Greenfield Runoff Volume

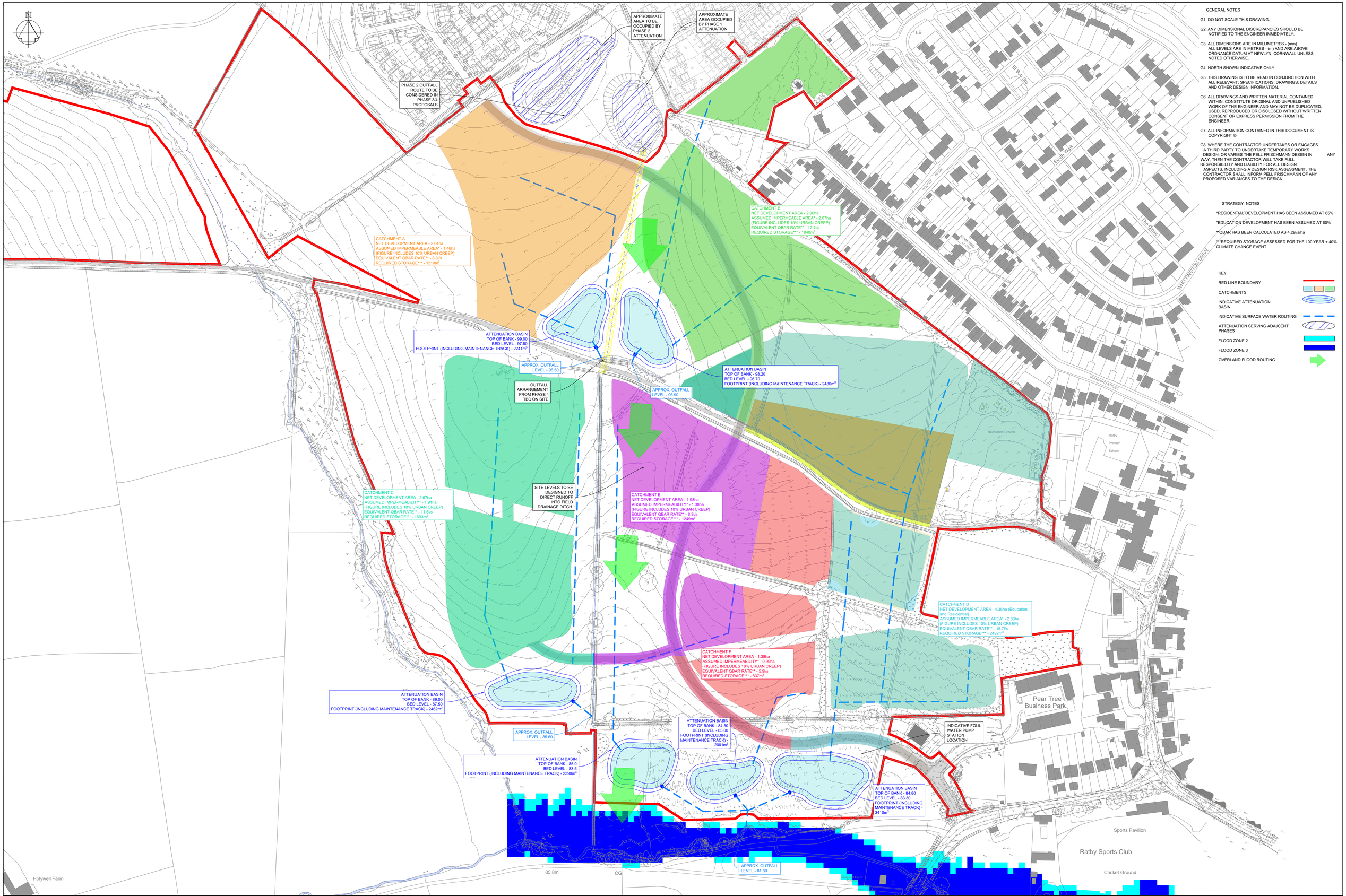
FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	20.000
Ratio R	0.400
Areal Reduction Factor	1.00
Area (ha)	14.200
SAAR (mm)	700
CWI	100.320
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	44.81
Greenfield Runoff Volume (m^3)	3977.272

Appendix F Conceptual Drainage Strategy



GENERAL NOTES

G1. DO NOT SCALE THIS DRAWING.

G2. ANY DIMENSIONAL DISCREPANCIES SHOULD BE NOTIFIED TO THE ENGINEER IMMEDIATELY.

G3. ALL DIMENSIONS ARE IN MILLIMETRES - (mm) ALL LEVELS ARE IN METRES - (m) AND ARE ABOVE ORDNANCE DATUM AT NEWLYN, CORNWALL UNLESS NOTED OTHERWISE.

G4. NORTH SHOWN INDICATIVE ONLY

G5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT; SPECIFICATIONS; DRAWINGS; DETAILS AND OTHER DESIGN INFORMATION.

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STRATEGY NOTES

*RESIDENTIAL DEVELOPMENT HAS BEEN ASSUMED AT 65%

*EDUCATION DEVELOPMENT HAS BEEN ASSUMED AT 60%

**QBAR HAS BEEN CALCULATED AS 4.29l/s/ha

***REQUIRED STORAGE ASSESSED FOR THE 100 YEAR + 40% CLIMATE CHANGE EVENT

KEY

- RED LINE BOUNDARY
- CATCHMENTS
- INDICATIVE ATTENUATION BASIN
- INDICATIVE SURFACE WATER ROUTING
- ATTENUATION SERVING ADJACENT PHASES
- FLOOD ZONE 2
- FLOOD ZONE 3
- OVERLAND FLOOD ROUTING

REV.	DESCRIPTION	DRN	CHK	APP	DATE
P04	UDPATED TO NEW SURVEY DATA	HM	DAR	DAR	04.07.24
P03	UPDATED TO NEW MASTERPLAN	HM	DAR	DAR	28.05.24
P02	UPDATED TO COMMENTS	HM	DAR	DAR	27.11.23
P01	INITIAL ISSUE	HM	DAR	DAR	17.11.23

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ARCHITECT/CLIENT/CONTRACTOR: LAGAN HOMES

Project: MARKFIELD ROAD, RATBY PHASE 3 & 4

Drawing Title: CONCEPTUAL SURFACE WATER DRAINAGE STRATEGY

Drawing Status: PRELIMINARY

	Name	Date
Drawn	H. McDOLL	13.11.23
Designed	H. McDOLL	13.11.23
Eng Chk	D. ALLUM-ROONEY	17.11.23
Approved	D. ALLUM-ROONEY	17.11.23

Status Code: S2
Scale: 1:1000
Revision: P04
Drawing No.: 109003 - PEF - ZZ - XX - DR - CD - 0500

Appendix G Attenuation Calculations

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	0.359	0.359	8.3	0.0	8.3	334.5	O K
30 min Winter	0.460	0.460	8.3	0.0	8.3	437.8	O K
60 min Winter	0.556	0.556	8.3	0.0	8.3	539.8	O K
120 min Winter	0.662	0.662	8.3	0.0	8.3	655.7	O K
180 min Winter	0.723	0.723	8.3	0.0	8.3	725.4	O K
240 min Winter	0.762	0.762	8.3	0.0	8.3	771.0	O K
360 min Winter	0.804	0.804	8.3	0.0	8.3	819.4	O K
480 min Winter	0.818	0.818	8.3	0.0	8.3	836.4	O K
600 min Winter	0.819	0.819	8.3	0.0	8.3	837.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Winter	138.460	0.0	323.5	0.0	26
30 min Winter	91.070	0.0	426.4	0.0	40
60 min Winter	56.875	0.0	553.3	0.0	70
120 min Winter	35.332	0.0	688.1	0.0	126
180 min Winter	26.592	0.0	776.5	0.0	184
240 min Winter	21.604	0.0	840.6	0.0	244
360 min Winter	15.907	0.0	926.7	0.0	360
480 min Winter	12.670	0.0	982.1	0.0	474
600 min Winter	10.563	0.0	1021.3	0.0	588

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
720 min Winter	0.812	0.812	8.3	0.0	8.3	829.0	O K
960 min Winter	0.784	0.784	8.3	0.0	8.3	796.4	O K
1440 min Winter	0.706	0.706	8.3	0.0	8.3	705.8	O K
2160 min Winter	0.601	0.601	8.3	0.0	8.3	588.9	O K
2880 min Winter	0.508	0.508	8.3	0.0	8.3	488.0	O K
4320 min Winter	0.359	0.359	8.3	0.0	8.3	334.2	O K
5760 min Winter	0.256	0.256	8.1	0.0	8.1	233.9	O K
7200 min Winter	0.193	0.193	7.8	0.0	7.8	173.9	O K
8640 min Winter	0.156	0.156	7.4	0.0	7.4	139.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
720 min Winter	9.077	0.0	1050.6	0.0	700
960 min Winter	7.106	0.0	1090.9	0.0	916
1440 min Winter	4.989	0.0	1134.7	0.0	1124
2160 min Winter	3.489	0.0	1237.1	0.0	1544
2880 min Winter	2.715	0.0	1283.1	0.0	1964
4320 min Winter	1.930	0.0	1364.7	0.0	2724
5760 min Winter	1.531	0.0	1452.3	0.0	3400
7200 min Winter	1.296	0.0	1535.6	0.0	4040
8640 min Winter	1.141	0.0	1620.5	0.0	4664

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	0.140	0.140	6.9	0.0	6.9	124.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
10080 min Winter	1.032	0.0	1706.6	0.0	5256

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 450501 306499 SK 50501 06499	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	No	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.990

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.330	4	8	0.330	8	12	0.330

Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	865.0	1.500	1497.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0131-8300-1200-8300	Sump Available	Yes
Design Head (m)	1.200	Diameter (mm)	131
Design Flow (l/s)	8.3	Invert Level (m)	0.000
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	8.3	Kick-Flo®	0.764	6.7
Flush-Flo™	0.353	8.3	Mean Flow over Head Range	-	7.2

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

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.7	0.600	7.9	1.600	9.5	2.600	12.0	5.000	16.3	7.500	19.8
0.200	7.9	0.800	6.9	1.800	10.0	3.000	12.8	5.500	17.1	8.000	20.4
0.300	8.3	1.000	7.6	2.000	10.6	3.500	13.8	6.000	17.8	8.500	21.0
0.400	8.3	1.200	8.3	2.200	11.0	4.000	14.7	6.500	18.5	9.000	21.6
0.500	8.1	1.400	8.9	2.400	11.5	4.500	15.5	7.000	19.2	9.500	22.2

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	0.436	0.436	8.8	0.0	8.8	499.8	O K
30 min Winter	0.559	0.559	8.8	0.0	8.8	655.1	O K
60 min Winter	0.678	0.678	8.8	0.0	8.8	811.1	O K
120 min Winter	0.811	0.811	8.8	0.0	8.8	992.8	O K
180 min Winter	0.889	0.889	8.8	0.0	8.8	1103.9	O K
240 min Winter	0.941	0.941	8.8	0.0	8.8	1177.8	O K
360 min Winter	0.998	0.998	8.8	0.0	8.8	1262.6	O K
480 min Winter	1.024	1.024	8.8	0.0	8.8	1301.5	O K
600 min Winter	1.034	1.034	8.8	0.0	8.8	1316.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Winter	138.460	0.0	473.2	0.0	26
30 min Winter	91.070	0.0	613.3	0.0	41
60 min Winter	56.875	0.0	817.8	0.0	70
120 min Winter	35.332	0.0	1013.0	0.0	128
180 min Winter	26.592	0.0	1137.5	0.0	186
240 min Winter	21.604	0.0	1223.4	0.0	244
360 min Winter	15.907	0.0	1321.7	0.0	360
480 min Winter	12.670	0.0	1353.3	0.0	476
600 min Winter	10.563	0.0	1348.1	0.0	592

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
720 min Winter	1.035	1.035	8.8	0.0	8.8	1317.8	O K
960 min Winter	1.021	1.021	8.8	0.0	8.8	1296.1	O K
1440 min Winter	0.963	0.963	8.8	0.0	8.8	1211.1	O K
2160 min Winter	0.873	0.873	8.8	0.0	8.8	1080.5	O K
2880 min Winter	0.791	0.791	8.8	0.0	8.8	964.3	O K
4320 min Winter	0.626	0.626	8.8	0.0	8.8	742.4	O K
5760 min Winter	0.498	0.498	8.8	0.0	8.8	576.2	O K
7200 min Winter	0.399	0.399	8.8	0.0	8.8	453.4	O K
8640 min Winter	0.323	0.323	8.8	0.0	8.8	362.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
720 min Winter	9.077	0.0	1336.1	0.0	706
960 min Winter	7.106	0.0	1308.0	0.0	930
1440 min Winter	4.989	0.0	1248.0	0.0	1354
2160 min Winter	3.489	0.0	1831.4	0.0	1684
2880 min Winter	2.715	0.0	1897.7	0.0	2144
4320 min Winter	1.930	0.0	2015.7	0.0	2948
5760 min Winter	1.531	0.0	2156.3	0.0	3744
7200 min Winter	1.296	0.0	2280.1	0.0	4464
8640 min Winter	1.141	0.0	2406.2	0.0	5112

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	0.268	0.268	8.7	0.0	8.7	297.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
10080 min Winter	1.032	0.0	2533.9	0.0	5848

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 450501 306499 SK 50501 06499	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	No	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.470

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.490	4	8	0.490	8	12	0.490

Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1058.0	1.500	1725.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0134-8800-1200-8800	Sump Available	Yes
Design Head (m)	1.200	Diameter (mm)	134
Design Flow (l/s)	8.8	Invert Level (m)	0.000
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	8.8	Kick-Flo®	0.769	7.1
Flush-Flo™	0.355	8.8	Mean Flow over Head Range	-	7.6

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

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	8.4	1.600	10.1	2.600	12.7	5.000	17.3	7.500	21.0
0.200	8.3	0.800	7.3	1.800	10.6	3.000	13.6	5.500	18.1	8.000	21.7
0.300	8.7	1.000	8.1	2.000	11.2	3.500	14.6	6.000	18.9	8.500	22.3
0.400	8.8	1.200	8.8	2.200	11.7	4.000	15.6	6.500	19.6	9.000	22.9
0.500	8.6	1.400	9.5	2.400	12.2	4.500	16.5	7.000	20.3	9.500	23.6

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	0.528	0.528	12.4	0.0	12.4	703.6	O K
30 min Winter	0.676	0.676	12.4	0.0	12.4	922.6	O K
60 min Winter	0.818	0.818	12.4	0.0	12.4	1143.0	O K
120 min Winter	0.973	0.973	12.4	0.0	12.4	1396.1	O K
180 min Winter	1.065	1.065	12.4	0.0	12.4	1550.2	O K
240 min Winter	1.124	1.124	12.4	0.0	12.4	1652.3	O K
360 min Winter	1.190	1.190	12.4	0.0	12.4	1767.8	O K
480 min Winter	1.219	1.219	12.5	0.0	12.5	1819.0	Flood Risk
600 min Winter	1.229	1.229	12.5	0.0	12.5	1836.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Winter	138.460	0.0	672.2	0.0	26
30 min Winter	91.070	0.0	870.7	0.0	41
60 min Winter	56.875	0.0	1154.4	0.0	70
120 min Winter	35.332	0.0	1430.4	0.0	128
180 min Winter	26.592	0.0	1607.9	0.0	186
240 min Winter	21.604	0.0	1731.7	0.0	244
360 min Winter	15.907	0.0	1880.0	0.0	360
480 min Winter	12.670	0.0	1939.8	0.0	476
600 min Winter	10.563	0.0	1941.5	0.0	590

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
720 min Winter	1.228	1.228	12.5	0.0	12.5	1835.2	Flood Risk
960 min Winter	1.207	1.207	12.4	0.0	12.4	1798.7	Flood Risk
1440 min Winter	1.135	1.135	12.4	0.0	12.4	1671.1	O K
2160 min Winter	1.033	1.033	12.4	0.0	12.4	1495.7	O K
2880 min Winter	0.940	0.940	12.4	0.0	12.4	1340.8	O K
4320 min Winter	0.758	0.758	12.4	0.0	12.4	1048.7	O K
5760 min Winter	0.591	0.591	12.4	0.0	12.4	795.7	O K
7200 min Winter	0.466	0.466	12.4	0.0	12.4	614.3	O K
8640 min Winter	0.370	0.370	12.4	0.0	12.4	480.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
720 min Winter	9.077	0.0	1927.5	0.0	704
960 min Winter	7.106	0.0	1890.9	0.0	926
1440 min Winter	4.989	0.0	1807.5	0.0	1332
2160 min Winter	3.489	0.0	2582.2	0.0	1652
2880 min Winter	2.715	0.0	2676.0	0.0	2112
4320 min Winter	1.930	0.0	2841.3	0.0	2992
5760 min Winter	1.531	0.0	3037.3	0.0	3752
7200 min Winter	1.296	0.0	3211.8	0.0	4472
8640 min Winter	1.141	0.0	3389.8	0.0	5112

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	0.301	0.301	12.3	0.0	12.3	385.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
10080 min Winter	1.032	0.0	3570.5	0.0	5760

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 450501 306499 SK 50501 06499	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	No	Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.070

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.690	4	8	0.690	8	12	0.690

Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1217.0	1.500	1933.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0158-1240-1200-1240	Sump Available	Yes
Design Head (m)	1.200	Diameter (mm)	158
Design Flow (l/s)	12.4	Invert Level (m)	0.000
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	12.4	Kick-Flo®	0.792	10.2
Flush-Flo™	0.360	12.4	Mean Flow over Head Range	-	10.7

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

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.7	0.600	11.9	1.600	14.2	2.600	17.9	5.000	24.5	7.500	29.7
0.200	11.7	0.800	10.2	1.800	15.0	3.000	19.2	5.500	25.6	8.000	30.7
0.300	12.3	1.000	11.4	2.000	15.8	3.500	20.6	6.000	26.7	8.500	31.6
0.400	12.4	1.200	12.4	2.200	16.5	4.000	22.0	6.500	27.8	9.000	32.5
0.500	12.2	1.400	13.3	2.400	17.2	4.500	23.3	7.000	28.8	9.500	33.3

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	0.516	0.516	11.5	0.0	11.5	648.4	O K
30 min Winter	0.659	0.659	11.5	0.0	11.5	850.2	O K
60 min Winter	0.797	0.797	11.5	0.0	11.5	1053.3	O K
120 min Winter	0.947	0.947	11.5	0.0	11.5	1286.6	O K
180 min Winter	1.035	1.035	11.5	0.0	11.5	1428.7	O K
240 min Winter	1.092	1.092	11.5	0.0	11.5	1522.8	O K
360 min Winter	1.155	1.155	11.5	0.0	11.5	1629.3	O K
480 min Winter	1.183	1.183	11.5	0.0	11.5	1676.4	O K
600 min Winter	1.192	1.192	11.5	0.0	11.5	1692.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Winter	138.460	0.0	620.8	0.0	26
30 min Winter	91.070	0.0	804.7	0.0	41
60 min Winter	56.875	0.0	1064.8	0.0	70
120 min Winter	35.332	0.0	1319.5	0.0	128
180 min Winter	26.592	0.0	1483.4	0.0	186
240 min Winter	21.604	0.0	1597.9	0.0	244
360 min Winter	15.907	0.0	1735.5	0.0	360
480 min Winter	12.670	0.0	1791.7	0.0	476
600 min Winter	10.563	0.0	1793.8	0.0	590

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
720 min Winter	1.191	1.191	11.5	0.0	11.5	1691.4	O K
960 min Winter	1.172	1.172	11.5	0.0	11.5	1657.7	O K
1440 min Winter	1.102	1.102	11.5	0.0	11.5	1539.6	O K
2160 min Winter	1.002	1.002	11.5	0.0	11.5	1375.8	O K
2880 min Winter	0.912	0.912	11.5	0.0	11.5	1231.1	O K
4320 min Winter	0.730	0.730	11.5	0.0	11.5	953.3	O K
5760 min Winter	0.570	0.570	11.5	0.0	11.5	723.4	O K
7200 min Winter	0.449	0.449	11.5	0.0	11.5	557.3	O K
8640 min Winter	0.357	0.357	11.5	0.0	11.5	435.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
720 min Winter	9.077	0.0	1780.6	0.0	704
960 min Winter	7.106	0.0	1746.4	0.0	926
1440 min Winter	4.989	0.0	1669.0	0.0	1334
2160 min Winter	3.489	0.0	2380.7	0.0	1652
2880 min Winter	2.715	0.0	2467.3	0.0	2116
4320 min Winter	1.930	0.0	2621.1	0.0	2988
5760 min Winter	1.531	0.0	2799.8	0.0	3744
7200 min Winter	1.296	0.0	2960.6	0.0	4464
8640 min Winter	1.141	0.0	3124.8	0.0	5112

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	0.290	0.290	11.4	0.0	11.4	349.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
10080 min Winter	1.032	0.0	3291.5	0.0	5760

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 450501 306499 SK 50501 06499	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	No	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.908

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.636	4	8	0.636	8	12	0.636

Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1139.0	1.500	1890.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0152-1150-1200-1150	Sump Available	Yes
Design Head (m)	1.200	Diameter (mm)	152
Design Flow (l/s)	11.5	Invert Level (m)	0.000
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	11.5	Kick-Flo®	0.787	9.4
Flush-Flo™	0.358	11.5	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

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.5	0.600	11.0	1.600	13.2	2.600	16.6	5.000	22.7	7.500	27.6
0.200	10.9	0.800	9.5	1.800	13.9	3.000	17.8	5.500	23.7	8.000	28.4
0.300	11.4	1.000	10.6	2.000	14.6	3.500	19.1	6.000	24.8	8.500	29.3
0.400	11.5	1.200	11.5	2.200	15.3	4.000	20.4	6.500	25.7	9.000	30.1
0.500	11.3	1.400	12.4	2.400	16.0	4.500	21.6	7.000	26.7	9.500	30.9

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	0.475	0.475	18.6	0.0	18.6	960.7	O K
30 min Winter	0.611	0.611	18.6	0.0	18.6	1258.9	O K
60 min Winter	0.743	0.743	18.6	0.0	18.6	1557.7	O K
120 min Winter	0.890	0.890	18.6	0.0	18.6	1903.8	O K
180 min Winter	0.977	0.977	18.6	0.0	18.6	2113.2	O K
240 min Winter	1.033	1.033	18.6	0.0	18.6	2251.1	O K
360 min Winter	1.095	1.095	18.6	0.0	18.6	2405.3	O K
480 min Winter	1.121	1.121	18.6	0.0	18.6	2471.4	O K
600 min Winter	1.129	1.129	18.6	0.0	18.6	2492.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Winter	138.460	0.0	898.9	0.0	26
30 min Winter	91.070	0.0	1176.1	0.0	41
60 min Winter	56.875	0.0	1566.0	0.0	70
120 min Winter	35.332	0.0	1943.1	0.0	128
180 min Winter	26.592	0.0	2187.5	0.0	186
240 min Winter	21.604	0.0	2361.4	0.0	244
360 min Winter	15.907	0.0	2586.2	0.0	360
480 min Winter	12.670	0.0	2717.8	0.0	476
600 min Winter	10.563	0.0	2794.8	0.0	590

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
720 min Winter	1.127	1.127	18.6	0.0	18.6	2486.3	O K
960 min Winter	1.104	1.104	18.6	0.0	18.6	2429.8	O K
1440 min Winter	1.030	1.030	18.6	0.0	18.6	2244.6	O K
2160 min Winter	0.929	0.929	18.6	0.0	18.6	1998.0	O K
2880 min Winter	0.829	0.829	18.6	0.0	18.6	1758.5	O K
4320 min Winter	0.636	0.636	18.6	0.0	18.6	1315.3	O K
5760 min Winter	0.488	0.488	18.6	0.0	18.6	989.4	O K
7200 min Winter	0.379	0.379	18.6	0.0	18.6	756.4	O K
8640 min Winter	0.301	0.301	18.5	0.0	18.5	594.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
720 min Winter	9.077	0.0	2832.7	0.0	702
960 min Winter	7.106	0.0	2818.9	0.0	922
1440 min Winter	4.989	0.0	2684.9	0.0	1296
2160 min Winter	3.489	0.0	3520.2	0.0	1640
2880 min Winter	2.715	0.0	3648.7	0.0	2108
4320 min Winter	1.930	0.0	3877.4	0.0	2896
5760 min Winter	1.531	0.0	4146.6	0.0	3632
7200 min Winter	1.296	0.0	4383.8	0.0	4328
8640 min Winter	1.141	0.0	4625.1	0.0	5008

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	0.248	0.248	18.1	0.0	18.1	487.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
10080 min Winter	1.032	0.0	4867.9	0.0	5640

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 450501 306499 SK 50501 06499	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	No	Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.829

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.943	4	8	0.943	8	12	0.943

Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1897.0	1.500	2762.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0190-1870-1200-1870	Sump Available	Yes
Design Head (m)	1.200	Diameter (mm)	190
Design Flow (l/s)	18.7	Invert Level (m)	0.000
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	225
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	18.7	Kick-Flo®	0.823	15.6
Flush-Flo™	0.376	18.6	Mean Flow over Head Range	-	16.0

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

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.6	0.600	18.0	1.600	21.4	2.600	27.0	5.000	37.0	7.500	45.1
0.200	17.5	0.800	16.1	1.800	22.7	3.000	29.0	5.500	38.8	8.000	46.5
0.300	18.5	1.000	17.1	2.000	23.8	3.500	31.2	6.000	40.5	8.500	47.9
0.400	18.6	1.200	18.7	2.200	25.0	4.000	33.3	6.500	42.1	9.000	49.2
0.500	18.4	1.400	20.1	2.400	26.0	4.500	35.2	7.000	43.6	9.500	50.6

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	0.363	0.363	8.3	0.0	8.3	469.5	O K
30 min Winter	0.468	0.468	8.3	0.0	8.3	615.3	O K
60 min Winter	0.570	0.570	8.3	0.0	8.3	761.6	O K
120 min Winter	0.685	0.685	8.3	0.0	8.3	931.3	O K
180 min Winter	0.755	0.755	8.3	0.0	8.3	1036.9	O K
240 min Winter	0.801	0.801	8.3	0.0	8.3	1108.4	O K
360 min Winter	0.854	0.854	8.3	0.0	8.3	1190.8	O K
480 min Winter	0.878	0.878	8.3	0.0	8.3	1229.7	O K
600 min Winter	0.889	0.889	8.3	0.0	8.3	1246.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Winter	138.460	0.0	433.7	0.0	26
30 min Winter	91.070	0.0	563.3	0.0	41
60 min Winter	56.875	0.0	761.6	0.0	70
120 min Winter	35.332	0.0	944.0	0.0	128
180 min Winter	26.592	0.0	1060.0	0.0	186
240 min Winter	21.604	0.0	1139.3	0.0	244
360 min Winter	15.907	0.0	1231.1	0.0	362
480 min Winter	12.670	0.0	1265.4	0.0	478
600 min Winter	10.563	0.0	1264.9	0.0	594

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
720 min Winter	0.890	0.890	8.3	0.0	8.3	1249.0	O K
960 min Winter	0.880	0.880	8.3	0.0	8.3	1231.9	O K
1440 min Winter	0.832	0.832	8.3	0.0	8.3	1156.3	O K
2160 min Winter	0.745	0.745	8.3	0.0	8.3	1021.7	O K
2880 min Winter	0.667	0.667	8.3	0.0	8.3	903.4	O K
4320 min Winter	0.536	0.536	8.3	0.0	8.3	711.3	O K
5760 min Winter	0.430	0.430	8.3	0.0	8.3	561.9	O K
7200 min Winter	0.350	0.350	8.3	0.0	8.3	451.2	O K
8640 min Winter	0.289	0.289	8.2	0.0	8.2	369.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
720 min Winter	9.077	0.0	1253.1	0.0	708
960 min Winter	7.106	0.0	1225.6	0.0	934
1440 min Winter	4.989	0.0	1168.5	0.0	1364
2160 min Winter	3.489	0.0	1714.1	0.0	1692
2880 min Winter	2.715	0.0	1776.6	0.0	2108
4320 min Winter	1.930	0.0	1883.7	0.0	2940
5760 min Winter	1.531	0.0	2022.4	0.0	3696
7200 min Winter	1.296	0.0	2138.2	0.0	4464
8640 min Winter	1.141	0.0	2255.8	0.0	5112

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	0.244	0.244	8.1	0.0	8.1	309.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
10080 min Winter	1.032	0.0	2374.0	0.0	5848

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 450501 306499 SK 50501 06499	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	No	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.380

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.460	4	8	0.460	8	12	0.460

Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1220.0	1.500	1878.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0131-8300-1200-8300	Sump Available	Yes
Design Head (m)	1.200	Diameter (mm)	131
Design Flow (l/s)	8.3	Invert Level (m)	0.000
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	8.3	Kick-Flo®	0.764	6.7
Flush-Flo™	0.353	8.3	Mean Flow over Head Range	-	7.2

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

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.7	0.600	7.9	1.600	9.5	2.600	12.0	5.000	16.3	7.500	19.8
0.200	7.9	0.800	6.9	1.800	10.0	3.000	12.8	5.500	17.1	8.000	20.4
0.300	8.3	1.000	7.6	2.000	10.6	3.500	13.8	6.000	17.8	8.500	21.0
0.400	8.3	1.200	8.3	2.200	11.0	4.000	14.7	6.500	18.5	9.000	21.6
0.500	8.1	1.400	8.9	2.400	11.5	4.500	15.5	7.000	19.2	9.500	22.2

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 1.500

Appendix H Simple Index Approach Summary

SUMMARY TABLE		DESIGN CONDITIONS			
		1	2	3	4
Land Use Type	Roads (excluding low traffic roads, highly frequented lorry approaches to industrial estates, trunk roads/motorways)				
Pollution Hazard Level	Medium				
Pollution Hazard Indices					
TSS	0.7				
Metals	0.6				
Hydrocarbons	0.7				
SuDS components proposed					
Component 1	Pond or wetland	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Ponds/wetlands should be preceded by an upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
Component 2	Filter drain (where the trench is not designed as an infiltration component)	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Filter drains should be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
Component 3	None				
SuDS Pollution Mitigation Indices					
TSS	0.9				
Metals	0.9				
Hydrocarbons	0.7				
Groundwater protection type	None				
Groundwater protection Pollution Mitigation Indices					
TSS	0				
Metals	0				
Hydrocarbons	0				
Combined Pollution Mitigation Indices					
TSS	0.9	Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England			
Metals	0.9				
Hydrocarbons	0.7				
Acceptability of Pollution Mitigation					
TSS	Sufficient				
Metals	Sufficient				
Hydrocarbons	Sufficient				