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Drainage Calculations

Client:	M2 Properties Ltd
Architect:	Staniforth Architects
Project:	68 Wood Street, Earl Shilton
Project No:	25-22559
Document No:	0-010
Issue:	Rev P1: December 2025
Status:	Preliminary
Date:	09/12/2025
Engineer:	LM

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

DWS
Consulting Engineers
Diamond Wood & Shaw Limited
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Title
25-22559 [68 Wood Street, Earl Shilton] Brownfield Runoff

Project No	25--22559
Date	DEC 2025
Engineer	LM
Checker	BP
Issue	1
Sheet No	1

Total Site Area = 0.132 ha (A)
Total Impermeable Area = 0.132 ha (Ai)

Modified rational method for site peak discharge rate (Qp)

Qp = 2.78 x Cr x Cv x I x Ai

Where,

Cr = Dimensionless routing coefficient (taken as 1.3)

Cv = Volumetric runoff coefficient = Pr / Pimp

Pr = Percentage runoff = (0.829 x Pimp) + (25 x SOIL) + (0.078 x UCWI) - 20.7
(equation 6.4 from Urban Drainage 2nd Ed: Butler et al)

Pimp = % Impervious area = (Ai / A) x 100 = $\frac{0.132}{0.132}$ x 100 = 100 %

SOIL = Soil Index = 0.45 (from MicroDrainage)

UCWI = Urban Catchment Wetness Index = 130 (fig 6.2 Urban Drainage 2nd)

Therefore, Pr = (0.829 x 100) + (25 x 0.45) +
(0.078 x 130) - 20.7
= 82.9 + 11.25 + 10.14 - 20.7
= 83.59

Check, Pr > 0.4 x Pimp So, 83.59 > 40 so, use Pr from equation above

So, if needed, Pr = 0.4 x 100 = N/A

Therefore, Cv = $\frac{83.59}{100}$ = 0.836

I = Rainfall intensity (taken from MicroDrainage)

1 in 1 year = 57.09
1 in 30 year = 133.76
1 in 100 year = 168.87

1 in 1	Qp	=	2.78	x	1.3	x	0.836	x	57.09	x	0.132	=	22.77	l/s
1 in 30	Qp	=	2.78	x	1.3	x	0.836	x	133.8	x	0.132	=	53.34	l/s
1 in 100	Qp	=	2.78	x	1.3	x	0.836	x	168.9	x	0.132	=	67.34	l/s

Proposed rates

Return	Existing		Proposed (50% betterment)	
1 in 1	22.77	l/s	11.38	l/s
1 in 30	53.34	l/s	26.67	l/s
1 in 100	67.34	l/s	33.67	l/s

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)	100	PIMP (%)	100
M5-60 (mm)	19.700	Add Flow / Climate Change (%)	0
Ratio R	0.407	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

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	17.700	0.200	88.5	0.012	4.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	15.000	0.170	88.2	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.002	3.200	0.150	21.3	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
2.000	13.500	0.670	20.1	0.012	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	34.200	3.000	11.4	0.057	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	9.200	0.300	30.7	0.014	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	15.500	0.850	18.2	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	13.500	0.350	38.6	0.011	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	2.500	0.180	13.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.36	113.070	0.012	0.0	0.0	0.0	0.82	6.4	1.6
1.001	50.00	4.67	112.870	0.012	0.0	0.0	0.0	0.82	6.4	1.6
1.002	50.00	4.70	112.700	0.012	0.0	0.0	0.0	1.68	13.2	1.6
2.000	50.00	4.10	113.170	0.012	0.0	0.0	0.0	2.25	39.8	1.6
1.003	50.00	4.89	112.500	0.081	0.0	0.0	0.0	3.00	53.0	11.0
1.004	50.00	4.97	109.500	0.095	0.0	0.0	0.0	1.82	32.2	12.9
1.005	50.00	5.08	109.200	0.102	0.0	0.0	0.0	2.37	41.9	13.8
3.000	50.00	4.14	108.700	0.011	0.0	0.0	0.0	1.63	28.7	1.5
1.006	50.00	5.10	108.350	0.113	0.0	0.0	0.0	2.72	48.0	15.3

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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)
S1	114.020	0.950	Junction		1.000	113.070	100				
S2	114.020	1.150	Open Manhole	225	1.001	112.870	100	1.000	112.870	100	
S3	114.050	1.350	Open Manhole	450	1.002	112.700	100	1.001	112.700	100	
S4	114.170	1.000	Junction		2.000	113.170	150				
S5	114.000	1.500	Open Manhole	450	1.003	112.500	150	1.002	112.550	100	
								2.000	112.500	150	
S6	111.050	1.550	Open Manhole	450	1.004	109.500	150	1.003	109.500	150	
S7	111.050	1.850	Open Manhole	450	1.005	109.200	150	1.004	109.200	150	
S8	110.600	1.900	Open Manhole	1200	3.000	108.700	150				
S9	110.550	2.200	Open Manhole	1200	1.006	108.350	150	1.005	108.350	150	
								3.000	108.350	150	
F7	110.550	2.380	Open Manhole	0		OUTFALL		1.006	108.170	150	

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	100	S1	114.020	113.070	0.850	Junction	
1.001	o	100	S2	114.020	112.870	1.050	Open Manhole	225
1.002	o	100	S3	114.050	112.700	1.250	Open Manhole	450
2.000	o	150	S4	114.170	113.170	0.850	Junction	
1.003	o	150	S5	114.000	112.500	1.350	Open Manhole	450
1.004	o	150	S6	111.050	109.500	1.400	Open Manhole	450
1.005	o	150	S7	111.050	109.200	1.700	Open Manhole	450
3.000	o	150	S8	110.600	108.700	1.750	Open Manhole	1200
1.006	o	150	S9	110.550	108.350	2.050	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	17.700	88.5	S2	114.020	112.870	1.050	Open Manhole	225
1.001	15.000	88.2	S3	114.050	112.700	1.250	Open Manhole	450
1.002	3.200	21.3	S5	114.000	112.550	1.350	Open Manhole	450
2.000	13.500	20.1	S5	114.000	112.500	1.350	Open Manhole	450
1.003	34.200	11.4	S6	111.050	109.500	1.400	Open Manhole	450
1.004	9.200	30.7	S7	111.050	109.200	1.700	Open Manhole	450
1.005	15.500	18.2	S9	110.550	108.350	2.050	Open Manhole	1200
3.000	13.500	38.6	S9	110.550	108.350	2.050	Open Manhole	1200
1.006	2.500	13.9	F7	110.550	108.170	2.230	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)
1.006	F7	110.550	108.170	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 * 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	1
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	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: 1.006, Volume (m³): 3.0

Unit Reference	MD-SHE-0142-1140-1800-1140
Design Head (m)	1.800
Design Flow (l/s)	11.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	142
Invert Level (m)	108.350
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	11.3
Flush-Flo™	0.530	11.3
Kick-Flo®	1.101	9.0
Mean Flow over Head Range	-	9.9

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	5.1	1.200	9.4	3.000	14.5	7.000	21.7
0.200	9.7	1.400	10.1	3.500	15.6	7.500	22.4
0.300	10.7	1.600	10.7	4.000	16.6	8.000	23.1
0.400	11.2	1.800	11.3	4.500	17.5	8.500	23.8
0.500	11.3	2.000	11.9	5.000	18.4	9.000	24.5
0.600	11.3	2.200	12.5	5.500	19.3	9.500	25.1
0.800	10.9	2.400	13.0	6.000	20.1		
1.000	10.0	2.600	13.5	6.500	20.9		

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Storage Structures for Storm

Cellular Storage Manhole: S6, DS/PN: 1.004

Invert Level (m) 109.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	28.0	28.0	0.801	0.0	46.4
0.800	28.0	46.4			

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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 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 1
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 0.405
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	1	+0%					113.105
1.001	S2	15 Winter	1	+0%	100/15 Summer				112.906
1.002	S3	15 Winter	1	+0%					112.727
2.000	S4	15 Winter	1	+0%					113.190
1.003	S5	15 Winter	1	+0%	100/15 Summer				112.545
1.004	S6	15 Winter	1	+0%	30/15 Summer				109.562
1.005	S7	15 Winter	1	+0%	30/15 Summer				109.254
3.000	S8	15 Summer	1	+0%	30/15 Summer				108.724
1.006	S9	15 Winter	1	+0%	1/15 Summer				108.659

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.065	0.000	0.27			1.7	OK*	
1.001	S2	-0.064	0.000	0.28			1.7	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.002	S3	-0.073	0.000	0.16			1.7	OK	
2.000	S4	-0.130	0.000	0.04			1.7	OK*	
1.003	S5	-0.105	0.000	0.19			9.9	OK	
1.004	S6	-0.088	0.000	0.36		9	10.3	OK	
1.005	S7	-0.096	0.000	0.28			11.0	OK	
3.000	S8	-0.126	0.000	0.06			1.6	OK	
1.006	S9	0.159	0.000	0.41			10.8	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 1
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 0.405
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	30	+0%					113.130
1.001	S2	15 Winter	30	+0%	100/15 Summer				112.932
1.002	S3	15 Winter	30	+0%					112.744
2.000	S4	15 Winter	30	+0%					113.203
1.003	S5	15 Winter	30	+0%	100/15 Summer				112.581
1.004	S6	15 Winter	30	+0%	30/15 Summer				109.761
1.005	S7	15 Summer	30	+0%	30/15 Summer				109.686
3.000	S8	15 Winter	30	+0%	30/15 Summer				109.692
1.006	S9	120 Summer	30	+0%	1/15 Summer				109.394

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.040	0.000	0.66			4.2	OK*	
1.001	S2	-0.038	0.000	0.68			4.2	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.002	S3	-0.056	0.000	0.39			4.2	OK	
2.000	S4	-0.117	0.000	0.11			4.3	OK*	
1.003	S5	-0.069	0.000	0.56			28.6	OK	
1.004	S6	0.111	0.000	0.78		11	22.1	SURCHARGED	
1.005	S7	0.336	0.000	0.58			22.3	SURCHARGED	
3.000	S8	0.842	0.000	0.17			4.5	SURCHARGED	
1.006	S9	0.894	0.000	0.43			11.3	SURCHARGED	

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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 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 1
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 0.405
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	100	+40%					113.170
1.001	S2	15 Winter	100	+40%	100/15 Summer				113.009
1.002	S3	15 Winter	100	+40%					112.758
2.000	S4	15 Winter	100	+40%					113.215
1.003	S5	15 Summer	100	+40%	100/15 Summer				112.673
1.004	S6	15 Summer	100	+40%	30/15 Summer				110.081
1.005	S7	15 Summer	100	+40%	30/15 Summer				110.050
3.000	S8	30 Summer	100	+40%	30/15 Summer				110.059
1.006	S9	30 Winter	100	+40%	1/15 Summer				110.171

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.000	0.000	1.08			6.9	SURCHARGED*	
1.001	S2	0.039	0.000	1.11			6.8	SURCHARGED	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.002	S3	-0.042	0.000	0.64			6.9	OK	
2.000	S4	-0.105	0.000	0.19			7.7	OK*	
1.003	S5	0.023	0.000	0.98			50.0	SURCHARGED	
1.004	S6	0.431	0.000	0.79		17	22.5	SURCHARGED	
1.005	S7	0.700	0.000	0.60			23.1	SURCHARGED	
3.000	S8	1.209	0.000	0.17			4.5	SURCHARGED	
1.006	S9	1.671	0.000	0.43			11.4	SURCHARGED	

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