

**Site Evolution Ltd**  
**Proposed Housing Development,**  
**Kirkland Road,**  
**Ennerdale Bridge.**  
**Drainage Strategy and Calculations**



**Civil Engineers**  
**Structural Engineers**  
**Project Managers**

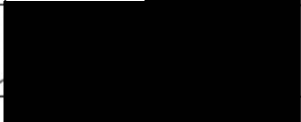
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Asher Associates Ltd

32 George Street

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	Name	Signature	Date
Prepared by	William Milne		20/1/21
Purpose of Issue	<b>Planning Application</b>		

20 January 2021

### Surface Water Drainage Design:

The proposed development site lies the Northern edge of Ennerdale bridge. The site contains three positive outlets to which individual catchments for overland flows can be attributed totalling 4.03ha. Outlets are located on Back Lane at the south western boundary (western catchment), beneath prospect house on the southern boundary (central catchment) and via a culvert beneath Kirkland Road (eastern catchment). The proposed development will bisect these catchments at the northern site boundary a filter drain backed by a 'Kested' hedge is to be installed intercept overland flows, direct them around the site to outfall at greenfield run-off rates. Remaining flows from the western catchment will be directed to the outfall at Prospect house (0.253ha), the remainder (central and easter catchments) will be discharged eastwards to the culvert beneath Kirkland Road (2.1 and 0.687ha correspondingly). It is anticipated that a section of Kirkland Roads also drains to the culvert as gullies can be seen upstream of the culvert. It is likely that the Kirkland Road from the lay-by at the crest of the hill above may also drain to Croasdale Beck via the culvert under the road and has been added to the contributing area for the culvert as 100% impermeable. This culvert is to be extended an incorporated into the drainage network, theoretical capacity will increase due to head/ flow relationship.

The development site has an area of 0.989ha and surface water falling on the development site will be treated and stored before being discharged to the site outlets at Qbar rates. Attenuation will be provided by use of cellular storage and treatment by the use of filter drains and porous paving in some driveways.

### Greenfield runoff rates:

Greenfield runoff rates were calculated using HR Wallingford's Greenfield runoff rate estimation for sites and the following values were obtained for an area of 0.99ha. Surface water discharge from the site is to be discharged at QBar = 13.6l/s.

**There are two proposed outfalls on the site and the discharge rate has been factored proportionally to the corresponding contributing areas. The main area plots 1,2, 5-9 and the access road will discharge via Network 1 to the culvert to the east at a rate of 9.5l/s. The remainder of the site will discharge via Network 2 to the culvert on the southern boundary at 3.1l/s.**

### Runoff rates for Overland flows from upstream catchments:

Runoff to be intercepted at the site boundary will be modelled at greenfield runoff rates for each corresponding return period to ensure that the proposed networks can accommodate the flows without risk of flooding downstream. These flows are added to the model as 'base flows' and will remain constant for each event.

#### **Western Catchment Rates:**

1 Year	3.03l/s
30 Years	5.92l/s
100 Years	2.08l/s
200 Years	8.25l/s

#### **Combined Central and Eastern catchment Rates:**

1 Year	38.38l/s
30 Years	65.22l/s
100years	79.8l/s
200 Years	90.9l/s

## Site contributing Areas:

Contributing Area	Plot Area (m <sup>2</sup> )	Impermeable Areas Within Plots (m <sup>2</sup> )	Soft Landscaping (25%) for Remainder (m <sup>2</sup> )	Impermeable Area (110%) (m <sup>2</sup> )	Total Areas for Modelling (m <sup>2</sup> )
Plot 1	877.50	269.74	151.94	296.71	448.65
Plot 2	911.80	211.64	175.04	232.80	407.84
Plot 3	664.00	247.50	104.13	272.25	376.38
Plot 4	884.30	277.20	151.78	304.92	456.70
Plot 5	958.14	339.00	154.79	372.90	527.69
Plot 6	940.60	339.60	150.25	373.56	523.81
Plot 7	854.71	332.50	130.55	365.75	496.30
Plot 8	1333.60	328.50	251.28	361.35	612.63
Plot 9	1148.60	318.80	207.45	350.68	558.13
Access Road	1326.00				1326.00
Total	9899.25				5734.12

**Calculations :** All calculations are as prescribed by the Wallingford Procedure – ‘Modified Rational Method’ and use the parameters set out in Sewers for Adoption 8<sup>th</sup> edition as the design criteria. The CASDeF application within the Microdrainage suite was used to generate various rainfall events with return periods of 1, 30 & 100 years.

The design criteria for the network is as follows:

Design Storm, pipes full	1 year
Design Storm, no flooding	30 year
Flood Risk Assessment	100 year
Minimum velocity, pipe full	1m/sec
Ks roughness value	0.6mm
Time of Entry	5 mins

Contributing Area classification:

Impervious areas	100%
Soft landscaping	25%

For all storm simulations the model was set to record a flood risk when manhole surcharge reached a level of 300mm below the cover level. A 40% uplift for climate change was added

to the design storms. A further 10% was added to the impervious areas contributing to the proposed networks to allow for urban creep.

Where possible, a minimum cover of 1200mm has been applied to pipework under roads and 900mm in open ground. Where cover is less than 1200mm below the road, concrete protection will be applied to pipework.

### Flow Controls:

Network 1 has two Hydrobrake flow controls, the first is located in the turning head and is used to mobilise storage in the upstream network. Another Hydrobrake is to be installed at the lowest point of the network to control the discharge to QBar.

Flows from Network 2 will be controlled by an orifice plate.

### Critical Storms:

The network was modelled in Microdrainage to ensure that no flooding is experienced for storms with a return period of up to 30 years and also to establish the critical storms with return periods of 1, 30, 100, and 200 years for use in the network simulation. The critical storms for the network were established during this process and are presented in the MicroDrainage calculations.

## Network Simulation Results:

The network including all manholes, pipes, storage features and flow control was simulated for the critical storm events shown in the Microdrainage calculations.

During the 1 year return period critical storms all flows are contained within the system. Surcharging is experienced one point in the system in Network 1 during the 1 year return period critical storm, this is insignificant as it is located next to the flow control.

During the 30 year return period critical storms all flows are contained within the system, some surcharging is evident in the manholes. No flooding is experienced at any point in the system during the 30 year return period critical storms.

During the 100 year return period critical storms no flooding occurs in either network.

Both networks were tested for exceedance up to 1000yrs + 40%. Flooding in Network 1 was noted from the 200 year simulation onwards at the lower end of the network where the flow control is. Flooding from this location will run downhill to a swale on the southern boundary and will be picked up by the culvert at prospect house. Network 2 shows very minor flooding at the flow control, which will be similarly picked up by the swale at the southern boundary.

## Microdrainage calculations – Network 1



**1 Year**

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for S NET -1.SWS

Pipe Sizes STORM 2 Manhole Sizes STORM 2






















FSR Rainfall Model - England and Wales

Return Period (years)	100	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	0.000
M5-60 (mm)	17.400	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.243	PIMP (%)	100	Min Vel for Auto Design only (m/s)	0.75
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	40	Min Slope for Optimisation (1:X)	200
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Network Design Table for S NET -1.SWS

« - Indicates pipe capacity < flow

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
S1.000	30.687	0.188	163.2	0.000	5.00	33.4	0.600	o	300	Pipe/Conduit	
S1.001	60.683	1.873	32.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	5.316	0.027	196.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	30.125	1.916	15.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	33.195	1.916	17.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	3.266	0.149	21.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	8.298	0.047	176.6	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	9.587	0.169	56.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	4.446	0.087	50.8	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.003	9.627	0.267	36.0	0.053	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.004	9.296	0.395	23.5	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.005	7.017	0.230	30.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	10.921	0.106	103.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	8.895	0.059	150.0	0.056	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.002	9.514	0.063	150.0	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	19.050	0.127	150.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.004	9.390	0.063	150.0	0.094	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	13.745	0.092	150.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.007	33.661	1.426	23.6	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.008	3.947	0.020	197.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	8.144	0.054	150.8	0.089	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)
S1.000	50.00	5.42	114.101	0.000	33.4	0.0	13.4	1.23	86.8	46.8
S1.001	50.00	5.78	113.913	0.000	33.4	0.0	13.4	2.77	195.9	46.8
S1.002	50.00	5.86	112.065	0.000	33.4	0.0	13.4	1.12	79.0	46.8
S1.003	50.00	5.99	112.038	0.000	33.4	0.0	13.4	3.98	281.6	46.8
S1.004	50.00	6.13	110.123	0.000	33.4	0.0	13.4	3.79	268.2	46.8
S1.005	50.00	6.15	108.207	0.000	33.4	0.0	13.4	3.37	238.4	46.8
S2.000	50.00	5.18	110.942	0.053	0.0	0.0	2.9	0.75	13.3	10.0
S2.001	50.00	5.30	110.895	0.053	0.0	0.0	2.9	1.34	23.6	10.0
S2.002	50.00	5.36	110.726	0.060	0.0	0.0	3.2	1.41	25.0	11.3
S2.003	50.00	5.45	110.639	0.113	0.0	0.0	6.1	1.68	29.7	21.3
S2.004	50.00	5.53	110.371	0.123	0.0	0.0	6.7	2.09	36.9	23.4
S2.005	50.00	5.57	109.826	0.123	0.0	0.0	6.7	2.86	201.9	23.4
S3.000	50.00	5.18	110.144	0.010	0.0	0.0	0.5	0.99	17.5	1.9
S3.001	50.00	5.37	110.038	0.066	0.0	0.0	3.6	0.82	14.5	12.5
S3.002	50.00	5.51	109.904	0.127	0.0	0.0	6.9	1.07	42.4	24.1
S3.003	50.00	5.81	109.840	0.143	0.0	0.0	7.7	1.07	42.4	27.1
S3.004	50.00	5.93	109.638	0.237	0.0	0.0	12.8	1.28	90.6	44.9
S2.006	50.00	6.11	109.576	0.374	0.0	0.0	20.3	1.28	90.6	70.9
S2.007	50.00	6.29	109.484	0.415	0.0	0.0	22.5	3.25	229.7	78.7
S2.008	50.00	6.34	108.078	0.415	0.0	0.0	22.5	1.12	78.9	78.7
S1.006	50.00	6.45	108.058	0.504	33.4	0.0	40.7	1.28	90.3«	142.3

Free Flowing Outfall Details for S NET -1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D, L (mm)	W (mm)
S1.006	S8 (HW)	109.000	108.004	18.000	0	0

Online Controls for S NET -1.SWS

Hydro-Brake® Optimum Manhole: S16, DS/PN: S2.007, Volume (m³): 2.9

Unit Reference MD-SHE-0143-1100-1600-1100	Sump Available	Yes
Design Head (m) 1.600	Diameter (mm)	143
Design Flow (l/s) 11.0	Invert Level (m)	109.484
Flush-Flo™ Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	10.9	Kick-Flo®	0.995	8.8
Flush-Flo™	0.473	11.0	Mean Flow over Head Range	-	9.6

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.600	10.8	1.600	10.9	2.600	13.8	5.000	18.8	7.500	22.9
0.200	9.7	0.800	10.3	1.800	11.6	3.000	14.7	5.500	19.7	8.000	23.6
0.300	10.6	1.000	8.8	2.000	12.2	3.500	15.9	6.000	20.5	8.500	24.3
0.400	10.9	1.200	9.6	2.200	12.7	4.000	16.9	6.500	21.3	9.000	25.0
0.500	10.9	1.400	10.3	2.400	13.3	4.500	17.9	7.000	22.1	9.500	25.6

Hydro-Brake® Optimum Manhole: S17, DS/PN: S2.008, Volume (m³): 4.0

Unit Reference MD-SHE-0133-9500-1600-9500	Sump Available	Yes
Design Head (m) 1.600	Diameter (mm)	133
Design Flow (l/s) 9.5	Invert Level (m)	108.078
Flush-Flo™ Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	9.5	Kick-Flo®	0.980	7.5
Flush-Flo™	0.466	9.5	Mean Flow over Head Range	-	8.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	9.4	1.600	9.5	2.600	11.9	5.000	16.3	7.500	19.8
0.200	8.4	0.800	8.8	1.800	10.0	3.000	12.8	5.500	17.1	8.000	20.4
0.300	9.2	1.000	7.6	2.000	10.5	3.500	13.7	6.000	17.8	8.500	21.0
0.400	9.4	1.200	8.3	2.200	11.0	4.000	14.7	6.500	18.5	9.000	21.6
0.500	9.5	1.400	8.9	2.400	11.5	4.500	15.5	7.000	19.1	9.500	22.2

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Ennerdale Bridge  
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Date 20/01/2021  
File S NET 1A-2MDX.MDX

Designed by WAM  
Checked by WAM

XP Solutions

Network 2020.1

Storage Structures for S NET -1.SWS

Cellular Storage Manhole: S11, DS/PN: S2.002

Invert Level (m) 110.823 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S13, DS/PN: S2.004

Invert Level (m) 110.468 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S20, DS/PN: S3.002

Invert Level (m) 109.912 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S21, DS/PN: S3.003

Invert Level (m) 109.864 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S15, DS/PN: S2.006

Invert Level (m) 109.652 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	80.0	0.0	0.800	80.0	0.0

Cellular Storage Manhole: S17, DS/PN: S2.008

Invert Level (m) 108.078 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

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Date 20/01/2021  
File S NET 1A-2MDX.MDX

Designed by WAM  
Checked by WAM

XP Solutions

Network 2020.1

Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.SWS

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor \* 10m<sup>3</sup>/ha Storage 2.000  
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800  
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0  
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.400 Cv (Summer) 0.750  
Region England and Wales Ratio R 0.246 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON  
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON  
DTS Status ON

Profile(s) Summer and Winter  
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880,  
4320, 5760, 7200, 8640, 10080  
Return Period(s) (years) 1  
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)	Surcharged Depth (m)	Flooded Volume (m <sup>3</sup> )	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1	15 Summer	1	+0%					114.237	-0.164	0.000	0.42			33.4
S1.001	S2	15 Summer	1	+0%					113.998	-0.215	0.000	0.18			33.4
S1.002	S4	15 Summer	1	+0%					112.238	-0.127	0.000	0.63			33.5
S1.003	S5	15 Summer	1	+0%					112.112	-0.226	0.000	0.13			33.8
S1.004	S5	15 Summer	1	+0%					110.200	-0.223	0.000	0.14			33.8
S1.005	S6	15 Summer	1	+0%					108.337	-0.170	0.000	0.35			33.4
S2.000	S9	15 Winter	1	+0%					111.015	-0.077	0.000	0.47			5.4
S2.001	S10	15 Winter	1	+0%					110.947	-0.098	0.000	0.26			5.4
S2.002	S11	15 Winter	1	+0%					110.785	-0.091	0.000	0.33		7	6.0
S2.003	S12	15 Winter	1	+0%					110.705	-0.084	0.000	0.40			10.6
S2.004	S13	15 Winter	1	+0%					110.433	-0.088	0.000	0.35		8	11.5
S2.005	S14	15 Winter	1	+0%					109.888	-0.238	0.000	0.10			11.5
S3.000	S18	15 Winter	1	+0%					110.169	-0.125	0.000	0.06			1.0
S3.001	S19	15 Winter	1	+0%					110.110	-0.078	0.000	0.46			5.9
S3.002	S20	30 Winter	1	+0%					109.982	-0.147	0.000	0.26		12	9.1
S3.003	S21	30 Winter	1	+0%					109.915	-0.150	0.000	0.24		12	9.3
S3.004	S22	60 Winter	1	+0%					109.789	-0.149	0.000	0.20			12.5
S2.006	S15	60 Winter	1	+0%					109.785	-0.091	0.000	0.13		21	9.7
S2.007	S16	60 Winter	1	+0%					109.776	-0.008	0.000	0.05			10.4
S2.008	S17	120 Winter	1	+0%	1/15 Summer				108.546	0.168	0.000	0.19		25	9.2
S1.006	S7	120 Winter	1	+0%					108.250	-0.108	0.000	0.74			45.3

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	OK	
S1.001	S2	OK	
S1.002	S4	OK	
S1.003	S5	OK	
S1.004	S5	OK	
S1.005	S6	OK	
S2.000	S9	OK	
S2.001	S10	OK	
S2.002	S11	OK	
S2.003	S12	OK	
S2.004	S13	OK	
S2.005	S14	OK	
S3.000	S18	OK	
S3.001	S19	OK	
S3.002	S20	OK	
S3.003	S21	OK	
S3.004	S22	OK	
S2.006	S15	OK	
S2.007	S16	OK	
S2.008	S17	SURCHARGED	
S1.006	S7	OK	

**30 Year**

32 George Street  
Dumfries  
DG1 1EH

6874  
Ennerdale Bridge  
30yr + 40%



Date 20/01/2021  
File S NET 1A-2MDX.MDX

Designed by WAM  
Checked by WAM

XP Solutions

Network 2020.1

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -1.SWS

< - Indicates pipe capacity < flow

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
S1.000	30.687	0.188	163.2	0.000	5.00	65.0	0.600	o	300	Pipe/Conduit	
S1.001	60.683	1.873	32.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	5.316	0.027	196.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	30.125	1.916	15.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	33.195	1.916	17.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	3.266	0.149	21.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	8.298	0.047	176.6	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	9.587	0.169	56.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	4.446	0.087	50.8	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.003	9.627	0.267	36.0	0.053	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.004	9.296	0.395	23.5	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.005	7.017	0.230	30.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	10.921	0.106	103.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	8.895	0.059	150.0	0.056	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.002	9.514	0.063	150.0	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	19.050	0.127	150.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.004	9.390	0.063	150.0	0.094	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	13.745	0.092	150.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.007	33.661	1.426	23.6	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.008	3.947	0.020	197.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	8.144	0.054	150.8	0.089	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)
S1.000	50.00	5.42	114.101	0.000	65.0	0.0	26.0	1.23	86.8<<	91.0
S1.001	50.00	5.78	113.913	0.000	65.0	0.0	26.0	2.77	195.9	91.0
S1.002	50.00	5.86	112.065	0.000	65.0	0.0	26.0	1.12	79.0<<	91.0
S1.003	50.00	5.99	112.038	0.000	65.0	0.0	26.0	3.98	281.6	91.0
S1.004	50.00	6.13	110.123	0.000	65.0	0.0	26.0	3.79	268.2	91.0
S1.005	50.00	6.15	108.207	0.000	65.0	0.0	26.0	3.37	238.4	91.0
S2.000	50.00	5.18	110.942	0.053	0.0	0.0	2.9	0.75	13.3	10.0
S2.001	50.00	5.30	110.895	0.053	0.0	0.0	2.9	1.34	23.6	10.0
S2.002	50.00	5.36	110.726	0.060	0.0	0.0	3.2	1.41	25.0	11.3
S2.003	50.00	5.45	110.639	0.113	0.0	0.0	6.1	1.68	29.7	21.3
S2.004	50.00	5.53	110.371	0.123	0.0	0.0	6.7	2.09	36.9	23.4
S2.005	50.00	5.57	109.826	0.123	0.0	0.0	6.7	2.86	201.9	23.4
S3.000	50.00	5.18	110.144	0.010	0.0	0.0	0.5	0.99	17.5	1.9
S3.001	50.00	5.37	110.038	0.066	0.0	0.0	3.6	0.82	14.5	12.5
S3.002	50.00	5.51	109.904	0.127	0.0	0.0	6.9	1.07	42.4	24.1
S3.003	50.00	5.81	109.840	0.143	0.0	0.0	7.7	1.07	42.4	27.1
S3.004	50.00	5.93	109.638	0.237	0.0	0.0	12.8	1.28	90.6	44.9
S2.006	50.00	6.11	109.576	0.374	0.0	0.0	20.3	1.28	90.6	70.9
S2.007	50.00	6.29	109.484	0.415	0.0	0.0	22.5	3.25	229.7	78.7
S2.008	50.00	6.34	108.078	0.415	0.0	0.0	22.5	1.12	78.9	78.7
S1.006	50.00	6.45	108.058	0.504	65.0	0.0	53.3	1.28	90.3<<	186.6

32 George Street  
Dumfries  
DG1 1EH

6874  
Ennerdale Bridge  
30yr + 40%



Date 20/01/2021  
File S NET 1A-2MDX.MDX

Designed by WAM  
Checked by WAM

XP Solutions

Network 2020.1

Online Controls for S NET -1.SWS

Hydro-Brake® Optimum Manhole: S16, DS/PN: S2.007, Volume (m³): 2.9

Unit Reference	MD-SHE-0143-1100-1600-1100	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	143
Design Flow (l/s)	11.0	Invert Level (m)	109.484
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	10.9	Kick-Flo®	0.995	8.8
Flush-Flo™	0.473	11.0	Mean Flow over Head Range	-	9.6

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.600	10.8	1.600	10.9	2.600	13.8	5.000	18.8	7.500	22.9
0.200	9.7	0.800	10.3	1.800	11.6	3.000	14.7	5.500	19.7	8.000	23.6
0.300	10.6	1.000	8.8	2.000	12.2	3.500	15.9	6.000	20.5	8.500	24.3
0.400	10.9	1.200	9.6	2.200	12.7	4.000	16.9	6.500	21.3	9.000	25.0
0.500	10.9	1.400	10.3	2.400	13.3	4.500	17.9	7.000	22.1	9.500	25.6

Hydro-Brake® Optimum Manhole: S17, DS/PN: S2.008, Volume (m³): 4.0

Unit Reference	MD-SHE-0133-9500-1600-9500	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	133
Design Flow (l/s)	9.5	Invert Level (m)	108.078
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	9.5	Kick-Flo®	0.980	7.5
Flush-Flo™	0.466	9.5	Mean Flow over Head Range	-	8.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	9.4	1.600	9.5	2.600	11.9	5.000	16.3	7.500	19.8
0.200	8.4	0.800	8.8	1.800	10.0	3.000	12.8	5.500	17.1	8.000	20.4
0.300	9.2	1.000	7.6	2.000	10.5	3.500	13.7	6.000	17.8	8.500	21.0
0.400	9.4	1.200	8.3	2.200	11.0	4.000	14.7	6.500	18.5	9.000	21.6
0.500	9.5	1.400	8.9	2.400	11.5	4.500	15.5	7.000	19.1	9.500	22.2



32 George Street  
Dumfries  
DG1 1EH

6874  
Ennerdale Bridge  
30yr + 40%



Date 20/01/2021  
File S NET 1A-2MDX.MDX

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Network 2020.1

Storage Structures for S NET -1.SWS

Cellular Storage Manhole: S11, DS/PN: S2.002

Invert Level (m) 110.823 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S13, DS/PN: S2.004

Invert Level (m) 110.468 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S20, DS/PN: S3.002

Invert Level (m) 109.912 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S21, DS/PN: S3.003

Invert Level (m) 109.864 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S15, DS/PN: S2.006

Invert Level (m) 109.652 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	80.0	0.0	0.800	80.0	0.0

Cellular Storage Manhole: S17, DS/PN: S2.008

Invert Level (m) 108.078 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

32 George Street  
Dumfries  
DG1 1EH

6874  
Ennerdale Bridge  
30yr + 40%



Date 20/01/2021  
File S NET 1A-2MDX.MDX

Designed by WAM  
Checked by WAM

XP Solutions

Network 2020.1

Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.SWS

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor \* 10m<sup>3</sup>/ha Storage 2.000  
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800  
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0  
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.400 Cv (Summer) 0.750  
Region England and Wales Ratio R 0.246 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON  
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON  
DTS Status ON

Profile(s) Summer and Winter  
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080  
Return Period(s) (years) 30  
Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m <sup>3</sup> )	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1	10080 Summer	30	+40%					114.309	-0.092	0.000	0.82			65.0
S1.001	S2	15 Summer	30	+40%					114.035	-0.178	0.000	0.35			65.0
S1.002	S4	15 Summer	30	+40%	30/15 Summer				112.398	0.033	0.000	1.23			65.6
S1.003	S5	15 Summer	30	+40%					112.144	-0.194	0.000	0.26			65.7
S1.004	S5	15 Summer	30	+40%					110.230	-0.193	0.000	0.26			65.0
S1.005	S6	30 Summer	30	+40%	30/15 Summer				108.570	0.063	0.000	0.68			65.6
S2.000	S9	15 Winter	30	+40%	30/15 Summer				111.161	0.069	0.000	1.58			18.3
S2.001	S10	15 Winter	30	+40%					111.005	-0.040	0.000	0.88			18.5
S2.002	S11	15 Winter	30	+40%	30/15 Summer				110.888	0.011	0.000	1.01		4	18.8
S2.003	S12	15 Winter	30	+40%	30/15 Summer				110.842	0.053	0.000	1.09			28.8
S2.004	S13	15 Winter	30	+40%					110.489	-0.032	0.000	0.97		5	31.6
S2.005	S14	180 Winter	30	+40%	30/15 Winter				110.478	0.352	0.000	0.11			13.6
S3.000	S18	180 Winter	30	+40%	30/15 Summer				110.495	0.201	0.000	0.07			1.1
S3.001	S19	180 Winter	30	+40%	30/15 Summer				110.494	0.306	0.000	0.57			7.3
S3.002	S20	180 Winter	30	+40%	30/15 Winter				110.489	0.361	0.000	0.32		102	11.3
S3.003	S21	180 Winter	30	+40%	30/15 Summer				110.486	0.421	0.000	0.27		109	10.3
S3.004	S22	180 Winter	30	+40%	30/15 Summer				110.480	0.542	0.000	0.26			16.3
S2.006	S15	180 Winter	30	+40%	30/15 Summer				110.477	0.601	0.000	0.15		132	11.1
S2.007	S16	180 Winter	30	+40%	30/15 Summer				110.483	0.699	0.000	0.05			10.8
S2.008	S17	600 Winter	30	+40%	30/15 Summer				109.113	0.735	0.000	0.19		34	9.4
S1.006	S7	30 Summer	30	+40%	30/15 Summer				108.438	0.080	0.000	1.56			95.8

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	OK	
S1.001	S2	OK	
S1.002	S4	SURCHARGED	
S1.003	S5	OK	
S1.004	S5	OK	
S1.005	S6	SURCHARGED	
S2.000	S9	SURCHARGED	
S2.001	S10	OK	
S2.002	S11	SURCHARGED	
S2.003	S12	SURCHARGED	
S2.004	S13	OK	
S2.005	S14	SURCHARGED	
S3.000	S18	SURCHARGED	
S3.001	S19	SURCHARGED	
S3.002	S20	SURCHARGED	
S3.003	S21	SURCHARGED	
S3.004	S22	SURCHARGED	
S2.006	S15	SURCHARGED	
S2.007	S16	SURCHARGED	
S2.008	S17	SURCHARGED	
S1.006	S7	SURCHARGED	

**100 Year**

32 George Street  
Dumfries  
DG1 1EH

6874  
Ennerdale Bridge  
100yr + 40%



Date 20/01/2021  
File S NET 1A-2MDX.MDX

Designed by WAM  
Checked by WAM

XP Solutions

Network 2020.1

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -1.SWS

< - Indicates pipe capacity < flow

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
S1.000	30.687	0.188	163.2	0.000	5.00	79.8	0.600	o	300	Pipe/Conduit	
S1.001	60.683	1.873	32.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	5.316	0.027	196.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	30.125	1.916	15.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	33.195	1.916	17.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	3.266	0.149	21.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	8.298	0.047	176.6	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	9.587	0.169	56.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	4.446	0.087	50.8	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.003	9.627	0.267	36.0	0.053	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.004	9.296	0.395	23.5	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.005	7.017	0.230	30.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	10.921	0.106	103.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	8.895	0.059	150.0	0.056	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.002	9.514	0.063	150.0	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	19.050	0.127	150.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.004	9.390	0.063	150.0	0.094	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	13.745	0.092	150.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.007	33.661	1.426	23.6	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.008	3.947	0.020	197.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	8.144	0.054	150.8	0.089	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)
S1.000	50.00	5.42	114.101	0.000	79.8	0.0	31.9	1.23	86.8<<	111.7
S1.001	50.00	5.78	113.913	0.000	79.8	0.0	31.9	2.77	195.9	111.7
S1.002	50.00	5.86	112.065	0.000	79.8	0.0	31.9	1.12	79.0<<	111.7
S1.003	50.00	5.99	112.038	0.000	79.8	0.0	31.9	3.98	281.6	111.7
S1.004	50.00	6.13	110.123	0.000	79.8	0.0	31.9	3.79	268.2	111.7
S1.005	50.00	6.15	108.207	0.000	79.8	0.0	31.9	3.37	238.4	111.7
S2.000	50.00	5.18	110.942	0.053	0.0	0.0	2.9	0.75	13.3	10.0
S2.001	50.00	5.30	110.895	0.053	0.0	0.0	2.9	1.34	23.6	10.0
S2.002	50.00	5.36	110.726	0.060	0.0	0.0	3.2	1.41	25.0	11.3
S2.003	50.00	5.45	110.639	0.113	0.0	0.0	6.1	1.68	29.7	21.3
S2.004	50.00	5.53	110.371	0.123	0.0	0.0	6.7	2.09	36.9	23.4
S2.005	50.00	5.57	109.826	0.123	0.0	0.0	6.7	2.86	201.9	23.4
S3.000	50.00	5.18	110.144	0.010	0.0	0.0	0.5	0.99	17.5	1.9
S3.001	50.00	5.37	110.038	0.066	0.0	0.0	3.6	0.82	14.5	12.5
S3.002	50.00	5.51	109.904	0.127	0.0	0.0	6.9	1.07	42.4	24.1
S3.003	50.00	5.81	109.840	0.143	0.0	0.0	7.7	1.07	42.4	27.1
S3.004	50.00	5.93	109.638	0.237	0.0	0.0	12.8	1.28	90.6	44.9
S2.006	50.00	6.11	109.576	0.374	0.0	0.0	20.3	1.28	90.6	70.9
S2.007	50.00	6.29	109.484	0.415	0.0	0.0	22.5	3.25	229.7	78.7
S2.008	50.00	6.34	108.078	0.415	0.0	0.0	22.5	1.12	78.9	78.7
S1.006	50.00	6.45	108.058	0.504	79.8	0.0	59.2	1.28	90.3<<	207.3

Free Flowing Outfall Details for S NET -1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D, L (mm)	W (mm)
S1.006	S8 (HW)	109.000	108.004	18.000	0	0

32 George Street  
Dumfries  
DG1 1EH

6874  
Ennerdale Bridge  
100yr + 40%



Date 20/01/2021  
File S NET 1A-2MDX.MDX

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Checked by WAM

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Network 2020.1

Online Controls for S NET -1.SWS

Hydro-Brake® Optimum Manhole: S16, DS/PN: S2.007, Volume (m³): 2.9

Unit Reference	MD-SHE-0143-1100-1600-1100	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	143
Design Flow (l/s)	11.0	Invert Level (m)	109.484
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	10.9	Kick-Flo®	0.995	8.8
Flush-Flo™	0.473	11.0	Mean Flow over Head Range	-	9.6

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.600	10.8	1.600	10.9	2.600	13.8	5.000	18.8	7.500	22.9
0.200	9.7	0.800	10.3	1.800	11.6	3.000	14.7	5.500	19.7	8.000	23.6
0.300	10.6	1.000	8.8	2.000	12.2	3.500	15.9	6.000	20.5	8.500	24.3
0.400	10.9	1.200	9.6	2.200	12.7	4.000	16.9	6.500	21.3	9.000	25.0
0.500	10.9	1.400	10.3	2.400	13.3	4.500	17.9	7.000	22.1	9.500	25.6

Hydro-Brake® Optimum Manhole: S17, DS/PN: S2.008, Volume (m³): 4.0

Unit Reference	MD-SHE-0133-9500-1600-9500	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	133
Design Flow (l/s)	9.5	Invert Level (m)	108.078
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	9.5	Kick-Flo®	0.980	7.5
Flush-Flo™	0.466	9.5	Mean Flow over Head Range	-	8.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	9.4	1.600	9.5	2.600	11.9	5.000	16.3	7.500	19.8
0.200	8.4	0.800	8.8	1.800	10.0	3.000	12.8	5.500	17.1	8.000	20.4
0.300	9.2	1.000	7.6	2.000	10.5	3.500	13.7	6.000	17.8	8.500	21.0
0.400	9.4	1.200	8.3	2.200	11.0	4.000	14.7	6.500	18.5	9.000	21.6
0.500	9.5	1.400	8.9	2.400	11.5	4.500	15.5	7.000	19.1	9.500	22.2

32 George Street  
Dumfries  
DG1 1EH

6874  
Ennerdale Bridge  
100yr + 40%



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Storage Structures for S NET -1.SWS

Cellular Storage Manhole: S11, DS/PN: S2.002

Invert Level (m) 110.823 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S13, DS/PN: S2.004

Invert Level (m) 110.468 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S20, DS/PN: S3.002

Invert Level (m) 109.912 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S21, DS/PN: S3.003

Invert Level (m) 109.864 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S15, DS/PN: S2.006

Invert Level (m) 109.652 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	80.0	0.0	0.800	80.0	0.0

Cellular Storage Manhole: S17, DS/PN: S2.008

Invert Level (m) 108.078 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

32 George Street  
Dumfries  
DG1 1EH

6874  
Ennerdale Bridge  
100yr + 40%



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Network 2020.1

Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.SWS

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor \* 10m<sup>3</sup>/ha Storage 2.000  
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800  
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0  
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.400 Cv (Summer) 0.750  
Region England and Wales Ratio R 0.246 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON  
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON  
DTS Status ON

Profile(s) Summer and Winter  
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080  
Return Period(s) (years) 100  
Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m <sup>3</sup> )	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1 1440	Summer	100	+40%					114.401	0.000	0.000	1.01		79.9
S1.001	S2 1440	Summer	100	+40%					114.050	-0.163	0.000	0.43		80.0
S1.002	S4 15	Summer	100	+40%	100/15	Summer			112.433	0.068	0.000	1.51		80.5
S1.003	S5 15	Summer	100	+40%					112.158	-0.180	0.000	0.32		80.9
S1.004	S5 15	Summer	100	+40%					110.245	-0.177	0.000	0.33		80.4
S1.005	S6 30	Summer	100	+40%	100/15	Summer			108.647	0.140	0.000	0.83		80.7
S2.000	S9 15	Winter	100	+40%	100/15	Summer			111.282	0.190	0.000	1.92		22.3
S2.001	S10 15	Winter	100	+40%	100/15	Summer			111.116	0.071	0.000	1.03		21.5
S2.002	S11 15	Winter	100	+40%	100/15	Summer			110.958	0.081	0.000	1.18	5	22.0
S2.003	S12 15	Winter	100	+40%	100/15	Summer			110.907	0.118	0.000	1.18		31.2
S2.004	S13 180	Winter	100	+40%	100/30	Summer			110.800	0.279	0.000	0.56	62	18.1
S2.005	S14 180	Winter	100	+40%	100/15	Summer			110.790	0.664	0.000	0.15		17.6
S3.000	S18 180	Winter	100	+40%	100/15	Summer			110.809	0.515	0.000	0.08		1.3
S3.001	S19 180	Winter	100	+40%	100/15	Summer			110.808	0.620	0.000	0.67		8.5
S3.002	S20 180	Winter	100	+40%	100/15	Summer			110.803	0.674	0.000	0.33	146	11.6
S3.003	S21 180	Winter	100	+40%	100/15	Summer			110.799	0.734	0.000	0.26	151	10.0
S3.004	S22 180	Winter	100	+40%	100/15	Summer			110.792	0.854	0.000	0.27		16.7
S2.006	S15 180	Winter	100	+40%	100/15	Summer			110.789	0.913	0.000	0.14	175	10.9
S2.007	S16 180	Winter	100	+40%	100/15	Summer			110.784	1.000	0.000	0.05		10.7
S2.008	S17 960	Winter	100	+40%	100/15	Summer			109.238	0.860	0.000	0.19	39	9.4
S1.006	S7 30	Summer	100	+40%	100/15	Summer			108.516	0.158	0.000	1.93		118.2

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	OK	
S1.001	S2	OK	
S1.002	S4	SURCHARGED	
S1.003	S5	OK	
S1.004	S5	OK	
S1.005	S6	SURCHARGED	
S2.000	S9	SURCHARGED	
S2.001	S10	SURCHARGED	
S2.002	S11	SURCHARGED	
S2.003	S12	SURCHARGED	
S2.004	S13	SURCHARGED	
S2.005	S14	SURCHARGED	
S3.000	S18	SURCHARGED	
S3.001	S19	SURCHARGED	
S3.002	S20	SURCHARGED	
S3.003	S21	SURCHARGED	
S3.004	S22	SURCHARGED	
S2.006	S15	SURCHARGED	
S2.007	S16	SURCHARGED	
S2.008	S17	SURCHARGED	
S1.006	S7	SURCHARGED	

**200 Year**



**1000 Year**

32 George Street  
Dumfries  
DG1 1EH

6874  
Ennerdale Bridge  
1000yr + 40%



Date 20/01/2021  
File S NET 1A-2MDX.MDX

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Network 2020.1

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -1.SWS

< - Indicates pipe capacity < flow

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
S1.000	30.687	0.188	163.2	0.000	5.00	33.4	0.600	o	300	Pipe/Conduit	
S1.001	60.683	1.873	32.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	5.316	0.027	196.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	30.125	1.916	15.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	33.195	1.916	17.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	3.266	0.149	21.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	8.298	0.047	176.6	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	9.587	0.169	56.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	4.446	0.087	50.8	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.003	9.627	0.267	36.0	0.053	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.004	9.296	0.395	23.5	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.005	7.017	0.230	30.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	10.921	0.106	103.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	8.895	0.059	150.0	0.056	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.002	9.514	0.063	150.0	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	19.050	0.127	150.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.004	9.390	0.063	150.0	0.094	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	13.745	0.092	150.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.007	33.661	1.426	23.6	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.008	3.947	0.020	197.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	8.144	0.054	150.8	0.089	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)
S1.000	50.00	5.42	114.101	0.000	33.4	0.0	13.4	1.23	86.8	46.8
S1.001	50.00	5.78	113.913	0.000	33.4	0.0	13.4	2.77	195.9	46.8
S1.002	50.00	5.86	112.065	0.000	33.4	0.0	13.4	1.12	79.0	46.8
S1.003	50.00	5.99	112.038	0.000	33.4	0.0	13.4	3.98	281.6	46.8
S1.004	50.00	6.13	110.123	0.000	33.4	0.0	13.4	3.79	268.2	46.8
S1.005	50.00	6.15	108.207	0.000	33.4	0.0	13.4	3.37	238.4	46.8
S2.000	50.00	5.18	110.942	0.053	0.0	0.0	2.9	0.75	13.3	10.0
S2.001	50.00	5.30	110.895	0.053	0.0	0.0	2.9	1.34	23.6	10.0
S2.002	50.00	5.36	110.726	0.060	0.0	0.0	3.2	1.41	25.0	11.3
S2.003	50.00	5.45	110.639	0.113	0.0	0.0	6.1	1.68	29.7	21.3
S2.004	50.00	5.53	110.371	0.123	0.0	0.0	6.7	2.09	36.9	23.4
S2.005	50.00	5.57	109.826	0.123	0.0	0.0	6.7	2.86	201.9	23.4
S3.000	50.00	5.18	110.144	0.010	0.0	0.0	0.5	0.99	17.5	1.9
S3.001	50.00	5.37	110.038	0.066	0.0	0.0	3.6	0.82	14.5	12.5
S3.002	50.00	5.51	109.904	0.127	0.0	0.0	6.9	1.07	42.4	24.1
S3.003	50.00	5.81	109.840	0.143	0.0	0.0	7.7	1.07	42.4	27.1
S3.004	50.00	5.93	109.638	0.237	0.0	0.0	12.8	1.28	90.6	44.9
S2.006	50.00	6.11	109.576	0.374	0.0	0.0	20.3	1.28	90.6	70.9
S2.007	50.00	6.29	109.484	0.415	0.0	0.0	22.5	3.25	229.7	78.7
S2.008	50.00	6.34	108.078	0.415	0.0	0.0	22.5	1.12	78.9	78.7
S1.006	50.00	6.45	108.058	0.504	33.4	0.0	40.7	1.28	90.3<	142.3

Free Flowing Outfall Details for S NET -1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D, L (mm)	W (mm)
S1.006	S8 (HW)	109.000	108.004	18.000	0	0

32 George Street  
Dumfries  
DG1 1EH

6874  
Ennerdale Bridge  
1000yr + 40%



Date 20/01/2021  
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Online Controls for S NET -1.SWS

Hydro-Brake® Optimum Manhole: S16, DS/PN: S2.007, Volume (m³): 2.9

Unit Reference	MD-SHE-0143-1100-1600-1100	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	143
Design Flow (l/s)	11.0	Invert Level (m)	109.484
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	10.9	Kick-Flo®	0.995	8.8
Flush-Flo™	0.473	11.0	Mean Flow over Head Range	-	9.6

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.600	10.8	1.600	10.9	2.600	13.8	5.000	18.8	7.500	22.9
0.200	9.7	0.800	10.3	1.800	11.6	3.000	14.7	5.500	19.7	8.000	23.6
0.300	10.6	1.000	8.8	2.000	12.2	3.500	15.9	6.000	20.5	8.500	24.3
0.400	10.9	1.200	9.6	2.200	12.7	4.000	16.9	6.500	21.3	9.000	25.0
0.500	10.9	1.400	10.3	2.400	13.3	4.500	17.9	7.000	22.1	9.500	25.6

Hydro-Brake® Optimum Manhole: S17, DS/PN: S2.008, Volume (m³): 4.0

Unit Reference	MD-SHE-0133-9500-1600-9500	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	133
Design Flow (l/s)	9.5	Invert Level (m)	108.078
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	9.5	Kick-Flo®	0.980	7.5
Flush-Flo™	0.466	9.5	Mean Flow over Head Range	-	8.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	9.4	1.600	9.5	2.600	11.9	5.000	16.3	7.500	19.8
0.200	8.4	0.800	8.8	1.800	10.0	3.000	12.8	5.500	17.1	8.000	20.4
0.300	9.2	1.000	7.6	2.000	10.5	3.500	13.7	6.000	17.8	8.500	21.0
0.400	9.4	1.200	8.3	2.200	11.0	4.000	14.7	6.500	18.5	9.000	21.6
0.500	9.5	1.400	8.9	2.400	11.5	4.500	15.5	7.000	19.1	9.500	22.2

32 George Street  
 Dumfries  
 DG1 1EH

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 Ennerdale Bridge  
 1000yr + 40%



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Storage Structures for S NET -1.SWS

Cellular Storage Manhole: S11, DS/PN: S2.002

Invert Level (m) 110.823 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
 Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S13, DS/PN: S2.004

Invert Level (m) 110.468 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
 Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S20, DS/PN: S3.002

Invert Level (m) 109.912 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
 Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S21, DS/PN: S3.003

Invert Level (m) 109.864 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
 Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S15, DS/PN: S2.006

Invert Level (m) 109.652 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
 Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	80.0	0.0	0.800	80.0	0.0

Cellular Storage Manhole: S17, DS/PN: S2.008

Invert Level (m) 108.078 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
 Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

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Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.SWS

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor \* 10m<sup>3</sup>/ha Storage 2.000  
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800  
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0  
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.400 Cv (Summer) 0.750  
Region England and Wales Ratio R 0.246 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON  
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON  
DTS Status ON

Profile(s) Summer and Winter  
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880,  
4320, 5760, 7200, 8640, 10080  
Return Period(s) (years) 1000  
Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m <sup>3</sup> )	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)
S1.000	S1	10080 Summer	1000	+40%					114.237	-0.164	0.000	0.42		
S1.001	S2	15 Summer	1000	+40%					113.998	-0.215	0.000	0.18		
S1.002	S4	15 Summer	1000	+40%					112.238	-0.127	0.000	0.63		
S1.003	S5	15 Summer	1000	+40%					112.112	-0.226	0.000	0.13		
S1.004	S5	15 Summer	1000	+40%					110.200	-0.223	0.000	0.14		
S1.005	S6	30 Summer	1000	+40%	1000/15 Summer				108.559	0.052	0.000	0.38		
S2.000	S9	15 Winter	1000	+40%	1000/15 Summer				111.897	0.805	0.000	2.85		
S2.001	S10	15 Winter	1000	+40%	1000/15 Summer				111.525	0.480	0.000	1.52		
S2.002	S11	180 Winter	1000	+40%	1000/15 Summer				111.445	0.569	0.000	0.68		182
S2.003	S12	180 Winter	1000	+40%	1000/15 Summer				111.438	0.650	0.000	0.89		
S2.004	S13	180 Winter	1000	+40%	1000/15 Summer				111.415	0.894	0.000	0.66		
S2.005	S14	180 Winter	1000	+40%	1000/15 Summer				111.391	1.265	0.000	0.17		
S3.000	S18	180 Winter	1000	+40%	1000/15 Summer				111.463	1.169	0.000	0.11		
S3.001	S19	180 Winter	1000	+40%	1000/15 Summer	1000/180 Winter			111.459	1.271	0.369	1.13		
S3.002	S20	180 Winter	1000	+40%	1000/15 Summer				111.443	1.315	0.000	0.41		
S3.003	S21	180 Winter	1000	+40%	1000/15 Summer				111.430	1.364	0.000	0.35		
S3.004	S22	180 Winter	1000	+40%	1000/15 Summer				111.410	1.472	0.000	0.41		
S2.006	S15	180 Winter	1000	+40%	1000/15 Summer				111.387	1.511	0.000	0.34		
S2.007	S16	240 Winter	1000	+40%	1000/15 Summer	1000/120 Winter			111.334	1.550	46.750	0.06		
S2.008	S17	720 Winter	1000	+40%	1000/15 Summer	1000/180 Summer			109.619	1.241	41.253	0.19		110
S1.006	S7	30 Summer	1000	+40%	1000/15 Summer				108.446	0.088	0.000	1.58		

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	33.4	OK	
S1.001	S2	33.4	OK	
S1.002	S4	33.5	OK	
S1.003	S5	33.8	OK	
S1.004	S5	33.8	OK	
S1.005	S6	36.4	SURCHARGED	
S2.000	S9	33.1	SURCHARGED	
S2.001	S10	31.9	SURCHARGED	
S2.002	S11	12.6	SURCHARGED	
S2.003	S12	23.4	SURCHARGED	
S2.004	S13	21.3	SURCHARGED	
S2.005	S14	20.7	FLOOD RISK	
S3.000	S18	1.8	FLOOD RISK	
S3.001	S19	14.4	FLOOD	1
S3.002	S20	14.4	FLOOD RISK	
S3.003	S21	13.4	SURCHARGED	
S3.004	S22	25.5	FLOOD RISK	
S2.006	S15	25.2	SURCHARGED	
S2.007	S16	11.7	FLOOD	10
S2.008	S17	9.4	FLOOD	17
S1.006	S7	97.2	SURCHARGED	

## Microdrainage calculations – Network 2

32 George Street  
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Ennerdale Bridge  
200yr + 40%



Date 20/01/2021  
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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -1.SWS

< - Indicates pipe capacity < flow

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
S1.000	30.687	0.188	163.2	0.000	5.00	33.4	0.600	o	300	Pipe/Conduit	
S1.001	60.683	1.873	32.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	5.316	0.027	196.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	30.125	1.916	15.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	33.195	1.916	17.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	3.266	0.149	21.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	8.298	0.047	176.6	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	9.587	0.169	56.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	4.446	0.087	50.8	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.003	9.627	0.267	36.0	0.053	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.004	9.296	0.395	23.5	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.005	7.017	0.230	30.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	10.921	0.106	103.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	8.895	0.059	150.0	0.056	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.002	9.514	0.063	150.0	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	19.050	0.127	150.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.004	9.390	0.063	150.0	0.094	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	13.745	0.092	150.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.007	33.661	1.426	23.6	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.008	3.947	0.020	197.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	8.144	0.054	150.8	0.089	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)
S1.000	50.00	5.42	114.101	0.000	33.4	0.0	13.4	1.23	86.8	46.8
S1.001	50.00	5.78	113.913	0.000	33.4	0.0	13.4	2.77	195.9	46.8
S1.002	50.00	5.86	112.065	0.000	33.4	0.0	13.4	1.12	79.0	46.8
S1.003	50.00	5.99	112.038	0.000	33.4	0.0	13.4	3.98	281.6	46.8
S1.004	50.00	6.13	110.123	0.000	33.4	0.0	13.4	3.79	268.2	46.8
S1.005	50.00	6.15	108.207	0.000	33.4	0.0	13.4	3.37	238.4	46.8
S2.000	50.00	5.18	110.942	0.053	0.0	0.0	2.9	0.75	13.3	10.0
S2.001	50.00	5.30	110.895	0.053	0.0	0.0	2.9	1.34	23.6	10.0
S2.002	50.00	5.36	110.726	0.060	0.0	0.0	3.2	1.41	25.0	11.3
S2.003	50.00	5.45	110.639	0.113	0.0	0.0	6.1	1.68	29.7	21.3
S2.004	50.00	5.53	110.371	0.123	0.0	0.0	6.7	2.09	36.9	23.4
S2.005	50.00	5.57	109.826	0.123	0.0	0.0	6.7	2.86	201.9	23.4
S3.000	50.00	5.18	110.144	0.010	0.0	0.0	0.5	0.99	17.5	1.9
S3.001	50.00	5.37	110.038	0.066	0.0	0.0	3.6	0.82	14.5	12.5
S3.002	50.00	5.51	109.904	0.127	0.0	0.0	6.9	1.07	42.4	24.1
S3.003	50.00	5.81	109.840	0.143	0.0	0.0	7.7	1.07	42.4	27.1
S3.004	50.00	5.93	109.638	0.237	0.0	0.0	12.8	1.28	90.6	44.9
S2.006	50.00	6.11	109.576	0.374	0.0	0.0	20.3	1.28	90.6	70.9
S2.007	50.00	6.29	109.484	0.415	0.0	0.0	22.5	3.25	229.7	78.7
S2.008	50.00	6.34	108.078	0.415	0.0	0.0	22.5	1.12	78.9	78.7
S1.006	50.00	6.45	108.058	0.504	33.4	0.0	40.7	1.28	90.3<	142.3

Free Flowing Outfall Details for S NET -1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D, L (mm)	W (mm)
S1.006	S8 (HW)	109.000	108.004	18.000	0	0

32 George Street  
Dumfries  
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Ennerdale Bridge  
200yr + 40%



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Online Controls for S NET -1.SWS

Hydro-Brake® Optimum Manhole: S16, DS/PN: S2.007, Volume (m³): 2.9

Unit Reference	MD-SHE-0143-1100-1600-1100	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	143
Design Flow (l/s)	11.0	Invert Level (m)	109.484
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	10.9	Kick-Flo®	0.995	8.8
Flush-Flo™	0.473	11.0	Mean Flow over Head Range	-	9.6

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.600	10.8	1.600	10.9	2.600	13.8	5.000	18.8	7.500	22.9
0.200	9.7	0.800	10.3	1.800	11.6	3.000	14.7	5.500	19.7	8.000	23.6
0.300	10.6	1.000	8.8	2.000	12.2	3.500	15.9	6.000	20.5	8.500	24.3
0.400	10.9	1.200	9.6	2.200	12.7	4.000	16.9	6.500	21.3	9.000	25.0
0.500	10.9	1.400	10.3	2.400	13.3	4.500	17.9	7.000	22.1	9.500	25.6

Hydro-Brake® Optimum Manhole: S17, DS/PN: S2.008, Volume (m³): 4.0

Unit Reference	MD-SHE-0133-9500-1600-9500	Sump Available	Yes
Design Head (m)	1.600	Diameter (mm)	133
Design Flow (l/s)	9.5	Invert Level (m)	108.078
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	9.5	Kick-Flo®	0.980	7.5
Flush-Flo™	0.466	9.5	Mean Flow over Head Range	-	8.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	9.4	1.600	9.5	2.600	11.9	5.000	16.3	7.500	19.8
0.200	8.4	0.800	8.8	1.800	10.0	3.000	12.8	5.500	17.1	8.000	20.4
0.300	9.2	1.000	7.6	2.000	10.5	3.500	13.7	6.000	17.8	8.500	21.0
0.400	9.4	1.200	8.3	2.200	11.0	4.000	14.7	6.500	18.5	9.000	21.6
0.500	9.5	1.400	8.9	2.400	11.5	4.500	15.5	7.000	19.1	9.500	22.2



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200yr + 40%



Date 20/01/2021  
File S NET 1A-2MDX.MDX

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Network 2020.1

Storage Structures for S NET -1.SWS

Cellular Storage Manhole: S11, DS/PN: S2.002

Invert Level (m) 110.823 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S13, DS/PN: S2.004

Invert Level (m) 110.468 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S20, DS/PN: S3.002

Invert Level (m) 109.912 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S21, DS/PN: S3.003

Invert Level (m) 109.864 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

Cellular Storage Manhole: S15, DS/PN: S2.006

Invert Level (m) 109.652 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	80.0	0.0	0.800	80.0	0.0

Cellular Storage Manhole: S17, DS/PN: S2.008

Invert Level (m) 108.078 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	30.0	0.0	0.800	30.0	0.0

32 George Street  
Dumfries  
DG1 1EH

6874  
Ennerdale Bridge  
200yr + 40%



Date 20/01/2021  
File S NET 1A-2MDX.MDX

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Checked by WAM

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Network 2020.1

Summary of Critical Results by Maximum Level (Rank 1) for S NET -1.SWS

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor \* 10m<sup>3</sup>/ha Storage 2.000  
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800  
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0  
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.400 Cv (Summer) 0.750  
Region England and Wales Ratio R 0.246 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON  
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON  
DTS Status ON

Profile(s)

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080  
Return Period(s) (years) 200  
Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
									(m)	(m)	(m <sup>3</sup> )			
S1.000	S1	10080 Summer	200	+40%					114.237	-0.164	0.000	0.42		
S1.001	S2	15 Summer	200	+40%					113.998	-0.215	0.000	0.18		
S1.002	S4	15 Summer	200	+40%					112.238	-0.127	0.000	0.63		
S1.003	S5	15 Summer	200	+40%					112.112	-0.226	0.000	0.13		
S1.004	S5	15 Summer	200	+40%					110.200	-0.223	0.000	0.14		
S1.005	S6	30 Summer	200	+40%					108.404	-0.103	0.000	0.36		
S2.000	S9	15 Winter	200	+40%	200/15 Summer				111.423	0.331	0.000	2.14		
S2.001	S10	15 Winter	200	+40%	200/15 Summer				111.207	0.162	0.000	1.15		
S2.002	S11	15 Winter	200	+40%	200/15 Summer				111.013	0.136	0.000	1.23		6
S2.003	S12	180 Winter	200	+40%	200/15 Summer				110.997	0.208	0.000	0.73		
S2.004	S13	180 Winter	200	+40%	200/15 Summer				110.987	0.465	0.000	0.61		93
S2.005	S14	180 Winter	200	+40%	200/15 Summer				110.976	0.850	0.000	0.16		
S3.000	S18	180 Winter	200	+40%	200/15 Summer				110.997	0.703	0.000	0.08		
S3.001	S19	180 Winter	200	+40%	200/15 Summer				110.996	0.808	0.000	0.79		
S3.002	S20	180 Winter	200	+40%	200/15 Summer				110.990	0.861	0.000	0.33		184
S3.003	S21	180 Winter	200	+40%	200/15 Summer				110.986	0.921	0.000	0.25		190
S3.004	S22	180 Winter	200	+40%	200/15 Summer				110.978	1.040	0.000	0.27		
S2.006	S15	180 Winter	200	+40%	200/15 Summer				110.975	1.099	0.000	0.14		
S2.007	S16	180 Winter	200	+40%	200/15 Summer				110.969	1.185	0.000	0.05		
S2.008	S17	1440 Winter	200	+40%	200/15 Summer	200/1440 Winter			109.587	1.209	8.656	0.19		112
S1.006	S7	30 Summer	200	+40%	200/15 Summer				108.393	0.035	0.000	1.29		

PN	US/MH Name	Pipe Flow	Status	Level Exceeded
		(l/s)		
S1.000	S1	33.4	OK	
S1.001	S2	33.4	OK	
S1.002	S4	33.5	OK	
S1.003	S5	33.8	OK	
S1.004	S5	33.8	OK	
S1.005	S6	34.5	OK	
S2.000	S9	24.9	SURCHARGED	
S2.001	S10	24.0	SURCHARGED	
S2.002	S11	22.8	SURCHARGED	
S2.003	S12	19.4	SURCHARGED	
S2.004	S13	19.9	SURCHARGED	
S2.005	S14	19.3	SURCHARGED	
S3.000	S18	1.3	SURCHARGED	
S3.001	S19	10.0	SURCHARGED	
S3.002	S20	11.6	SURCHARGED	
S3.003	S21	9.6	SURCHARGED	
S3.004	S22	17.0	SURCHARGED	
S2.006	S15	10.8	SURCHARGED	
S2.007	S16	10.8	SURCHARGED	
S2.008	S17	9.4	FLOOD	1
S1.006	S7	79.3	SURCHARGED	

**1 Year**

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
lyr

Date 20/01/2021  
File S-Net 2.MDX

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XP Solutions

Network 2020.1



STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -2.SWS

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
S1.000	45.730	1.526	30.0	0.000	5.00	5.9	0.600	o	100	Pipe/Conduit	
S1.001	25.910	1.479	17.5	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	8.050	0.265	30.3	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.003	33.733	2.717	12.4	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.004	31.579	1.051	30.1	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S2.000	17.655	0.171	103.2	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	10.254	0.350	29.3	0.037	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	7.354	1.162	6.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	8.122	0.041	200.0	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)
S1.000	50.00	5.54	114.253	0.000	5.9	0.0	2.4	1.41	11.1	8.3
S1.001	50.00	5.77	112.727	0.000	5.9	0.0	2.4	1.85	14.6	8.3
S1.002	50.00	5.87	111.248	0.000	5.9	0.0	2.4	1.41	11.0	8.3
S1.003	50.00	6.12	110.983	0.000	5.9	0.0	2.4	2.20	17.3	8.3
S1.004	50.00	6.49	108.267	0.000	5.9	0.0	2.4	1.41	11.1	8.3
S2.000	50.00	5.30	108.849	0.046	0.0	0.0	2.5	0.99	17.5	8.7
S2.001	50.00	5.39	108.678	0.083	0.0	0.0	4.5	1.87	33.0	15.7
S2.002	50.00	5.42	108.328	0.083	0.0	0.0	4.5	4.03	71.3	15.7
S1.005	50.00	6.64	107.091	0.083	5.9	0.0	6.9	0.92	36.6	24.0

Free Flowing Outfall Details for S NET -2.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.005	S28	108.500	107.050	107.000	0	0

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
lyr

Date 20/01/2021  
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Online Controls for S NET -2.SWS

Orifice Manhole: S31, DS/PN: S2.002, Volume (m<sup>3</sup>): 1.7

Diameter (m) 0.041 Discharge Coefficient 0.600 Invert Level (m) 108.328

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
lyr

Date 20/01/2021  
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Storage Structures for S NET -2.SWS

Cellular Storage Manhole: S30, DS/PN: S2.001

Invert Level (m) 108.678 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	20.0	20.0	8.000	20.0	163.1

Cellular Storage Manhole: S31, DS/PN: S2.002

Invert Level (m) 108.328 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	20.0	0.0	0.800	20.0	0.0

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
lyr



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Network 2020.1

Summary of Critical Results by Maximum Level (Rank 1) for S NET -2.SWS

Simulation Criteria

Areal Reduction Factor 1.000    Manhole Headloss Coeff (Global) 0.500    MADD Factor \* 10m<sup>3</sup>/ha Storage 2.000  
Hot Start (mins) 0    Foul Sewage per hectare (l/s) 0.000    Inlet Coefficient 0.800  
Hot Start Level (mm) 0    Additional Flow - % of Total Flow 0.000    Flow per Person per Day (l/per/day) 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 2    Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model    FSR M5-60 (mm) 17.200 Cv (Summer) 0.750  
Region England and Wales    Ratio R 0.248 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0    DTS Status ON    Inertia Status OFF  
Analysis Timestep    Fine DVD Status OFF

Profile(s)

Duration(s) (mins)    15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080  
Return Period(s) (years)    1  
Climate Change (%)    0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded	Flow / Overflow Cap.	Half Drain Time (mins)	Pipe
									Level (m)	Depth (m)	Volume (m <sup>3</sup> )			Flow (l/s)
S1.000	S22	60 Summer	1	+0%					114.305	-0.048	0.000	0.54		5.9
S1.001	S23	15 Summer	1	+0%					112.775	-0.052	0.000	0.42		5.9
S1.002	S24	60 Summer	1	+0%					111.304	-0.045	0.000	0.58		5.9
S1.003	S25	60 Summer	1	+0%					111.027	-0.056	0.000	0.35		6.0
S1.004	S26	180 Summer	1	+0%					108.320	-0.047	0.000	0.55		5.9
S2.000	S29	15 Winter	1	+0%					108.904	-0.095	0.000	0.28		4.6
S2.001	S30	15 Winter	1	+0%					108.728	-0.100	0.000	0.25	9	7.2
S2.002	S31	120 Winter	1	+0%	1/30 Summer				108.561	0.082	0.000	0.03	56	1.6
S1.005	S27	120 Winter	1	+0%					107.168	-0.148	0.000	0.25		7.5

PN	US/MH Name	Status	Level Exceeded
S1.000	S22	OK	
S1.001	S23	OK	
S1.002	S24	OK	
S1.003	S25	OK	
S1.004	S26	OK	
S2.000	S29	OK	
S2.001	S30	OK	
S2.002	S31	SURCHARGED	
S1.005	S27	OK	

**30 Year**



32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
30yr+40%



Date 20/01/2021  
File S-Net 2.MDX

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XP Solutions

Network 2020.1

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -2.SWS

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
S1.000	45.730	1.526	30.0	0.000	5.00	5.9	0.600	o	100	Pipe/Conduit	
S1.001	25.910	1.479	17.5	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	8.050	0.265	30.3	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.003	33.733	2.717	12.4	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.004	31.579	1.051	30.1	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S2.000	17.655	0.171	103.2	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	10.254	0.350	29.3	0.037	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	7.354	1.162	6.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	8.122	0.041	200.0	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)
S1.000	50.00	5.54	114.253	0.000	5.9	0.0	2.4	1.41	11.1	8.3
S1.001	50.00	5.77	112.727	0.000	5.9	0.0	2.4	1.85	14.6	8.3
S1.002	50.00	5.87	111.248	0.000	5.9	0.0	2.4	1.41	11.0	8.3
S1.003	50.00	6.12	110.983	0.000	5.9	0.0	2.4	2.20	17.3	8.3
S1.004	50.00	6.49	108.267	0.000	5.9	0.0	2.4	1.41	11.1	8.3
S2.000	50.00	5.30	108.849	0.046	0.0	0.0	2.5	0.99	17.5	8.7
S2.001	50.00	5.39	108.678	0.083	0.0	0.0	4.5	1.87	33.0	15.7
S2.002	50.00	5.42	108.328	0.083	0.0	0.0	4.5	4.03	71.3	15.7
S1.005	50.00	6.64	107.091	0.083	5.9	0.0	6.9	0.92	36.6	24.0

Free Flowing Outfall Details for S NET -2.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.005	S28	108.500	107.050	107.000	0	0

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
30yr+40%



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Network 2020.1

Online Controls for S NET -2.SWS

Orifice Manhole: S31, DS/PN: S2.002, Volume (m<sup>3</sup>): 1.7

Diameter (m) 0.041 Discharge Coefficient 0.600 Invert Level (m) 108.328

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
30yr+40%



Date 20/01/2021  
File S-Net 2.MDX

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Network 2020.1

Summary of Critical Results by Maximum Level (Rank 1) for S NET -2.SWS

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor \* 10m<sup>3</sup>/ha Storage 2.000  
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800  
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 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 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.200 Cv (Summer) 0.750  
Region England and Wales Ratio R 0.248 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF  
Analysis Timestep Fine DVD Status OFF

Profile(s)

Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880,  
4320, 5760, 7200, 8640, 10080

Return Period(s) (years)

30

Climate Change (%)

40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded	Flow / Overflow (l/s)	Half Drain	Pipe
									Level (m)	Depth (m)	Volume (m <sup>3</sup> )		Time (mins)	Flow (l/s)
S1.000	S22	60 Summer	30	+40%					114.305	-0.048	0.000	0.54		5.9
S1.001	S23	15 Summer	30	+40%					112.775	-0.052	0.000	0.42		5.9
S1.002	S24	60 Summer	30	+40%					111.304	-0.045	0.000	0.58		5.9
S1.003	S25	60 Summer	30	+40%					111.027	-0.056	0.000	0.35		6.0
S1.004	S26	180 Winter	30	+40%					108.320	-0.047	0.000	0.55		5.9
S2.000	S29	180 Winter	30	+40%	30/120 Winter				109.042	0.043	0.000	0.31		5.1
S2.001	S30	180 Winter	30	+40%	30/30 Summer				109.034	0.206	0.000	0.24	84	7.0
S2.002	S31	180 Winter	30	+40%	30/15 Summer				109.024	0.545	0.000	0.05	132	2.9
S1.005	S27	180 Winter	30	+40%					107.174	-0.141	0.000	0.30		8.8

PN	US/MH Name	Status	Level
			Exceeded
S1.000	S22	OK	
S1.001	S23	OK	
S1.002	S24	OK	
S1.003	S25	OK	
S1.004	S26	OK	
S2.000	S29	SURCHARGED	
S2.001	S30	SURCHARGED	
S2.002	S31	SURCHARGED	
S1.005	S27	OK	

**100 Year**

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
100yr+40%



Date 20/01/2021  
File S-Net 2.MDX

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -2.SWS

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
S1.000	45.730	1.526	30.0	0.000	5.00	7.2	0.600	o	100	Pipe/Conduit	
S1.001	25.910	1.479	17.5	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	8.050	0.265	30.3	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.003	33.733	2.717	12.4	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.004	31.579	1.051	30.1	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S2.000	17.655	0.171	103.2	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	10.254	0.350	29.3	0.037	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	7.354	1.162	6.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	8.122	0.041	200.0	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)
S1.000	50.00	5.54	114.253	0.000	7.2	0.0	2.9	1.41	11.1	10.1
S1.001	50.00	5.77	112.727	0.000	7.2	0.0	2.9	1.85	14.6	10.1
S1.002	50.00	5.87	111.248	0.000	7.2	0.0	2.9	1.41	11.0	10.1
S1.003	50.00	6.12	110.983	0.000	7.2	0.0	2.9	2.20	17.3	10.1
S1.004	50.00	6.49	108.267	0.000	7.2	0.0	2.9	1.41	11.1	10.1
S2.000	50.00	5.30	108.849	0.046	0.0	0.0	2.5	0.99	17.5	8.7
S2.001	50.00	5.39	108.678	0.083	0.0	0.0	4.5	1.87	33.0	15.7
S2.002	50.00	5.42	108.328	0.083	0.0	0.0	4.5	4.03	71.3	15.7
S1.005	50.00	6.64	107.091	0.083	7.2	0.0	7.4	0.92	36.6	25.8

Free Flowing Outfall Details for S NET -2.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.005	S28	108.500	107.050	107.000	0	0

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
100yr+40%



Date 20/01/2021  
File S-Net 2.MDX

Designed by WAM  
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XP Solutions

Network 2020.1

Online Controls for S NET -2.SWS

Orifice Manhole: S31, DS/PN: S2.002, Volume (m<sup>3</sup>): 1.7

Diameter (m) 0.041 Discharge Coefficient 0.600 Invert Level (m) 108.328

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
100yr+40%



Date 20/01/2021  
File S-Net 2.MDX

Designed by WAM  
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XP Solutions

Network 2020.1

Summary of Critical Results by Maximum Level (Rank 1) for S NET -2.SWS

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor \* 10m<sup>3</sup>/ha Storage 2.000  
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800  
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 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 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.200 Cv (Summer) 0.750  
Region England and Wales Ratio R 0.248 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF  
Analysis Timestep Fine DVD Status OFF

Profile(s)

Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880,  
4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 100  
Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded	Flow / Overflow (l/s)	Half Drain	Pipe
									Level (m)	Depth (m)	Volume (m <sup>3</sup> )		Time (mins)	Flow (l/s)
S1.000	S22	120	Summer	100	+40%				114.312	-0.041	0.000	0.66		7.2
S1.001	S23	15	Summer	100	+40%				112.783	-0.044	0.000	0.51		7.2
S1.002	S24	60	Summer	100	+40%				111.311	-0.037	0.000	0.71		7.2
S1.003	S25	60	Summer	100	+40%				111.032	-0.051	0.000	0.43		7.3
S1.004	S26	15	Summer	100	+40%				108.327	-0.040	0.000	0.66		7.2
S2.000	S29	180	Winter	100	+40%	100/15	Summer		109.251	0.252	0.000	0.38		6.2
S2.001	S30	180	Winter	100	+40%	100/15	Summer		109.241	0.413	0.000	0.24	102	7.0
S2.002	S31	180	Winter	100	+40%	100/15	Summer		109.230	0.751	0.000	0.05	150	3.3
S1.005	S27	180	Winter	100	+40%				107.183	-0.133	0.000	0.36		10.5

PN	US/MH Name	Status	Level
			Exceeded
S1.000	S22	OK	
S1.001	S23	OK	
S1.002	S24	OK	
S1.003	S25	OK	
S1.004	S26	OK	
S2.000	S29	SURCHARGED	
S2.001	S30	SURCHARGED	
S2.002	S31	SURCHARGED	
S1.005	S27	OK	

**200 Year**



32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
200yr+40%



Date 20/01/2021  
File S-Net 2.MDX

Designed by WAM  
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Network 2020.1

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -2.SWS


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
S1.000	45.730	1.526	30.0	0.000	5.00	8.3	0.600	o	150	Pipe/Conduit	
S1.001	25.910	1.479	17.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	8.050	0.265	30.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	33.733	2.717	12.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	31.579	1.101	28.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	17.655	0.171	103.2	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	10.254	0.350	29.3	0.037	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	7.354	1.162	6.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	8.122	0.041	200.0	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)
S1.000	50.00	5.41	114.253	0.000	8.3	0.0	3.3	1.85	32.6	11.6
S1.001	50.00	5.59	112.727	0.000	8.3	0.0	3.3	2.42	42.7	11.6
S1.002	50.00	5.66	111.248	0.000	8.3	0.0	3.3	1.83	32.4	11.6
S1.003	50.00	5.86	110.983	0.000	8.3	0.0	3.3	2.87	50.8	11.6
S1.004	50.00	6.14	108.267	0.000	8.3	0.0	3.3	1.89	33.3	11.6
S2.000	50.00	5.30	108.849	0.046	0.0	0.0	2.5	0.99	17.5	8.7
S2.001	50.00	5.39	108.678	0.083	0.0	0.0	4.5	1.87	33.0	15.7
S2.002	50.00	5.42	108.328	0.083	0.0	0.0	4.5	4.03	71.3	15.7
S1.005	50.00	6.29	107.091	0.083	8.3	0.0	7.8	0.92	36.6	27.4

Free Flowing Outfall Details for S NET -2.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.005	S28	108.500	107.050	107.000	0	0

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32 George Street Dumfries DG1 1EH	Ennerdale Bridge Network 2 200yr+40%	
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Online Controls for S NET -2.SWS

Orifice Manhole: S31, DS/PN: S2.002, Volume (m<sup>3</sup>): 1.7

Diameter (m) 0.041 Discharge Coefficient 0.600 Invert Level (m) 108.328

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
200yr+40%



Date 20/01/2021  
File S-Net 2.MDX

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Storage Structures for S NET -2.SWS

Cellular Storage Manhole: S30, DS/PN: S2.001

Invert Level (m) 108.678 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	20.0	20.0	8.000	20.0	163.1

Cellular Storage Manhole: S31, DS/PN: S2.002

Invert Level (m) 108.328 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	20.0	0.0	0.800	20.0	0.0

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
200yr+40%



Date 20/01/2021  
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Network 2020.1

Summary of Critical Results by Maximum Level (Rank 1) for S NET -2.SWS

Simulation Criteria

Areal Reduction Factor 1.000    Manhole Headloss Coeff (Global) 0.500    MADD Factor \* 10m<sup>3</sup>/ha Storage 2.000  
Hot Start (mins) 0    Foul Sewage per hectare (l/s) 0.000    Inlet Coefficient 0.800  
Hot Start Level (mm) 0    Additional Flow - % of Total Flow 0.000    Flow per Person per Day (l/per/day) 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 2    Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model    FSR M5-60 (mm) 17.200 Cv (Summer) 0.750  
Region England and Wales    Ratio R 0.248 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0    DTS Status ON    Inertia Status OFF  
Analysis Timestep    Fine DVD Status OFF

Profile(s)

Duration(s) (mins)    15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080  
Return Period(s) (years)    200  
Climate Change (%)    40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded	Flow / Overflow (l/s)	Half Drain	Pipe
									Level (m)	Depth (m)	Volume (m <sup>3</sup> )		Time (mins)	Flow (l/s)
S1.000	S22	15 Summer	200	+40%					114.305	-0.098	0.000	0.26		8.3
S1.001	S23	15 Summer	200	+40%					112.776	-0.101	0.000	0.20		8.3
S1.002	S24	60 Summer	200	+40%					111.304	-0.095	0.000	0.29		8.3
S1.003	S25	180 Summer	200	+40%					111.024	-0.109	0.000	0.17		8.3
S1.004	S26	60 Winter	200	+40%					108.322	-0.094	0.000	0.26		8.4
S2.000	S29	180 Winter	200	+40%	200/15 Summer				109.404	0.405	0.000	0.45		7.3
S2.001	S30	180 Winter	200	+40%	200/15 Summer				109.394	0.566	0.000	0.28	114	8.1
S2.002	S31	180 Winter	200	+40%	200/15 Summer				109.381	0.903	0.000	0.06	159	3.6
S1.005	S27	180 Winter	200	+40%					107.190	-0.126	0.000	0.40		11.9

PN	US/MH Name	Status	Level
			Exceeded
S1.000	S22	OK	
S1.001	S23	OK	
S1.002	S24	OK	
S1.003	S25	OK	
S1.004	S26	OK	
S2.000	S29	SURCHARGED	
S2.001	S30	SURCHARGED	
S2.002	S31	FLOOD RISK	
S1.005	S27	OK	

**1000 Year**

32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
1000yr+40%



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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for S NET -2.SWS

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
S1.000	45.730	1.526	30.0	0.000	5.00	8.3	0.600	o	150	Pipe/Conduit	
S1.001	25.910	1.479	17.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	8.050	0.265	30.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	33.733	2.717	12.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	31.579	1.101	28.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	17.655	0.171	103.2	0.046	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	10.254	0.350	29.3	0.037	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	7.354	1.162	6.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	8.122	0.041	200.0	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)
S1.000	50.00	5.41	114.253	0.000	8.3	0.0	3.3	1.85	32.6	11.6
S1.001	50.00	5.59	112.727	0.000	8.3	0.0	3.3	2.42	42.7	11.6
S1.002	50.00	5.66	111.248	0.000	8.3	0.0	3.3	1.83	32.4	11.6
S1.003	50.00	5.86	110.983	0.000	8.3	0.0	3.3	2.87	50.8	11.6
S1.004	50.00	6.14	108.267	0.000	8.3	0.0	3.3	1.89	33.3	11.6
S2.000	50.00	5.30	108.849	0.046	0.0	0.0	2.5	0.99	17.5	8.7
S2.001	50.00	5.39	108.678	0.083	0.0	0.0	4.5	1.87	33.0	15.7
S2.002	50.00	5.42	108.328	0.083	0.0	0.0	4.5	4.03	71.3	15.7
S1.005	50.00	6.29	107.091	0.083	8.3	0.0	7.8	0.92	36.6	27.4

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32 George Street Dumfries DG1 1EH	Ennerdale Bridge Network 2 1000yr+40%	
Date 20/01/2021 File S-Net 2.MDX	Designed by WAM Checked by WAM	
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Online Controls for S NET -2.SWS

Orifice Manhole: S31, DS/PN: S2.002, Volume (m<sup>3</sup>): 1.7

Diameter (m) 0.041 Discharge Coefficient 0.600 Invert Level (m) 108.328

32 George Street  
 Dumfries  
 DG1 1EH

Ennerdale Bridge  
 Network 2  
 1000yr+40%



Date 20/01/2021  
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Storage Structures for S NET -2.SWS

Cellular Storage Manhole: S30, DS/PN: S2.001

Invert Level (m) 108.678 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
 Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	20.0	20.0	8.000	20.0	163.1

Cellular Storage Manhole: S31, DS/PN: S2.002

Invert Level (m) 108.328 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
 Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	20.0	0.0	0.800	20.0	0.0



32 George Street  
Dumfries  
DG1 1EH

Ennerdale Bridge  
Network 2  
1000yr+40%



Date 20/01/2021  
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Network 2020.1

Summary of Critical Results by Maximum Level (Rank 1) for S NET -2.SWS

Simulation Criteria

Areal Reduction Factor 1.000    Manhole Headloss Coeff (Global) 0.500    MADD Factor \* 10m<sup>3</sup>/ha Storage 2.000  
Hot Start (mins) 0    Foul Sewage per hectare (l/s) 0.000    Inlet Coefficient 0.800  
Hot Start Level (mm) 0    Additional Flow - % of Total Flow 0.000    Flow per Person per Day (l/per/day) 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 2    Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model    FSR M5-60 (mm) 17.200 Cv (Summer) 0.750  
Region England and Wales    Ratio R 0.248 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0    DTS Status ON    Inertia Status OFF  
Analysis Timestep    Fine DVD Status OFF

Profile(s)

Duration(s) (mins)    15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080  
Return Period(s) (years)    1000  
Climate Change (%)    40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m <sup>3</sup> )	Flow / Cap.	Overflow (l/s)	Half Drain
														Time (mins)
S1.000	S22	15 Summer	1000	+40%					114.305	-0.098	0.000	0.26		
S1.001	S23	15 Summer	1000	+40%					112.776	-0.101	0.000	0.20		
S1.002	S24	60 Summer	1000	+40%					111.304	-0.095	0.000	0.29		
S1.003	S25	180 Winter	1000	+40%					111.024	-0.109	0.000	0.17		
S1.004	S26	60 Winter	1000	+40%					108.322	-0.094	0.000	0.26		
S2.000	S29	180 Winter	1000	+40%	1000/15 Summer				109.764	0.765	0.000	0.64		
S2.001	S30	180 Winter	1000	+40%	1000/15 Summer				109.735	0.907	0.000	0.39		186
S2.002	S31	180 Winter	1000	+40%	1000/15 Summer	1000/120 Winter			109.686	1.208	7.594	0.07		159
S1.005	S27	180 Winter	1000	+40%					107.192	-0.124	0.000	0.42		

Pipe

PN	US/MH Name	Flow (l/s)	Status	Level
				Exceeded
S1.000	S22	8.3	OK	
S1.001	S23	8.3	OK	
S1.002	S24	8.3	OK	
S1.003	S25	8.3	OK	
S1.004	S26	8.4	OK	
S2.000	S29	10.4	SURCHARGED	
S2.001	S30	11.4	FLOOD RISK	
S2.002	S31	4.1	FLOOD	7
S1.005	S27	12.4	OK	

## **Greenfield Calculations**

Calculated by:

Site name:

Site location:

### Site Details

Latitude:

Longitude:

Reference:

Date:

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

### Runoff estimation approach

### Site characteristics

Total site area (ha):

### Methodology

Q<sub>BAR</sub> estimation method:

SPR estimation method:

### Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

### Hydrological characteristics

	Default	Edited
SAAR (mm):	1714	1714
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

### Notes

#### (1) Is Q<sub>BAR</sub> < 2.0 l/s/ha?

When Q<sub>BAR</sub> is < 2.0 l/s/ha then limiting discharge rates 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 consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

#### (3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

### Greenfield runoff rates

	Default	Edited
Q <sub>BAR</sub> (l/s):	3.48	3.48
1 in 1 year (l/s):	3.03	3.03
1 in 30 years (l/s):	5.92	5.92
1 in 100 year (l/s):	7.24	7.24
1 in 200 years (l/s):	8.25	8.25

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at [www.uksuds.com](http://www.uksuds.com). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [www.uksuds.com/terms-and-conditions.htm](http://www.uksuds.com/terms-and-conditions.htm). The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Calculated by:

Site name:

Site location:

## Site Details

Latitude:

Longitude:

Reference:

Date:

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

## Runoff estimation approach

## Site characteristics

Total site area (ha):

## Methodology

Q<sub>BAR</sub> estimation method:

SPR estimation method:

## Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

## Hydrological characteristics

	Default	Edited
SAAR (mm):	1714	1714
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

## Notes

### (1) Is Q<sub>BAR</sub> < 2.0 l/s/ha?

When Q<sub>BAR</sub> is < 2.0 l/s/ha then limiting discharge rates 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 consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

### (3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

## Greenfield runoff rates

	Default	Edited
Q <sub>BAR</sub> (l/s):	38.36	38.36
1 in 1 year (l/s):	33.38	33.38
1 in 30 years (l/s):	65.22	65.22
1 in 100 year (l/s):	79.8	79.8
1 in 200 years (l/s):	90.92	90.92

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Calculated by:

Site name:

Site location:

## Site Details

Latitude:

Longitude:

Reference:

Date:

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

**Runoff estimation approach**

## Site characteristics

Total site area (ha):

## Methodology

Q<sub>BAR</sub> estimation method:

SPR estimation method:

## Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

## Hydrological characteristics

	Default	Edited
SAAR (mm):	1714	1714
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

## Notes

### (1) Is Q<sub>BAR</sub> < 2.0 l/s/ha?

When Q<sub>BAR</sub> is < 2.0 l/s/ha then limiting discharge rates 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 consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

### (3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

## Greenfield runoff rates

	Default	Edited
Q <sub>BAR</sub> (l/s):	13.63	13.63
1 in 1 year (l/s):	11.86	11.86
1 in 30 years (l/s):	23.17	23.17
1 in 100 year (l/s):	28.35	28.35
1 in 200 years (l/s):	32.3	32.3

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