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Project

Naylor's Office, Barugh Green

Title

Drainage Strategy

Client

Naylor

MSJ Job No 221070

Document No
221070 GEN 0002 – Drainage Strategy

Rev P1 Date 26/11/21

Directors: Alex Bell B.Sc., C.Eng., M.I.Struct.E., Ben Mabbs B.Eng., C.Eng., M.I.Struct.E., Fred Higham M.Eng., C.Eng, M.I.Struct.E.
Consultants: Steve Jones B.Eng., C.Eng., M.I.Struct.E., Brian Melia B.Sc., M.I.Struct.E. Neil Chambers B.Sc., M.I.C.E.,
Melia Smith & Jones Limited, Registered in England 4041907

M S J

Issue Record

Status	Rev	Description	By	Chk		Date
S2	P1	Initial Drainage Strategy	LW	MH		26/11/21

Contents

Introduction

This design document is for the foul and surface water drainage for the proposed Naylor's Office. It should be read in conjunction with the existing Flood Risk Assessment 221070 GEN 0001-P1 [Flood Risk Assessment], produced by Melia Smith and Jones.

Existing Drainage Infrastructure

See Existing Drainage Plans (Appendix A and B)

The existing site is a large irregular shaped piece of land. It has some changes in level. The site falls approximately 0.75m from west to east and approximately 0.75m from south to north. The site has a maximum level of approximately +72.75m AOD and a minimum of approximately +71.8m AOD. An existing culverted watercourse (>50m long) passes the site approximately 450m to the north of the site. There is an abandoned canal 750m north beyond the rail lines and the River Dearne is approximately 1km north and east of the site.

There are recorded Yorkshire Water sewers adjacent north of the site. Private foul and surface water sewers have been built in the entrance road and drainage tails have been built to accommodate the site. It is understood that these sewers connect into the adopted network further downstream and that they have been provided to service this site and adjoining plots. The surface water sewer has been built with oversized pipes and a Hydrobrake flow control device. It is not known however if these sewers have the capacity to accept surface water flow from this development.

Foul water from the existing buildings drained to an onsite manhole which discharged to the existing Yorkshire Water sewer outside of the site. The foul system currently takes foul water from the other sites it is surrounded by, via a 150Ø pipe.

Drainage Investigations

See Drawing Drainage Investigation Results (Appendix B and C)

A survey of the existing off site sewer network has been carried out where possible. The network has generally been constructed in accordance with the existing drainage drawing. The current drainage is relatively new and is in good condition so it is reusable for the proposed development.

Existing Drainage

The existing surface water system discharges off site and into the Yorkshire Water network via a flow control (15l/s sec). Attenuated flow is stored in an oversized pipe located in the access road to the existing Naylor factory. The existing site access road and the existing Wordsworth office buildings currently discharge into the existing system. See appendix B.

An analysis of the existing system has been carried out and the following results have been obtained.

- No surcharge for 1in2 year
- No flooding for 1in30 year
- 70m³ of flooding for 1in100 year of which 39m³ occurs in the existing office car park and 31m³ adjacent to the Naylors Factory.

See Appendix D for more information.

Given that the existing system already floods for 100 year storms, it is considered that the existing system has no extra capacity to accept additional surface water flow without some form of mitigation.

Proposed Drainage Design

In accordance with the Approved Document H, adequate consideration has been taken to discharge via the following listed in priority.

1. Discharge via a soakaway or some other infiltration system
2. Discharge into a watercourse
3. Discharge into a sewer

Soakaway tests have not yet been carried out but the ground conditions (Shallow mudstone) suggest that they will not be viable.

There are no watercourses in the immediate locality of the site, so discharge to a watercourse is not considered viable.

It is proposed to limit run off to IH124 Greenfield runoff. The attached (See FRA) analysis shows Greenfield runoff to be:

Annual Probability (Return Period, years)	Greenfield Runoff (l/s) IH124*
Q_{BAR}	0.35
1 in 1 yr	0.3
1 in 30 yr	0.62
1 in 100 yr	0.73

These limits are very low and to limit how to flow to these amounts is likely to need an orifice which would be liable to blockage. It is proposed therefore to limit surface water discharge to 5l/s, with a minimum orifice of 75mm. Attenuated water will be stored in an underground tank under the car park. See appendix E and F. Silt traps will be used upstream of the attenuation tank.

Preliminary calculations demonstrated that this additional flow into the existing network increased the amount of existing flooding during extreme events. This occurred near the existing attenuation tank adjacent to the existing Naylor's factory. It is proposed to add an extension to the existing Naylor's factory attenuation tank to provide mitigation.

The calculations show that when the new offices are added and additional mitigation storage, the existing Naylor's drainage system is not unacceptably affected.

In addition, the new Naylor's office development will be designed so that the system will:

- Not surcharge for 1in2 year
- Not flood for 1in30 year
- Flood for 1in100 year however the flood water will be managed so that property is not at risk on or off site.

See Appendix G for further information.

Foul Drainage

Discharge Unit Method adopted for calculation of flow within foul runs.

$k\sqrt{\sum}$ DU's

k = Frequency Factor
∑ DU's = Sum of Discharge Units

Frequency factor adopted = 0.7 for frequent use e.g Hospital, School, Restaurant

DU's
Toilet 1.5
Urinal 0.4
Wash Hand Basin 0.3
Kitchen Sink 1.3

Proposed Building

5 x Toilets 7.5 DU's
2 x Urinals 0.8 DU's
9 x Wash Hand Basin 3 DU's
2 x Kitchen Sink 2.6 DU's

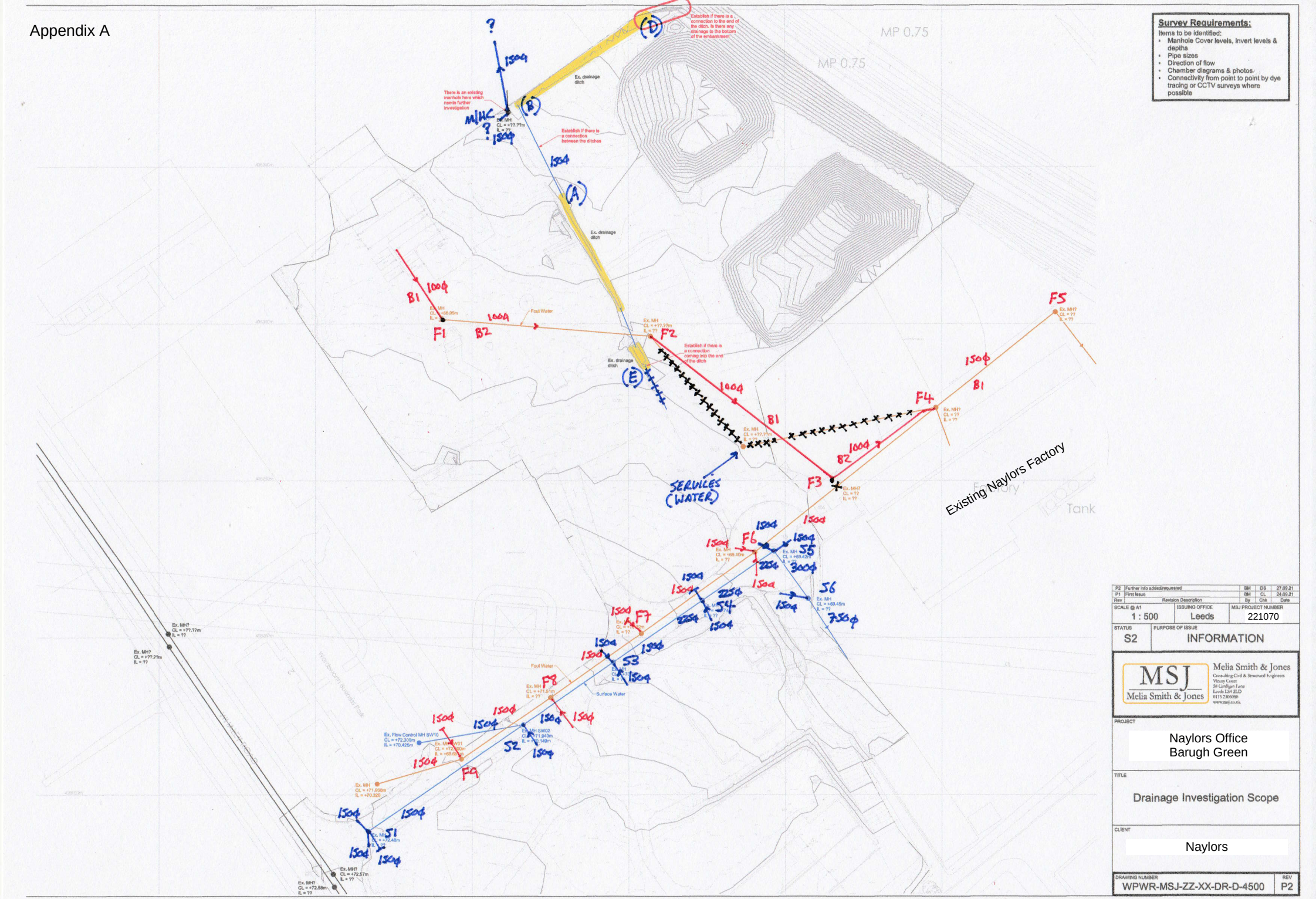
∑ DU's = 13.9

$0.7\sqrt{13.9} = 2.61$ l/sec

Flattest pipe in run is 100dia at 1:40
Capacity of 100dia at 1:40 (K = 1.5, ¾ cap) = 9 l/sec therefore OK

Appendix A

Appendix A


Survey Requirements:
Items to be identified:
Manhole Cover levels, Invert levels & depths
Pipe sizes
Direction of flow
Chamber diagrams & photos
Connectivity from point to point by dye tracing or CCTV surveys where possible
Establish if there is a connection to the end of the ditch. Is there any drainage to the bottom of the embankment
There is an existing manhole here which needs further investigation
Establish if there is a connection between the ditches
Establish if there is a connection coming into the end of the ditch
Ex. drainage ditch
Foul Water
Surface Water
SERVICES (WATER)
Existing Naylors Factory
Tank
MP 0.75
F1
F2
F3
F4
F5
F6
F7
F8
F9
S1
S2
S3
S4
S5
S6
B1
B2
Ex. MH
Ex. MH?
Ex. Flow Control MH SW10
MH SW02
Wordsworth Avenue
P2 Further info added/requested BM DS 27.09.21
P1 First Issue BM CL 24.09.21
Rev Revision Description By Chk Date
SCALE @ A1 1 : 500
ISSUING OFFICE Leeds
MSJ PROJECT NUMBER 221070
STATUS S2
PURPOSE OF ISSUE INFORMATION
MSJ Melia Smith & Jones
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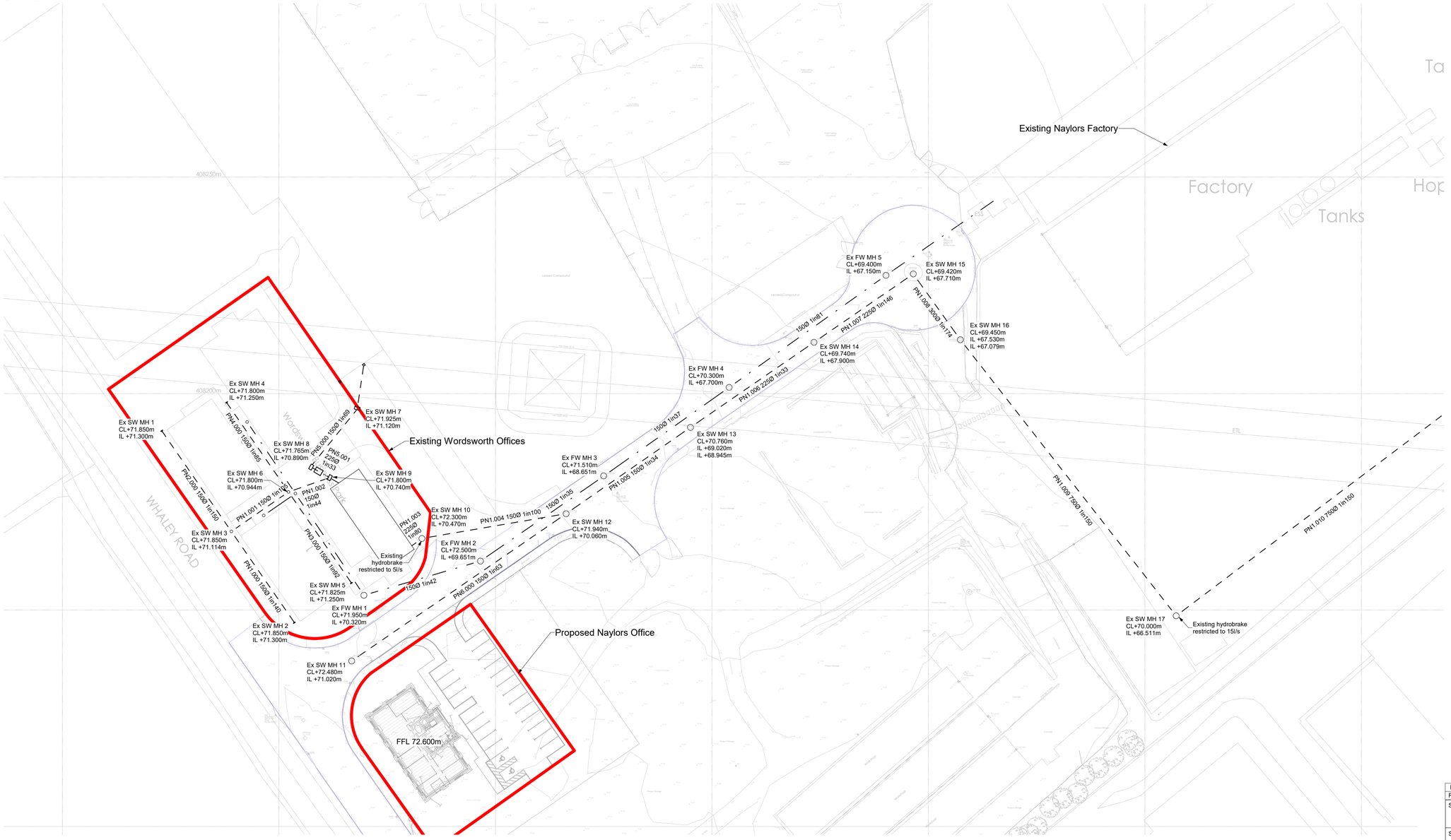
PROJECT
Naylors Office
Barugh Green
TITLE
Drainage Investigation Scope
CLIENT
Naylors
DRAWING NUMBER
WPWR-MSJ-ZZ-XX-DR-D-4500
REV
P2

Appendix B

Appendix B



1 Existing Drainage Layout
1 : 500

KEY

Existing Surface Water

Existing Foul Water

P1	First Issue	LW	MH	26.11.21
Rev	Revision Description	By	Chk	Date

SCALE @ A1	ISSUING OFFICE	MSJ PROJECT NUMBER
1 : 500	Leeds	221070

STATUS	PURPOSE OF ISSUE
S0	WORK IN PROGRESS

MSJ Melia Smith & Jones

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PROJECT

Naylors Office,
Barugh Green

TITLE

Existing Drainage Layout

CLIENT

Martin Walsh Architectural

DRAWING NUMBER	REV
221070-MSJ-ZZ-XX-DR-D-4001	P1

Appendix C

G.P. DRAIN SURVEYS

CLEANING, JETTING, RE-LINING, REPAIRS & SURVEYS

REGISTERED OFFICE:
THORNY CROFT
56 B SCATCHERD LANE
MORLEY
LEEDS
LS27 OJJ

TEL\FAX: 0113 2533154
MOBILE: 07973 834690

Our Ref : GMP/lhg/2805

Your Ref : Mark Holmes / Ben Mabbs

13th October 2021

Melia Smith & Jones Ltd
Vinery Court
58 Cardigan Lane
Leeds
LS4 2LD

For the attention of : Mark Holmes / Ben Mabbs.

C.C.T.V. DRAINAGE SURVEY.

Site at Wordsworth Crushing Barugh Green.

Manhole	Invert	Pipe Size	Material	Service
F1	790mm	4”	Plastic	Foul
F2	1090mm	4”	Plastic	Foul
F3	2250mm	4”	Plastic	Foul
	To top of biscuit			
F4	2240mm	4” & 6”	Clay	Foul
F5	Concealed	6”	Clay	Foul
F6	2250mm	6”	Clay	Foul
F7	2600mm	6”	Clay	Foul
F8	2850mm	6”	Clay	Foul
F9	2860mm	6”	Clay	Foul
S1	1460mm	6”	Clay	Surface Water
S2	1880mm	6”	Clay	Surface Water
S3	1740mm	6”	Clay	Surface Water
S4	1840mm	6” & 9”	Clay	Surface Water
S5	1710mm	6” 9” & 12”	Clay & concrete	Surface Water
S6	2340mm	6” 12” & 30”	Clay & concrete	Surface Water
	1920mm Invert of pipe from S5			
Open Ditch A		6”	Plastic	Surface Water
Open Ditch B		9”	Clay	Surface Water
M/HC	1250mm	6”	Clay	Surface Water
	To cover level – not raised concrete ring			

M/HF1 – B1
00.0 – Start scan
23.9 – Line of the drain deviates right
25.2 – Line of the drain deviates right
25.2 – Enter a soil stack – horizontal
25.2 – Blind branch 12.0'clock
28.7 – Line of the drain deviates right
29.4 – Line of the drain deviates left
35.5 – Line of the drain deviates right
35.7 – End of survey

Conclusion
This drainage run serves the yards toilet block cabins, no further action required.

M/HF1 – B2
00.0 – Start scan
67.7 – End survey at M/HF2

Conclusion
No action required.

M/HF3 – B1
00.0 – Start scan
70.4 – End survey at M/HF2

Conclusion
No action required.

M/HF3 – B2
00.0 – Start scan
48.0 – Drain increases in size from 4" plastic to 6" clay
48.6 – Line of the drain deviates right
49.1 – End survey at M/HF4

Conclusion
No action required.

M/HF4 – B1
00.0 – Start scan
51.4 – Enter concealed M/HF5 – Under a mass of concrete

Conclusion
We only surveyed this Sewer because we were unable to raise M/HF5 because it is buried under a mass of concrete and we wanted to prove that the outfall was not on a back-drop due to us being able to gain an invert of M/HF5.

M/HC – B1
00.0 – Start scan
00.4 – Survey abandoned at a mass of rubble

Conclusion
We are unsure is this drainage run is even in use, it seemed extremely dry and maybe used to serve something in the past. We would suggest that this not be used as an outfall chamber for the proposed development.

OPEN DITCH PIPE A – B1
00.0 – Start scan
00.0 to 34.0 – Drain full of silt & mud
33.8 – Material changes from 6" plastic to 9" clay
34.0 – End survey at OPEN DITCH PIPE B
34.0 – Clean camera and film in reverse
00.0 – End survey back at OPEN DITCH PIPE A

Conclusion
We only surveyed this drainage system to prove the connectivity of the two ditches, no further action required

M/HC – B2
00.0 – Start scan
00.0 to 14.0 – Rubble and silt within the drain
00.5 – Material changes from clay to plastic
14.0 – Survey abandoned at a mass of debris & silt

Conclusion
We are unsure is this drainage run is even in use, it seemed extremely dry and maybe used to serve something in the past. We would suggest that this not be used as an outfall chamber for the proposed development.

COMMENTS ON OUT FINDINGS.

We were instructed to attend site to carry out a connectivity survey on the open ditches and to gain inverts of existing foul and surface water chambers around the proposed development.

We have proved that the two ditches (A) & (B) are connected together with an underground drainage system although this is only 6" in diameter. We were unable to prove any positive connection marked (D) on the drawing where the open ditches actually discharge. It appears that any water just soaks away to ground at that point and also the whole length of the ditch.

We were asked to check if there was a connection coming into the open ditch marked (E) on the drawing. There is no sign of any drainage system entering the ditch at that position. Please note that there is a large hard standing area where there were a load of wagon trailers parked up and it looks as though this area just allows the surface water to fall into the open ditch at position (E).

Please see drawing for reference.

END OF SURVEY.

Appendix D

Melia Smith and Jones		Page 1
Vinery Court 58 Cardigan Lane Leeds LS4 2LD	Naylor Naylors Office, Barugh Green Existing Calculations	
Date 25/11/2021 11:51 File 221070 - Existing Drain...	Designed by LW Checked by MH	
Innovyze	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.352	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
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)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.027	4-8	0.376	8-12	0.099

Total Area Contributing (ha) = 0.501

Total Pipe Volume (m³) = 52.722

Network Design Table for Storm

- Indicates pipe length does not match coordinates
« - 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	28.000	0.186	150.5	0.017	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	26.000	0.186	139.8	0.017	5.00	0.0	0.600	o	150	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	5.57	71.300	0.017	0.0	0.0	0.0	0.82	14.4	2.3
S2.000	50.00	5.51	71.300	0.017	0.0	0.0	0.0	0.85	15.0	2.3

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.001	18.000	0.170	105.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.000	28.000	0.306	91.5	0.017	5.00	0.0	0.600	o	150	Pipe/Conduit	
S4.000	26.000	0.306	85.0	0.017	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	9.000	0.204	44.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S5.000	16.000#	0.230	69.6	0.041	5.00	0.0	0.600	o	150	Pipe/Conduit	
S5.001	5.000	0.150	33.3	0.140	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	8.000	0.100	80.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	32.000	0.321	99.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S6.000	60.023	0.960	62.5	0.037	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	34.904	1.039	33.6	0.035	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.006	34.659	1.044	33.2	0.039	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	27.792	0.190	146.3	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.008	18.645	0.107	174.3	0.084	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.009	85.160	0.568	149.9	0.017	0.00	0.0	0.600	o	750	Pipe/Conduit	
S1.010	97.602	0.651	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)
S1.001	50.00	5.88	71.114	0.034	0.0	0.0	0.0	0.98	17.3	4.6
S3.000	50.00	5.44	71.250	0.017	0.0	0.0	0.0	1.05	18.6	2.3
S4.000	50.00	5.40	71.250	0.017	0.0	0.0	0.0	1.09	19.3	2.3
S1.002	50.00	5.98	70.944	0.068	0.0	0.0	0.0	1.52	26.8	9.2
S5.000	50.00	5.22	71.120	0.041	0.0	0.0	0.0	1.21	21.3	5.6
S5.001	50.00	5.26	70.890	0.181	0.0	0.0	0.0	2.27	90.4	24.5
S1.003	50.00	6.07	70.570	0.249	0.0	0.0	0.0	1.46	58.2	33.7
S1.004	50.00	6.60	70.470	0.249	0.0	0.0	0.0	1.01	17.8«	33.7
S6.000	50.00	5.79	71.020	0.037	0.0	0.0	0.0	1.27	22.5	5.0
S1.005	50.00	6.93	70.060	0.321	0.0	0.0	0.0	1.74	30.8«	43.5
S1.006	50.00	7.19	68.945	0.360	0.0	0.0	0.0	2.28	90.6	48.7
S1.007	50.00	7.62	67.901	0.400	0.0	0.0	0.0	1.08	42.9«	54.2
S1.008	50.00	7.88	67.636	0.484	0.0	0.0	0.0	1.19	84.0	65.5
S1.009	50.00	8.50	67.079	0.501	0.0	0.0	0.0	2.28	1008.7	67.8
S1.010	50.00	10.03	66.511	0.501	0.0	0.0	0.0	1.07	42.4«	67.8

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.011	50.042	0.334	149.8	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)
S1.011	50.00	10.81	65.860	0.501	0.0	0.0	0.0	1.07	42.4«	67.8

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	1.000
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: SW Ex 10, DS/PN: S1.004, Volume (m³): 1.7

Unit Reference	MD-SHE-0098-5000-1500-5000
Design Head (m)	1.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	70.470
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0
Flush-Flo™	0.431	4.9
Kick-Flo®	0.878	3.9
Mean Flow over Head Range	-	4.3

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)
0.100	3.2	1.200	4.5	3.000	6.9	7.000	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.7
0.300	4.8	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.9	1.800	5.4	4.500	8.4	8.500	11.3
0.500	4.9	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.8	2.200	6.0	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.5	6.500	10.0		

Hydro-Brake® Optimum Manhole: SW Ex 17, DS/PN: S1.010, Volume (m³): 45.7

Unit Reference	MD-SHE-0146-1500-3000-1500
Design Head (m)	3.000
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	146
Invert Level (m)	66.511
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

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Hydro-Brake® Optimum Manhole: SW Ex 17, DS/PN: S1.010, Volume (m³): 45.7

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	15.0
Flush-Flo™	0.636	12.9
Kick-Flo®	1.307	10.1
Mean Flow over Head Range	-	12.0

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	5.3	1.200	11.1	3.000	15.0	7.000	22.5
0.200	10.4	1.400	10.4	3.500	16.1	7.500	23.2
0.300	11.7	1.600	11.1	4.000	17.2	8.000	24.0
0.400	12.4	1.800	11.8	4.500	18.2	8.500	24.7
0.500	12.7	2.000	12.4	5.000	19.1	9.000	25.4
0.600	12.8	2.200	12.9	5.500	20.0	9.500	26.0
0.800	12.7	2.400	13.5	6.000	20.9		
1.000	12.2	2.600	14.0	6.500	21.7		

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Storage Structures for Storm

Cellular Storage Manhole: SW Ex 10, DS/PN: S1.004

Invert Level (m) 70.475 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	180.0	0.0	0.300	180.0	0.0
0.100	180.0	0.0	0.400	180.0	0.0
0.200	180.0	0.0	0.401	0.0	0.0

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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	1.000
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 Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SW Ex 1	15 Winter	2	+0%	100/15 Summer	100/15 Winter	
S2.000	SW Ex 2	15 Winter	2	+0%	100/15 Summer		
S1.001	SW Ex 3	15 Winter	2	+0%	100/15 Summer		
S3.000	SW Ex 5	15 Winter	2	+0%	100/15 Summer		
S4.000	SW Ex 4	15 Winter	2	+0%	100/15 Summer		
S1.002	SW Ex 6	15 Winter	2	+0%	30/15 Summer		
S5.000	SW Ex 7	15 Winter	2	+0%	100/15 Summer		
S5.001	SW Ex 8	15 Winter	2	+0%	30/15 Summer		
S1.003	SW Ex Tank	15 Winter	2	+0%	30/15 Summer	100/30 Winter	
S1.004	SW Ex 10	120 Winter	2	+0%	2/60 Winter	100/30 Winter	
S6.000	SW Ex 11	15 Winter	2	+0%	100/15 Summer		
S1.005	SW Ex 12	15 Winter	2	+0%	100/15 Summer		
S1.006	SW Ex 13	15 Winter	2	+0%	100/15 Summer		
S1.007	SW Ex 14	15 Winter	2	+0%	30/15 Summer		
S1.008	SW Ex 15	15 Winter	2	+0%	30/15 Summer	100/15 Winter	
S1.009	SW Ex 16	15 Winter	2	+0%	100/15 Summer	100/15 Winter	
S1.010	SW Ex 17	30 Winter	2	+0%	2/15 Summer		

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SW Ex 1		71.348	-0.102	0.000	0.22			3.0
S2.000	SW Ex 2		71.347	-0.103	0.000	0.21			3.0
S1.001	SW Ex 3		71.177	-0.087	0.000	0.37			6.0
S3.000	SW Ex 5		71.292	-0.108	0.000	0.17			3.0
S4.000	SW Ex 4		71.291	-0.109	0.000	0.16			3.0
S1.002	SW Ex 6		71.019	-0.075	0.000	0.51			11.9
S5.000	SW Ex 7		71.184	-0.086	0.000	0.37			7.4
S5.001	SW Ex 8		70.995	-0.120	0.000	0.44			28.6
S1.003	SW Ex Tank		70.733	-0.062	0.000	0.87			40.5
S1.004	SW Ex 10		70.629	0.009	0.000	0.24		84	4.2
S6.000	SW Ex 11		71.077	-0.093	0.000	0.29			6.5
S1.005	SW Ex 12		70.130	-0.080	0.000	0.43			12.9
S1.006	SW Ex 13		69.016	-0.154	0.000	0.22			18.6
S1.007	SW Ex 14		68.029	-0.097	0.000	0.61			24.2
S1.008	SW Ex 15		67.788	-0.148	0.000	0.50			36.2
S1.009	SW Ex 16		67.179	-0.650	0.000	0.04			38.5
S1.010	SW Ex 17		67.053	0.317	0.000	0.30			12.6

PN	US/MH Name	Status	Level Exceeded
S1.000	SW Ex 1	OK	1
S2.000	SW Ex 2	OK	
S1.001	SW Ex 3	OK	
S3.000	SW Ex 5	OK	
S4.000	SW Ex 4	OK	
S1.002	SW Ex 6	OK	
S5.000	SW Ex 7	OK	
S5.001	SW Ex 8	OK	
S1.003	SW Ex Tank	OK	17
S1.004	SW Ex 10	SURCHARGED	17
S6.000	SW Ex 11	OK	
S1.005	SW Ex 12	OK	
S1.006	SW Ex 13	OK	
S1.007	SW Ex 14	OK	
S1.008	SW Ex 15	OK	13
S1.009	SW Ex 16	OK	13
S1.010	SW Ex 17	SURCHARGED	

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.011	SW Ex 18	60 Summer	2	+0%					65.946

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.011	SW Ex 18	-0.139	0.000	0.31			12.6	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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	1.000
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 Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SW Ex 1	15 Winter	30	+0%	100/15 Summer	100/15 Winter	
S2.000	SW Ex 2	15 Winter	30	+0%	100/15 Summer		
S1.001	SW Ex 3	15 Winter	30	+0%	100/15 Summer		
S3.000	SW Ex 5	15 Winter	30	+0%	100/15 Summer		
S4.000	SW Ex 4	15 Winter	30	+0%	100/15 Summer		
S1.002	SW Ex 6	15 Winter	30	+0%	30/15 Summer		
S5.000	SW Ex 7	15 Winter	30	+0%	100/15 Summer		
S5.001	SW Ex 8	15 Winter	30	+0%	30/15 Summer		
S1.003	SW Ex Tank	15 Winter	30	+0%	30/15 Summer	100/30 Winter	
S1.004	SW Ex 10	120 Winter	30	+0%	2/60 Winter	100/30 Winter	
S6.000	SW Ex 11	15 Winter	30	+0%	100/15 Summer		
S1.005	SW Ex 12	15 Winter	30	+0%	100/15 Summer		
S1.006	SW Ex 13	15 Winter	30	+0%	100/15 Summer		
S1.007	SW Ex 14	15 Winter	30	+0%	30/15 Summer		
S1.008	SW Ex 15	15 Winter	30	+0%	30/15 Summer	100/15 Winter	
S1.009	SW Ex 16	60 Winter	30	+0%	100/15 Summer	100/15 Winter	
S1.010	SW Ex 17	60 Winter	30	+0%	2/15 Summer		

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SW Ex 1		71.368	-0.082	0.000	0.41			5.7
S2.000	SW Ex 2		71.367	-0.083	0.000	0.40			5.7
S1.001	SW Ex 3		71.215	-0.049	0.000	0.69			11.1
S3.000	SW Ex 5		71.309	-0.091	0.000	0.32			5.7
S4.000	SW Ex 4		71.308	-0.092	0.000	0.31			5.7
S1.002	SW Ex 6		71.141	0.047	0.000	1.03			24.3
S5.000	SW Ex 7		71.239	-0.031	0.000	0.71			14.1
S5.001	SW Ex 8		71.129	0.014	0.000	0.96			63.4
S1.003	SW Ex Tank		70.988	0.193	0.000	1.73			80.7
S1.004	SW Ex 10		70.796	0.176	0.000	0.28		115	4.8
S6.000	SW Ex 11		71.102	-0.068	0.000	0.56			12.3
S1.005	SW Ex 12		70.175	-0.035	0.000	0.91			27.1
S1.006	SW Ex 13		69.056	-0.114	0.000	0.47			40.1
S1.007	SW Ex 14		68.287	0.161	0.000	1.32			52.8
S1.008	SW Ex 15		67.946	0.010	0.000	1.09			79.4
S1.009	SW Ex 16		67.628	-0.201	0.000	0.05			47.8
S1.010	SW Ex 17		67.626	0.890	0.000	0.30			12.4

PN	US/MH Name	Status	Level Exceeded
S1.000	SW Ex 1	OK	1
S2.000	SW Ex 2	OK	
S1.001	SW Ex 3	OK	
S3.000	SW Ex 5	OK	
S4.000	SW Ex 4	OK	
S1.002	SW Ex 6	SURCHARGED	
S5.000	SW Ex 7	OK	
S5.001	SW Ex 8	SURCHARGED	
S1.003	SW Ex Tank	SURCHARGED	17
S1.004	SW Ex 10	SURCHARGED	17
S6.000	SW Ex 11	OK	
S1.005	SW Ex 12	OK	
S1.006	SW Ex 13	OK	
S1.007	SW Ex 14	SURCHARGED	
S1.008	SW Ex 15	SURCHARGED	13
S1.009	SW Ex 16	OK	13
S1.010	SW Ex 17	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.011	SW Ex 18	480 Summer	30	+0%					65.946

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.011	SW Ex 18	-0.139	0.000	0.31			12.6	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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	1.000
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 Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SW Ex 1	15 Winter	100	+40%	100/15 Summer	100/15 Winter	
S2.000	SW Ex 2	15 Winter	100	+40%	100/15 Summer		
S1.001	SW Ex 3	60 Winter	100	+40%	100/15 Summer		
S3.000	SW Ex 5	60 Winter	100	+40%	100/15 Summer		
S4.000	SW Ex 4	60 Winter	100	+40%	100/15 Summer		
S1.002	SW Ex 6	60 Winter	100	+40%	30/15 Summer		
S5.000	SW Ex 7	15 Winter	100	+40%	100/15 Summer		
S5.001	SW Ex 8	60 Winter	100	+40%	30/15 Summer		
S1.003	SW Ex Tank	180 Winter	100	+40%	30/15 Summer	100/30 Winter	
S1.004	SW Ex 10	180 Winter	100	+40%	2/60 Winter	100/30 Winter	
S6.000	SW Ex 11	15 Winter	100	+40%	100/15 Summer		
S1.005	SW Ex 12	15 Winter	100	+40%	100/15 Summer		
S1.006	SW Ex 13	30 Winter	100	+40%	100/15 Summer		
S1.007	SW Ex 14	30 Winter	100	+40%	30/15 Summer		

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SW Ex 1		71.850	0.400	0.002	0.62			8.5
S2.000	SW Ex 2		71.848	0.398	0.000	0.60			8.6
S1.001	SW Ex 3		71.831	0.567	0.000	0.65			10.5
S3.000	SW Ex 5		71.821	0.421	0.000	0.31			5.5
S4.000	SW Ex 4		71.821	0.421	0.000	0.30			5.5
S1.002	SW Ex 6		71.805	0.711	0.000	0.79			18.8
S5.000	SW Ex 7		71.922	0.652	0.000	1.40			27.7
S5.001	SW Ex 8		71.811	0.696	0.000	0.87			57.2
S1.003	SW Ex Tank		71.773	0.978	22.651	0.78			36.3
S1.004	SW Ex 10		71.767	1.147	16.788	0.28			4.8
S6.000	SW Ex 11		71.550	0.380	0.000	0.88			19.4
S1.005	SW Ex 12		70.795	0.585	0.000	1.19			35.5
S1.006	SW Ex 13		69.842	0.672	0.000	0.61			52.0
S1.007	SW Ex 14		69.666	1.540	0.000	1.77			70.5

PN	US/MH Name	Status	Level Exceeded
S1.000	SW Ex 1	FLOOD	1
S2.000	SW Ex 2	FLOOD RISK	
S1.001	SW Ex 3	FLOOD RISK	
S3.000	SW Ex 5	FLOOD RISK	
S4.000	SW Ex 4	FLOOD RISK	
S1.002	SW Ex 6	FLOOD RISK	
S5.000	SW Ex 7	FLOOD RISK	
S5.001	SW Ex 8	FLOOD RISK	
S1.003	SW Ex Tank	FLOOD	17
S1.004	SW Ex 10	FLOOD	17
S6.000	SW Ex 11	SURCHARGED	
S1.005	SW Ex 12	SURCHARGED	
S1.006	SW Ex 13	SURCHARGED	
S1.007	SW Ex 14	FLOOD RISK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.008	SW Ex 15	60 Winter	100	+40%	30/15 Summer	100/15 Winter		
S1.009	SW Ex 16	60 Summer	100	+40%	100/15 Summer	100/15 Winter		
S1.010	SW Ex 17	30 Winter	100	+40%	2/15 Summer			
S1.011	SW Ex 18	60 Winter	100	+40%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.008	SW Ex 15	69.448	1.512	28.538	1.09			78.9	FLOOD
S1.009	SW Ex 16	69.451	1.622	1.148	0.10			94.5	FLOOD
S1.010	SW Ex 17	69.508	2.772	0.000	0.36			14.8	SURCHARGED
S1.011	SW Ex 18	65.954	-0.131	0.000	0.36			14.8	OK

PN	US/MH Name	Level Exceeded
S1.008	SW Ex 15	13
S1.009	SW Ex 16	13
S1.010	SW Ex 17	
S1.011	SW Ex 18	

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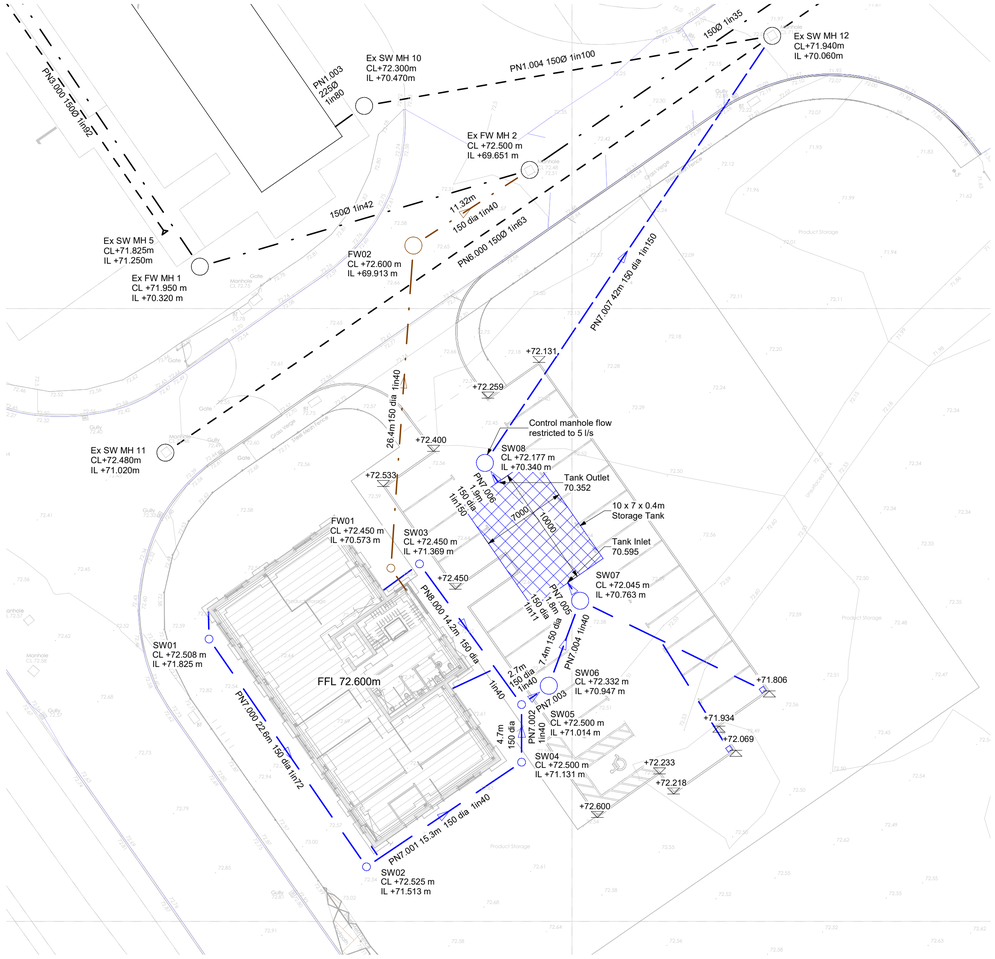
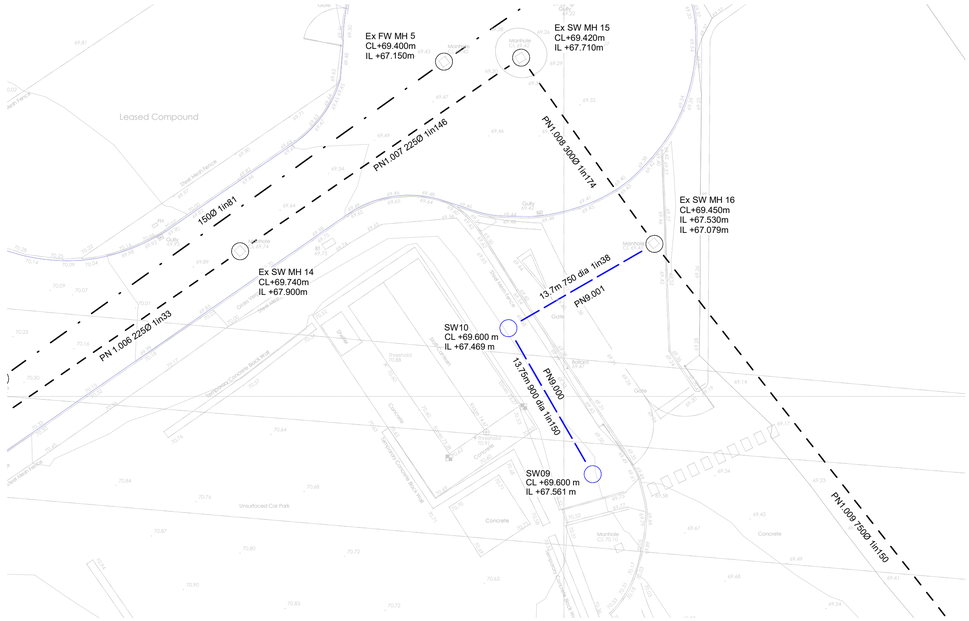
Appendix E

Appendix E



2 Drainage Layout 1
1 : 250



3 Drainage Layout 2
1 : 250

KEY

- Surface Water Drainage
- Foul Water Drainage
- Existing Surface Water
- Existing Foul Water

Drainage Notes

1. Underground drains for foul and surface water drainage shall be as follows:-
   Twin wall plastic to BS 13476
2. Manhole covers to be as follows:-
   D400 in parking areas
   A15 in non-parking areas
3. Rainwater and foul outlet positions to be confirmed by Architect.
4. Drains passing through manhole walls to be built in. A flexible joint shall be provided within 150mm of the face of the wall with a further flexible joint within 600mm of the first joint.
5. All gullies, rest bends, drainage channels, rodding eyes and attachments are to be installed strictly in accordance with the manufacturers printed instructions.
6. The drainage shall be installed and tested strictly in accordance with the manufacturers printed instructions, BS 8000, BS 8301 and Local Authority byelaws.
7. All existing manhole positions, invert levels & pipe sizes are to be confirmed on site by the contractor prior to commencement of work on site and be reported to MSJ.
8. All in-situ concrete to comply with BS 8500.
9. All precast concrete items to comply with BS 5911.
10. Sulphate resisting cement (C20-DC2) and pre-cast concrete products must be used or a laboratory report provided proving that such measures are not necessary.
11. All private drainage works to comply with Approved Document 'H' of the Building Regulations.
12. All gullies and rainwater outlets are to be trapped.

CDM Regulations - Drainage

1. All design work has been carried out with health & safety aspects given full consideration. Wherever possible risks have been eliminated from the design, however due to the nature of this type of work it is not possible to remove all risk.

The contractor shall provide satisfactory responses via suitable method statements as to the manner in which they propose to carry out the work and deal with any highlighted risk, in particular the following :-

- All trench excavations, regardless of depth.
- Guarding to edges of excavations to prevent injury.
- Guarding of the works outside normal working hours.
- Undermining of adjacent roads or structures.
- Confined spaces operations.
- Dealing with existing services.
- Traffic management on existing highways.
- Procedures to be followed in the event of an emergency.
- Methods of working where ground contamination may be present.
- Dealing with existing sewer flows.

The above list is by no means exhaustive, but does highlight operations that present a risk to both contractors and the general public.

Rev	Revision Description	By	Chk	Date
P1	First Issue	LW	MH	26.11.21

SCALE @ A1	ISSUING OFFICE	MSJ PROJECT NUMBER
1 : 250	Leeds	221070

STATUS	PURPOSE OF ISSUE
S0	WORK IN PROGRESS

MSJ
Melia Smith & Jones
Melia Smith & Jones
Consulting Civil & Structural Engineers
Vinery Court
58 Cardigan Lane
Leeds LS4 2LD
0113 2306080
www.msj.co.uk

PROJECT

Naylors Office,
Barugh Green

TITLE

Drainage Layout

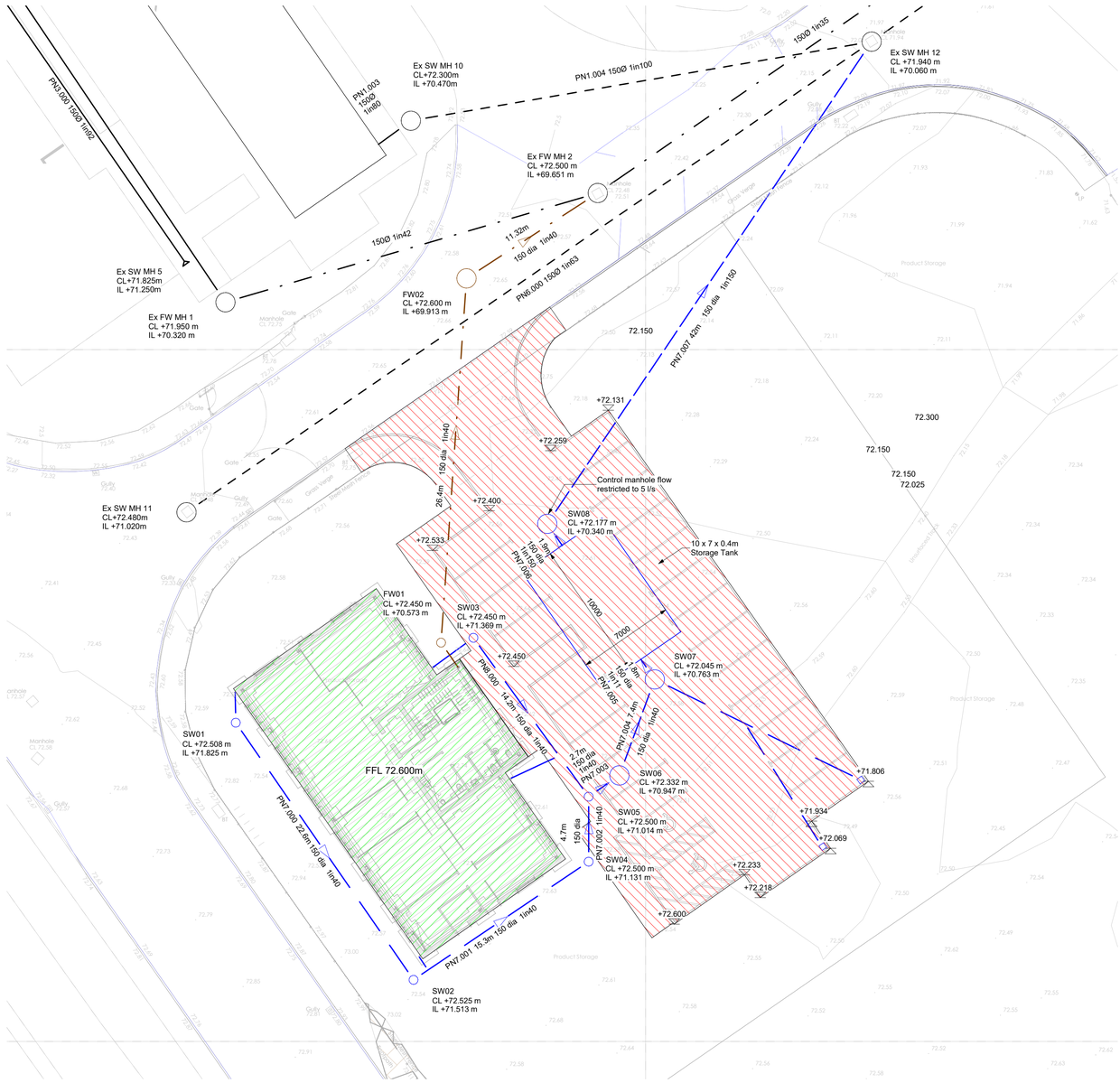
CLIENT

Martin Walsh Architectural

DRAWING NUMBER	REV
221070-MSJ-ZZ-XX-DR-D-4000	P1

Appendix F

Appendix F



1 Impermeable Area Plan
1 : 200

KEY

Car Park 744m²

Proposed Building 318m²

Drainage Notes

1. Underground drains for foul and surface water drainage shall be as follows:-
   Twin wall plastic to BS 13476
2. Manhole covers to be as follows:-
   D400 in parking areas
   A15 in non-parking areas
3. Rainwater and foul outlet positions to be confirmed by Architect.
4. Drains passing through manhole walls to be built in. A flexible joint shall be provided within 150mm of the face of the wall with a further flexible joint within 600mm of the first joint.
5. All gullies, rest bends, drainage channels, rodding eyes and attachments are to be installed strictly in accordance with the manufacturers printed instructions.
6. The drainage shall be installed and tested strictly in accordance with the manufaturers printed instructions, BS 8000, BS 8301 and Local Authority byelaws.
7. All existing manhole positions, invert levels & pipe sizes are to be confirmed on site by the contractor prior to commencement of work on site and be reported to MSJ.
8. All in-situ concrete to comply with BS 8500.
9. All precast concrete items to comply with BS 5911.
10. Sulphate resisting cement (C20-DC2) and pre-cast concrete products must be used or a laboratory report provided proving that such measures are not necessary.
11. All private drainage works to comply with Approved Document 'H' of the Building Regulations.
12. All gullies and rainwater outlets are to be trapped.

CDM Regulations - Drainage

1. All design work has been carried out with health & safety aspects given full consideration. Wherever possible risks have been eliminated from the design, however due to the nature of this type of work it is not possible to remove all risk.

The contractor shall provide satisfactory responses via suitable method statements as to the manner in which they propose to carry out the work and deal with any highlighted risk, in particular the following :-

- All trench excavations, regardless of depth.
- Guarding to edges of excavations to prevent injury.
- Guarding of the works outside normal working hours.
- Undermining of adjacent roads or structures.
- Confined spaces operations.
- Dealing with existing services.
- Traffic management on existing highways.
- Procedures to be followed in the event of an emergency.
- Methods of working where ground contamination may be present.
- Dealing with existing sewer flows.

The above list is by no means exhaustive, but does highlight operations that present a risk to both contractors and the general public.

Rev	Revision Description	By	Chk	Date
P1	First Issue	LW	MH	26.11.21

SCALE @ A1	ISSUING OFFICE	MSJ PROJECT NUMBER
1 : 200	Leeds	221070

STATUS	PURPOSE OF ISSUE
S0	WORK IN PROGRESS

MSJ Melia Smith & Jones
Melia Smith & Jones
Consulting Civil & Structural Engineers
Vinery Court
58 Cardigan Lane
Leeds LS4 2LD
0113 2306080
www.msj.co.uk

PROJECT

Naylors Office,
Barugh Green

TITLE

Impermeable Area Plan

CLIENT

Martin Walsh Architectural

DRAWING NUMBER	REV
221070-MSJ-ZZ-XX-DR-D-4002	P1

Appendix G

Melia Smith and Jones		Page 1
Vinery Court 58 Cardigan Lane Leeds LS4 2LD	Naylor Naylors Office, Barugh Green Proposed Calculations	
Date 25/11/2021 12:33 File 221070 Naylors microdra...	Designed by LW Checked by MH	
Innovyze	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.352	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
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)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.027	4-8	0.451	8-12	0.129

Total Area Contributing (ha) = 0.607

Total Pipe Volume (m³) = 69.512

Network Design Table for Storm

« - 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	26.000	0.186	139.8	0.017	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	28.000	0.186	150.5	0.017	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	18.000	0.170	105.9	0.000	0.00	0.0	0.600	o	150	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	5.51	71.300	0.017	0.0	0.0	0.0	0.85	15.0	2.3
S2.000	50.00	5.57	71.300	0.017	0.0	0.0	0.0	0.82	14.4	2.3
S1.001	50.00	5.88	71.114	0.034	0.0	0.0	0.0	0.98	17.3	4.6

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S3.000	28.000	0.306	91.5	0.017	5.00	0.0	0.600	o	150	Pipe/Conduit	
S4.000	26.000	0.306	85.0	0.017	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	9.000	0.204	44.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S5.000	16.000	0.230	69.6	0.041	5.00	0.0	0.600	o	150	Pipe/Conduit	
S5.001	5.000	0.150	33.3	0.140	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	8.000	0.100	80.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	32.000	0.321	99.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S6.000	60.023	0.960	62.5	0.037	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.000	22.600	0.312	72.4	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.001	15.300	0.383	39.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S7.002	4.700	0.118	39.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S8.000	14.200	0.355	40.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.003	2.700	0.068	39.7	0.032	0.00	0.0	0.600	o	150	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)
S3.000	50.00	5.44	71.250	0.017	0.0	0.0	0.0	1.05	18.6	2.3
S4.000	50.00	5.40	71.250	0.017	0.0	0.0	0.0	1.09	19.3	2.3
S1.002	50.00	5.98	70.944	0.068	0.0	0.0	0.0	1.52	26.8	9.2
S5.000	50.00	5.22	71.120	0.041	0.0	0.0	0.0	1.21	21.3	5.6
S5.001	50.00	5.26	70.890	0.181	0.0	0.0	0.0	2.27	90.4	24.5
S1.003	50.00	6.07	70.570	0.249	0.0	0.0	0.0	1.46	58.2	33.7
S1.004	50.00	6.60	70.470	0.249	0.0	0.0	0.0	1.01	17.8«	33.7
S6.000	50.00	5.79	71.020	0.037	0.0	0.0	0.0	1.27	22.5	5.0
S7.000	50.00	5.32	71.825	0.000	0.0	0.0	0.0	1.18	20.9	0.0
S7.001	50.00	5.48	71.513	0.000	0.0	0.0	0.0	1.60	28.2	0.0
S7.002	50.00	5.53	71.130	0.000	0.0	0.0	0.0	1.60	28.3	0.0
S8.000	50.00	5.15	71.369	0.000	0.0	0.0	0.0	1.60	28.2	0.0
S7.003	50.00	5.56	71.012	0.032	0.0	0.0	0.0	1.60	28.3	4.3

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S7.004	7.400	0.185	40.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S7.005	1.800	0.164	11.0	0.074	0.00	0.0	0.600	o	150	Pipe/Conduit	
S7.006	1.900	0.013	146.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S7.007	42.000	0.280	150.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	34.904	1.039	33.6	0.035	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.006	34.659	1.044	33.2	0.039	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	27.792	0.190	146.3	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.008	18.645	0.107	174.3	0.084	0.00	0.0	0.600	o	300	Pipe/Conduit	
S9.000	13.750	0.092	149.5	0.000	5.00	0.0	0.600	o	900	Pipe/Conduit	
S9.001	13.700	0.359	38.2	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
S1.009	85.160	0.568	149.9	0.017	0.00	0.0	0.600	o	750	Pipe/Conduit	
S1.010	97.602	0.651	149.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.011	50.042	0.334	149.8	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)
S7.004	50.00	5.63	70.944	0.032	0.0	0.0	0.0	1.60	28.2	4.3
S7.005	50.00	5.64	70.759	0.106	0.0	0.0	0.0	3.06	54.1	14.4
S7.006	50.00	5.68	70.352	0.106	0.0	0.0	0.0	0.83	14.7	14.4
S7.007	50.00	6.54	70.339	0.106	0.0	0.0	0.0	0.82	14.5	14.4
S1.005	50.00	6.93	70.060	0.427	0.0	0.0	0.0	1.74	30.8«	57.8
S1.006	50.00	7.19	68.945	0.466	0.0	0.0	0.0	2.28	90.6	63.1
S1.007	50.00	7.62	67.901	0.506	0.0	0.0	0.0	1.08	42.9«	68.5
S1.008	50.00	7.88	67.636	0.590	0.0	0.0	0.0	1.19	84.0	79.9
S9.000	50.00	5.09	67.561	0.000	0.0	0.0	0.0	2.56	1629.2	0.0
S9.001	50.00	5.14	67.469	0.000	0.0	0.0	0.0	4.54	2005.1	0.0
S1.009	50.00	8.50	67.079	0.607	0.0	0.0	0.0	2.28	1008.7	82.2
S1.010	50.00	10.03	66.511	0.607	0.0	0.0	0.0	1.07	42.4«	82.2
S1.011	50.00	10.81	65.860	0.607	0.0	0.0	0.0	1.07	42.4«	82.2

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	1.000
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: SW Ex 10, DS/PN: S1.004, Volume (m³): 1.7

Unit Reference	MD-SHE-0098-5000-1500-5000
Design Head (m)	1.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	70.470
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0
Flush-Flo™	0.431	4.9
Kick-Flo®	0.878	3.9
Mean Flow over Head Range	-	4.3

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)
0.100	3.2	1.200	4.5	3.000	6.9	7.000	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.7
0.300	4.8	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.9	1.800	5.4	4.500	8.4	8.500	11.3
0.500	4.9	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.8	2.200	6.0	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.5	6.500	10.0		

Hydro-Brake® Optimum Manhole: S8, DS/PN: S7.007, Volume (m³): 2.1

Unit Reference	MD-SHE-0098-5000-1500-5000
Design Head (m)	1.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	70.339
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum Manhole: S8, DS/PN: S7.007, Volume (m³): 2.1

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0
Flush-Flo™	0.431	4.9
Kick-Flo®	0.878	3.9
Mean Flow over Head Range	-	4.3

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)
0.100	3.2	1.200	4.5	3.000	6.9	7.000	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.7
0.300	4.8	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.9	1.800	5.4	4.500	8.4	8.500	11.3
0.500	4.9	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.8	2.200	6.0	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.5	6.500	10.0		

Hydro-Brake® Optimum Manhole: SW Ex 17, DS/PN: S1.010, Volume (m³): 45.7

Unit Reference	MD-SHE-0146-1500-3000-1500
Design Head (m)	3.000
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	146
Invert Level (m)	66.511
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	15.0
Flush-Flo™	0.636	12.9
Kick-Flo®	1.307	10.1
Mean Flow over Head Range	-	12.0

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	5.3	0.300	11.7	0.500	12.7	0.800	12.7
0.200	10.4	0.400	12.4	0.600	12.8	1.000	12.2

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Hydro-Brake® Optimum Manhole: SW Ex 17, DS/PN: S1.010, Volume (m³): 45.7

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	11.1	2.400	13.5	5.000	19.1	8.000	24.0
1.400	10.4	2.600	14.0	5.500	20.0	8.500	24.7
1.600	11.1	3.000	15.0	6.000	20.9	9.000	25.4
1.800	11.8	3.500	16.1	6.500	21.7	9.500	26.0
2.000	12.4	4.000	17.2	7.000	22.5		
2.200	12.9	4.500	18.2	7.500	23.2		

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Storage Structures for Storm

Cellular Storage Manhole: SW Ex 10, DS/PN: S1.004

Invert Level (m) 70.475 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	180.0	0.0	0.300	180.0	0.0
0.100	180.0	0.0	0.400	180.0	0.0
0.200	180.0	0.0	0.401	0.0	0.0

Cellular Storage Manhole: STank, DS/PN: S7.006

Invert Level (m) 70.352 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	70.0	0.0	0.300	70.0	0.0
0.100	70.0	0.0	0.400	70.0	0.0
0.200	70.0	0.0	0.401	0.0	0.0

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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	1.000
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 Storage Structures	2
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SW Ex 2	15 Winter	2	+0%	100/15 Summer		
S2.000	SW Ex 1	15 Winter	2	+0%	100/15 Summer	100/15 Winter	
S1.001	SW Ex 3	15 Winter	2	+0%	100/15 Summer		
S3.000	SW Ex 5	15 Winter	2	+0%	100/15 Summer		
S4.000	SW Ex 4	15 Winter	2	+0%	100/15 Summer		
S1.002	SW Ex 6	15 Winter	2	+0%	30/15 Summer		
S5.000	SW Ex 7	15 Winter	2	+0%	100/15 Summer		
S5.001	SW Ex 8	15 Winter	2	+0%	30/15 Summer		
S1.003	SW Ex Tank	15 Winter	2	+0%	30/15 Summer	100/30 Winter	
S1.004	SW Ex 10	120 Winter	2	+0%	2/60 Winter	100/30 Winter	
S6.000	SW Ex 11	15 Winter	2	+0%	100/15 Summer		
S7.000	S1	15 Summer	2	+0%			
S7.001	S2	15 Summer	2	+0%	100/30 Winter		
S7.002	S4	15 Summer	2	+0%	100/15 Summer		
S8.000	S3	15 Summer	2	+0%	100/30 Winter		
S7.003	S5	15 Winter	2	+0%	100/15 Summer		
S7.004	S6	15 Winter	2	+0%	100/15 Summer		

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SW Ex 2		71.347	-0.103	0.000	0.21			3.0
S2.000	SW Ex 1		71.348	-0.102	0.000	0.22			3.0
S1.001	SW Ex 3		71.177	-0.087	0.000	0.37			6.0
S3.000	SW Ex 5		71.292	-0.108	0.000	0.17			3.0
S4.000	SW Ex 4		71.291	-0.109	0.000	0.16			3.0
S1.002	SW Ex 6		71.019	-0.075	0.000	0.51			11.9
S5.000	SW Ex 7		71.184	-0.086	0.000	0.37			7.4
S5.001	SW Ex 8		70.995	-0.120	0.000	0.44			28.6
S1.003	SW Ex Tank		70.733	-0.062	0.000	0.87			40.5
S1.004	SW Ex 10		70.629	0.009	0.000	0.24		85	4.2
S6.000	SW Ex 11		71.077	-0.093	0.000	0.29			6.5
S7.000	S1		71.825	-0.150	0.000	0.00			0.0
S7.001	S2		71.513	-0.150	0.000	0.00			0.0
S7.002	S4		71.130	-0.150	0.000	0.00			0.0
S8.000	S3		71.369	-0.150	0.000	0.00			0.0
S7.003	S5		71.062	-0.100	0.000	0.24			4.9
S7.004	S6		70.990	-0.104	0.000	0.20			4.9

PN	US/MH Name	Status	Level Exceeded
S1.000	SW Ex 2	OK	
S2.000	SW Ex 1	OK	1
S1.001	SW Ex 3	OK	
S3.000	SW Ex 5	OK	
S4.000	SW Ex 4	OK	
S1.002	SW Ex 6	OK	
S5.000	SW Ex 7	OK	
S5.001	SW Ex 8	OK	
S1.003	SW Ex Tank	OK	17
S1.004	SW Ex 10	SURCHARGED	17
S6.000	SW Ex 11	OK	
S7.000	S1	OK	
S7.001	S2	OK	
S7.002	S4	OK	
S8.000	S3	OK	
S7.003	S5	OK	
S7.004	S6	OK	

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S7.005	S7	15 Winter	2	+0%	30/15 Summer			
S7.006	STank	60 Winter	2	+0%	30/15 Summer	100/60 Winter		
S7.007	S8	60 Winter	2	+0%	30/15 Summer			
S1.005	SW Ex 12	15 Winter	2	+0%	100/15 Summer			
S1.006	SW Ex 13	15 Winter	2	+0%	100/15 Summer			
S1.007	SW Ex 14	15 Winter	2	+0%	30/15 Summer			
S1.008	SW Ex 15	15 Winter	2	+0%	30/15 Summer	100/30 Winter		
S9.000	S9	15 Summer	2	+0%	100/30 Summer			
S9.001	S10	15 Summer	2	+0%	100/15 Winter			
S1.009	SW Ex 16	15 Winter	2	+0%	30/120 Winter	100/30 Winter		
S1.010	SW Ex 17	60 Winter	2	+0%	2/15 Summer			
S1.011	SW Ex 18	180 Winter	2	+0%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S7.005	S7	70.836	-0.073	0.000	0.51			16.1	OK
S7.006	STank	70.471	-0.031	0.000	0.42		33	4.9	OK
S7.007	S8	70.488	-0.001	0.000	0.28			3.9	OK
S1.005	SW Ex 12	70.135	-0.075	0.000	0.50			14.7	OK
S1.006	SW Ex 13	69.019	-0.151	0.000	0.23			20.0	OK
S1.007	SW Ex 14	68.034	-0.092	0.000	0.64			25.6	OK
S1.008	SW Ex 15	67.790	-0.146	0.000	0.51			37.3	OK
S9.000	S9	67.561	-0.900	0.000	0.00			0.0	OK
S9.001	S10	67.469	-0.750	0.000	0.00			0.0	OK
S1.009	SW Ex 16	67.180	-0.649	0.000	0.04			39.2	OK
S1.010	SW Ex 17	67.112	0.376	0.000	0.30			12.6	SURCHARGED
S1.011	SW Ex 18	65.946	-0.139	0.000	0.31			12.6	OK

PN	US/MH Name	Level Exceeded
S7.005	S7	
S7.006	STank	2
S7.007	S8	
S1.005	SW Ex 12	
S1.006	SW Ex 13	
S1.007	SW Ex 14	
S1.008	SW Ex 15	15
S9.000	S9	
S9.001	S10	
S1.009	SW Ex 16	14
S1.010	SW Ex 17	
S1.011	SW Ex 18	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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	1.000
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 Storage Structures	2
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SW Ex 2	15 Winter	30	+0%	100/15 Summer		
S2.000	SW Ex 1	15 Winter	30	+0%	100/15 Summer	100/15 Winter	
S1.001	SW Ex 3	15 Winter	30	+0%	100/15 Summer		
S3.000	SW Ex 5	15 Winter	30	+0%	100/15 Summer		
S4.000	SW Ex 4	15 Winter	30	+0%	100/15 Summer		
S1.002	SW Ex 6	15 Winter	30	+0%	30/15 Summer		
S5.000	SW Ex 7	15 Winter	30	+0%	100/15 Summer		
S5.001	SW Ex 8	15 Winter	30	+0%	30/15 Summer		
S1.003	SW Ex Tank	15 Winter	30	+0%	30/15 Summer	100/30 Winter	
S1.004	SW Ex 10	120 Winter	30	+0%	2/60 Winter	100/30 Winter	
S6.000	SW Ex 11	15 Winter	30	+0%	100/15 Summer		
S7.000	S1	15 Summer	30	+0%			
S7.001	S2	15 Summer	30	+0%	100/30 Winter		
S7.002	S4	15 Summer	30	+0%	100/15 Summer		
S8.000	S3	15 Summer	30	+0%	100/30 Winter		
S7.003	S5	15 Winter	30	+0%	100/15 Summer		
S7.004	S6	15 Winter	30	+0%	100/15 Summer		

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SW Ex 2		71.367	-0.083	0.000	0.40			5.7
S2.000	SW Ex 1		71.368	-0.082	0.000	0.41			5.7
S1.001	SW Ex 3		71.215	-0.049	0.000	0.69			11.1
S3.000	SW Ex 5		71.309	-0.091	0.000	0.32			5.7
S4.000	SW Ex 4		71.308	-0.092	0.000	0.31			5.7
S1.002	SW Ex 6		71.141	0.047	0.000	1.03			24.3
S5.000	SW Ex 7		71.239	-0.031	0.000	0.71			14.1
S5.001	SW Ex 8		71.129	0.014	0.000	0.96			63.4
S1.003	SW Ex Tank		70.988	0.193	0.000	1.73			80.7
S1.004	SW Ex 10		70.797	0.177	0.000	0.28		114	4.8
S6.000	SW Ex 11		71.102	-0.068	0.000	0.56			12.3
S7.000	S1		71.825	-0.150	0.000	0.00			0.0
S7.001	S2		71.513	-0.150	0.000	0.00			0.0
S7.002	S4		71.130	-0.150	0.000	0.00			0.0
S8.000	S3		71.369	-0.150	0.000	0.00			0.0
S7.003	S5		71.094	-0.068	0.000	0.58			11.7
S7.004	S6		71.025	-0.069	0.000	0.48			11.6

PN	US/MH Name	Status	Level Exceeded
S1.000	SW Ex 2	OK	
S2.000	SW Ex 1	OK	1
S1.001	SW Ex 3	OK	
S3.000	SW Ex 5	OK	
S4.000	SW Ex 4	OK	
S1.002	SW Ex 6	SURCHARGED	
S5.000	SW Ex 7	OK	
S5.001	SW Ex 8	SURCHARGED	
S1.003	SW Ex Tank	SURCHARGED	17
S1.004	SW Ex 10	SURCHARGED	17
S6.000	SW Ex 11	OK	
S7.000	S1	OK	
S7.001	S2	OK	
S7.002	S4	OK	
S8.000	S3	OK	
S7.003	S5	OK	
S7.004	S6	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S7.005	S7	15 Winter	30	+0%	30/15 Summer			
S7.006	STank	60 Winter	30	+0%	30/15 Summer	100/60 Winter		
S7.007	S8	60 Winter	30	+0%	30/15 Summer			
S1.005	SW Ex 12	15 Winter	30	+0%	100/15 Summer			
S1.006	SW Ex 13	15 Winter	30	+0%	100/15 Summer			
S1.007	SW Ex 14	15 Winter	30	+0%	30/15 Summer			
S1.008	SW Ex 15	120 Winter	30	+0%	30/15 Summer	100/30 Winter		
S9.000	S9	120 Winter	30	+0%	100/30 Summer			
S9.001	S10	120 Winter	30	+0%	100/15 Winter			
S1.009	SW Ex 16	120 Winter	30	+0%	30/120 Winter	100/30 Winter		
S1.010	SW Ex 17	120 Winter	30	+0%	2/15 Summer			
S1.011	SW Ex 18	600 Winter	30	+0%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S7.005	S7	70.982	0.073	0.000	1.21			38.4	SURCHARGED
S7.006	STank	70.609	0.107	0.000	0.40		45	4.7	SURCHARGED
S7.007	S8	70.604	0.115	0.000	0.33			4.7	SURCHARGED
S1.005	SW Ex 12	70.197	-0.013	0.000	1.00			29.7	OK
S1.006	SW Ex 13	69.059	-0.111	0.000	0.49			42.2	OK
S1.007	SW Ex 14	68.315	0.189	0.000	1.37			54.5	SURCHARGED
S1.008	SW Ex 15	67.972	0.036	0.000	0.47			34.0	SURCHARGED
S9.000	S9	67.961	-0.500	0.000	0.00			0.4	OK
S9.001	S10	67.961	-0.258	0.000	0.00			1.8	OK
S1.009	SW Ex 16	67.961	0.132	0.000	0.04			35.0	SURCHARGED
S1.010	SW Ex 17	67.959	1.223	0.000	0.30			12.5	SURCHARGED
S1.011	SW Ex 18	65.946	-0.139	0.000	0.31			12.6	OK

PN	US/MH Name	Level Exceeded
S7.005	S7	
S7.006	STank	2
S7.007	S8	
S1.005	SW Ex 12	
S1.006	SW Ex 13	
S1.007	SW Ex 14	
S1.008	SW Ex 15	15
S9.000	S9	
S9.001	S10	
S1.009	SW Ex 16	14
S1.010	SW Ex 17	
S1.011	SW Ex 18	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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	1.000
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 Storage Structures	2
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SW Ex 2	15 Winter	100	+40%	100/15 Summer		
S2.000	SW Ex 1	15 Winter	100	+40%	100/15 Summer	100/15 Winter	
S1.001	SW Ex 3	60 Winter	100	+40%	100/15 Summer		
S3.000	SW Ex 5	60 Winter	100	+40%	100/15 Summer		
S4.000	SW Ex 4	60 Winter	100	+40%	100/15 Summer		
S1.002	SW Ex 6	60 Winter	100	+40%	30/15 Summer		
S5.000	SW Ex 7	15 Winter	100	+40%	100/15 Summer		
S5.001	SW Ex 8	60 Winter	100	+40%	30/15 Summer		
S1.003	SW Ex Tank	180 Winter	100	+40%	30/15 Summer	100/30 Winter	
S1.004	SW Ex 10	180 Winter	100	+40%	2/60 Winter	100/30 Winter	
S6.000	SW Ex 11	15 Winter	100	+40%	100/15 Summer		
S7.000	S1	60 Winter	100	+40%			
S7.001	S2	60 Winter	100	+40%	100/30 Winter		
S7.002	S4	60 Winter	100	+40%	100/15 Summer		

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SW Ex 2		71.848	0.398	0.000	0.60			8.6
S2.000	SW Ex 1		71.850	0.400	0.002	0.62			8.5
S1.001	SW Ex 3		71.831	0.567	0.000	0.65			10.5
S3.000	SW Ex 5		71.821	0.421	0.000	0.31			5.5
S4.000	SW Ex 4		71.821	0.421	0.000	0.30			5.5
S1.002	SW Ex 6		71.805	0.711	0.000	0.79			18.8
S5.000	SW Ex 7		71.922	0.652	0.000	1.40			27.7
S5.001	SW Ex 8		71.811	0.696	0.000	0.87			57.2
S1.003	SW Ex Tank		71.773	0.978	22.644	0.78			36.3
S1.004	SW Ex 10		71.767	1.147	16.781	0.28			4.8
S6.000	SW Ex 11		71.534	0.364	0.000	0.89			19.6
S7.000	S1		71.953	-0.022	0.000	0.03			0.5
S7.001	S2		71.953	0.290	0.000	0.05			1.4
S7.002	S4		71.953	0.673	0.000	0.08			1.9

PN	US/MH Name	Status	Level Exceeded
S1.000	SW Ex 2	FLOOD RISK	
S2.000	SW Ex 1	FLOOD	1
S1.001	SW Ex 3	FLOOD RISK	
S3.000	SW Ex 5	FLOOD RISK	
S4.000	SW Ex 4	FLOOD RISK	
S1.002	SW Ex 6	FLOOD RISK	
S5.000	SW Ex 7	FLOOD RISK	
S5.001	SW Ex 8	FLOOD RISK	
S1.003	SW Ex Tank	FLOOD	17
S1.004	SW Ex 10	FLOOD	17
S6.000	SW Ex 11	SURCHARGED	
S7.000	S1	OK	
S7.001	S2	SURCHARGED	
S7.002	S4	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S8.000	S3	60 Winter	100	+40%	100/30 Winter			
S7.003	S5	60 Winter	100	+40%	100/15 Summer			
S7.004	S6	60 Winter	100	+40%	100/15 Summer			
S7.005	S7	60 Winter	100	+40%	30/15 Summer			
S7.006	STank	60 Winter	100	+40%	30/15 Summer	100/60 Winter		
S7.007	S8	60 Winter	100	+40%	30/15 Summer			
S1.005	SW Ex 12	15 Winter	100	+40%	100/15 Summer			
S1.006	SW Ex 13	60 Winter	100	+40%	100/15 Summer			
S1.007	SW Ex 14	60 Winter	100	+40%	30/15 Summer			
S1.008	SW Ex 15	120 Winter	100	+40%	30/15 Summer	100/30 Winter		
S9.000	S9	180 Winter	100	+40%	100/30 Summer			
S9.001	S10	180 Winter	100	+40%	100/15 Winter			
S1.009	SW Ex 16	240 Winter	100	+40%	30/120 Winter	100/30 Winter		
S1.010	SW Ex 17	240 Summer	100	+40%	2/15 Summer			
S1.011	SW Ex 18	120 Winter	100	+40%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S8.000	S3	71.953	0.434	0.000	0.03			0.7	SURCHARGED
S7.003	S5	71.953	0.791	0.000	0.52			10.5	SURCHARGED
S7.004	S6	71.951	0.857	0.000	0.43			10.5	SURCHARGED
S7.005	S7	71.946	1.037	0.000	1.09			34.6	FLOOD RISK
S7.006	STank	71.940	1.438	0.368	1.04			12.3	FLOOD
S7.007	S8	71.938	1.449	0.000	0.37			5.1	FLOOD RISK
S1.005	SW Ex 12	70.768	0.558	0.000	1.18			35.0	SURCHARGED
S1.006	SW Ex 13	69.667	0.497	0.000	0.50			43.0	SURCHARGED
S1.007	SW Ex 14	69.559	1.433	0.000	1.39			55.5	FLOOD RISK
S1.008	SW Ex 15	69.448	1.512	27.726	0.76			55.1	FLOOD
S9.000	S9	69.450	0.989	0.000	0.00			2.6	FLOOD RISK
S9.001	S10	69.450	1.231	0.000	0.00			4.3	FLOOD RISK
S1.009	SW Ex 16	69.450	1.621	0.458	0.04			31.9	FLOOD
S1.010	SW Ex 17	69.461	2.725	0.000	0.36			14.8	SURCHARGED
S1.011	SW Ex 18	65.954	-0.131	0.000	0.36			14.8	OK

PN	US/MH Name	Level Exceeded
S8.000	S3	
S7.003	S5	
S7.004	S6	
S7.005	S7	
S7.006	STank	2
S7.007	S8	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Level Exceeded
S1.005	SW Ex 12	
S1.006	SW Ex 13	
S1.007	SW Ex 14	
S1.008	SW Ex 15	15
S9.000	S9	
S9.001	S10	
S1.009	SW Ex 16	14
S1.010	SW Ex 17	
S1.011	SW Ex 18	

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