GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.
5. ALL LEVELS IN mAOD UNLESS SPECIFIED OTHERWISE.
6. EXISTING UTILITIES INFORMATION TO BE SUPPLIED BY OTHERS.
7. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE ACCURACY OF THE TOPOGRAPHICAL SURVEY AND UNDERTAKING ADDITIONAL SURVEYS FOR VALIDATION PURPOSES.
8. ALL WORKS TO BE AGREED AND APPROVED BY THE LOCAL AUTHORITY PRIOR TO COMMENCING ON SITE.

KEY

- SITE BOUNDARY
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED FILTER DRAIN
- EXISTING COMBINED DRAINAGE
- EXISTING COMBINED MANHOLE
- SURFACE WATER MH
- VORTEX FLOW CONTROL MH
- PROPOSED TYPE 3 PAVEMENT STONE DEPTH 450mm

Rev:	Description:	Date:	By:	Chkd:
P02	AMENDED TO SUIT NEW LAYOUT	11.01.18	AMG	RMZ
P01	ISSUED FOR PLANNING	28.11.17	AMG	e

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Status: PRELIMINARY — S0

Project: PEARY STREET CAR PARK, MANCHESTER

Drg Title: DRAINAGE STRATEGY GENERAL ARRANGEMENT

Size:	Date:	Drawn By:	Designed By:	Checked By:
A1	28.11.17	AMG	AMG	RM
Scale: 1:500				

Project No:	Originator:	Zone:	Level:	Type:	Discipline:	Category / Number:	Rev:
065619	CUR	00	XX	DR	D	72001	-P02

\\mafs01\Projects\065001 - 065000\065619 - Peary Street Car Park\CARS 4 Production\4B Models & Drawings_Civil-C\CAD\

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

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 Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 7
Number of Online Controls 4 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) 17.000 Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	360 Winter	1	+0%					50.233
1.001	S2	360 Winter	1	+0%	1/60 Winter				50.232
1.002	S3	360 Winter	1	+0%	1/15 Summer				50.231
2.000	S4	480 Winter	1	+0%	1/120 Summer				49.931
2.001	S5	480 Winter	1	+0%	1/60 Winter				49.931
1.003	S6	480 Winter	1	+0%	1/15 Summer				49.931
3.000	S7	15 Winter	1	+0%					46.606
3.001	S8	360 Winter	1	+0%					46.563
1.004	S9	360 Winter	1	+0%	1/15 Summer				46.562
1.005	S10	360 Winter	1	+0%	1/30 Summer				46.051

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.362	0.000	0.02		3.3	OK	
1.001	S2	0.228	0.000	0.03		5.6	SURCHARGED	
1.002	S3	1.323	0.000	0.01		2.5	SURCHARGED	
2.000	S4	0.224	0.000	0.01		1.6	FLOOD RISK	

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
2.001	S5	0.570	0.000	0.02		2.4	SURCHARGED	
1.003	S6	1.421	0.000	0.01		2.5	SURCHARGED	
3.000	S7	-0.839	0.000	0.04		9.0	OK	
3.001	S8	-0.052	0.000	0.02		4.4	OK	
1.004	S9	1.282	0.000	0.04		4.8	SURCHARGED	
1.005	S10	0.871	0.000	0.01		3.9	SURCHARGED	

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

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 Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 7
Number of Online Controls 4 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) 17.000 Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	360 Winter	30	+0%					50.350
1.001	S2	480 Winter	30	+0%	30/15 Summer				50.349
1.002	S3	480 Winter	30	+0%	30/15 Summer				50.347
2.000	S4	960 Winter	30	+0%	30/15 Summer				50.024
2.001	S5	960 Winter	30	+0%	30/15 Summer				50.023
1.003	S6	960 Winter	30	+0%	30/15 Summer				50.023
3.000	S7	240 Winter	30	+0%	30/15 Winter				47.903
3.001	S8	240 Winter	30	+0%	30/15 Summer				47.902
1.004	S9	240 Winter	30	+0%	30/15 Summer				47.901
1.005	S10	360 Winter	30	+0%	30/15 Summer				47.025

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.245	0.000	0.04		7.7	OK	
1.001	S2	0.345	0.000	0.05		8.5	FLOOD RISK	
1.002	S3	1.439	0.000	0.01		2.3	FLOOD RISK	
2.000	S4	0.317	0.000	0.02		2.7	FLOOD RISK	

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
2.001	S5	0.662	0.000	0.02		3.2	SURCHARGED	
1.003	S6	1.513	0.000	0.01		2.6	SURCHARGED	
3.000	S7	0.458	0.000	0.03		6.5	SURCHARGED	
3.001	S8	1.287	0.000	0.03		8.3	FLOOD RISK	
1.004	S9	2.621	0.000	0.05		5.6	FLOOD RISK	
1.005	S10	1.845	0.000	0.01		5.0	FLOOD RISK	

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

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 Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 7
Number of Online Controls 4 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) 17.000 Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	60 Winter	100	+30%					50.481
1.001	S2	960 Winter	100	+30%	100/15 Summer				50.439
1.002	S3	960 Winter	100	+30%	100/15 Summer				50.437
2.000	S4	1440 Winter	100	+30%	100/15 Summer				50.120
2.001	S5	1440 Winter	100	+30%	100/15 Summer				50.120
1.003	S6	1440 Winter	100	+30%	100/15 Summer				50.120
3.000	S7	360 Winter	100	+30%	100/15 Summer				48.088
3.001	S8	360 Winter	100	+30%	100/15 Summer				48.086
1.004	S9	360 Winter	100	+30%	100/15 Summer				48.084
1.005	S10	480 Winter	100	+30%	100/15 Summer				47.155

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.114	0.000	0.24		44.1	OK	
1.001	S2	0.435	0.000	0.05		8.6	FLOOD RISK	
1.002	S3	1.529	0.000	0.01		2.0	FLOOD RISK	
2.000	S4	0.413	0.000	0.02		3.3	FLOOD RISK	

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
2.001	S5	0.759	0.000	0.03		3.7	FLOOD RISK	
1.003	S6	1.610	0.000	0.01		2.6	FLOOD RISK	
3.000	S7	0.643	0.000	0.03		8.5	SURCHARGED	
3.001	S8	1.471	0.000	0.04		10.6	FLOOD RISK	
1.004	S9	2.804	0.000	0.04		5.1	FLOOD RISK	
1.005	S10	1.975	0.000	0.01		5.1	FLOOD RISK	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.400	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Surface Network 1

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	59.092	0.591	100.0	0.193	12.00	0.0	0.600	[]	-3	Pipe/Conduit	
1.001	59.092	0.591	100.0	0.273	0.00	0.0	0.600	[]	-3	Pipe/Conduit	
1.002	39.840	0.398	100.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	51.970	0.346	150.2	0.142	12.00	0.0	0.600	[]	-3	Pipe/Conduit	
2.001	51.970	0.346	150.2	0.204	0.00	0.0	0.600	[]	-3	Pipe/Conduit	
1.003	53.307	2.665	20.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
3.000	41.508	0.830	50.0	0.125	12.00	0.0	0.600	[]	-3	Pipe/Conduit	
3.001	41.508	0.830	50.0	0.152	0.00	0.0	0.600	[]	-3	Pipe/Conduit	
1.004	13.232	0.100	132.3	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	28.82	12.69	49.715	0.193	0.0	0.0	0.0	1.42	187.7	15.1
1.001	27.97	13.39	49.124	0.466	0.0	0.0	0.0	1.42	187.7	35.3
1.002	27.54	13.75	48.533	0.466	0.0	0.0	0.0	1.81	200.1	35.3
2.000	28.75	12.75	48.827	0.142	0.0	0.0	0.0	1.16	152.8	11.1
2.001	27.83	13.50	48.481	0.346	0.0	0.0	0.0	1.16	152.8	26.1
1.003	27.29	13.97	48.135	0.812	0.0	0.0	0.0	4.07	449.2	60.0
3.000	29.30	12.34	46.565	0.125	0.0	0.0	0.0	2.02	266.1	9.9
3.001	28.83	12.69	45.735	0.277	0.0	0.0	0.0	2.02	266.1	21.6
1.004	27.13	14.11	44.905	1.089	0.0	0.0	0.0	1.57	173.8	80.0

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Network Design Table for Surface Network 1

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
1.005	25.952	1.298	20.0	0.029	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)
1.005	27.01	14.22	44.805	1.118	0.0	0.0	0.0	4.07	449.3	81.8

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Manhole Schedules for Surface Network 1

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)
S1	51.044	1.329	Open Manhole	1200	1.000	49.715	-3				
S2	50.638	1.514	Open Manhole	1200	1.001	49.124	-3	1.000	49.124	-3	
S3	50.638	2.105	Open Manhole	1200	1.002	48.533	375	1.001	48.533	-3	
S4	50.150	1.323	Open Manhole	1200	2.000	48.827	-3				
S5	50.329	1.848	Open Manhole	1200	2.001	48.481	-3	2.000	48.481	-3	
S6	50.329	2.194	Open Manhole	1200	1.003	48.135	375	1.002	48.135	375	
								2.001	48.135	-3	
S7	49.884	3.319	Open Manhole	1200	3.000	46.565	-3				
S8	48.122	2.387	Open Manhole	1200	3.001	45.735	-3	3.000	45.735	-3	
S9	48.122	3.217	Open Manhole	1200	1.004	44.905	375	1.003	45.470	375	565
								3.001	44.905	-3	
S10	47.308	2.503	Open Manhole	1500	1.005	44.805	375	1.004	44.805	375	
S20	46.110	2.603	Open Manhole	1200		OUTFALL		1.005	43.507	375	

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PIPELINE SCHEDULES for Surface Network 1

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	[]	-3	S1	51.044	49.715	0.449	Open Manhole	1200
1.001	[]	-3	S2	50.638	49.124	0.634	Open Manhole	1200
1.002	o	375	S3	50.638	48.533	1.730	Open Manhole	1200
2.000	[]	-3	S4	50.150	48.827	0.443	Open Manhole	1200
2.001	[]	-3	S5	50.329	48.481	0.968	Open Manhole	1200
1.003	o	375	S6	50.329	48.135	1.819	Open Manhole	1200
3.000	[]	-3	S7	49.884	46.565	2.439	Open Manhole	1200
3.001	[]	-3	S8	48.122	45.735	1.507	Open Manhole	1200
1.004	o	375	S9	48.122	44.905	2.842	Open Manhole	1200
1.005	o	375	S10	47.308	44.805	2.128	Open Manhole	1500

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	59.092	100.0	S2	50.638	49.124	0.634	Open Manhole	1200
1.001	59.092	100.0	S3	50.638	48.533	1.225	Open Manhole	1200
1.002	39.840	100.0	S6	50.329	48.135	1.819	Open Manhole	1200
2.000	51.970	150.2	S5	50.329	48.481	0.968	Open Manhole	1200
2.001	51.970	150.2	S6	50.329	48.135	1.314	Open Manhole	1200
1.003	53.307	20.0	S9	48.122	45.470	2.277	Open Manhole	1200
3.000	41.508	50.0	S8	48.122	45.735	1.507	Open Manhole	1200
3.001	41.508	50.0	S9	48.122	44.905	2.337	Open Manhole	1200
1.004	13.232	132.3	S10	47.308	44.805	2.128	Open Manhole	1500
1.005	25.952	20.0	S20	46.110	43.507	2.228	Open Manhole	1200

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.005	S20	46.110	43.507	0.000	1200	0

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Simulation Criteria for Surface Network 1

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 Storage Structures	7
Number of Online Controls	4	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)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Surface Network 1

Orifice Manhole: S3, DS/PN: 1.002, Volume (m³): 10.0

Diameter (m) 0.040 Discharge Coefficient 0.600 Invert Level (m) 48.533

Orifice Manhole: S6, DS/PN: 1.003, Volume (m³): 13.5

Diameter (m) 0.030 Discharge Coefficient 0.600 Invert Level (m) 48.135

Orifice Manhole: S9, DS/PN: 1.004, Volume (m³): 14.7

Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 44.905

Hydro-Brake Optimum® Manhole: S10, DS/PN: 1.005, Volume (m³): 5.7

Unit Reference	MD-SHE-0089-5000-2200-5000
Design Head (m)	2.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	89
Invert Level (m)	44.805
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.200	5.0
Flush-Flo™	0.391	3.9
Kick-Flo®	0.801	3.1
Mean Flow over Head Range	-	3.9

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	2.8	1.200	3.8	3.000	5.8	7.000	8.6
0.200	3.6	1.400	4.0	3.500	6.2	7.500	8.9
0.300	3.9	1.600	4.3	4.000	6.6	8.000	9.2
0.400	3.9	1.800	4.5	4.500	7.0	8.500	9.4
0.500	3.9	2.000	4.8	5.000	7.3	9.000	9.7
0.600	3.8	2.200	5.0	5.500	7.7	9.500	10.0
0.800	3.1	2.400	5.2	6.000	8.0		
1.000	3.5	2.600	5.4	6.500	8.3		

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Storage Structures for Surface Network 1

Porous Car Park Manhole: S2, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	33.0
Membrane Percolation (mm/hr)	1000	Length (m)	58.0
Max Percolation (l/s)	531.7	Slope (1:X)	330.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.188	Membrane Depth (mm)	0

Porous Car Park Manhole: S3, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	37.0
Membrane Percolation (mm/hr)	1000	Length (m)	74.0
Max Percolation (l/s)	760.6	Slope (1:X)	330.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.188	Membrane Depth (mm)	0

Porous Car Park Manhole: S5, DS/PN: 2.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	31.0
Membrane Percolation (mm/hr)	1000	Length (m)	66.0
Max Percolation (l/s)	568.3	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	49.879	Membrane Depth (mm)	0

Porous Car Park Manhole: S6, DS/PN: 1.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	25.0
Membrane Percolation (mm/hr)	1000	Length (m)	57.0
Max Percolation (l/s)	395.8	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	49.879	Membrane Depth (mm)	0

Porous Car Park Manhole: S8, DS/PN: 3.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	33.0
Membrane Percolation (mm/hr)	1000	Length (m)	38.0
Max Percolation (l/s)	348.3	Slope (1:X)	50.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	47.672	Membrane Depth (mm)	0

Porous Car Park Manhole: S9, DS/PN: 1.004

Infiltration Coefficient Base (m/hr)	0.00000	Max Percolation (l/s)	421.7
Membrane Percolation (mm/hr)	1000	Safety Factor	2.0

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Porous Car Park Manhole: S9, DS/PN: 1.004

Porosity	0.30	Slope (1:X)	50.0
Invert Level (m)	47.672	Depression Storage (mm)	5
Width (m)	33.0	Evaporation (mm/day)	3
Length (m)	46.0	Membrane Depth (mm)	0

Porous Car Park Manhole: S10, DS/PN: 1.005

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.0
Membrane Percolation (mm/hr)	1000	Length (m)	34.0
Max Percolation (l/s)	151.1	Slope (1:X)	50.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	46.858	Membrane Depth (mm)	0

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

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 Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 3
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) 17.000 Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S11	15 Winter	1	+0%					49.889
1.001	S12	60 Winter	1	+0%	1/15 Summer				48.985
1.002	S13	240 Winter	1	+0%	1/240 Winter				47.400
1.003	S14	240 Winter	1	+0%	1/15 Winter				47.155

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S11	-0.818	0.000	0.07		29.1	OK	
1.001	S12	0.083	0.000	0.01		5.1	SURCHARGED	
1.002	S13	0.016	0.000	0.03		6.8	SURCHARGED	
1.003	S14	0.759	0.000	0.02		5.0	SURCHARGED	

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

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 Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 3
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) 17.000 Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S11	15 Winter	30	+0%					49.981
1.001	S12	120 Winter	30	+0%	30/15 Summer				49.165
1.002	S13	240 Winter	30	+0%	30/15 Summer				47.547
1.003	S14	480 Winter	30	+0%	30/15 Summer				47.299

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S11	-0.726	0.000	0.17		71.4	OK	
1.001	S12	0.263	0.000	0.01		5.6	FLOOD RISK	
1.002	S13	0.163	0.000	0.04		7.5	FLOOD RISK	
1.003	S14	0.903	0.000	0.02		5.0	FLOOD RISK	

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

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 Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 3
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) 17.000 Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S11	15 Winter	100	+30%					50.080
1.001	S12	240 Winter	100	+30%	100/15 Summer				49.303
1.002	S13	480 Winter	100	+30%	100/15 Summer				47.646
1.003	S14	960 Winter	100	+30%	100/15 Summer				47.394

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S11	-0.627	0.000	0.28		119.8	OK	
1.001	S12	0.401	0.000	0.01		5.9	FLOOD RISK	
1.002	S13	0.262	0.000	0.04		7.2	FLOOD RISK	
1.003	S14	0.998	0.000	0.02		5.0	FLOOD RISK	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.400	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Surface Network 1

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	32.290	1.805	17.9	0.250	5.00	0.0	0.600	[]	-2	Pipe/Conduit	
1.001	31.362	1.518	20.7	0.149	0.00	0.0	0.600	[]	-2	Pipe/Conduit	
1.002	24.611	0.313	78.6	0.141	0.00	0.0	0.600	[]	-2	Pipe/Conduit	
1.003	7.701	2.401	3.2	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)
1.000	46.04	5.16	49.807	0.250	0.0	0.0	0.0	3.39	457.1	31.2
1.001	45.40	5.32	48.002	0.399	0.0	0.0	0.0	3.15	425.2	49.1
1.002	44.45	5.58	46.484	0.540	0.0	0.0	0.0	1.61	217.1	65.0
1.003	44.39	5.60	46.171	0.540	0.0	0.0	0.0	7.36	292.6	65.0

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Manhole Schedules for Surface Network 1

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)
S11	51.157	1.350	Open Manhole	1200	1.000	49.807	-2				
S12	49.342	1.340	Open Manhole	1200	1.001	48.002	-2	1.000	48.002	-2	
S13	47.833	1.349	Open Manhole	1200	1.002	46.484	-2	1.001	46.484	-2	
S14	47.521	1.350	Open Manhole	1200	1.003	46.171	225	1.002	46.171	-2	
S6	46.699	2.929	Open Manhole	1200		OUTFALL		1.003	43.770	225	

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PIPELINE SCHEDULES for Surface Network 1

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	[]	-2	S11	51.157	49.807	0.450	Open Manhole	1200
1.001	[]	-2	S12	49.342	48.002	0.440	Open Manhole	1200
1.002	[]	-2	S13	47.833	46.484	0.449	Open Manhole	1200
1.003	o	225	S14	47.521	46.171	1.125	Open Manhole	1200

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	32.290	17.9	S12	49.342	48.002	0.440	Open Manhole	1200
1.001	31.362	20.7	S13	47.833	46.484	0.449	Open Manhole	1200
1.002	24.611	78.6	S14	47.521	46.171	0.450	Open Manhole	1200
1.003	7.701	3.2	S6	46.699	43.770	2.704	Open Manhole	1200

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003	S6	46.699	43.770	0.000	1200	0

Simulation Criteria for Surface Network 1

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 Storage Structures	3
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)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Surface Network 1

Orifice Manhole: S12, DS/PN: 1.001, Volume (m³): 5.7

Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 48.002

Orifice Manhole: S13, DS/PN: 1.002, Volume (m³): 5.6

Diameter (m) 0.075 Discharge Coefficient 0.600 Invert Level (m) 46.484

Hydro-Brake Optimum® Manhole: S14, DS/PN: 1.003, Volume (m³): 4.7

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	46.171
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	5.0
Flush-Flo™	0.354	5.0
Kick-Flo®	0.745	4.0
Mean Flow over Head Range	-	4.4

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	3.4	1.200	5.0	3.000	7.7	7.000	11.5
0.200	4.7	1.400	5.4	3.500	8.3	7.500	11.8
0.300	5.0	1.600	5.7	4.000	8.8	8.000	12.2
0.400	5.0	1.800	6.0	4.500	9.3	8.500	12.6
0.500	4.9	2.000	6.3	5.000	9.8	9.000	12.9
0.600	4.7	2.200	6.6	5.500	10.2	9.500	13.3
0.800	4.1	2.400	6.9	6.000	10.7		
1.000	4.6	2.600	7.2	6.500	11.1		

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Storage Structures for Surface Network 1

Porous Car Park Manhole: S12, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	34.0
Membrane Percolation (mm/hr)	1000	Length (m)	65.0
Max Percolation (l/s)	613.9	Slope (1:X)	150.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	48.892	Membrane Depth (mm)	0

Porous Car Park Manhole: S13, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	30.0
Membrane Percolation (mm/hr)	1000	Length (m)	52.0
Max Percolation (l/s)	433.3	Slope (1:X)	150.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	47.383	Membrane Depth (mm)	0

Porous Car Park Manhole: S14, DS/PN: 1.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	28.0
Membrane Percolation (mm/hr)	1000	Length (m)	50.0
Max Percolation (l/s)	388.9	Slope (1:X)	150.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	47.071	Membrane Depth (mm)	0

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APPENDIX J: NOTES OF LIMITATIONS

The data essentially comprised a study of available documented information from various sources together with discussions with relevant authorities and other interested parties. There may also be circumstances at the site that are not documented. The information reviewed is not exhaustive and has been accepted in good faith as providing representative and true data pertaining to site conditions. If additional information becomes available which might impact our conclusions, we request the opportunity to review the information, reassess the potential concerns and modify our opinion if warranted.

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