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Grove House Mansion Gate Drive Leeds LS7 4DN	Faversham Crematorium Surface Water FEH Network Calculations	
Date 21/09/2023 File SW NETWORK-FEH-CALCS-P04...	Designed by YP Checked by CH	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	26.250	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm



Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.285	4-8	0.276	8-12	0.001

Total Area Contributing (ha) = 0.563

Total Pipe Volume (m³) = 13.932


Network Design Table for Storm

« - Indicates pipe capacity < flow












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	Auto Design
1.000	17.025	0.170	100.1	0.018	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	11.492	0.140	82.0	0.004	5.00	0.0	0.600	o	100	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	50.00	5.28	22.140	0.018	0.0	0.0	0.0	1.00	17.7	2.4
2.000	50.00	5.23	22.160	0.004	0.0	0.0	0.0	0.85	6.7	0.5


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Network Design Table for Storm













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	Auto Design
1.001	9.935	0.075	133.0	0.004	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	8.785	0.514	17.1	0.013	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.002	17.760	0.060	295.0	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	8.593	0.031	277.0	0.052	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	18.031	0.345	52.2	0.013	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.004	6.321	0.023	277.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.000	21.083	0.398	52.9	0.015	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.005	21.102	0.076	277.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	42.898	0.149	287.0	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.000	18.366	0.594	30.9	0.016	5.00	0.0	0.600	o	100	Pipe/Conduit	
7.000	17.588	0.205	85.8	0.026	5.00	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)
1.001	50.00	5.47	21.970	0.026	0.0	0.0	0.0	0.87	15.4	3.5
3.000	50.00	5.08	22.460	0.013	0.0	0.0	0.0	1.88	14.7	1.8
1.002	50.00	5.86	21.820	0.061	0.0	0.0	0.0	0.76	30.1	8.3
1.003	50.00	6.05	21.760	0.113	0.0	0.0	0.0	0.78	31.0	15.3
4.000	50.00	5.28	22.100	0.013	0.0	0.0	0.0	1.07	8.4	1.8
1.004	50.00	6.18	21.729	0.126	0.0	0.0	0.0	0.78	31.0	17.1
5.000	50.00	5.33	22.130	0.015	0.0	0.0	0.0	1.06	8.3	2.0
1.005	50.00	6.63	21.706	0.141	0.0	0.0	0.0	0.78	31.0	19.1
1.006	50.00	7.57	21.630	0.181	0.0	0.0	0.0	0.77	30.5	24.5
6.000	50.00	5.22	22.280	0.016	0.0	0.0	0.0	1.39	10.9	2.2
7.000	50.00	5.27	21.840	0.026	0.0	0.0	0.0	1.09	19.2	3.5


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Network Design Table for Storm

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	Auto Design
6.001	20.166	0.081	249.0	0.044	0.00	0.0	0.600	o	225	Pipe/Conduit		
8.000	18.812	0.440	42.8	0.033	5.00	0.0	0.600	o	150	Pipe/Conduit		
1.007	13.671	0.030	455.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit		
9.000	18.219	0.100	182.2	0.059	5.00	0.0	0.600	o	225	Pipe/Conduit		
9.001	41.368	0.200	206.8	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit		
9.002	46.517	0.240	193.8	0.100	0.00	0.0	0.600	o	225	Pipe/Conduit		
9.003	8.228	0.050	164.6	0.091	0.00	0.0	0.600	o	300	Pipe/Conduit		
10.000	7.126	0.070	101.8	0.009	5.00	0.0	0.600	o	150	Pipe/Conduit		
10.001	2.144	0.020	107.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
9.004	18.880	0.040	472.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit		
1.008	13.268	0.050	265.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
1.009	3.196	0.050	63.9	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)
6.001	50.00	5.68	21.560	0.086	0.0	0.0	0.0	0.82	32.8	11.6
8.000	50.00	5.20	22.000	0.033	0.0	0.0	0.0	1.54	27.3	4.5
1.007	50.00	7.88	21.480	0.300	0.0	0.0	0.0	0.73	51.6	40.6
9.000	50.00	5.31	22.080	0.059	0.0	0.0	0.0	0.97	38.4	8.0
9.001	50.00	6.08	21.980	0.063	0.0	0.0	0.0	0.91	36.0	8.5
9.002	50.00	6.90	21.780	0.163	0.0	0.0	0.0	0.94	37.2	22.1
9.003	50.00	7.02	21.540	0.254	0.0	0.0	0.0	1.22	86.4	34.4
10.000	50.00	5.12	21.670	0.009	0.0	0.0	0.0	1.00	17.6	1.2
10.001	50.00	5.16	21.600	0.009	0.0	0.0	0.0	0.97	17.1	1.2
9.004	50.00	7.46	21.490	0.263	0.0	0.0	0.0	0.72	50.7	35.6
1.008	50.00	8.24	21.200	0.563	0.0	0.0	0.0	0.61	10.8	76.2
1.009	50.00	8.28	21.150	0.563	0.0	0.0	0.0	1.26	22.3	76.2

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Online Controls for Storm

Orifice Manhole: SW13 - ORIFICE, DS/PN: 9.004, Volume (m³): 1.6

Diameter (m) 0.026 Discharge Coefficient 0.600 Invert Level (m) 21.490


Hydro-Brake® Optimum Manhole: SW19-HYDBRK, DS/PN: 1.009, Volume (m³): 1.1

Unit Reference	MD-SHE-0049-1000-0840-1000
Design Head (m)	0.840
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	49
Invert Level (m)	21.150
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.840	1.0	Kick-Flo®	0.435	0.7
Flush-Flo™	0.214	0.9	Mean Flow over Head Range	-	0.8

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	0.8	1.200	1.2	3.000	1.8	7.000	2.6
0.200	0.9	1.400	1.3	3.500	1.9	7.500	2.7
0.300	0.9	1.600	1.3	4.000	2.0	8.000	2.8
0.400	0.8	1.800	1.4	4.500	2.1	8.500	2.9
0.500	0.8	2.000	1.5	5.000	2.2	9.000	3.0
0.600	0.9	2.200	1.5	5.500	2.3	9.500	3.0
0.800	1.0	2.400	1.6	6.000	2.4		
1.000	1.1	2.600	1.7	6.500	2.5		

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Storage Structures for Storm


Porous Car Park Manhole: SW13 - ORIFICE, DS/PN: 9.004

Infiltration Coefficient Base (m/hr)	0.09300	Width (m)	46.0
Membrane Percolation (mm/hr)	1000	Length (m)	46.3
Max Percolation (l/s)	591.6	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	21.820	Membrane Depth (mm)	0

Tank or Pond Manhole: SUDS POND, DS/PN: 1.008

Invert Level (m) 21.200

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	280.0	0.700	470.7	1.400	0.0	2.100	0.0
0.100	304.2	0.800	580.0	1.500	0.0	2.200	0.0
0.200	329.5	0.900	0.0	1.600	0.0	2.300	0.0
0.300	355.7	1.000	0.0	1.700	0.0	2.400	0.0
0.400	383.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	411.2	1.200	0.0	1.900	0.0		
0.600	440.5	1.300	0.0	2.000	0.0		

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coefficient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0


Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 26.250 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF


Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Surcharged Flooded						
				Level (m)	Depth (m)	Volume (m³)	Flow / Cap.			
1.000	SWRE-01	15 minute 100 year Winter I+40%	23.000	23.000	0.710	0.483	0.72			
2.000	SW03	15 minute 100 year Winter I+40%	23.070	22.969	0.709	0.000	0.66			
1.001	SW04	15 minute 100 year Winter I+40%	23.220	22.935	0.815	0.000	1.22			
3.000	SW05	15 minute 100 year Winter I+40%	23.130	23.091	0.531	0.000	0.71			
1.002	SW06	15 minute 100 year Winter I+40%	22.820	22.823	0.778	2.734	1.03			
1.003	SW07	15 minute 100 year Winter I+40%	22.750	22.763	0.778	13.389	2.05			
4.000	SWRE-04	15 minute 100 year Winter I+40%	23.000	23.001	0.801	0.525	0.92			
1.004	Junction	1440 minute 100 year Winter I+40%	22.830	21.954	0.000	0.000	0.15			
5.000	SWRE-05	15 minute 100 year Winter I+40%	23.000	23.001	0.771	0.898	0.99			
1.005	Junction	1440 minute 100 year Winter I+40%	22.950	21.931	0.000	0.000	0.16			
1.006	SW08	15 minute 100 year Winter I+40%	23.020	22.714	0.860	0.000	1.97			
6.000	SW14	15 minute 100 year Winter I+40%	22.960	22.960	0.580	0.385	1.14			
7.000	SW15	15 minute 100 year Winter I+40%	23.040	22.773	0.783	0.000	1.16			
6.001	SW17	15 minute 100 year Winter I+40%	22.980	22.499	0.714	0.000	2.19			
8.000	SWRE-03	15 minute 100 year Winter I+40%	22.960	22.553	0.403	0.000	1.00			
1.007	SW18	15 minute 100 year Winter I+40%	22.570	22.094	0.314	0.000	4.25			

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Pipe Flow (l/s)	Status
1.000	SWRE-01	11.9	FLOOD
2.000	SW03	4.1	FLOOD RISK
1.001	SW04	16.6	FLOOD RISK
3.000	SW05	9.6	FLOOD RISK
1.002	SW06	27.8	FLOOD
1.003	SW07	51.8	FLOOD
4.000	SWRE-04	7.4	FLOOD
1.004	Junction	4.5	SURCHARGED*
5.000	SWRE-05	8.0	FLOOD
1.005	Junction	5.0	SURCHARGED*
1.006	SW08	57.2	SURCHARGED
6.000	SW14	12.0	FLOOD
7.000	SW15	20.8	FLOOD RISK
6.001	SW17	65.0	SURCHARGED
8.000	SWRE-03	25.6	SURCHARGED
1.007	SW18	147.3	SURCHARGED

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)
9.000	SW9A	15 minute 100 year Winter I+40%	22.925	22.942	0.637	17.107
9.001	SW10A	15 minute 100 year Winter I+40%	22.950	22.955	0.750	5.314
9.002	SW10	15 minute 100 year Summer I+40%	23.110	23.111	1.106	0.965
9.003	SW11	15 minute 100 year Winter I+40%	22.580	22.356	0.516	0.000
10.000	SWRE-02	60 minute 100 year Winter I+40%	22.420	22.209	0.389	0.000
10.001	SW12	60 minute 100 year Winter I+40%	22.500	22.207	0.457	0.000
9.004	SW13 - ORIFICE	60 minute 100 year Winter I+40%	22.470	22.206	0.416	0.000
1.008	SUDS POND	1440 minute 100 year Winter I+40%	22.000	21.978	0.628	0.000
1.009	SW19-HYDBRK	1440 minute 100 year Winter I+40%	21.970	21.974	0.674	3.828

PN	US/MH Name	Flow / Cap.	Pipe Flow (l/s)	Status
9.000	SW9A	1.22	42.1	FLOOD
9.001	SW10A	1.22	41.8	FLOOD
9.002	SW10	1.80	64.1	FLOOD
9.003	SW11	2.33	142.8	FLOOD RISK
10.000	SWRE-02	0.24	3.6	FLOOD RISK
10.001	SW12	0.33	3.6	FLOOD RISK
9.004	SW13 - ORIFICE	0.03	1.1	FLOOD RISK
1.008	SUDS POND	0.14	1.4	FLOOD RISK
1.009	SW19-HYDBRK	0.07	1.0	FLOOD