

APPENDIX 7

GREENFIELD RUNOFF RATE

Calculated by: Rory Harris

Site name: site 3

Site location: wrexham industrial estate

Site coordinates

Latitude: 53.03743° N

Longitude: 2.93751° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference: 6487656

Date: 2018-11-02T15:35:31

Methodology

IH124

Site characteristics

Total site area (ha)	1.339
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Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	1	4
HOST class	---	---
SPR/SPRHOST	0.1	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm)	692	692
Hydrological region	9	9
Growth curve factor: 1 year	0.88	0.88
Growth curve factor: 30 year	1.78	1.78
Growth curve factor: 100 year	2.18	2.18

Notes:

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

Normally limiting discharge rates which are less than 2.0 l/s/ha are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite may be a requirement for disposal of surface water runoff.

Greenfield runoff rates

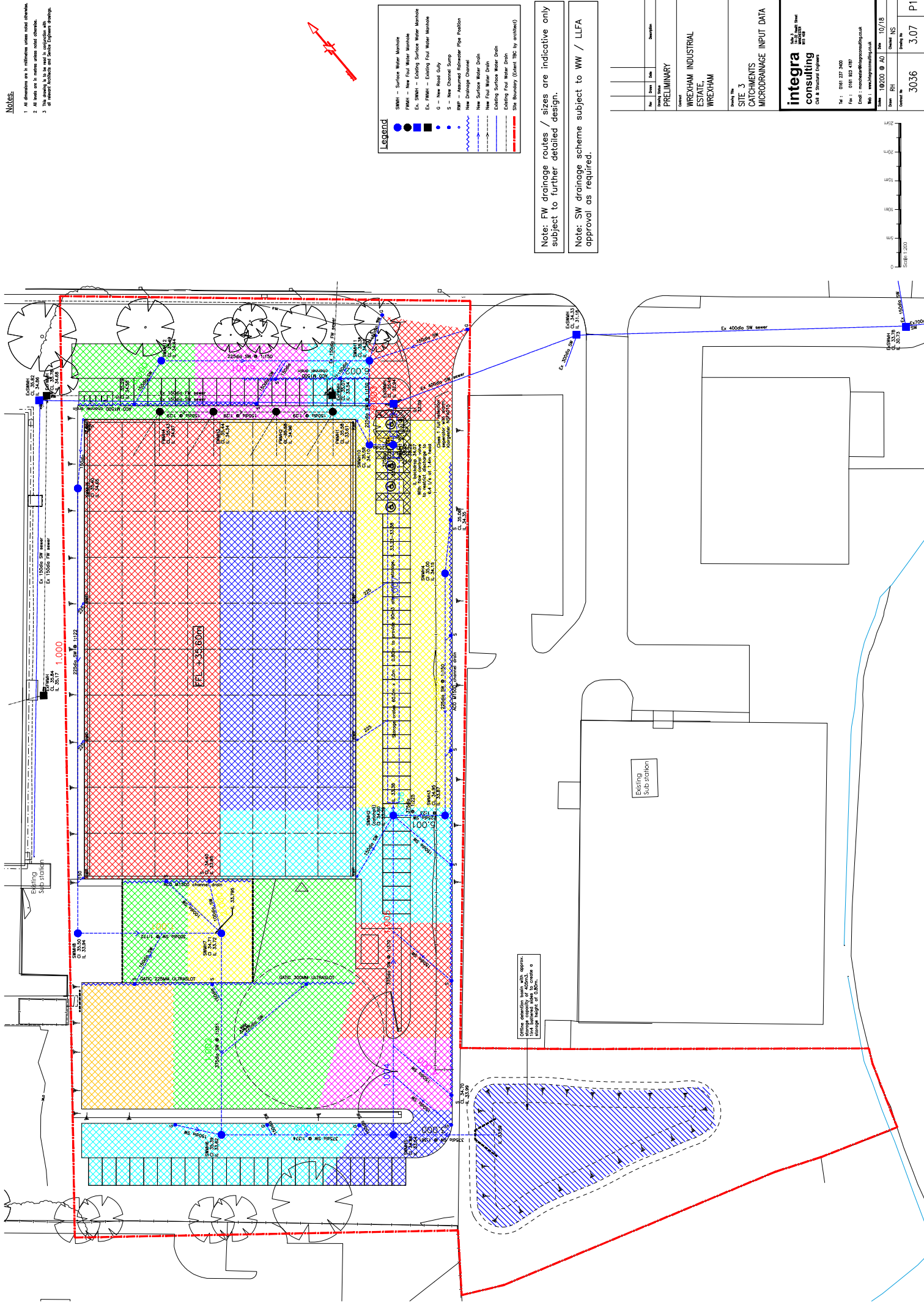
	Default	Edited
Qbar (l/s)	0.22	6.38
1 in 1 year (l/s)	0.2	5.61
1 in 30 years (l/s)	0.4	11.35
1 in 100 years (l/s)	0.48	13.9

APPENDIX 8

MICRO DRAINAGE ANALYSIS

Notes.

- 1 All dimensions are in millimetres unless noted otherwise.
2 All levels are in metres unless noted otherwise.
3 This drawing is to be read in conjunction with all relevant Architects and Service Engineers drawings.



Note: FW drainage routes / sizes are indicative only
subject to further detailed design.

Note: SW drainage scheme subject to WW / LLFA approval as required.

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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)	30	Add Flow / Climate Change (%)	0
M5-60 (mm)	18.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.335	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	20	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	400
PIMP (%)	100		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.427	4-8	0.439	8-12	0.049

Total Area Contributing (ha) = 0.915

Total Pipe Volume (m³) = 117.177

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)
1.000	77.406	0.635	121.9	0.189	5.00	0.0	0.600	o	225
1.001	24.981	0.145	172.3	0.035	0.00	0.0	0.600	o	300
2.000	9.343	0.155	60.3	0.020	5.00	0.0	0.600	o	100
1.002	35.075	0.100	350.8	0.115	0.00	0.0	0.600	o	375
1.003	29.913	0.080	373.9	0.048	0.00	0.0	0.600	o	375

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	20.00	6.09	34.650	0.189	0.0	0.0	0.0	1.18	47.0	10.2
1.001	20.00	6.44	33.940	0.224	0.0	0.0	0.0	1.19	84.5	12.1
2.000	20.00	5.16	33.950	0.020	0.0	0.0	0.0	0.99	7.8	1.1
1.002	20.00	7.05	33.720	0.359	0.0	0.0	0.0	0.96	106.2	19.4
1.003	20.00	7.58	33.620	0.407	0.0	0.0	0.0	0.93	102.8	22.0

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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)
6.003	14.630	0.100	146.3	0.024	0.00	0.0	0.600	o	225
6.004	4.160	0.030	138.7	0.038	0.00	0.0	0.600	o	225
1.009	7.164	0.090	79.6	0.000	0.00	0.0	0.600	o	300

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)
6.003	20.00	5.97	34.200	0.091	0.0	0.0	0.0	1.08	42.9	4.9
6.004	20.00	6.03	34.100	0.129	0.0	0.0	0.0	1.11	44.1	7.0
1.009	20.00	9.29	33.220	0.915	0.0	0.0	0.0	1.76	124.7	49.6

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<u>Manhole Schedules for Storm</u>										
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)
1	35.400	0.750	Open Manhole	450	1.000	34.650	225			
2	35.400	1.460	Open Manhole	1050	1.001	33.940	300	1.000	34.015	225
3	34.400	0.450	Open Manhole	150	2.000	33.950	100			
4	34.710	0.990	Open Manhole	1050	1.002	33.720	375	1.001	33.795	300
								2.000	33.795	100
5	35.390	1.770	Open Manhole	1050	1.003	33.620	375	1.002	33.620	375
6	34.390	0.800	Open Manhole	1050	3.000	33.590	375			
7	34.860	1.320	Open Manhole		1.004	33.540	375	1.003	33.540	375
								3.000	33.540	375
8	34.700	0.710	Open Manhole		4.000	33.990	150			
9	34.960	1.462	Junction	0	1.005	33.498	375	1.004	33.498	375
								4.000	33.723	150
10	35.000	0.850	Open Manhole	1050	5.000	34.150	225			
11	34.950	1.080	Open Manhole	1050	5.001	33.870	225	5.000	33.870	225
12	34.800	1.410	Open Manhole		1.006	33.390	375	1.005	33.390	375
								5.001	33.540	225
13	34.800	1.420	Junction		1.007	33.380	-1	1.006	33.380	375
14	35.450	2.220	Junction	0	1.008	33.230	375	1.007	33.230	-1
15	35.290	0.710	Open Manhole	150	6.000	34.580	150			
16	35.490	1.050	Open Manhole		6.001	34.440	225	6.000	34.515	150
17	35.290	0.710	Open Manhole		7.000	34.580	150			
18	35.380	1.160	Junction	0	6.002	34.220	225	6.001	34.220	225
								7.000	34.295	150
19	35.380	1.180	Open Manhole	1050	6.003	34.200	225	6.002	34.200	225
20	35.580	1.480	Open Manhole	1050	6.004	34.100	225	6.003	34.100	225
21	35.450	2.230	Open Manhole	1200	1.009	33.220	300	1.008	33.220	375
								6.004	34.070	225
	35.400	2.270	Open Manhole	0		OUTFALL		1.009	33.130	300
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<u>PIPELINE SCHEDULES for Storm</u> <u>Upstream Manhole</u>								
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	225	1	35.400	34.650	0.525	Open Manhole	450
1.001	o	300	2	35.400	33.940	1.160	Open Manhole	1050
2.000	o	100	3	34.400	33.950	0.350	Open Manhole	150
1.002	o	375	4	34.710	33.720	0.615	Open Manhole	1050
1.003	o	375	5	35.390	33.620	1.395	Open Manhole	1050
3.000	o	375	6	34.390	33.590	0.425	Open Manhole	1050
1.004	o	375	7	34.860	33.540	0.945	Open Manhole	1200
4.000	o	150	8	34.700	33.990	0.560	Open Manhole	150
1.005	o	375	9	34.960	33.498	1.087	Junction	
5.000	o	225	10	35.000	34.150	0.625	Open Manhole	1050
5.001	o	225	11	34.950	33.870	0.855	Open Manhole	1050
1.006	o	375	12	34.800	33.390	1.035	Open Manhole	1200
1.007	[]	-1	13	34.800	33.380	0.620	Junction	
<u>Downstream Manhole</u>								
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	77.406	121.9	2	35.400	34.015	1.160	Open Manhole	1050
1.001	24.981	172.3	4	34.710	33.795	0.615	Open Manhole	1050
2.000	9.343	60.3	4	34.710	33.795	0.815	Open Manhole	1050
1.002	35.075	350.8	5	35.390	33.620	1.395	Open Manhole	1050
1.003	29.913	373.9	7	34.860	33.540	0.945	Open Manhole	1200
3.000	18.054	361.1	7	34.860	33.540	0.945	Open Manhole	1200
1.004	15.494	368.9	9	34.960	33.498	1.087	Junction	
4.000	11.208	42.0	9	34.960	33.723	1.087	Junction	
1.005	40.080	371.1	12	34.800	33.390	1.035	Open Manhole	1200
5.000	42.123	150.4	11	34.950	33.870	0.855	Open Manhole	1050
5.001	7.497	22.7	12	34.800	33.540	1.035	Open Manhole	1200
1.006	3.000	300.0	13	34.800	33.380	1.045	Junction	
1.007	60.000	400.0	14	35.450	33.230	1.420	Junction	
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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)
1.008	o	375	14	35.450	33.230	1.845	Junction	
6.000	o	150	15	35.290	34.580	0.560	Open Manhole	150
6.001	o	225	16	35.490	34.440	0.825	Open Manhole	1050
7.000	o	150	17	35.290	34.580	0.560	Open Manhole	150
6.002	o	225	18	35.380	34.220	0.935	Junction	
6.003	o	225	19	35.380	34.200	0.955	Open Manhole	1050
6.004	o	225	20	35.580	34.100	1.255	Open Manhole	1050
1.009	o	300	21	35.450	33.220	1.930	Open Manhole	1200

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)
1.008	3.000	300.0	21	35.450	33.220	1.855	Open Manhole	1200
6.000	8.959	137.8	16	35.490	34.515	0.825	Open Manhole	1050
6.001	32.976	149.9	18	35.380	34.220	0.935	Junction	
7.000	3.638	12.8	18	35.380	34.295	0.935	Junction	
6.002	3.255	162.8	19	35.380	34.200	0.955	Open Manhole	1050
6.003	14.630	146.3	20	35.580	34.100	1.255	Open Manhole	1050
6.004	4.160	138.7	21	35.450	34.070	1.155	Open Manhole	1200
1.009	7.164	79.6		35.400	33.130	1.970	Open Manhole	0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.189	0.189	0.189
1.001	-	-	100	0.035	0.035	0.035
2.000	-	-	100	0.020	0.020	0.020
1.002	-	-	100	0.115	0.115	0.115
1.003	-	-	100	0.048	0.048	0.048
3.000	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.018	0.018	0.018
4.000	-	-	100	0.027	0.027	0.027
1.005	-	-	100	0.035	0.035	0.035
5.000	-	-	100	0.114	0.114	0.114
5.001	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.062	0.062	0.062
1.007	-	-	100	0.123	0.123	0.123
1.008	-	-	100	0.000	0.000	0.000
6.000	-	-	100	0.027	0.027	0.027
6.001	-	-	100	0.026	0.026	0.026
7.000	-	-	100	0.014	0.014	0.014
6.002	-	-	100	0.000	0.000	0.000
6.003	-	-	100	0.024	0.024	0.024
6.004	-	-	100	0.038	0.038	0.038
1.009	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.915	0.915	0.915

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)
1.009		35.400	33.130	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 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	Region	England and Wales
Return Period (years)	30	M5-60 (mm)	18.000

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Synthetic Rainfall Details

Ratio R 0.335 Cv (Winter) 0.840
Profile Type Summer Storm Duration (mins) 30
Cv (Summer) 0.750

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Online Controls for Storm

Depth/Flow Relationship Manhole: 21, DS/PN: 1.009, Volume (m³): 2.9

Invert Level (m) 33.220

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.033	0.5910	0.457	6.3890	0.882	5.6550	1.306	5.8180
0.065	2.0480	0.490	6.3900	0.914	5.4880	1.339	5.8860
0.098	3.6930	0.522	6.3810	0.947	5.2920	1.371	5.9520
0.131	4.9120	0.555	6.3640	0.980	5.0970	1.404	6.0180
0.163	5.3410	0.588	6.3390	1.012	5.1690	1.437	6.0830
0.196	5.6240	0.620	6.3070	1.045	5.2450	1.469	6.1470
0.229	5.8430	0.653	6.2680	1.078	5.3210	1.502	6.2100
0.261	6.0110	0.686	6.2210	1.110	5.3950	1.535	6.2730
0.294	6.1390	0.718	6.1640	1.143	5.4680	1.567	6.3350
0.327	6.2340	0.751	6.0950	1.176	5.5400	1.600	6.3960
0.359	6.3020	0.784	6.0130	1.208	5.6110	1.760	6.6880
0.392	6.3470	0.816	5.9140	1.241	5.6810	1.920	6.9660
0.424	6.3750	0.849	5.7960	1.273	5.7500		

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Storage Structures for Storm

Tank or Pond Manhole: 6, DS/PN: 3.000

Invert Level (m) 33.590

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	345.1	0.800	674.8

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
1.000	1	0.500
1.001	2	0.500
2.000	3	0.500
1.002	4	0.500
1.003	5	0.500
3.000	6	0.500
1.004	7	0.500
4.000	8	0.500
1.005	9	0.000
5.000	10	0.500
5.001	11	0.500
1.006	12	0.500
1.007	13	0.000
1.008	14	0.000
6.000	15	0.500
6.001	16	0.500
7.000	17	0.500
6.002	18	0.000
6.003	19	0.500
6.004	20	0.500
1.009	21	0.500

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<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>								
Margin for Flood Risk Warning (mm) 300.0								
Analysis Timestep 2.5 Second Increment (Extended)								
DTS Status ON								
DVD Status ON								
Inertia Status ON								
Profile(s) Summer and Winter								
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440								
Return Period(s) (years) 2								
Climate Change (%) 0								
PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act. Exc.	Lvl
1.000	15 Winter	2	0%					
1.001	15 Winter	2	0%					
2.000	15 Winter	2	0%					
1.002	15 Winter	2	0%					
1.003	15 Winter	2	0%					
3.000	240 Winter	2	0%					
1.004	120 Winter	2	0%					
4.000	15 Winter	2	0%					
1.005	120 Winter	2	0%					
5.000	15 Winter	2	0%					
5.001	15 Winter	2	0%					
1.006	120 Winter	2	0%	2/30 Winter				
1.007	120 Winter	2	0%					
1.008	120 Winter	2	0%	2/15 Summer				
6.000	15 Winter	2	0%					
6.001	15 Winter	2	0%					
7.000	15 Winter	2	0%					
6.002	15 Winter	2	0%					
6.003	15 Winter	2	0%					
6.004	15 Winter	2	0%					
1.009	120 Winter	2	0%	2/15 Summer				
PN	US/MH Name	Water Level (m)	Surch'd Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	34.780	-0.095	0.000	0.59	0.0	27.2	OK
1.001	2	34.075	-0.165	0.000	0.41	0.0	31.3	OK
2.000	3	33.996	-0.054	0.000	0.42	0.0	3.0	OK
1.002	4	33.910	-0.185	0.000	0.50	0.0	47.4	OK
1.003	5	33.825	-0.170	0.000	0.57	0.0	51.8	OK
3.000	6	33.716	-0.249	0.000	0.05	0.0	4.3	OK
1.004	7	33.808	-0.107	0.000	0.21	0.0	16.2	OK
4.000	8	34.031	-0.109	0.000	0.17	0.0	4.1	OK
1.005	9	33.817	-0.056	0.000	0.18	0.0	18.3	OK*
5.000	10	34.254	-0.121	0.000	0.42	0.0	16.9	OK
5.001	11	33.940	-0.155	0.000	0.21	0.0	16.9	OK
1.006	12	33.822	0.057	0.000	0.28	0.0	22.9	SURCHARGED
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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water	Surch'd Depth (m)	Flooded	Flow / Cap.	O'flow (l/s)	Pipe	Status
		Level (m)		Volume (m³)			Flow (l/s)	
1.007	13	33.821	-0.359	0.000	0.01	0.0	28.2	OK*
1.008	14	33.821	0.216	0.000	0.07	0.0	7.2	SURCHARGED*
6.000	15	34.637	-0.093	0.000	0.31	0.0	4.1	OK
6.001	16	34.506	-0.159	0.000	0.19	0.0	7.4	OK
7.000	17	34.605	-0.125	0.000	0.06	0.0	2.1	OK
6.002	18	34.307	-0.138	0.000	0.32	0.0	9.5	OK*
6.003	19	34.289	-0.136	0.000	0.33	0.0	12.5	OK
6.004	20	34.223	-0.102	0.000	0.57	0.0	17.2	OK
1.009	21	33.850	0.330	0.000	0.08	0.0	6.4	SURCHARGED

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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)	30	Add Flow / Climate Change (%)	0
M5-60 (mm)	18.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.335	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	20	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	400
PIMP (%)	100		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.427	4-8	0.439	8-12	0.049

Total Area Contributing (ha) = 0.915

Total Pipe Volume (m³) = 117.177

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)
1.000	77.406	0.635	121.9	0.189	5.00	0.0	0.600	o	225
1.001	24.981	0.145	172.3	0.035	0.00	0.0	0.600	o	300
2.000	9.343	0.155	60.3	0.020	5.00	0.0	0.600	o	100
1.002	35.075	0.100	350.8	0.115	0.00	0.0	0.600	o	375
1.003	29.913	0.080	373.9	0.048	0.00	0.0	0.600	o	375

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	20.00	6.09	34.650	0.189	0.0	0.0	0.0	1.18	47.0	10.2
1.001	20.00	6.44	33.940	0.224	0.0	0.0	0.0	1.19	84.5	12.1
2.000	20.00	5.16	33.950	0.020	0.0	0.0	0.0	0.99	7.8	1.1
1.002	20.00	7.05	33.720	0.359	0.0	0.0	0.0	0.96	106.2	19.4
1.003	20.00	7.58	33.620	0.407	0.0	0.0	0.0	0.93	102.8	22.0

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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)
6.003	14.630	0.100	146.3	0.024	0.00	0.0	0.600	o	225
6.004	4.160	0.030	138.7	0.038	0.00	0.0	0.600	o	225
1.009	7.164	0.090	79.6	0.000	0.00	0.0	0.600	o	300

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)
6.003	20.00	5.97	34.200	0.091	0.0	0.0	0.0	1.08	42.9	4.9
6.004	20.00	6.03	34.100	0.129	0.0	0.0	0.0	1.11	44.1	7.0
1.009	20.00	9.29	33.220	0.915	0.0	0.0	0.0	1.76	124.7	49.6