Following the submission of documents relating to the Planning Application 21/00953/FUL, comments, observations and requests for additional information have been received from the following consultees in respect of matters related to surface water drainage.

ANGLIAN WATER (REF 173078/1/0121009)

1. "It is noted that the surface water drainage strategy involves discharge to the sewers in Whitehouse Lane. These sewers are not owned by Anglian Water, we are therefore unable to agree/make comment on the suitability of a discharge to this location."

SOUTH CAMBRIDGESHIRE DISTRICT COUNCIL / CAMBRIDGE CITY COUNCIL

2. "The flood risk assessment should include an assessment of the flood risk from all sources of flooding. The flood risk should include assessment of: fluvial flood risk, mapped surface water, flood risk associated with potential overland flow from adjacent steeply sloping land, groundwater flood risk, flooding from surface water, foul sewers and summary of historic flooding records (if any)"

CAMBRIDGE COUNTY COUNCIL LLFA (REF R/21-000154)

3. TREATMENT OF WATER

The system for treating water needs to accommodate for the highway water runoff on the access road. As it currently stands there is no treatment of the highways water runoff. This is not in line with the Pollution Hazard Indices within the CIRIA SuDS Manual (C753) Chapter 26. Additional surface water treatment is required on site to ensure all surface water runoff receives adequate treatment prior to discharging offsite. This could be through the use of open attenuation or permeable surfaces such as permeable paving over the access road. Until there is suitable treatment of surface water in line with the Pollution Hazard Indices we are unable to support this.

4. FSR vs FEH

The submitted calculations are using FSR rainfall data. However, FSR rainfall data is now outdated and there are more accurate data sets in FEH 1999 and 2013 models. This due to recording of rainfall over a longer period of time, as well as updated calculations behind the model. Therefore, FEH rainfall data is now required on all applications to ensure the hydraulic modelling is an accurate representation of the proposed network.

5. PERMISSION TO DISCHARGE INTO ANGLIAN WATER CONNECTION

The applicant plans to discharge surface water from the site into an existing Anglian Water surface water network. Although it is thought that the site currently drains into an existing Anglian Water sewer, no assumption should be made that this historic connection still exists and therefore the application must be assessed as if there is no existing connection. Until agreement in principle with Anglian Water has been submitted, we are unable to support this application.

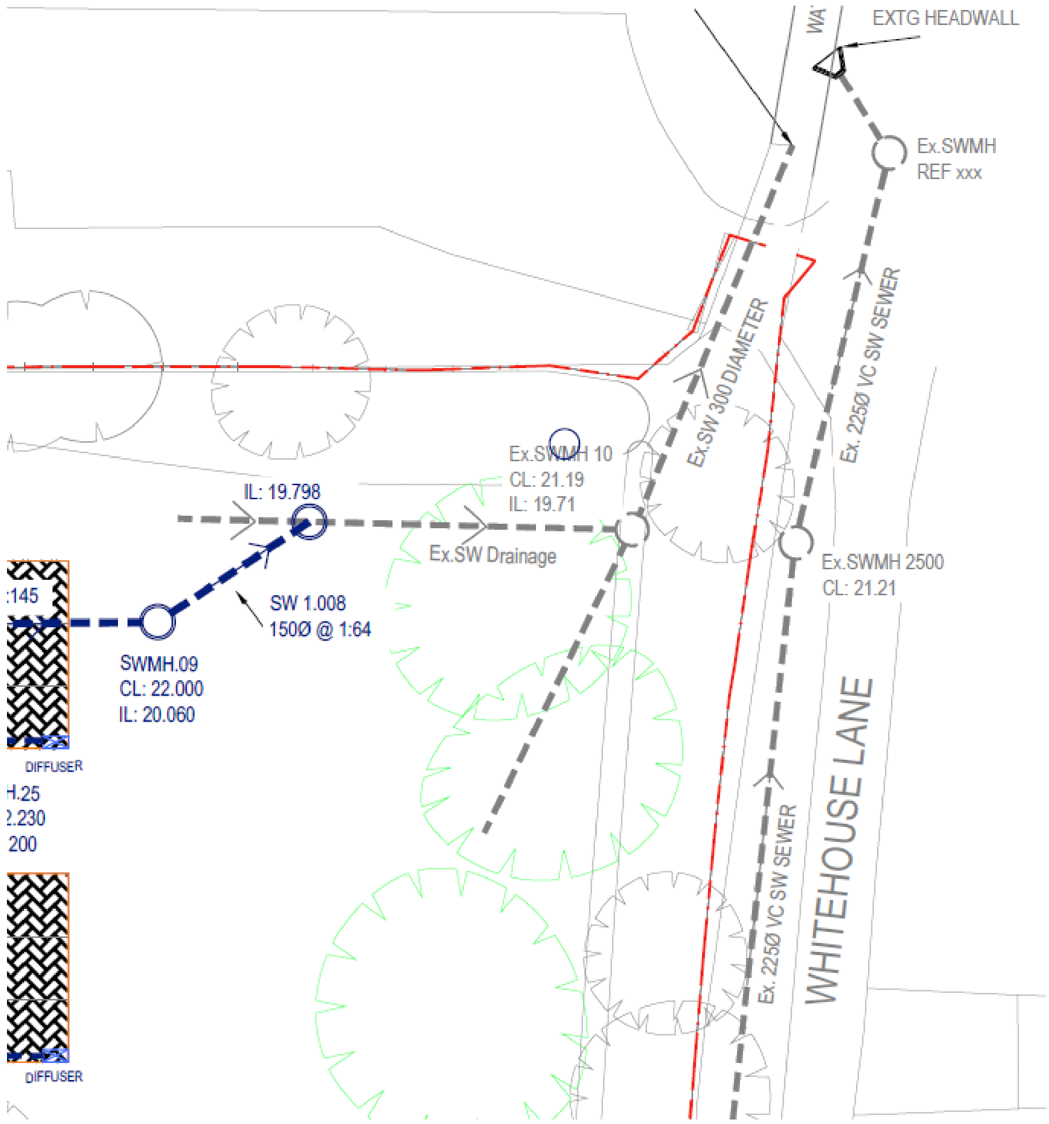
6. **ATTENUATION VOLUMES**

The applicant has used a 'Quick Storage Estimate' to calculate the volume of attenuation required. This is not a suitable method for calculating the volume of attenuation for a full planning application where a greater level of detail is required.

This note has been complied to address the above aspects.

1. ANGLIAN WATER

Further investigation has been undertaken which shows that the surface water drainage does not connect to the public sewer in Whitehouse Lane as originally expected. It has been determined that the surface water discharges to the adjacent water course to the east of the site via a 300mm diameter pipe leaving ex SWMH 10 on the site boundary. This is shown on plan below with photographs in Appendix A.



The proposed strategy for discharge of surface water has been amended to be discharge to watercourse, subject to the necessary consents.

2. SOUTH CAMBRIDGESHIRE DISTRICT COUNCIL / CAMBRIDGE CITY COUNCIL

FLUVIAL FLOOD RISK

As noted in figure 1 below the site is not at risk from fluvial flooding.

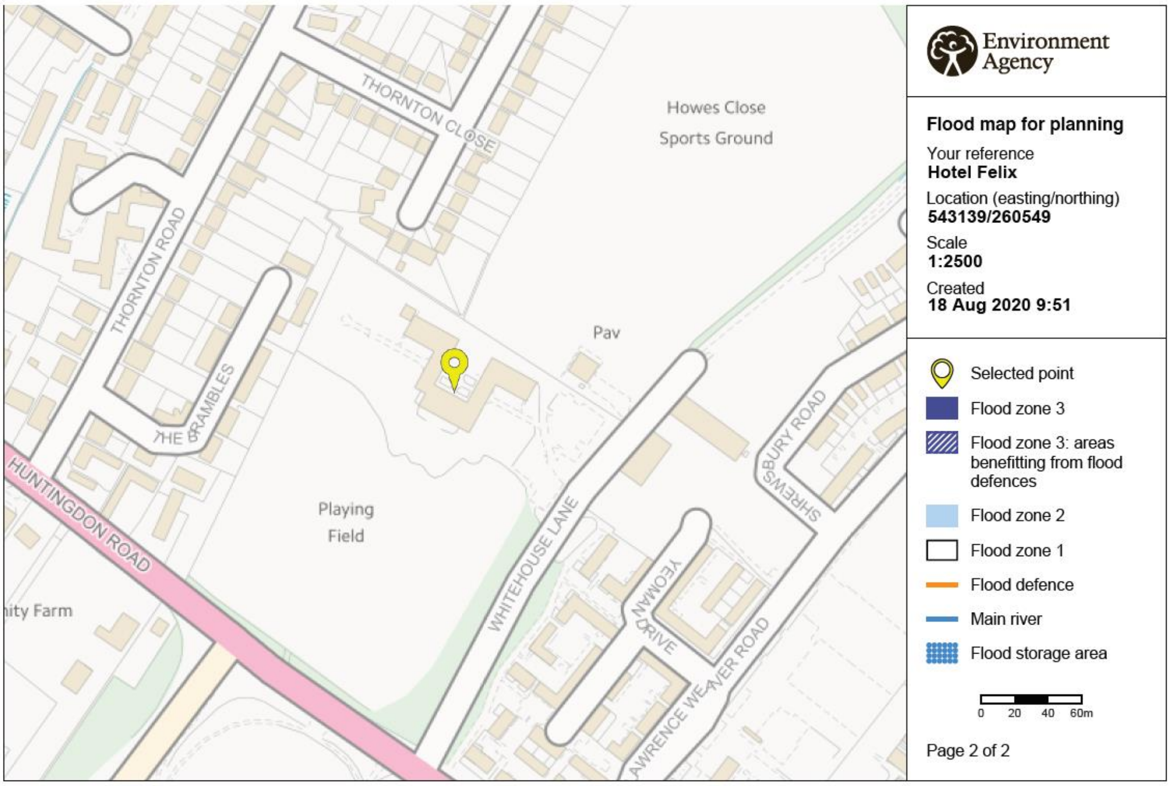


FIGURE 1

PLUVIAL FLOOD RISK

The Government website Your long term flood risk assessment - GOV.UK (flood-warning-information.service.gov.uk) has been consulted in relation to the risk of surface water flooding, which confirms the site is at low risk of surface water flooding. This is explored further in the subsequent pages.

HOTEL FELIX, HUNTINGDON ROAD, GIRTON, CAMBRIDGE, CB3 0LX

Surface water

Low risk

▼ What this information means

This flood risk summary reports the highest risk from surface water within a 20m radius of this property.

Low risk means that each year this area has a chance of flooding of between 0.1% and 1%.

This information is suitable for identifying:

- which parts of streets or parcels of land are at risk, or have the most risk
- the extent, depth and approximate velocity of flooding

It's very likely to be reliable for identifying the risk to:

- local areas of land
- individual properties - though not whether they will flood internally

The EA map showing the extent of potential surface water flooding on the site is shown in figure 2. This has been superimposed with the site plan of the proposed development. There is a small area to the south side of the development that may be subject to low level surface water flooding, however, this can be managed and diverted around the building by means of soft landscaping and footpaths. It should also be noted that the high-risk areas (dark blue) are predominantly outside the redline boundary to the west.

The watercourse to the east of the site flows away from the site in an easterly direction and does not present a flood risk to the proposed development.

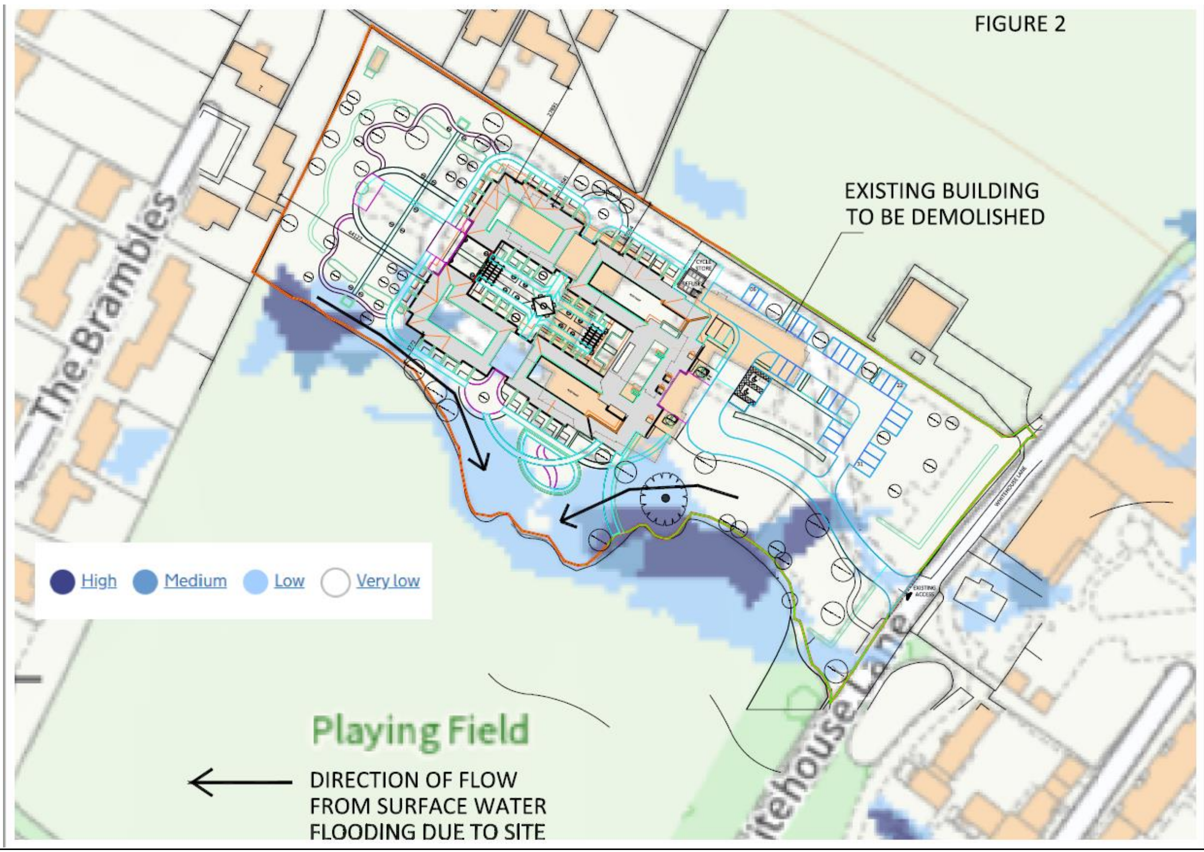


FIGURE 2 (a larger version of this figure is appended for reference)

High risk means that each year this area has a chance of flooding of greater than 3.3%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

Medium risk means that each year this area has a chance of flooding of between 1% and 3.3%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

Low risk means that each year this area has a chance of flooding of between 0.1% and 1%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding

When viewing the depth of the potential surface water flooding, Figure 3, the maximum depth of water is expected to be less than 300mm deep and is in fact found largely off site, presenting little or no risk to the proposed development.

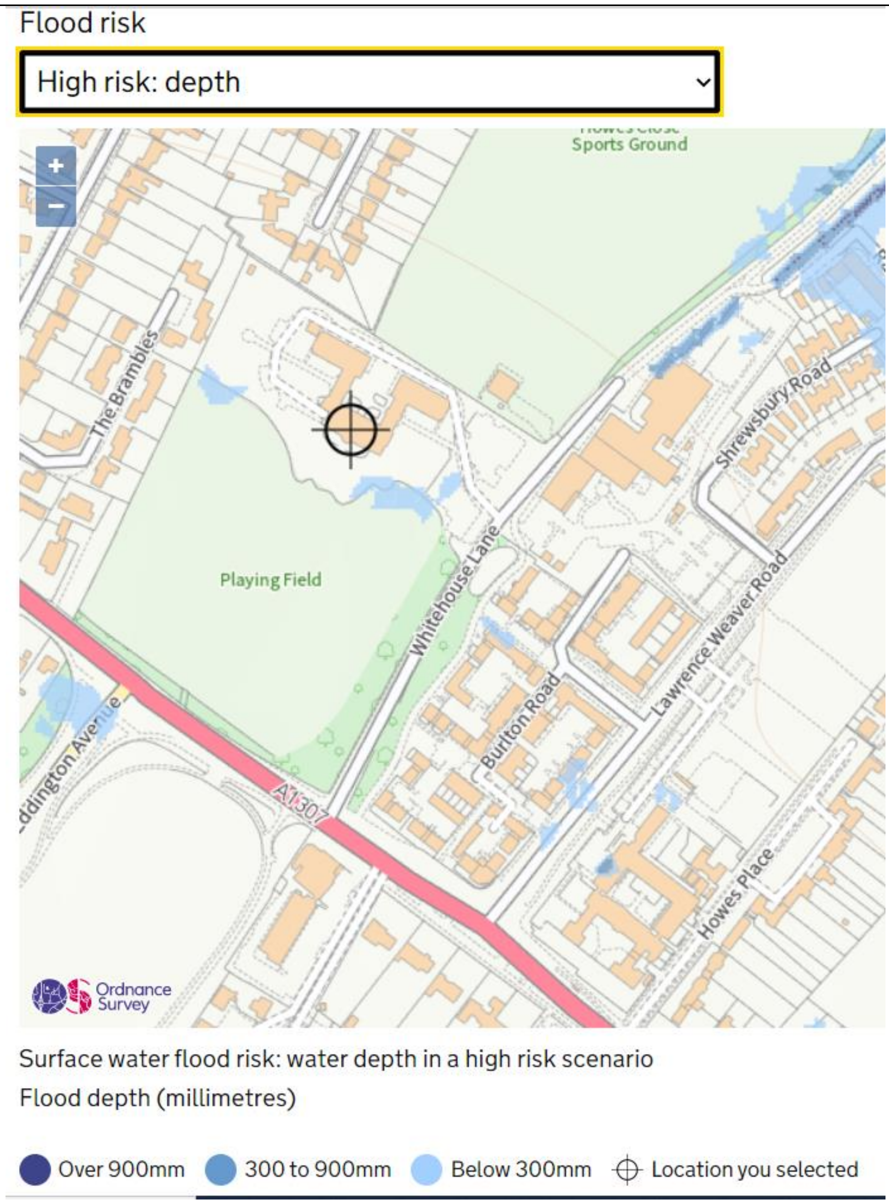


FIGURE 3

From the topographical survey of the site, the ground level at the location of the proposed building is generally around +22.00 to +22.50 mAOD, with the ground falling away to the site boundaries.

This is further demonstrated with reference to the extract from the ordnance survey map, figure 4, showing contours at +20.00 mAOD to the east and west of the site which demonstrates the site is not at risk from surface water flooding from steeply sloping adjacent land.

Whilst the final finished floor level of the building is yet to be set, it is anticipated it will be similar to the existing property and will provide a resilient defence to shallow surface or foul water flooding

FIGURE 4

GROUNDWATER FLOODING

An intrusive ground investigation was undertaken in January 2021 and no groundwater was encountered during these works. To mitigate against any potential ground water flooding, a suspended precast concrete floor will be used for the property with a sub-floor void of 200mm provided with ventilation ducts. This should be adequate protection should groundwater flooding occur in the future.

HISTORIC FLOODING

From reviewing the maps available in the Level SFRA for South Cambridge and Cambridge City, there are no records or evidence of historic flooding on or close to the site, either foul or surface water. See Figure 5 below

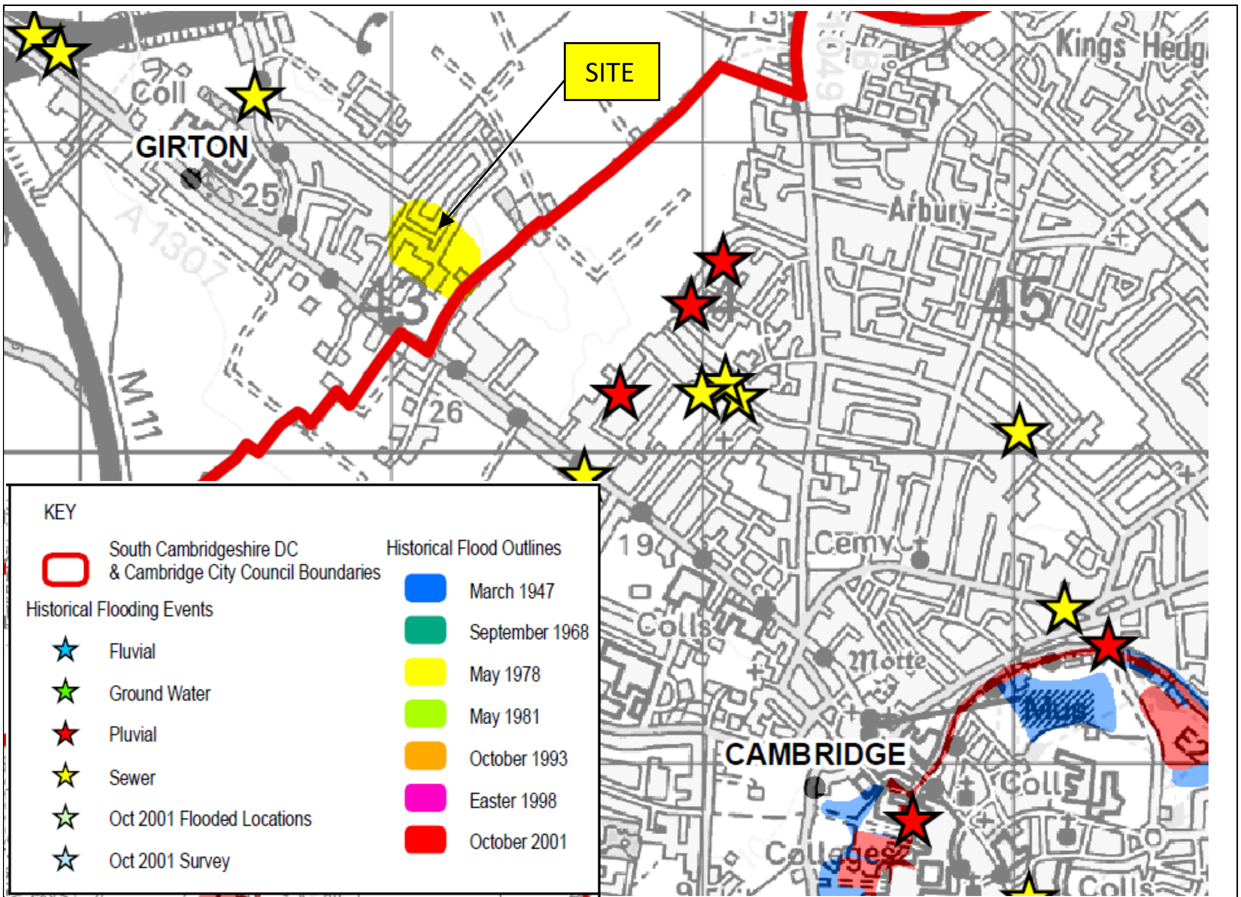


FIGURE 5 (HISTORIC FLOODING)
SOUTH CAMBRIDGESHIRE DC AND CAMBRIDGE CITY COUNCIL
LEVEL 1 SFRA, HISTORICAL DATA 1402 - B - 3.5

CAMBRIDGE COUNTY COUNCIL LLFA (REF R/21-000154)

3. TREATMENT OF WATER

The proposals have been updated to include drainage to the access road and drained permeable paving to the car parking areas. Downstream Defenders (details provided in Appendix B) are to be included to capture sediment and pollution from the highway / access road prior to water entering the attenuation.

Permeable paving is to be included with a sub base to provide means of filtration and improvement of water quality prior to entering the attenuation tank.

4. FSR vs FEH

Calculations have been carried out using the FEH rainfall data. These are included in Appendix C.

5. PERMISSION TO DISCHARGE INTO ANGLIAN WATER CONNECTION

As noted in (1) it is no longer proposed to discharge surface water to Anglian Water Sewers

6. **ATTENUATION VOLUMES**

The volume of attenuation has been updated to reflect the MicroDrainage model rather than a quick estimate. Calculations are enclosed in Appendix C.

APPENDIX A – PHOTOGRAPHS OF EXISTING SURFACE WATER DRAINAGE DISCHARGE

EXISTING SW MH 10 (Inlets 3 o'clock and 6 o'clock, outfall at 9 o'clock)

EXISTING HEADWALL FROM S106 SEWER

300mm DIAMETER OUTLET FROM SITE

APPENDIX B – DOWNSTREAM DEFENDER

Downstream Defender®

High-Level Treatment in a Small Footprint

Product Profile

The Downstream Defender® is an advanced vortex separator used to treat stormwater runoff in pretreatment or stand-alone applications. Its unique flow-modifying internal components distinguish the Downstream Defender® from conventional and simple swirl separators that typically bypass untreated peak flows to prevent washout of captured pollutants. Its wide treatment flow range, low headloss, small footprint and low-profile make it a compact and economical solution for capturing nonpoint source pollution.

Components

1. Inlet to Precast Vortex Chamber
2. Cylindrical Baffle
3. Center Shaft
4. Outlet Pipe
5. Sediment Storage Sump
6. Access Lid

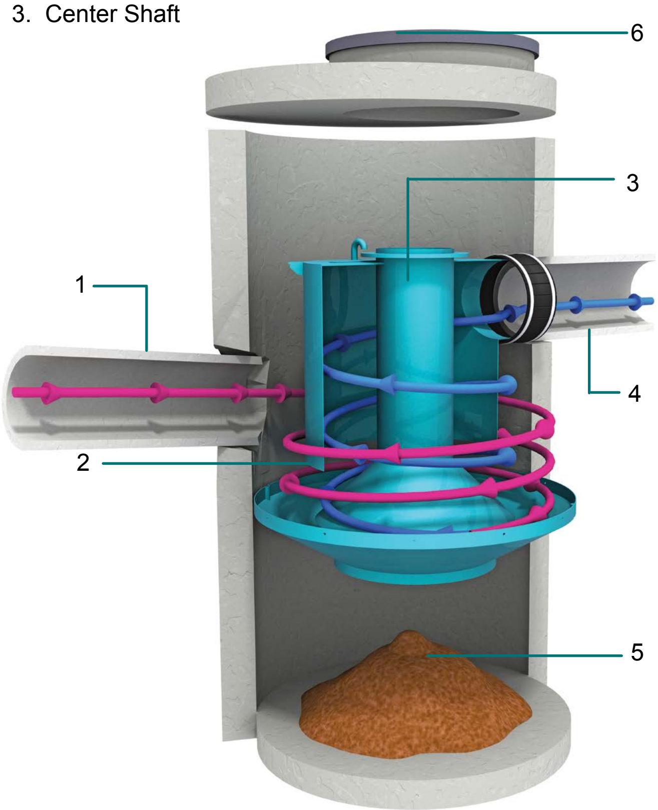


Fig.1 The Downstream Defender® has internal components designed to maximize pollutant capture and minimize pollutant washout.

Applications

- Removal of total suspended solids (TSS), floatable trash and petroleum products from stormwater runoff
- New construction or redevelopment of commercial and residential sites
- Pollutant hotspots such as maintenance yards, parking lots, gas stations, streets, highways, airports and transportation hubs
- Site constrained LID or green infrastructure based developments
- LEED® development projects

Advantages

- Special internal components maximize pollutant capture and minimize footprint, headloss and washout
- Captures and retains a wide range of TSS particles
- High peak treatment flow rates
- Treats the entire storm with no washout or untreated bypass flows
- Low maintenance requirements - no dredging required, and no screens or media to block
- Variable inlet/outlet angles for ease of site layout

How it Works

Advanced hydrodynamic vortex separation is a complex hydraulic process that augments gravity separation with low-energy rotary forces. The flow modifying internal components used in the Downstream Defender® harness the energy from vortex flow and maximize the time for separation to occur while deflecting high scour velocities (**Fig.1**).

Polluted stormwater is introduced tangentially into the side of the precast vortex chamber to establish rotational flow. A cylindrical baffle with an inner center shaft creates an outer (magenta arrow) and inner (blue arrow) spiraling column of flow and ensures maximum residence time for pollutant travel between the inlet and outlet.

Oil, trash and other floating pollutants are captured and stored on the surface of the outer spiraling column. Low energy vortex motion directs sediment into the protected sump region. Only after following a long three-dimensional flow path is the treated stormwater discharged from the outlet pipe. Maintenance ports at ground level provide access for easy inspection and clean-out.

Downstream Defender®

Drainage Profile

The Downstream Defender® is designed with a submerged tangential inlet to minimize turbulence within the device. Turbulence increases system headlosses and reduces performance by keeping pollutant particles in suspension.

The inlet elevation of the Downstream Defender® is located one inlet pipe diameter lower than the elevation of the outlet invert (**Fig.2**). This arrangement ensures that influent flows are introduced to the treatment chamber quiescently below the water surface elevation, minimizing turbulence.

The unique flow-modifying internal components also minimize hydraulic losses. There are no internal weirs or orifices; large clear openings ensure low headloss at peak flow rates with little risk of blockages that cause upstream flooding.

Inspections, Repairs and Clean-out

Nobody maintains our systems better than we do. To ensure optimal, ongoing device performance, be sure to recommend Hydro International as a preferred service and maintenance provider to your clients.

Call **1 (800) 848-2706** to schedule an inspection and clean-out or learn more at **hydro-int.com/service**

Sizing & Design

The Downstream Defender® can be used to meet a wide range of stormwater treatment objectives. It is available in 5 precast models that fit easily into the drainage network (**Table 1**). Selection and layout of the appropriate Downstream Defender® model depends on site hydraulics, site constraints and local regulations. Both online (**Fig.3a)** and offline (**Fig.3b**) configurations are common.

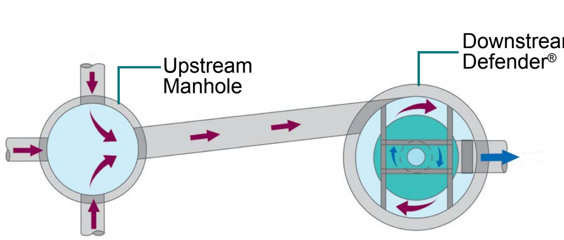


Fig.3a The Downstream Defender® in an online configuration.

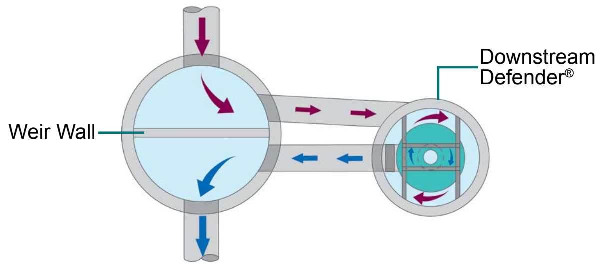


Fig.3b The Downstream Defender® in an offline configuration.

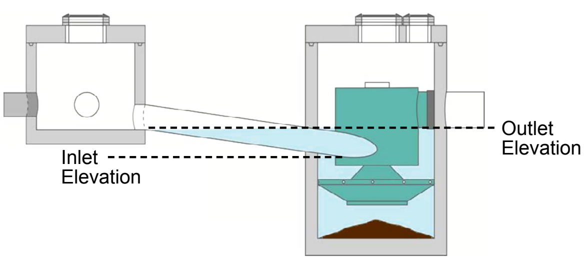


Fig.2 The Downstream Defender® has a submerged inlet that reduces headloss and improves efficiency of pollutant capture.

Free *Stormwater Sizing Tool*

This simple online tool will recommend the best separator, model size and online/offline arrangement based on site-specific data entered by the user.

Go to hydro-int.com/sizing to access the tool.

Table 1. Downstream Defender® Design Chart.

Model Number and Diameter		Peak Treatment Flow Rate		Maximum Pipe Diameter		Oil Storage Capacity		Sediment Storage Capacity		Minimum Distance from Outlet Invert to Top of Rim		Standard Height from Outlet Invert to Sump Floor	
(ft)	(m)	(cfs)	(L/s)	(in)	(mm)	(gal)	(L)	(yd^3)	(m^3)	(ft)	(m)	(ft)	(m)
4	1.2	3.0	85	12	300	70	265	0.70	0.53	2.8	0.85	4.1	1.25
6	1.8	8.0	227	18	450	216	818	2.10	1.61	3.2	0.98	5.9	1.80
8	2.4	15.0	425	24	600	540	2,044	4.65	3.56	4.2	1.28	7.7	2.35
10	3.0	25.0	708	30	750	1,050	3,975	8.70	6.65	5.0	1.52	9.4	2.85
12*	3.7	38.0	1,076	36	900	1,770	6,700	14.70	11.24	5.6	1.71	11.2	3.41

*Not available in all areas. Contact Hydro International for details.

Hydro International, 94 Hutchins Drive, Portland, ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212
Email: stormwaterinquiry@hydro-int.com Web: www.hydro-int.com

APPENDIX C – UPDATED CALCULATIONS FOR FEH RAINFALL DATA

MicroDrainage Calculations

1. These calculations provide the hydraulic analysis of the proposed surface water system for the proposed Hotel Felix, Whitehouse Lane, Cambridge. They should be read in conjunction with ARC Engineers Drainage GA drawing.

   The calculations have been based on modelling the proposed network in Microdrainage and simulation of all storm durations on the system to ensure that no flooding occurs.

2. They are based on the following criteria:-

   FEH Rainfall data
   Storm Return period: 1 in 100 years.
   Climate Change Factor: +40%.
   (No urban creep allowance provided as no extensions envisaged).
   Maximum permitted discharge to watercourse 3.5l/s

3. Main system details:

   Piped system on site.
   Flow control using hydrobrake.
   Attenuation storage provided by cellular storage system.
   Permeable paving (underdrained) to majority of car parking areas.
   Gullies to access road.

4. MicroDrainage criteria.

   Return Period storm 1 in 100 year
   Climate change +40%
   Cv for winter storms = 0.84
   FEH Rainfall data
   MADD Factor = 1

5. Contributing Drainage Areas

   The following contributing areas have been determined for the drainage network, based on the pipe number. Pipe numbers are shown on the Drainage GA drawing.

Pipe Number (PN)	Contributing area (Hectare)	Pipe Number (PN)	Contributing area (Hectare)
1.000	0.019	3.004	0
1.001	0.018	3.005	0
2.000	0.051	3.006	0
2.001	0.054	5.000	0.022
1.002	0.066	6.000	0.063
1.003	0	6.001	0
1.004	0	7.000	0.053
1.005	0	5.001	0
3.000	0.016	5.002	0
3.001	0.077	5.003	0
3.002	0.021	1.006	0
3.003	0	1.007	0
4.000	0.039	1.008	0
3.004	0	TOTAL	0.499

6. Microdrainage results.

   The Microdrainage program has been used to model the surface water system on this scheme and the 1 in 100 year storm + 40% climate change. The system has been designed so that no flooding occurs within the 1 in 100 year plus 40% climate change storm and the discharge rate does not exceed 3.5l/s

   All durations of storm has been simulated on the system to determine the critical storm event. The critical storm event for the system is the 480 minute storm. This has been determined on water levels within the system and discharge rate.

   The following Microdrainage results are appended.

   1 in 100 year plus 40% climate change (MADD Factor 1.0).

   480 minute duration storm simulation details.
   420 minute and 540 minute summaries.

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Micro Drainage	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for FELIX SW.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 543146 260556 TL 43146 60556
Data Type	Point
Maximum Rainfall (mm/hr)	10
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.000
Maximum Backdrop Height (m)	0.000
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	0.75
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for FELIX SW.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
1.000	21.881	0.200	109.4	0.019	5.00	0.0	0.600	o	150	Pipe/Conduit
1.001	31.889	0.225	141.7	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit
2.000	6.585	0.257	25.6	0.051	5.00	0.0	0.600	o	150	Pipe/Conduit
2.001	23.862	0.168	142.0	0.054	0.00	0.0	0.600	o	225	Pipe/Conduit
1.002	42.564	0.300	141.9	0.066	0.00	0.0	0.600	o	300	Pipe/Conduit
1.003	14.295	0.700	20.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit
1.004	2.908	0.150	19.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	10.00	5.38	22.000	0.019	0.0	0.0	0.0	0.96	17.0	0.5
1.001	10.00	6.01	21.800	0.037	0.0	0.0	0.0	0.84	14.9	1.0
2.000	10.00	5.05	22.000	0.051	0.0	0.0	0.0	2.00	35.3	1.4
2.001	10.00	5.42	21.668	0.105	0.0	0.0	0.0	1.10	43.5	2.8
1.002	10.00	6.55	21.425	0.208	0.0	0.0	0.0	1.32	93.2	5.6
1.003	10.00	6.62	21.125	0.208	0.0	0.0	0.0	3.49	247.0	5.6
1.004	10.00	6.63	20.425	0.208	0.0	0.0	0.0	3.59	253.6	5.6

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	FELIX HOTEL CAMBRIDGE	Micro Drainage
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Micro Drainage	Network 2020.1	

Network Design Table for FELIX SW.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
1.005	17.987	0.050	359.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit
3.000	21.837	0.210	104.0	0.016	5.00	0.0	0.600	o	150	Pipe/Conduit
3.001	74.568	0.790	94.4	0.077	0.00	0.0	0.600	o	225	Pipe/Conduit
3.002	31.429	0.250	125.7	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit
3.003	7.589	0.170	44.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
4.000	17.482	0.825	21.2	0.039	5.00	0.0	0.600	o	150	Pipe/Conduit
3.004	6.073	0.100	60.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
3.005	3.483	0.050	69.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
3.006	28.697	0.050	573.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
5.000	24.341	0.175	139.1	0.022	5.00	0.0	0.600	o	225	Pipe/Conduit
6.000	19.687	0.375	52.5	0.063	5.00	0.0	0.600	o	225	Pipe/Conduit
6.001	3.249	0.225	14.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
7.000	21.450	0.375	57.2	0.053	5.00	0.0	0.600	o	225	Pipe/Conduit
5.001	5.530	0.100	55.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
5.002	2.390	0.075	31.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.005	10.00	7.00	20.275	0.208	0.0	0.0	0.0	0.82	58.2	5.6
3.000	10.00	5.37	22.000	0.016	0.0	0.0	0.0	0.99	17.4	0.4
3.001	10.00	6.29	21.715	0.093	0.0	0.0	0.0	1.35	53.5	2.5
3.002	10.00	6.74	20.925	0.114	0.0	0.0	0.0	1.16	46.3	3.1
3.003	10.00	6.81	20.675	0.114	0.0	0.0	0.0	1.96	78.1	3.1
4.000	10.00	5.13	21.400	0.039	0.0	0.0	0.0	2.20	38.8	1.1
3.004	10.00	6.87	20.500	0.153	0.0	0.0	0.0	1.68	66.8	4.1
3.005	10.00	6.90	20.400	0.153	0.0	0.0	0.0	1.57	62.4	4.1
3.006	10.00	7.79	20.350	0.153	0.0	0.0	0.0	0.54	21.4	4.1
5.000	10.00	5.37	20.700	0.022	0.0	0.0	0.0	1.11	44.0	0.6
6.000	10.00	5.18	21.200	0.063	0.0	0.0	0.0	1.81	71.9	1.7
6.001	10.00	5.20	20.825	0.063	0.0	0.0	0.0	3.46	137.6	1.7
7.000	10.00	5.21	20.900	0.053	0.0	0.0	0.0	1.73	68.9	1.4
5.001	10.00	5.42	20.525	0.138	0.0	0.0	0.0	1.76	70.1	3.7
5.002	10.00	5.44	20.425	0.138	0.0	0.0	0.0	2.33	92.5	3.7

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Micro Drainage	Network 2020.1	

Network Design Table for FELIX SW.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
5.003	22.225	0.050	444.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
1.006	3.386	0.050	67.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit
1.007	16.639	0.115	144.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit
1.008	4.385	0.165	26.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.003	10.00	6.04	20.350	0.138	0.0	0.0	0.0	0.61	24.4	3.7
1.006	10.00	7.82	20.225	0.499	0.0	0.0	0.0	1.91	135.2	13.5
1.007	10.00	8.15	20.175	0.499	0.0	0.0	0.0	0.83	14.7	13.5
1.008	10.00	8.19	20.060	0.499	0.0	0.0	0.0	1.96	34.7	13.5

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PIPELINE SCHEDULES for FELIX SW.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	1	22.720	22.000	0.570	Open Manhole	1200
1.001	o	150	2	22.720	21.800	0.770	Open Manhole	1200
2.000	o	150	11	22.820	22.000	0.670	Open Manhole	1200
2.001	o	225	12	22.820	21.668	0.927	Open Manhole	1200
1.002	o	300	3	22.720	21.425	0.995	Open Manhole	1200
1.003	o	300	4	22.580	21.125	1.155	Open Manhole	1200
1.004	o	300	5	22.380	20.425	1.655	Open Manhole	1200
1.005	o	300	6	22.370	20.275	1.795	Open Manhole	1200
3.000	o	150	13	22.720	22.000	0.570	Open Manhole	1200
3.001	o	225	14	22.720	21.715	0.780	Open Manhole	1200
3.002	o	225	15	21.780	20.925	0.630	Open Manhole	1200
3.003	o	225	16	22.720	20.675	1.820	Open Manhole	1200
4.000	o	150	20	22.490	21.400	0.940	Open Manhole	1200
3.004	o	225	17	22.340	20.500	1.615	Open Manhole	1200
3.005	o	225	18	22.340	20.400	1.715	Open Manhole	1200
3.006	o	225	19	22.300	20.350	1.725	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	21.881	109.4	2	22.720	21.800	0.770	Open Manhole	1200
1.001	31.889	141.7	3	22.720	21.575	0.995	Open Manhole	1200
2.000	6.585	25.6	12	22.820	21.743	0.927	Open Manhole	1200
2.001	23.862	142.0	3	22.720	21.500	0.995	Open Manhole	1200
1.002	42.564	141.9	4	22.580	21.125	1.155	Open Manhole	1200
1.003	14.295	20.4	5	22.380	20.425	1.655	Open Manhole	1200
1.004	2.908	19.4	6	22.370	20.275	1.795	Open Manhole	1200
1.005	17.987	359.7	7	22.290	20.225	1.765	Open Manhole	1200
3.000	21.837	104.0	14	22.720	21.790	0.780	Open Manhole	1200
3.001	74.568	94.4	15	21.780	20.925	0.630	Open Manhole	1200
3.002	31.429	125.7	16	22.720	20.675	1.820	Open Manhole	1200
3.003	7.589	44.6	17	22.340	20.505	1.610	Open Manhole	1200
4.000	17.482	21.2	17	22.340	20.575	1.615	Open Manhole	1200
3.004	6.073	60.7	18	22.340	20.400	1.715	Open Manhole	1200
3.005	3.483	69.7	19	22.300	20.350	1.725	Open Manhole	1200
3.006	28.697	573.9	7	22.290	20.300	1.765	Open Manhole	1200

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PIPELINE SCHEDULES for FELIX SW.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
5.000	o	225	21	21.700	20.700	0.775	Open Manhole	1200
6.000	o	225	25	22.230	21.200	0.805	Open Manhole	1200
6.001	o	225	26	22.060	20.825	1.010	Open Manhole	1200
7.000	o	225	27	22.220	20.900	1.095	Open Manhole	1200
5.001	o	225	22	22.060	20.525	1.310	Open Manhole	1200
5.002	o	225	23	22.100	20.425	1.450	Open Manhole	1200
5.003	o	225	24	22.100	20.350	1.525	Open Manhole	1200
1.006	o	300	7	22.290	20.225	1.765	Open Manhole	1200
1.007	o	150	8	22.270	20.175	1.945	Open Manhole	1200
1.008	o	150	9	22.000	20.060	1.790	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
5.000	24.341	139.1	22	22.060	20.525	1.310	Open Manhole	1200
6.000	19.687	52.5	26	22.060	20.825	1.010	Open Manhole	1200
6.001	3.249	14.4	22	22.060	20.600	1.235	Open Manhole	1200
7.000	21.450	57.2	22	22.060	20.525	1.310	Open Manhole	1200
5.001	5.530	55.3	23	22.100	20.425	1.450	Open Manhole	1200
5.002	2.390	31.9	24	22.100	20.350	1.525	Open Manhole	1200
5.003	22.225	444.5	7	22.290	20.300	1.765	Open Manhole	1200
1.006	3.386	67.7	8	22.270	20.175	1.795	Open Manhole	1200
1.007	16.639	144.7	9	22.000	20.060	1.790	Open Manhole	1200
1.008	4.385	26.6	10	21.000	19.895	0.955	Open Manhole	1200

Simulation Criteria for FELIX SW.SWS

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	1.000
Hot Start Level (mm)	0	Run Time (mins)	2000
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	8

Number of Input Hydrographs	0	Number of Offline Controls	0
Number of Online Controls	1	Number of Storage Structures	3

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Simulation Criteria for FELIX SW.SWS

Number of Time/Area Diagrams 0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 543146 260556 TL 43146 60556
Data Type	Point
Summer Storms	No
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	480

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Online Controls for FELIX SW.SWS

Hydro-Brake® Optimum Manhole: 8, DS/PN: 1.007, Volume (m³): 2.5

Unit Reference	MD-SHE-0089-3500-1000-3500
Design Head (m)	1.000
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	89
Invert Level (m)	20.175
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.5
Flush-Flo™	0.300	3.5
Kick-Flo®	0.632	2.8
Mean Flow over Head Range	-	3.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.7	1.200	3.8	3.000	5.8	7.000	8.7
0.200	3.4	1.400	4.1	3.500	6.2	7.500	9.0
0.300	3.5	1.600	4.3	4.000	6.7	8.000	9.2
0.400	3.4	1.800	4.6	4.500	7.0	8.500	9.5
0.500	3.3	2.000	4.8	5.000	7.4	9.000	9.8
0.600	3.0	2.200	5.0	5.500	7.7	9.500	10.0
0.800	3.1	2.400	5.2	6.000	8.1		
1.000	3.5	2.600	5.4	6.500	8.4		

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Storage Structures for FELIX SW.SWS

Porous Car Park Manhole: 17, DS/PN: 3.004

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.7
Membrane Percolation (mm/hr)	1000	Length (m)	20.1
Max Percolation (l/s)	70.9	Slope (1:X)	130.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	21.990	Membrane Depth (mm)	200

Porous Car Park Manhole: 26, DS/PN: 6.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	22.0
Membrane Percolation (mm/hr)	1000	Length (m)	28.7
Max Percolation (l/s)	175.4	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	21.710	Membrane Depth (mm)	200

Cellular Storage Manhole: 7, DS/PN: 1.006

Invert Level (m)	20.225	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m^2)	Inf. Area (m^2)	Depth (m)	Area (m^2)	Inf. Area (m^2)
0.000	500.0	500.0	0.801	0.0	571.6
0.800	500.0	571.6			

Summary of Results for 480 minute 100 year Winter (FELIX SW.SWS)

Margin for Flood Risk Warning (mm) 230.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1	22.031	-0.119	0.000	0.10			1.6	OK
1.001	2	21.847	-0.103	0.000	0.22			3.1	OK
2.000	11	22.038	-0.112	0.000	0.14			4.3	OK
2.001	12	21.739	-0.154	0.000	0.22			8.8	OK
1.002	3	21.516	-0.209	0.000	0.20			17.4	OK
1.003	4	21.183	-0.242	0.000	0.08			17.4	OK
1.004	5	21.041	0.316	0.000	0.18			17.2	SURCHARGED
1.005	6	21.041	0.466	0.000	0.34			17.1	SURCHARGED
3.000	13	22.028	-0.122	0.000	0.08			1.3	OK
3.001	14	21.773	-0.167	0.000	0.15			7.8	OK
3.002	15	21.046	-0.104	0.000	0.22			9.5	OK
3.003	16	21.044	0.144	0.000	0.16			9.5	SURCHARGED
4.000	20	21.430	-0.120	0.000	0.09			3.3	OK
3.004	17	21.043	0.318	0.000	0.28		760	12.6	SURCHARGED
3.005	18	21.042	0.417	0.000	0.40			12.5	SURCHARGED
3.006	19	21.042	0.467	0.000	0.62			12.4	SURCHARGED
5.000	21	21.042	0.117	0.000	0.05			1.8	SURCHARGED
6.000	25	21.242	-0.183	0.000	0.08			5.3	OK
6.001	26	21.043	-0.007	0.000	0.08		200	5.3	OK
7.000	27	21.043	-0.082	0.000	0.07			4.4	OK
5.001	22	21.042	0.292	0.000	0.25			11.1	SURCHARGED
5.002	23	21.042	0.392	0.000	0.28			10.9	SURCHARGED
5.003	24	21.041	0.466	0.000	0.49			10.8	SURCHARGED
1.006	7	21.039	0.514	0.000	0.06		1112	3.7	SURCHARGED
1.007	8	21.041	0.716	0.000	0.25			3.5	SURCHARGED
1.008	9	20.097	-0.113	0.000	0.14			3.5	OK

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Summary of Results for 420 minute 100 year Winter (FELIX SW.SWS)

Margin for Flood Risk Warning (mm)	230.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1	22.033	-0.117	0.000	0.11			1.8	OK
1.001	2	21.850	-0.100	0.000	0.24			3.5	OK
2.000	11	22.040	-0.110	0.000	0.16			4.8	OK
2.001	12	21.743	-0.150	0.000	0.25			9.8	OK
1.002	3	21.521	-0.204	0.000	0.22			19.4	OK
1.003	4	21.187	-0.238	0.000	0.09			19.4	OK
1.004	5	21.027	0.302	0.000	0.20			19.2	SURCHARGED
1.005	6	21.026	0.451	0.000	0.38			19.1	SURCHARGED
3.000	13	22.030	-0.120	0.000	0.09			1.5	OK
3.001	14	21.776	-0.164	0.000	0.17			8.7	OK
3.002	15	21.035	-0.115	0.000	0.25			10.6	OK
3.003	16	21.032	0.132	0.000	0.18			10.6	SURCHARGED
4.000	20	21.432	-0.118	0.000	0.10			3.6	OK
3.004	17	21.030	0.305	0.000	0.31		770	14.0	SURCHARGED
3.005	18	21.029	0.404	0.000	0.44			13.9	SURCHARGED
3.006	19	21.028	0.453	0.000	0.69			13.8	SURCHARGED
5.000	21	21.029	0.104	0.000	0.05			2.0	SURCHARGED
6.000	25	21.245	-0.180	0.000	0.09			5.9	OK
6.001	26	21.029	-0.021	0.000	0.09		224	5.9	OK
7.000	27	21.030	-0.095	0.000	0.08			4.9	OK
5.001	22	21.029	0.279	0.000	0.28			12.3	SURCHARGED
5.002	23	21.028	0.378	0.000	0.32			12.2	SURCHARGED
5.003	24	21.027	0.452	0.000	0.54			12.1	SURCHARGED
1.006	7	21.025	0.500	0.000	0.06		1106	3.6	SURCHARGED
1.007	8	21.041	0.716	0.000	0.25			3.5	SURCHARGED
1.008	9	20.097	-0.113	0.000	0.14			3.5	OK

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Summary of Results for 540 minute 100 year Winter (FELIX SW.SWS)

Margin for Flood Risk Warning (mm) 230.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1	22.030	-0.120	0.000	0.09			1.4	OK
1.001	2	21.845	-0.105	0.000	0.20			2.8	OK
2.000	11	22.036	-0.114	0.000	0.13			3.9	OK
2.001	12	21.736	-0.157	0.000	0.20			7.9	OK
1.002	3	21.511	-0.214	0.000	0.18			15.7	OK
1.003	4	21.180	-0.245	0.000	0.08			15.7	OK
1.004	5	21.026	0.301	0.000	0.16			15.6	SURCHARGED
1.005	6	21.026	0.451	0.000	0.31			15.5	SURCHARGED
3.000	13	22.027	-0.123	0.000	0.07			1.2	OK
3.001	14	21.770	-0.170	0.000	0.14			7.0	OK
3.002	15	21.033	-0.117	0.000	0.20			8.6	OK
3.003	16	21.030	0.130	0.000	0.15			8.6	SURCHARGED
4.000	20	21.428	-0.122	0.000	0.08			3.0	OK
3.004	17	21.029	0.304	0.000	0.26		774	11.4	SURCHARGED
3.005	18	21.028	0.403	0.000	0.36			11.3	SURCHARGED
3.006	19	21.027	0.452	0.000	0.56			11.2	SURCHARGED
5.000	21	21.028	0.103	0.000	0.04			1.7	SURCHARGED
6.000	25	21.240	-0.185	0.000	0.07			4.8	OK
6.001	26	21.028	-0.022	0.000	0.07		225	4.8	OK
7.000	27	21.029	-0.096	0.000	0.06			4.0	OK
5.001	22	21.028	0.278	0.000	0.23			10.0	SURCHARGED
5.002	23	21.027	0.377	0.000	0.26			9.9	SURCHARGED
5.003	24	21.027	0.452	0.000	0.44			9.8	SURCHARGED
1.006	7	21.024	0.499	0.000	0.06		1107	3.6	SURCHARGED
1.007	8	21.041	0.716	0.000	0.25			3.5	SURCHARGED
1.008	9	20.097	-0.113	0.000	0.14			3.5	OK

APPENDIX D – FIGURE 2 - SURFACE WATER FLOOD RISK

FIGURE 2


EXISTING BUILDING
TO BE DEMOLISHED
The Brambles
Whitehouse Lane
WHITEHOUSE LANE
EXISTING ACCESS
CYCLE STORE
REFUSE
Playing Field
High
Medium
Low
Very low
DIRECTION OF FLOW
FROM SURFACE WATER
FLOODING DUE TO SITE