Waterman Moylan
Engineering Consultants

Engineering Assessment Report

Proposed Phase 3 of Aderrig Development at Adamstown SDZ, Co. Dublin

October 2022

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Issue	Date	Prepared by	Checked by	Approved by
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Comments

Disclaimer

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1. Introduction

This report has been prepared by Waterman Moylan in support of the proposed Development of **Phase 3** of the **Aderrig Tile** located in the **Adamstown Strategic Development Zone (ASDZ)**, Co. Dublin.

This report details the criteria used to design and detail the foul water drainage, surface water drainage, water supply and road construction required to serve the proposed development.

A plan showing the **Adamstown Strategic Development Zone** is set out in Figure 1-1 below: -

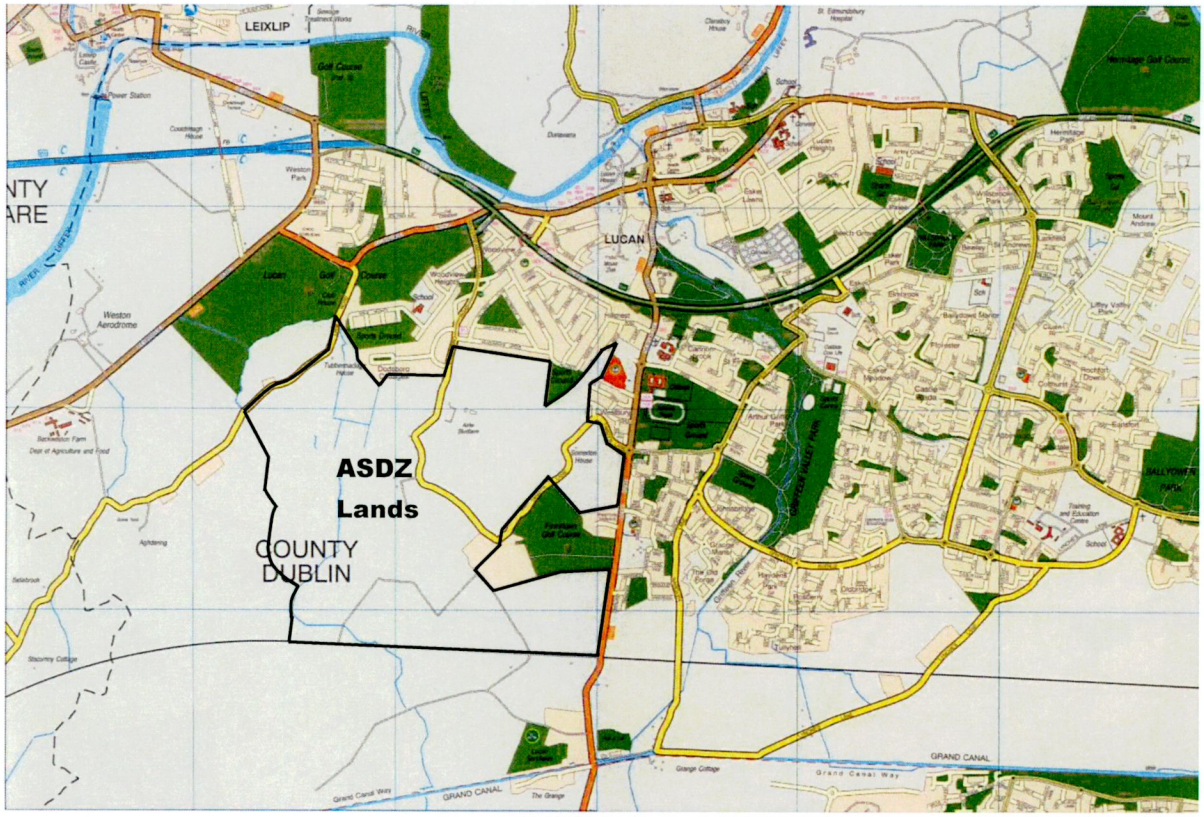


Figure 1-1: Location of ASDZ Lands

1.1 Site Location and Description

The proposed development lands are located within the "**Aderrig"** tile of the **ASDZ.** The Aderrig site is approximately 13 km west of Dublin and 2.5 km south of Lucan Village.

Quintain Developments Ireland Limited intend to apply for permission for development on 2 No. sites separated by the permitted Celbridge Link Road (Reg. Ref. SDZ17A/0009) with a total area of 6.36 Ha in the townland of Aderrig, Adamstown, Lucan, Co. Dublin.

The south-western site (5.39 Ha) is generally bound:

- to the east by **Celbridge Link Road** Reg. Ref. SDZ17A/0009,
- to the south and west by undeveloped land and an **electrical substation** Reg. Ref. SD06A/0497 and
- to the north by the **Tubber Lane Development Area** with pending planning permission Reg. Ref. SDZ21A/0023 for residential development.

Adamstown Way constructed in 2006 under the Reg. Ref. SDZ06A/5 extends inside the site from the east and provides access to the **electrical substation** Reg. Ref. SD06A/0497 at the site's western boundary.

The northern site (0.97 Ha) is generally bound:

- to the east by the **undeveloped Primary School** site and **Aderrig Park Avenue** Reg. Ref. SDZ20A/0017,
- to the south by **Airlie Park Road West** Reg. Ref. SDZ18A/0014,
- to the west by **Celbridge Link Road** Reg. Ref. SDZ17A/0009 and the **Tubber Lane Development Area** with pending planning permission Reg. Ref. SDZ21A/0023 for residential development and
- to the north by the **Tubermaclugg Development Area** with adjacent **Shackleton Phase 4** Reg. Ref. SDZ21A/0003 residential development.

This application is being made in accordance with the Adamstown Planning Scheme 2014 (as amended) and relates to a proposed development within the Aderrig Development Area of the Adamstown Strategic Development Zone.

The site is served by existing infrastructure constructed under the ASDZ Strategic Drainage Scheme and the Overall Adamstown Watermain Network Scheme. The existing infrastructure includes wastewater drainage, surface water drainage and watermains built within the existing roads around the subject site.

An indication of the location of the **Aderrig tile** within the ASDZ lands can be seen in Figure 1-2 below. Figure 1-2 further indicates the location of **Phase 3** within the Aderrig Tile. For the exact site location, site boundary and site layout please refer to the accompanying architects' drawings.

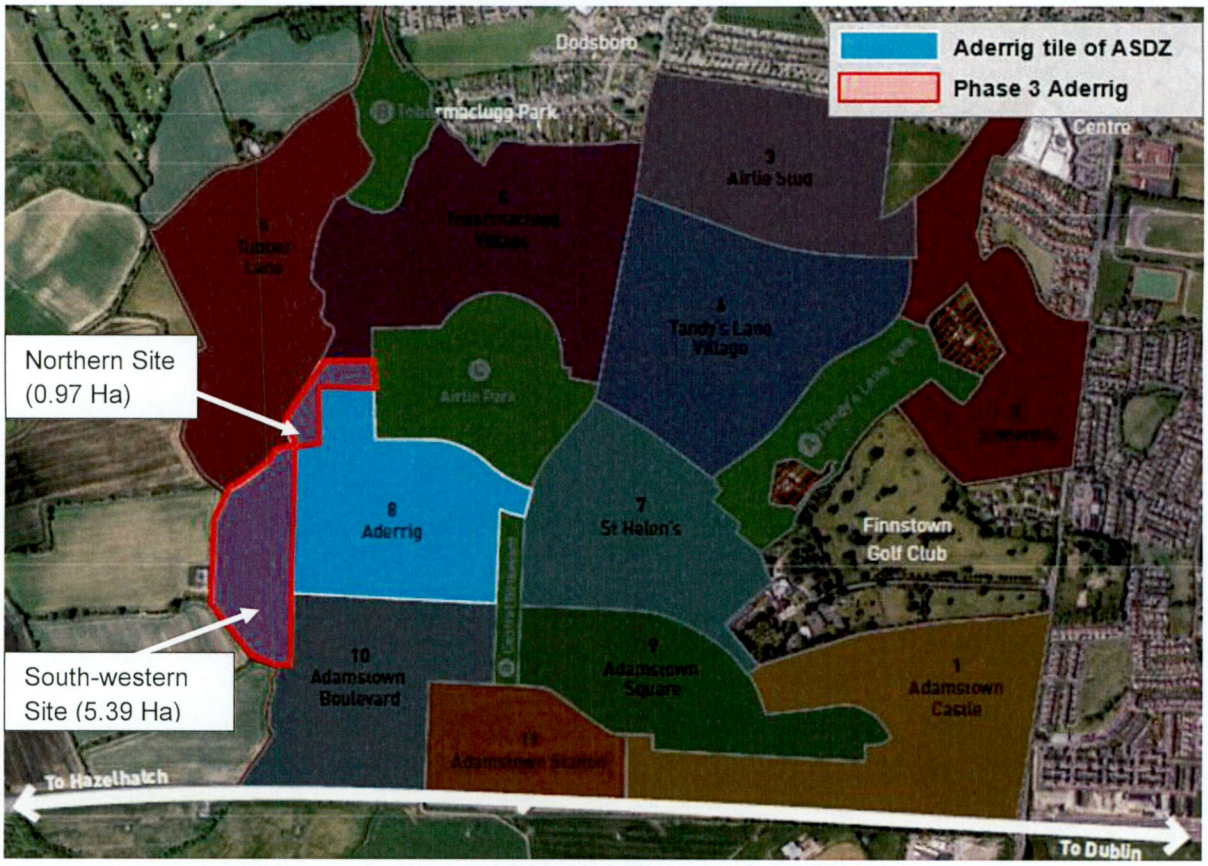


Figure 1-2: Aderrig Phase 3 within Aderrig Tile of the ASDZ Lands

1.2 Existing Topography

The existing topography of the **Phase 3** Aderrig site is illustrated in Figure 1-3 below.

The south-western site (5.39 Ha) generally slopes 1:40 from the south-southwest to the north-northeast with an overall elevation difference of approximately 8m. A maximum ground elevation of 59.67m OD Malin exists within the southern portion of the subject site. A minimum ground elevation of 51.46m OD Malin exists in the north.

The northern site (0.97 Ha) generally slopes 1:55 from the south-southwest to the north-northeast with an overall elevation difference of approximately 3.2m. A maximum ground elevation of 50.82m OD Malin exists within the southern portion of the subject site. A minimum ground elevation of 47.60m OD Malin exists in the north.

See Figure 1-3 for the existing contours within the subject site.

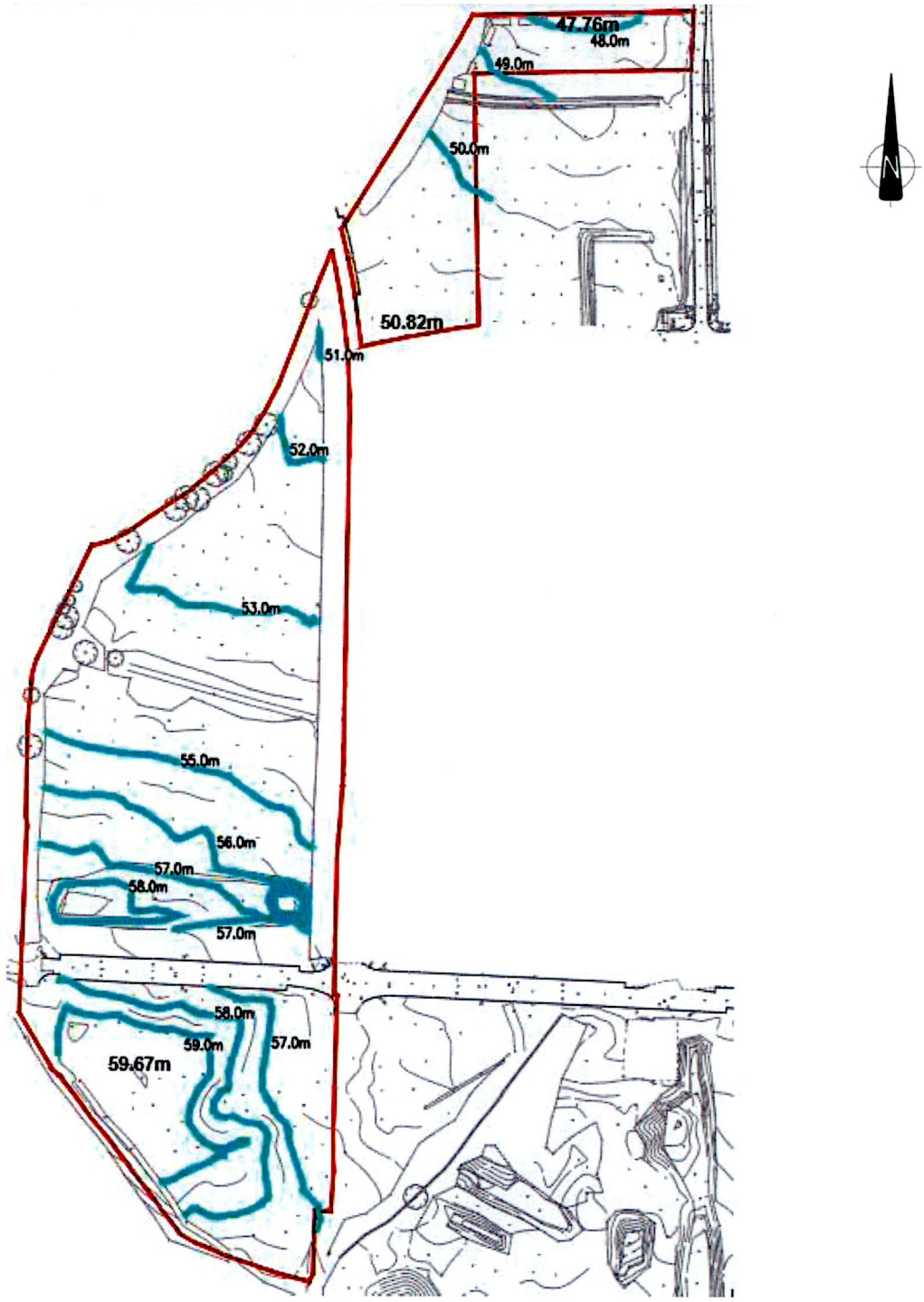


Figure 1-3: Topographical Map of Phase 3 Aderrig

1.3 Proposed Development

The current application is for permission for development on 2 No. sites (6.36Ha) located within Development Area 8 – Aderrig of the Adamstown SDZ Planning Scheme, 2014, as amended.

The proposed residential development is in its entirety located on the south-western site of 5.39 Ha.

The proposed development principally consist of 207 No. residential units (64 No. 2-bed, 127 No. 3-bed and 16 No. 4-bed), ranging in height from 2 No. storeys to 4 No. storeys, comprising 75 No. houses (59 No. 3-bed and 16 No. 4-bed) and 132 No. duplexes (64 No. 2-bed and 68 No. 3-bed).

The development will also include: vehicular junctions to access the development from Celbridge Link Road (2 No.) and Adamstown Way (3 No.); internal road, cycle and footpath network; 314 No. car parking spaces; cycle parking; bin storage areas; public, communal and private open space areas, with balconies and terraces facing all aspects; hard and soft landscaped areas; boundary treatments; public lighting; 2 No. sub-stations; and all associated site and development works above and below ground.

The proposed development will provide for roads, drainage (wastewater and surface water), water supply and utilities to serve the above-mentioned dwellings.

The development will be accessed from Celbridge Link Road via access points already approved and under construction by SDCC Reg. Ref. SDZ17A/0009. Parking bays, buffer zones, cycle paths and footpaths along the western side of the Celbridge Link Road permitted under Reg. Ref. SDZ17A/0009 are included in the site extent of the current application.

The proposed development, **Phase 3 Aderrig**, is to be constructed as the third Phase of a four-Phase development within the Aderrig Tile. The construction of Phase 1 is well progressed, and Phase 2 has recently commenced enabling works.

2. Foul Water Drainage

2.1 Foul Water Drainage – Existing

Overview

The majority of ASDZ lands drains by gravity to the Tobermaclugg Pumping Station through a series of existing 225mm, 300mm, 375mm, 450mmmm, 600mm, 750mm and 900mm diameter foul sewers predominantly within the road network. Tobermaclugg Pumping Station was completed in 2008 and is located approx. 1.2km north of the site. The pumping station discharges the foul water from the majority of the SDZ lands (85%), to the 9B trunk sewer at Balgaddy, via twin rising mains and a gravity sewer. Refer to Figure 2-1 below, which shows the existing foul network.

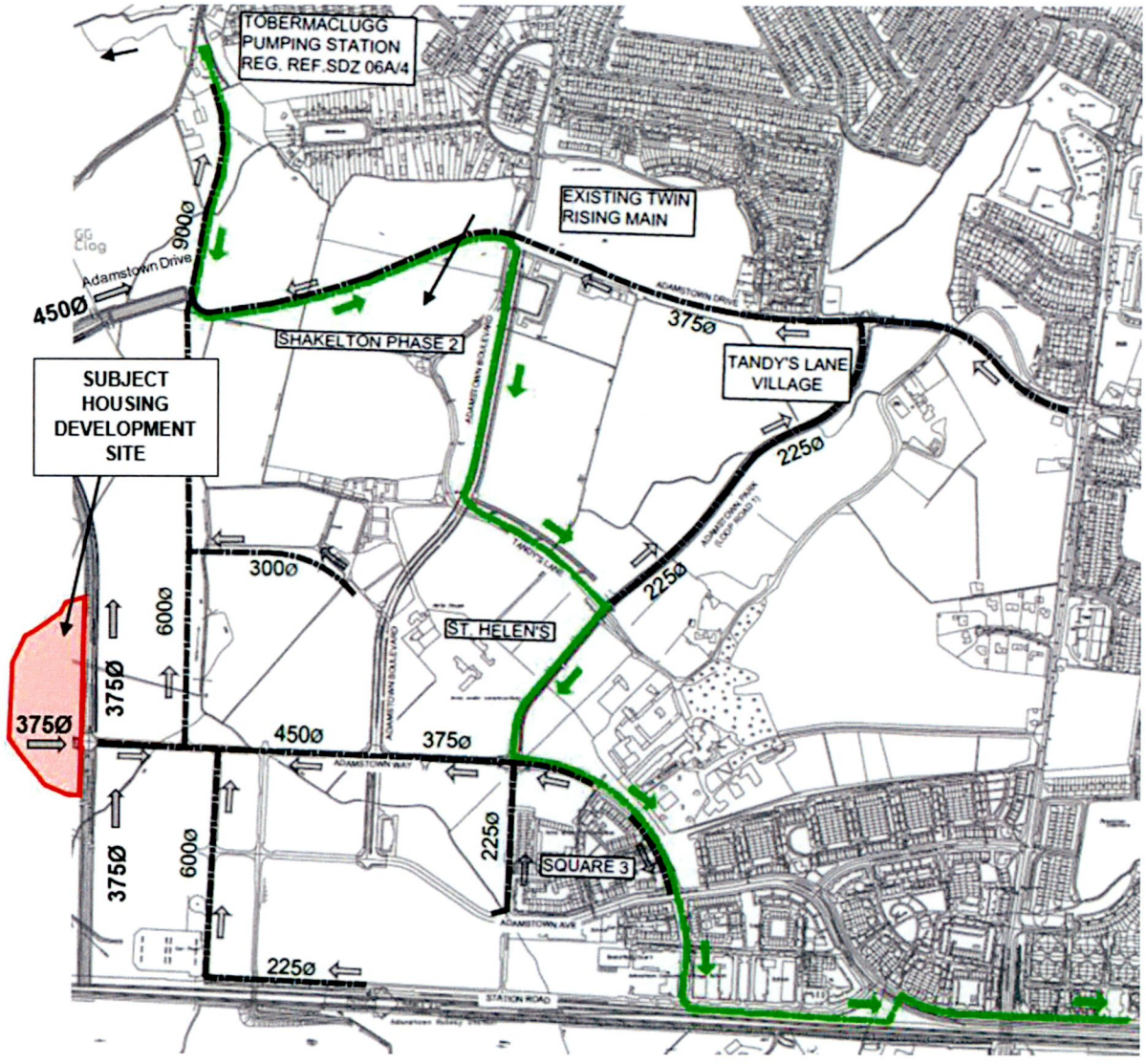


Figure 2-1: Overview of SDZ Foul Drainage Discharging into Existing 9B Trunk Sewer in Balgaddy

The existing foul sewers serving the **Phase 3 Aderrig** development have been constructed under the ASDZ Strategic Drainage Scheme. The network has been designed and constructed to accommodate the subject development.

The existing sewer network can be summarised as follows:

- There is an existing **375mm Ø** foul water sewer within the site and in the Celbridge Link Road draining foul water north to **450mm Ø** sewer in Adamstown Drive.

Connection Points:

The subject site will drain via 150mm Ø and 225mm Ø foul water pipe network and it will connect via three separate spurs into the existing 375mm Ø foul water sewer in the Celbridge Link Road.

2.2 Proposed Foul Water Drainage – General

It is proposed to discharge foul water from the Phase 3 Aderrig development directly to the existing foul water system as outlined in Section 2.1 above.

On the 7 March 2019, in response to a Pre-Connection Enquiry (PCE) submission, Irish Water confirmed (customer reference no. 9540800086) that there is capacity available within the system to facilitate the proposed development. Refer to Appendix A for the Irish Water Confirmation of Feasibility Letter.

Also refer to Waterman Moylan drawing 22-023-P200 which accompanies this submission, and which shows the existing and proposed foul water drainage layout for the proposed development.

2.3 Proposed Foul Water – Calculations

Aderrig Phase 3 will discharge into the existing foul water pipeline installed on the eastern boundary of the development, as outlined in Section 2.2 above.

The foul water drainage for the proposed development has been designed to ensure minimum cleansing velocities as outlined in the "Irish Water Code of Practice for Wastewater Infrastructure" are achieved for all foul sewers. The peak foul flow is based on Irish Water recommended peak demand/flow factors which are provided in the Irish Water 'Code of Practice for Wastewater Infrastructure', Appendix D - Wastewater Flow Rates for Design. A peak flow factor of **6x** the dry weather flow was used.

The proposed foul water network was modelled in the Causeway FLOW software package to confirm pipe cover levels and slopes.

Pipe capacities and velocities have been calculated using Colebrook-White formula with a roughness coefficient (Ks) of 1.5mm.

The estimated foul flows generated from the proposed Phase 3 Aderrig development are as follows:

Table 2-1: Calculation of proposed Foul Water Flow for Phase 3 Aderrig Development

Description	No. of Units	Population per unit	PE	Flow (l/hd/day)	Infiltration Factor	Total Discharge (l/d)
Dwellings	207	2.7	558.9	150	1.1	92, 219
Totals						**92, 219**

Calculation of Proposed Peak Foul Flow		
Total Daily Discharge *(from Table 2.2 above)*	92, 219	**l/d**
Dry Weather Flow (DWF)	1.07	**ℓ/s**
Peak Foul Flow (=6 x DWF)	**6.42**	**ℓ/s**

The proposed internal foul network will consist of 150mm and 225mm diameter pipes laid at minimum gradients of 1:150 and 1:200 respectively. The 150mm diameter pipes laid at the required minimum gradient provide a capacity of 13 ℓ/s, whilst the 225mm diameter pipes laid at the required minimum gradient provide a capacity of 32 ℓ/s and therefore have adequate capacity to cater for the flows from the development.

Refer to Waterman Moylan drawing 22-023-P200 which accompanies this report, and which shows the existing and proposed foul water drainage layout for the proposed development.

2.4 Foul Water – General

Proposed foul water sewers will be constructed strictly in accordance with Irish Water requirements. No private drainage will be located within public areas, and if they are, valid engineering reasoning will be given for this design. A Connection Application will be made to Irish Water once planning has been granted.

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

3. Surface Water Drainage

3.1 Surface Water Drainage - Existing

The site is located in the Tobermaclugg Tributary surface water catchment area of the ASDZ lands. According to the ASDZ Planning Scheme 2014 Amendment, Ref. No. 2.5.5, the catchment drains to a large surface water outfall (2.4m ø stormwater pipe) and 5000m^3 attenuation pond to the north-east of Lucan Golf Course on the Backstown/Tobermaclugg Stream. Dry weather and normal flows will continue to discharge into the outfall.

The Tobermaclugg Stream is primarily culverted (via 2.1/2.4m ø pipes) next to Tubber Lane Road and then through the Lucan Golf Course. On exiting the ASDZ near the Tobermaclugg Foul Pump Station (reflected as PS) in Figure 3-1 below, the Tobermaclugg Stream has been culverted in 2.4m ø pipes (bar 100m) through the Lucan Golf Course before it is re-joined by the Backstown Stream at the Attenuation Area (reflected below in Figure 3-1) and then passes under Dodsborough Rd. thereafter passing under the N4 via an existing culvert before discharging to the River Liffey in the vicinity of Lucan Village.

Figure 3-1: Location of Backstown Stream and Old Confluence Point with Tobermaclugg Stream

The above existing surface water sewers and attenuation area serving the Phase 3 Aderrig development have been constructed under the ASDZ Strategic Drainage Scheme. The network has been designed and constructed to accommodate the subject development.

The existing stormwater infrastructure in the vicinity of the site includes a 750mm Ø surface water drainage sewer in Adamstown Way and a 375mm Ø and 900mm Ø surface water drainage sewer in the Celbridge Link Road.

Refer to Figure 3-2 for an illustration of the installed stormwater drainage infrastructure within the larger ASDZ lands, and of the installed stormwater drainage infrastructure in the vicinity of the Phase 3 Aderrig development.

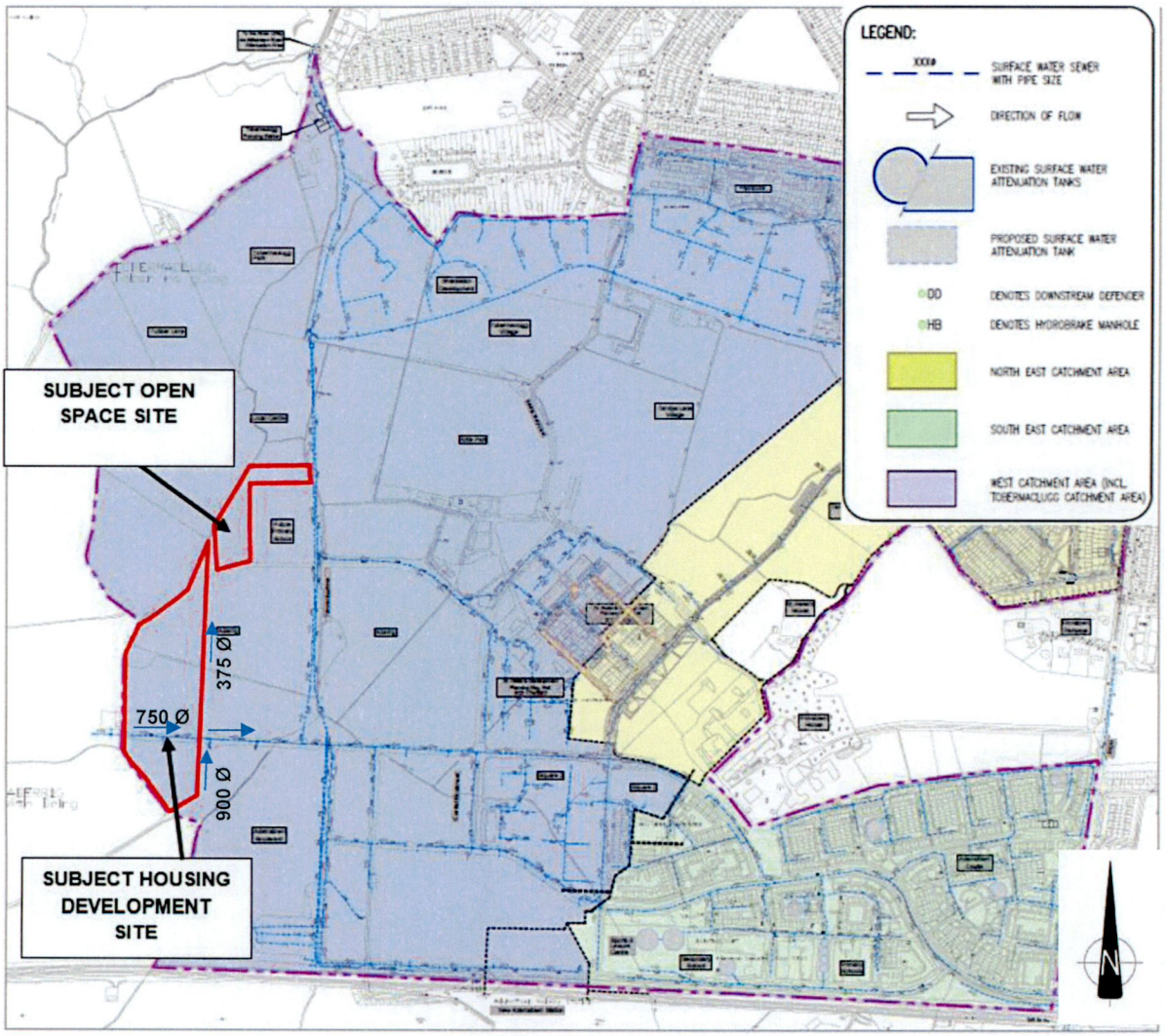


Figure 3-2: Existing Surface Water Drainage Installed within ASDZ

3.2 Surface Water Drainage – Proposed

Meetings have taken place with SDCC (Mr Brian Harkin and Mr Ronan Toft) to discuss the design approach taken for the ASDZ and the previous agreed strategies implemented at the onset of the ASDZ development along with the review of reports. (See the **Adamstown Strategic Development Zone Surface Water Drainage Engineering Assessment Report - Consolidated Review of Strategic Surface Water Drainage via the Tobermaclugg Stream and Backstown Stream** (Dec 2017)), included as part of this application.

3.2.1 Proposed Surface Water Drainage

General

The proposed internal surface water drainage system was designed and modelled within the Causeway FLOW software package. The sizing and gradients of the surface water sewers were based on a storm return period (N) of 5 years. Pipe capacities and velocities have been calculated using a roughness coefficient (Ks) of 0.6mm.

It is proposed that the **Phase 3 Aderrig** be split into two catchments A, A-1 and B.

- The catchment A will outfall to the existing 375mm Ø sewer in Celbridge Link Road.
- The catchment A-1 will outfall to the existing 750mm Ø sewer in Adamstown Way.
- The catchment B will outfall to the existing 900mm Ø sewer in Celbridge Link Road.

Refer to Figure 3-3 for the catchment locations.

The calculation of the greenfield run-off rate is discussed in Section 3.3.3 of this report. The capacity of the surface water network to which the proposed development will discharge, has been designed to receive the Aderrig area, amongst other development areas.

Downstream defenders

Downstream defenders are proposed within the storm water network to ensure the effective removal of hydrocarbons, sediments and other floatable debris within the network before discharging into the existing surface water network.

3 no. downstream defenders are proposed to serve the subject site at each outfall. The proposed downstream defenders are 2no. 1.2m and 1no. 1.8m in size, with treatment flow rate of 38 ℓ/s and 85 ℓ/s respectively, and hydraulic capacities of 120 ℓ/s and 270 ℓ /s respectively.

The downstream defenders will be installed at the downstream positions of the surface water catchment A, A-1 and B before connecting into the existing stormwater system.

Refer to Waterman Moylan drawings 22-023-P200, which accompany this report, and which show the existing and proposed foul water and stormwater drainage network layout for the proposed development.

3.3 Surface Water Drainage - Calculations

3.3.1 Site Characteristics

The following site characteristics are contained in the attenuation calculations located in the Planning Report submitted as part of **SDZ06A/5** permission, which can be defined as the construction of 3 no. roads connecting various parts of the SDZ in the vicinity of the Aderrig Tile, and included the provision of surface water drainage, and water supply pipework to serve the future surrounding developments.

The site characteristics used for the Phase 3 Aderrig site can be seen in Table 3-1 below:-

Table 3-1: Phase 3 Aderrig Site Characteristics

Characteristic	Phase 3 Aderrig
SAAR - mm	963*
Soil Type	2*
SOIL Index	0.3*
Climate Change	10%

*HR Wallingford Greenfield Run-off Tool

3.3.2 Pipe Network Calculations

Calculations for pipe sizes and gradients are based on storm water runoff from the roofs and surfaced areas within the proposed development using the Rational Method for surface water design (Bilhams Formula), with a storm return period (N) of 5 years.

Pipe capacities and velocities have been calculated using Colebrook-White formula with a roughness coefficient (Ks) of 0.6mm.

The total area used within the surface water calculations for the subject site is approx. 5.39 hectares (i.e. the residential site area, excluding the open open space to the north-east), see sections 3.3.3 and 3.3.4 below for further details. The total impermeable area of the site is approximately 4.05 hectares which equates to 75% of the total site residential area.

3.3.3 Attenuation Strategy

As set out in the **Adamstown Strategic Development Zone Surface Water Drainage Engineering Assessment Report - Consolidated Review of Strategic Surface Water Drainage via the Tobermaclugg Stream and Backstown Stream** (Dec 2017 the Strategic development zone, Aderrig, lies within the Tobermaclugg drainage sub-catchment and hence no additional attenuation/storage is required for the proposed Phase 3 Aderrig site, however some additional on-site storage is proposed in the form or "water butts" and "bio retention tree pits" are proposed in line with previously approved proposals for Aderrig Phase 1 and 2.

3.3.4 Proposed Catchment Areas

The proposed sites surface water drainage network has been separated into 3 no. catchments areas with differing outfall locations due to the existing ground levels in relation to the receiving drainage network invert levels.

The total surface water catchment area taken into consideration for sizing of the stormwater network within the Phase 3 Aderrig site is 3.539 ha. The description of each catchment is given in the sections to follow, with Figure 3-3 showing the layout of the catchments.

Catchment A

The northern portion of the site drains in an easterly direction and will connect into a 375mm Ø stormwater sewer in the Celbridge Link Road at the eastern boundary.

Catchment A, with a total area of approx. 2.17 ha, has a contributing hardstanding surface area of approx. 1.90 Ha which equates to 87% hardstanding area within this catchment. Catchment A can be seen in Figure 3-3, illustrated in orange colour.

Catchment A-1

The northern portion of the site drains in a southerly direction and will connect into a 750mm Ø stormwater sewer in the Adamstown Way within the site.

Catchment A-1, with a total area of approx. 0.33 ha, has a hardstanding surface area of approx. 0.28 Ha which equates to 85% hardstanding area within this catchment. Catchment A-1 can be seen in Figure 3-3, illustrated in purple colour.

Catchment B

The southern portion of the site drains in an easterly direction into the existing 900mm Ø stormwater pipe in Adamstown Way.

Catchment B, with a total area of approx. 1.04 ha, has a hardstanding surface area of approx. 0.57 Ha which equates to 55% hardstanding area within this catchment. Catchment B can be seen in Figure 3-3, illustrated in blue colour.

Refer to Figure 3-3 below for an illustration of the 3 no. catchment areas and proposed outfall locations.

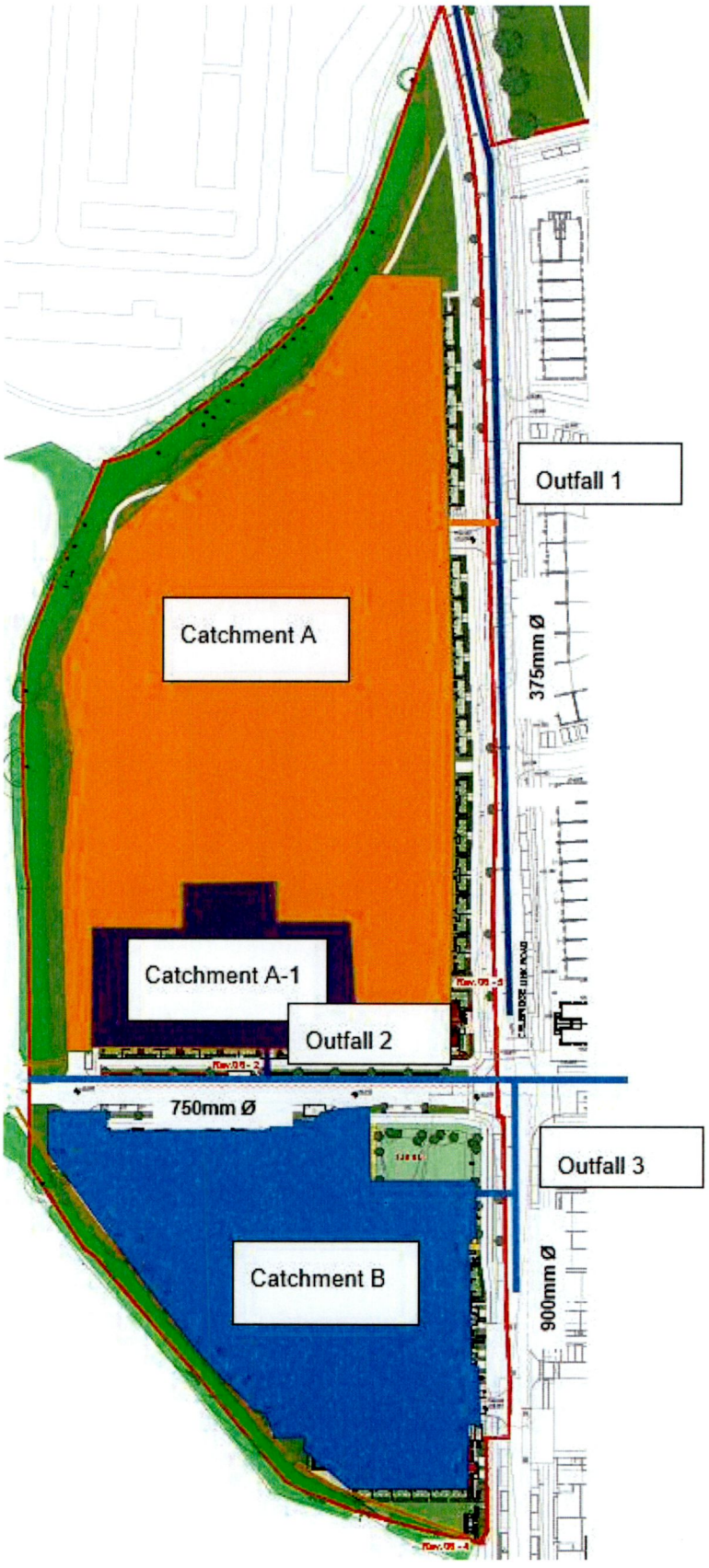


Figure 3-3: Phase 3 Aderrig Catchment Areas & Outfall Locations

3.3.5 Calculations – Storage

According to the Surface Water Drainage subsections 2.5.6 – 2.5.19 of the Adamstown Strategic Development Zone (ASDZ) Planning Scheme by South Dublin County Council (SDCC), 5000m^3 of stormwater attenuation is proposed for the Tobermaclugg surface water catchment area off site north of the Lucan Golf Course. Attenuation of stormwater drainage on site within the ASDZ is only relevant within the North East Griffeen Tributary and South East Griffeen Tributary Catchment Areas.

The Strategic development zone, Aderrig, lies within the Tobermaclugg drainage sub-catchment and hence **no additional attenuation/storage is required for the proposed Phase 3 Aderrig site,** however some additional on-site storage is proposed in the form or **"water butts"** and **"bio retention tree pits"** are proposed in line with previously approved proposals for Aderrig Phase 1 and 2.

3.4 SuDS Strategy

3.4.1 Storm Water Management Plan

It is proposed to discharge the surface water from the proposed development, via a series of SuDS features and downstream defender manholes, into the existing downstream stormwater system. The methodology involved in developing a Storm Water Management Plan for the subject site is based on recommendations in the Greater Dublin Strategic Drainage Study (GDSDS) and in the SuDS Manual. It is proposed to incorporate a Storm Water Management Plan though the use of various SuDS techniques.

Based on three key elements, Water Quantity, Water Quality and Amenity, the targets of SuDS train concept have been implemented in the design. The SuDS train provided SuDS devices for each of the following:

- Source Control – Individual house or private property
- Site Control – Internal Roads within the development
- Regional Control – The entire development

The SuDS devices proposed throughout the subject application consist of the following:-

Source Control:

- Permeable pavements:

  Have not been included in the SuDS proposals for the development in line with other sites across Adamstown SDZ due to the poor infiltration properties of the existing ground on site.

- Water butts:
  A water butt is a structure or barrel with the purpose of collecting surface water runoff from a unit's roof through the downpipes on the perimeter walls. The water butts used for the proposed development have a capacity of approximately 200 litres each, the quantum of water butts will match the number of units within the proposed development.

Site Control:

- Bio-retention tree pits:
  These tree pits are engineered pits that allow for the drainage through and retention of water within the tree pit below the root ball. In some cases, the tree pit is retained by a pre-cast concrete structure. In others, a polymer-based support structure within the root zone of the tree is used, which can also provide for additional aeration. Aeration of the subsoil and overflow drainage pipework within the pit is provided or an adjacent road gully, downstream of the inlet to the tree pit is used.

  Discussions with the Landscape architect has taken place to incorporate "bio retention" tree pits, however only certain species of trees realistically survive with saturated root base. Therefore, bio retention tree pits can be incorporated where agreement is reached with SDCC Parks and the proposed landscaping strategy during the detailed design process for those areas that will be taken in charge and maintained by the Council, to ensure that the selected planting strategy is in accordance with their requirements. Where trees are incorporated, the tree pit details need to comply with the Irish Water Code of Practice.

- Swales:
  A swale is a grassed depression, usually liner in direction with the road that collects runoff, both treating and providing a level of infiltration. Swales can be planted and be managed as wet or dry swales. Dry swales would be more appropriate for the proposed layout of the site.
  The location of swales within the site will determind as appropriate considering the hardstanding areas location adjacent to green or landscaped areas.

Regional Control:

- Downstream defenders:
  The Defenders will remove sediment and pollutants/hydrocarbons from the storm water before discharge to the existing surface water network. The defenders will be located at strategic points on the outfall to surface water sewers.

3.4.1 Water Quality

"Downstream Defender" units are located at the point of discharge from each sub catchment to the sewer that drains to the existing storm water network. These units improve the quality of the water being discharged into the pipe network leading to the Stream and protect against the 'first flush' pollutants of a rainfall event. The "Downstream Defender" is an advanced hydrodynamic vortex separator designed to remove sediment, floatables, hydrocarbons and associated pollutants from storm water.

This "Downstream Defender" meets the requirements of a class 1 or 2 separator and removes material suspended within the water column. The device is installed into a concrete manhole and is made from co-polymer polypropylene, which will not corrode and has no moving parts. A "Downstream Defender" is positioned to allow for easy access and is maintained using a simple gully sucker to remove the oils and sediments by means of the access points provided. (See Appendix B for Downstream Defender details).

3.5 Surface Water Drainage - General

Surface water drains within the proposed private development area will be laid to comply with the requirements of the Building Regulations, and in accordance with the recommendations contained in the Technical Guidance Documents, Section H.

Surface water sewers, which will be taken into charge by South Dublin County Council, will be laid strictly in accordance with South Dublin County Council requirements for taking in charge.

3.6 Flood Risk Assessment

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

4. Water Supply

4.1 Water Supply – Existing

It is proposed to connect the **Phase 3 Aderrig** site into the water network by connecting into the 300mmø (ID) existing public watermain located along the site eastern boundary in Celbridge Link Road. The connection will be made into the existing Tee off in accordance with the **Overall ASDZ Watermain Network Strategy** agreed with SDCC as reflected on PHMcC Drawing 821/06/001 Rev E **"Proposed Network and DMA Design". (**See below the Aderrig **DMA** (District Metered Area) **AD6** extracted from the PHMcCarthy Dwg. 821/06/001 Draft Rev E)

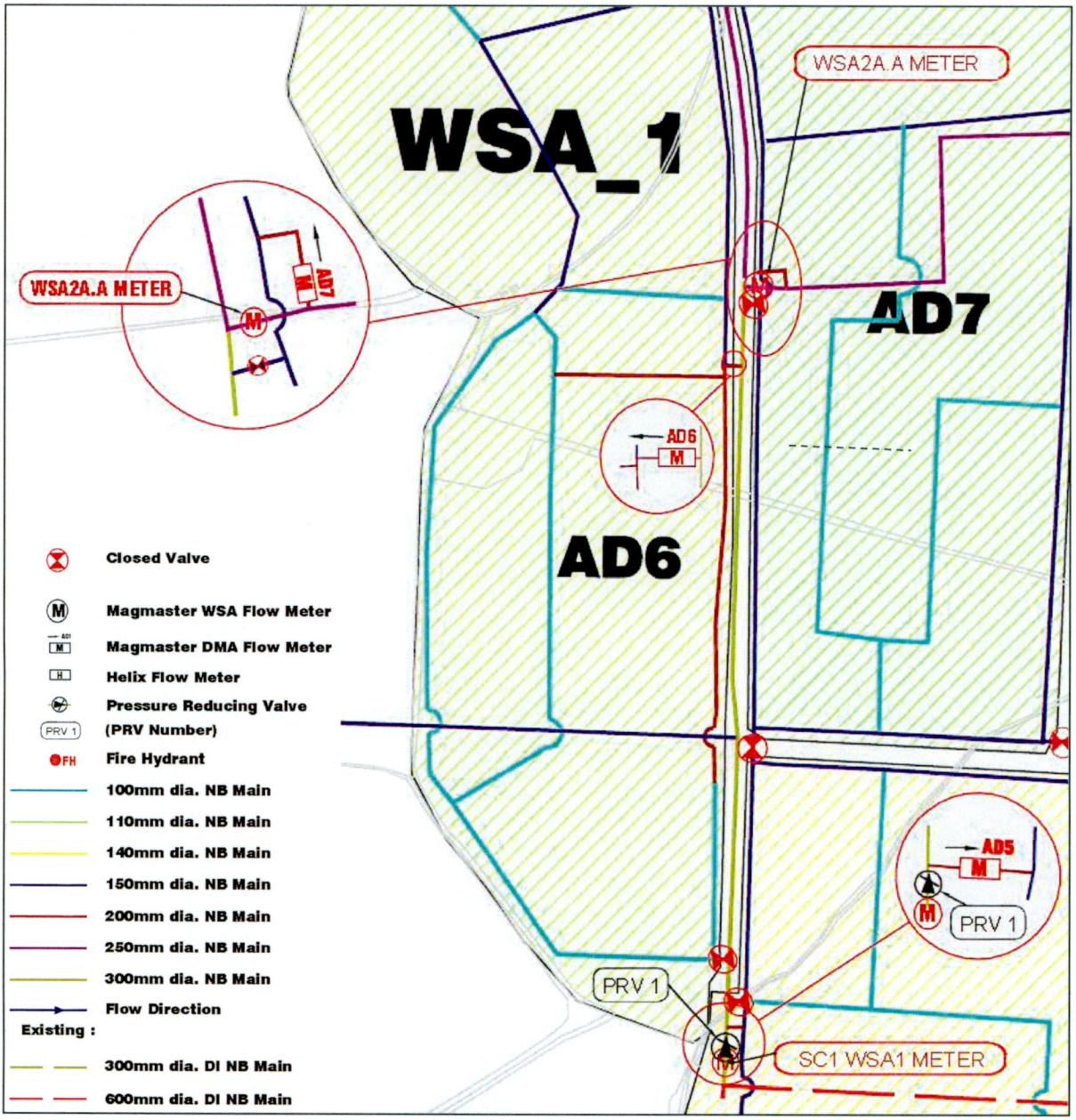


Figure 4-1: Extract from PHMcCarthy Water Schematic Drawing 821/06/001

4.2 Water Supply – Proposed

The proposed development, Aderrig Phase 3, is located completely within **DMA AD6** watermain network. Design follows the approved watermain masterplan as shown on PHMcC Drawing 821/06/01 Draft Rev E **"Proposed Network and DMA Design.**

It is proposed as illustrated in the watermain network strategy within Figure 4-1: -

- To provide 2no. connection points to the existing 300mm ø (ID) watermain. 200mm ø (ID) connection and 100mm ø (ID) connection as shown in Figure 4-1.
- The proposed 200mm ø (ID) watermain will distribute water across the northern and the southern portion of the site.
- To the north, an internal loop network of 150mm and 100mm ø (ID) watermains will feed the housing units.
- To the north, 2no. connections will be made to the 150mm ø (ID) watermain spurs left for future connection at the boundary of the adjacent development Reg. Ref. SDZ21A/0023 in accordance with the DMA AD6 Scheme.
- To the south, an internal loop network of 100mm ø (ID) watermain will feed the housing units.
- Each internal loop will consist of a maximum of 40 units, as per "Irish Water Code of Practice for Water Infrastructure".
- A district area meter (DMA), **AD6**, will be located on the eastern edge of the development, installed off the 300mm ø (ID) watermain which is constructed under the Celbridge Link Road Project.

Refer to Waterman Moylan Drawings 22-023-P300 which accompany this report, and which show the existing and proposed watermain network layout for the proposed development.

On 07 March 2019, in response to a Pre-Connection enquiry submission, Irish Water confirmed that the first 1000 housing units within Adamstown AD6, AD7 and AD8, can be connected to the Irish Water Network. Refer to Appendix A for the Irish Water Confirmation of Feasibility Letter.

All water supply details shall be in accordance with Irish Water requirements and Code of Practice.

4.3 Water Demand Calculation

Water demand has been calculated based on 2.7 average occupancy factor per residential unit with a per capita wastewater flow of 150 litres per person per day along with an average day/peak week demand factor 1.25 for average daily domestic demand. A peak week demand multiplier of 5 has been used, as per Section 3.7.2 of the Irish Water Code of Practice for Water Infrastructure.

Water calculations providing details of the anticipated water consumption for the proposed development are illustrated inTable 4-1 over.

Table 4-1: Total Water Demand

Description	No. of Units	Population per Unit	PE	Flow l/h/day	Total Demand (l/d)
Proposed	207	2.7	558.9	150	83, 835
				Total	**83, 835**
Calculation of Proposed Peak Water Demand					
Total Daily Demand *(from Table 4.1)*				83, 835	ℓ l/d
Average Daily Demand (x1.25)				1.22	ℓ/s
Peak Demand (x5)				**6.1**	**ℓ/s**

5. Roads

5.1 Roads – Existing and Proposed

The proposed development is located to the west of the Celbridge Link Road, approximately 1.2 km from the proposed Adamstown District Centre (under construction) and approx. 2.5km from the centre of Lucan village.

Adamstown Way extends into the site westwards towards the existing Electrical Transformer Station adjacent to the western boundary of the subject site.

As per recommended widths for local streets in the Design Manual for Urban Roads and Streets (**DMURS**), and recommended widths for side streets and back streets in the ASDZ planning scheme, the proposed internal site roads are 5.5m wide with a 2.2m wide footpath to cater for the minimum offsets of Irish Water. Carriageways within the 'home zones'/shared surface areas are 4.5m wide with a 1.5m wide services strip/pedestrian refuge/buffer on one side of the carriageway.

Refer to Waterman Moylan drawings 22-023-P120 and P121 for details of proposed roads and cross sections.

Crossing points are located along desire lines at various points within the development such that unimpeded pedestrian movement is facilitated.

The layout of the proposed development and associated internal road network is indicated on Waterman Moylan drawings 22-023-P100, which ties into the adjoining roads.

Proposed radii at junctions are as per DMURS recommendations. SDCC have indicated in recent Permissions within Adamstown to only provide tactile paving on the main peripheral footpaths and not within the general estate footpaths.

5.2 Roads – Traffic and Parking

Extensive traffic analysis was undertaken as part of the overall ASDZ Planning Scheme by **WS Atkins Ireland Limited** (Atkins). The proposed development is in accordance with their assessment in relation to the masterplan of the planning scheme as part of this application.

5.3 Roads - Site Access and Sightlines

The proposed development is directly accessed at six points:

- 1 no. access point on the north from the **Celbridge Link Road**
- 1 no. access point on the south from the **Celbridge Link Road**
- 1 no. access point on the north from the **Adamstown Way**
- 2 no. access points on the south from **Adamstown Way extension**

As reflected with red arrows show in Figure 5-1 below: -


CELBRIDGE LINK ROAD
ADAMSTOWN WAY ex sion

Figure 5-1: Road Access Points for Aderrig Phase 3

The internal road layout has been slightly adjusted, relative to the master plan. This has affected position of 3no. junctions on to the Adamstown Way shiftly them to the east, as shown in Figure 5-2 below. Adamstown Way is within the site designated as a side street in the ASDZ scheme, and no adverse impacts from the adjustment are expected.

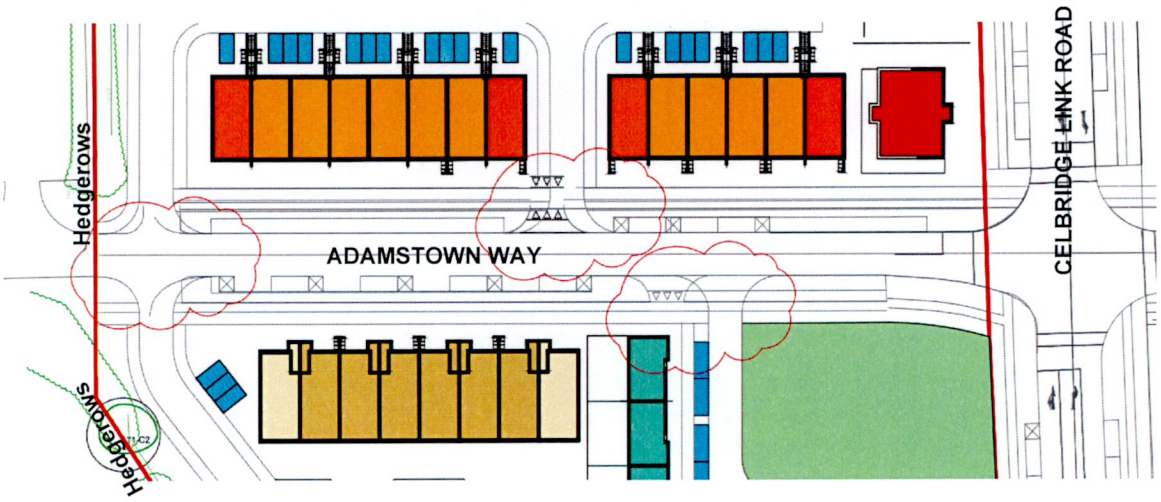
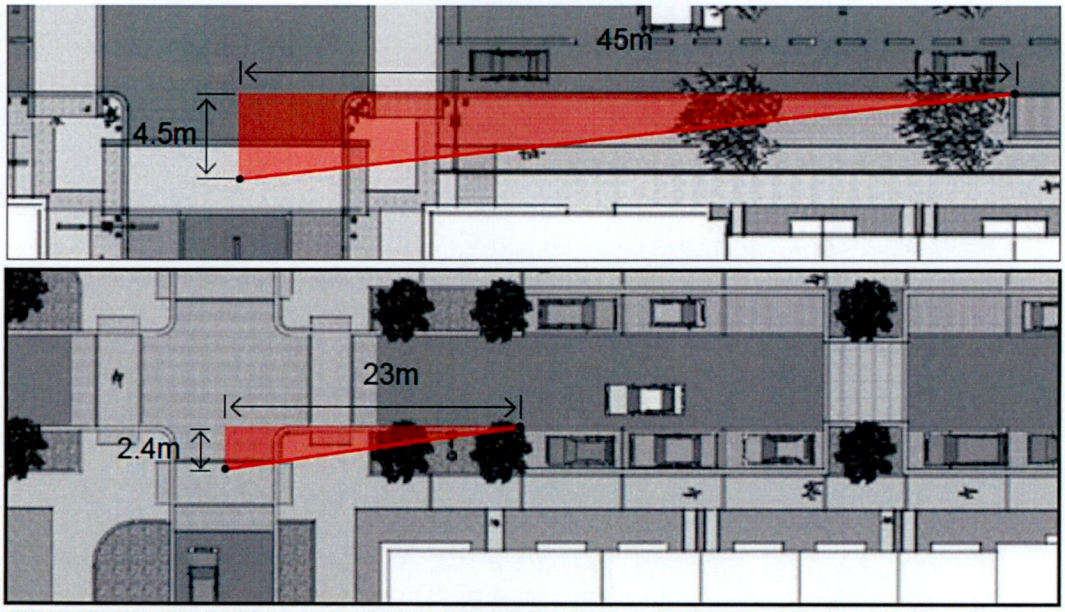


Figure 5-2: Junctions shift to accommodate the protected hedgerows

In Addition, to reflect the planning application Reg. Ref. SDZ21A/0023 RFI on the neighbouring Tubber Lane lands, no vehicular link is proposed to the north. But, in order to facilitate pedestrian and cycle permeability, a pedestrians and cyclists only link is proposed to connect the proposed development with the pedestrian and cycling facilities on the Celbridge Link Road. Similarly, to enhance safety in and around the park to the south of Adamstown Way, a homezone with a cul-de-sac and a link for pedestrians and cyclists only is proposed to the south of the green space. This is in line with the treatment applied to other tiles across the SDZ where pedestrian and cyclist movement is prioritised on roads subject to low traffic volumes rather than strict compliance with the SDZ.

In accordance with DMURS guidelines, all access points to the proposed development have minimum sightlines of 45m with a minor road setback of 2.4m, as per the extract below. For roads network visibility splays for the proposed development refer to Waterman Moylan drawings 22-023-P113.



Illustrations of the main two types of visibility splays used within Adamstown for 50 kph Adamstown Boulevard/Main Streets (top) and 30 kph Side Streets/Back Streets (bottom).

APPENDICES

A. Irish Water Confirmation of Feasibility Letter

Clear Real Estate Investments PLC c/o Ian Swartz
Block s,
EastPoint Business Park
Alfie Byrne Road
Co. Dublin

Uisce Éireann
Bosca OP 6000
Baile Átha Cliath 1
Éire

Irish Water
PO Box 6000
Dublin 1
Ireland

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

07 March 2019

Dear Sir/Madam,

Re: Customer Reference No 9540800086 pre-connection enquiry - Subject to contract | Contract denied
1000 housing units within AD 6, 7 & 8 Adamstown Way Lucan

Irish Water has reviewed your pre-connection enquiry in relation to water and wastewater connections at Adamstown Way, Lucan. Based upon the details you have provided with your pre-connection enquiry and on the capacity currently available as assessed by Irish Water, we wish to advise you that, subject to a valid connection agreement being put in place, your proposed connection to the Irish Water network can be facilitated.
In the case of wastewater connections, this assessment does not confirm that a gravity connection is achievable. Therefore a suitably sized pumping station may be required to be installed on your site. All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details.

This Confirmation of Feasibility to connect to the Irish Water infrastructure also does not extend to your fire flow requirements. Please note that Irish Water can not guarantee a flow rate to meet fire flow requirements and in order to guarantee a flow to meet the Fire Authority requirements, you should provide adequate fire storage capacity within your development.
The proposed water and wastewater connections for this development connect to the Irish Water network via infrastructure that has not been taken in charge by Irish Water (Third Party Infrastructure). Please be advised that at connection application stage you have to:
• Provide written confirmation from the owner of the infrastructure that you have received permission to connect to and wayleave from water and wastewater connection points into existing infrastructure up to the Irish Water infrastructure.
• Demonstrate that the Third Party Infrastructure is in compliance with requirements of Irish Water Code of Practice and Standard Details and in adequate condition and capacity to cater for additional load from the Development.
For the water connection, a full telemetry outstation, PRV controller, Wet& Dry kiosks and associated ducting are required (details to be agreed with Irish Water)
The infrastructure has to be designed and constructed in conjunction with adjacent developments and in accordance with the Infrastructure Master Plan for the Zone.
All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details. A design proposal for the water and wastewater infrastructure should be submitted to Irish Water for assessment. Prior to submitting your planning application, you are required to submit these detailed design proposals to Irish Water for review.

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

A connection agreement can be applied for by completing the connection application form available at **www.water.ie/connections**. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Utility Regulation.

If you have any further questions, please contact Kevin McManmon from the design team on 018230374 or email kmcmanmon@water.ie. For further information, visit **www.water.ie/connections**

Yours sincerely,

Maria O'Dwyer
Connections and Developer Services

B. Downstream Defender Details

Design Data

Downstream Defender®

Advanced Hydrodynamic Vortex Separator

The Downstream Defender® is an advanced hydrodynamic vortex separator for the effective and reliable removal of fine particles, oils and other floatable debris from surface water runoff.

Its innovative design delivers high efficiency across a wide range of flows in a much smaller footprint than conventional or other swirl-type devices and it is the perfect choice for any catchment likely to convey high quantities of contamination.

1. Access for removal of floatables and sediments.
2. Inlet pipe.
3. Inlet chute.
4. Centre shaft.
5. Dip plate.
6. Centre cone.
7. Benching skirt.
8. Floatables and oil storage.
9. Isolated sediment storage zone.
10. Outlet pipe.

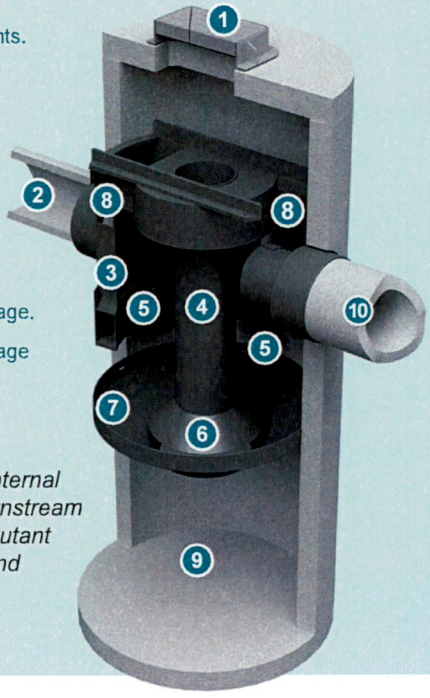


Figure 1 - The unique internal components of the Downstream Defender® enhance pollutant removal performance and prevent wash out.

Unique Flow Modifying Components

The Downstream Defender® consists of a choice of concrete or HDPE chamber with unique flow modifying internal components. It is these internal components that differentiate the Downstream Defender® from catchpits, sedimentation basins or sedimentation sumps. They facilitate advanced hydrodynamic vortex separation by reducing turbulence, lengthening the flow path to increase chamber residence time and introducing shear planes.

The internal components also ensure that the pollutant storage zones are isolated and protected from high flows that could cause pollutant re-entrainment or wash out.

Compared to devices that have poorly designed internal components, the Downstream Defender® captures and retains more of the annual pollutant load.

Watch a short video showing the Downstream Defender® components and operation at:

http://www.hydro-int.com/en-gb/products/downstream-defender-0

Repeatable, Reliable Performance

The Downstream Defender® delivers high removal of pollutants through advanced, hydrodynamic separation across a wide range of flows. The device has a proven track record of tackling an assortment of pollutants including:

Sediment (or Total Suspended Solids)

The Downstream Defender® is a highly effective sediment/TSS removal device. It can be sized in a number of ways to suit the application and level of protection required (see Table 1). **SuDS Mitigation Index = 0.5.**

Gross Pollutants

100% removal of floatable debris, such as food wrappers, Styrofoam cups and drinks cartons

Liquid Hydrocarbons

Effective spill containment device that meets the BS EN 858-1:2002 Class I and Class II effluent targets at low flow rates. Note these systems are not considered oil separators according to the BS EN 858-1 and must not be used in applications where full certification is required. **SuDS Mitigation Index = 0.8.**

Sediment Bound Hydrocarbons (including Polycylic Aromatic Hydrocarbons - PAHs)

PAHs have low solubility in water and are readily adsorbed onto sediment particles. Effective removal of sediment particles will also ensure the removal of many PAHs.

Sediment Bound Heavy Metals and Nutrients

Heavy Metals

Nutrients

As an efficient device for removal of fine sediment, the Downstream Defender® is also effective for the removal of sediment bound pollutants. **SuDS Mitigation Index (Metals) = 0.4.**

Tel: +44 (0)1275 337955
stormtrain@hydro-int.com

hydro-int.com/stormtrain

Design Data
Downstream Defender®
Advanced Hydrodynamic Vortex Separator

No Risk of Pollutant Wash Out

The Downstream Defender® has been specially designed to isolate the pollutant storage zones and is proven to prevent pollutant wash out.

Sizing

The Downstream Defender® can be sized for different treatment goals and objectives.

For design purposes, the selected model's Treatment Flow Rate should be greater than or equal to the site's Water Quality Flow Rate.

The hydraulic capacity of the selected model should be considered with respect to the peak discharge flow rate from the site.

Model Diameter (m)	Treatment Flow Rate - Fine (l/s) [a]	Treatment Flow Rate - Coarse (l/s) [b]	Hydraulic Capacity (l/s) [c]	Minimum Oil Storage Capacity (l)	Minimum Sediment Storage Capacity (m^3) [e]	Maximum Headloss at Treatment Flow Rate - Coarse (mm)
1.2	30	38	120	283	0.39	150
1.8	69	85	270	1356	0.73	225
2.55	138	171	542	2535	2.89	300
3.0	190	237	750	4693	3.10	375

Notes:
a) Treatment Flow Rate - Fine is based on an annualised removal efficiency of >50% of all particles up to 1000 microns with a mass-median particle size (D_{50}) of 75 microns and a specific gravity of 2.65.
b) Treatment Flow Rate - Coarse is based on an annualised removal efficiency of >80% of all particles between 50 and 1000 microns with a mass-median particle size (D_{50}) of 146 microns and a specific gravity of 2.65.
c) Maximum flow rate that can pass through the chamber with a maximum headloss of 500mm.
d) Alternative sizing based on different sediment grades available on request.
e) Additional sediment storage capacity can be provided to extend maintenance intervals if required.

Table 1 - Downstream Defender® design information.

Expert Design Service

Hydro International's professional engineers are on hand to provide free support with the correct sizing and selection of the Downstream Defender® within each drainage design.

We can also provide estimated maintenance intervals, whole life cost estimates and predicted pollutant removal performance.

Call the StormTrain® Hotline on: 01275 337955 or email stormtrain@hydro-int.com

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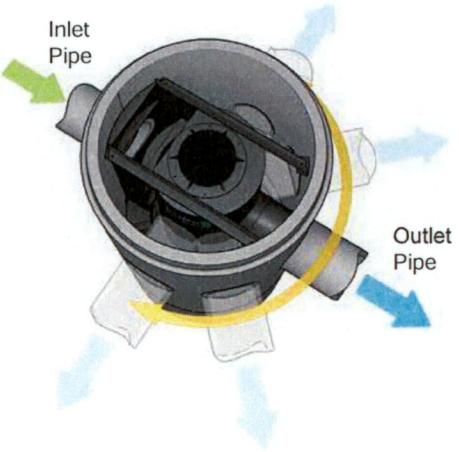
Design Data
Downstream Defender®
Advanced Hydrodynamic Vortex Separator

Setting Out



The Downstream Defender® can accommodate a change in pipe direction to suit site specific requirements. Combined with the high rate internal bypass, this helps to avoid the need for additional manholes on site. Head loss across the chamber is kept to a minimum (see Table 1). The inlet and outlet pipes should be sized in accordance with Table 2 (opposite), and a minimum of 90 degrees between inlet and outlet is required.

Inlet and outlet pipe connections are at the same invert level.

Additional manhole sections can be provided to extend the chamber to meet site cover and invert levels or provide additional pollutant storage where required.

Easy to Install

The Downstream Defender® is delivered to site as a near finished manhole with internal components already installed. Installation is therefore similar to any other manhole installation on site. Full installation guidelines are available.

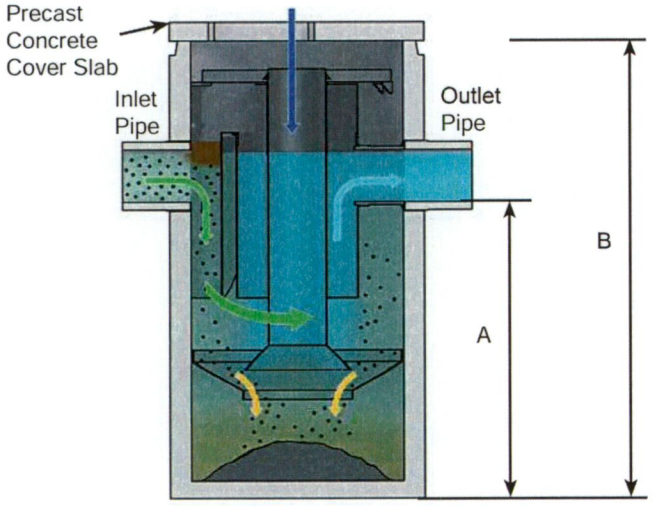
We can provide structural concrete systems for simple plug-and-play installation or choice of lightweight single and twin wall plastic chambers.

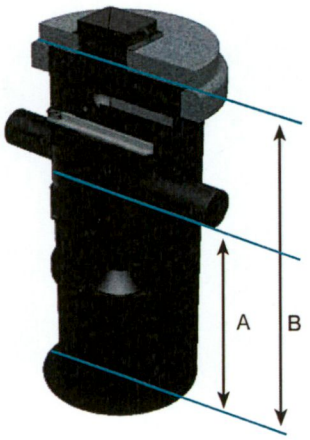
Easy to Maintain

Maintenance of the Downstream Defender® is simple, safe and cost-effective. Maintenance is carried out from the surface, using a standard vacuum tanker and personnel are not required to enter the device.

With a large capacity to store sediments and oils (see Table 1), and with a proven ability to prevent wash out, maintenance intervals can be years rather than months - depending on site conditions. The unit can also be fitted with a Hydro-Logic™ Smart Monitoring system to alert the site operator when maintenance is required and provide peace of mind that the unit is operating normally at other times.

Additional pollutant storage can be built into the chamber to extend maintenance intervals if required.





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stormtrain@hydro-int.com

Design Data
Downstream Defender®
Advanced Hydrodynamic Vortex Separator

Hydro International

Dimensions and Weights

General arrangement drawings of all units are available for download from:
http://www.hydro-int.com/en-gb/products/downstream-defender-0

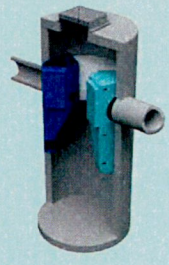
Model	Material	Chamber Diameter - Internal (mm)	Chamber Diameter - External (mm)	Inlet and Outlet ID (mm)	Depth to invert (m) (A) [1]	Chamber Depth (m) (B) [2]	Max Component Lift Weight (kg)
PQL1320.1000	Concrete	1200	1460	300	1.916	2.830	2200
PQL1320.1030	Concrete	1800	2160	450	2.495	4.029	5450
PQL1320.1060	Concrete	2550	2850	600	2.95	4.95	8700
PQL1320.1090	Concrete	3000	3350	750	3.12	5.20	12100
PQL1320.1020	HDPE Single Wall	1188	1200	300	1.55	2.3	140
PQL1320.1050	HDPE Single Wall	1776	1812	500	2.11	3.41	460
PQL1320.1080	HDPE Single Wall	2530	2570	600	2.94	4.8	900
PQL1320.1110	HDPE Single Wall	2974	3000	800	3.13	5.3	1300
PQL1320.1025	HDPE Twin Wall	1200	1300	300	1.56	2.22	400
PQL1320.1055	HDPE Twin Wall	1800	2200	560	2.467	3.75	1100

Notes:
1) Minimum depth to invert shown. Depth to invert can be increased if required.
2) Minimum chamber depth shown. Additional sediment storage capacity or increased depth to invert can be provided if required.

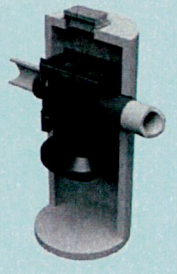
Table 2 - Downstream Defender® unit types, dimensions and weights.

The Hydro StormTrain® Series of Surface Water Treatment Devices

The Downstream Defender® is one of the Hydro StormTrain® Series of surface water treatment devices. Each device delivers proven, measurable and repeatable surface water treatment performance. Each can be used independently to meet the specific needs of a site or combined to form a management train. They can be used alongside natural SuDS features to protect, enable or enhance them.



First Defense®
Vortex Separator



Downstream Defender®
Advanced Hydrodynamic
Vortex Separator

Up-Flo™ Filter
Fluidised Bed Up Flow
Filtration System

Hydro Biofilter™
Biofiltration System

Patent: www.hydro-int.com/patents

Tel: +44 (0)1275 337955 stormtrain@hydro-int.com

Hydro International
Shearwater House, Clevedon Hall Estate, Victoria Road, Clevedon, BS21 7RD

hydro-int.com/stormtrain

C. Foul Water Network Drainage Model Results

Design Settings

Frequency of use (kDU)	0.00	Minimum Velocity (m/s)	1.00
Flow per dwelling per day (l/day)	2700	Connection Type	Level Soffits
Domestic Flow (l/s/ha)	0.0	Minimum Backdrop Height (m)	0.200
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	1.200
Additional Flow (%)	0	Include Intermediate Ground	✓

Nodes

Name	Dwellings	Cover Level (m)	Manhole Type	Easting (m)	Northing (m)	Depth (m)
13	5	56.070	Adoptable	701325.623	733392.369	1.650
14	1	55.070	Adoptable	701323.186	733420.262	1.470
15	8	54.650	Adoptable	701333.317	733437.705	1.461
1	3	57.900	Adoptable	701320.052	733334.353	1.750
2	3	57.410	Adoptable	701320.382	733353.380	1.916
3	5	56.330	Adoptable	701326.455	733384.184	1.855
5	37	58.020	Adoptable	701333.821	733321.887	1.935
7	24	55.850	Adoptable	701419.981	733325.359	1.660
8	26	54.760	Adoptable	701421.976	733379.026	1.787
16		53.880	Adoptable	701424.016	733434.329	1.599
21		53.450	Adoptable	701424.489	733457.325	1.476
22		53.190	Adoptable	701439.482	733456.879	1.447
22_OUT		53.120	Adoptable	701451.288	733454.067	1.529
4	3	55.700	Adoptable	701376.045	733381.154	1.906
6		56.240	Adoptable	701410.453	733318.480	1.550
7.1	2	56.050	Adoptable	701426.550	733312.790	1.549
7.2	2	56.050	Adoptable	701426.066	733300.834	1.350

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.007	22	22_OUT	12.166	1.500	51.743	51.591	0.152	80.0	225
1.006	21	22	15.014	1.500	51.974	51.743	0.231	65.0	225
1.005	16	21	23.003	1.500	52.281	51.974	0.307	74.9	225
4.002	15	16	90.780	1.500	53.189	52.281	0.908	100.0	225
1.004	8	16	55.342	1.500	52.973	52.420	0.553	100.1	225
1.003	4	8	45.989	1.500	53.794	52.973	0.821	56.0	225
2.002	7	8	53.705	1.500	54.190	53.116	1.074	50.0	225
3.001	7.1	7	14.182	1.500	54.501	54.265	0.236	60.1	150
2.001	6	7	11.752	1.500	54.690	54.334	0.356	33.0	225

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
1.007	0.528	1.283	51.0	3.7	1.222	1.304	0.000	119	0.0	0.0	41	0.741
1.006	0.572	1.425	56.7	3.7	1.251	1.222	0.000	119	0.0	0.0	39	0.801
1.005	0.546	1.327	52.7	3.7	1.374	1.251	0.000	119	0.0	0.0	41	0.766
4.002	0.239	1.148	45.6	0.4	1.236	1.374	0.000	14	0.0	0.0	16	0.360
1.004	0.472	1.147	45.6	3.3	1.562	1.235	0.000	105	0.0	0.0	41	0.662
1.003	0.298	1.535	61.0	0.4	1.681	1.562	0.000	14	0.0	0.0	14	0.426
2.002	0.511	1.625	64.6	2.0	1.435	1.419	0.000	65	0.0	0.0	28	0.733
3.001	0.210	1.131	20.0	0.1	1.399	1.435	0.000	4	0.0	0.0	9	0.304
2.001	0.504	2.001	79.6	1.2	1.325	1.291	0.000	37	0.0	0.0	19	0.699

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
2.000	5	6	76.715	1.500	56.085	54.690	1.395	55.0	225
3.000	7.2	7.1	11.966	1.500	54.700	54.501	0.199	60.1	150
1.002	3	4	49.694	1.500	54.475	53.794	0.681	73.0	225
1.001	2	3	31.397	1.500	55.494	54.544	0.950	33.0	150
1.000	1	2	19.031	1.500	56.150	55.494	0.656	29.0	150
4.001	14	15	20.189	1.500	53.600	53.264	0.336	60.1	150
4.000	13	14	28.002	1.500	54.420	53.620	0.800	35.0	150

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	0.410	1.549	61.6	1.2	1.710	1.325	0.000	37	0.0	0.0	22	0.591
3.000	0.154	1.131	20.0	0.1	1.200	1.399	0.000	2	0.0	0.0	7	0.243
1.002	0.260	1.344	53.5	0.3	1.630	1.681	0.000	11	0.0	0.0	14	0.373
1.001	0.284	1.527	27.0	0.2	1.766	1.636	0.000	6	0.0	0.0	9	0.412
1.000	0.224	1.630	28.8	0.1	1.600	1.766	0.000	3	0.0	0.0	7	0.352
4.001	0.243	1.131	20.0	0.2	1.320	1.236	0.000	6	0.0	0.0	11	0.346
4.000	0.276	1.484	26.2	0.2	1.500	1.300	0.000	5	0.0	0.0	8	0.381

Simulation Settings

Analysis Speed	Normal	Drain Down Time (mins)	240
Skip Steady State	x	Foul Event Duration (mins)	60

Storm Durations

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

Results for Foul Event Critical Storm Duration. Lowest mass balance: 71.46%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
Foul Event	13	21	54.430	0.010	0.2	0.0108	0.0000	OK
Foul Event	14	25	53.611	0.011	0.2	0.0122	0.0000	OK
Foul Event	15	36	53.206	0.017	0.5	0.0190	0.0000	OK
Foul Event	1	15	56.157	0.007	0.1	0.0075	0.0000	OK
Foul Event	2	29	55.503	0.009	0.2	0.0106	0.0000	OK
Foul Event	3	29	54.489	0.014	0.4	0.0160	0.0000	OK
Foul Event	5	4	56.108	0.023	1.2	0.0264	0.0000	OK
Foul Event	7	11	54.219	0.029	2.2	0.0326	0.0000	OK
Foul Event	8	32	53.016	0.043	3.5	0.0483	0.0000	OK
Foul Event	16	266	53.011	0.730	4.5	0.8256	0.0000	SURCHARGED
Foul Event	21	255	53.011	1.037	4.1	1.1729	0.0000	SURCHARGED
Foul Event	22	255	53.011	1.268	4.7	1.4344	0.0000	FLOOD RISK
Foul Event	22_OUT	252	53.011	1.420	3.4	1.6063	0.0000	OK
Foul Event	4	34	53.809	0.015	0.5	0.0167	0.0000	OK
Foul Event	6	8	54.710	0.020	1.2	0.0224	0.0000	OK
Foul Event	7.1	20	54.512	0.011	0.2	0.0069	0.0000	OK
Foul Event	7.2	15	54.708	0.008	0.1	0.0050	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)
Foul Event	13	4.000	14	0.2	0.433	0.008	0.0129	
Foul Event	14	4.001	15	0.2	0.359	0.010	0.0113	
Foul Event	15	4.002	16	0.5	0.288	0.011	1.8657	
Foul Event	1	1.000	2	0.1	0.349	0.003	0.0068	
Foul Event	2	1.001	3	0.2	0.442	0.007	0.0142	
Foul Event	3	1.002	4	0.4	0.401	0.007	0.0525	
Foul Event	5	2.000	6	1.2	0.762	0.020	0.1442	
Foul Event	7	2.002	8	2.2	0.749	0.034	0.1578	
Foul Event	8	1.004	16	3.5	0.673	0.077	1.2438	
Foul Event	16	1.005	21	4.1	0.785	0.078	0.9149	
Foul Event	21	1.006	22	3.9	0.734	0.070	0.5971	
Foul Event	22	1.007	22_OUT	3.4	0.523	0.066	0.4839	0.0
Foul Event	4	1.003	8	0.5	0.172	0.008	0.1451	
Foul Event	6	2.001	7	1.2	0.719	0.015	0.0197	
Foul Event	7.1	3.001	7	0.2	0.358	0.010	0.0079	
Foul Event	7.2	3.000	7.1	0.1	0.252	0.005	0.0054	

Design Settings

Frequency of use (kDU)	0.00	Minimum Velocity (m/s)	1.00
Flow per dwelling per day (l/day)	2700	Connection Type	Level Soffits
Domestic Flow (l/s/ha)	0.0	Minimum Backdrop Height (m)	0.200
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	1.200
Additional Flow (%)	0	Include Intermediate Ground	✓

Nodes

Name	Dwellings	Cover Level (m)	Manhole Type	Easting (m)	Northing (m)	Depth (m)
08	2	53.000	Adoptable	701371.176	733483.969	1.350
07	1	52.800	Adoptable	701392.432	733497.637	1.782
06		52.460	Adoptable	701403.841	733504.897	1.780
05	12	53.150	Adoptable	701424.627	733469.762	1.450
04	4	52.530	Adoptable	701425.092	733504.895	2.381
03		52.000	Adoptable	701425.186	733531.326	2.181
02	4	51.810	Adoptable	701431.690	733540.103	2.203
01		51.760	Adoptable	701467.709	733540.332	2.393

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
02	02	01	36.020	1.500	49.607	49.367	0.240	150.0	225
03	03	02	10.924	1.500	49.819	49.682	0.137	80.0	150
04	04	03	26.431	1.500	50.149	49.819	0.330	80.0	150
06	06	04	21.251	1.500	50.680	50.149	0.531	40.0	150
05	05	04	35.136	1.500	51.700	51.114	0.586	60.0	150
07	07	06	13.523	1.500	51.018	50.680	0.338	40.0	150
08	08	07	25.271	1.500	51.650	51.018	0.632	40.0	150

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
02	0.258	0.936	37.2	0.7	1.978	2.168	0.000	23	0.0	0.0	22	0.356
03	0.311	0.980	17.3	0.6	2.031	1.978	0.000	19	0.0	0.0	19	0.443
04	0.311	0.980	17.3	0.6	2.231	2.031	0.000	19	0.0	0.0	19	0.443
06	0.214	1.388	24.5	0.1	1.630	2.231	0.000	3	0.0	0.0	7	0.318
05	0.304	1.132	20.0	0.4	1.300	1.266	0.000	12	0.0	0.0	14	0.422
07	0.214	1.388	24.5	0.1	1.632	1.630	0.000	3	0.0	0.0	7	0.318
08	0.190	1.388	24.5	0.1	1.200	1.632	0.000	2	0.0	0.0	6	0.279

Simulation Settings

Analysis Speed	Normal	Drain Down Time (mins)	240
Skip Steady State	x	Foul Event Duration (mins)	60

Storm Durations

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

Results for Foul Event Critical Storm Duration. Lowest mass balance: 87.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
Foul Event	08	5	51.658	0.008	0.1	0.0085	0.0000	OK
Foul Event	07	8	51.026	0.008	0.1	0.0086	0.0000	OK
Foul Event	06	12	50.687	0.007	0.1	0.0081	0.0000	OK
Foul Event	05	24	51.715	0.015	0.4	0.0168	0.0000	OK
Foul Event	04	54	50.168	0.019	0.6	0.0219	0.0000	OK
Foul Event	03	15	49.838	0.019	0.6	0.0220	0.0000	OK
Foul Event	02	234	49.805	0.198	0.8	0.2239	0.0000	OK
Foul Event	01	256	49.805	0.438	0.7	0.4956	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)
Foul Event	08	08	07	0.1	0.446	0.004	0.0080	
Foul Event	07	07	06	0.1	0.436	0.004	0.0041	
Foul Event	06	06	04	0.1	0.155	0.004	0.0173	
Foul Event	05	05	04	0.4	0.445	0.020	0.0316	
Foul Event	04	04	03	0.6	0.489	0.035	0.0352	
Foul Event	03	03	02	0.6	0.453	0.035	0.0844	
Foul Event	02	02	01	0.7	0.323	0.019	1.3832	0.0

Design Settings

Frequency of use (kDU)	0.00	Minimum Velocity (m/s)	1.00
Flow per dwelling per day (l/day)	2700	Connection Type	Level Soffits
Domestic Flow (l/s/ha)	0.0	Minimum Backdrop Height (m)	0.200
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	1.200
Additional Flow (%)	0	Include Intermediate Ground	✓

Nodes

Name	Dwellings	Cover Level (m)	Manhole Type	Easting (m)	Northing (m)	Depth (m)
6	16	58.000	Adoptable	701330.084	733271.968	1.350
9_OUT		56.290	Adoptable	701464.049	733235.002	2.329
9		56.500	Adoptable	701449.200	733235.493	2.390
5		56.400	Adoptable	701448.882	733224.854	2.157
4		56.370	Adoptable	701449.796	733208.685	1.925
3	12	56.540	Adoptable	701448.030	733176.418	1.691
2	13	57.340	Adoptable	701372.479	733181.078	1.545
1	9	58.000	Adoptable	701334.958	733230.924	1.350
8	7	57.050	Adoptable	701406.441	733238.150	2.150
7	3	56.740	Adoptable	701407.737	733268.537	1.385

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
9	9	9_OUT	14.857	1.500	54.110	53.961	0.149	100.0	225
8	8	9	42.848	1.500	54.900	54.364	0.536	80.0	225
5	5	9	10.644	1.500	54.243	54.110	0.133	80.0	225
4	4	5	16.197	1.500	54.445	54.243	0.202	80.2	225
3	3	4	32.315	1.500	54.849	54.445	0.404	80.0	225
2	2	3	75.702	1.500	55.795	54.849	0.946	80.0	225
1	1	2	62.396	1.500	56.650	55.870	0.780	80.0	150
7	7	8	30.416	1.500	55.355	54.975	0.380	80.0	150
6	6	7	77.729	1.500	56.650	55.355	1.295	60.0	150

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
9	0.399	1.148	45.6	1.9	2.165	2.104	0.000	60	0.0	0.0	31	0.558
8	0.322	1.284	51.0	0.8	1.925	1.911	0.000	26	0.0	0.0	20	0.461
5	0.356	1.284	51.0	1.1	1.932	2.165	0.000	34	0.0	0.0	22	0.502
4	0.355	1.282	51.0	1.1	1.700	1.932	0.000	34	0.0	0.0	22	0.502
3	0.356	1.284	51.0	1.1	1.466	1.700	0.000	34	0.0	0.0	22	0.502
2	0.305	1.284	51.0	0.7	1.320	1.466	0.000	22	0.0	0.0	19	0.447
1	0.250	0.980	17.3	0.3	1.200	1.320	0.000	9	0.0	0.0	14	0.354
7	0.310	0.979	17.3	0.6	1.235	1.925	0.000	19	0.0	0.0	19	0.443
6	0.332	1.132	20.0	0.5	1.200	1.235	0.000	16	0.0	0.0	17	0.468

Simulation Settings

Analysis Speed	Normal	Drain Down Time (mins)	240
Skip Steady State	x	Foul Event Duration (mins)	60

Storm Durations

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

Results for Foul Event Critical Storm Duration. Lowest mass balance: 86.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
Foul Event	6	6	56.667	0.017	0.5	0.0192	0.0000	OK
Foul Event	9_OUT	291	54.796	0.835	1.7	0.9449	0.0000	OK
Foul Event	9	297	54.796	0.686	2.5	0.7762	0.0000	SURCHARGED
Foul Event	5	293	54.796	0.553	1.1	0.6256	0.0000	SURCHARGED
Foul Event	4	294	54.796	0.351	1.4	0.3975	0.0000	SURCHARGED
Foul Event	3	32	54.872	0.023	1.1	0.0262	0.0000	OK
Foul Event	2	40	55.814	0.019	0.7	0.0211	0.0000	OK
Foul Event	1	45	56.664	0.014	0.3	0.0157	0.0000	OK
Foul Event	8	25	54.920	0.020	0.8	0.0225	0.0000	OK
Foul Event	7	36	55.374	0.019	0.6	0.0219	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)
Foul Event	6	6	7	0.5	0.550	0.026	0.0923	
Foul Event	9	9	9_OUT	1.7	0.394	0.038	0.5909	0.0
Foul Event	5	5	9	1.1	0.398	0.021	0.4233	
Foul Event	4	4	5	1.1	0.512	0.022	0.6442	
Foul Event	3	3	4	1.1	0.515	0.022	0.6770	
Foul Event	2	2	3	0.7	0.382	0.014	0.1400	
Foul Event	1	1	2	0.3	0.369	0.017	0.0507	
Foul Event	8	8	9	0.8	0.469	0.016	0.8885	
Foul Event	7	7	8	0.6	0.454	0.035	0.0402	

D. Surface Water Network Drainage Model Results

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	10	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	16.600	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
12	0.187	4.00	52.450	1200	701422.637	733512.503	0.950
9	0.159	4.00	57.570	1200	701343.676	733380.518	1.425
8	0.173	4.00	55.850	1200	701417.442	733325.497	1.471
10	0.133	4.00	54.760	1200	701419.902	733377.500	1.500
2	0.062	4.00	57.410	1200	701317.603	733351.649	1.425
3	0.040	4.00	56.070	1200	701323.706	733389.091	1.425
4	0.037	4.00	55.070	1200	701321.630	733421.217	1.425
11	0.101	4.00	53.800	1350	701421.142	733436.378	2.206
13	0.031	4.00	53.400	1350	701421.799	733460.347	2.188
14	0.024	4.00	53.120	1350	701447.309	733459.648	2.112
14_OUT			53.050	1350	701463.849	733460.380	2.174
15	0.137	4.00	54.650	1350	701332.356	733439.169	1.575
16		4.00	57.000	1200	701391.455	733321.908	1.550
17	0.042	4.00	56.240	1200	701411.324	733320.921	1.555

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)
14	14	14_OUT	16.561	0.600	51.008	50.876	0.132	125.0	375	6.01	50.0
13	13	14	25.525	0.600	51.212	51.008	0.204	125.0	375	5.84	50.0
12	12	13	52.164	0.600	51.500	51.287	0.213	245.0	300	4.87	50.0
11	11	13	23.986	0.600	51.594	51.434	0.160	150.0	375	5.58	50.0
15	15	11	88.837	0.600	53.075	51.594	1.481	60.0	375	5.31	50.0
10	10	11	58.891	0.600	53.260	52.295	0.965	61.0	300	5.12	50.0
10a	8	10	52.061	0.600	54.379	53.294	1.085	48.0	225	4.64	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)
14	1.619	178.8	167.9	1.737	1.799	1.126	0.0	290	1.829
13	1.619	178.8	164.4	1.813	1.737	1.103	0.0	285	1.826
12	1.000	70.7	27.9	0.650	1.813	0.187	0.0	131	0.943
11	1.477	163.1	131.9	1.831	1.591	0.884	0.0	257	1.636
15	2.343	258.7	41.2	1.200	1.831	0.277	0.0	101	1.734
10	2.016	142.5	75.5	1.200	1.205	0.507	0.0	156	2.045
10a	1.893	75.3	32.1	1.246	1.241	0.215	0.0	102	1.818

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)
9	9	10	76.297	0.600	56.145	53.319	2.826	27.0	225	4.50	50.0
17	17	8	7.640	0.600	54.685	54.379	0.306	25.0	225	4.18	50.0
16	16	17	19.893	0.600	55.450	54.685	0.765	26.0	225	4.13	50.0
4	4	15	20.921	0.600	53.645	53.225	0.420	49.8	225	4.68	50.0
3	3	4	32.198	0.600	54.645	53.645	1.000	32.2	225	4.49	50.0
2	2	3	37.938	0.600	55.985	54.645	1.340	28.3	225	4.26	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)
9	2.528	100.5	23.6	1.200	1.216	0.159	0.0	74	2.079
17	2.629	104.5	6.2	1.330	1.246	0.042	0.0	37	1.465
16	2.576	102.4	0.0	1.325	1.330	0.000	0.0	0	0.000
4	1.857	73.9	20.9	1.200	1.200	0.140	0.0	81	1.600
3	2.313	92.0	15.3	1.200	1.200	0.103	0.0	62	1.728
2	2.468	98.1	9.3	1.200	1.200	0.062	0.0	46	1.559

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	16.600	Additional Storage (m³/ha)	20.0
Ratio-R	0.300	Check Discharge Rate(s)	x
Summer CV	0.750	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 %)
5	0	0	0
30	0	0	0
100	10	0	0

Results for 5 year Critical Storm Duration. Lowest mass balance: 99.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	12	12	51.692	0.192	35.2	0.9725	0.0000	OK
15 minute summer	9	10	56.229	0.084	29.8	0.2807	0.0000	OK
15 minute summer	8	10	54.496	0.117	40.6	0.4084	0.0000	OK
15 minute summer	10	10	53.444	0.184	95.6	0.5349	0.0000	OK
15 minute summer	2	10	56.037	0.052	11.8	0.1052	0.0000	OK
15 minute summer	3	10	54.715	0.070	19.4	0.1185	0.0000	OK
15 minute summer	4	10	53.742	0.097	26.3	0.1607	0.0000	OK
15 minute summer	11	11	51.925	0.331	163.4	0.7788	0.0000	OK
15 minute summer	13	11	51.685	0.473	186.5	0.8130	0.0000	SURCHARGED
15 minute summer	14	11	51.409	0.401	183.5	0.6632	0.0000	SURCHARGED
15 minute summer	14_OUT	11	51.190	0.314	183.7	0.0000	0.0000	OK
15 minute summer	15	10	53.187	0.112	51.9	0.3534	0.0000	OK
15 minute summer	16	1	55.450	0.000	0.0	0.0000	0.0000	OK
15 minute summer	17	10	54.727	0.042	7.9	0.0696	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	12	12	13	35.0	0.804	0.495	3.0782	
15 minute summer	9	9	10	29.9	1.927	0.297	1.3785	
15 minute summer	8	10a	10	40.7	1.740	0.541	1.2765	
15 minute summer	10	10	11	93.3	2.127	0.654	2.5914	
15 minute summer	2	2	3	11.8	1.357	0.120	0.3317	
15 minute summer	3	3	4	19.4	1.447	0.210	0.4326	
15 minute summer	4	4	15	26.1	1.653	0.354	0.3309	
15 minute summer	11	11	13	156.8	1.628	0.961	2.3211	
15 minute summer	13	13	14	179.8	1.631	1.006	2.8153	
15 minute summer	14	14	14_OUT	183.7	1.748	1.027	1.7286	82.2
15 minute summer	15	15	11	51.0	0.857	0.197	5.7455	
15 minute summer	16	16	17	0.0	0.000	0.000	0.0503	
15 minute summer	17	17	8	7.9	0.632	0.076	0.0990	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	12	12	52.182	0.682	51.8	3.4552	0.0000	FLOOD RISK
15 minute summer	9	10	56.248	0.103	43.9	0.3470	0.0000	OK
15 minute summer	8	10	54.529	0.150	59.6	0.5227	0.0000	OK
15 minute summer	10	10	53.509	0.249	140.3	0.7228	0.0000	OK
15 minute summer	2	10	56.048	0.063	17.2	0.1272	0.0000	OK
15 minute summer	3	10	54.730	0.085	28.4	0.1448	0.0000	OK
15 minute summer	4	10	53.768	0.123	38.6	0.2032	0.0000	OK
15 minute summer	11	11	52.464	0.870	238.7	2.0442	0.0000	SURCHARGED
15 minute summer	13	12	52.126	0.914	244.9	1.5704	0.0000	SURCHARGED
15 minute summer	14	12	51.615	0.607	248.0	1.0033	0.0000	SURCHARGED
15 minute summer	14_OUT	12	51.224	0.348	249.1	0.0000	0.0000	OK
15 minute summer	15	10	53.212	0.137	76.3	0.4336	0.0000	OK
15 minute summer	16	1	55.450	0.000	0.0	0.0000	0.0000	OK
15 minute summer	17	10	54.735	0.050	11.6	0.0841	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	12	12	13	42.0	0.845	0.595	3.6734	
15 minute summer	9	9	10	43.9	1.959	0.437	2.0441	
15 minute summer	8	10a	10	59.7	1.812	0.793	1.7492	
15 minute summer	10	10	11	135.1	2.265	0.948	3.5413	
15 minute summer	2	2	3	17.2	1.506	0.175	0.4356	
15 minute summer	3	3	4	28.4	1.581	0.308	0.5786	
15 minute summer	4	4	15	38.4	1.812	0.520	0.4437	
15 minute summer	11	11	13	204.2	1.852	1.252	2.6456	
15 minute summer	13	13	14	244.8	2.220	1.369	2.8153	
15 minute summer	14	14	14_OUT	249.1	2.259	1.393	1.7973	120.9
15 minute summer	15	15	11	75.5	0.904	0.292	6.5146	
15 minute summer	16	16	17	0.0	0.000	0.000	0.0659	
15 minute summer	17	17	8	11.6	0.680	0.111	0.1326	

Results for 100 year +10% CC Critical Storm Duration. Lowest mass balance: 99.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	12	10	52.450	0.950	73.8	4.8127	6.7879	FLOOD
15 minute summer	9	10	56.273	0.128	62.6	0.4290	0.0000	OK
15 minute summer	8	11	54.967	0.588	84.7	2.0498	0.0000	SURCHARGED
15 minute summer	10	11	54.210	0.950	183.0	2.7558	0.0000	SURCHARGED
15 minute summer	2	10	56.061	0.076	24.6	0.1532	0.0000	OK
15 minute summer	3	10	54.749	0.104	40.6	0.1766	0.0000	OK
15 minute summer	4	10	53.803	0.158	55.2	0.2606	0.0000	OK
15 minute summer	11	11	53.055	1.461	292.6	3.4325	0.0000	SURCHARGED
15 minute summer	13	11	52.471	1.259	284.9	2.1625	0.0000	SURCHARGED
15 minute summer	14	11	51.769	0.761	293.1	1.2593	0.0000	SURCHARGED
15 minute summer	14_OUT	10	51.231	0.355	293.4	0.0000	0.0000	OK
15 minute summer	15	11	53.249	0.174	109.0	0.5497	0.0000	OK
15 minute summer	16	1	55.450	0.000	0.0	0.0000	0.0000	OK
15 minute summer	17	11	54.958	0.273	21.7	0.4545	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)
15 minute summer	12	12	13	50.2	0.813	0.711	3.6734	
15 minute summer	9	9	10	62.7	1.971	0.624	2.4051	
15 minute summer	8	10a	10	70.4	1.846	0.936	2.0705	
15 minute summer	10	10	11	144.8	2.130	1.016	4.1471	
15 minute summer	2	2	3	24.6	1.662	0.251	0.5652	
15 minute summer	3	3	4	40.6	1.706	0.441	0.7666	
15 minute summer	4	4	15	54.9	1.948	0.744	0.5897	
15 minute summer	11	11	13	267.6	2.427	1.641	2.6456	
15 minute summer	13	13	14	285.4	2.588	1.596	2.8153	
15 minute summer	14	14	14_OUT	293.4	2.660	1.641	1.8082	167.8
15 minute summer	15	15	11	108.2	1.183	0.418	7.1143	
15 minute summer	16	16	17	0.0	0.000	0.000	0.3956	
15 minute summer	17	17	8	16.1	0.690	0.154	0.3039	

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	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)	16.600	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	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)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
04	0.051	4.00	58.000	1200	701318.138	733296.754	1.425
03	0.161	4.00	58.200	1200	701318.698	733325.209	2.162
02	0.077	4.00	56.925	1200	701382.428	733322.202	1.600
01			57.380	1200	701380.823	733281.452	2.225

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)
02	02	01	40.782	0.600	55.325	55.155	0.170	240.0	300	5.75	50.0
03	03	02	63.801	0.600	56.038	55.400	0.638	100.0	225	5.08	50.0
01	04	03	28.461	0.600	56.575	56.038	0.537	53.0	225	4.26	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)
02	1.010	71.4	39.2	1.300	1.925	0.289	0.0	158	1.033
03	1.307	52.0	28.8	1.937	1.300	0.212	0.0	120	1.341
01	1.800	71.6	6.9	1.200	1.937	0.051	0.0	47	1.149

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	16.600	Additional Storage (m³/ha)	20.0
Ratio-R	0.300	Check Discharge Rate(s)	x
Summer CV	0.750	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 %)
5	0	0	0
30	0	0	0
100	10	0	0

Results for 5 year Critical Storm Duration. Lowest mass balance: 99.19%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	04	10	56.631	0.056	9.7	0.1030	0.0000	OK
15 minute summer	03	10	56.186	0.148	40.2	0.3872	0.0000	OK
15 minute summer	02	10	55.524	0.199	52.6	0.4149	0.0000	OK
15 minute summer	01	11	55.331	0.176	51.6	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)
15 minute summer	04	01	03	9.7	0.593	0.135	0.5015	
15 minute summer	03	03	02	38.1	1.425	0.734	1.7206	
15 minute summer	02	02	01	51.6	1.129	0.722	1.8834	21.3

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.19%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	04	10	56.643	0.068	14.2	0.1250	0.0000	OK
15 minute summer	03	10	56.247	0.209	58.8	0.5479	0.0000	OK
15 minute summer	02	10	55.593	0.268	75.4	0.5600	0.0000	OK
15 minute summer	01	11	55.367	0.212	73.8	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	04	01	03	14.2	0.641	0.198	0.6899	
15 minute summer	03	03	02	54.4	1.502	1.046	2.3838	
15 minute summer	02	02	01	73.8	1.227	1.034	2.4361	31.2

Results for 100 year +10% CC Critical Storm Duration. Lowest mass balance: 99.19%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	04	11	56.886	0.311	20.2	0.5759	0.0000	SURCHARGED
15 minute summer	03	11	56.877	0.839	83.3	2.2008	0.0000	SURCHARGED
15 minute summer	02	10	55.705	0.380	93.2	0.7938	0.0000	SURCHARGED
15 minute summer	01	11	55.391	0.236	91.8	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	04	01	03	19.7	0.673	0.276	1.1319	
15 minute summer	03	03	02	66.5	1.673	1.280	2.5374	
15 minute summer	02	02	01	91.8	1.333	1.286	2.6477	44.7

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	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)	16.600	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
7	0.079	4.00	58.000	1200	701327.585	733273.522	1.425
10_OUT			56.400	1350	701458.127	733236.909	2.167
5			56.540	1200	701453.654	733173.975	1.526
4	0.197	4.00	57.340	1200	701371.693	733178.652	1.430
3			57.820	1200	701343.710	733216.414	1.634
2	0.125	4.00	58.320	1200	701315.728	733254.176	1.858
9	0.078	4.00	57.050	1200	701408.946	733240.250	2.373
8	0.062	4.00	56.740	1200	701410.046	733270.515	1.884
6			56.370	1200	701454.198	733228.589	1.585
1	0.026	4.00	57.980	1200	701316.573	733269.942	1.425
10			56.500	1350	701454.461	733237.154	2.255

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)
10	10	10_OUT	3.674	0.600	54.245	54.233	0.012	306.0	375	7.97	50.0
9	9	10	45.623	0.600	54.677	54.395	0.282	162.0	225	5.97	50.0
6	6	10	8.569	0.600	54.785	54.746	0.039	219.0	300	7.91	50.0
5	5	6	54.617	0.600	55.014	54.785	0.229	238.0	300	7.77	50.0
4	4	5	82.101	0.600	55.910	55.089	0.821	100.0	225	6.88	50.0
3	3	4	47.002	0.600	56.186	55.910	0.276	170.0	225	5.83	50.0
2	2	3	47.001	0.600	56.462	56.186	0.276	170.0	225	5.05	50.0
1	1	2	15.791	0.600	56.555	56.462	0.093	169.8	225	4.26	50.0
8	8	9	30.314	0.600	54.856	54.677	0.179	169.0	225	5.23	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)
10	1.030	113.8	76.8	1.880	1.792	0.567	0.0	226	1.103
9	1.024	40.7	29.6	2.148	1.880	0.219	0.0	143	1.115
6	1.058	74.8	47.2	1.285	1.454	0.348	0.0	173	1.117
5	1.015	71.7	47.2	1.226	1.285	0.348	0.0	178	1.081
4	1.307	52.0	47.2	1.205	1.226	0.348	0.0	169	1.475
3	1.000	39.7	20.4	1.409	1.205	0.151	0.0	115	1.008
2	1.000	39.7	20.4	1.633	1.409	0.151	0.0	115	1.008
1	1.000	39.8	3.5	1.200	1.633	0.026	0.0	45	0.622
8	1.003	39.9	19.0	1.659	2.148	0.140	0.0	109	0.991

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)
7	7	8	82.519	0.600	56.575	54.856	1.719	48.0	225	4.73	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)
7	1.892	75.2	10.6	1.200	1.659	0.079	0.0	57	1.345

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	16.600	Additional Storage (m³/ha)	20.0
Ratio-R	0.300	Check Discharge Rate(s)	x
Summer CV	0.750	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 %)
5	0	0	0
30	0	0	0
100	10	0	0

Results for 5 year Critical Storm Duration. Lowest mass balance: 99.60%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	7	10	56.642	0.067	14.8	0.1497	0.0000	OK
15 minute summer	10_OUT	12	54.453	0.220	89.8	0.0000	0.0000	OK
15 minute summer	5	11	55.217	0.203	54.9	0.2298	0.0000	OK
15 minute summer	4	11	56.126	0.216	63.6	0.8424	0.0000	OK
15 minute summer	3	11	56.321	0.135	28.4	0.1531	0.0000	OK
15 minute summer	2	10	56.607	0.145	28.4	0.3584	0.0000	OK
15 minute summer	9	11	54.855	0.178	39.6	0.3197	0.0000	OK
15 minute summer	8	10	54.986	0.130	26.4	0.2331	0.0000	OK
15 minute summer	6	12	54.995	0.210	54.8	0.2380	0.0000	OK
15 minute summer	1	10	56.608	0.053	4.9	0.0792	0.0000	OK
15 minute summer	10	12	54.508	0.263	89.7	0.3760	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	7	7	8	14.7	0.905	0.195	1.3930	
15 minute summer	5	5	6	54.8	1.072	0.765	2.8205	
15 minute summer	4	4	5	54.9	1.499	1.056	3.1023	
15 minute summer	3	3	4	27.3	0.855	0.686	1.5084	
15 minute summer	2	2	3	28.4	1.110	0.713	1.2053	
15 minute summer	9	9	10	37.7	1.167	0.925	1.4720	
15 minute summer	8	8	9	25.1	0.888	0.629	0.8653	
15 minute summer	6	6	10	54.8	1.122	0.732	0.4177	
15 minute summer	1	1	2	4.9	0.292	0.122	0.2694	
15 minute summer	10	10	10_OUT	89.8	1.198	0.789	0.2749	41.6

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.60%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	7	10	56.657	0.082	21.7	0.1832	0.0000	OK
15 minute summer	10_OUT	12	54.477	0.244	109.3	0.0000	0.0000	OK
15 minute summer	5	12	55.242	0.228	63.2	0.2578	0.0000	OK
15 minute summer	4	11	56.508	0.598	85.2	2.3263	0.0000	SURCHARGED
15 minute summer	3	12	56.630	0.444	41.4	0.5020	0.0000	SURCHARGED
15 minute summer	2	12	56.774	0.312	40.8	0.7716	0.0000	SURCHARGED
15 minute summer	9	11	54.967	0.290	51.8	0.5193	0.0000	SURCHARGED
15 minute summer	8	11	55.087	0.231	38.7	0.4123	0.0000	SURCHARGED
15 minute summer	6	12	55.017	0.232	63.4	0.2619	0.0000	OK
15 minute summer	1	12	56.762	0.207	7.2	0.3090	0.0000	OK
15 minute summer	10	12	54.542	0.297	109.2	0.4245	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	7	7	8	21.6	0.977	0.287	2.1380	
15 minute summer	5	5	6	63.4	1.095	0.884	3.1625	
15 minute summer	4	4	5	63.2	1.591	1.217	3.1831	
15 minute summer	3	3	4	33.0	0.839	0.831	1.8693	
15 minute summer	2	2	3	41.4	1.170	1.042	1.8693	
15 minute summer	9	9	10	47.5	1.216	1.167	1.6915	
15 minute summer	8	8	9	31.6	0.920	0.793	1.2056	
15 minute summer	6	6	10	63.0	1.174	0.842	0.4586	
15 minute summer	1	1	2	7.2	0.305	0.181	0.6158	
15 minute summer	10	10	10_OUT	109.3	1.286	0.961	0.3110	60.7

Results for 100 year +10% CC Critical Storm Duration. Lowest mass balance: 99.60%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	7	10	56.675	0.100	31.0	0.2229	0.0000	OK
15 minute summer	10_OUT	12	54.508	0.275	139.0	0.0000	0.0000	OK
15 minute summer	5	12	55.316	0.302	78.2	0.3418	0.0000	SURCHARGED
15 minute summer	4	12	57.279	1.369	100.0	5.3268	0.0000	FLOOD RISK
15 minute summer	3	12	57.499	1.313	36.6	1.4851	0.0000	SURCHARGED
15 minute summer	2	12	57.702	1.240	49.4	3.0699	0.0000	SURCHARGED
15 minute summer	9	11	55.296	0.619	66.5	1.1101	0.0000	SURCHARGED
15 minute summer	8	11	55.507	0.651	55.3	1.1638	0.0000	SURCHARGED
15 minute summer	6	12	55.054	0.269	77.7	0.3046	0.0000	OK
15 minute summer	1	12	57.708	1.153	12.2	1.7226	0.0000	FLOOD RISK
15 minute summer	10	12	54.593	0.348	138.9	0.4979	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	7	7	8	30.9	1.041	0.411	2.3422	
15 minute summer	5	5	6	77.7	1.128	1.084	3.7431	
15 minute summer	4	4	5	78.2	1.965	1.504	3.2648	
15 minute summer	3	3	4	36.9	0.929	0.929	1.8693	
15 minute summer	2	2	3	36.6	1.193	0.921	1.8693	
15 minute summer	9	9	10	62.7	1.579	1.540	1.7672	
15 minute summer	8	8	9	41.9	1.055	1.052	1.2056	
15 minute summer	6	6	10	77.2	1.263	1.032	0.5191	
15 minute summer	1	1	2	9.9	0.297	0.249	0.6280	
15 minute summer	10	10	10_OUT	139.0	1.420	1.222	0.3553	86.9

UK and Ireland Office Locations