



Diamond Wood & Shaw Limited

The Old School · Blaby Road · Enderby · Leicester · LE19 4AR
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Surface Water Calculations

Client: Morro Partnerships

Architect: Staniforth Architects

Project: Sapcote Road, Burbage

Project No: 23-20589

Document No: 0-010

Issue: P1

Status: Preliminary

Date: 18.01.2024

Engineer: LM

Issue Status:
A=Approval
B=Building Regulations
C=Construction
D=Draft
P=Preliminary
R=Review
T=Tender
Z=Final Construction

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Leicester, LE19 4AR	Surface Water Calculations	
Date 17/01/2024	Designed by LM	
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Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Pipe Sizes STANDARD Manhole Sizes STANDARD

Designed with Level Soffits

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	18.725	0.115	162.8	0.004	4.00	0.0	0.600	o	150	Pipe/Conduit		
1.001	44.367	0.450	98.6	0.136	0.00	0.0	0.600	o	225	Pipe/Conduit		
2.000	22.408	0.230	97.4	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit		
3.000	13.496	0.135	100.0	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit		
1.002	17.793	0.180	98.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
1.003	10.167	0.200	50.8	0.069	0.00	0.0	0.600	o	225	Pipe/Conduit		
4.000	6.632	0.070	94.7	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit		
4.001	16.614	0.150	110.8	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit		

Network Results Table

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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)
RE	114.700	0.680	Junction		1.000	114.020	150				
S1	114.857	1.027	Open Manhole	1200	1.001	113.830	225	1.000	113.905	150	
S2	115.432	1.822	Open Manhole	450	2.000	113.610	225				
S3	114.533	1.018	Open Manhole	450	3.000	113.515	225				
S4	115.036	1.656	Open Manhole	1200	1.002	113.380	225	1.001	113.380	225	
								2.000	113.380	225	
								3.000	113.380	225	
S6	114.795	1.595	Open Manhole	450	1.003	113.200	225	1.002	113.200	225	
RE	115.900	2.555	Junction		4.000	113.345	150				
S7	115.450	2.175	Open Manhole	450	4.001	113.275	150	4.000	113.275	150	
S8	114.600	1.475	Open Manhole	450	4.002	113.125	150	4.001	113.125	150	
S9	114.656	1.656	Open Manhole	1200	1.004	113.000	225	1.003	113.000	225	
								4.002	113.075	150	
F7	114.100	1.170	Open Manhole	0		OUTFALL		1.004	112.930	225	

No coordinates have been specified, layout information cannot be produced.

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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	150	RE	114.700	114.020	0.530	Junction	
1.001	o	225	S1	114.857	113.830	0.802	Open Manhole	1200
2.000	o	225	S2	115.432	113.610	1.597	Open Manhole	450
3.000	o	225	S3	114.533	113.515	0.793	Open Manhole	450
1.002	o	225	S4	115.036	113.380	1.431	Open Manhole	1200
1.003	o	225	S6	114.795	113.200	1.370	Open Manhole	450
4.000	o	150	RE	115.900	113.345	2.405	Junction	
4.001	o	150	S7	115.450	113.275	2.025	Open Manhole	450
4.002	o	150	S8	114.600	113.125	1.325	Open Manhole	450
1.004	o	225	S9	114.656	113.000	1.431	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	18.725	162.8	S1	114.857	113.905	0.802	Open Manhole	1200
1.001	44.367	98.6	S4	115.036	113.380	1.431	Open Manhole	1200
2.000	22.408	97.4	S4	115.036	113.380	1.431	Open Manhole	1200
3.000	13.496	100.0	S4	115.036	113.380	1.431	Open Manhole	1200
1.002	17.793	98.9	S6	114.795	113.200	1.370	Open Manhole	450
1.003	10.167	50.8	S9	114.656	113.000	1.431	Open Manhole	1200
4.000	6.632	94.7	S7	115.450	113.275	2.025	Open Manhole	450
4.001	16.614	110.8	S8	114.600	113.125	1.325	Open Manhole	450
4.002	3.083	61.7	S9	114.656	113.075	1.431	Open Manhole	1200
1.004	3.238	46.3	F7	114.100	112.930	0.945	Open Manhole	0

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)
1.004	F7	114.100	112.930	0.000	0	0

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File 23-20589 0-010P1	Checked by BP	
Innovyze		Network 2020.1.3
<u>Simulation Criteria for Storm</u> 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 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 Storage Structures 2 Number of Online Controls 1 Number of Time/Area Diagrams 0 Number of Offline Controls 0 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> 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) 19.700 Storm Duration (mins) 30 Ratio R 0.407		
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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S9, DS/PN: 1.004, Volume (m³): 2.3

Unit Reference	MD-SHE-0079-3400-1600-3400
Design Head (m)	1.600
Design Flow (l/s)	3.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	79
Invert Level (m)	113.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	3.4	Kick-Flo®	0.706	2.3
Flush-Flo™	0.348	2.9	Mean Flow over Head Range	-	2.7

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	2.3	1.200	3.0	3.000	4.5	7.000	6.8
0.200	2.7	1.400	3.2	3.500	4.9	7.500	7.0
0.300	2.9	1.600	3.4	4.000	5.2	8.000	7.2
0.400	2.9	1.800	3.6	4.500	5.5	8.500	7.4
0.500	2.8	2.000	3.8	5.000	5.8	9.000	7.6
0.600	2.7	2.200	3.9	5.500	6.0	9.500	7.8
0.800	2.5	2.400	4.1	6.000	6.3		
1.000	2.7	2.600	4.2	6.500	6.5		

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Storage Structures for Storm

Complex Manhole: S4, DS/PN: 1.002

Cellular Storage

Invert Level (m) 113.380 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)
0.000	72.0	72.0	0.801	0.0	104.8
0.800	72.0	104.8			

Cellular Storage

Invert Level (m) 113.380 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)
0.000	14.0	14.0	0.401	0.0	20.0
0.400	14.0	20.0			

Porous Car Park

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 17.5
Membrane Percolation (mm/hr) 1000 Length (m) 45.0
Max Percolation (l/s) 218.8 Slope (1:X) 100.0
Safety Factor 2.0 Depression Storage (mm) 5
Porosity 0.30 Evaporation (mm/day) 3
Invert Level (m) 113.050 Cap Volume Depth (m) 0.350

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

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 7.5
Membrane Percolation (mm/hr) 1000 Length (m) 66.0
Max Percolation (l/s) 137.5 Slope (1:X) 75.0
Safety Factor 2.0 Depression Storage (mm) 5
Porosity 0.30 Evaporation (mm/day) 3
Invert Level (m) 114.017 Cap Volume Depth (m) 0.350

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1 year Return Period Summary of Critical Results by Maximum Outflow (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 Storage Structures 2
Number of Online Controls 1	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 0.406
Region England and Wales	Cv (Summer) 0.750
M5-60 (mm)	19.700 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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

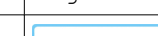
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	RE	15 Winter	1	+0%					114.040
1.001	S1	15 Winter	1	+0%	100/15 Summer				113.919
2.000	S2	15 Summer	1	+0%	100/60 Summer				113.610
3.000	S3	15 Summer	1	+0%	100/30 Winter				113.515
1.002	S4	60 Winter	1	+0%	30/120 Winter				113.438
1.003	S6	15 Summer	1	+0%	1/15 Summer				113.460
4.000	RE	30 Winter	1	+0%					113.495
4.001	S7	15 Summer	1	+0%	1/15 Summer				113.460
4.002	S8	30 Winter	1	+0%	1/15 Summer				113.553
1.004	S9	600 Winter	1	+0%	1/15 Summer				113.385

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

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m ³)						
1.000	RE	-0.130	0.000	0.04			0.6	OK*	
1.001	S1	-0.136	0.000	0.33			16.5	OK	
2.000	S2	-0.225	0.000	0.00			0.0	OK	
3.000	S3	-0.225	0.000	0.00			0.0	OK	
1.002	S4	-0.167	0.000	0.06			2.8	OK	
1.003	S6	0.035	0.000	0.12			7.1	SURCHARGED	
4.000	RE	0.000	0.000	0.02			0.4	SURCHARGED*	
4.001	S7	0.035	0.000	0.07			1.2	SURCHARGED	
4.002	S8	0.278	0.000	0.06			0.9	SURCHARGED	
1.004	S9	0.160	0.000	0.08		79	2.9	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Outflow (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 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	2
Number of Online Controls	1	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	0.406
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.700	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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

									Water
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
1.000	RE	15 Winter	30	+0%					114.052
1.001	S1	15 Winter	30	+0%	100/15 Summer				114.020
2.000	S2	180 Winter	30	+0%	100/60 Summer				113.620
3.000	S3	360 Winter	30	+0%	100/30 Winter				113.598
1.002	S4	120 Summer	30	+0%	30/120 Winter				113.575
1.003	S6	15 Summer	30	+0%	1/15 Summer				113.808
4.000	RE	15 Summer	30	+0%					113.495
4.001	S7	15 Summer	30	+0%	1/15 Summer				113.847
4.002	S8	15 Summer	30	+0%	1/15 Summer				113.857
1.004	S9	2160 Winter	30	+0%	1/15 Summer				113.360

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100 year Return Period Summary of Critical Results by Maximum Outflow
(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 Storage Structures	2
Number of Online Controls	1	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	0.406
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.700	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, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

									Water
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow
PN	Name	Storm		Period	Change	Surcharge	Flood	Overflow	Act.
1.000	RE	15	Summer	100	+40%				
1.001	S1	15	Winter	100	+40%	100/15	Summer		
2.000	S2	360	Summer	100	+40%	100/60	Summer		
3.000	S3	960	Winter	100	+40%	100/30	Winter		
1.002	S4	240	Winter	100	+40%	30/120	Winter		
1.003	S6	15	Winter	100	+40%	1/15	Summer		
4.000	RE	15	Summer	100	+40%				
4.001	S7	15	Summer	100	+40%	1/15	Summer		
4.002	S8	15	Summer	100	+40%	1/15	Summer		
1.004	S9	240	Winter	100	+40%	1/15	Summer		

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

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)		
1.000	RE	0.000	0.000	0.49			6.8	SURCHARGED*	
1.001	S1	0.658	0.000	1.54			77.0	FLOOD RISK	
2.000	S2	0.251	0.000	0.00			0.0	SURCHARGED	
3.000	S3	0.331	0.000	0.00			0.0	SURCHARGED	
1.002	S4	0.780	0.000	0.09		583	4.0	SURCHARGED	
1.003	S6	0.610	0.000	0.14			8.8	SURCHARGED	
4.000	RE	0.000	0.000	0.33			5.5	SURCHARGED*	
4.001	S7	0.733	0.000	0.62			9.7	SURCHARGED	
4.002	S8	0.853	0.000	0.74			10.3	SURCHARGED	
1.004	S9	1.153	0.000	0.08		47	3.2	FLOOD RISK	