A1
ORIGINAL
PLOT SIZE

INDICATIVE

NOTES:

KEY:

FOOD STORE IMPERMEABLE AREAS

SITE BOUNDARY

TOTAL SITE AREA= 23495m²

SURFACE WATER RUNOFF ARROWS

Rev	Date	Details	Drawn by	Checked by	Approved by
-	-	-	-	-	-

Bristol
Cambridge
Cardiff
Welwyn Garden City

tpa Transport Planning Associates

Mercury House
Broadwater Road
Welwyn Garden City
AL7 3BQ
01707 385 200
www.tpa.uk.com

CLIENT:
COTSWOLD BMW GROUP

PROJECT:
GROVEFIELD WAY
CHELTENHAM

TITLE:
FLOOD FLOW
DIRECTION ARROWS

STATUS:
INFORMATION

SCALE:	DATE:	DRAWN:	CHECKED:	APPROVED:
1:500	26.06.13	AJH	PCP	JC

JOB NO:	DRAWING NO:	REVISION:
1303-30	Appendix A.5	

APPENDIX B

SEVERN TRENT WATER ASSET LOCATION SEARCHES

SEVERN TRENT WATER Ltd
Asset Data Management
GIS Mapping Team
PO Box 5344
Coventry
CV3 9FT
Tel 0845 601 6616
Fax 02477 715862
Contact A Halford
Our Ref 68886
21 May 2013

Apparatus Location Enquiry

Further to your enquiry re: Grovefield Way Cheltenham Gloucestershire

Enclosed is a copy of the plans showing the approximate positions of public sewers situated within the vicinity of the land/property which is the subject of your enquiry.

Asset Data Management can only provide plans of the location of the Company's underground assets. Therefore service pipes and drains are the responsibility of the property owner and should be anticipated during any excavation.
However, we wish to inform you that although most private lateral drains and sewers were transferred to Severn Trent Water's ownership on 1st October 2011, the Company does not possess complete records of these assets and therefore they may not be shown on these maps.

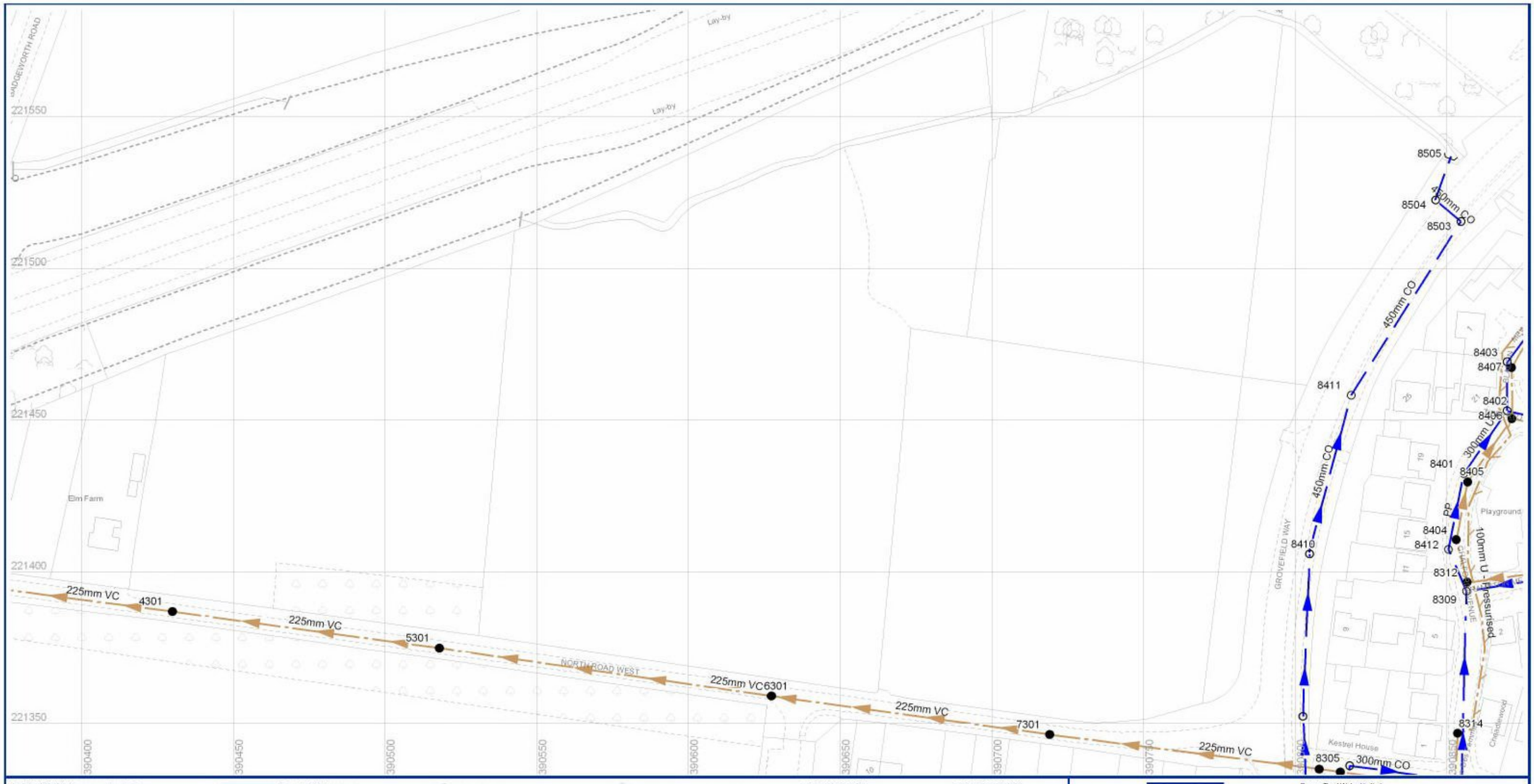
You may have to contact our Asset Protection Team at Regis Road Tettenhall with regard to records of flooding if any. (Tel 0116 234 3834).

Please also find enclosed a copy of Severn Trent Water's General Conditions and Precautions for your information.

Please forward VAT receipt to your finance department.

Kind Regards

GISmapping Team



- Abandoned Gravity Sewer
- Private Combined Gravity Sewer
- Private Foul Gravity Sewer
- Private Surface Water Gravity Sewer
- Public Combined Gravity Sewer
- Public Foul Gravity Sewer
- Public Surface Water Gravity Sewer
- Trunk Combined Gravity Sewer
- Trunk Foul Use Gravity Sewer
- Trunk Surface Water Gravity Sewer
- Combined Use Pressurised Sewer
- Foul Use Pressurised Sewer
- Surface Water Pressurised Sewer
- Highway Drain
- Combined Lateral Drain (SS)
- Foul Lateral Drain (SS)
- Surface Water Lateral Drain (SS)

All Private Sewers are shown in magenta
All section 104 sewers are shown in green
All Sewers that have been transferred to Severn Trent Water after the 1st October 2011, but have not been surveyed and confirmed by Severn Trent Water are shown in orange

- Culverted Watercourse
- Cable, Earthing
- Cable Junction
- Cable, Optical Fibre/Instrumentation
- Cable, Low Voltage
- Cable, High Voltage
- Cable, Other
- Housing, Building
- Housing, Kiosk
- Disposal Site
- Sewage Treatment Works
- Housing, Other
- Pipe Support Structure
- Sewage Pumping Facility
- Sewer Facility Connection Inlet / Outlet

- Blind Shaft
- Combined Use Manhole
- Flushing Chamber
- Foul Use Manhole
- Grease Trap
- Head Node
- Hydrobrake
- Lamphole
- Outfall
- Overflow
- Penstock
- Petrol Interceptor

- Sewer Chemical Injection Point
- Sewer Junction
- Sewerage Air Valve
- Sewerage Hatch Box Point
- Sewerage Isolation Valve
- Soakaway
- Surface Water Manhole
- Vent Column
- Waste Water Storage
- Pre-1937 Properties

MATERIALS

-	- NONE
AC	- ASBESTOS CEMENT
BR	- BRICK
CC	- CONCRETE BOX CULVERT
CI	- CAST IRON
CO	- CONCRETE
CSB	- CONCRETE SEGMENTS (BOLTED)
CSU	- CONCRETE SEGMENTS (UNBOLTED)
DI	- DUCTILE IRON
GRC	- GLASS REINFORCED CONCRETE
GRP	- GLASS REINFORCED PLASTIC
MAC	- MASONRY IN REGULAR COURSES
MAR	- MASONRY RANDOMLY COURSED
PE	- POLYETHLENE
PF	- PITCH
PP	- POLYPROPYLENE
PSC	- PLASTIC STEEL COMPOSITE
PVC	- POLYVINYL CHLORIDE
RPM	- REINFORCED PLASTIC MATRIX
SI	- SPUN (GREY) IRON
ST	- STEEL
U	- UNKNOWN
VC	- VITRIFIED CLAY
XXX	- OTHER

CATEGORIES

W	- WEIR
C	- CASCADE
DB	- DAMBOARD
SE	- SIDE ENTRY
FV	- FLAP VALVE
BD	- BACK DROP
S	- SIPHON
HD	- HIGHWAY DRAIN
S104	- SECTION 104

SHAPE

C	- CIRCULAR
E	- EGG SHAPED
O	- OTHER
R	- RECTANGLE
S	- SQUARE
T	- TRAPEZOIDAL
U	- UNKNOWN

PURPOSE

C	- COMBINED
E	- FINAL EFFLUENT
F	- FOUL
L	- SLUDGE
S	- SURFACE WATER

N W E S

SEVERN TRENT WATER

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0845 601 8616

SEWER RECORD

O/S Map scale: 1:1250

Date of issue: 21.05.13

This map is centred upon:
O / S Grid reference:

x : 390626

y : 221459

APPENDIX C

WINDES QBAR ANALYSIS & STORAGE ESTIMATES

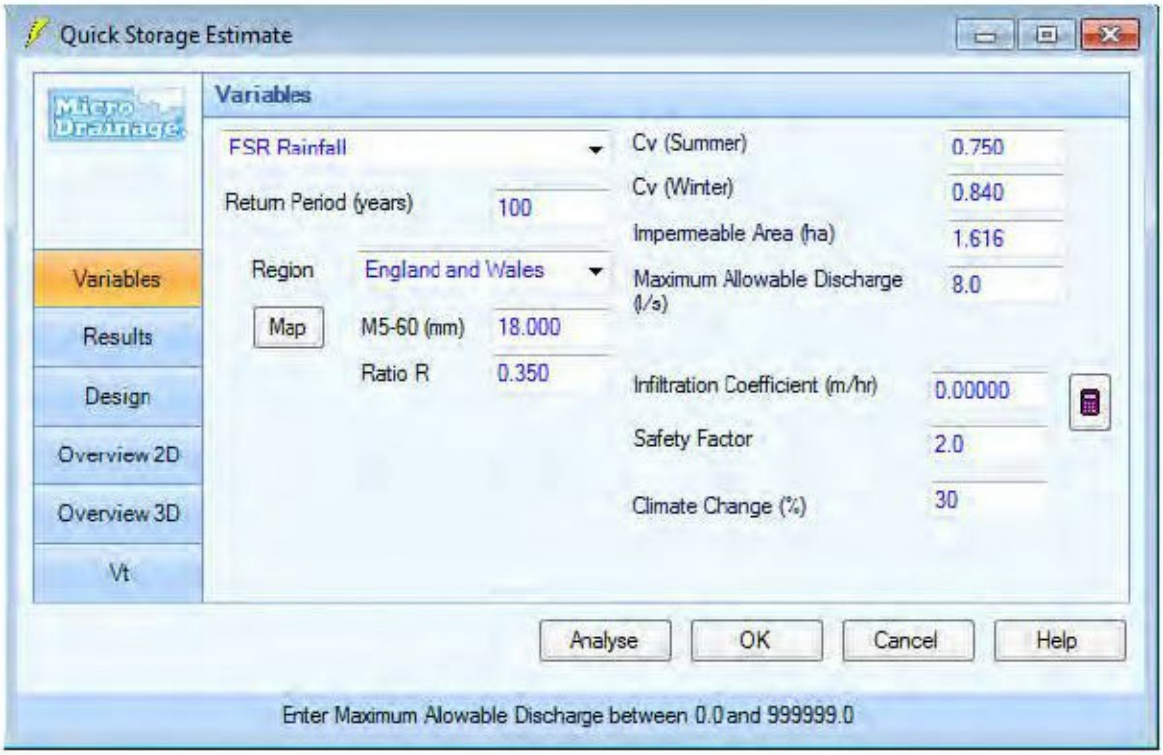
ICP SUDS Mean Annual Flood

Input

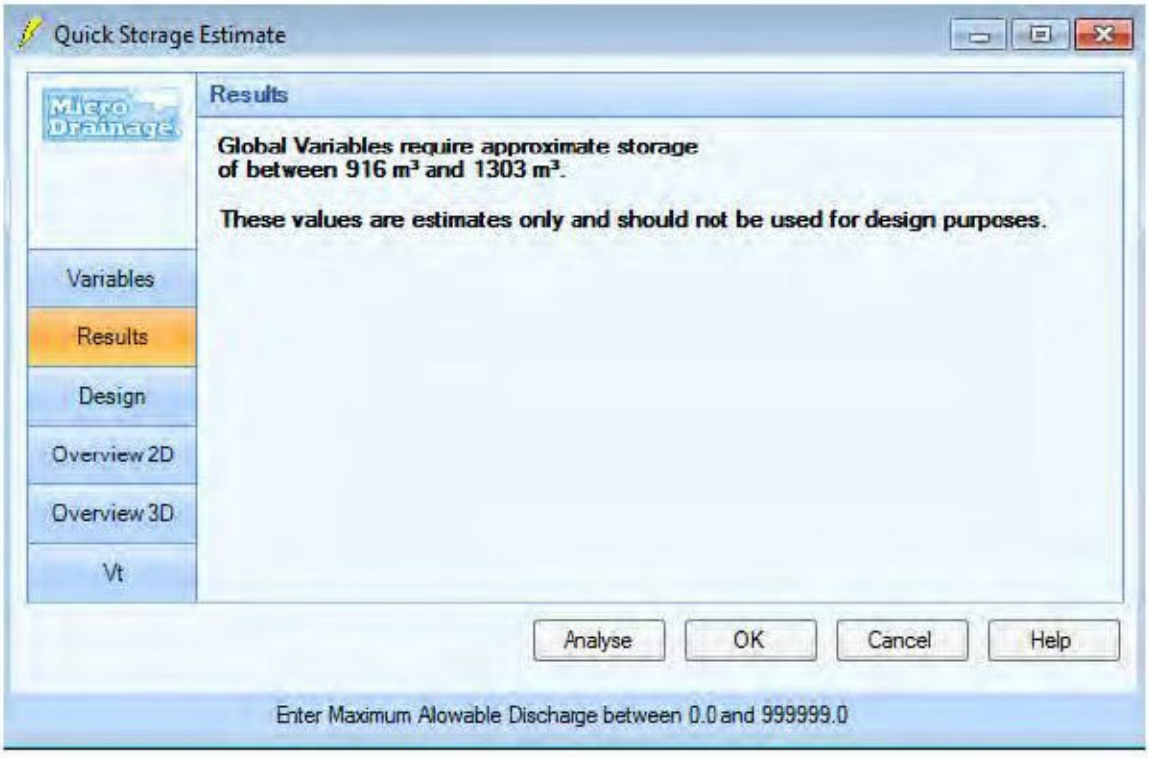
Return Period (years)	2	Soil	0.400
Area (ha)	2.350	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results 1/s

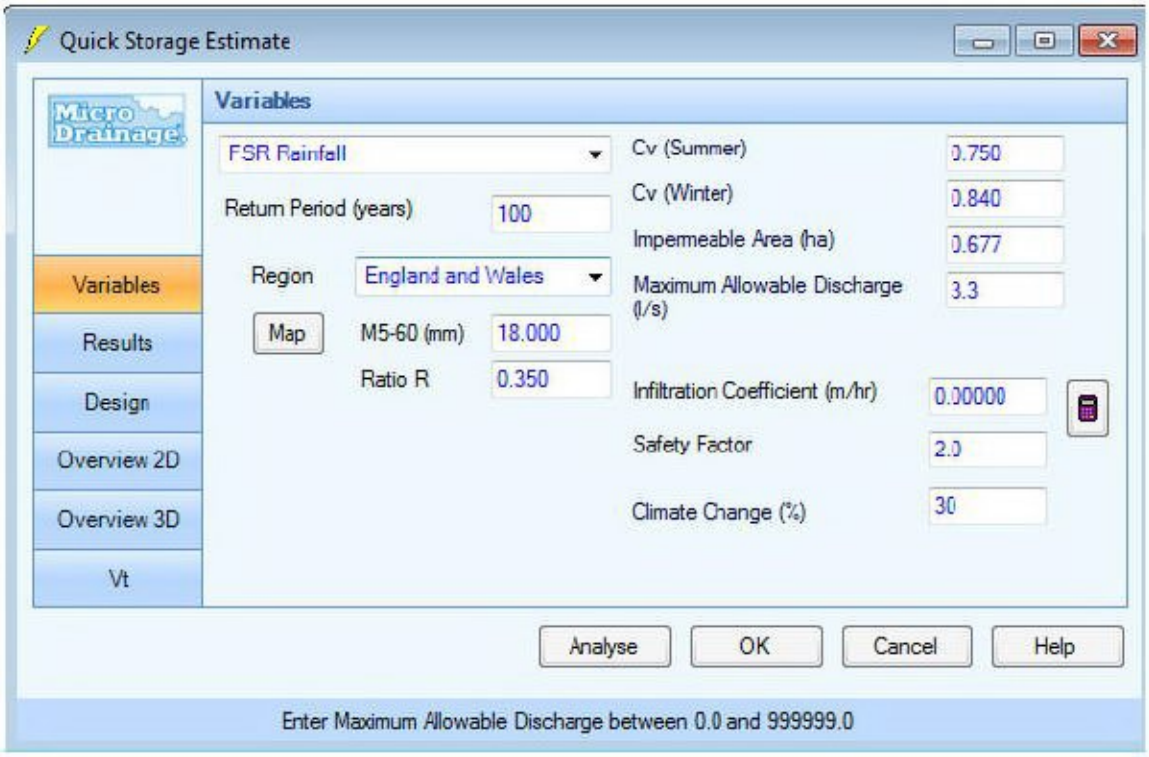
QBAR Rural	8.0
QBAR Urban	8.0
Q2 years	7.0
Q1 year	6.8
Q30 years	18.1
Q100 years	25.5



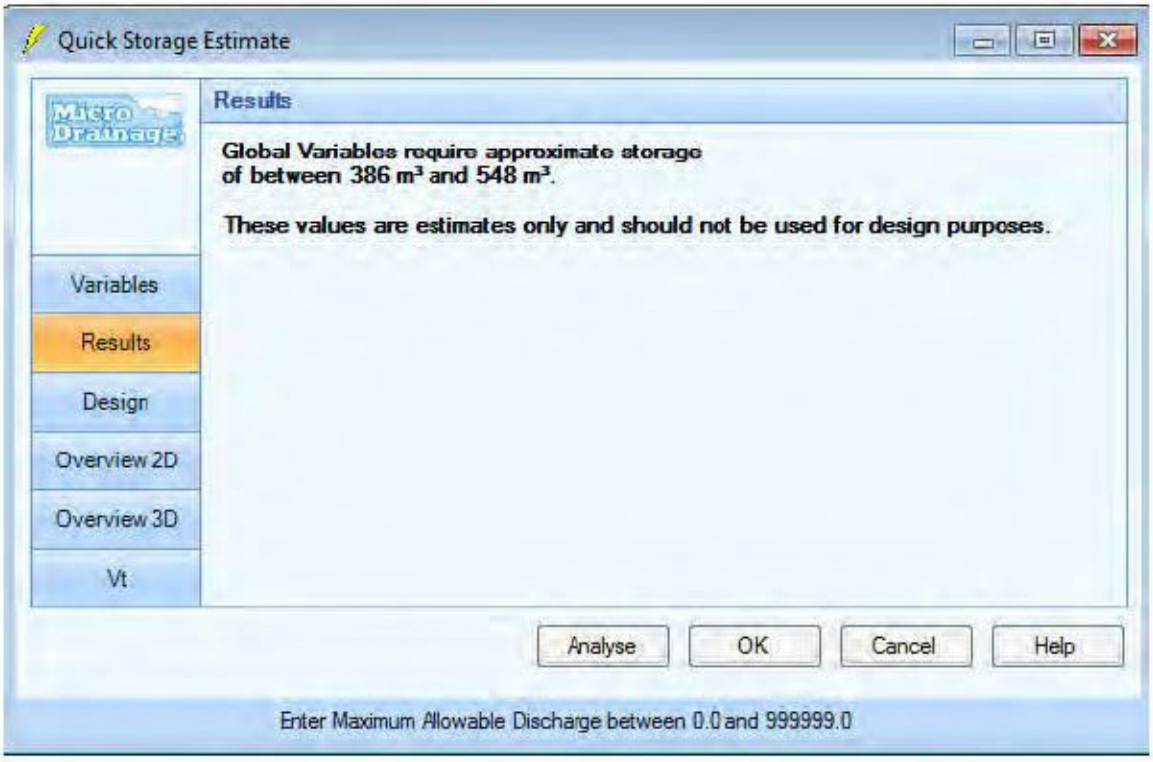
C.2a - Variables for calculating proposed attenuation requirements.



C.2b - Attenuation requirements for the site overall site.



C.3a - Variables for calculating proposed attenuation requirements of western car parking court.



C.3b - Attenuation requirements for western parking court.

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

Half Drain Time : 1145 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	31.969	0.069	0.0	1.6	1.6	110.5	O K
30 min Summer	31.998	0.098	0.0	2.4	2.4	156.6	O K
60 min Summer	32.029	0.129	0.0	2.9	2.9	206.4	O K
120 min Summer	32.061	0.161	0.0	3.1	3.1	257.8	O K
180 min Summer	32.079	0.179	0.0	3.2	3.2	286.8	O K
240 min Summer	32.091	0.191	0.0	3.2	3.2	305.6	O K
360 min Summer	32.105	0.205	0.0	3.2	3.2	327.9	O K
480 min Summer	32.114	0.214	0.0	3.2	3.2	342.0	O K
600 min Summer	32.119	0.219	0.0	3.2	3.2	350.5	O K
720 min Summer	32.122	0.222	0.0	3.2	3.2	355.5	O K
960 min Summer	32.125	0.225	0.0	3.2	3.2	359.9	O K
1440 min Summer	32.127	0.227	0.0	3.2	3.2	363.1	O K
2160 min Summer	32.125	0.225	0.0	3.2	3.2	359.3	O K
2880 min Summer	32.119	0.219	0.0	3.2	3.2	349.6	O K
4320 min Summer	32.102	0.202	0.0	3.2	3.2	323.4	O K
5760 min Summer	32.085	0.185	0.0	3.2	3.2	295.2	O K
7200 min Summer	32.068	0.168	0.0	3.2	3.2	268.8	O K
8640 min Summer	32.054	0.154	0.0	3.1	3.1	245.7	O K
10080 min Summer	32.042	0.142	0.0	3.1	3.1	226.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	109.059	0.0	69.3	27
30 min Summer	73.366	0.0	106.0	41
60 min Summer	47.182	0.0	181.8	70
120 min Summer	29.362	0.0	234.8	130
180 min Summer	21.949	0.0	266.4	188
240 min Summer	17.740	0.0	288.3	248
360 min Summer	13.035	0.0	317.9	366
480 min Summer	10.480	0.0	339.2	484
600 min Summer	8.842	0.0	355.1	602
720 min Summer	7.691	0.0	367.3	720
960 min Summer	6.166	0.0	383.7	844
1440 min Summer	4.508	0.0	394.9	1090
2160 min Summer	3.288	0.0	523.0	1488
2880 min Summer	2.626	0.0	548.1	1900
4320 min Summer	1.908	0.0	572.2	2688
5760 min Summer	1.520	0.0	640.2	3464
7200 min Summer	1.273	0.0	656.7	4248
8640 min Summer	1.101	0.0	666.0	4936
10080 min Summer	0.974	0.0	669.0	5656

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	31.979	0.079	0.0	1.9	1.9	126.9	O K
30 min Winter	32.012	0.112	0.0	2.7	2.7	178.6	O K
60 min Winter	32.047	0.147	0.0	3.1	3.1	234.7	O K
120 min Winter	32.083	0.183	0.0	3.2	3.2	293.2	O K
180 min Winter	32.104	0.204	0.0	3.2	3.2	326.4	O K
240 min Winter	32.118	0.218	0.0	3.2	3.2	348.2	O K
360 min Winter	32.134	0.234	0.0	3.2	3.2	374.7	O K
480 min Winter	32.145	0.245	0.0	3.2	3.2	392.0	O K
600 min Winter	32.152	0.252	0.0	3.2	3.2	403.2	O K
720 min Winter	32.157	0.257	0.0	3.2	3.2	410.4	O K
960 min Winter	32.161	0.261	0.0	3.2	3.2	417.2	O K
1440 min Winter	32.160	0.260	0.0	3.2	3.2	414.8	O K
2160 min Winter	32.153	0.253	0.0	3.2	3.2	404.9	O K
2880 min Winter	32.142	0.242	0.0	3.2	3.2	386.8	O K
4320 min Winter	32.114	0.214	0.0	3.2	3.2	342.1	O K
5760 min Winter	32.086	0.186	0.0	3.2	3.2	297.5	O K
7200 min Winter	32.062	0.162	0.0	3.1	3.1	258.9	O K
8640 min Winter	32.042	0.142	0.0	3.1	3.1	227.7	O K
10080 min Winter	32.028	0.128	0.0	2.9	2.9	204.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	109.059	0.0	82.1	26
30 min Winter	73.366	0.0	123.3	41
60 min Winter	47.182	0.0	208.4	70
120 min Winter	29.362	0.0	267.2	126
180 min Winter	21.949	0.0	302.1	184
240 min Winter	17.740	0.0	326.1	242
360 min Winter	13.035	0.0	357.9	358
480 min Winter	10.480	0.0	380.5	474
600 min Winter	8.842	0.0	396.7	588
720 min Winter	7.691	0.0	408.6	700
960 min Winter	6.166	0.0	422.8	920
1440 min Winter	4.508	0.0	425.4	1186
2160 min Winter	3.288	0.0	591.4	1624
2880 min Winter	2.626	0.0	619.9	2076
4320 min Winter	1.908	0.0	647.2	2936
5760 min Winter	1.520	0.0	729.5	3696
7200 min Winter	1.273	0.0	750.4	4464
8640 min Winter	1.101	0.0	763.5	5184
10080 min Winter	0.974	0.0	769.6	5856

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.677

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.226	4	8	0.226	8	12	0.226

Model Details

Storage is Online Cover Level (m) 32.500

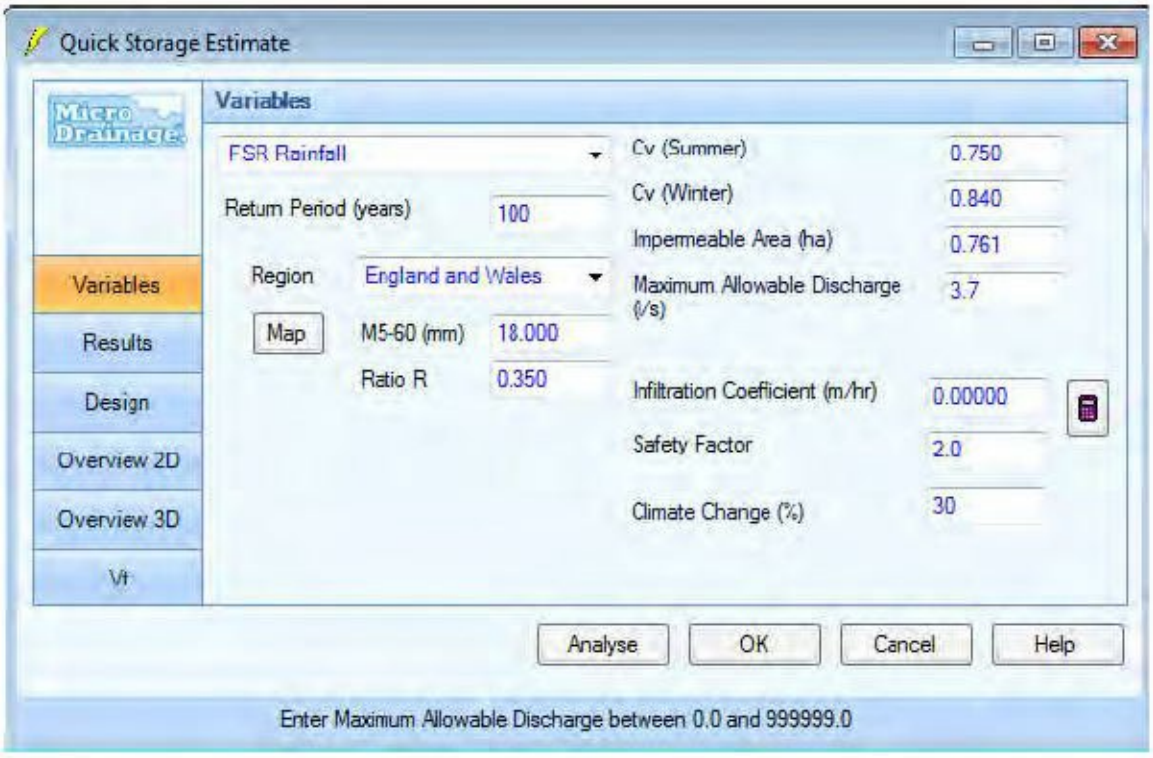
Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	72.0
Membrane Percolation (mm/hr)	1000	Length (m)	74.0
Max Percolation (l/s)	1480.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	31.900	Cap Volume Depth (m)	0.000

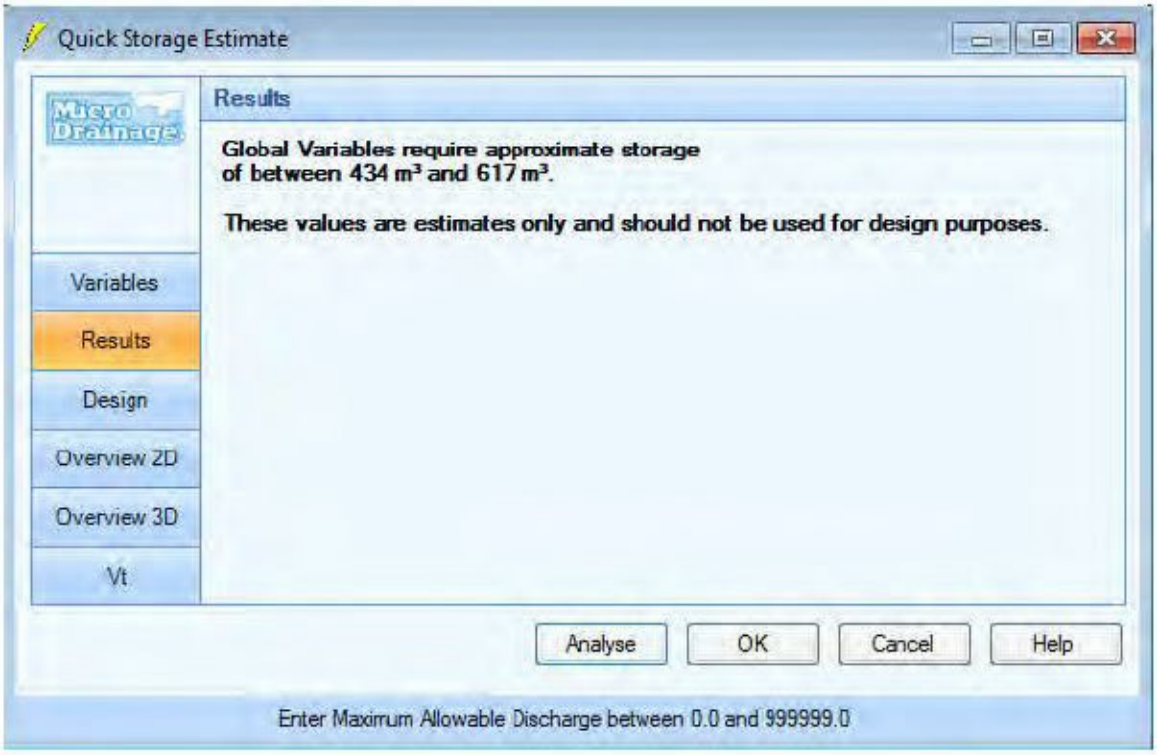
Hydro-Brake® Outflow Control

Design Head (m) 0.600 Hydro-Brake® Type Md6 SW Only Invert Level (m) 31.900
Design Flow (l/s) 3.3 Diameter (mm) 85

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	4.5	3.000	7.1	7.000	10.9
0.200	3.2	1.400	4.9	3.500	7.7	7.500	11.3
0.300	3.0	1.600	5.2	4.000	8.2	8.000	11.7
0.400	2.9	1.800	5.5	4.500	8.7	8.500	12.0
0.500	3.0	2.000	5.8	5.000	9.2	9.000	12.4
0.600	3.2	2.200	6.1	5.500	9.7	9.500	12.7
0.800	3.7	2.400	6.4	6.000	10.1		
1.000	4.1	2.600	6.6	6.500	10.5		



C.4a - Variables for calculating proposed attenuation requirements for roof areas.



C.4b - Attenuation requirements for roof areas.

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

Half Drain Time : 1145 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	32.062	0.162	0.0	5.7	5.7	262.5	O K
30 min Summer	32.123	0.223	0.0	6.3	6.3	360.1	O K
60 min Summer	32.188	0.288	0.0	6.4	6.4	466.0	O K
120 min Summer	32.256	0.356	0.0	6.4	6.4	575.7	Flood Risk
180 min Summer	32.294	0.394	0.0	6.4	6.4	637.4	Flood Risk
240 min Summer	32.319	0.419	0.0	6.4	6.4	677.0	Flood Risk
360 min Summer	32.348	0.448	0.0	6.4	6.4	723.6	Flood Risk
480 min Summer	32.366	0.466	0.0	6.5	6.5	752.1	Flood Risk
600 min Summer	32.376	0.476	0.0	6.5	6.5	768.8	Flood Risk
720 min Summer	32.381	0.481	0.0	6.5	6.5	777.7	Flood Risk
960 min Summer	32.384	0.484	0.0	6.5	6.5	782.1	Flood Risk
1440 min Summer	32.382	0.482	0.0	6.5	6.5	779.1	Flood Risk
2160 min Summer	32.370	0.470	0.0	6.5	6.5	759.5	Flood Risk
2880 min Summer	32.352	0.452	0.0	6.4	6.4	730.3	Flood Risk
4320 min Summer	32.310	0.410	0.0	6.4	6.4	661.7	Flood Risk
5760 min Summer	32.266	0.366	0.0	6.4	6.4	591.1	Flood Risk
7200 min Summer	32.224	0.324	0.0	6.4	6.4	524.1	Flood Risk
8640 min Summer	32.187	0.287	0.0	6.4	6.4	464.3	O K
10080 min Summer	32.156	0.256	0.0	6.4	6.4	413.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	109.059	0.0	219.3	26
30 min Summer	73.366	0.0	306.3	41
60 min Summer	47.182	0.0	455.7	70
120 min Summer	29.362	0.0	572.9	130
180 min Summer	21.949	0.0	643.4	188
240 min Summer	17.740	0.0	692.6	248
360 min Summer	13.035	0.0	759.3	366
480 min Summer	10.480	0.0	807.7	484
600 min Summer	8.842	0.0	843.5	602
720 min Summer	7.691	0.0	870.4	722
960 min Summer	6.166	0.0	903.6	882
1440 min Summer	4.508	0.0	907.4	1118
2160 min Summer	3.288	0.0	1203.5	1512
2880 min Summer	2.626	0.0	1271.2	1928
4320 min Summer	1.908	0.0	1353.0	2728
5760 min Summer	1.520	0.0	1476.4	3520
7200 min Summer	1.273	0.0	1532.3	4264
8640 min Summer	1.101	0.0	1574.6	5016
10080 min Summer	0.974	0.0	1605.1	5744

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	32.084	0.184	0.0	6.0	6.0	297.4	O K
30 min Winter	32.152	0.252	0.0	6.4	6.4	407.3	O K
60 min Winter	32.226	0.326	0.0	6.4	6.4	526.6	Flood Risk
120 min Winter	32.303	0.403	0.0	6.4	6.4	650.9	Flood Risk
180 min Winter	32.346	0.446	0.0	6.4	6.4	721.1	Flood Risk
240 min Winter	32.374	0.474	0.0	6.5	6.5	766.6	Flood Risk
360 min Winter	32.408	0.508	0.0	6.6	6.6	821.1	Flood Risk
480 min Winter	32.429	0.529	0.0	6.7	6.7	855.4	Flood Risk
600 min Winter	32.443	0.543	0.0	6.7	6.7	876.6	Flood Risk
720 min Winter	32.450	0.550	0.0	6.8	6.8	889.4	Flood Risk
960 min Winter	32.456	0.556	0.0	6.8	6.8	898.9	Flood Risk
1440 min Winter	32.449	0.549	0.0	6.7	6.7	886.3	Flood Risk
2160 min Winter	32.430	0.530	0.0	6.7	6.7	856.4	Flood Risk
2880 min Winter	32.403	0.503	0.0	6.6	6.6	811.9	Flood Risk
4320 min Winter	32.338	0.438	0.0	6.4	6.4	707.6	Flood Risk
5760 min Winter	32.272	0.372	0.0	6.4	6.4	600.4	Flood Risk
7200 min Winter	32.209	0.309	0.0	6.4	6.4	499.8	Flood Risk
8640 min Winter	32.157	0.257	0.0	6.4	6.4	414.8	O K
10080 min Winter	32.117	0.217	0.0	6.3	6.3	351.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	109.059	0.0	250.2	26
30 min Winter	73.366	0.0	345.4	40
60 min Winter	47.182	0.0	514.1	70
120 min Winter	29.362	0.0	644.0	128
180 min Winter	21.949	0.0	721.4	186
240 min Winter	17.740	0.0	774.9	244
360 min Winter	13.035	0.0	845.9	360
480 min Winter	10.480	0.0	895.6	474
600 min Winter	8.842	0.0	930.0	588
720 min Winter	7.691	0.0	953.2	700
960 min Winter	6.166	0.0	973.6	920
1440 min Winter	4.508	0.0	949.1	1182
2160 min Winter	3.288	0.0	1352.6	1628
2880 min Winter	2.626	0.0	1427.6	2084
4320 min Winter	1.908	0.0	1512.0	2980
5760 min Winter	1.520	0.0	1665.1	3800
7200 min Winter	1.273	0.0	1730.3	4544
8640 min Winter	1.101	0.0	1780.5	5200
10080 min Winter	0.974	0.0	1818.5	5864

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 1.438

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.479	4	8	0.479	8	12	0.479

Model Details

Storage is Online Cover Level (m) 32.500

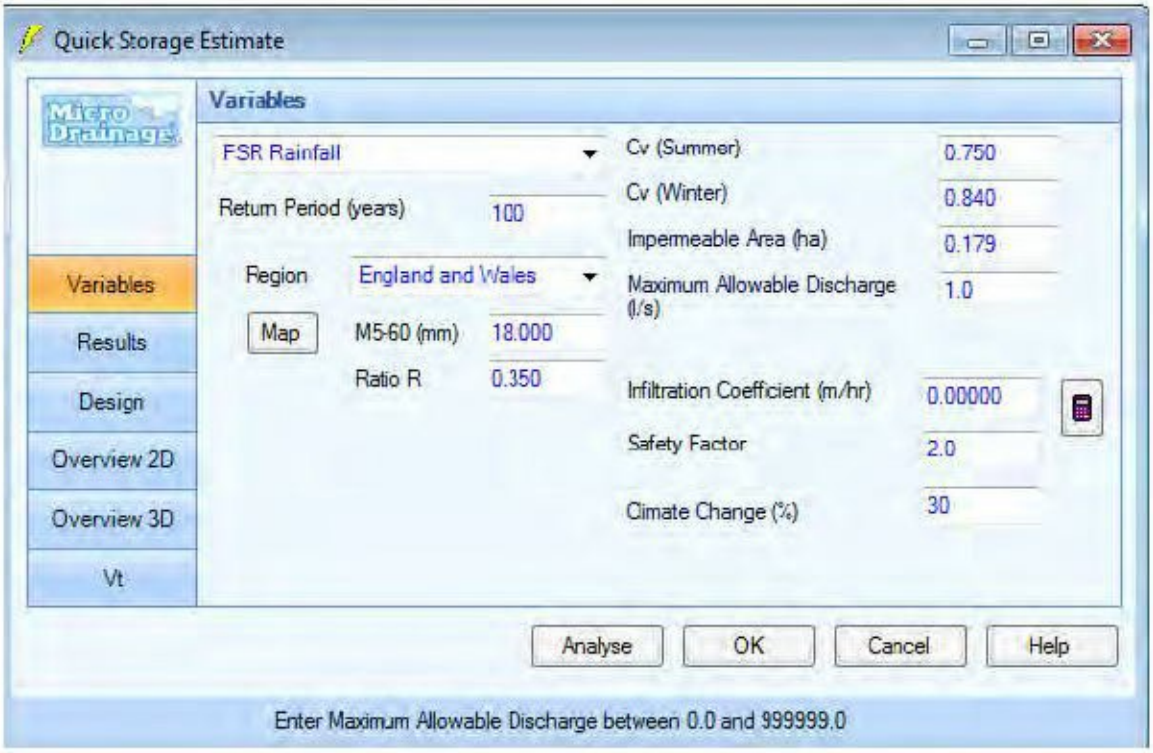
Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	72.0
Membrane Percolation (mm/hr)	1000	Length (m)	74.8
Max Percolation (l/s)	1496.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	31.900	Cap Volume Depth (m)	0.000

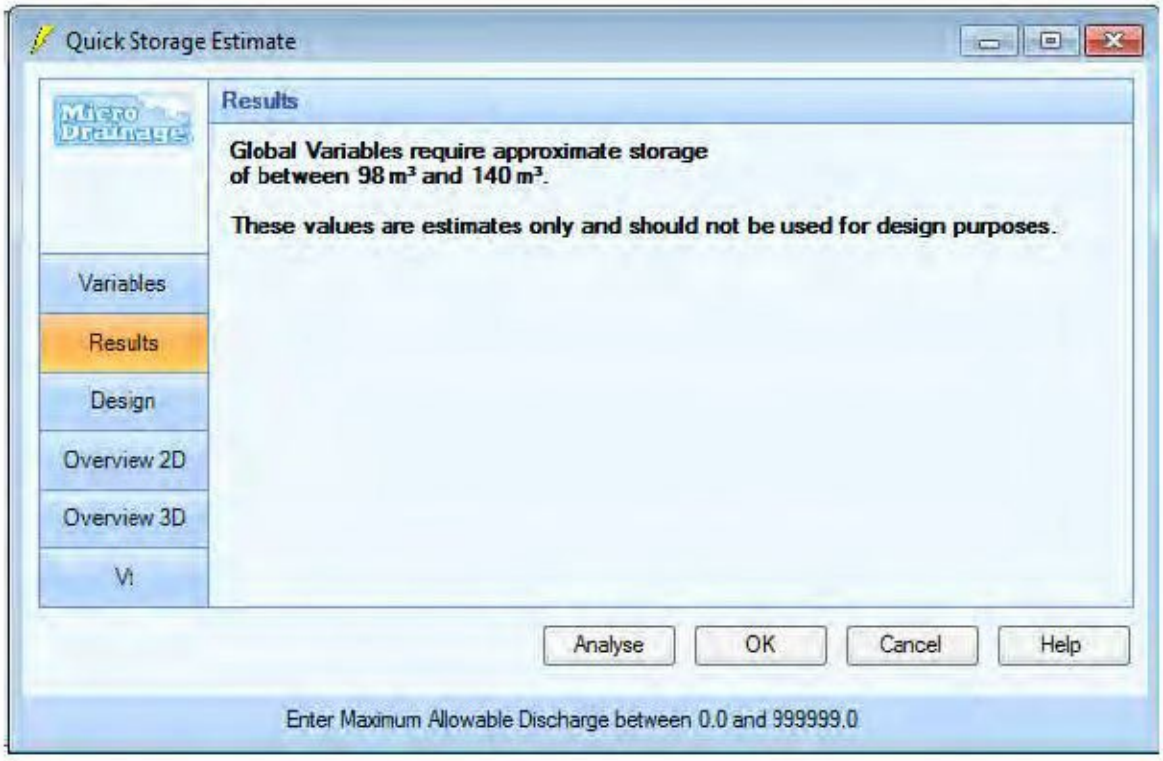
Hydro-Brake® Outflow Control

Design Head (m) 0.600 Hydro-Brake® Type Md5 SW Only Invert Level (m) 31.900
Design Flow (l/s) 7.0 Diameter (mm) 121

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.8	1.200	9.7	3.000	15.3	7.000	23.3
0.200	6.2	1.400	10.4	3.500	16.5	7.500	24.1
0.300	6.4	1.600	11.1	4.000	17.6	8.000	24.9
0.400	6.3	1.800	11.8	4.500	18.7	8.500	25.7
0.500	6.6	2.000	12.5	5.000	19.7	9.000	26.4
0.600	7.0	2.200	13.1	5.500	20.7	9.500	27.2
0.800	7.9	2.400	13.7	6.000	21.6		
1.000	8.8	2.600	14.2	6.500	22.5		



C.5a - Variables for calculating proposed attenuation requirements for carriageway and footway impermeable areas.



C.5b - Attenuation requirements for all highway drainage systems

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

Half Drain Time : 1231 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	31.869	0.369	0.0	0.0	0.0	36.6	O K
30 min Summer	31.958	0.458	0.0	0.6	0.6	48.9	O K
60 min Summer	32.053	0.553	0.0	0.7	0.7	62.1	O K
120 min Summer	32.156	0.656	0.0	0.7	0.7	76.3	O K
180 min Summer	32.215	0.715	0.0	0.7	0.7	84.5	Flood Risk
240 min Summer	32.254	0.754	0.0	0.8	0.8	89.9	Flood Risk
360 min Summer	32.301	0.801	0.0	0.8	0.8	96.5	Flood Risk
480 min Summer	32.332	0.832	0.0	0.8	0.8	100.8	Flood Risk
600 min Summer	32.352	0.852	0.0	0.8	0.8	103.5	Flood Risk
720 min Summer	32.364	0.864	0.0	0.9	0.9	105.2	Flood Risk
960 min Summer	32.378	0.878	0.0	0.9	0.9	107.1	Flood Risk
1440 min Summer	32.395	0.895	0.0	0.9	0.9	109.5	Flood Risk
2160 min Summer	32.404	0.904	0.0	0.9	0.9	110.8	Flood Risk
2880 min Summer	32.401	0.901	0.0	0.9	0.9	110.3	Flood Risk
4320 min Summer	32.375	0.875	0.0	0.9	0.9	106.7	Flood Risk
5760 min Summer	32.338	0.838	0.0	0.8	0.8	101.6	Flood Risk
7200 min Summer	32.298	0.798	0.0	0.8	0.8	96.0	Flood Risk
8640 min Summer	32.256	0.756	0.0	0.8	0.8	90.2	Flood Risk
10080 min Summer	32.216	0.716	0.0	0.7	0.7	84.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	109.059	0.0	0.0	27
30 min Summer	73.366	0.0	7.9	41
60 min Summer	47.182	0.0	22.2	70
120 min Summer	29.362	0.0	37.7	130
180 min Summer	21.949	0.0	47.2	188
240 min Summer	17.740	0.0	54.0	248
360 min Summer	13.035	0.0	63.6	366
480 min Summer	10.480	0.0	71.1	484
600 min Summer	8.842	0.0	77.1	602
720 min Summer	7.691	0.0	82.1	720
960 min Summer	6.166	0.0	90.2	856
1440 min Summer	4.508	0.0	99.8	1088
2160 min Summer	3.288	0.0	117.8	1480
2880 min Summer	2.626	0.0	128.0	1884
4320 min Summer	1.908	0.0	142.8	2720
5760 min Summer	1.520	0.0	154.9	3520
7200 min Summer	1.273	0.0	164.1	4320
8640 min Summer	1.101	0.0	171.8	5096
10080 min Summer	0.974	0.0	178.5	5848

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	31.901	0.401	0.0	0.0	0.0	41.0	O K
30 min Winter	31.999	0.499	0.0	0.7	0.7	54.6	O K
60 min Winter	32.108	0.608	0.0	0.7	0.7	69.7	O K
120 min Winter	32.223	0.723	0.0	0.7	0.7	85.7	Flood Risk
180 min Winter	32.289	0.789	0.0	0.8	0.8	94.9	Flood Risk
240 min Winter	32.333	0.833	0.0	0.8	0.8	100.9	Flood Risk
360 min Winter	32.387	0.887	0.0	0.9	0.9	108.4	Flood Risk
480 min Winter	32.422	0.922	0.0	0.9	0.9	113.3	Flood Risk
600 min Winter	32.445	0.945	0.0	0.9	0.9	116.4	Flood Risk
720 min Winter	32.460	0.960	0.0	0.9	0.9	118.5	Flood Risk
960 min Winter	32.476	0.976	0.0	1.0	1.0	120.7	Flood Risk
1440 min Winter	32.485	0.985	0.0	1.0	1.0	122.0	Flood Risk
2160 min Winter	32.483	0.983	0.0	1.0	1.0	121.7	Flood Risk
2880 min Winter	32.465	0.965	0.0	0.9	0.9	119.2	Flood Risk
4320 min Winter	32.411	0.911	0.0	0.9	0.9	111.7	Flood Risk
5760 min Winter	32.350	0.850	0.0	0.8	0.8	103.3	Flood Risk
7200 min Winter	32.289	0.789	0.0	0.8	0.8	94.7	Flood Risk
8640 min Winter	32.228	0.728	0.0	0.7	0.7	86.3	Flood Risk
10080 min Winter	32.167	0.667	0.0	0.7	0.7	77.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	109.059	0.0	0.0	27
30 min Winter	73.366	0.0	13.7	41
60 min Winter	47.182	0.0	29.8	70
120 min Winter	29.362	0.0	47.1	128
180 min Winter	21.949	0.0	57.7	186
240 min Winter	17.740	0.0	65.4	244
360 min Winter	13.035	0.0	76.1	358
480 min Winter	10.480	0.0	84.4	474
600 min Winter	8.842	0.0	91.1	586
720 min Winter	7.691	0.0	96.6	698
960 min Winter	6.166	0.0	105.2	910
1440 min Winter	4.508	0.0	109.9	1134
2160 min Winter	3.288	0.0	136.8	1588
2880 min Winter	2.626	0.0	148.2	2048
4320 min Winter	1.908	0.0	164.7	2904
5760 min Winter	1.520	0.0	178.4	3752
7200 min Winter	1.273	0.0	188.7	4552
8640 min Winter	1.101	0.0	197.3	5368
10080 min Winter	0.974	0.0	204.9	6168

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.179

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.060	4	8	0.060	8	12	0.060

Model Details

Storage is Online Cover Level (m) 32.500

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	2.2
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	210.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	31.500	Cap Infiltration Depth (m)	0.000

Hydro-Brake® Outflow Control

Design Head (m)	0.600	Hydro-Brake® Type	Md6 SW Only	Invert Level (m)	31.900
Design Flow (l/s)	1.0	Diameter (mm)	85		

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	4.5	3.000	7.1	7.000	10.9
0.200	3.2	1.400	4.9	3.500	7.7	7.500	11.3
0.300	3.0	1.600	5.2	4.000	8.2	8.000	11.7
0.400	2.9	1.800	5.5	4.500	8.7	8.500	12.0
0.500	3.0	2.000	5.8	5.000	9.2	9.000	12.4
0.600	3.2	2.200	6.1	5.500	9.7	9.500	12.7
0.800	3.7	2.400	6.4	6.000	10.1		
1.000	4.1	2.600	6.6	6.500	10.5		

APPENDIX D

FLOODING CONSULTATION

Gloucestershire County Council

Preliminary Flood Risk Assessment

Preliminary Assessment Report

November 2011

Gloucestershire
COUNTY COUNCIL

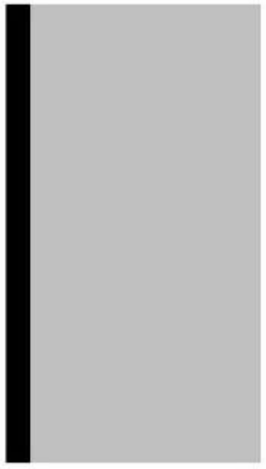
ANNEX 1: Records of past floods and their significant consequences (preliminary assessment report spreadsheet)

Field:	Flood ID	Summary description	Name of Location	National Grid Reference	Location Description	Start date
Mandatory / optional:	**Mandatory**	**Mandatory**	**Mandatory**	**Mandatory**	Optional	Optional for first cycle
Format:	Unique number between 1-9999	Max 5,000 characters	Max 250 characters	12 characters: 2 letters, 10 numbers	Max 250 characters	'yyyy' or 'yyyy-mm' or 'yyyy-mm-dd'
Notes:	A sequential number starting at 1 and incrementing by 1 for each record.	Description of the flood and its adverse or potentially adverse consequences. Where available, information from other fields (Start date, Days duration, Probability, Main source, Main mechanism, Main characteristics, Significant consequences) should be repeated here.	Name of the locality associated with the flood, using recognised postal address names such as streets, towns, counties. If the flood affected the whole LLFA, then record the name of the LLFA.	National Grid Reference of the centroid (centre point, falls within polygon) of the flood extent, or of the area affected if there is no extent information.	A description of the general location that was flooded.	The date when the flood commenced - when land not normally covered by water became covered by water.
Example:	1	On the 14 April 1998 an intense storm system produced surface water flooding across Essex, concentrated in the west of the county. The flooding lasted about 6 hours, and 23 residential properties were recorded as suffering internal flooding, in Epping and North Weald. The surface runoff exceeded the drainage capacity in several places, and so probably had a 1 in 30 to 1 in 50 chance of occuring in any given year.	Essex	SX1234512345	Several towns and villages across west Essex	1998-04-15
Records begin here:	1	In June and July 2007 severe storm events across Gloucestershire causes widespread flooding throighout the county. . Heavy rainfall at the end of June led to flooding in some areas in Gloucestershire, both from surface water overloading the drainage systems and very high water levels in rivers and brooks. Heavier rain fell in July and on the 20th July the equivalent of two months' rain fell in 14 hours. Flooding came from numerous sources including surface runoff, rivers and watercourses, and exceedance of drainage systems (including highway and surface water drainage). The July 2007 event was estimated to have a 1 in 125 to 1 in 400 chance of occurring in any given year.	Gloucestershire		Communities across Gloucestershire	2007

Annex 1 Past floods

Annex 1 Past floods

Annex 1 Past floods



Days duration	Probability	Main source of flooding	Additional source(s) of flooding	Confidence in main source of flooding
Optional for first cycle Number with two decimal places	Optional for first cycle Max 25 characters	Optional for first cycle Pick from drop-down	Optional Max 250 characters, same source terms	Optional Pick from drop-down
The number of days (duration) of the flood - that land not normally covered by water was covered by water. Values should be within the range 0.01 - 999.99 (permitting records to the nearest quarter of an hour, where appropriate).	The chance of the flood occuring in any given year - record X from "a 1 in X chance of occurring in any given year". Where this is difficult to estimate, a range can be recorded.	Pick the source from which the majority of flooding occurred. Refer to the PFRA guidance for definitions of sources.	If flooding occurred from, or interacted with, any other sources (other than the Main source of flooding), report the source(s) here, using the same source terms.	Pick a broad level of confidence in the Main source of flooding from; 'High' (compelling evidence of source - about 80% confident that source is correct), 'Medium' (some evidence of source but not compelling - about 50% confident that source is correct) 'Low' (source assumed - about 20% confident that source is correct) or 'Unknown'.
0.25	20-50	Surface runoff		High
	125-400	Surface runoff	Main River, ordinary watercourses, exceedance of drainage systems	High

Annex 1 Past floods

Annex 1 Past floods

Annex 1 Past floods

Annex 1 Past floods

Main mechanism of flooding	Main characteristic of flooding	Significant consequences to human health	Human health consequences - residential properties	Property count method	Other human health consequences	Significant economic consequences	Number of non-residential properties flooded	Property count method	Other economic consequences
Optional for first cycle Pick from drop-down	Optional for first cycle Pick from drop-down	**Mandatory** Pick from drop-down	Optional Number between 1-10,000,000	Optional Pick from drop-down	Optional Max 250 characters	**Mandatory** Pick from drop-down	Optional Number between 1-10,000,000	Optional Pick from drop-down	Optional Max 250 characters
Pick a mechanism from; 'Natural exceedance' (of capacity), 'Defence exceedance' (floodwater overtopping defences), 'Failure' (of natural or artificial defences or infrastructure, or of pumping), 'Blockage or restriction' (natural or artificial blockage or restriction of a conveyance channel or system), or 'No data'.	Pick a characteristic from; 'Flash flood' (rises and falls quite rapidly with little or no advance warning), 'Natural flood' (due to significant precipitation, at a slower rate than a flash flood), 'Snow melt flood' (due to rapid snow melt), 'Debris flow' (conveying a high degree of debris), or 'No data'. Most UK floods are 'Natural floods'.	Were there any significant consequences to human health when the flood occurred, or would there be if it were to re-occur?	Record the number of residential properties where the building structure was affected either internally or externally by the flood, or that would be so affected if the flood were to re-occur.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If there were other Significant consequences to human health, describe them including information such as the number of critical services flooded.	Were there any significant economic consequences when the flood occurred, or would there be if it were to re-occur?	Record the number of non-residential properties where the building structure was affected either internally or externally by the flood, or that would be so affected if the flood were to re-occur.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If there were other Significant economic consequences, describe them including information such as the area of agricultural land flooded, length of roads and rail flooded.
Natural exceedance	Natural flood	Yes	23	Observed number		No			
Natural exceedance	Natural flood	Yes	>5000	Observed number	Mythe treatment works flooded - 135,000 homes without water for up to 17 days. 48,000 homes without electricity for 2 days.	Yes	>500	Observed number	Gloucester and Cheltenham train stations flooded. 10,000 people stranded on M5 overnight.

Annex 1 Past floods

Annex 1 Past floods

Annex 1 Past floods

Significant consequences to the environment	Environment consequences	**Significant consequences to cultural heritage**	Cultural heritage consequences
Mandatory Pick from drop-down	Optional Max 250 characters	**Mandatory** Pick from drop-down	Optional Max 250 characters
Were there any significant consequences to the environment when the flood occurred, or would there be if it were to re-occur?	If there were Significant consequences to the environment, describe them including information such as national and international designated sites flooded, and pollution sources flooded.	Were there any significant consequences to cultural heritage when the flood occurred, or would there be if it were to re-occur?	If there were Significant consequences to cultural heritage, describe them including information such as the number and type of heritage assets flooded.
No		No	
No		No	

Annex 1 Past floods

Annex 1 Past floods

Annex 1 Past floods

Comments	Data owner	Area flooded	Flood event outline confidence	Flood event outline source	Survey date	Photo ID	Lineage	Sensitive data	Protective marking descriptor
Optional Max 1,000 characters Any additional comments about the past flood record.	Optional Max 250 characters	Optional Number with two decimal places The total area of the land flooded, in km^2	Optional Pick from drop-down Choose from; 'High' (data includes one of: Aerial video, Aerial photos, Professional survey, Flood level information, EA flood data recording staff notes), 'Medium' (data includes one of: EA/LA ground video, EA/LA ground photos, EA/LA flood event outline map, LA/professional partner officer site records, Public ground video), 'Low' (not confident) or 'Unknown'.	Optional Pick from drop-down	Optional 'yyyy' or 'yyyy-mm' or 'yyyy-mm-dd'	Optional Max 50 characters Provide references to relevant specific photographs, or to a set of relevant photographs. It may not be practical to reference all relevant photographs for each flood event.	Optional Max 250 characters Lineage is how and what the data is made from. Has this data been created by using data owned or derived from data owned by 3rd party (external) organisations? If yes please give details.	Optional Pick from drop-down Has the information been classified under the Government's Protective Marking Scheme? Include protective marking time limit where known. Note: If "Approved for Access" then report "Unmarked".	Optional Max 50 characters For use where organisations apply the Government's Protective Marking Scheme.
	Epping Forest District Council		Medium	Site survey	1998-04-20		Ordnance Survey AddressPoint; CEH 1:50k River Centreline; NextMap DTM.	Unmarked	Private
	Various authorities. Data from water companies held under confidentiality agreement							Protect	Commercial

Annex 1 Past floods

Annex 1 Past floods

Annex 1 Past floods

European Flood Event Code Auto-populated Max 42 characters This field will autopopulate using the LLFA name provided on the "Instructions" tab, and the Flood ID. It is an EU-wide unique identifier and will be used to report the flood information. Format: UK<ONS Code><P or F><LLFA Flood ID>. "ONS Code" is a unique reference for each LLFA. "P or F" indicates if the event is past or future. "LLFA Flood ID" is a sequential number beginning with 0001.
UKE10000012P0001
UKE10000013P0001

Annex 1 Past floods

Annex 1 Past floods

Annex 1 Past floods

ANNEX 3: Records of Flood Risk Areas and their rationale (preliminary assessment report spreadsheet)

Field:	Flood Risk Area ID	Name of Flood Risk Area	National Grid Reference	Main source of flooding	Additional source(s) of flooding	Confidence in main source of flooding	Main mechanism of flooding	Main characteristic of flooding
Mandatory / optional:	Mandatory	Mandatory	Mandatory	Mandatory	Optional	Optional	Mandatory	Mandatory
Format:	Unique number between 1-9999	Max 250 characters	12 characters: 2 letters, 10 numbers	Pick from drop-down	Max 250 characters, same source terms	Pick from drop-down	Pick from drop-down	Pick from drop-down
Notes:	A sequential number starting at 1 and incrementing by 1 for each record.	Name of the locality associated with the Flood Risk Area; a town, city, or county.	National Grid Reference of the centroid (centre point, falls within polygon) of the Flood Risk Area.	Pick the source from which there is a significant flood risk. Refer to the PFRA guidance for definitions of sources.	If there is also significant flood risk generated by another source (other than the Main source of flooding), report the source(s) here, using the same source terms.	Pick a broad level of confidence in the Main source of flooding from; 'High' (compelling evidence of source - about 80% confident that source is correct), 'Medium' (some evidence of source but not compelling - about 50% confident that source is correct) 'Low' (source assumed - about 20% confident that source is correct) or 'Unknown'.	Pick a mechanism from; 'Natural exceedance' (of capacity), 'Defence exceedance' (floodwater overtopping defences), 'Failure' (of natural or artificial defences or infrastructure, or of pumping), 'Blockage or restriction' (natural or artificial blockage or restriction of a conveyance channel or system), or 'No data'.	Pick a characteristic from; 'Flash flood' (rises and falls quite rapidly with little or no advance warning), 'Natural flood' (due to significant precipitation, at a slower rate than a flash flood), 'Snow melt flood' (due to rapid snow melt), 'Debris flow' (conveying a high degree of debris), or 'No data'. Most UK floods are 'Natural floods'.
Example:	1	London	SX1234512345	Surface runoff	NA	High	Natural exceedance	Natural flood
Records begin here:								