


Bryan G Hall		Page 0
Suite E8 Joseph's Well Hanover Walk Leeds LS3 1AB		
Date 01/01/0001 File SWSV1 REV B.MDX	Designed by IEllis Checked by	
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SWSV1.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.342	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
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)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for SWSV1.SWS






Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.348	4-8	0.666	8-12	0.018

Total Area Contributing (ha) = 1.032

Total Pipe Volume (m³) = 71.617


Network Design Table for SWSV1.SWS

« - 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	24.300	1.025	23.7	0.092	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	44.342	3.625	12.2	0.110	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	21.484	2.000	10.7	0.011	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	30.433	0.581	52.4	0.037	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	59.548	1.009	59.0	0.097	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	47.33	5.19	91.600	0.092	0.0	0.0	0.0	2.08	36.7	11.8
1.001	46.59	5.39	90.500	0.202	0.0	0.0	0.0	3.76	149.6	25.5
1.002	46.32	5.47	86.800	0.213	0.0	0.0	0.0	4.82	341.0	26.7
1.003	45.49	5.70	84.800	0.250	0.0	0.0	0.0	2.18	153.9	30.8
1.004	44.08	6.12	84.144	0.347	0.0	0.0	0.0	2.36	260.9	41.4

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Network Design Table for SWSV1.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
1.005	70.301	1.365	51.5	0.137	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.006	23.516	0.047	500.3	0.042	0.00	0.0	0.600	o	600	Pipe/Conduit	
2.000	60.387	4.929	12.3	0.055	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	37.530	3.044	12.3	0.211	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.002	12.014	1.152	10.4	0.022	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	61.758	0.124	500.0	0.082	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.008	35.149	0.195	180.3	0.077	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.009	16.289	0.891	18.3	0.059	0.00	0.0	0.600	o	600	Pipe/Conduit	
3.000	11.850	0.024	493.8	0.000	5.00	0.0	0.600	o	600	Pipe/Conduit	
1.010	20.444	1.066	19.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.011	38.264	1.157	33.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.012	21.790	0.515	42.3	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)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.005	42.80	6.53	83.060	0.484	0.0	0.0	0.0	2.84	451.4	56.1
1.006	41.74	6.89	81.545	0.526	0.0	0.0	0.0	1.08	305.9	59.5
2.000	46.75	5.35	92.500	0.055	0.0	0.0	0.0	2.89	51.1	7.0
2.001	46.24	5.49	87.421	0.266	0.0	0.0	0.0	4.50	318.2	33.3
2.002	46.10	5.53	84.377	0.288	0.0	0.0	0.0	4.90	346.1	36.0
1.007	39.23	7.84	81.498	0.896	0.0	0.0	0.0	1.08	306.0	95.2
1.008	38.45	8.17	81.374	0.973	0.0	0.0	0.0	1.81	512.0	101.3
1.009	38.34	8.22	81.179	1.032	0.0	0.0	0.0	5.71	1615.4	107.2
3.000	47.38	5.18	80.312	0.000	0.0	0.0	0.0	1.09	307.9	0.0
1.010	38.00	8.36	80.238	1.032	0.0	0.0	0.0	2.31	40.8«	107.2
1.011	37.19	8.73	79.172	1.032	0.0	0.0	0.0	1.76	31.0«	107.2
1.012	36.69	8.96	78.015	1.032	0.0	0.0	0.0	1.55	27.4«	107.2

Free Flowing Outfall Details for SWSV1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.012	18	78.500	77.500	77.400	0	0

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Simulation Criteria for SWSV1.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m <sup>3</sup> /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)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.342		

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Online Controls for SWSV1.SWS


Hydro-Brake® Optimum Manhole: 15, DS/PN: 1.010, Volume (m³): 13.4

Unit Reference	MD-SHE-0116-1000-3350-1000
Design Head (m)	3.350
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	116
Invert Level (m)	80.238
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.350	10.0
Flush-Flo™	0.500	7.3
Kick-Flo®	1.034	5.8
Mean Flow over Head Range	-	7.5

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	4.1	1.200	6.2	3.000	9.5	7.000	14.2
0.200	6.4	1.400	6.6	3.500	10.2	7.500	14.7
0.300	7.0	1.600	7.1	4.000	10.9	8.000	15.1
0.400	7.2	1.800	7.5	4.500	11.5	8.500	15.6
0.500	7.3	2.000	7.8	5.000	12.1	9.000	16.0
0.600	7.3	2.200	8.2	5.500	12.7	9.500	16.4
0.800	6.9	2.400	8.5	6.000	13.2		
1.000	6.0	2.600	8.9	6.500	13.7		

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Storage Structures for SWSV1.SWS

Tank or Pond Manhole: 14, DS/PN: 3.000

Invert Level (m) 80.312


Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	247.0	1.400	247.0	2.800	247.0	4.200	0.0
0.200	247.0	1.600	247.0	3.000	247.0	4.400	0.0
0.400	247.0	1.800	247.0	3.200	247.0	4.600	0.0
0.600	247.0	2.000	247.0	3.400	247.0	4.800	0.0
0.800	247.0	2.200	247.0	3.600	0.0	5.000	0.0
1.000	247.0	2.400	247.0	3.800	0.0		
1.200	247.0	2.600	247.0	4.000	0.0		



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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)  
for SWSV1.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m <sup>3</sup> )	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.082	0.000	0.42		14.7	OK	
1.001	2	-0.156	0.000	0.21		29.4	OK	
1.002	3	-0.236	0.000	0.10		30.7	OK	
1.003	4	-0.197	0.000	0.25		35.5	OK	
1.004	5	-0.261	0.000	0.20		48.5	OK	
1.005	6	-0.330	0.000	0.16		66.0	OK	
1.006	7	-0.329	0.000	0.30		69.8	OK	
2.000	8	-0.108	0.000	0.17		8.7	OK	
2.001	9	-0.229	0.000	0.13		37.2	OK	
2.002	10	-0.223	0.000	0.15		39.9	OK	
1.007	11	-0.324	0.000	0.41		112.4	OK	
1.008	12	-0.384	0.000	0.28		119.4	OK	
1.009	13	-0.456	0.000	0.13		124.5	OK	
3.000	14	-0.145	0.000	0.07		11.3	OK	
1.010	15	0.492	0.000	0.19		7.3	SURCHARGED	
1.011	16	-0.100	0.000	0.24		7.3	OK	
1.012	17	-0.096	0.000	0.28		7.3	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)  
for SWSV1.SWS

Simulation Criteria

Areal Reduction Factor 1.000      Additional Flow - % of Total Flow 0.000  
Hot Start (mins)                      0                      MADD Factor \* 10m<sup>3</sup>/ha Storage 0.000  
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 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 0.342  
Region England and Wales Cv (Summer) 1.000  
M5-60 (mm)                      19.000 Cv (Winter) 1.000

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, 180, 240, 360, 480, 600,  
720, 960, 1440, 2160  
Return Period(s) (years)                      1, 30, 100  
Climate Change (%)                      0, 0, 40

	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level (m)
1.000	1	15 Summer	30	+0%	30/15 Summer				91.784
1.001	2	15 Summer	30	+0%					90.624
1.002	3	15 Summer	30	+0%					86.911
1.003	4	15 Summer	30	+0%	100/15 Summer				84.994
1.004	5	15 Summer	30	+0%					84.354
1.005	6	15 Summer	30	+0%	100/15 Summer				83.282
1.006	7	15 Summer	30	+0%	30/15 Summer				82.194
2.000	8	15 Summer	30	+0%					92.569
2.001	9	15 Summer	30	+0%					87.550
2.002	10	15 Summer	30	+0%					84.520
1.007	11	15 Summer	30	+0%	30/15 Summer				82.151
1.008	12	15 Summer	30	+0%	100/15 Summer				81.779
1.009	13	360 Winter	30	+0%	100/30 Summer				81.641
3.000	14	360 Winter	30	+0%	30/15 Summer				81.733
1.010	15	360 Winter	30	+0%	1/15 Summer				82.115
1.011	16	2160 Summer	30	+0%	30/360 Winter				80.893
1.012	17	2160 Summer	30	+0%	30/2160 Summer				78.569

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)  
for SWSV1.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.034	0.000	1.01		35.4	SURCHARGED	
1.001	2	-0.101	0.000	0.58		83.1	OK	
1.002	3	-0.189	0.000	0.29		87.8	OK	
1.003	4	-0.106	0.000	0.74		103.9	OK	
1.004	5	-0.165	0.000	0.59		143.1	OK	
1.005	6	-0.228	0.000	0.47		196.7	OK	
1.006	7	0.049	0.000	0.90		208.8	SURCHARGED	
2.000	8	-0.081	0.000	0.43		21.3	OK	
2.001	9	-0.171	0.000	0.39		113.6	OK	
2.002	10	-0.157	0.000	0.46		123.0	OK	
1.007	11	0.053	0.000	1.19		325.2	SURCHARGED	
1.008	12	-0.195	0.000	0.78		335.3	OK	
1.009	13	-0.138	0.000	0.06		59.3	OK	
3.000	14	0.821	0.000	0.17		26.5	SURCHARGED	
1.010	15	1.727	0.000	0.60		23.1	SURCHARGED	
1.011	16	1.571	0.000	1.35		40.6	SURCHARGED	
1.012	17	0.404	0.000	1.33		34.3	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWSV1.SWS

Simulation Criteria

Areal Reduction Factor 1.000      Additional Flow - % of Total Flow 0.000  
Hot Start (mins)                      0                      MADD Factor \* 10m<sup>3</sup>/ha Storage 0.000  
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 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 0.342  
Region England and Wales Cv (Summer) 1.000  
M5-60 (mm)                      19.000 Cv (Winter) 1.000

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, 180, 240, 360, 480, 600,  
720, 960, 1440, 2160  
Return Period(s) (years)                      1, 30, 100  
Climate Change (%)                      0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	100	+40%	30/15 Summer				93.690
1.001	2	15 Summer	100	+40%					90.685
1.002	3	15 Summer	100	+40%					86.951
1.003	4	15 Summer	100	+40%	100/15 Summer				85.449
1.004	5	15 Summer	100	+40%					84.507
1.005	6	15 Summer	100	+40%	100/15 Summer				83.591
1.006	7	600 Winter	100	+40%	30/15 Summer				83.158
2.000	8	15 Summer	100	+40%					92.600
2.001	9	15 Summer	100	+40%					87.607
2.002	10	15 Summer	100	+40%					84.587
1.007	11	600 Winter	100	+40%	30/15 Summer				83.191
1.008	12	600 Winter	100	+40%	100/15 Summer				83.199
1.009	13	600 Winter	100	+40%	100/30 Summer				83.202
3.000	14	600 Winter	100	+40%	30/15 Summer				83.145
1.010	15	600 Winter	100	+40%	1/15 Summer				83.204
1.011	16	180 Winter	100	+40%	30/360 Winter				79.690
1.012	17	180 Winter	100	+40%	30/2160 Summer				78.262

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWSV1.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m <sup>3</sup> )	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	1.940	0.000	1.67		58.3	FLOOD RISK	
1.001	2	-0.040	0.000	0.98		139.5	OK	
1.002	3	-0.149	0.000	0.49		147.2	OK	
1.003	4	0.349	0.000	1.23		172.6	SURCHARGED	
1.004	5	-0.012	0.000	0.98		239.2	OK	
1.005	6	0.081	0.000	0.76		321.6	SURCHARGED	
1.006	7	1.013	0.000	0.16		38.1	FLOOD RISK	
2.000	8	-0.050	0.000	0.77		38.4	OK	
2.001	9	-0.114	0.000	0.70		205.4	OK	
2.002	10	-0.090	0.000	0.83		222.5	OK	
1.007	11	1.093	0.000	0.23		62.2	SURCHARGED	
1.008	12	1.225	0.000	0.16		67.8	SURCHARGED	
1.009	13	1.423	0.000	0.08		77.7	SURCHARGED	
3.000	14	2.233	0.000	0.07		11.8	SURCHARGED	
1.010	15	2.816	0.000	0.24		9.3	SURCHARGED	
1.011	16	0.368	0.000	1.03		30.9	SURCHARGED	
1.012	17	0.097	0.000	1.00		25.8	SURCHARGED	