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Amber House Green Lane, Old Swan Liverpool, L13 7GD	Ducie Street SW Hydraulic Calcs Rev A	
Date 17/03/2022 13:07 File XDRAINAGE 3 ATERNATIVE OUTF...	Designed by EJC Checked by	
Innovyze	Network 2018.1.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.359	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 Surface Network 1

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.043	4-8	0.012

Total Area Contributing (ha) = 0.055

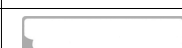
Total Pipe Volume (m³) = 0.945

Network Design Table for Surface Network 1

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	11.672	0.117	100.0	0.010	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	11.405	0.114	100.0	0.015	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	14.626	0.146	100.0	0.015	5.00	0.0	0.600	o	100	Pipe/Conduit	
2.001	6.614	0.066	100.2	0.015	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	2.476	0.654	3.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	13.897	0.105	132.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	7.411	0.741	10.0	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	45.77	5.25	46.100	0.010	0.0	0.0	0.0	0.77	6.0	1.2
1.001	45.08	5.44	45.933	0.025	0.0	0.0	0.0	1.00	17.8	3.1
2.000	45.53	5.32	46.100	0.015	0.0	0.0	0.0	0.77	6.0	1.8
2.001	45.13	5.43	45.904	0.030	0.0	0.0	0.0	1.00	17.7	3.7
1.002	45.05	5.45	45.819	0.055	0.0	0.0	0.0	5.22	92.2	6.7
1.003	44.12	5.72	45.165	0.055	0.0	0.0	0.0	0.87	15.4	6.7
1.004	43.99	5.75	45.060	0.055	0.0	0.0	0.0	3.20	56.6	6.7

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Manhole Schedules for Surface Network 1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	Pipe Out PN	Invert Level (m)	Diameter (mm)	Pipes In PN	Invert Level (m)	Diameter (mm)	Backdrop (mm)
PS1	46.650	0.550	Open Manhole	450	1.000	46.100	100				
PS2	46.650	0.717	Open Manhole	450	1.001	45.933	150	1.000	45.983	100	
PS6	46.650	0.550	Open Manhole	450	2.000	46.100	100				
PS3	46.650	0.746	Open Manhole	250	2.001	45.904	150	2.000	45.954	100	
S1	46.650	0.831	Open Manhole	450	1.002	45.819	150	1.001	45.819	150	
								2.001	45.838	150	19
S2	46.650	1.485	Open Manhole	1200	1.003	45.165	150	1.002	45.165	150	
S3	46.650	1.590	Open Manhole	450	1.004	45.060	150	1.003	45.060	150	
S4	45.450	1.131	Open Manhole	1500		OUTFALL		1.004	44.319	150	

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PIPELINE SCHEDULES for Surface Network 1

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	100	PS1	46.650	46.100	0.450	Open Manhole	450
1.001	o	150	PS2	46.650	45.933	0.567	Open Manhole	450
2.000	o	100	PS6	46.650	46.100	0.450	Open Manhole	450
2.001	o	150	PS3	46.650	45.904	0.596	Open Manhole	250
1.002	o	150	S1	46.650	45.819	0.681	Open Manhole	450
1.003	o	150	S2	46.650	45.165	1.335	Open Manhole	1200
1.004	o	150	S3	46.650	45.060	1.440	Open Manhole	450

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	11.672	100.0	PS2	46.650	45.983	0.567	Open Manhole	450
1.001	11.405	100.0	S1	46.650	45.819	0.681	Open Manhole	450
2.000	14.626	100.0	PS3	46.650	45.954	0.596	Open Manhole	250
2.001	6.614	100.2	S1	46.650	45.838	0.662	Open Manhole	450
1.002	2.476	3.8	S2	46.650	45.165	1.335	Open Manhole	1200
1.003	13.897	132.4	S3	46.650	45.060	1.440	Open Manhole	450
1.004	7.411	10.0	S4	45.450	44.319	0.981	Open Manhole	1500

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Network Classifications for Surface Network 1

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	PS1	100	0.450	0.567	Unclassified	450	0	0.450	Unclassified
1.001	PS2	150	0.567	0.681	Unclassified	450	0	0.567	Unclassified
2.000	PS6	100	0.450	0.596	Unclassified	450	0	0.450	Unclassified
2.001	PS3	150	0.596	0.662	Unclassified	250	0	0.596	Unclassified
1.002	S1	150	0.681	1.335	Unclassified	450	0	0.681	Unclassified
1.003	S2	150	1.335	1.440	Unclassified	1200	0	1.335	Unclassified
1.004	S3	150	0.981	1.440	Unclassified	450	0	1.440	Unclassified

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.004	S4	45.450	44.319	0.000	1500	0
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Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	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)	18.000	Storm Duration (mins)	30
Ratio R	0.359		

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Online Controls for Surface Network 1

Hydro-Brake® Optimum Manhole: S2, DS/PN: 1.003, Volume (m³): 1.7

Unit Reference	MD-SHE-0098-5000-1500-5000
Design Head (m)	1.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	45.165
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0	Kick-Flo®	0.878	3.9
Flush-Flo™	0.431	4.9	Mean Flow over Head Range	-	4.3

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	3.2	1.200	4.5	3.000	6.9	7.000	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.7
0.300	4.8	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.9	1.800	5.4	4.500	8.4	8.500	11.3
0.500	4.9	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.8	2.200	6.0	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.5	6.500	10.0		

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Storage Structures for Surface Network 1

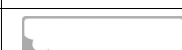
Cellular Storage Manhole: S2, DS/PN: 1.003

Invert Level (m) 45.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	10.5	10.5	0.900	0.0	20.9
0.800	10.5	20.9			

Manhole Headloss for Surface Network 1

PN	US/MH Name	US/MH Headloss
1.000	PS1	0.000
1.001	PS2	0.000
2.000	PS6	0.000
2.001	PS3	0.000
1.002	S1	0.000
1.003	S2	0.000
1.004	S3	0.000

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

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

Synthetic Rainfall Details

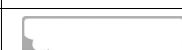
Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.359 Cv (Winter) 0.840

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

										Water Surcharged
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)
1.000	PS1	15 Winter	1	+0%	100/30 Winter				46.131	-0.069
1.001	PS2	15 Winter	1	+0%	100/15 Winter				45.975	-0.108
2.000	PS6	15 Winter	1	+0%	100/15 Summer				46.139	-0.061
2.001	PS3	15 Winter	1	+0%	100/15 Winter				45.952	-0.102
1.002	S1	15 Winter	1	+0%	100/15 Winter				45.854	-0.115
1.003	S2	15 Winter	1	+0%	30/15 Summer				45.293	-0.022
1.004	S3	15 Winter	1	+0%					45.088	-0.122

		Flooded		Pipe		Level	
PN	US/MH Name	Volume (m³)	Flow / Cap.	Flow (l/s)	Overflow (l/s)	Status	Exceeded
1.000	PS1	0.000	0.21		1.2	OK	
1.001	PS2	0.000	0.17		2.7	OK	
2.000	PS6	0.000	0.31		1.8	OK	
2.001	PS3	0.000	0.22		3.3	OK	
1.002	S1	0.000	0.12		6.1	OK	
1.003	S2	0.000	0.28		3.9	OK	
1.004	S3	0.000	0.08		3.9	OK	

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.359 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

									Water	Surcharged
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)
1.000	PS1	15 Winter	30	+0%	100/30 Winter				46.151	-0.049
1.001	PS2	15 Winter	30	+0%	100/15 Winter				46.007	-0.077
2.000	PS6	15 Winter	30	+0%	100/15 Summer				46.167	-0.033
2.001	PS3	15 Winter	30	+0%	100/15 Winter				45.989	-0.065
1.002	S1	15 Winter	30	+0%	100/15 Winter				45.879	-0.090
1.003	S2	30 Winter	30	+0%	30/15 Summer				45.605	0.290
1.004	S3	30 Winter	30	+0%					45.092	-0.118

			Flooded	Pipe		Level	
PN	US/MH Name	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded
1.000	PS1	0.000	0.52		2.9	OK	
1.001	PS2	0.000	0.48		7.6	OK	
2.000	PS6	0.000	0.76		4.3	OK	
2.001	PS3	0.000	0.60		9.0	OK	
1.002	S1	0.000	0.33		16.6	OK	
1.003	S2	0.000	0.34		4.9	SURCHARGED	
1.004	S3	0.000	0.10		4.9	OK	

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.359 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

										Water Surcharged
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)
1.000	PS1	30 Winter	100	+40%	100/30 Winter				46.481	0.281
1.001	PS2	30 Winter	100	+40%	100/15 Winter				46.473	0.390
2.000	PS6	30 Winter	100	+40%	100/15 Summer				46.485	0.285
2.001	PS3	30 Winter	100	+40%	100/15 Winter				46.471	0.417
1.002	S1	30 Winter	100	+40%	100/15 Winter				46.465	0.496
1.003	S2	30 Winter	100	+40%	30/15 Summer				46.459	1.144
1.004	S3	240 Summer	100	+40%					45.092	-0.118

		Flooded		Pipe			
PN	US/MH Name	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	PS1	0.000	0.75		4.3	FLOOD RISK	
1.001	PS2	0.000	0.67		10.7	FLOOD RISK	
2.000	PS6	0.000	1.09		6.3	FLOOD RISK	
2.001	PS3	0.000	0.84		12.7	FLOOD RISK	
1.002	S1	0.000	0.45		23.0	FLOOD RISK	
1.003	S2	0.000	0.34		4.9	FLOOD RISK	
1.004	S3	0.000	0.10		4.9	OK	