Kinsealy Village (via a pumping station known as Floraville)

   b) Broomfield LAP and Kinsealy Lane developments

   c) Housing in Streamstown

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 in Millview, where some spare capacity has previously been identified. However, this capacity is thought to be limited.

The Connolly Avenue pumping station, rising main and outfall have been recently upgraded by Fingal County Council to accommodate development at Kinsealy Village and the Kinsealy Lane/Broomfield area. However, this pumping station is not suitable for significant additional development in addition to the existing flows from Kinsealy Village (Floraville). Significant capacity is taken up by storm water inflows from the Kinsealy Village area.

2.2 Future 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 subject development and to establish the scope of upgrades required to accommodate the proposal and the current status of any such upgrades.

Irish Water have tendered for 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 is to be decommissioned and the c.300 units outfalling to Floraville will instead fall by gravity to the new Chapel Road pumping station (thus freeing up capacity at the Connolly Avenue Pumping Station). These works are anticipated to be completed by the last quarter of 2021.

Irish Water also discussed the possibility of a new pumping station on private lands off Kinsealy Lane, which would pump wastewater south to the new Chapel Road Pumping Station. This is a long-term solution to relieve capacity constraints at Connolly Avenue Pumping Station but has not been designed or applied for yet and no programme is in place.

A Pre-Connection Enquiry was submitted to Irish Water and a Confirmation of Feasibility Letter was issued, dated 11 June 2020 – 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 subject to delivery of a new Kinsealy Lane pumping station and completion of the Chapel Road pumping station, which is due for completion in the last quarter of 2021. It was established and agreed in subsequent discussions with Irish Water that wastewater connection for the subject development is not contingent on Kinsealy Lane pumping station – refer to the strategy set out in Section 2.3 below and to the letter from Irish included Appendix B which supports the proposed strategy.

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 wastewater pumping station will have a 24-hour storage tank (185m^3 of storage for 411 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 buildings proposed within this 35m buffer zone.

Wastewater will be pumped from the development site via Back Road and Kinsealy Lane to outfall via a stand-off manhole to the existing 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, as per drawing number 19-020-P205. Discussions with Irish Water on this issue have been ongoing: numerous options were investigated, and this is the most favourable strategy to Irish Water. It is a developer led solution to alleviate issues, improve and expand the network and its capacity in the locality. A letter from Irish Water supporting this strategy, dated November 13th, 2020, is included in Appendix B.

As part of ongoing consultations with Irish Water (as discussed in section 2.2 above), it has been noted that there is potential for a future development by another party that may require a pumping station to be located on private lands off Kinsealy Lane. Irish Water have indicated that the rising main to be constructed under this application will also be utilised by this potential pumping station. It is the Applicant's intention to design and construct this rising main to the requirements of Irish Water, in order to also facilitate future developments in the area.

Fingal County Council have issued a letter of consent for the necessary works on public lands to facilitate the proposed rising main.

An application for a Statement of Design Acceptance was submitted to Irish Water. The Statement of Design Acceptance, dated 22 February 2021, states that Irish Water has no objection to the proposal. A copy of this letter is included in Appendix C.

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 41 persons (7 staff and 34 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.

The 178m² multi-purpose community building can function as an office space for up to 10 workers, or alternatively as an exercise/yoga space for up to 10 people and as a community meeting space for up to 40 people. Of the possible uses for the building, office use generates the greatest daily volume of wastewater, and as such the calculations tabulated below conservatively assume that the community building is in use as an office space for 10 workers. The calculated flow is based on per capita daily wastewater flow of 100 litres, as per Appendix C of the Code of Practice, at a maximum capacity of 10 people.

Description	Total Population	Load per Capita	Daily Load	Total DWF	Peak Flow
	No. People	*l/day*	*l/day*	*l/s*	*l/s*
102 Houses	275.4	150	45,441.0	0.526	1.578
43 Duplexes	116.1	150	19,156.5	0.222	0.665
266 Apartments	718.2	150	118,503.0	1.372	4.115
Community Building	10	100	1,100.0	0.013	0.038
Crèche	34	90	3,366.0	0.039	0.117
Total	**1,153.7**	**-**	**187,566.5**	**2.171**	**6.513**

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

The total dry weather flow from the development is 2.171 l/s, with a peak flow of 6.513 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 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 proposed pumping station will be sized to accommodate the fully developed site. 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	2.171l/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 2.172l/s, is 188m³.

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)*
2.171l/s	6.513l/s	23.446m³/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	2.40

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
187.6m³/day	15.109m³	1.93 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. 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 six separate sub-catchments, as indicated in the Figure below:

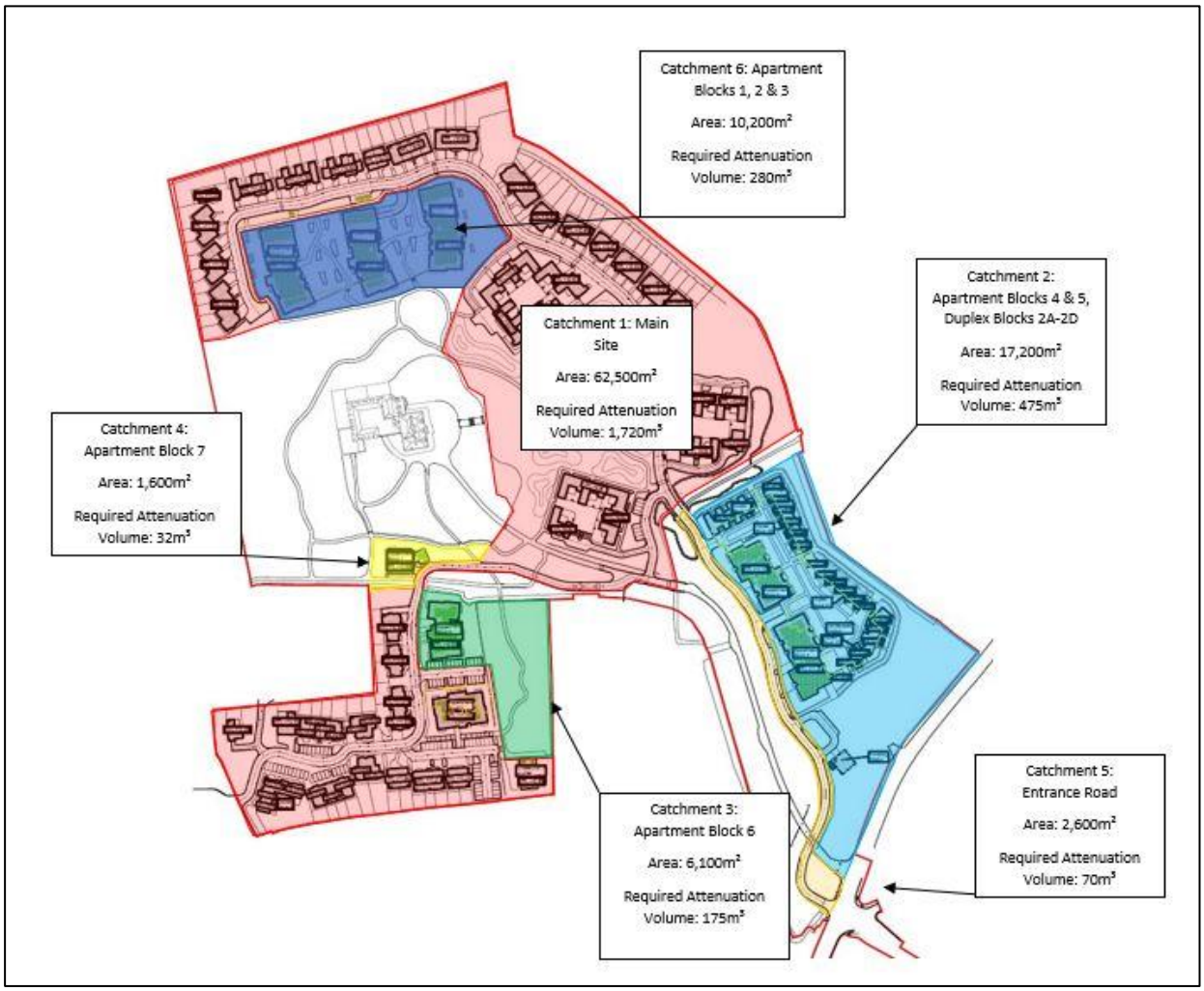

Figure 2 | *Proposed Sub-Catchments*

The main portion of the site falls within one catchment, Catchment 1, which is 62,500m^2 and which will be attenuated in a proposed dry detention basin in the open space at the centre of the site. Catchment 5 (Entrance Road) will be attenuated in another dry detention basin near the site entrance. Catchment 2 (Blocks 4 & 5 and Duplex Blocks 2), Catchment 3 (Block 6 & the Community Room), Catchment 4 (Apartment Block 7) and Catchment 6 (Blocks 1-3), will each utilise private on-site attenuation tanks, which will be privately managed and maintained.

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 D.

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 project's SuDS checklist has been included in Appendix E. 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:

- 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 / Sedum Roof:

It is proposed to introduce sedum roofing as a source control device. The sedum roofing is proposed to cover 60% of the apartment roof area, duplex roof area and community room totalling a cumulative green roof area of 5,006m^2 minimum. The sedum 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. It should be noted that the community room is below the specified threshold of 300m^2 but will also incorporate a green roof.

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 sedum 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.

A paper entitled *Green Roofs Over Dublin: A Green Roof Policy Guidance Paper for Dublin* was published in August 2008 with guidelines for Dublin City Council to develop planning directives for the incorporation of green roofs in new development. The below table is taken from this document and shows the percentage of total rainfall retention over a 14-month period for different green roof treatments.

Slope	**Media Depth**	**Light Rain** *<2mm*	**Medium Rain** *2mm-6mm*	**Heavy Rain** *>6mm*	**Overall**
2.0%	25mm	95.1%	82.9%	64.7%	69.8%
2.0%	40mm	97.1%	85.5%	65.1%	70.1%
6.5%	40mm	94.9%	83.1%	59.5%	65.9%
6.5%	60mm	95.8%	84.6%	62.0%	68.1%

Table 7 *| Percentage of Total Rainfall Retention Over a 14-Month Period (Aug 2002-Oct 2003)*

The proposed sedum roofing shall be on flat roofs with 2% slope with a media depth of 75mm, exceeding the depths shown above. Thus, the percentage of total rainfall retention can be expected to exceed the tabulated figures.

Bio-retention Systems/Raingardens:

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.

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.

3.2.3 Regional Control

Dry Detention Basin:

A dry detention basin is proposed in the open space at the centre of the site, designed to store surface water and accommodate attenuation from Catchment 1 for rainfall events greater than the 1-in-100 year

rainfall event. The detention basin will typically remain dry but will act as a storage pond during extreme rainfall events. A secondary dry detention basin is also proposed to cater for the entrance road, this is a separate catchment from the main site due to existing site topography.

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 D 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:

Paved surfaces connected to drainage system	*100200m² x 0.5 x 0.75 =* 37,575.00m²	*100,200m² site area* *50% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*37575m² x 5mm x 0.8 =* **150.30m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

Table 8 | *Interception Calculation*

The required interception volume is 150m³. It is not proposed to provide the entire required interception volume. Criterion 1.2 will therefore be assessed to provide the required River Water Quality Protection in accordance with Criterion 1.

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:

Paved surfaces draining to river	*100200m² x 0.5 x 0.75 =* 37,575.00m²	*100,200m² site area* *50% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*37575m² x 15mm x 0.8 =* **450.90m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

***Table 9** | Treatment Volume Calculation*

The required treatment volume for the site is met through the introduction of various SuDS features (which have been described in Section 3.2.1, above).

Permeable paving is proposed in private driveways and accounts for a total cumulative area of c.5,450m². Assuming a depth of 0.4m with 33% voids, this yields a treatment volume of 720m³.

As noted above, the green sedum roofing amounts to a cumulative area of 5,006m² minimum, and shall consist of 75mm substrate with a sedum blanket. Assuming a 30% water volume retention, this amounts to approximately 112m³ of treatment storage volume. Filter drains, raingardens and roadside trees around the site provide further treatment volume.

These SuDS features provide ample treatment volume to meet the Criteria 1 requirements.

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 D.

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

Catchment		**Area**	**Allowable Discharge Rate**	**Required Attenuation Volume**
		m²	*m³/s*	*m³*
Catchment 1:	Main Site	62,500	12.35	1,719.64
Catchment 2:	Blocks 4 & 5 and Duplexes	17,200	3.40	473.25
Catchment 3:	Blocks 6 & community Room	6,100	2.00	174.93
Catchment 4:	Block 7	1,600	2.00	31.87
Catchment 5:	Entrance Road	2,600	2.00	70.13
Catchment 6:	Blocks 1, 2 & 3	10,200	2.02	280.65
Total		**100,200**	**23.77**	**2,750.47**

***Table 10** | Attenuation Volume for Each Sub-Catchment*

The main site (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 well in excess of the required storage volume of 1,720m³, 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 12.35l/s.

Catchments 2, 3, 4 & 6 will each be attenuated in privately managed and maintained StormTech or similar approved attenuation chambers. Surface water will be stored in the attenuation chambers 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 5 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 D for each of the six 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.

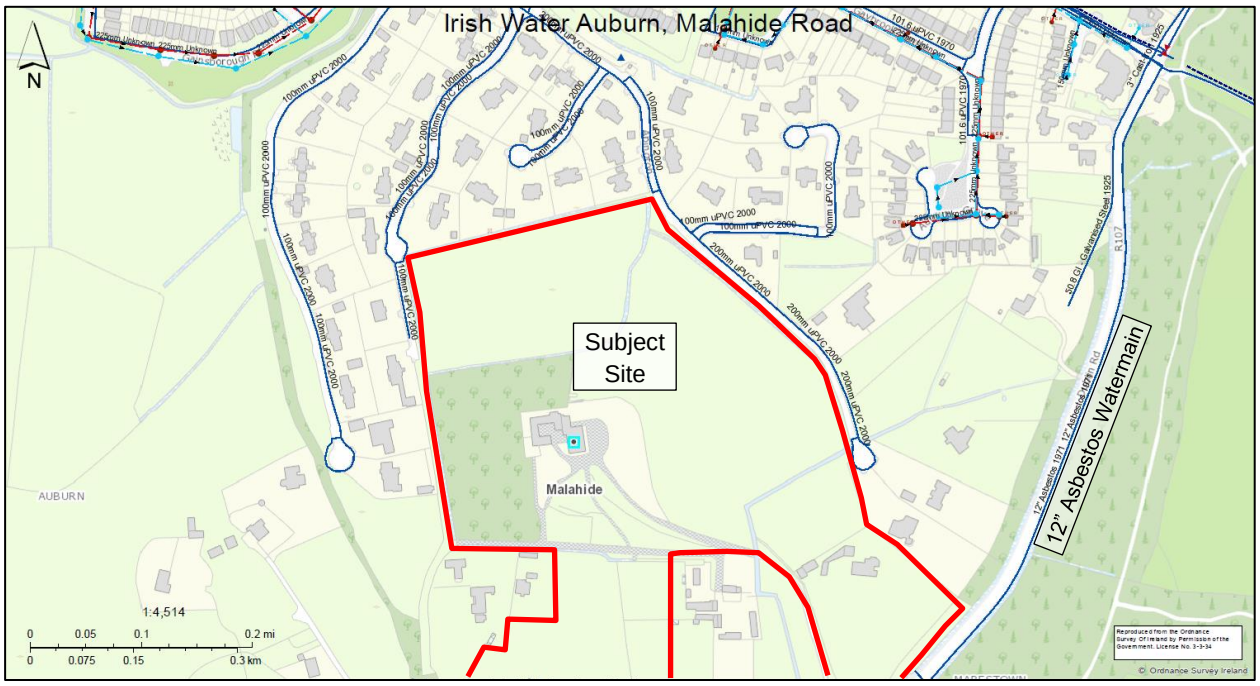

Figure 3 | *Extract of Irish Water's Water Supply Service Records (provided by FCC)*

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 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 11 June 2020 is included in Appendix A. In this letter, Irish Water state that a new connection to the existing network is feasible without upgrades.

Irish Water also noted that the scale of this development dictates that it is subject to the Strategic Housing Development planning process, and that a Statement of Design Acceptance in relation to the layout of water and wastewater services will be required prior to submitting the full application to An Bord Pleanála. A Statement of Design Acceptance was received from Irish Water, dated 22 February 2021. This letter states that Irish Water has no objection to the proposal. A copy of this letter is included in Appendix C.

4.3 Water Supply Calculations

The calculated water demand at the subject development is set out in the below overleaf. 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.

As noted in Section 2.4, above, the multi-purpose community building can function as an office space for up to 10 workers, or alternatively as an exercise/yoga space for up to 10 people and as a community meeting space for up to 40 people. Of the possible uses for the building, office use generates the greatest daily water demand, and as such the calculations tabulated below conservatively assume that the community building is in use as an office space for 10 workers. The water demand for the crèche and community building are based on per capita daily consumption rates of 90 litres and 100 litres, respectively.

Description	**Total Population**	**Water Demand**	**Average Demand**	**Average Peak Demand**	**Peak Demand**
	No. People	*l/day*	*l/s*	*l/s*	*l/s*
102 Houses	275.4	45,441	0.526	0.657	3.287
43 Duplexes	116.1	19,157	0.222	0.277	1.386
266 Apartments	718.2	118,503	1.372	1.714	8.572
Community Building	10	1,100	0.013	0.016	0.080
Crèche	34	3,366	0.039	0.049	0.243
Total	**1,153.7**	**187,567**	**2.171**	**2.714**	**13.568**

Table 11 | *Calculation of Water Demand for the Development*

The average demand for the development is 2.171 l/s, with a peak demand of 13.568 l/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 and Fingal County Council Water Services Department.

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 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 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

It is proposed to provide a new site entrance opposite the Back Road, to form a new 4-way signalised junction – refer to the Proposed Malahide Road Junction Upgrade Layout drawing 19-020-P110.

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.

5.2.1 Road Safety Audit

A Stage 1 Road Safety Audit was carried out by Bruton Consulting Engineers and the report is included in Appendix F. The Road Safety Audit comprised an examination of draft planning drawings provided by Waterman Moylan and a site visit by the Audit Team, which was carried out on the 6th of February 2020.

The report identified five problems that needed either clarification or to be rectified, and the report provided recommended measures. The following is a summary of the problems identified and the measures taken to resolve the issues:

1. From the draft drawings, it was unclear whether the existing Auburn access is to be closed to vehicular traffic. The Road Safety Audit recommended that the entrance should be closed to vehicles.

   The proposal is for the existing access is to be closed to vehicles, and the planning drawings have been revised to clarify this. The access will remain open to pedestrians and cyclists.

2. From the draft drawings, it was unclear whether the new site entrance junction at the Malahide Road/Back Road is to be signalised, and where the signal heads will be located. The recommendation was for the new junction to be signalised.

   This new junction is proposed as a signalized junction. Refer to drawing *19-020-P110 Proposed Malahide Road Junction Upgrade Layout*, which shows the proposed junction layout including signal head locations.

3. The audit notes there is a risk that the existing hard standing facilities for the bus stops on Malahide Road may not be adequate to cater for additional usage from the proposed development, and recommends that the bus stops and paths to the bus stops from the signalised pedestrian crossing be included in the design.

   The proposed junction includes pedestrian crossings with tactile paving and new 2m wide footpaths from the site entrance to the bus stops.

4. The audit notes that there are no proposed facilities for cyclists at the Malahide Road/Back Road junction and recommends that cyclist facilities be included in the junction design.

   The proposed R107 Malahide Road / Back Road junction design considers cyclist safety. Advanced stop lines to accommodate cyclists are proposed on the southern, northern and eastern approaches of the junction. These advanced stop lines will provide a safe area for cyclists in front of vehicular queues and help cyclists position themselves correctly for right/left turning movements.

5. In the draft drawings, there was a gap in the provision of a footpath along Carey's Lane between the Claireville Lodge development and the proposed secondary access to the development. The audit recommends a continuous footpath be provided along Carey's Lane.

   This recommended measure has been taken on board, and a continuous footpath connection to the existing footpath on Carey's Lane is now provided – refer to drawing *19-020-P102 Road Layout Sheet 2 of 3*.

5.2.2 DMURS

Waterman Moylan Consulting Engineers considers that the proposal is consistent with the principles and guidance outlined in the Design Manual for Urban Roads and Streets (DMURS). Outlined below are some of the specific design features that have been incorporated within the proposed scheme with the objective of delivering a design that is in full compliance with DMURS.

In order of importance, DMURS prioritises pedestrians, cyclists, public transport and private cars. The proposed development has been designed with pedestrians and cyclists taking precedence over other modes of transport. In this regard, footpaths are provided throughout the development, including routes through open spaces along anticipated desire lines. Vehicular access is provided via the main entrance onto Malahide Road and a secondary entrance to Carey's Lane. There is an additional pedestrian/cyclist only access from Malahide Road, and there is a proposed pedestrian access at the west of the site connecting to Auburn Grove/Carey's Lane.

Active edges are recommended in DMURS to enliven the edges of the street, creating a more interesting and engaging environment. An active frontage is achieved with frequent entrances and openings that ensure the street is overlooked and generate pedestrian activity as people come and go from buildings. The roads throughout the development have regular junctions and driveways in accordance with this recommendation.

On-street parking is proposed at several locations. On-street parking separates pedestrians from the vehicle carriageway and, as per DMURS Section 4.4.9, can calm traffic by increasing driver caution, contribute to pedestrian comfort by providing a buffer between the vehicular carriageway and footpath and provide good levels of passive security.

Streets have been designed in accordance with the alignment and curvature recommendations set out in DMURS Section 4.4.6. The road layout is generally curvilinear. Horizontal curvature will promote lower vehicle speeds in accordance with DMURS Section 4.4.7

The road hierarchy comprises local access roads and “home-zone” / shared surfaces. The local access roads comprise of 5.5m wide carriageways (i.e. 2.75m wide vehicle lanes) with 2m footpaths.

The proposed “home-zones” are designed primarily to meet the needs of pedestrians, cyclists, children and residents and where the speed and dominance of cars will be reduced. The home-zones comprise of a shared-surface carriageway. Entry treatment to home-zones is provided in the form of a ramp up, which helps announce that a driver is entering into a home-zone, and it is proposed to utilise a buff coloured chipping / macadam at home-zones, subject to Fingal County Council Roads and Transportation approval.

Suitable sightlines will be provided throughout the development, ensuring that localised planting does not obscure visibility as cars make turning manoeuvres, improving the pedestrian safety at crossing points.

Public areas fronting and within the proposed development will be designed by a multidisciplinary design team to accommodate pedestrians and cyclists in accordance with the appropriate principles and guidelines set out in DMURS. In particular the vehicular access and public footways within the remit of the development will incorporate the relevant DMURS requirements and guidelines as set out above.

5.3 Traffic and Transport Assessment

As noted above, a comprehensive Traffic and Transport Assessment and Travel Plan have also been prepared by Waterman Moylan and accompanies this submission under separate cover.

Appendices

A. Confirmation of Feasibility Letter

Robert Walpole
Waterman Moylan
Block S
EastPoint Business Park
Alfie Byrne Road
East Wall
Dublin 3
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

11 June 2020

Dear Robert Walpole,

Re: Connection Reference No CDS20001740 pre-connection enquiry -
Subject to contract | Contract denied

Connection for Housing Development of 444 unit(s) at Malahide Road, Co Dublin

Irish Water has reviewed your pre-connection enquiry in relation to a water and wastewater connection at Malahide Road, Co Dublin.

Based upon the details that you have provided with your pre-connection enquiry and on the capacity currently available in the network(s), as assessed by Irish Water, we wish to advise you that, subject to a valid connection agreement being put in place, your proposed connection to the Irish Water network(s) can be facilitated.

Water:

New connection to the existing network is feasible without upgrade.

Wastewater:

Feasible subject to the delivery of the following:

1. A new Kinsealy Lane 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 530m^3. This includes 362m^3 of existing storage at the site. An additional 168m^3 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 Kinsealy Lane pumping station.
   g) Upgrade the foul network downstream of the new Kinsealy Lane 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).

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.

2. 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).

Strategic Housing Development:

Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. In advance of submitting your full application to An Bord Pleanála for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.

All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details. A design proposal for the water and/or wastewater infrastructure should be submitted to Irish Water for assessment. Prior to submitting your planning application, you are required to submit these detailed design proposals to Irish Water for review.

You are advised that this correspondence does not constitute an offer in whole or in part to provide a connection to any Irish Water infrastructure and is provided subject to a connection agreement being signed at a later date.

A connection agreement can be applied for by completing the connection application form available 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.

If you have any further questions, please contact Deirdre Ryan from the design team on 022 54620 or email deiryan@water.ie. For further information, visit www.water.ie/connections.

Yours sincerely,

Maria O'Dwyer

Connections and Developer Service

B. Irish Water Letter to An Bord Pleanála

Uisce Éireann
Bosca OP 6000
Baile Átha Cliath 1
Éire

Irish Water
PO Box 6000
Dublin 1
Ireland

T: +353 1 89 25000
F: +353 1 89 25001
www.water.ie

Your Ref: ABP-307610-20
Our Ref: CDS20001740

An Bord Pleanála,
64 Marlborough Street,
Dublin 1

13th November 2020

Dear Sir/ Madam,

Re: Strategic Housing Development – Preservation of Auburn House as 1 no. residential dwelling, conversion of existing stables of Auburn House to accommodate 4 no. dwellings, construction of 412 no. residential units (110 no. houses, 307 no. apartments), creche and associated site works. Lands at Auburn House (a protected structure), Little Auburn and Streamstown, Off Malahide Road and Carey's Lane, Back Road and Kinsealy Lane, Malahide, Co. Dublin.

Irish Water has received notification of Kinwest Ltd request to enter into consultations under Section 5 of the Planning and Development (Housing) and Residential Tenancies Act 2016 in respect of the above-mentioned proposed development.

Irish Water has assessed and has issued a Confirmation of Feasibility for connection(s) to the Irish Water network(s) subject to the following;

In respect of Wastewater:

Irish Water is currently progressing a high-level strategy for this area which includes the delivery of a new pumping station to serve the existing and future Connolly Avenue pumping station catchment. The existing Kinsealy Lane pumping station, and the Connolly avenue pumping station are currently at capacity. In order to support growth in the area Irish Water has capital works in progress to deliver a new Chapel Lane Pumping Station in the south of the catchment and a rising main extension from Chapel Lane pumping station to the North Fringe Sewer. These works are including on Irish Waters Capital Investment Plan and due to be completed by Q4 2021 (subject to change).

In order to service this proposed development with a wastewater connection, an extension of the Irish Water network is required east along *Back Road* and then south along *Kinsealy Lane* and then gravitate to the new Chapel Lane Pumping Station. These works will be subject to a valid Connection Agreement at Connection Application Stage. It is expected that works for this extension will be along public roads, delivered by Irish Water with the costs borne by the applicant.

In light of the wastewater connection contingencies outlined above and the significant growth in this area, the applicant is required to continue regular engagement with Irish Water prior to progressing to SHD application to agree all site-specific requirements and designs to service the development and the delivery mechanism for any works.

In respect of Water:

New connection to the existing network is feasible without upgrade.

General observations;

All development is to be carried out in compliance with Irish Waters Standards Codes and Practices and that design layouts for the development proposal have been submitted to Irish Water and that a Statement of Design Acceptance has been issued to the applicant by Irish Water ahead of any SHD Application.

Where any proposals by the applicant to build over or divert existing water or wastewater services the applicant is required to submit details to Irish Water for assessment of feasibility and have written confirmation of feasibility of diversion(s) from Irish Water ahead of any SHD Application to the board.

Queries relating to the observations above should be sent to planning@water.ie

pp. *Ali Robinson*

Yvonne Harris
Connections and Developer Services

C. Irish Water Statement of Design Acceptance

Robert Walpole
Eastman Business Park
Block B
Alfie Byrne Road, 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

22 February 2021

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: Alvaro Garcia
Email: agarcia@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

19-020-P200A Drainage General Arrangement Layout
19-020-P201A Drainage Layout Sheet 1 of 3
19-020-P202A Drainage Layout Sheet 2 of 3
19-020-P203A Drainage Layout Sheet 3 of 3
19-020-P204A Foul Drainage Longitudinal Sections
19-020-P205A Foul Rising Main Outfall Layout
19-020-P300A Watermain General Arrangement Layout
19-020-P301A Watermain Layout Sheet 1 of 3
19-020-P302A Watermain Layout Sheet 2 of 3
19-020-P303A Watermain Layout Sheet 3 of 3

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.

D. GDSDS Calculations

Waterman Moylan
Engineering Consultants

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

Calculation By:	RW
Approved by:	SDN

Project Data

Catchment	Main Site
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Description		%	Area
Total Site Area		-	62,500m²
Paved Area	Total	50%	31,250m²
	Drained	100%	31,250m²
Soil Area	Total	50%	31,250m²
	Drained	0%	0m²

Soil Type:	Type 2
SPR Index (from FSR):	0.30
SAAR:	750mm
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 = 0.0625km² … *Total site area in km²*
SAAR = 750mm … *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.

$Q_{BARrural}$ = 0.012m³/s
$Q_{BARrural}$ = 12.348 l/s
$Q_{BARrural}$ = 1.976 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	10.50	25.93	32.10
Q_{BAR} (l/s/Ha)	1.68	4.15	5.14
Allowable Discharge	12.35	12.35	12.35

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:	RW
Approved by:	SDN

Summary

Catchment	Main Site
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**93.75m³**
Treatment Volume	**281.25m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	465.36m³
1-in-30-Year Storm	794.39m³
1-in-100-Year Storm	459.90m³
Reduction of Long-Term Storage	-840.75m³
Volume Required	**878.89m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**840.75m³**
Long Term Storage *(Interception provided)*	**747.00m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	465.36m³
1-in-30-Year Storm	794.39m³
1-in-100-Year Storm	459.90m³
Total	**1,719.64m³**

The maximum attenuation volume required is 1,719.64m³

Waterman Moylan
Engineering Consultants

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

Calculation By:	RW
Approved by:	SDN

Criterion 1
River Protection Volume

Catchment	Main Site
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

1.1 Interception

Paved surfaces connected to drainage system	*62500m² x 0.5 x 0.75 =* 23,437.50m²	*62,500m² site area* *50% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*23437.5m² x 5mm x 0.8 =* **93.75m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*62500m² x 0.5 x 0.75 =* 23,437.50m²	*62,500m² site area* *50% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*23437.5m² x 15mm x 0.8 =* **281.25m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

Waterman Moylan
Engineering Consultants

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t 01 664 8900 f 01 661 3618 e info@waterman-moylan.ie

Calculation By:	RW
Approved by:	SDN

Criterion 2
River Regime Protection

Catchment	Main Site
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	125.00	0.00	125.00	225.0	12.35	22.2	112.65	202.8
1	33.33	83.33	0.00	83.33	300.0	12.35	44.5	70.99	255.5
2	21.83	54.58	0.00	54.58	393.0	12.35	88.9	42.24	304.1
4	14.75	36.88	0.00	36.88	531.0	12.35	177.8	24.53	353.2
6	11.83	29.58	0.00	29.58	639.0	12.35	266.7	17.24	372.3
12	7.50	18.75	0.00	18.75	810.0	12.35	533.4	6.40	276.6

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	336.67	0.00	336.67	606.0	12.35	8.1	324.32	211.5
1	84.43	211.08	0.00	211.08	759.9	12.35	21.3	198.74	343.2
2	52.22	130.54	0.00	130.54	939.9	12.35	50.0	118.19	478.7
4	32.23	80.56	0.00	80.56	1,160.1	12.35	110.4	68.21	610.0
6	25.18	62.96	0.00	62.96	1,359.9	12.35	175.9	50.61	720.9
12	15.74	39.35	0.00	39.35	1,700.1	12.35	363.2	27.01	794.4

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	466.67	0.00	466.67	840.0	12.35	-9.5	454.32	-348.9
1	116.67	291.67	0.00	291.67	1,050.0	12.35	-7.1	279.32	-161.1
2	70.00	175.00	0.00	175.00	1,260.0	12.35	0.3	162.65	4.4
4	42.50	106.25	0.00	106.25	1,530.0	12.35	24.4	93.90	185.5
6	32.78	81.94	0.00	81.94	1,770.0	12.35	59.7	69.60	336.6
12	20.00	50.00	0.00	50.00	2,160.0	12.35	150.8	37.65	459.9

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Criterion 4
River Flood Protection

Catchment	Main Site
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	=	6.250 Ha	*… Area of site*
PIMP	=	50%	*… 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} = 840.75m³

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Calculation By:	RW
Approved by:	SDN

Project Data

Catchment	Blocks 4-5
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Description		%	Area
Total Site Area		-	17,200m²
Paved Area	Total	50%	8,600m²
	Drained	100%	8,600m²
Soil Area	Total	50%	8,600m²
	Drained	0%	0m²

Soil Type:	Type 2
SPR Index (from FSR):	0.30
SAAR:	750mm
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 = 0.0172km² … *Total site area in km²*
SAAR = 750mm … *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.

$Q_{BARrural} = 0.003m^3/s$
$Q_{BARrural} = 3.398$ l/s
$Q_{BARrural} = 1.976$ l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	2.89	7.14	8.84
Q_{BAR} (l/s/Ha)	1.68	4.15	5.14
Allowable Discharge	3.40	3.40	3.40

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	Blocks 4-5
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**25.80m³**
Treatment Volume	**77.40m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	128.07m³
1-in-30-Year Storm	218.62m³
1-in-100-Year Storm	126.56m³
Reduction of Long-Term Storage	-231.37m³
Volume Required	**241.87m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**231.37m³**
Long Term Storage *(Interception provided)*	**205.57m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	128.07m³
1-in-30-Year Storm	218.62m³
1-in-100-Year Storm	126.56m³
Total	**473.25m³**

The maximum attenuation volume required is 473.25m³

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Calculation By:	RW
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Criterion 1
River Protection Volume

Catchment	Blocks 4-5
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

1.1 Interception

Paved surfaces connected to drainage system	*17200m² x 0.5 x 0.75 =* 6,450.00m²	*17,200m² site area* *50% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*6450m² x 5mm x 0.8 =* **25.80m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*17200m² x 0.5 x 0.75 =* 6,450.00m²	*17,200m² site area* *50% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*6450m² x 15mm x 0.8 =* **77.40m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Calculation By:	RW
Approved by:	SDN

Criterion 2
River Regime Protection

Catchment	Blocks 4-5
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	34.40	0.00	34.40	61.9	3.40	6.1	31.00	55.8
1	33.33	22.93	0.00	22.93	82.6	3.40	12.2	19.54	70.3
2	21.83	15.02	0.00	15.02	108.2	3.40	24.5	11.62	83.7
4	14.75	10.15	0.00	10.15	146.1	3.40	48.9	6.75	97.2
6	11.83	8.14	0.00	8.14	175.9	3.40	73.4	4.74	102.5
12	7.50	5.16	0.00	5.16	222.9	3.40	146.8	1.76	76.1

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	92.65	0.00	92.65	166.8	3.40	2.2	89.25	58.2
1	84.43	58.09	0.00	58.09	209.1	3.40	5.9	54.69	94.4
2	52.22	35.93	0.00	35.93	258.7	3.40	13.8	32.53	131.7
4	32.23	22.17	0.00	22.17	319.3	3.40	30.4	18.77	167.9
6	25.18	17.33	0.00	17.33	374.2	3.40	48.4	13.93	198.4
12	15.74	10.83	0.00	10.83	467.9	3.40	100.0	7.43	218.6

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	128.43	0.00	128.43	231.2	3.40	-2.6	125.03	-96.0
1	116.67	80.27	0.00	80.27	289.0	3.40	-2.0	76.87	-44.3
2	70.00	48.16	0.00	48.16	346.8	3.40	0.1	44.76	1.2
4	42.50	29.24	0.00	29.24	421.1	3.40	6.7	25.84	51.1
6	32.78	22.55	0.00	22.55	487.1	3.40	16.4	19.15	92.6
12	20.00	13.76	0.00	13.76	594.4	3.40	41.5	10.36	126.6

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Criterion 4
River Flood Protection

Catchment	Blocks 4-5
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	=	1.720 Ha	*… Area of site*
PIMP	=	50%	*… 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} = 231.37m³

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Project Data

Catchment	Block 6 and Community Room
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Description		%	Area
Total Site Area		-	6,100m²
Paved Area	Total	60%	3,660m²
	Drained	100%	3,660m²
Soil Area	Total	40%	2,440m²
	Drained	0%	0m²

Soil Type:	Type 2
SPR Index (from FSR):	0.30
SAAR:	750mm
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 = 0.0061km² … *Total site area in km²*
SAAR = 750mm … *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
$Q_{BARrural}$ = 1.205 l/s … *Note: where greenfield runoff value is <2l/s, a value of 2l/s shall be taken*
$Q_{BARrural}$ = 3.279 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)	2.79	6.89	8.52
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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Summary

Catchment	Block 6 and Community Room
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**10.98m³**
Treatment Volume	**32.94m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	41.74m³
1-in-30-Year Storm	82.68m³
1-in-100-Year Storm	50.51m³
Reduction of Long-Term Storage	-108.83m³
Volume Required	**66.09m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**108.83m³**
Long Term Storage *(Interception provided)*	**97.85m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	41.74m³
1-in-30-Year Storm	82.68m³
1-in-100-Year Storm	50.51m³
Total	**174.93m³**

The maximum attenuation volume required is 174.93m³

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Calculation By:	RW
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Criterion 1
River Protection Volume

Catchment	Block 6 and Community Room
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

1.1 Interception

Paved surfaces connected to drainage system	*6100m² x 0.6 x 0.75 =* 2,745.00m²	*6,100m² site area* *60% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*2745m² x 5mm x 0.8 =* **10.98m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*6100m² x 0.6 x 0.75 =* 2,745.00m²	*6,100m² site area* *60% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*2745m² x 15mm x 0.8 =* **32.94m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Criterion 2
River Regime Protection

Catchment	Block 6 and Community Room
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	14.64	0.00	14.64	26.4	2.00	3.6	12.64	22.8
1	33.33	9.76	0.00	9.76	35.1	2.00	7.2	7.76	27.9
2	21.83	6.39	0.00	6.39	46.0	2.00	14.4	4.39	31.6
4	14.75	4.32	0.00	4.32	62.2	2.00	28.8	2.32	33.4
6	11.83	3.46	0.00	3.46	74.8	2.00	43.2	1.46	31.6
12	7.50	2.20	0.00	2.20	94.9	2.00	86.4	0.20	8.5

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	39.43	0.00	39.43	71.0	2.00	1.8	37.43	34.0
1	84.43	24.72	0.00	24.72	89.0	2.00	4.3	22.72	48.4
2	52.22	15.29	0.00	15.29	110.1	2.00	9.4	13.29	62.3
4	32.23	9.44	0.00	9.44	135.9	2.00	19.8	7.44	73.7
6	25.18	7.37	0.00	7.37	159.3	2.00	30.8	5.37	82.7
12	15.74	4.61	0.00	4.61	199.1	2.00	60.8	2.61	79.3

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	54.66	0.00	54.66	98.4	2.00	-0.8	52.66	-21.3
1	116.67	34.16	0.00	34.16	123.0	2.00	0.0	32.16	-0.3
2	70.00	20.50	0.00	20.50	147.6	2.00	1.8	18.50	17.1
4	42.50	12.44	0.00	12.44	179.2	2.00	6.6	10.44	34.3
6	32.78	9.60	0.00	9.60	207.3	2.00	12.6	7.60	48.0
12	20.00	5.86	0.00	5.86	253.0	2.00	26.2	3.86	50.5

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Criterion 4
River Flood Protection

Catchment	Block 6 and Community Room
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	=	0.610 Ha	*… Area of site*
PIMP	=	60%	*… 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} = 108.83m³

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Calculation By:	RW
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Project Data

Catchment	Block 7
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Description		%	Area
Total Site Area		-	1,600m²
Paved Area	Total	70%	1,120m²
	Drained	100%	1,120m²
Soil Area	Total	30%	480m²
	Drained	0%	0m²

Soil Type:	Type 2
SPR Index (from FSR):	0.30
SAAR:	750mm
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 = 0.0016km² … *Total site area in km²*
SAAR = 750mm … *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.

$Q_{BARrural}$ = 0.000m³/s
$Q_{BARrural}$ = 0.316 l/s … *Note: where greenfield runoff value is <2l/s, a value of 2l/s shall be taken*
$Q_{BARrural}$ = 12.500 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)	10.63	26.25	32.50
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:	RW
Approved by:	SDN

Summary

Catchment	Block 7
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**3.36m³**
Treatment Volume	**10.08m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	5.58m³
1-in-30-Year Storm	15.57m³
1-in-100-Year Storm	10.72m³
Reduction of Long-Term Storage	-35.57m³
Volume Required	**-3.70m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**35.57m³**
Long Term Storage *(Interception provided)*	**32.21m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	5.58m³
1-in-30-Year Storm	15.57m³
1-in-100-Year Storm	10.72m³
Total	**31.87m³**

The maximum attenuation volume required is 31.87m³

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Criterion 1
River Protection Volume

Catchment	Block 7
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

1.1 Interception

Paved surfaces connected to drainage system	*1600m² x 0.7 x 0.75 =* 840.00m²	*1,600m² site area* *70% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*840m² x 5mm x 0.8 =* **3.36m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*1600m² x 0.7 x 0.75 =* 840.00m²	*1,600m² site area* *70% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*840m² x 15mm x 0.8 =* **10.08m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Criterion 2
River Regime Protection

Catchment	Block 7
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	4.48	0.00	4.48	8.1	2.00	3.6	2.48	4.5
1	33.33	2.99	0.00	2.99	10.8	2.00	7.2	0.99	3.6
2	21.83	1.96	0.00	1.96	14.1	1.96	14.1	0.00	0.0
4	14.75	1.32	0.00	1.32	19.0	1.32	19.0	0.00	0.0
6	11.83	1.06	0.00	1.06	22.9	1.06	22.9	0.00	0.0
12	7.50	0.67	0.00	0.67	29.0	0.67	29.0	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	12.07	0.00	12.07	21.7	2.00	2.7	10.07	13.7
1	84.43	7.57	0.00	7.57	27.2	2.00	5.6	5.57	15.6
2	52.22	4.68	0.00	4.68	33.7	2.00	11.1	2.68	14.8
4	32.23	2.89	0.00	2.89	41.6	2.00	18.7	0.89	8.3
6	25.18	2.26	0.00	2.26	48.7	2.00	8.4	0.26	1.1
12	15.74	1.41	0.00	1.41	60.9	1.41	0.0	0.00	0.0

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	16.73	0.00	16.73	30.1	2.00	0.9	14.73	6.5
1	116.67	10.45	0.00	10.45	37.6	2.00	2.5	8.45	10.4
2	70.00	6.27	0.00	6.27	45.2	2.00	5.0	4.27	10.7
4	42.50	3.81	0.00	3.81	54.8	2.00	6.6	1.81	6.0
6	32.78	2.94	0.00	2.94	63.4	2.00	0.4	0.94	0.2
12	20.00	1.79	0.00	1.79	77.4	1.79	0.0	0.00	0.0

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Calculation By:	RW
Approved by:	SDN

Criterion 4
River Flood Protection

Catchment	Block 7
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	=	0.160 Ha	*… Area of site*
PIMP	=	70%	*… 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} = 35.57m³

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Calculation By:	RW
Approved by:	SDN

Project Data

Catchment	Entrance Road
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Description		%	Area
Total Site Area		-	2,600m²
Paved Area	Total	75%	1,950m²
	Drained	100%	1,950m²
Soil Area	Total	25%	650m²
	Drained	0%	0m²

Soil Type:	Type 2
SPR Index (from FSR):	0.30
SAAR:	750mm
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 = 0.0026km² … *Total site area in km²*
SAAR = 750mm … *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
$Q_{BARrural}$ = 0.514 l/s … *Note: where greenfield runoff value is <2l/s, a value of 2l/s shall be taken*
$Q_{BARrural}$ = 7.692 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)	6.54	16.15	20.00
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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Summary

Catchment	Entrance Road
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**5.85m³**
Treatment Volume	**17.55m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	14.40m³
1-in-30-Year Storm	32.73m³
1-in-100-Year Storm	23.00m³
Reduction of Long-Term Storage	-63.51m³
Volume Required	**6.62m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**63.51m³**
Long Term Storage *(Interception provided)*	**57.66m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	14.40m³
1-in-30-Year Storm	32.73m³
1-in-100-Year Storm	23.00m³
Total	**70.13m³**

The maximum attenuation volume required is 70.13m³

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Calculation By:	RW
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Criterion 1
River Protection Volume

Catchment	Entrance Road
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

1.1 Interception

Paved surfaces connected to drainage system	*2600m² x 0.75 x 0.75 =* 1,462.50m²	*2,600m² site area* *75% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*1462.5m² x 5mm x 0.8 =* **5.85m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*2600m² x 0.75 x 0.75 =* 1,462.50m²	*2,600m² site area* *75% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*1462.5m² x 15mm x 0.8 =* **17.55m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Calculation By:	RW
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Criterion 2
River Regime Protection

Catchment	Entrance Road
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	7.80	0.00	7.80	14.0	2.00	3.6	5.80	10.4
1	33.33	5.20	0.00	5.20	18.7	2.00	7.2	3.20	11.5
2	21.83	3.41	0.00	3.41	24.5	2.00	14.4	1.41	10.1
4	14.75	2.30	0.00	2.30	33.1	2.00	28.8	0.30	4.3
6	11.83	1.85	0.00	1.85	39.9	1.85	39.9	0.00	0.0
12	7.50	1.17	0.00	1.17	50.5	1.17	50.5	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	21.01	0.00	21.01	37.8	2.00	2.4	19.01	22.7
1	84.43	13.17	0.00	13.17	47.4	2.00	5.1	11.17	28.7
2	52.22	8.15	0.00	8.15	58.6	2.00	10.7	6.15	32.7
4	32.23	5.03	0.00	5.03	72.4	2.00	21.2	3.03	32.1
6	25.18	3.93	0.00	3.93	84.9	2.00	31.3	1.93	30.1
12	15.74	2.46	0.00	2.46	106.1	2.00	35.8	0.46	8.2

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	29.12	0.00	29.12	52.4	2.00	0.3	27.12	4.6
1	116.67	18.20	0.00	18.20	65.5	2.00	1.7	16.20	14.1
2	70.00	10.92	0.00	10.92	78.6	2.00	4.5	8.92	20.0
4	42.50	6.63	0.00	6.63	95.5	2.00	9.7	4.63	22.4
6	32.78	5.11	0.00	5.11	110.4	2.00	14.8	3.11	23.0
12	20.00	3.12	0.00	3.12	134.8	2.00	7.4	1.12	4.1

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Calculation By:	RW
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Criterion 4
River Flood Protection

Catchment	Entrance Road
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	=	0.260 Ha	*… Area of site*
PIMP	=	75%	*… 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} = 63.51m³

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Calculation By:	RW
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Project Data

Catchment	Blocks 1-3
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Description		%	Area
Total Site Area		-	10,200m²
Paved Area	Total	50%	5,100m²
	Drained	100%	5,100m²
Soil Area	Total	50%	5,100m²
	Drained	0%	0m²

Soil Type:	Type 2
SPR Index (from FSR):	0.30
SAAR:	750mm
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 = 0.0102km² … *Total site area in km²*
SAAR = 750mm … *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.

$Q_{BARrural}$ = 0.002m³/s
$Q_{BARrural}$ = 2.015 l/s
$Q_{BARrural}$ = 1.976 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	1.71	4.23	5.24
Q_{BAR} (l/s/Ha)	1.68	4.15	5.14
Allowable Discharge	2.02	2.02	2.02

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:	RW
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Summary

Catchment	Blocks 1-3
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**15.30m³**
Treatment Volume	**45.90m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	75.95m³
1-in-30-Year Storm	129.64m³
1-in-100-Year Storm	75.06m³
Reduction of Long-Term Storage	-137.21m³
Volume Required	**143.44m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**137.21m³**
Long Term Storage *(Interception provided)*	**121.91m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	75.95m³
1-in-30-Year Storm	129.64m³
1-in-100-Year Storm	75.06m³
Total	**280.65m³**

The maximum attenuation volume required is 280.65m³

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Calculation By:	RW
Approved by:	SDN

Criterion 1
River Protection Volume

Catchment	Blocks 1-3
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

1.1 Interception

Paved surfaces connected to drainage system	*10200m² x 0.5 x 0.75 =* 3,825.00m²	*10,200m² site area* *50% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*3825m² x 5mm x 0.8 =* **15.30m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*10200m² x 0.5 x 0.75 =* 3,825.00m²	*10,200m² site area* *50% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*3825m² x 15mm x 0.8 =* **45.90m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Calculation By:	RW
Approved by:	SDN

Criterion 2
River Regime Protection

Catchment	Blocks 1-3
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	20.40	0.00	20.40	36.7	2.02	3.6	18.38	33.1
1	33.33	13.60	0.00	13.60	49.0	2.02	7.3	11.58	41.7
2	21.83	8.91	0.00	8.91	64.1	2.02	14.5	6.89	49.6
4	14.75	6.02	0.00	6.02	86.7	2.02	29.0	4.00	57.6
6	11.83	4.83	0.00	4.83	104.3	2.02	43.5	2.81	60.8
12	7.50	3.06	0.00	3.06	132.2	2.02	87.1	1.04	45.1

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	54.94	0.00	54.94	98.9	2.02	1.3	52.93	34.5
1	84.43	34.45	0.00	34.45	124.0	2.02	3.5	32.43	56.0
2	52.22	21.30	0.00	21.30	153.4	2.02	8.2	19.29	78.1
4	32.23	13.15	0.00	13.15	189.3	2.02	18.0	11.13	99.6
6	25.18	10.27	0.00	10.27	221.9	2.02	28.7	8.26	117.7
12	15.74	6.42	0.00	6.42	277.5	2.02	59.3	4.41	129.6

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	76.16	0.00	76.16	137.1	2.02	-1.5	74.14	-56.9
1	116.67	47.60	0.00	47.60	171.4	2.02	-1.2	45.58	-26.3
2	70.00	28.56	0.00	28.56	205.6	2.02	0.1	26.54	0.7
4	42.50	17.34	0.00	17.34	249.7	2.02	4.0	15.32	30.3
6	32.78	13.37	0.00	13.37	288.9	2.02	9.7	11.36	54.9
12	20.00	8.16	0.00	8.16	352.5	2.02	24.6	6.14	75.1

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Calculation By:	RW
Approved by:	SDN

Criterion 4
River Flood Protection

Catchment	Blocks 1-3
Project Name	Auburn, Malahide Road
Project Number	19-020
Client	Kinwest Ltd.
Architect	Conroy Crowe Kelly Architects
Status	Planning
Date	22/02/2021 Rev.B

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	=	1.020 Ha	*… Area of site*
PIMP	=	50%	*… 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} = 137.21m³

E. SuDS 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 2A-2D. 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	✓	Detention basins are to be utilised for 2 catchments within the development, including for the main site. The 2nd detention basin will cater separately for the main entrance road due to site topography. They will have storage capacities of 1,800m³ and 70m³ respectively	
Retentions 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	✓	Attenuation tanks (StormTech or similar approved), to be utilised within the development for apartment blocks only, where detention basins are not suitable. Tanks will be privately managed and maintained. Storage for all tanks is designed to have capacity for greater than the 1-in-100-year storm plus 20% for climate change. All outflows will be limited to greenfield rates (or allowable) via hydrobrake system.	
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

Appendix	**Name**
B3	Full planning
B4	Scheme design
B5	Health and safety
B6	Infiltration assessment
B7	Proprietary treatment
B9	filter strip
B11	filter drain
B13	swale
B15	bioretention
B16	pervious pavement
B17	attenuation tank
B19	basin
B21	pond wetland

F. Road Safety Audit

Title: **STAGE 1 ROAD SAFETY AUDIT**

For

Auburn, Malahide Road.

Client: **Waterman Moylan**

Date: **February 2020**

Report reference: **0725R01**

VERSION: **FINAL**

Prepared By:

Bruton Consulting Engineers Ltd

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BRUTON CONSULTING ENGINEERS

CONTENTS SHEET

Contents

1.0 Introduction

This report was prepared in response to a request from Mr. Stephen Dent Neville, Waterman Moylan Consulting Engineers, for a Stage 1 Road Safety Audit of a proposed residential development at Auburn, Malahide Road.

The Road Safety Audit Team comprised of;

Team Leader: **Norman Bruton**, BE CEng FIEI, Cert Comp RSA.

TII Auditor Approval no. NB 168446

Team Member: **Owen O'Reilly**, B.SC. Eng Dip Struct. Eng NCEA Civil Dip Civil. Eng CEng MIEI

TII Auditor Approval no. OO1291756

The Road Safety Audit comprised an examination of the drawings and a site visit by the Audit Team, together, on the 6th February 2020.

The weather at the time of the daytime site visit was dry and the road surface was damp.

This Stage 1 Road Safety Audit has been carried out in accordance with the requirements of TII Publication Number GE-STY-01024, dated December 2017.

The scheme has been examined and this report compiled in respect of the consideration of those matters that have an adverse effect on road safety. It has not been examined or verified for compliance with any other standards or criteria.

The problems identified in this report are considered to require action in order to improve the safety of the scheme for road users.

If any of the recommendations within this safety audit report are not accepted, a written response is required, stating reasons for non-acceptance. Comments made within the report under the heading of Observation are intended to be for information only. Written responses to Observations are not required.

A list of the documents provided to the Audit Team is contained in **Appendix A.**

A Problem Location Map is contained in **Appendix B.**

A feedback Form is contained in **Appendix C.**

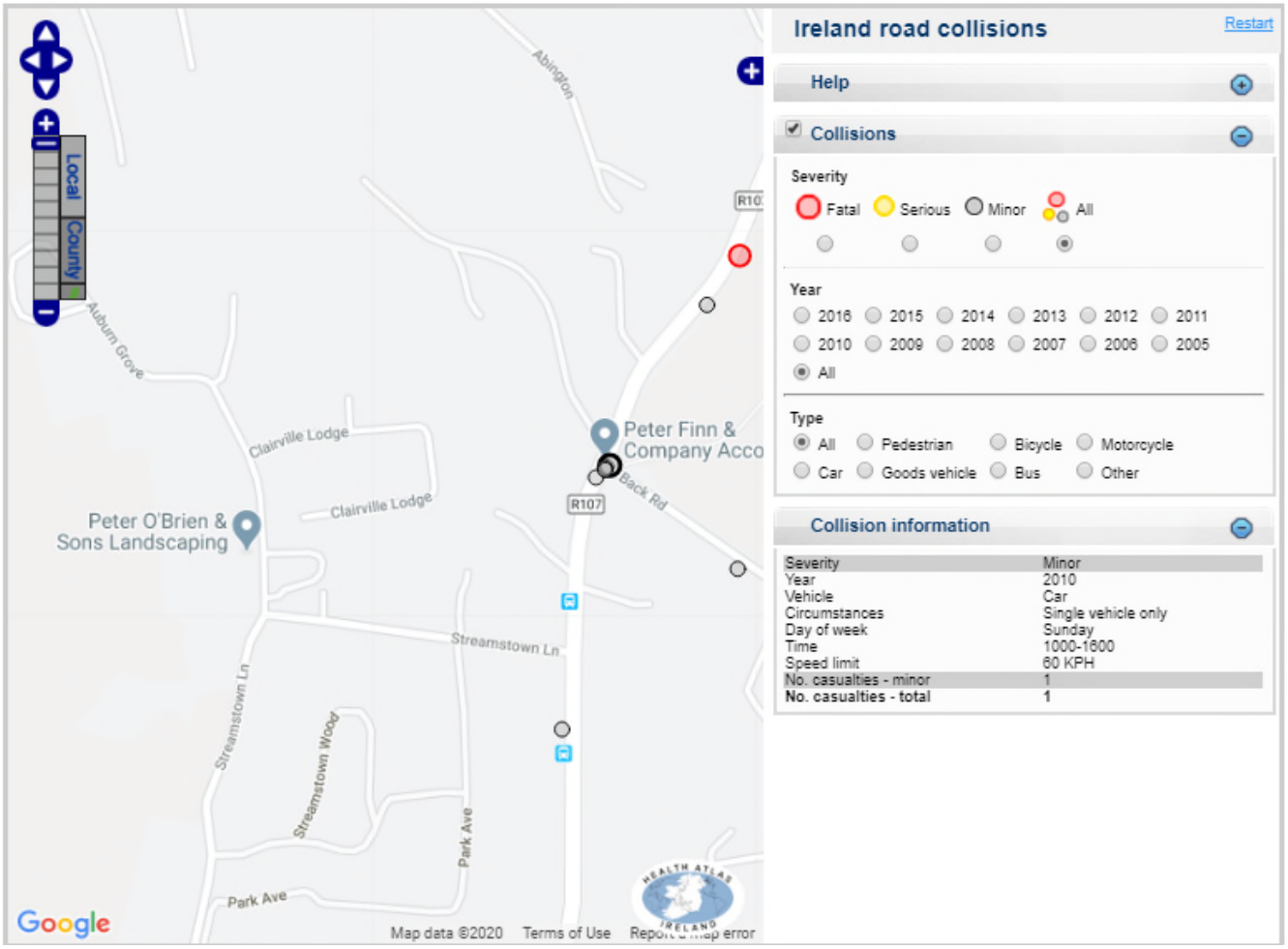
2.0 Background

It is proposed to construct a residential development at Auburn on the Malahide Road (R107). The main access to the development would be via a new signalised junction on the Malahide Road which would form a crossroads junction with Back Road. A secondary vehicular access would be provided onto Carey's Lane, the existing cul-de-sac road off Streamstown Lane.

The site location is shown in the map below.

Image courtesy of Openstreetmap.org

The Road Safety Authority's website (www.rsa.ie) shows that there were a number of minor injury vehicular collisions recorded at the R107/Back Road Junction between the years 2005 and 2016.



3.0 Main Report

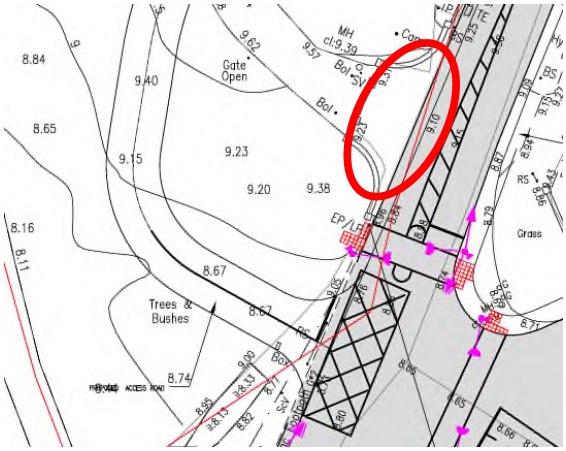
3.1 Problem

LOCATION

Drawing P120 Rev -

PROBLEM

It is unclear if the existing Auburn access is to be closed to vehicular traffic. If the existing access is to remain open to vehicular traffic if could lead to rear end shunts as drivers would not expect other vehicles ahead to slow and enter this access so close to the signalised junction.



RECOMMENDATION

It is recommended that the existing access be closed to vehicles.

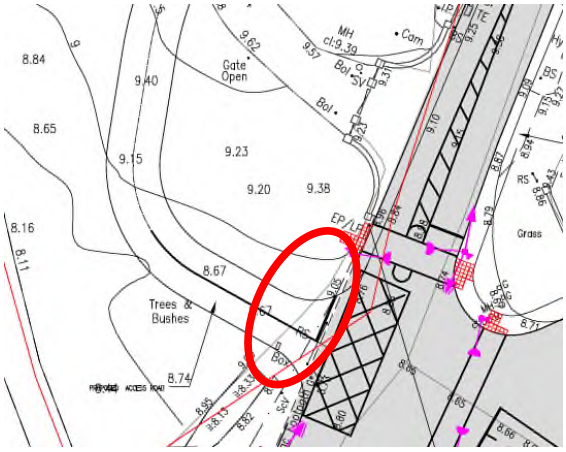
3.2 Problem

LOCATION

Drawing P120 Rev -

PROBLEM

The drawing does not show that the new access arm of the junction is to be signalised or where the signal heads will be located. If this arm of the junction is not signalised drivers may enter the junction at the same time as traffic in another arm moves forward which could result in side-impact or side-swipe collisions.



RECOMMENDATION

It is recommended that the new access arm of the junction be signalised.

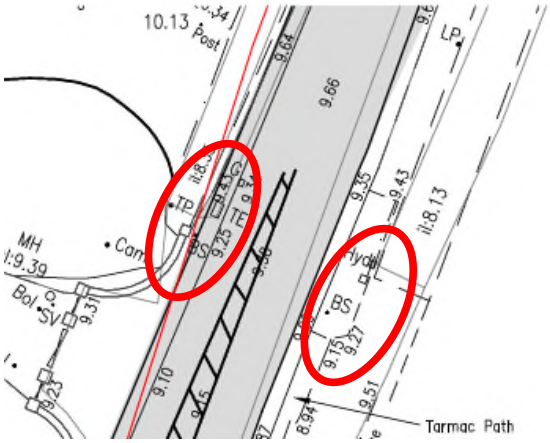
3.3 Problem

LOCATION

Drawing P120 Rev -

PROBLEM

There are bus stops on both sides of the R107 immediately North of the proposed signalised junction. There is a risk that the existing hard standing facilities for these bus stops will not be adequate to cater for the additional usage that may come from the proposed development. It was observed during the site visit that there are open drains behind the bus stops and that the footpaths are narrow.



RECOMMENDATION

It is recommended that the bus stops and paths to the bus stops from the signalised pedestrian crossing are included in the design.

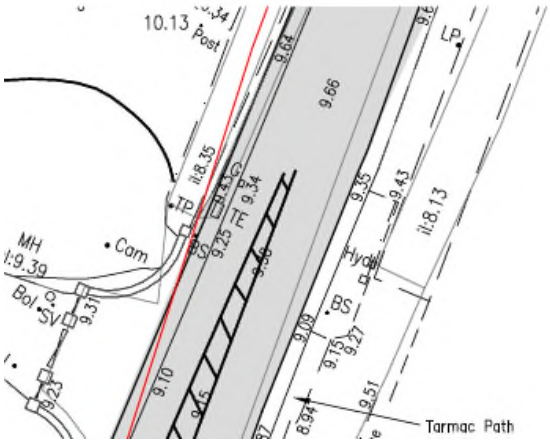
3.4 Problem

LOCATION

Drawing P120 Rev -

PROBLEM

There are no proposed facilities for cyclists at the R107/Back Road junction. The R107 is a popular cyclist route and Malahide Castle is a popular destination for cyclists. Without provision for cyclists, those vulnerable road users may be squeezed by through traffic or may not be able to take right or left turns without being at risk of being struck by turning vehicles.



RECOMMENDATION

It is recommended that cyclist facilities be included in the junction design.

3.5 Problem

LOCATION

Drawing P102 Rev -

PROBLEM

There is a gap in the provision of a footpath along Carey's Lane between the Claireville Lodge development and the proposed secondary access to the development. Without a suitable footpath, pedestrians would have to enter the carriageway where they would be at risk of being struck by passing vehicles or would have to travel on the grassed verge which could lead to slips and falls in wet or frosty conditions.

RECOMMENDATION

It is recommended that a continuous footpath be provided along Carey's Lane.

4.0 Observations

4.1 Observation

The vertical alignment of the proposed internal road layout has not been provided to the Audit Team.

5.0 Audit Statement

We certify that we have examined the site on the 6th February 2020. The examination has been carried out with the sole purpose of identifying any aspects of the design which could be added, removed or modified in order to improve the safety of the scheme.

The problems identified have been noted in this report together with associated safety improvement suggestions which we would recommend should be studied for implementation. The audit has been carried out by the persons named below who have not been involved in any design work on this scheme as a member of the Design Team.

Norman Bruton **Signed:** Norman Bruton

(Audit Team Leader) **Dated: 7/4/2020**

Owen O'Reilly **Signed:** Owen O'Reilly

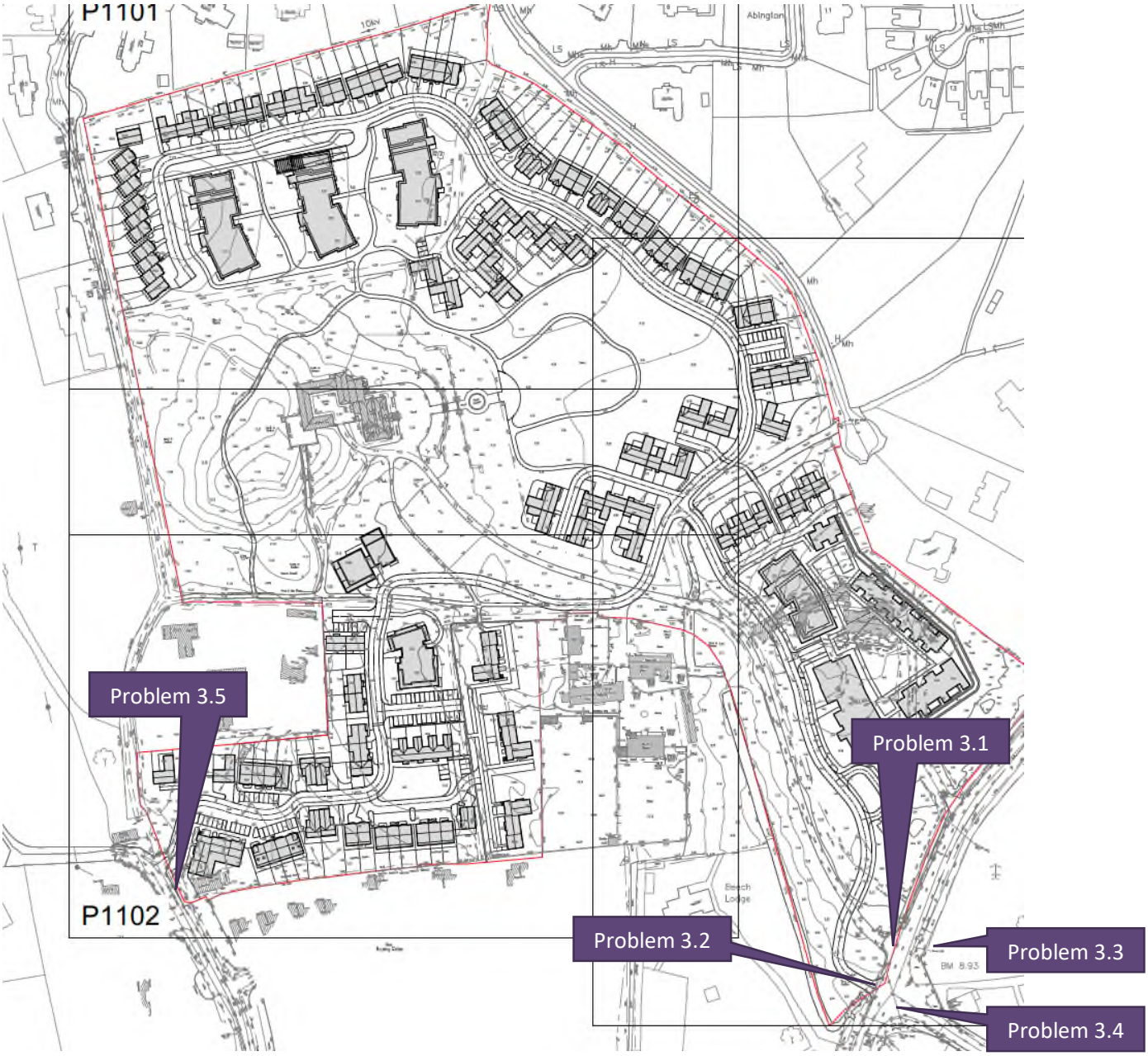
(Audit Team Member) **Dated: 7/4/2020**

Appendix A

Information Supplied to the Audit Team

- Drawing 19020 -P010
- Drawing 19020 -P100
- Drawing 19020 -P101
- Drawing 19020 -P102
- Drawing 19020 -P103
- Drawing 19020 -P120

Appendix B - Problem Location Map



Appendix C

Feedback Form

SAFETY AUDIT FORM – FEEDBACK ON AUDIT REPORT

Scheme: Auburn, Malahide Road
Stage: 1 Road Safety Audit
Date Audit (Site Visit) Completed: 6th February 2020

Paragraph No. in Safety Audit Report	Problem accepted (yes/no)	Recommended measure accepted (yes/no)	Alternative measures (describe)	Alternative measures accepted by Auditors (Yes/No)
3.1	Yes	Yes	The existing access is to be closed to vehicles as part of the proposed development. The drawings have been revised to clarify this. The access will remain open to pedestrians only.	Yes
3.2	Yes	Yes	The junction is proposed as a signalized junction. Please refer to drawing *19-020-P110 Proposed Malahide Road Junction Upgrade Layout*, which shows the proposed junction layout including signal head locations.	Yes
3.3	Yes	Yes	The proposed junction includes pedestrian crossings with tactile paving and new 2m wide footpaths from the site entrance to the bus stops. Please refer to the updated drawings.	Yes
3.4	Yes	Yes	The proposed R107 Malahide Road / Back Road junction design considers cyclist safety. Advanced stop lines to accommodate cyclists are proposed on the southern, northern and eastern approaches of the junction, with a 15m length of advisory cycle lane provided on the approaches to the junction. These advanced stop lines will provide a safe area for cyclists in front of vehicular queues and help cyclists	Yes

			position themselves correctly for right/left turning movements.	
3.5	Yes	Yes	A continuous footpath connection to the existing footpath on Carey's Lane is now provided. Refer to drawing *19-020-P102 Road Layout Sheet 2 of 3*.	Yes

Signed.....Mark Deignan..... **Date**.....3/4/2020...
Design Team Leader

Signed.....Norman Bruton..... **Date**.....2/4/2020...
Audit Team Leader

Signed.....Susan McClafferty..... **Date**.....7.4.2020
Employer

UK and Ireland Office Locations