Surface Water Management Plan

Application at Church Fields East, Mulhuddart, Dublin 15.

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This document has been prepared and checked in accordance with
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1	May 23	NM	IW	IAn Worrell

Comments

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1. Introduction

1.1 Context

This Surface Water Management Plan has been prepared by Waterman Moylan as part of the documentation in support of the Church Fields East development planning application for a proposed residential development at Damastown Avenue, Mulhuddart, Dublin 15.

This report sets out to demonstrate how pollution of watercourses during and after the construction period will be prevented and/or mitigated. This is in accordance with Objective IUO15 of the FCC Development Plan 2023-2029, which states that new developments shall include the following:

“Identify and assess the existing surface water movements through the development before considering and developing a surface water management system using SuDS, having regard to our Fingal Guidance Document “Green/ Blue Infrastructure for Development”, as amended. (Appendix 11).”

“Incorporate SuDS along the route of the water movement to enhance the water quality effects of nature-based systems at the different stages – Treatment Train approach from source to discharge.”

1.2 Site Location and Description

The proposed development relates to a site of c.5.52 hectares at Church Fields East, Mulhuddart, Dublin 15. The development site is located south of Damastown Avenue; west of Church Road; east of previously permitted residential development at Church Fields (Planning Reg. Ref.: PARTXI/012/21); and north of a permitted linear park (Eastern Linear Park Planning Reg. Ref.: PARTXI/012/21), in the townland of Tyrrelstown, Dublin 15. The proposed development seeks the construction of 217 no. residential units (ranging from 2 – 4 storeys in height) in a mixed tenure development, comprising of 121 no. houses and 96 no. apartments. The development will also include the provision of car parking, cycle parking, new pedestrian / cycle links, services, drainage and attenuation, and all associated site and infrastructural works.

Refer to Figure 1 for the location of the proposed development. Refer to Waterman Moylan Drawing 20-074-P4010 for details.

The proposed development consists of:

- 217 Residential units (121 houses, 96 apartments)
- The provision of access roads and associated infrastructure
- SuDS features such as swales, permeable paving, green roofs, and rain garden planters.
- Upgrading 2No. attenuation systems in the Church Fields Housing and Eastern Linear Park

Figure 1: Site Location (image taken from Google Earth)

The site falls from northeast to southwest at a natural slope of c. 1:54, ranging in levels from 87.00m to 80.00m OD Malin. Vehicular access to the site is via the Church Fields lands to the west (granted under Part XI /012/21). The Church Fields Link Road (currently under construction) services the entire Church Fields lands by linking Ladyswell Road to the south and Damastown Avenue to the north.

1.3 Topographic details

According to the area's topographic study, the site's lowest point has a level of 80.00m OD. This is located in the site's southwest corner. The site's highest point, at an altitude of 87.00m OD, is situated in the northeast site boundary. Vehicular access to the site is via the Church Fields Housing and Eastern Linear Park development to the west (granted under Part XI /012/21). The Church Fields Link Road (currently under construction) services the entire Church Fields lands by linking Ladyswell Road to the south and Damastown Avenue to the north.

1.4 Site Investigation Details

Ground Investigations Ireland (GII) completed geotechnical testing at the subject site and the lands to the west (Church Fields Housing and Eastern Linear Park) between December 2022 and February 2023. The reports are included in appendices to the Environmental Impact Assessment Report, submitted under a separate cover.

The fieldworks comprised a program of 5 no. trial pits with dynamic probes, and 5 No. soakaway tests, 2 slit trenches to investigate existing services, 4 No. dynamic probes to determine soil strength, 5 No. rotary boreholes, 2 No. groundwater monitoring wells, and geotechnical and environmental laboratory testing

were also undertaken. The procedures undertaken as part of the site investigation were in accordance with Eurocode 7 Part 2: Ground investigation and testing (ISEN 1997-2:2007) & B.S. 5930:2015.

1.5 Proposed Development

The proposed development consists of a total of 217 residential units, comprised of 96 apartment-type units and 121 house-type units. The proposed location is equipped with access roads and related infrastructure. Additionally, it offers sustainability elements including swales, infiltration trenches, permeable paving, green roofs, and planters for rain gardens.

Table 1: Schedule of Accommodation

Description	Number
House	121
Apartment	96

The development includes all associated site works, undergrounding of overhead lines, boundary treatments, drainage, and service connections.

1.6 Surface Water Impacts

Surface water run-off from surface construction activities has the potential to become contaminated. The main contaminants arising from construction activities include:

- Suspended solids: arising from ground disturbance and excavation.
- Hydrocarbons: accidental spillage from construction plant and storage depots.
- Faecal coliforms: contamination from coliforms can arise if there is inadequate containment and treatment of onsite toilet and washing facilities; and
- Concrete/cementitious products: arising from construction materials.

These pollutants pose a temporary risk to surface water quality for the duration of the project if not properly contained and managed.

1.7 Proposed Construction Works

The proposed work will consist of the following:

- Site preparation.
- Erection of security fencing/perimeter fencing.
- Setting up a secure site compound including wash down area.
- Site clearance including topsoil stripping.
- Construction of infrastructure including roads, drainage, and services.
- Provision of road upgrades and pedestrian links.
- Construction of residential and commercial units.
- Reinstatement landscaping.

2. Mitigation Measures

The surface water from the subject site will outfall into Church Fields Housing and Eastern Linear Park drainage network to the west of the site. The receiving network drain westwards ultimately outfalling at the southwestern corner of the overall Church Fields masterplan via the existing infrastructure provided by the external roads project and outfall through their network into the River Pinkeen.

The following Mitigation Measures are to address potential impacts on water quality and are required to protect the River Pinkeen which is the ultimate outfall of the proposed sites surface water. All works will be undertaken with reference to the following guidelines:

- CIRIA C532: Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors (Masters-Williams et al., 2001).
- CIRIA C692: Environmental Good Practice on Site, (Audus et al., 2010)
- BPGCS005: Oil Storage Guidelines.
- CIRIA C648: Control of Water Pollution from Linear Construction Projects: Technical Guidance (Murnane et al., 2006a).
- CIRIA C648: Control of Water Pollution from Linear Construction Projects: Site Guide (Murnane et al., 2006a).
- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI 2016).
- Guidelines for Planning Authorities – Architectural Heritage Protection – Guidance on Part IV of the Planning and Development Act 2000. (Part 2, Chapter 7) and ICOMOS Principles.

The mitigation schedule presented within *Table 2* summarises measures that will be undertaken in order to reduce impacts on ecological receptors within the zone of influence of the proposed development.

Table 2: Schedule of Surface Water Mitigation Measures

No.	Risk	Possible Impact	Mitigation	Result of Mitigation
1	Hydrocarbons from the car parking area entering the watercourse.	Water quality impacts Reduction in habitat quality Mortality of aquatic key ecological receptors/qualifying interests	Designated parking at least 50m from any watercourse.	Ensures no soil disturbance or hydrocarbons leak near the aquatic zone
2	Pollutants from site compound areas entering the watercourse.	Water quality impacts Reduction in habitat quality Mortality of aquatic key ecological receptors/qualifying interests	The site compound will be located at least 50m from any watercourse.	Prevents pollution of the aquatic zone from toxic pollutants

No.	Risk	Possible Impact	Mitigation	Result of Mitigation
3	Pollutants from material storage areas entering the watercourse.	Water quality impacts Reduction in habitat quality Mortality of aquatic key ecological receptors/qualifying interests	Fuels, oils, greases, and other potentially polluting chemicals will be stored in bunded compounds at the Contractor's compound or at a location at least 50m from any body of water. Bunds are to be provided with a 110% capacity of the storage container. Spill kits will be always kept on site and all staff trained in their appropriate use. Method statements for dealing with accidental spillages will be provided to the Contractor for review by the Employer's Representative.	Prevents contamination of aquatic zone by toxic pollutants
4	Concrete/ cementitious materials entering the watercourse from washdown.	Water quality impacts Reduction in habitat quality Mortality of aquatic key ecological receptors/qualifying interests	A designated wash-down area within the Contractor's compound will be used for cleaning any equipment or plant, with the safe disposal of any contaminated water.	Prevents contamination of aquatic zone by suspended solids or pollutants, ensures invasive species material is not transported off-site
5	Concrete/ cementitious materials entering the watercourse from concrete pours.	Water quality impacts Reduction in habitat quality Mortality of aquatic key ecological receptors/qualifying interests	Pouring of cementitious materials will be carried out in the dry.	Prevents contamination of aquatic zone by suspended solids or pollutants, ensures invasive species material is not transported off-site
6	Leaching of contaminated soil into groundwater.	Water quality impacts Reduction in habitat quality Mortality of aquatic key ecological receptors/qualifying interests	Spill kits will contain 10 hr terrestrial oil booms (80mm diameter x 1000mm) and a plastic sheet, upon which contaminated soil can be placed to prevent leaching to groundwater	Prevents contamination of aquatic zone by petrochemicals
7	Pollutants from equipment storage/ refuelling area entering the watercourse.	Water quality impacts Reduction in habitat quality Mortality of aquatic key ecological receptors/qualifying interests	Any refuelling and maintenance of equipment will be done at designated bunded areas with full attendance of plant operative(s) within contained areas at least 50m from any watercourse	Prevents contamination of aquatic zone by petrochemicals
8	Runoff from exposed work areas and excavated material storage areas entering the watercourse.	Water quality impacts Reduction in habitat quality Mortality of aquatic key ecological receptors/qualifying interests	The Contractor is to prepare a site plan showing the location of all surface water drainage lines and proposed discharge points to the sewer. The plan will include the location of all surface water protection measures, including monitoring points and treatment facilities.	Prevents contamination of aquatic zone by suspended solids or pollutants.

3. Construction Stage

Construction is envisaged to commence once final planning permission has been obtained. The construction program and duration are yet to be confirmed.

The proposed potential pollution mitigation measures outlined below will be implemented in accordance with 'CIRIA C532 – Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors' – CIRIA-2001.

3.1 Roles and Responsibilities

3.1.1 Main Contractor

The main Contractor will be responsible for implementing the project Construction Surface Water Management Plan (CSWMP) during the construction phase. The appointed person from the Main Contractors team will be appropriately trained and assigned the authority to instruct all site personnel to comply with the specific provisions of the CSWMP. At the operational level, a designated person from each sub-contractor on the site shall be assigned the direct responsibility to ensure that the operations stated in the CSWMP are performed on an ongoing basis.

Copies of the Construction Surface Water Management Plan will be made available to all relevant personnel on-site. All site personnel and sub-contractors will be instructed about the objectives of the CSWMP and informed of the responsibilities which fall upon them because of its provisions.

The responsibilities of the appointed person will be as follows.

- Updating the CSWMP as necessary to reflect activities on site.
- Advise site management (including, but not limited to, the site Construction Manager) on environmental matters.
- Ensure pre-construction checks for protected species, if any, are undertaken.
- Review the method statement of the sub-contractors to ensure that it incorporates all aspects of CSWMP.
- Provide toolbox talks and other training and ensure understanding by all involved of all mitigation measures.
- Assess the effectiveness of mitigation, check the weather forecast and site conditions where trigger levels are required.
- Ensure adherence to the specific measures listed in the Planning Conditions.
- Advise upon the production of written method statements and site environmental rules and on the arrangements to bring these to the attention of the workforce.
- Investigate incidents of significant, potential, or actual environmental damage, ensure corrective actions are carried out and recommend means to prevent recurrence.
- Be responsible for maintaining all environmental-related documentation.
- Ensure the plant suggested is environmentally suited to the task in hand.
- Co-ordinate environmental planning of the construction activities to comply with environmental authorities' requirements and with minimal risk to the environment. Give contractors precise

instructions as to their responsibility to ensure correct working methods where the risk of environmental damage exists.

3.2 Pre-Construction Plan

3.2.1 Designated Storage Area & Site Compound

A site compound(s) including offices and welfare facilities will be set up by the main contractor in locations to be decided within the subject site.

The main contractor will be required to schedule delivery of materials daily. The main contractor will be required to provide a site compound on the site for the secure storage of materials.

Measures will be implemented throughout the construction stage to prevent contamination of the soil and surrounding watercourses from oil and petrol leakages and significant siltation. Suitable bunded areas will be installed for oil and petrol storage tanks. Designated fuel filling points will be put in place with appropriate oil and petrol interceptors to provide protection from accidental spills. Spill kits will be provided by the Contractor to cater for any other spills.

3.3 Construction Plan

3.3.1 Vehicle Washdown

Where possible, and subject to license, the permanent connection to the public foul sewer will be used temporarily for the construction phase. Vehicle wash-down water will discharge directly, via suitable pollution control and attenuation, to the foul sewer system. If this connection is not permitted, then wastewater generated will be required to be stored for collection and treatment off-site at a suitable waste disposal facility.

3.3.2 Surface Water Run-off

On-site treatment measures will be installed to treat surface water run-off from the site prior to discharge to the receiving surface water sewer. This treatment will be achieved by the construction of settlement tanks/ponds, in conjunction with the installation of proprietary surface water treatment systems including class 1 full retention petrol interceptors, and spill protection control measures. Settlement tanks/ponds will be sized to deal with surface run-off and any groundwater encountered.

A sampling chamber with a shutdown valve will be installed downstream of the settlement pond/tank and water quality monitoring will be carried out here prior to discharge to the surface water sewer.

3.3.3 Surface Water Monitoring Parameters.

In addition to daily visual inspections, a surface water monitoring programme, as outlined in *Table 3* must be followed during construction in order to ensure maintenance of water quality protection. This is in line with Transport Infrastructure Ireland (TII)'s 'Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan'. It is considered that the parameter limit values (Guide/Mandatory) defined in the Fresh Water Quality Regulations (EU Directive 2006/44/EEC) should act as a trigger value for the monitoring of Surface Water.

Table 3: Monitoring Guidelines (Fresh Water Quality Regulations)

Parameter	Limit		Frequency and Manner of Samplings
	Limit Value	Guide/Mandatory	
Temperature	1.5°C	Mandatory Limit	Weekly, and at appropriate intervals where the works activities associated with the scheme have the potential to alter the temperature of the waters.
Dissolved oxygen	50% of Samples ≥ 9 (mg/l O2) 100% of Samples ≥ 7 (mg/l O2)	Guide Limit	Weekly, a minimum of one sample representative of flow oxygen conditions of the day of sampling
pH	6 to 9	Mandatory Limit	Weekly
Nitrites	≤0.01 (mg/l N02)	Guide Limit	Monthly
Suspended Solids	≤25 (mg/l)	Guide Limit	Monthly
BOD5	≤3 (mg/l)	Guide Limit	Monthly
Phenolic Compounds	-	-	Monthly where the presence of phenolic compounds is presumed (An examination by test)
Petroleum Hydrocarbons	5 (mg/l)	Guide Limit	Monthly (visual)
Non-Ionized Ammonia	≤ 0.005 (mg/l NH3)	Guide Limit	Monthly
Total Ammonium	≤ 0.004 (mg/l NH4)	Guide Limit	Monthly
Total Residual Chlorine	≤ 0.005 (mg/l HOCl)	Mandatory Limit	At appropriate intervals where works activities associated with the scheme have the potential to alter the Total residual Chlorine of the waters
Electrical Conductivity	-	-	Weekly

4. Operational Stage

The design of the surface water network is discussed in full in the Engineering Assessment Report, submitted under a separate cover, with the main items of relevance to this report being outlined in the following sections.

4.1 SuDS

Sustainable Drainage System (SuDS) are a collection of water management practices that aim to align modern drainage systems with natural water processes.

SuDS facilities are designed to prevent pollution of streams and rivers and to slow down runoff from sites, therefore helping to prevent downstream flooding and improve water quality. This closely mimics natural catchment behaviour where rainfall either infiltrates through the soil or runs off slowly over the ground surface to the nearest watercourse. This is known as the “treatment train” approach. SuDS devices should be placed at source, site, and regional levels. SuDS can also provide amenity benefits to local communities and benefits for biodiversity simultaneously.

In the following sections of the surface water chapter, it will be outlined in detail how SuDS devices have been utilised and incorporated as an integral part of the overall plan for the proposed development, and how their inclusion will mitigate the risk of localised and downstream flooding, while also promoting residential amenity and biodiversity.

4.2 Proposed Surface Water Network and SuDS Strategy

The surface water from the subject site will outfall into the Church Fields Housing and Eastern Linear Park Development (Permitted under FCC Ref.: Part XI/012/21) drainage network to the west of the site. Church Fields Housing and Eastern Linear Park Development drain westwards ultimately outfalling at the southwestern corner of the overall Church Fields Site Strategy via the existing infrastructure provided by the external roads project and outfall through their network into the River Pinkeen.

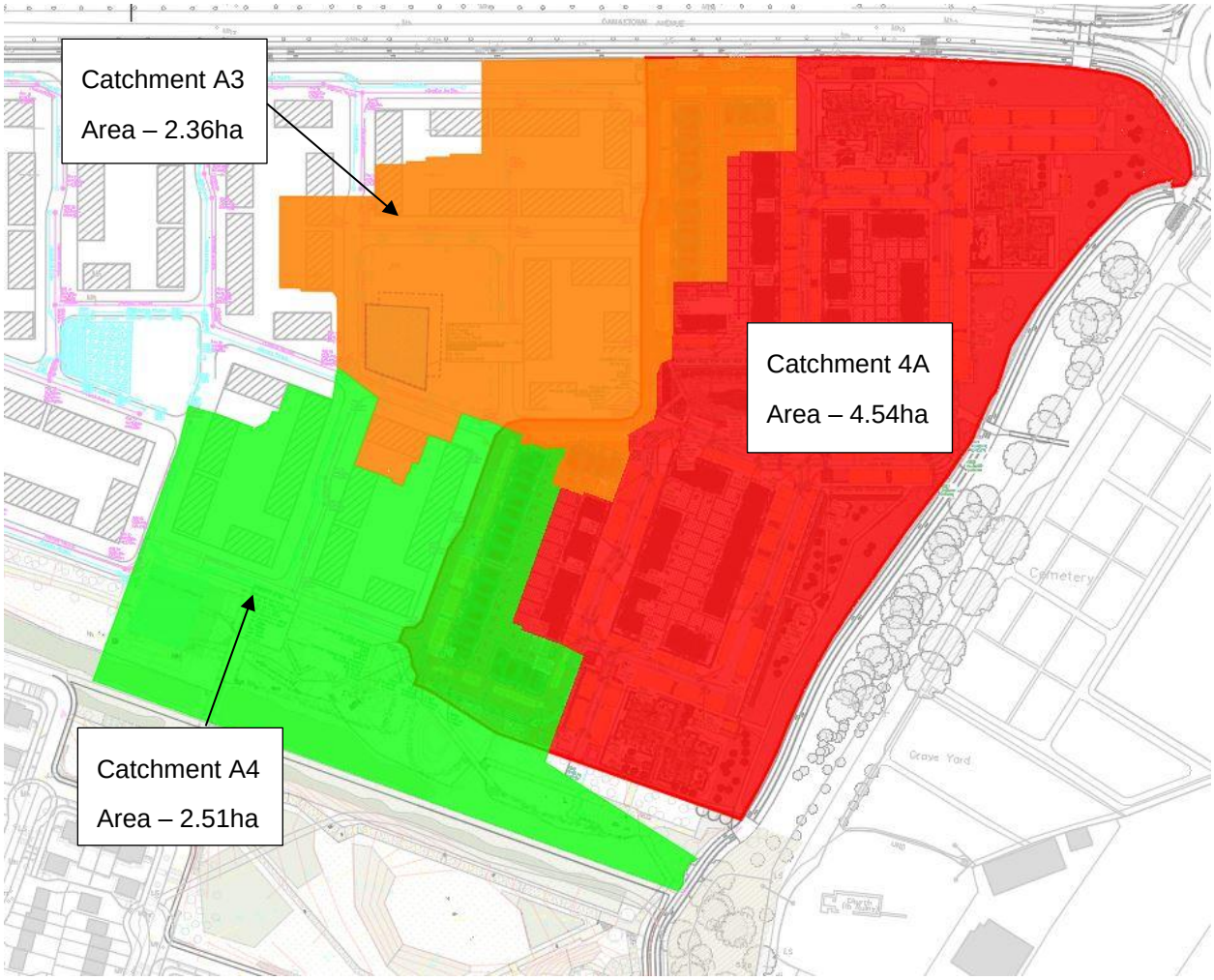
The preliminary Surface Water strategy, SuDS strategy, and outfall arrangements have been developed in conjunction and following consultation with Fingal County Council.

It has been agreed with Fingal County Council in pre-application meetings that the allowable outfall for the Church Fields Site Strategic Plan area is 3.70 l/s/Ha. Due to the topography of the site, it is not possible to attenuate the full area within the open space. The western boundary of the site will connect into the surface water network for Church Fields Housing and Eastern Linear Park Development (Permitted under FCC Ref.: Part XI/012/21), into catchments A3 & A4. We have liaised with Mr Daragh Sheedy (Executive Engineer at FCC) and agreed to upgrade the existing attenuation systems in A3 & A4.

It is proposed to change the underground storage systems from stone tanks to cellular systems (Stormtech or similar approved) with larger storage volumes. Please refer to drawings P4202 & 4203 for details.

- Attenuation A3 – The overground depression basin remains the same with a capacity of 48m³. The underground storage volume provided is now 638m². Overall volume provided = 686m³.
- Attenuation A4 –It is proposed to change from a stone tank system to a cellular storage tank. The underground storage volume provided is now 640m².

Figure 2: Sketch of Drainage Catchments



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

- Source Control
- Site Control
- Regional Control

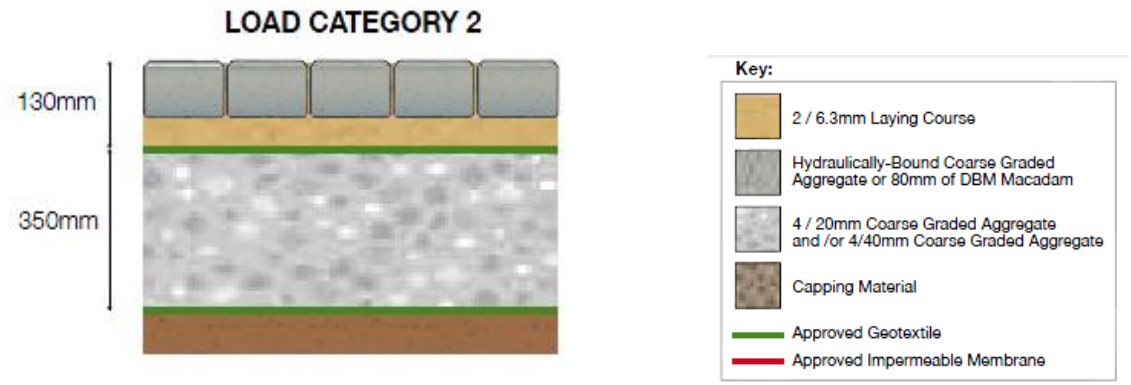
4.2.1 Source Control

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.

Figure 3: Typical Permeable Paving Build-up



Raingarden Planters:

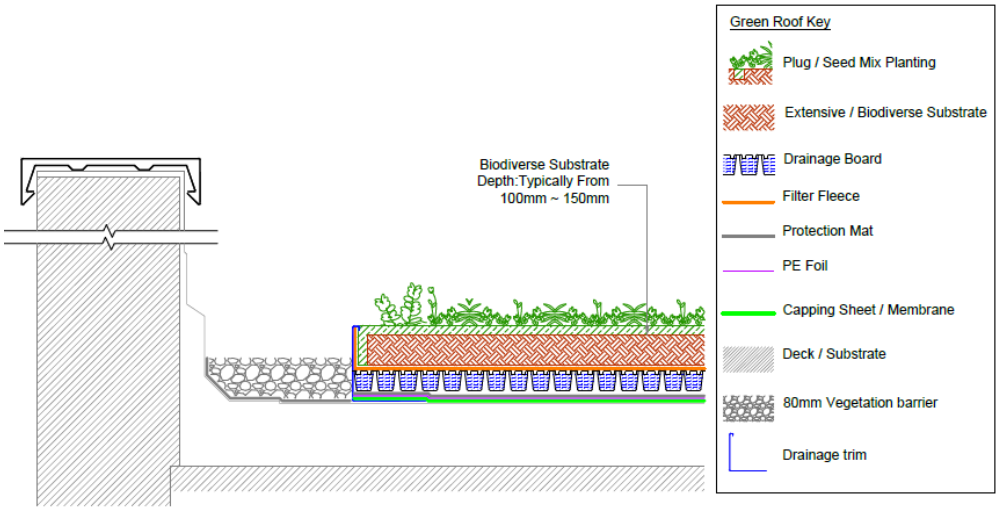
We have also included rain garden planters to the rear of each individual dwelling. The planters are designed to store the run-off from 50% of the roof areas for a 10 year storm event with a 2 hour duration. Each planter will be fitted with weep holes to act as an overflow and to provide a connection back into the main surface water network drainage.

Green / Sedum Roof:

It is proposed to introduce sedum roofing as a source control device on the roofs of all apartment buildings within subject site. The sedum roofing is proposed to cover approximately 70% of the total apartment roof area, in accordance with Green/Blue Infrastructure for Development Guidance Notes. The total cumulative green roof area is 1,800 m^2. The sedum roofing typically consists of 75mm substrate with a sedum blanket.

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.

Figure 4: Typical Green Roof Detail



Swale & Infiltration Trench:

It is proposed to drain the surface water run-off from a portion of the roads and footpaths into infiltration trenches. It is proposed to drain the surface water run-off from sections of the roads into an infiltration trench and swale system located at the open space area and at the parking bays to the northwest of the site, please refer to Drawing 20-074-P4200 for locations. The infiltration trench and swale treat the surface water run-off and act as a form of attenuation during storm events. The infiltration trench has been designed to store the 1:100 year storm event +20% for climate change, with a ø150mm overflow pipe connecting back into the main ø225mm surface water network.

Swales are grassed channels proposed to run parallel and adjacent to selected roads throughout the site. Rainfall from the road surface will be directed to gaps in the road kerbing and will flow to the swales. The swales will be linked back to the drainage network to prevent flooding in extreme weather events, where the volume of rainfall exceeds the percolation capacity of the swales.

Grassed swales enhance surface water runoff quality as they slow down water flow, allowing suspended particles to filter and settle out of suspension.

4.2.2 Site Control

Bio-retention Systems (Raingardens):

Bio-retention planted areas will be provided within the private domain to the rear of each dwelling. Planter boxes will intercept down pipes from the rear area of roofs.

Attenuation systems:

An underground attenuation system is also proposed to be utilised for the attenuation of the surface water. The attenuation tank is located under the public open space and has been sized to accommodate the majority of the surface water run-off in 1-in-100-year event, plus 20% for climate change.

Detention Basin

A detention basin is proposed to be utilised for attenuation of surface water. The basin can be utilised during regular weather conditions for other purposes and will only fill with water during extreme rainfall events in

excess of the 30 year storm. Detention basins are engineered depressions in the ground and are typical seeded with grass and may also be suitable for planting. Detention basins may be further utilised as recreational/play areas, an option which has been utilised in the proposals for this project. Please refer to drawing number: 20-074-P4200 for details.

4.2.3 Regional Control

Flow Control:

A flow control device (Hydrobrake or similar approved) is proposed at the attenuation feature, which will limit exiting flows to a maximum rate of 3.7l/s/ha (4.54 x 3.7 =16.8 l/s) as permitted by FCC.

Petrol interceptor:

A Class 1 petrol interceptor will be provided before the surface water outfalls to the adjacent surface water network.

4.3 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 summarised below:

4.3.1 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:

Table 4: Interception Calculation

Storage Provision Required		
Interception calculation (5mm of rainfall)	Imp Area x 0.8 x 0.005 (45408x0.432x0.8x0.005)	78 m^3
Required Interception Storage		**78 m^3**
Interception Storage Provided		
Swales	Length x Width x Depth (376x1.0x0.1)	37 m^3
Rain garden planters	Number x Volume (121 x 0.72)	87 m^3
Green roofs	Area x Depth (1800 x 0.075)	135 m^3
Total Storage		**259 m^3**

As noted above, the green sedum roofing amounts to a cumulative area of approximately 1,800m^2 and shall consist of a 75mm substrate with a sedum blanket. Assuming a 95% water volume retention, this amounts to approximately 135**m^3** of interception storage volume.

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 utilising SuDS 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:

Table 5: Treatment Volume Calculation

Treatment Storage Provision Required		
Treatment calculation (15mm of rainfall)	Imp Area x 0.8 x 0.015 (45408x0.432x0.8x0.015)	235 m^3
Required Treatment Storage		**235 m^3**
Treatment Storage Provided		
Infiltration Trenches	L x D x W x Voids (376x0.6x0.75x0.4)	68 m^3
Permeable paving	Area x D x Voids (2970x0.35x0.4)	416 m^3
Total Storage		**484 m^3**

Permeable paving is proposed in private driveways and accounts for a total cumulative area of C. 2,970m^2. Assuming a subbase depth of 0.35m with 40% voids, this yields a treatment volume of **416m^3**.

Green roofs, swales, and rain gardens, around the site provide further treatment volume. These SuDS features provide ample treatment volume to meet the Criteria 1 requirements.

4.3.2 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 80% runoff from paved areas (20% assumed as permeable paved parking bays, excludes calculations for apartment blocks which have been calculated as 100%), and has been calculated for the 1-year, 30-year and 100-year return periods, identifying the critical storm for each – refer to calculations included in Appendix A.

The calculations included in Appendix A have been based on the usage of an outflow rate of 16.8 l/s, in line with FCC's requirement for a max permitted value of 3.7 l/s/ha.

Based on the calculations, included in Appendix A, the required attenuation storage volume for the sub-catchment is set out in *Table 6* below, as well as the permitted outflow rate per catchment, and the actual outflow rate of the catchments running in the chain system.

Table 6: Attenuation Volume for Sub-Catchment 4A

Catchment	**Area**	**Allowable Discharge Rate**	**Required Attenuation Volume**
	m^2	*l/s*	*m^3*
Catchment 4A	45,409	16.8	860
Total			**860**

It should be noted that the figures provided in the table above, and the calculations in Appendix A

4.3.3 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 report under a separate cover. 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.

4.3.4 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 a greenfield run-off rate or 2 l/s/Ha, whichever is the greater. However, we have agreed with the FCC drainage department to use an outflow rate of 3.7 l/s/ha, resulting in a 16.8l/s allowable outflow for the subject site. The proposed drainage system includes a flow control device at the outfall to ensure that the discharge rate is limited to the permitted outflow rate, and ample attenuation is provided for the 1-in-100 year storm, accounting for a 20% increase due to climate change.

4.4 Surface Water – General

The proposed surface water drainage layout is shown on drawing numbers: 20-074-P4200 to P4201. Drawing number 20-074-P4500 shows the surface water catchments. Drawing number: 20-074-P4205 shows the overland flood routing, while drawing number: 20-074-P4501 shows the proposed SuDS layout.

Surface water long sections have been prepared in line with the Development plan requirements for the preparation of a Surface Water Management Plan Report and are submitted as Drawing Number:20-074-P4250.

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 Dublin City 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.

4.5 Flood Risk Assessment

A site-specific Flood Risk Assessment has been carried out for the proposed development and accompanies this submission under separate cover.

Appendices

A. GDSDS Attenuation Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	0.75
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	16.800	Minimum Backdrop Height (m)	0.600
Ratio-R	0.270	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	1.960	4.00	82.900	13.556	61.037	2.065

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	16.800	Drain Down Time (mins)	240
Ratio-R	0.270	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0

Node Depth/Area 1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	80.800	Product Number	CTL-SHE-0162-1680-2500-1680
Design Depth (m)	2.500	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	16.8	Min Node Diameter (mm)	1800

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.06300	Safety Factor	1.0	Invert Level (m)	80.835
Side Inf Coefficient (m/hr)	0.06300	Porosity	0.40	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1170.0	0.0	1.765	1170.0	0.0	1.766	0.0	1100.0

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	Depth/Area 1	264	81.350	0.515	53.7	250.8400	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
360 minute winter	Depth/Area 1	Hydro-Brake®	16.3	428.3
360 minute winter	Depth/Area 1	Infiltration	0.0	

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	0.75
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	16.800	Minimum Backdrop Height (m)	0.600
Ratio-R	0.270	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	1.960	4.00	82.900	13.556	61.037	2.065

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	16.800	Drain Down Time (mins)	240
Ratio-R	0.270	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	20	0	0

Node Depth/Area 1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	80.800	Product Number	CTL-SHE-0162-1680-2500-1680
Design Depth (m)	2.500	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	16.8	Min Node Diameter (mm)	1800

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.06300	Safety Factor	1.0	Invert Level (m)	80.835
Side Inf Coefficient (m/hr)	0.06300	Porosity	0.40	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1170.0	0.0	1.765	1170.0	0.0	1.766	0.0	1100.0

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.14%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	Depth/Area 1	456	82.199	1.364	88.1	664.4689	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
480 minute winter	Depth/Area 1	Hydro-Brake®	16.5	570.0
480 minute winter	Depth/Area 1	Infiltration	0.0	

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	0.75
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	16.800	Minimum Backdrop Height (m)	0.200
Ratio-R	0.270	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	1.960	4.00	82.900	13.556	61.037	2.065

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	16.800	Drain Down Time (mins)	240
Ratio-R	0.270	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	20	0	0

Node Depth/Area 1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	80.800	Product Number	CTL-SHE-0162-1680-2500-1680
Design Depth (m)	2.500	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	16.8	Min Node Diameter (mm)	1800

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.06300	Safety Factor	1.0	Invert Level (m)	80.835
Side Inf Coefficient (m/hr)	0.06300	Porosity	0.40	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1170.0	0.0	1.765	1170.0	0.0	1.766	0.0	1100.0

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.13%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	Depth/Area 1	352	82.610	1.775	110.8	860.1888	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
480 minute winter	Depth/Area 1	Hydro-Brake®	16.5	558.1
480 minute winter	Depth/Area 1	Infiltration	19.3	

UK and Ireland Office Locations