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Pickfords Wharf Clink Street London, SE1 9DG	A41 Roundabout SW Drainage Graven Hill, Bicester	
Date 30/11/2021 11:26 File WIE11386-A41-92-CAL - A...	Designed by Karthi Palanniya... Checked by Darryl Pearson	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm






Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location GB 459550 219500 SP 59550 19500	
Data Type	Catchment
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	1.000
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500


Designed with Level Soffits

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)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	66.218	0.123	538.4	0.099	5.00	0.0	0.600		o	600	Pipe/Conduit	
S2.000	31.238	0.089	351.0	0.048	5.00	0.0	0.600		o	600	Pipe/Conduit	
S1.001	37.823	0.071	532.7	0.036	0.00	0.0	0.600		o	600	Pipe/Conduit	
S3.000	20.139	0.066	305.1	0.043	5.00	0.0	0.600		o	600	Pipe/Conduit	
S4.000	21.501	0.050	430.0	0.031	5.00	0.0	0.600		o	600	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)
S1.000	50.00	6.06	68.799	0.099	0.0	0.0	0.0	1.04	294.8	17.9
S2.000	50.00	5.40	68.765	0.048	0.0	0.0	0.0	1.29	365.9	8.7
S1.001	50.00	6.66	68.676	0.183	0.0	0.0	0.0	1.05	296.3	33.0
S3.000	50.00	5.24	68.800	0.043	0.0	0.0	0.0	1.39	392.7	7.8
S4.000	50.00	5.31	68.850	0.031	0.0	0.0	0.0	1.17	330.2	5.6

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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)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S4.001	31.078	0.066	470.9	0.062	0.00	0.0	0.600		o	600	Pipe/Conduit	
S3.001	68.465	0.129	530.7	0.017	0.00	0.0	0.600		o	600	Pipe/Conduit	
S5.000	45.620	0.105	434.5	0.061	5.00	0.0	0.600		o	600	Pipe/Conduit	
S1.002	5.808	0.012	484.0	0.036	0.00	0.0	0.600		o	600	Pipe/Conduit	
S6.000	41.898	0.089	470.8	0.047	5.00	0.0	0.600		o	600	Pipe/Conduit	
S7.000	55.030	0.285	193.1	0.055	5.00	0.0		0.045	3 \=/	225	1:3 Swale	
S8.000	35.075	0.185	189.6	0.034	5.00	0.0		0.045	3 \=/	225	1:3 Swale	
S7.001	21.376	0.847	25.2	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
S1.003	14.786	0.148	99.9	0.000	0.00	0.0	0.600		o	300	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)
S4.001	50.00	5.77	68.800	0.093	0.0	0.0	0.0	1.12	315.4	16.8
S3.001	50.00	6.86	68.734	0.153	0.0	0.0	0.0	1.05	296.9	27.6
S5.000	50.00	5.65	68.710	0.061	0.0	0.0	0.0	1.16	328.5	11.0
S1.002	50.00	6.95	68.605	0.433	0.0	0.0	0.0	1.10	311.1	78.2
S6.000	50.00	5.63	68.682	0.047	0.0	0.0	0.0	1.12	315.5	8.5
S7.000	50.00	7.94	70.100	0.055	0.0	0.0	0.0	0.31	31.6	9.9
S8.000	50.00	6.86	70.000	0.034	0.0	0.0	0.0	0.32	31.9	6.1
S7.001	50.00	8.05	69.740	0.089	0.0	0.0	0.0	3.14	222.1	16.1
S1.003	50.00	8.21	68.593	0.569	0.0	0.0	0.0	1.57	111.2	102.7

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	70.778	1.979	Open Manhole	1500	S1.000	68.799	600				
S5	71.125	2.360	Open Manhole	1500	S2.000	68.765	600				
S2	70.854	2.178	Open Manhole	1500	S1.001	68.676	600	S1.000	68.676	600	
								S2.000	68.676	600	
S6	71.031	2.231	Open Manhole	1500	S3.000	68.800	600				
S8	70.205	1.355	Open Manhole	1500	S4.000	68.850	600				
S9	70.447	1.647	Open Manhole	1500	S4.001	68.800	600	S4.000	68.800	600	
S7	70.712	1.978	Open Manhole	1500	S3.001	68.734	600	S3.000	68.734	600	
								S4.001	68.734	600	
S10	70.874	2.164	Open Manhole	1500	S5.000	68.710	600				
S3	70.805	2.200	Open Manhole	1500	S1.002	68.605	600	S1.001	68.605	600	
								S3.001	68.605	600	
								S5.000	68.605	600	
S11	70.896	2.214	Open Manhole	1500	S6.000	68.682	600				
SIC13	70.794	0.694	Open Manhole	600	S7.000	70.100	225				
SIC14	70.595	0.595	Open Manhole	600	S8.000	70.000	225				
SS12	70.669	0.929	Open Manhole	1200	S7.001	69.740	300	S7.000	69.815	225	
								S8.000	69.815	225	
S4	70.997	2.404	Open Manhole	1500	S1.003	68.593	300	S1.002	68.593	600	
								S6.000	68.593	600	
								S7.001	68.893	300	
SHW1	69.500	1.055	Open Manhole	0		OUTFALL		S1.003	68.445	300	300


MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	459604.722	220800.306	459604.722	220800.306	Required	
S5	459636.121	220709.657	459636.121	220709.657	Required	
S2	459633.786	220740.807	459633.786	220740.807	Required	
S6	459667.372	220695.832	459667.372	220695.832	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S8	459734.827	220684.550	459734.827	220684.550	Required	
S9	459717.226	220696.899	459717.226	220696.899	Required	
S7	459686.561	220701.946	459686.561	220701.946	Required	
S10	459632.586	220800.681	459632.586	220800.681	Required	
S3	459662.095	220765.890	459662.095	220765.890	Required	
S11	459698.909	220744.685	459698.909	220744.685	Required	
SIC13	459674.027	220719.300	459674.027	220719.300	Required	
SIC14	459680.643	220723.026	459680.643	220723.026	Required	
SS12	459671.959	220749.892	459671.959	220749.892	Required	
S4	459665.801	220770.362	459665.801	220770.362	Required	
SHW1	459660.889	220784.308			No Entry	

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)
S1.003	SHW1	69.500	68.445	67.850	0	0


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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.900	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 Storage Structures	2
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	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 459550 219500 SP 59550 19500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	No
Cv (Summer)	0.900
Cv (Winter)	0.840
Storm Duration (mins)	30

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Online Controls for Storm


Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 18.3

Unit Reference	MD-SHE-0254-3530-1000-3530
Design Head (m)	1.000
Design Flow (l/s)	35.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	254
Invert Level (m)	68.593
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	35.3
Flush-Flo™	0.401	35.3
Kick-Flo®	0.759	30.9
Mean Flow over Head Range	-	28.9

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	8.2	1.200	38.5	3.000	59.9	7.000	90.5
0.200	26.0	1.400	41.5	3.500	64.6	7.500	93.5
0.300	34.7	1.600	44.2	4.000	68.9	8.000	96.5
0.400	35.3	1.800	46.8	4.500	72.9	8.500	99.4
0.500	34.9	2.000	49.2	5.000	76.8	9.000	102.3
0.600	34.1	2.200	51.6	5.500	80.4	9.500	105.0
0.800	31.7	2.400	53.8	6.000	83.9		
1.000	35.3	2.600	55.9	6.500	87.2		

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Storage Structures for Storm

Swale Manhole: SIC13, DS/PN: S7.000


Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	55.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	1.00	Cap Volume Depth (m)	0.500
Invert Level (m)	70.100	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.6	Include Swale Volume	Yes

Swale Manhole: SIC14, DS/PN: S8.000

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	35.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	1.00	Cap Volume Depth (m)	0.500
Invert Level (m)	70.000	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.6	Include Swale Volume	Yes

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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 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 2
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 0.400
Region England and Wales Cv (Summer) 0.900
M5-60 (mm) 20.000 Cv (Winter) 0.900

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) 30
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	30	Summer	30	+0%				69.121
S2.000	S5	30	Summer	30	+0%				69.119
S1.001	S2	30	Summer	30	+0%				69.119
S3.000	S6	30	Summer	30	+0%				69.119
S4.000	S8	30	Summer	30	+0%				69.120
S4.001	S9	30	Summer	30	+0%				69.120
S3.001	S7	30	Summer	30	+0%				69.119
S5.000	S10	30	Summer	30	+0%				69.117
S1.002	S3	30	Summer	30	+0%				69.117
S6.000	S11	30	Summer	30	+0%				69.114
S7.000	SIC13	15	Summer	30	+0%				70.210
S8.000	SIC14	15	Summer	30	+0%				70.089
S7.001	SS12	15	Summer	30	+0%				69.816
S1.003	S4	30	Summer	30	+0%	30/15	Summer		69.114

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.278	0.000	0.12		32.1	OK	
S2.000	S5	-0.246	0.000	0.05		15.6	OK	

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

PN	US/MH Name	Surcharged Flooded		Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m ³)					
S1.001	S2	-0.157	0.000	0.11		26.6	OK	
S3.000	S6	-0.281	0.000	0.05		14.2	OK	
S4.000	S8	-0.330	0.000	0.04		10.4	OK	
S4.001	S9	-0.280	0.000	0.12		29.9	OK	
S3.001	S7	-0.215	0.000	0.13		34.3	OK	
S5.000	S10	-0.193	0.000	0.07		19.5	OK	
S1.002	S3	-0.088	0.000	0.14		30.6	OK	
S6.000	S11	-0.168	0.000	0.05		14.6	OK	
S7.000	SIC13	-0.584	0.000	0.01	6	17.4	OK	
S8.000	SIC14	-0.506	0.000	0.01	6	11.0	OK	
S7.001	SS12	-0.224	0.000	0.15		28.4	OK	
S1.003	S4	0.221	0.000	0.38		35.3	SURCHARGED	