



**Plate 17**      WS05b - 1.00 to 3.00m bgl



**Plate 18**      WS05b - Reinstated



**Environmental Consultancy  
Ground Technologies & Investigation**

**Project :-  
Welwyn Garden City Town Centre GI**

**Client: Welwyn Hatfield Borough Council**

**Project No.: A115249**

**Date : November 2019**





Plate 19

WS08 - 1.20 to 2.80m bgl



Plate 20

WS09 - 1.20 to 3.00m bgl



Environmental Consultancy  
Ground Technologies & Investigation

Project :-  
Welwyn Garden City Town Centre GI

Client: Welwyn Hatfield Borough Council

Project No.: A115249

Date : November 2019

## **Appendix J - SPT Hammer Energy Ratios and Calibration Certificates**

# SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING (UK) LTD  
AINLEYS INDUSTRIAL ESTATE  
ELLAND  
WEST YORKSHIRE  
HX5 9JP

SPT Hammer Ref: CP01  
Test Date: 07/05/2019  
Report Date: 08/05/2019  
File Name: CP01.spt  
Test Operator: CM

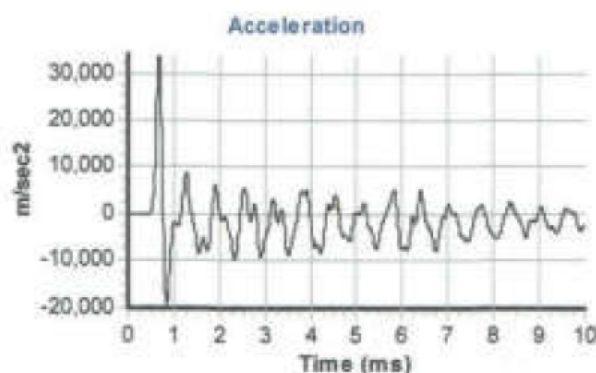
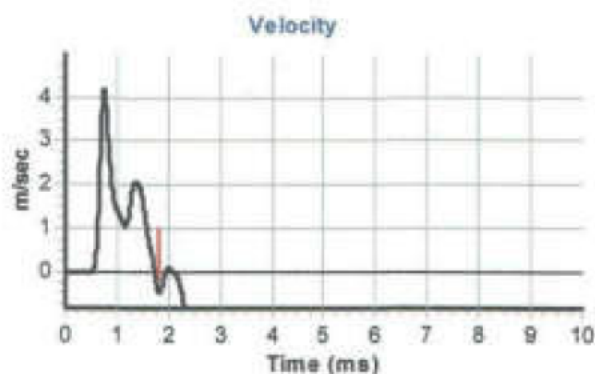
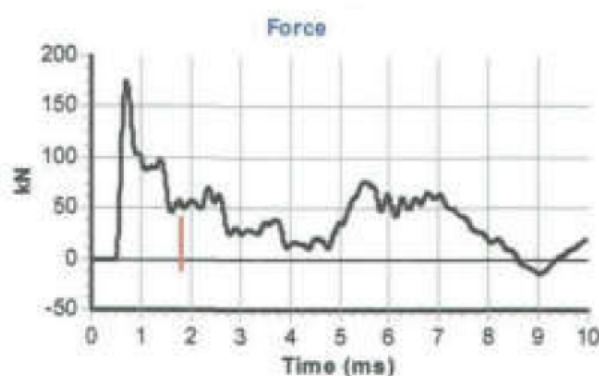
## Instrumented Rod Data

Diameter  $d_r$  (mm): 54  
Wall Thickness  $t_r$  (mm): 6.5  
Assumed Modulus  $E_a$  (GPa): 208  
Accelerometer No.1: 7080  
Accelerometer No.2: 11609

## SPT Hammer Information

Hammer Mass  $m$  (kg): 63.5  
Falling Height  $h$  (mm): 760  
SPT String Length  $L$  (m): 10.0

## Comments / Location



## Calculations

Area of Rod  $A$  (mm²): 970  
Theoretical Energy  $E_{theor}$  (J): 473  
Measured Energy  $E_{meas}$  (J): 261

Energy Ratio  $E_r$  (%): **55**

Signed: S. HOWARTH  
Title: FITTER

The recommended calibration interval is 12 months



# SPT Hammer Energy Test Report

In accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING (UK) LTD  
AINLEYS INDUSTRIAL ESTATE  
ELLAND  
WEST YORKSHIRE  
HX5 9JP

SPT Hammer Ref: RP07  
Test Date: 08/07/2019  
Report Date: 08/07/2019  
File Name: RP07.spt  
Test Operator: CM

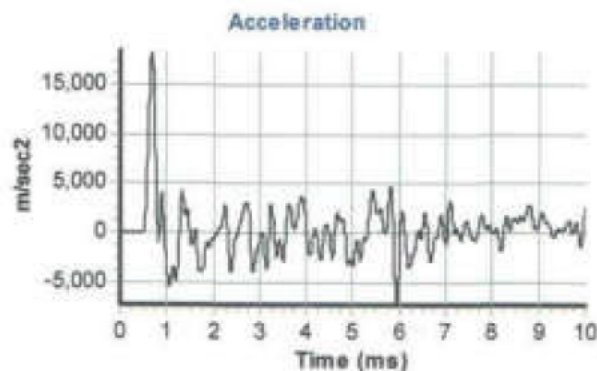
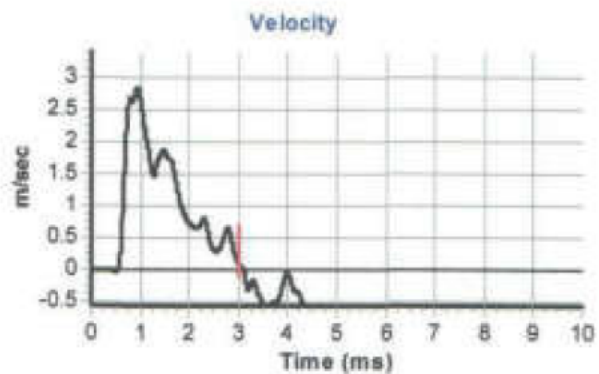
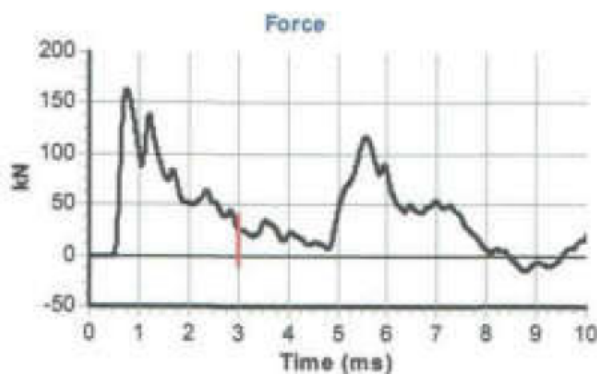
## Instrumented Rod Data

Diameter  $d_r$  (mm): 54  
Wall Thickness  $t_r$  (mm): 6.5  
Assumed Modulus  $E_a$  (GPa): 208  
Accelerometer No.1: 7080  
Accelerometer No.2: 11609

## SPT Hammer Information

Hammer Mass  $m$  (kg): 63.5  
Falling Height  $h$  (mm): 760  
SPT String Length  $L$  (m): 10.0

## Comments / Location



## Calculations

Area of Rod  $A$  (mm<sup>2</sup>): 970  
Theoretical Energy  $E_{theor}$  (J): 473  
Measured Energy  $E_{meas}$  (J): 334

Energy Ratio  $E_r$  (%): **71**

Signed: C.MCCLUSKEY  
Title: FITTER

The recommended calibration interval is 12 months

**Appendix D**  
**Thames Water Sewer Asset Mapping & Correspondence**



# Asset location search



## Property Searches

Ardent Consulting Engineers Ltd  
Ardent Third Flo,Ardent

LONDON  
EC3M 5JE

**Search address supplied** 2007510 - Welwyn Garden City Campus East  
3  
Bridge Road  
Welwyn Garden City  
AL8 6UN

**Your reference** 2007510 - Welwyn Garden City Campus East

**Our reference** ALS/ALS/24/2020\_4305713

**Search date** 19 November 2020

### Knowledge of features below the surface is essential for every development

The benefits of this knowledge not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility of any development.

Did you know that Thames Water Property Searches can also provide a variety of utility searches including a more comprehensive view of utility providers' assets (across up to 35-45 different providers), as well as more focused searches relating to specific major utility companies such as National Grid (gas and electric).

Contact us to find out more.



Thames Water Utilities Ltd  
Property Searches, PO Box 3189, Slough SL1 4WW  
DX 151280 Slough 13



[searches@thameswater.co.uk](mailto:searches@thameswater.co.uk)  
[www.thameswater-propertysearches.co.uk](http://www.thameswater-propertysearches.co.uk)



0845 070 9148

**Search address supplied:** 2007510 - Welwyn Garden City Campus East, 3, Bridge Road, Welwyn Garden City, AL8 6UN

Dear Sir / Madam

**An Asset Location Search is recommended when undertaking a site development.** It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This search provides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

### Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

Thames Water Utilities Ltd  
Property Searches  
PO Box 3189  
Slough  
SL1 4WW

Email: [searches@thameswater.co.uk](mailto:searches@thameswater.co.uk)

Web: [www.thameswater-propertysearches.co.uk](http://www.thameswater-propertysearches.co.uk)



### Waste Water Services

**Please provide a copy extract from the public sewer map.**

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

### Clean Water Services

**Please provide a copy extract from the public water main map.**

With regard to the fresh water supply, this site falls within the boundary of another water company. For more information, please redirect your enquiry to the following address:

Affinity Water Ltd  
Tamblin Way  
Hatfield



AL10 9EZ  
Tel: 0345 3572401

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

## **Payment for this Search**

A charge will be added to your suppliers account.



### Further contacts:

#### Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)  
Thames Water  
Clearwater Court  
Vastern Road  
Reading  
RG1 8DB

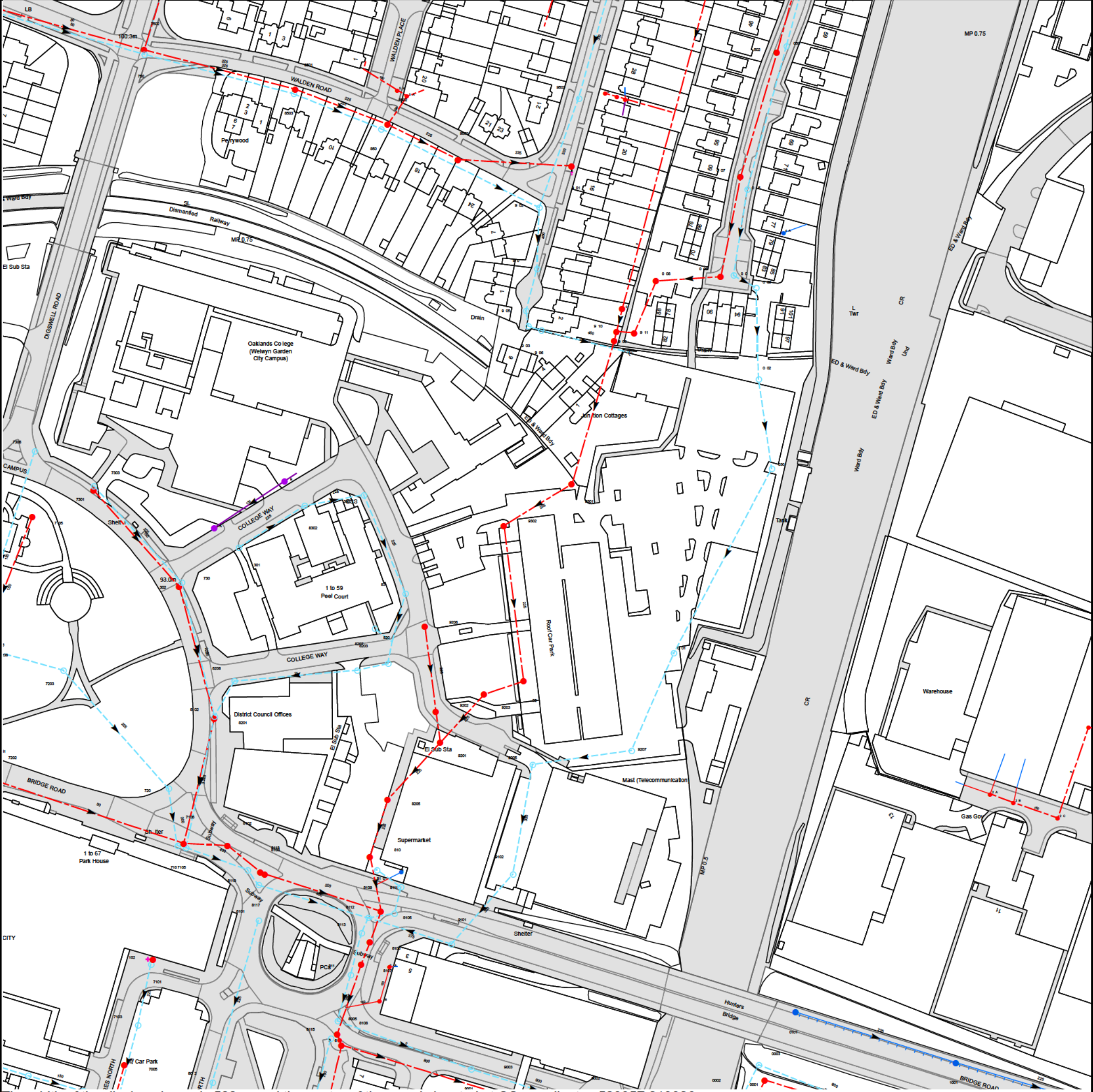
Tel: 0800 009 3921  
Email: [developer.services@thameswater.co.uk](mailto:developer.services@thameswater.co.uk)

#### Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)  
Thames Water  
Clearwater Court  
Vastern Road  
Reading  
RG1 8DB

Tel: 0800 009 3921  
Email: [developer.services@thameswater.co.uk](mailto:developer.services@thameswater.co.uk)



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 523957,213326  
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
9411	n/a	n/a
9410	n/a	n/a
9406	92.4	91.48
9403	92.41	91.45
9405	92.48	91.51
9408	n/a	n/a
0403	n/a	n/a
0408	n/a	n/a
0406	n/a	n/a
0404	n/a	n/a
9404	92.77	91.69
041A	n/a	n/a
9402	93.4	92.03
0405	n/a	n/a
0407	n/a	n/a
9401	93.8	91.73
951C	n/a	n/a
9503	94.53	92.88
951B	n/a	n/a
951A	n/a	n/a
0502	n/a	n/a
0501	n/a	n/a
8113	87.89	84.86
8112	88.21	85.18
8111	n/a	n/a
8105	88.45	84.99
8110	88.51	86.18
811D	n/a	n/a
8109	88.48	86.53
8104	n/a	n/a
8205	88.62	85.32
9201	89.26	85.52
9202	89.7	87.6
9203	89.71	85.71
8204	90.46	89.04
8203	91.07	89.52
9206	90.46	88.23
8304	90.96	89.41
8302	92.78	90.95
8303	92.24	90.53
831B	n/a	n/a
9502	95.45	93.08
8504	93.4	92.1
8502	97.15	94.55
851A	n/a	n/a
8503	98.96	96.11
851B	n/a	n/a
8501	98.9	96.47
7203	92.33	89.75
7103	88.77	86.56
7102	88.67	86.73
7101	88.58	86.48
7204	89.35	87.79
7104	89.18	87.06
7106	89.1	86.73
7105	89.12	86.94
8202	89.89	87.95
8201	89.86	87.67
8102	89.25	86.56
8119	n/a	n/a
8101	88.62	86.63
8117	88.98	85.9
8118	n/a	n/a
8103	89	87.33
7004	89.24	86.78
8002	88.33	85.58
7011	89.98	87.14
7005	88.88	86.18
9302	89.72	87.78
9102	87.43	85.91
9204	88.24	86.38
9205	87.45	86.22
9301	90.64	88.44
9409	n/a	n/a
9207	n/a	n/a
0201	n/a	n/a
0402	n/a	n/a
0001	86.76	79.43
0003	84.9	80.61
0301	n/a	n/a
0101	91.69	89.82
1001	88.25	86.44
121A	n/a	n/a
121B	n/a	n/a
121C	n/a	n/a
221A	n/a	n/a
9001	86.29	80.94
8005	87.05	81
8115	86.94	84.15
8108	86.89	83.96
8116	87.14	n/a



Manhole Reference	Manhole Cover Level	Manhole Invert Level
811B	n/a	n/a
8114	87.14	84.63
811A	n/a	n/a
8107	87.47	84.48
9101	89.06	85.55
8106	87.87	84.52
8207	90.49	88.9
8208	90.78	88.21
7305	96.03	93.27
7306	n/a	n/a
7301	95.58	92.98
7303	95.51	92.49
7504	100.37	98.22
7502	100.37	98.2
7304	92.78	89.82
7302	92.83	90.32
831A	n/a	n/a
8301	92.88	91.38
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.		



# ALS Sewer Map Key

## Public Sewer Types (Operated & Maintained by Thames Water)

	<b>Foul</b> A sewer designed to convey waste water from domestic and industrial sources to a treatment works.
	<b>Surface Water</b> A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.
	<b>Combined</b> A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.
	<b>Trunk Surface Water</b>
	<b>Trunk Foul</b>
	<b>Storm Relief</b>
	<b>Trunk Combined</b>
	<b>Vent Pipe</b>
	<b>Bio-solids (Sludge)</b>
	<b>Proposed Thames Surface Water Sewer</b>
	<b>Proposed Thames Water Foul Sewer</b>
	<b>Gallery</b>
	<b>Foul Rising Main</b>
	<b>Surface Water Rising Main</b>
	<b>Combined Rising Main</b>
	<b>Sludge Rising Main</b>
	<b>Proposed Thames Water Rising Main</b>
	<b>Vacuum</b>

## Notes

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plans are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
- 5) 'na' or '0' on a manhole level indicates that data is unavailable.

## Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

	<b>Air Valve</b>
	<b>Dam Chase</b>
	<b>Fitting</b>
	<b>Meter</b>
	<b>Vent Column</b>

## Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

	<b>Control Valve</b>
	<b>Drop Pipe</b>
	<b>Ancillary</b>
	<b>Weir</b>

## End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

	<b>Outfall</b>
	<b>Undefined End</b>
	<b>Inlet</b>

## Other Symbols

Symbols used on maps which do not fall under other general categories

	<b>Public/Private Pumping Station</b>
	<b>Change of characteristic indicator (C.O.C.I.)</b>
	<b>Invert Level</b>
	<b>Summit</b>

## Areas

Lines denoting areas of underground surveys, etc.

	<b>Agreement</b>
	<b>Operational Site</b>
	<b>Chamber</b>
	<b>Tunnel</b>
	<b>Conduit Bridge</b>

## Other Sewer Types (Not Operated or Maintained by Thames Water)

	<b>Foul Sewer</b>		<b>Surface Water Sewer</b>
	<b>Combined Sewer</b>		<b>Gully</b>
	<b>Culverted Watercourse</b>		<b>Proposed</b>
			<b>Abandoned Sewer</b>

- 6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

## Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL's terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

## Ways to pay your bill

Credit Card	BACS Payment	Telephone Banking	Cheque
Call <b>0845 070 9148</b> quoting your invoice number starting CBA or ADS / OSS	Account number <b>90478703</b> Sort code <b>60-00-01</b> A remittance advice must be sent to: <b>Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.</b> or email <a href="mailto:ps.billing@thameswater.co.uk">ps.billing@thameswater.co.uk</a>	By calling your bank and quoting: Account number <b>90478703</b> Sort code <b>60-00-01</b> and your invoice number	Made payable to ' <b>Thames Water Utilities Ltd</b> ' Write your Thames Water account number on the back. Send to: <b>Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW</b> or by DX to <b>151280 Slough 13</b>

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.



Bruce Wickham

Ardent Consulting Engineers  
Office 3, The Garage Studios,  
41-43 St Mary's Gate, Lace Market  
NG1 1PU Nottingham



18 October 2022

## Pre-planning enquiry: Confirmation of sufficient capacity

Dear Mr Wickham,

Thank you for providing information on your development at East Lower Car Park, Welwyn Garden City, Hertfordshire, AL8 6AB. You are proposing to discharge sewerage via gravity from 307 new flats and Café with floor space of 55.7m<sup>2</sup> with maximum capacity of 56 people

Proposed foul water discharge via gravity into manhole 9203 (112 flats) and new connection on existing foul water sewer between foul water Manholes 9301 and 9204 (for 195 flats and the cafe).

Proposed surface water discharge at total of 8l/s into existing surface water sewer. Being the split 4l/s for the connection between surface water Manholes 9207 and 9205 and two more connections between surface water Manholes 9207 and 0402 at 2l/s each.

We have completed the assessment of the foul water flows and surface water run-off based on the information submitted in your application with the purpose of assessing sewerage capacity within the existing Thames Water sewer network.

### Foul Water

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent foul water sewer network to serve your development.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

**You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.**

### Surface Water

In accordance with the Building Act 2000 Clause H3.3, positive connection of surface water to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable. Before we can consider your surface water needs, you'll need written approval from the lead local flood authority that you



have followed the sequential approach to the disposal of surface water and considered all practical means.

The disposal hierarchy being:

- 1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
- 2) rainwater infiltration to ground at or close to source
- 3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
- 4) rainwater discharge direct to a watercourse (unless not appropriate)
- 5) controlled rainwater discharge to a surface water sewer or drain
- 6) controlled rainwater discharge to a combined sewer.

Where connection to the public sewerage network is required to manage surface water flows we will accept these flows at a discharge rate in line with CIRIA's best practice guide on SuDS or that stated within the sites planning approval.

If the above surface water hierarchy has been followed and if the flows are restricted and split at 4l/s, 2l/s and 2l/s then Thames Water would not have any objections to the proposal.

Please see the attached 'Planning your wastewater' leaflet for additional information.

#### **What happens next?**

Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

If you've any further questions, please contact me on 0800 009 3921.

Yours sincerely

**Maria Merchan**

Adoption Engineer  
Developer Services

**Appendix E**  
**CCTV Sewer Survey**





NOTES

1. EXISTING TOPOGRAPHICAL SURVEY INFORMATION TAKEN FROM NYC GROUP LTD  
DRAWING NUMBER A115249-NYC001.

TOPO LEGEND

AA	ALIVE	C/NO	REPEATED COST WASH OUT
AB	ALIVE AND BREATHING	DI	DIAGNOSTIC
AD	ALIVE	DI	DIAGNOSTIC
AE	ALIVE	DI	DIAGNOSTIC
AF	ALIVE	DI	DIAGNOSTIC
AG	ALIVE	DI	DIAGNOSTIC
AH	ALIVE	DI	DIAGNOSTIC
AI	ALIVE	DI	DIAGNOSTIC
AJ	ALIVE	DI	DIAGNOSTIC
AK	ALIVE	DI	DIAGNOSTIC
AL	ALIVE	DI	DIAGNOSTIC
AM	ALIVE	DI	DIAGNOSTIC
AN	ALIVE	DI	DIAGNOSTIC
AO	ALIVE	DI	DIAGNOSTIC
AP	ALIVE	DI	DIAGNOSTIC
AQ	ALIVE	DI	DIAGNOSTIC
AR	ALIVE	DI	DIAGNOSTIC
AS	ALIVE	DI	DIAGNOSTIC
AT	ALIVE	DI	DIAGNOSTIC
AV	ALIVE	DI	DIAGNOSTIC
AW	ALIVE	DI	DIAGNOSTIC
AX	ALIVE	DI	DIAGNOSTIC
AY	ALIVE	DI	DIAGNOSTIC
AZ	ALIVE	DI	DIAGNOSTIC
BA	ALIVE	DI	DIAGNOSTIC
BB	ALIVE	DI	DIAGNOSTIC
BC	ALIVE	DI	DIAGNOSTIC
BD	ALIVE	DI	DIAGNOSTIC
BE	ALIVE	DI	DIAGNOSTIC
BF	ALIVE	DI	DIAGNOSTIC
BG	ALIVE	DI	DIAGNOSTIC
BH	ALIVE	DI	DIAGNOSTIC
BI	ALIVE	DI	DIAGNOSTIC
BJ	ALIVE	DI	DIAGNOSTIC
BK	ALIVE	DI	DIAGNOSTIC
BL	ALIVE	DI	DIAGNOSTIC
BM	ALIVE	DI	DIAGNOSTIC
BN	ALIVE	DI	DIAGNOSTIC
BO	ALIVE	DI	DIAGNOSTIC
BP	ALIVE	DI	DIAGNOSTIC
BQ	ALIVE	DI	DIAGNOSTIC
BR	ALIVE	DI	DIAGNOSTIC
BS	ALIVE	DI	DIAGNOSTIC
BT	ALIVE	DI	DIAGNOSTIC
BU	ALIVE	DI	DIAGNOSTIC
BV	ALIVE	DI	DIAGNOSTIC
BW	ALIVE	DI	DIAGNOSTIC
BX	ALIVE	DI	DIAGNOSTIC
BY	ALIVE	DI	DIAGNOSTIC
BZ	ALIVE	DI	DIAGNOSTIC
CA	ALIVE	DI	DIAGNOSTIC
CB	ALIVE	DI	DIAGNOSTIC
CC	ALIVE	DI	DIAGNOSTIC
CD	ALIVE	DI	DIAGNOSTIC
CE	ALIVE	DI	DIAGNOSTIC
CF	ALIVE	DI	DIAGNOSTIC
CG	ALIVE	DI	DIAGNOSTIC
CH	ALIVE	DI	DIAGNOSTIC
CI	ALIVE	DI	DIAGNOSTIC
CJ	ALIVE	DI	DIAGNOSTIC
CK	ALIVE	DI	DIAGNOSTIC
CL	ALIVE	DI	DIAGNOSTIC
CM	ALIVE	DI	DIAGNOSTIC
CN	ALIVE	DI	DIAGNOSTIC
CO	ALIVE	DI	DIAGNOSTIC
CP	ALIVE	DI	DIAGNOSTIC
CQ	ALIVE	DI	DIAGNOSTIC
CR	ALIVE	DI	DIAGNOSTIC
CS	ALIVE	DI	DIAGNOSTIC
CT	ALIVE	DI	DIAGNOSTIC
CU	ALIVE	DI	DIAGNOSTIC
CV	ALIVE	DI	DIAGNOSTIC
CW	ALIVE	DI	DIAGNOSTIC
CX	ALIVE	DI	DIAGNOSTIC
CY	ALIVE	DI	DIAGNOSTIC
CZ	ALIVE	DI	DIAGNOSTIC
DA	ALIVE	DI	DIAGNOSTIC
DB	ALIVE	DI	DIAGNOSTIC
DC	ALIVE	DI	DIAGNOSTIC
DD	ALIVE	DI	DIAGNOSTIC
DE	ALIVE	DI	DIAGNOSTIC
DF	ALIVE	DI	DIAGNOSTIC
DG	ALIVE	DI	DIAGNOSTIC
DH	ALIVE	DI	DIAGNOSTIC
DI	ALIVE	DI	DIAGNOSTIC
DJ	ALIVE	DI	DIAGNOSTIC
DK	ALIVE	DI	DIAGNOSTIC
DL	ALIVE	DI	DIAGNOSTIC
DM	ALIVE	DI	DIAGNOSTIC
DN	ALIVE	DI	DIAGNOSTIC
DO	ALIVE	DI	DIAGNOSTIC
DP	ALIVE	DI	DIAGNOSTIC
DQ	ALIVE	DI	DIAGNOSTIC
DR	ALIVE	DI	DIAGNOSTIC
DS	ALIVE	DI	DIAGNOSTIC
DT	ALIVE	DI	DIAGNOSTIC
DU	ALIVE	DI	DIAGNOSTIC
DV	ALIVE	DI	DIAGNOSTIC
DW	ALIVE	DI	DIAGNOSTIC
DX	ALIVE	DI	DIAGNOSTIC
DY	ALIVE	DI	DIAGNOSTIC
DZ	ALIVE	DI	DIAGNOSTIC
EA	ALIVE	DI	DIAGNOSTIC
EB	ALIVE	DI	DIAGNOSTIC
EC	ALIVE	DI	DIAGNOSTIC
ED	ALIVE	DI	DIAGNOSTIC
EE	ALIVE	DI	DIAGNOSTIC
EF	ALIVE	DI	DIAGNOSTIC
EG	ALIVE	DI	DIAGNOSTIC
EH	ALIVE	DI	DIAGNOSTIC
EI	ALIVE	DI	DIAGNOSTIC
EJ	ALIVE	DI	DIAGNOSTIC
EK	ALIVE	DI	DIAGNOSTIC
EL	ALIVE	DI	DIAGNOSTIC
EM	ALIVE	DI	DIAGNOSTIC
EN	ALIVE	DI	DI



C U C R R  
N B C

C	R		
N	N	OR	U

C

1:200	1	2
-------	---	---

JL	GG	FEB 2021
----	----	----------

**D a i n a e t d**

	W		H
		H	



$$\begin{array}{ccccc} & W & & H & \\ & & \searrow & / & \\ & & H & & \end{array}$$



**Appendix F**  
**Surface Water Drainage Calculations**

## EXISTING SURFACE WATER

### Existing site information:

Site Boundary Area	21148	m2
Developable Area	2.1148	ha
Impermeable Area	1.8130	ha



### Modified Rational Method Equation:

$$Q_n = 2.78 CiA$$

where:

$C$	Runoff Coeffic =	1 (in this case 1 as using impermeable area)
$i_n$	Rainfall Intensity for $n$ return period (mm/hr)	
$A$	Impermeable Area (Ha)	
$Q_n$	Runoff for $n$ return period (l/s)	

### Rainfall Intensity:

The rainfall intensities for various return periods were extracted from Table 1(a) of the Transport and Road Research Laboratory Report - Estimated rainfall for drainage calculations in the United Kingdom (TRRL Report LR 595) by C. P. Young. For the 5 min duration.

$i_1$	50.8 mm/hr
$i_{30}$	113.02 mm/hr
$i_{100}$	143.9 mm/hr

### Existing Surface Water Runoff:

Therefore:

			$C$		$i_n$		$A$		$Q_n$
$Q_1$	2.78	x	1	x	50.8	x	1.813	=	256.04 l/s
$Q_{30}$	2.78	x	1	x	113.0	x	1.813	=	569.64 l/s
$Q_{100}$	2.78	x	1	x	143.9	x	1.813	=	725.28 l/s

## Difference in Runoff Volume Following Development (i.e. Long Term Storage Volume)

This methodology is taken from *The SuDS Manual* (Ciria C753) and is also in accordance with the methods in *SC030219 Rainfall Runoff for Developments* and *BS 8582 Code of Practice for Surface Water Management for Development Sites*.

### The SuDS Manual Equation for brownfield development sites

$$Vol_{xs} = RD \times A \times 10 \left[ (0.8 - SPR) \frac{PIMP_2}{100} + (SPR - 0.8) \frac{PIMP_1}{100} \right]$$


### Calculation Inputs

<b>RD</b>	63	Rainfall depth during 1 in 100 year, 6hour storm event (taken from Figure A3.1 in 'Rainfall runoff management for developments ') (mm)
<b>A</b>	2.115	Total area of site (ha)
<b>SPR</b>	0.3	Standard Percentage Runoff from greenfield site
<b>PIMP<sub>1</sub></b>	86	Percentage impermeable area before development (%)
<b>PIMP<sub>2</sub></b>	59	Percentage impermeable area following development (%)

### Calculation Outputs

<b>Pre-development runoff volume</b>	<b>972.69</b>	m <sup>3</sup>	(assuming brownfield site)
<b>Post development runoff volume</b>	<b>792.81</b>	m <sup>3</sup>	
<b>Difference in Runoff Volume, Vol<sub>xs</sub> (i.e. Long Term Storage Volume)</b>	<b>-179.88</b>	m <sup>3</sup>	

Where a development is found to increase the volume of runoff then the additional volume should be prevented from leaving the site (i.e. infiltration or rainwater harvesting). If this is not possible then the additional volume should be released at a very low rate (2 l/s/ha or less).

Ardent		Page 1
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn garden City Greenfield	
Date 26/09/2022 16:08 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze		
Source Control 2020.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 662 Urban 0.000  
Area (ha) 2.115 Soil 0.300 Region Number Region 6


**Results 1/s**

QBAR Rural 3.6  
QBAR Urban 3.6

Q100 years 11.5

Q1 year 3.1  
Q30 years 8.2  
Q100 years 11.5




Ardent		Page 1
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Tank 1 lin100-yr+40%CC	
Date 30/09/2022 16:06 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

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

Half Drain Time : 978 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	89.218	0.618	0.0	1.7	1.7	84.5	O K
30 min Summer	89.391	0.791	0.0	1.7	1.7	108.1	O K
60 min Summer	89.557	0.957	0.0	1.8	1.8	130.9	O K
120 min Summer	89.757	1.157	0.0	1.9	1.9	158.3	O K
180 min Summer	89.860	1.260	0.0	1.9	1.9	172.3	O K
240 min Summer	89.915	1.315	0.0	1.9	1.9	179.9	Flood Risk
360 min Summer	89.955	1.355	0.0	1.9	1.9	185.3	Flood Risk
480 min Summer	89.947	1.347	0.0	1.9	1.9	184.3	Flood Risk
600 min Summer	89.918	1.318	0.0	1.9	1.9	180.3	Flood Risk
720 min Summer	89.876	1.276	0.0	1.9	1.9	174.6	O K
960 min Summer	89.790	1.190	0.0	1.9	1.9	162.7	O K
1440 min Summer	89.652	1.052	0.0	1.8	1.8	143.9	O K
2160 min Summer	89.511	0.911	0.0	1.8	1.8	124.6	O K
2880 min Summer	89.402	0.802	0.0	1.7	1.7	109.8	O K
4320 min Summer	89.235	0.635	0.0	1.7	1.7	86.8	O K
5760 min Summer	89.105	0.505	0.0	1.6	1.6	69.1	O K
7200 min Summer	89.004	0.404	0.0	1.6	1.6	55.2	O K
8640 min Summer	88.922	0.322	0.0	1.5	1.5	44.0	O K
10080 min Summer	88.856	0.256	0.0	1.5	1.5	35.0	O K
15 min Winter	89.293	0.693	0.0	1.7	1.7	94.8	O K
30 min Winter	89.488	0.888	0.0	1.8	1.8	121.5	O K
60 min Winter	89.676	1.076	0.0	1.8	1.8	147.2	O K
120 min Winter	89.907	1.307	0.0	1.9	1.9	178.7	Flood Risk
180 min Winter	90.026	1.426	0.0	1.9	1.9	195.1	Flood Risk


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	149.720	0.0	86.1	19
30 min Summer	96.659	0.0	111.2	34
60 min Summer	59.445	0.0	136.8	64
120 min Summer	36.981	0.0	170.4	124
180 min Summer	27.553	0.0	190.3	182
240 min Summer	22.148	0.0	203.9	242
360 min Summer	16.027	0.0	221.3	362
480 min Summer	12.613	0.0	232.3	482
600 min Summer	10.426	0.0	240.0	600
720 min Summer	8.901	0.0	245.9	702
960 min Summer	6.905	0.0	254.4	800
1440 min Summer	4.808	0.0	265.8	1040
2160 min Summer	3.348	0.0	277.4	1448
2880 min Summer	2.598	0.0	287.2	1844
4320 min Summer	1.836	0.0	304.4	2640
5760 min Summer	1.449	0.0	320.4	3408
7200 min Summer	1.216	0.0	336.1	4176
8640 min Summer	1.061	0.0	351.6	4920
10080 min Summer	0.951	0.0	367.9	5640
15 min Winter	149.720	0.0	96.5	19
30 min Winter	96.659	0.0	124.5	33
60 min Winter	59.445	0.0	153.3	62
120 min Winter	36.981	0.0	190.8	122
180 min Winter	27.553	0.0	213.1	180

Ardent		Page 2
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Tank 1 lin100-yr+40%CC	
Date 30/09/2022 16:06 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

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

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
240 min Winter	90.094	1.494	0.0	2.0	2.0	204.4	Flood Risk
360 min Winter	90.149	1.549	0.0	2.0	2.0	211.9	Flood Risk
480 min Winter	90.152	1.552	0.0	2.0	2.0	212.4	Flood Risk
600 min Winter	90.131	1.531	0.0	2.0	2.0	209.5	Flood Risk
720 min Winter	90.097	1.497	0.0	2.0	2.0	204.8	Flood Risk
960 min Winter	90.008	1.408	0.0	1.9	1.9	192.6	Flood Risk
1440 min Winter	89.838	1.238	0.0	1.9	1.9	169.4	O K
2160 min Winter	89.649	1.049	0.0	1.8	1.8	143.5	O K
2880 min Winter	89.497	0.897	0.0	1.8	1.8	122.6	O K
4320 min Winter	89.254	0.654	0.0	1.7	1.7	89.4	O K
5760 min Winter	89.067	0.467	0.0	1.6	1.6	63.9	O K
7200 min Winter	88.923	0.323	0.0	1.5	1.5	44.2	O K
8640 min Winter	88.811	0.211	0.0	1.5	1.5	28.9	O K
10080 min Winter	88.724	0.124	0.0	1.4	1.4	17.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	22.148	0.0	228.4	238
360 min Winter	16.027	0.0	248.0	354
480 min Winter	12.613	0.0	260.3	470
600 min Winter	10.426	0.0	268.9	582
720 min Winter	8.901	0.0	275.5	692
960 min Winter	6.905	0.0	284.9	902
1440 min Winter	4.808	0.0	280.8	1112
2160 min Winter	3.348	0.0	310.6	1560
2880 min Winter	2.598	0.0	321.5	2016
4320 min Winter	1.836	0.0	340.9	2852
5760 min Winter	1.449	0.0	358.8	3632
7200 min Winter	1.216	0.0	376.3	4392
8640 min Winter	1.061	0.0	394.0	5096
10080 min Winter	0.951	0.0	411.8	5752

Ardent		Page 3
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Tank 1 lin100-yr+40%CC	
Date 30/09/2022 16:06 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze		Source Control 2020.1


Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 523970 213285 TL 23970 13285	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.307

Time (mins)		Area
From:	To:	(ha)
0	4	0.307

Ardent		Page 4
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Tank 1 1in100-yr+40%CC	
Date 30/09/2022 16:06 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

#### Model Details

Storage is Online Cover Level (m) 90.200

#### Cellular Storage Structure

Invert Level (m) 88.600 Safety Factor 2.0  
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	144.0	144.0	1.600	144.0	220.8	1.601	0.0	220.8


#### Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0052-2000-2880-2000  
Design Head (m) 2.880  
Design Flow (l/s) 2.0  
Flush-Flo™ Calculated  
Objective Minimise upstream storage  
Application Surface  
Sump Available Yes  
Diameter (mm) 52  
Invert Level (m) 87.320  
Minimum Outlet Pipe Diameter (mm) 75  
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.880	2.0	Kick-Flo®	0.469	0.9
Flush-Flo™	0.231	1.1	Mean Flow over Head Range	-	1.4

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)	Depth (m)	Flow (l/s)
0.100	1.0	0.800	1.1	2.000	1.7	4.000	2.3	7.000	3.0
0.200	1.1	1.000	1.2	2.200	1.8	4.500	2.5	7.500	3.1
0.300	1.1	1.200	1.3	2.400	1.8	5.000	2.6	8.000	3.2
0.400	1.0	1.400	1.4	2.600	1.9	5.500	2.7	8.500	3.3
0.500	0.9	1.600	1.5	3.000	2.0	6.000	2.8	9.000	3.4
0.600	1.0	1.800	1.6	3.500	2.2	6.500	2.9	9.500	3.5

Ardent		Page 1
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Tank 1 lin30yr	
Date 30/09/2022 16:07 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	


### Summary of Results for 30 year Return Period

Half Drain Time : 545 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	88.936	0.336	0.0	1.5	1.5	45.9	O K
30 min Summer	89.024	0.424	0.0	1.6	1.6	58.0	O K
60 min Summer	89.103	0.503	0.0	1.6	1.6	68.8	O K
120 min Summer	89.200	0.600	0.0	1.6	1.6	82.1	O K
180 min Summer	89.240	0.640	0.0	1.7	1.7	87.5	O K
240 min Summer	89.253	0.653	0.0	1.7	1.7	89.3	O K
360 min Summer	89.242	0.642	0.0	1.7	1.7	87.8	O K
480 min Summer	89.209	0.609	0.0	1.6	1.6	83.3	O K
600 min Summer	89.177	0.577	0.0	1.6	1.6	79.0	O K
720 min Summer	89.151	0.551	0.0	1.6	1.6	75.3	O K
960 min Summer	89.106	0.506	0.0	1.6	1.6	69.2	O K
1440 min Summer	89.035	0.435	0.0	1.6	1.6	59.5	O K
2160 min Summer	88.950	0.350	0.0	1.5	1.5	47.8	O K
2880 min Summer	88.881	0.281	0.0	1.5	1.5	38.4	O K
4320 min Summer	88.776	0.176	0.0	1.5	1.5	24.1	O K
5760 min Summer	88.705	0.105	0.0	1.4	1.4	14.3	O K
7200 min Summer	88.656	0.056	0.0	1.4	1.4	7.7	O K
8640 min Summer	88.625	0.025	0.0	1.4	1.4	3.5	O K
10080 min Summer	88.608	0.008	0.0	1.4	1.4	1.0	O K
15 min Winter	88.977	0.377	0.0	1.6	1.6	51.6	O K
30 min Winter	89.078	0.478	0.0	1.6	1.6	65.3	O K
60 min Winter	89.169	0.569	0.0	1.6	1.6	77.8	O K
120 min Winter	89.283	0.683	0.0	1.7	1.7	93.5	O K
180 min Winter	89.333	0.733	0.0	1.7	1.7	100.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	82.569	0.0	47.4	19
30 min Summer	52.959	0.0	60.9	33
60 min Summer	32.340	0.0	74.4	64
120 min Summer	20.264	0.0	93.2	122
180 min Summer	15.080	0.0	104.1	182
240 min Summer	12.105	0.0	111.4	242
360 min Summer	8.748	0.0	120.8	360
480 min Summer	6.879	0.0	126.6	430
600 min Summer	5.690	0.0	130.9	486
720 min Summer	4.864	0.0	134.3	544
960 min Summer	3.790	0.0	139.6	674
1440 min Summer	2.667	0.0	147.3	940
2160 min Summer	1.886	0.0	156.3	1344
2880 min Summer	1.483	0.0	163.7	1732
4320 min Summer	1.073	0.0	177.8	2468
5760 min Summer	0.862	0.0	190.5	3176
7200 min Summer	0.735	0.0	202.8	3888
8640 min Summer	0.649	0.0	215.0	4504
10080 min Summer	0.587	0.0	227.0	5144
15 min Winter	82.569	0.0	53.2	19
30 min Winter	52.959	0.0	68.3	33
60 min Winter	32.340	0.0	83.2	62
120 min Winter	20.264	0.0	104.4	120
180 min Winter	15.080	0.0	116.6	178




Ardent		Page 2
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Tank 1 1in30yr	
Date 30/09/2022 16:07 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	89.353	0.753	0.0	1.7	1.7	103.0	O K
360 min Winter	89.352	0.752	0.0	1.7	1.7	102.9	O K
480 min Winter	89.325	0.725	0.0	1.7	1.7	99.2	O K
600 min Winter	89.289	0.689	0.0	1.7	1.7	94.2	O K
720 min Winter	89.252	0.652	0.0	1.7	1.7	89.2	O K
960 min Winter	89.192	0.592	0.0	1.6	1.6	81.0	O K
1440 min Winter	89.094	0.494	0.0	1.6	1.6	67.6	O K
2160 min Winter	88.970	0.370	0.0	1.5	1.5	50.6	O K
2880 min Winter	88.868	0.268	0.0	1.5	1.5	36.7	O K
4320 min Winter	88.720	0.120	0.0	1.4	1.4	16.4	O K
5760 min Winter	88.629	0.029	0.0	1.4	1.4	4.0	O K
7200 min Winter	88.600	0.000	0.0	1.3	1.3	0.0	O K
8640 min Winter	88.600	0.000	0.0	1.2	1.2	0.0	O K
10080 min Winter	88.600	0.000	0.0	1.1	1.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	12.105	0.0	124.8	236
360 min Winter	8.748	0.0	135.4	350
480 min Winter	6.879	0.0	141.8	458
600 min Winter	5.690	0.0	146.6	558
720 min Winter	4.864	0.0	150.4	578
960 min Winter	3.790	0.0	156.3	728
1440 min Winter	2.667	0.0	165.0	1024
2160 min Winter	1.886	0.0	174.8	1452
2880 min Winter	1.483	0.0	183.6	1848
4320 min Winter	1.073	0.0	199.1	2592
5760 min Winter	0.862	0.0	213.5	3176
7200 min Winter	0.735	0.0	227.3	0
8640 min Winter	0.649	0.0	240.9	0
10080 min Winter	0.587	0.0	254.3	0


Ardent		Page 1
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Tank 1 lin2yr	
Date 30/09/2022 16:08 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

### Summary of Results for 2 year Return Period

Half Drain Time : 255 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	88.741	0.141	0.0	1.4	1.4	19.2	O K
30 min Summer	88.772	0.172	0.0	1.5	1.5	23.5	O K
60 min Summer	88.796	0.196	0.0	1.5	1.5	26.8	O K
120 min Summer	88.851	0.251	0.0	1.5	1.5	34.3	O K
180 min Summer	88.868	0.268	0.0	1.5	1.5	36.6	O K
240 min Summer	88.869	0.269	0.0	1.5	1.5	36.8	O K
360 min Summer	88.861	0.261	0.0	1.5	1.5	35.7	O K
480 min Summer	88.849	0.249	0.0	1.5	1.5	34.0	O K
600 min Summer	88.836	0.236	0.0	1.5	1.5	32.3	O K
720 min Summer	88.823	0.223	0.0	1.5	1.5	30.5	O K
960 min Summer	88.798	0.198	0.0	1.5	1.5	27.0	O K
1440 min Summer	88.752	0.152	0.0	1.5	1.5	20.8	O K
2160 min Summer	88.698	0.098	0.0	1.4	1.4	13.4	O K
2880 min Summer	88.659	0.059	0.0	1.4	1.4	8.1	O K
4320 min Summer	88.615	0.015	0.0	1.4	1.4	2.1	O K
5760 min Summer	88.600	0.000	0.0	1.4	1.4	0.0	O K
7200 min Summer	88.600	0.000	0.0	1.2	1.2	0.0	O K
8640 min Summer	88.600	0.000	0.0	1.1	1.1	0.0	O K
10080 min Summer	88.600	0.000	0.0	1.0	1.0	0.0	O K
15 min Winter	88.759	0.159	0.0	1.5	1.5	21.7	O K
30 min Winter	88.795	0.195	0.0	1.5	1.5	26.7	O K
60 min Winter	88.825	0.225	0.0	1.5	1.5	30.8	O K
120 min Winter	88.892	0.292	0.0	1.5	1.5	39.9	O K
180 min Winter	88.916	0.316	0.0	1.5	1.5	43.3	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	36.112	0.0	20.7	18
30 min Summer	22.876	0.0	26.3	33
60 min Summer	13.954	0.0	32.0	62
120 min Summer	9.731	0.0	44.9	122
180 min Summer	7.565	0.0	52.3	180
240 min Summer	6.226	0.0	57.4	214
360 min Summer	4.626	0.0	63.8	278
480 min Summer	3.700	0.0	68.1	342
600 min Summer	3.098	0.0	71.3	410
720 min Summer	2.673	0.0	73.7	478
960 min Summer	2.113	0.0	77.7	614
1440 min Summer	1.517	0.0	83.8	878
2160 min Summer	1.099	0.0	91.1	1252
2880 min Summer	0.882	0.0	97.4	1612
4320 min Summer	0.661	0.0	109.4	2252
5760 min Summer	0.546	0.0	120.7	0
7200 min Summer	0.476	0.0	131.6	0
8640 min Summer	0.429	0.0	142.2	0
10080 min Summer	0.395	0.0	152.8	0
15 min Winter	36.112	0.0	23.2	18
30 min Winter	22.876	0.0	29.4	32
60 min Winter	13.954	0.0	35.9	62
120 min Winter	9.731	0.0	50.1	118
180 min Winter	7.565	0.0	58.5	176

Ardent		Page 2
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Tank 1 1in2yr	
Date 30/09/2022 16:08 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	88.922	0.322	0.0	1.5	1.5	44.1	O K
360 min Winter	88.909	0.309	0.0	1.5	1.5	42.3	O K
480 min Winter	88.892	0.292	0.0	1.5	1.5	40.0	O K
600 min Winter	88.875	0.275	0.0	1.5	1.5	37.6	O K
720 min Winter	88.856	0.256	0.0	1.5	1.5	35.0	O K
960 min Winter	88.817	0.217	0.0	1.5	1.5	29.7	O K
1440 min Winter	88.749	0.149	0.0	1.5	1.5	20.4	O K
2160 min Winter	88.671	0.071	0.0	1.4	1.4	9.7	O K
2880 min Winter	88.620	0.020	0.0	1.4	1.4	2.7	O K
4320 min Winter	88.600	0.000	0.0	1.2	1.2	0.0	O K
5760 min Winter	88.600	0.000	0.0	1.0	1.0	0.0	O K
7200 min Winter	88.600	0.000	0.0	0.9	0.9	0.0	O K
8640 min Winter	88.600	0.000	0.0	0.8	0.8	0.0	O K
10080 min Winter	88.600	0.000	0.0	0.7	0.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	6.226	0.0	64.2	230
360 min Winter	4.626	0.0	71.6	296
480 min Winter	3.700	0.0	76.3	368
600 min Winter	3.098	0.0	79.9	446
720 min Winter	2.673	0.0	82.6	520
960 min Winter	2.113	0.0	87.1	666
1440 min Winter	1.517	0.0	93.8	938
2160 min Winter	1.099	0.0	102.0	1300
2880 min Winter	0.882	0.0	109.2	1616
4320 min Winter	0.661	0.0	122.7	0
5760 min Winter	0.546	0.0	135.2	0
7200 min Winter	0.476	0.0	147.4	0
8640 min Winter	0.429	0.0	159.3	0
10080 min Winter	0.395	0.0	171.1	0


Ardent Consulting Engineers		Page 1
Office 3, Garage Studios, St Mary'...	2007511 - Welwyn Garden City C	
The Lace Market, Nottingham	Tank 2	
NG1 1PU	1 in 100+40%CC	
Date 05/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY ...	Checked by EF	
XP Solutions	Source Control 2020.1	

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

Half Drain Time : 2553 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	88.154	0.554	0.0	1.5	1.5	191.4	O K
30 min Summer	88.312	0.712	0.0	1.6	1.6	246.3	O K
60 min Summer	88.470	0.870	0.0	1.7	1.7	301.0	O K
120 min Summer	88.671	1.071	0.0	1.8	1.8	370.3	O K
180 min Summer	88.784	1.184	0.0	1.8	1.8	409.6	O K
240 min Summer	88.857	1.257	0.0	1.8	1.8	434.6	O K
360 min Summer	88.937	1.337	0.0	1.9	1.9	462.3	O K
480 min Summer	88.975	1.375	0.0	1.9	1.9	475.6	O K
600 min Summer	88.993	1.393	0.0	1.9	1.9	481.7	O K
720 min Summer	88.999	1.399	0.0	1.9	1.9	483.6	O K
960 min Summer	88.989	1.389	0.0	1.9	1.9	480.5	O K
1440 min Summer	88.937	1.337	0.0	1.9	1.9	462.5	O K
2160 min Summer	88.839	1.239	0.0	1.8	1.8	428.4	O K
2880 min Summer	88.759	1.159	0.0	1.8	1.8	400.7	O K
4320 min Summer	88.645	1.045	0.0	1.7	1.7	361.4	O K
5760 min Summer	88.572	0.972	0.0	1.7	1.7	336.3	O K
7200 min Summer	88.521	0.921	0.0	1.7	1.7	318.6	O K
8640 min Summer	88.481	0.881	0.0	1.7	1.7	304.8	O K
10080 min Summer	88.449	0.849	0.0	1.6	1.6	293.7	O K
15 min Winter	88.220	0.620	0.0	1.5	1.5	214.5	O K
30 min Winter	88.399	0.799	0.0	1.6	1.6	276.1	O K
60 min Winter	88.576	0.976	0.0	1.7	1.7	337.6	O K
120 min Winter	88.803	1.203	0.0	1.8	1.8	415.8	O K
180 min Winter	88.932	1.332	0.0	1.9	1.9	460.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	149.720	0.0	119.1	19
30 min Summer	96.659	0.0	126.9	34
60 min Summer	59.445	0.0	250.2	64
120 min Summer	36.981	0.0	267.9	124
180 min Summer	27.553	0.0	277.4	184
240 min Summer	22.148	0.0	283.3	244
360 min Summer	16.027	0.0	289.5	362
480 min Summer	12.613	0.0	292.2	482
600 min Summer	10.426	0.0	293.3	602
720 min Summer	8.901	0.0	293.4	722
960 min Summer	6.905	0.0	291.8	962
1440 min Summer	4.808	0.0	285.5	1440
2160 min Summer	3.348	0.0	533.8	1884
2880 min Summer	2.598	0.0	526.7	2248
4320 min Summer	1.836	0.0	501.6	3024
5760 min Summer	1.449	0.0	716.2	3856
7200 min Summer	1.216	0.0	751.9	4680
8640 min Summer	1.061	0.0	787.5	5528
10080 min Summer	0.951	0.0	819.3	6352
15 min Winter	149.720	0.0	122.4	19
30 min Winter	96.659	0.0	130.8	34
60 min Winter	59.445	0.0	259.5	64
120 min Winter	36.981	0.0	278.6	122
180 min Winter	27.553	0.0	288.8	182

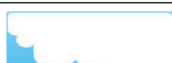
Ardent Consulting Engineers		Page 2
Office 3, Garage Studios, St Mary'...	2007511 - Welwyn Garden City C	
The Lace Market, Nottingham	Tank 2	
NG1 1PU	1 in 100+40%CC	
Date 05/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY ...	Checked by EF	
XP Solutions	Source Control 2020.1	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	89.014	1.414	0.0	1.9	1.9	489.1	O K
360 min Winter	89.108	1.508	0.0	2.0	2.0	521.3	O K
480 min Winter	89.154	1.554	0.0	2.0	2.0	537.3	O K
600 min Winter	89.177	1.577	0.0	2.0	2.0	545.4	O K
720 min Winter	89.187	1.587	0.0	2.0	2.0	548.8	O K
960 min Winter	89.184	1.584	0.0	2.0	2.0	547.8	O K
1440 min Winter	89.142	1.542	0.0	2.0	2.0	533.1	O K
2160 min Winter	89.049	1.449	0.0	1.9	1.9	501.1	O K
2880 min Winter	88.955	1.355	0.0	1.9	1.9	468.6	O K
4320 min Winter	88.822	1.222	0.0	1.8	1.8	422.5	O K
5760 min Winter	88.716	1.116	0.0	1.8	1.8	385.9	O K
7200 min Winter	88.641	1.041	0.0	1.7	1.7	359.8	O K
8640 min Winter	88.578	0.978	0.0	1.7	1.7	338.1	O K
10080 min Winter	88.524	0.924	0.0	1.7	1.7	319.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	22.148	0.0	295.0	240
360 min Winter	16.027	0.0	301.6	358
480 min Winter	12.613	0.0	304.5	476
600 min Winter	10.426	0.0	305.5	594
720 min Winter	8.901	0.0	305.5	710
960 min Winter	6.905	0.0	303.6	942
1440 min Winter	4.808	0.0	296.3	1398
2160 min Winter	3.348	0.0	558.7	2052
2880 min Winter	2.598	0.0	549.9	2364
4320 min Winter	1.836	0.0	524.2	3244
5760 min Winter	1.449	0.0	802.9	4152
7200 min Winter	1.216	0.0	842.2	5048
8640 min Winter	1.061	0.0	881.9	5960
10080 min Winter	0.951	0.0	875.8	6848



Ardent Consulting Engineers		Page 3
Office 3, Garage Studios, St Mary'...	2007511 - Welwyn Garden City C	
The Lace Market, Nottingham	Tank 2	
NG1 1PU	1 in 100+40%CC	
Date 05/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY ...	Checked by EF	
XP Solutions	Source Control 2020.1	

### Rainfall Details


Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 523970 213285 TL 23970 13285	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

### Time Area Diagram

Total Area (ha) 0.687

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

0	4	0.687
---	---	-------

Ardent Consulting Engineers		Page 4
Office 3, Garage Studios, St Mary'...	2007511 - Welwyn Garden City C	
The Lace Market, Nottingham	Tank 2	
NG1 1PU	1 in 100+40%CC	
Date 05/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY ...	Checked by EF	
XP Solutions	Source Control 2020.1	

### Model Details

Storage is Online Cover Level (m) 90.100

### Cellular Storage Structure

Invert Level (m) 87.600 Safety Factor 2.0  
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	364.0	364.0	1.600	364.0	486.1	1.601	0.0	486.1


### Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0056-2000-2200-2000  
Design Head (m) 2.200  
Design Flow (l/s) 2.0  
Flush-Flo™ Calculated  
Objective Minimise upstream storage  
Application Surface  
Sump Available Yes  
Diameter (mm) 56  
Invert Level (m) 87.000  
Minimum Outlet Pipe Diameter (mm) 75  
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.200	2.0	Kick-Flo®	0.495	1.0
Flush-Flo™	0.244	1.2	Mean Flow over Head Range	-	1.5

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)	Depth (m)	Flow (l/s)
0.100	1.1	0.800	1.3	2.000	1.9	4.000	2.6	7.000	3.4
0.200	1.2	1.000	1.4	2.200	2.0	4.500	2.8	7.500	3.5
0.300	1.2	1.200	1.5	2.400	2.1	5.000	2.9	8.000	3.6
0.400	1.2	1.400	1.6	2.600	2.2	5.500	3.0	8.500	3.7
0.500	1.0	1.600	1.7	3.000	2.3	6.000	3.2	9.000	3.8
0.600	1.1	1.800	1.8	3.500	2.5	6.500	3.3	9.500	3.9


Ardent Consulting Engineers		Page 1
Office 3, Garage Studios, St Mary'...	2007511 - Welwyn Garden City C	
The Lace Market, Nottingham	Tank 2	
NG1 1PU	1 in 30yr	
Date 05/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY ...	Checked by EF	
XP Solutions	Source Control 2020.1	

### Summary of Results for 30 year Return Period

Half Drain Time : 1564 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	87.904	0.304	0.0	1.3	1.3	105.0	O K
30 min Summer	87.987	0.387	0.0	1.4	1.4	133.9	O K
60 min Summer	88.068	0.468	0.0	1.4	1.4	161.8	O K
120 min Summer	88.176	0.576	0.0	1.5	1.5	199.1	O K
180 min Summer	88.232	0.632	0.0	1.5	1.5	218.5	O K
240 min Summer	88.265	0.665	0.0	1.6	1.6	230.0	O K
360 min Summer	88.297	0.697	0.0	1.6	1.6	241.0	O K
480 min Summer	88.307	0.707	0.0	1.6	1.6	244.4	O K
600 min Summer	88.306	0.706	0.0	1.6	1.6	244.3	O K
720 min Summer	88.300	0.700	0.0	1.6	1.6	242.2	O K
960 min Summer	88.279	0.679	0.0	1.6	1.6	234.9	O K
1440 min Summer	88.227	0.627	0.0	1.5	1.5	216.9	O K
2160 min Summer	88.168	0.568	0.0	1.5	1.5	196.4	O K
2880 min Summer	88.130	0.530	0.0	1.5	1.5	183.1	O K
4320 min Summer	88.077	0.477	0.0	1.4	1.4	165.1	O K
5760 min Summer	88.038	0.438	0.0	1.4	1.4	151.6	O K
7200 min Summer	88.007	0.407	0.0	1.4	1.4	140.7	O K
8640 min Summer	87.981	0.381	0.0	1.4	1.4	131.6	O K
10080 min Summer	87.958	0.358	0.0	1.4	1.4	123.9	O K
15 min Winter	87.941	0.341	0.0	1.4	1.4	117.7	O K
30 min Winter	88.035	0.435	0.0	1.4	1.4	150.3	O K
60 min Winter	88.125	0.525	0.0	1.5	1.5	181.7	O K
120 min Winter	88.248	0.648	0.0	1.5	1.5	224.1	O K
180 min Winter	88.313	0.713	0.0	1.6	1.6	246.5	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	82.569	0.0	105.7	19
30 min Summer	52.959	0.0	110.4	34
60 min Summer	32.340	0.0	166.4	64
120 min Summer	20.264	0.0	208.6	124
180 min Summer	15.080	0.0	229.4	184
240 min Summer	12.105	0.0	233.3	242
360 min Summer	8.748	0.0	237.5	362
480 min Summer	6.879	0.0	239.5	482
600 min Summer	5.690	0.0	240.4	602
720 min Summer	4.864	0.0	240.8	722
960 min Summer	3.790	0.0	240.4	960
1440 min Summer	2.667	0.0	237.4	1228
2160 min Summer	1.886	0.0	349.5	1600
2880 min Summer	1.483	0.0	366.7	1992
4320 min Summer	1.073	0.0	397.8	2812
5760 min Summer	0.862	0.0	426.6	3632
7200 min Summer	0.735	0.0	454.0	4464
8640 min Summer	0.649	0.0	481.2	5272
10080 min Summer	0.587	0.0	507.8	6048
15 min Winter	82.569	0.0	107.8	19
30 min Winter	52.959	0.0	113.0	34
60 min Winter	32.340	0.0	186.4	64
120 min Winter	20.264	0.0	230.2	122
180 min Winter	15.080	0.0	236.9	180

Ardent Consulting Engineers		Page 2
Office 3, Garage Studios, St Mary'...	2007511 - Welwyn Garden City C	
The Lace Market, Nottingham	Tank 2	
NG1 1PU	1 in 30yr	
Date 05/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY ...	Checked by EF	
XP Solutions	Source Control 2020.1	

### Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	88.351	0.751	0.0	1.6	1.6	259.8	O K
360 min Winter	88.391	0.791	0.0	1.6	1.6	273.4	O K
480 min Winter	88.405	0.805	0.0	1.6	1.6	278.4	O K
600 min Winter	88.408	0.808	0.0	1.6	1.6	279.4	O K
720 min Winter	88.405	0.805	0.0	1.6	1.6	278.3	O K
960 min Winter	88.389	0.789	0.0	1.6	1.6	272.7	O K
1440 min Winter	88.341	0.741	0.0	1.6	1.6	256.2	O K
2160 min Winter	88.271	0.671	0.0	1.6	1.6	231.9	O K
2880 min Winter	88.217	0.617	0.0	1.5	1.5	213.2	O K
4320 min Winter	88.142	0.542	0.0	1.5	1.5	187.3	O K
5760 min Winter	88.081	0.481	0.0	1.4	1.4	166.2	O K
7200 min Winter	88.029	0.429	0.0	1.4	1.4	148.5	O K
8640 min Winter	87.986	0.386	0.0	1.4	1.4	133.5	O K
10080 min Winter	87.948	0.348	0.0	1.4	1.4	120.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	12.105	0.0	241.1	240
360 min Winter	8.748	0.0	245.6	358
480 min Winter	6.879	0.0	247.7	474
600 min Winter	5.690	0.0	248.6	590
720 min Winter	4.864	0.0	248.8	704
960 min Winter	3.790	0.0	248.1	930
1440 min Winter	2.667	0.0	244.2	1356
2160 min Winter	1.886	0.0	391.4	1688
2880 min Winter	1.483	0.0	410.7	2160
4320 min Winter	1.073	0.0	419.3	3068
5760 min Winter	0.862	0.0	477.8	3928
7200 min Winter	0.735	0.0	508.7	4824
8640 min Winter	0.649	0.0	538.8	5624
10080 min Winter	0.587	0.0	568.9	6456

Ardent Consulting Engineers		Page 1
Office 3, Garage Studios, St Mary'...	2007511 - Welwyn Garden City C	
The Lace Market, Nottingham	Tank 2	
NG1 1PU	1 in 2yr	
Date 05/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY ...	Checked by EF	
XP Solutions	Source Control 2020.1	


### Summary of Results for 2 year Return Period

Half Drain Time : 857 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	87.731	0.131	0.0	1.2	1.2	45.2	O K
30 min Summer	87.764	0.164	0.0	1.2	1.2	56.6	O K
60 min Summer	87.795	0.195	0.0	1.3	1.3	67.4	O K
120 min Summer	87.864	0.264	0.0	1.3	1.3	91.4	O K
180 min Summer	87.899	0.299	0.0	1.3	1.3	103.5	O K
240 min Summer	87.919	0.319	0.0	1.3	1.3	110.4	O K
360 min Summer	87.936	0.336	0.0	1.4	1.4	116.2	O K
480 min Summer	87.938	0.338	0.0	1.4	1.4	116.8	O K
600 min Summer	87.933	0.333	0.0	1.4	1.4	115.1	O K
720 min Summer	87.924	0.324	0.0	1.3	1.3	112.2	O K
960 min Summer	87.907	0.307	0.0	1.3	1.3	106.3	O K
1440 min Summer	87.883	0.283	0.0	1.3	1.3	97.8	O K
2160 min Summer	87.858	0.258	0.0	1.3	1.3	89.2	O K
2880 min Summer	87.839	0.239	0.0	1.3	1.3	82.5	O K
4320 min Summer	87.809	0.209	0.0	1.3	1.3	72.2	O K
5760 min Summer	87.785	0.185	0.0	1.3	1.3	64.1	O K
7200 min Summer	87.766	0.166	0.0	1.2	1.2	57.4	O K
8640 min Summer	87.750	0.150	0.0	1.2	1.2	51.9	O K
10080 min Summer	87.737	0.137	0.0	1.2	1.2	47.3	O K
15 min Winter	87.747	0.147	0.0	1.2	1.2	50.8	O K
30 min Winter	87.784	0.184	0.0	1.3	1.3	63.7	O K
60 min Winter	87.820	0.220	0.0	1.3	1.3	76.0	O K
120 min Winter	87.899	0.299	0.0	1.3	1.3	103.5	O K
180 min Winter	87.940	0.340	0.0	1.4	1.4	117.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	36.112	0.0	46.3	19
30 min Summer	22.876	0.0	58.8	34
60 min Summer	13.954	0.0	71.7	64
120 min Summer	9.731	0.0	100.1	122
180 min Summer	7.565	0.0	116.8	182
240 min Summer	6.226	0.0	128.2	242
360 min Summer	4.626	0.0	142.8	362
480 min Summer	3.700	0.0	152.4	480
600 min Summer	3.098	0.0	159.4	600
720 min Summer	2.673	0.0	165.1	674
960 min Summer	2.113	0.0	174.0	782
1440 min Summer	1.517	0.0	187.4	1036
2160 min Summer	1.099	0.0	203.7	1448
2880 min Summer	0.882	0.0	218.0	1848
4320 min Summer	0.661	0.0	244.9	2676
5760 min Summer	0.546	0.0	270.0	3464
7200 min Summer	0.476	0.0	294.4	4248
8640 min Summer	0.429	0.0	317.9	5016
10080 min Summer	0.395	0.0	341.9	5752
15 min Winter	36.112	0.0	51.9	19
30 min Winter	22.876	0.0	65.8	33
60 min Winter	13.954	0.0	80.4	62
120 min Winter	9.731	0.0	112.1	122
180 min Winter	7.565	0.0	130.8	180




Ardent Consulting Engineers		Page 2
Office 3, Garage Studios, St Mary'...	2007511 - Welwyn Garden City C	
The Lace Market, Nottingham	Tank 2	
NG1 1PU	1 in 2yr	
Date 05/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY ...	Checked by EF	
XP Solutions	Source Control 2020.1	

### Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	87.964	0.364	0.0	1.4	1.4	126.0	O K
360 min Winter	87.986	0.386	0.0	1.4	1.4	133.6	O K
480 min Winter	87.992	0.392	0.0	1.4	1.4	135.6	O K
600 min Winter	87.990	0.390	0.0	1.4	1.4	135.0	O K
720 min Winter	87.984	0.384	0.0	1.4	1.4	133.0	O K
960 min Winter	87.967	0.367	0.0	1.4	1.4	126.8	O K
1440 min Winter	87.932	0.332	0.0	1.4	1.4	114.8	O K
2160 min Winter	87.897	0.297	0.0	1.3	1.3	102.8	O K
2880 min Winter	87.867	0.267	0.0	1.3	1.3	92.3	O K
4320 min Winter	87.818	0.218	0.0	1.3	1.3	75.3	O K
5760 min Winter	87.778	0.178	0.0	1.2	1.2	61.6	O K
7200 min Winter	87.746	0.146	0.0	1.2	1.2	50.4	O K
8640 min Winter	87.719	0.119	0.0	1.2	1.2	41.1	O K
10080 min Winter	87.696	0.096	0.0	1.2	1.2	33.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	6.226	0.0	143.5	238
360 min Winter	4.626	0.0	160.0	354
480 min Winter	3.700	0.0	170.6	468
600 min Winter	3.098	0.0	178.6	580
720 min Winter	2.673	0.0	184.9	688
960 min Winter	2.113	0.0	194.9	894
1440 min Winter	1.517	0.0	208.9	1110
2160 min Winter	1.099	0.0	228.2	1560
2880 min Winter	0.882	0.0	244.2	2016
4320 min Winter	0.661	0.0	274.3	2856
5760 min Winter	0.546	0.0	302.3	3696
7200 min Winter	0.476	0.0	329.5	4472
8640 min Winter	0.429	0.0	356.2	5272
10080 min Winter	0.395	0.0	382.9	6048


Ardent		Page 1
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Podium with Pongola lin100yr+40%CC	
Date 30/09/2022 16:11	Designed by BNW	
File 2007511 - Welwyn Garden City	Checked by EF	
Innovyze	Source Control 2020.1	

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

Half Drain Time : 954 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	90.008	0.158	0.0	0.9	0.9	48.1	O K
30 min Summer	90.053	0.203	0.0	0.9	0.9	61.6	O K
60 min Summer	90.096	0.246	0.0	1.0	1.0	74.6	O K
120 min Summer	90.148	0.298	0.0	1.1	1.1	90.4	O K
180 min Summer	90.175	0.325	0.0	1.1	1.1	98.6	O K
240 min Summer	90.189	0.339	0.0	1.1	1.1	103.1	O K
360 min Summer	90.201	0.351	0.0	1.2	1.2	106.6	O K
480 min Summer	90.201	0.351	0.0	1.2	1.2	106.5	O K
600 min Summer	90.195	0.345	0.0	1.2	1.2	104.7	O K
720 min Summer	90.186	0.336	0.0	1.1	1.1	102.2	O K
960 min Summer	90.170	0.320	0.0	1.1	1.1	97.2	O K
1440 min Summer	90.140	0.290	0.0	1.1	1.1	88.1	O K
2160 min Summer	90.104	0.254	0.0	1.0	1.0	77.1	O K
2880 min Summer	90.078	0.228	0.0	1.0	1.0	69.3	O K
4320 min Summer	90.041	0.191	0.0	0.9	0.9	57.9	O K
5760 min Summer	90.013	0.163	0.0	0.9	0.9	49.5	O K
7200 min Summer	89.992	0.142	0.0	0.8	0.8	43.1	O K
8640 min Summer	89.975	0.125	0.0	0.8	0.8	37.9	O K
10080 min Summer	89.961	0.111	0.0	0.8	0.8	33.7	O K
15 min Winter	90.027	0.177	0.0	0.9	0.9	53.9	O K
30 min Winter	90.077	0.227	0.0	1.0	1.0	69.1	O K
60 min Winter	90.126	0.276	0.0	1.1	1.1	83.9	O K
120 min Winter	90.185	0.335	0.0	1.1	1.1	101.9	O K
180 min Winter	90.217	0.367	0.0	1.2	1.2	111.4	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	149.720	0.0	48.7	19
30 min Summer	96.659	0.0	62.9	34
60 min Summer	59.445	0.0	77.4	64
120 min Summer	36.981	0.0	96.4	122
180 min Summer	27.553	0.0	107.7	182
240 min Summer	22.148	0.0	115.5	242
360 min Summer	16.027	0.0	125.3	362
480 min Summer	12.613	0.0	131.5	480
600 min Summer	10.426	0.0	135.9	600
720 min Summer	8.901	0.0	139.2	672
960 min Summer	6.905	0.0	143.0	780
1440 min Summer	4.808	0.0	141.2	1026
2160 min Summer	3.348	0.0	157.1	1432
2880 min Summer	2.598	0.0	162.6	1844
4320 min Summer	1.836	0.0	172.4	2640
5760 min Summer	1.449	0.0	181.3	3456
7200 min Summer	1.216	0.0	190.4	4184
8640 min Summer	1.061	0.0	199.2	4936
10080 min Summer	0.951	0.0	208.4	5744
15 min Winter	149.720	0.0	54.6	19
30 min Winter	96.659	0.0	66.4	33
60 min Winter	59.445	0.0	86.8	62
120 min Winter	36.981	0.0	107.9	122
180 min Winter	27.553	0.0	120.7	180

Ardent		Page 2
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Podium with Pongola lin100yr+40%CC	
Date 30/09/2022 16:11 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	90.234	0.384	0.0	1.2	1.2	116.7	O K
360 min Winter	90.249	0.399	0.0	1.2	1.2	121.3	O K
480 min Winter	90.251	0.401	0.0	1.2	1.2	121.9	O K
600 min Winter	90.247	0.397	0.0	1.2	1.2	120.6	O K
720 min Winter	90.240	0.390	0.0	1.2	1.2	118.3	O K
960 min Winter	90.220	0.370	0.0	1.2	1.2	112.4	O K
1440 min Winter	90.186	0.336	0.0	1.1	1.1	102.0	O K
2160 min Winter	90.141	0.291	0.0	1.1	1.1	88.4	O K
2880 min Winter	90.104	0.254	0.0	1.0	1.0	77.3	O K
4320 min Winter	90.052	0.202	0.0	0.9	0.9	61.4	O K
5760 min Winter	90.013	0.163	0.0	0.9	0.9	49.5	O K
7200 min Winter	89.984	0.134	0.0	0.8	0.8	40.6	O K
8640 min Winter	89.960	0.110	0.0	0.8	0.8	33.5	O K
10080 min Winter	89.942	0.092	0.0	0.7	0.7	27.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	22.148	0.0	129.3	238
360 min Winter	16.027	0.0	140.4	354
480 min Winter	12.613	0.0	147.3	468
600 min Winter	10.426	0.0	151.4	578
720 min Winter	8.901	0.0	152.5	686
960 min Winter	6.905	0.0	152.9	884
1440 min Winter	4.808	0.0	150.5	1096
2160 min Winter	3.348	0.0	176.1	1556
2880 min Winter	2.598	0.0	182.1	1992
4320 min Winter	1.836	0.0	193.1	2852
5760 min Winter	1.449	0.0	203.2	3640
7200 min Winter	1.216	0.0	213.2	4464
8640 min Winter	1.061	0.0	223.2	5192
10080 min Winter	0.951	0.0	233.2	5952

Ardent		Page 3
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Podium with Pongola lin100yr+40%CC	
Date 30/09/2022 16:11 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	


#### Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 523970 213285 TL 23970 13285	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

#### Time Area Diagram

Total Area (ha) 0.174

Time (mins)	Area
From:	To: (ha)
0	4 0.174

Ardent		Page 4
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Podium with Pongola lin100yr+40%CC	
Date 30/09/2022 16:11 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

#### Model Details

Storage is Online Cover Level (m) 90.750

#### Cellular Storage Structure


Invert Level (m) 89.850 Safety Factor 2.0  
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	319.8	319.8	0.450	319.8	352.0	0.451	0.0	352.0

#### Orifice Outflow Control

Diameter (m) 0.029 Discharge Coefficient 0.600 Invert Level (m) 89.750



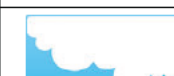
Ardent		Page 1
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Podium with Pongola lin30yr	
Date 30/09/2022 16:12 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

### Summary of Results for 30 year Return Period

Half Drain Time : 608 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	89.936	0.086	0.0	0.7	0.7	26.2	O K
30 min Summer	89.959	0.109	0.0	0.8	0.8	33.2	O K
60 min Summer	89.981	0.131	0.0	0.8	0.8	39.7	O K
120 min Summer	90.007	0.157	0.0	0.9	0.9	47.7	O K
180 min Summer	90.019	0.169	0.0	0.9	0.9	51.3	O K
240 min Summer	90.024	0.174	0.0	0.9	0.9	52.8	O K
360 min Summer	90.024	0.174	0.0	0.9	0.9	52.9	O K
480 min Summer	90.019	0.169	0.0	0.9	0.9	51.3	O K
600 min Summer	90.013	0.163	0.0	0.9	0.9	49.5	O K
720 min Summer	90.007	0.157	0.0	0.9	0.9	47.6	O K
960 min Summer	89.995	0.145	0.0	0.8	0.8	44.1	O K
1440 min Summer	89.979	0.129	0.0	0.8	0.8	39.0	O K
2160 min Summer	89.960	0.110	0.0	0.8	0.8	33.5	O K
2880 min Summer	89.946	0.096	0.0	0.7	0.7	29.1	O K
4320 min Summer	89.924	0.074	0.0	0.7	0.7	22.5	O K
5760 min Summer	89.908	0.058	0.0	0.7	0.7	17.7	O K
7200 min Summer	89.896	0.046	0.0	0.6	0.6	14.0	O K
8640 min Summer	89.887	0.037	0.0	0.6	0.6	11.1	O K
10080 min Summer	89.879	0.029	0.0	0.6	0.6	8.9	O K
15 min Winter	89.947	0.097	0.0	0.7	0.7	29.5	O K
30 min Winter	89.973	0.123	0.0	0.8	0.8	37.4	O K
60 min Winter	89.997	0.147	0.0	0.8	0.8	44.7	O K
120 min Winter	90.028	0.178	0.0	0.9	0.9	54.0	O K
180 min Winter	90.042	0.192	0.0	0.9	0.9	58.3	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	82.569	0.0	26.8	19
30 min Summer	52.959	0.0	34.4	34
60 min Summer	32.340	0.0	42.0	64
120 min Summer	20.264	0.0	52.7	122
180 min Summer	15.080	0.0	58.8	182
240 min Summer	12.105	0.0	63.1	242
360 min Summer	8.748	0.0	68.4	360
480 min Summer	6.879	0.0	71.6	448
600 min Summer	5.690	0.0	74.1	500
720 min Summer	4.864	0.0	76.0	560
960 min Summer	3.790	0.0	79.0	686
1440 min Summer	2.667	0.0	83.3	956
2160 min Summer	1.886	0.0	88.5	1364
2880 min Summer	1.483	0.0	92.8	1760
4320 min Summer	1.073	0.0	100.6	2552
5760 min Summer	0.862	0.0	107.9	3288
7200 min Summer	0.735	0.0	114.8	4032
8640 min Summer	0.649	0.0	121.7	4760
10080 min Summer	0.587	0.0	128.5	5448
15 min Winter	82.569	0.0	30.0	19
30 min Winter	52.959	0.0	38.6	33
60 min Winter	32.340	0.0	47.1	62
120 min Winter	20.264	0.0	59.1	120
180 min Winter	15.080	0.0	66.0	178

Ardent		Page 2
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Podium with Pongola lin30yr	
Date 30/09/2022 16:12 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze Source Control 2020.1		

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	90.048	0.198	0.0	0.9	0.9	60.3	O K
360 min Winter	90.051	0.201	0.0	0.9	0.9	61.0	O K
480 min Winter	90.047	0.197	0.0	0.9	0.9	59.8	O K
600 min Winter	90.040	0.190	0.0	0.9	0.9	57.8	O K
720 min Winter	90.033	0.183	0.0	0.9	0.9	55.6	O K
960 min Winter	90.020	0.170	0.0	0.9	0.9	51.8	O K
1440 min Winter	89.997	0.147	0.0	0.8	0.8	44.7	O K
2160 min Winter	89.972	0.122	0.0	0.8	0.8	36.9	O K
2880 min Winter	89.951	0.101	0.0	0.8	0.8	30.6	O K
4320 min Winter	89.920	0.070	0.0	0.7	0.7	21.2	O K
5760 min Winter	89.898	0.048	0.0	0.6	0.6	14.5	O K
7200 min Winter	89.881	0.031	0.0	0.6	0.6	9.6	O K
8640 min Winter	89.869	0.019	0.0	0.6	0.6	5.9	O K
10080 min Winter	89.860	0.010	0.0	0.5	0.5	3.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	12.105	0.0	70.6	236
360 min Winter	8.748	0.0	76.6	350
480 min Winter	6.879	0.0	80.3	458
600 min Winter	5.690	0.0	83.0	560
720 min Winter	4.864	0.0	85.2	588
960 min Winter	3.790	0.0	88.5	732
1440 min Winter	2.667	0.0	93.4	1038
2160 min Winter	1.886	0.0	99.1	1472
2880 min Winter	1.483	0.0	103.9	1900
4320 min Winter	1.073	0.0	112.8	2684
5760 min Winter	0.862	0.0	120.8	3456
7200 min Winter	0.735	0.0	128.7	4184
8640 min Winter	0.649	0.0	136.3	4920
10080 min Winter	0.587	0.0	144.0	5552


Ardent		Page 1
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Podium with Pongola 1in2yr	
Date 30/09/2022 16:13 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

### Summary of Results for 2 year Return Period

Half Drain Time : 339 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	89.887	0.037	0.0	0.6	0.6	11.2	O K
30 min Summer	89.895	0.045	0.0	0.6	0.6	13.8	O K
60 min Summer	89.903	0.053	0.0	0.7	0.7	16.0	O K
120 min Summer	89.919	0.069	0.0	0.7	0.7	21.0	O K
180 min Summer	89.926	0.076	0.0	0.7	0.7	23.0	O K
240 min Summer	89.928	0.078	0.0	0.7	0.7	23.6	O K
360 min Summer	89.927	0.077	0.0	0.7	0.7	23.3	O K
480 min Summer	89.924	0.074	0.0	0.7	0.7	22.4	O K
600 min Summer	89.921	0.071	0.0	0.7	0.7	21.5	O K
720 min Summer	89.918	0.068	0.0	0.7	0.7	20.7	O K
960 min Summer	89.913	0.063	0.0	0.7	0.7	19.1	O K
1440 min Summer	89.904	0.054	0.0	0.7	0.7	16.4	O K
2160 min Summer	89.893	0.043	0.0	0.6	0.6	13.1	O K
2880 min Summer	89.884	0.034	0.0	0.6	0.6	10.4	O K
4320 min Summer	89.872	0.022	0.0	0.6	0.6	6.7	O K
5760 min Summer	89.864	0.014	0.0	0.6	0.6	4.2	O K
7200 min Summer	89.858	0.008	0.0	0.5	0.5	2.5	O K
8640 min Summer	89.854	0.004	0.0	0.5	0.5	1.3	O K
10080 min Summer	89.852	0.002	0.0	0.5	0.5	0.5	O K
15 min Winter	89.891	0.041	0.0	0.6	0.6	12.6	O K
30 min Winter	89.901	0.051	0.0	0.6	0.6	15.6	O K
60 min Winter	89.910	0.060	0.0	0.7	0.7	18.2	O K
120 min Winter	89.929	0.079	0.0	0.7	0.7	24.0	O K
180 min Winter	89.937	0.087	0.0	0.7	0.7	26.6	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	36.112	0.0	11.6	18
30 min Summer	22.876	0.0	14.8	33
60 min Summer	13.954	0.0	18.0	62
120 min Summer	9.731	0.0	25.2	122
180 min Summer	7.565	0.0	29.4	180
240 min Summer	6.226	0.0	32.3	240
360 min Summer	4.626	0.0	36.1	302
480 min Summer	3.700	0.0	38.5	364
600 min Summer	3.098	0.0	40.3	428
720 min Summer	2.673	0.0	41.7	498
960 min Summer	2.113	0.0	44.0	636
1440 min Summer	1.517	0.0	47.4	908
2160 min Summer	1.099	0.0	51.5	1300
2880 min Summer	0.882	0.0	55.1	1676
4320 min Summer	0.661	0.0	61.9	2420
5760 min Summer	0.546	0.0	68.3	3120
7200 min Summer	0.476	0.0	74.4	3824
8640 min Summer	0.429	0.0	80.5	4496
10080 min Summer	0.395	0.0	86.6	5152
15 min Winter	36.112	0.0	13.0	18
30 min Winter	22.876	0.0	16.6	33
60 min Winter	13.954	0.0	20.2	62
120 min Winter	9.731	0.0	28.3	120
180 min Winter	7.565	0.0	33.0	176

Ardent		Page 2
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Podium with Pongola 1in2yr	
Date 30/09/2022 16:13 File 2007511 - Welwyn Garden City	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	89.941	0.091	0.0	0.7	0.7	27.6	O K
360 min Winter	89.941	0.091	0.0	0.7	0.7	27.5	O K
480 min Winter	89.937	0.087	0.0	0.7	0.7	26.5	O K
600 min Winter	89.933	0.083	0.0	0.7	0.7	25.3	O K
720 min Winter	89.929	0.079	0.0	0.7	0.7	24.1	O K
960 min Winter	89.922	0.072	0.0	0.7	0.7	21.9	O K
1440 min Winter	89.909	0.059	0.0	0.7	0.7	17.8	O K
2160 min Winter	89.892	0.042	0.0	0.6	0.6	12.9	O K
2880 min Winter	89.880	0.030	0.0	0.6	0.6	9.1	O K
4320 min Winter	89.863	0.013	0.0	0.6	0.6	3.8	O K
5760 min Winter	89.853	0.003	0.0	0.5	0.5	0.8	O K
7200 min Winter	89.850	0.000	0.0	0.5	0.5	0.0	O K
8640 min Winter	89.850	0.000	0.0	0.4	0.4	0.0	O K
10080 min Winter	89.850	0.000	0.0	0.4	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	6.226	0.0	36.3	232
360 min Winter	4.626	0.0	40.4	338
480 min Winter	3.700	0.0	43.1	384
600 min Winter	3.098	0.0	45.1	460
720 min Winter	2.673	0.0	46.8	536
960 min Winter	2.113	0.0	49.3	690
1440 min Winter	1.517	0.0	53.0	980
2160 min Winter	1.099	0.0	57.7	1388
2880 min Winter	0.882	0.0	61.7	1784
4320 min Winter	0.661	0.0	69.3	2504
5760 min Winter	0.546	0.0	76.7	3112
7200 min Winter	0.476	0.0	83.5	0
8640 min Winter	0.429	0.0	90.3	0
10080 min Winter	0.395	0.0	97.0	0


Ardent		Page 1
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Permavoid 1in100yr+40%CC	
Date 27/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY	Checked by EF	
Innovyze	Source Control 2020.1	

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

Half Drain Time : 199 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	86.547	0.177	0.0	1.6	1.6	25.7	O K
30 min Summer	86.593	0.223	0.0	1.8	1.8	32.4	O K
60 min Summer	86.632	0.262	0.0	1.9	1.9	38.1	Flood Risk
120 min Summer	86.670	0.300	0.0	2.1	2.1	43.5	Flood Risk
180 min Summer	86.900	0.530	0.0	2.8	2.8	44.1	FLOOD
240 min Summer	86.900	0.530	0.0	2.8	2.8	44.4	FLOOD
360 min Summer	86.900	0.530	0.0	2.8	2.8	43.9	FLOOD
480 min Summer	86.665	0.295	0.0	2.1	2.1	42.8	Flood Risk
600 min Summer	86.652	0.282	0.0	2.0	2.0	40.9	Flood Risk
720 min Summer	86.638	0.268	0.0	2.0	2.0	39.0	Flood Risk
960 min Summer	86.613	0.243	0.0	1.9	1.9	35.2	Flood Risk
1440 min Summer	86.571	0.201	0.0	1.7	1.7	29.2	O K
2160 min Summer	86.527	0.157	0.0	1.5	1.5	22.8	O K
2880 min Summer	86.498	0.128	0.0	1.3	1.3	18.5	O K
4320 min Summer	86.462	0.092	0.0	1.1	1.1	13.3	O K
5760 min Summer	86.442	0.072	0.0	0.9	0.9	10.4	O K
7200 min Summer	86.430	0.060	0.0	0.8	0.8	8.7	O K
8640 min Summer	86.422	0.052	0.0	0.8	0.8	7.6	O K
10080 min Summer	86.418	0.048	0.0	0.7	0.7	7.0	O K
15 min Winter	86.568	0.198	0.0	1.7	1.7	28.8	O K
30 min Winter	86.621	0.251	0.0	1.9	1.9	36.4	Flood Risk
60 min Winter	86.665	0.295	0.0	2.1	2.1	42.9	Flood Risk
120 min Winter	86.904	0.534	0.0	2.8	2.8	48.1	FLOOD
180 min Winter	86.906	0.536	0.0	2.8	2.8	49.4	FLOOD

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	149.720	0.0	26.6	18
30 min Summer	96.659	0.0	34.4	33
60 min Summer	59.445	0.0	42.3	62
120 min Summer	36.981	0.0	52.6	120
180 min Summer	27.553	0.4	58.8	140
240 min Summer	22.148	0.7	63.1	172
360 min Summer	16.027	0.3	68.4	240
480 min Summer	12.613	0.0	71.8	322
600 min Summer	10.426	0.0	74.2	390
720 min Summer	8.901	0.0	76.0	458
960 min Summer	6.905	0.0	78.6	594
1440 min Summer	4.808	0.0	82.1	852
2160 min Summer	3.348	0.0	85.8	1232
2880 min Summer	2.598	0.0	88.8	1588
4320 min Summer	1.836	0.0	94.1	2296
5760 min Summer	1.449	0.0	99.0	3008
7200 min Summer	1.216	0.0	103.9	3744
8640 min Summer	1.061	0.0	108.8	4416
10080 min Summer	0.951	0.0	113.7	5144
15 min Winter	149.720	0.0	29.8	18
30 min Winter	96.659	0.0	38.5	32
60 min Winter	59.445	0.0	47.4	60
120 min Winter	36.981	4.5	58.9	116
180 min Winter	27.553	5.8	65.9	150


Ardent		Page 2
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Permavoid 1in100yr+40%CC	
Date 27/10/2022 File 2007511 - WELWYN GARDEN CITY	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

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

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
240 min Winter	86.906	0.536	0.0	2.8	2.8	49.7	FLOOD
360 min Winter	86.904	0.534	0.0	2.8	2.8	48.2	FLOOD
480 min Winter	86.902	0.532	0.0	2.8	2.8	45.9	FLOOD
600 min Winter	86.900	0.530	0.0	2.8	2.8	44.0	FLOOD
720 min Winter	86.661	0.291	0.0	2.0	2.0	42.2	Flood Risk
960 min Winter	86.626	0.256	0.0	1.9	1.9	37.1	Flood Risk
1440 min Winter	86.570	0.200	0.0	1.7	1.7	29.1	O K
2160 min Winter	86.515	0.145	0.0	1.4	1.4	21.0	O K
2880 min Winter	86.480	0.110	0.0	1.2	1.2	16.0	O K
4320 min Winter	86.442	0.072	0.0	0.9	0.9	10.4	O K
5760 min Winter	86.423	0.053	0.0	0.8	0.8	7.7	O K
7200 min Winter	86.416	0.046	0.0	0.7	0.7	6.6	O K
8640 min Winter	86.411	0.041	0.0	0.6	0.6	5.9	O K
10080 min Winter	86.407	0.037	0.0	0.5	0.5	5.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	22.148	6.1	70.6	186
360 min Winter	16.027	4.6	76.7	262
480 min Winter	12.613	2.3	80.5	334
600 min Winter	10.426	0.3	83.1	400
720 min Winter	8.901	0.0	85.2	494
960 min Winter	6.905	0.0	88.1	636
1440 min Winter	4.808	0.0	92.0	906
2160 min Winter	3.348	0.0	96.1	1280
2880 min Winter	2.598	0.0	99.4	1644
4320 min Winter	1.836	0.0	105.4	2336
5760 min Winter	1.449	0.0	110.9	3008
7200 min Winter	1.216	0.0	116.4	3680
8640 min Winter	1.061	0.0	121.9	4488
10080 min Winter	0.951	0.0	127.4	5152



Ardent		Page 3
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Permavoid lin100yr+40%CC	
Date 27/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY	Checked by EF	
Innovyze	Source Control 2020.1	

#### Rainfall Details


Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 523970 213285 TL 23970 13285	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

#### Time Area Diagram

Total Area (ha) 0.095

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

0	4 0.095
---	---------

Ardent		Page 4
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Permavoid 1in100yr+40%CC	
Date 27/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY	Checked by EF	
Innovyze	Source Control 2020.1	

#### Model Details

Storage is Online Cover Level (m) 86.900


#### Cellular Storage Structure

Invert Level (m) 86.370 Safety Factor 2.0  
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	152.9	152.9	0.300	152.9	167.7	0.301	0.0	167.8

#### Orifice Outflow Control

Diameter (m) 0.043 Discharge Coefficient 0.600 Invert Level (m) 86.360


Ardent		Page 1
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Permavoid 1in30yr	
Date 27/10/2022 File 2007511 - WELWYN GARDEN CITY	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

### Summary of Results for 30 year Return Period

Half Drain Time : 176 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	86.467	0.097	0.0	1.1	1.1	14.0	O K
30 min Summer	86.490	0.120	0.0	1.3	1.3	17.5	O K
60 min Summer	86.509	0.139	0.0	1.4	1.4	20.1	O K
120 min Summer	86.526	0.156	0.0	1.5	1.5	22.6	O K
180 min Summer	86.530	0.160	0.0	1.5	1.5	23.3	O K
240 min Summer	86.531	0.161	0.0	1.5	1.5	23.3	O K
360 min Summer	86.526	0.156	0.0	1.5	1.5	22.6	O K
480 min Summer	86.518	0.148	0.0	1.4	1.4	21.5	O K
600 min Summer	86.510	0.140	0.0	1.4	1.4	20.4	O K
720 min Summer	86.502	0.132	0.0	1.3	1.3	19.2	O K
960 min Summer	86.488	0.118	0.0	1.3	1.3	17.2	O K
1440 min Summer	86.467	0.097	0.0	1.1	1.1	14.0	O K
2160 min Summer	86.446	0.076	0.0	1.0	1.0	11.0	O K
2880 min Summer	86.432	0.062	0.0	0.9	0.9	9.1	O K
4320 min Summer	86.419	0.049	0.0	0.7	0.7	7.1	O K
5760 min Summer	86.412	0.042	0.0	0.6	0.6	6.1	O K
7200 min Summer	86.407	0.037	0.0	0.5	0.5	5.4	O K
8640 min Summer	86.404	0.034	0.0	0.5	0.5	5.0	O K
10080 min Summer	86.402	0.032	0.0	0.4	0.4	4.6	O K
15 min Winter	86.478	0.108	0.0	1.2	1.2	15.8	O K
30 min Winter	86.505	0.135	0.0	1.4	1.4	19.7	O K
60 min Winter	86.526	0.156	0.0	1.5	1.5	22.7	O K
120 min Winter	86.547	0.177	0.0	1.6	1.6	25.7	O K
180 min Winter	86.551	0.181	0.0	1.6	1.6	26.2	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	82.569	0.0	14.6	18
30 min Summer	52.959	0.0	18.8	33
60 min Summer	32.340	0.0	23.0	62
120 min Summer	20.264	0.0	28.8	112
180 min Summer	15.080	0.0	32.2	140
240 min Summer	12.105	0.0	34.4	172
360 min Summer	8.748	0.0	37.3	242
480 min Summer	6.879	0.0	39.1	310
600 min Summer	5.690	0.0	40.5	378
720 min Summer	4.864	0.0	41.5	442
960 min Summer	3.790	0.0	43.1	576
1440 min Summer	2.667	0.0	45.5	824
2160 min Summer	1.886	0.0	48.3	1192
2880 min Summer	1.483	0.0	50.6	1556
4320 min Summer	1.073	0.0	54.9	2248
5760 min Summer	0.862	0.0	58.9	2992
7200 min Summer	0.735	0.0	62.7	3680
8640 min Summer	0.649	0.0	66.5	4416
10080 min Summer	0.587	0.0	70.2	5144
15 min Winter	82.569	0.0	16.4	18
30 min Winter	52.959	0.0	21.1	32
60 min Winter	32.340	0.0	25.7	60
120 min Winter	20.264	0.0	32.3	116
180 min Winter	15.080	0.0	36.0	146

Ardent		Page 2
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Permavoid 1in30yr	
Date 27/10/2022 File 2007511 - WELWYN GARDEN CITY	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	86.550	0.180	0.0	1.6	1.6	26.2	O K
360 min Winter	86.542	0.172	0.0	1.5	1.5	25.0	O K
480 min Winter	86.531	0.161	0.0	1.5	1.5	23.4	O K
600 min Winter	86.519	0.149	0.0	1.4	1.4	21.7	O K
720 min Winter	86.508	0.138	0.0	1.4	1.4	20.1	O K
960 min Winter	86.489	0.119	0.0	1.3	1.3	17.3	O K
1440 min Winter	86.461	0.091	0.0	1.1	1.1	13.2	O K
2160 min Winter	86.435	0.065	0.0	0.9	0.9	9.5	O K
2880 min Winter	86.422	0.052	0.0	0.8	0.8	7.5	O K
4320 min Winter	86.410	0.040	0.0	0.6	0.6	5.8	O K
5760 min Winter	86.404	0.034	0.0	0.5	0.5	4.9	O K
7200 min Winter	86.400	0.030	0.0	0.4	0.4	4.4	O K
8640 min Winter	86.397	0.027	0.0	0.4	0.4	3.9	O K
10080 min Winter	86.395	0.025	0.0	0.3	0.3	3.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	12.105	0.0	38.6	184
360 min Winter	8.748	0.0	41.8	260
480 min Winter	6.879	0.0	43.8	334
600 min Winter	5.690	0.0	45.3	404
720 min Winter	4.864	0.0	46.5	476
960 min Winter	3.790	0.0	48.3	608
1440 min Winter	2.667	0.0	51.0	866
2160 min Winter	1.886	0.0	54.1	1232
2880 min Winter	1.483	0.0	56.7	1556
4320 min Winter	1.073	0.0	61.6	2288
5760 min Winter	0.862	0.0	66.0	2992
7200 min Winter	0.735	0.0	70.3	3736
8640 min Winter	0.649	0.0	74.5	4416
10080 min Winter	0.587	0.0	78.6	5144


Ardent		Page 1
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Permavoid lin2yr	
Date 27/10/2022	Designed by BNW	
File 2007511 - WELWYN GARDEN CITY	Checked by EF	
Innovyze	Source Control 2020.1	

### Summary of Results for 2 year Return Period

Half Drain Time : 132 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	86.412	0.042	0.0	0.6	0.6	6.1	O K
30 min Summer	86.421	0.051	0.0	0.8	0.8	7.4	O K
60 min Summer	86.427	0.057	0.0	0.8	0.8	8.3	O K
120 min Summer	86.441	0.071	0.0	0.9	0.9	10.3	O K
180 min Summer	86.446	0.076	0.0	1.0	1.0	11.1	O K
240 min Summer	86.448	0.078	0.0	1.0	1.0	11.4	O K
360 min Summer	86.447	0.077	0.0	1.0	1.0	11.2	O K
480 min Summer	86.444	0.074	0.0	1.0	1.0	10.8	O K
600 min Summer	86.441	0.071	0.0	0.9	0.9	10.3	O K
720 min Summer	86.437	0.067	0.0	0.9	0.9	9.7	O K
960 min Summer	86.431	0.061	0.0	0.9	0.9	8.8	O K
1440 min Summer	86.421	0.051	0.0	0.8	0.8	7.4	O K
2160 min Summer	86.413	0.043	0.0	0.6	0.6	6.3	O K
2880 min Summer	86.408	0.038	0.0	0.5	0.5	5.5	O K
4320 min Summer	86.402	0.032	0.0	0.4	0.4	4.6	O K
5760 min Summer	86.398	0.028	0.0	0.4	0.4	4.1	O K
7200 min Summer	86.396	0.026	0.0	0.3	0.3	3.7	O K
8640 min Summer	86.394	0.024	0.0	0.3	0.3	3.5	O K
10080 min Summer	86.392	0.022	0.0	0.3	0.3	3.2	O K
15 min Winter	86.417	0.047	0.0	0.7	0.7	6.8	O K
30 min Winter	86.427	0.057	0.0	0.8	0.8	8.3	O K
60 min Winter	86.435	0.065	0.0	0.9	0.9	9.4	O K
120 min Winter	86.450	0.080	0.0	1.0	1.0	11.6	O K
180 min Winter	86.455	0.085	0.0	1.0	1.0	12.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	36.112	0.0	6.4	18
30 min Summer	22.876	0.0	8.1	32
60 min Summer	13.954	0.0	9.9	60
120 min Summer	9.731	0.0	13.8	96
180 min Summer	7.565	0.0	16.1	128
240 min Summer	6.226	0.0	17.7	162
360 min Summer	4.626	0.0	19.7	232
480 min Summer	3.700	0.0	21.0	298
600 min Summer	3.098	0.0	22.0	364
720 min Summer	2.673	0.0	22.8	428
960 min Summer	2.113	0.0	24.0	558
1440 min Summer	1.517	0.0	25.9	796
2160 min Summer	1.099	0.0	28.1	1168
2880 min Summer	0.882	0.0	30.1	1528
4320 min Summer	0.661	0.0	33.8	2252
5760 min Summer	0.546	0.0	37.3	3000
7200 min Summer	0.476	0.0	40.6	3744
8640 min Summer	0.429	0.0	43.9	4488
10080 min Summer	0.395	0.0	47.2	5152
15 min Winter	36.112	0.0	7.1	18
30 min Winter	22.876	0.0	9.1	32
60 min Winter	13.954	0.0	11.1	60
120 min Winter	9.731	0.0	15.5	100
180 min Winter	7.565	0.0	18.0	138

Ardent		Page 2
3rd Floor, The Hallmark Building 52-56 LeadenHall Street London, EC3M 5JE	2007511 - Welwyn Garden City C Permavoid 1in2yr	
Date 27/10/2022 File 2007511 - WELWYN GARDEN CITY	Designed by BNW Checked by EF	
Innovyze	Source Control 2020.1	

Summary of Results for 2 year Return Period

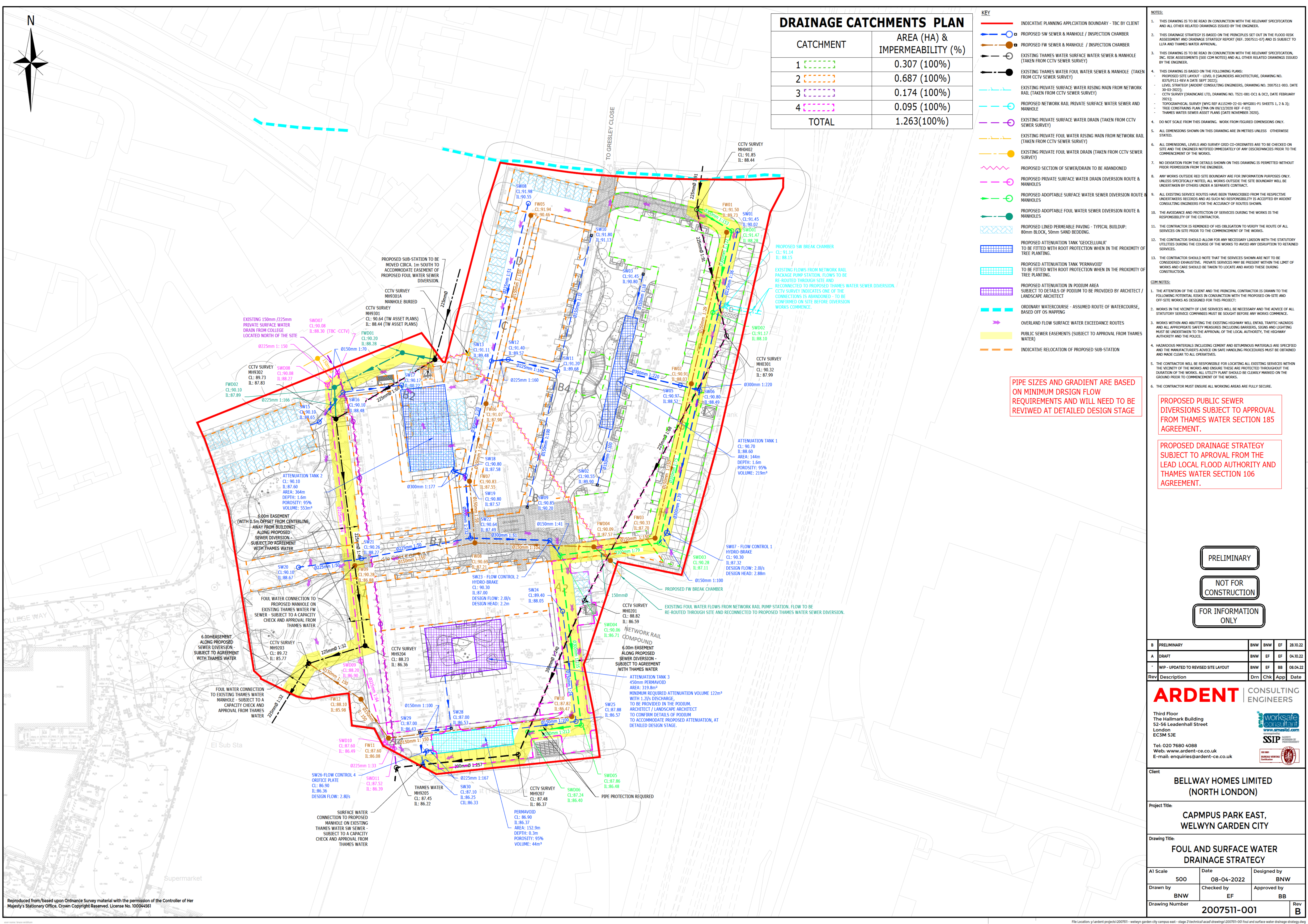
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	86.456	0.086	0.0	1.1	1.1	12.6	O K
360 min Winter	86.454	0.084	0.0	1.0	1.0	12.1	O K
480 min Winter	86.448	0.078	0.0	1.0	1.0	11.4	O K
600 min Winter	86.443	0.073	0.0	1.0	1.0	10.6	O K
720 min Winter	86.438	0.068	0.0	0.9	0.9	9.8	O K
960 min Winter	86.429	0.059	0.0	0.8	0.8	8.5	O K
1440 min Winter	86.418	0.048	0.0	0.7	0.7	6.9	O K
2160 min Winter	86.409	0.039	0.0	0.6	0.6	5.6	O K
2880 min Winter	86.403	0.033	0.0	0.5	0.5	4.8	O K
4320 min Winter	86.397	0.027	0.0	0.4	0.4	3.9	O K
5760 min Winter	86.393	0.023	0.0	0.3	0.3	3.3	O K
7200 min Winter	86.390	0.020	0.0	0.3	0.3	2.9	O K
8640 min Winter	86.388	0.018	0.0	0.2	0.2	2.6	O K
10080 min Winter	86.387	0.017	0.0	0.2	0.2	2.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	6.226	0.0	19.8	176
360 min Winter	4.626	0.0	22.1	250
480 min Winter	3.700	0.0	23.6	320
600 min Winter	3.098	0.0	24.6	388
720 min Winter	2.673	0.0	25.5	456
960 min Winter	2.113	0.0	26.9	580
1440 min Winter	1.517	0.0	29.0	824
2160 min Winter	1.099	0.0	31.5	1192
2880 min Winter	0.882	0.0	33.7	1560
4320 min Winter	0.661	0.0	37.9	2296
5760 min Winter	0.546	0.0	41.8	3056
7200 min Winter	0.476	0.0	45.5	3744
8640 min Winter	0.429	0.0	49.2	4488
10080 min Winter	0.395	0.0	52.9	5152



**Appendix G**  
**Surface and Foul Water Drainage Strategy Plan**





DRAINAGE CATCHMENTS PLAN	
CATCHMENT	AREA (HA) & IMPERMEABILITY (%)
1	0.307 (100%)
2	0.687 (100%)
3	0.174 (100%)
4	0.095 (100%)
TOTAL	1.263(100%)

- KEY**
- INDICATIVE PLANNING APPLICATION BOUNDARY - TBC BY CLIENT
  - PROPOSED SW SEWER & MANHOLE / INSPECTION CHAMBER
  - PROPOSED FW SEWER & MANHOLE / INSPECTION CHAMBER
  - EXISTING THAMES WATER SURFACE WATER SEWER & MANHOLE (TAKEN FROM CCTV SEWER SURVEY)
  - EXISTING THAMES WATER FOUL WATER SEWER & MANHOLE (TAKEN FROM CCTV SEWER SURVEY)
  - EXISTING PRIVATE SURFACE WATER RISING MAIN FROM NETWORK RAIL (TAKEN FROM CCTV SEWER SURVEY)
  - PROPOSED NETWORK RAIL PRIVATE SURFACE WATER SEWER AND MANHOLE
  - EXISTING PRIVATE SURFACE WATER DRAIN (TAKEN FROM CCTV SEWER SURVEY)
  - EXISTING PRIVATE FOUL WATER RISING MAIN FROM NETWORK RAIL (TAKEN FROM CCTV SEWER SURVEY)
  - EXISTING PRIVATE FOUL WATER DRAIN (TAKEN FROM CCTV SEWER SURVEY)
  - PROPOSED SECTION OF SEWER/DRAIN TO BE ABANDONED
  - PROPOSED PRIVATE SURFACE WATER DRAIN DIVERSION ROUTE & MANHOLES
  - PROPOSED ADAPTABLE SURFACE WATER SEWER DIVERSION ROUTE & MANHOLES
  - PROPOSED ADAPTABLE FOUL WATER SEWER DIVERSION ROUTE & MANHOLES
  - PROPOSED LINED PERMEABLE PAVING - TYPICAL BUILDUP: 80mm BLOCK, 50mm SAND BEDDING.
  - PROPOSED ATTENUATION TANK 'GEOCELLULAR' TO BE FITTED WITH ROOT PROTECTION WHEN IN THE PROXIMITY OF TREE PLANTING.
  - PROPOSED ATTENUATION TANK 'PERMAVOID' TO BE FITTED WITH ROOT PROTECTION WHEN IN THE PROXIMITY OF TREE PLANTING.
  - PROPOSED ATTENUATION IN PODIUM AREA SUBJECT TO DETAILS OF PODIUM TO BE PROVIDED BY ARCHITECT / LANDSCAPE ARCHITECT
  - ORDINARY WATERCOURSE - ASSUMED ROUTE OF WATERCOURSE, BASED OFF OS MAPPING
  - OVERLAND FLOW SURFACE WATER EXCEEDANCE ROUTES
  - PUBLIC SEWER EASEMENTS (SUBJECT TO APPROVAL FROM THAMES WATER)
  - INDICATIVE RELOCATION OF PROPOSED SUB-STATION

PIPE SIZES AND GRADIENT ARE BASED ON MINIMUM DRSN FLOW REQUIREMENTS AND WILL NEED TO BE REVIED AT DETAILED DESIGN STAGE

- NOTES:**
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
  - THIS DRAINAGE STRATEGY IS BASED ON THE PRINCIPLES SET OUT IN THE FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY REPORT (REF: 2007511-07) AND IS SUBJECT TO LFA AND THAMES WATER APPROVAL.
  - THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION, INC. RISK ASSESSMENTS (SEE COM NOTES) AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
  - THIS DRAWING IS BASED ON THE FOLLOWING PLANS:
    - PROPOSED SITE LAYOUT - LEVEL 0 (SAUNDERS ARCHITECTURE, DRAWING NO. 8375/P11-REV A DATE SEPT 2022);
    - LEVEL STRATEGY (ARDENT CONSULTING ENGINEERS, DRAWING NO. 2007511-003, DATE 30-03-2023);
    - CCTV SURVEY (DRAINAGE LTD, DRAWING NO. TS21-081-DC1 & DC2, DATE FEBRUARY 2021);
    - TOPOGRAPHICAL SURVEY (WYG REF A115249-22-01-WY001-P1 SHEETS 1, 2 & 3);
    - TREE CONSTRAINTS PLAN (TMA ON 09/12/2020 REF-F-02);
    - THAMES WATER SEWER ASSET PLANS (DATE NOVEMBER 2020).
  - DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY.
  - ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES UNLESS OTHERWISE STATED.
  - ALL DIMENSIONS, LEVELS AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS.
  - NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.
  - ANY WORKS OUTSIDE RED SITE BOUNDARY ARE FOR INFORMATION PURPOSES ONLY. UNLESS SPECIFICALLY NOTED, ALL WORKS OUTSIDE THE SITE BOUNDARY WILL BE UNDERTAKEN BY OTHERS UNDER A SEPARATE CONTRACT.
  - ALL EXISTING SERVICE ROUTES HAVE BEEN TRANSFERRED FROM THE RESPECTIVE UNDERTAKERS RECORDS AND AS SUCH NO RESPONSIBILITY IS ACCEPTED BY ARDENT CONSULTING ENGINEERS FOR THE ACCURACY OF ROUTES SHOWN.
  - THE AVOIDANCE AND PROTECTION OF SERVICES DURING THE WORKS IS THE RESPONSIBILITY OF THE CONTRACTOR.
  - THE CONTRACTOR IS REMOVED OF HIS OBLIGATION TO VERIFY THE ROUTE OF ALL SERVICES ON SITE PRIOR TO THE COMMENCEMENT OF THE WORKS.
  - THE CONTRACTOR SHOULD ALLOW FOR ANY NECESSARY LIAISON WITH THE STATUTORY UTILITIES DURING THE COURSE OF THE WORKS TO AVOID ANY DISRUPTION TO RETAINED SERVICES.
  - THE CONTRACTOR SHOULD NOTE THAT THE SERVICES SHOWN ARE NOT TO BE CONSIDERED EXHAUSTIVE. PRIVATE SERVICES MAY BE PRESENT WITHIN THE LIMIT OF WORKS AND CARE SHOULD BE TAKEN TO LOCATE AND AVOID THESE DURING CONSTRUCTION.

- COM NOTES:**
- THE ATTENTION OF THE CLIENT AND THE PRINCIPAL CONTRACTOR IS DRAWN TO THE FOLLOWING POTENTIAL RISKS IN CONJUNCTION WITH THE PROPOSED ON-SITE AND OFF-SITE WORKS AS DESIGNED FOR THIS PROJECT:
  - WORKS IN THE VICINITY OF LIVE SERVICES WILL BE NECESSARY AND THE ADVICE OF ALL STATUTORY SERVICE COMPANIES MUST BE SOUGHT BEFORE ANY WORKS COMMENCE.
  - WORKS WITHIN AND ADJUTING THE EXISTING HIGHWAY WILL ENTAIL TRAFFIC HAZARDS AND ALL APPROPRIATE SAFETY MEASURES INCLUDING BARRIERS, SIGNS AND LIGHTING MUST BE UNDERTAKEN TO THE APPROVAL OF THE LOCAL AUTHORITY, THE HIGHWAY AUTHORITY AND THE POLICE.
  - HAZARDOUS MATERIALS INCLUDING CEMENT AND BITUMINOUS MATERIALS ARE SPECIFIED AND THE MANUFACTURER'S ADVICE ON SAFE HANDLING PROCEDURES MUST BE OBTAINED AND MADE CLEAR TO ALL OPERATIVES.
  - THE CONTRACTOR WILL BE RESPONSIBLE FOR LOCATING ALL EXISTING SERVICES WITHIN THE VICINITY OF THE WORKS AND ENSURE THESE ARE PROTECTED THROUGHOUT THE DURATION OF THE WORKS. ALL UTILITY PLANT SHOULD BE CLEARLY MARKED ON THE GROUND PRIOR TO COMMENCEMENT OF THE WORKS.
  - THE CONTRACTOR MUST ENSURE ALL WORKING AREAS ARE FULLY SECURE.

PROPOSED PUBLIC SEWER DIVERSIONS SUBJECT TO APPROVAL FROM THAMES WATER SECTION 185 AGREEMENT.

PROPOSED DRAINAGE STRATEGY SUBJECT TO APPROVAL FROM THE LEAD LOCAL FLOOD AUTHORITY AND THAMES WATER SECTION 106 AGREEMENT.

PRELIMINARY

NOT FOR CONSTRUCTION

FOR INFORMATION ONLY

B	PRELIMINARY	BNW	BNW	EF	28.10.22
A	DRAFT	BNW	EF	EF	04.10.22
-	WIP - UPDATED TO REVISED SITE LAYOUT	BNW	EF	BB	08.04.22
Rev	Description	Drm	Chk	App	Date

**ARDENT** CONSULTING ENGINEERS

Third Floor  
The Hallmark Building  
52-56 Leadenhall Street  
London  
EC3M 5JE

Tel: 020 7680 4088  
Web: [www.ardent-ce.co.uk](http://www.ardent-ce.co.uk)  
E-mail: [enquiries@ardent-ce.co.uk](mailto:enquiries@ardent-ce.co.uk)

**worksafe** consultant  
[www.amsaidt.com](http://www.amsaidt.com)

**SSIP** SKILLSAFE

ISO 9001 BUREAU VERITAS

Client				BELLWAY HOMES LIMITED (NORTH LONDON)	
Project Title:				CAPMPUS PARK EAST, WELWYN GARDEN CITY	
Drawing Title:				FOUL AND SURFACE WATER DRAINAGE STRATEGY	
A1 Scale		Date		Designed by	
500		08-04-2022		BNW	
Drawn by		Checked by		Approved by	
BNW		EF		BB	
Drawing Number				2007511-001	
				Rev B	



**Appendix H**  
**SuDS Operation and Maintenance Schedules**

**OPERATION AND MAINTENANCE REQUIREMENTS BASED ON C753 THE SuDS**  
**MANUAL 2015**

<b>Inlets, Outlets, Controls and Inspection Chambers</b>	
<b>Regular Maintenance</b>	<b>Frequency</b>
<b>Inlets, outlets and surface control structures</b>  Inspect surface structures, removing obstructions and silt as necessary. Check there is no physical damage.	Monthly
<b>Inspection chambers and below-ground control chambers</b>  Remove cover and inspect, ensuring that water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt.  Undertake inspection after leaf fall in autumn.	Annually
<b>Occasional Maintenance</b>	
Check topsoil levels are 20mm above edges of baskets and chambers to avoid mower damage.	As necessary
<b>Remedial Work</b>	<b>Frequency</b>
Repair physical damage if necessary	As Required

Operation and Maintenance Requirements for Pervious Pavements		
Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface).	Once a year, after autumn leaf fall, or reduce frequency as required, based on site-specific observations of clogging or manufacture's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is the most likely to collect the most sediment.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weeds or management using glyphosphate applied directly into the weeds by an applicator rather than a spray.	As required – once per a year on less frequently used pavements.
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required.
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing materials.	As required.
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection.	Monthly for three months after instillation.

Operation and Maintenance Requirements for Pervious Pavements		
Maintenance Schedule	Required Action	Typical Frequency
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action.	Three-monthly, 48 hours after large storms in first six months.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspection chambers.	Annually.



## Operation and Maintenance Requirements for Attenuation Storage Tanks

Maintenance Schedule	Required Action	Typical Frequency
Regular Inspections	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risk to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface or filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays.	Annually, or as required
Remedial Action	Repair/rehabilitate inlets, outlets, overflows and vents.	As required
Monitoring	Inspect/ check all inlets, outlets vents and overflows to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of tank for sediment build-up and remove if necessary.	Every 5 years or as required