



Surface Water Management Plan

Proposed Residential Development at Beaumont Road /
Beaumont Grove / Grace Park Court / Ellenfield Road, Beaumont,
Dublin 9

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This document has been prepared and checked in accordance with
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1. Introduction

1.1 Context

Waterman Moylan has prepared this Surface Water Management Plan on behalf Urban Life (BMD) Ltd, as part of the planning application for a large-scale residential development on a site comprises of 100 no. units located at Beaumont Road / Beaumont Grove / Grace Park Court / Ellenfield Road, Beaumont, Dublin 9.

1.2 Site and Description and Location

The subject site is located at Beaumont Road, Beaumont, Dublin 9. Refer to Figure 1. The subject site is approximately 0.58 hectares. The subject site is bounded by the Beaumont Grove Road to the northeast, by the Grace Park Court and Beaumont Road to the southeast and by Grace Park Court to the southwest and existing neighbouring houses to the north and west.

The location of the site is shown in Figure 1. Please refer to Waterman Moylan Drawing No. 20-048-P2010-Site Location Map for the exact site location and surrounding lands.

Figure 1 - Site Location Map



1.3 Existing Site

The overall site area is approximately 0.58 Ha. The site is currently brownfield area with car parking area and existing former properties to the west of the overall site. The site is bounded in the north by large, scaled trees.

It falls from southeast to northwest gently with the high point of c. 42.09m OD observed to the southwest and the low point of c. 39.24m OD to the northeast. The road located within the subject site will range between 40.74m and 40.14m OD Malin.

The lands are zoned as Z1 Sustainable Residential Neighbourhood land use zoning in the new Dublin City Council Development Plan 2022-2028.

1.4 Proposed Development

The proposed Large Scale Residential Development (LRD) will comprise 100 no. apartments/duplexes (17 no. studios, 45 no. 1-beds, 27 no. 2-beds and 11 no. 3 beds) within 4 no. blocks ranging in height from 3 to 6 storeys. All residential units will be provided with associated private balconies/terraces to the north/ south/ east/ west elevations. Provision of internal amenity space and lobby/reception area at ground floor of the apartment block. Vehicular/pedestrian/cyclist access from Grace Park Court and pedestrian/cyclist and emergency access via Ellenfield Road. All associated site development works including import, export and reuse of material to achieve appropriate site levels, infrastructure and enabling works including water services provision and upgrades, public utilities, open spaces (including play areas), surface car parking, set down areas, cycle parking areas/buildings, landscaping and boundary treatment works, plant areas (at ground and roof level), green roofs, roof mounted photovoltaic (PV) panels, ESB substation, and waste storage.

1.5 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.

1.6 Proposed Construction Works

Working hours for the site will be set out in the conditions of planning approval and would typically be 08.00 to 19.00 from Monday to Friday and 08.00 to 14.00 on Saturday. No Sunday or Bank Holiday work will generally be permitted. The above working hours are typical; however, special construction operations may need to be carried out outside these hours in order to minimise disruption to the surrounding area.

The proposed work will consist of the following:

- Site preparation;
- Setting up a secure site compound including wash down area;
- Construction of infrastructure including roads, drainage, and services;

- Provision of road upgrades and pedestrian and cycling facilities;
- Construction of the educational campus and children accommodation.
- Construction of open spaces and landscaping.

The site access during construction will be primarily through the site entrance at Beaumont Road.

1.7 Development of the Management Plan

The plan should be considered as a dynamic process which will be further developed and carried forward by the school from the outset and during the operation of the school.

As part of the preparation of this SuDS management Plan the following documents/Websites have been consulted:

- Dublin City Council - <https://www.dublincity.ie/>
- Dublin City Development Plan Written Statement (2022 -2028)
- DCC Sustainable Drainage Design & Evaluation Guide – 2021
- DCC Green & Blue Roof Design & Evaluation Guide - 2021
- The SuDS Manual – CIRIA C753
- Greater Dublin Strategic Drainage Study (GDSDS)

2. Mitigation Measures

The site has no direct hydrological connectivity to natural watercourses, the site is located c. 1.85km to the south of the nearest water course. The proposed development will decrease the brownfield surface water runoff from the site by implementing SUDS measures.

It is proposed that the existing 225mm diameter surface water line traversing the site from Ellenfield Road to Beaumont Grove will be decommissioned, and the line will be redirected from Ellenfield Road to Beaumont Road, with all surface water from the site draining under gravity to this diverted 225mm pipeline, with outfall to the existing 250mm surface water line along Beaumont Road. In addition, excess flow will be stored in 2 no. underground stone attenuation areas totalling 108.4m³ of available underground storage. All outfall flow will be restricted to the greenfield runoff rate.

The schedule of mitigation presented within Table 1 summarises measures that will be undertaken in order to reduce impacts on ecological receptors within the zone of influence of the proposed development during construction.

Table 1 - Schedule of Surface Water Mitigation Measures

No.	Risk	Possible Impact	Mitigation	Result of Mitigation
1	Hydrocarbons from carparking 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 leaks
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
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 110% capacity of storage container. Spill kits will be kept on site at all times and all staff trained in their appropriate use. Method statements for dealing with accidental spillages will be provided the Contractor for review by the Employer's Representative.	Prevents contamination of aquatic zone by toxic pollutants

No.	Risk	Possible Impact	Mitigation	Result of Mitigation
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 of 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 ground water	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	Contractor 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

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 have overall responsibility for the implementation of 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 on-going 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 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 effectiveness of mitigation, check 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; and,
- Be responsible for maintaining all environmental related documentation.
- Ensure 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 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 licence, the permanent connection to the public foul sewer will be used temporarily for 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 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 shut down 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 2 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 2 - 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 $\geq$ 9 (mg/l O ₂) 100% of Samples $\geq$ 7 (mg/l O ₂)	Guide Limit	Weekly, minimum one sample representative of flow oxygen conditions of the day of sampling
pH	6 to 9	Mandatory Limit	Weekly
Nitrites	≤ 0.01 (mg/l N ₀₂)	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 NH ₃)	Guide Limit	Monthly
Total Ammonium	≤ 0.004 (mg/l NH ₄)	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 with this application under a separate cover. This report, however, discusses the surface water and SuDS management plan as a whole, with an emphasis on describing the rationale for the selection of proposed SuDS, and calculations for attenuation volumes, discharged water quality enhancement, and the further enhancement of amenity and biodiversity values.

4.1 SuDS

According to the Dublin City County Council's Sustainable Drainage Design & Evaluation Guide (2021), *"Sustainable Drainage is a way of managing rainfall that minimises the negative impact on the quantity and quality of runoff whilst maximising the benefits of amenity and biodiversity for people and the environment"*. These Sustainable Drainage System (SuDS) are considered a collection of water management practices that aim to align modern drainage systems with natural water processes.

SuDS facilities are designed as an integral part of the urban fabric to prevent pollution of watercourses and to slow down runoff from sites, reducing the impact on the natural landscape, therefore helping to improve water quality and prevent downstream flooding. This is achieved by closely mimicking 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 it will be outlined in detail how SuDS devices have been utilised and incorporated as an integral part of the 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

Surface water from the site will drain to the proposed diverted line, which will outfall to the existing 250mm surface water line on Beaumont Road. The attenuation strategy has been designed considering 2 catchments as highlighted in the Figure below. The surface water for each catchment will be attenuated in 2 No. attenuation areas, and excess stormwater will outfall at a restricted rate calculated for each catchment. It is proposed to construct a new surface water manhole in the existing surface water network at south of the site.

Please refer to Waterman Moylan Drawing No 20-048-P2200 - Proposed Drainage Layout for details of the proposed drainage arrangements.

Figure 2 - Site Catchment Split Up



The proposed development will be designed to convey foul sewer and surface water drainage separately within the site. The Stormwater drainage consists of permeable paving used throughout the site, a green-blue roof on the apartment building, rain gardens and tree pits, and 2 no. underground stone attenuation areas, with a flow control device installed downstream of the green-blue roof system, and each of the storages for a controlled discharge rate.

Soil type 4 was selected based on the application of sound engineering judgement considering the current soil classification of the site and percolation test results that were carried out, showing a very poor infiltration to the soil. The runoff rate for the site has been calculated in accordance with the Institute of Hydrology report No. 124 – “*Flood Estimation for Small Catchments*” using the UK SuDS website and the rate for the overall site is 3.16 l/s.

It is proposed to incorporate this 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 SuDS

Management Plan for the subject site is based on recommendations set out in the Greater Dublin Strategic Drainage Study (GDSDS), Dublin City Council's Sustainable Drainage Design and Evaluation Guide 2021, and in the CIRIA 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

4.2.1 Source Control

See table below for area x volume of storage of each SuDS device within the overall site. Those are described in detail below.

SuDS Element	Area (m ²)	Storage (m ³)
Permeable Paving	1,270.26	177.83
Green/Blue Roof	797	49.60
Stone Attenuation Storage	358.40	102.20
Rain Garden / Bioretention Systems	106.81	14.95
Tree Pit	72 (8 tree pits)	28
TOTAL	2,604.47	372.58

We would note that where the porosity and the total attenuation height of the SuDS element vary, the below table was used to calculate the indicative attenuation storage.

Figure 3 - Initial Guide of the Potential Storage

SuDS structure	Indicative Attenuation storage (m ³ of storage per m ² of SuDS structure)
Blue roofs	0.05-0.1
Rain water harvesting	0
Swales	0.15-0.4
Permeable pavements	0.05-0.15
Filter Drains	0.15-0.5
Rain Gardens	0.3
Tree pits	0.4
Detention basins	0.6
Ponds	0.6-1.2
Wetland	0.3-0.9
Underground storage	0.4-2.0

Permeable Paving / Porous Surfacing:

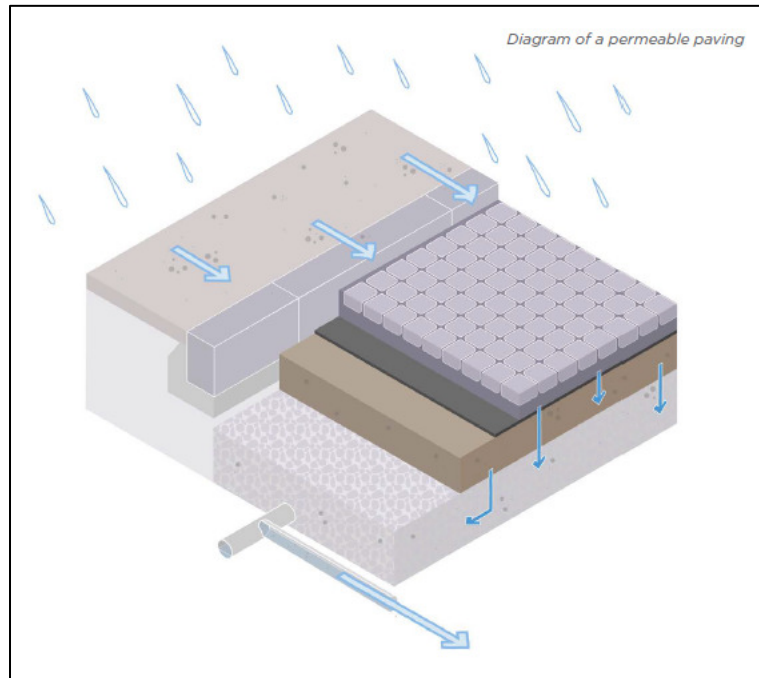
It is proposed to introduce permeable paving on the parking spaces, internal paths (main plaza) and the main shared zone in the development. Please refer to the Waterman Moylan Drawing 20-048-P2040-Proposed SUDS Layout for the accurate location.

The goal of permeable paving / porous surfacing 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 substrate layers.

Within this proposal the permeable paving has the objective of intercept rainwater and attenuate excess storm water on specific locations. The permeable paving that is designed to cater for water storage is marked with perforated pipes, chamber and pipe connections to the main line in Waterman Moylan Drawing 20-048-P200 – Proposed Drainage Layout.

The interception area with permeable / porous paving is 1,270.26m², including the main circulation area of the site, footpaths and the parking spaces. The volume of interception for this SuDS element will be 177.83m³ considering the material porosity of 0.40 and available draining depth of 0.350m.

Figure 4 - Illustration of Permeable Paving Extracted from the Sustainable Drainage Design and Evaluation Guide - 2021



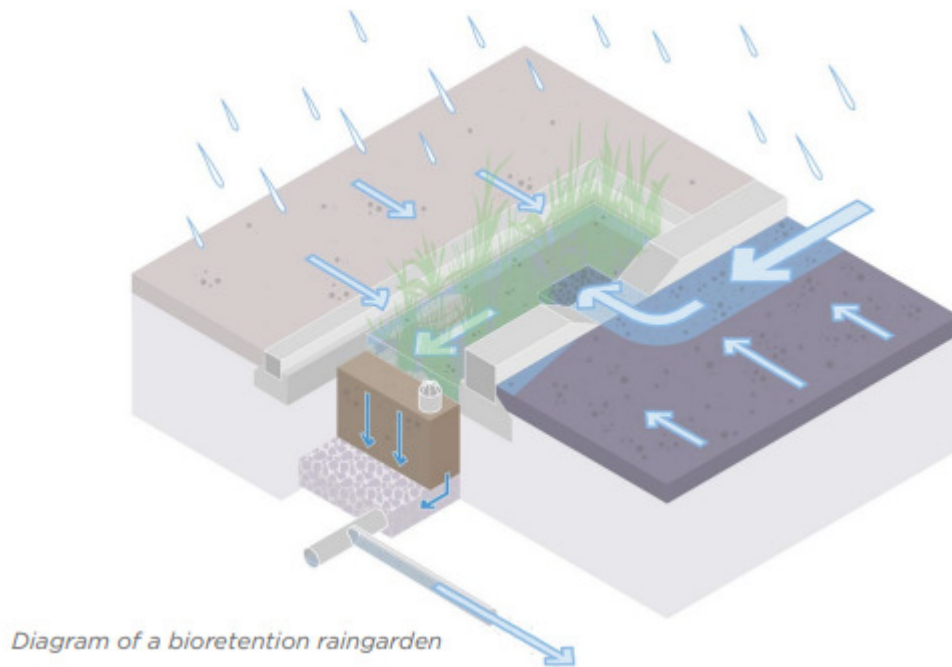
Rain Gardens:

It is proposed to integrate rain gardens / biodiversity systems throughout the site, with two in the central shared area, and one on between the proposed duplex blocks, the specific locations can be found in Waterman Moylan drawing 20-048-P2040-Proposed SUDS Layout.

These are vegetated depressions in the land with a free drainage substrate soil and a perforate pipe connection to the main drainage line. Rain gardens act to reduce excess stormwater runoff by providing storage and allowing infiltration. Additionally, these will provide water quality treatment by allowing suspended solids to settle out under gravity, as well as by filtering contaminants as they move through the substrate layers.

Across the site, rain gardens will have a total area of 106.81m², and storage for this SUDs device will be 14.95m³, considering the depth of 0.350m and material porosity of 0.40.

Figure 5 - Illustration of a Rain Garden Extracted from the Sustainable Drainage Design and Evaluation Guide - 2021



Tree Pit:

There are 8 no. tree pits proposed in landscaping areas throughout the site, as indicated in Waterman Moylan drawing 20-048-P2040-Proposed SUDS Layout.

Tree pits reduce stormwater runoff at the source by intercepting surface water from the surrounding impermeable areas, where it can be absorbed by the tree and/or percolate through the free draining soil to the under-drain systems below. This reduces water pollutants through filtration and trapping of particles in the runoff.

Tree pits on the development site will have a collective area of 72.0m², providing a potential storage volume of 28m³ (considering the average values of the Table taken directly from the Sustainable Drainage Design and Evaluation Guide – 2021).

Figure 6 - Illustration of a Tree Pit Extracted from the Sustainable Drainage Design and Evaluation Guide
- 2021

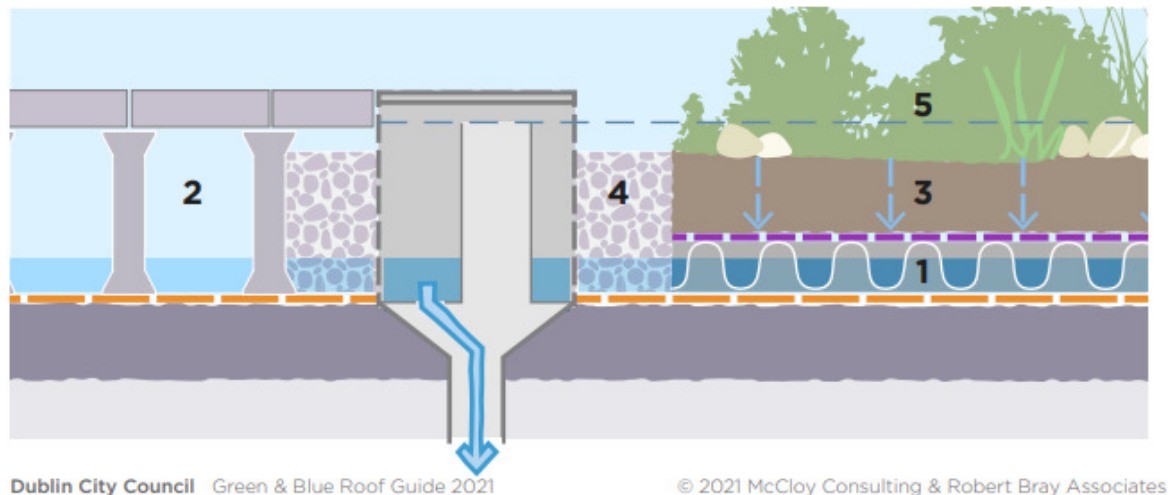


Green/Blue Roof:

Green roofs are multi-layered system that covers the roof of a building or podium structure with vegetation over a drainage layer. Green roofs are used to reduce the volume and rate of runoff from development roofs and hence reduce the amount of hardstanding resulting from a development. Blue Roofs are a roof construction that stores water and can include open water surfaces, storage within or beneath a porous media or modular surface or below a raised decking surface or cover. The total amount of available flat roofs will be used as blue roofs. The green/blue roof areas are shown in Waterman Moylan's drawing 20-048-P2040-Proposed SUDS Layout.

The proposed development consists of 1 Apartment block building and duplex units, with only the apartment block building containing a flat roof available for a green/blue roof. This building has an area of c. 797 m² of flat roof, making it suitable for a green roof. It is proposed that c. 50% of the total roof area will be dedicated to intensive green roofing. Considering the depth of the proposed blue roof, that will cover the whole roof area, this will provide storage of 49.60m³.

Figure 7 - Illustration of Blue-Green roof Extracted from DCC Green Blue Roof Design and Evaluation Guide - 2021



4.2.2 Site Control

Petrol Interceptor:

The Petrol Interceptor is a trap used to filter out hydrocarbon pollutants from rainwater runoff. It is typically used in road construction to prevent fuel contamination of water courses carrying away the runoff. Petrol interceptors work on the premise that some hydrocarbons such as petroleum and diesel float on the top of water. The contaminated water enters the interceptor typically after flowing off roads and entering a channel drain before being deposited into the first tank inside the interceptor. The first tank builds up a layer of the hydrocarbon as well as other scum preventing it from entering the water course.

At this site it is proposed a Petrol interceptor class NSBP003 prior to the connections to the stone storage areas where pollutants may be encountered (i.e. parking and internal roads).

Stone Attenuation Storage:

The stone storage area is an underground tank of porous stone media that will attenuate surface water to restrict the outflow to the equivalent of the existing agricultural runoff. This ensures the development will not give rise to any impact downstream of the site.

For the complete design calculations and assumptions for the 2 No. stone attenuation storages, please refer to Watermain Moylan Engineering Assessment Report, submitted with this application under separate cover.

4.3 SuDS Maintenance Regime

For the SuDS to work appropriately as designed is important to ensure that the entire system is well maintained. A maintenance regime for the SuDS features will be incorporated to the Operation and Maintenance manual for the development. Surface SuDS features can typically be maintained as part of the regular maintenance of the landscape, incorporating litter picking, grass cutting, and inspections. Site management requires an element of regular site attendance, often monthly, which corresponds with most SuDS maintenance.

Figures 8 and 9, taken directly from the Sustainable Drainage Design and Evaluation Guide – 2021 shows the regular and occasional maintenance for general SuDS and the recommended maintenance plan/program for each of the SuDS specifically that can be found in the site are listed in the tables below.

Figure 8 - Regular SuDS Maintenance

Type	Activity	Normal site care (Site) or SuDS-specific maintenance (SuDS)	Suggested frequency
Regular Maintenance			
Litter	Pick up all litter in SUDS Landscape areas along with remainder of the site – remove from site	Site	1 visit monthly
Grass	Mow all grass verges, paths and amenity grass at 35-50mm with 75mm max. Leaving cuttings in situ	Site	As required or 1 visit monthly
Grass	Mow all dry swales, dry SUDS basins and margins to low flow channels and other SUDS features at 100mm with 150mm max. Cut wet swales or basins annually as wildflower areas – 1st and last cuts to be collected	Site	4-8 visits per year or as required
Grass	Wildflower areas strimmed to 100mm in Sept or at end of school holidays – all cuttings removed Or Wildflower areas strimmed to 100mm on 3 year rotation – 30% each year – all cuttings removed	Site	1 visit annually 1 visit annually
Inlets & outlets	Inspect monthly, remove silt from slab aprons and debris. Strim 1m round for access	SuDS	1 visit monthly
Permeable paving	Sweep all paving regularly to keep surface tidy	Site	1 visit annually or as required

Figure 9 - Occasional and Remedial SuDS maintenance

Occasional Tasks			
Permeable paving	Sweep and suction brush permeable paving when ponding occurs	SuDS	As required - estimate 10-15 year intervals
Flow controls	Annual inspection of control chambers - remove silt and check free flow	SuDS	1 visit annually
Wetland & pond	Wetland vegetation to be cut at 100mm on 3 – 5 year rotation or 30% each year. All cuttings to be removed to wildlife piles or from site.	Site	As required
Silt	Inspect swales, ponds, wetlands annually for silt accumulation	Site & SuDS	1 visit annually
Silt	Excavate silt, stack and dry within 10m of the SUDS feature, but outside the design profile where water flows. Spread, rake and overseed.	Site & SuDS	As required
Native planting	Remove lower branches where necessary to ensure good ground cover to protect soil profile from erosion.	SuDS	1 visit annually
Remedial Work			
General SuDS	Inspect SuDS system to check for damage or failure when carrying out other tasks.	SuDS	Monthly
	Undertake remedial work as required.		As required

Table 3 – Permeable Pavements Maintenance Schedule

SUDS Element	Maintenance		
	Maintenance period	Maintenance Task	Frequency
Permeable Paving and Porous Surface	Regular	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or as required, based on site specific observations of clogging or manufacturer's recommendations. Particular attention to areas where water runs onto previous surface from adjacent impermeable areas.
	Occasional	Removal of weeds or use of glyphosate directly into the weeds	As required – once per year or less on frequently used pavements
		Stabilise and mow contributing and adjacent areas	As required

	Remedial work	Remediation work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
		Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
		Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required
	Monitoring	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
		Monitor inspection chambers	Annually
		Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48h after large storm in first six months

Table 4 - Green Roof Maintenance Schedule

SUDS Element	Maintenance		
	Maintenance period	Maintenance Task	Frequency
Green Roof	Regular Inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
		Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
		Inspect drains inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
		Inspect underside of roof for evidence of leakage	Annually and after severe storms
	Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six months and annually or as required
		During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
		Post establishment, replace dead plants as required (Where > 5% of coverage)	Annually (in Autumn)

		Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
		Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
		Mow grasses, prune shrubs and manage other planting (if appropriate) as required – Clippings should be removed and not allowed to accumulate	Six monthly or as required
	Remedial actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and source of erosion damage should be identified and controlled	As required
		If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

Table 5 - Attenuation Tank Maintenance Schedule

SUDS Element	Maintenance		
Attenuation Tanks	Maintenance Issues	Failure of components, blockage from debris	
	Maintenance Period	Maintenance Task	Frequency
	Regular	Inspect and identify any elements that are not operating correctly. If required, take remedial action.	Monthly for three months, then annually
		Remove sediment/debris from catchment surface that may lead to blockage of structures.	Monthly or as required
		Remove sediment/debris from catch pits/gullies and control structures.	Annually, after severe storms or as required
		For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter remove and replace surface infiltration medium as necessary.	Annually
	Remedial Work	Repair inlets, outlets, vents, overflows and control structures.	As required
	Monitoring	Inspect all inlets, outlets, vents, overflows and control structures to ensure they are in good condition and operating as designed.	Annually or after severe storms

4.4 Interception of Treatment Storage and Attenuation Storage

In the 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. Please note that for the purpose of producing the volumetric attenuation requirement calculations, green roofs for this project have been considered as paved surfaces (hardstanding areas) for the progression of these calculations.

4.4.1 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 6 - Interception Calculation

Paved surfaces connected to drainage system	$5810.77\text{m}^2 \times 0.72 \times 0.65 =$ 2,719.44m²	<i>5810.77m² site area</i> <i>72% of the site is paved</i> <i>65% of the paved area drains directly to the drainage system</i>
Volume of Interception	$2,719.44\text{m}^2 \times 0.005\text{m} \times 0.8 =$ 10.87m³	<i>Paved area directly drained</i> <i>5mm rainfall depth</i> <i>80% paved runoff factor</i>

The required interception volume is 10.87m³. The volume will be intercepted via the proposed SuDS measures as described in this report; however, Criterion 1.2 will still be assessed to ensure River Water Quality Protection in accordance with Criterion 1.

4.4.2 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.

The required treatment volume for the site is met through the introduction of various SuDS features as described in Section 4.2.

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

4.4.3 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 and considering an outflow rate as calculated per the Report No. 124 from the Institute of Hydrology.

Based on the calculations, included as Appendix A, the required attenuation storage volume is set out in Table 7 below, as well as the outflow rate for the site.

Table 7 - Attenuation Volume and Discharge Rate

Catchment	Area	Calculated Discharge Rate	Considered Discharge Rate	Required Attenuation Volume
Catchment 1	0.384 ha	2.09 l/s	2.10 l/s	74.20m ³
Catchment 2	0.197 ha	1.08 l/s*	2.00 l/s	45.50m ³

*We would note that the final outflow rate for this catchment will be set to 2.0l/s, to comply with the minimum allowable orifice size (50mm) of the hydrobrake.

It should be noted that the figures provided in the table above, and the calculations in Appendix A, are indicative only for the purpose of this submission.

4.4.4 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 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.

4.4.5 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 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.

Appendices

A. 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)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	15.700	Minimum Backdrop Height (m)	0.200
Ratio-R	0.276	Preferred Cover Depth (m)	1.200
CV	1.000	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)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
SWIC1	0.035	4.00	40.300	600	717331.303	738633.901	1.050	39.250
IC2	0.007	4.00	40.600	600	717294.352	738676.429	1.632	38.968
IC3	0.047	4.00	40.700	600	717279.190	738663.132	1.833	38.867
SWIC5	0.005	4.00	40.100	600	717320.518	738616.488	0.714	39.386
SWIC6			40.200	600	717308.204	738606.016	0.985	39.215
PP1	0.004	4.00	40.750		717294.351	738628.101	0.500	40.250
PPEntrance	0.016	4.00	40.600		717297.448	738620.818	0.500	40.100
SMH1			40.400	1200	717293.703	738621.492	1.291	39.109
SMH2			40.300	1200	717298.081	738625.359	1.453	38.847
GR/BR	0.089	4.00	40.915		717306.502	738641.927	0.600	40.315
IC4 - HB	0.003	4.00	40.600	1200	717299.581	738639.753	0.800	39.800
Attenuation 01	0.030	4.00	40.700		717294.276	738630.286	1.900	38.800
SMH3 - HB			40.550	1200	717290.463	738625.373	1.781	38.769
PP8	0.040	4.00	40.700		717279.870	738592.966	0.500	40.200
SMH4	0.014	4.00	40.650	1200	717279.614	738584.175	1.425	39.225
PP6	0.003	4.00	40.700		717271.318	738598.712	0.500	40.200
PP7	0.007	4.00	40.800		717269.113	738588.823	0.500	40.300
SMH5	0.018	4.00	40.800	1200	717273.015	738591.665	1.625	39.175
PP2	0.003	4.00	41.000		717261.369	738615.216	0.500	40.500
PP3	0.008	4.00	41.000		717250.784	738619.516	0.500	40.500
SMH7	0.009	4.00	41.090	1200	717255.456	738616.635	1.425	39.665
PP4	0.005	4.00	40.900		717257.479	738605.337	0.500	40.400
PP5	0.005	4.00	40.900		717248.088	738599.866	0.500	40.400
SMH6			40.963	1200	717248.325	738604.780	1.928	39.035
SWIC7	0.022	4.00	40.600	600	717271.916	738606.463	0.975	39.625
SWIC8			40.600	600	717267.393	738603.826	1.027	39.573
Attenuation 02			40.900		717260.847	738609.205	1.931	38.969
SMH8 - HB	0.004	4.00	40.600	1200	717273.242	738609.396	1.693	38.907
EXSWMH1		4.00	40.750	1200	717269.069	738653.104	0.920	39.830
SDMH1	0.006	4.00	40.750	1200	717273.724	738649.836	1.425	39.325
SDMH2	0.005	4.00	40.940	1200	717280.004	738637.122	1.686	39.254
SDMH3			40.490	1200	717288.742	738621.372	1.818	38.672
SDMH4	0.006	4.00	40.250	1200	717303.671	738601.285	1.703	38.547
SDMH5			40.500	1200	717303.783	738584.827	2.035	38.465
EX SMH			39.690	1200	717315.084	738574.152	1.303	38.387

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	SWIC1	IC2	56.338	0.600	39.250	38.968	0.282	200.0	225	5.02	50.0
1.001	IC2	IC3	20.167	0.600	38.968	38.867	0.101	200.0	225	5.38	50.0
1.002	IC3	Attenuation 01	36.145	0.600	38.867	38.800	0.067	539.5	225	6.47	50.0
2.000	SWIC5	SWIC6	16.165	0.600	39.386	39.224	0.162	100.0	225	4.21	50.0
2.001	SWIC6	SMH1	21.211	0.600	39.215	39.109	0.106	200.0	225	4.59	50.0
3.000	PP1	SMH1	6.641	0.600	40.250	39.918	0.332	20.0	100	4.06	50.0
4.000	PPEntrance	SMH1	3.805	0.600	40.100	39.910	0.190	20.0	100	4.04	50.0
2.002	SMH1	SMH2	5.841	0.600	39.109	39.080	0.029	201.4	225	4.70	50.0
2.003	SMH2	Attenuation 01	6.225	0.600	38.847	38.816	0.031	200.0	225	4.81	50.0
5.000	GR/BR	IC4 - HB	7.254	0.600	40.315	39.952	0.363	20.0	150	4.05	50.0
5.001	IC4 - HB	Attenuation 01	10.852	0.600	39.800	39.257	0.543	20.0	150	4.13	50.0
1.003	Attenuation 01	SMH3 - HB	6.219	0.600	38.800	38.769	0.031	200.0	300	6.56	50.0
1.004	SMH3 - HB	SDMH3	4.355	0.600	38.769	38.747	0.022	200.0	225	6.64	40.0
6.000	PP8	SMH4	8.799	0.600	40.200	40.112	0.088	100.0	150	4.15	50.0
6.001	SMH4	SMH5	9.999	0.600	39.225	39.175	0.050	200.0	225	4.33	50.0
7.000	PP6	SMH5	7.259	0.600	40.200	40.127	0.073	100.0	100	4.16	50.0
8.000	PP7	SMH5	4.833	0.600	40.300	40.058	0.242	20.0	100	4.05	50.0
6.002	SMH5	SMH6	27.959	0.600	39.175	39.035	0.140	199.7	225	4.83	50.0
9.000	PP2	SMH7	6.096	0.600	40.500	40.439	0.061	100.0	100	4.13	50.0
10.000	PP3	SMH7	5.496	0.600	40.500	40.445	0.055	100.0	100	4.12	50.0
9.001	SMH7	SMH6	13.834	0.600	39.665	39.538	0.127	108.9	225	4.32	50.0
11.000	PP4	SMH6	9.171	0.600	40.400	40.308	0.092	100.0	100	4.20	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.921	36.6	6.3	0.825	1.407	0.035	0.0	63	0.691
1.001	0.921	36.6	7.6	1.407	1.608	0.042	0.0	70	0.732
1.002	0.556	22.1	16.1	1.608	1.675	0.089	0.0	143	0.606
2.000	1.307	52.0	0.8	0.489	0.751	0.005	0.0	20	0.484
2.001	0.921	36.6	0.8	0.760	1.066	0.005	0.0	23	0.378
3.000	1.734	13.6	0.7	0.400	0.382	0.004	0.0	15	0.897
4.000	1.734	13.6	2.9	0.400	0.390	0.016	0.0	32	1.386
2.002	0.917	36.5	4.4	1.066	0.995	0.025	0.0	53	0.627
2.003	0.921	36.6	4.4	1.228	1.659	0.025	0.0	53	0.629
5.000	2.262	40.0	16.2	0.450	0.498	0.089	0.0	67	2.147
5.001	2.262	40.0	16.6	0.650	1.293	0.092	0.0	68	2.164
1.003	1.108	78.3	42.6	1.600	1.481	0.236	0.0	158	1.131
1.004	0.921	36.6	34.1	1.556	1.518	0.236	0.0	173	1.042
6.000	1.005	17.8	7.3	0.350	0.388	0.040	0.0	67	0.957
6.001	0.921	36.6	9.8	1.200	1.400	0.055	0.0	80	0.783
7.000	0.769	6.0	0.6	0.400	0.573	0.003	0.0	21	0.490
8.000	1.734	13.6	1.3	0.400	0.642	0.007	0.0	21	1.085
6.002	0.921	36.6	15.1	1.400	1.703	0.083	0.0	101	0.878
9.000	0.769	6.0	0.6	0.400	0.551	0.003	0.0	21	0.490
10.000	0.769	6.0	1.5	0.400	0.545	0.008	0.0	34	0.637
9.001	1.252	49.8	3.8	1.200	1.200	0.021	0.0	42	0.743
11.000	0.769	6.0	0.9	0.400	0.555	0.005	0.0	26	0.551

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
12.000	PP5	SMH6	4.920	0.600	40.400	40.351	0.049	100.0	100	4.11	50.0
6.003	SMH6	Attenuation 02	13.281	0.600	39.035	38.969	0.066	200.0	225	5.07	50.0
13.000	SWIC7	SWIC8	5.236	0.600	39.625	39.573	0.052	100.0	225	4.07	50.0
13.001	SWIC8	Attenuation 02	8.473	0.600	39.573	39.488	0.085	100.0	225	4.17	50.0
6.004	Attenuation 02	SMH8 - HB	12.402	0.600	38.969	38.907	0.062	200.0	225	5.30	50.0
6.005	SMH8 - HB	SDMH3	19.613	0.600	38.907	38.809	0.098	200.0	225	5.65	50.0
14.000	EXSWMH1	SDMH1	5.688	0.600	39.830	39.802	0.028	200.0	225	4.10	50.0
14.001	SDMH1	SDMH2	14.180	0.600	39.325	39.254	0.071	200.0	225	4.36	50.0
14.002	SDMH2	SDMH3	18.012	0.600	39.254	39.164	0.090	200.0	225	4.69	50.0
1.005	SDMH3	SDMH4	25.027	0.600	38.672	38.547	0.125	200.0	300	7.02	50.0
1.006	SDMH4	SDMH5	16.458	0.600	38.547	38.465	0.082	200.0	300	7.27	50.0
1.007	SDMH5	EX SMH	15.546	0.600	38.465	38.387	0.078	200.0	300	7.50	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
12.000	0.769	6.0	0.9	0.400	0.512	0.005	0.0	26	0.551
6.003	0.921	36.6	20.7	1.703	1.706	0.114	0.0	121	0.947
13.000	1.307	52.0	4.0	0.750	0.802	0.022	0.0	43	0.786
13.001	1.307	52.0	4.0	0.802	1.187	0.022	0.0	43	0.786
6.004	0.921	36.6	24.7	1.706	1.468	0.137	0.0	136	0.987
6.005	0.921	36.6	25.5	1.468	1.456	0.141	0.0	138	0.993
14.000	0.921	36.6	0.0	0.695	0.723	0.000	0.0	0	0.000
14.001	0.921	36.6	1.1	1.200	1.461	0.006	0.0	26	0.405
14.002	0.921	36.6	2.0	1.461	1.101	0.011	0.0	36	0.495
1.005	1.108	78.3	70.1	1.518	1.403	0.388	0.0	222	1.247
1.006	1.108	78.3	71.2	1.403	1.735	0.394	0.0	225	1.249
1.007	1.108	78.3	71.2	1.735	1.003	0.394	0.0	225	1.249

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
Rainfall Events	Singular	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Additional Storage (m³/ha)	20.0
M5-60 (mm)	15.700	Starting Level (m)	
Ratio-R	0.276	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

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
100	20	0	0

Node GR/BR Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	5.000	Sump Available	✓
Replaces Downstream Link	x	Product Number	CTL-SHE-0039-4000-0100-4000
Invert Level (m)	40.315	Min Outlet Diameter (m)	0.075
Design Depth (m)	0.100	Min Node Diameter (mm)	1200
Design Flow (l/s)	0.4		

Node SMH3 - HB Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	1.004	Sump Available	✓
Replaces Downstream Link	x	Product Number	CTL-SHE-0063-2100-1500-2100
Invert Level (m)	38.769	Min Outlet Diameter (m)	0.075
Design Depth (m)	1.500	Min Node Diameter (mm)	1200
Design Flow (l/s)	2.1		

Node SMH8 - HB Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	6.005	Sump Available	✓
Replaces Downstream Link	x	Product Number	CTL-SHE-0061-2000-1500-2000
Invert Level (m)	38.907	Min Outlet Diameter (m)	0.075
Design Depth (m)	1.500	Min Node Diameter (mm)	1200
Design Flow (l/s)	2.0		

Node PP1 Online Orifice Control

Flap Valve	x	Invert Level (m)	40.500	Diameter (m)	0.018
Downstream Link	3.000	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	0.5		

Node PPEntrance Online Orifice Control

Flap Valve	x	Invert Level (m)	40.300	Diameter (m)	0.026
Downstream Link	4.000	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		

Node PP3 Online Orifice Control

Flap Valve	x	Invert Level (m)	40.700	Diameter (m)	0.018
Downstream Link	10.000	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	0.5		

Node GR/BR Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	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	830.0	830.0	0.100	830.0	840.2	0.101	0.0	840.2

Node PP1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.250
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	50.0	50.0	0.350	50.0	58.8	0.351	0.0	58.8

Node Attenuation 01 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	38.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	157.0	157.0	0.900	157.0	197.0	0.901	0.0	197.0

Node PPEntrance Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	218.0	218.0	0.350	218.0	236.3	0.351	0.0	236.3

Node Attenuation 02 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	39.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	152.0	152.0	0.750	152.0	184.8	0.751	0.0	184.8

Node PP2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	0

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	107.0	107.0	0.350	107.0	119.8	0.351	0.0	119.8

Node PP3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	107.0	107.0	0.350	107.0	119.8	0.351	0.0	119.8

Node PP4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	107.0	107.0	0.350	107.0	119.8	0.351	0.0	119.8

Node PP5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.400
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	0

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	57.6	57.6	0.350	57.6	67.0	0.351	0.0	67.0

Node PP6 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.200
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	0

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	57.6	57.6	0.350	57.6	67.0	0.351	0.0	67.0

Node PP7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.300
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	0

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	80.6	80.6	0.350	80.6	91.7	0.351	0.0	91.7

Node PP8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.200
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	2

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	103.7	103.7	0.350	103.7	116.3	0.351	0.0	116.3

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute summer	SWIC1	570	39.440	0.190	1.9	0.1787	0.0000	OK
720 minute summer	IC2	570	39.440	0.472	2.3	0.1768	0.0000	SURCHARGED
720 minute summer	IC3	570	39.440	0.573	4.5	0.4534	0.0000	SURCHARGED
720 minute summer	SWIC5	570	39.439	0.053	0.3	0.0219	0.0000	OK
600 minute summer	SWIC6	510	39.439	0.224	0.3	0.0634	0.0000	OK
2160 minute summer	PP1	1320	40.393	0.143	0.1	2.1600	0.0000	SURCHARGED
8640 minute summer	PPEntrance	5520	40.280	0.180	0.2	15.8399	0.0000	SURCHARGED
720 minute summer	SMH1	570	39.439	0.330	0.4	0.3736	0.0000	SURCHARGED
720 minute summer	SMH2	570	39.439	0.592	0.3	0.6700	0.0000	SURCHARGED
600 minute summer	GR/BR	555	40.544	0.229	5.6	35.9890	0.0000	SURCHARGED
15 minute summer	IC4 - HB	10	39.821	0.021	1.6	0.0249	0.0000	OK
720 minute summer	Attenuation 01	570	39.439	0.639	6.8	40.3628	0.0000	SURCHARGED
720 minute summer	SMH3 - HB	570	39.439	0.670	1.7	0.7583	0.0000	SURCHARGED
30 minute summer	PP8	20	40.284	0.084	15.1	3.6248	0.0000	OK
360 minute summer	SMH4	304	39.597	0.372	4.7	0.4936	0.0000	SURCHARGED
60 minute summer	PP6	37	40.220	0.020	1.0	0.4625	0.0000	OK
30 minute summer	PP7	20	40.324	0.024	2.7	0.7768	0.0000	OK
360 minute summer	SMH5	296	39.597	0.422	7.3	0.5709	0.0000	SURCHARGED
120 minute summer	PP2	72	40.516	0.016	0.7	0.6760	0.0000	OK
8640 minute summer	PP3	4980	40.667	0.167	0.1	7.1999	0.0000	SURCHARGED
15 minute summer	SMH7	10	39.709	0.044	4.0	0.0555	0.0000	OK
15 minute summer	PP4	10	40.440	0.040	2.0	0.0079	0.0000	OK
60 minute summer	PP5	36	40.426	0.026	1.4	0.6003	0.0000	OK
360 minute summer	SMH6	296	39.597	0.562	8.5	0.6351	0.0000	SURCHARGED
15 minute summer	SWIC7	10	39.695	0.070	9.1	0.0521	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute summer	SWIC1	1.000	IC2	1.9	0.393	0.052	2.1261	
720 minute summer	IC2	1.001	IC3	1.9	0.214	0.052	0.8021	
720 minute summer	IC3	1.002	Attenuation 01	4.4	0.347	0.200	1.4375	
720 minute summer	SWIC5	2.000	SWIC6	0.3	0.355	0.006	0.3739	
600 minute summer	SWIC6	2.001	SMH1	0.3	0.278	0.008	0.8431	
2160 minute summer	PP1	3.000	SMH1	0.0	0.000	0.000	0.0000	
8640 minute summer	PPEntrance	4.000	SMH1	0.0	0.000	0.000	0.0000	
720 minute summer	SMH1	2.002	SMH2	0.3	0.259	0.008	0.2323	
720 minute summer	SMH2	2.003	Attenuation 01	-0.3	0.009	-0.007	0.2476	
600 minute summer	GR/BR	5.000	IC4 - HB	0.6	0.800	0.014	0.0050	
15 minute summer	IC4 - HB	5.001	Attenuation 01	1.6	1.102	0.040	0.0159	
720 minute summer	Attenuation 01	1.003	SMH3 - HB	1.7	0.184	0.022	0.4379	
720 minute summer	SMH3 - HB	1.004	SDMH3	1.7	0.456	0.045	0.0158	
30 minute summer	PP8	6.000	SMH4	10.1	1.017	0.568	0.0872	
360 minute summer	SMH4	6.001	SMH5	4.7	0.509	0.129	0.3977	
60 minute summer	PP6	7.000	SMH5	0.5	0.470	0.086	0.0080	
30 minute summer	PP7	8.000	SMH5	1.6	1.149	0.119	0.0068	
360 minute summer	SMH5	6.002	SMH6	6.6	0.526	0.179	1.1120	
120 minute summer	PP2	9.000	SMH7	0.3	0.406	0.053	0.0048	
8640 minute summer	PP3	10.000	SMH7	0.0	0.000	0.000	0.0000	
15 minute summer	SMH7	9.001	SMH6	3.9	0.740	0.079	0.0737	
15 minute summer	PP4	11.000	SMH6	2.0	0.686	0.331	0.0267	
60 minute summer	PP5	12.000	SMH6	0.8	0.536	0.140	0.0078	
360 minute summer	SMH6	6.003	Attenuation 02	8.1	0.354	0.222	0.5282	
15 minute summer	SWIC7	13.000	SWIC8	9.1	0.903	0.175	0.0528	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SWIC8	10	39.639	0.066	9.1	0.0186	0.0000	OK
360 minute summer	Attenuation 02	304	39.597	0.628	10.2	36.2978	0.0000	SURCHARGED
360 minute summer	SMH8 - HB	304	39.596	0.689	1.7	0.8149	0.0000	SURCHARGED
15 minute summer	EXSWMH1	1	39.830	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SDMH1	10	39.364	0.039	2.4	0.0470	0.0000	OK
15 minute summer	SDMH2	10	39.308	0.054	4.5	0.0639	0.0000	OK
15 minute summer	SDMH3	11	38.734	0.062	7.3	0.0696	0.0000	OK
15 minute summer	SDMH4	11	38.620	0.073	9.4	0.0873	0.0000	OK
15 minute summer	SDMH5	11	38.538	0.073	9.4	0.0820	0.0000	OK
15 minute summer	EX SMH	11	38.456	0.069	9.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SWIC8	13.001	Attenuation 02	9.1	0.972	0.175	0.0794	
360 minute summer	Attenuation 02	6.004	SMH8 - HB	1.5	0.166	0.041	0.4932	
360 minute summer	SMH8 - HB	6.005	SDMH3	1.6	0.459	0.043	0.0666	
15 minute summer	EXSWMH1	14.000	SDMH1	0.0	0.000	0.000	0.0000	
15 minute summer	SDMH1	14.001	SDMH2	2.4	0.418	0.065	0.0834	
15 minute summer	SDMH2	14.002	SDMH3	4.3	0.614	0.118	0.1273	
15 minute summer	SDMH3	1.005	SDMH4	7.3	0.623	0.093	0.2942	
15 minute summer	SDMH4	1.006	SDMH5	9.4	0.718	0.120	0.2160	
15 minute summer	SDMH5	1.007	EX SMH	9.4	0.737	0.119	0.1973	45.7

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.31%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute summer	SWIC1	585	39.666	0.416	2.4	0.3921	0.0000	SURCHARGED
720 minute summer	IC2	585	39.666	0.698	2.9	0.2617	0.0000	SURCHARGED
720 minute summer	IC3	585	39.666	0.799	5.8	0.6326	0.0000	SURCHARGED
720 minute summer	SWIC5	600	39.666	0.280	0.3	0.1153	0.0000	SURCHARGED
720 minute summer	SWIC6	600	39.666	0.451	0.5	0.1276	0.0000	SURCHARGED
4320 minute summer	PP1	2460	40.440	0.190	0.1	2.8800	0.0000	SURCHARGED
10080 minute summer	PPEntrance	6420	40.316	0.216	0.2	18.9786	0.0000	FLOOD RISK
720 minute summer	SMH1	585	39.666	0.557	0.5	0.6296	0.0000	SURCHARGED
720 minute summer	SMH2	585	39.666	0.819	0.7	0.9260	0.0000	SURCHARGED
720 minute summer	GR/BR	705	40.561	0.246	6.3	49.5756	0.0000	SURCHARGED
15 minute summer	IC4 - HB	10	39.823	0.023	1.9	0.0271	0.0000	OK
720 minute summer	Attenuation 01	585	39.666	0.866	8.5	54.6408	0.0000	SURCHARGED
720 minute summer	SMH3 - HB	585	39.666	0.897	1.7	1.0141	0.0000	SURCHARGED
30 minute summer	PP8	19	40.303	0.103	19.7	4.4250	0.0000	OK
360 minute summer	SMH4	320	40.111	0.886	6.1	1.1766	0.0000	SURCHARGED
30 minute summer	PP6	21	40.224	0.024	1.7	0.5625	0.0000	OK
30 minute summer	PP7	20	40.328	0.028	3.5	0.9241	0.0000	OK
360 minute summer	SMH5	320	40.111	0.936	8.8	1.2673	0.0000	SURCHARGED
120 minute summer	PP2	72	40.519	0.019	0.8	0.7965	0.0000	OK
10080 minute summer	PP3	5820	40.700	0.200	0.1	8.6398	0.0000	FLOOD RISK
360 minute summer	SMH7	320	40.111	0.446	1.4	0.5635	0.0000	SURCHARGED
15 minute summer	PP4	10	40.447	0.047	2.6	0.0091	0.0000	OK
30 minute summer	PP5	20	40.431	0.031	2.4	0.7304	0.0000	OK
360 minute summer	SMH6	320	40.111	1.076	10.7	1.2168	0.0000	SURCHARGED
360 minute summer	SWIC7	320	40.111	0.486	2.7	0.3604	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute summer	SWIC1	1.000	IC2	2.4	0.393	0.065	2.2406	
720 minute summer	IC2	1.001	IC3	2.5	0.205	0.069	0.8021	
720 minute summer	IC3	1.002	Attenuation 01	5.7	0.351	0.258	1.4375	
720 minute summer	SWIC5	2.000	SWIC6	0.3	0.355	0.006	0.6429	
720 minute summer	SWIC6	2.001	SMH1	0.3	0.242	0.008	0.8436	
4320 minute summer	PP1	3.000	SMH1	0.0	0.000	0.000	0.0000	
10080 minute summer	PPEntrance	4.000	SMH1	0.1	0.464	0.006	0.0006	
720 minute summer	SMH1	2.002	SMH2	-0.5	0.259	-0.015	0.2323	
720 minute summer	SMH2	2.003	Attenuation 01	-0.7	-0.016	-0.018	0.2476	
720 minute summer	GR/BR	5.000	IC4 - HB	0.6	0.808	0.014	0.0052	
15 minute summer	IC4 - HB	5.001	Attenuation 01	1.9	1.161	0.048	0.0179	
720 minute summer	Attenuation 01	1.003	SMH3 - HB	1.7	0.149	0.022	0.4379	
720 minute summer	SMH3 - HB	1.004	SDMH3	1.7	0.456	0.045	0.0158	
30 minute summer	PP8	6.000	SMH4	13.5	1.082	0.758	0.1097	
360 minute summer	SMH4	6.001	SMH5	5.6	0.519	0.152	0.3977	
30 minute summer	PP6	7.000	SMH5	0.8	0.525	0.126	0.0105	
30 minute summer	PP7	8.000	SMH5	2.3	1.262	0.166	0.0087	
360 minute summer	SMH5	6.002	SMH6	8.4	0.488	0.229	1.1120	
120 minute summer	PP2	9.000	SMH7	0.4	0.448	0.073	0.0060	
10080 minute summer	PP3	10.000	SMH7	0.0	0.000	0.000	0.0001	
360 minute summer	SMH7	9.001	SMH6	1.4	0.543	0.027	0.5502	
15 minute summer	PP4	11.000	SMH6	2.6	0.734	0.431	0.0325	
30 minute summer	PP5	12.000	SMH6	1.2	0.595	0.204	0.0102	
360 minute summer	SMH6	6.003	Attenuation 02	10.5	0.348	0.287	0.5282	
360 minute summer	SWIC7	13.000	SWIC8	2.7	0.660	0.052	0.2082	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.31%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute summer	SWIC8	320	40.111	0.538	2.7	0.1522	0.0000	SURCHARGED
360 minute summer	Attenuation 02	320	40.111	1.142	12.9	45.6608	0.0000	SURCHARGED
360 minute summer	SMH8 - HB	320	40.111	1.204	1.8	1.4226	0.0000	SURCHARGED
15 minute summer	EXSWMH1	1	39.830	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SDMH1	10	39.369	0.044	3.1	0.0533	0.0000	OK
15 minute summer	SDMH2	10	39.315	0.061	5.8	0.0733	0.0000	OK
15 minute summer	SDMH3	11	38.739	0.067	8.6	0.0757	0.0000	OK
15 minute summer	SDMH4	11	38.628	0.081	11.7	0.0970	0.0000	OK
15 minute summer	SDMH5	11	38.546	0.081	11.6	0.0916	0.0000	OK
15 minute summer	EX SMH	11	38.464	0.077	11.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute summer	SWIC8	13.001	Attenuation 02	2.7	0.688	0.052	0.3370	
360 minute summer	Attenuation 02	6.004	SMH8 - HB	1.8	0.173	0.048	0.4932	
360 minute summer	SMH8 - HB	6.005	SDMH3	1.8	0.479	0.049	0.0734	
15 minute summer	EXSWMH1	14.000	SDMH1	0.0	0.000	0.000	0.0000	
15 minute summer	SDMH1	14.001	SDMH2	3.1	0.447	0.085	0.1007	
15 minute summer	SDMH2	14.002	SDMH3	5.6	0.661	0.154	0.1540	
15 minute summer	SDMH3	1.005	SDMH4	8.7	0.646	0.111	0.3373	
15 minute summer	SDMH4	1.006	SDMH5	11.6	0.756	0.148	0.2517	
15 minute summer	SDMH5	1.007	EX SMH	11.6	0.784	0.148	0.2302	50.0

UK and Ireland Office Locations

