STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for WEST BOLDON - 08.05.19.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
1.000	23.980	1.667	14.4	0.144	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	6.016	0.401	15.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	7.717	0.014	551.2	0.038	0.00	0.0	0.600	o	1200	Pipe/Conduit	
2.000	2.500	0.013	200.0	0.000	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	7.155	0.036	198.8	0.026	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	15.152	0.030	507.6	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
1.004	2.693	0.013	207.2	0.026	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)
1.000	56.86	5.12	40.094	0.144	0.0	0.0	0.0	3.47	137.9	22.2
1.001	56.73	5.14	38.427	0.144	0.0	0.0	0.0	3.40	135.0	22.2
1.002	56.37	5.23	37.051	0.182	0.0	0.0	0.0	1.59	1794.1	27.8
2.000	57.18	5.05	38.061	0.000	0.0	0.0	0.0	0.92	36.6	0.0
2.001	56.60	5.17	38.049	0.026	0.0	0.0	0.0	0.92	36.7	4.0
1.003	55.70	5.38	37.037	0.208	0.0	0.0	0.0	1.65	1870.2	31.4
1.004	55.49	5.43	37.007	0.234	0.0	0.0	0.0	0.90	36.0	35.2

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PIPELINE SCHEDULES for WEST BOLDON - 08.05.19.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	225	1	41.811	40.094	1.492	Open Manhole	1200
1.001	o	225	2	40.629	38.427	1.977	Open Manhole	1200
1.002	o	1200	3	40.290	37.051	2.039	Open Manhole	2400
2.000	o	225	P1	40.769	38.061	2.483	Open Manhole	1200
2.001	o	225	P2	40.600	38.049	2.327	Open Manhole	1200
1.003	o	1200	P3	39.895	37.037	1.658	Junction	
1.004	o	225	4	39.058	37.007	1.826	Open Manhole	2400

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	23.980	14.4	2	40.629	38.427	1.977	Open Manhole	1200
1.001	6.016	15.0	3	40.290	38.026	2.039	Open Manhole	2400
1.002	7.717	551.2	P3	39.895	37.037	1.658	Junction	
2.000	2.500	200.0	P2	40.600	38.049	2.327	Open Manhole	1200
2.001	7.155	198.8	P3	39.895	38.013	1.658	Junction	
1.003	15.152	507.6	4	39.058	37.007	0.851	Open Manhole	2400
1.004	2.693	207.2	5	37.806	36.994	0.586	Open Manhole	0

Free Flowing Outfall Details for WEST BOLDON - 08.05.19.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004	5	37.806	36.994	0.000	0	0

Simulation Criteria for WEST BOLDON - 08.05.19.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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

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Simulation Criteria for WEST BOLDON - 08.05.19.SWS

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)	17.500	Storm Duration (mins)	30
Ratio R	0.350		

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Online Controls for WEST BOLDON - 08.05.19.SWS

Hydro-Brake® Optimum Manhole: 4, DS/PN: 1.004, Volume (m³): 25.1

Unit Reference	MD-SHE-0080-3700-1800-3700
Design Head (m)	1.800
Design Flow (l/s)	3.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	80
Invert Level (m)	37.007
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	3.7
Flush-Flo™	0.354	3.0
Kick-Flo®	0.719	2.4
Mean Flow over Head Range	-	2.9

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	2.3	1.200	3.1	3.000	4.7	7.000	7.0
0.200	2.9	1.400	3.3	3.500	5.0	7.500	7.2
0.300	3.0	1.600	3.5	4.000	5.4	8.000	7.4
0.400	3.0	1.800	3.7	4.500	5.7	8.500	7.7
0.500	2.9	2.000	3.9	5.000	6.0	9.000	7.9
0.600	2.8	2.200	4.1	5.500	6.2	9.500	8.1
0.800	2.5	2.400	4.2	6.000	6.5		
1.000	2.8	2.600	4.4	6.500	6.7		

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Storage Structures for WEST BOLDON - 08.05.19.SWS

Cellular Storage Manhole: P1, DS/PN: 2.000

Invert Level (m) 38.061 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	70.4	70.4	0.900	0.0	103.0
0.800	70.4	103.0			

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for WEST BOLDON - 08.05.19.SWS

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 Coeffiecient	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 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	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.500	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1	+0%					40.148
1.001	2	15 Winter	1	+0%	100/15 Winter				38.493
1.002	3	60 Winter	1	+0%	30/60 Winter				37.571
2.000	P1	30 Winter	1	+0%	100/15 Winter				38.062
2.001	P2	15 Winter	1	+0%	30/60 Winter				38.092
1.003	P3	60 Winter	1	+0%					37.571
1.004	4	60 Winter	1	+0%	1/15 Summer				37.571

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.171	0.000	0.13		16.7	OK	
1.001	2	-0.159	0.000	0.18		16.5	OK	
1.002	3	-0.680	0.000	0.01		9.5	OK	
2.000	P1	-0.224	0.000	0.00		0.0	OK	
2.001	P2	-0.181	0.000	0.08		2.4	OK	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for WEST BOLDON - 08.05.19.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	P3	-0.666	0.000	0.01		8.4	OK*	
1.004	4	0.338	0.000	0.11		3.0	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for WEST BOLDON - 08.05.19.SWS

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 Coeffiecient	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 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	Ratio R 0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.500	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+0%					40.182
1.001	2	15 Winter	30	+0%	100/15 Winter				38.534
1.002	3	60 Winter	30	+0%	30/60 Winter				38.299
2.000	P1	120 Winter	30	+0%	100/15 Winter				38.226
2.001	P2	60 Winter	30	+0%	30/60 Winter				38.275
1.003	P3	240 Winter	30	+0%					38.237
1.004	4	60 Winter	30	+0%	1/15 Summer				38.298

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.137	0.000	0.32		40.8	OK	
1.001	2	-0.118	0.000	0.45		40.4	OK	
1.002	3	0.048	0.000	0.03		23.4	SURCHARGED	
2.000	P1	-0.060	0.000	0.08		2.1	OK	
2.001	P2	0.001	0.000	0.13		3.8	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for WEST BOLDON - 08.05.19.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	P3	0.000	0.000	0.01		8.0	SURCHARGED*	
1.004	4	1.066	0.000	0.11		3.2	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for WEST BOLDON - 08.05.19.SWS

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 Coeffiecient	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 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	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.500	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+40%					40.218
1.001	2	180 Winter	100	+40%	100/15 Winter				38.920
1.002	3	180 Winter	100	+40%	30/60 Winter				38.918
2.000	P1	180 Winter	100	+40%	100/15 Winter				38.918
2.001	P2	180 Winter	100	+40%	30/60 Winter				38.918
1.003	P3	120 Winter	100	+40%					38.237
1.004	4	180 Winter	100	+40%	1/15 Summer				38.918

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.101	0.000	0.58		73.7	OK	
1.001	2	0.268	0.000	0.22		19.5	SURCHARGED	
1.002	3	0.667	0.000	0.03		24.4	SURCHARGED	
2.000	P1	0.632	0.000	0.11		3.1	SURCHARGED	
2.001	P2	0.645	0.000	0.11		3.2	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for WEST BOLDON - 08.05.19.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	P3	0.000	0.000	0.01		16.8	SURCHARGED*	
1.004	4	1.686	0.000	0.14		3.8	FLOOD RISK	

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