KAVANAGH BURKE
CONSULTING ENGINEERS

Drainage Design Report

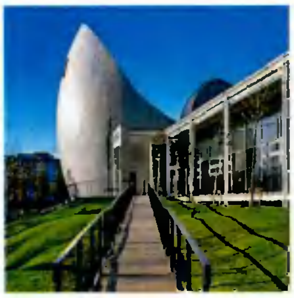
for

Industrial Development

at

Site C,
College Lane,
Greenogue,
Rathcoole,
Co. Dublin

Job No:	**D1658**
Client:	**JORDANSTOWN PROPERTIES LTD**
Date:	**Nov 2021**
Local Authority:	**South Dublin County Council**
Revision:	**PL5**




Calmount Park, Ballymount, Dublin 12.

Tel: 353 1 4500694
Fax: 353 1 4264340

www.kavanaghburke.ie

Ulick Burke & Associates Limited.
Registered in Ireland No: 233579.
V.A.T. Registration No: IE 82335791

Registered Address: Unit G3, Calmount Park, Ballymount, Dublin 12
Directors: U Burke, R Burke, P Kavanagh

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Introduction

The subject site is located south of the existing Greenogue Business Park on the R120, Newcastle to Rathcoole Road. Greenogue Business Park is accessed by three roundabouts on this road, the central roundabout being Greenogue Roundabout. It is proposed to access the subject site from an arm to this roundabout in the southward direction (constructed as part of granted planning application Ref. SD18A/0265), providing access and egress for the lands through 9.0m and 7.5m wide access roads.

The site will be serviced primarily through connections with the services proposed as part of granted planning application Ref. SD18A/0265.

Surface Water

The storm water runoff from the entire site will be collected in the proposed SW drainage network and it will be attenuated in the underground Stormtech Attenuation System (MC-4500 or similar approved) before being discharged to the storm water drainage network as per granted planning application Reg. Ref. SD18A/0265. The flow control device is proposed on the outlet of the on-site attenuation system ensuring that no runoff will leave the site unattenuated. The discharge from site was set at the rate not exceeding the runoff from the site in its green field state as demonstrated in this report.

A series of pollution removing devices are incorporated in the proposed drainage network. Vortex style silt trap and petrol interceptor are proposed on the inlet to the attenuation system to remove suspended solids and hydrocarbons from the runoff before it enters the attenuation system. In addition to the aforementioned devices, an isolator row is integrated into the proprietary attenuation tank. This row of geotextile wrapped cells is specifically designed to capture any residual silts and debris that may have found their way into the tank. The isolator row also allows periodical inspection and maintenance (jetting out) of the captured debris. The details of the surface water attenuation system, interceptors, flow control device, storage volume and network calculations are included in this Drainage Design Report.

Interception storage capturing first 5mm of every rainfall event is proposed as part of the attenuation tank system to promote infiltration and to reduce the overall discharge to the receiving watercourses. Given the design size of the interception storage, the majority of rainfall events will be stored in the attenuation and disposed by infiltration and will never leave the site.

An extensive (sedum type) green roof is proposed to the roof above the office block. The roof substrate will be made up of fabric mats sown with sedum planting. 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 697 SUDS Manual, typical green roofs should attenuate storms up to a two-year return period event.

In addition to the storm water network elements listed above, we propose green, living walls to the portion of the elevation of the warehouse building. Green walls will create more visually appealing and dynamic facades that sway in the breeze and change with the seasons. These dense facade coverings will not only help to break the monotony of cladding surfaces but will also help to create efficient building envelope, minimizing heat loss and cooling loads, reducing rainwater runoff and filtering pollutants out of the air.

To minimise the storm water runoff and to increase the ratio of the green surfaces on site, Grasscrete type surface is proposed to the carparking spaces (excluding disabled carparking where the permeable paving will be used). Grasscrete surface is not proposed to the circulation roads of the car park to prevent damage to the surfacing and to prevent reduction of the grip between tyres and road surface. However, open texture macadam is proposed to the car park roads to assist other permeable hardstanding areas in rainfall runoff reduction. The runoff from the proposed open texture macadam will be collected in a series of infiltration tree pits where the excess runoff from the car parking road will be able to infiltrate to ground. These tree pits will be provided with overflow pipes discharging excess runoff to the proposed on-site attenuation tank from which the storm water will be discharged to the existing storm water network at green field runoff rate.

The nature of the development will not allow for the storm water runoff from the marshalling yard to be discharged directly to swales or tree pits. The runoff from these areas will pass through the aforementioned silt trap, petrol interceptor and isolator row prior to being attenuated. These devices will ensure that the water trapped in the interception storage in the tank is free of pollutants before it is allowed to infiltrate to subsoil.

The proposed runoff quality improving devices together with the proposed interception storage (volume reduction) and flow restriction not exceeding the green field runoff rate form a SUDS management train that will ensure:

- Prevention and removal of the pollutants through the proposed devices and through the implementation of site housekeeping/ routine maintenance
- Source control of the runoff by infiltration near its source through the proposed permeable surfacing and through the base of the tank and also by infiltration and evaporation from landscaped areas (including green walls)
- Site Control and management of water on site in the proposed attenuation system with restricted discharge limited to the green field runoff rate.

Foul Sewer

It is proposed to connect two separate foul sewer outfalls from the site to the private foul sewer network constructed as per granted planning application Reg. Ref. SD18A/0265.

There will be no trade effluent discharged from the subject development.

Watermain

It is proposed to supply the potable and firefighting water to the development through connection to the private watermain network proposed as part of granted planning application Ref. SD18A/0265.

The 150mm diameter watermain will be provided throughout the site with all required sluice valves, water meter & fire hydrants for meter calibration and firefighting purposes. The proposed number and location of hydrants (while meeting the minimum firefighting hydrants provision set out in Part B of the Building Regulations), is indicative and might change following the Fire Safety Certificate assessment of the development.

The BCAR system of inspections and certification will be adopted to ensure all fire safety elements are designed and implemented as per Part B of Technical Guidance Documents.

Surface Water Attenuation Calculations

Surface Water Attenuation Calculations:

1) Interception Storage

Calculate runoff from 5mm of rainfall on developed area.
For this calculation hardstanding areas are assumed to provide 80% runoff, and non-hardstanding areas are assumed to provide 0% runoff.

The equivalent volume of Interception Storage should be provided on site as no discharge from site should occur for this depth of rainfall. The Interception Storage on this subject site will be provided through the base of attenuation tank located in the centre of the development.

Drainage Catchment Area:	27022m^2 (2.702 ha)
Landscaping	2292m^2
Building Roof Area:	14463m^2
Roads, Footpaths and Parking areas):	10267m^2
Total Impermeable Areas:	24730m^2
Design Impermeable Areas for Interception storage calculations:	24730 x 0.8 = 19784 m^2
Total volume for 5mm rainfall:	5mm x 19784m^2 = **100m^3**

Therefore a minimum Interception Storage volume of 100m^3 should be provided for corresponding catchments. This will prevent discharge from the portion of the site during rainfall events of up to 5mm rainfall. For the basis of this calculation infiltration will be provided through the base of the attenuation system. The soft landscaping on site will also be a source of rainfall infiltration.

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 (302000E, 228000N): 800mm (Met 1981-2010 Annual Average Rainfall Grid)

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 x $AREA^{0.89}$ x $SAAR^{1.17}$ x $SOIL^{2.17}$
0.00108 x $(0.5)^{0.89}$ x $(800)^{1.17}$ x $(0.3)^{2.17}$
106.53 l/sec
2.13 l/sec/Ha

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

2.13 l/sec/Ha x 2.702 Ha
5.76 l/sec

Allowable discharge set at:
QBAR = 5.76l/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.

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:

Interception Storage: 100m^3 to be provided by a lowered base to the attenuation system. Attenuation System Area: 1386m^2. Therefore the Interception Storage Depth will equal 165mm. A lowered base level to the attenuation tank allowing base infiltration will facilitate on site discharge of this interception volume.

Required Attenuation Volume: 1940m^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: 1940m^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.

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 301950, Northing: 227750,

	Interval		Years													
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.4,	3.6,	4.3,	5.3,	6.0,	6.6,	8.4,	10.6,	12.1,	14.2,	16.1,	17.6,	19.9,	21.8,	23.3,	N/A ,
10 mins	3.4,	5.1,	6.0,	7.4,	8.4,	9.1,	11.7,	14.8,	16.8,	19.7,	22.4,	24.5,	27.8,	30.4,	32.5,	N/A ,
15 mins	4.0,	5.9,	7.0,	8.7,	9.9,	10.8,	13.8,	17.4,	19.8,	23.2,	26.4,	28.8,	32.7,	35.7,	38.3,	N/A ,
30 mins	5.3,	7.7,	9.1,	11.2,	12.7,	13.8,	17.6,	22.1,	25.1,	29.3,	33.2,	36.2,	41.0,	44.7,	47.8,	N/A ,
1 hours	6.9,	10.1,	11.8,	14.5,	16.3,	17.8,	22.5,	28.1,	31.8,	37.1,	41.8,	45.5,	51.3,	55.9,	59.7,	N/A ,
2 hours	9.1,	13.1,	15.3,	18.7,	21.0,	22.8,	28.8,	35.7,	40.3,	46.8,	52.7,	57.2,	64.4,	69.9,	74.6,	N/A ,
3 hours	10.7,	15.3,	17.9,	21.7,	24.4,	26.4,	33.2,	41.1,	46.3,	53.7,	60.3,	65.4,	73.5,	79.7,	84.9,	N/A ,
4 hours	11.9,	17.1,	19.9,	24.2,	27.1,	29.3,	36.8,	45.4,	51.1,	59.1,	66.3,	72.0,	80.7,	87.5,	93.1,	N/A ,
6 hours	14.0,	20.0,	23.2,	28.1,	31.4,	34.0,	42.5,	52.2,	58.7,	67.8,	75.9,	82.3,	92.1,	99.7,	106.1,	N/A ,
9 hours	16.4,	23.3,	27.0,	32.6,	36.4,	39.3,	49.0,	60.1,	67.4,	77.7,	86.9,	94.0,	105.1,	113.7,	120.8,	N/A ,
12 hours	18.4,	26.0,	30.1,	36.2,	40.4,	43.7,	54.3,	66.4,	74.4,	85.6,	95.6,	103.4,	115.4,	124.8,	132.5,	N/A ,
18 hours	21.6,	30.3,	35.0,	42.1,	46.9,	50.6,	62.7,	76.4,	85.4,	98.1,	109.5,	118.2,	131.7,	142.2,	150.9,	N/A ,
24 hours	24.2,	33.8,	39.0,	46.8,	52.0,	56.1,	69.4,	84.4,	94.3,	108.1,	120.5,	130.0,	144.7,	156.1,	165.5,	198.5,
2 days	30.5,	41.4,	47.2,	55.7,	61.4,	65.7,	79.8,	95.4,	105.5,	119.6,	132.0,	141.5,	156.0,	167.2,	176.4,	208.3,
3 days	35.6,	47.6,	53.8,	62.9,	69.0,	73.6,	88.4,	104.6,	115.0,	129.5,	142.1,	151.8,	166.4,	177.7,	186.9,	218.6,
4 days	40.1,	53.0,	59.6,	69.3,	75.6,	80.5,	95.9,	112.7,	123.5,	138.3,	151.2,	161.0,	175.8,	187.2,	196.5,	228.3,
6 days	48.1,	62.5,	69.8,	80.3,	87.2,	92.5,	109.0,	126.8,	138.2,	153.7,	167.1,	177.2,	192.5,	204.2,	213.6,	246.0,
8 days	55.3,	70.9,	78.8,	90.1,	97.4,	103.0,	120.5,	139.2,	151.0,	167.1,	181.0,	191.5,	207.2,	219.1,	228.8,	261.7,
10 days	61.9,	78.6,	87.0,	99.0,	106.7,	112.6,	130.9,	150.4,	162.7,	179.3,	193.6,	204.4,	220.5,	232.7,	242.6,	276.1,
12 days	68.1,	85.8,	94.7,	107.2,	115.3,	121.5,	140.5,	160.7,	173.5,	190.6,	205.3,	216.3,	232.8,	245.3,	255.4,	289.4,
16 days	79.6,	99.2,	108.8,	122.5,	131.2,	137.8,	158.2,	179.7,	193.1,	211.2,	226.5,	238.1,	255.2,	268.1,	278.6,	313.6,
20 days	90.4,	111.5,	121.9,	136.5,	145.8,	152.8,	174.4,	197.0,	211.0,	229.9,	245.8,	257.8,	275.5,	288.9,	299.6,	335.6,
25 days	103.1,	126.0,	137.1,	152.8,	162.7,	170.2,	193.1,	216.9,	231.6,	251.3,	268.0,	280.4,	298.8,	312.6,	323.7,	360.7,

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

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.

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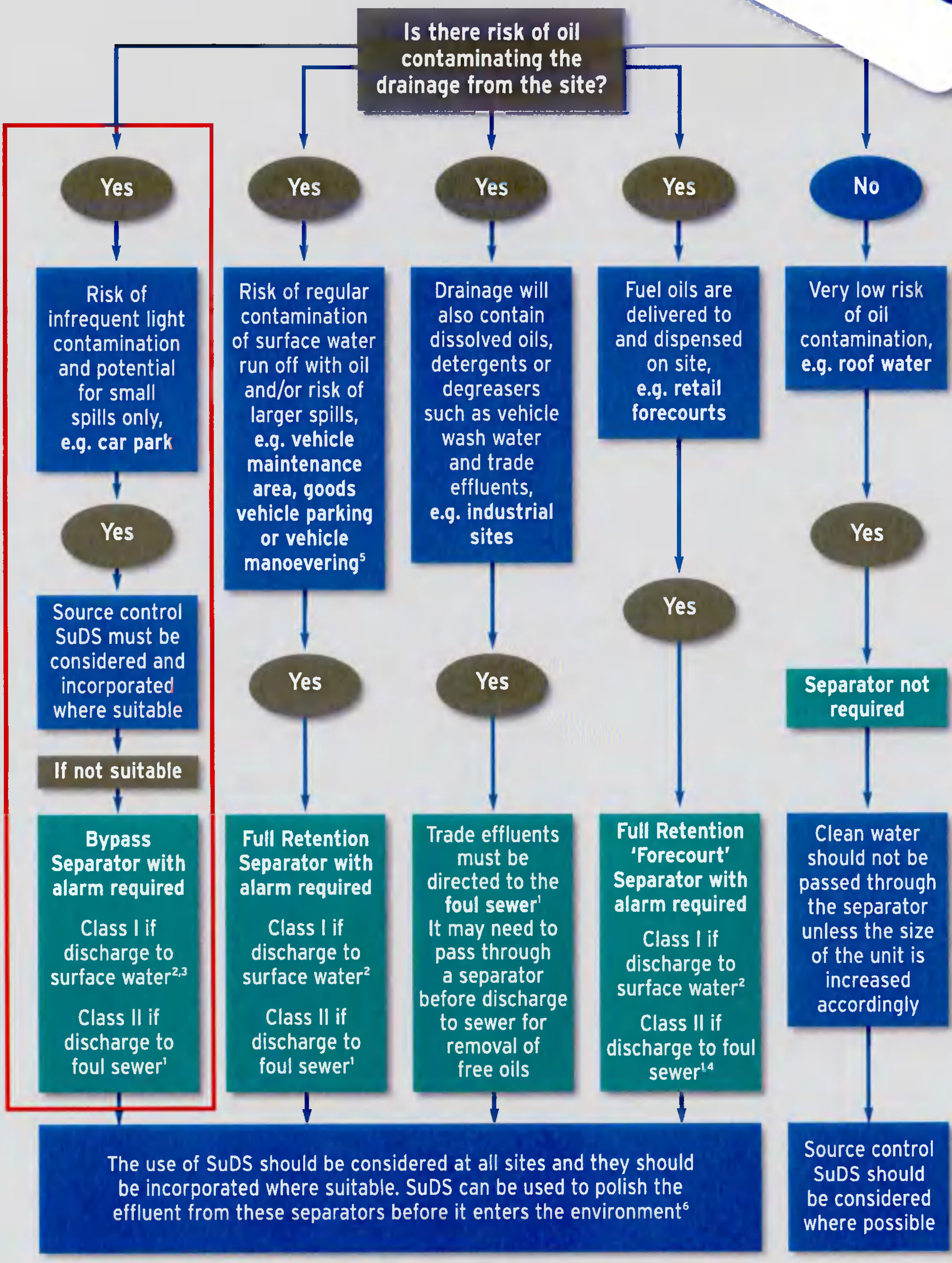
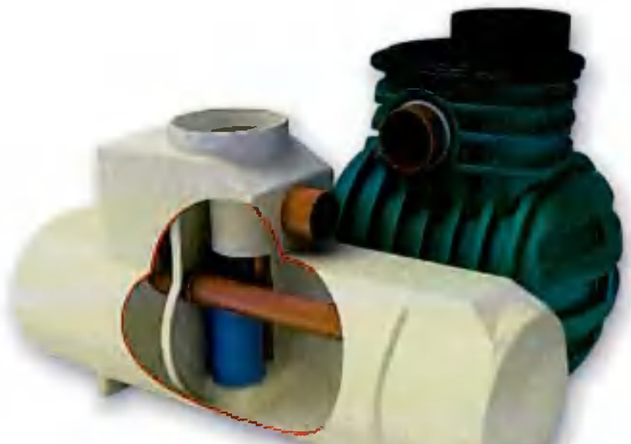


1 *You must seek prior permission from your local sewer provider before you decide which separator to install and before you make any discharge.*
2 *You must seek prior permission from the relevant environmental body before you decide which separator to install.*
3 *In this case, if it is considered 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 (m²)	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

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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

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www.klargester.com/installers

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- **PUMPSTOR24** PUMPING SYSTEMS
- STORMWATER ATTENUATION SYSTEMS
- OIL/WATER SEPARATORS
- BELOW GROUND STORAGE TANKS
- GREASE & SILT TRAPS

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- ABOVE GROUND RAINWATER HARVESTING SYSTEMS

Klargester

UK: College Road North, Aston Clinton, Aylesbury, Buckinghamshire HP22 5EW

Tel: +44 (0) 1296 633000 Fax: +44 (0) 1296 633001 Scottish Office: Tel: +44 (0) 1355 248484

email: info@klargester.com

Ireland: Unit 1a, Derryboy Road, Carnbane Business Park, Newry. Co. Down BT35 6QH

NI Tel : +44 (0) 28 302 66799 Fax: +44 (0) 28 302 60046 **ROI** Tel: 048 302 66799 Fax: 048 302 60046

email: info@klargester.ie

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

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Certificate No. FM 563603

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BRITISH WATER

UK GREEN BUILDING COUNCIL

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CDS TECHNOLOGIES

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.

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.

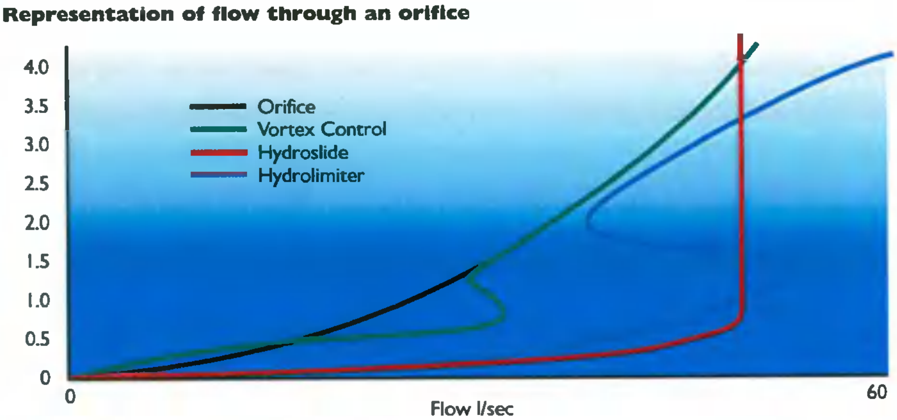
Typical SurfSep installation

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

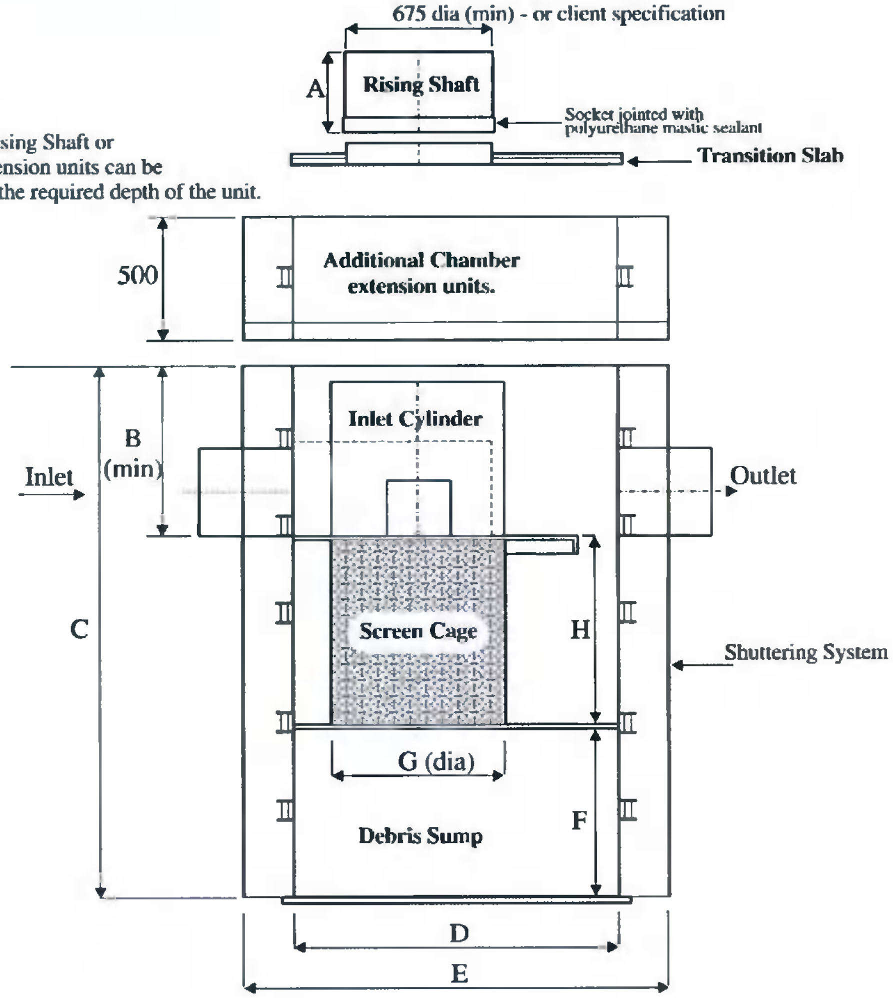
Maintenance Cycle

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

Note:
Additional Rising Shaft or Chamber extension units can be added to suit the required depth of the unit.



SurfSep Dimensions (mm)

	SW10404	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

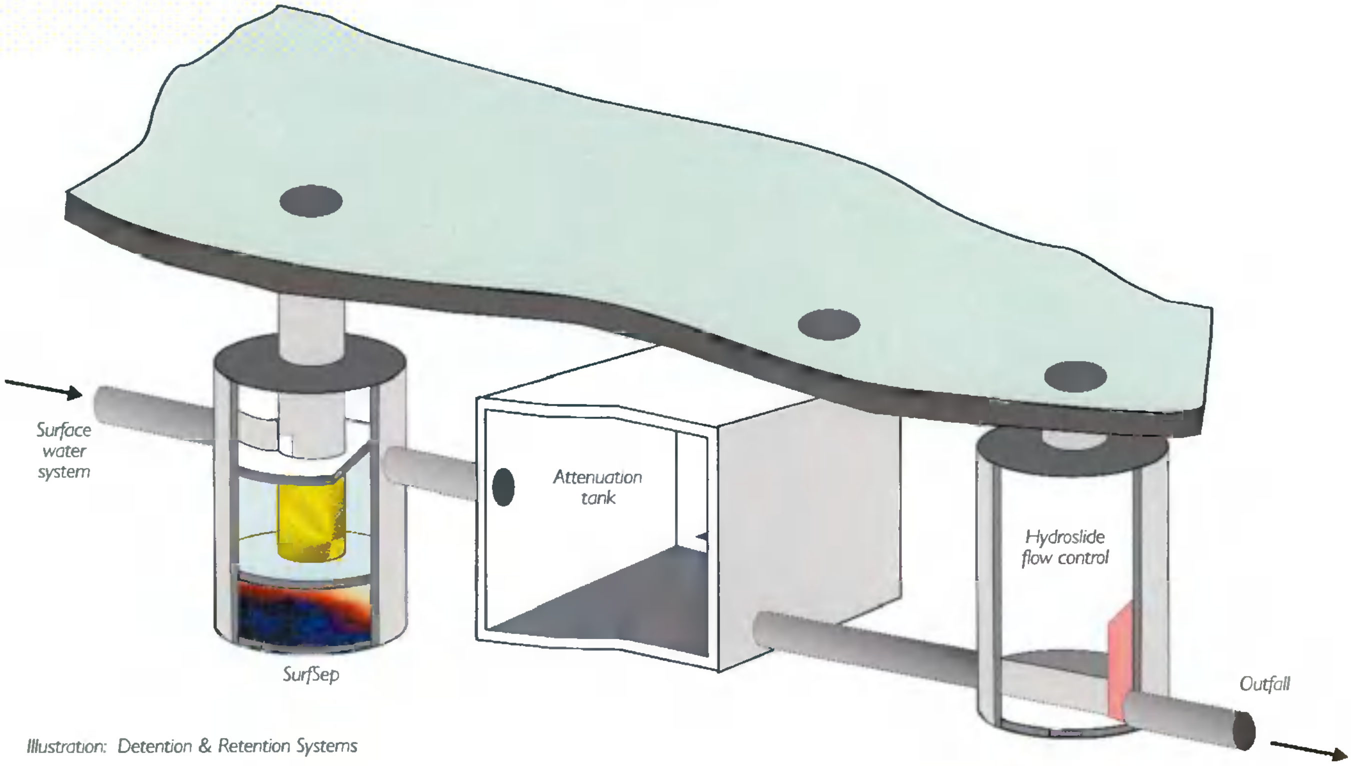


Illustration: Detention & Retention Systems

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

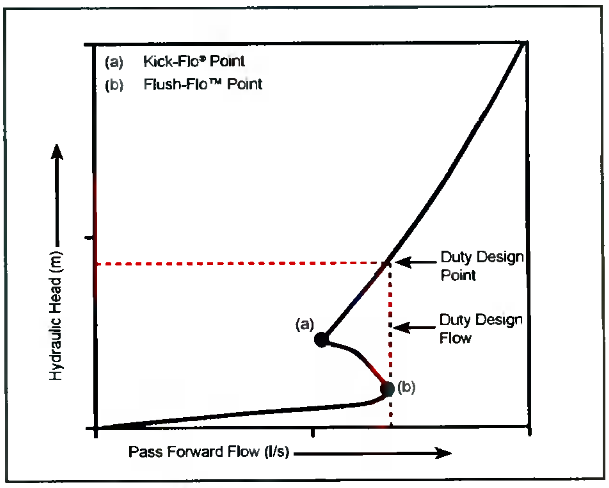
BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4599

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:

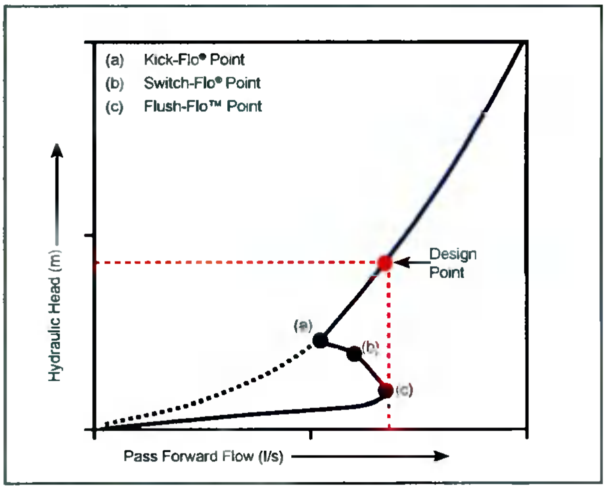
- outlet size and model of Hydro-Brake® Flow Control
- definition of the duty/design point (head and flow)
- definition of the Flush-Flo™ point (head and flow)
- definition of the Kick-Flo® point (head and flow)

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

HRD Technologies Ltd • Tootenhill House • Rathcoole • Co. Dublin • Ireland
Tel: +353 (0) 1 4013964 • Fax: +353 (0) 1 4013978 • www.hrdtec.com
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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 (%)	10	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.800	Minimum Backdrop Height (m)	0.200
Ratio-R	0.271	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	0.096	5.00	101.750	1200	1.550
SW2	0.090	5.00	101.150	1200	1.450
SW3	0.070	5.00	100.950	1200	1.950
SW4	0.137	5.00	99.600	1200	2.100
SW5	0.134	5.00	99.100	1200	1.550
SW6	0.101	5.00	99.100	1200	1.900
SW7			99.250	1350	2.320
SW8			99.050	1350	2.150
SW10	0.496	5.00	98.200	1500	1.600
SW11	0.190	5.00	99.100	1200	1.600
SW12	0.091	5.00	99.100	1200	2.050
SW13	0.059	5.00	99.750	1200	2.880
SW14	0.291	5.00	99.100	1200	1.700
SW15	0.139	5.00	99.400	1350	2.600
SW16	0.067	5.00	99.150	1350	2.500
SW17	0.284	5.00	99.000	1200	1.500
SW18	0.173	5.00	99.400	1350	2.550
SW19	0.054	5.00	99.100	1500	2.700
SW20			98.340	1500	2.090
SW21	0.069		98.700	1500	2.991
SW22		5.00	98.880	1200	3.180
SW23			99.250	1200	3.650
SW24			99.100	1200	3.700
SW25			99.150	1200	3.950
EX SW MH			99.100	1200	4.000

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	SW1	SW3	31.933	0.600	100.200	99.000	1.200	26.6	225	5.21	50.0
2.000	SW2	SW3	16.009	0.600	99.700	99.000	0.700	22.9	225	5.10	50.0
1.001	SW3	SW4	51.565	0.600	99.000	97.500	1.500	34.4	225	5.59	50.0
1.002	SW4	SW7	17.137	0.600	97.500	97.080	0.420	40.8	225	5.73	50.0
3.000	SW5	SW6	32.434	0.600	97.550	97.275	0.275	117.9	225	5.45	50.0
3.001	SW6	SW7	29.716	0.600	97.200	97.005	0.195	152.4	300	5.84	50.0
1.003	SW7	SW8	5.464	0.600	96.930	96.900	0.030	182.1	375	5.91	49.9
1.004	SW8	SW10	26.951	0.600	96.900	96.750	0.150	179.7	375	6.24	48.8
1.005	SW10	SW20	87.098	0.600	96.600	96.325	0.275	316.7	525	7.40	45.5
4.000	SW11	SW12	90.000	0.600	97.500	97.050	0.450	200.0	300	6.35	48.4
4.001	SW12	SW13	47.117	0.600	97.050	96.870	0.180	261.8	300	7.17	46.1
4.002	SW13	SW16	39.485	0.600	96.870	96.725	0.145	272.3	300	7.86	44.3
5.000	SW14	SW15	90.000	0.600	97.400	96.875	0.525	171.4	300	6.25	48.7
5.001	SW15	SW16	59.032	0.600	96.800	96.650	0.150	393.5	375	7.34	45.6
4.003	SW16	SW19	32.511	0.600	96.650	96.550	0.100	325.1	375	8.40	43.0
6.000	SW17	SW18	90.000	0.600	97.500	96.925	0.575	156.5	300	6.20	48.9
6.001	SW18	SW19	64.834	0.600	96.850	96.550	0.300	216.1	375	7.08	46.3
4.004	SW19	SW20	35.847	0.600	96.400	96.325	0.075	478.0	525	8.99	41.7
1.006	SW20	SW21	14.366	0.600	96.250	96.210	0.040	359.2	600	9.18	41.3
7.000	SW22	SW23	14.242	0.600	95.700	95.600	0.100	142.4	225	5.22	50.0
7.001	SW23	SW24	30.434	0.600	95.600	95.400	0.200	152.2	225	5.70	50.0
7.002	SW24	SW25	32.403	0.600	95.400	95.200	0.200	162.0	225	6.22	48.8
7.003	SW25	EX SW MH	16.108	0.600	95.200	95.100	0.100	161.1	225	6.49	48.0

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	2.546	101.2	14.3	1.325	1.725	0.096	0.0	57
2.000	2.747	109.2	13.4	1.225	1.725	0.090	0.0	53
1.001	2.238	89.0	38.2	1.725	1.875	0.256	0.0	103
1.002	2.054	81.7	58.6	1.875	1.945	0.393	0.0	141
3.000	1.203	47.8	20.0	1.325	1.600	0.134	0.0	102
3.001	1.271	89.8	35.1	1.600	1.945	0.235	0.0	130
1.003	1.339	147.9	93.4	1.945	1.775	0.628	0.0	216
1.004	1.348	148.9	91.3	1.775	1.075	0.628	0.0	213
1.005	1.253	271.2	152.3	1.075	1.490	1.124	0.0	282
4.000	1.108	78.3	27.4	1.300	1.750	0.190	0.0	122
4.001	0.967	68.3	38.7	1.750	2.580	0.281	0.0	161
4.002	0.948	67.0	45.0	2.580	2.125	0.341	0.0	180
5.000	1.198	84.7	42.3	1.400	2.225	0.291	0.0	150
5.001	0.907	100.2	58.5	2.225	2.125	0.430	0.0	206
4.003	0.999	110.4	107.4	2.125	2.175	0.838	0.0	301
6.000	1.254	88.6	41.4	1.200	2.175	0.284	0.0	144
6.001	1.228	135.7	63.1	2.175	2.175	0.457	0.0	180
4.004	1.018	220.3	167.8	2.175	1.490	1.349	0.0	344
1.006	1.279	361.6	304.6	1.490	1.890	2.473	0.0	425
7.000	1.093	43.5	0.0	2.955	3.425	0.000	0.0	0
7.001	1.057	42.0	0.0	3.425	3.475	0.000	0.0	0
7.002	1.024	40.7	0.0	3.475	3.725	0.000	0.0	0
7.003	1.027	40.8	0.0	3.725	3.775	0.000	0.0	0

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW1	701604.340	727689.265	101.750	1.550	1200	0	1.000	100.200	225
SW2	701603.016	727722.052	101.150	1.450	1200	0	2.000	99.700	225
SW3	701618.477	727717.898	100.950	1.950	1200	1	2.000	99.000	225
						2	1.000	99.000	225
						0	1.001	99.000	225
SW4	701643.699	727762.874	99.600	2.100	1200	1	1.001	97.500	225
						0	1.002	97.500	225
SW5	701696.182	727820.922	99.100	1.550	1200	0	3.000	97.550	225
SW6	701679.486	727793.115	99.100	1.900	1200	1	3.000	97.275	225
						0	3.001	97.200	300
SW7	701656.789	727773.935	99.250	2.320	1350	1	3.001	97.005	300
						2	1.002	97.080	225
						0	1.003	96.930	375
SW8	701660.315	727769.761	99.050	2.150	1350	1	1.003	96.900	375
						0	1.004	96.900	375
SW10	701684.315	727757.498	98.200	1.600	1500	1	1.004	96.750	375
						0	1.005	96.600	525
SW11	701808.057	727765.374	99.100	1.600	1200	0	4.000	97.500	300
SW12	701767.357	727685.103	99.100	2.050	1200	1	4.000	97.050	300
						0	4.001	97.050	300
SW13	701746.049	727643.079	99.750	2.880	1200	1	4.001	96.870	300
						0	4.002	96.870	300
SW14	701775.791	727787.883	99.100	1.700	1200	0	5.000	97.400	300

Kavanagh Burke Consulting Engineers	Kavanagh Burke Consulting Engineers	File: SW1 2021 planning AI.pfd Network: SW1 Bartosz Kedzierski 18/10/2021	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW15	701735.090	727707.612	99.400	2.600	1350	1	5.000	96.875	300
						0	5.001	96.800	375
SW16	701708.394	727654.961	99.150	2.500	1350	1	5.001	96.650	375
						2	4.002	96.725	300
						0	4.003	96.650	375
SW17	701747.290	727802.452	99.000	1.500	1200	0	6.000	97.500	300
SW18	701706.589	727722.181	99.400	2.550	1350	1	6.000	96.925	300
						0	6.001	96.850	375
SW19	701677.270	727664.355	99.100	2.700	1500	1	6.001	96.550	375
						2	4.003	96.550	375
						0	4.004	96.400	525
SW20	701644.928	727679.815	98.340	2.090	1500	1	1.005	96.325	525
						2	4.004	96.325	525
						0	1.006	96.250	600
SW21	701632.115	727686.312	98.700	2.991	1500	1	1.006	96.210	600
SW22	701663.459	727763.479	98.880	3.180	1200	0	7.000	95.700	225
SW23	701654.266	727774.357	99.250	3.650	1200	1	7.000	95.600	225
						0	7.001	95.600	225
SW24	701677.512	727794.000	99.100	3.700	1200	1	7.001	95.400	225
						0	7.002	95.400	225
SW25	701694.281	727821.726	99.150	3.950	1200	1	7.002	95.200	225
						0	7.003	95.200	225
EX SW MH	701691.645	727837.617	99.100	4.000	1200	1	7.003	95.100	225

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	17.800	Drain Down Time (mins)	240
Ratio-R	0.271	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	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	10	0	0
100	10	0	0

Node SW22 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	95.865	Product Number	CTL-SHE-0097-5800-2175-5800
Design Depth (m)	2.175	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.8	Min Node Diameter (mm)	1200

Node SW22 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	90.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	95.700	Main Channel Slope (1:X)	10000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.002

Inlets
SW21

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	803.0	0.0	2.340	803.0	0.0	2.341	0.1	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +10% CC 15 minute summer	232.730	65.855	30 year +10% CC 360 minute winter	22.706	8.989
30 year +10% CC 15 minute winter	163.319	65.855	30 year +10% CC 480 minute summer	27.959	7.389
30 year +10% CC 30 minute summer	159.850	45.232	30 year +10% CC 480 minute winter	18.575	7.389
30 year +10% CC 30 minute winter	112.175	45.232	30 year +10% CC 600 minute summer	23.192	6.344
30 year +10% CC 60 minute summer	111.653	29.507	30 year +10% CC 600 minute winter	15.846	6.344
30 year +10% CC 60 minute winter	74.180	29.507	30 year +10% CC 720 minute summer	20.892	5.599
30 year +10% CC 120 minute summer	71.182	18.811	30 year +10% CC 720 minute winter	14.041	5.599
30 year +10% CC 120 minute winter	47.292	18.811	30 year +10% CC 960 minute summer	17.460	4.598
30 year +10% CC 180 minute summer	55.801	14.359	30 year +10% CC 960 minute winter	11.566	4.598
30 year +10% CC 180 minute winter	36.272	14.359	30 year +10% CC 1440 minute summer	12.989	3.481
30 year +10% CC 240 minute summer	44.773	11.832	30 year +10% CC 1440 minute winter	8.730	3.481
30 year +10% CC 240 minute winter	29.746	11.832	30 year +10% CC 2160 minute summer	9.527	2.633
30 year +10% CC 360 minute summer	34.931	8.989	30 year +10% CC 2160 minute winter	6.565	2.633

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +10% CC 2880 minute summer	8.053	2.158	100 year +10% CC 360 minute winter	28.629	11.334
30 year +10% CC 2880 minute winter	5.412	2.158	100 year +10% CC 480 minute summer	35.064	9.266
30 year +10% CC 4320 minute summer	6.233	1.630	100 year +10% CC 480 minute winter	23.296	9.266
30 year +10% CC 4320 minute winter	4.105	1.630	100 year +10% CC 600 minute summer	28.964	7.922
30 year +10% CC 5760 minute summer	5.213	1.335	100 year +10% CC 600 minute winter	19.790	7.922
30 year +10% CC 5760 minute winter	3.374	1.335	100 year +10% CC 720 minute summer	26.001	6.968
30 year +10% CC 7200 minute summer	4.480	1.143	100 year +10% CC 720 minute winter	17.474	6.968
30 year +10% CC 7200 minute winter	2.892	1.143	100 year +10% CC 960 minute summer	21.611	5.691
100 year +10% CC 15 minute summer	302.362	85.558	100 year +10% CC 960 minute winter	14.315	5.691
100 year +10% CC 15 minute winter	212.184	85.558	100 year +10% CC 1440 minute summer	15.955	4.276
100 year +10% CC 30 minute summer	208.666	59.045	100 year +10% CC 1440 minute winter	10.722	4.276
100 year +10% CC 30 minute winter	146.432	59.045	100 year +10% CC 2160 minute summer	11.607	3.208
100 year +10% CC 60 minute summer	144.765	38.257	100 year +10% CC 2160 minute winter	7.998	3.208
100 year +10% CC 60 minute winter	96.178	38.257	100 year +10% CC 2880 minute summer	9.751	2.613
100 year +10% CC 120 minute summer	91.438	24.164	100 year +10% CC 2880 minute winter	6.553	2.613
100 year +10% CC 120 minute winter	60.749	24.164	100 year +10% CC 4320 minute summer	7.479	1.955
100 year +10% CC 180 minute summer	71.218	18.327	100 year +10% CC 4320 minute winter	4.925	1.955
100 year +10% CC 180 minute winter	46.293	18.327	100 year +10% CC 5760 minute summer	6.214	1.591
100 year +10% CC 240 minute summer	56.863	15.027	100 year +10% CC 5760 minute winter	4.022	1.591
100 year +10% CC 240 minute winter	37.778	15.027	100 year +10% CC 7200 minute summer	5.313	1.355
100 year +10% CC 360 minute summer	44.043	11.334	100 year +10% CC 7200 minute winter	3.429	1.355

Results for 30 year +10% CC Critical Storm Duration. Lowest mass balance: 99.46%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	10	100.281	0.081	28.8	0.1929	0.0000	OK
15 minute winter	SW2	10	99.776	0.076	26.9	0.1788	0.0000	OK
15 minute winter	SW3	12	99.192	0.192	76.4	0.3562	0.0000	OK
15 minute winter	SW4	12	98.405	0.905	111.8	2.2014	0.0000	SURCHARGED
15 minute winter	SW5	12	97.807	0.257	40.2	0.7361	0.0000	SURCHARGED
15 minute winter	SW6	12	97.670	0.470	69.2	1.0328	0.0000	SURCHARGED
4320 minute winter	SW7	3360	97.580	0.650	6.1	0.9308	0.0000	SURCHARGED
4320 minute winter	SW8	3360	97.580	0.680	6.1	0.9737	0.0000	SURCHARGED
4320 minute winter	SW10	3360	97.580	0.980	10.8	7.8072	0.0000	SURCHARGED
15 minute winter	SW11	13	97.912	0.412	56.9	1.4442	0.0000	SURCHARGED
15 minute winter	SW12	13	97.792	0.742	81.7	1.5018	0.0000	SURCHARGED
15 minute winter	SW13	12	97.642	0.772	75.2	1.1915	0.0000	SURCHARGED
15 minute winter	SW14	12	98.049	0.649	87.1	2.9559	0.0000	SURCHARGED
15 minute winter	SW15	12	97.669	0.869	112.2	2.1754	0.0000	SURCHARGED
4320 minute winter	SW16	3360	97.580	0.930	8.0	1.8293	0.0000	SURCHARGED
15 minute winter	SW17	11	97.727	0.227	85.0	1.1130	0.0000	OK
4320 minute winter	SW18	3360	97.580	0.730	4.4	2.0372	0.0000	SURCHARGED
4320 minute winter	SW19	3360	97.580	1.180	12.7	2.5604	0.0000	SURCHARGED
4320 minute winter	SW20	3360	97.580	1.330	22.0	2.3509	0.0000	SURCHARGED
4320 minute winter	SW21	3360	97.580	1.871	22.1	4.1676	0.0000	OK
4320 minute winter	SW22	3360	97.580	1.880	13.9	2.1267	0.0000	SURCHARGED
4320 minute winter	SW23	3360	95.654	0.054	5.2	0.0609	0.0000	OK
4320 minute winter	SW24	3360	95.455	0.055	5.2	0.0618	0.0000	OK
4320 minute winter	SW25	3360	95.256	0.056	5.2	0.0629	0.0000	OK
4320 minute winter	EX SW MH	3360	95.154	0.054	5.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.000	SW3	28.5	1.343	0.282	0.7764	
15 minute winter	SW2	2.000	SW3	26.7	1.304	0.245	0.3791	
15 minute winter	SW3	1.001	SW4	70.8	1.837	0.796	1.9576	
15 minute winter	SW4	1.002	SW7	100.1	2.517	1.226	0.6816	
15 minute winter	SW5	3.000	SW6	38.9	1.283	0.814	1.2899	
15 minute winter	SW6	3.001	SW7	61.4	1.008	0.684	2.0926	
4320 minute winter	SW7	1.003	SW8	6.1	0.643	0.041	0.6027	
4320 minute winter	SW8	1.004	SW10	6.1	0.668	0.041	2.9726	
4320 minute winter	SW10	1.005	SW20	10.1	0.599	0.037	18.8160	
15 minute winter	SW11	4.000	SW12	54.3	0.975	0.694	6.3377	
15 minute winter	SW12	4.001	SW13	59.1	0.968	0.865	3.3179	
15 minute winter	SW13	4.002	SW16	70.4	1.000	1.051	2.7805	
15 minute winter	SW14	5.000	SW15	71.4	1.286	0.843	6.3377	
15 minute winter	SW15	5.001	SW16	101.5	0.921	1.013	6.5111	
4320 minute winter	SW16	4.003	SW19	7.9	0.597	0.071	3.5859	
15 minute winter	SW17	6.000	SW18	81.4	1.369	0.918	5.7375	
4320 minute winter	SW18	6.001	SW19	4.4	0.556	0.032	7.1510	
4320 minute winter	SW19	4.004	SW20	12.0	0.573	0.055	7.7441	
4320 minute winter	SW20	1.006	SW21	21.4	0.684	0.059	4.0466	
4320 minute winter	SW21	Flow through pond	SW22	13.9	0.006	0.000	1506.1637	
4320 minute winter	SW22	Hydro-Brake®	SW23	5.2				
4320 minute winter	SW23	7.001	SW24	5.2	0.706	0.124	0.2238	
4320 minute winter	SW24	7.002	SW25	5.2	0.690	0.128	0.2438	
4320 minute winter	SW25	7.003	EX SW MH	5.2	0.698	0.127	0.1199	1025.5

Max water level in the attenuation and drainage network for storms up to 1:30y return. Critical event duration 3360min. Maximum achieved water level during this event does not exceed the high water level in the proposed attenuation tank (98.04m) therefore proposed attenuation has sufficient capacity to accommodate storms up to 1in30 years return. See drawing ref. D1658-D3-PL6for attenuation base and high water level.

Results for 100 year +10% CC Critical Storm Duration. Lowest mass balance: 99.46%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	10	100.294	0.094	37.4	0.2224	0.0000	OK
15 minute winter	SW2	12	100.173	0.473	34.9	1.1208	0.0000	SURCHARGED
15 minute winter	SW3	12	100.127	1.127	97.1	2.0868	0.0000	SURCHARGED
15 minute winter	SW4	12	99.072	1.572	119.9	3.8243	0.0000	SURCHARGED
15 minute winter	SW5	12	98.461	0.911	52.2	2.6069	0.0000	SURCHARGED
15 minute winter	SW6	12	98.213	1.013	83.2	2.2235	0.0000	SURCHARGED
15 minute winter	SW7	12	98.049	1.119	184.8	1.6007	0.0000	SURCHARGED
4320 minute winter	SW8	3420	98.026	1.126	7.1	1.6111	0.0000	SURCHARGED
4320 minute winter	SW10	3420	98.026	1.426	12.6	11.3537	0.0000	FLOOD RISK
15 minute winter	SW11	12	98.847	1.347	74.0	4.7229	0.0000	FLOOD RISK
15 minute winter	SW12	12	98.631	1.581	95.6	3.1992	0.0000	SURCHARGED
15 minute winter	SW13	12	98.373	1.503	92.9	2.3203	0.0000	SURCHARGED
15 minute winter	SW14	12	98.934	1.534	113.2	6.9842	0.0000	FLOOD RISK
15 minute winter	SW15	12	98.327	1.527	134.8	3.8236	0.0000	SURCHARGED
15 minute winter	SW16	12	98.046	1.396	239.2	2.7445	0.0000	SURCHARGED
15 minute winter	SW17	12	98.491	0.991	110.4	4.8710	0.0000	SURCHARGED
4320 minute winter	SW18	3420	98.026	1.176	5.3	3.2794	0.0000	SURCHARGED
4320 minute winter	SW19	3420	98.026	1.626	14.1	3.5264	0.0000	SURCHARGED
4320 minute winter	SW20	3420	98.026	1.776	25.7	3.1378	0.0000	SURCHARGED
4320 minute winter	SW21	3420	98.026	2.317	26.4	5.1594	0.0000	OK
4320 minute winter	SW22	3420	98.026	2.326	15.5	2.6304	0.0000	SURCHARGED
4320 minute winter	SW23	3420	95.657	0.057	5.8	0.0644	0.0000	OK
4320 minute winter	SW24	3420	95.458	0.058	5.8	0.0653	0.0000	OK
4320 minute winter	SW25	3420	95.259	0.059	5.8	0.0665	0.0000	OK
4320 minute winter	EX SW MH	3420	95.157	0.057	5.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.000	SW3	37.1	1.375	0.367	0.8849	
15 minute winter	SW2	2.000	SW3	32.6	1.341	0.299	0.6367	
15 minute winter	SW3	1.001	SW4	73.5	1.860	0.826	2.0508	
15 minute winter	SW4	1.002	SW7	111.3	2.798	1.363	0.6816	
15 minute winter	SW5	3.000	SW6	46.1	1.271	0.964	1.2899	
15 minute winter	SW6	3.001	SW7	73.5	1.044	0.818	2.0926	
15 minute winter	SW7	1.003	SW8	186.3	1.689	1.260	0.6027	
4320 minute winter	SW8	1.004	SW10	7.0	0.680	0.047	2.9726	
4320 minute winter	SW10	1.005	SW20	12.1	0.603	0.045	18.8160	
15 minute winter	SW11	4.000	SW12	62.1	1.002	0.793	6.3377	
15 minute winter	SW12	4.001	SW13	77.8	1.105	1.139	3.3179	
15 minute winter	SW13	4.002	SW16	95.1	1.350	1.419	2.7805	
15 minute winter	SW14	5.000	SW15	86.2	1.285	1.019	6.3377	
15 minute winter	SW15	5.001	SW16	127.8	1.159	1.276	6.5111	
15 minute winter	SW16	4.003	SW19	238.9	2.167	2.165	3.5859	
15 minute winter	SW17	6.000	SW18	89.8	1.377	1.013	6.3377	
4320 minute winter	SW18	6.001	SW19	5.0	0.568	0.037	7.1510	
4320 minute winter	SW19	4.004	SW20	13.7	0.574	0.062	7.7441	
4320 minute winter	SW20	1.006	SW21	25.6	0.685	0.071	4.0466	
4320 minute winter	SW21	Flow through pond	SW22	15.5	0.059	0.000	1856.1445	
4320 minute winter	SW22	Hydro-Brake®	SW23	5.8				
4320 minute winter	SW23	7.001	SW24	5.8	0.727	0.138	0.2420	
4320 minute winter	SW24	7.002	SW25	5.8	0.711	0.142	0.2637	
4320 minute winter	SW25	7.003	EX SW MH	5.8	0.719	0.142	0.1296	1136.2

Max water level in the attenuation and drainage network for storms up to 1:100y return. Critical event duration 3420min. Maximum achieved water level during this event does not exceed the high water level in the proposed attenuation tank (98.04m) therefore proposed attenuation has sufficient capacity to accommodate storms up to 1in100 years return. See drawing ref. D1658-D3-PL6 for attenuation base and high water level.

Appendix B - Foul Sewer Network Design

The proposed private foul sewer spurs on the subject site will be constructed to the gradient of 1 in 60 or steeper ensuring that minimum self-cleansing velocities of 0.75m/s will be achieved. The minimum capacity of the proposed foul pipes for the 150diameter pipe laid at 1:60 gradient equals 20l/s which is multiple times greater than the generated flow from the staff facilities and the canteen.