KAVANAGH BURKE
CONSULTING ENGINEERS

Drainage Design Report

for

Residential Development

at

Hazelhatch Road,
Celbridge,
Co. Kildare

Job No:	**D1686**
Date:	**August 2022**
Local Authority:	**Kildare County Council**
Revision:	**PL3**

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Contents:

SURFACE WATER RUNOFF MANAGEMENT

The surface water runoff generated from the proposed development will be routed through a series of Sustainable Urban Drainage System (SuDS) elements. These elements will promote runoff interception, detention and infiltration at source before runoff reaches the underground attenuation system. The flow control device will be installed on the outfall of the proposed site drainage system designed to drain and attenuate 1 in 100 year storm event of any duration (+30% climate change factor). Therefore, no flooding on or off the site will be caused by the runoff originating from the development in the event of storm up to 1in100 year return. Since the temporary flood storage forms a part of the overall attenuation tank volume, the maximum allowable discharge was limited to the green filed runoff rate QBAR (see calculations in the succeeding chapters) as per criterion 4.3 “River Flood Protection” chapter 6.3.4 of GDSDS. All flows and volumes for the storm water network design and the attenuation sizing were calculated with a 30% climate change factor applied to all rainfall intensities. We have accounted for the 10% urban creep of impermeable areas by including all patches of the landscaping areas in private front gardens in our impervious areas take-off. In addition, we have treated all permeable paving as impervious areas to account for urban creep and permeable paving loss of performance over time. A series of soakaway tests was conducted to determine soil infiltration factor. The soakaway test results report is appended to this report (see Appendix D). Despite of sufficient permeability, a conservative approach was taken and all permeable paving areas were deemed impervious for the SW network and attenuation calculation purpose.

The interception of the first flush runoff (capturing first 5mm or more of every rainfall event) will be provided in a series of sustainable urban drainage system devices upstream of the attenuation storage.

The subbase of the permeable surfacing, green roof planting and substrate, irrigation tree pits, bioretention areas and swales are designed to intercept storm water runoff from all hardstanding surfaces on site. The roofs on all apartment blocks (excluding lift shafts, AOVs, M&E equipment and balconies) are covered with an extensive green roof. The runoff from the roofs of all houses and creche will be directed to the subbase of the permeable paving as shown on the schematic secondary drainage drawing Ref. D1686-D2-PL3. Measured soil infiltration rate was above the threshold allowing for discharge of up to 5 times the areas of the permeable paving into the subbase of the permeable paving in accordance with CIRIA C753 SUDS Manual Table 24.6. All hardstanding surfaces in private property (around houses) will be made permeable. All runoff from the roads and footpaths will be directed to SuDS tree pits, bio-retention areas, swales or permeable paving before it will be allowed into underground storm water drainage network as demonstrated on the accompanying drainage and watermain layout DRG. REF. D1686-D1-1-PL3.

The proposed attenuation system will be equipped with a horizontal inspection row (inspection tunnel) to enable access for inspection and maintenance activities such as jetting and debris removal in the unlikely event of such debris passing through the proposed SUDS features, trapped gullies, vortex type silt trap/debris separator and the proprietary petrol interceptor. A proprietary Petrol Interceptor and Silt Trap will be provided on the inlet to the proposed attenuation. The “hydrobrake” or equivalent flow control device provided on the outfall pipe of the attenuation system is designed to control the flow to calculated green field runoff rate QBAR=4.1 l/sec as described in this report.

The excess SW runoff from the site (that was not disposed in the provided SUDS devices) will discharge at green field runoff rate to the neighbouring residential development to the north of the proposed site. Condition and capacity checks of the receiving SW pipe were performed and the results can be seen in Appendix E of this drainage report.

RUNOFF TREATMENT MANAGEMENT TRAIN

The treatment train approach was applied to the storm water network and attenuation design to ascertain that both the runoff quality and quantity are appropriately addressed. An array of techniques has been used to fulfil the requirements of each element of the treatment train:

Pollution prevention – To prevent chemicals and other pollutants from contaminating the rainfall runoff, a maintenance regime for the proposed development will be established and it will include regular sweeping of the estate roads and collection of rubbish. Waste bins provided will be watertight and will incorporate lids or will be located in designated bin storage to prevent the rainfall flushing the contaminants out of them. Proprietary silt trap and petrol interceptor will be provided on the surface water drainage network to intercept debris, silts and hydrocarbons and prevent them from entering the attenuation tank and from being discharged to the soil or receiving watercourse.

Source control – To detain and infiltrate the runoff as close as possible to the point of origin, we have included the following infiltration SUDS devices:

- Extensive green roofs
- Permeable surfacing
- Irrigation tree pits
- Swales
- Bioretention Areas
- Infiltration trenches

The above mentioned devices are explained in greater detail in the next chapter.

Site control – To deal with as much of the runoff as possible within the site, all storm water runoff will be intercepted in the Suds devices (permeable surfacing, swales, tree pits, green roofs and bioretention areas). Storm water runoff from all impervious surfacing will be routed through various SuDS devices allowing for runoff interception and disposal through infiltration. The routing of the storm water flows is demonstrated on the accompanying drainage layout Reg. Ref D1686-D1-1-PL3.

Regional control – to mimic the behaviour of the green field site and protect the receiving watercourse, the attenuation tank is designed to cater for all durations of rainfall up to 100-year return period for the purpose of minimising on-site and offsite flooding.

SUDS DEVICES

During the surface water drainage design process, a matrix of possible SUDS devices and their environmental benefits were analysed to decide on which of these elements were suitable for inclusion in the proposed development. The following is our review of these devices;

Excluded SUDS devices:

Ponds, Wetlands, Detention basins, Infiltration Basins are not suitable for the site of this size and its location and nature. The existing site topography, existing storm water outfall levels, flood modelling and proximity of the proposed development to the neighbouring properties rendered the site unsuitable for open, at grade attenuation pond or basin.

SUDS devices incorporated in the storm water network and attenuation design:

Pervious paving is proposed to all carparking spaces and pedestrian circulation areas throughout the development allowing storm water infiltration into underlying stone and soil. This device not only reduces the quantity of runoff but it also has a positive impact on runoff quality. Due to the shallow nature of the underlying build-up, permeable paving can be utilised even on sites with high ground water levels where other deeper infiltration devices would not work. According to CIRIA 697 SUDS Manual: "Pervious surfaces, together with their associated substructures, intercept surface water runoff and provide a pollutant treatment medium prior to discharge to receiving waters. Treatment processes that occur within the surface structure, the subsurface matrix (including soil layers where infiltration is allowed) and the geotextile layers include:

- filtration
- adsorption
- biodegradation
- sedimentation."

Water butts are proposed to all houses to reduce the quantity of storm water runoff, (water collected and retained from wet weather and used/released during dry period for watering plants, washing cars etc.), and to provide runoff water quality improvement (sedimentation of the particles and pollutions washed from the roof). Water butts also have the potential of reducing the water demand from the mains supply.

Extensive green roof is proposed to the roofs of the proposed apartment blocks as shown on the drainage layout submitted as part of this application. This roof type allows for storm water interception and disposal through transpiration and evaporation. In addition to quantity reduction, the green roofs will improve the quality of the runoff and will become a wildlife habitat, improve biodiversity and boost the environmental credentials of the development. According to CIRIA 679 SUDS Manual, typical green roof should attenuate storms up to a two-year return period event. Sustainable drainage studies indicate that Green Roofs reduce annual run-off from roofs by at least 50%, and more usually by 60-70%. Moreover, the rate of release following heavy rainfall will be slower thus assisting with issues relating to storm surges. Rainfall runoff from roofs can contain pollutants for example, from bird droppings; atmospheric pollution; as well as standard roof covering such as bitumen which give off a range of pollutants under heat stress, which then are carried along with the runoff. One of the roles of a sustainable urban drainage system is to remove some if not all of this pollution. Green roofs can retain and bind contaminants that fall on their surface either as dust or dissolved in rainwater. Research by (Johnston et al, 2004) found that 95% of heavy metals are removed from runoff by green roofs and nitrogen levels can be reduced.

In conjunction with the green roof approximately 1,310m² of blue roof attenuation storage is also proposed. Restrictor outlets regulate the flow from the roof thus helping to reduce the volume of attenuation required at ground level and allowing for more areas to be landscape which will further assist in storm water retention and disposal in these landscaped areas. A layout of the proposed blue roof can be seen on drawing Ref D1686-D1-1-PL3. The design calculations for the discharge from blue roof can be seen in Appendix B. A 40% climate change factor have been used in the design of the blue roof attenuation storage as per the requirements of the blue roof system manufacturers.

Bioretention Areas formed by providing shallow depressed vegetated areas are incorporated into planting areas where there are no underground services. These areas area designed to collect and treat surface water runoff before discharging it to the surface water drainage network through low level underdrain pipes. Bioretention areas will intercept the runoff from hardstanding surfaces and slow down the outflow to the drainage network. The runoff quality is improved by filtering it through enhanced vegetation and the underlying soil. Since the soil (filtration medium) is engineered, bioretention areas can be installed on sites with low soil permeability. Bioretention areas, while having a moderate impact on the total runoff volume reduction, have high potential to remove suspended solids, heavy metals, nutrients (phosphorous, nitrogen) and to treat fine suspended sediments and dissolved pollutants.

Irrigation Tree Pits are proposed to collect the runoff from the proposed access road and other hardstanding areas. The proposed tree pits will have a positive impact on the total storm water runoff reduction by allowing for runoff infiltration to sub soil. These tree pits will be provided with overflow pipes discharging excess runoff to the proposed on-site attenuation tank.

In addition to the above SuDS devices, pre-treatment components such as "Surf-Sep" or equivalent vortex debris and silt particle separator and "Klargester" or equivalent oil separator are proposed to collect sediments and pollutants and treat the surface water runoff from areas of possible hydrocarbons spills that are exposed to rainfall. All runoff from carriageways, roofs and any hardstanding areas will pass through the Surf-sep vortex debris and silt particle separator which according to manufacturer's specification has potential for capturing more than 95% of solid pollutants (see brochure attached). Housing developments are low risk in relation to hydrocarbon polluted runoff however the interception precaution will be included.

An underground surface water attenuation tank is proposed as the main runoff quantity reducing device. The attenuation facility proposed is a proprietary system formed with thermoplastic cells backfilled in specified drainage stone and wrapped in a pervious geotextile. Downstream of this tank, a flow control device will be provided which is designed to restrict the discharge off site to ensure the green field runoff rate is not exceeded. It is also important to note that the proposed surface water attenuation system incorporates an inspection row. This row of cells connected to an access manhole, is designed to provide an access for inspection and cleaning forming another line of defence against debris and suspended solids. Together with the proprietary pre-treatment devices of petrol interceptor and silt trap, good quality discharge will be provided with ease of inspection and maintenance ensuring a long efficient service life.

Rainwater harvesting systems

During the detailed design stage of the proposed development Environmental Design Partnership (M&E consulting engineers) will evaluate the storage and consumption of potable water. The general application of harvested storm water, particularly in sanitary applications, will be assessed to ensure compliance with SDCC and water authority recommendations and requirements and to achieve optimum reclamation of rainwater.

The detailed design stage calculations will include:

- Rainwater yield for the catchment area

- Predicted WC/Urinal flushing demand

- Size (litres) of the rainwater collection tank

The design calculations listed above will provide a cost/benefit analysis which will help to evaluate the suitability of the rainwater harvesting system for the proposed development.

FOUL SEWER;

The proposed foul sewer, fully separated from the proposed storm water drainage, is designed for sewage and wastewater collection from the proposed 137 No. of dwellings and creche. The entire wastewater network was designed using the hydraulic modelling computer program to calculate pipe gradients to achieve minimum self-cleansing velocities of 0.75m/s throughout the proposed network. In accordance with the BS EN 752.

The proposed foul sewer will discharge to the proposed foul pumping station. The effluent from foul pumping station will then be pumped to a new discharge manhole constructed in Simmonstown Park from where it will discharge by gravity to the existing foul sewer network in Simmonstown Park estate approximately 450m to the north of the subject site. For details refer to the attached Drainage Layout Drg. Ref. D1686-D1-1-PL3 and D1686-D1-2-PL3.

Irish Water's Confirmation of feasibility identifies foul network capacity constraints in the Celbridge area. Irish Water's Capital Investment Plan projects in the Lower Liffey Valley Catchment (Drainage Area Plan and the Primrose Hill Pumping Station Project) will provide the solutions to the capacity constraints. The Primrose Hill Pumping Station project is currently scheduled to be completed by Q4 2023. The proposed housing development is currently at planning stage and it will not require connection to services before the Q4 2023 therefore no interim connection solution is necessary.

The proposed development will discharge to an existing foul sewer in Simmonstown Park. This sewer is a part of Irish Water assets. Records of that sewer are shown on the Irish Water infrastructure map included in the appended Confirmation of Feasibility. The development will not be discharging to Hazelhatch Park foul network therefore no investigations or surveys will be necessary to determine the extent or capacity of this network. Since the survey is not necessary the client will not be entering into Project Works Service Agreement to carry out any investigations.

WATERMAIN;

The water supply to the proposed development will be provided through a new 200ø watermain connection to the existing watermain located in Shinkeen Road approx. 400m to the north of the subject site. This new 200ø watermain will replace the existing 6" AC watermain as per Irish Water's requirements set out in the Confirmation of Feasibility letter (Appendix C). A bulk water meter will be provided on the new watermain connection on site boundary. Several hydrants for firefighting and loop flushing purpose are proposed on the new watermain as detailed on the attached Watermain Layout Drg. Ref. D1686-D1-1-PL2 and D1686-D1-2-PL2.

Surface Water Attenuation Calculations

Surface Water Attenuation Calculations:

1) Storm Water Catchment

Catchment Area:	$20338m^2$ (2.034 ha)
Landscaping	$10150m^2$
Roads and footpaths	$4370m^2$
Roof Areas	$4128m^2$
Carparking - permeable paving	$1690m^2$
Total Impermeable Areas:	$10188m^2$

Despite the hardstanding surfaces in car parking areas being permeable for the purpose of attenuation storage calculations all hard standing areas are deemed impervious.

2) Greenfield Runoff Rate – QBAR, (mean annual flood flow):

$QBAR_{rural}$ (m^3/sec) = 0.00108 x $AREA^{0.89}$ x $SAAR^{1.17}$ x $SOIL^{2.17}$

SAAR (298000E, 232000N): 748 mm

Soil Index: S1 (very low runoff)
S2
S3 (moderate runoff)
S4
S5 (very high runoff)

Soil = 0.1($Soil_1$) + 0.3($Soil_2$) + 0.37($Soil_3$) + 0.47($Soil_4$) + 0.53($Soil_5$)
As the site is relatively small in catchment terms the soil class will be 100% $Soil_2$ as per online Wallingford Procedure Greenfield runoff estimation tool on www.uksuds.com

Soil Class: $Soil_2$
Runoff Potential: Low
Soil Value: 0.3

QBAR:
As the site area is less than 50 hectares;
QBAR for 50 hectares is firstly calculated,

QBAR (m^3/sec) = $0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$
$0.00108 \times (0.5)^{0.89} \times (748)^{1.17} \times (0.3)^{2.17}$
98.47 l/sec
1.97 l/sec/Ha

QBAR for the smaller area (i.e. the subject site area):

1.97 l/sec/ha x 2.034 ha
4.0 l/sec

According to GDSDS chapter 6.3.1.4 if the separate long term storage cannot be provided and temporary flood storage forms part of the single attenuation system, all the runoff from the site should be discharged at either a rate of 2 l/s/ha or the average annual peak flow rate QBAR, whichever is greater.

QBAR set at 2.034 ha x 2 l/s/ha = 4.1 l/s

3) Attenuation storage volume

Refer to Appendix A for detailed storm water network modelling and attenuation storage volume check with a specific Hydrobrake flow control device included in the analysis

In summary:

The interception of the first flush runoff (capturing first 5mm or more of every rainfall event) will be provided in a series of sustainable urban drainage system devices upstream of the attenuation storage.

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Required Attenuation Volume: 817m^3 to be provided within the attenuation system on site.

Temporary Flood Storage: The proposed attenuation storage will accommodate all rainfall events of all durations up to 1 in 100 years return. Therefore no separate flood storage is needed.

<u>Total volume required: 817m^3</u>

Storm Water Network analysis and Attenuation Tank Size checks were performed using a computer hydraulic analysis software. The analysis did not highlight any ponding for any storm durations up to 1:100y return therefore the network and attenuation capacity calculated above are satisfactory. The results of the analysis are included in this report.

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Bartosz Kedzierski
Site name:	Hazelhatch
Site location:	Celbridge

Site Details

Latitude:	53.33090° N
Longitude:	6.53199° W
Reference:	2235963199
Date:	Aug 19 2022 11:30

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 2.034

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	950	748
Hydrological region:	12	12
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.13	2.13
Growth curve factor 100 years:	2.61	2.61
Growth curve factor 200 years:	2.86	2.86

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	5.3	4.01
1 in 1 year (l/s):	4.5	3.41
1 in 30 years (l/s):	11.29	8.53
1 in 100 year (l/s):	13.83	10.46
1 in 200 years (l/s):	15.15	11.46

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 297870, Northing: 232160,

	Interval		Years													
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.3,	3.4,	4.0,	5.0,	5.6,	6.1,	7.9,	9.9,	11.3,	13.3,	15.1,	16.5,	18.7,	20.5,	22.0,	N/A ,
10 mins	3.2,	4.7,	5.6,	6.9,	7.8,	8.6,	11.0,	13.8,	15.8,	18.5,	21.1,	23.0,	26.1,	28.6,	30.6,	N/A ,
15 mins	3.7,	5.6,	6.6,	8.1,	9.2,	10.1,	12.9,	16.3,	18.6,	21.8,	24.8,	27.1,	30.7,	33.6,	36.0,	N/A ,
30 mins	4.9,	7.2,	8.5,	10.5,	11.8,	12.9,	16.4,	20.5,	23.2,	27.2,	30.7,	33.5,	37.8,	41.2,	44.1,	N/A ,
1 hours	6.5,	9.5,	11.1,	13.5,	15.2,	16.5,	20.8,	25.8,	29.1,	33.8,	38.1,	41.4,	46.6,	50.6,	54.0,	N/A ,
2 hours	8.6,	12.3,	14.3,	17.4,	19.4,	21.0,	26.4,	32.4,	36.4,	42.1,	47.2,	51.2,	57.3,	62.1,	66.1,	N/A ,
3 hours	10.2,	14.4,	16.7,	20.1,	22.5,	24.3,	30.3,	37.1,	41.6,	47.9,	53.6,	58.0,	64.8,	70.0,	74.4,	N/A ,
4 hours	11.4,	16.1,	18.6,	22.4,	24.9,	26.9,	33.4,	40.8,	45.6,	52.5,	58.6,	63.3,	70.6,	76.3,	81.0,	N/A ,
6 hours	13.4,	18.8,	21.6,	25.9,	28.8,	31.1,	38.4,	46.6,	52.0,	59.7,	66.4,	71.7,	79.7,	86.0,	91.1,	N/A ,
9 hours	15.8,	21.9,	25.2,	30.1,	33.3,	35.9,	44.1,	53.3,	59.4,	67.8,	75.3,	81.1,	90.0,	96.9,	102.6,	N/A ,
12 hours	17.7,	24.5,	28.1,	33.4,	36.9,	39.7,	48.6,	58.6,	65.2,	74.3,	82.4,	88.6,	98.2,	105.5,	111.6,	N/A ,
18 hours	20.9,	28.6,	32.7,	38.7,	42.7,	45.8,	55.9,	67.0,	74.3,	84.5,	93.4,	100.3,	110.8,	119.0,	125.7,	N/A ,
24 hours	23.5,	31.9,	36.4,	43.0,	47.4,	50.8,	61.6,	73.7,	81.6,	92.6,	102.2,	109.6,	120.8,	129.5,	136.7,	161.5,
2 days	29.4,	38.9,	43.8,	51.0,	55.7,	59.3,	70.8,	83.3,	91.4,	102.5,	112.1,	119.5,	130.6,	139.2,	146.1,	170.1,
3 days	34.2,	44.6,	49.9,	57.6,	62.6,	66.4,	78.5,	91.5,	99.8,	111.2,	121.1,	128.5,	139.8,	148.4,	155.4,	179.3,
4 days	38.6,	49.7,	55.3,	63.4,	68.7,	72.7,	85.3,	98.8,	107.4,	119.1,	129.1,	136.7,	148.2,	156.9,	164.0,	188.0,
6 days	46.3,	58.7,	64.9,	73.7,	79.4,	83.7,	97.2,	111.6,	120.6,	132.9,	143.4,	151.3,	163.1,	172.1,	179.3,	203.8,
8 days	53.2,	66.6,	73.3,	82.8,	88.9,	93.5,	107.8,	122.9,	132.4,	145.1,	156.0,	164.2,	176.4,	185.6,	193.0,	218.0,
10 days	59.6,	74.0,	81.1,	91.2,	97.6,	102.4,	117.4,	133.2,	143.0,	156.3,	167.5,	175.9,	188.5,	197.9,	205.5,	231.0,
12 days	65.6,	80.9,	88.4,	99.0,	105.7,	110.8,	126.4,	142.8,	153.0,	166.6,	178.2,	186.8,	199.7,	209.3,	217.1,	243.1,
16 days	76.9,	93.8,	101.9,	113.4,	120.7,	126.2,	143.0,	160.4,	171.2,	185.6,	197.7,	206.8,	220.2,	230.3,	238.4,	265.3,
20 days	87.5,	105.7,	114.5,	126.8,	134.6,	140.4,	158.2,	176.6,	187.9,	202.9,	215.6,	225.1,	239.0,	249.4,	257.7,	285.5,
25 days	100.0,	119.8,	129.3,	142.5,	150.8,	157.0,	175.9,	195.3,	207.2,	223.0,	236.3,	246.1,	260.6,	271.4,	280.1,	308.7,

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

Design Specification/Product Information for;

a) **Petrol Interceptor**

b) **Silt Trap**

c) **Flow Control Devices**

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Surface water drains normally discharge to a watercourse or indirectly into underground waters (groundwater) via a soakaway. Contamination of surface water by oil, chemicals or suspended solids can cause these discharges to have a serious impact on the receiving water.

The Environment Regulators, Environment Agency, England and Wales, SEPA, Scottish Environmental Protection Agency in Scotland and Department of Environment & Heritage in Northern Ireland, have published guidance on surface water disposal, which offers a range of means of dealing with pollution both at source and at the point of discharge from site (so called 'end of pipe' treatment). These techniques are known as 'Sustainable Drainage Systems' (SuDS).

Where run-off is draining from relatively low risk areas such as car-parks and non-operational areas, a source control approach, such as permeable surfaces or infiltration trenches, may offer a suitable means of treatment, removing the need for a separator.

Oil separators are installed on surface water drainage systems to protect receiving waters from pollution by oil, which may be present due to minor leaks from vehicles and plant, from accidental spillage.

Effluent from industrial processes and vehicle washing should normally be discharged to the foul sewer (subject to the approval of the sewerage undertaker) for further treatment at a municipal treatment works.

SEPARATOR STANDARDS AND TYPES

A British (and European) standard (EN 858-1 and 858-2) for the design and use of prefabricated oil separators has been adopted. New prefabricated separators should comply with the standard.

SEPARATOR CLASSES

The standard refers to two 'classes' of separator, based on performance under standard test conditions.

CLASS I

Designed to achieve a concentration of less than 5mg/l of oil under standard test conditions, should be used when the separator is required to remove very small oil droplets.

CLASS II

Designed to achieve a concentration of less than 100mg/l oil under standard test conditions and are suitable for dealing with discharges where a lower quality requirement applies (for example where the effluent passes to foul sewer).

Both classes can be produced as full retention or bypass separators. The oil concentration limits of 5 mg/l and 100 mg/l are only applicable under standard test conditions. It should not be expected that separators will comply with these limits when operating under field conditions.

FULL RETENTION SEPARATORS

Full retention separators treat the full flow that can be delivered by the drainage system, which is normally equivalent to the flow generated by a rainfall intensity of 65mm/hr.

On large sites, some short term flooding may be an acceptable means of limiting the flow rate and hence the size of full retention systems.

BYPASS SEPARATORS

Bypass separators fully treat all flows generated by rainfall rates of up to 6.5mm/hr. This covers over 99% of all rainfall events. Flows above this rate are allowed to bypass the separator. These separators are used when it is considered an acceptable risk not to provide full treatment for high flows, for example where the risk of a large spillage and heavy rainfall occurring at the same time is small.

FORECOURT SEPARATORS

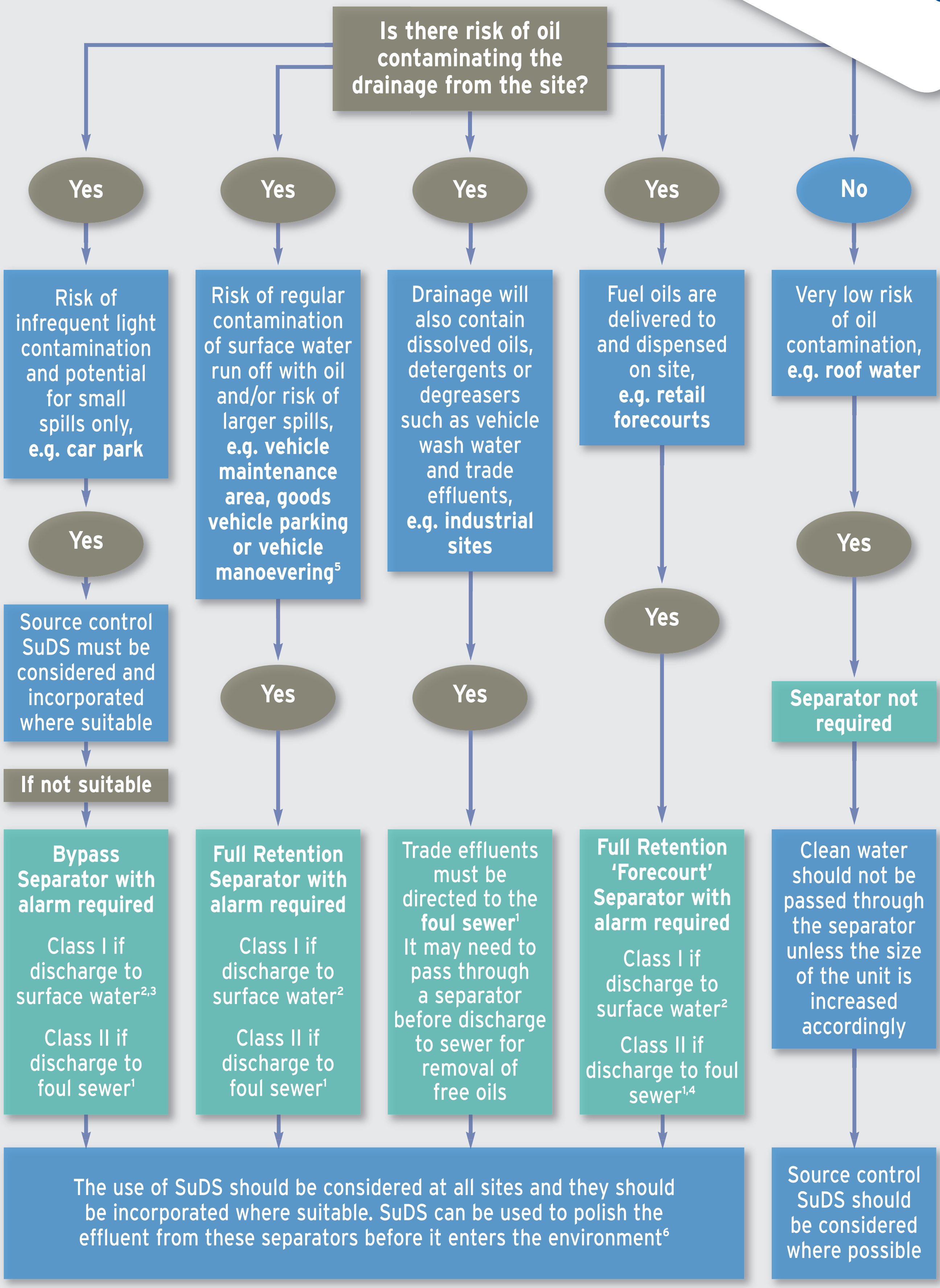
Forecourt separators are full retention separators specified to retain on site the maximum spillage likely to occur on a petrol filling station. They are required for both safety and environmental reasons and will treat spillages occurring during vehicle refuelling and road tanker delivery. The size of the separator is increased in order to retain the possible loss of the contents of one compartment of a road tanker, which may be up to 7,600 litres.

SELECTING THE RIGHT SEPARATOR

The chart on the following page gives guidance to aid selection of the appropriate type of fuel/oil separator for use in surface water drainage systems which discharge into rivers and soakaways.

For further detailed information, please consult the Environment Agency Pollution Prevention Guideline 03 (PPG 3) 'Use and design of oil separators in surface water drainage systems' available from their website.

Klargester has a specialist team who provide technical assistance in selecting the appropriate separator for your application.



1 *You must seek prior permission from your local sewer provider before you decide which separator to install and before you make any discharge.*
2 *You must seek prior permission from the relevant environmental body before you decide which separator to install.*
3 *In this case, if it is considered that there is a low risk of pollution a source control SuDS scheme may be appropriate.*
4 *In certain circumstances, the sewer provider may require a Class 1 separator for discharges to sewer to prevent explosive atmospheres from being generated.*
5 *Drainage from higher risk areas such as vehicle maintenance yards and goods vehicle parking areas should be connected to foul sewer in preference to surface water.*
6 *In certain circumstances, a separator may be one of the devices used in the SuDS scheme. Ask us for advice.*

Bypass NSB RANGE

APPLICATION

Bypass separators are used when it is considered an acceptable risk not to provide full treatment, for very high flows, and are used, for example, where the risk of a large spillage and heavy rainfall occurring at the same time is small, e.g.

- Surface car parks.
- Roadways.
- Lightly contaminated commercial areas.

PERFORMANCE

Klargester were one of the first UK manufacturers to have separators tested to EN 858-1. Klargester have now added the NSB bypass range to their portfolio of certified and tested models. The NSB number denotes the maximum flow at which the separator treats liquids. The British Standards Institute (BSI) tested the required range of Klargester full retention separators and certified their performance in relation to their flow and process performance assessing the effluent qualities to the requirements of EN 858-1. Klargester bypass separator designs follow the parameters determined during the testing of the required range of bypass separators.

Each bypass separator design includes the necessary volume requirements for:

- Oil separation capacity.
- Silt storage capacity.
- Oil storage volume.
- Coalescer.

The unit is designed to treat 10% of peak flow. The calculated drainage areas served by each separator are indicated according to the formula given by PPG3 NSB = 0.0018A(m2). Flows generated by higher rainfall rates will pass through part of the separator and bypass the main separation chamber.

Class I separators are designed to achieve a concentration of 5mg/litre of oil under standard test conditions.

Class II separators are designed to achieve a concentration of 100mg/litre of oil under standard test conditions.

FEATURES

- Light and easy to install.
- Class I and Class II designs.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.
- Vent points within necks.
- Oil alarm system available (required by EN 858-1 and PPG3).
- Extension access shafts for deep inverts.
- Maintenance from ground level.
- GRP or rotomoulded construction (subject to model).

To specify a nominal size bypass separator, the following information is needed:-

- The calculated flow rate for the drainage area served. Our designs are based on the assumption that any interconnecting pipework fitted elsewhere on site does not impede flow into or out of the separator and that the flow is not pumped .
- The required discharge standard. This will decide whether a Class I or Class II unit is required.
- The drain invert inlet depth.
- Pipework type, size and orientation.

SIZES AND SPECIFICATIONS

UNIT NOMINAL SIZE	FLOW (l/s)	PEAK FLOW RATE (l/s)	DRAINAGE AREA (m^2)	STORAGE CAPACITY (litres) SILT	OIL	UNIT LENGTH (mm)	UNIT DIA. (mm)	ACCESS SHAFT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT	STANDARD FALL ACROSS (mm)	MIN. INLET INVERT (mm)	STANDARD PIPEWORK DIA. (mm)
NSBP003	3	30	1670	300	45	1700	1350	600	1420	1320	100	500	160
NSBP004	4.5	45	2500	450	60	1700	1350	600	1420	1320	100	500	160
NSBP006	6	60	3335	600	90	1700	1350	600	1420	1320	100	500	160
NSBE010	10	100	5560	1000	150	2069	1220	750	1450	1350	100	700	315
NSBE015	15	150	8335	1500	225	2947	1220	750	1450	1350	100	700	315
NSBE020	20	200	11111	2000	300	3893	1220	750	1450	1350	100	700	375
NSBE025	25	250	13890	2500	375	3575	1420	750	1680	1580	100	700	375
NSBE030	30	300	16670	3000	450	4265	1420	750	1680	1580	100	700	450
NSBE040	40	400	22222	4000	600	3230	1920	600	2185	2035	150	1000	500
NSBE050	50	500	27778	5000	750	3960	1920	600	2185	2035	150	1000	600
NSBE075	75	750	41667	7500	1125	5841	1920	600	2235	2035	200	950	675
NSBE100	100	1000	55556	10000	1500	7661	1920	600	2235	2035	200	950	750
NSBE125	125	1250	69444	12500	1875	9548	1920	600	2235	2035	200	950	750

Rotomoulded chamber construction *GRP chamber construction* ** Some units have more than one access shaft – diameter of largest shown.*

PROFESSIONAL INSTALLERS

Klargester Accredited Installers

Experience shows that correct installation is a prerequisite for the long-lasting and successful operation of any wastewater treatment product. This is why using an installer with the experience and expertise to install your product is highly recommended.

Services include :

- Site survey to establish ground conditions and soil types
- Advice on system design and product selection
- Assistance on gaining environmental consents and building approvals
- Tank and drainage system installation
- Connection to discharge point and electrical networks
- Waste emptying and disposal

Discover more about the Accredited Installers and locate your local expert online.

www.klargester.com/installers

Kingspan Klargester Accredited Installer

CARE & MAINTENANCE

Kingspan Environmental Services

Who better to look after your treatment plant than the people who designed and built it?

Kingspan Environmental have a dedicated service division providing maintenance for wastewater products.

Factory trained engineers are available for site visits as part of a planned maintenance contract or on a one-off call out basis.

To find out more about protecting your investment and ensuring peace of mind, call us on:

0844 846 0500

or visit us online:

www.kingspanenvservice.com

Kingspan Environmental Services

Kingspan Klargester

COMMERCIAL WASTEWATER SOLUTIONS

- **BIODISC®, BIOTEC™ & ENVIROSAFE** HIGH PERFORMANCE SEWAGE TREATMENT SYSTEMS
- **HILLMASTER** PACKAGE PUMP STATIONS
- **PUMPSTOR24** PUMPING SYSTEMS
- STORMWATER ATTENUATION SYSTEMS
- OIL/WATER SEPARATORS
- BELOW GROUND STORAGE TANKS
- GREASE & SILT TRAPS

Kingspan Water

NEW BUILD & RETROFIT SOLUTIONS

- BELOW GROUND RAINWATER HARVESTING SYSTEMS
- ABOVE GROUND RAINWATER HARVESTING SYSTEMS

Klargester

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Visit our website **www.klargester.com**, or our company website **www.kingspanenv.com**

Part of Kingspan Environmental

BSI UKAS Quality Management 003

Certificate No. FM 563603

BSI UKAS Management Systems Health and Safety 003

Certificate No. OHS 563604

RIBA CPD Providers Network

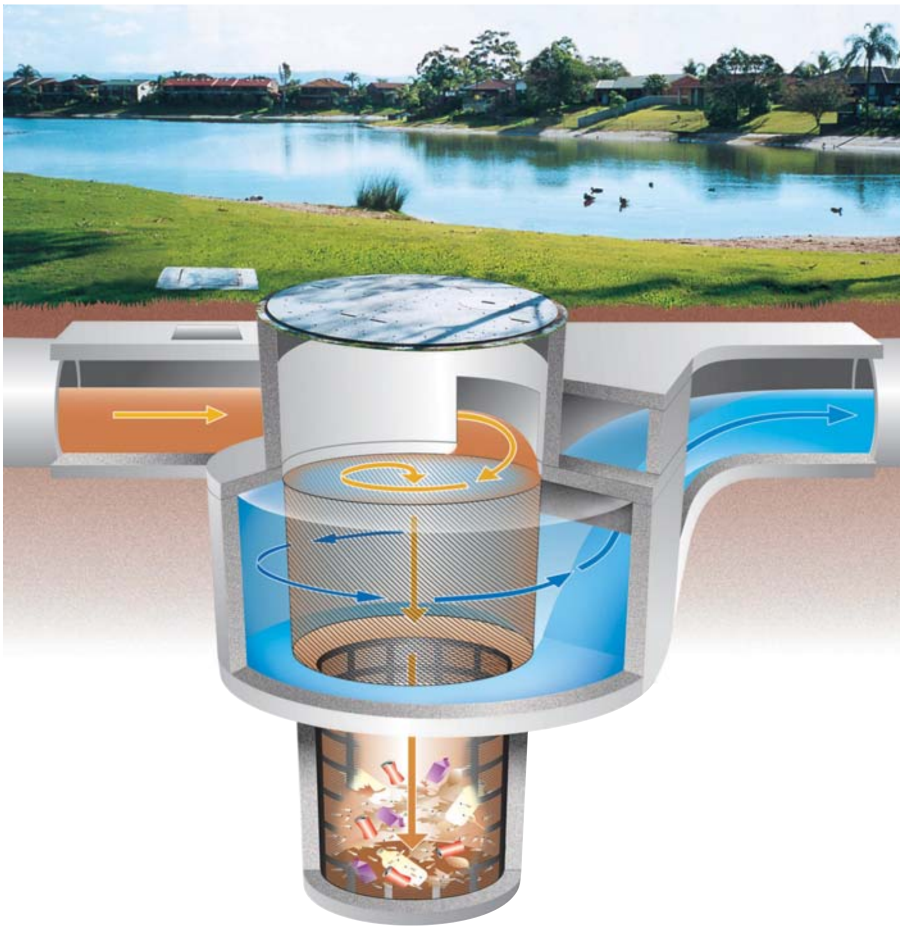
BRITISH WATER

UK GREEN BUILDING COUNCIL Founding Member

Issue No. 20: August 2014

Specialists in Wastewater Treatment & Stormwater Management

Surface Water Treatment SUDs Protector



The CDS Non Blocking screening technology is an innovative method of liquid / solid separation for Surface Water, Combined Sewer Overflows (CSO) and Foul Sewage Systems.

- ***SurfSep*** for Surface Water applications
- ***OverSep*** for Combined Sewer Overflow applications.

The technology accomplishes high efficiency separation of settleable particulate matter and capture of floatable material.

A unique feature of the CDS Technology is it's compact design. Both the *SurfSep* and *OverSep* are available as packaged systems, which can either be installed inside pre-cast concrete chamber rings, or complete BBA Approved Polyethylene Chambers unit.

Applications

- Storm-water Treatment
- Combined Sewer Overflow Treatment
- Parking Area Run-Off Treatment
- Vehicle Service Yard Areas
- Pre-treatment for Wetlands, Ponds and Swales
- Rainwater Harvesting
- Pre-treatment for Oil Separators
- Pre-treatment for media and Ground In-filtration Systems

Rapid installation

Primary features

- **Effective**: Capturing more than 95% of solid pollutants.
- **Non-Blocking**: Unique design takes advantage of indirect filtration and properly proportioned hydraulic forces that virtually makes the unit unblockable.
- **Non-Mechanical**: The unit has no moving parts and requires no mechanical devices to support the solid separation function.
- **Low Maintenance Costs**: The system has no moving parts and is fabricated of durable materials.
- **Compact & Flexible**: Design and size flexibility enables the use of various configurations.
- **High Flow Effectiveness**: The technology remains highly effective across a broad spectrum of flow ranges.
- **Assured Pollutant Capture**: All materials captured are retained during high flow conditions.
- **Safe & Easy Pollutant Removal**: Extraction methods allow safe and easy removal of pollutants without manual handling.

Surface Water System

Hydraulic Analysis

In storm water applications, an analysis of the catchment in terms of its size, topography and land use will provide information for determining flow to be expected for various return periods.

The *SurfSep* is designed for the flow that mobilizes the gross pollutants within the catchment. Since there are variations in catchment response due to region, land use and topography, it is recommended that the selection of flow to be treated will be for return periods of between 3 months and 1 year.

Balancing the cost to the operator against the benefits to the environment

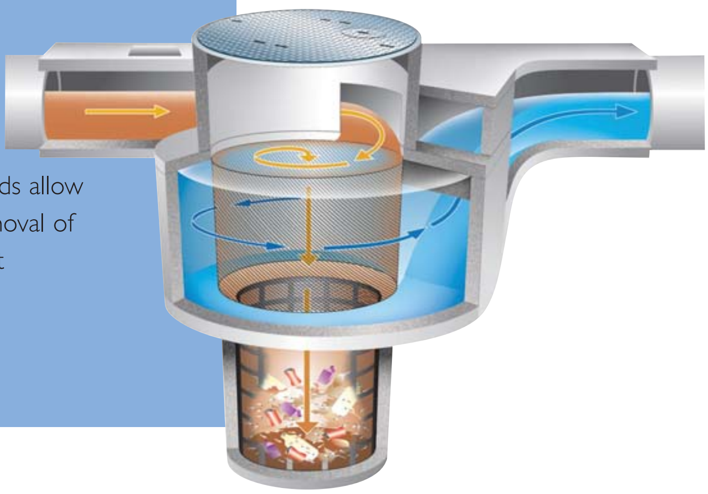
Field evaluations to determine pollutant mobilization have found that the vast majority of pollutants are mobilized in flows that are well below the design capacity' for the conveyance facility - typically known as the 'first flush'.

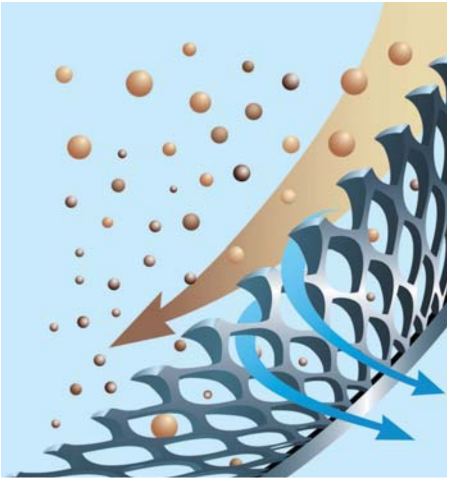
Therefore it is typical not to design the *SurfSep* models to process the conveyance system's maximum flow in order to achieve a very high level of pollutant removal.

The added value benefit to the operator is reduced civil costs without compromising the benefits to the environment.

How it works

Water and pollutants enter the system and are introduced tangentially inside the separation chamber forming a circular flow motion. Floatables and suspended solids are diverted to the slow moving centre of the flow. Negatively buoyant solids settle out to an undisturbed sump chamber below, while the water passes countercurrently through the separation screen. Floatables remain at the water surface and retained within the screen.





Surface Water Treatment Systems

Hydraulic Design

Every application requires a detailed hydraulic analysis to ensure the final installation will perform to effect optimum solids separation without blocking the screen.

After the design flow has been determined, the appropriate standard model can be selected. A selection table is provided on page 7.

The Ultimate SUDs Protector

There a four principal areas of proprietary SUDs technology;

• Infiltration • Flow Control • Storage/attenuation • Treatment

SurfSeps, although a common form of treatment are unique. When installed upstream of any proprietary SUDs technology, the *SurfSep* protects the receiving SUDs from fine solids and debris that would otherwise accumulate over time rendering the SUDs non-operational, as the worst case.

SurfSeps have been successfully installed in front of;

- Soakaways
- Infiltration Trenches
- Filters
- Wetlands
- Ponds and Water Features
- Detention and Retention Systems
- Oil Separators
- Create storage storage systems

to remove fine solids and debris that would otherwise accumulate over time reducing the down stream effectiveness of downstream SUDs assets.

Various independent field trials have shown that the *SurfSep* can remove high levels of Phosphates, Heavy Metals and PolyAramatic Hydrocarbons (PAH's) from the flow.

Infiltration

SurfSeps have been successfully installed in front of ground Infiltration systems to remove grit, fine solids and debris which accumulates in and around the SUDs causing visual degradation in the short term and accumulation of silt and grits leading to reduced volume in the long term.

Studies have also shown that Heavy metals & PAH's accumulate within the SUDs over time before being released back to the environment resulting in elevated concentrations.

Detention & Retention Systems

SurfSeps have been successfully installed in front of collection and attenuation SUDs to remove grit, fine solids and debris which accumulates in the SUDs leading to potential blockage of flow regulators resulting in increased Occupational Health & Safety risk during the treatment of blockages and during the periodic cleaning operations.

Applications

- Rainwater Harvesting
- Road run off
- New Developments
- Motorways
- A / B Roads
- Local Roads
- Residential
- Industrial
- Commercial

Purpose

Removal of plastics, oil, grit, fine solids, organic and inorganic debris, from point source pollution.

CDS TECHNOLOGIES

Flow Control Systems

Flow Control

Flow control is often required to reduce flooding of downstream sewer networks or receiving water courses. There are a number of ways to achieve this. The Hydroslide - Float controlled, constant flow regulator, as detailed below is ideally suited to the providing an efficient and reliable means of flow control.

There are four types of standard Hydroslide flow regulators as pictured.

1) Mini
2) HydroLimiter
3) VS - Vertical Standard
4) Combi - self flushing, can be mounted on the dry or wet side of the flow chamber.

Most applications can be dealt with using any of the four models to suit the flow. An accuracy of +/-5% is achievable.

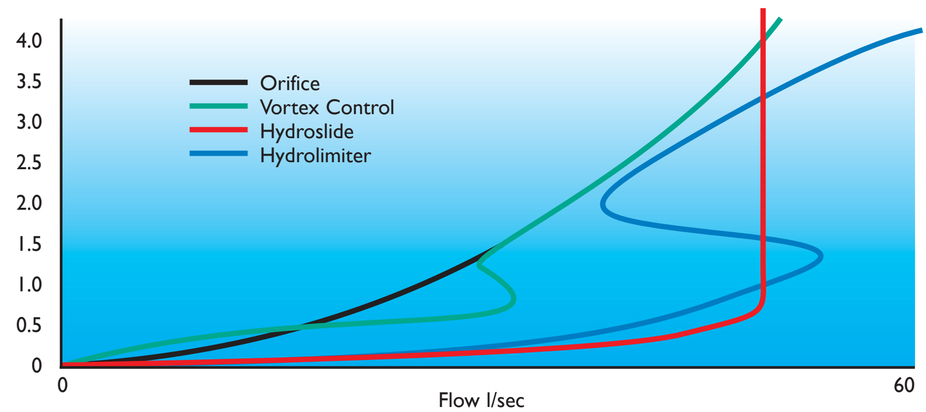
Typical SurfSep installation

Flow Control Technical Design

The Hydroslide regulator does not affect the flow until the flow is approaching the set discharge limit, this allows all flow (the first flush) to be discharged to the sewer. Because the flow to the sewer can be optimised at it's maximum permitted capacity the attentuation/storage capacity can be reduced over other methods of flow control, thus giving cost savings in storage provision. This is best explained by looking at a single storm event and comparing the 3 flow regulation processes as was done independantly by WRc in the report titled 'REDUCING THE COST OF STORMWATER STORAGE', Report No. PT1052, March 1995. The chart below represents 50 l/s control and up to 4m of head. The area difference between the curves being the detention volume saving.

Typically the volume saving when using a Hydroslide regulator is between 7% to 40%

Representation of flow through an orifice



Operation & Performance

Performance Criteria

Note: Screen apertures of 4.8 mm , 2.4 mm and 1.2 mm are available.

The 4.8 and 2.4 mm screens are generally used for Surface Water applications, with foul applications using either 2.4 or 1.2 mm aperture units.

Typical 1.2 mm aperture Performance

- shall remove all solids with a single dimension greater than 1.2 mm and positively contain those solids until the unit is cleaned.
- shall remove and positively contain 100 percent of all neutrally buoyant particles with a single dimension greater than 1.2 mm for all flow conditions to design capacity.
- shall remove and positively contain 100 percent of all floating trash and debris with a single dimension greater than 1.2 mm for all flow conditions to the design capacity.
- shall remove a minimum of 50 percent of oil and grease (as defined as the floating portion of total hexane extractable materials) for all flow conditions to the design capacity, without the addition of absorbents.
- shall provide the following minimum particle removal efficiencies (based on a specific gravity of 2.65):

a) 100 percent of all particles greater than 1100 microns.

b) 95 percent of all particles greater than 550 microns.

c) 90 percent of all particles greater than 367 microns.

d) 20 percent of all particles greater than 200 microns.

Maintenance

SurfSep maintenance can be site and drainage area specific. The installation should be inspected periodically to assure its condition to handle anticipated runoff. If pollutant loadings are known, then a preventive maintenance schedule can be developed based on runoff volumes processed.

Since this is seldom the case we recommend;

New Installations

Check the condition of the installation after the first few events. This includes a visual inspection to ascertain that the unit is operating correctly and measuring the amount of deposition that has occurred in the unit. This may be achieved using a 'Dip Stick'.

Ongoing Operation

For the first 12 months the installations sump full volume should be inspected monthly and recorded. When the inspection indicates that the sump full volume is approaching the top of the sump (base of screen) a cleanout should be undertaken.

Cleaning Methods

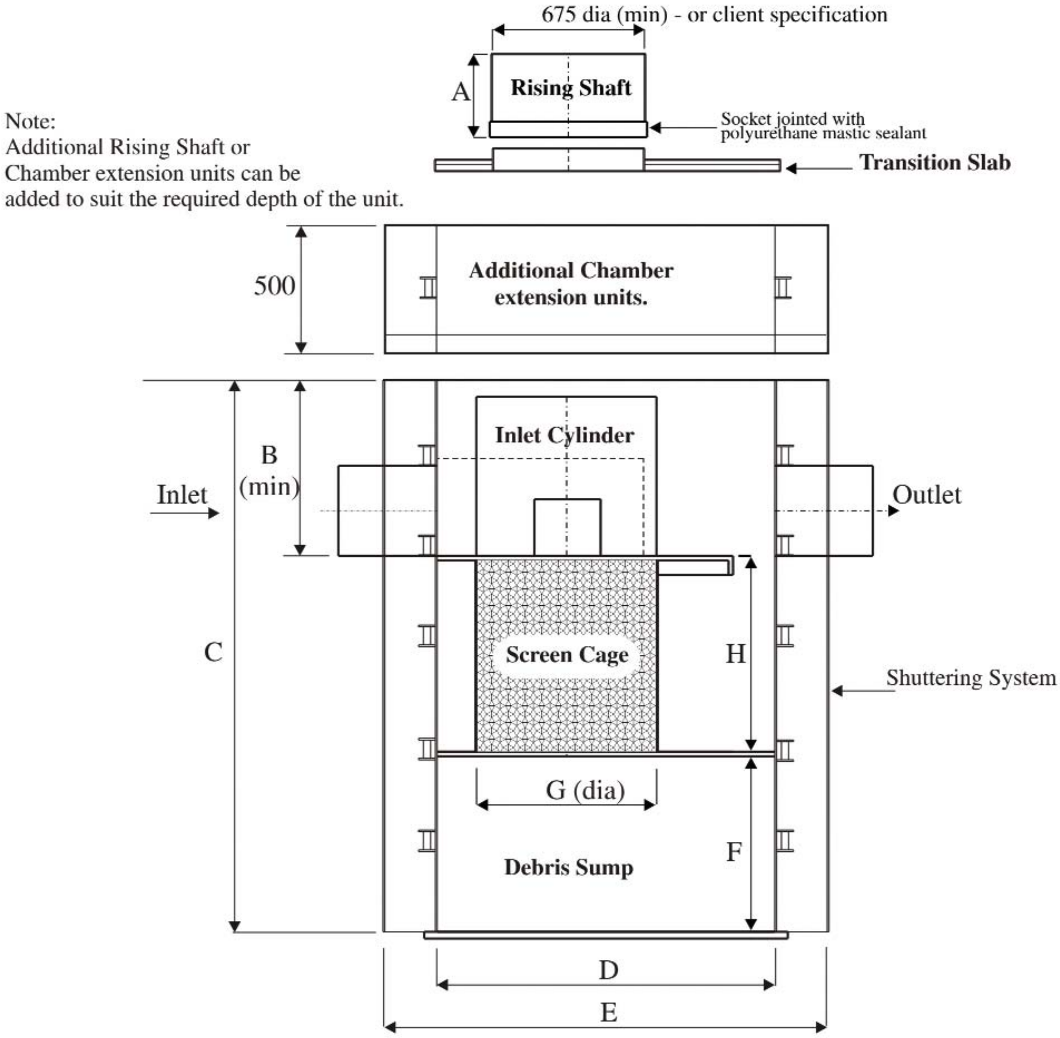
- Eduction (Suction)
- Basket Removal
- Mechanical Grab

Maintenance Cycle

Minimum once per year. Depending on the pollutant load it may be necessary to maintain the installation more frequently.

The operator shall be able to devise the most efficient maintenance schedule for any particular installation over a 12 month operating cycle.

SurfSep Dimensions



SurfSep Dimensions (mm)

	SW0404	SW0604	SW0606	SW0804	SW0806	SW0808	SW1010	SW1012	SW1015
A	370	370	370	370	370	370	500	500	500
B	444	815	615	810	830	810	800	800	830
C	1250	1985	1985	2080	2300	2480	2800	3000	3330
D	800	1200	1200	1500	1500	1500	2000	2000	2000
E	1112	1665	1665	1966	1966	1966	2475	2475	2475
F	400	700	700	700	700	800	1000	1000	1000
G (dia)	400	600	600	800	800	800	1000	1000	1000
H	400	400	600	400	600	800	1000	1200	1500

Selection Table - *SurfSep*

Model Reference	Hydraulic Peak Flow Rate l/s	Drainage Area - Impermeable m^2	Chamber Diameter (mm)	Internal Pipe Diameter (mm)
SWI 0404	30	2,000	900	150 / 225
SWI 0604	70	5,000	1200	225
SWI 0606 / 01	140	10,000	1200	225 - 375
SWI 0606 / 02	200	15,000	1200	225 - 375
SWI 0804	275	20,000	1500	300
SWI 0806	350	25,000	1500	450
SWI 0808	400	30,000	1500	450
SWI 1010	480	35,000	2000	450
SWI 1012	550	40,000	2000	450 / 750
SWI 1015	700	50,000	2000	450 / 750

* Proposed Peak Flow Rate for each model calculated using Rational Lloyd Davies with a rainfall intensity of 50mm/hr. For greater flows - special design / construction required.

In-Line *SurfSep* Units (SWI)

These units are used with in the drainage system in-line and are supplied as BBA Approved complete Polyethylene Chamber units from the selection table above.

Off-Line *SurfSep* Units (SWO)

These can be designed either using pre-cast concrete or specially designed Polyethylene chambers.

Model Designation

SurfSep models are firstly identified by the letters SW for Surface Water followed by a letter (**I** or **O**) representing the configuration (**I**nline or **O**ffline).

A four digit number representing the screen diameter and screen height then follows to give the standard model designation for a *SurfSep* screen for installation into standard commercially available pre-fabricated manhole chambers i.e SWI 0806. Example: SWI 0806 designates Surface Water Inline with a separation screen dia 0.8 m and screen height of 0.6m.

Surface Water Treatment

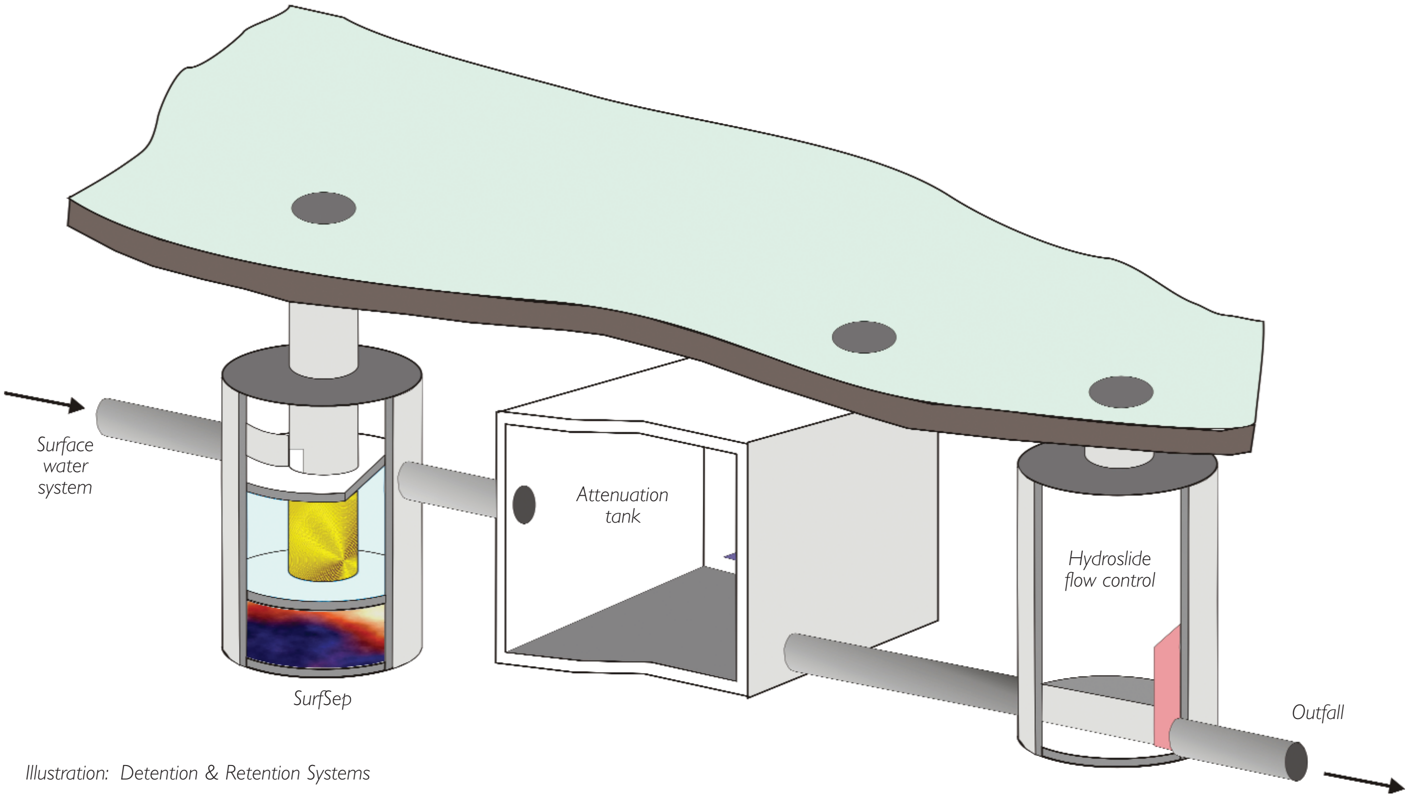


Illustration: Detention & Retention Systems

SurfSeps unit installed in front of attenuation tank / cellular storage system, to remove grit, fine sediments and floating debris which can accumulate within surface water systems. Hydroslide flow control regulating the discharge to the outfall. The Hydroslide can be supplied for installation in an insitu constructed chamber, or as a complete unit housed within a pre-fabricated polyethylene manhole chamber.

* BBA - THIS CERTIFICATE RELATES TO PIPEX UNIVERSAL MANHOLES AND ACCESS CHAMBERS, WHICH ARE MANUFACTURED FROM WELDED POLYPROPYLENE. This Certificate covers the use of the manholes and chambers for drain and sewer applications where they are used for maintenance to depths of 6 mtrs.

Approved Suppliers

If you would like more information please contact:

CDS Technologies is a multi disciplined, international, company offering a comprehensive product range of; wastewater treatment technologies and processes, and stormwater management solutions for attenuation, infiltration, flow control and overflow treatment. CDS have an established network of Distributors and Representatives. Further information can be found on our website www.cdstech.com.au
Alternatively please contact our approved supplier detailed left.

Hydro-Brake® Flow Control

Modelling Guide

Unit Selection Design Guide

Overview

Hydro-Brake® Flow Controls restrict the flow in surface/storm water or foul/combined sewer systems by inducing a vortex flow pattern in the water passing through the device, having the effect of increasing back-pressure.

Their 'hydrodynamic' rather than 'physical restriction' based operation provides flow regulation whilst maintaining larger clearances than most other types of flow control, making them less susceptible to blockage. Their unique "S"-shaped head-flow characteristic also enables them to pass greater flows at lower heads, which can enable more efficient use of upstream storage facilities.

This document provides guidance relating to the selection and use of Hydro-Brake® Flow Controls for use in surface/storm water and foul/combined sewer systems.

The information provided here is intended for the purposes of general guidance only - individual application requirements may differ. If in doubt, or to enquire about new product additions, please contact HRD Technologies Ltd.

STH Range of Hydro-Brake® Flow Controls

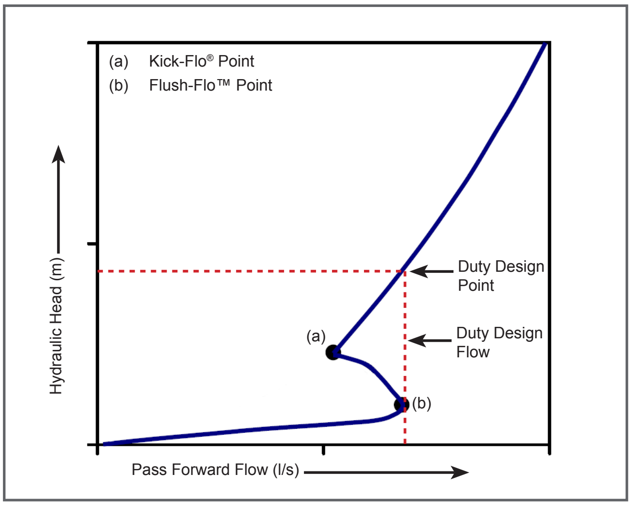
BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4599

See back cover for details.

Hydraulic Characteristics and Specification

Hydro-Brake® Flow Controls should be selected such that the duty/design flow is not exceeded at any point on the head-flow curve, see illustration right. If this is not achievable using the initially selected unit, it may be appropriate to select an alternative option (see selection guidance overleaf).

While the primary aim of a flow control is to provide a particular flow rate at a given upstream head (giving a design/duty point), it is important to note that secondary opportunities, such as potential for optimised storage use, derive from consideration of the full hydraulic characteristic. It is therefore important to ensure that the same flow control, or one confirmed to provide equivalent hydraulic performance, is implemented in any final installation.



Typical Hydro-Brake® Head Versus Flow Characteristics

To ensure correct implementation a multiple design-point specification, defining the main hydraulic features of the selected flow control, can be provided by HRD Technologies Ltd. This should include at least the following information:

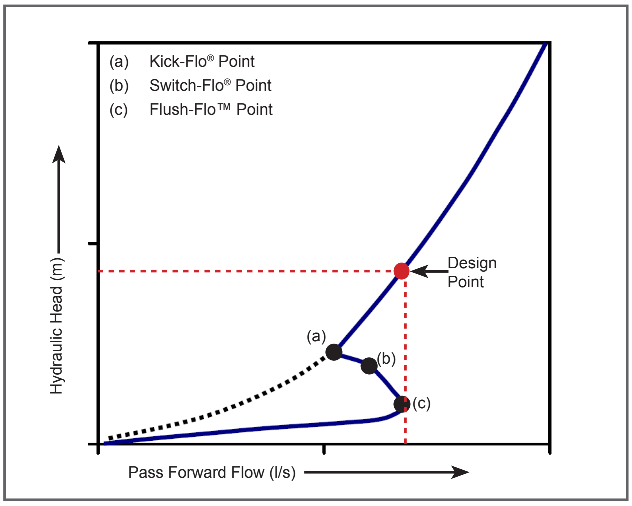
- outlet size and model of Hydro-Brake® Flow Control
- definition of the duty/design point (head and flow)
- definition of the Flush-Flo™ point (head and flow)
- definition of the Kick-Flo® point (head and flow)

To ensure that a drainage system performs as designed, it is strongly recommended that this information is reproduced on any technical specifications.

STH Type Hydro-Brake® Flow Control with BBA Approval

Now included in Win*Des*® W.12.6!

The new STH type Hydro-Brake® Flow Control range has a unique head / discharge performance curve which introduces a very important feature - the Switch-Flo® Point. This point illustrates the unique performance feature of the STH range which can lead to further savings in upstream storage, whilst also enabling increased inlet / outlet size to further reduce the risk of blockage.



Typical STH Head Versus Flow Characteristics

Kick-Flo® (a) - the point at which the vortex has initiated and at which the curve begins to return back to follow the orifice curve and reach the same design point or desired head / flow condition.

NEW Switch-Flo® (b) - marks the transition between the Kick-Flo® and Flush-Flo™, from vortex initiation to stabilisation. This point adds a new layer of resolution to the Hydro-Brake® curve that has implications to upstream storage savings.

Flush-Flo™ (c) - the point at which the vortex begins to initiate and have a throttling effect. This point on the Hydro-Brake® curve is usually much nearer to the maximum design flow (Design Point), than other vortex flow controls leading to more water passing through the unit during the earlier stages of a storm, thus reducing the amount of water that needs to be stored upstream.

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4599

STH Range of
Hydro-Brake® Flow Controls

The STH Hydro-Brake® Flow Control is the only vortex flow control available today that has been given the prestigious BBA Approval Certificate. The BBA assessment procedure entails rigorous assessment of production and manufacturing standards, and confirms that the hydraulic performance of the Hydro-Brake® Flow Control matches the data given to designers by HRD Technologies with their head / discharge curves.

A worked example showing the steps to model a Hydro-Brake® Flow Control and associated Stormcell® Storage System within Micro Drainage Win*Des*® is available on our website:

www.hrdtec.com

Take a Look at Our New Stormwater Web Resource

Engineering Nature's Way™

www.engineeringnaturesway.co.uk

Engineering Nature's Way is a brand new resource for people working with Sustainable Drainage and flood management in the UK.

The site provides an opportunity to share news, opinion, information and best practice for people working in local and central Government; developers, consulting engineers and contractors. Do you have something to share? We would be delighted to receive your contributions.

turning water around ...®

HRD Technologies Ltd

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Tel: +353 (0) 1 4013964 • Fax: +353 (0) 1 4013978 • www.hrdtec.com
HRD Technologies Ltd is a subsidiary of Hydro International plc

Appendix A – Storm Water Network Design

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	20	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	16.500	Minimum Backdrop Height (m)	0.200
Ratio-R	0.278	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
SW1	0.102	5.00	56.740	1200	1.090
SW2			56.680	1200	1.225
SW3	0.168	5.00	56.700	1200	1.100
SW4	0.165	5.00	56.750	1200	1.470
SW5	0.057	5.00	56.700	1200	1.060
SW6	0.123	5.00	56.820	1200	1.320
SW7			56.370	1200	1.260
SW8	0.094	5.00	56.380	1200	1.285
SW9	0.059	5.00	56.430	1200	1.390
SW10			56.230	1200	1.310
SW11	0.305		56.200	1200	1.408
SW12		5.00	56.200	1200	1.410
SW13			56.000	1200	1.300
T3		5.00	56.700		1.200
T2			56.700		1.200
C2	0.017	5.00	70.000	1200	1.425
C3	0.009	5.00	70.000	1200	1.425
C1	0.032	5.00	70.000	1200	1.425
B1	0.066	5.00	70.000	1200	1.425
A1	0.041	5.00	70.000	1200	1.425
A2	0.020	5.00	70.000	1200	1.425
A3	0.008	5.00	70.000	1200	1.425
T1	0.059	5.00	56.700		1.100

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)
1.007	SW10	SW11	22.402	0.600	54.920	54.870	0.050	448.0	450	9.30	38.5
1.006	SW9	SW10	53.788	0.600	55.040	54.920	0.120	448.2	450	8.91	39.2
7.000	C1	SW10	18.676	0.600	68.575	55.000	13.575	1.4	225	5.03	49.8
9.000	C3	SW10	8.058	0.600	68.575	55.000	13.575	0.6	225	5.01	49.9

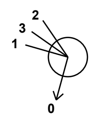
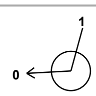
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)
1.007	0.954	151.7	120.1	0.860	0.880	0.960	0.0	304
1.006	0.954	151.7	115.1	0.940	0.860	0.902	0.0	294
7.000	11.242	447.0	5.1	1.200	1.005	0.032	0.0	17
9.000	17.122	680.8	1.5	1.200	1.005	0.009	0.0	7

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)
8.000	C2	SW10	9.519	0.600	68.575	55.000	13.575	0.7	225	5.01	49.8
1.005	SW8	SW9	23.005	0.600	55.095	55.040	0.055	418.3	450	7.97	41.3
1.004	SW7	SW8	5.164	0.600	55.110	55.095	0.015	344.3	450	7.58	42.2
1.003	SW4	SW7	75.360	0.600	55.280	55.110	0.170	443.3	450	7.51	42.4
6.002	SW6	SW7	65.456	0.600	55.500	55.260	0.240	272.7	300	6.77	44.3
6.001	SW5	SW6	34.804	0.600	55.640	55.500	0.140	248.6	300	5.62	47.7
6.000	T3	SW5	1.929	0.600	55.500	56.000	-0.500	-3.9	225	5.03	49.8
1.002	SW2	SW4	6.274	0.600	55.455	55.430	0.025	251.0	300	6.20	45.9
5.000	B1	SW4	17.556	0.600	68.575	55.500	13.075	1.3	225	5.03	49.8
4.000	SW3	SW4	49.700	0.600	55.600	55.430	0.170	292.4	300	5.91	46.8
1.001	SW1	SW2	57.563	0.600	55.650	55.455	0.195	295.2	300	6.09	46.2
1.000	A3	SW1	21.511	0.600	68.575	56.000	12.575	1.7	225	5.04	49.8
2.000	A2	SW1	12.225	0.600	68.575	56.000	12.575	1.0	225	5.02	49.8
3.000	A1	SW1	11.383	0.600	68.575	56.000	12.575	0.9	225	5.01	49.8
10.000	SW12	SW13	7.971	0.600	54.790	54.700	0.090	88.6	225	5.10	49.5
11.000	T1	T2	1.954	0.600	55.600	55.500	0.100	19.5	225	5.01	49.8

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)
8.000	15.752	626.3	2.8	1.200	1.005	0.017	0.0	11
1.005	0.988	157.1	113.1	0.835	0.940	0.843	0.0	283
1.004	1.090	173.3	102.8	0.810	0.835	0.750	0.0	250
1.003	0.959	152.5	78.5	1.020	0.810	0.570	0.0	229
6.002	0.947	66.9	25.9	1.020	0.810	0.180	0.0	129
6.001	0.992	70.2	8.8	0.760	1.020	0.057	0.0	71
6.000	1.000	39.8	0.0	0.975	0.475	0.000	0.0	0
1.002	0.988	69.8	25.4	0.925	1.020	0.170	0.0	125
5.000	11.380	452.5	10.8	1.200	1.025	0.066	0.0	24
4.000	0.914	64.6	25.6	0.800	1.020	0.168	0.0	131
1.001	0.910	64.3	25.6	0.790	0.925	0.170	0.0	132
1.000	10.080	400.8	1.2	1.200	0.515	0.008	0.0	9
2.000	13.376	531.8	3.2	1.200	0.515	0.020	0.0	13
3.000	13.862	551.2	6.6	1.200	0.515	0.041	0.0	17
10.000	1.390	55.3	0.0	1.185	1.075	0.000	0.0	0
11.000	2.974	118.2	9.5	0.875	0.975	0.059	0.0	43

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SW1	697858.335	732225.826	56.740	1.090	1200		1	3.000	56.000	225
							2	2.000	56.000	225
							3	1.000	56.000	225
							0	1.001	55.650	300
SW2	697843.091	732170.318	56.680	1.225	1200		1	1.001	55.455	300
							0	1.002	55.455	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW3	697825.301	732121.636	56.700	1.100	1200	0	4.000	55.600	300
SW4	697836.826	732169.981	56.750	1.470	1200	1	5.000	55.500	225
						2	4.000	55.430	300
						3	1.002	55.430	300
						0	1.003	55.280	450
SW5	697785.271	732115.292	56.700	1.060	1200	1	6.000	56.000	225
						0	6.001	55.640	300
SW6	697751.453	732123.517	56.820	1.320	1200	1	6.001	55.500	300
						0	6.002	55.500	300
SW7	697763.611	732187.834	56.370	1.260	1200	1	6.002	55.260	300
						2	1.003	55.110	450
						0	1.004	55.110	450
SW8	697758.831	732189.789	56.380	1.285	1200	1	1.004	55.095	450
						0	1.005	55.095	450
SW9	697745.494	732208.533	56.430	1.390	1200	1	1.005	55.040	450
						0	1.006	55.040	450
SW10	697782.467	732247.599	56.230	1.310	1200	1	9.000	55.000	225
						2	8.000	55.000	225
						3	7.000	55.000	225
						4	1.006	54.920	450
						0	1.007	54.920	450
SW11	697804.664	732250.621	56.200	1.408	1200	1	1.007	54.870	450
SW12	697803.846	732252.102	56.200	1.410	1200	0	10.000	54.790	225
SW13	697804.288	732260.061	56.000	1.300	1200	1	10.000	54.700	225
T3	697785.766	732117.156	56.700	1.200		0	6.000	55.500	225
T2	697767.889	732121.447	56.700	1.200		1	11.000	55.500	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
C2	697787.578	732239.568	70.000	1.425	1200	0	8.000	68.575	225
C3	697782.645	732239.543	70.000	1.425	1200	0	9.000	68.575	225
C1	697778.035	732229.457	70.000	1.425	1200	0	7.000	68.575	225
B1	697836.732	732187.537	70.000	1.425	1200	0	5.000	68.575	225
A1	697847.386	732228.939	70.000	1.425	1200	0	3.000	68.575	225
A2	697851.411	732235.901	70.000	1.425	1200	0	2.000	68.575	225
A3	697840.704	732238.150	70.000	1.425	1200	0	1.000	68.575	225
T1	697766.011	732121.985	56.700	1.100		0	11.000	55.600	225

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	16.500	Drain Down Time (mins)	240
Ratio-R	0.278	Additional Storage (m³/ha)	75.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	30	0	0
100	30	0	0

Node SW12 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	54.790	Product Number	CTL-SHE-0095-4100-1100-4100
Design Depth (m)	1.100	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.1	Min Node Diameter (mm)	1200

Node A1 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.5		
Invert Level (m)	68.575	Diameter (m)	0.028		

Node A2 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.2		
Invert Level (m)	68.575	Diameter (m)	0.017		

Node A3 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.1		
Invert Level (m)	68.575	Diameter (m)	0.012		

Node B1 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.5		
Invert Level (m)	68.575	Diameter (m)	0.028		

Node C1 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.4		
Invert Level (m)	68.575	Diameter (m)	0.025		

Node C2 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.2		
Invert Level (m)	68.575	Diameter (m)	0.017		

Node C3 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.1		
Invert Level (m)	68.575	Diameter (m)	0.012		

Node SW12 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Main Channel Length (m)	25.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	54.790	Main Channel Slope (1:X)	10000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.015

Inlets
SW11

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	681.0	0.0	1.200	681.0	0.0	1.210	0.5	0.0

Node T3 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.43	Main Channel Length (m)	60.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	55.500	Main Channel Slope (1:X)	10000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.150

Inlets
T2

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	120.0	0.0	0.800	120.0	0.0	0.810	1.0	0.0

Node A1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	251.0	0.0	0.100	251.0	0.0

Node A2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	149.0	0.0	0.100	149.0	0.0

Node A3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	51.0	0.0	0.100	51.0	0.0

Node B1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	490.0	0.0	0.100	490.0	0.0

Node C1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	195.0	0.0	0.100	195.0	0.0

Node C2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	125.0	0.0	0.100	125.0	0.0

Node C3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	62.0	0.0	0.100	62.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +30% CC 15 minute summer	256.250	72.510	30 year +30% CC 2160 minute winter	7.090	2.844
30 year +30% CC 15 minute winter	179.825	72.510	30 year +30% CC 2880 minute summer	8.686	2.328
30 year +30% CC 30 minute summer	175.863	49.763	30 year +30% CC 2880 minute winter	5.838	2.328
30 year +30% CC 30 minute winter	123.413	49.763	30 year +30% CC 4320 minute summer	6.710	1.754
30 year +30% CC 60 minute summer	122.730	32.434	30 year +30% CC 4320 minute winter	4.419	1.754
30 year +30% CC 60 minute winter	81.539	32.434	30 year +30% CC 5760 minute summer	5.604	1.435
30 year +30% CC 120 minute summer	78.040	20.624	30 year +30% CC 5760 minute winter	3.627	1.435
30 year +30% CC 120 minute winter	51.848	20.624	30 year +30% CC 7200 minute summer	4.810	1.227
30 year +30% CC 180 minute summer	61.046	15.709	30 year +30% CC 7200 minute winter	3.105	1.227
30 year +30% CC 180 minute winter	39.682	15.709	100 year +30% CC 15 minute summer	332.272	94.022
30 year +30% CC 240 minute summer	48.928	12.930	100 year +30% CC 15 minute winter	233.174	94.022
30 year +30% CC 240 minute winter	32.506	12.930	100 year +30% CC 30 minute summer	229.572	64.961
30 year +30% CC 360 minute summer	38.096	9.803	100 year +30% CC 30 minute winter	161.103	64.961
30 year +30% CC 360 minute winter	24.763	9.803	100 year +30% CC 60 minute summer	159.465	42.142
30 year +30% CC 480 minute summer	30.446	8.046	100 year +30% CC 60 minute winter	105.945	42.142
30 year +30% CC 480 minute winter	20.228	8.046	100 year +30% CC 120 minute summer	100.576	26.579
30 year +30% CC 600 minute summer	25.225	6.900	100 year +30% CC 120 minute winter	66.821	26.579
30 year +30% CC 600 minute winter	17.235	6.900	100 year +30% CC 180 minute summer	78.194	20.122
30 year +30% CC 720 minute summer	22.700	6.084	100 year +30% CC 180 minute winter	50.828	20.122
30 year +30% CC 720 minute winter	15.256	6.084	100 year +30% CC 240 minute summer	62.395	16.489
30 year +30% CC 960 minute summer	18.937	4.987	100 year +30% CC 240 minute winter	41.454	16.489
30 year +30% CC 960 minute winter	12.544	4.987	100 year +30% CC 360 minute summer	48.250	12.416
30 year +30% CC 1440 minute summer	14.054	3.767	100 year +30% CC 360 minute winter	31.364	12.416
30 year +30% CC 1440 minute winter	9.445	3.767	100 year +30% CC 480 minute summer	38.366	10.139
30 year +30% CC 2160 minute summer	10.289	2.844	100 year +30% CC 480 minute winter	25.489	10.139

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +30% CC 600 minute summer	31.658	8.659	100 year +30% CC 2160 minute winter	8.689	3.485
100 year +30% CC 600 minute winter	21.631	8.659	100 year +30% CC 2880 minute summer	10.584	2.837
100 year +30% CC 720 minute summer	28.394	7.610	100 year +30% CC 2880 minute winter	7.113	2.837
100 year +30% CC 720 minute winter	19.082	7.610	100 year +30% CC 4320 minute summer	8.107	2.120
100 year +30% CC 960 minute summer	23.561	6.204	100 year +30% CC 4320 minute winter	5.339	2.120
100 year +30% CC 960 minute winter	15.607	6.204	100 year +30% CC 5760 minute summer	6.728	1.722
100 year +30% CC 1440 minute summer	17.355	4.651	100 year +30% CC 5760 minute winter	4.355	1.722
100 year +30% CC 1440 minute winter	11.663	4.651	100 year +30% CC 7200 minute summer	5.746	1.466
100 year +30% CC 2160 minute summer	12.610	3.485	100 year +30% CC 7200 minute winter	3.709	1.466

Results for 30 year +30% CC Critical Storm Duration. Lowest mass balance: 99.65%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	10	55.803	0.153	33.7	1.2431	0.0000	OK
15 minute winter	SW2	13	55.722	0.267	33.4	0.3016	0.0000	OK
15 minute winter	SW3	11	55.811	0.211	55.4	2.6486	0.0000	OK
15 minute winter	SW4	13	55.714	0.434	129.0	4.1448	0.0000	OK
15 minute winter	SW5	11	55.742	0.102	18.7	0.5265	0.0000	OK
15 minute winter	SW6	12	55.714	0.214	58.7	1.7417	0.0000	OK
2160 minute winter	SW7	2040	55.709	0.599	10.9	0.6776	0.0000	SURCHARGED
2160 minute winter	SW8	2040	55.709	0.614	12.0	4.0469	0.0000	SURCHARGED
2160 minute winter	SW9	2040	55.709	0.669	12.8	2.8790	0.0000	SURCHARGED
2160 minute winter	SW10	2040	55.709	0.789	12.8	0.8924	0.0000	SURCHARGED
2160 minute winter	SW11	2040	55.708	0.916	17.5	15.8989	0.0000	OK
2160 minute winter	SW12	2040	55.709	0.919	10.5	1.0394	0.0000	SURCHARGED
15 minute summer	SW13	1	54.700	0.000	4.0	0.0000	0.0000	OK
1440 minute winter	T3	840	56.012	0.512	1.1	0.0000	0.0000	SURCHARGED
1440 minute winter	T2	840	56.012	0.512	6.1	0.0000	0.0000	OK
1440 minute winter	C2	1020	68.639	0.064	0.4	7.7146	0.0000	OK
720 minute winter	C3	675	68.643	0.068	0.3	4.1081	0.0000	OK
720 minute winter	C1	540	68.644	0.069	1.1	13.0519	0.0000	OK
2160 minute winter	B1	1560	68.647	0.072	1.1	33.7281	0.0000	OK
960 minute winter	A1	705	68.646	0.071	1.2	17.0590	0.0000	OK
960 minute winter	A2	735	68.640	0.065	0.6	9.3339	0.0000	OK
600 minute winter	A3	555	68.643	0.068	0.3	3.3800	0.0000	OK
1440 minute winter	T1	840	56.012	0.412	9.7	1.6502	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.001	SW2	33.4	0.874	0.520	2.7382	
15 minute summer	SW2	1.002	SW4	27.7	0.804	0.397	0.3494	
15 minute winter	SW3	4.000	SW4	52.2	1.042	0.808	2.8804	
15 minute winter	SW4	1.003	SW7	107.9	0.837	0.708	11.8772	
15 minute winter	SW5	6.001	SW6	18.0	0.515	0.256	1.2747	
15 minute winter	SW6	6.002	SW7	54.3	0.935	0.812	4.0650	
15 minute winter	SW7	1.004	SW8	151.0	0.953	0.871	0.8182	
15 minute winter	SW8	1.005	SW9	169.9	1.072	1.082	3.6450	
15 minute winter	SW9	1.006	SW10	182.3	1.181	1.202	8.2204	
15 minute winter	SW10	1.007	SW11	182.1	1.387	1.201	2.9087	
15 minute winter	SW11	Flow through pond	SW12	135.1	0.131	0.009	150.3571	
60 minute summer	SW12	Hydro-Brake®	SW13	4.1				67.1
480 minute winter	T3	6.000	SW5	-3.6	-0.148	-0.091	0.0397	
30 minute winter	T2	Flow through pond	T3	9.9	0.075	0.697	11.2972	
1440 minute winter	C2	Orifice	SW10	0.1				
720 minute winter	C3	Orifice	SW10	0.1				
720 minute winter	C1	Orifice	SW10	0.3				
2160 minute winter	B1	Orifice	SW4	0.4				
960 minute winter	A1	Orifice	SW1	0.4				
960 minute winter	A2	Orifice	SW1	0.1				
600 minute winter	A3	Orifice	SW1	0.1				
30 minute winter	T1	11.000	T2	36.3	1.485	0.307	0.0655	

Results for 100 year +30% CC Critical Storm Duration. Lowest mass balance: 99.65%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2880 minute winter	SW1	2700	55.990	0.340	2.2	2.7636	0.0000	SURCHARGED
2880 minute winter	SW2	2700	55.989	0.534	4.8	0.6045	0.0000	SURCHARGED
15 minute winter	SW3	13	56.024	0.423	71.8	5.3263	0.0000	SURCHARGED
2880 minute winter	SW4	2700	55.989	0.709	8.9	6.7712	0.0000	SURCHARGED
2880 minute winter	SW5	2700	55.989	0.349	5.1	1.7984	0.0000	SURCHARGED
2880 minute winter	SW6	2700	55.989	0.489	18.3	3.9823	0.0000	SURCHARGED
2880 minute winter	SW7	2700	55.989	0.879	17.9	0.9946	0.0000	SURCHARGED
2880 minute winter	SW8	2700	55.989	0.894	16.6	5.8943	0.0000	SURCHARGED
2880 minute winter	SW9	2700	55.989	0.949	18.6	4.0853	0.0000	SURCHARGED
2880 minute winter	SW10	2700	55.989	1.069	18.7	1.2094	0.0000	FLOOD RISK
2880 minute winter	SW11	2700	55.989	1.196	18.4	20.7641	0.0000	OK
2880 minute winter	SW12	2700	55.989	1.199	10.8	1.3564	0.0000	FLOOD RISK
15 minute summer	SW13	1	54.700	0.000	4.1	0.0000	0.0000	OK
720 minute winter	T3	780	56.055	0.555	2.1	0.0000	0.0000	SURCHARGED
2880 minute winter	T2	3060	56.037	0.537	11.1	0.0000	0.0000	OK
1440 minute winter	C2	1050	68.657	0.082	0.5	9.8671	0.0000	OK
960 minute winter	C3	900	68.662	0.087	0.3	5.2452	0.0000	OK
960 minute winter	C1	690	68.662	0.087	1.2	16.4274	0.0000	OK
1440 minute winter	B1	1080	68.665	0.090	1.8	42.3585	0.0000	OK
960 minute winter	A1	690	68.665	0.090	1.5	21.6526	0.0000	OK
720 minute winter	A2	660	68.656	0.081	0.9	11.7110	0.0000	OK
960 minute winter	A3	810	68.660	0.085	0.3	4.2630	0.0000	OK
2880 minute winter	T1	3060	56.036	0.436	6.5	1.7470	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.001	SW2	43.0	0.900	0.669	4.0535	
15 minute winter	SW2	1.002	SW4	37.1	0.821	0.531	0.4418	
15 minute winter	SW3	4.000	SW4	64.0	1.054	0.990	3.4998	
15 minute winter	SW4	1.003	SW7	121.0	0.846	0.793	11.9403	
15 minute summer	SW5	6.001	SW6	22.4	0.549	0.319	2.2202	
15 minute summer	SW6	6.002	SW7	61.3	0.963	0.916	4.6094	
15 minute winter	SW7	1.004	SW8	169.9	1.072	0.980	0.8182	
15 minute winter	SW8	1.005	SW9	194.8	1.230	1.240	3.6450	
15 minute winter	SW9	1.006	SW10	210.3	1.327	1.386	8.5176	
15 minute winter	SW10	1.007	SW11	210.7	1.457	1.389	3.1403	
15 minute winter	SW11	Flow through pond	SW12	159.2	0.138	0.011	195.5035	
2880 minute winter	SW12	Hydro-Brake®	SW13	4.3				631.0
2160 minute summer	T3	6.000	SW5	-24.3	-0.888	-0.612	0.0439	
30 minute winter	T2	Flow through pond	T3	14.2	0.085	0.999	14.6131	
1440 minute winter	C2	Orifice	SW10	0.2				
960 minute winter	C3	Orifice	SW10	0.1				
960 minute winter	C1	Orifice	SW10	0.4				
1440 minute winter	B1	Orifice	SW4	0.5				
960 minute winter	A1	Orifice	SW1	0.4				
720 minute winter	A2	Orifice	SW1	0.2				
960 minute winter	A3	Orifice	SW1	0.1				
15 minute winter	T1	11.000	T2	49.7	1.844	0.420	0.0720	

Appendix B – Blue Roof Preliminary Design

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	20	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	16.500	Minimum Backdrop Height (m)	0.200
Ratio-R	0.278	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
SW1	0.102	5.00	56.740	1200	1.090
SW2			56.680	1200	1.225
SW3	0.168	5.00	56.700	1200	1.100
SW4	0.165	5.00	56.750	1200	1.470
SW5	0.057	5.00	56.700	1200	1.060
SW6	0.123	5.00	56.820	1200	1.320
SW7			56.370	1200	1.260
SW8	0.094	5.00	56.380	1200	1.285
SW9	0.059	5.00	56.430	1200	1.390
SW10			56.230	1200	1.310
SW11			56.200	1200	1.433
SW12		5.00	56.200	1200	1.435
SW13			56.000	1200	1.300
T1	0.059	5.00	56.700		1.100
T2			56.700		1.200
T3		5.00	56.700		1.200
A1	0.041	5.00	70.000	1200	1.425
A2	0.020	5.00	70.000	1200	1.425
A3	0.008	5.00	70.000	1200	1.425
B1	0.066	5.00	70.000	1200	1.425
C1	0.032	5.00	70.000	1200	1.425
C2	0.017	5.00	70.000	1200	1.425
C3	0.009	5.00	70.000	1200	1.425

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)
1.007	SW10	SW11	22.402	0.600	54.920	54.870	0.050	448.0	450	9.30	38.5
1.006	SW9	SW10	53.788	0.600	55.040	54.920	0.120	448.2	450	8.91	39.2
7.000	C1	SW10	18.676	0.600	68.575	55.000	13.575	1.4	225	5.03	49.8
9.000	C3	SW10	8.058	0.600	68.575	55.000	13.575	0.6	225	5.01	49.9

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)
1.007	0.954	151.7	120.1	0.860	0.880	0.960	0.0	304
1.006	0.954	151.7	115.1	0.940	0.860	0.902	0.0	294
7.000	11.242	447.0	5.1	1.200	1.005	0.032	0.0	17
9.000	17.122	680.8	1.5	1.200	1.005	0.009	0.0	7

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)
8.000	C2	SW10	9.519	0.600	68.575	55.000	13.575	0.7	225	5.01	49.8
1.005	SW8	SW9	23.005	0.600	55.095	55.040	0.055	418.3	450	7.97	41.3
1.004	SW7	SW8	5.164	0.600	55.110	55.095	0.015	344.3	450	7.58	42.2
1.003	SW4	SW7	75.360	0.600	55.280	55.110	0.170	443.3	450	7.51	42.4
6.002	SW6	SW7	65.456	0.600	55.500	55.260	0.240	272.7	300	6.77	44.3
6.001	SW5	SW6	34.804	0.600	55.640	55.500	0.140	248.6	300	5.62	47.7
6.000	T3	SW5	1.929	0.600	55.500	56.000	-0.500	-3.9	225	5.03	49.8
1.002	SW2	SW4	6.274	0.600	55.455	55.430	0.025	251.0	300	6.20	45.9
5.000	B1	SW4	17.556	0.600	68.575	55.500	13.075	1.3	225	5.03	49.8
4.000	SW3	SW4	49.700	0.600	55.600	55.430	0.170	292.4	300	5.91	46.8
1.001	SW1	SW2	57.563	0.600	55.650	55.455	0.195	295.2	300	6.09	46.2
1.000	A3	SW1	21.511	0.600	68.575	56.000	12.575	1.7	225	5.04	49.8
2.000	A2	SW1	12.225	0.600	68.575	56.000	12.575	1.0	225	5.02	49.8
3.000	A1	SW1	11.383	0.600	68.575	56.000	12.575	0.9	225	5.01	49.8
11.000	T1	T2	1.954	0.600	55.600	55.500	0.100	19.5	225	5.01	49.8
10.000	SW12	SW13	7.971	0.600	54.765	54.700	0.065	122.6	225	5.11	49.5

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)
8.000	15.752	626.3	2.8	1.200	1.005	0.017	0.0	11
1.005	0.988	157.1	113.1	0.835	0.940	0.843	0.0	283
1.004	1.090	173.3	102.8	0.810	0.835	0.750	0.0	250
1.003	0.959	152.5	78.5	1.020	0.810	0.570	0.0	229
6.002	0.947	66.9	25.9	1.020	0.810	0.180	0.0	129
6.001	0.992	70.2	8.8	0.760	1.020	0.057	0.0	71
6.000	1.000	39.8	0.0	0.975	0.475	0.000	0.0	0
1.002	0.988	69.8	25.4	0.925	1.020	0.170	0.0	125
5.000	11.380	452.5	10.8	1.200	1.025	0.066	0.0	24
4.000	0.914	64.6	25.6	0.800	1.020	0.168	0.0	131
1.001	0.910	64.3	25.6	0.790	0.925	0.170	0.0	132
1.000	10.080	400.8	1.2	1.200	0.515	0.008	0.0	9
2.000	13.376	531.8	3.2	1.200	0.515	0.020	0.0	13
3.000	13.862	551.2	6.6	1.200	0.515	0.041	0.0	17
11.000	2.974	118.2	9.5	0.875	0.975	0.059	0.0	43
10.000	1.179	46.9	0.0	1.210	1.075	0.000	0.0	0

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	16.500	Drain Down Time (mins)	240
Ratio-R	0.278	Additional Storage (m^3/ha)	25.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node SW12 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	54.840	Product Number	CTL-SHE-0095-4100-1100-4100
Design Depth (m)	1.100	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.1	Min Node Diameter (mm)	1200

Node A1 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.5		
Invert Level (m)	68.575	Diameter (m)	0.028		

Node A2 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.2		
Invert Level (m)	68.575	Diameter (m)	0.017		

Node A3 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.1		
Invert Level (m)	68.575	Diameter (m)	0.012		

Node B1 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.5		
Invert Level (m)	68.575	Diameter (m)	0.028		

Node C1 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.4		
Invert Level (m)	68.575	Diameter (m)	0.025		

Node C2 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.2		
Invert Level (m)	68.575	Diameter (m)	0.017		

Node C3 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.1		
Invert Level (m)	68.575	Diameter (m)	0.012		

Node SW12 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Main Channel Length (m)	25.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	54.765	Main Channel Slope (1:X)	10000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.015

Inlets
SW11

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	560.0	0.0	1.200	560.0	0.0	1.210	0.5	0.0

Node T3 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.43	Main Channel Length (m)	60.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	55.500	Main Channel Slope (1:X)	10000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.150

Inlets
T2

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	120.0	0.0	0.800	120.0	0.0	0.810	1.0	0.0

Node A1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	251.0	0.0	0.100	251.0	0.0

Node A2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	149.0	0.0	0.100	149.0	0.0

Node A3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	51.0	0.0	0.100	51.0	0.0

Node B1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	490.0	0.0	0.100	490.0	0.0

Node C1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	195.0	0.0	0.100	195.0	0.0

Node C2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	125.0	0.0	0.100	125.0	0.0

Node C3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	68.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	62.0	0.0	0.100	62.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 15 minute summer	357.832	101.254	100 year +40% CC 600 minute winter	23.295	9.325
100 year +40% CC 15 minute winter	251.110	101.254	100 year +40% CC 720 minute summer	30.578	8.195
100 year +40% CC 30 minute summer	247.232	69.958	100 year +40% CC 720 minute winter	20.550	8.195
100 year +40% CC 30 minute winter	173.496	69.958	100 year +40% CC 960 minute summer	25.373	6.681
100 year +40% CC 60 minute summer	171.732	45.384	100 year +40% CC 960 minute winter	16.808	6.681
100 year +40% CC 60 minute winter	114.094	45.384	100 year +40% CC 1440 minute summer	18.690	5.009
100 year +40% CC 120 minute summer	108.313	28.624	100 year +40% CC 1440 minute winter	12.561	5.009
100 year +40% CC 120 minute winter	71.961	28.624	100 year +40% CC 2160 minute summer	13.580	3.753
100 year +40% CC 180 minute summer	84.209	21.670	100 year +40% CC 2160 minute winter	9.357	3.753
100 year +40% CC 180 minute winter	54.738	21.670	100 year +40% CC 2880 minute summer	11.398	3.055
100 year +40% CC 240 minute summer	67.195	17.758	100 year +40% CC 2880 minute winter	7.660	3.055
100 year +40% CC 240 minute winter	44.643	17.758	100 year +40% CC 4320 minute summer	8.731	2.283
100 year +40% CC 360 minute summer	51.962	13.372	100 year +40% CC 4320 minute winter	5.750	2.283
100 year +40% CC 360 minute winter	33.776	13.372	100 year +40% CC 5760 minute summer	7.246	1.855
100 year +40% CC 480 minute summer	41.317	10.919	100 year +40% CC 5760 minute winter	4.690	1.855
100 year +40% CC 480 minute winter	27.450	10.919	100 year +40% CC 7200 minute summer	6.188	1.579
100 year +40% CC 600 minute summer	34.094	9.325	100 year +40% CC 7200 minute winter	3.994	1.579

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.41%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	12	56.354	0.704	47.1	2.4399	0.0000	SURCHARGED
15 minute winter	SW2	12	56.272	0.817	41.4	0.9243	0.0000	SURCHARGED
15 minute winter	SW3	12	56.442	0.842	77.3	4.1647	0.0000	FLOOD RISK
15 minute winter	SW4	12	56.255	0.975	160.0	3.8363	0.0000	SURCHARGED
15 minute winter	SW5	11	56.066	0.426	40.1	1.0523	0.0000	SURCHARGED
15 minute winter	SW6	11	56.086	0.586	76.5	2.0318	0.0000	SURCHARGED
15 minute winter	SW7	12	56.033	0.923	190.5	1.0436	0.0000	SURCHARGED
15 minute winter	SW8	12	55.978	0.883	227.7	2.6045	0.0000	SURCHARGED
2160 minute winter	SW9	2040	55.916	0.876	18.0	1.9156	0.0000	SURCHARGED
2160 minute winter	SW10	2040	55.915	0.995	18.0	1.1258	0.0000	SURCHARGED
2160 minute winter	SW11	2040	55.915	1.147	17.7	1.2977	0.0000	OK
2160 minute winter	SW12	2040	55.915	1.150	10.8	1.3011	0.0000	FLOOD RISK
15 minute summer	SW13	1	54.700	0.000	3.9	0.0000	0.0000	OK
960 minute winter	T1	1020	56.027	0.427	17.8	0.5700	0.0000	SURCHARGED
960 minute winter	T2	1020	56.026	0.526	12.9	0.0000	0.0000	OK
960 minute winter	T3	1020	56.028	0.528	4.2	0.0000	0.0000	SURCHARGED
960 minute winter	A1	705	68.673	0.098	1.6	23.4538	0.0000	OK
720 minute winter	A2	675	68.664	0.089	1.0	12.7036	0.0000	OK
960 minute winter	A3	885	68.668	0.093	0.3	4.6480	0.0000	OK
2160 minute winter	B1	1560	68.674	0.099	1.5	46.3339	0.0000	OK
720 minute winter	C1	555	68.672	0.097	1.5	18.0661	0.0000	OK
960 minute winter	C2	735	68.663	0.088	0.7	10.5252	0.0000	OK
960 minute winter	C3	915	68.670	0.095	0.4	5.7146	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.001	SW2	41.4	0.893	0.644	4.0535	
15 minute summer	SW2	1.002	SW4	41.4	0.805	0.593	0.4418	
15 minute winter	SW3	4.000	SW4	63.5	1.038	0.983	3.4998	
15 minute winter	SW4	1.003	SW7	161.2	1.017	1.057	11.9403	
15 minute winter	SW5	6.001	SW6	23.0	0.518	0.328	2.4509	
15 minute summer	SW6	6.002	SW7	61.4	0.966	0.917	4.6094	
15 minute winter	SW7	1.004	SW8	190.3	1.201	1.098	0.8182	
15 minute winter	SW8	1.005	SW9	224.8	1.419	1.431	3.6450	
15 minute winter	SW9	1.006	SW10	246.5	1.556	1.626	8.5224	
15 minute winter	SW10	1.007	SW11	247.1	1.599	1.629	3.2559	
15 minute winter	SW11	Flow through pond	SW12	163.1	0.171	0.014	149.5816	
30 minute winter	SW12	Hydro-Brake®	SW13	4.1				61.4
30 minute winter	T1	11.000	T2	50.0	1.581	0.423	0.0777	
30 minute winter	T2	Flow through pond	T3	14.5	0.085	1.021	18.7360	
15 minute winter	T3	6.000	SW5	-39.5	-3.545	-0.994	0.0439	
960 minute winter	A1	Orifice	SW1	0.5				
720 minute winter	A2	Orifice	SW1	0.2				
960 minute winter	A3	Orifice	SW1	0.1				
2160 minute winter	B1	Orifice	SW4	0.5				
720 minute winter	C1	Orifice	SW10	0.4				
960 minute winter	C2	Orifice	SW10	0.2				
960 minute winter	C3	Orifice	SW10	0.1				

Appendix C - Foul Sewer Network Design

Design Settings

Frequency of use (kDU)	0.50	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	Units	Cover Level (m)	Manhole Type	Depth (m)
F1	234.0	56.720	Foul	1.120
F2		56.680	Foul	1.780
F3	42.0	56.600	Foul	0.900
F4	318.0	56.750	Foul	1.900
F5	30.0	56.730	Foul	0.930
F7	48.0	56.800	Foul	1.580
F8	0.0	56.360	Foul	1.960
F9	30.0	56.360	Foul	1.990
F10	150.0	56.450	Foul	2.220
F11		56.290	Foul	2.350
F12		56.500	Foul	2.640
F13		56.500	Foul	2.690
F14		56.500	Foul	2.710
F15		56.500	Foul	2.790

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.009	F14	F15	14.592	1.500	53.790	53.710	0.080	182.4	225
1.008	F13	F14	2.448	1.500	53.810	53.790	0.020	122.4	225
1.007	F12	F13	7.939	1.500	53.860	53.810	0.050	158.8	225
1.006	F11	F12	14.518	1.500	53.940	53.860	0.080	181.5	225
1.005	F10	F11	54.285	1.500	54.230	53.940	0.290	187.2	225
1.004	F9	F10	24.246	1.500	54.370	54.230	0.140	173.2	225
1.003	F8	F9	5.163	1.500	54.400	54.370	0.030	172.1	225
1.002	F4	F8	75.057	1.500	54.850	54.400	0.450	166.8	225
3.001	F7	F8	65.358	1.500	55.220	54.475	0.745	87.7	150
3.000	F5	F7	34.633	1.500	55.800	55.220	0.580	59.7	150

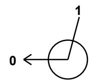
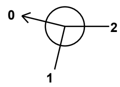
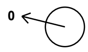
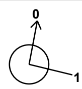
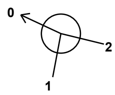
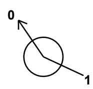
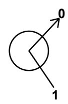
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
1.009	0.848	33.7	14.6	2.485	2.565	0.000	0	852.0	0.0	103	0.817
1.008	1.037	41.2	14.6	2.465	2.485	0.000	0	852.0	0.0	93	0.950
1.007	0.910	36.2	14.6	2.415	2.465	0.000	0	852.0	0.0	100	0.862
1.006	0.851	33.8	14.6	2.125	2.415	0.000	0	852.0	0.0	103	0.819
1.005	0.837	33.3	14.6	1.995	2.125	0.000	0	852.0	0.0	104	0.810
1.004	0.871	34.6	13.2	1.765	1.995	0.000	0	702.0	0.0	96	0.812
1.003	0.874	34.7	13.0	1.735	1.765	0.000	0	672.0	0.0	95	0.811
1.002	0.887	35.3	12.2	1.675	1.735	0.000	0	594.0	0.0	91	0.805
3.001	0.935	16.5	4.4	1.430	1.735	0.000	0	78.0	0.0	53	0.791
3.000	1.135	20.1	2.7	0.780	1.430	0.000	0	30.0	0.0	38	0.793

Links

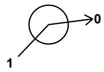
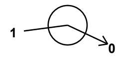
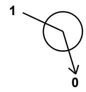
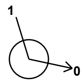
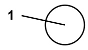
Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.001	F2	F4	6.424	1.500	54.900	54.850	0.050	128.5	225
2.000	F3	F4	50.459	1.500	55.700	54.925	0.775	65.1	150
1.000	F1	F2	59.313	1.500	55.600	54.900	0.700	84.7	225

Name	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)
1.001	1.012	40.2	7.6	1.555	1.675	0.000	0	234.0	0.0	66	0.778
2.000	1.087	19.2	3.2	0.750	1.675	0.000	0	42.0	0.0	42	0.806
1.000	1.247	49.6	7.6	0.895	1.555	0.000	0	234.0	0.0	59	0.900

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
F1	697856.661	732226.285	56.720	1.120	1200		0	1.000	55.600	225
F2	697841.483	732168.947	56.680	1.780	1200		1	1.000	54.900	225
							0	1.001	54.900	225
F3	697823.336	732119.869	56.600	0.900	1200		0	2.000	55.700	150
F4	697835.059	732168.947	56.750	1.900	1200		1	2.000	54.925	150
							2	1.001	54.850	225
							0	1.002	54.850	225
F5	697783.681	732114.269	56.730	0.930	1200		0	3.000	55.800	150
F7	697750.037	732122.488	56.800	1.580	1200		1	3.000	55.220	150
							0	3.001	55.220	150
F8	697762.136	732186.716	56.360	1.960	1200		1	3.001	54.475	150
							2	1.002	54.400	225
							0	1.003	54.400	225
F9	697757.455	732188.895	56.360	1.990	1200		1	1.003	54.370	225
							0	1.004	54.370	225
F10	697743.779	732208.916	56.450	2.220	1200		1	1.004	54.230	225
							0	1.005	54.230	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
F11	697780.996	732248.435	56.290	2.350	1200		1	1.005	53.940	225
							0	1.006	53.940	225
F12	697795.393	732250.304	56.500	2.640	1200		1	1.006	53.860	225
							0	1.007	53.860	225
F13	697802.598	732246.969	56.500	2.690	1200		1	1.007	53.810	225
							0	1.008	53.810	225
F14	697803.309	732244.627	56.500	2.710	1200		1	1.008	53.790	225
							0	1.009	53.790	225
F15	697817.577	732241.568	56.500	2.790	1200		1	1.009	53.710	225

- **Appendix D - Soakaway Test Report**

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JMA
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& Associates

Chartered Engineers • Registered Architects • Chartered Surveyors

Soakaway Test & Design

Client: Garyaron Homes Ltd.

Site: Residential Development at Glencarrig, Celbridge, Co. Kildare

1. INTRODUCTION

At the proposed Development at Glencarrig, Celbridge, Co. Kildare it will be necessary to dispose of the storm water from the site by means of a soakaway system on site.

A site investigation has been carried out to assess the suitability of the sub-soils for this purpose and to determine soakaway requirements.

2. SITE INVESTIGATION

4 No. test holes were excavated on the site in order to ascertain subsoil conditions and the depth to groundwater.

3. TESTING

To determine the soil infiltration rate, water was poured into the test holes and records made of the fall in water level against time. Testing was continued until a constant rate of fall was established.

From the rate of fall in water level and measurement of the average internal surface area of the test pits over the test zone, the soil infiltration rate "f" was calculated.

The average infiltration rate (f value) in the area of trial pit SA1 was determined to be 0.00002702 m/sec.

4. DESIGN CALCULATIONS

4.1 SOAKAWAYS

The soakaways have been designed in accordance with "BRE Digest 365 - Design of soakaways".

The digest suggests that a soakaway should be designed to accommodate the immediate storm-water run-off and permit infiltration into the surrounding ground at a sufficient rate so as to provide the necessary capacity to receive run-off from a subsequent storm.

For this analysis, rainfall statistics have been obtained from Met Eireann and calculations have been carried out, based on a 100 year return period, for a run off area for the total development will be 11473m2.

The required soakaway capacity is obtained by calculating the inflow and outflow for a range of storm durations, and choosing the storm duration which gives the maximum storage requirement.

For analysis purposes, a trench 4m wide and 2.7m deep has been assumed. The invert level of the pipe into the soakaway is taken to be 0.7m below ground level, which would give an effective depth of 2.0m for the soakaway system.

5. RECOMMENDATIONS

5.1 SOAKAWAYS

Using above assumptions, the required soakaway sizes are as follows:

4 no. soakaways to be provides throughout the development with a combined storage capacity of 237.04m3.

It is noted that soakaways can become clogged with silt through time and regular monitoring of silt levels must be carried out. The use of a silt trap manhole at the head of a soakaway can, however, greatly reduce the inflow of silt and suspended solids.

The construction of the soakaway trench should be supervised and certified by a suitably qualified civil engineer. The rounded gravel used for the soakaway must have a certified void ratio of 0.30. Soakaways must be located a minimum of 5.0m from any structure/foundation and a minimum of 3.0m from any boundary.

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Appendix 1 Calculations

Name: A&G Residential
Address: Celbridge
Irish Grid Coor.: 253711 257998
FI Planning Ref: 21/133
Date: 17/08/2022
Test Hole 01

Trial Hole Dimensions (From Ground Level)

2 m deep
1.1 m wide
1 m long

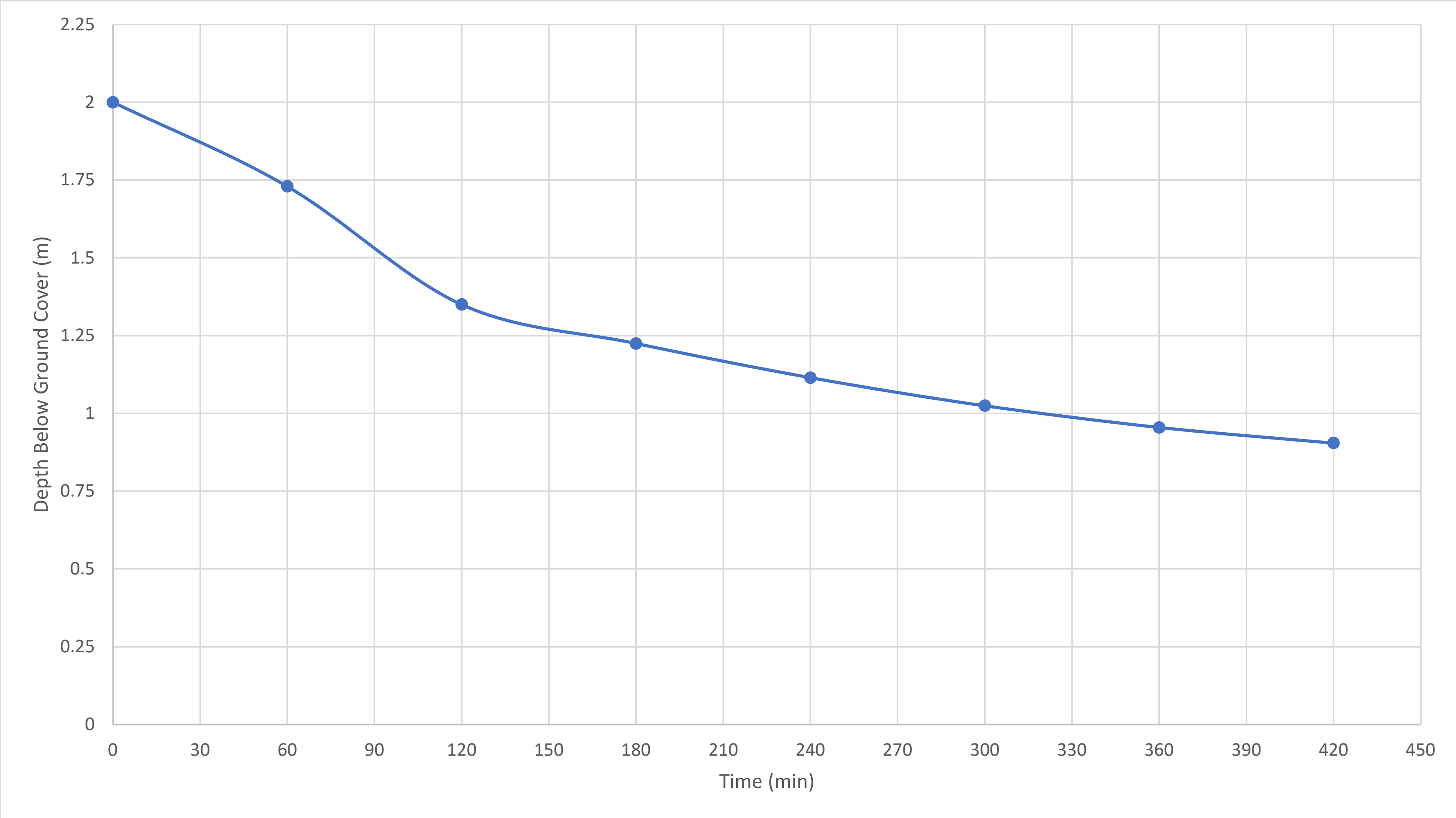
Effective Storage Depth 1.0m Take V_{free} at 30%
Trial Hole Was Filled From Empty on 7th & 8th

Trail Hole Recorded Levels

Test Date	Test Time	Water Level Within Trial Hole
09/08/2022	12:30	2
09/08/2022	13:30	1.73
09/08/2022	14:30	1.35
09/08/2022	15:30	1.225
09/08/2022	16:30	1.115
09/08/2022	17:30	1.025
09/08/2022	18:30	0.955
09/08/2022	19:30	0.905

Field Obervation From Trial Hole Shown On Figure 1 On Next Page

Figure 1:



VP75 - VP25 = 1.1 x 1.0 x (1.75 - 1.25) = 0.55m^3

as50 = (1.1 x 0.5 x 2) + (1.0 x 0.5 x 2) + (1.1 x 1.0) = 3.2m^2

tp75 - 25 = (162 - 56) = 106 min

Soil Infiltration Rate :

$$f = \frac{0.55}{3.2 \times 106 \times 60} = 2.702E\text{-}05 \text{ m/sec}$$

Soakaway Sizing

From Rainfall Return Period Tables - M5 - 60 = 15.9
Z1 Growth Rate & Z2 Growth Rate Taken From Table 1 & 2 in BRE 365

Imperable Area From Roof, Footpaths & Roadway 11473**m²** Total
Take it 4 No. Soakholes Will Be Provided On Site = 11473/4 = 2868**m²**

Inflow → I = A x R

Outflow → O = as50 x f x D

Soakaway → I - O = S → See table below

Duration (D/min)	Growth Factor Z1	M5 Rainfall (mm)	Growth Factor Z2	M100 Rainfall (mm)	Inflow (m^3)	Outflow (m^3)	Storage Required (m^3)
5	0.36	5.72	1.91	10.93	31.36	0.03	31.33
10	0.51	8.11	1.97	15.97	45.82	0.05	45.76
15	0.62	9.86	1.97	19.42	55.70	0.08	55.62
30	0.79	12.56	1.97	24.75	70.97	0.16	70.81
60	1	15.9	1.93	30.69	88.01	0.31	87.70
120	1.22	19.40	1.89	36.66	105.15	0.62	104.52
240	1.48	23.53	1.85	43.53	130.60	1.25	129.36
360	1.67	26.55	1.82	48.33	138.60	1.87	136.73
600	1.9	30.21	1.78	53.77	154.22	3.11	151.11
1440	2.42	38.48	1.72	66.18	189.81	7.47	182.34

Required Storage (Sreq) = 182.34 + 30% Climate Change → 237.04m^3

To Find L - Using Soakaway Storage Volume (Sact)using Trial Hole Width and Depth with 30% climate change at void ratio 30%→ L x d x w x Vfree = 4.66m3

→ To Find L Design = $\frac{237.4}{2 \times 4 \times 0.3}$ = 98.92 m

Therefore Taking Soakhole Dimensions For 100m^2 Area Capture can be interpreted as Follows.

L= 98.92m
w= 4
d= 2 (Note Base Of Soakhole 2.000m Below Ground Cover)

Name: A&G Residential
Address: Celbridge
Irish Grid Coor.: 253711 257998
FI Planning Ref: 21/133
Date: 17/08/2022
Test Hole 02

Trial Hole Dimensions (From Ground Level)

2 m deep
1.1 m wide
1 m long

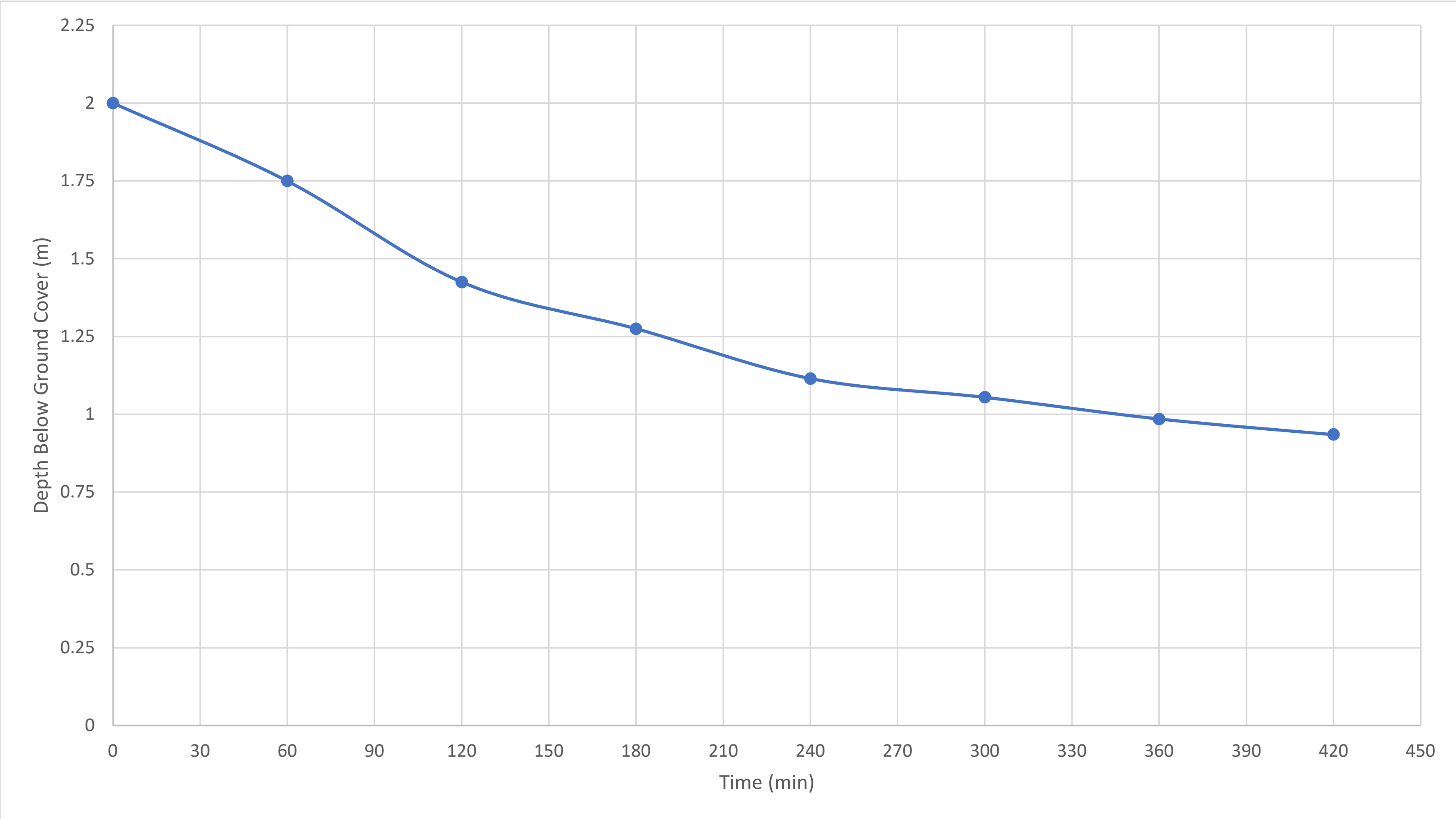
Effective Storage Depth 1.0m Take V_{free} at 30%
Trial Hole Was Filled From Empty on 7th & 8th

Trail Hole Recorded Levels

Test Date	Test Time	Water Level Within Trial Hole
09/08/2022	12:30	2
09/08/2022	13:30	1.75
09/08/2022	14:30	1.425
09/08/2022	15:30	1.275
09/08/2022	16:30	1.115
09/08/2022	17:30	1.055
09/08/2022	18:30	0.985
09/08/2022	19:30	0.935

Field Obervation From Trial Hole Shown On Figure 1 On Next Page

Figure 1:



VP75 - VP25 = 1.1 x 1.0 x (1.75 - 1.25) = 0.55m^3

as50 = (1.1 x 0.5 x 2) + (1.0 x 0.5 x 2) + (1.1 x 1.0) = 3.2m^2

tp75 - 25 = (190 - 60) 130 min

Soil Infiltration Rate :

$$f = \frac{0.55}{3.2 \times 130 \times 60} = 2.204E\text{-}05 \text{ m/sec}$$

Soakaway Sizing

From Rainfall Return Period Tables - M5 - 60 = 15.9
Z1 Growth Rate & Z2 Growth Rate Taken From Table 1 & 2 in BRE 365

Imperable Area From Roof, Footpaths & Roadway 11473**m²** Total
Take it 4 No. Soakholes Will Be Provided On Site = 11473/4 = 2868**m²**

Inflow → I = A x R

Outflow → O = as50 x f x D

Soakaway → I - O = S → See table below

Duration (D/min)	Growth Factor Z1	M5 Rainfall (mm)	Growth Factor Z2	M100 Rainfall (mm)	Inflow (m^3)	Outflow (m^3)	Storage Required (m^3)
5	0.36	5.72	1.91	10.93	31.36	0.02	31.33
10	0.51	8.11	1.97	15.97	45.82	0.04	45.77
15	0.62	9.86	1.97	19.42	55.70	0.06	55.63
30	0.79	12.56	1.97	24.75	70.97	0.13	70.84
60	1	15.9	1.93	30.69	88.01	0.25	87.76
120	1.22	19.40	1.89	36.66	105.15	0.51	104.64
240	1.48	23.53	1.85	43.53	130.60	1.02	129.59
360	1.67	26.55	1.82	48.33	138.60	1.52	137.08
600	1.9	30.21	1.78	53.77	154.22	2.54	151.68
1440	2.42	38.48	1.72	66.18	189.81	6.09	183.72

Required Storage (Sreq) = 183.72 + 30% Climate Change → 238.84m^3

To Find L - Using Soakaway Storage Volume (Sact)using Trial Hole Width and Depth with 30% climate change at void ratio 30%→ L x d x w x Vfree = 4.66m3

→ To Find L Design = $\dfrac{238.84}{2 \times 4 \times 0.3}$ = 99.52 m

Therefore Taking Soakhole Dimensions For 100m^2 Area Capture can be interpreted as Follows.

L= 99.52m
w= 4
d= 2 (Note Base Of Soakhole 2.000m Below Ground Cover)

Name: A&G Residential
Address: Celbridge
Irish Grid Coor.: 253711 257998
FI Planning Ref: 21/133
Date: 17/08/2022
Test Hole 03

Trial Hole Dimensions (From Ground Level)

2 m deep
1.1 m wide
1 m long

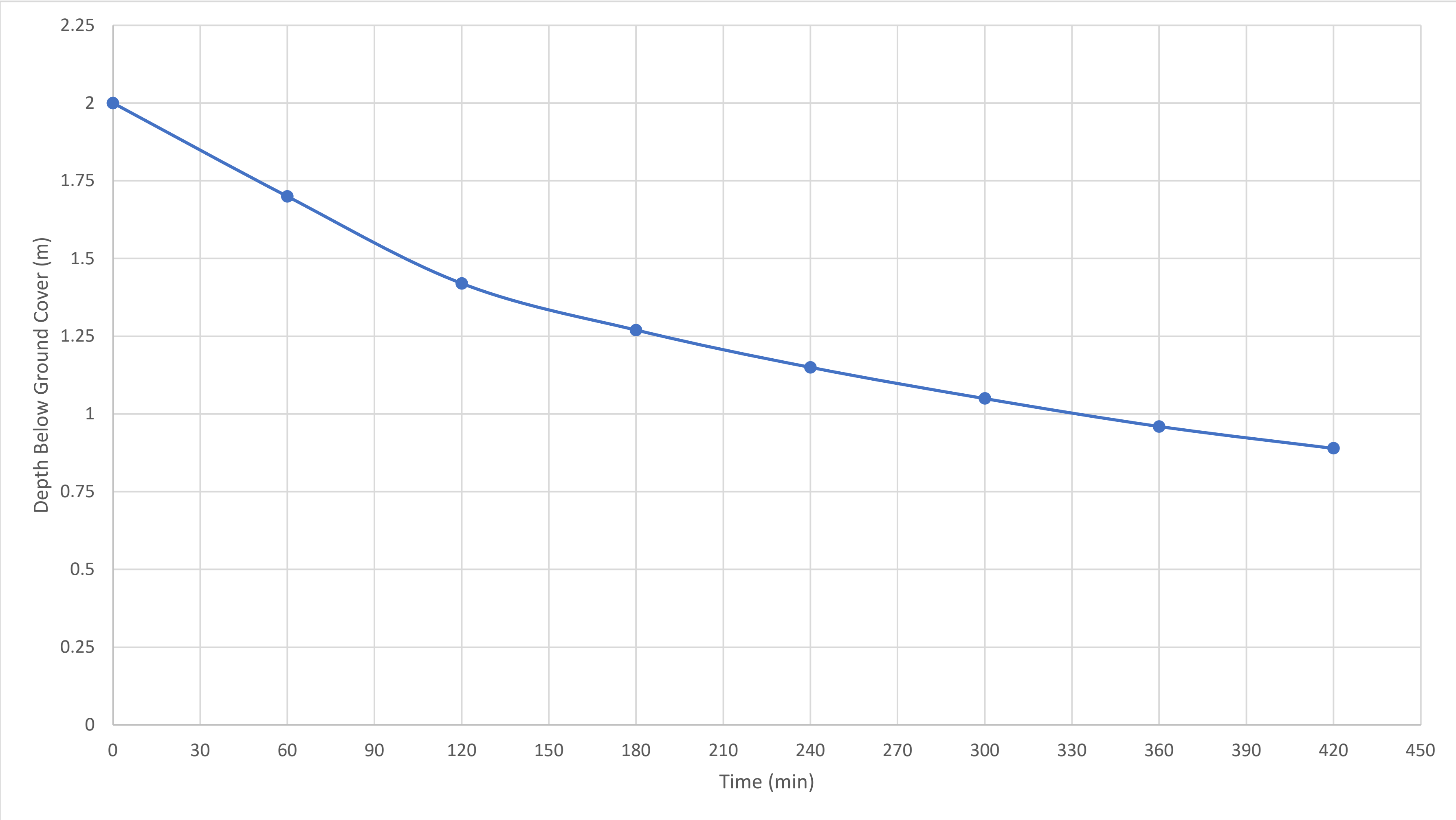
Effective Storage Depth 1.0m Take V_{free} at 30%
Trial Hole Was Filled From Empty on 7^{th} & 8^{th}

Trail Hole Recorded Levels

Test Date	Test Time	Water Level Within Trial Hole
09/08/2022	12:30	2
09/08/2022	13:30	1.7
09/08/2022	14:30	1.42
09/08/2022	15:30	1.27
09/08/2022	16:30	1.15
09/08/2022	17:30	1.05
09/08/2022	18:30	0.96
09/08/2022	19:30	0.89

Field Obervation From Trial Hole Shown On Figure 1 On Next Page

Figure 1:



VP75 - VP25 = 1.1 x 1.0 x (1.75 - 1.25) = 0.55m^3

as50 = (1.1 x 0.5 x 2) + (1.0 x 0.5 x 2) + (1.1 x 1.0) = 3.2m^2

tp75 - 25 = (194-55) 139 min

Soil Infiltration Rate :

$$f = \frac{0.55}{3.2 \times 106 \times 60} = 2.061E-05 \text{ m/sec}$$

Soakaway Sizing

From Rainfall Return Period Tables - M5 - 60 = 15.9
Z1 Growth Rate & Z2 Growth Rate Taken From Table 1 & 2 in BRE 365

Imperable Area From Roof, Footpaths & Roadway 11473m^2 Total
Take it 4 No. Soakholes Will Be Provided On Site = 11473/4 = 2868m^2

Inflow → I = A x R

Outflow → O = as50 x f x D

Soakaway → I - O = S → See table below

Duration (D/min)	Growth Factor Z1	M5 Rainfall (mm)	Growth Factor Z2	M100 Rainfall (mm)	Inflow (m^3)	Outflow (m^3)	Storage Required (m^3)
5	0.36	5.72	1.91	10.93	31.36	0.02	31.34
10	0.51	8.11	1.97	15.97	45.82	0.04	45.78
15	0.62	9.86	1.97	19.42	55.70	0.06	55.64
30	0.79	12.56	1.97	24.75	70.97	0.12	70.85
60	1	15.9	1.93	30.69	88.01	0.24	87.77
120	1.22	19.40	1.89	36.66	105.15	0.47	104.67
240	1.48	23.53	1.85	43.53	130.60	0.95	129.65
360	1.67	26.55	1.82	48.33	138.60	1.42	137.18
600	1.9	30.21	1.78	53.77	154.22	2.37	151.85
1440	2.42	38.48	1.72	66.18	189.81	5.70	184.11

Required Storage (Sreq) = 184.11 + 30% Climate Change → 239.34m^3

To Find L - Using Soakaway Storage Volume (Sact)using Trial Hole Width and Depth with 30% climate change at void ratio 30%→ L x d x w x Vfree = 4.66m3

→ To Find L Design = $\frac{239.34}{2 \times 4 \times 0.3}$ = 99.73 m

Therefore Taking Soakhole Dimensions For 100m^2 Area Capture can be interpreted as Follows.

L=	99.73m	
w=	4	
d=	2	(Note Base Of Soakhole 2.000m Below Ground Cover)

Name: A&G Residential
Address: Celbridge
Irish Grid Coor.: 253711 257998
FI Planning Ref: 21/133
Date: 17/08/2022
Test Hole 04

Trial Hole Dimensions (From Ground Level)

2 m deep
1.1 m wide
1 m long

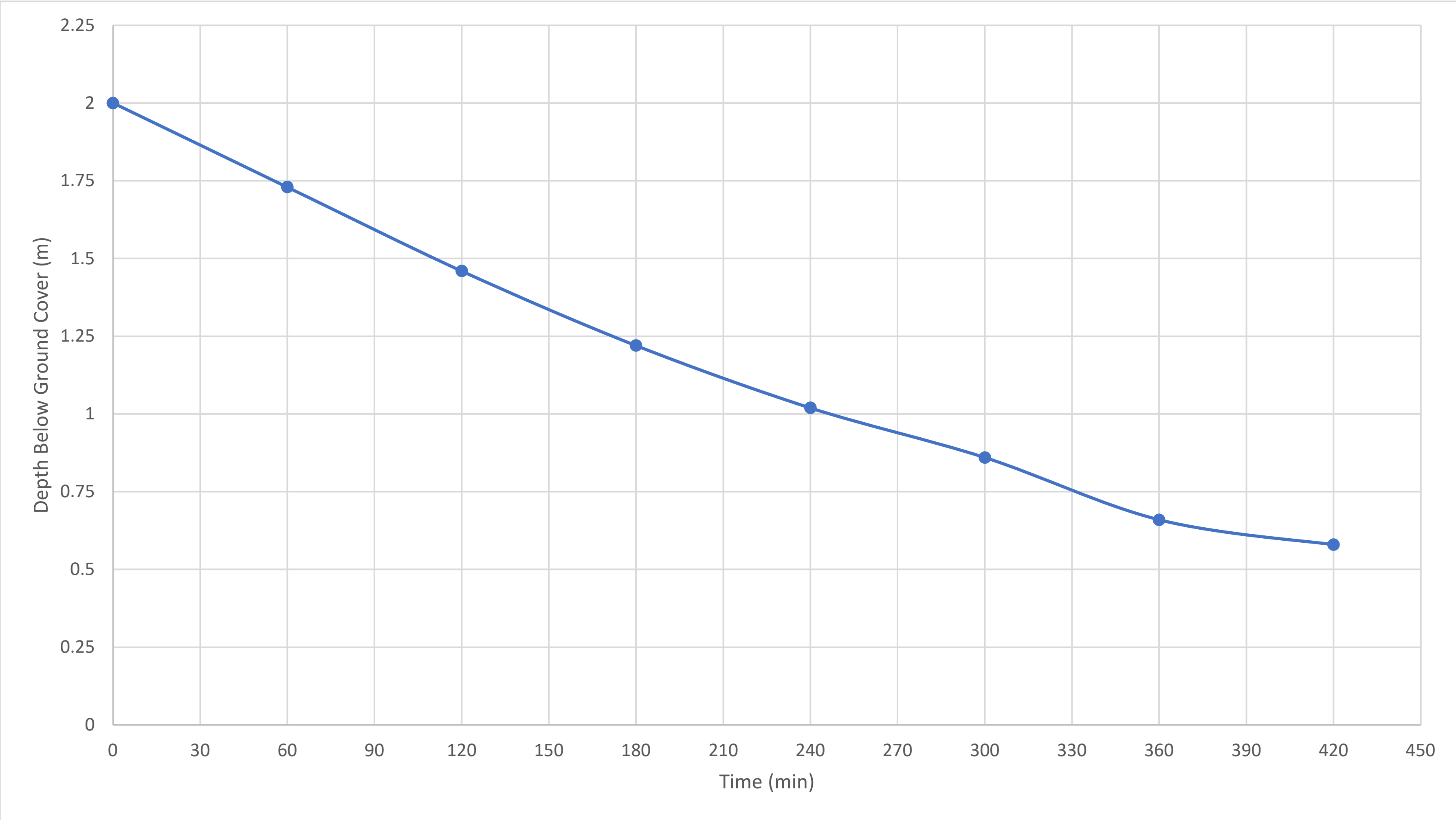
Effective Storage Depth 1.0m Take V_{free} at 30%
Trial Hole Was Filled From Empty on 7th & 8th

Trail Hole Recorded Levels

Test Date	Test Time	Water Level Within Trial Hole
09/08/2022	12:30	2
09/08/2022	13:30	1.73
09/08/2022	14:30	1.46
09/08/2022	15:30	1.22
09/08/2022	16:30	1.02
09/08/2022	17:30	0.86
09/08/2022	18:30	0.66
09/08/2022	19:30	0.58

Field Obervation From Trial Hole Shown On Figure 1 On Next Page

Figure 1:



VP75 - VP25 = 1.1 x 1.0 x (1.75 - 1.25) = 0.55m^3

as50 = (1.1 x 0.5 x 2) + (1.0 x 0.5 x 2) + (1.1 x 1.0) = 3.2m^2

tp75 - 25 = (240-120) 120 min

Soil Infiltration Rate :

$$f = \frac{0.55}{3.2 \times 120 \times 60} = 2.387E\text{-}05 \text{ m/sec}$$

Soakaway Sizing

From Rainfall Return Period Tables - M5 - 60 = 15.9
Z1 Growth Rate & Z2 Growth Rate Taken From Table 1 & 2 in BRE 365

Imperable Area From Roof, Footpaths & Roadway 11473**m^2** Total
Take it 4 No. Soakholes Will Be Provided On Site = 11473/4 = 2868**m^2**

Inflow → I = A x R

Outflow → O = as50 x f x D

Soakaway → I - O = S → See table below

Duration (D/min)	Growth Factor Z1	M5 Rainfall (mm)	Growth Factor Z2	M100 Rainfall (mm)	Inflow (m^3)	Outflow (m^3)	Storage Required (m^3)
5	0.36	5.72	1.91	10.93	31.36	0.02	31.33
10	0.51	8.11	1.97	15.97	45.82	0.05	45.77
15	0.62	9.86	1.97	19.42	55.70	0.07	55.63
30	0.79	12.56	1.97	24.75	70.97	0.14	70.83
60	1	15.9	1.93	30.69	88.01	0.27	87.74
120	1.22	19.40	1.89	36.66	105.15	0.55	104.60
240	1.48	23.53	1.85	43.53	130.60	1.10	129.50
360	1.67	26.55	1.82	48.33	138.60	1.65	136.95
600	1.9	30.21	1.78	53.77	154.22	2.75	151.47
1440	2.42	38.48	1.72	66.18	189.81	6.60	183.21

Required Storage (Sreq) = 183.21 + 30% Climate Change → 238.17m^3

To Find L - Using Soakaway Storage Volume (Sact)using Trial Hole Width and Depth with 30% climate change at void ratio 30%→ L x d x w x Vfree = 4.66m3

→ To Find L Design = $\frac{238.17}{2 \times 4 \times 0.3}$ = 99.24 m

Therefore Taking Soakhole Dimensions For 100m^2 Area Capture can be interpreted as Follows.

L= 99.24m
w= 4
d= 2 (Note Base Of Soakhole 2.000m Below Ground Cover)

- **Appendix E - Receiving SW Network Capacity and Condition Check**

Part 1 of 2 of the capacity check performed on the existing drainage network in Hazelhatch residential development receiving the restricted discharge from the proposed site. For area take-off refer to Drg. Ref. D1686-D3 and for original survey of existing SW network refer to J&L Surveys Limited drawing included in this planning application. This part includes all nodes up to existing hydrobrake in manhole S10

Design Settings

Rainfall Methodology	FSR
Return Period (years)	17
Additional Flow (%)	20
FSR Region	Scotland and Ireland
M5-60 (mm)	16.500
Ratio-R	0.278
CV	0.750
Time of Entry (mins)	7.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	✓
Enforce best practice design rules	x

Nodes

Restricted discharge from proposed development added

Impervious area of 4.26ha included. Refer to DRG D1686- D3 for details

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Diameter (mm)	Depth (m)
S1	0.524	7.00	4.1	56.022	1350	1.247
S2	0.674	7.00		56.512	1350	2.727
S3				56.370	1350	2.810
S4				56.280	1350	2.740
S5	1.963	7.00		55.558	1500	2.458
S6				55.901	1500	3.547
S7				56.339	1500	4.263
S8				56.712	1500	4.832
S9				56.766	1500	4.817
S10	1.104	7.00		56.364	1500	4.860

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	S1	S2	66.619	0.600	54.775	53.785	0.990	67.3	450	7.45	50.0
1.001	S2	S3	52.764	0.600	53.785	53.560	0.225	234.5	450	8.11	50.0
1.002	S3	S4	22.494	0.600	53.560	53.540	0.020	1124.7	450	8.74	50.0
1.003	S4	S5	60.998	0.600	53.540	53.175	0.365	167.1	450	9.39	50.0
1.004	S5	S6	36.093	0.600	53.100	52.354	0.746	48.4	525	9.57	50.0
1.005	S6	S7	20.287	0.600	52.354	52.076	0.278	73.0	525	9.70	50.0
1.006	S7	S8	35.958	0.600	52.076	51.880	0.196	183.5	525	10.07	50.0
1.007	S8	S9	36.539	0.600	51.880	51.949	-0.069	-529.6	525	10.67	50.0
1.008	S9	S10	8.699	0.600	51.949	51.504	0.445	19.5	525	10.70	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)
1.000	2.481	394.6	90.1	0.797	2.277	0.524	4.1	145
1.001	1.323	210.4	199.8	2.277	2.360	1.198	4.1	352
1.002	0.598	95.0	199.8	2.360	2.290	1.198	4.1	450
1.003	1.570	249.6	199.8	2.290	1.933	1.198	4.1	305
1.004	3.225	698.2	519.0	1.933	3.022	3.161	4.1	339
1.005	2.624	568.0	519.0	3.022	3.738	3.161	4.1	397
1.006	1.650	357.2	519.0	3.738	4.307	3.161	4.1	525
1.007	1.000	216.5	519.0	4.307	4.292	3.161	4.1	525
1.008	5.082	1100.1	519.0	4.292	4.335	3.161	4.1	254

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1	697801.263	732284.496	56.022	1.247	1350				
						0	1.000	54.775	450
S2	697797.544	732351.011	56.512	2.727	1350	1	1.000	53.785	450
						0	1.001	53.785	450
S3	697745.947	732339.974	56.370	2.810	1350	1	1.001	53.560	450
						0	1.002	53.560	450
S4	697724.755	732332.431	56.280	2.740	1350	1	1.002	53.540	450
						0	1.003	53.540	450
S5	697670.384	732304.780	55.558	2.458	1500	1	1.003	53.175	450
						0	1.004	53.100	525
S6	697640.240	732284.929	55.901	3.547	1500	1	1.004	52.354	525
						0	1.005	52.354	525
S7	697620.166	732287.859	56.339	4.263	1500	1	1.005	52.076	525
						0	1.006	52.076	525
S8	697585.163	732279.627	56.712	4.832	1500	1	1.006	51.880	525
						0	1.007	51.880	525
S9	697548.823	732283.437	56.766	4.817	1500	1	1.007	51.949	525
						0	1.008	51.949	525
S10	697540.537	732286.084	56.364	4.860	1500	1	1.008	51.504	525

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	16.500	Drain Down Time (mins)	240
Ratio-R	0.278	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	20	0	0
30	20	0	0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +20% CC 15 minute summer	128.690	36.415	30 year +20% CC 15 minute summer	236.539	66.932
2 year +20% CC 15 minute winter	90.309	36.415	30 year +20% CC 15 minute winter	165.992	66.932
2 year +20% CC 30 minute summer	87.935	24.883	30 year +20% CC 30 minute summer	162.335	45.935
2 year +20% CC 30 minute winter	61.709	24.883	30 year +20% CC 30 minute winter	113.920	45.935
2 year +20% CC 60 minute summer	62.411	16.493	30 year +20% CC 60 minute summer	113.289	29.939
2 year +20% CC 60 minute winter	41.464	16.493	30 year +20% CC 60 minute winter	75.266	29.939
2 year +20% CC 120 minute summer	40.537	10.713	30 year +20% CC 120 minute summer	72.037	19.037
2 year +20% CC 120 minute winter	26.931	10.713	30 year +20% CC 120 minute winter	47.859	19.037
2 year +20% CC 180 minute summer	32.018	8.239	30 year +20% CC 180 minute summer	56.350	14.501
2 year +20% CC 180 minute winter	20.813	8.239	30 year +20% CC 180 minute winter	36.629	14.501
2 year +20% CC 240 minute summer	25.971	6.863	30 year +20% CC 240 minute summer	45.164	11.936
2 year +20% CC 240 minute winter	17.255	6.863	30 year +20% CC 240 minute winter	30.006	11.936
2 year +20% CC 360 minute summer	20.609	5.304	30 year +20% CC 360 minute summer	35.165	9.049
2 year +20% CC 360 minute winter	13.397	5.304	30 year +20% CC 360 minute winter	22.858	9.049
2 year +20% CC 480 minute summer	16.667	4.404	30 year +20% CC 480 minute summer	28.104	7.427
2 year +20% CC 480 minute winter	11.073	4.404	30 year +20% CC 480 minute winter	18.672	7.427
2 year +20% CC 600 minute summer	13.941	3.813	30 year +20% CC 600 minute summer	23.285	6.369
2 year +20% CC 600 minute winter	9.525	3.813	30 year +20% CC 600 minute winter	15.909	6.369
2 year +20% CC 720 minute summer	12.647	3.390	30 year +20% CC 720 minute summer	20.954	5.616
2 year +20% CC 720 minute winter	8.500	3.390	30 year +20% CC 720 minute winter	14.082	5.616
2 year +20% CC 960 minute summer	10.690	2.815	30 year +20% CC 960 minute summer	17.480	4.603
2 year +20% CC 960 minute winter	7.081	2.815	30 year +20% CC 960 minute winter	11.579	4.603
2 year +20% CC 1440 minute summer	8.087	2.167	30 year +20% CC 1440 minute summer	12.973	3.477
2 year +20% CC 1440 minute winter	5.435	2.167	30 year +20% CC 1440 minute winter	8.718	3.477

Results for 2 year +20% CC Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute winter	S1	11	54.908	0.133	77.9	1.3052	0.0000	OK
15 minute winter	S2	12	54.116	0.331	171.9	2.1124	0.0000	OK
15 minute winter	S3	12	53.956	0.396	168.0	0.5674	0.0000	OK
15 minute winter	S4	12	53.820	0.280	166.7	0.4009	0.0000	OK
15 minute winter	S5	13	53.514	0.414	433.3	7.3510	0.0000	OK
15 minute winter	S6	13	53.235	0.881	413.7	1.5570	0.0000	SURCHARGED
15 minute winter	S7	13	52.994	0.918	413.8	1.6218	0.0000	SURCHARGED
15 minute winter	S8	13	52.638	0.758	413.9	1.3392	0.0000	SURCHARGED
15 minute winter	S9	13	52.247	0.298	413.9	0.5263	0.0000	OK
15 minute winter	S10	13	51.723	0.219	554.7	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute winter	S1	1.000	S2	77.0	0.974	0.195	5.4585	
15 minute winter	S2	1.001	S3	168.0	1.229	0.798	7.2028	
15 minute winter	S3	1.002	S4	166.7	1.307	1.754	2.8299	
15 minute winter	S4	1.003	S5	167.8	1.640	0.672	7.0668	
15 minute winter	S5	1.004	S6	413.7	2.417	0.592	7.1984	
15 minute winter	S6	1.005	S7	413.8	1.916	0.729	4.3827	
15 minute winter	S7	1.006	S8	413.9	1.916	1.159	7.7681	
15 minute winter	S8	1.007	S9	413.9	2.150	1.912	6.2554	
15 minute winter	S9	1.008	S10	413.6	3.915	0.376	0.9193	298.9

No flood recorded for all storms up to 2years return +20% CCF

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	14	55.999	1.224	139.8	12.0386	0.0000	FLOOD RISK
15 minute winter	S2	14	55.930	2.145	301.2	13.6775	0.0000	SURCHARGED
15 minute winter	S3	14	55.626	2.066	230.5	2.9571	0.0000	SURCHARGED
15 minute winter	S4	14	55.467	1.927	241.2	2.7568	0.0000	SURCHARGED
15 minute winter	S5	14	55.113	2.013	676.6	35.7002	0.0000	SURCHARGED
15 minute winter	S6	14	54.342	1.988	609.8	3.5124	0.0000	SURCHARGED
15 minute winter	S7	14	53.818	1.742	610.3	3.0779	0.0000	SURCHARGED
15 minute winter	S8	14	53.044	1.164	610.7	2.0576	0.0000	SURCHARGED
15 minute winter	S9	14	52.348	0.399	611.1	0.7049	0.0000	OK
15 minute winter	S10	14	51.777	0.273	855.9	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S2	132.0	1.045	0.335	10.5553	
15 minute winter	S2	1.001	S3	230.5	1.455	1.095	8.3601	
15 minute winter	S3	1.002	S4	241.2	1.523	2.538	3.5640	
15 minute winter	S4	1.003	S5	250.9	1.796	1.005	9.6647	
15 minute winter	S5	1.004	S6	609.8	2.823	0.873	7.7973	
15 minute winter	S6	1.005	S7	610.3	2.825	1.074	4.3827	
15 minute winter	S7	1.006	S8	610.7	2.827	1.710	7.7681	
15 minute winter	S8	1.007	S9	611.1	2.918	2.823	7.1636	
15 minute winter	S9	1.008	S10	611.0	4.186	0.555	1.2598	499.8

SW pipes surcharged but no flood recorded for all storms up to 30years return +20% CCF

Part 2 of 2 of the capacity check performed on the existing drainage network in Hazelhatch residential development receiving the restricted discharge from the proposed site. For area take-off refer to Drg. Ref. D1686-D3 and for original survey of existing SW network refer to J&L Surveys Limited drawing included in this planning application. This part includes nodes downstream from existing hydrobrake in manhole S10

Design Settings

Rainfall Methodology	FSR
Return Period (years)	17
Additional Flow (%)	20
FSR Region	Scotland and Ireland
M5-60 (mm)	16.500
Ratio-R	0.278
CV	0.750
Time of Entry (mins)	7.00

Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	✓
Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Diameter (mm)	Depth (m)
S10	0.241	7.00	56.0	56.364	2100	4.860
S11				55.709	2100	4.126
S12	1.281	7.00		56.157	2100	4.588
S13				56.281	2100	4.776
S14	1.011	7.00		56.279	2100	4.739
S15				56.249	2100	4.993
S16	0.947	7.00		54.940	2100	4.208
S17				54.425	2100	3.851
S18	1.009	7.00		53.360	2100	3.622
S19				53.025	2100	3.409
S20				52.881	2100	3.250
S21				52.540	2100	3.396
S22				48.000	2100	1.367

Restricted discharge from the existing Hazelhatch catchment of 8.6ha and from the proposed development. Maximum (theoretical) discharge from existing Hazelhatch development 8.6ha x 6l/s/ha=51.6l/s Restricted discharge from proposed development =4.1l/s Total max discharge for SW network check = 56l/s

Impervious area of 4.49ha included. Refer to DRG D1686- D3 for details

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	S10	S11	45.968	0.600	51.504	51.583	-0.079	-581.9	1200	7.77	50.0
1.001	S11	S12	27.543	0.600	51.583	51.569	0.014	1967.4	1200	8.32	50.0
1.002	S12	S13	49.356	0.600	51.569	51.505	0.064	771.2	1200	8.93	50.0
1.003	S13	S14	61.780	0.600	51.505	51.540	-0.035	-1765.1	1200	9.96	50.0
1.004	S14	S15	91.041	0.600	51.540	51.256	0.284	320.6	1200	10.69	50.0
1.005	S15	S16	54.108	0.600	51.256	50.732	0.524	103.3	1200	10.93	50.0
1.006	S16	S17	24.193	0.600	50.732	50.574	0.158	153.1	1200	11.07	50.0
1.007	S17	S18	49.600	0.600	50.574	50.175	0.399	124.3	1200	11.31	50.0
1.008	S18	S19	49.470	0.600	49.738	49.616	0.122	405.5	1200	11.76	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)
1.000	1.000	1131.0	106.4	3.660	2.926	0.241	56.0	1200
1.001	0.834	943.0	106.4	2.926	3.388	0.241	56.0	269
1.002	1.339	1514.3	314.7	3.388	3.576	1.522	56.0	368
1.003	1.000	1131.0	314.7	3.576	3.539	1.522	56.0	1200
1.004	2.084	2356.6	479.1	3.539	3.793	2.533	56.0	364
1.005	3.681	4163.4	479.1	3.793	3.008	2.533	56.0	271
1.006	3.021	3416.3	633.2	3.008	2.651	3.480	56.0	347
1.007	3.354	3793.2	633.2	2.651	1.985	3.480	56.0	328
1.008	1.851	2093.7	797.2	2.422	2.209	4.489	56.0	512

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)
1.009	S19	S20	30.470	0.600	49.616	49.631	-0.015	-2031.3	1200	12.27	50.0
1.010	S20	S21	54.454	0.600	49.631	49.374	0.257	211.9	1200	12.62	50.0
1.011	S21	S22	42.744	0.600	49.144	46.633	2.511	17.0	1200	12.70	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)
1.009	1.000	1131.0	797.2	2.209	2.050	4.489	56.0	1200
1.010	2.566	2902.0	797.2	2.050	1.966	4.489	56.0	427
1.011	9.086	10275.9	797.2	2.196	0.167	4.489	56.0	222

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S10	697540.537	732286.084	56.364	4.860	2100	0	1.000	51.504	1200
S11	697498.618	732304.949	55.709	4.126	2100	1	1.000	51.583	1200
						0	1.001	51.583	1200
S12	697476.797	732321.756	56.157	4.588	2100	1	1.001	51.569	1200
						0	1.002	51.569	1200
S13	697439.684	732354.293	56.281	4.776	2100	1	1.002	51.505	1200
						0	1.003	51.505	1200
S14	697392.842	732394.574	56.279	4.739	2100	1	1.003	51.540	1200
						0	1.004	51.540	1200
S15	697322.059	732451.830	56.249	4.993	2100	1	1.004	51.256	1200
						0	1.005	51.256	1200
S16	697278.967	732484.552	54.940	4.208	2100	1	1.005	50.732	1200
						0	1.006	50.732	1200
S17	697260.719	732500.436	54.425	3.851	2100	1	1.006	50.574	1200
						0	1.007	50.574	1200
S18	697222.611	732532.184	53.360	3.622	2100	1	1.007	50.175	1200
						0	1.008	49.738	1200

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S19	697187.134	732566.661	53.025	3.409	2100	1	1.008	49.616	1200
						0	1.009	49.616	1200
S20	697166.216	732588.816	52.881	3.250	2100	1	1.009	49.631	1200
						0	1.010	49.631	1200
S21	697197.517	732633.375	52.540	3.396	2100	1	1.010	49.374	1200
						0	1.011	49.144	1200
S22	697172.979	732668.374	48.000	1.367	2100	1	1.011	46.633	1200

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	16.500	Drain Down Time (mins)	240
Ratio-R	0.278	Additional Storage (m^3/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	20	0	0
30	20	0	0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +20% CC 15 minute summer	128.690	36.415	2 year +20% CC 480 minute summer	16.667	4.404
2 year +20% CC 15 minute winter	90.309	36.415	2 year +20% CC 480 minute winter	11.073	4.404
2 year +20% CC 30 minute summer	87.935	24.883	30 year +20% CC 15 minute summer	236.539	66.932
2 year +20% CC 30 minute winter	61.709	24.883	30 year +20% CC 15 minute winter	165.992	66.932
2 year +20% CC 60 minute summer	62.411	16.493	30 year +20% CC 30 minute summer	162.335	45.935
2 year +20% CC 60 minute winter	41.464	16.493	30 year +20% CC 30 minute winter	113.920	45.935
2 year +20% CC 120 minute summer	40.537	10.713	30 year +20% CC 60 minute summer	113.289	29.939
2 year +20% CC 120 minute winter	26.931	10.713	30 year +20% CC 60 minute winter	75.266	29.939
2 year +20% CC 180 minute summer	32.018	8.239	30 year +20% CC 120 minute summer	72.037	19.037
2 year +20% CC 180 minute winter	20.813	8.239	30 year +20% CC 120 minute winter	47.859	19.037
2 year +20% CC 240 minute summer	25.971	6.863	30 year +20% CC 180 minute summer	56.350	14.501
2 year +20% CC 240 minute winter	17.255	6.863	30 year +20% CC 180 minute winter	36.629	14.501
2 year +20% CC 360 minute summer	20.609	5.304	30 year +20% CC 240 minute summer	45.164	11.936
2 year +20% CC 360 minute winter	13.397	5.304	30 year +20% CC 240 minute winter	30.006	11.936

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +20% CC 360 minute summer	35.165	9.049	30 year +20% CC 480 minute summer	28.104	7.427
30 year +20% CC 360 minute winter	22.858	9.049	30 year +20% CC 480 minute winter	18.672	7.427

Results for 2 year +20% CC Critical Storm Duration. Lowest mass balance: 99.86%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S10	13	51.976	0.472	89.9	2.1018	0.0000	OK
15 minute winter	S11	13	51.971	0.388	84.8	1.3425	0.0000	OK
15 minute winter	S12	13	51.966	0.397	248.6	3.5927	0.0000	OK
15 minute winter	S13	13	51.941	0.436	240.2	1.5094	0.0000	OK
15 minute winter	S14	13	51.860	0.320	362.1	2.4711	0.0000	OK
15 minute winter	S15	13	51.499	0.243	362.5	0.8418	0.0000	OK
15 minute winter	S16	13	51.067	0.335	475.1	2.6660	0.0000	OK
15 minute winter	S17	13	50.875	0.301	473.1	1.0411	0.0000	OK
15 minute winter	S18	13	50.245	0.507	593.4	4.5774	0.0000	OK
15 minute winter	S19	14	50.165	0.549	589.3	1.9027	0.0000	OK
15 minute winter	S20	14	50.018	0.387	589.6	1.3396	0.0000	OK
15 minute winter	S21	14	49.348	0.204	590.2	0.7056	0.0000	OK
15 minute winter	S22	14	46.821	0.188	589.6	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S10	1.000	S11	84.8	0.525	0.075	16.6800	
15 minute winter	S11	1.001	S12	97.3	0.665	0.103	8.8111	
15 minute winter	S12	1.002	S13	240.2	0.903	0.159	17.1411	
15 minute winter	S13	1.003	S14	238.7	0.801	0.211	18.8388	
15 minute winter	S14	1.004	S15	362.5	1.805	0.154	18.3656	
15 minute winter	S15	1.005	S16	362.3	1.776	0.087	11.3495	
15 minute winter	S16	1.006	S17	473.1	1.985	0.138	5.7708	
15 minute winter	S17	1.007	S18	473.0	2.282	0.125	10.2925	
15 minute winter	S18	1.008	S19	589.3	1.237	0.281	23.5654	
15 minute winter	S19	1.009	S20	589.6	1.450	0.521	12.4382	
15 minute winter	S20	1.010	S21	590.2	2.008	0.203	16.0566	
15 minute winter	S21	1.011	S22	589.6	4.929	0.057	5.1139	1145.7

No flood recorded for all storms up to 2years return +20% CCF

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.86%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S10	13	52.106	0.602	118.4	2.6814	0.0000	OK
15 minute winter	S11	13	52.102	0.519	111.5	1.7969	0.0000	OK
15 minute winter	S12	13	52.098	0.529	420.6	4.7866	0.0000	OK
15 minute winter	S13	13	52.065	0.560	407.5	1.9407	0.0000	OK
15 minute winter	S14	13	51.971	0.431	642.3	3.3291	0.0000	OK
15 minute winter	S15	13	51.599	0.343	645.1	1.1880	0.0000	OK
15 minute winter	S16	13	51.202	0.470	858.5	3.7457	0.0000	OK
15 minute winter	S17	13	50.993	0.419	857.8	1.4503	0.0000	OK
15 minute winter	S18	13	50.471	0.733	1083.8	6.6271	0.0000	OK
15 minute winter	S19	13	50.362	0.746	1079.9	2.5854	0.0000	OK
15 minute winter	S20	14	50.174	0.543	1072.1	1.8813	0.0000	OK
15 minute winter	S21	14	49.427	0.283	1080.8	0.9795	0.0000	OK
15 minute winter	S22	14	46.886	0.253	1081.4	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S10	1.000	S11	111.5	0.530	0.099	23.7240	
15 minute winter	S11	1.001	S12	134.1	0.562	0.142	13.0169	
15 minute winter	S12	1.002	S13	407.5	0.879	0.269	24.5437	
15 minute winter	S13	1.003	S14	408.2	0.948	0.361	27.1649	
15 minute winter	S14	1.004	S15	645.1	2.056	0.274	28.6278	
15 minute winter	S15	1.005	S16	643.0	1.975	0.154	18.2543	
15 minute winter	S16	1.006	S17	857.8	2.261	0.251	9.1835	
15 minute winter	S17	1.007	S18	854.1	2.655	0.225	16.0476	
15 minute winter	S18	1.008	S19	1079.9	1.481	0.516	36.0800	
15 minute winter	S19	1.009	S20	1072.1	1.743	0.948	18.7238	
15 minute winter	S20	1.010	S21	1080.8	2.343	0.372	25.1304	
15 minute winter	S21	1.011	S22	1081.4	5.769	0.105	8.0212	1433.2

No flood recorded for all storms up to 30years return +20% CCF

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wrc

Project

Project Name: CELNRIDGE

Project Date: 04/08/2022

Inspection Standard: MSCC5 Sewers & Drainage GB (SRM5 Scoring)

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CELNRIDGE		04/08/2022

Boyne Waste Services
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Project Information

Project Name	Project Number	Project Date
CELNRIDGE		04/08/2022

Client

Company: MC CALE PLANT HIRE
Town or City: CELBRIDGE

Contractor

Company: Boyne Waste Services
Description: Waste Management Service
Contact: Terry Kerans
Street: Rathdrinagh, Navan
County: Co. Meath
Phone: 0469024860
Email: Info@boynewaste.ie

BOYNE
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BOYNE
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Scoring Summary

Project Name	Project Number	Project Date
CELNRIDGE		04/08/2022

Structural Defects

Grade 3: Best practice suggests consideration should be given to repairs in the medium term.

Grade 4: Best practice suggests consideration should be given to repairs to avoid a potential collapse.

Grade 5: Best practice suggests that this pipe is at risk of collapse at any time. Urgent consideration should be given to repairs to avoid total failure.

Section	PLR	Grade	Description
5	MH4X	4	Broken pipe from 9 o'clock to 3 o'clock

Service / Operational Condition

Grade 3: Best practice suggests consideration should be given to maintenance activities in the medium term.

Grade 4: Best practice suggests consideration should be given to maintenance activity to avoid potential blockages.

Grade 5: Best practice suggests that this pipe is at a high risk of backing up or causing flooding.

Section	PLR	Grade	Description
5	MH4X	3	Settled deposits, hard or compacted, 5% cross-sectional area loss
9	MH9X	3	Settled deposits, hard or compacted, 10% cross-sectional area loss

Abandoned Surveys

Section	PLR	Description
2	MH1.1X	Survey abandoned

Information

These scoring summaries are based on the SRM grading from the WRc.

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Section Profile

Project Name	Project Number	Project Date
CELNRIDGE		04/08/2022

Circular, 225 mm

Section	Upstream Node	Downstream Node	Date	Road	Material	Total Length	Inspected Length
1	MH1	MH2	04/08/2022		Polyvinyl chloride	64.61 m	64.61 m

Total: 1 Inspection x Circular 225 mm = 64.61 m Total Length and 64.61 m Inspected Length

Circular, 450 mm

Section	Upstream Node	Downstream Node	Date	Road	Material	Total Length	Inspected Length
3	MH2	MH3	04/08/2022		Concrete	51.00 m	51.00 m
4	MH3	MH4	04/08/2022		Concrete	19.24 m	19.24 m
5	MH4	MH5	04/08/2022		Concrete	54.20 m	**54.18 m**
6	MH5	MH6	04/08/2022		Concrete	33.60 m	33.60 m
7	MH6	MH7	04/08/2022		Concrete	17.70 m	**16.05 m**
8	MH8	MH9	04/08/2022		Concrete	29.04 m	29.04 m
9	MH9	MH10	05/08/2022		Concrete	20.46 m	21.14 m
10	MH7	MH8	05/08/2022		Concrete	32.59 m	32.59 m

Total: 8 Inspections x Circular 450 mm = 257.84 m Total Length and 256.84 m Inspected Length

Total: 9 Inspections = 322.45 m Total Length and 321.45 m Inspected Length

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Section Summary

Project Name	Project Number	Project Date
CELNRIDGE		04/08/2022

Number of sections	10
Total length of sewer network	352.62 m
Total length of inspections	351.63 m
Total length of abandoned inspections	0.00 m
Total abandoned inspections	1
Number of section inspection photos	53
Number of section inspection videos	11
Number of section inspection scans	0
Number of section inclination measurements	0

PLR:	MH1X	**Upstream Node:**	MH1
Inspection Direction:	Upstream	**Downstream Node:**	MH2
Inspected Length:	64.61 m	**Dia/Height:**	225 mm
Total Length:	64.61 m	**Material:**	Polyvinyl chloride

No.	m+	Code	Observation
1	0.00	MH	Start node type, manhole, reference number: MH2
2	0.00	WL	Water level, 5% of the vertical dimension
3	7.80	CN	Connection other than junction at 12 o'clock, diameter: 150mm
4	14.51	CN	Connection other than junction at 12 o'clock, diameter: 150mm
5	33.89	CN	Connection other than junction at 3 o'clock, diameter: 150mm
6	34.66	CN	Connection other than junction at 12 o'clock, diameter: 150mm
7	37.68	CN	Connection other than junction at 10 o'clock, diameter: 150mm
8	40.22	CN	Connection other than junction at 12 o'clock, diameter: 150mm
9	48.11	CN	Connection other than junction at 12 o'clock, diameter: 150mm
10	53.58	CN	Connection other than junction at 10 o'clock, diameter: 150mm
11	61.64	CN	Connection other than junction at 9 o'clock, diameter: 150mm
12	64.61	MHF	Finish node type, manhole, reference number: MH1
13	64.61	WL	Water level, 5% of the vertical dimension

PLR:	MH1.1X	**Upstream Node:**	MH1.1
Inspection Direction:	Upstream	**Downstream Node:**	MH1
Inspected Length:	30.17 m	**Dia/Height:**	225 mm
Total Length:	30.17 m	**Material:**	Polyvinyl chloride

No.	m+	Code	Observation
1	0.00	MH	Start node type, manhole, reference number: MH1
2	0.00	WL	Water level, 5% of the vertical dimension
3	0.98	CN	Connection other than junction at 12 o'clock, diameter: 150mm

BOYNE
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Section Summary

Project Name	Project Number	Project Date
CELNRIDGE		04/08/2022

No.	m+	Code	Observation
4	1.95	CN	Connection other than junction at 11 o'clock, diameter: 150mm
5	2.46	CN	Connection other than junction at 1 o'clock, diameter: 150mm
6	30.17	SA	Survey abandoned
7	30.17	WL	Water level, 5% of the vertical dimension

PLR:	MH2X	**Upstream Node:**	MH2
Inspection Direction:	Downstream	**Downstream Node:**	MH3
Inspected Length:	51.00 m	**Dia/Height:**	450 mm
Total Length:	51.00 m	**Material:**	Concrete

No.	m+	Code	Observation
1	0.00	MH	Start node type, manhole, reference number: MH2
2	0.00	WL	Water level, 5% of the vertical dimension
3	10.05	CN	Connection other than junction at 12 o'clock, diameter: 150mm
4	11.16	CN	Connection other than junction at 11 o'clock, diameter: 150mm
5	15.04	CNC	Connection other than junction, closed at 1 o'clock, diameter: 150mm
6	16.08	CN	Connection other than junction at 1 o'clock, diameter: 150mm
7	24.91	CN	Connection other than junction at 11 o'clock, diameter: 150mm
8	26.00	CN	Connection other than junction at 11 o'clock, diameter: 150mm
9	51.00	MHF	Finish node type, manhole, reference number: MH3
10	51.00	WL	Water level, 5% of the vertical dimension

PLR:	MH3X	**Upstream Node:**	MH3
Inspection Direction:	Downstream	**Downstream Node:**	MH4
Inspected Length:	19.24 m	**Dia/Height:**	450 mm
Total Length:	19.24 m	**Material:**	Concrete

No.	m+	Code	Observation
1	0.00	MH	Start node type, manhole, reference number: MH3
2	0.00	WL	Water level, 5% of the vertical dimension
3	1.59	CN	Connection other than junction at 12 o'clock, diameter: 150mm
4	11.24	CN	Connection other than junction at 12 o'clock, diameter: 150mm
5	19.24	MHF	Finish node type, manhole, reference number: MH4
6	19.24	WL	Water level, 5% of the vertical dimension

PLR:	MH4X	**Upstream Node:**	MH4
Inspection Direction:	Downstream	**Downstream Node:**	MH5
Inspected Length:	54.18 m	**Dia/Height:**	450 mm
Total Length:	54.20 m	**Material:**	Concrete

No.	m+	Code	Observation
1	0.02	MH	Start node type, manhole, reference number: MH4
2	0.02	WL	Water level, 5% of the vertical dimension
3	7.48	CN	Connection other than junction at 12 o'clock, diameter: 150mm
4	8.42	CN	Connection other than junction at 10 o'clock, diameter: 150mm
5	12.27	CN	Connection other than junction at 1 o'clock, diameter: 150mm
6	28.80	CN	Connection other than junction at 2 o'clock, diameter: 150mm
7	34.40	DEC	Settled deposits, hard or compacted, 5% cross-sectional area loss

BOYNE
WASTE SERVICES

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Section Summary

Project Name	Project Number	Project Date
CELNRIDGE		04/08/2022

No.	m+	Code	Observation
8	34.87	CN	Connection other than junction at 12 o'clock, diameter: 150mm
9	35.41	CL	Crack, longitudinal at 12 o'clock
10	35.90	CN	Connection other than junction at 12 o'clock, diameter: 150mm
11	37.02	CN	Connection other than junction at 12 o'clock, diameter: 150mm
12	46.69	B	Broken pipe from 9 o'clock to 3 o'clock
13	54.07	WL	Water level, 5% of the vertical dimension
14	54.20	MHF	Finish node type, manhole, reference number: MH5

PLR:	MH5X	**Upstream Node:**	MH5
Inspection Direction:	Downstream	**Downstream Node:**	MH6
Inspected Length:	33.60 m	**Dia/Height:**	450 mm
Total Length:	33.60 m	**Material:**	Concrete

No.	m+	Code	Observation
1	0.00	MH	Start node type, manhole, reference number: MH5
2	0.00	WL	Water level, 5% of the vertical dimension
3	1.63	CN	Connection other than junction at 11 o'clock, diameter: 100mm
4	10.68	CN	Connection other than junction at 12 o'clock, diameter: 100mm
5	11.50	CN	Connection other than junction at 12 o'clock, diameter: 100mm
6	13.05	CN	Connection other than junction at 12 o'clock, diameter: 100mm
7	14.01	CN	Connection other than junction at 12 o'clock, diameter: 100mm
8	33.60	MHF	Finish node type, manhole, reference number: MH6
9	33.60	WL	Water level, 5% of the vertical dimension

PLR:	MH6X	**Upstream Node:**	MH6
Inspection Direction:	Downstream	**Downstream Node:**	MH7
Inspected Length:	16.05 m	**Dia/Height:**	450 mm
Total Length:	17.70 m	**Material:**	Concrete

No.	m+	Code	Observation
1	0.05	MH	Start node type, manhole, reference number: MH6
2	0.05	WL	Water level, 5% of the vertical dimension
3	12.15	CN	Connection other than junction at 12 o'clock, diameter: 150mm
4	15.79	WL	Water level, 5% of the vertical dimension
5	16.10	MHF	Finish node type, manhole, reference number: MH7

PLR:	MH8X	**Upstream Node:**	MH8
Inspection Direction:	Downstream	**Downstream Node:**	MH9
Inspected Length:	29.04 m	**Dia/Height:**	450 mm
Total Length:	29.04 m	**Material:**	Concrete

No.	m+	Code	Observation
1	0.00	MH	Start node type, manhole, reference number: MH8
2	0.00	WL	Water level, 5% of the vertical dimension
3	2.82	CN	Connection other than junction at 12 o'clock, diameter: 150mm
4	11.79	WL	Water level, 20% of the vertical dimension
5	21.84	CN	Connection other than junction at 12 o'clock, diameter: 150mm
6	25.78	WL	Water level, 60% of the vertical dimension

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Section Summary

Project Name	Project Number	Project Date
CELNRIDGE		04/08/2022

No.	m+	Code	Observation
7	29.03	WL	Water level, 40% of the vertical dimension
8	29.04	MHF	Finish node type, manhole, reference number: MH9

PLR:	MH9X	**Upstream Node:**	MH9
Inspection Direction:	Downstream	**Downstream Node:**	MH10
Inspected Length:	21.14 m	**Dia/Height:**	450 mm
Total Length:	20.46 m	**Material:**	Concrete

No.	m+	Code	Observation
1	-0.68	CN	Connection other than junction at 12 o'clock, diameter: 150mm
2	0.00	MH	Start node type, manhole, reference number: MH8
3	0.00	WL	Water level, 5% of the vertical dimension
4	9.88	DEC	Settled deposits, hard or compacted, 10% cross-sectional area loss
5	12.89	CN	Connection other than junction at 12 o'clock, diameter: 150mm
6	20.46	MHF	Finish node type, manhole, reference number: MH9
7	20.46	WL	Water level, 50% of the vertical dimension

PLR:	MH7X	**Upstream Node:**	MH7
Inspection Direction:	Downstream	**Downstream Node:**	MH8
Inspected Length:	32.59 m	**Dia/Height:**	450 mm
Total Length:	32.59 m	**Material:**	Concrete

No.	m+	Code	Observation
1	0.00	MH	Start node type, manhole, reference number: MH7
2	0.00	WL	Water level, 5% of the vertical dimension
3	5.74	CN	Connection other than junction at 12 o'clock, diameter: 150mm
4	24.95	CN	Connection other than junction at 11 o'clock, diameter: 150mm
5	32.59	WL	Water level, 5% of the vertical dimension
6	32.59	MHF	Finish node type, manhole, reference number: MH8

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Section Inspection - 04/08/2022 - MH1X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
1	1	04/08/22	10:52	Not Specified	Not Specified	Not Specified	MH1X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

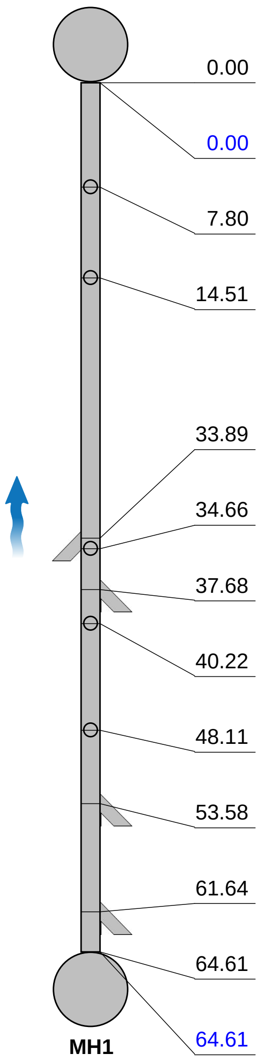
Town or Village:		**Inspection Direction:**	Upstream	**Upstream Node:**	MH1
Road:		**Inspected Length:**	64.61 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	64.61 m	**Downstream Node:**	MH2
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:		**Dia/Height:**	225 mm
Year Constructed:		**Material:**	Polyvinyl chloride
Flow Control:		**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: **1:562**

Depth: m
MH2



MH1
Depth: m

Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node type, manhole, reference number: MH2	00:00:01		
0.00	WL	Water level, 5% of the vertical dimension	00:00:02		
7.80	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:00:38	MH1X_c59e1057-652b-4675-b5f	
14.51	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:01:11	MH1X_d9aab10f-7e2f-4dd3-80	
33.89	CN	Connection other than junction at 3 o'clock, diameter: 150mm	00:02:25	MH1X_94586d56-b03d-4219-8	
34.66	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:02:33	MH1X_919a2f75-a54f-4835-92	
37.68	CN	Connection other than junction at 10 o'clock, diameter: 150mm	00:02:48	MH1X_ee1c0f99-87a8-4087-8f	
40.22	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:03:02	MH1X_df94edc2-c377-4cb8-bc	
48.11	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:03:34	MH1X_57d0c272-1b53-45a2-a	
53.58	CN	Connection other than junction at 10 o'clock, diameter: 150mm	00:04:01	MH1X_bfc75bec-4735-4d00-81	
61.64	CN	Connection other than junction at 9 o'clock, diameter: 150mm	00:04:39	MH1X_29b6fb07-e6ee-477f-82	
64.61	MHF	Finish node type, manhole, reference number: MH1	00:05:02	MH1X_3fdef57e-0be9-4e71-afe	
64.61	WL	Water level, 5% of the vertical dimension	00:04:59		

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	0	0.0	0.0	0.0	1.0

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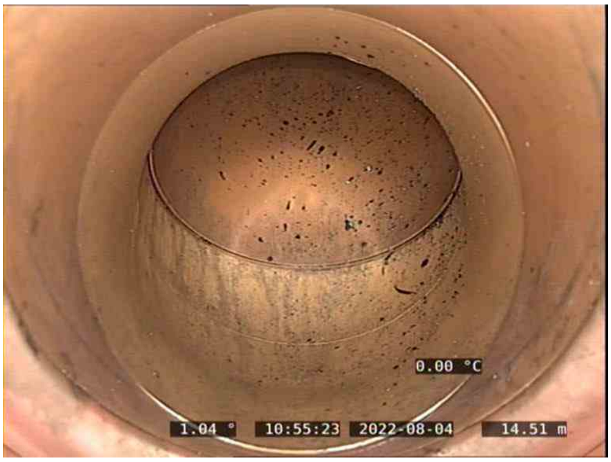
Section Pictures - 04/08/2022 - MH1X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
1	Upstream	MH1X		

MH1X_c59e1057-652b-4675-b5fb-71543a52f9b3_20220804_121302_668.jpg, 00:00:38, 7.80 m
Connection other than junction at 12 o'clock, diameter: 150mm



MH1X_d9aab10f-7e2f-4dd3-80fa-f1b6acda4d06_20220804_121342_777.jpg, 00:01:11, 14.51 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH1X_94586d56-b03d-4219-8d0e-ef077a339e11_20220804_121504_889.jpg, 00:02:25, 33.89 m
Connection other than junction at 3 o'clock, diameter: 150mm

MH1X_919a2f75-a54f-4835-92be-6198dc03eb63_20220804_121519_569.jpg, 00:02:33, 34.66 m
Connection other than junction at 12 o'clock, diameter: 150mm

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Section Pictures - 04/08/2022 - MH1X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
1	Upstream	MH1X		

MH1X_ee1c0f99-87a8-4087-8f07-f0800bf0e12d_20220804_121542_999.jpg, 00:02:48, 37.68 m
Connection other than junction at 10 o'clock, diameter: 150mm

MH1X_df94edc2-c377-4cb8-bc71-2699117895ee_20220804_121604_615.jpg, 00:03:02, 40.22 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH1X_57d0c272-1b53-45a2-a4a9-7421570706f0_20220804_121647_528.jpg, 00:03:34, 48.11 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH1X_bfc75bec-4735-4d00-8117-5ff57860b03f_20220804_121724_311.jpg, 00:04:01, 53.58 m
Connection other than junction at 10 o'clock, diameter: 150mm

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Section Pictures - 04/08/2022 - MH1X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
1	Upstream	MH1X		

MH1X_29b6fb07-e6ee-477f-82b9-db043515d9ac_20220804_121812_773.jpg, 00:04:39, 61.64 m
Connection other than junction at 9 o'clock, diameter: 150mm

MH1X_3fdef57e-0be9-4e71-afe2-355dc82f51ad_20220804_121855_215.jpg, 00:05:02, 64.61 m
Finish node type, manhole, reference number: MH1

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Section Inspection - 04/08/2022 - MH1.1X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
2	1	04/08/22	11:43	Not Specified	Not Specified	Not Specified	MH1.1X

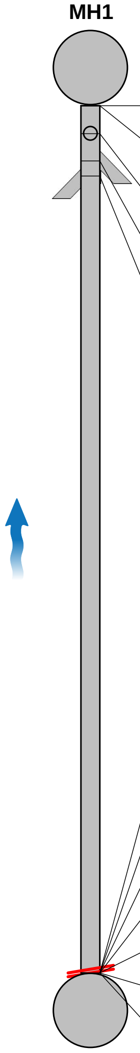
Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

Town or Village:		**Inspection Direction:**	Upstream	**Upstream Node:**	MH1.1
Road:		**Inspected Length:**	30.17 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	30.17 m	**Downstream Node:**	MH1
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:		**Dia/Height:**	225 mm
Year Constructed:		**Material:**	Polyvinyl chloride
Flow Control:		**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:263



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node type, manhole, reference number: MH1	00:00:05		
0.00	WL	Water level, 5% of the vertical dimension	00:00:05		
0.98	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:00:10	MH1.1X_eb26a47c-e8d7-4cdc-	
1.95	CN	Connection other than junction at 11 o'clock, diameter: 150mm	00:00:17	MH1.1X_2df983e1-084d-4531-	
2.46	CN	Connection other than junction at 1 o'clock, diameter: 150mm	00:00:23	MH1.1X_23de506c-98d2-4258-	
30.17	C	Remark: ***** Combined *****			
30.17	C	Remark: Inspection from the other side			
30.17	C	Remark: Uninspected Length: 0.0			
30.17	C	Remark: Inspection from the other side			
30.17	C	Remark: ***** Combined *****			
30.17	SA	Survey abandoned: CAP IN LINE	00:02:52	MH1.1X_9d9612db-57f7-4430-8	
30.17	WL	Water level, 5% of the vertical dimension	00:02:51		

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	0	0.0	0.0	0.0	1.0

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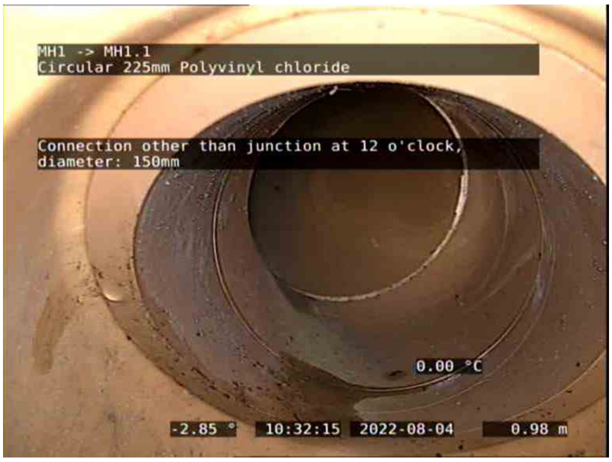
Section Pictures - 04/08/2022 - MH1.1X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
2	Upstream	MH1.1X		



MH1.1X_eb26a47c-e8d7-4cdc-8ef7-24576831a7a5_20220804_115034_873.jpg, 00:00:10, 0.98 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH1.1X_2df983e1-084d-4531-a5d4-77eb7f9ac8f0_20220804_115052_484.jpg, 00:00:17, 1.95 m
Connection other than junction at 11 o'clock, diameter: 150mm

MH1.1X_23de506c-98d2-4258-9eee-1a5e4b4a140f_20220804_115107_227.jpg, 00:00:23, 2.46 m
Connection other than junction at 1 o'clock, diameter: 150mm

MH1.1X_9d9612db-57f7-4430-8fa4-a6007b2ed667_20220804_115347_738.jpg, 00:02:52, 30.17 m
Survey abandoned, CAP IN LINE

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Section Inspection - 04/08/2022 - MH2X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
3	1	04/08/22	13:36	Not Specified	Not Specified	Not Specified	MH2X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

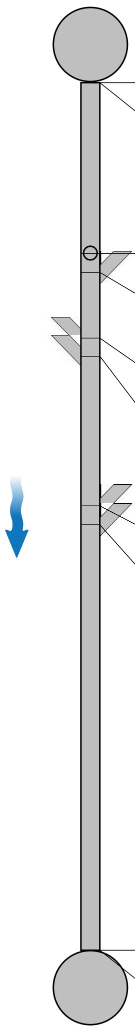
Town or Village:		**Inspection Direction:**	Downstream	**Upstream Node:**	MH2
Road:		**Inspected Length:**	51.00 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	51.00 m	**Downstream Node:**	MH3
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:		**Dia/Height:**	450 mm
Year Constructed:		**Material:**	Concrete
Flow Control:		**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: **1:444**

Depth: m
MH2



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node type, manhole, reference number: MH2	00:00:01		
0.00	WL	Water level, 5% of the vertical dimension	00:00:01		
10.05	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:00:33	MH2X_74 82183b-d5 ff-479a-a0	
11.16	CN	Connection other than junction at 11 o'clock, diameter: 150mm	00:00:45	MH2X_93 004614-2d ab-4f1f-be	
15.04	CNC	Connection other than junction, closed at 1 o'clock, diameter: 150mm	00:01:05	MH2X_66 6c2b3b-85 b3-4103-a	
16.08	CN	Connection other than junction at 1 o'clock, diameter: 150mm	00:01:14	MH2X_0fb efb3f-81ea -41ca-8cd	
24.91	CN	Connection other than junction at 11 o'clock, diameter: 150mm	00:01:44	MH2X_be e51b38-34 24-4548-9	
26.00	CN	Connection other than junction at 11 o'clock, diameter: 150mm	00:00:00	MH2X_dd 127a78-8b 3f-426c-97	
51.00	MHF	Finish node type, manhole, reference number: MH3	00:01:42	MH2X_b0 0454b0-83 f7-4a2c-9b	
51.00	WL	Water level, 5% of the vertical dimension	00:01:36		

MH3
Depth: m

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	0	0.0	0.0	0.0	1.0

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Section Pictures - 04/08/2022 - MH2X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
3	Downstream	MH2X		

MH2X_7482183b-d5ff-479a-a0ec-112988d212a8_20220804_141425_772.jpg, 00:00:33, 10.05 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH2X_93004614-2dab-4f1f-be98-76fc9a9a2bfa_20220804_141446_221.jpg, 00:00:45, 11.16 m
Connection other than junction at 11 o'clock, diameter: 150mm

MH2X_666c2b3b-85b3-4103-aea0-eb7b00f0e43d_20220804_141516_528.jpg, 00:01:05, 15.04 m
Connection other than junction, closed at 1 o'clock, diameter: 150mm

MH2X_0fbefb3f-81ea-41ca-8cd9-dafe8da40b41_20220804_141534_444.jpg, 00:01:14, 16.08 m
Connection other than junction at 1 o'clock, diameter: 150mm

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Section Pictures - 04/08/2022 - MH2X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
3	Downstream	MH2X		

MH2X_bee51b38-3424-4548-923f-fe8398646836_20220804_141613_321.jpg, 00:01:44, 24.91 m
Connection other than junction at 11 o'clock, diameter: 150mm

MH2X_dd127a78-8b3f-426c-9723-177f43cbf157_20220804_141633_588.jpg, 00:00:00, 26.00 m
Connection other than junction at 11 o'clock, diameter: 150mm

MH2X_b00454b0-83f7-4a2c-9b09-4c48b9ac647b_20220804_142538_780.jpg, 00:01:42, 51.00 m
Finish node type, manhole, reference number: MH3

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Section Inspection - 04/08/2022 - MH3X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
4	1	04/08/22	13:37	Not Specified	Not Specified	Not Specified	MH3X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

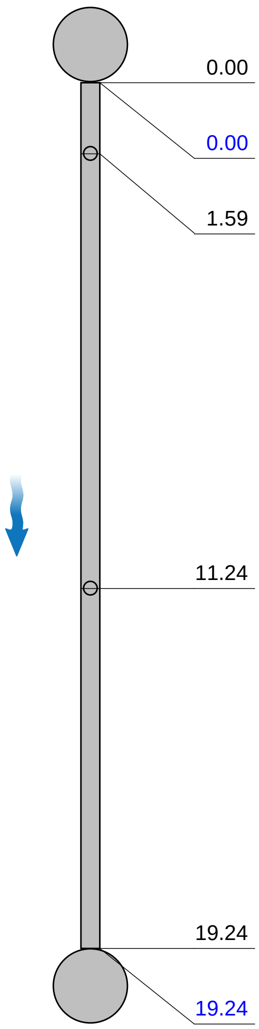
Town or Village:		**Inspection Direction:**	Downstream	**Upstream Node:**	MH3
Road:		**Inspected Length:**	19.24 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	19.24 m	**Downstream Node:**	MH4
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:		**Dia/Height:**	450 mm
Year Constructed:		**Material:**	Concrete
Flow Control:		**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: **1:168**

Depth: m
MH3



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node type, manhole, reference number: MH3	00:00:07		
0.00	WL	Water level, 5% of the vertical dimension	00:00:08		
1.59	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:00:23	MH3X_59 44b09f-6b 3e-4628-a	
11.24	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:01:02		
19.24	MHF	Finish node type, manhole, reference number: MH4	00:01:37	MH3X_66 dc5b38-db c4-479a-9	
19.24	WL	Water level, 5% of the vertical dimension	00:01:33		

MH4
Depth: m

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	0	0.0	0.0	0.0	1.0

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Section Pictures - 04/08/2022 - MH3X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
4	Downstream	MH3X		

MH3X_5944b09f-6b3e-4628-ad87-44621e35d087_20220804_163534_120.jpg, 00:00:23, 1.59 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH3X_66dc5b38-dbc4-479a-97a2-ba4f1dc3f7ed_20220804_163709_772.jpg, 00:01:37, 19.24 m
Finish node type, manhole, reference number: MH4

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Section Inspection - 04/08/2022 - MH4X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
5	1	04/08/22	14:49	Not Specified	Not Specified	Not Specified	MH4X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

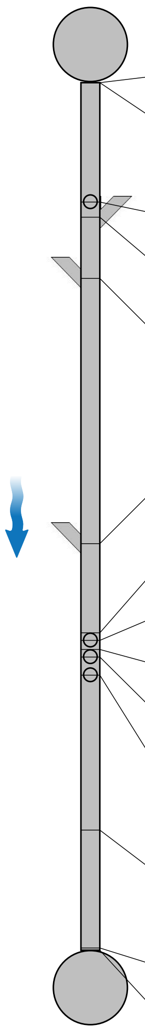
Town or Village:		**Inspection Direction:**	Downstream	**Upstream Node:**	MH4
Road:		**Inspected Length:**	54.18 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	54.20 m	**Downstream Node:**	MH5
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:		**Dia/Height:**	450 mm
Year Constructed:		**Material:**	Concrete
Flow Control:		**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: **1:472**

Depth: m
MH4



MH5
Depth: m

Position [m]	Code	Observation	MPEG	Photo	Grade
0.02	MH	Start node type, manhole, reference number: MH4	00:00:03		
0.02	WL	Water level, 5% of the vertical dimension	00:00:05		
7.48	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:00:30	MH4X_92050bf0-f740-4607-9b	
8.42	CN	Connection other than junction at 10 o'clock, diameter: 150mm	00:00:40	MH4X_d2172e04-21e3-4639-9	
12.27	CN	Connection other than junction at 1 o'clock, diameter: 150mm	00:00:59	MH4X_f9fb5a8f-5cf2-4926-9ab	
28.80	CN	Connection other than junction at 2 o'clock, diameter: 150mm	00:01:53	MH4X_3820b1cc-3fdb-46e6-b	
34.40	DEC	Settled deposits, hard or compacted, 5% cross-sectional area loss	00:02:13	MH4X_8c2c4c15-0083-4a6c-98	3
34.87	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:02:24	MH4X_b957c167-655b-45b4-8	
35.41	CL	Crack, longitudinal at 12 o'clock	00:02:37	MH4X_c4c76fa8-e3ef-4675-af0d	2 / 2
35.90	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:02:47	MH4X_bb7a1c2d-76d3-4f1f-8d	
37.02	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:02:55	MH4X_c62315f6-b43b-4b93-b0	
46.69	B	Broken pipe from 9 o'clock to 3 o'clock	00:03:27	MH4X_aa8623a6-4cc7-4b5b-9	4
54.07	WL	Water level, 5% of the vertical dimension	00:03:52		
54.20	MHF	Finish node type, manhole, reference number: MH5	00:03:58	MH4X_c982e121-5ee6-4a2f-a20	

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
2	80.0	0.0	90.0	4.0	2	2.0	0.0	3.0	3.0

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Section Pictures - 04/08/2022 - MH4X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
5	Downstream	MH4X		

MH4X_92050bf0-f740-4607-9b7b-0fe72b8dc872_20220805_172843_281.jpg, 00:00:30, 7.48 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH4X_d2172e04-21e3-4639-9c44-073264f7bc07_20220805_172907_873.jpg, 00:00:40, 8.42 m
Connection other than junction at 10 o'clock, diameter: 150mm

MH4X_f9fb5a8f-5cf2-4926-9ab0-6a22cdceed50_20220805_172938_252.jpg, 00:00:59, 12.27 m
Connection other than junction at 1 o'clock, diameter: 150mm

MH4X_3820b1cc-3fdb-46e6-ba0c-613c482e512a_20220805_173038_719.jpg, 00:01:53, 28.80 m
Connection other than junction at 2 o'clock, diameter: 150mm

Section Pictures - 04/08/2022 - MH4X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
5	Downstream	MH4X		

MH4X_8c2c4c15-0083-4a6c-9828-72418e1577c4_20220805_173111_103.jpg, 00:02:13, 34.40 m
Settled deposits, hard or compacted, 5% cross-sectional area loss

MH4X_b957c167-655b-45b4-8396-585a4c5eb49d_20220805_173133_527.jpg, 00:02:24, 34.87 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH4X_c4c76fa8-e3ef-4675-af0d-2880a4e39879_20220805_173212_533.jpg, 00:02:37, 35.41 m
Crack, longitudinal at 12 o'clock

MH4X_bb7a1c2d-76d3-4f1f-8d7e-f57be96ffa52_20220805_173227_966.jpg, 00:02:47, 35.90 m
Connection other than junction at 12 o'clock, diameter: 150mm

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Section Pictures - 04/08/2022 - MH4X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
5	Downstream	MH4X		

MH4X_c62315f6-b43b-4b93-b076-27b8a2d1c621_20220805_173242_641.jpg, 00:02:55, 37.02 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH4X_aa8623a6-4cc7-4b5b-9792-67304da7b6f0_20220805_173322_595.jpg, 00:03:27, 46.69 m
Broken pipe from 9 o'clock to 3 o'clock

MH4X_c982e121-5ee6-4a2f-a205-f978410f3d16_20220805_173403_908.jpg, 00:03:58, 54.20 m
Finish node type, manhole, reference number: MH5

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Section Inspection - 04/08/2022 - MH5X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
6	1	04/08/22	14:50	Not Specified	Not Specified	Not Specified	MH5X
Operator		**Vehicle**		**Camera**	**Preset Length**	**Legal Status**	**Alternative ID**
Not Specified		Not Specified		Not Specified	Not Specified	Not Specified	Not Specified

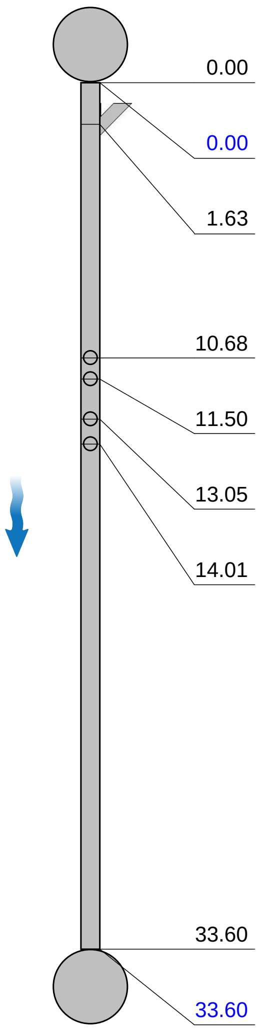
Town or Village:		**Inspection Direction:**	Downstream	**Upstream Node:**	MH5
Road:		**Inspected Length:**	33.60 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	33.60 m	**Downstream Node:**	MH6
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:		**Dia/Height:**	450 mm
Year Constructed:		**Material:**	Concrete
Flow Control:		**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: **1:293**

Depth: m
MH5



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node type, manhole, reference number: MH5	00:00:01		
0.00	WL	Water level, 5% of the vertical dimension	00:00:01		
1.63	CN	Connection other than junction at 11 o'clock, diameter: 100mm	00:00:16	MH5X_00ef02e1-d7ae-46a4-9	
10.68	CN	Connection other than junction at 12 o'clock, diameter: 100mm	00:00:50	MH5X_298aa1be-bd16-47c7-9	
11.50	CN	Connection other than junction at 12 o'clock, diameter: 100mm	00:00:56	MH5X_9a3bcb6c-8a19-4129-8	
13.05	CN	Connection other than junction at 12 o'clock, diameter: 100mm	00:01:04	MH5X_2f53dd40-0308-4f60-a98	
14.01	CN	Connection other than junction at 12 o'clock, diameter: 100mm	00:01:08	MH5X_c3ea5c05-a3c9-404c-a9	
33.60	MHF	Finish node type, manhole, reference number: MH6	00:02:11	MH5X_6d89e4dd-bb26-4e1c-9	
33.60	WL	Water level, 5% of the vertical dimension	00:02:06		

MH6
Depth: m

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	0	0.0	0.0	0.0	1.0

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Section Pictures - 04/08/2022 - MH5X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
6	Downstream	MH5X		

MH5X_00ef02e1-d7ae-46a4-986d-423b8e6d8f3e_20220804_145955_364.jpg, 00:00:16, 1.63 m
Connection other than junction at 11 o'clock, diameter: 100mm

MH5X_298aa1be-bd16-47c7-9377-e1a066887a31_20220804_150035_500.jpg, 00:00:50, 10.68 m
Connection other than junction at 12 o'clock, diameter: 100mm

MH5X_9a3bcb6c-8a19-4129-8283-d12bec9899ee_20220804_150051_413.jpg, 00:00:56, 11.50 m
Connection other than junction at 12 o'clock, diameter: 100mm

MH5X_2f53dd40-0308-4f60-a98e-8cc3040b2a7f_20220804_150106_148.jpg, 00:01:04, 13.05 m
Connection other than junction at 12 o'clock, diameter: 100mm

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Section Pictures - 04/08/2022 - MH5X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
6	Downstream	MH5X		

MH5X_c3ea5c05-a3c9-404c-a91c-e7099bafd223_20220804_150118_331.jpg, 00:01:08, 14.01 m
Connection other than junction at 12 o'clock, diameter: 100mm

MH5X_6d89e4dd-bb26-4e1c-906e-07a0eba9e581_20220804_150228_422.jpg, 00:02:11, 33.60 m
Finish node type, manhole, reference number: MH6

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Section Inspection - 04/08/2022 - MH6X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
7	1	04/08/22	14:53	Not Specified	Not Specified	Not Specified	MH6X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

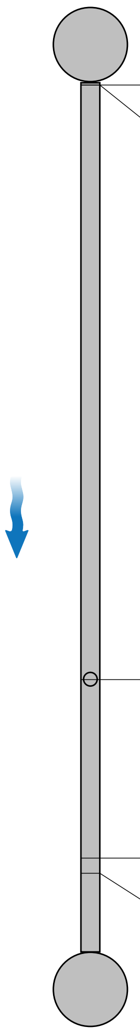
Town or Village:		**Inspection Direction:**	Downstream	**Upstream Node:**	MH6
Road:		**Inspected Length:**	16.05 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	17.70 m	**Downstream Node:**	MH7
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:		**Dia/Height:**	450 mm
Year Constructed:		**Material:**	Concrete
Flow Control:		**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: **1:154**

Depth: m
MH6



MH7
Depth: m

Position [m]	Code	Observation	MPEG	Photo	Grade
0.05	MH	Start node type, manhole, reference number: MH6	00:00:01		
0.05	WL	Water level, 5% of the vertical dimension	00:00:02		
12.15	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:00:43	MH6X_a13bbe58-4804-48f6-a7	
15.79	WL	Water level, 5% of the vertical dimension	00:01:01		
16.10	MHF	Finish node type, manhole, reference number: MH7	00:01:26	MH6X_8e92713d-7006-4241-b	

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	0	0.0	0.0	0.0	1.0

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Section Pictures - 04/08/2022 - MH6X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
7	Downstream	MH6X		

MH6X_a13bbe58-4804-48f6-a760-cd3fb3e73915_20220805_161305_076.jpg, 00:00:43, 12.15 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH6X_8e92713d-7006-4241-bd2f-b0ae56d4a3e7_20220805_161401_064.jpg, 00:01:26, 16.10 m
Finish node type, manhole, reference number: MH7

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Section Inspection - 04/08/2022 - MH8X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
8	1	04/08/22	15:34	Not Specified	Not Specified	Not Specified	MH8X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

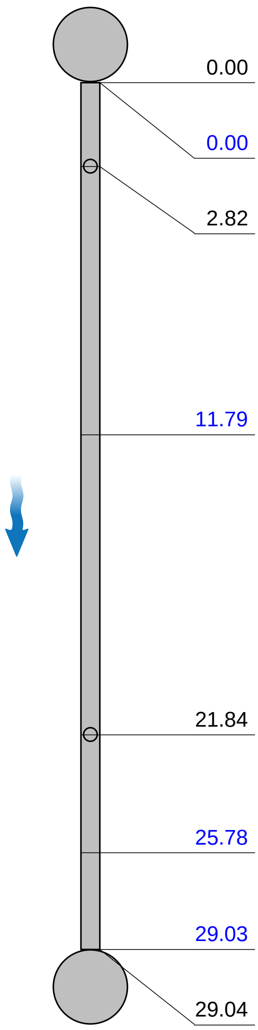
Town or Village:		**Inspection Direction:**	Downstream	**Upstream Node:**	MH8
Road:		**Inspected Length:**	29.04 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	29.04 m	**Downstream Node:**	MH9
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:		**Dia/Height:**	450 mm
Year Constructed:		**Material:**	Concrete
Flow Control:		**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: **1:253**

Depth: m
MH8



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node type, manhole, reference number: MH8	00:00:01		
0.00	WL	Water level, 5% of the vertical dimension	00:00:02		
2.82	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:00:22	MH8X_9b b48e7c-6a ae-4410-b	
11.79	WL	Water level, 20% of the vertical dimension	00:00:53		
21.84	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:01:35	MH8X_54 369bac-51 d1-4a4a-8f	
25.78	WL	Water level, 60% of the vertical dimension	00:02:01		
29.03	WL	Water level, 40% of the vertical dimension	00:02:45		
29.04	MHF	Finish node type, manhole, reference number: MH9	00:02:47	MH8X_29 90f5ed-9d 5b-450f-8d	

MH9
Depth: m

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	0	0.0	0.0	0.0	1.0

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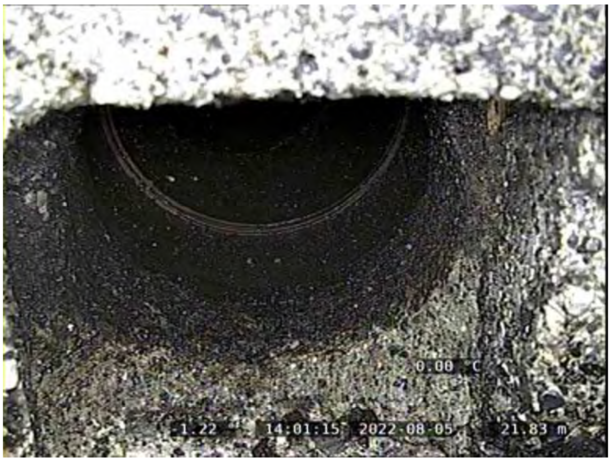
Section Pictures - 04/08/2022 - MH8X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
8	Downstream	MH8X		

MH8X_9bb48e7c-6aae-4410-b7f9-bf8978277f6b_20220805_151812_737.jpg, 00:00:22, 2.82 m
Connection other than junction at 12 o'clock, diameter: 150mm



MH8X_54369bac-51d1-4a4a-8fae-aa22ed78e9c6_20220805_151939_572.jpg, 00:01:35, 21.84 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH8X_2990f5ed-9d5b-450f-8d1c-ecebac531aa9_20220805_152104_711.jpg, 00:02:47, 29.04 m
Finish node type, manhole, reference number: MH9

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Section Inspection - 05/08/2022 - MH9X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
9	1	05/08/22	12:03	Not Specified	Not Specified	Not Specified	MH9X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

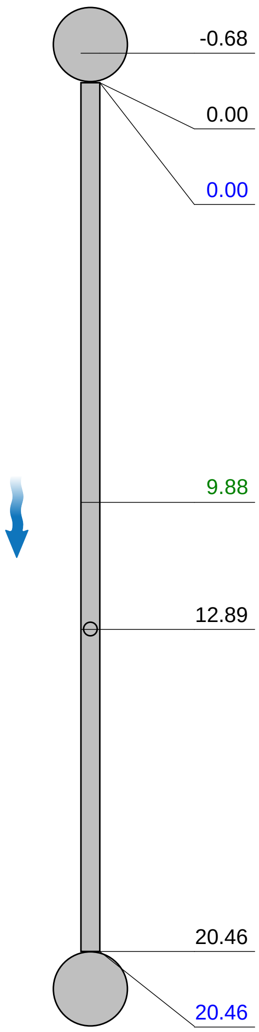
Town or Village:		**Inspection Direction:**	Downstream	**Upstream Node:**	MH9
Road:		**Inspected Length:**	21.14 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	20.46 m	**Downstream Node:**	MH10
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:		**Dia/Height:**	450 mm
Year Constructed:		**Material:**	Concrete
Flow Control:		**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: **1:178**

Depth: m
MH9



Position [m]	Code	Observation	MPEG	Photo	Grade
-0.68	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:00:24	MH9X_55eb9941-6ede-49a7-9	
0.00	MH	Start node type, manhole, reference number: MH8	00:00:06		
0.00	WL	Water level, 5% of the vertical dimension	00:00:06		
9.88	DEC	Settled deposits, hard or compacted, 10% cross-sectional area loss	00:01:22	MH9X_787e869a-8378-4749-a	3
12.89	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:01:58	MH9X_9ecf4b2d-1af4-40b8-b06	
20.46	MHF	Finish node type, manhole, reference number: MH9	00:02:57	MH9X_bef71765-3064-4345-a1	
20.46	WL	Water level, 50% of the vertical dimension	00:02:56	MH9X_91d419d6-71e4-419a-9	

MH10
Depth: m

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	1	2.0	0.0	2.0	3.0

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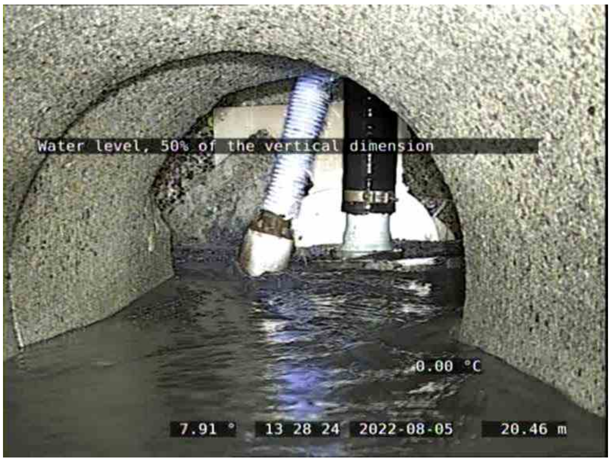
Section Pictures - 05/08/2022 - MH9X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
9	Downstream	MH9X		

MH9X_55eb9941-6ede-49a7-9ce2-b5dd9289a6e8_20220805_144337_418.jpg, 00:00:24, -0.68 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH9X_787e869a-8378-4749-a37d-4b26b602aa63_20220805_144445_918.jpg, 00:01:22, 9.88 m
Settled deposits, hard or compacted, 10% cross-sectional area loss

MH9X_9ecf4b2d-1af4-40b8-b06e-abfc7873eb98_20220805_144532_231.jpg, 00:01:58, 12.89 m
Connection other than junction at 12 o'clock, diameter: 150mm



MH9X_bef71765-3064-4345-a152-cb3d374b75d8_20220805_144648_586.jpg, 00:02:57, 20.46 m
Finish node type, manhole, reference number: MH9

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Section Pictures - 05/08/2022 - MH9X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
9	Downstream	MH9X		

MH9X_91d419d6-71e4-419a-9e57-8c79d224374a_20220805_144643_656.jpg, 00:02:56, 20.46 m
Water level, 50% of the vertical dimension

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Section Inspection - 05/08/2022 - MH7X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
10	1	05/08/22	16:14	Not Specified	Not Specified	Not Specified	MH7X

Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
Not Specified	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified

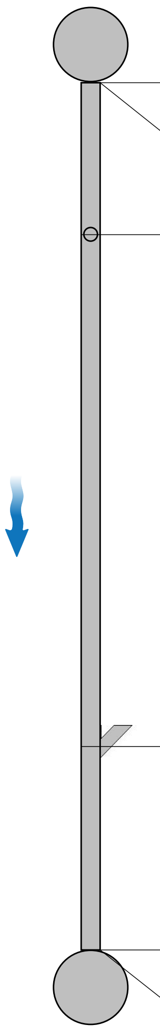
Town or Village:		**Inspection Direction:**	Downstream	**Upstream Node:**	MH7
Road:		**Inspected Length:**	32.59 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	32.59 m	**Downstream Node:**	MH8
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Surface water	**Pipe Shape:**	Circular
Type of Pipe:		**Dia/Height:**	450 mm
Year Constructed:		**Material:**	Concrete
Flow Control:		**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: **1:284**

Depth: m
MH7



MH8
Depth: m

Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node type, manhole, reference number: MH7	00:00:01		
0.00	WL	Water level, 5% of the vertical dimension	00:00:02		
5.74	CN	Connection other than junction at 12 o'clock, diameter: 150mm	00:00:25	MH7X_f82 40791-451 2-47cd-86	
24.95	CN	Connection other than junction at 11 o'clock, diameter: 150mm	00:01:44	MH7X_76 a1a7cf-80 ab-4d9b-a	
32.59	WL	Water level, 5% of the vertical dimension	00:02:13		
32.59	MHF	Finish node type, manhole, reference number: MH8	00:02:16	MH7X_58 041a47-fa aa-4b3f-bd	

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	0	0.0	0.0	0.0	1.0

BOYNE
WASTE SERVICES

Boyne Waste Services
Rathdrinagh, Navan
Tel. 0469024860
Info@boynewaste.ie

Section Pictures - 05/08/2022 - MH7X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
10	Downstream	MH7X		

MH7X_f8240791-4512-47cd-8631-766719a8df01_20220805_163057_381.jpg, 00:00:25, 5.74 m
Connection other than junction at 12 o'clock, diameter: 150mm

MH7X_76a1a7cf-80ab-4d9b-a6c7-ca2d42bbfd2d_20220805_164623_993.jpg, 00:01:44, 24.95 m
Connection other than junction at 11 o'clock, diameter: 150mm

MH7X_58041a47-faaa-4b3f-bdfc-3aee8cd1e9f3_20220805_164706_089.jpg, 00:02:16, 32.59 m
Finish node type, manhole, reference number: MH8

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WinCan

Notes:

Thank you for choosing to use WinCan to carry out your drainage investigation works.

The results and views carried in this report are those of the engineer(s) appointed to carry out the investigation and are considered relevant on the day of the survey. Drain and sewer performance is known to alter over time, so liability cannot be accepted for differences between the recorded data and the actual data at a time after this report was generated.

This survey has been created in accordance with the drainage standard used in the country and language settings for this PC.

If a DVD has been supplied with this report, please not that it can only be used in a Windows based PC. Please browse the DVD and navigate to the PDF folder to find project-based documents such as drawings, engineer's site notes and survey specifications amongst others.

CCTV subsidence investigations do not account for the water tightness of the pipes and are merely a visual inspection of inside of the drains. CCTV drainage engineers are generally not qualified to comment on the causes of subsidence, and can only suggest required remedial actions for the pipes, and not the affected buildings.

Subsidence is a building structural failure, which can occur for many reasons. Although drainage failures can contribute to subsidence problems, other causes should always be investigated as part of a considered approach. In order to eliminate drains from suspicion, WinCan suggests that all pipes within at least 10m of the subsidence area be pressure tested over and above a CCTV inspection, and remedial suggestions considered based on the findings.

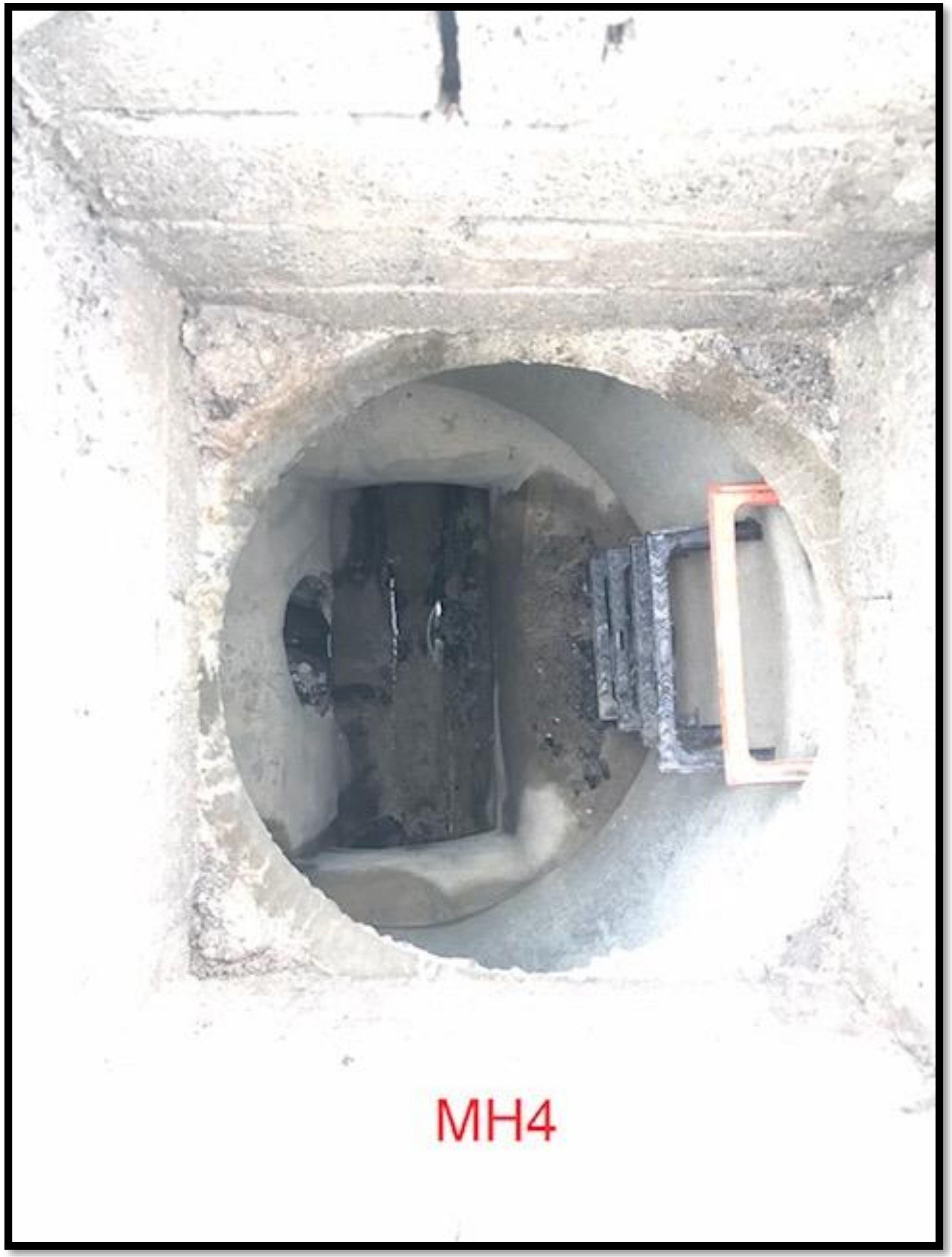
Unless otherwise specified in an associated task order (or similar), the data gathered in this report may not be suitable for use as a pre-lining investigation. WinCan are happy to carry out such surveys, but this must be agreed prior to the commencement of the works, and a the client must specify the data they wish to capture and the acceptable tolerances.

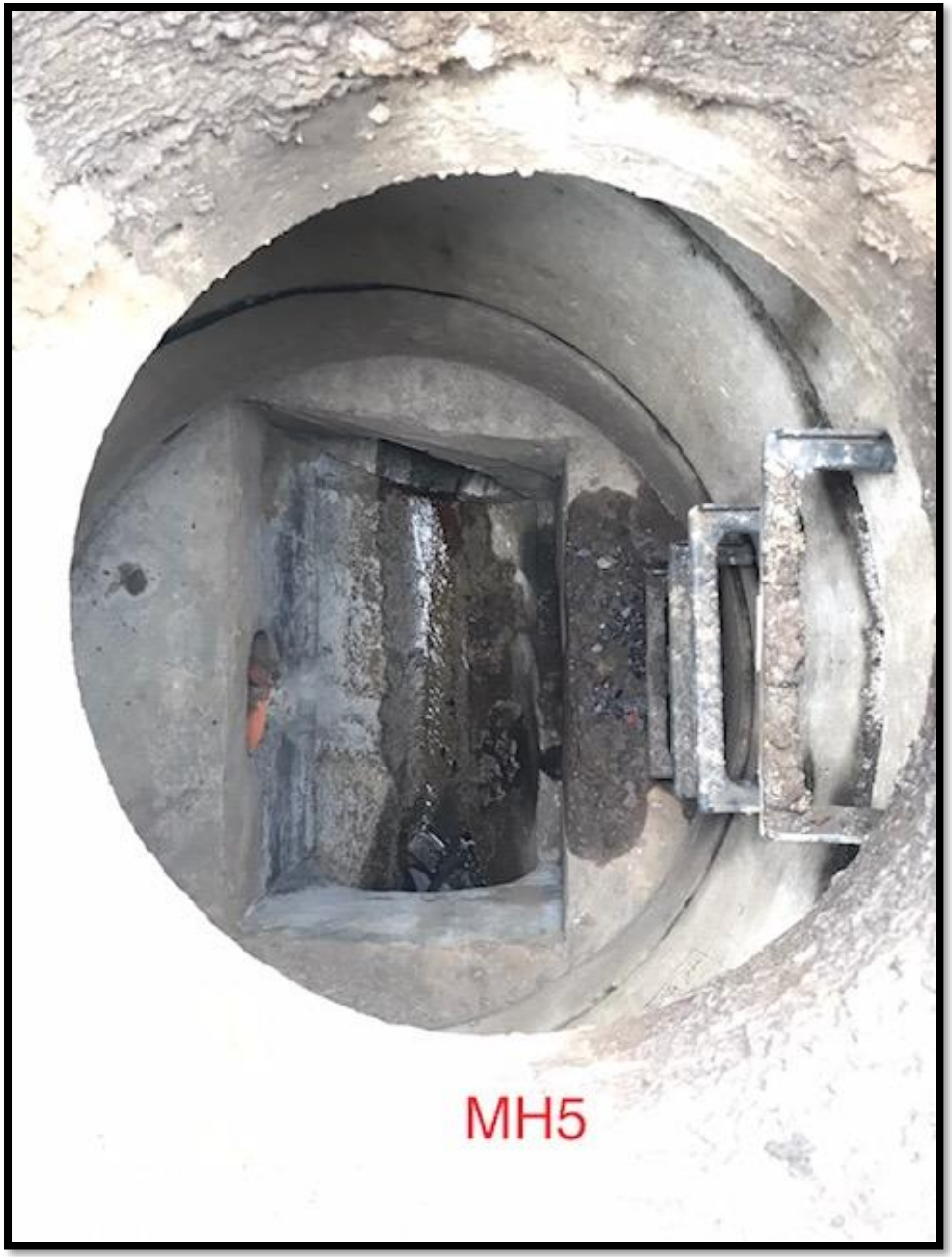
Where GPS coordinates and heights have been issued within this report, they are to 1m accuracy, and 2m accuracy for heights. Greater accuracy can be provided on request.


MH1


MH 2


MH3


MH4

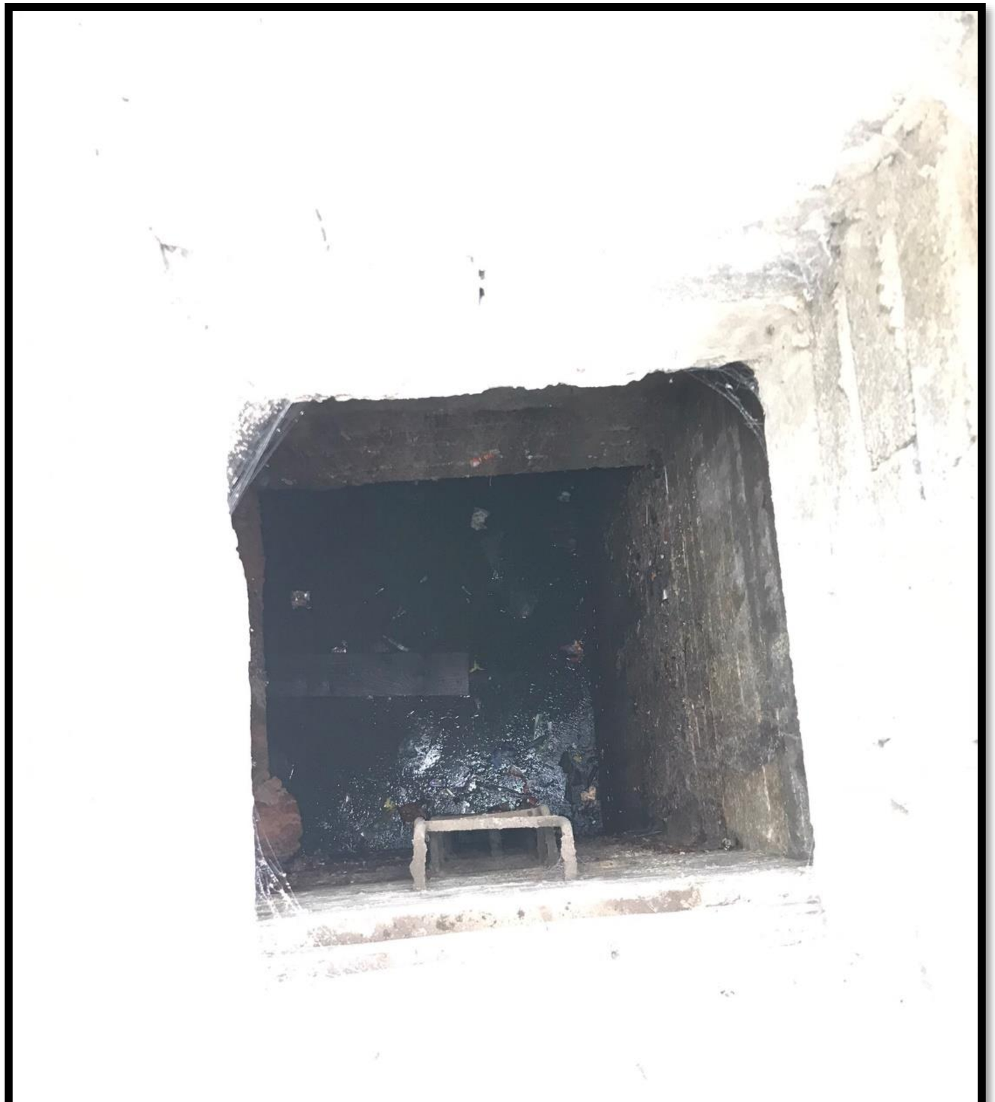

MH5


MH6

MH7

MH8

MH9 Hydrobrake Inside



Attenuation Tank Empty


MH10 Downstream
Defender


MH11 1200mm Pipe


MH12


MH13


MH15


MH16

MH17

MH18. Step in drainage


MH19


MH20


MH21 into Liffey


MH14