Drainage Design Report

Flow+

v8.0

Network	Surface Network 1
Filename	Z:\Ingent Jobs\2019\03 March\1903-330 Chancellors School Hatfield\Ingent\xp3D\Storm 19_03_2019.pfd
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Rainfall Methodology	FSR
Return Period (years)	2
Additional Flow (%)	0
FSR Region	England and Wales
M5-60 (mm)	20.000
Ratio-R	0.400
CV	0.750
Time of Entry (mins)	5.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	0.900
Include Intermediate Ground	
Enforce best practice design rules	x

	Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Node Type	Manhole Type	Diameter (mm)	Width (mm)	Easting (m)	Northing (m)	Depth (m)	Notes
	S1	0.027	5.00		126.367	Manhole	1 STANDARD	1200		525482.272	204715.615	1.050	
	S2	0.055	5.00		126.377	Manhole	1 STANDARD	1200		525499.668	204715.545	1.163	
	S3	0.058	5.00		126.200	Manhole	1 STANDARD	1200		525499.457	204684.431	1.245	
	S9	0.042	5.00		126.407	Manhole	1 STANDARD	1200		525458.035	204720.472	1.050	
	S4	0.000			126.033	Manhole	1 STANDARD	1200		525457.823	204684.571	1.433	
	S5	0.170	5.00		126.118	Manhole	1 STANDARD	1200		525450.137	204686.713	1.551	
	S6	0.000			125.878	Manhole	1 STANDARD	1200		525385.892	204687.088	1.574	
	S7	0.000			125.823	Manhole	1 STANDARD	1200		525381.651	204682.516	1.545	
	S8	0.000			125.467	Manhole	1 STANDARD	1200		525359.905	204669.688	1.293	
	S3A	0.106	5.00		126.200	Manhole	1 STANDARD	1200		525504.362	204684.431	1.050	

	Name	US Node	DS Node	Length (m)	ks (mm) / n	Velocity Equation	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)	Con Offset (m)	Min DS IL (m)	Lateral Area (ha)	Lateral Ins Point (%)	Lateral T of E (mins)
?	1.000	S1	S2	17.397	0.600	Colebrook-White	125.317	125.214	0.103	168.9	225	1 STANDARD	5.29	50.0					
	1.001	S2	S3	31.114	0.600	Colebrook-White	125.214	125.030	0.184	169.1	225	1 STANDARD	5.81	50.0					
	1.002	S3	S4	41.634	0.600	Colebrook-White	124.955	124.600	0.355	117.3	300	1 STANDARD	6.28	50.0					
	2.000	S9	S4	35.901	0.600	Colebrook-White	125.357	124.750	0.607	59.1	150	1 STANDARD	5.46	50.0					
	1.003	S4	S5	7.979	0.600	Colebrook-White	124.600	124.567	0.033	241.8	300	1 STANDARD	6.42	50.0					
	1.004	S5	S6	64.246	0.600	Colebrook-White	124.567	124.304	0.263	244.3	300	1 STANDARD	7.49	50.0					
	1.005	S6	S7	6.236	0.600	Colebrook-White	124.304	124.278	0.026	239.8	300	1 STANDARD	7.59	50.0					
	1.006	S7	S8	25.248	0.600	Colebrook-White	124.278	124.174	0.104	242.8	300	1 STANDARD	8.01	50.0					
?	3.000	S3A	S3	4.905	0.600	Colebrook-White	125.150	125.030	0.120	40.9	225	1 STANDARD	5.04	50.0					

	Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)	Notes
?	1.000	S1	S2	1.003	39.9	3.7	0.825	0.938	0.825	0.938	0.027	0.0	46	0.631	Upstream Depth is less than the specified minimum
	1.001	S2	S3	1.002	39.9	11.1	0.938	0.945	0.938	0.945	0.082	0.0	81	0.863	
	1.002	S3	S4	1.451	102.5	33.3	0.945	1.133	0.945	1.133	0.246	0.0	117	1.301	Fall increased to remove backdrop
	2.000	S9	S4	1.310	23.2	5.7	0.900	1.133	0.900	1.133	0.042	0.0	51	1.087	
	1.003	S4	S5	1.006	71.1	39.0	1.133	1.251	1.133	1.251	0.288	0.0	158	1.029	
	1.004	S5	S6	1.001	70.8	62.1	1.251	1.274	1.251	1.274	0.458	0.0	219	1.124	
	1.005	S6	S7	1.011	71.4	62.1	1.274	1.245	1.245	1.274	0.458	0.0	217	1.133	
	1.006	S7	S8	1.004	71.0	62.1	1.245	0.993	0.993	1.245	0.458	0.0	218	1.127	
?	3.000	S3A	S3	2.052	81.6	14.4	0.825	0.945	0.825	0.945	0.106	0.0	64	1.555	Upstream Depth is less than the specified minimum

Link Name	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)	US Node Name	Dia (mm)	Width (mm)	Node Type	MH Type	DS Node Name	Dia (mm)	Width (mm)	Node Type	MH Type
1.000	17.397	168.9	225	1 STANDARD	126.367	125.317	0.825	126.377	125.214	0.938	S1	1200		Manhole	1 STANDARD	S2	1200		Manhole	1 STANDARD
1.001	31.114	169.1	225	1 STANDARD	126.377	125.214	0.938	126.200	125.030	0.945	S2	1200		Manhole	1 STANDARD	S3	1200		Manhole	1 STANDARD
1.002	41.634	117.3	300	1 STANDARD	126.200	124.955	0.945	126.033	124.600	1.133	S3	1200		Manhole	1 STANDARD	S4	1200		Manhole	1 STANDARD
2.000	35.901	59.1	150	1 STANDARD	126.407	125.357	0.900	126.033	124.750	1.133	S9	1200		Manhole	1 STANDARD	S4	1200		Manhole	1 STANDARD
1.003	7.979	241.8	300	1 STANDARD	126.033	124.600	1.133	126.118	124.567	1.251	S4	1200		Manhole	1 STANDARD	S5	1200		Manhole	1 STANDARD
1.004	64.246	244.3	300	1 STANDARD	126.118	124.567	1.251	125.878	124.304	1.274	S5	1200		Manhole	1 STANDARD	S6	1200		Manhole	1 STANDARD
1.005	6.236	239.8	300	1 STANDARD	125.878	124.304	1.274	125.823	124.278	1.245	S6	1200		Manhole	1 STANDARD	S7	1200		Manhole	1 STANDARD
1.006	25.248	242.8	300	1 STANDARD	125.823	124.278	1.245	125.467	124.174	0.993	S7	1200		Manhole	1 STANDARD	S8	1200		Manhole	1 STANDARD
3.000	4.905	40.9	225	1 STANDARD	126.200	125.150	0.825	126.200	125.030	0.945	S3A	1200		Manhole	1 STANDARD	S3	1200		Manhole	1 STANDARD

Node Name	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Node Type	MH Type		Link ID	IL (m)	Dia (mm)	Link Type
S1	525482.272	204715.615	126.367	1.050	1200		Manhole	1 STANDARD					
									0	1.000	125.317	225	1 STANDARD
S2	525499.668	204715.545	126.377	1.163	1200		Manhole	1 STANDARD	1	1.000	125.214	225	1 STANDARD
									0	1.001	125.214	225	1 STANDARD
S3	525499.457	204684.431	126.200	1.245	1200		Manhole	1 STANDARD	1	3.000	125.030	225	1 STANDARD
									2	1.001	125.030	225	1 STANDARD
									0	1.002	124.955	300	1 STANDARD
S9	525458.035	204720.472	126.407	1.050	1200		Manhole	1 STANDARD					
									0	2.000	125.357	150	1 STANDARD
S4	525457.823	204684.571	126.033	1.433	1200		Manhole	1 STANDARD	1	2.000	124.750	150	1 STANDARD
									2	1.002	124.600	300	1 STANDARD
									0	1.003	124.600	300	1 STANDARD
S5	525450.137	204686.713	126.118	1.551	1200		Manhole	1 STANDARD	1	1.003	124.567	300	1 STANDARD
									0	1.004	124.567	300	1 STANDARD
S6	525385.892	204687.088	125.878	1.574	1200		Manhole	1 STANDARD	1	1.004	124.304	300	1 STANDARD
									0	1.005	124.304	300	1 STANDARD
S7	525381.651	204682.516	125.823	1.545	1200		Manhole	1 STANDARD	1	1.005	124.278	300	1 STANDARD

									0	1.006	124.278	300	1 STANDARD
S8	525359.905	204669.688	125.467	1.293	1200		Manhole	1 STANDARD	1	1.006	124.174	300	1 STANDARD
S3A	525504.362	204684.431	126.200	1.050	1200		Manhole	1 STANDARD					
									0	3.000	125.150	225	1 STANDARD

Rainfall Methodology	FSR		Return Period (years)	Climate Change (%)
FSR Region	England and Wales		100	40
M5-60 (mm)	20.000			
Ratio-R	0.400			
Summer CV	0.750			
Analysis Speed	Normal			
Skip Steady State	x			
Drain Down Time (mins)	240			
Additional Storage (m³/ha)	20.0			
Storm Durations (mins)	15			
	30			
	60			
	120			
	240			
	480			
	720			
	960			
	1440			
	2160			
Check Discharge Rate(s)	x			
1 year (l/s)				
30 year (l/s)				
100 year (l/s)				
Check Discharge Volume	x			
100 year 360 minute (m³)				

Hydro-Brake®

Node	Flap Valve	Online / Offline	Downstream Link	Replaces Downstream Link	Loop to Node	Invert Level (m)	Design Depth (m)	Design Flow (l/s)	Objective	Sump Available	Product Number	Min Outlet Diameter (m)	Min Node Diameter (mm)
S6	x	Online				124.304	1.700	5.0	(HE) Minimise upstream storage		CTL-SHE-0095-5000-1700-5000	0.150	1200

Depth/Area/Inf Area

Node	Base Inf Coefficient (m/hr)	Side Inf Coefficient (m/hr)	Safety Factor	Porosity	Invert Level (m)	Time to half empty (mins)	Depth (m)	Area (m²)	Inf. Area (m²)
S6	0.00000	0.00000	2.0	1.00	124.400		0.000	168.0	0.0
							0.200	168.0	0.0
							0.400	168.0	0.0
							0.600	168.0	0.0
							0.800	168.0	0.0
							1.000	168.0	0.0
							1.001	0.0	0.0
S3A	0.00000	0.00000	2.0	1.00	125.150	13	0.000	54.0	0.0
							0.200	54.0	0.0
							0.400	54.0	0.0
							0.401	0.0	0.0

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% 15 minute summer	488.233	138.153
100 year +40% 30 minute summer	320.551	90.705
100 year +40% 60 minute summer	214.603	56.713
100 year +40% 120 minute summer	129.587	34.246
100 year +40% 240 minute summer	75.977	20.078
100 year +40% 480 minute summer	43.979	11.622
100 year +40% 720 minute summer	31.433	8.424
100 year +40% 960 minute summer	25.432	6.697
100 year +40% 1440 minute summer	18.055	4.839
100 year +40% 2160 minute summer	12.630	3.490

Results for 100 year +40% Critical Storm Duration. Lowest mass balance: 98.97%

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	S1	21	126.204	0.887	14.5	1.4592	0.0000	FLOOD RISK	1.000	S2	12.6	0.537	0.317	0.6919	
30 minute summer	S2	21	126.197	0.983	40.4	2.0419	0.0000	FLOOD RISK	1.001	S3	37.0	1.069	0.928	1.2374	
30 minute summer	S3	21	126.119	1.164	75.2	2.4010	0.0000	FLOOD RISK	1.002	S4	75.8	1.077	0.739	2.9318	
30 minute summer	S9	21	126.127	0.770	22.6	1.4862	0.0000	FLOOD RISK	2.000	S4	18.2	1.176	0.785	0.6320	
30 minute summer	S4	21	125.916	1.316	88.9	1.4889	0.0000	FLOOD RISK	1.003	S5	90.0	1.278	1.265	0.5619	
240 minute summer	S5	244	125.864	1.297	64.2	4.3103	0.0000	FLOOD RISK	1.004	S6	62.4	0.886	0.881	4.5242	
240 minute summer	S6	244	125.863	1.559	62.4	169.9313	0.0000	FLOOD RISK	Hydro-Brake®	S7	4.8				
240 minute summer	S7	244	124.330	0.052	4.8	0.0591	0.0000	OK	1.006	S8	4.8	0.588	0.067	0.2051	113.0
240 minute summer	S8	244	124.226	0.052	4.8	0.0000	0.0000	OK							
30 minute summer	S3A	21	126.139	0.989	101.2	24.7427	0.0000	FLOOD RISK	3.000	S3	-44.1	1.659	-0.541	0.1951	