STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for LINGARDS SURFACE7.SWS

Pipe Sizes LINGARDS SURFACE6 Manhole Sizes LINGARDS SURFACE6

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	75	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for LINGARDS SURFACE7.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	15.000	0.350	42.9	0.020	4.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	10.000	0.125	80.0	0.011	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	15.213	0.101	150.6	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	20.104	0.134	150.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	10.000	0.067	149.3	0.022	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.004	40.102	0.267	150.2	0.253	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.005	40.214	0.268	150.1	0.091	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.006	49.182	0.328	149.9	0.120	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.007	10.154	0.068	149.3	0.044	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.008	5.000	0.033	151.5	0.112	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.009	5.547	0.037	149.9	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	67.11	4.12	179.650	0.020	0.0	0.0	0.0	2.00	79.7	3.6
S2.000	67.17	4.11	179.300	0.011	0.0	0.0	0.0	1.46	58.2	2.0
S1.001	65.72	4.36	179.175	0.053	0.0	0.0	0.0	1.06	42.3	9.4
S1.002	64.26	4.62	178.999	0.067	0.0	0.0	0.0	1.28	90.6	11.7
S1.003	63.66	4.74	178.790	0.089	0.0	0.0	0.0	1.48	163.6	15.3
S1.004	61.37	5.19	178.723	0.342	0.0	0.0	0.0	1.48	163.0	56.8
S1.005	59.26	5.64	176.500	0.433	0.0	0.0	0.0	1.48	163.1	69.5
S1.006	57.15	6.14	176.157	0.553	0.0	0.0	0.0	1.66	263.7	85.6
S1.007	56.74	6.24	175.829	0.597	0.0	0.0	0.0	1.66	264.2	91.7
S1.008	56.53	6.29	175.761	0.709	0.0	0.0	0.0	1.65	262.3	108.6
S1.009	67.34	4.09	172.950	0.000	6.6	0.0	0.0	1.07	42.4	6.6

PIPELINE SCHEDULES for LINGARDS SURFACE7.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	S1	181.155	179.650	1.280	Open Manhole	1200
S2.000	o	225	S11	180.967	179.300	1.442	Open Manhole	1200
S1.001	o	225	S2	181.649	179.175	2.249	Open Manhole	1200
S1.002	o	300	S3	182.713	178.999	3.414	Open Manhole	1200
S1.003	o	375	S4	183.614	178.790	4.449	Open Manhole	1500
S1.004	o	375	S12	182.755	178.723	3.657	Open Manhole	1500
S1.005	o	375	S5	180.961	176.500	4.086	Open Manhole	1500
S1.006	o	450	S6	181.501	176.157	4.894	Open Manhole	1500
S1.007	o	450	S7	182.020	175.829	5.741	Open Manhole	1800
S1.008	o	450	S8	181.342	175.761	5.131	Open Manhole	1800
S1.009	o	225	S9	181.250	172.950	8.075	Open Manhole	2100

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	15.000	42.9	S2	181.649	179.300	2.124	Open Manhole	1200
S2.000	10.000	80.0	S2	181.649	179.175	2.249	Open Manhole	1200
S1.001	15.213	150.6	S3	182.713	179.074	3.414	Open Manhole	1200
S1.002	20.104	150.0	S4	183.614	178.865	4.449	Open Manhole	1500
S1.003	10.000	149.3	S12	182.755	178.723	3.657	Open Manhole	1500
S1.004	40.102	150.2	S5	180.961	178.456	2.130	Open Manhole	1500
S1.005	40.214	150.1	S6	181.501	176.232	4.894	Open Manhole	1500
S1.006	49.182	149.9	S7	182.020	175.829	5.741	Open Manhole	1800
S1.007	10.154	149.3	S8	181.342	175.761	5.131	Open Manhole	1800
S1.008	5.000	151.5	S9	181.250	175.728	5.072	Open Manhole	2100
S1.009	5.547	149.9	S10	178.000	172.913	4.862	Open Manhole	1200

Area Summary for LINGARDS SURFACE7.SWS

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.020	0.020	0.020
2.000	-	-	100	0.011	0.011	0.011
1.001	-	-	100	0.022	0.022	0.022
1.002	-	-	100	0.014	0.014	0.014
1.003	-	-	100	0.022	0.022	0.022
1.004	-	-	100	0.253	0.253	0.253
1.005	-	-	100	0.091	0.091	0.091
1.006	-	-	100	0.120	0.120	0.120
1.007	-	-	100	0.044	0.044	0.044
1.008	-	-	100	0.112	0.112	0.112
1.009	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.709	0.709	0.709

Online Controls for LINGARDS SURFACE7.SWS

Hydro-Brake® Optimum Manhole: S9, DS/PN: S1.009, Volume (m³): 29.2

Unit Reference	MD-SHE-0100-6600-2500-6600
Design Head (m)	2.500
Design Flow (l/s)	6.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	172.950
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.500	6.6	Kick-Flo®	0.896	4.1
Flush-Flo™	0.438	5.1	Mean Flow over Head Range	-	5.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.3	1.200	4.7	3.000	7.2	7.000	10.7
0.200	4.6	1.400	5.0	3.500	7.7	7.500	11.1
0.300	5.0	1.600	5.4	4.000	8.2	8.000	11.4
0.400	5.1	1.800	5.7	4.500	8.7	8.500	11.8
0.500	5.1	2.000	5.9	5.000	9.1	9.000	12.1
0.600	5.0	2.200	6.2	5.500	9.6	9.500	12.4
0.800	4.6	2.400	6.5	6.000	10.0		
1.000	4.3	2.600	6.7	6.500	10.4		

Storage Structures for LINGARDS SURFACE7.SWS

Tank or Pond Manhole: S9, DS/PN: S1.009

Invert Level (m) 173.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	180.0	2.200	180.0	2.250	0.0

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	2.500	6.600
Flush-Flo™	0.438	5.130
Kick-Flo®	0.896	4.092
Mean Flow		5.088

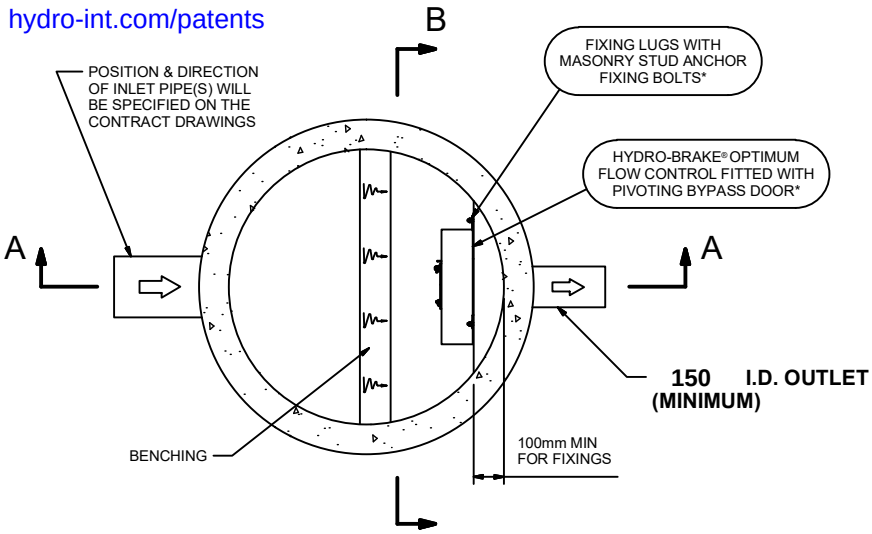
Hydro-Brake® Optimum Flow Control including:

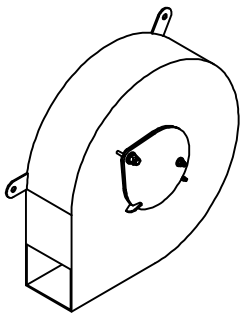
- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Indicative Weight: 20 kg

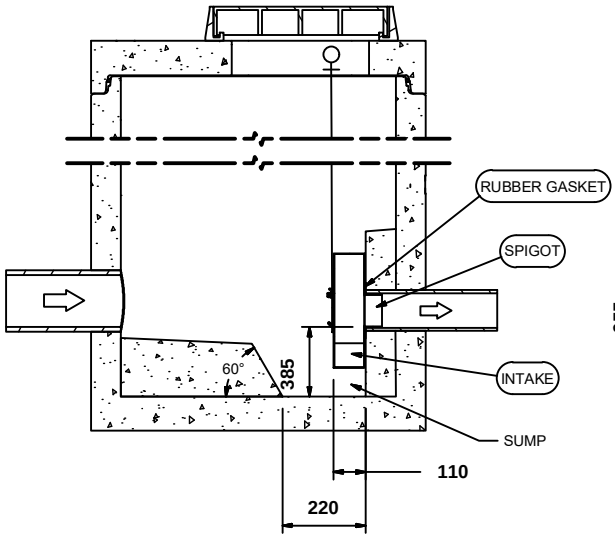
BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

wrc approved PT/503/0422 Valid: 01/04/2022 - 31/03/2027

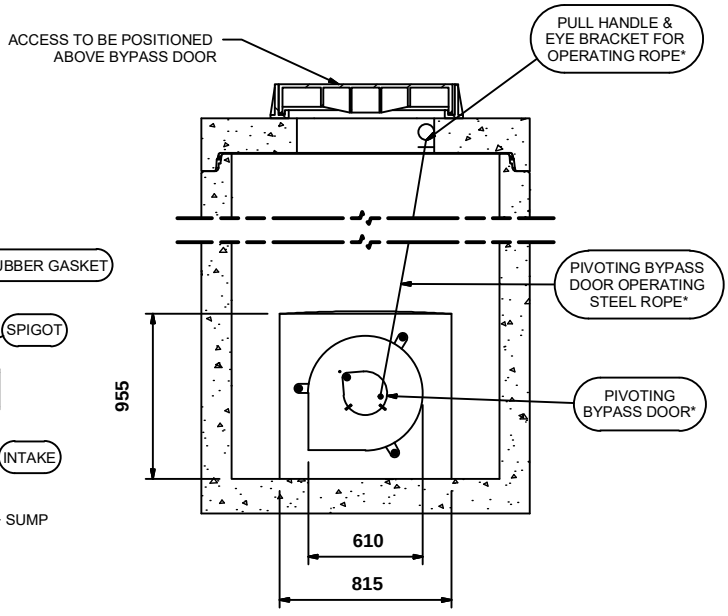
hydro-int.com/patents







SECTION A-A



SECTION B-B

IMPORTANT: ⬭ LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this SHE-0100-6600-2500-6600 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	22/08/2023 08:11
SITE	Lingard Rd
DESIGNER	Helen Hossanee
REF	

SHE-0100-6600-2500-6600
Hydro-Brake® Optimum

Hydro International Ltd • Unit 2, Rivermead Court • Kenn Business Park • Windmill Road • Kenn • Clevedon • BS21 6FT • Tel: 01275 878371 • www.hydro-int.com • Email: Enquiries@hydro-int.com

h.hossanee@haighhuddleston.co.uk

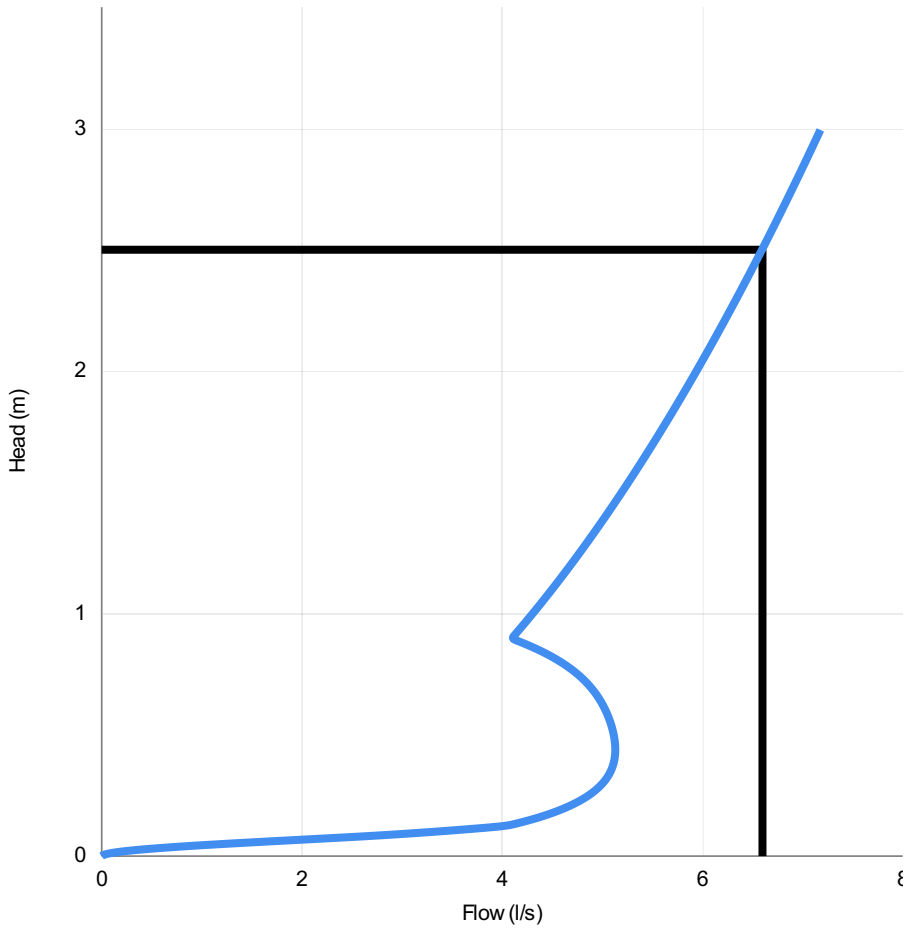
Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	2.500	6.600
Flush-Flo	0.438	5.130
Kick-Flo®	0.896	4.092
Mean Flow		5.088

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

wrc approved™
PT/503/0422
Valid: 01/04/2022 - 31/03/2027

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.086	2.808
0.172	4.462
0.259	4.892
0.345	5.078
0.431	5.129
0.517	5.105
0.603	5.030
0.690	4.897
0.776	4.673
0.862	4.301
0.948	4.201
1.034	4.373
1.121	4.538
1.207	4.696
1.293	4.849
1.379	4.996
1.466	5.139
1.552	5.277
1.638	5.412
1.724	5.543
1.810	5.670
1.897	5.795
1.983	5.917
2.069	6.035
2.155	6.152
2.241	6.266
2.328	6.378
2.414	6.487
2.500	6.595

DESIGN ADVICE

The head/flow characteristics of this SHE-0100-6600-2500-6600 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International®

DATE	22/08/2023 08:11
Site	Lingard Rd
DESIGNER	Helen Hossanee
Ref	

SHE-0100-6600-2500-6600

Hydro-Brake Optimum®

Summary of Critical Results by Maximum Level (Rank 1) for LINGARDS SURFACE7.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000		

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

Profile(s) Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Sensitivity flows(s) (%) 0

PN	US/MH Name	Storm	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	+0%					179.682	-0.193
S2.000	S11	15 Winter	+0%					179.329	-0.196
S1.001	S2	15 Winter	+0%					179.248	-0.152
S1.002	S3	15 Winter	+0%					179.071	-0.228
S1.003	S4	15 Winter	+0%					178.891	-0.274
S1.004	S12	15 Winter	+0%					178.871	-0.227
S1.005	S5	15 Winter	+0%					176.667	-0.208
S1.006	S6	15 Winter	+0%					176.332	-0.275
S1.007	S7	15 Winter	+0%					176.053	-0.226
S1.008	S8	15 Winter	+0%					176.022	-0.189
S1.009	S9	120 Winter	+0%	+0%/15 Winter				173.732	0.557

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.05			3.5	OK	
S2.000	S11	0.000	0.04			1.9	OK	
S1.001	S2	0.000	0.23			8.5	OK	
S1.002	S3	0.000	0.13			10.3	OK	
S1.003	S4	0.000	0.13			13.5	OK	
S1.004	S12	0.000	0.33			48.4	OK	
S1.005	S5	0.000	0.41			60.2	OK	
S1.006	S6	0.000	0.31			75.3	OK	

Summary of Critical Results by Maximum Level (Rank 1) for LINGARDS SURFACE7.SWS

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.007	S7	0.000	0.48			80.3	OK	
S1.008	S8	0.000	0.63			93.6	OK	
S1.009	S9	0.000	0.17			5.1	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for LINGARDS SURFACE7.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.350
Return Period (years)		30	Cv (Summer) 0.750
Region	England and Wales		Cv (Winter) 0.840
M5-60 (mm)	19.000		

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

Profile(s) Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Sensitivity flows(s) (%) 0

PN	US/MH Name	Storm	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	+0%					179.696	-0.179
S2.000	S11	15 Winter	+0%					179.341	-0.184
S1.001	S2	15 Winter	+0%					179.284	-0.116
S1.002	S3	15 Winter	+0%					179.107	-0.192
S1.003	S4	15 Winter	+0%					178.985	-0.180
S1.004	S12	15 Winter	+0%					178.969	-0.129
S1.005	S5	15 Winter	+0%					176.792	-0.083
S1.006	S6	15 Winter	+0%					176.539	-0.068
S1.007	S7	15 Winter	+0%	+0%/15 Winter				176.387	0.108
S1.008	S8	15 Winter	+0%	+0%/15 Winter				176.282	0.071
S1.009	S9	240 Winter	+0%	+0%/15 Winter				174.345	1.170

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.09			6.6	OK	
S2.000	S11	0.000	0.08			3.6	OK	
S1.001	S2	0.000	0.47			17.6	OK	
S1.002	S3	0.000	0.28			22.1	OK	
S1.003	S4	0.000	0.27			29.3	OK	
S1.004	S12	0.000	0.75			110.9	OK	
S1.005	S5	0.000	0.93			138.4	OK	
S1.006	S6	0.000	0.67			159.9	OK	

Summary of Critical Results by Maximum Level (Rank 1) for LINGARDS SURFACE7.SWS

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.007	S7	0.000	1.01			170.9	SURCHARGED	
S1.008	S8	0.000	1.31			194.6	SURCHARGED	
S1.009	S9	0.000	0.17			5.1	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for LINGARDS SURFACE7.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000		

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

Profile(s) Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Sensitivity flows(s) (%) 0, +30

PN	US/MH Name	Storm	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	+30%					179.710	-0.165
S2.000	S11	15 Winter	+30%					179.470	-0.055
S1.001	S2	15 Winter	+30%	+30%/15 Winter				179.463	0.063
S1.002	S3	15 Winter	+30%	+30%/15 Winter				179.385	0.086
S1.003	S4	15 Winter	+30%	+30%/15 Winter				179.292	0.127
S1.004	S12	15 Winter	+30%	+30%/15 Winter				179.197	0.099
S1.005	S5	15 Winter	+30%	+0%/15 Winter				177.712	0.837
S1.006	S6	15 Winter	+30%	+0%/15 Winter				177.188	0.581
S1.007	S7	15 Winter	+30%	+0%/15 Winter				176.775	0.496
S1.008	S8	15 Winter	+30%	+0%/15 Winter				176.514	0.303
S1.009	S9	360 Winter	+30%	+0%/15 Winter				175.331	2.156

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.16			11.2	OK	
S2.000	S11	0.000	0.12			5.9	OK	
S1.001	S2	0.000	0.74			27.6	SURCHARGED	
S1.002	S3	0.000	0.43			34.3	SURCHARGED	
S1.003	S4	0.000	0.44			46.8	SURCHARGED	
S1.004	S12	0.000	1.15			170.3	SURCHARGED	
S1.005	S5	0.000	1.43			212.5	SURCHARGED	
S1.006	S6	0.000	1.09			260.6	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for LINGARDS SURFACE7.SWS

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.007	S7	0.000	1.66			281.5	SURCHARGED	
S1.008	S8	0.000	2.20			325.6	SURCHARGED	
S1.009	S9	0.000	0.22			6.4	SURCHARGED	