

TOPPING ENGINEERS

CONSULTING CIVIL & STRUCTURAL ENGINEERS

DRAINAGE CALCULATIONS

LOCATION:

Jewsons
St Andrews Road
Huddersfield
HD16PT

CLIENT:

Stark Building Materials Ltd

DOCUMENT REF:
24399-C-Calcs-001

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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)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.306	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	0.182	4-8	0.055

Total Area Contributing (ha) = 0.237

Total Pipe Volume (m³) = 4.271

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
1.000	30.330	0.358	84.7	0.069	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	25.780	0.258	99.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	12.660	0.143	88.5	0.069	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	24.980	0.357	70.0	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	5.480	0.239	22.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	4.200	0.060	70.0	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)
1.000	44.23	5.36	59.030	0.069	0.0	0.0	0.0	1.42	56.5	8.3
1.001	43.15	5.68	58.672	0.069	0.0	0.0	0.0	1.31	52.0	8.3
1.002	42.68	5.84	58.414	0.138	0.0	0.0	0.0	1.39	55.3	15.9
1.003	41.87	6.10	58.271	0.178	0.0	0.0	0.0	1.57	62.2	20.2
1.004	41.78	6.14	57.914	0.178	0.0	0.0	0.0	2.74	109.1	20.2
1.005	41.65	6.18	57.675	0.178	0.0	0.0	0.0	1.57	62.2	20.2

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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
2.000	3.770	1.099	3.4	0.059	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	2.300	0.038	60.0	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)
2.000	45.42	5.01	58.814	0.059	0.0	0.0	0.0	5.48	96.9	7.3
1.006	41.58	6.20	57.615	0.237	0.0	0.0	0.0	1.69	67.3	26.7

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)
1.006		59.800	57.577	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	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	0.306		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 8, DS/PN: 1.006, Volume (m³): 2.6

Unit Reference	MD-SHE-0206-2230-1200-2230
Design Head (m)	1.200
Design Flow (l/s)	22.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	206
Invert Level (m)	57.615
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	22.3
Flush-Flo™	0.382	22.3
Kick-Flo®	0.836	18.8
Mean Flow over Head Range	-	19.0

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	7.0	1.200	22.3	3.000	34.6	7.000	52.1
0.200	19.7	1.400	24.0	3.500	37.3	7.500	53.9
0.300	22.1	1.600	25.6	4.000	39.7	8.000	55.6
0.400	22.3	1.800	27.1	4.500	42.1	8.500	57.2
0.500	22.1	2.000	28.5	5.000	44.3	9.000	58.9
0.600	21.6	2.200	29.8	5.500	46.3	9.500	60.4
0.800	19.6	2.400	31.1	6.000	48.3		
1.000	20.4	2.600	32.3	6.500	50.3		

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Storage Structures for Storm

Cellular Storage Manhole: 6, DS/PN: 1.005

Invert Level (m) 57.675 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	45.0	45.0	1.300	0.0	79.8
1.200	45.0	79.8			

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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	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	0.306
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	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

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	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%	100/15 Summer				59.090
1.001	2	15 Winter	1	+0%	100/15 Summer				58.735
1.002	3	15 Winter	1	+0%	100/15 Summer				58.501
1.003	4	15 Winter	1	+0%	100/15 Summer				58.361
1.004	5	15 Winter	1	+0%	100/15 Summer				57.995
1.005	6	30 Winter	1	+0%	30/15 Summer				57.793
2.000	7	15 Winter	1	+0%					58.847
1.006	8	30 Winter	1	+0%	30/15 Summer				57.785

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	-0.165	0.000	0.16		8.2	OK	
1.001	2	-0.162	0.000	0.17		8.2	OK	
1.002	3	-0.138	0.000	0.32		15.2	OK	
1.003	4	-0.135	0.000	0.33		19.2	OK	
1.004	5	-0.144	0.000	0.28		19.1	OK	
1.005	6	-0.107	0.000	0.39		13.4	OK	
2.000	7	-0.117	0.000	0.11		7.1	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.006	8	-0.055	0.000	0.54		16.2	OK	

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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	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	0.306
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	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

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	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%	100/15 Summer				59.127
1.001	2	15 Winter	30	+0%	100/15 Summer				58.774
1.002	3	15 Winter	30	+0%	100/15 Summer				58.577
1.003	4	15 Winter	30	+0%	100/15 Summer				58.443
1.004	5	30 Winter	30	+0%	100/15 Summer				58.122
1.005	6	30 Winter	30	+0%	30/15 Summer				58.109
2.000	7	15 Winter	30	+0%					58.867
1.006	8	30 Winter	30	+0%	30/15 Summer				58.101

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	-0.128	0.000	0.38		20.0	OK	
1.001	2	-0.123	0.000	0.42		20.2	OK	
1.002	3	-0.062	0.000	0.84		40.0	OK	
1.003	4	-0.053	0.000	0.90		51.9	OK	
1.004	5	-0.017	0.000	0.62		42.4	OK	
1.005	6	0.209	0.000	0.63		21.6	SURCHARGED	
2.000	7	-0.097	0.000	0.27		17.4	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.006	8	0.261	0.000	0.75		22.3	SURCHARGED	

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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	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	0.306
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	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

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	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%	100/15 Summer				59.325
1.001	2	15 Winter	100	+40%	100/15 Summer				59.219
1.002	3	15 Winter	100	+40%	100/15 Summer				59.140
1.003	4	15 Winter	100	+40%	100/15 Summer				58.949
1.004	5	60 Winter	100	+40%	100/15 Summer				58.741
1.005	6	60 Winter	100	+40%	30/15 Summer				58.729
2.000	7	15 Winter	100	+40%					58.888
1.006	8	120 Winter	100	+40%	30/15 Summer				58.906

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	0.070	0.000	0.66		34.7	SURCHARGED	
1.001	2	0.322	0.000	0.64		30.8	SURCHARGED	
1.002	3	0.501	0.000	1.15		54.8	SURCHARGED	
1.003	4	0.453	0.000	1.25		71.9	SURCHARGED	
1.004	5	0.602	0.000	0.65		44.6	SURCHARGED	
1.005	6	0.829	0.000	0.63		21.6	SURCHARGED	
2.000	7	-0.076	0.000	0.48		31.5	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.006	8	1.066	0.000	0.73		21.7	SURCHARGED	

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