SHARPE-TOPPING
STRUCTURAL ENGINEERS

Storage Drainage Calculations

Site West of Millstones

Bower Hill

Oxspring



For

Yorkshire Land Ltd

Project No. 14089

April 2014

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Date 16/04/2014 11:09 File	Designed by Paul Checked by	
Micro Drainage	Source Control 2014.1	

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (ha)	50.000	Urban	0.000
SAAR (mm)	1133	Region Number	Region 3

Results	**l/s**
QBAR Rural	485.0
QBAR Urban	485.0
Q100 years	1008.8
Q1 year	417.1
Q2 years	457.6
Q5 years	606.2
Q10 years	703.2
Q20 years	796.4
Q25 years	827.4
Q30 years	852.5
Q50 years	918.5
Q100 years	1008.8
Q200 years	1144.5
Q250 years	1188.2
Q1000 years	1474.3

QBAR FOR 50 Ha = 485 L/SEC.

SITE MEASURES 0.372 Ha.

INTERPOLATED RUN OFF = 3.6 L/SEC.

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Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 198 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	174.460	0.360	0.0	3.5	3.5	34.8	O K
30 min Summer	174.585	0.485	0.0	3.5	3.5	47.0	O K
60 min Summer	174.707	0.607	0.0	3.5	3.5	58.9	O K
120 min Summer	174.793	0.693	0.0	3.5	3.5	67.2	O K
180 min Summer	174.806	0.706	0.0	3.5	3.5	68.4	O K
240 min Summer	174.798	0.698	0.0	3.5	3.5	67.6	O K
360 min Summer	174.776	0.676	0.0	3.5	3.5	65.5	O K
480 min Summer	174.750	0.650	0.0	3.5	3.5	63.0	O K
600 min Summer	174.721	0.621	0.0	3.5	3.5	60.2	O K
720 min Summer	174.689	0.589	0.0	3.5	3.5	57.1	O K
960 min Summer	174.615	0.515	0.0	3.5	3.5	49.9	O K
1440 min Summer	174.487	0.387	0.0	3.5	3.5	37.5	O K
2160 min Summer	174.342	0.242	0.0	3.5	3.5	23.5	O K
2880 min Summer	174.251	0.151	0.0	3.4	3.4	14.7	O K
4320 min Summer	174.167	0.067	0.0	3.1	3.1	6.5	O K
5760 min Summer	174.143	0.043	0.0	2.6	2.6	4.2	O K
7200 min Summer	174.130	0.030	0.0	2.2	2.2	2.9	O K
8640 min Summer	174.122	0.022	0.0	1.9	1.9	2.1	O K
10080 min Summer	174.116	0.016	0.0	1.7	1.7	1.6	O K
15 min Winter	174.508	0.408	0.0	3.5	3.5	39.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	113.993	0.0	39.1	24
30 min Summer	78.041	0.0	53.5	38
60 min Summer	51.031	0.0	70.0	66
120 min Summer	32.151	0.0	88.2	124
180 min Summer	24.110	0.0	99.2	180
240 min Summer	19.515	0.0	107.1	208
360 min Summer	14.501	0.0	119.4	272
480 min Summer	11.724	0.0	128.7	340
600 min Summer	9.932	0.0	136.3	412
720 min Summer	8.668	0.0	142.7	482
960 min Summer	6.984	0.0	153.3	608
1440 min Summer	5.139	0.0	169.2	858
2160 min Summer	3.772	0.0	186.3	1212
2880 min Summer	3.023	0.0	199.1	1556
4320 min Summer	2.209	0.0	218.3	2212
5760 min Summer	1.770	0.0	233.2	2936
7200 min Summer	1.491	0.0	245.6	3672
8640 min Summer	1.297	0.0	256.2	4400
10080 min Summer	1.152	0.0	265.6	5136
15 min Winter	113.993	0.0	43.8	25

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	174.652	0.552	0.0	3.5	3.5	53.5	O K
60 min Winter	174.794	0.694	0.0	3.5	3.5	67.2	O K
120 min Winter	174.900	0.800	0.0	3.5	3.5	77.5	O K
180 min Winter	174.933	0.833	0.0	3.5	3.5	79.8	O K
240 min Winter	174.918	0.818	0.0	3.5	3.5	78.9	O K
360 min Winter	174.884	0.784	0.0	3.5	3.5	76.0	O K
480 min Winter	174.847	0.747	0.0	3.5	3.5	72.4	O K
600 min Winter	174.804	0.704	0.0	3.5	3.5	68.2	O K
720 min Winter	174.757	0.657	0.0	3.5	3.5	63.7	O K
960 min Winter	174.645	0.545	0.0	3.5	3.5	52.8	O K
1440 min Winter	174.440	0.340	0.0	3.5	3.5	33.0	O K
2160 min Winter	174.254	0.154	0.0	3.5	3.5	14.9	O K
2880 min Winter	174.172	0.072	0.0	3.1	3.1	7.0	O K
4320 min Winter	174.135	0.035	0.0	2.4	2.4	3.4	O K
5760 min Winter	174.121	0.021	0.0	1.9	1.9	2.0	O K
7200 min Winter	174.113	0.013	0.0	1.6	1.6	1.3	O K
8640 min Winter	174.108	0.008	0.0	1.4	1.4	0.8	O K
10080 min Winter	174.104	0.004	0.0	1.2	1.2	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	78.041	0.0	59.9	39
60 min Winter	51.031	0.0	78.4	66
120 min Winter	32.151	0.0	98.7	122
180 min Winter	24.110	0.0	111.2	176
240 min Winter	19.515	0.0	119.9	228
360 min Winter	14.501	0.0	133.6	286
480 min Winter	11.724	0.0	144.1	366
600 min Winter	9.932	0.0	152.7	444
720 min Winter	8.668	0.0	159.9	520
960 min Winter	6.984	0.0	171.8	664
1440 min Winter	5.139	0.0	189.5	904
2160 min Winter	3.772	0.0	208.7	1232
2880 min Winter	3.023	0.0	223.0	1532
4320 min Winter	2.209	0.0	244.5	2212
5760 min Winter	1.770	0.0	261.2	2936
7200 min Winter	1.491	0.0	275.1	3672
8640 min Winter	1.297	0.0	287.0	4400
10080 min Winter	1.152	0.0	297.5	5144

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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)	19.400	Shortest Storm (mins)	15
Ratio R	0.314	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.183

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.061	4	8	0.061	8	12	0.061

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Model Details

Storage is Online Cover Level (m) 175.300

Cellular Storage Structure

Invert Level (m) 174.100 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	102.0	102.0	0.900	0.0	186.8
0.800	102.0	186.8			

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0089-3600-1000-3600
Design Head (m)	1.000
Design Flow (l/s)	3.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	89
Invert Level (m)	174.050
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.5
Flush-Flo™	0.297	3.5
Kick-Flo®	0.627	2.9
Mean Flow over Head Range	-	3.1

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)
0.100	2.8	1.200	3.8	3.000	5.9	7.000	8.8
0.200	3.4	1.400	4.1	3.500	6.3	7.500	9.1
0.300	3.5	1.600	4.4	4.000	6.7	8.000	9.4
0.400	3.5	1.800	4.6	4.500	7.1	8.500	9.6
0.500	3.3	2.000	4.9	5.000	7.5	9.000	9.9
0.600	3.0	2.200	5.1	5.500	7.8	9.500	10.2
0.800	3.2	2.400	5.3	6.000	8.2		
1.000	3.5	2.600	5.5	6.500	8.5		

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