Appendix J

Surface Water Flood Risk Map – Masterplan Overlay

NOTES

1. This drawing to be read in conjunction with all other drawings and specifications.
2. Dimensions not to be scaled.
3. Topographical survey information taken from Brunel Surveys Ltd drawing number 17932-500-01 Feb 2018.
4. Surface water flood risk mapping published online on the data.gov.uk website, licensed under the Open Government Licence v3.0. © Environment Agency copyright and/or database right 2015. All rights reserved.

Where flow routes are maintained, it is proposed to channel flows and attenuate ponding more effectively through careful consideration of the existing and proposed topography, potentially combined with swales, ditches and terraced areas where appropriate. Therefore, the footprint of the area at-risk will be reduced post-development. As such, green corridors will follow the route of the overland flow paths, the entire footprint of at-risk areas has not been sterilised for built development on the proposed masterplan. This strategy will also enable green corridors to have usable open space, with landscaping and biodiversity designed specifically for dry or seasonally wet conditions.

Risk Area A

Risk Area B

Risk Area C

Risk Area D

Risk Area E

Flooding in and around farm buildings and farmhouse generated from overland flow from surrounding land, and collapse/blockage of drainage system through farm buildings.

100.0 0.0 100.0 200.0 300.0 400.0 500.0

Scale = 1:5000 @ A3

N

KEY

- Site boundary
- Existing ditch and direction of flow
- Pipe route (CCTV surveyed)
- Pipe route (from records / interpolation)

Risk of Flooding from Surface Water

- High risk (1 in 30 year return period)
- Medium risk (1 in 100 year return period)
- Low risk (1 in 1000 year return period)

Risk Area Flood risk generated from site itself with no contribution from off-site sources.

Urbanising the catchment should remove this flood risk entirely. Therefore, there is no requirement to maintain these flow paths and/or avoid these areas for development. Nevertheless, since the flow paths tend to follow the topography of the site, consideration has been given to retaining these routes as green or road corridors in order to act as exceedance flow paths post-development, directing flows which exceed the drainage system away from the proposed buildings.

Risk Area Flood risk generated from a combination of on-site and off-site flows.

Area to be retained as green corridors in order to maintain flow routes through the development and act as exceedance flow paths post-development.

Rev.	Description	Date	Chkd
PA3	Masterplan updated.	26/02/2024 CS	JH
PA2	Masterplan updated.	21/11/2023 BW	JH
PA1	Issued for Planning Approval	09/02/2023 BW	JH

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Client : Bellway Homes Limited and Christ Church, Oxford

Project : Water Eaton (Site PR6a) Land East of Oxford Road

Title : Risk of Flooding From Surface Water Masterplan Overlay

Project Engineer :	C Salt	Scale :	1:5000 @A3
Project Director :	J Hanlon	Date :	December 2022
Status :	PLANNING APPROVAL		

Drawing No. 8210440-1205 Rev PA3

Appendix K

Greenfield Run-off Calculations

ICP SUDS Mean Annual Flood

Input

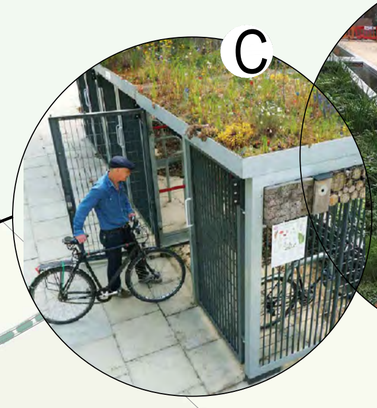
Return Period (years)	2	Soil	0.400
Area (ha)	1.000	Urban	0.000
SAAR (mm)	660	Region Number	Region 6

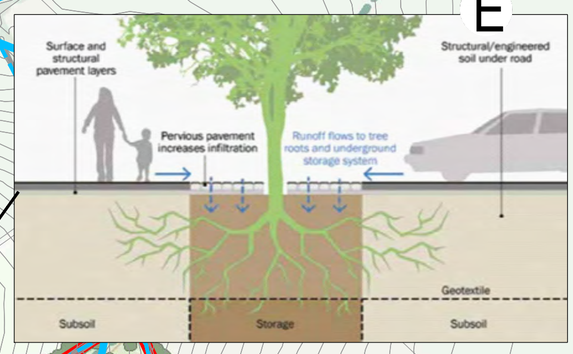
Results l/s

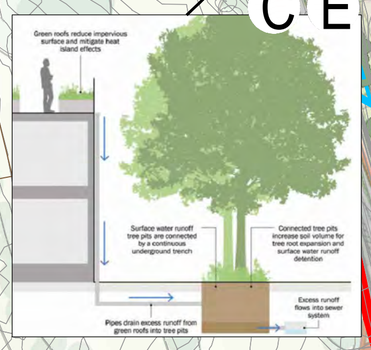
QBAR Rural	3.2
QBAR Urban	3.2
Q2 years	2.8
Q1 year	2.7
Q30 years	7.2
Q100 years	10.1

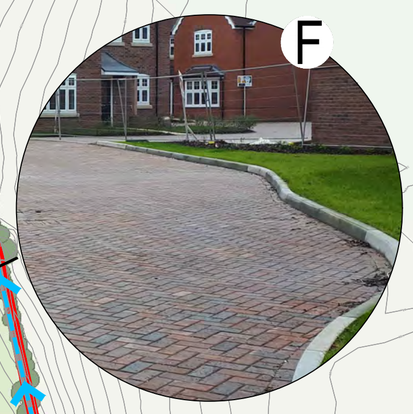
Appendix L

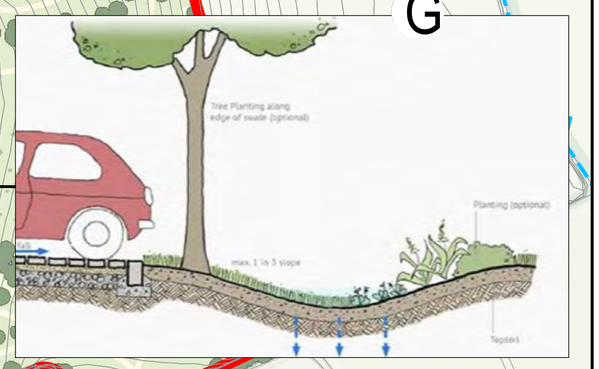
Outline SuDS Strategy











NOTES

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4. Images courtesy of J. Hanlon and C. Salt (Glanville Consultants). Diagrams copyright CIRIA C753 The SuDS Manual (London, 2015).

STRATEGY NOTES:

The SuDS Strategy illustrated on this drawing is outline only and is designed to give an idea of the type and mix of Sustainable Drainage Systems (SuDS) proposed within the development.

KEY

- Site boundary
- Existing ditch
- Existing pipe route (CCTV surveyed)
- Existing pipe route (from records / interpolated)

SUSTAINABLE DRAINAGE TECHNIQUES

KEY	DESCRIPTION	LOCATION
A	Attenuation basin / pond. For use as public open space with permanent pools for ecology / biodiversity where feasible.	Low ends of each catchment.
B	Terraced areas around basins / ponds / swales to be used as public open space, providing additional climate change resilience.	Surrounding basins / ponds / swales in open space as appropriate.
C	Green roof / rainwater harvesting discharging into downstream SuDS features.	Commercial, business and service use buildings are best-suited to green roofs. Rainwater harvesting and re-use site-wide.
D	Rill providing a conveyance path downstream.	Hard-landscaped public realm areas.
E	Tree pit providing storage before discharging into network. Integrated with bioretention systems where appropriate.	Site-wide, where appropriate ground conditions exist.
F	Pervious paving (lined) providing storage before discharging into network.	Site-wide, in particular in private driveways and car parking areas.
G	Roadside conveyance swale / filter drain (lined) providing storage and/or conveyance downstream using an underdrain.	Along road corridors.
H	Conveyance swale (lined), providing storage and/or conveyance downstream using an underdrain.	Along green corridors.

40.0 0.0 40.0 80.0 120.0 160.0 200.0

Scale = 1:2000 @ A1

Rev.	Description	Date	Chkd
PA3	Masterplan updated.	26/02/2024 CS	JH
PA2	Masterplan updated.	21/11/2023 BW	JH
PA1	Issued for Planning Approval	09/02/2023 BW	JH

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Client :
Bellway Homes Limited
and Christ Church, Oxford

Project :
Water Eaton (Site PR6a)
Land East of Oxford Road

Title :
Outline SuDS Strategy

Project Engineer : C. Salt Scale : 1:2000 @A1

Project Director : J. Hanlon Date : December 2022

Status : PLANNING APPROVAL

Drawing No. 8210440-1301 Rev PA3

Appendix M

Outline Surface Water Drainage Strategy

OUTFALL A
Discharge Rate: 3.2 l/s

BASIN A
CL: 60.750-61.250
IL: 59.650
Maximum Water Depth: 0.8m
+Permanent Water Depth: ~0.5m
Storage Volume: 573m³

BASIN B-1
CL: 61.800-62.000
IL: 60.700
Maximum Water Depth: 1.0m
+Permanent Water Depth: ~0.5m
Storage Volume: 332m³

BASIN B-2
CL: 61.050-61.500
IL: 60.150
Maximum Water Depth: 0.6m
+Permanent Water Depth: ~0.5m
Storage Volume: 1457m³

OUTFALL B
Discharge Rate: 28.7 l/s

BASIN B-3
CL: 62.750-65.750
IL: 60.700
Maximum Water Depth: 1.75m
+Permanent Water Depth: NONE
Storage Volume: 2489m³

SuDS B-4
Various SuDS features and drainage network providing a total storage volume of c. 1298m³

BASIN C
CL: 64.800-66.500
IL: 63.500
Maximum Water Depth: 1.0m
+Permanent Water Depth: NONE
Storage Volume: 1636m³

OUTFALL C
Discharge Rate: 9.1 l/s

OUTFALL D
Discharge Rate: 24.0 l/s

BASIN D-1
CL: 65.300-67.300
IL: 63.850
Maximum Water Depth: 1.15m
+Permanent Water Depth: ~0.5m
Storage Volume: 1321m³

BASIN D-2
CL: 68.000-69.000
IL: 65.500
Maximum Water Depth: 2.50m
+Permanent Water Depth: NONE
Storage Volume: 1367m³

BASIN D-3
CL: 67.300-68.500
IL: 65.950
Maximum Water Depth: 1.04m
+Permanent Water Depth: ~0.5m
Storage Volume: 2031m³

Indicative ditch to channel overland flow path through site.

Existing field ditch could be re-routed via new ditch system following the natural topography, and bypassing the St Frideswide Farm drainage network, which is known to be blocked up / collapsed.

BASIN E
CL: 68.800-69.500
IL: 67.500
Maximum Water Depth: 0.827m
+Permanent Water Depth: 0.5m
Storage Volume: 591m³

OUTFALL E
Discharge Rate: 3.3 l/s

OUTFALL A
OUTFALL B
OUTFALL C
OUTFALL D
OUTFALL E

225Ø
150Ø
400Ø

229 / 9 / 30
229 / 8 / 10

Earthwork
Tumuli

40.0 0.0 40.0 80.0 120.0 160.0 200.0
Scale = 1:2000 @ A1

STRATEGY NOTES:

The SuDS Strategy illustrated on this drawing is outline only and subject to detailed design.

Principles

In accordance with the hierarchy stipulated by Building Regulations, since infiltration drainage is not feasible, surface water will be discharged into the network of ditches, mimicking the existing situation.

The topography of the site leads to several catchment areas and "outfalls", as illustrated on the Existing Drainage Plan (8210440-1101). The proposed drainage strategy will seek to retain broadly similar catchments to the existing situation, and restrict run-off rates and volumes to each outfall point at or below the existing greenfield rates for the existing catchment draining to each outfall point.

SuDS

It is proposed to utilise detention basins and ponds/wetlands as the primary form of storage on the site. These will be located at the lower end of each of the catchments, and attenuate and treat run-off prior to discharge to the ditch network.

At-source techniques, such as rainwater harvesting, green roofs, bioretention systems, pervious pavements and tree pits, will be incorporated throughout the development. These will reduce the rate and / or volume discharging into the downstream ponds / basins and receiving watercourses, as well as providing additional water quality treatment and biodiversity and amenity value. Swales, filter strips or filter drains will be considered as means of flow conveyance through the site in-place of conventional pipe networks wherever practical. Refer to Outline SuDS Strategy drawing (8210440-1301).

Flow Rates and Storage Volumes

The surface water drainage system will be designed to accommodate surface water run-off from all rainfall events up to and including the 1 in 100 year event, including a 40% increase in rainfall intensity as allowance for the potential effects of climate change, without flooding from surface water.

Basin volumes are shown in Table 1. These represent a worst-case volume as it is expected that the upstream drainage network and SuDS features will also provide storage. Catchment B includes an allowance for storage within the extensive upstream SuDS network.

NOTES

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KEY

- Site boundary
- Existing ditch
- Existing pipe route (CCTV surveyed)
- Existing pipe route (from records / interpolated)

TABLE 1: CATCHMENT AREAS AND BASIN VOLUMES

Outfall Ref.	Basin Ref.	Total Area (ha)	Development Area (ha)	Impermeable Area (ha)	Proposed Discharge Rate (l/s)	Basin Volume (m^3)
A	A	2.060	1.004	0.663	3.2	573
B	B1	13.590	0.900	0.594	28.7	332
	B2		2.241	1.479		1457
	B3		3.701	2.443		2489
	B4		2.128	1.404		1298
C	C	6.120	2.858	1.886	9.1	1636
D	D1	10.440	2.544	1.679	24.0	1321
	D2		2.480	1.637		1367
	D3		2.475	1.634		2031
E	E	6.110	1.031	0.680	3.3	591
F	F	6.290	0.000	0.000	0.0	0
Total		**44.61**	**21.36**	**14.10**	**68.4**	**13095**

PROPOSED DRAINAGE KEY

- Development Area with Outfall Catchment Boundary
- Rerouted drainage ditch
- Indicative surface water pipe route
- +65.000 Indicative proposed level
- +63.110 (ex) Indicative existing level
- IL 63.260 Indicative pipe invert level
- Detention Basin — Top and bottom of bank. *1:3 side slopes assumed for the purposes of this assessment*
- Water level in 1:100yr +40% CC event
- Indicative permanent water level

SUSTAINABLE DRAINAGE TECHNIQUES

KEY	DESCRIPTION	LOCATION
	Rill providing a conveyance path downstream.	Hard-landscaped public realm areas.
	Tree pit providing storage before discharging into network. Integrated with bioretention systems where appropriate.	Site-wide, where appropriate ground conditions exist.
	Roadside conveyance swale / filter drain (lined) providing storage and/or conveyance downstream using an underdrain.	Along road corridors.
	Conveyance swale (lined), providing storage and/or conveyance downstream using an underdrain.	Along green corridors.

Rev.	Description	Date	Chkd
PA3	Masterplan updated. Basins updated.	26/02/2024 CS	JH
PA2	Masterplan updated. Catchment Areas updated accordingly. Basin B-1 relocated.	21/11/2023 BW	JH
PA1	Issued for Planning Approval	09/02/2023 BW	JH

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Client : Bellway Homes Limited and Christ Church, Oxford

Project : Water Eaton (Site PR6a) Land East of Oxford Road

Title : Outline Surface Water Drainage Strategy

Project Engineer : C. Salt | Scale : 1:2000 @A1
Project Director : J. Hanlon | Date : August 2021
Status : PLANNING APPROVAL

Drawing No. 8210440-1302 | Rev PA3

Appendix N

Drainage Calculations

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	60.005	0.355	3.2	235.0	O K
30 min Summer	60.105	0.455	3.2	307.3	O K
60 min Summer	60.200	0.550	3.2	379.5	Flood Risk
120 min Summer	60.292	0.642	3.2	451.2	Flood Risk
180 min Summer	60.343	0.693	3.2	492.4	Flood Risk
240 min Summer	60.376	0.726	3.2	519.4	Flood Risk
360 min Summer	60.415	0.765	3.2	551.0	Flood Risk
480 min Summer	60.432	0.782	3.2	565.3	Flood Risk
600 min Summer	60.438	0.788	3.2	570.5	Flood Risk
720 min Summer	60.438	0.788	3.2	570.5	Flood Risk
960 min Summer	60.427	0.777	3.2	561.2	Flood Risk
1440 min Summer	60.387	0.737	3.2	528.2	Flood Risk
2160 min Summer	60.332	0.682	3.2	483.6	Flood Risk
2880 min Summer	60.288	0.638	3.2	447.7	Flood Risk
4320 min Summer	60.215	0.565	3.2	390.6	Flood Risk
5760 min Summer	60.147	0.497	3.2	339.1	O K
7200 min Summer	60.089	0.439	3.2	295.5	O K
8640 min Summer	60.041	0.391	3.2	260.6	O K
10080 min Summer	60.000	0.350	3.2	231.4	O K
15 min Winter	60.005	0.355	3.2	235.0	O K
30 min Winter	60.105	0.455	3.2	307.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	151.760	0.0	217.6	30
30 min Summer	99.400	0.0	262.2	45
60 min Summer	61.740	0.0	377.9	74
120 min Summer	37.240	0.0	450.0	134
180 min Summer	27.483	0.0	487.4	192
240 min Summer	22.050	0.0	502.7	252
360 min Summer	16.030	0.0	502.9	370
480 min Summer	12.675	0.0	498.7	488
600 min Summer	10.517	0.0	494.3	608
720 min Summer	9.007	0.0	489.8	726
960 min Summer	7.019	0.0	480.6	964
1440 min Summer	4.912	0.0	460.9	1342
2160 min Summer	3.425	0.0	767.9	1672
2880 min Summer	2.657	0.0	791.5	2056
4320 min Summer	1.872	0.0	816.2	2896
5760 min Summer	1.471	0.0	887.6	3688
7200 min Summer	1.230	0.0	927.5	4408
8640 min Summer	1.069	0.0	966.1	5192
10080 min Summer	0.954	0.0	1003.2	5944
15 min Winter	151.760	0.0	217.6	30
30 min Winter	99.400	0.0	262.2	45

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	60.200	0.550	3.2	379.5	Flood Risk
120 min Winter	60.292	0.642	3.2	451.4	Flood Risk
180 min Winter	60.344	0.694	3.2	492.8	Flood Risk
240 min Winter	60.377	0.727	3.2	520.0	Flood Risk
360 min Winter	60.416	0.766	3.2	552.2	Flood Risk
480 min Winter	60.433	0.783	3.2	566.9	Flood Risk
600 min Winter	60.440	0.790	3.2	572.6	Flood Risk
720 min Winter	60.441	0.791	3.2	573.0	Flood Risk
960 min Winter	60.431	0.781	3.2	564.6	Flood Risk
1440 min Winter	60.393	0.743	3.2	533.0	Flood Risk
2160 min Winter	60.329	0.679	3.2	480.8	Flood Risk
2880 min Winter	60.275	0.625	3.2	437.8	Flood Risk
4320 min Winter	60.173	0.523	3.2	358.4	Flood Risk
5760 min Winter	60.069	0.419	3.2	280.9	O K
7200 min Winter	59.988	0.338	3.2	222.9	O K
8640 min Winter	59.922	0.272	3.2	177.2	O K
10080 min Winter	59.871	0.221	3.2	142.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	61.740	0.0	377.9	74
120 min Winter	37.240	0.0	450.1	132
180 min Winter	27.483	0.0	487.4	190
240 min Winter	22.050	0.0	502.7	248
360 min Winter	16.030	0.0	502.8	364
480 min Winter	12.675	0.0	498.5	480
600 min Winter	10.517	0.0	494.0	596
720 min Winter	9.007	0.0	489.5	710
960 min Winter	7.019	0.0	480.3	936
1440 min Winter	4.912	0.0	461.2	1370
2160 min Winter	3.425	0.0	768.0	1716
2880 min Winter	2.657	0.0	791.9	2172
4320 min Winter	1.872	0.0	824.0	3112
5760 min Winter	1.471	0.0	887.6	3864
7200 min Winter	1.230	0.0	927.5	4616
8640 min Winter	1.069	0.0	966.3	5280
10080 min Winter	0.954	0.0	1003.7	5960

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 451400 210550 SP 51400 10550
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.950
Cv (Winter)	0.950
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.663

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.166	4	8	0.166	8	12	0.166	12	16	0.165

Model Details

Storage is Online Cover Level (m) 60.450

Tank or Pond Structure

Invert Level (m) 59.650

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	614.0	0.800	844.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0088-3200-0800-3200
Design Head (m)	0.800
Design Flow (l/s)	3.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	88
Invert Level (m)	59.650
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	3.2
Flush-Flo™	0.237	3.2
Kick-Flo®	0.517	2.6
Mean Flow over Head Range	-	2.8

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	2.7	1.200	3.9	3.000	5.9	7.000	8.8
0.200	3.2	1.400	4.1	3.500	6.4	7.500	9.1
0.300	3.2	1.600	4.4	4.000	6.8	8.000	9.4
0.400	3.1	1.800	4.7	4.500	7.2	8.500	9.7
0.500	2.7	2.000	4.9	5.000	7.5	9.000	9.9
0.600	2.8	2.200	5.1	5.500	7.9	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		

Cascade Summary of Results for B - Basin B-1 Calculation .SRCX

Upstream Structures	Outflow To	Overflow To
(None)	B - Basin B-2 Calculation .SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	61.167	0.667	16.0	195.0	O K
30 min Summer	61.314	0.814	16.0	253.0	Flood Risk
60 min Summer	61.423	0.923	16.0	300.1	Flood Risk
120 min Summer	61.483	0.983	16.0	327.9	Flood Risk
180 min Summer	61.486	0.986	16.0	329.2	Flood Risk
240 min Summer	61.474	0.974	16.0	323.8	Flood Risk
360 min Summer	61.439	0.939	16.0	307.6	Flood Risk
480 min Summer	61.395	0.895	16.0	288.0	Flood Risk
600 min Summer	61.349	0.849	16.0	267.9	Flood Risk
720 min Summer	61.301	0.801	16.0	247.9	Flood Risk
960 min Summer	61.199	0.699	16.0	207.0	O K
1440 min Summer	60.993	0.493	16.0	133.7	O K
2160 min Summer	60.785	0.285	15.9	70.3	O K
2880 min Summer	60.691	0.191	15.3	45.2	O K
4320 min Summer	60.645	0.145	11.3	33.6	O K
5760 min Summer	60.624	0.124	9.0	28.4	O K
7200 min Summer	60.611	0.111	7.6	25.3	O K
8640 min Summer	60.602	0.102	6.6	23.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	151.760	0.0	213.3	28
30 min Summer	99.400	0.0	279.6	42
60 min Summer	61.740	0.0	348.0	68
120 min Summer	37.240	0.0	419.9	124
180 min Summer	27.483	0.0	464.9	170
240 min Summer	22.050	0.0	497.3	200
360 min Summer	16.030	0.0	542.3	264
480 min Summer	12.675	0.0	571.7	334
600 min Summer	10.517	0.0	593.0	402
720 min Summer	9.007	0.0	609.4	470
960 min Summer	7.019	0.0	633.2	606
1440 min Summer	4.912	0.0	664.5	840
2160 min Summer	3.425	0.0	695.6	1168
2880 min Summer	2.657	0.0	719.4	1480
4320 min Summer	1.872	0.0	760.0	2204
5760 min Summer	1.471	0.0	797.0	2936
7200 min Summer	1.230	0.0	833.0	3672
8640 min Summer	1.069	0.0	868.5	4408

Cascade Summary of Results for B - Basin B-1 Calculation .SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	60.596	0.096	5.9	21.6	O K
15 min Winter	61.167	0.667	16.0	195.1	O K
30 min Winter	61.314	0.814	16.0	253.1	Flood Risk
60 min Winter	61.424	0.924	16.0	300.7	Flood Risk
120 min Winter	61.487	0.987	16.0	329.7	Flood Risk
180 min Winter	61.491	0.991	16.0	331.7	Flood Risk
240 min Winter	61.474	0.974	16.0	323.7	Flood Risk
360 min Winter	61.429	0.929	16.0	302.9	Flood Risk
480 min Winter	61.368	0.868	16.0	276.3	Flood Risk
600 min Winter	61.301	0.801	16.0	247.9	Flood Risk
720 min Winter	61.228	0.728	16.0	218.3	Flood Risk
960 min Winter	61.057	0.557	16.0	155.3	O K
1440 min Winter	60.794	0.294	16.0	72.8	O K
2160 min Winter	60.666	0.166	13.3	38.8	O K
2880 min Winter	60.637	0.137	10.5	31.6	O K
4320 min Winter	60.610	0.110	7.4	24.9	O K
5760 min Winter	60.595	0.095	5.8	21.5	O K
7200 min Winter	60.586	0.086	4.9	19.3	O K
8640 min Winter	60.579	0.079	4.2	17.8	O K
10080 min Winter	60.575	0.075	3.8	16.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.954	0.0	903.7	5120
15 min Winter	151.760	0.0	213.3	28
30 min Winter	99.400	0.0	279.6	42
60 min Winter	61.740	0.0	348.0	68
120 min Winter	37.240	0.0	419.9	122
180 min Winter	27.483	0.0	464.9	176
240 min Winter	22.050	0.0	497.3	206
360 min Winter	16.030	0.0	542.3	280
480 min Winter	12.675	0.0	571.7	356
600 min Winter	10.517	0.0	593.0	432
720 min Winter	9.007	0.0	609.4	506
960 min Winter	7.019	0.0	633.3	626
1440 min Winter	4.912	0.0	664.5	836
2160 min Winter	3.425	0.0	695.6	1128
2880 min Winter	2.657	0.0	719.4	1476
4320 min Winter	1.872	0.0	760.1	2204
5760 min Winter	1.471	0.0	797.0	2936
7200 min Winter	1.230	0.0	833.0	3672
8640 min Winter	1.069	0.0	868.5	4408
10080 min Winter	0.954	0.0	903.7	5136

Cascade Rainfall Details for B - Basin B-1 Calculation .SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 451400 210550 SP 51400 10550
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.950
Cv (Winter)	0.950
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.594

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.149	4	8	0.149	8	12	0.148	12	16	0.148

Cascade Model Details for B - Basin B-1 Calculation .SRCX

Storage is Online Cover Level (m) 61.500

Tank or Pond Structure

Invert Level (m) 60.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	216.0	1.000	472.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0180-1600-1000-1600
Design Head (m)	1.000
Design Flow (l/s)	16.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	180
Invert Level (m)	60.500
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	16.0
Flush-Flo™	0.324	16.0
Kick-Flo®	0.706	13.6
Mean Flow over Head Range	-	13.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.3	1.200	17.4	3.000	27.0	7.000	40.7
0.200	15.4	1.400	18.8	3.500	29.1	7.500	42.1
0.300	16.0	1.600	20.0	4.000	31.0	8.000	43.4
0.400	15.9	1.800	21.2	4.500	32.9	8.500	44.7
0.500	15.6	2.000	22.3	5.000	34.6	9.000	45.9
0.600	15.0	2.200	23.3	5.500	36.2	9.500	47.2
0.800	14.4	2.400	24.3	6.000	37.7		
1.000	16.0	2.600	25.2	6.500	39.2		

Cascade Summary of Results for B - Basin B-2 Calculation .SRCX

Upstream Structures	Outflow To	Overflow To
B - Basin B-1 Calculation .SRCX B - SuDS B-4 Calculation .SRCX B - Basin B-3 Calculation .SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	60.387	0.237	27.9	538.5	O K
30 min Summer	60.454	0.304	28.6	699.7	Flood Risk
60 min Summer	60.523	0.373	28.7	868.7	Flood Risk
120 min Summer	60.595	0.445	28.7	1052.2	Flood Risk
180 min Summer	60.641	0.491	28.7	1168.6	Flood Risk
240 min Summer	60.673	0.523	28.7	1251.9	Flood Risk
360 min Summer	60.712	0.562	28.7	1355.2	Flood Risk
480 min Summer	60.731	0.581	28.7	1406.4	Flood Risk
600 min Summer	60.740	0.590	28.7	1430.1	Flood Risk
720 min Summer	60.746	0.596	28.7	1446.5	Flood Risk
960 min Summer	60.749	0.599	28.7	1453.8	Flood Risk
1440 min Summer	60.720	0.570	28.7	1377.7	Flood Risk
2160 min Summer	60.662	0.512	28.7	1223.5	Flood Risk
2880 min Summer	60.597	0.447	28.7	1056.6	Flood Risk
4320 min Summer	60.499	0.349	28.7	809.5	Flood Risk
5760 min Summer	60.436	0.286	28.5	655.6	O K
7200 min Summer	60.396	0.246	28.0	560.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	151.760	0.0	1142.5	30
30 min Summer	99.400	0.0	1366.6	45
60 min Summer	61.740	0.0	2214.4	74
120 min Summer	37.240	0.0	2476.8	134
180 min Summer	27.483	0.0	2638.1	194
240 min Summer	22.050	0.0	2756.1	254
360 min Summer	16.030	0.0	2921.8	372
480 min Summer	12.675	0.0	3029.6	490
600 min Summer	10.517	0.0	3106.0	608
720 min Summer	9.007	0.0	3163.5	730
960 min Summer	7.019	0.0	3240.7	928
1440 min Summer	4.912	0.0	3317.5	1074
2160 min Summer	3.425	0.0	4677.9	1412
2880 min Summer	2.657	0.0	4692.1	1788
4320 min Summer	1.872	0.0	4676.6	2508
5760 min Summer	1.471	0.0	6625.4	3176
7200 min Summer	1.230	0.0	6800.9	3832

Cascade Summary of Results for B - Basin B-2 Calculation .SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Summer	60.374	0.224	27.3	508.5	O K
10080 min Summer	60.362	0.212	25.7	479.8	O K
15 min Winter	60.387	0.237	27.9	538.7	O K
30 min Winter	60.454	0.304	28.6	700.1	Flood Risk
60 min Winter	60.523	0.373	28.7	868.8	Flood Risk
120 min Winter	60.595	0.445	28.7	1050.1	Flood Risk
180 min Winter	60.639	0.489	28.7	1164.2	Flood Risk
240 min Winter	60.670	0.520	28.7	1245.8	Flood Risk
360 min Winter	60.709	0.559	28.7	1347.8	Flood Risk
480 min Winter	60.728	0.578	28.7	1399.5	Flood Risk
600 min Winter	60.738	0.588	28.7	1424.6	Flood Risk
720 min Winter	60.746	0.596	28.7	1446.2	Flood Risk
960 min Winter	60.750	0.600	28.7	1457.1	Flood Risk
1440 min Winter	60.704	0.554	28.7	1334.3	Flood Risk
2160 min Winter	60.610	0.460	28.7	1088.7	Flood Risk
2880 min Winter	60.524	0.374	28.7	872.9	Flood Risk
4320 min Winter	60.412	0.262	28.3	598.5	O K
5760 min Winter	60.367	0.217	26.3	490.9	O K
7200 min Winter	60.347	0.197	23.6	446.2	O K
8640 min Winter	60.335	0.185	21.7	417.2	O K
10080 min Winter	60.326	0.176	20.1	397.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.069	0.0	6952.7	4504
10080 min Summer	0.954	0.0	7071.4	5248
15 min Winter	151.760	0.0	1142.5	30
30 min Winter	99.400	0.0	1366.7	45
60 min Winter	61.740	0.0	2214.5	74
120 min Winter	37.240	0.0	2476.9	132
180 min Winter	27.483	0.0	2638.0	192
240 min Winter	22.050	0.0	2755.8	250
360 min Winter	16.030	0.0	2920.9	366
480 min Winter	12.675	0.0	3028.3	480
600 min Winter	10.517	0.0	3104.2	598
720 min Winter	9.007	0.0	3161.3	716
960 min Winter	7.019	0.0	3237.8	894
1440 min Winter	4.912	0.0	3314.0	1074
2160 min Winter	3.425	0.0	4673.0	1492
2880 min Winter	2.657	0.0	4688.1	1856
4320 min Winter	1.872	0.0	4678.3	2504
5760 min Winter	1.471	0.0	6616.1	3120
7200 min Winter	1.230	0.0	6792.9	3832
8640 min Winter	1.069	0.0	6952.5	4584
10080 min Winter	0.954	0.0	7089.0	5344

Cascade Rainfall Details for B - Basin B-2 Calculation .SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 451400 210550 SP 51400 10550
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.950
Cv (Winter)	0.950
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.479

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.370	4	8	0.370	8	12	0.370	12	16	0.369

Cascade Model Details for B - Basin B-2 Calculation .SRCX

Storage is Online Cover Level (m) 60.750

Tank or Pond Structure

Invert Level (m) 60.150

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2179.0	0.600	2687.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0237-2870-0600-2870
Design Head (m)	0.600
Design Flow (l/s)	28.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	237
Invert Level (m)	60.150
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	28.7
Flush-Flo™	0.333	28.7
Kick-Flo®	0.511	26.6
Mean Flow over Head Range	-	21.7

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	7.8	1.200	40.0	3.000	62.3	7.000	93.5
0.200	24.0	1.400	43.1	3.500	67.2	7.500	96.9
0.300	28.6	1.600	46.0	4.000	71.7	8.000	100.1
0.400	28.4	1.800	48.7	4.500	75.9	8.500	103.2
0.500	26.9	2.000	51.2	5.000	79.9	9.000	106.3
0.600	28.7	2.200	53.6	5.500	83.7	9.500	109.2
0.800	32.9	2.400	55.9	6.000	87.3		
1.000	36.7	2.600	58.1	6.500	90.1		

Cascade Summary of Results for B - Basin B-3 Calculation .SRCX

Upstream Structures	Outflow To	Overflow To
(None)	B - Basin B-2 Calculation .SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	61.423	0.723	3.1	876.0	O K
30 min Summer	61.617	0.917	3.1	1147.1	O K
60 min Summer	61.804	1.104	3.1	1422.0	O K
120 min Summer	61.988	1.288	3.2	1707.8	O K
180 min Summer	62.096	1.396	3.3	1882.4	O K
240 min Summer	62.170	1.470	3.4	2005.4	Flood Risk
360 min Summer	62.267	1.567	3.5	2169.3	Flood Risk
480 min Summer	62.325	1.625	3.6	2268.9	Flood Risk
600 min Summer	62.362	1.662	3.6	2334.9	Flood Risk
720 min Summer	62.388	1.688	3.6	2380.9	Flood Risk
960 min Summer	62.419	1.719	3.7	2435.9	Flood Risk
1440 min Summer	62.443	1.743	3.7	2479.1	Flood Risk
2160 min Summer	62.442	1.742	3.7	2477.0	Flood Risk
2880 min Summer	62.426	1.726	3.7	2448.3	Flood Risk
4320 min Summer	62.380	1.680	3.6	2366.7	Flood Risk
5760 min Summer	62.333	1.633	3.6	2282.9	Flood Risk
7200 min Summer	62.302	1.602	3.5	2229.7	Flood Risk
8640 min Summer	62.281	1.581	3.5	2192.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	151.760	0.0	235.1	35
30 min Summer	99.400	0.0	226.0	50
60 min Summer	61.740	0.0	476.8	80
120 min Summer	37.240	0.0	515.7	140
180 min Summer	27.483	0.0	536.4	198
240 min Summer	22.050	0.0	549.7	258
360 min Summer	16.030	0.0	565.1	378
480 min Summer	12.675	0.0	572.5	498
600 min Summer	10.517	0.0	576.0	616
720 min Summer	9.007	0.0	577.1	736
960 min Summer	7.019	0.0	575.4	974
1440 min Summer	4.912	0.0	564.3	1452
2160 min Summer	3.425	0.0	1129.3	2168
2880 min Summer	2.657	0.0	1112.3	2888
4320 min Summer	1.872	0.0	1065.3	4320
5760 min Summer	1.471	0.0	2105.3	5136
7200 min Summer	1.230	0.0	2080.4	5840
8640 min Summer	1.069	0.0	2041.9	6584

Cascade Summary of Results for B - Basin B-3 Calculation .SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	62.267	1.567	3.5	2169.3	Flood Risk
15 min Winter	61.423	0.723	3.1	876.0	O K
30 min Winter	61.617	0.917	3.1	1147.1	O K
60 min Winter	61.804	1.104	3.1	1422.1	O K
120 min Winter	61.988	1.288	3.2	1708.3	O K
180 min Winter	62.097	1.397	3.3	1883.3	O K
240 min Winter	62.171	1.471	3.4	2006.5	Flood Risk
360 min Winter	62.268	1.568	3.5	2171.1	Flood Risk
480 min Winter	62.326	1.626	3.6	2271.5	Flood Risk
600 min Winter	62.364	1.664	3.6	2338.2	Flood Risk
720 min Winter	62.391	1.691	3.6	2384.8	Flood Risk
960 min Winter	62.422	1.722	3.7	2441.1	Flood Risk
1440 min Winter	62.448	1.748	3.7	2487.1	Flood Risk
2160 min Winter	62.449	1.749	3.7	2489.3	Flood Risk
2880 min Winter	62.436	1.736	3.7	2465.5	Flood Risk
4320 min Winter	62.397	1.697	3.6	2395.6	Flood Risk
5760 min Winter	62.351	1.651	3.6	2315.8	Flood Risk
7200 min Winter	62.311	1.611	3.6	2245.5	Flood Risk
8640 min Winter	62.287	1.587	3.5	2203.7	Flood Risk
10080 min Winter	62.268	1.568	3.5	2171.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.954	0.0	1990.2	7368
15 min Winter	151.760	0.0	235.1	35
30 min Winter	99.400	0.0	226.0	49
60 min Winter	61.740	0.0	476.8	78
120 min Winter	37.240	0.0	515.5	138
180 min Winter	27.483	0.0	536.1	196
240 min Winter	22.050	0.0	549.1	254
360 min Winter	16.030	0.0	564.1	372
480 min Winter	12.675	0.0	571.2	490
600 min Winter	10.517	0.0	574.3	608
720 min Winter	9.007	0.0	575.1	726
960 min Winter	7.019	0.0	572.6	960
1440 min Winter	4.912	0.0	560.0	1430
2160 min Winter	3.425	0.0	1123.5	2128
2880 min Winter	2.657	0.0	1104.7	2812
4320 min Winter	1.872	0.0	1054.7	4156
5760 min Winter	1.471	0.0	2095.5	5424
7200 min Winter	1.230	0.0	2069.9	5992
8640 min Winter	1.069	0.0	2031.8	6760
10080 min Winter	0.954	0.0	1981.7	7680

Cascade Rainfall Details for B - Basin B-3 Calculation .SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 451400 210550 SP 51400 10550
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.950
Cv (Winter)	0.950
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.443

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.489	8	12	0.489	16	20	0.488
4	8	0.489	12	16	0.488			

Cascade Model Details for B - Basin B-3 Calculation .SRCX

Storage is Online Cover Level (m) 62.450

Tank or Pond Structure

Invert Level (m) 60.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1076.0	1.750	1802.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0081-3700-1750-3700
Design Head (m)	1.750
Design Flow (l/s)	3.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	81
Invert Level (m)	60.700
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.750	3.7
Flush-Flo™	0.351	3.1
Kick-Flo®	0.720	2.5
Mean Flow over Head Range	-	2.9

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	2.4	1.200	3.1	3.000	4.7	7.000	7.1
0.200	2.9	1.400	3.3	3.500	5.1	7.500	7.3
0.300	3.1	1.600	3.5	4.000	5.4	8.000	7.5
0.400	3.1	1.800	3.7	4.500	5.7	8.500	7.7
0.500	3.0	2.000	3.9	5.000	6.0	9.000	8.0
0.600	2.9	2.200	4.1	5.500	6.3	9.500	8.2
0.800	2.6	2.400	4.3	6.000	6.6		
1.000	2.9	2.600	4.4	6.500	6.8		

Cascade Summary of Results for B - SuDS B-4 Calculation .SRCX

Upstream Structures	Outflow To	Overflow To
(None)	B - Basin B-2 Calculation .SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	60.685	0.385	4.5	500.5	O K
30 min Summer	60.804	0.504	4.5	654.8	O K
60 min Summer	60.923	0.623	4.5	810.4	O K
120 min Summer	61.045	0.745	4.5	969.1	Flood Risk
180 min Summer	61.118	0.818	4.5	1063.2	Flood Risk
240 min Summer	61.167	0.867	4.5	1127.2	Flood Risk
360 min Summer	61.229	0.929	4.5	1208.0	Flood Risk
480 min Summer	61.263	0.963	4.5	1251.7	Flood Risk
600 min Summer	61.282	0.982	4.5	1276.1	Flood Risk
720 min Summer	61.292	0.992	4.5	1289.1	Flood Risk
960 min Summer	61.296	0.996	4.5	1294.4	Flood Risk
1440 min Summer	61.276	0.976	4.5	1268.6	Flood Risk
2160 min Summer	61.221	0.921	4.5	1197.5	Flood Risk
2880 min Summer	61.172	0.872	4.5	1134.1	Flood Risk
4320 min Summer	61.100	0.800	4.5	1039.5	Flood Risk
5760 min Summer	61.044	0.744	4.5	966.7	Flood Risk
7200 min Summer	60.999	0.699	4.5	908.1	O K
8640 min Summer	60.959	0.659	4.5	857.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	151.760	0.0	371.4	31
30 min Summer	99.400	0.0	377.2	45
60 min Summer	61.740	0.0	717.3	76
120 min Summer	37.240	0.0	708.6	134
180 min Summer	27.483	0.0	694.3	194
240 min Summer	22.050	0.0	686.2	254
360 min Summer	16.030	0.0	678.6	372
480 min Summer	12.675	0.0	675.2	492
600 min Summer	10.517	0.0	673.3	610
720 min Summer	9.007	0.0	672.1	730
960 min Summer	7.019	0.0	670.2	968
1440 min Summer	4.912	0.0	658.9	1444
2160 min Summer	3.425	0.0	1341.1	2064
2880 min Summer	2.657	0.0	1289.3	2392
4320 min Summer	1.872	0.0	1176.4	3124
5760 min Summer	1.471	0.0	1868.6	3968
7200 min Summer	1.230	0.0	1949.1	4824
8640 min Summer	1.069	0.0	2024.7	5624

Cascade Summary of Results for B - SuDS B-4 Calculation .SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	60.921	0.621	4.5	807.6	O K
15 min Winter	60.685	0.385	4.5	500.5	O K
30 min Winter	60.804	0.504	4.5	654.9	O K
60 min Winter	60.923	0.623	4.5	810.4	O K
120 min Winter	61.046	0.746	4.5	969.2	Flood Risk
180 min Winter	61.118	0.818	4.5	1063.5	Flood Risk
240 min Winter	61.168	0.868	4.5	1127.8	Flood Risk
360 min Winter	61.230	0.930	4.5	1209.1	Flood Risk
480 min Winter	61.264	0.964	4.5	1253.4	Flood Risk
600 min Winter	61.283	0.983	4.5	1278.4	Flood Risk
720 min Winter	61.294	0.994	4.5	1292.0	Flood Risk
960 min Winter	61.299	0.999	4.5	1298.3	Flood Risk
1440 min Winter	61.281	0.981	4.5	1275.0	Flood Risk
2160 min Winter	61.229	0.929	4.5	1208.1	Flood Risk
2880 min Winter	61.173	0.873	4.5	1134.5	Flood Risk
4320 min Winter	61.086	0.786	4.5	1022.1	Flood Risk
5760 min Winter	61.011	0.711	4.5	924.2	Flood Risk
7200 min Winter	60.941	0.641	4.5	833.3	O K
8640 min Winter	60.867	0.567	4.5	737.6	O K
10080 min Winter	60.807	0.507	4.5	659.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.954	0.0	2091.1	6456
15 min Winter	151.760	0.0	371.4	30
30 min Winter	99.400	0.0	377.3	45
60 min Winter	61.740	0.0	717.4	74
120 min Winter	37.240	0.0	708.9	132
180 min Winter	27.483	0.0	694.6	190
240 min Winter	22.050	0.0	686.5	250
360 min Winter	16.030	0.0	678.7	366
480 min Winter	12.675	0.0	675.2	482
600 min Winter	10.517	0.0	673.2	600
720 min Winter	9.007	0.0	671.8	716
960 min Winter	7.019	0.0	669.9	948
1440 min Winter	4.912	0.0	658.6	1404
2160 min Winter	3.425	0.0	1342.1	2060
2880 min Winter	2.657	0.0	1292.9	2648
4320 min Winter	1.872	0.0	1189.2	3292
5760 min Winter	1.471	0.0	1869.1	4224
7200 min Winter	1.230	0.0	1950.7	5184
8640 min Winter	1.069	0.0	2030.3	5968
10080 min Winter	0.954	0.0	2104.4	6752

Cascade Rainfall Details for B - SuDS B-4 Calculation .SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 451400 210550 SP 51400 10550
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.950
Cv (Winter)	0.950
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.404

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.351	4	8	0.351	8	12	0.351	12	16	0.351

Cascade Model Details for B - SuDS B-4 Calculation .SRCX

Storage is Online Cover Level (m) 61.300

Tank or Pond Structure

Invert Level (m) 60.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1300.0	1.000	1300.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0100-4500-1000-4500
Design Head (m)	1.000
Design Flow (l/s)	4.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	60.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.5
Flush-Flo™	0.292	4.5
Kick-Flo®	0.630	3.6
Mean Flow over Head Range	-	3.9

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	3.3	1.200	4.9	3.000	7.5	7.000	11.2
0.200	4.4	1.400	5.3	3.500	8.1	7.500	11.6
0.300	4.5	1.600	5.6	4.000	8.6	8.000	12.0
0.400	4.4	1.800	5.9	4.500	9.1	8.500	12.3
0.500	4.2	2.000	6.2	5.000	9.6	9.000	12.7
0.600	3.8	2.200	6.5	5.500	10.0	9.500	13.0
0.800	4.1	2.400	6.8	6.000	10.4		
1.000	4.5	2.600	7.0	6.500	10.8		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Summer	64.188	0.688	9.1	1080.0	O K
120 min Summer	64.304	0.804	9.1	1285.0	Flood Risk
180 min Summer	64.369	0.869	9.1	1402.7	Flood Risk
240 min Summer	64.411	0.911	9.1	1480.2	Flood Risk
360 min Summer	64.460	0.960	9.1	1571.3	Flood Risk
480 min Summer	64.482	0.982	9.1	1612.9	Flood Risk
600 min Summer	64.490	0.990	9.1	1628.9	Flood Risk
720 min Summer	64.491	0.991	9.1	1629.8	Flood Risk
960 min Summer	64.478	0.978	9.1	1605.1	Flood Risk
1440 min Summer	64.429	0.929	9.1	1514.4	Flood Risk
2160 min Summer	64.363	0.863	9.1	1391.1	Flood Risk
2880 min Summer	64.307	0.807	9.1	1291.0	Flood Risk
4320 min Summer	64.216	0.716	9.1	1128.9	Flood Risk
5760 min Summer	64.130	0.630	9.1	980.2	O K
7200 min Summer	64.059	0.559	9.1	859.5	O K
8640 min Summer	64.000	0.500	9.1	761.4	O K
10080 min Summer	63.949	0.449	9.1	678.8	O K
60 min Winter	64.188	0.688	9.1	1080.0	O K
120 min Winter	64.304	0.804	9.1	1285.3	Flood Risk
180 min Winter	64.369	0.869	9.1	1403.7	Flood Risk
240 min Winter	64.412	0.912	9.1	1481.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Summer	61.740	0.0	1065.2	74
120 min Summer	37.240	0.0	1267.9	134
180 min Summer	27.483	0.0	1375.0	192
240 min Summer	22.050	0.0	1426.2	252
360 min Summer	16.030	0.0	1433.6	370
480 min Summer	12.675	0.0	1421.3	488
600 min Summer	10.517	0.0	1407.8	608
720 min Summer	9.007	0.0	1394.0	726
960 min Summer	7.019	0.0	1365.6	964
1440 min Summer	4.912	0.0	1305.6	1340
2160 min Summer	3.425	0.0	2175.3	1672
2880 min Summer	2.657	0.0	2240.0	2056
4320 min Summer	1.872	0.0	2306.4	2896
5760 min Summer	1.471	0.0	2522.2	3680
7200 min Summer	1.230	0.0	2635.2	4408
8640 min Summer	1.069	0.0	2744.2	5192
10080 min Summer	0.954	0.0	2847.4	5944
60 min Winter	61.740	0.0	1065.2	74
120 min Winter	37.240	0.0	1268.0	132
180 min Winter	27.483	0.0	1375.2	190
240 min Winter	22.050	0.0	1426.5	248

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	64.461	0.961	9.1	1574.0	Flood Risk
480 min Winter	64.484	0.984	9.1	1616.8	Flood Risk
600 min Winter	64.493	0.993	9.1	1633.9	Flood Risk
720 min Winter	64.494	0.994	9.1	1636.0	Flood Risk
960 min Winter	64.482	0.982	9.1	1613.7	Flood Risk
1440 min Winter	64.436	0.936	9.1	1526.6	Flood Risk
2160 min Winter	64.357	0.857	9.1	1381.7	Flood Risk
2880 min Winter	64.291	0.791	9.1	1261.1	Flood Risk
4320 min Winter	64.160	0.660	9.1	1031.8	O K
5760 min Winter	64.034	0.534	9.1	818.2	O K
7200 min Winter	63.934	0.434	9.1	654.6	O K
8640 min Winter	63.852	0.352	9.1	524.4	O K
10080 min Winter	63.788	0.288	9.1	424.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	16.030	0.0	1433.8	364
480 min Winter	12.675	0.0	1421.3	480
600 min Winter	10.517	0.0	1407.7	596
720 min Winter	9.007	0.0	1393.9	710
960 min Winter	7.019	0.0	1365.8	936
1440 min Winter	4.912	0.0	1307.7	1370
2160 min Winter	3.425	0.0	2175.7	1716
2880 min Winter	2.657	0.0	2241.5	2172
4320 min Winter	1.872	0.0	2331.1	3080
5760 min Winter	1.471	0.0	2522.5	3864
7200 min Winter	1.230	0.0	2635.5	4616
8640 min Winter	1.069	0.0	2744.7	5280
10080 min Winter	0.954	0.0	2849.1	5960

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 451400 210550 SP 51400 10550
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.950
Cv (Winter)	0.950
Shortest Storm (mins)	60
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.886

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.472	4	8	0.472	8	12	0.471	12	16	0.471

Model Details

Storage is Online Cover Level (m) 64.500

Tank or Pond Structure

Invert Level (m) 63.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1405.0	1.000	1903.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0140-9100-1000-9100
Design Head (m)	1.000
Design Flow (l/s)	9.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	140
Invert Level (m)	63.500
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	9.1
Flush-Flo™	0.304	9.1
Kick-Flo®	0.671	7.6
Mean Flow over Head Range	-	7.8

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	5.0	1.200	9.9	3.000	15.3	7.000	23.0
0.200	8.8	1.400	10.7	3.500	16.5	7.500	23.7
0.300	9.1	1.600	11.4	4.000	17.6	8.000	24.5
0.400	9.0	1.800	12.0	4.500	18.6	8.500	25.2
0.500	8.8	2.000	12.6	5.000	19.5	9.000	25.9
0.600	8.3	2.200	13.2	5.500	20.4	9.500	26.6
0.800	8.2	2.400	13.8	6.000	21.3		
1.000	9.1	2.600	14.3	6.500	22.2		

Cascade Summary of Results for D - Basin D-1 Calculation.SRCX

Upstream Structures	Outflow To	Overflow To
D - Basin D-2 Calculation.SRCX	(None)	(None)
D - Basin D-3 Calculation.SRCX		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Summer	64.716	0.866	24.0	948.2	Flood Risk
120 min Summer	64.845	0.995	24.0	1117.9	Flood Risk
180 min Summer	64.912	1.062	24.0	1208.1	Flood Risk
240 min Summer	64.950	1.100	24.0	1261.6	Flood Risk
360 min Summer	64.986	1.136	24.0	1311.2	Flood Risk
480 min Summer	64.990	1.140	24.0	1316.9	Flood Risk
600 min Summer	64.978	1.128	24.0	1300.6	Flood Risk
720 min Summer	64.958	1.108	24.0	1272.5	Flood Risk
960 min Summer	64.915	1.065	24.0	1212.4	Flood Risk
1440 min Summer	64.831	0.981	24.0	1099.2	Flood Risk
2160 min Summer	64.715	0.865	24.0	947.0	Flood Risk
2880 min Summer	64.589	0.739	24.0	788.8	O K
4320 min Summer	64.394	0.544	24.0	558.2	O K
5760 min Summer	64.254	0.404	24.0	403.5	O K
7200 min Summer	64.166	0.316	23.8	309.5	O K
8640 min Summer	64.116	0.266	23.5	258.1	O K
10080 min Summer	64.088	0.238	23.1	229.6	O K
60 min Winter	64.715	0.865	24.0	947.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Summer	61.740	0.0	2027.7	74
120 min Summer	37.240	0.0	2421.1	132
180 min Summer	27.483	0.0	2633.2	190
240 min Summer	22.050	0.0	2743.2	250
360 min Summer	16.030	0.0	2881.5	366
480 min Summer	12.675	0.0	2972.8	484
600 min Summer	10.517	0.0	3039.9	602
720 min Summer	9.007	0.0	3091.7	698
960 min Summer	7.019	0.0	3162.0	802
1440 min Summer	4.912	0.0	3228.4	1052
2160 min Summer	3.425	0.0	4140.7	1472
2880 min Summer	2.657	0.0	4267.3	1832
4320 min Summer	1.872	0.0	4445.4	2556
5760 min Summer	1.471	0.0	4998.4	3232
7200 min Summer	1.230	0.0	5190.5	3888
8640 min Summer	1.069	0.0	5377.8	4496
10080 min Summer	0.954	0.0	5562.9	5160
60 min Winter	61.740	0.0	2027.7	72

Cascade Summary of Results for D - Basin D-1 Calculation.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	64.845	0.995	24.0	1117.1	Flood Risk
180 min Winter	64.912	1.062	24.0	1207.9	Flood Risk
240 min Winter	64.951	1.101	24.0	1262.3	Flood Risk
360 min Winter	64.987	1.137	24.0	1313.4	Flood Risk
480 min Winter	64.993	1.143	24.0	1320.7	Flood Risk
600 min Winter	64.982	1.132	24.0	1306.3	Flood Risk
720 min Winter	64.963	1.113	24.0	1279.8	Flood Risk
960 min Winter	64.912	1.062	24.0	1208.8	Flood Risk
1440 min Winter	64.812	0.962	24.0	1073.0	Flood Risk
2160 min Winter	64.639	0.789	24.0	851.3	O K
2880 min Winter	64.462	0.612	24.0	637.1	O K
4320 min Winter	64.209	0.359	24.0	355.2	O K
5760 min Winter	64.089	0.239	23.1	230.9	O K
7200 min Winter	64.060	0.210	21.9	201.8	O K
8640 min Winter	64.047	0.197	20.4	188.1	O K
10080 min Winter	64.037	0.187	19.2	178.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	37.240	0.0	2420.9	130
180 min Winter	27.483	0.0	2632.2	186
240 min Winter	22.050	0.0	2741.1	244
360 min Winter	16.030	0.0	2878.4	358
480 min Winter	12.675	0.0	2969.0	472
600 min Winter	10.517	0.0	3035.5	584
720 min Winter	9.007	0.0	3086.9	692
960 min Winter	7.019	0.0	3155.9	888
1440 min Winter	4.912	0.0	3221.4	1108
2160 min Winter	3.425	0.0	4139.3	1564
2880 min Winter	2.657	0.0	4265.4	1916
4320 min Winter	1.872	0.0	4449.3	2560
5760 min Winter	1.471	0.0	4994.8	3000
7200 min Winter	1.230	0.0	5185.8	3680
8640 min Winter	1.069	0.0	5372.2	4416
10080 min Winter	0.954	0.0	5556.4	5152

Cascade Rainfall Details for D - Basin D-1 Calculation.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 451400 210550 SP 51400 10550
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.950
Cv (Winter)	0.950
Shortest Storm (mins)	60
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.679

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.420	4	8	0.420	8	12	0.420	12	16	0.419

Cascade Model Details for D - Basin D-1 Calculation.SRCX

Storage is Online Cover Level (m) 65.000

Tank or Pond Structure

Invert Level (m) 63.850

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	918.0	1.150	1415.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0213-2400-1150-2400
Design Head (m)	1.150
Design Flow (l/s)	24.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	213
Invert Level (m)	63.850
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.150	24.0
Flush-Flo™	0.381	24.0
Kick-Flo®	0.818	20.4
Mean Flow over Head Range	-	20.3

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	7.2	1.200	24.5	3.000	38.0	7.000	57.3
0.200	20.8	1.400	26.4	3.500	40.9	7.500	59.2
0.300	23.8	1.600	28.1	4.000	43.7	8.000	61.1
0.400	24.0	1.800	29.7	4.500	46.2	8.500	62.9
0.500	23.7	2.000	31.3	5.000	48.6	9.000	64.7
0.600	23.3	2.200	32.7	5.500	50.9	9.500	66.4
0.800	20.9	2.400	34.1	6.000	53.1		
1.000	22.4	2.600	35.5	6.500	55.2		

Cascade Summary of Results for D - Basin D-2 Calculation.SRCX

Upstream Structures	Outflow To	Overflow To
D - Basin D-3 Calculation.SRCX	D - Basin D-1 Calculation.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Summer	67.475	1.975	8.9	930.7	O K
120 min Summer	67.693	2.193	9.4	1101.6	O K
180 min Summer	67.807	2.307	9.6	1197.8	Flood Risk
240 min Summer	67.878	2.378	9.8	1259.3	Flood Risk
360 min Summer	67.954	2.454	9.9	1327.4	Flood Risk
480 min Summer	67.982	2.482	10.0	1353.0	Flood Risk
600 min Summer	67.986	2.486	10.0	1356.6	Flood Risk
720 min Summer	67.976	2.476	9.9	1347.4	Flood Risk
960 min Summer	67.931	2.431	9.9	1306.7	Flood Risk
1440 min Summer	67.816	2.316	9.6	1205.3	Flood Risk
2160 min Summer	67.672	2.172	9.4	1084.6	O K
2880 min Summer	67.559	2.059	9.1	995.0	O K
4320 min Summer	67.380	1.880	8.7	861.5	O K
5760 min Summer	67.231	1.731	8.6	758.3	O K
7200 min Summer	67.103	1.603	8.6	675.1	O K
8640 min Summer	66.989	1.489	8.6	604.9	O K
10080 min Summer	66.884	1.384	8.6	543.8	O K
60 min Winter	67.475	1.975	8.9	931.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Summer	61.740	0.0	1074.7	74
120 min Summer	37.240	0.0	1281.4	134
180 min Summer	27.483	0.0	1402.2	192
240 min Summer	22.050	0.0	1438.4	252
360 min Summer	16.030	0.0	1449.1	370
480 min Summer	12.675	0.0	1453.8	488
600 min Summer	10.517	0.0	1457.3	606
720 min Summer	9.007	0.0	1460.5	724
960 min Summer	7.019	0.0	1464.7	962
1440 min Summer	4.912	0.0	1447.9	1224
2160 min Summer	3.425	0.0	2205.2	1584
2880 min Summer	2.657	0.0	2265.8	1988
4320 min Summer	1.872	0.0	2363.0	2812
5760 min Summer	1.471	0.0	2776.1	3632
7200 min Summer	1.230	0.0	2866.5	4464
8640 min Summer	1.069	0.0	2953.6	5272
10080 min Summer	0.954	0.0	3038.8	6056
60 min Winter	61.740	0.0	1074.7	74

Cascade Summary of Results for D - Basin D-2 Calculation.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	67.695	2.195	9.4	1103.6	O K
180 min Winter	67.811	2.311	9.6	1201.0	Flood Risk
240 min Winter	67.883	2.383	9.8	1263.6	Flood Risk
360 min Winter	67.961	2.461	9.9	1334.0	Flood Risk
480 min Winter	67.991	2.491	10.0	1361.6	Flood Risk
600 min Winter	67.997	2.497	10.0	1367.3	Flood Risk
720 min Winter	67.990	2.490	10.0	1360.2	Flood Risk
960 min Winter	67.950	2.450	9.9	1324.2	Flood Risk
1440 min Winter	67.834	2.334	9.7	1220.6	Flood Risk
2160 min Winter	67.672	2.172	9.4	1084.3	O K
2880 min Winter	67.534	2.034	9.1	975.7	O K
4320 min Winter	67.292	1.792	8.6	799.7	O K
5760 min Winter	67.072	1.572	8.6	655.4	O K
7200 min Winter	66.863	1.363	8.6	532.1	O K
8640 min Winter	66.615	1.115	8.6	401.4	O K
10080 min Winter	66.300	0.800	8.6	259.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	37.240	0.0	1281.4	130
180 min Winter	27.483	0.0	1401.8	188
240 min Winter	22.050	0.0	1436.5	246
360 min Winter	16.030	0.0	1446.0	362
480 min Winter	12.675	0.0	1449.8	478
600 min Winter	10.517	0.0	1452.7	594
720 min Winter	9.007	0.0	1455.5	706
960 min Winter	7.019	0.0	1458.8	930
1440 min Winter	4.912	0.0	1440.6	1342
2160 min Winter	3.425	0.0	2203.8	1656
2880 min Winter	2.657	0.0	2263.9	2116
4320 min Winter	1.872	0.0	2361.1	3028
5760 min Winter	1.471	0.0	2772.5	3880
7200 min Winter	1.230	0.0	2861.9	4760
8640 min Winter	1.069	0.0	2948.0	5704
10080 min Winter	0.954	0.0	3032.3	6056

Cascade Rainfall Details for D - Basin D-2 Calculation.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 451400 210550 SP 51400 10550
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.950
Cv (Winter)	0.950
Shortest Storm (mins)	60
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.637

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.410	4	8	0.409	8	12	0.409	12	16	0.409

Cascade Model Details for D - Basin D-2 Calculation.SRCX

Storage is Online Cover Level (m) 68.000

Tank or Pond Structure

Invert Level (m) 65.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	242.0	2.500	928.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0124-1000-2500-1000
Design Head (m)	2.500
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	124
Invert Level (m)	65.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.500	10.0
Flush-Flo™	0.539	8.6
Kick-Flo®	1.107	6.8
Mean Flow over Head Range	-	8.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.4	1.200	7.1	3.000	10.9	7.000	16.3
0.200	7.4	1.400	7.6	3.500	11.7	7.500	16.9
0.300	8.1	1.600	8.1	4.000	12.5	8.000	17.4
0.400	8.5	1.800	8.6	4.500	13.2	8.500	17.9
0.500	8.6	2.000	9.0	5.000	13.9	9.000	18.4
0.600	8.6	2.200	9.4	5.500	14.5	9.500	18.9
0.800	8.3	2.400	9.8	6.000	15.2		
1.000	7.6	2.600	10.2	6.500	15.7		

Cascade Summary of Results for D - Basin D-3 Calculation.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	D - Basin D-2 Calculation.SRCX	(None)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Summer	66.474	0.524	0.8	955.9	O K
120 min Summer	66.573	0.623	0.8	1151.2	O K
180 min Summer	66.633	0.683	0.8	1272.4	O K
240 min Summer	66.675	0.725	0.8	1359.0	O K
360 min Summer	66.732	0.782	0.9	1477.6	Flood Risk
480 min Summer	66.768	0.818	0.9	1553.3	Flood Risk
600 min Summer	66.793	0.843	0.9	1606.4	Flood Risk
720 min Summer	66.812	0.862	0.9	1646.2	Flood Risk
960 min Summer	66.837	0.887	0.9	1701.0	Flood Risk
1440 min Summer	66.867	0.917	0.9	1765.7	Flood Risk
2160 min Summer	66.891	0.941	1.0	1817.0	Flood Risk
2880 min Summer	66.906	0.956	1.0	1849.6	Flood Risk
4320 min Summer	66.927	0.977	1.0	1895.3	Flood Risk
5760 min Summer	66.942	0.992	1.0	1928.1	Flood Risk
7200 min Summer	66.956	1.006	1.0	1958.9	Flood Risk
8640 min Summer	66.969	1.019	1.0	1987.6	Flood Risk
10080 min Summer	66.981	1.031	1.0	2015.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Summer	61.740	0.0	123.0	76
120 min Summer	37.240	0.0	132.5	136
180 min Summer	27.483	0.0	137.7	196
240 min Summer	22.050	0.0	140.9	256
360 min Summer	16.030	0.0	144.8	376
480 min Summer	12.675	0.0	146.6	496
600 min Summer	10.517	0.0	147.4	614
720 min Summer	9.007	0.0	147.6	734
960 min Summer	7.019	0.0	147.0	974
1440 min Summer	4.912	0.0	143.9	1454
2160 min Summer	3.425	0.0	297.3	2172
2880 min Summer	2.657	0.0	292.1	2892
4320 min Summer	1.872	0.0	279.3	4332
5760 min Summer	1.471	0.0	589.0	5768
7200 min Summer	1.230	0.0	580.1	7208
8640 min Summer	1.069	0.0	569.3	8648
10080 min Summer	0.954	0.0	556.7	10080

Cascade Summary of Results for D - Basin D-3 Calculation.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	66.474	0.524	0.8	955.8	O K
120 min Winter	66.573	0.623	0.8	1151.2	O K
180 min Winter	66.633	0.683	0.8	1272.5	O K
240 min Winter	66.675	0.725	0.8	1359.2	O K
360 min Winter	66.732	0.782	0.9	1477.9	Flood Risk
480 min Winter	66.768	0.818	0.9	1553.7	Flood Risk
600 min Winter	66.793	0.843	0.9	1607.0	Flood Risk
720 min Winter	66.812	0.862	0.9	1646.9	Flood Risk
960 min Winter	66.838	0.888	0.9	1701.9	Flood Risk
1440 min Winter	66.868	0.918	0.9	1767.1	Flood Risk
2160 min Winter	66.892	0.942	1.0	1819.3	Flood Risk
2880 min Winter	66.907	0.957	1.0	1852.7	Flood Risk
4320 min Winter	66.929	0.979	1.0	1900.4	Flood Risk
5760 min Winter	66.945	0.995	1.0	1935.4	Flood Risk
7200 min Winter	66.960	1.010	1.0	1968.7	Flood Risk
8640 min Winter	66.974	1.024	1.0	2000.0	Flood Risk
10080 min Winter	66.988	1.038	1.0	2031.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	61.740	0.0	123.0	76
120 min Winter	37.240	0.0	132.5	134
180 min Winter	27.483	0.0	137.6	194
240 min Winter	22.050	0.0	140.8	254
360 min Winter	16.030	0.0	144.6	372
480 min Winter	12.675	0.0	146.3	490
600 min Winter	10.517	0.0	147.0	610
720 min Winter	9.007	0.0	147.2	728
960 min Winter	7.019	0.0	146.4	966
1440 min Winter	4.912	0.0	143.0	1440
2160 min Winter	3.425	0.0	295.9	2148
2880 min Winter	2.657	0.0	290.3	2860
4320 min Winter	1.872	0.0	276.4	4276
5760 min Winter	1.471	0.0	585.4	5656
7200 min Winter	1.230	0.0	575.5	7064
8640 min Winter	1.069	0.0	563.7	8400
10080 min Winter	0.954	0.0	550.2	9784

Cascade Rainfall Details for D - Basin D-3 Calculation.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 451400 210550 SP 51400 10550
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.950
Cv (Winter)	0.950
Shortest Storm (mins)	60
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.634

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.409	4	8	0.409	8	12	0.408	12	16	0.408

Cascade Model Details for D - Basin D-3 Calculation.SRCX

Storage is Online Cover Level (m) 67.000

Tank or Pond Structure

Invert Level (m) 65.950

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1693.0	1.050	2239.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0046-1000-1050-1000
Design Head (m)	1.050
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	46
Invert Level (m)	65.950
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.050	1.0
Flush-Flo™	0.205	0.8
Kick-Flo®	0.412	0.7
Mean Flow over Head Range	-	0.8

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	0.7	1.200	1.1	3.000	1.6	7.000	2.4
0.200	0.8	1.400	1.1	3.500	1.7	7.500	2.4
0.300	0.8	1.600	1.2	4.000	1.8	8.000	2.5
0.400	0.7	1.800	1.3	4.500	1.9	8.500	2.6
0.500	0.7	2.000	1.3	5.000	2.0	9.000	2.7
0.600	0.8	2.200	1.4	5.500	2.1	9.500	2.7
0.800	0.9	2.400	1.4	6.000	2.2		
1.000	1.0	2.600	1.5	6.500	2.3		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Summer	68.076	0.576	3.3	388.8	O K
120 min Summer	68.171	0.671	3.3	463.1	O K
180 min Summer	68.224	0.724	3.3	505.7	Flood Risk
240 min Summer	68.258	0.758	3.3	533.8	Flood Risk
360 min Summer	68.298	0.798	3.3	567.0	Flood Risk
480 min Summer	68.316	0.816	3.3	582.4	Flood Risk
600 min Summer	68.324	0.824	3.3	588.5	Flood Risk
720 min Summer	68.325	0.825	3.3	589.2	Flood Risk
960 min Summer	68.315	0.815	3.3	581.0	Flood Risk
1440 min Summer	68.276	0.776	3.3	548.5	Flood Risk
2160 min Summer	68.218	0.718	3.3	500.6	Flood Risk
2880 min Summer	68.170	0.670	3.3	461.8	O K
4320 min Summer	68.084	0.584	3.3	394.5	O K
5760 min Summer	68.013	0.513	3.3	341.5	O K
7200 min Summer	67.957	0.457	3.3	300.0	O K
8640 min Summer	67.909	0.409	3.3	265.7	O K
10080 min Summer	67.869	0.369	3.3	237.1	O K
60 min Winter	68.076	0.576	3.3	388.9	O K
120 min Winter	68.171	0.671	3.3	463.2	O K
180 min Winter	68.225	0.725	3.3	506.0	Flood Risk
240 min Winter	68.259	0.759	3.3	534.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Summer	61.740	0.0	388.7	74
120 min Summer	37.240	0.0	463.0	134
180 min Summer	27.483	0.0	500.4	194
240 min Summer	22.050	0.0	513.1	252
360 min Summer	16.030	0.0	510.3	370
480 min Summer	12.675	0.0	504.4	490
600 min Summer	10.517	0.0	498.6	608
720 min Summer	9.007	0.0	493.0	726
960 min Summer	7.019	0.0	482.3	964
1440 min Summer	4.912	0.0	461.2	1408
2160 min Summer	3.425	0.0	787.9	1724
2880 min Summer	2.657	0.0	812.1	2104
4320 min Summer	1.872	0.0	845.8	2864
5760 min Summer	1.471	0.0	910.6	3640
7200 min Summer	1.230	0.0	951.5	4400
8640 min Summer	1.069	0.0	991.2	5184
10080 min Summer	0.954	0.0	1029.5	5864
60 min Winter	61.740	0.0	388.7	74
120 min Winter	37.240	0.0	463.0	132
180 min Winter	27.483	0.0	500.4	190
240 min Winter	22.050	0.0	513.3	248

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	68.299	0.799	3.3	567.9	Flood Risk
480 min Winter	68.318	0.818	3.3	583.6	Flood Risk
600 min Winter	68.325	0.825	3.3	590.0	Flood Risk
720 min Winter	68.327	0.827	3.3	591.0	Flood Risk
960 min Winter	68.318	0.818	3.3	583.4	Flood Risk
1440 min Winter	68.281	0.781	3.3	552.5	Flood Risk
2160 min Winter	68.213	0.713	3.3	496.5	Flood Risk
2880 min Winter	68.155	0.655	3.3	449.8	O K
4320 min Winter	68.036	0.536	3.3	358.1	O K
5760 min Winter	67.937	0.437	3.3	285.5	O K
7200 min Winter	67.857	0.357	3.3	228.8	O K
8640 min Winter	67.792	0.292	3.3	184.3	O K
10080 min Winter	67.741	0.241	3.3	150.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	16.030	0.0	510.5	364
480 min Winter	12.675	0.0	504.5	480
600 min Winter	10.517	0.0	498.7	596
720 min Winter	9.007	0.0	493.1	712
960 min Winter	7.019	0.0	482.7	940
1440 min Winter	4.912	0.0	462.6	1380
2160 min Winter	3.425	0.0	788.1	1772
2880 min Winter	2.657	0.0	812.8	2204
4320 min Winter	1.872	0.0	851.4	3036
5760 min Winter	1.471	0.0	910.6	3816
7200 min Winter	1.230	0.0	951.6	4552
8640 min Winter	1.069	0.0	991.4	5280
10080 min Winter	0.954	0.0	1029.9	5960

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 451400 210550 SP 51400 10550
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.950
Cv (Winter)	0.950
Shortest Storm (mins)	60
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.680

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.170	4	8	0.170	8	12	0.170	12	16	0.170

Model Details

Storage is Online Cover Level (m) 68.500

Tank or Pond Structure

Invert Level (m) 67.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	588.0	1.000	911.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0086-3300-1000-3300
Design Head (m)	1.000
Design Flow (l/s)	3.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	86
Invert Level (m)	67.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.3
Flush-Flo™	0.296	3.3
Kick-Flo®	0.624	2.7
Mean Flow over Head Range	-	2.9

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	2.6	1.200	3.6	3.000	5.5	7.000	8.2
0.200	3.2	1.400	3.9	3.500	5.9	7.500	8.5
0.300	3.3	1.600	4.1	4.000	6.3	8.000	8.7
0.400	3.2	1.800	4.3	4.500	6.6	8.500	9.0
0.500	3.1	2.000	4.5	5.000	7.0	9.000	9.2
0.600	2.8	2.200	4.8	5.500	7.3	9.500	9.5
0.800	3.0	2.400	4.9	6.000	7.6		
1.000	3.3	2.600	5.1	6.500	7.9		

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