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)	100	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.319	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)
0-4	0.141	4-8	0.031

Total Area Contributing (ha) = 0.172

Total Pipe Volume (m³) = 62.550

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	27.500	0.054	509.3	0.086	5.00	0.0	0.600	[]	-4	Pipe/Conduit	
1.001	12.535	0.020	626.8	0.086	0.00	0.0	0.600	[]	-4	Pipe/Conduit	
1.002	5.374	0.079	68.0	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)
1.000	50.00	5.31	161.045	0.086	0.0	0.0	0.0	1.50	2333.4	11.6
1.001	50.00	5.46	160.991	0.172	0.0	0.0	0.0	1.35	2101.5	23.3
1.002	50.00	5.53	160.971	0.172	0.0	0.0	0.0	1.22	21.6«	23.3

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	162.800	1.755	Junction		1.000	161.045	-4				
2	162.800	1.809	Junction		1.001	160.991	-4	1.000	160.991	-4	
3	162.600	1.629	Open Manhole	3000	1.002	160.971	150	1.001	160.971	-4	
	163.000	2.108	Open Manhole	0		OUTFALL		1.002	160.892	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	414327.093	414647.791			No Entry	
2	414304.493	414663.459			No Entry	
3	414295.515	414654.711	414295.515	414654.711	Required	
	414291.697	414650.929			No Entry	



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PIPELINE SCHEDULES for Storm

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	[]	-4	1	162.800	161.045	1.105	Junction	
1.001	[]	-4	2	162.800	160.991	1.159	Junction	
1.002	o	150	3	162.600	160.971	1.479	Open Manhole	3000

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	27.500	509.3	2	162.800	160.991	1.159	Junction	
1.001	12.535	626.8	3	162.600	160.971	0.979	Open Manhole	3000
1.002	5.374	68.0		163.000	160.892	1.958	Open Manhole	0

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Setting Out Information - True Coordinates (Storm)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
1.000	1			414327.093	414647.791			
1.001	2			414304.493	414663.459			
1.002	3	3000		414295.515	414654.711	414295.515	414654.711	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
1.002		0		414291.697	414650.929	



Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002		163.000	160.892	0.000	0	0

Simulation Criteria for Storm

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	0
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)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.319		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 3, DS/PN: 1.002, Volume (m³): 28.7

Unit Reference	MD-SHE-0084-3500-1300-3500
Design Head (m)	1.300
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	84
Invert Level (m)	160.971
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.300	3.5
Flush-Flo™	0.368	3.4
Kick-Flo®	0.751	2.7
Mean Flow over Head Range	-	3.0

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	2.5	1.200	3.4	3.000	5.1	7.000	7.7
0.200	3.2	1.400	3.6	3.500	5.5	7.500	7.9
0.300	3.4	1.600	3.8	4.000	5.9	8.000	8.2
0.400	3.4	1.800	4.1	4.500	6.2	8.500	8.4
0.500	3.3	2.000	4.3	5.000	6.5	9.000	8.7
0.600	3.2	2.200	4.5	5.500	6.8	9.500	8.9
0.800	2.8	2.400	4.6	6.000	7.1		
1.000	3.1	2.600	4.8	6.500	7.4		

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	1	0.000	42.900	0.000	42.900
1.001	2	0.000	19.555	0.000	19.555
1.002	3	11.515	0.095	0.000	11.610
Total		11.515	62.550	0.000	74.064

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1 year Return Period 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 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	0
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	0.317
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	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, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

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	60 Winter	1	+0%					161.149
1.001	2	60 Winter	1	+0%					161.149
1.002	3	60 Winter	1	+0%	1/15 Winter				161.149

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.546	0.000	0.00			5.8	OK*	
1.001	2	-0.492	0.000	0.00			7.0	OK*	
1.002	3	0.028	0.000	0.18			3.1	SURCHARGED	

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Rainfall Hyetograph for 60 minute 1 year Winter I+0% for Pipe 1.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	0.859	13	6.000	25	23.165	37	21.024	49	5.644
2	2.470	14	6.485	26	24.988	38	19.103	50	5.468
3	3.652	15	7.128	27	26.688	39	17.211	51	5.386
4	4.526	16	8.074	28	28.357	40	15.170	52	5.374
5	4.990	17	9.115	29	29.541	41	13.472	53	5.385
6	5.254	18	10.326	30	30.395	42	11.901	54	5.371
7	5.371	19	11.901	31	30.395	43	10.326	55	5.254
8	5.385	20	13.472	32	29.541	44	9.115	56	4.990
9	5.374	21	15.170	33	28.357	45	8.074	57	4.526
10	5.386	22	17.211	34	26.688	46	7.128	58	3.653
11	5.468	23	19.103	35	24.988	47	6.485	59	2.470
12	5.644	24	21.024	36	23.165	48	6.000	60	0.859

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Rainfall Hyetograph for 60 minute 1 year Winter I+0% for Pipe 1.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	0.859	13	6.000	25	23.165	37	21.024	49	5.644
2	2.470	14	6.485	26	24.988	38	19.103	50	5.468
3	3.652	15	7.128	27	26.688	39	17.211	51	5.386
4	4.526	16	8.074	28	28.357	40	15.170	52	5.374
5	4.990	17	9.115	29	29.541	41	13.472	53	5.385
6	5.254	18	10.326	30	30.395	42	11.901	54	5.371
7	5.371	19	11.901	31	30.395	43	10.326	55	5.254
8	5.385	20	13.472	32	29.541	44	9.115	56	4.990
9	5.374	21	15.170	33	28.357	45	8.074	57	4.526
10	5.386	22	17.211	34	26.688	46	7.128	58	3.653
11	5.468	23	19.103	35	24.988	47	6.485	59	2.470
12	5.644	24	21.024	36	23.165	48	6.000	60	0.859

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Rainfall Hyetograph for 60 minute 1 year Winter I+0% for Pipe 1.002 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	0.859	13	6.000	25	23.165	37	21.024	49	5.644
2	2.470	14	6.485	26	24.988	38	19.103	50	5.468
3	3.652	15	7.128	27	26.688	39	17.211	51	5.386
4	4.526	16	8.074	28	28.357	40	15.170	52	5.374
5	4.990	17	9.115	29	29.541	41	13.472	53	5.385
6	5.254	18	10.326	30	30.395	42	11.901	54	5.371
7	5.371	19	11.901	31	30.395	43	10.326	55	5.254
8	5.385	20	13.472	32	29.541	44	9.115	56	4.990
9	5.374	21	15.170	33	28.357	45	8.074	57	4.526
10	5.386	22	17.211	34	26.688	46	7.128	58	3.653
11	5.468	23	19.103	35	24.988	47	6.485	59	2.470
12	5.644	24	21.024	36	23.165	48	6.000	60	0.859

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30 year Return Period 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 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	0
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	0.317
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	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, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

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	120 Winter	30	+0%					161.381
1.001	2	120 Winter	30	+0%					161.381
1.002	3	120 Winter	30	+0%	1/15 Winter				161.380

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.314	0.000	0.00			8.9	OK*	
1.001	2	-0.260	0.000	0.01			8.2	OK*	
1.002	3	0.259	0.000	0.19			3.4	SURCHARGED	

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Rainfall Hyetograph for 120 minute 30 year Winter I+0% for Pipe 1.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	0.606	25	8.990	49	34.595	73	32.778	97	8.690
2	2.013	26	9.301	50	36.021	74	31.311	98	8.514
3	3.237	27	9.670	51	37.413	75	29.846	99	8.381
4	4.292	28	10.098	52	38.762	76	28.388	100	8.287
5	5.190	29	10.588	53	40.060	77	26.945	101	8.226
6	5.944	30	11.142	54	41.297	78	25.522	102	8.193
7	6.678	31	11.942	55	42.716	79	23.790	103	8.186
8	7.120	32	12.670	56	43.730	80	22.453	104	8.195
9	7.471	33	13.464	57	44.635	81	21.158	105	8.206
10	7.740	34	14.323	58	45.420	82	19.910	106	8.210
11	7.939	35	15.246	59	46.074	83	18.712	107	8.201
12	8.077	36	16.233	60	46.583	84	17.568	108	8.171
13	8.171	37	17.568	61	46.583	85	16.233	109	8.077
14	8.201	38	18.712	62	46.074	86	15.246	110	7.939
15	8.210	39	19.910	63	45.420	87	14.323	111	7.741
16	8.206	40	21.158	64	44.635	88	13.464	112	7.471
17	8.195	41	22.453	65	43.730	89	12.670	113	7.120
18	8.186	42	23.790	66	42.716	90	11.942	114	6.678
19	8.193	43	25.522	67	41.297	91	11.142	115	5.944
20	8.226	44	26.945	68	40.060	92	10.588	116	5.190
21	8.287	45	28.388	69	38.762	93	10.098	117	4.292
22	8.382	46	29.846	70	37.413	94	9.670	118	3.237
23	8.514	47	31.311	71	36.021	95	9.301	119	2.013
24	8.690	48	32.778	72	34.595	96	8.990	120	0.606

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Rainfall Hyetograph for 120 minute 30 year Winter I+0% for Pipe 1.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	0.606	25	8.990	49	34.595	73	32.778	97	8.690
2	2.013	26	9.301	50	36.021	74	31.311	98	8.514
3	3.237	27	9.670	51	37.413	75	29.846	99	8.381
4	4.292	28	10.098	52	38.762	76	28.388	100	8.287
5	5.190	29	10.588	53	40.060	77	26.945	101	8.226
6	5.944	30	11.142	54	41.297	78	25.522	102	8.193
7	6.678	31	11.942	55	42.716	79	23.790	103	8.186
8	7.120	32	12.670	56	43.730	80	22.453	104	8.195
9	7.471	33	13.464	57	44.635	81	21.158	105	8.206
10	7.740	34	14.323	58	45.420	82	19.910	106	8.210
11	7.939	35	15.246	59	46.074	83	18.712	107	8.201
12	8.077	36	16.233	60	46.583	84	17.568	108	8.171
13	8.171	37	17.568	61	46.583	85	16.233	109	8.077
14	8.201	38	18.712	62	46.074	86	15.246	110	7.939
15	8.210	39	19.910	63	45.420	87	14.323	111	7.741
16	8.206	40	21.158	64	44.635	88	13.464	112	7.471
17	8.195	41	22.453	65	43.730	89	12.670	113	7.120
18	8.186	42	23.790	66	42.716	90	11.942	114	6.678
19	8.193	43	25.522	67	41.297	91	11.142	115	5.944
20	8.226	44	26.945	68	40.060	92	10.588	116	5.190
21	8.287	45	28.388	69	38.762	93	10.098	117	4.292
22	8.382	46	29.846	70	37.413	94	9.670	118	3.237
23	8.514	47	31.311	71	36.021	95	9.301	119	2.013
24	8.690	48	32.778	72	34.595	96	8.990	120	0.606

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Rainfall Hyetograph for 120 minute 30 year Winter I+0% for Pipe 1.002 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	0.606	25	8.990	49	34.595	73	32.778	97	8.690
2	2.013	26	9.301	50	36.021	74	31.311	98	8.514
3	3.237	27	9.670	51	37.413	75	29.846	99	8.381
4	4.292	28	10.098	52	38.762	76	28.388	100	8.287
5	5.190	29	10.588	53	40.060	77	26.945	101	8.226
6	5.944	30	11.142	54	41.297	78	25.522	102	8.193
7	6.678	31	11.942	55	42.716	79	23.790	103	8.186
8	7.120	32	12.670	56	43.730	80	22.453	104	8.195
9	7.471	33	13.464	57	44.635	81	21.158	105	8.206
10	7.740	34	14.323	58	45.420	82	19.910	106	8.210
11	7.939	35	15.246	59	46.074	83	18.712	107	8.201
12	8.077	36	16.233	60	46.583	84	17.568	108	8.171
13	8.171	37	17.568	61	46.583	85	16.233	109	8.077
14	8.201	38	18.712	62	46.074	86	15.246	110	7.939
15	8.210	39	19.910	63	45.420	87	14.323	111	7.741
16	8.206	40	21.158	64	44.635	88	13.464	112	7.471
17	8.195	41	22.453	65	43.730	89	12.670	113	7.120
18	8.186	42	23.790	66	42.716	90	11.942	114	6.678
19	8.193	43	25.522	67	41.297	91	11.142	115	5.944
20	8.226	44	26.945	68	40.060	92	10.588	116	5.190
21	8.287	45	28.388	69	38.762	93	10.098	117	4.292
22	8.382	46	29.846	70	37.413	94	9.670	118	3.237
23	8.514	47	31.311	71	36.021	95	9.301	119	2.013
24	8.690	48	32.778	72	34.595	96	8.990	120	0.606

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100 year Return Period 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 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	0
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 0.317
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	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, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

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	180 Winter	100	+30%					161.695
1.001	2	180 Winter	100	+30%					161.641
1.002	3	180 Winter	100	+30%	1/15 Winter				162.109

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.000	0.00			11.5	SURCHARGED*	
1.001	2	0.000	0.000	0.01			10.0	SURCHARGED*	
1.002	3	0.988	0.000	0.19			3.4	SURCHARGED	

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Rainfall Hyetograph for 180 minute 100 year Winter I+30% for Pipe 1.000 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	0.777	37	11.531	73	44.375	109	42.044	145	11.146
2	1.228	38	11.631	74	44.832	110	41.573	146	11.090
3	3.033	39	12.030	75	46.660	111	39.692	147	10.865
4	3.779	40	12.279	76	47.546	112	38.753	148	10.789
5	4.898	41	12.652	77	48.874	113	37.343	149	10.675
6	5.809	42	13.103	78	50.142	114	35.948	150	10.607
7	6.415	43	13.404	79	50.987	115	35.018	151	10.562
8	7.383	44	14.114	80	52.574	116	33.193	152	10.520
9	7.625	45	14.291	81	52.971	117	32.736	153	10.509
10	8.565	46	15.318	82	54.791	118	30.515	154	10.500
11	8.707	47	15.551	83	55.116	119	30.087	155	10.503
12	9.275	48	16.485	84	56.416	120	28.371	156	10.515
13	9.480	49	17.008	85	56.973	121	27.550	157	10.522
14	9.788	50	17.793	86	57.809	122	26.318	158	10.532
15	9.999	51	18.661	87	58.484	123	25.149	159	10.530
16	10.139	52	19.239	88	58.934	124	24.369	160	10.529
17	10.316	53	20.505	89	59.588	125	22.901	161	10.490
18	10.360	54	20.821	90	59.752	126	22.534	162	10.480
19	10.480	55	22.534	91	59.752	127	20.821	163	10.360
20	10.490	56	22.901	92	59.588	128	20.505	164	10.316
21	10.529	57	24.369	93	58.934	129	19.239	165	10.139
22	10.530	58	25.149	94	58.484	130	18.661	166	9.999
23	10.532	59	26.318	95	57.809	131	17.793	167	9.788
24	10.522	60	27.550	96	56.973	132	17.008	168	9.480
25	10.515	61	28.371	97	56.416	133	16.485	169	9.275
26	10.503	62	30.087	98	55.116	134	15.551	170	8.707
27	10.500	63	30.515	99	54.791	135	15.318	171	8.565
28	10.509	64	32.736	100	52.971	136	14.291	172	7.625
29	10.520	65	33.193	101	52.574	137	14.114	173	7.383
30	10.562	66	35.018	102	50.987	138	13.404	174	6.415
31	10.607	67	35.948	103	50.142	139	13.103	175	5.809
32	10.675	68	37.343	104	48.874	140	12.652	176	4.898
33	10.789	69	38.753	105	47.546	141	12.279	177	3.779
34	10.865	70	39.692	106	46.660	142	12.030	178	3.033
35	11.090	71	41.573	107	44.832	143	11.631	179	1.228
36	11.146	72	42.044	108	44.375	144	11.531	180	0.777

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Rainfall Hyetograph for 180 minute 100 year Winter I+30% for Pipe 1.001 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	0.777	37	11.531	73	44.375	109	42.044	145	11.146
2	1.228	38	11.631	74	44.832	110	41.573	146	11.090
3	3.033	39	12.030	75	46.660	111	39.692	147	10.865
4	3.779	40	12.279	76	47.546	112	38.753	148	10.789
5	4.898	41	12.652	77	48.874	113	37.343	149	10.675
6	5.809	42	13.103	78	50.142	114	35.948	150	10.607
7	6.415	43	13.404	79	50.987	115	35.018	151	10.562
8	7.383	44	14.114	80	52.574	116	33.193	152	10.520
9	7.625	45	14.291	81	52.971	117	32.736	153	10.509
10	8.565	46	15.318	82	54.791	118	30.515	154	10.500
11	8.707	47	15.551	83	55.116	119	30.087	155	10.503
12	9.275	48	16.485	84	56.416	120	28.371	156	10.515
13	9.480	49	17.008	85	56.973	121	27.550	157	10.522
14	9.788	50	17.793	86	57.809	122	26.318	158	10.532
15	9.999	51	18.661	87	58.484	123	25.149	159	10.530
16	10.139	52	19.239	88	58.934	124	24.369	160	10.529
17	10.316	53	20.505	89	59.588	125	22.901	161	10.490
18	10.360	54	20.821	90	59.752	126	22.534	162	10.480
19	10.480	55	22.534	91	59.752	127	20.821	163	10.360
20	10.490	56	22.901	92	59.588	128	20.505	164	10.316
21	10.529	57	24.369	93	58.934	129	19.239	165	10.139
22	10.530	58	25.149	94	58.484	130	18.661	166	9.999
23	10.532	59	26.318	95	57.809	131	17.793	167	9.788
24	10.522	60	27.550	96	56.973	132	17.008	168	9.480
25	10.515	61	28.371	97	56.416	133	16.485	169	9.275
26	10.503	62	30.087	98	55.116	134	15.551	170	8.707
27	10.500	63	30.515	99	54.791	135	15.318	171	8.565
28	10.509	64	32.736	100	52.971	136	14.291	172	7.625
29	10.520	65	33.193	101	52.574	137	14.114	173	7.383
30	10.562	66	35.018	102	50.987	138	13.404	174	6.415
31	10.607	67	35.948	103	50.142	139	13.103	175	5.809
32	10.675	68	37.343	104	48.874	140	12.652	176	4.898
33	10.789	69	38.753	105	47.546	141	12.279	177	3.779
34	10.865	70	39.692	106	46.660	142	12.030	178	3.033
35	11.090	71	41.573	107	44.832	143	11.631	179	1.228
36	11.146	72	42.044	108	44.375	144	11.531	180	0.777

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Rainfall Hyetograph for 180 minute 100 year Winter I+30% for Pipe 1.002 (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	0.777	37	11.531	73	44.375	109	42.044	145	11.146
2	1.228	38	11.631	74	44.832	110	41.573	146	11.090
3	3.033	39	12.030	75	46.660	111	39.692	147	10.865
4	3.779	40	12.279	76	47.546	112	38.753	148	10.789
5	4.898	41	12.652	77	48.874	113	37.343	149	10.675
6	5.809	42	13.103	78	50.142	114	35.948	150	10.607
7	6.415	43	13.404	79	50.987	115	35.018	151	10.562
8	7.383	44	14.114	80	52.574	116	33.193	152	10.520
9	7.625	45	14.291	81	52.971	117	32.736	153	10.509
10	8.565	46	15.318	82	54.791	118	30.515	154	10.500
11	8.707	47	15.551	83	55.116	119	30.087	155	10.503
12	9.275	48	16.485	84	56.416	120	28.371	156	10.515
13	9.480	49	17.008	85	56.973	121	27.550	157	10.522
14	9.788	50	17.793	86	57.809	122	26.318	158	10.532
15	9.999	51	18.661	87	58.484	123	25.149	159	10.530
16	10.139	52	19.239	88	58.934	124	24.369	160	10.529
17	10.316	53	20.505	89	59.588	125	22.901	161	10.490
18	10.360	54	20.821	90	59.752	126	22.534	162	10.480
19	10.480	55	22.534	91	59.752	127	20.821	163	10.360
20	10.490	56	22.901	92	59.588	128	20.505	164	10.316
21	10.529	57	24.369	93	58.934	129	19.239	165	10.139
22	10.530	58	25.149	94	58.484	130	18.661	166	9.999
23	10.532	59	26.318	95	57.809	131	17.793	167	9.788
24	10.522	60	27.550	96	56.973	132	17.008	168	9.480
25	10.515	61	28.371	97	56.416	133	16.485	169	9.275
26	10.503	62	30.087	98	55.116	134	15.551	170	8.707
27	10.500	63	30.515	99	54.791	135	15.318	171	8.565
28	10.509	64	32.736	100	52.971	136	14.291	172	7.625
29	10.520	65	33.193	101	52.574	137	14.114	173	7.383
30	10.562	66	35.018	102	50.987	138	13.404	174	6.415
31	10.607	67	35.948	103	50.142	139	13.103	175	5.809
32	10.675	68	37.343	104	48.874	140	12.652	176	4.898
33	10.789	69	38.753	105	47.546	141	12.279	177	3.779
34	10.865	70	39.692	106	46.660	142	12.030	178	3.033
35	11.090	71	41.573	107	44.832	143	11.631	179	1.228
36	11.146	72	42.044	108	44.375	144	11.531	180	0.777

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MH Name				1	
Hor Scale 1500 Ver Scale 200 Datum (m) 157.000					
PN				1.000	
Dia (mm)				-4	
Slope (1:X)				509.3	
Cover Level (m)	163.000		162.800	162.800	
Invert Level (m)			160.971 160.991	160.991 161.045	
Length (m)				27.500	

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