

Travis Baker		Page 0
Trinity Point New Road Halesowen West Midlands B63 3HY	HIGHAM ON THE HILL STORM 2, 30 & 100YR	
Date 09.11.23	Designed by GE	
File HIGHAM STORM 19.10.23.MDX	Checked by	
Micro Drainage		Network 2016.1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for HIGHAM STORM.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.400	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	0.75
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for HIGHAM STORM.SWS

- Indicates pipe length does not match coordinates

« - 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	6.981	0.030	232.7	0.095	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	24.314	0.106	229.4	0.082	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	31.251	0.136	229.8	0.097	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	15.783	0.069	228.7	0.058	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	27.212	0.500	54.4	0.177	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	19.839	1.066	18.6	0.062	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	32.005	0.107	299.1	0.012	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.005	34.358	0.577	59.5	0.089	0.00	0.0	0.600	o	450	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	5.11	110.250	0.095	0.0	0.0	0.0	1.03	72.6	12.9
1.001	50.00	5.51	110.220	0.177	0.0	0.0	0.0	1.03	73.1	24.0
1.002	50.00	6.01	110.114	0.274	0.0	0.0	0.0	1.03	73.0	37.1
1.003	50.00	6.26	109.978	0.332	0.0	0.0	0.0	1.04	73.2	45.0
2.000	50.00	5.26	111.550	0.177	0.0	0.0	0.0	1.78	70.6	24.0
2.001	50.00	5.35	110.975	0.239	0.0	0.0	0.0	3.66	258.8	32.4
1.004	50.00	6.72	109.759	0.583	0.0	0.0	0.0	1.17	186.1	78.9
1.005	50.00	6.94	109.652	0.672	0.0	0.0	0.0	2.64	419.6	91.0

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Network Design Table for HIGHAM STORM.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	Auto Design
1.006	39.280	1.273	30.9	0.142	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.007	5.714	0.815	7.0	0.063	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.008	5.376	0.012	455.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.009	11.100#	0.022	500.0	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.010	20.293	0.041	500.0	0.011	0.00	0.0	0.600	o	900	Pipe/Conduit	
3.000	9.180	0.055	166.9	0.040	5.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	20.251	0.685	29.6	0.063	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	17.969	1.683	10.7	0.014	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.011	29.594	0.177	167.2	0.124	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.012	70.980	0.425	167.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.013	36.823	0.220	167.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.014	62.474	0.374	167.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.015	69.882	1.295	54.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.016	34.405	0.206	167.0	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)
1.006	50.00	7.10	109.000	0.814	0.0	0.0	0.0	4.04	875.2	110.2
1.007	50.00	7.11	107.727	0.877	0.0	0.0	0.0	8.50	1839.2	118.8
1.008	50.00	7.20	106.912	0.877	0.0	0.0	0.0	1.04	225.9	118.8
1.009	50.00	7.33	106.900	0.877	0.0	0.0	0.0	1.39	887.1	118.8
1.010	50.00	7.57	106.878	0.888	0.0	0.0	0.0	1.39	887.1	120.2
3.000	50.00	5.15	109.250	0.040	0.0	0.0	0.0	1.01	40.1	5.4
4.000	50.00	5.14	109.880	0.063	0.0	0.0	0.0	2.42	96.0	8.5
3.001	50.00	5.23	109.195	0.117	0.0	0.0	0.0	4.03	160.1	15.8
1.011	50.00	8.06	106.837	1.129	0.0	0.0	0.0	1.01	40.1	152.9
1.012	50.00	9.23	106.660	1.129	0.0	0.0	0.0	1.01	40.1	152.9
1.013	50.00	9.84	106.235	1.129	0.0	0.0	0.0	1.01	40.1	152.9
1.014	48.07	10.87	106.015	1.129	0.0	0.0	0.0	1.01	40.1	152.9
1.015	46.55	11.53	105.641	1.129	0.0	0.0	0.0	1.78	70.9	152.9
1.016	45.33	12.09	104.346	1.129	0.0	0.0	0.0	1.01	40.1	152.9

Free Flowing Outfall Details for HIGHAM STORM.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.016	Outfall	104.820	104.140	0.000	0	0

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Simulation Criteria for HIGHAM STORM.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	0.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for HIGHAM STORM.SWS

Hydro-Brake Optimum® Manhole: 12, DS/PN: 1.011, Volume (m³): 37.2

Unit Reference	MD-SHE-0136-9400-1400-9400
Design Head (m)	1.400
Design Flow (l/s)	9.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	136
Invert Level (m)	106.837
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	9.4
Flush-Flo™	0.410	9.4
Kick-Flo®	0.876	7.5
Mean Flow over Head Range	-	8.2

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	4.9	1.200	8.7	3.000	13.5	7.000	20.2
0.200	8.6	1.400	9.4	3.500	14.5	7.500	20.9
0.300	9.2	1.600	10.0	4.000	15.4	8.000	21.5
0.400	9.4	1.800	10.6	4.500	16.3	8.500	22.2
0.500	9.3	2.000	11.1	5.000	17.2	9.000	22.8
0.600	9.2	2.200	11.6	5.500	18.0	9.500	23.4
0.800	8.3	2.400	12.1	6.000	18.7		
1.000	8.0	2.600	12.6	6.500	19.5		

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Storage Structures for HIGHAM STORM.SWS

Tank or Pond Manhole: POND, DS/PN: 1.009

Invert Level (m) 106.900

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	383.7	1.500	887.9

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for HIGHAM STORM.SWS

PN	US/MH Name	Surcharged Flooded		Pipe		Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	
1.000	1	-0.171	0.000	0.33		17.1	OK
1.001	2	-0.157	0.000	0.45		29.3	OK
1.002	3	-0.122	0.000	0.65		43.2	OK
1.003	4	-0.090	0.000	0.83		51.3	OK
2.000	19	-0.114	0.000	0.48		31.6	OK
2.001	20	-0.213	0.000	0.18		40.8	OK
1.004	5	-0.206	0.000	0.56		91.1	OK
1.005	6	-0.287	0.000	0.28		103.3	OK
1.006	7	-0.384	0.000	0.16		122.6	OK
1.007	8	-0.370	0.000	0.19		131.2	OK
1.008	9	-0.161	0.000	0.82		130.8	OK
1.009	POND	-0.597	0.000	0.05		17.7	OK
1.010	11	-0.574	0.000	0.03		16.7	OK
3.000	21	-0.154	0.000	0.22		7.2	OK
4.000	23	-0.171	0.000	0.13		11.3	OK
3.001	22	-0.168	0.000	0.14		20.4	OK
1.011	12	0.143	0.000	0.25		9.4	SURCHARGED

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for HIGHAM STORM.SWS

									Water
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level (m)
1.012	13	180 Winter	2	+0%					106.735
1.013	14	180 Winter	2	+0%					106.311
1.014	15	180 Winter	2	+0%					106.090
1.015	16	180 Winter	2	+0%					105.696
1.016	17	180 Winter	2	+0%					104.422

US/MH		Surcharged		Flooded	Pipe		Level	
PN	Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded
1.012	13	-0.150	0.000	0.24		9.4	OK	
1.013	14	-0.149	0.000	0.25		9.4	OK	
1.014	15	-0.150	0.000	0.24		9.4	OK	
1.015	16	-0.170	0.000	0.14		9.4	OK	
1.016	17	-0.149	0.000	0.25		9.4	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for HIGHAM STORM.SWS

PN	US/MH Name	Surcharged Flooded		Pipe		Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	
1.000	1	0.268	0.000	0.59		30.8	SURCHARGED
1.001	2	0.241	0.000	0.87		56.9	SURCHARGED
1.002	3	0.270	0.000	1.31		87.3	SURCHARGED
1.003	4	0.159	0.000	1.69		104.2	SURCHARGED
2.000	19	-0.054	0.000	0.92		60.0	OK
2.001	20	-0.174	0.000	0.36		82.0	OK
1.004	5	0.019	0.000	1.12		181.1	SURCHARGED
1.005	6	-0.203	0.000	0.56		207.1	OK
1.006	7	-0.315	0.000	0.32		244.6	OK
1.007	8	-0.296	0.000	0.38		262.6	OK
1.008	9	0.088	0.000	1.66		264.1	SURCHARGED
1.009	POND	-0.288	0.000	0.06		24.0	OK
1.010	11	-0.265	0.000	0.03		15.0	OK
3.000	21	-0.124	0.000	0.41		13.6	OK
4.000	23	-0.149	0.000	0.25		21.5	OK
3.001	22	-0.144	0.000	0.28		39.9	OK
1.011	12	0.449	0.000	0.25		9.4	SURCHARGED

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for HIGHAM STORM.SWS

									Water
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level (m)
1.012	13	720 Summer	30	+0%					106.735
1.013	14	960 Summer	30	+0%					106.311
1.014	15	960 Summer	30	+0%					106.090
1.015	16	960 Summer	30	+0%					105.696
1.016	17	960 Summer	30	+0%					104.422

US/MH		Surcharged		Flooded	Pipe		Level	
PN	Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded
1.012	13	-0.150	0.000	0.24		9.4	OK	
1.013	14	-0.149	0.000	0.25		9.4	OK	
1.014	15	-0.150	0.000	0.24		9.4	OK	
1.015	16	-0.170	0.000	0.14		9.4	OK	
1.016	17	-0.149	0.000	0.25		9.4	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for HIGHAM STORM.SWS

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
1.000	1	0.715	0.000	0.77		40.4	SURCHARGED	
1.001	2	0.681	0.000	1.13		73.6	SURCHARGED	
1.002	3	0.647	0.000	1.68		112.0	SURCHARGED	
1.003	4	0.378	0.000	2.17		134.3	SURCHARGED	
2.000	19	0.205	0.000	1.18		77.1	SURCHARGED	
2.001	20	-0.154	0.000	0.46		103.2	OK	
1.004	5	0.112	0.000	1.47		237.1	SURCHARGED	
1.005	6	-0.157	0.000	0.73		269.3	OK	
1.006	7	-0.282	0.000	0.43		325.1	OK	
1.007	8	-0.258	0.000	0.50		348.8	OK	
1.008	9	0.278	0.000	0.46		73.7	SURCHARGED	
1.009	POND	-0.085	0.000	0.03		13.0	OK	
1.010	11	-0.064	0.000	0.02		11.8	OK	
3.000	21	-0.107	0.000	0.54		17.7	OK	
4.000	23	-0.137	0.000	0.32		28.0	OK	
3.001	22	-0.131	0.000	0.36		51.8	OK	
1.011	12	0.647	0.000	0.25		9.4	SURCHARGED	

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									Water
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level (m)
1.012	13	720 Summer	100	+0%					106.735
1.013	14	960 Summer	100	+0%					106.311
1.014	15	960 Summer	100	+0%					106.090
1.015	16	960 Summer	100	+0%					105.696
1.016	17	960 Summer	100	+0%					104.422

US/MH		Surcharged		Flooded	Pipe		Level	
PN	Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded
1.012	13	-0.150	0.000	0.24		9.4	OK	
1.013	14	-0.149	0.000	0.25		9.4	OK	
1.014	15	-0.150	0.000	0.24		9.4	OK	
1.015	16	-0.170	0.000	0.14		9.4	OK	
1.016	17	-0.149	0.000	0.25		9.4	OK	