A1
ORIGINAL
PLOT SIZE

NOTES:

KEY:

FOOD STORE IMPERMEABLE AREAS

SITE BOUNDARY	
TOTAL SITE AREA=	23495m²
EXISTING IMPERMEABLE AREA=	0m²
EXISTING VEGETATED AREA=	23495m²
PROPOSED % IMPERMEABLE AREA=	0%

Lay-by

BLADON MEWS

TIBBERTON GROV

CHALFORD AVENUE

FRAMPTON MEWS

Playground

INDICATIVE

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:
EXISTING IMPERMEABLE AREAS PLAN

STATUS:
INFORMATION

SCALE:	DATE:	DRAWN:	CHECKED:	APPROVED:
1:500	15.05.13	AJH	PCP	JC

JOB NO:	DRAWING NO:	REVISION:
1303-30	Appendix A.2	

A1
ORIGINAL
PLOT SIZE

NOTES:

KEY:

FOOD STORE IMPERMEABLE AREAS

SITE BOUNDARY

TOTAL SITE AREA=	23495m²
PROPOSED IMPERMEABLE AREA=	16155m²
PROPOSED VEGETATED AREA=	7340m²
PROPOSED % IMPERMEABLE AREA=	68.7%

Lay-by

BLADON MEWS

TIBBERTON GROV

CHALFORD AVENUE

FRAMPTON MEWS

Playground

5
1
2
21
25
19
15
11
3

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:
PROPOSED IMPERMEABLE AREAS PLAN

STATUS:
INFORMATION

SCALE:	DATE:	DRAWN:	CHECKED:	APPROVED:
1:500	15.05.13	AJH	PCP	JC

JOB NO:	DRAWING NO:	REVISION:
1303-30	Appendix A.3	

INDICATIVE

A1
ORIGINAL
PLOT SIZE

NOTES:

KEY:

SITE BOUNDARY

TOTAL SITE AREA=	23495m²
PROPOSED ROOF AREA=	7605m²
PROPOSED DRIVEWAYS=	1380m²
PROPOSED PARKING BAYS=	5385m²
PROPOSED ACCESS ROAD=	1420m²
PROPOSED FOOTWAYS=	365m²
PROPOSED LANDSCAPING=	7340m²
TOTAL IMPERMEABLE AREA=	16155m²
PROPOSED % IMPERMEABLE AREA=	68.7%

DRAINAGE KEY:

SURFACE WATER SEWER/HIGHWAY DRAIN

SURFACE WATER MANHOLE

6m DRAINAGE EASEMENT

ASSUMING A LIMITED DISCHARGE RATE OF 8L/S FOR THE WHOLE SITE ATTENUATING UP TO THE 1 IN 100 YEAR RETURN PERIOD BETWEEN AND RUNOFF IS GENERATED.

ATTENUATION

ROOF AREAS INTO RAINWATER HARVESTING SYSTEM TO BE RE-USED AS GREY WATER FOR UTILITIES AS TOILETS AND FIRE SPRINKLER SYSTEMS= 50m³ (NOT TO BE INCL. IN CALCS)

REMAINING ROOF VOLUME TO ENTER INTO ADDITIONAL DEPTH OF FILTER MATERIAL PROVIDED BENEATH THE PERMEABLE PAVED CAR PARK

HIGHWAY AND FOOTWAY AREAS TO ENTER INTO 2m WIDE BY 1.5m DEEP LINED FILTRATION TRENCH RUNNING BENEATH THE FOOTWAYS. 2.2m x 1m x 200m x 30% void ratio= 122m³

PERMEABLE PAVED CAR PARKING COURTS TO TAKE RUNOFF FROM ITSELF AS WELL AS FROM THE REMAINING HARD SURFACED DRIVES. 5385m² x 555mm deep x 30% voids= 899m³

TOTAL ATTENUATION PROPOSED=

Lay-by

BLADON MEWS

TIBBERTON GROV

CHALFORD AVENUE

FRAMPTON MEWS

Playground

INDICATIVE

Rev	Date	Details	Drawn by	Checked by	Authorised by
A	05.06.13	Amended strategy to suit revised attenuation calculations.	AJH	PCP	CMR

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:
SURFACE WATER
MANAGEMENT PLAN

STATUS:
INFORMATION

SCALE:	DATE:	DRAWN:	CHECKED:	APPROVED:
1:500	15.05.13	AJH	PCP	JC

JOB NO:	DRAWING NO:	REVISION:
1303-30	Appendix A.4	A

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.

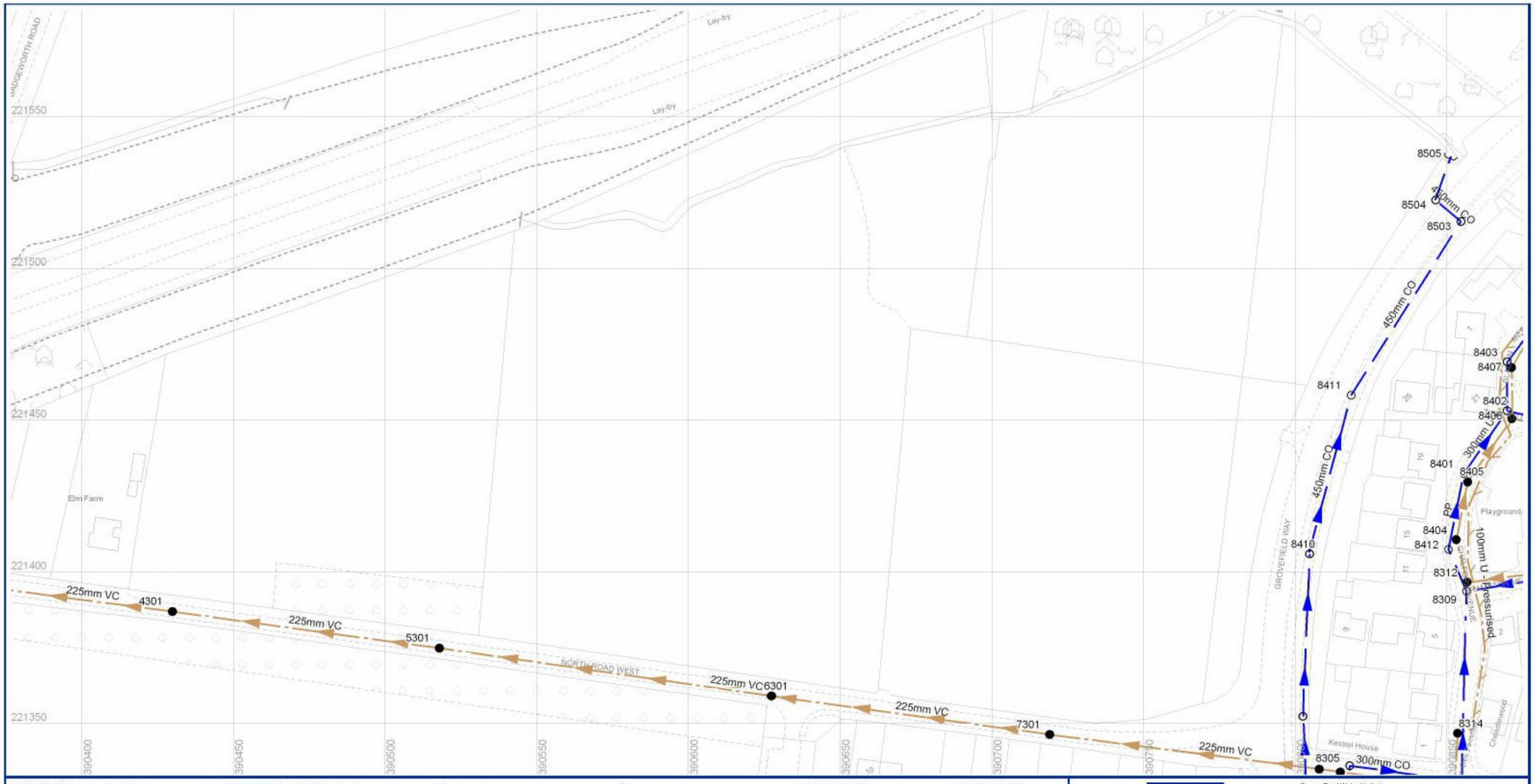
You may have to contact our Asset Protection Team at Regis Road Tettenhall with regard to records of flooding if any. (Tel 0116 234 3834).

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

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

CATEGORIES

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

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

2 St. John's Street
COVENTRY
CV1 2LZ

VAT Regn No.: 486 9855 65

VAT RECEIPT

NAME **Transport Planning Associates**

VAT NUMBER **68886**

CUSTOMER REFERENCE 1303-30/AJH/04

DESCRIPTION PAYMENT FOR – 1 Sewer Map

NET COST	20.00	GBP
VAT at 20%	4.00	GBP
TOTAL COST	24.00	GBP

RECEIVED BY (OFFICE) GISmapping

DATE 21/05/2013

Please make cheques payable to: Severn Trent Water Ltd

And send to:
Severn Trent Water Limited
Asset Data Management
GIS Mapping Team
PO Box 5344
Coventry
CV1 2LZ

Telephone: 0845 601 6616
Fax: 02477 715 862

TERMS AND CONDITIONS AND GENERAL PRECAUTIONS

These general terms and conditions and precautions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the Agreement for the self construction of water mains) (STW Apparatus) of Severn Trent Water Limited (STW) and are not to be taken as exhaustive.

TERMS AND CONDITIONS:

1. This plan and any information supplied with it is issued subject to these terms and conditions.
2. This plan and any information supplied with it is furnished as a general guide only and no representation or warranty as to its accuracy is given or implied.
3. In particular, the position and depth of STW Apparatus shown on the plan are approximate only. It is strongly recommended that a survey is carried out to determine the precise location of STW Apparatus. The exact positions and depths should be obtained by excavation trial holes.
4. The position of private drains, private sewers and service pipes to properties are not normally shown on this plan but their presence must be anticipated and you are strongly advised to carry out your own enquiries and investigations to locate them.
5. The position and depth of STW Apparatus may change and therefore this plan is issued subject to any such change. The onus is entirely upon you to confirm whether any changes to the plan have been made subsequent to issue and prior to any works being carried out.
6. This plan and any information shown on it must not be relied upon in the event of any development or other works (including but not limited to excavations) in the vicinity of STW Apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or distribution systems.
7. No person or company shall be relieved from liability for any damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan and any information supplied with it.
8. If any provision of these terms is or becomes invalid or unenforceable, it will be taken to be removed from the rest of these terms to the extent that it is invalid or unenforceable. No other provision of these terms shall be affected.
9. These terms shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts.

PRECAUTIONS:

STW staff will visit any site at reasonable notice to assist in the location of our apparatus and advise of any precautions necessary to avoid damage.

In order to achieve safe working conditions adjacent to any apparatus the following should be observed:

1. All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.
2. During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.
3. No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.
4. Where it is proposed to carry out piling or boring within 15 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.
5. Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.
6. Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.
7. No apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within 5.0 metres either side of the centre line of STW Apparatus without prior approval. A minimum of radial clearance of 300 millimetres should be allowed between any plant being installed and existing STW Apparatus. No manhole or chamber shall be built over or around any STW Apparatus.
8. Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged.
9. With regard to any proposed resurfacing works, you are required to contact STW on the number given below to arrange a site inspection to establish the condition of any STW Apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken.
10. Trees or shrubs - please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not encroach within the recommended distances specified in the notes overleaf.

NOTES:

PARTICULAR RISKS INVOLVED WHEN WORKING WITH SEWERAGE SYSTEMS AND WATER MAINS

The following risks can be encountered when working on STW Apparatus

- Working in deep excavations.
- Working in the public highway (NRSWA)
- Working in confined spaces.
- Contents of the sewage. i.e. Aggressive Trade Effluent, Petrol, Chemicals etc.
- Accidental spillages may enter a public sewer and cause a harmful and/or explosive atmosphere
- In times of storm the water level in sewers may rise rapidly.
- Sewage can contain rat's urine. Infection from such contaminated sewage can cause Leptospirosis (Weil's Disease) and therefore appropriate hygiene measures should be taken.

You must not enter the public sewerage system without prior approval.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

1 Both Poplar and Willow trees have extensive root systems and should not be planted within 10 metres of a sewer, water main or other STW Apparatus.

2 The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. e.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear.

3 STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 1 metre of the centre line of a sewer, water main or other STW Apparatus.

4 In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main of other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.

Please ensure that a copy of this is passed to your representative and/or your Contractor on site. If any damage is caused to STW apparatus, the person, Contractor or Subcontractor responsible must inform STW immediately on

0800 783 4444 (24 hours)

APPENDIX C

WINDES QBAR ANALYSIS & STORAGE ESTIMATES

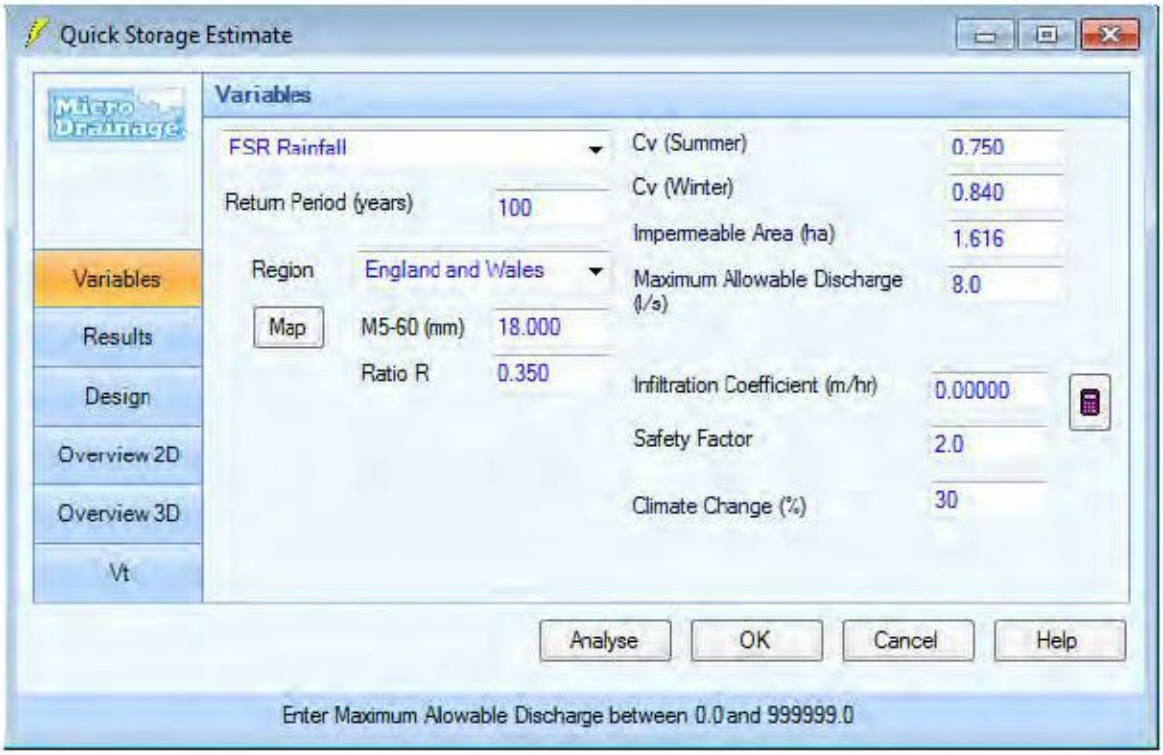
ICP SUDS Mean Annual Flood

Input

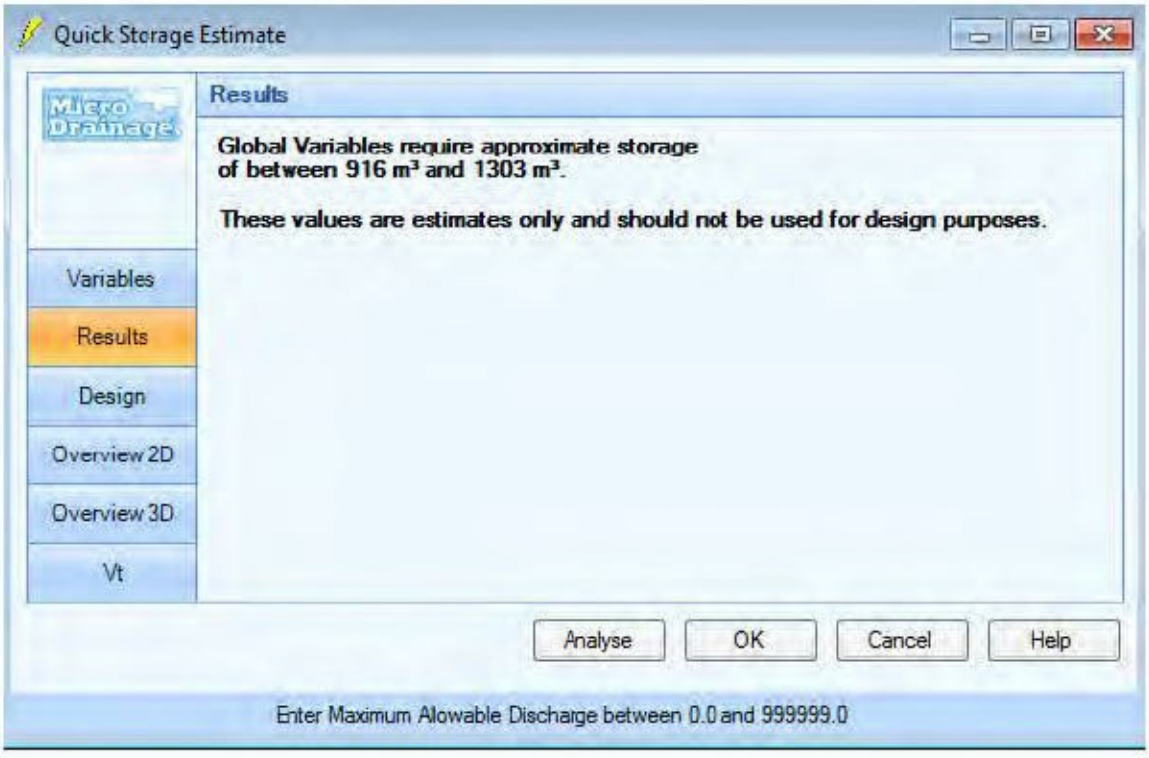
Return Period (years)	2	Soil	0.400
Area (ha)	2.350	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results 1/s

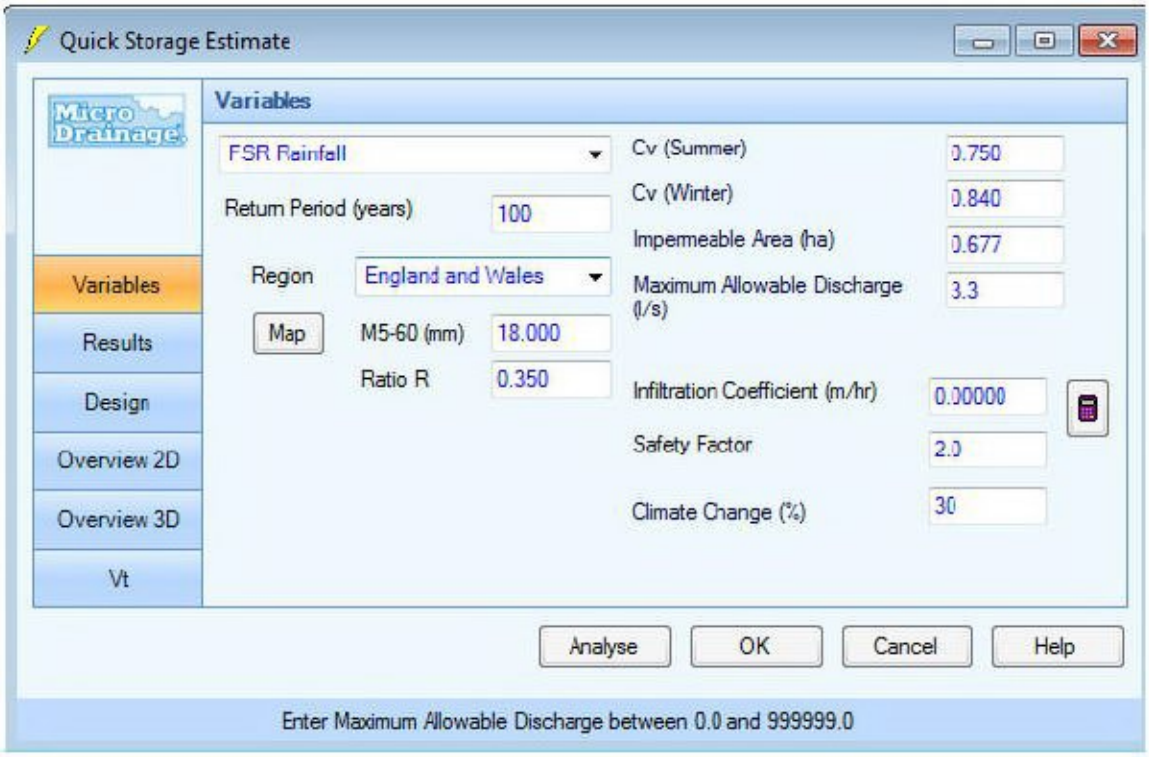
QBAR Rural	8.0
QBAR Urban	8.0
Q2 years	7.0
Q1 year	6.8
Q30 years	18.1
Q100 years	25.5



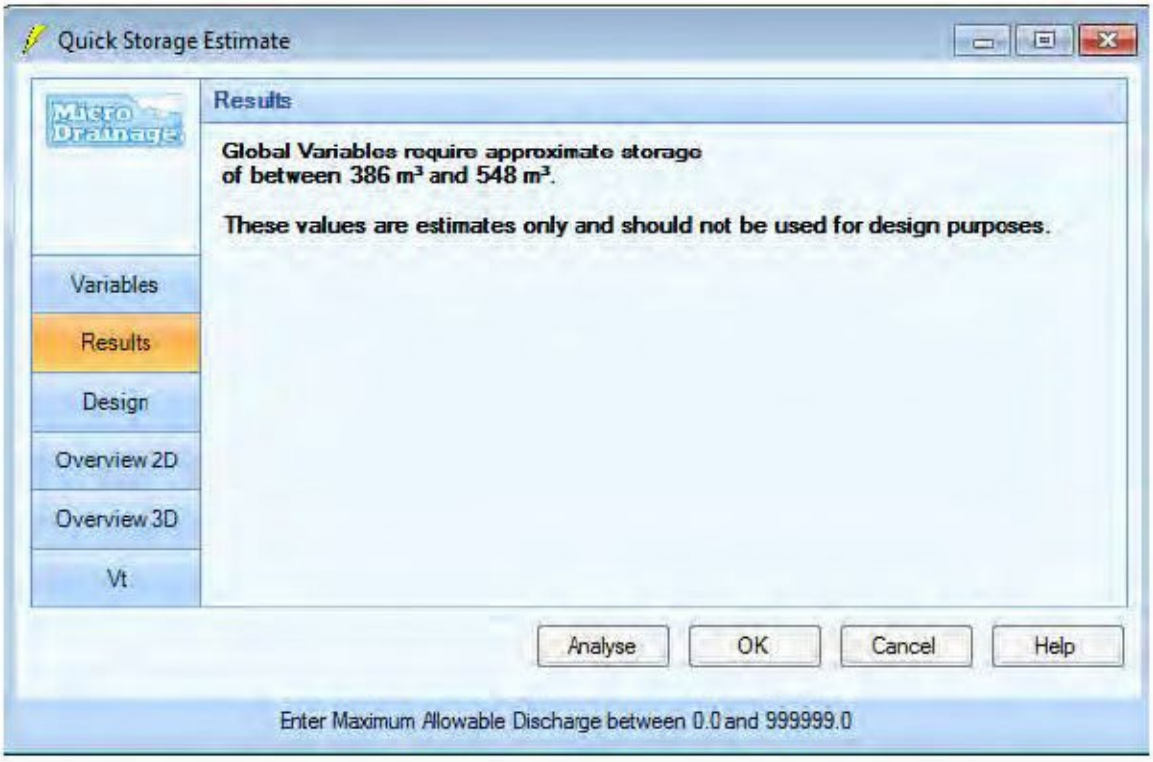
C.2a - Variables for calculating proposed attenuation requirements.



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 (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	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

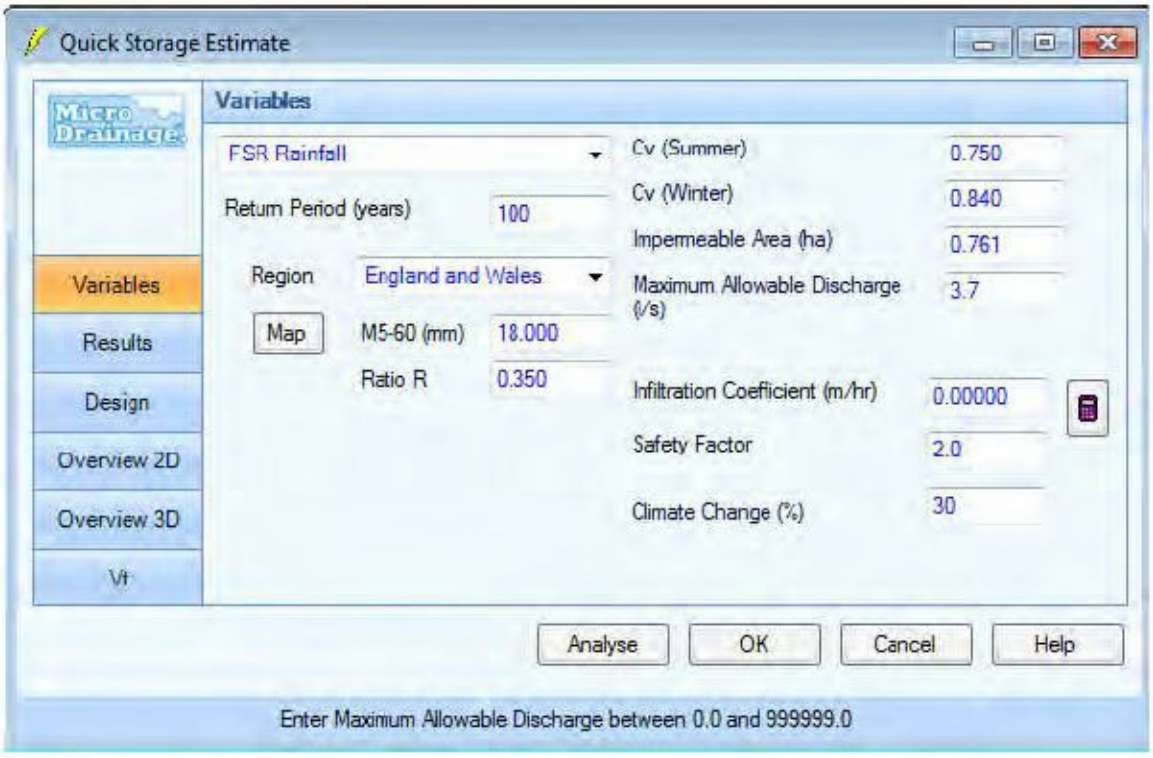
Porous Car Park Structure

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

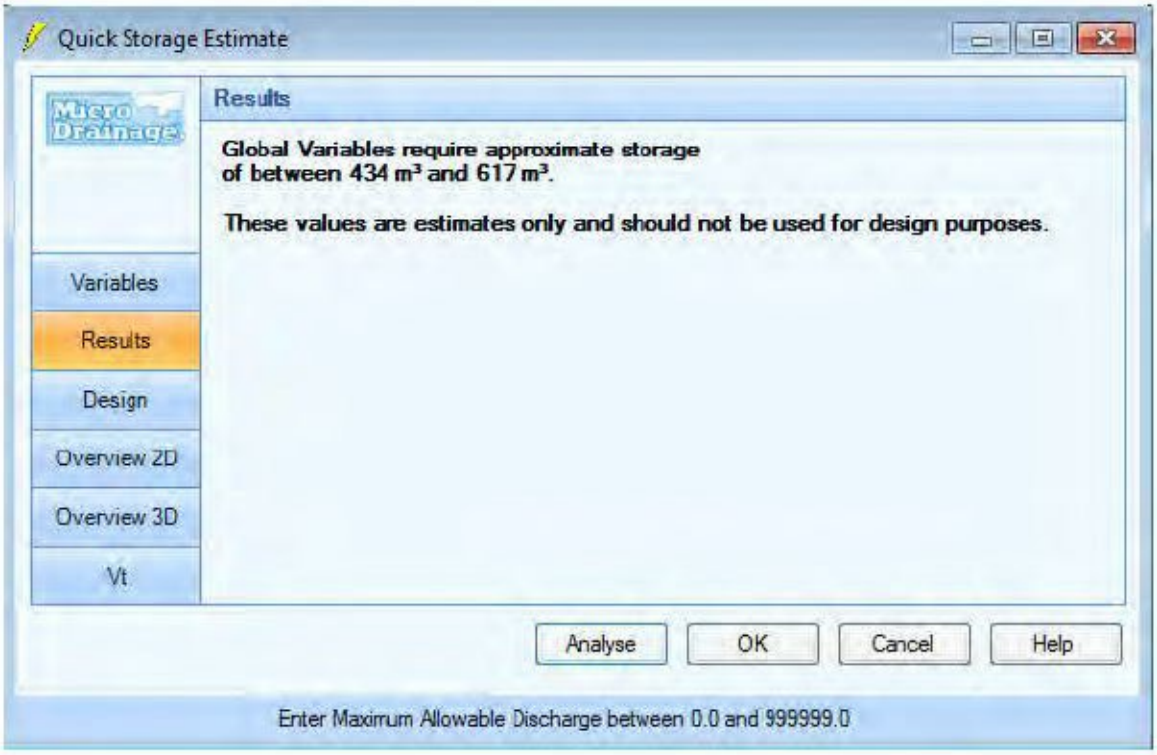
Hydro-Brake® Outflow Control

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 (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	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

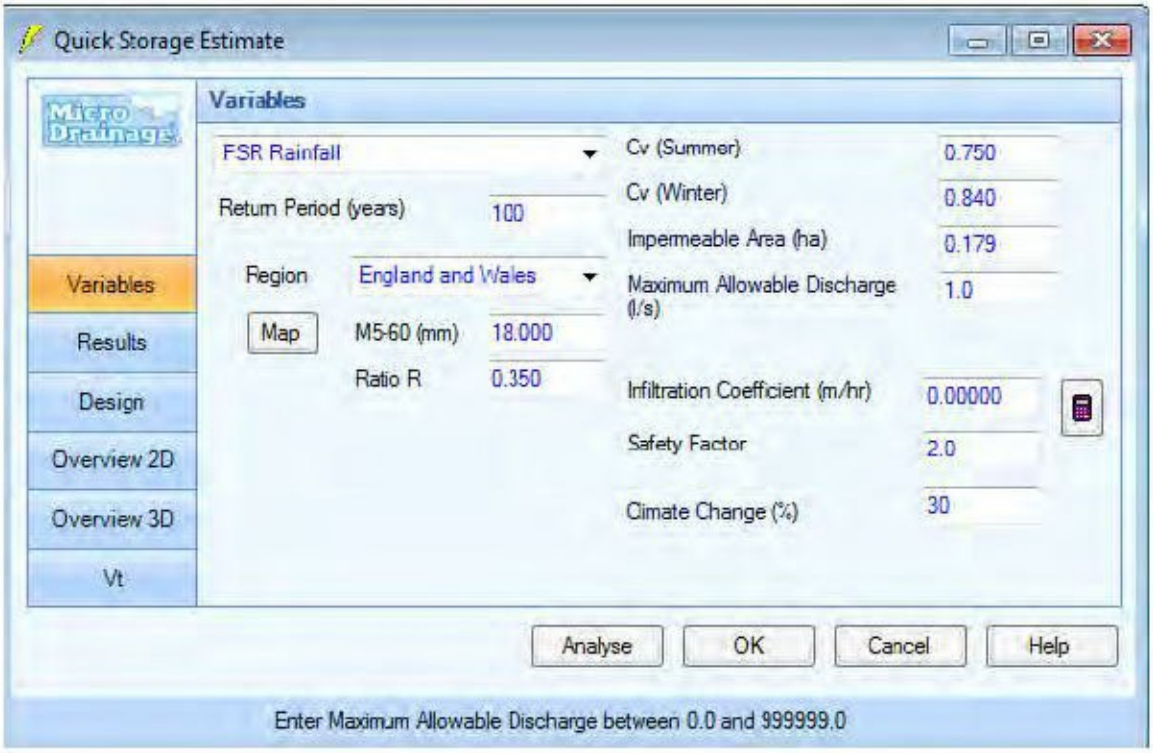
Porous Car Park Structure

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

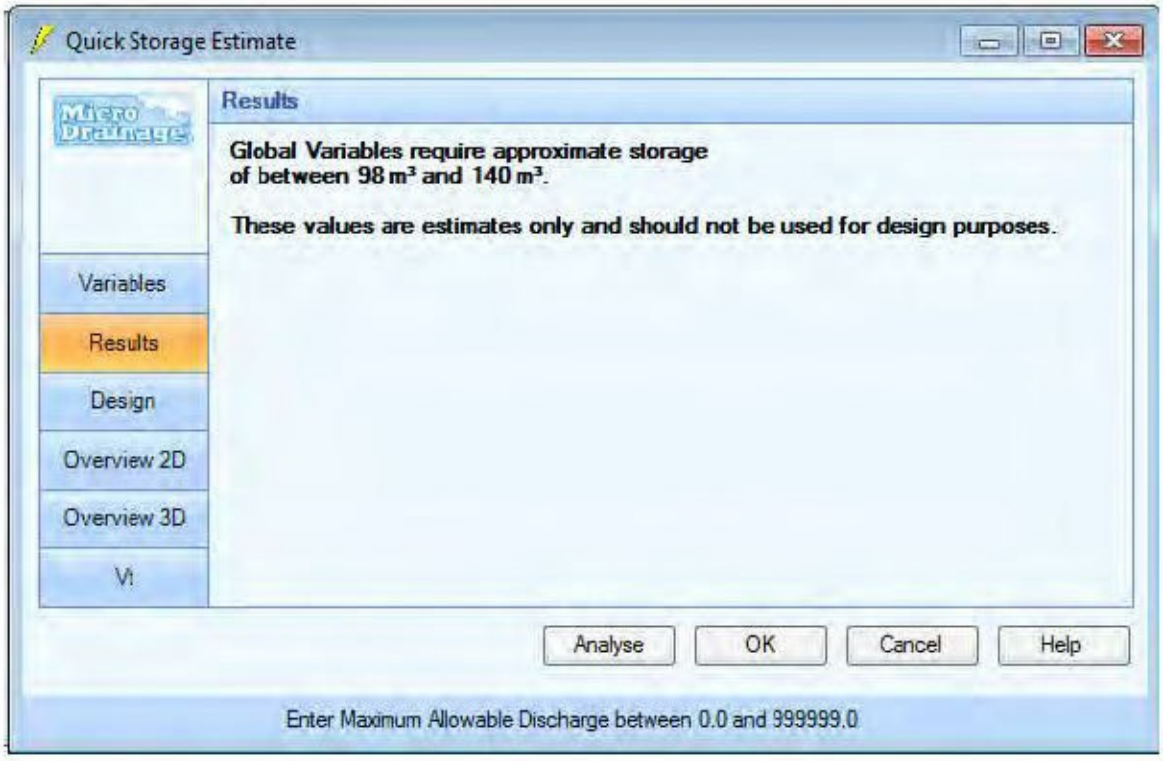
Hydro-Brake® Outflow Control

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