DRAINAGE STRATEGY

for

CHRIS and BARBARA WILLAN

PROPOSED RESIDENTIAL DEVELOPMENT

at

BROCKHALL FARM, OLD LANGHO

JANUARY 2021

REFORD

Consulting Engineers Limited

7 Hall Road, Fulwood, Preston, PR2 9QD

Mobile [redacted]

CONTENTS

1. INTRODUCTION

1.1 This drainage strategy has been produced on behalf of Chris and Barbara Willan in support of a planning application for residential development at Brockhall Farm, Old Langho. A location plan is included within Appendix A.

1.2 This drainage strategy describes the existing site conditions and proposed development. It assesses the potential impact of proposals on existing sewers and includes a proposed strategy for the provision of foul and surface water drainage to serve the proposed development.

2. BASE INFORMATION

Existing site

2.1 The existing site is located to the north of Brockhall Village that is accessed from Old Langho Road.

2.2 The existing site comprises farm buildings and associated hardstanding areas.

2.3 Access into the site is from an established access track from Larkhill off Old Langho Road.

2.4 The site is relatively level. Beyond the site's eastern boundary the site falls towards the River Ribble.

Site geology

2.5 Site investigations have not been carried out for the site.

2.6 The online Soilscapes Viewer has identified that the geology encountered is likely to comprise slowly permeable seasonally wet acid loamy and clayey soils with impeded drainage.

2.7 Soakaways are therefore not likely to be appropriate for the discharge of surface water into the ground and infiltration tests have not been carried out.

Understanding of existing drainage local to and within the site

2.8 The River Ribble lies below the site approx. 120m to the northeast.

2.9 A watercourse flows north eastwards from the eastern side of the site into the River Ribble.

2.10 The existing site has a private segregated drainage system for both foul water and surface water.

2.11 Surface water from the existing site is discharged unrestricted into the River Ribble via the watercourse on the eastern side of the site.

2.12 Foul water from the existing site is treated by a septic tank that lies on the eastern side of the site and the effluent is discharged into the River Ribble via the watercourse on the eastern side of the site.

2.13 The two existing dwellings on the southern side of the site have a separate drainage system to the main site. Foul water discharges to the west of the properties into a septic tank within the field to the west and the effluent discharges into the private drainage system serving the residential site to the southwest which enters a pumping station on Larkhill. It is also believed that surface water discharges into drainage to the west. The drainage serving these two properties is unaffected by the proposed development.

Proposed development

2.14 The proposal is to convert the main building and three existing out-buildings into eight luxury family homes with garages, and to demolish the remaining structures and construct two new garage buildings for the main building conversion. The two existing houses on the southern side of the site are to be retained.

2.15 The proposed site roof plan is shown on drawing 65.19 07 accompanying the planning applications.

3. PROPOSED DRAINAGE STRATEGY

3.1 The proposed foul and surface water drainage layout is included within Appendix B.

Surface water drainage

3.2 In accordance with the National Standards for Sustainable Drainage, the surface water drainage strategy should incorporate the use of Sustainable Drainage (SUDS) where possible. The approach promotes the use infiltration features in the first instance. If drainage cannot be achieved solely through infiltration due to site conditions or contamination risks, the preferred options are (in order of preference):

(i) a controlled discharge to a local waterbody or watercourse, or

(ii) a controlled discharge into the public sewer network (depending on availability and capacity).

3.3 The rate and volume of discharge should be restricted to the pre-development values as far as practicable.

3.4 The nature of the geology of the site means that infiltration back into the ground is not likely to be feasible.

3.5 A watercourse flows north eastwards from the eastern side of the site into the River Ribble that lies approx. 120m to the northeast of the site.

3.6 Surface water from the existing site is discharged unrestricted into the River Ribble via the watercourse on the eastern side of the site.

3.7 It is intended that surface water runoff from the developed site will be attenuated and discharge into the watercourse, mimicking the existing scenario.

3.8 The site is a Brownfield site and the area of existing roofs and hardstanding have been measured as 0.6 ha.

3.9 To determine the pre-development surface water discharge rates from the existing site, the pre-development discharge rates have been calculated using the 'Causeway Flow' programme.

3.10 The calculated pre-development Brownfield discharge rates are as follows:

- Q1 – 6.2 l/s
- Q30 – 14.5 l/s
- Q100 – 18.2 l/s

3.11 It is therefore intended that new surface water drainage will be installed to collect water from the buildings roofs and hardstanding areas within the developed site, and the surface water runoff restricted to 6.2 l/s, the one year discharge rate from the existing brownfield site, prior to discharging into the watercourse that lies on the eastern side of the site.

3.12 A surface water drainage design has been carried out for the proposed site development for all events up to the 100 year critical rain storm plus 30% on stored volumes. The additional 30% is to allow for climate change and has been included in the surface water volume. Attenuation is provided using underground storage within the soft landscaped areas.

3.13 The surface water drainage design is included within Appendix C.

Foul Water Drainage

3.14 Foul water from the existing development is collected by the site foul water drainage system and is treated by a septic tank that lies on the eastern side of the site and the effluent is discharged into the River Ribble via the watercourse on the eastern side of the site.

3.15 It is therefore intended that new foul water drainage will be installed, the existing septic tank made redundant and replaced with a sewage treatment plant, and the effluent discharged into the River Ribble via the watercourse on the eastern side of the site.

4. SUMMARY AND CONCLUSIONS

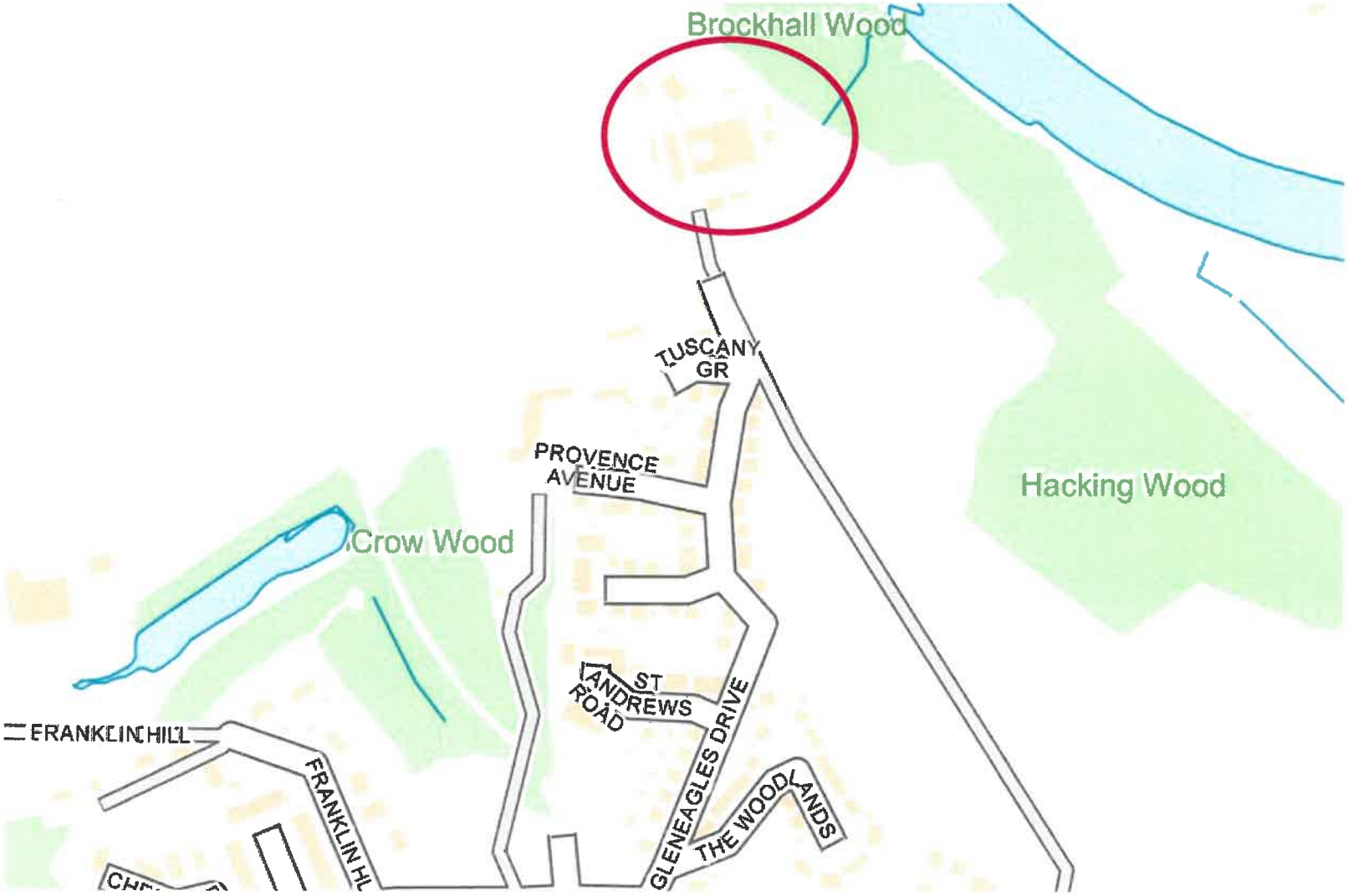
4.1 This drainage strategy has been produced on behalf of Chris and Barbara Willan in support of a planning application for residential development at Brockhall Farm, Old Langho.

4.2 The nature of the local geology means that infiltration of surface water runoff back into the ground is not likely to be feasible.

4.3 It is intended that surface water runoff from the developed site will be attenuated and discharged into the watercourse that lies on the eastern side of the site that flows north eastwards from the eastern side of the site into the River Ribble, mimicking the existing scenario. The surface water runoff will be restricted to 6.2 l/s, the one year discharge rate from the existing brownfield site.

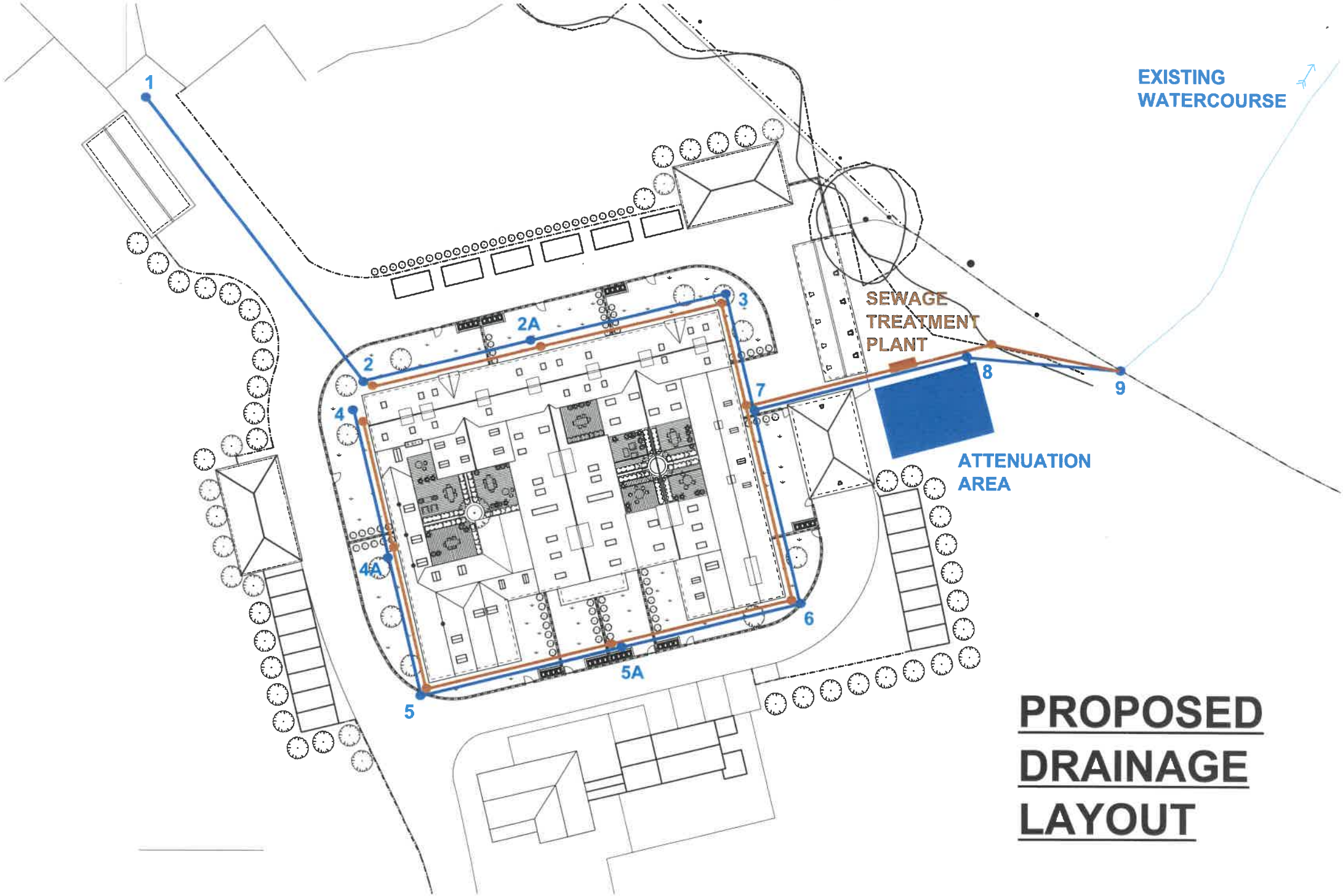
4.4 The surface water drainage design has catered for surface water runoff generated by all rainfall events up to the 100 year critical rain storm plus 30% on stored volumes. Attenuation is provided using underground storage within the soft landscaped areas.

4.5 Foul water will be collected by a new foul water drainage system, the existing septic tank made redundant and replaced with a sewage treatment plant, and the effluent discharged into the River Ribble via the watercourse on the eastern side of the site.



LOCATION PLAN

APPENDIX B



PROPOSED DRAINAGE LAYOUT

APPENDIX C

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	75.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	18.900	Minimum Backdrop Height (m)	2.000
Ratio-R	0.300	Preferred Cover Depth (m)	0.900
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
1	0.058	5.00	55.100	1200	1.125
2	0.025	5.00	55.000	1200	1.312
2a	0.026	5.00	55.000	1200	1.415
3	0.138	5.00	55.000	1200	1.497
4	0.029	5.00	55.000	1200	1.125
4a	0.029	5.00	55.000	1200	1.231
5	0.035	5.00	55.000	1200	1.412
5a	0.035	5.00	55.000	1200	1.515
6	0.052	5.00	55.000	1200	1.618
7	0.023	5.00	55.000	1200	1.708
8			55.000	1500	1.839
9			53.000	1200	1.200

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	1	2	36.000	0.600	53.975	53.763	0.212	169.8	225	5.60	54.8
2.001	2	2a	25.000	0.600	53.688	53.585	0.103	242.7	300	6.01	53.2
2.002	2a	3	20.000	0.600	53.585	53.503	0.082	243.9	300	6.35	52.0
2.003	3	7	14.000	0.600	53.503	53.292	0.211	66.4	300	6.47	51.6
1.000	4	4a	18.000	0.600	53.875	53.769	0.106	169.8	225	5.30	56.0
1.001	4a	5	18.000	0.600	53.769	53.663	0.106	169.8	225	5.60	54.8
1.002	5	5a	25.000	0.600	53.588	53.485	0.103	242.7	300	6.01	53.2
1.003	5a	6	25.000	0.600	53.485	53.382	0.103	242.7	300	6.43	51.7
1.004	6	7	22.000	0.600	53.382	53.292	0.090	244.4	300	6.80	50.5
1.005	7	8	32.000	0.600	53.292	53.161	0.131	244.3	300	7.33	48.9

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	1.000	39.8	8.6	0.900	1.012	0.058	0.0	71	0.801
2.001	1.005	71.0	12.0	1.012	1.115	0.083	0.0	83	0.752
2.002	1.002	70.8	15.4	1.115	1.197	0.109	0.0	95	0.805
2.003	1.933	136.6	34.6	1.197	1.408	0.247	0.0	102	1.619
1.000	1.000	39.8	4.4	0.900	1.006	0.029	0.0	51	0.664
1.001	1.000	39.8	8.6	1.006	1.112	0.058	0.0	71	0.801
1.002	1.005	71.0	13.4	1.112	1.215	0.093	0.0	88	0.777
1.003	1.005	71.0	18.0	1.215	1.318	0.128	0.0	102	0.840
1.004	1.001	70.8	24.7	1.318	1.408	0.180	0.0	122	0.914
1.005	1.001	70.8	59.6	1.408	1.539	0.450	0.0	212	1.118

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.006	8	9	12.000	0.600	53.161	51.800	1.361	8.8	300	7.37	48.8

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.006	5.325	376.4	59.5	1.539	0.900	0.450	0.0	80	3.921

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
2.000	36.000	169.8	225	Circular	55.100	53.975	0.900	55.000	53.763	1.012
2.001	25.000	242.7	300	Circular	55.000	53.688	1.012	55.000	53.585	1.115
2.002	20.000	243.9	300	Circular	55.000	53.585	1.115	55.000	53.503	1.197
2.003	14.000	66.4	300	Circular	55.000	53.503	1.197	55.000	53.292	1.408
1.000	18.000	169.8	225	Circular	55.000	53.875	0.900	55.000	53.769	1.006
1.001	18.000	169.8	225	Circular	55.000	53.769	1.006	55.000	53.663	1.112
1.002	25.000	242.7	300	Circular	55.000	53.588	1.112	55.000	53.485	1.215
1.003	25.000	242.7	300	Circular	55.000	53.485	1.215	55.000	53.382	1.318
1.004	22.000	244.4	300	Circular	55.000	53.382	1.318	55.000	53.292	1.408
1.005	32.000	244.3	300	Circular	55.000	53.292	1.408	55.000	53.161	1.539
1.006	12.000	8.8	300	Circular	55.000	53.161	1.539	53.000	51.800	0.900

Link
2.000
2.001
2.002
2.003
1.000
1.001
1.002
1.003
1.004
1.005
1.006

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	18.900	Drain Down Time (mins)	240
Ratio-R	0.300	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	30	0	0

Node 8 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	53.161	Product Number	CTL-SHE-0105-6200-1800-6200
Design Depth (m)	1.800	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.2	Min Node Diameter (mm)	1200

Node 8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	53.161
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	200.0	0.0	1.000	200.0	0.0	1.001	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 98.48%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	11	54.038	0.063	7.0	0.1370	0.0000	OK
15 minute winter	2	11	53.762	0.074	9.6	0.1123	0.0000	OK
15 minute winter	2a	11	53.674	0.089	12.7	0.1329	0.0000	OK
15 minute winter	3	11	53.595	0.092	28.3	0.2734	0.0000	OK
15 minute winter	4	10	53.919	0.044	3.5	0.0731	0.0000	OK
15 minute winter	4a	11	53.834	0.065	6.9	0.1035	0.0000	OK
15 minute winter	5	11	53.666	0.078	10.8	0.1275	0.0000	OK
15 minute winter	5a	10	53.643	0.158	14.8	0.2521	0.0000	OK
15 minute summer	6	10	53.600	0.218	28.2	0.3876	0.0000	OK
15 minute winter	7	9	53.596	0.304	62.0	0.4252	0.0000	SURCHARGED
240 minute winter	8	172	53.372	0.211	13.6	40.5356	0.0000	OK
15 minute summer	9	1	51.800	0.000	3.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	2.000	2	6.8	0.747	0.170	0.3256	
15 minute winter	2	2.001	2a	9.7	0.626	0.136	0.3870	
15 minute winter	2a	2.002	3	12.6	0.718	0.177	0.3567	
15 minute winter	3	2.003	7	28.3	0.715	0.207	0.6092	
15 minute winter	4	1.000	4a	3.4	0.467	0.086	0.1335	
15 minute winter	4a	1.001	5	6.8	0.740	0.171	0.1653	
15 minute winter	5	1.002	5a	10.8	0.629	0.153	0.6496	
15 minute winter	5a	1.003	6	20.3	0.612	0.286	1.1576	
15 minute summer	6	1.004	7	34.3	0.578	0.485	1.3772	
15 minute winter	7	1.005	8	69.5	1.903	0.982	1.1735	
240 minute winter	8	Hydro-Brake®	9	5.2				72.4

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.48%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	54.079	0.104	17.1	0.2241	0.0000	OK
15 minute winter	2	12	53.934	0.246	23.8	0.3721	0.0000	OK
15 minute winter	2a	12	53.921	0.336	29.2	0.5036	0.0000	SURCHARGED
15 minute winter	3	12	53.900	0.397	62.2	1.1821	0.0000	SURCHARGED
15 minute winter	4	12	53.945	0.070	8.6	0.1155	0.0000	OK
15 minute winter	4a	12	53.940	0.171	17.1	0.2736	0.0000	OK
15 minute winter	5	12	53.927	0.339	24.8	0.5518	0.0000	SURCHARGED
15 minute winter	5a	12	53.911	0.426	31.8	0.6789	0.0000	SURCHARGED
15 minute winter	6	11	53.885	0.503	45.0	0.8928	0.0000	SURCHARGED
15 minute winter	7	12	53.834	0.542	113.0	0.7590	0.0000	SURCHARGED
240 minute winter	8	200	53.710	0.549	27.7	105.3333	0.0000	SURCHARGED
15 minute summer	9	1	51.800	0.000	5.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	2.000	2	16.5	0.922	0.416	0.8618	
15 minute winter	2	2.001	2a	24.8	0.688	0.349	1.6535	
15 minute winter	2a	2.002	3	33.5	0.732	0.473	1.4084	
15 minute winter	3	2.003	7	62.7	0.890	0.459	0.9859	
15 minute winter	4	1.000	4a	8.5	0.589	0.213	0.3860	
15 minute winter	4a	1.001	5	16.5	0.828	0.416	0.6490	
15 minute winter	5	1.002	5a	25.8	0.604	0.363	1.7605	
15 minute winter	5a	1.003	6	33.4	0.541	0.471	1.7605	
15 minute winter	6	1.004	7	45.0	0.673	0.636	1.5492	
15 minute winter	7	1.005	8	114.5	2.035	1.618	2.0890	
240 minute winter	8	Hydro-Brake®	9	5.8				138.3

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.48%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	12	54.274	0.299	22.1	0.6455	0.0000	SURCHARGED
15 minute winter	2	12	54.223	0.535	29.1	0.8091	0.0000	SURCHARGED
15 minute winter	2a	12	54.204	0.619	35.3	0.9277	0.0000	SURCHARGED
15 minute winter	3	12	54.177	0.674	82.4	2.0042	0.0000	SURCHARGED
15 minute winter	4	12	54.249	0.374	11.1	0.6163	0.0000	SURCHARGED
15 minute winter	4a	12	54.242	0.473	20.4	0.7575	0.0000	SURCHARGED
15 minute winter	5	12	54.214	0.626	28.7	1.0177	0.0000	SURCHARGED
15 minute winter	5a	12	54.192	0.707	39.4	1.1260	0.0000	SURCHARGED
15 minute winter	6	12	54.151	0.769	55.8	1.3634	0.0000	SURCHARGED
15 minute winter	7	12	54.077	0.785	139.7	1.0987	0.0000	SURCHARGED
240 minute winter	8	232	53.925	0.764	34.6	146.5219	0.0000	SURCHARGED
15 minute summer	9	1	51.800	0.000	5.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	2.000	2	20.0	0.898	0.503	1.4318	
15 minute winter	2	2.001	2a	31.3	0.687	0.441	1.7605	
15 minute winter	2a	2.002	3	39.1	0.611	0.551	1.4084	
15 minute winter	3	2.003	7	76.9	1.093	0.563	0.9859	
15 minute winter	4	1.000	4a	10.7	0.608	0.270	0.7159	
15 minute winter	4a	1.001	5	21.8	0.806	0.549	0.7159	
15 minute winter	5	1.002	5a	31.1	0.635	0.438	1.7605	
15 minute winter	5a	1.003	6	40.3	0.573	0.568	1.7605	
15 minute winter	6	1.004	7	55.9	0.793	0.790	1.5492	
15 minute winter	7	1.005	8	140.9	2.327	1.991	2.2534	
240 minute winter	8	Hydro-Brake®	9	5.8				141.1

Results for 100 year +30% CC Critical Storm Duration. Lowest mass balance: 98.48%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	1	336	54.977	1.002	6.8	2.1661	0.0000	FLOOD RISK
360 minute winter	2	336	54.977	1.289	7.0	1.9487	0.0000	FLOOD RISK
360 minute winter	2a	336	54.977	1.392	9.1	2.0849	0.0000	FLOOD RISK
360 minute winter	3	336	54.977	1.474	19.3	4.3844	0.0000	FLOOD RISK
360 minute winter	4	336	54.977	1.102	4.1	1.8148	0.0000	FLOOD RISK
360 minute winter	4a	336	54.977	1.208	5.0	1.9350	0.0000	FLOOD RISK
360 minute winter	5	336	54.977	1.389	8.0	2.2596	0.0000	FLOOD RISK
360 minute winter	5a	336	54.977	1.492	9.9	2.3764	0.0000	FLOOD RISK
360 minute winter	6	336	54.977	1.595	13.7	2.8290	0.0000	FLOOD RISK
360 minute winter	7	336	54.977	1.685	33.5	2.3584	0.0000	FLOOD RISK
360 minute winter	8	336	54.975	1.814	33.2	193.3009	0.0000	FLOOD RISK
15 minute summer	9	1	51.800	0.000	5.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	1	2.000	2	4.9	0.681	0.123	1.4318	
360 minute winter	2	2.001	2a	6.9	0.576	0.096	1.7605	
360 minute winter	2a	2.002	3	8.4	0.618	0.119	1.4084	
360 minute winter	3	2.003	7	18.1	0.693	0.133	0.9859	
360 minute winter	4	1.000	4a	-3.0	0.433	-0.075	0.7159	
360 minute winter	4a	1.001	5	5.0	0.670	0.125	0.7159	
360 minute winter	5	1.002	5a	7.2	0.556	0.102	1.7605	
360 minute winter	5a	1.003	6	9.3	0.564	0.131	1.7605	
360 minute winter	6	1.004	7	13.4	0.465	0.190	1.5492	
360 minute winter	7	1.005	8	33.2	1.007	0.470	2.2534	
360 minute winter	8	Hydro-Brake®	9	6.2				170.2