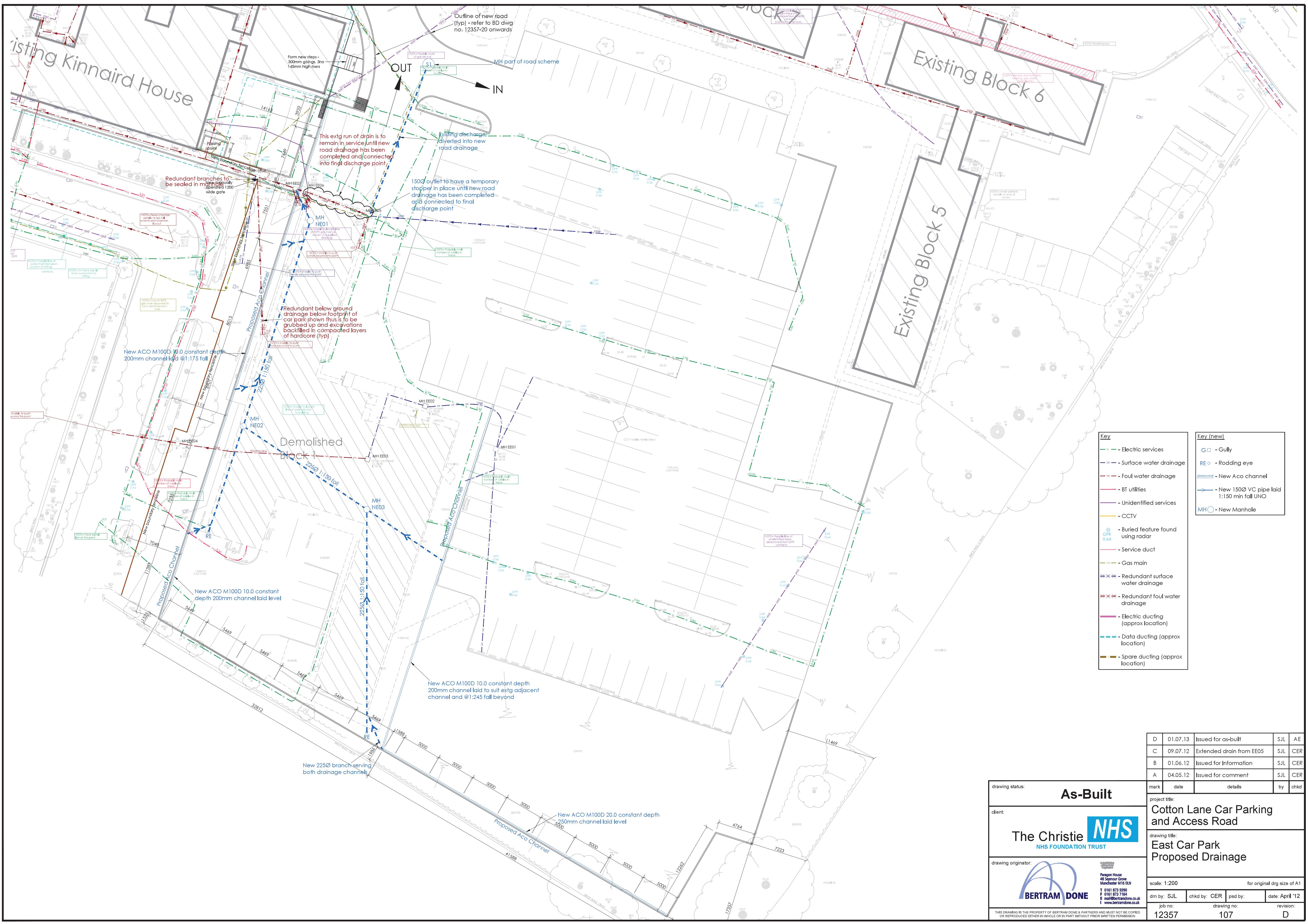




Key

- Electric services
- Surface water drainage
- Foul water drainage
- BT utilities
- Unidentified services
- CCTV
- Buried feature found using radar
- Service duct
- Gas main
- Redundant surface water drainage
- Redundant foul water drainage
- Electric ducting (approx location)
- Data ducting (approx location)
- Spare ducting (approx location)

Key (new)

- Gully
- Rodding eye
- New Aco channel
- New 150Ø VC pipe laid 1:150 min fall UNO
- New Manhole

drawing status:	As-Built			
	client:	The Christie NHS FOUNDATION TRUST		
	drawing originator:			
	Pragon House 48 Seymour Grove Manchester M16 6LN T 0161 873 5090 F 0161 873 7164 E mail@bertramdone.co.uk www.bertramdone.co.uk			
project title:		Cotton Lane Car Parking and Access Road		
drawing title:		East Car Park Proposed Drainage		
scale: 1:200		for original drg size of A1		
dm by: SJL	chkd by: CER	psd by:	date: April '12	
job no: 12357	drawing no: 107		revision: D	

D	01.07.13	Issued for as-built	SJL	AE
C	09.07.12	Extended drain from EE05	SJL	CER
B	01.06.12	Issued for Information	SJL	CER
A	04.05.12	Issued for comment	SJL	CER
mark	date	details	by chkd	

Appendix G Brownfield Runoff Calculations

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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)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.362	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)
0-4	0.559	4-8	0.204

Total Area Contributing (ha) = 0.763

Total Pipe Volume (m³) = 3.313

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
1.000	10.000	0.067	150.0	0.763	5.00	0.0	0.600	o	375	Pipe/Conduit	
1.001	10.000	0.067	150.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.002	10.000	0.067	150.0	0.000	0.00	0.0	0.600	o	375	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)
1.000	50.00	5.11	35.500	0.763	0.0	0.0	0.0	1.48	163.1	103.3
1.001	50.00	5.23	35.433	0.763	0.0	0.0	0.0	1.48	163.1	103.3
1.002	50.00	5.34	35.367	0.763	0.0	0.0	0.0	1.48	163.1	103.3

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002		37.000	35.300	0.000	0	0

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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 * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
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 Offline Controls	0
Number of Online Controls	0	Number of Storage Structures	0
		Number of Time/Area Diagrams	0
		Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.362		

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1 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 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.362 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SW01	15 Winter	1	+0%	2/15 Winter				35.770	-0.105	0.000
1.001	SW02	15 Winter	1	+0%	30/15 Summer				35.702	-0.107	0.000
1.002	SW03	15 Winter	1	+0%	30/15 Summer				35.632	-0.110	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Level Exceeded	Status		
1.000	SW01	0.85			90.7	OK			
1.001	SW02	0.85			91.5	OK			
1.002	SW03	0.85			91.1	OK			

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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 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.362 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 0

	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water	Surcharged	Flooded
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level	Depth	Volume
									(m)	(m)	(m³)
1.000	SW01	15 Winter	2	+0%	2/15 Winter				35.882	0.007	0.000
1.001	SW02	15 Winter	2	+0%	30/15 Summer				35.806	-0.003	0.000
1.002	SW03	15 Winter	2	+0%	30/15 Summer				35.673	-0.069	0.000

	US/MH	Flow /	Half Drain	Pipe			
PN	Name	Cap.	(l/s)	Time	Flow	Status	Level
				(mins)	(l/s)		Exceeded
1.000	SW01	1.04			111.5	SURCHARGED	
1.001	SW02	1.00			107.5	OK	
1.002	SW03	1.00			107.2	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 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.362 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SW01	15 Winter	30	+0%	2/15 Winter			36.473	0.598	0.000
1.001	SW02	15 Winter	30	+0%	30/15 Summer			36.197	0.389	0.000
1.002	SW03	15 Winter	30	+0%	30/15 Summer			35.925	0.183	0.000

PN	US/MH Name	Flow / Cap.	Half Drain (l/s)	Pipe Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SW01	1.88			201.2	SURCHARGED	
1.001	SW02	1.87			200.9	SURCHARGED	
1.002	SW03	1.88			201.9	SURCHARGED	

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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 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.362 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 0

	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water	Surcharged	Flooded
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level	Depth	Volume
									(m)	(m)	(m³)
1.000	SW01	15 Winter	100	+0%	2/15 Winter				36.932	1.057	0.000
1.001	SW02	15 Winter	100	+0%	30/15 Summer				36.499	0.690	0.000
1.002	SW03	15 Winter	100	+0%	30/15 Summer				36.074	0.332	0.000

	US/MH	Flow /	Half Drain	Pipe			
PN	Name	Cap.	(l/s)	Time	Flow	Status	Level
				(mins)	(l/s)		Exceeded
1.000	SW01	2.34			250.9	FLOOD RISK	
1.001	SW02	2.36			252.5	SURCHARGED	
1.002	SW03	2.36			252.9	SURCHARGED	

Appendix H Preliminary Attenuation Estimate

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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 28 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	35.775	0.775	0.0	53.6	53.6	115.6	O K
30 min Summer	35.985	0.985	0.0	53.6	53.6	146.9	O K
60 min Summer	36.058	1.058	0.0	53.6	53.6	157.8	O K
120 min Summer	35.991	0.991	0.0	53.6	53.6	147.8	O K
180 min Summer	35.854	0.854	0.0	53.6	53.6	127.4	O K
240 min Summer	35.711	0.711	0.0	53.6	53.6	106.1	O K
360 min Summer	35.486	0.486	0.0	53.6	53.6	72.6	O K
480 min Summer	35.355	0.355	0.0	52.7	52.7	52.9	O K
600 min Summer	35.289	0.289	0.0	50.6	50.6	43.2	O K
720 min Summer	35.261	0.261	0.0	45.1	45.1	38.9	O K
960 min Summer	35.225	0.225	0.0	37.1	37.1	33.6	O K
1440 min Summer	35.186	0.186	0.0	27.6	27.6	27.7	O K
2160 min Summer	35.155	0.155	0.0	20.2	20.2	23.1	O K
2880 min Summer	35.136	0.136	0.0	16.2	16.2	20.3	O K
4320 min Summer	35.114	0.114	0.0	11.8	11.8	17.0	O K
5760 min Summer	35.101	0.101	0.0	9.3	9.3	15.0	O K
7200 min Summer	35.092	0.092	0.0	7.8	7.8	13.7	O K
8640 min Summer	35.085	0.085	0.0	6.7	6.7	12.7	O K
10080 min Summer	35.080	0.080	0.0	6.0	6.0	11.9	O K
15 min Winter	35.894	0.894	0.0	53.6	53.6	133.4	O K
30 min Winter	36.126	1.126	0.0	53.6	53.6	168.0	O K
60 min Winter	36.197	1.197	0.0	53.6	53.6	178.5	O K
120 min Winter	36.071	1.071	0.0	53.6	53.6	159.8	O K
180 min Winter	35.850	0.850	0.0	53.6	53.6	126.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	118.843	0.0	160.2	21
30 min Summer	79.493	0.0	214.4	32
60 min Summer	50.812	0.0	274.3	50
120 min Summer	31.438	0.0	339.4	84
180 min Summer	23.432	0.0	379.5	116
240 min Summer	18.907	0.0	408.3	148
360 min Summer	13.852	0.0	448.7	204
480 min Summer	11.115	0.0	480.0	260
600 min Summer	9.363	0.0	505.4	314
720 min Summer	8.134	0.0	526.9	374
960 min Summer	6.509	0.0	562.2	494
1440 min Summer	4.746	0.0	614.9	736
2160 min Summer	3.454	0.0	671.4	1100
2880 min Summer	2.754	0.0	713.6	1468
4320 min Summer	1.997	0.0	776.3	2184
5760 min Summer	1.588	0.0	823.3	2936
7200 min Summer	1.329	0.0	861.0	3664
8640 min Summer	1.148	0.0	892.7	4400
10080 min Summer	1.014	0.0	920.1	5112
15 min Winter	118.843	0.0	179.4	22
30 min Winter	79.493	0.0	240.1	33
60 min Winter	50.812	0.0	307.2	52
120 min Winter	31.438	0.0	380.2	90
180 min Winter	23.432	0.0	425.0	124

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	35.626	0.626	0.0	53.6	53.6	93.3	O K
360 min Winter	35.344	0.344	0.0	52.5	52.5	51.3	O K
480 min Winter	35.265	0.265	0.0	46.0	46.0	39.6	O K
600 min Winter	35.234	0.234	0.0	39.3	39.3	34.9	O K
720 min Winter	35.213	0.213	0.0	34.2	34.2	31.8	O K
960 min Winter	35.186	0.186	0.0	27.5	27.5	27.7	O K
1440 min Winter	35.154	0.154	0.0	20.1	20.1	23.0	O K
2160 min Winter	35.129	0.129	0.0	14.7	14.7	19.2	O K
2880 min Winter	35.114	0.114	0.0	11.7	11.7	17.0	O K
4320 min Winter	35.096	0.096	0.0	8.5	8.5	14.3	O K
5760 min Winter	35.085	0.085	0.0	6.7	6.7	12.6	O K
7200 min Winter	35.077	0.077	0.0	5.7	5.7	11.5	O K
8640 min Winter	35.072	0.072	0.0	4.9	4.9	10.7	O K
10080 min Winter	35.067	0.067	0.0	4.3	4.3	10.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	18.907	0.0	457.3	154
360 min Winter	13.852	0.0	502.5	204
480 min Winter	11.115	0.0	537.6	256
600 min Winter	9.363	0.0	566.1	314
720 min Winter	8.134	0.0	590.2	376
960 min Winter	6.509	0.0	629.7	494
1440 min Winter	4.746	0.0	688.7	736
2160 min Winter	3.454	0.0	752.0	1096
2880 min Winter	2.754	0.0	799.3	1472
4320 min Winter	1.997	0.0	869.5	2200
5760 min Winter	1.588	0.0	922.1	2936
7200 min Winter	1.329	0.0	964.4	3608
8640 min Winter	1.148	0.0	999.9	4312
10080 min Winter	1.014	0.0	1030.5	5056

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.362	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.720

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)		From: To: (ha)		From: To: (ha)	
0 4	0.240	4 8	0.240	8 12	0.240

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Model Details

Storage is Online Cover Level (m) 37.000

Cellular Storage Structure

Invert Level (m) 35.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	157.0	0.0	1.200	157.0	0.0	1.201	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0301-5360-1200-5360
Design Head (m) 1.200
Design Flow (l/s) 53.6
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 301
Invert Level (m) 35.000
Minimum Outlet Pipe Diameter (mm) 375
Suggested Manhole Diameter (mm) 2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	53.6	Kick-Flo®	0.908	46.8
Flush-Flo™	0.477	53.6	Mean Flow over Head Range	-	44.1

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

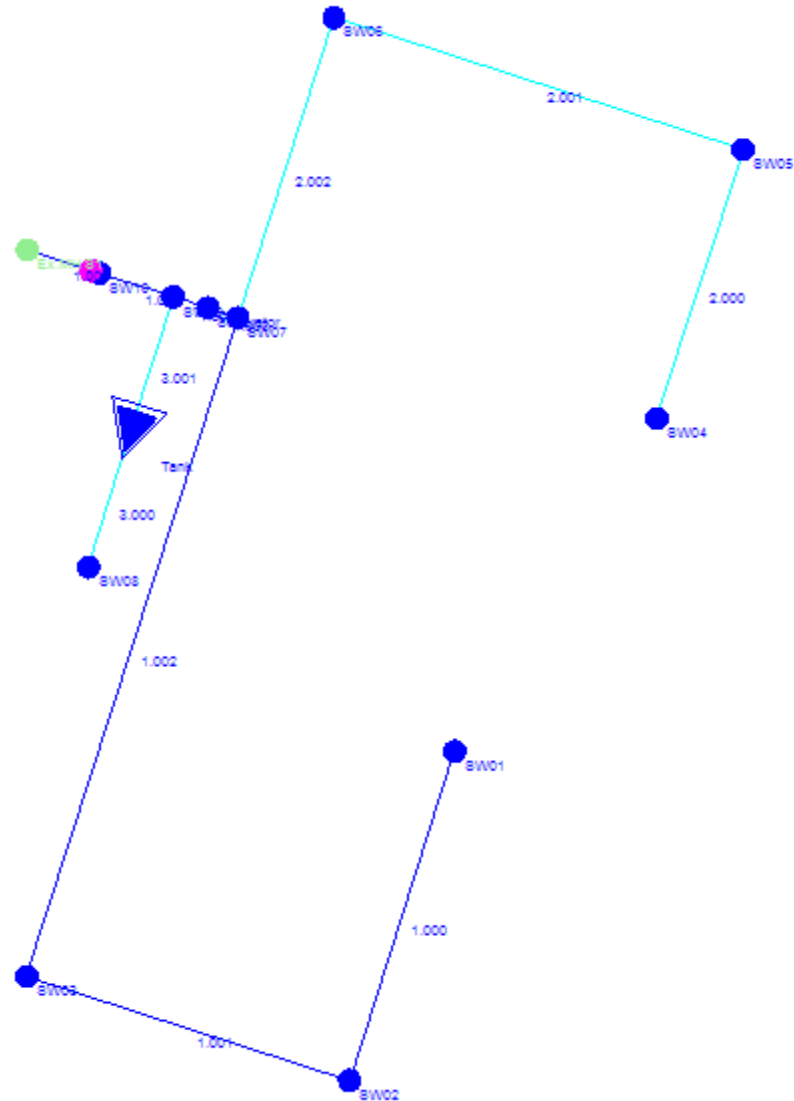
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.2	0.800	50.4	2.000	68.6	4.000	96.0	7.000	126.2
0.200	31.0	1.000	49.1	2.200	71.8	4.500	101.7	7.500	130.5
0.300	51.5	1.200	53.6	2.400	74.9	5.000	107.0	8.000	134.7
0.400	53.3	1.400	57.7	2.600	77.9	5.500	112.1	8.500	138.7
0.500	53.6	1.600	61.6	3.000	83.5	6.000	117.0	9.000	142.7
0.600	53.1	1.800	65.2	3.500	90.0	6.500	121.7	9.500	146.5

Appendix I Drainage Strategy Drawing & Calculations



XP Solutions

Network 2020.1



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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)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.362	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)
0-4	0.361	4-8	0.353

Total Area Contributing (ha) = 0.714

Total Pipe Volume (m³) = 33.211

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
1.000	38.712	0.165	235.0	0.119	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	38.063	0.130	293.0	0.019	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.002	77.472	0.260	298.0	0.241	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	31.616	0.135	235.0	0.163	5.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	48.293	0.160	301.8	0.039	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.002	35.304	0.120	295.0	0.133	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.003	3.568	0.010	340.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.004	4.065	0.010	400.0	0.000	0.00	0.0	0.600	o	375	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)
1.000	50.00	5.63	35.040	0.119	0.0	0.0	0.0	1.02	72.2	16.1
1.001	50.00	6.23	34.800	0.138	0.0	0.0	0.0	1.05	116.3	18.7
1.002	50.00	7.47	34.670	0.379	0.0	0.0	0.0	1.04	115.3	51.3
2.000	50.00	5.52	34.900	0.163	0.0	0.0	0.0	1.02	72.2	22.1
2.001	50.00	6.29	34.690	0.202	0.0	0.0	0.0	1.04	114.6	27.4
2.002	50.00	6.85	34.530	0.335	0.0	0.0	0.0	1.05	115.9	45.4
1.003	50.00	7.53	34.410	0.714	0.0	0.0	0.0	0.98	107.9	96.7
1.004	50.00	7.61	34.300	0.714	0.0	0.0	0.0	0.90	99.4	96.7

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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
3.000	15.861	0.050	320.0	0.000	5.00	0.0	0.600	o	375	Pipe/Conduit	
3.001	15.861	0.010	1600.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.005	8.691	0.030	289.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.006	8.510	0.043	197.9	0.000	0.00	0.0	0.600	o	375	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)
3.000	50.00	5.26	34.350	0.000	0.0	0.0	0.0	1.01	111.3	0.0
3.001	50.00	5.86	34.300	0.000	0.0	0.0	0.0	0.44	49.1	0.0
1.005	50.00	7.74	34.290	0.714	0.0	0.0	0.0	1.06	117.0	96.7
1.006	50.00	7.85	34.260	0.714	0.0	0.0	0.0	1.28	141.9	96.7

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SW01	36.200	1.160	Open Manhole	1500	1.000	35.040	300				
SW02	36.200	1.400	Open Manhole	1500	1.001	34.800	375	1.000	34.875	300	
SW03	36.200	1.530	Open Manhole	1500	1.002	34.670	375	1.001	34.670	375	
SW04	36.100	1.200	Open Manhole	1500	2.000	34.900	300				
SW05	36.100	1.410	Open Manhole	1500	2.001	34.690	375	2.000	34.765	300	
SW06	36.200	1.670	Open Manhole	1500	2.002	34.530	375	2.001	34.530	375	
SW07	36.200	1.790	Open Manhole	1500	1.003	34.410	375	1.002	34.410	375	
Separator	36.100	1.800	Open Manhole	1500	1.004	34.300	375	2.002	34.410	375	
SW08	36.100	1.750	Open Manhole	1500	3.000	34.350	375	1.003	34.400	375	100
Tank	36.100	1.800	Open Manhole	1500	3.001	34.300	375				
SW09	36.100	1.810	Open Manhole	1500	1.005	34.290	375	3.000	34.300	375	
SW10	36.250	1.990	Open Manhole	2100				1.004	34.290	375	
Ex.MH S1	36.710	2.493	Open Manhole	1500	1.006	34.260	375	3.001	34.290	375	
						OUTFALL		1.005	34.260	375	
								1.006	34.217	375	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SW01	385194.010	392409.428	385194.010	392409.428	Required	
SW02	385182.169	392372.571	385182.169	392372.571	Required	
SW03	385145.931	392384.213	385145.931	392384.213	Required	
SW04	385216.733	392446.712	385216.733	392446.712	Required	
SW05	385226.403	392476.813	385226.403	392476.813	Required	
SW06	385180.424	392491.584	385180.424	392491.584	Required	
SW07	385169.626	392457.972	385169.626	392457.972	Required	
Separator	385166.239	392459.095	385166.239	392459.095	Required	
SW08	385152.870	392430.037	385152.870	392430.037	Required	
SW09	385162.359	392460.306	385162.359	392460.306	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SW10	385154.084	392462.965	385154.084	392462.965	Required	
Ex.MH S1	385145.982	392465.568			No Entry	

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PIPELINE SCHEDULES for Storm

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)
1.000	o	300	SW01	36.200	35.040	0.860	Open Manhole	1500
1.001	o	375	SW02	36.200	34.800	1.025	Open Manhole	1500
1.002	o	375	SW03	36.200	34.670	1.155	Open Manhole	1500
2.000	o	300	SW04	36.100	34.900	0.900	Open Manhole	1500
2.001	o	375	SW05	36.100	34.690	1.035	Open Manhole	1500
2.002	o	375	SW06	36.200	34.530	1.295	Open Manhole	1500
1.003	o	375	SW07	36.200	34.410	1.415	Open Manhole	1500
1.004	o	375	Separator	36.100	34.300	1.425	Open Manhole	1500
3.000	o	375	SW08	36.100	34.350	1.375	Open Manhole	1500
3.001	o	375	Tank	36.100	34.300	1.425	Open Manhole	1500
1.005	o	375	SW09	36.100	34.290	1.435	Open Manhole	1500
1.006	o	375	SW10	36.250	34.260	1.615	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)
1.000	38.712	235.0	SW02	36.200	34.875	1.025	Open Manhole	1500
1.001	38.063	293.0	SW03	36.200	34.670	1.155	Open Manhole	1500
1.002	77.472	298.0	SW07	36.200	34.410	1.415	Open Manhole	1500
2.000	31.616	235.0	SW05	36.100	34.765	1.035	Open Manhole	1500
2.001	48.293	301.8	SW06	36.200	34.530	1.295	Open Manhole	1500
2.002	35.304	295.0	SW07	36.200	34.410	1.415	Open Manhole	1500
1.003	3.568	340.0	Separator	36.100	34.400	1.325	Open Manhole	1500
1.004	4.065	400.0	SW09	36.100	34.290	1.435	Open Manhole	1500
3.000	15.861	320.0	Tank	36.100	34.300	1.425	Open Manhole	1500
3.001	15.861	1600.0	SW09	36.100	34.290	1.435	Open Manhole	1500
1.005	8.691	289.7	SW10	36.250	34.260	1.615	Open Manhole	2100
1.006	8.510	197.9	Ex.MH S1	36.710	34.217	2.118	Open Manhole	1500

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D, L (mm)	W (mm)
1.006	Ex.MH S1	36.710	34.217	34.217	1500	0

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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 * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
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 Offline Controls	0
Number of Online Controls	1	Number of Storage Structures	1
		Number of Time/Area Diagrams	0
		Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.362		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: SW10, DS/PN: 1.006, Volume (m³): 7.7

Unit Reference	MD-SHE-0302-5360-1100-5360
Design Head (m)	1.100
Design Flow (l/s)	53.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	302
Invert Level (m)	34.260
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	53.6	Kick-Flo®	0.848	47.3
Flush-Flo™	0.465	53.6	Mean Flow over Head Range	-	43.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.2	0.800	49.2	2.000	71.5	4.000	100.2	7.000	131.6
0.200	31.0	1.000	51.2	2.200	74.9	4.500	106.1	7.500	136.2
0.300	51.7	1.200	55.9	2.400	78.1	5.000	111.7	8.000	140.5
0.400	53.3	1.400	60.2	2.600	81.2	5.500	117.0	8.500	144.8
0.500	53.5	1.600	64.2	3.000	87.1	6.000	122.1	9.000	148.9
0.600	52.9	1.800	68.0	3.500	93.9	6.500	127.0	9.500	152.9

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Storage Structures for Storm

Cellular Storage Manhole: Tank, DS/PN: 3.001

Invert Level (m) 34.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	158.0	0.0	0.800	158.0	0.0	0.801	0.0	0.0

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1 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 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.362 Cv (Winter) 0.840

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

Profile(s)

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 30, 100
 Climate Change (%) 0, 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	Overflow Act.	Water	Surcharged
									Level (m)	Depth (m)
1.000	SW01	15 Winter	1	+0%	100/15 Summer				35.134	-0.206
1.001	SW02	15 Winter	1	+0%	100/15 Summer				34.900	-0.275
1.002	SW03	15 Winter	1	+0%	30/15 Winter				34.825	-0.220
2.000	SW04	15 Winter	1	+0%	100/15 Summer				35.012	-0.188
2.001	SW05	15 Winter	1	+0%	100/15 Summer				34.808	-0.257
2.002	SW06	15 Winter	1	+0%	30/15 Summer				34.701	-0.204
1.003	SW07	15 Winter	1	+0%	30/15 Summer				34.664	-0.121
1.004	Separator	15 Winter	1	+0%	2/15 Winter				34.561	-0.114
3.000	SW08	60 Winter	1	+0%	100/15 Summer				34.387	-0.338
3.001	Tank	60 Winter	1	+0%	100/15 Summer				34.387	-0.288
1.005	SW09	15 Winter	1	+0%	30/15 Summer				34.548	-0.117
1.006	SW10	15 Winter	1	+0%	2/15 Winter				34.532	-0.103

PN	US/MH Name	Flooded		Half Drain	Pipe	Status	Level Exceeded
		Volume (m³)	Flow / Cap.	Time (mins)	Flow (l/s)		
1.000	Separator	SW01	0.000	0.21		14.4	OK
1.001		SW02	0.000	0.15		15.8	OK
1.002		SW03	0.000	0.34		36.8	OK
2.000		SW04	0.000	0.29		19.3	OK
2.001		SW05	0.000	0.21		22.6	OK
2.002		SW06	0.000	0.31		32.2	OK
1.003		SW07	0.000	0.80		64.8	OK
1.004				0.81		64.5	OK
3.000		SW08	0.000	0.00		0.0	OK
3.001		Tank	0.000	0.07		2.5	OK
1.005	SW09	0.000	0.56		46.9	OK	
1.006	SW10	0.000	0.46		46.5	OK	

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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 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.362 Cv (Winter) 0.840

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

Profile(s)

Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 40

PN	US/MH		Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
	Name	Storm							(m)	(m)
1.000	SW01	15 Winter	2	+0%	100/15 Summer				35.148	-0.192
1.001	SW02	15 Winter	2	+0%	100/15 Summer				34.917	-0.258
1.002	SW03	15 Winter	2	+0%	30/15 Winter				34.850	-0.195
2.000	SW04	15 Winter	2	+0%	100/15 Summer				35.030	-0.170
2.001	SW05	15 Winter	2	+0%	100/15 Summer				34.826	-0.239
2.002	SW06	15 Winter	2	+0%	30/15 Summer				34.742	-0.163
1.003	SW07	15 Winter	2	+0%	30/15 Summer				34.715	-0.070
1.004	Separator	15 Winter	2	+0%	2/15 Winter				34.683	0.008
3.000	SW08	60 Winter	2	+0%	100/15 Summer				34.414	-0.311
3.001	Tank	60 Winter	2	+0%	100/15 Summer				34.414	-0.261
1.005	SW09	15 Winter	2	+0%	30/15 Summer				34.661	-0.004
1.006	SW10	15 Winter	2	+0%	2/15 Winter				34.641	0.006

PN	US/MH Name	Flooded		Half Drain		Pipe Flow	Status	Level Exceeded
		Volume (m³)	Flow / Cap. (l/s)	Time (mins)	Flow (l/s)			
1.000	SW01	0.000	0.27		18.3	OK		
1.001	SW02	0.000	0.19		20.2	OK		
1.002	SW03	0.000	0.43		47.6	OK		
2.000	SW04	0.000	0.38		25.0	OK		
2.001	SW05	0.000	0.28		29.2	OK		
2.002	SW06	0.000	0.39		40.8	OK		
1.003	SW07	0.000	1.00		81.2	OK		
1.004	Separator	0.000	1.00		79.9	SURCHARGED		
3.000	SW08	0.000	0.00		0.0	OK		
3.001	Tank	0.000	0.11	58	4.1	OK		
1.005	SW09	0.000	0.67		55.6	OK		
1.006	SW10	0.000	0.53		53.1	SURCHARGED		

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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 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.362 Cv (Winter) 0.840

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

Profile(s)

Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged
									Level (m)	Depth (m)
1.000	SW01	15 Winter	30	+0%	100/15 Summer				35.196	-0.144
1.001	SW02	15 Winter	30	+0%	100/15 Summer				35.112	-0.063
1.002	SW03	15 Winter	30	+0%	30/15 Winter				35.094	0.049
2.000	SW04	15 Winter	30	+0%	100/15 Summer				35.104	-0.096
2.001	SW05	15 Winter	30	+0%	100/15 Summer				35.063	-0.002
2.002	SW06	15 Winter	30	+0%	30/15 Summer				35.037	0.132
1.003	SW07	15 Winter	30	+0%	30/15 Summer				34.994	0.209
1.004	Separator	15 Winter	30	+0%	2/15 Winter				34.886	0.211
3.000	SW08	30 Winter	30	+0%	100/15 Summer				34.616	-0.109
3.001	Tank	30 Winter	30	+0%	100/15 Summer				34.616	-0.059
1.005	SW09	15 Winter	30	+0%	30/15 Summer				34.777	0.113
1.006	SW10	15 Winter	30	+0%	2/15 Winter				34.769	0.134

PN	US/MH Name	Flooded		Half Drain	Pipe	Status	Level Exceeded
		Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)		
1.000	SW01	0.000	0.51			34.4	OK
1.001	SW02	0.000	0.31			32.4	OK
1.002	SW03	0.000	0.77			83.9	SURCHARGED
2.000	SW04	0.000	0.72			47.3	OK
2.001	SW05	0.000	0.46			48.6	OK
2.002	SW06	0.000	0.60			62.1	SURCHARGED
1.003	SW07	0.000	1.71			138.6	SURCHARGED
1.004	Separator	0.000	1.74			138.4	SURCHARGED
3.000	SW08	0.000	0.00			0.3	OK
3.001	Tank	0.000	0.79		21	28.3	OK
1.005	SW09	0.000	0.73			61.0	SURCHARGED
1.006	SW10	0.000	0.53			53.4	SURCHARGED

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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 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.362 Cv (Winter) 0.840

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

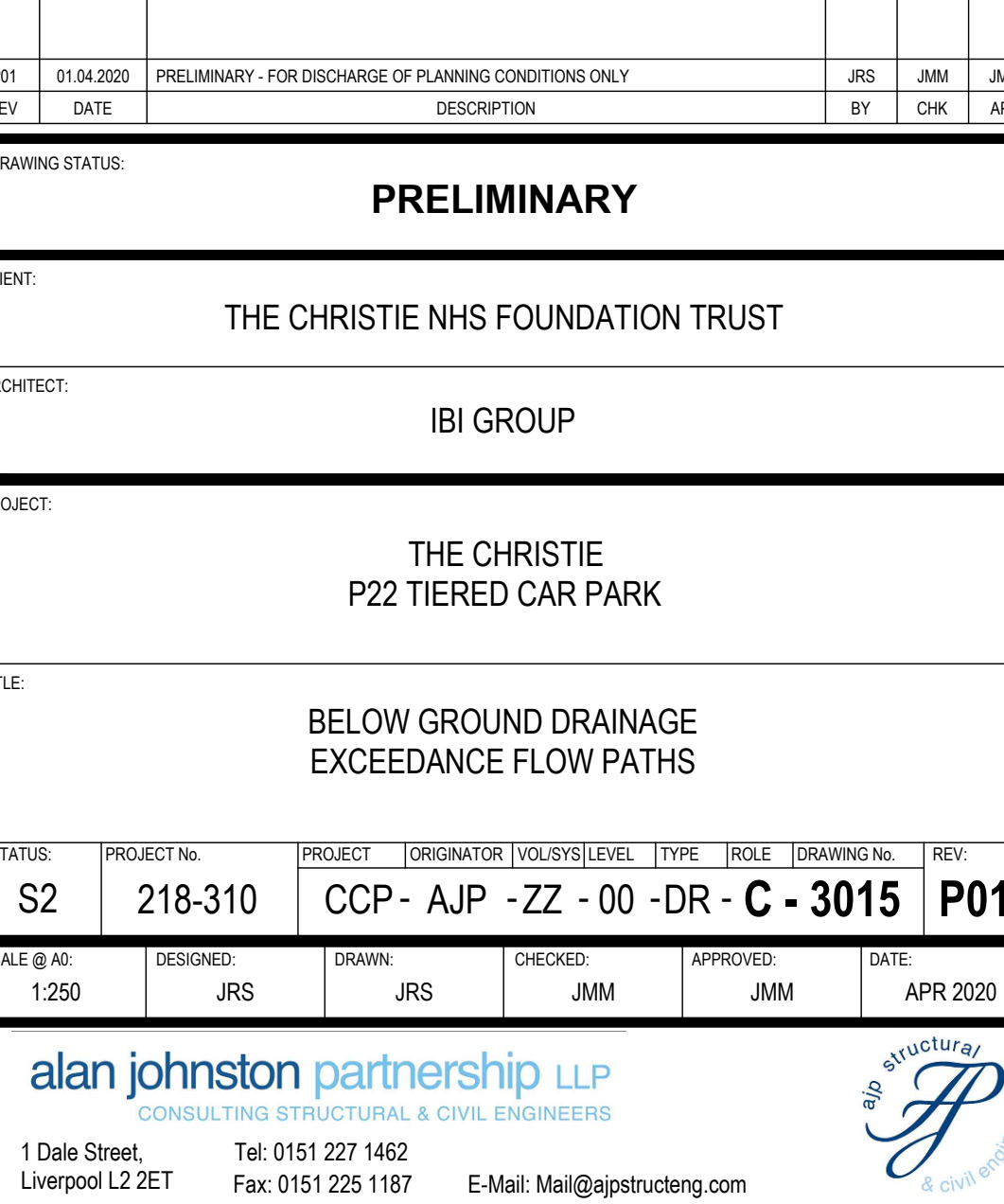
Profile(s)

Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 40

									Water	Surcharged
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)
1.000	SW01	15 Winter	100	+40%	100/15 Summer				36.176	0.836
1.001	SW02	15 Winter	100	+40%	100/15 Summer				36.096	0.921
1.002	SW03	15 Winter	100	+40%	30/15 Winter				36.056	1.011
2.000	SW04	15 Winter	100	+40%	100/15 Summer				36.049	0.849
2.001	SW05	15 Winter	100	+40%	100/15 Summer				35.925	0.860
2.002	SW06	15 Winter	100	+40%	30/15 Summer				35.842	0.937
1.003	SW07	15 Winter	100	+40%	30/15 Summer				35.688	0.903
1.004	Separator	120 Winter	100	+40%	2/15 Winter				35.305	0.630
3.000	SW08	60 Winter	100	+40%	100/15 Summer				35.091	0.366
3.001	Tank	60 Winter	100	+40%	100/15 Summer				35.091	0.416
1.005	SW09	120 Winter	100	+40%	30/15 Summer				35.288	0.623
1.006	SW10	120 Winter	100	+40%	2/15 Winter				35.380	0.746

		Flooded		Half Drain		Pipe			Level
PN	US/MH Name	Volume (m³)	Flow / Cap. (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded		
1.000	SW01	0.000	0.71		47.3	FLOOD RISK			
1.001	SW02	0.000	0.51		54.2	FLOOD RISK			
1.002	SW03	0.000	1.19		130.4	FLOOD RISK			
2.000	SW04	0.000	1.00		65.9	FLOOD RISK			
2.001	SW05	0.000	0.71		75.0	FLOOD RISK			
2.002	SW06	0.000	1.13		117.2	SURCHARGED			
1.003	SW07	0.000	3.01		244.9	SURCHARGED			
1.004	Separator	0.000	1.41		112.4	SURCHARGED			
3.000	SW08	0.000	0.01		0.5	SURCHARGED			
3.001	Tank	0.000	1.23	36	44.2	SURCHARGED			
1.005	SW09	0.000	0.68		56.4	SURCHARGED			
1.006	SW10	0.000	0.53		53.3	SURCHARGED			

Appendix J Exceedance Flow Path Drawing & Exceedance Event Calculations



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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)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.362	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)
0-4	0.361	4-8	0.353

Total Area Contributing (ha) = 0.714

Total Pipe Volume (m³) = 33.211

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
1.000	38.712	0.165	235.0	0.119	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	38.063	0.130	293.0	0.019	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.002	77.472	0.260	298.0	0.241	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	31.616	0.135	235.0	0.163	5.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	48.293	0.160	301.8	0.039	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.002	35.304	0.120	295.0	0.133	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.003	3.568	0.010	340.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.004	4.065	0.010	400.0	0.000	0.00	0.0	0.600	o	375	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)
1.000	50.00	5.63	35.040	0.119	0.0	0.0	0.0	1.02	72.2	16.1
1.001	50.00	6.23	34.800	0.138	0.0	0.0	0.0	1.05	116.3	18.7
1.002	50.00	7.47	34.670	0.379	0.0	0.0	0.0	1.04	115.3	51.3
2.000	50.00	5.52	34.900	0.163	0.0	0.0	0.0	1.02	72.2	22.1
2.001	50.00	6.29	34.690	0.202	0.0	0.0	0.0	1.04	114.6	27.4
2.002	50.00	6.85	34.530	0.335	0.0	0.0	0.0	1.05	115.9	45.4
1.003	50.00	7.53	34.410	0.714	0.0	0.0	0.0	0.98	107.9	96.7
1.004	50.00	7.61	34.300	0.714	0.0	0.0	0.0	0.90	99.4	96.7

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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
3.000	15.861	0.050	320.0	0.000	5.00	0.0	0.600	o	375	Pipe/Conduit	
3.001	15.861	0.010	1600.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.005	8.691	0.030	289.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.006	8.510	0.043	197.9	0.000	0.00	0.0	0.600	o	375	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)
3.000	50.00	5.26	34.350	0.000	0.0	0.0	0.0	1.01	111.3	0.0
3.001	50.00	5.86	34.300	0.000	0.0	0.0	0.0	0.44	49.1	0.0
1.005	50.00	7.74	34.290	0.714	0.0	0.0	0.0	1.06	117.0	96.7
1.006	50.00	7.85	34.260	0.714	0.0	0.0	0.0	1.28	141.9	96.7

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
SW01	36.200	1.160	Open Manhole	1500	1.000	35.040	300				
SW02	36.200	1.400	Open Manhole	1500	1.001	34.800	375	1.000	34.875	300	
SW03	36.200	1.530	Open Manhole	1500	1.002	34.670	375	1.001	34.670	375	
SW04	36.100	1.200	Open Manhole	1500	2.000	34.900	300				
SW05	36.100	1.410	Open Manhole	1500	2.001	34.690	375	2.000	34.765	300	
SW06	36.200	1.670	Open Manhole	1500	2.002	34.530	375	2.001	34.530	375	
SW07	36.200	1.790	Open Manhole	1500	1.003	34.410	375	1.002	34.410	375	
								2.002	34.410	375	
Separator	36.100	1.800	Open Manhole	1500	1.004	34.300	375	1.003	34.400	375	100
SW08	36.100	1.750	Open Manhole	1500	3.000	34.350	375				
Tank	36.100	1.800	Open Manhole	1500	3.001	34.300	375	3.000	34.300	375	
SW09	36.100	1.810	Open Manhole	1500	1.005	34.290	375	1.004	34.290	375	
								3.001	34.290	375	
SW10	36.250	1.990	Open Manhole	2100	1.006	34.260	375	1.005	34.260	375	
Ex.MH S1	36.710	2.493	Open Manhole	1500		OUTFALL		1.006	34.217	375	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SW01	385194.010	392409.428	385194.010	392409.428	Required	
SW02	385182.169	392372.571	385182.169	392372.571	Required	
SW03	385145.931	392384.213	385145.931	392384.213	Required	
SW04	385216.733	392446.712	385216.733	392446.712	Required	
SW05	385226.403	392476.813	385226.403	392476.813	Required	
SW06	385180.424	392491.584	385180.424	392491.584	Required	
SW07	385169.626	392457.972	385169.626	392457.972	Required	
Separator	385166.239	392459.095	385166.239	392459.095	Required	
SW08	385152.870	392430.037	385152.870	392430.037	Required	
SW09	385162.359	392460.306	385162.359	392460.306	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SW10	385154.084	392462.965	385154.084	392462.965	Required	
Ex.MH S1	385145.982	392465.568			No Entry	

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PIPELINE SCHEDULES for Storm

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)
1.000	o	300	SW01	36.200	35.040	0.860	Open Manhole	1500
1.001	o	375	SW02	36.200	34.800	1.025	Open Manhole	1500
1.002	o	375	SW03	36.200	34.670	1.155	Open Manhole	1500
2.000	o	300	SW04	36.100	34.900	0.900	Open Manhole	1500
2.001	o	375	SW05	36.100	34.690	1.035	Open Manhole	1500
2.002	o	375	SW06	36.200	34.530	1.295	Open Manhole	1500
1.003	o	375	SW07	36.200	34.410	1.415	Open Manhole	1500
1.004	o	375	Separator	36.100	34.300	1.425	Open Manhole	1500
3.000	o	375	SW08	36.100	34.350	1.375	Open Manhole	1500
3.001	o	375	Tank	36.100	34.300	1.425	Open Manhole	1500
1.005	o	375	SW09	36.100	34.290	1.435	Open Manhole	1500
1.006	o	375	SW10	36.250	34.260	1.615	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)
1.000	38.712	235.0	SW02	36.200	34.875	1.025	Open Manhole	1500
1.001	38.063	293.0	SW03	36.200	34.670	1.155	Open Manhole	1500
1.002	77.472	298.0	SW07	36.200	34.410	1.415	Open Manhole	1500
2.000	31.616	235.0	SW05	36.100	34.765	1.035	Open Manhole	1500
2.001	48.293	301.8	SW06	36.200	34.530	1.295	Open Manhole	1500
2.002	35.304	295.0	SW07	36.200	34.410	1.415	Open Manhole	1500
1.003	3.568	340.0	Separator	36.100	34.400	1.325	Open Manhole	1500
1.004	4.065	400.0	SW09	36.100	34.290	1.435	Open Manhole	1500
3.000	15.861	320.0	Tank	36.100	34.300	1.425	Open Manhole	1500
3.001	15.861	1600.0	SW09	36.100	34.290	1.435	Open Manhole	1500
1.005	8.691	289.7	SW10	36.250	34.260	1.615	Open Manhole	2100
1.006	8.510	197.9	Ex.MH S1	36.710	34.217	2.118	Open Manhole	1500

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D, L (mm)	W (mm)
1.006	Ex.MH S1	36.710	34.217	34.217	1500	0

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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	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
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 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	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.362		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: SW10, DS/PN: 1.006, Volume (m³): 7.7

Unit Reference	MD-SHE-0302-5360-1100-5360
Design Head (m)	1.100
Design Flow (l/s)	53.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	302
Invert Level (m)	34.260
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	53.6	Kick-Flo®	0.848	47.3
Flush-Flo™	0.465	53.6	Mean Flow over Head Range	-	43.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.2	0.800	49.2	2.000	71.5	4.000	100.2	7.000	131.6
0.200	31.0	1.000	51.2	2.200	74.9	4.500	106.1	7.500	136.2
0.300	51.7	1.200	55.9	2.400	78.1	5.000	111.7	8.000	140.5
0.400	53.3	1.400	60.2	2.600	81.2	5.500	117.0	8.500	144.8
0.500	53.5	1.600	64.2	3.000	87.1	6.000	122.1	9.000	148.9
0.600	52.9	1.800	68.0	3.500	93.9	6.500	127.0	9.500	152.9

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Storage Structures for Storm

Cellular Storage Manhole: Tank, DS/PN: 3.001

Invert Level (m) 34.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	158.0	0.0	0.800	158.0	0.0	0.801	0.0	0.0

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200 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 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.362 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, 240, 360, 480, 960, 1440
 Return Period(s) (years) 200, 1000
 Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	SW01	15 Winter	200	+0%	200/15 Summer	1000/15 Summer			35.729	0.389
1.001	SW02	15 Winter	200	+0%	200/15 Summer	1000/15 Summer			35.680	0.505
1.002	SW03	15 Winter	200	+0%	200/15 Summer	1000/15 Summer			35.651	0.606
2.000	SW04	15 Winter	200	+0%	200/15 Summer	1000/15 Summer			35.634	0.434
2.001	SW05	15 Winter	200	+0%	200/15 Summer	1000/15 Winter			35.554	0.489
2.002	SW06	15 Winter	200	+0%	200/15 Summer				35.499	0.594
1.003	SW07	15 Winter	200	+0%	200/15 Summer				35.398	0.612
1.004	Separator	15 Winter	200	+0%	200/15 Summer	1000/60 Winter			35.122	0.447
3.000	SW08	60 Winter	200	+0%	200/15 Winter				34.888	0.163
3.001	Tank	60 Winter	200	+0%	200/15 Summer				34.888	0.213
1.005	SW09	60 Winter	200	+0%	200/15 Summer				34.934	0.269
1.006	SW10	60 Winter	200	+0%	200/15 Summer				34.948	0.313

PN	US/MH Name	Flooded		Half Drain	Pipe	Status	Level Exceeded	
		Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)			Flow (l/s)
1.000	SW01	0.000	0.63			42.5	SURCHARGED	4
1.001	SW02	0.000	0.43			44.9	SURCHARGED	4
1.002	SW03	0.000	1.00			109.6	SURCHARGED	3
2.000	SW04	0.000	0.89			58.4	SURCHARGED	5
2.001	SW05	0.000	0.60			63.2	SURCHARGED	2
2.002	SW06	0.000	0.94			98.4	SURCHARGED	
1.003	SW07	0.000	2.54			206.2	SURCHARGED	
1.004	Separator	0.000	2.61			207.7	SURCHARGED	1
3.000	SW08	0.000	0.00			0.4	SURCHARGED	
3.001	Tank	0.000	1.01		32	36.4	SURCHARGED	
1.005	SW09	0.000	0.68			56.9	SURCHARGED	
1.006	SW10	0.000	0.53			53.5	SURCHARGED	

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XP Solutions	Network 2020.1	

1000 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 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 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 M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.362 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, 240, 360, 480, 960, 1440
 Return Period(s) (years) 200, 1000
 Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	SW01	15 Winter	1000	+0%	200/15 Summer	1000/15 Summer			36.209	0.869
1.001	SW02	15 Winter	1000	+0%	200/15 Summer	1000/15 Summer			36.202	1.027
1.002	SW03	15 Winter	1000	+0%	200/15 Summer	1000/15 Summer			36.201	1.156
2.000	SW04	15 Winter	1000	+0%	200/15 Summer	1000/15 Summer			36.107	0.907
2.001	SW05	60 Winter	1000	+0%	200/15 Summer	1000/15 Winter			36.103	1.038
2.002	SW06	60 Winter	1000	+0%	200/15 Summer				36.137	1.232
1.003	SW07	60 Winter	1000	+0%	200/15 Summer				36.119	1.334
1.004	Separator	60 Winter	1000	+0%	200/15 Summer	1000/60 Winter			36.100	1.425
3.000	SW08	60 Winter	1000	+0%	200/15 Winter				36.091	1.366
3.001	Tank	60 Winter	1000	+0%	200/15 Summer				36.090	1.415
1.005	SW09	60 Winter	1000	+0%	200/15 Summer				36.088	1.424
1.006	SW10	60 Winter	1000	+0%	200/15 Summer				36.074	1.439

PN	US/MH Name	Flooded		Half Drain	Pipe	Status	Level Exceeded	
		Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)			Flow (l/s)
1.000	SW01	9.585	1.23			82.4	FLOOD	4
1.001	SW02	2.384	0.79			83.4	FLOOD	4
1.002	SW03	1.169	1.25			136.9	FLOOD	3
2.000	SW04	6.893	1.35			89.1	FLOOD	5
2.001	SW05	3.007	0.56			59.2	FLOOD	2
2.002	SW06	0.000	0.95			98.9	FLOOD RISK	
1.003	SW07	0.000	2.56			207.9	FLOOD RISK	
1.004	Separator	0.507	2.59			206.0	FLOOD	1
3.000	SW08	0.000	0.03			2.6	FLOOD RISK	
3.001	Tank	0.000	1.07		57	38.5	FLOOD RISK	
1.005	SW09	0.000	0.97			80.6	FLOOD RISK	
1.006	SW10	0.000	0.67			67.8	FLOOD RISK	