WML CONSULTING

Civil, Structural and Geotechnical Engineers

Surface Water Drainage Calculations

For a site known as

Spire Yale,

Chesney Court

On behalf of

Spire Healthcare.

Project Number: 9132

Document Number: 9132-WML-ZZ-XX-CAL-C-1001

Published: October 2021

Infiltration Test Results

PERMEABILITY TEST RESULTS (Trial Pit)

Contract:

Spire Yale Hospital, Wrexham

Borehole	TP1
Test No.	1
Test Zone	0.22-1.20m
Date	06.10.2020

Type of Test : Falling Head

Elapsed Time (mins)	Depth of water below top of casing
0.0	0.00
1.0	0.22
2.0	0.25
3.0	0.25
4.0	0.28
5.0	0.28
10.0	0.28
15.0	0.28
20.0	0.28
30.0	0.28
40.0	0.29
50.0	0.31
60.0	0.31

Depth to water level within trial pit before start of test (mbgl)

DRY

Water added within pit to a depth of (mbgl)

0.22m

Remarks:

Permeability : of subbase $f \approx 4 \times 10^{-4}$ m/sec

Test undertaken by: Simon Edwards

Geo-Ventures (UK) Limited
70 Riverside Close, Waterside, Howley, Warrington, Cheshire, WA1 2JD
Tel. 01925 240476 / 01942 870967

PERMEABILITY TEST RESULTS (Trial Pit)

Contract:

Spire Yale Hospital, Wrexham

Borehole	TP2
Test No.	1
Test Zone	0.18-1.20m
Date	06.10.2020

Type of Test : Falling Head

Elapsed Time (mins)	Depth of water below top of casing
0.0	0.00
1.0	0.18
2.0	0.19
3.0	0.24
4.0	0.24
5.0	0.25
10.0	0.27
15.0	0.29
20.0	0.29
30.0	0.29
40.0	0.30
50.0	0.30
60.0	0.30

Depth to water level within trial pit before start of test (mbgl)

DRY

Water added within pit to a depth of (mbgl)

0.18m

Remarks:

Permeability : of subbase $f \approx 4 \times 10^{-4}$ m/sec

Test undertaken by: Simon Edwards

Geo-Ventures (UK) Limited
70 Riverside Close, Waterside, Howley, Warrington, Cheshire, WA1 2JD
Tel. 01925 240476 / 01942 870967

PERMEABILITY TEST RESULTS (Trial Pit)

Contract:

Spire Yale Hospital, Wrexham

Borehole	TP3
Test No.	1
Test Zone	0.08-1.20m
Date	06.10.2020

Type of Test : Falling Head

Elapsed Time (mins)	Depth of water below top of casing
0.0	0.00
1.0	0.08
2.0	0.11
3.0	0.15
4.0	0.18
5.0	0.23
10.0	0.29
15.0	0.30
20.0	0.40
30.0	0.48
40.0	0.54
50.0	1.12
60.0	1.15

Depth to water level within trial pit before start of test (mbgl)

DRY

Water added within pit to a depth of (mbgl)

0.08m

Remarks:

Permeability : $f \approx 3 \times 10^{-5}$ m/sec

Test undertaken by: Simon Edwards

Geo-Ventures (UK) Limited
70 Riverside Close, Waterside, Howley, Warrington, Cheshire, WA1 2JD
Tel. 01925 240476 / 01942 870967

Proposed Drainage Network

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.100	100.0	0.014	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	6.000	0.060	100.0	0.014	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	2.000	0.020	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	4.500	0.000	0.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	44.00	5.17	89.175	0.014	0.0	0.0	0.0	1.00	17.8	1.7
S2.000	44.23	5.10	89.135	0.014	0.0	0.0	0.0	1.00	17.8	1.7
S1.001	43.91	5.19	89.000	0.028	0.0	0.0	0.0	1.31	52.0	3.3
S1.002	41.89	5.80	89.000	0.028	0.0	0.0	0.0	0.12	4.9	3.3

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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	89.925	0.750	Open Manhole	600	S1.000	89.175	150				
S2	89.925	0.790	Open Manhole	600	S2.000	89.135	150				
S2	90.000	1.000	Open Manhole	1050	S1.001	89.000	225	S1.000	89.075	150	
								S2.000	89.075	150	
S3	90.000	1.020	Junction		S1.002	89.000	225	S1.001	88.980	225	
S	90.000	1.000	Open Manhole	0		OUTFALL		S1.002	89.000	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	332135.359	350807.691	332135.359	350807.691	Required	
S2	332138.583	350823.363	332138.583	350823.363	Required	
S2	332137.374	350817.486	332137.374	350817.486	Required	
S3	332135.416	350817.894			No Entry	
S	332131.011	350818.812			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)
S1.000	o	150	S1	89.925	89.175	0.600	Open Manhole	600
S2.000	o	150	S2	89.925	89.135	0.640	Open Manhole	600
S1.001	o	225	S2	90.000	89.000	0.775	Open Manhole	1050
S1.002	o	225	S3	90.000	89.000	0.775	Junction	

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)
S1.000	10.000	100.0	S2	90.000	89.075	0.775	Open Manhole	1050
S2.000	6.000	100.0	S2	90.000	89.075	0.775	Open Manhole	1050
S1.001	2.000	100.0	S3	90.000	88.980	0.795	Junction	
S1.002	4.500	0.0	S	90.000	89.000	0.775	Open Manhole	0

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)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.327		

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Online Controls for Storm

Pump Manhole: S3, DS/PN: S1.002, Volume (m³): 0.1

Invert Level (m) 89.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.200	0.0000	1.800	0.0000	3.400	0.0000	5.000	0.0000
0.400	0.0000	2.000	0.0000	3.600	0.0000	5.200	0.0000
0.600	0.0000	2.200	0.0000	3.800	0.0000	5.400	0.0000
0.800	0.0000	2.400	0.0000	4.000	0.0000	5.600	0.0000
1.000	0.0000	2.600	0.0000	4.200	0.0000	5.800	0.0000
1.200	0.0000	2.800	0.0000	4.400	0.0000	6.000	0.0000
1.400	0.0000	3.000	0.0000	4.600	0.0000		
1.600	0.0000	3.200	0.0000	4.800	0.0000		

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Storage Structures for Storm

Cellular Storage Manhole: S3, DS/PN: S1.002

Invert Level (m) 89.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.10800 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.10800

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	24.0	24.0	1.300	0.0	36.2
0.100	24.0	26.0	1.400	0.0	36.2
0.200	24.0	27.9	1.500	0.0	36.2
0.300	24.0	29.9	1.600	0.0	36.2
0.400	24.0	31.8	1.700	0.0	36.2
0.500	24.0	33.8	1.800	0.0	36.2
0.600	12.0	35.5	1.900	0.0	36.2
0.700	0.0	36.2	2.000	0.0	36.2
0.800	0.0	36.2	2.100	0.0	36.2
0.900	0.0	36.2	2.200	0.0	36.2
1.000	0.0	36.2	2.300	0.0	36.2
1.100	0.0	36.2	2.400	0.0	36.2
1.200	0.0	36.2	2.500	0.0	36.2

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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 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 0.324
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 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 OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
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)
S1.000	S1	15 Winter	1	+0%	100/60 Summer				89.207
S2.000	S2	15 Winter	1	+0%	100/30 Summer				89.168
S1.001	S2	120 Winter	1	+0%	30/120 Winter				89.080
S1.002	S3	120 Winter	1	+0%	30/120 Winter				89.080

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
S1.000	S1	-0.118	0.000	0.10			1.6	OK	
S2.000	S2	-0.117	0.000	0.11			1.6	OK	
S1.001	S2	-0.145	0.000	0.04			1.2	OK	
S1.002	S3	-0.145	0.000	0.00			0.0	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 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 0.324
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 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 OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
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)
S1.000	S1	180 Winter	30	+0%	100/60 Summer				89.232
S2.000	S2	180 Winter	30	+0%	100/30 Summer				89.232
S1.001	S2	180 Winter	30	+0%	30/120 Winter				89.231
S1.002	S3	180 Winter	30	+0%	30/120 Winter				89.231

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
S1.000	S1	-0.093	0.000	0.07			1.1	OK	
S2.000	S2	-0.053	0.000	0.07			1.1	OK	
S1.001	S2	0.006	0.000	0.07			2.0	SURCHARGED	
S1.002	S3	0.006	0.000	0.00			0.0	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 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 0.324
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 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 OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
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)
S1.000	S1	240 Winter	100	+40%	100/60 Summer				89.495
S2.000	S2	240 Winter	100	+40%	100/30 Summer				89.494
S1.001	S2	240 Winter	100	+40%	30/120 Winter				89.494
S1.002	S3	240 Winter	100	+40%	30/120 Winter				89.494

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
S1.000	S1	0.170	0.000	0.10			1.5	SURCHARGED	
S2.000	S2	0.209	0.000	0.10			1.5	SURCHARGED	
S1.001	S2	0.269	0.000	0.10			2.9	SURCHARGED	
S1.002	S3	0.269	0.000	0.00			0.0	SURCHARGED*	

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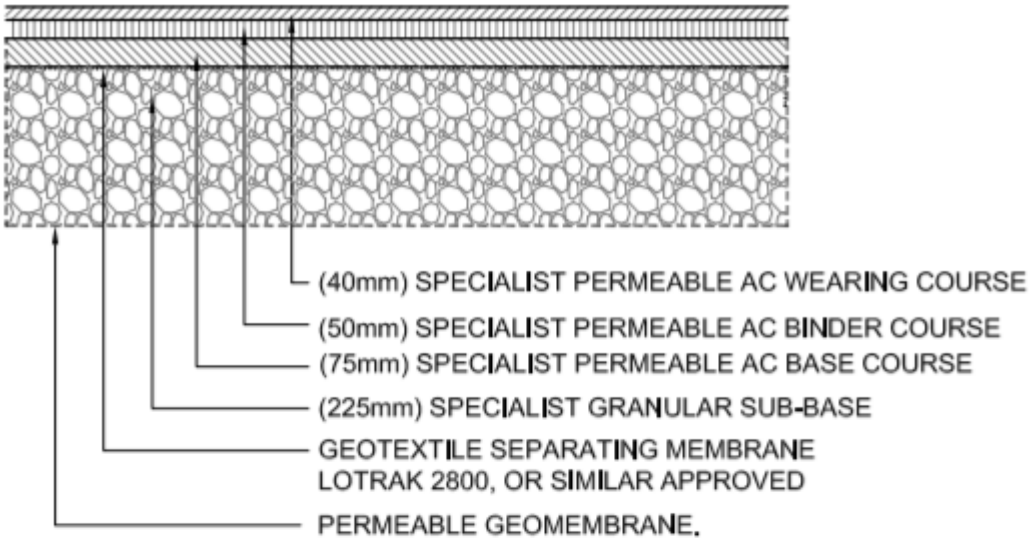
New Permeable Paving
(10m² Area of Porous Access Road Construction)



ALL WORKS TO BE IN ACCORDANCE WITH BS7533-3 GENERALLY.

SURFACE COURSE: 40mm AC10 OPEN SURF PA

BINDER COURSE: 50mm AC20 OPEN BIN PA

BASE COURSE: 75mm AC32 BAS PA

GRANULAR SUB-BASE: MIN 225mm CLEAN ANGULAR STONE TYPE 4/20

5% CBR ON UNSATURATED GRANULAR NATURAL SOILS
MIN. SUB-BASE = 225mm

ADDITIONAL FILLING REQUIRED TO SUIT PROPOSED LEVELS TO USE TYPE 3 SUB-BASE OR CLEAN ANGULAR STONE TYPE 4/20.

ALL MATERIAL WITHIN 450mm OF SURFACE LEVEL TO BE NON-FROST SUSCEPTIBLE. IF ENCOUNTERED NOTIFY WML. REPLACEMENT FILL TO BE GRADE 6F2 OR 6F5 UNLESS AGREED OTHERWISE.

TYPICAL PERMEABLE PAVING DETAIL
POROUS ACCESS ROAD CONSTRUCTION

[SCALE 1:10]

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

Half Drain Time : 15 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	9.649	0.039	0.1	0.1	O K
30 min Summer	9.659	0.049	0.1	0.1	O K
60 min Summer	9.663	0.053	0.2	0.2	O K
120 min Summer	9.659	0.049	0.1	0.1	O K
180 min Summer	9.654	0.044	0.1	0.1	O K
240 min Summer	9.649	0.039	0.1	0.1	O K
360 min Summer	9.642	0.032	0.1	0.1	O K
480 min Summer	9.637	0.027	0.1	0.1	O K
600 min Summer	9.634	0.024	0.1	0.1	O K
720 min Summer	9.631	0.021	0.1	0.1	O K
960 min Summer	9.628	0.018	0.1	0.1	O K
1440 min Summer	9.623	0.013	0.0	0.0	O K
2160 min Summer	9.620	0.010	0.0	0.0	O K
2880 min Summer	9.618	0.008	0.0	0.0	O K
4320 min Summer	9.616	0.006	0.0	0.0	O K
5760 min Summer	9.615	0.005	0.0	0.0	O K
7200 min Summer	9.614	0.004	0.0	0.0	O K
8640 min Summer	9.614	0.004	0.0	0.0	O K
10080 min Summer	9.613	0.003	0.0	0.0	O K
15 min Winter	9.655	0.045	0.1	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	114.685	0.0	15
30 min Summer	78.044	0.0	23
60 min Summer	50.812	0.0	40
120 min Summer	31.992	0.0	70
180 min Summer	24.052	0.0	102
240 min Summer	19.503	0.0	132
360 min Summer	14.418	0.0	192
480 min Summer	11.639	0.0	252
600 min Summer	9.849	0.0	314
720 min Summer	8.588	0.0	374
960 min Summer	6.911	0.0	492
1440 min Summer	5.078	0.0	736
2160 min Summer	3.722	0.0	1104
2880 min Summer	2.981	0.0	1472
4320 min Summer	2.176	0.0	2204
5760 min Summer	1.738	0.0	2880
7200 min Summer	1.460	0.0	3656
8640 min Summer	1.267	0.0	4320
10080 min Summer	1.124	0.0	4992
15 min Winter	114.685	0.0	15

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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 Volume (m³)	Status
30 min Winter	9.665	0.055	0.2	0.2	O K
60 min Winter	9.666	0.056	0.2	0.2	O K
120 min Winter	9.657	0.047	0.1	0.1	O K
180 min Winter	9.650	0.040	0.1	0.1	O K
240 min Winter	9.644	0.034	0.1	0.1	O K
360 min Winter	9.636	0.026	0.1	0.1	O K
480 min Winter	9.632	0.022	0.1	0.1	O K
600 min Winter	9.629	0.019	0.1	0.1	O K
720 min Winter	9.626	0.016	0.0	0.0	O K
960 min Winter	9.623	0.013	0.0	0.0	O K
1440 min Winter	9.620	0.010	0.0	0.0	O K
2160 min Winter	9.617	0.007	0.0	0.0	O K
2880 min Winter	9.616	0.006	0.0	0.0	O K
4320 min Winter	9.614	0.004	0.0	0.0	O K
5760 min Winter	9.613	0.003	0.0	0.0	O K
7200 min Winter	9.613	0.003	0.0	0.0	O K
8640 min Winter	9.613	0.003	0.0	0.0	O K
10080 min Winter	9.612	0.002	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	78.044	0.0	24
60 min Winter	50.812	0.0	42
120 min Winter	31.992	0.0	74
180 min Winter	24.052	0.0	104
240 min Winter	19.503	0.0	136
360 min Winter	14.418	0.0	198
480 min Winter	11.639	0.0	258
600 min Winter	9.849	0.0	316
720 min Winter	8.588	0.0	380
960 min Winter	6.911	0.0	500
1440 min Winter	5.078	0.0	740
2160 min Winter	3.722	0.0	1096
2880 min Winter	2.981	0.0	1480
4320 min Winter	2.176	0.0	2128
5760 min Winter	1.738	0.0	2992
7200 min Winter	1.460	0.0	3728
8640 min Winter	1.267	0.0	4456
10080 min Winter	1.124	0.0	4952

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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	0.327	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.001

Time (mins) From:	To:	Area (ha)
0	5	0.001

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Model Details

Storage is Online Cover Level (m) 10.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.10800	Width (m)	2.0
Membrane Percolation (mm/hr)	1000	Length (m)	5.0
Max Percolation (l/s)	2.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.610	Cap Volume Depth (m)	0.225

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