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:	**June 2021**
Local Authority:	**South Dublin County Council**
Revision:	**PL3**




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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.

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 base of the tank)
- 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.

Total volume required: 1940m^3

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

Project: Site C Greenogue

Chamber Model -	MC-4500	
Units -	Metric	Click Here for Imperial
Number of Chambers -	342	
Number of chambers -	20	
Voids in the stone (porosity) -	43	%
Base of Stone Elevation -	95.70	m
Amount of Stone Above Chambers -	420	mm
Amount of Stone Below Chambers -	300	mm
Area of system -	1386	sq.meters

☑ Include Perimeter Stone in Calculations

Min. Area - 1221.917 sq.meters

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StormTech MC-4500 Cumulative Storage Volumes

Height of System *(mm)*	Incremental Single Chamber *(cubic meters)*	Incremental Single End Cap *(cubic meters)*	Incremental Chambers *(cubic meters)*	Incremental End Cap *(cubic meters)*	Incremental Stone *(cubic meters)*	Incremental Chamber, End Cap and Stone *(cubic meters)*	Cumulative System *(cubic meters)*	Elevation *(meters)*
2261	0.00	0.00	0.00	0.00	15.130	15.13	1946.05	97.96
2235	0.00	0.00	0.00	0.00	15.130	15.13	1930.92	97.94
2210	0.00	0.00	0.00	0.00	15.130	15.13	1915.79	97.91
2184	0.00	0.00	0.00	0.00	15.130	15.13	1900.66	97.88
2159	0.00	0.00	0.00	0.00	15.130	15.13	1885.53	97.86
2134	0.00	0.00	0.00	0.00	15.130	15.13	1870.40	97.83
2108	0.00	0.00	0.00	0.00	15.130	15.13	1855.27	97.81
2083	0.00	0.00	0.00	0.00	15.130	15.13	1840.14	97.78
2057	0.00	0.00	0.00	0.00	15.130	15.13	1825.01	97.76
2032	0.00	0.00	0.00	0.00	15.130	15.13	1809.88	97.73
2007	0.00	0.00	0.00	0.00	15.130	15.13	1794.75	97.71
1981	0.00	0.00	0.00	0.00	15.130	15.13	1779.62	97.68
1956	0.00	0.00	0.00	0.00	15.130	15.13	1764.49	97.66
1930	0.00	0.00	0.00	0.00	15.130	15.13	1749.36	97.63
1905	0.00	0.00	0.00	0.00	15.130	15.13	1734.23	97.61
1880	0.00	0.00	0.00	0.00	15.130	15.13	1719.10	97.58
1854	0.00	0.00	0.00	0.00	15.130	15.13	1703.97	97.55
1829	0.00	0.00	0.40	0.00	14.960	15.36	1688.84	97.53
1803	0.00	0.00	1.12	0.01	14.644	15.77	1673.48	97.50
1778	0.00	0.00	1.60	0.01	14.438	16.05	1657.71	97.48
1753	0.01	0.00	2.02	0.03	14.249	16.30	1641.66	97.45
1727	0.01	0.00	2.60	0.04	13.996	16.63	1625.36	97.43
1702	0.01	0.00	4.39	0.05	13.223	17.66	1608.73	97.40
1676	0.02	0.00	6.44	0.06	12.332	18.84	1591.07	97.38
1651	0.02	0.00	7.74	0.08	11.768	19.59	1572.23	97.35
1626	0.03	0.00	8.79	0.09	11.308	20.20	1552.64	97.33
1600	0.03	0.01	9.71	0.11	10.907	20.73	1532.45	97.30
1575	0.03	0.01	10.53	0.12	10.550	21.20	1511.72	97.27
1549	0.03	0.01	11.27	0.14	10.226	21.63	1490.52	97.25
1524	0.03	0.01	11.95	0.15	9.926	22.03	1468.89	97.22
1499	0.04	0.01	12.59	0.17	9.646	22.40	1446.86	97.20
1473	0.04	0.01	13.18	0.18	9.384	22.75	1424.46	97.17
1448	0.04	0.01	13.74	0.20	9.138	23.07	1401.71	97.15
1422	0.04	0.01	14.27	0.21	8.905	23.38	1378.63	97.12
1397	0.04	0.01	14.77	0.22	8.683	23.68	1355.25	97.10
1372	0.04	0.01	15.25	0.24	8.472	23.96	1331.57	97.07
1346	0.05	0.01	15.70	0.25	8.271	24.22	1307.62	97.05
1321	0.05	0.01	16.14	0.26	8.079	24.48	1283.40	97.02
1295	0.05	0.01	16.55	0.27	7.895	24.72	1258.92	97.00
1270	0.05	0.01	16.95	0.29	7.719	24.95	1234.20	96.97
1245	0.05	0.01	17.33	0.30	7.551	25.18	1209.24	96.94
1219	0.05	0.02	17.70	0.31	7.389	25.39	1184.07	96.92
1194	0.05	0.02	18.05	0.32	7.233	25.60	1158.67	96.89
1168	0.05	0.02	18.38	0.33	7.083	25.80	1133.07	96.87
1143	0.05	0.02	18.71	0.34	6.939	25.99	1107.28	96.84
1118	0.06	0.02	19.02	0.35	6.800	26.17	1081.29	96.82

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.

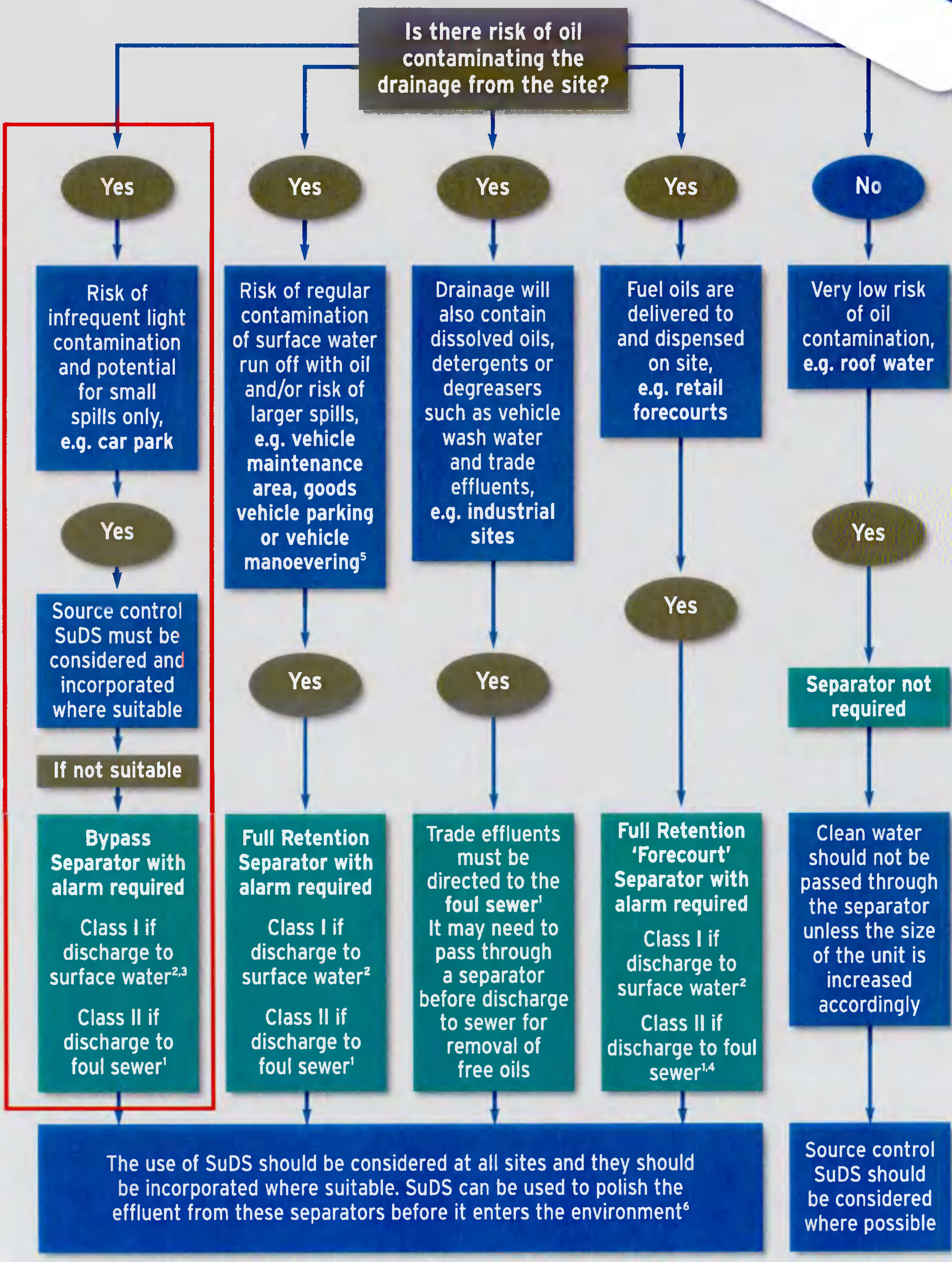
SELECTING THE RIGHT SEPARATOR

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.

Kingspan Klargester



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.
- Oil storage volume.
- Silt storage capacity.
- 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.

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BRITISH WATER

UK GREEN BUILDING COUNCIL

Issue No. 20: August 2014

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

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.

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 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.

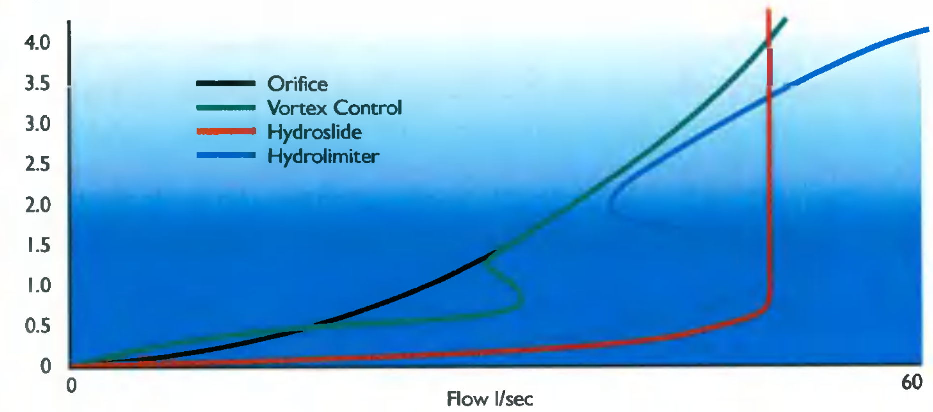
Typical SurfSep installation

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

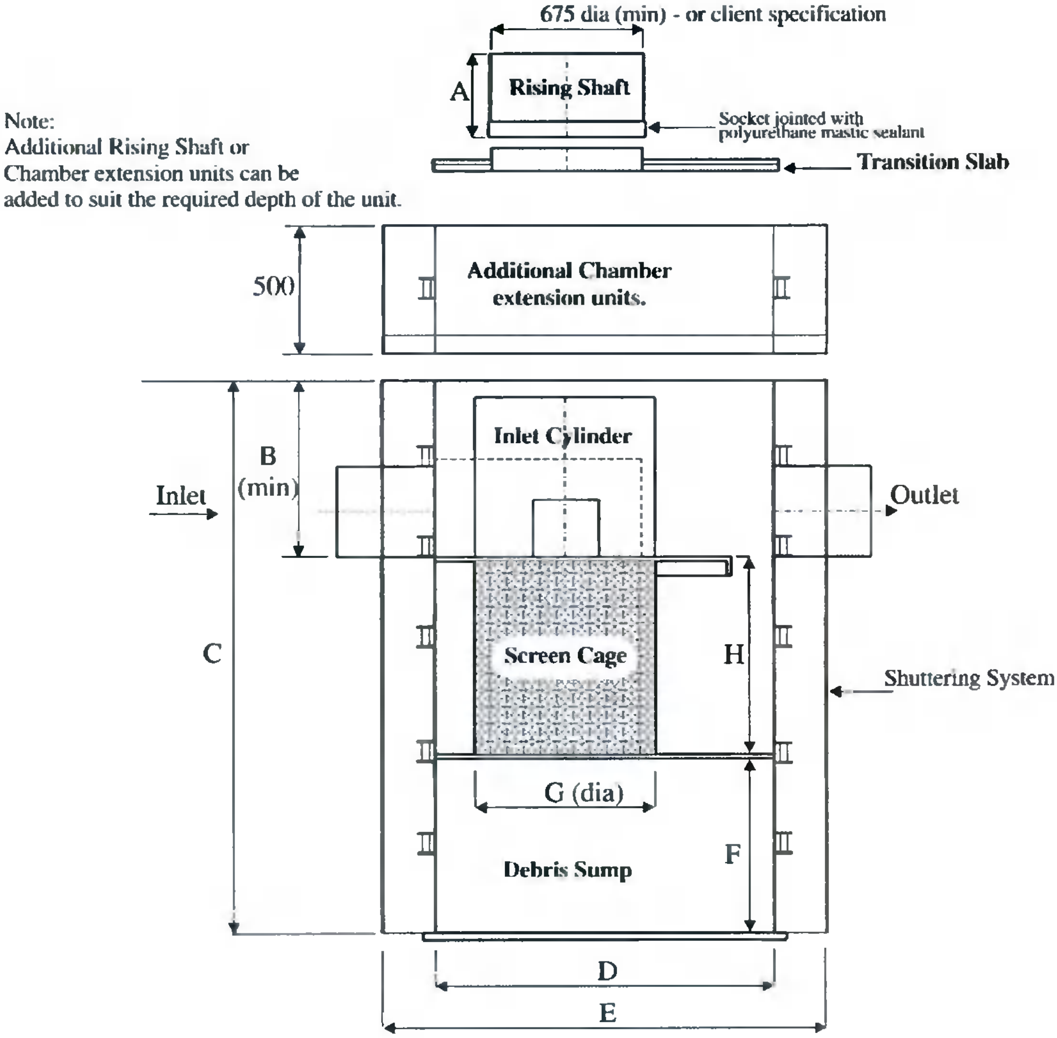
- Eduction (Suction)
- Basket Removal
- Mechanical Grab

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



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

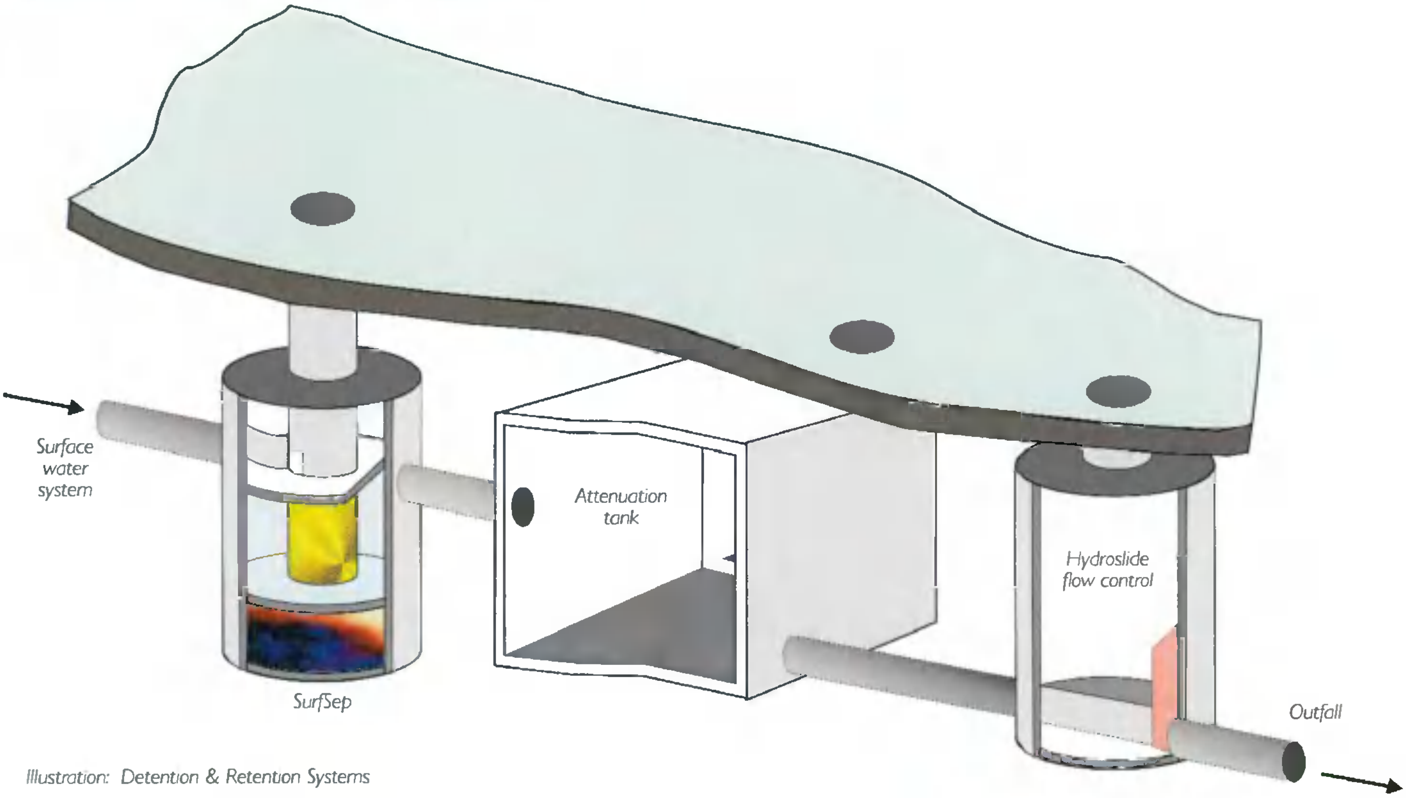


Illustration: Detention & Retention Systems

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 BRITISH BOARD OF AGRÉMENT TECHNICAL APPROVALS FOR CONSTRUCTION

• 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.

 Issue 1001/100206

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

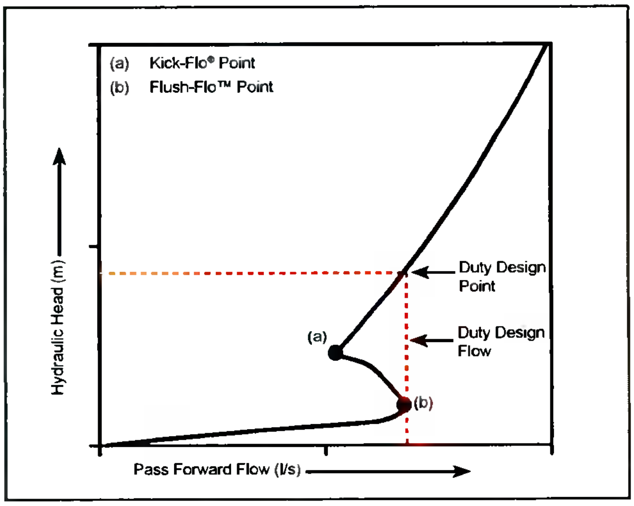
CERTIFICATE No 08/4599

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:

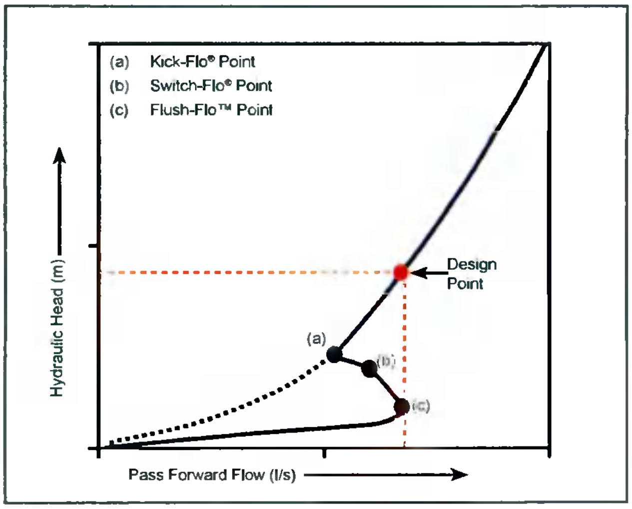
- outlet size and model of Hydro-Brake® Flow Control
- definition of the duty/design point (head and flow)
- definition of the Flush-Flo™ point (head and flow)
- definition of the Kick-Flo® point (head and flow)

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 WinDes® 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 WinDes® 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.

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HRD Technologies Ltd is a subsidiary of Hydro International plc

Appendix A – Storm Water Network Design

Design Settings

Rainfall Methodology	FSR
Return Period (years)	2
Additional Flow (%)	10
FSR Region	England and Wales
M5-60 (mm)	17.800
Ratio-R	0.271
CV	0.750
Time of Entry (mins)	5.00
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)	Cover Level (m)	Diameter (mm)	Depth (m)
SW1	0.096	5.00	100.750	1200	1.425
SW2			100.750	1200	1.770
SW3	0.090	5.00	100.750	1200	1.425
SW4	0.070	5.00	100.750	1200	1.960
SW5	0.137	5.00	100.750	1200	2.330
SW6			99.150	1200	1.700
SW7	0.134	5.00	98.800	1200	1.500
SW8	0.101	5.00	98.800	1350	1.675
SW9			98.650	1350	1.720
SW10	0.496	5.00	98.200	1500	1.470
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	2.080
SW21			98.500	1500	2.260
SW22	0.069		98.650	1500	2.941
SW23		5.00	98.700	1200	3.000
SW24			98.300	1200	2.890
SW25			98.300	1200	2.970

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	SW2	34.642	0.600	99.325	98.980	0.345	100.4	225	5.44	49.6
1.001	SW2	SW4	19.543	0.600	98.980	98.790	0.190	102.9	225	5.70	48.7
2.000	SW3	SW4	49.802	0.600	99.325	98.790	0.535	93.1	225	5.61	49.0
1.002	SW4	SW5	36.180	0.600	98.790	98.420	0.370	97.8	225	6.15	47.3
1.003	SW5	SW6	66.928	0.600	98.420	97.450	0.970	69.0	225	6.86	45.2
1.004	SW6	SW8	7.190	0.600	97.450	97.275	0.175	41.1	225	6.92	45.1
3.000	SW7	SW8	25.630	0.600	97.300	97.200	0.100	256.3	300	5.44	49.6
1.005	SW8	SW9	43.662	0.600	97.125	96.930	0.195	223.9	375	7.52	43.5
1.006	SW9	SW10	13.558	0.600	96.930	96.880	0.050	271.2	375	7.73	43.0
1.007	SW10	SW20	81.508	0.600	96.730	96.335	0.395	206.3	525	8.60	41.0
4.000	SW11	SW12	90.000	0.600	97.500	97.050	0.450	200.0	300	6.35	46.7
4.001	SW12	SW13	47.117	0.600	97.050	96.870	0.180	261.8	300	7.17	44.4
4.002	SW13	SW16	39.485	0.600	96.870	96.725	0.145	272.3	300	7.86	42.7
5.000	SW14	SW15	90.000	0.600	97.400	96.875	0.525	171.4	300	6.25	47.0
5.001	SW15	SW16	59.032	0.600	96.800	96.650	0.150	393.5	375	7.34	44.0
4.003	SW16	SW19	32.511	0.600	96.650	96.550	0.100	325.1	375	8.40	41.4
6.000	SW17	SW18	90.000	0.600	97.500	96.925	0.575	156.5	300	6.20	47.1
6.001	SW18	SW19	64.834	0.600	96.850	96.550	0.300	216.1	375	7.08	44.6
4.004	SW19	SW20	35.839	0.600	96.400	96.335	0.065	551.4	525	9.03	40.1
1.008	SW20	SW21	8.705	0.600	96.260	96.240	0.020	435.3	600	9.16	39.8
1.009	SW21	SW22	12.632	0.600	96.240	96.210	0.030	421.1	600	9.34	39.5
7.000	SW23	SW24	67.630	0.600	95.700	95.410	0.290	233.2	225	6.32	46.7
7.001	SW24	SW25	16.108	0.600	95.410	95.330	0.080	201.4	225	6.62	45.9

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)
1.000	1.304	51.9	14.2	1.200	1.545	0.096	0.0	80
1.001	1.289	51.2	14.0	1.545	1.735	0.096	0.0	80
2.000	1.355	53.9	13.1	1.200	1.735	0.090	0.0	75
1.002	1.322	52.6	36.1	1.735	2.105	0.256	0.0	138
1.003	1.576	62.7	53.0	2.105	1.475	0.393	0.0	160
1.004	2.046	81.4	52.8	1.475	1.300	0.393	0.0	132
3.000	0.977	69.1	19.8	1.200	1.300	0.134	0.0	110
1.005	1.206	133.3	81.4	1.300	1.345	0.628	0.0	212
1.006	1.095	121.0	80.5	1.345	0.945	0.628	0.0	224
1.007	1.555	336.7	137.4	0.945	1.480	1.124	0.0	233
4.000	1.108	78.3	26.4	1.300	1.750	0.190	0.0	120
4.001	0.967	68.3	37.2	1.750	2.580	0.281	0.0	158
4.002	0.948	67.0	43.4	2.580	2.125	0.341	0.0	176
5.000	1.198	84.7	40.7	1.400	2.225	0.291	0.0	147
5.001	0.907	100.2	56.4	2.225	2.125	0.430	0.0	202
4.003	0.999	110.4	103.5	2.125	2.175	0.838	0.0	290
6.000	1.254	88.6	39.9	1.200	2.175	0.284	0.0	141
6.001	1.228	135.7	60.8	2.175	2.175	0.457	0.0	175
4.004	0.947	204.9	161.3	2.175	1.480	1.349	0.0	352
1.008	1.161	328.1	293.7	1.480	1.660	2.473	0.0	446
1.009	1.180	333.7	291.1	1.660	1.840	2.473	0.0	436
7.000	0.852	33.9	0.0	2.775	2.665	0.000	0.0	0
7.001	0.918	36.5	0.0	2.665	2.745	0.000	0.0	0

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	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 SW23 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-0098-5800-2085-5800
Design Depth (m)	2.085	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.8	Min Node Diameter (mm)	1200

Node SW23 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

SW22

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	861.5	0.0	2.250	861.5	0.0	2.251	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	228.951	64.785	30 year +10% CC 360 minute winter	23.605	9.345
30 year +10% CC 15 minute winter	160.667	64.785	30 year +10% CC 480 minute summer	29.035	7.673
30 year +10% CC 30 minute summer	159.027	44.999	30 year +10% CC 480 minute winter	19.290	7.673
30 year +10% CC 30 minute winter	111.598	44.999	30 year +10% CC 600 minute summer	24.055	6.580
30 year +10% CC 60 minute summer	113.781	30.069	30 year +10% CC 600 minute winter	16.436	6.580
30 year +10% CC 60 minute winter	75.593	30.069	30 year +10% CC 720 minute summer	21.641	5.800
30 year +10% CC 120 minute summer	73.866	19.521	30 year +10% CC 720 minute winter	14.544	5.800
30 year +10% CC 120 minute winter	49.075	19.521	30 year +10% CC 960 minute summer	18.034	4.749
30 year +10% CC 180 minute summer	58.162	14.967	30 year +10% CC 960 minute winter	11.946	4.749
30 year +10% CC 180 minute winter	37.807	14.967	30 year +10% CC 1440 minute summer	13.343	3.576
30 year +10% CC 240 minute summer	46.597	12.314	30 year +10% CC 1440 minute winter	8.967	3.576
30 year +10% CC 240 minute winter	30.958	12.314	30 year +10% CC 2160 minute summer	9.722	2.687
30 year +10% CC 360 minute summer	36.313	9.345	30 year +10% CC 2160 minute winter	6.699	2.687

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +10% CC 2880 minute summer	8.175	2.191
30 year +10% CC 2880 minute winter	5.494	2.191
30 year +10% CC 4320 minute summer	6.284	1.643
30 year +10% CC 4320 minute winter	4.138	1.643
30 year +10% CC 5760 minute summer	5.236	1.340
30 year +10% CC 5760 minute winter	3.389	1.340
30 year +10% CC 7200 minute summer	4.488	1.145
30 year +10% CC 7200 minute winter	2.897	1.145
100 year +10% CC 15 minute summer	294.385	83.301
100 year +10% CC 15 minute winter	206.586	83.301
100 year +10% CC 30 minute summer	206.915	58.550
100 year +10% CC 30 minute winter	145.204	58.550
100 year +10% CC 60 minute summer	149.298	39.455
100 year +10% CC 60 minute winter	99.190	39.455
100 year +10% CC 120 minute summer	97.135	25.670
100 year +10% CC 120 minute winter	64.534	25.670
100 year +10% CC 180 minute summer	76.206	19.610
100 year +10% CC 180 minute winter	49.536	19.610
100 year +10% CC 240 minute summer	60.695	16.040
100 year +10% CC 240 minute winter	40.324	16.040
100 year +10% CC 360 minute summer	46.925	12.075

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +10% CC 360 minute winter	30.502	12.075
100 year +10% CC 480 minute summer	37.294	9.856
100 year +10% CC 480 minute winter	24.777	9.856
100 year +10% CC 600 minute summer	30.744	8.409
100 year +10% CC 600 minute winter	21.006	8.409
100 year +10% CC 720 minute summer	27.539	7.381
100 year +10% CC 720 minute winter	18.508	7.381
100 year +10% CC 960 minute summer	22.784	6.000
100 year +10% CC 960 minute winter	15.093	6.000
100 year +10% CC 1440 minute summer	16.670	4.468
100 year +10% CC 1440 minute winter	11.203	4.468
100 year +10% CC 2160 minute summer	11.998	3.316
100 year +10% CC 2160 minute winter	8.267	3.316
100 year +10% CC 2880 minute summer	9.993	2.678
100 year +10% CC 2880 minute winter	6.716	2.678
100 year +10% CC 4320 minute summer	7.579	1.982
100 year +10% CC 4320 minute winter	4.991	1.982
100 year +10% CC 5760 minute summer	6.258	1.602
100 year +10% CC 5760 minute winter	4.051	1.602
100 year +10% CC 7200 minute summer	5.328	1.359
100 year +10% CC 7200 minute winter	3.439	1.359

Results for 30 year +10% CC Critical Storm Duration. Lowest mass balance: 99.48%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	13	99.700	0.375	28.3	0.9291	0.0000	SURCHARGED
15 minute winter	SW2	13	99.654	0.674	28.2	0.7619	0.0000	SURCHARGED
15 minute winter	SW3	13	99.681	0.356	26.4	0.8506	0.0000	SURCHARGED
15 minute winter	SW4	13	99.621	0.831	66.7	1.5372	0.0000	SURCHARGED
15 minute winter	SW5	12	99.266	0.846	79.0	1.9503	0.0000	SURCHARGED
15 minute winter	SW6	12	97.747	0.297	74.3	0.3359	0.0000	SURCHARGED
15 minute winter	SW7	13	97.514	0.214	39.5	0.6252	0.0000	OK
15 minute winter	SW8	12	97.515	0.390	137.7	1.0289	0.0000	SURCHARGED
4320 minute winter	SW9	3360	97.484	0.554	6.1	0.7921	0.0000	SURCHARGED
4320 minute winter	SW10	3420	97.485	0.755	10.9	6.4253	0.0000	SURCHARGED
15 minute winter	SW11	13	97.937	0.437	56.0	1.5325	0.0000	SURCHARGED
15 minute winter	SW12	13	97.826	0.776	80.3	1.5695	0.0000	SURCHARGED
15 minute winter	SW13	13	97.685	0.815	73.9	1.2579	0.0000	SURCHARGED
15 minute winter	SW14	12	98.067	0.667	85.7	3.0359	0.0000	SURCHARGED
15 minute winter	SW15	12	97.701	0.901	109.3	2.2569	0.0000	SURCHARGED
15 minute winter	SW16	12	97.532	0.882	173.6	1.7333	0.0000	SURCHARGED
15 minute winter	SW17	12	97.740	0.240	83.6	1.1767	0.0000	OK
4320 minute winter	SW18	3360	97.484	0.634	4.4	1.7673	0.0000	SURCHARGED
4320 minute winter	SW19	3420	97.484	1.084	12.8	2.3517	0.0000	SURCHARGED
4320 minute winter	SW20	3420	97.484	1.224	22.9	2.1628	0.0000	SURCHARGED
4320 minute winter	SW21	3420	97.484	1.244	22.2	2.1979	0.0000	SURCHARGED
4320 minute winter	SW22	3360	97.484	1.775	22.7	3.9645	0.0000	OK
4320 minute winter	SW23	3360	97.484	1.784	14.7	2.0173	0.0000	SURCHARGED
4320 minute winter	SW24	3360	95.469	0.059	5.2	0.0663	0.0000	OK
4320 minute winter	SW25	3360	95.387	0.057	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	SW2	28.2	1.287	0.543	1.3777	
15 minute winter	SW2	1.001	SW4	22.9	0.769	0.448	0.7772	
15 minute winter	SW3	2.000	SW4	25.9	0.792	0.481	1.9807	
15 minute winter	SW4	1.002	SW5	53.4	1.343	1.016	1.4389	
15 minute winter	SW5	1.003	SW6	74.3	1.868	1.186	2.6618	
15 minute winter	SW6	1.004	SW8	75.1	2.039	0.923	0.2860	
15 minute winter	SW7	3.000	SW8	36.4	0.766	0.527	1.5901	
15 minute winter	SW8	1.005	SW9	135.6	1.267	1.017	4.8158	
4320 minute winter	SW9	1.006	SW10	6.1	0.585	0.050	1.4954	
4320 minute winter	SW10	1.007	SW20	10.9	0.687	0.032	17.6084	
15 minute winter	SW11	4.000	SW12	53.4	0.972	0.682	6.3377	
15 minute winter	SW12	4.001	SW13	57.4	0.967	0.840	3.3179	
15 minute winter	SW13	4.002	SW16	68.0	0.966	1.015	2.7805	
15 minute winter	SW14	5.000	SW15	70.0	1.284	0.827	6.3377	
15 minute winter	SW15	5.001	SW16	99.3	0.900	0.991	6.5111	
15 minute winter	SW16	4.003	SW19	174.4	1.581	1.580	3.5859	
15 minute winter	SW17	6.000	SW18	77.0	1.338	0.868	5.8825	
4320 minute winter	SW18	6.001	SW19	4.4	0.564	0.032	7.1510	
4320 minute winter	SW19	4.004	SW20	12.2	0.564	0.060	7.7424	
4320 minute winter	SW20	1.008	SW21	22.2	0.582	0.068	2.4520	
4320 minute winter	SW21	1.009	SW22	22.0	0.667	0.066	3.5581	
4320 minute winter	SW22	Flow through pond	SW23	14.7	0.017	0.000	1533.2535	
4320 minute winter	SW23	Hydro-Brake®	SW24	5.2				
4320 minute winter	SW24	7.001	SW25	5.2	0.643	0.141	0.1292	1018.4

Max water level in the attenuation and drainage network for storms up to 1:30y return. Critical event duration 3420min. Maximum achieved water level during this event does not exceed the high water level in the proposed attenuation tank (97.95m) therefore proposed attenuation has sufficient capacity to accommodate storms up to 1in30 years return. See drawing ref. D658-D3-PL3 for attenuation base and high water level.

Results for 100 year +10% CC Critical Storm Duration. Lowest mass balance: 99.48%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	13	100.602	1.277	36.4	3.1681	0.0000	FLOOD RISK
15 minute winter	SW2	13	100.549	1.568	29.9	1.7739	0.0000	FLOOD RISK
15 minute winter	SW3	13	100.585	1.260	34.0	3.0103	0.0000	FLOOD RISK
15 minute winter	SW4	13	100.516	1.725	71.3	3.1904	0.0000	FLOOD RISK
15 minute winter	SW5	13	100.114	1.694	90.1	3.9025	0.0000	SURCHARGED
15 minute winter	SW6	12	98.317	0.867	82.9	0.9806	0.0000	SURCHARGED
15 minute winter	SW7	12	98.086	0.786	50.8	2.2926	0.0000	SURCHARGED
15 minute winter	SW8	12	98.043	0.918	148.4	2.4238	0.0000	SURCHARGED
2880 minute winter	SW9	2760	97.948	1.018	9.8	1.4568	0.0000	SURCHARGED
2880 minute winter	SW10	2760	97.948	1.218	17.6	10.3668	0.0000	FLOOD RISK
15 minute winter	SW11	12	98.823	1.323	72.0	4.6402	0.0000	FLOOD RISK
15 minute winter	SW12	12	98.629	1.579	93.4	3.1944	0.0000	SURCHARGED
15 minute winter	SW13	12	98.397	1.527	88.3	2.3580	0.0000	SURCHARGED
15 minute winter	SW14	12	98.912	1.512	110.2	6.8836	0.0000	FLOOD RISK
15 minute winter	SW15	12	98.360	1.560	130.0	3.9074	0.0000	SURCHARGED
15 minute winter	SW16	12	98.105	1.455	227.6	2.8605	0.0000	SURCHARGED
15 minute winter	SW17	12	98.508	1.008	107.5	4.9528	0.0000	SURCHARGED
2880 minute winter	SW18	2760	97.948	1.098	7.1	3.0625	0.0000	SURCHARGED
2880 minute winter	SW19	2760	97.948	1.548	19.7	3.3577	0.0000	SURCHARGED
2880 minute winter	SW20	2760	97.948	1.688	35.7	2.9827	0.0000	SURCHARGED
2880 minute winter	SW21	2760	97.948	1.708	35.1	3.0180	0.0000	SURCHARGED
2880 minute winter	SW22	2760	97.948	2.239	36.2	5.0019	0.0000	OK
2880 minute winter	SW23	2760	97.948	2.248	24.6	2.5425	0.0000	SURCHARGED
2880 minute winter	SW24	2760	95.472	0.062	5.8	0.0705	0.0000	OK
2880 minute winter	SW25	2760	95.390	0.060	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	SW2	29.9	1.306	0.577	1.3777	
15 minute winter	SW2	1.001	SW4	25.5	0.761	0.497	0.7772	
15 minute winter	SW3	2.000	SW4	29.4	0.846	0.546	1.9807	
15 minute winter	SW4	1.002	SW5	58.6	1.474	1.115	1.4389	
15 minute winter	SW5	1.003	SW6	82.9	2.086	1.323	2.6618	
15 minute winter	SW6	1.004	SW8	87.1	2.190	1.070	0.2860	
15 minute winter	SW7	3.000	SW8	41.0	0.762	0.593	1.8048	
15 minute winter	SW8	1.005	SW9	150.2	1.362	1.127	4.8158	
2880 minute winter	SW9	1.006	SW10	9.8	0.661	0.081	1.4954	
2880 minute winter	SW10	1.007	SW20	17.0	0.743	0.050	17.6084	
15 minute winter	SW11	4.000	SW12	60.8	0.997	0.777	6.3377	
15 minute winter	SW12	4.001	SW13	74.2	1.053	1.085	3.3179	
15 minute winter	SW13	4.002	SW16	90.6	1.287	1.352	2.7805	
15 minute winter	SW14	5.000	SW15	82.2	1.284	0.971	6.3377	
15 minute winter	SW15	5.001	SW16	121.8	1.104	1.216	6.5111	
15 minute winter	SW16	4.003	SW19	228.5	2.071	2.070	3.5859	
15 minute winter	SW17	6.000	SW18	85.4	1.351	0.963	6.3377	
2880 minute winter	SW18	6.001	SW19	7.1	0.627	0.052	7.1510	
2880 minute winter	SW19	4.004	SW20	19.0	0.616	0.093	7.7424	
2880 minute winter	SW20	1.008	SW21	35.1	0.629	0.107	2.4520	
2880 minute winter	SW21	1.009	SW22	35.1	0.725	0.105	3.5581	
2880 minute winter	SW22	Flow through pond	SW23	24.6	0.046	0.000	1920.3052	
2880 minute winter	SW23	Hydro-Brake®	SW24	5.8				
2880 minute winter	SW24	7.001	SW25	5.8	0.664	0.159	0.1406	771.2

Max water level in the attenuation and drainage network for storms up to 1:100y return Critical event duration 2760min Maximum achieved water level during this event does not exceed the high water level in the proposed attenuation tank (97.95m) therefore proposed attenuation has sufficient capacity to accommodate storms up to 1in100 years return. See drawing ref. D658-D3-PL3 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.