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civil + structural engineers

PROPOSED RESIDENTIAL DEVELOPMENT

19 HERTFORD COURT

ENFIELD

LONDON, N13 4DD

DRAINAGE STRATEGY

FOR

MS G. THEODOROU

13th December 2023

Report No.: 5918 DS

P02

Contents Amendment Record

Revision	Date	Author	Checker	Approver
P01	06/12/2023	Kapriel Chiarini	Jack Moss	Jack Moss
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Contents

List of Appendices

1. Introduction and Brief

This report has been prepared for Ms G. Theodorou to provide guidance on the method of foul and surface water disposal for the proposed residential development at 19 Hertford Court, Enfield, London, N13 4DD. The proposal is to demolish four garages with a flat above and to construct two dwellings in their place.

Figure 1.1 – Development Proposals – full drawings within Appendix 1

This document has been produced in accordance with current best practice and recommendations and guidance set out in the National Planning Policy Framework (NPPF).

Considine has no responsibility to any other parties to whom this report may be circulated, in part or in full, and any such parties rely on the contents of this report solely at their own risk.

2. Existing Site Conditions

2.1 Location

The development site is located at 19 Hertford Court, Enfield, London, N13 4DD. The British National Grid Reference is E: 531366, N: 193408. The figures below show the site in the wider area, more locally and then an aerial image to show the site in its current context.

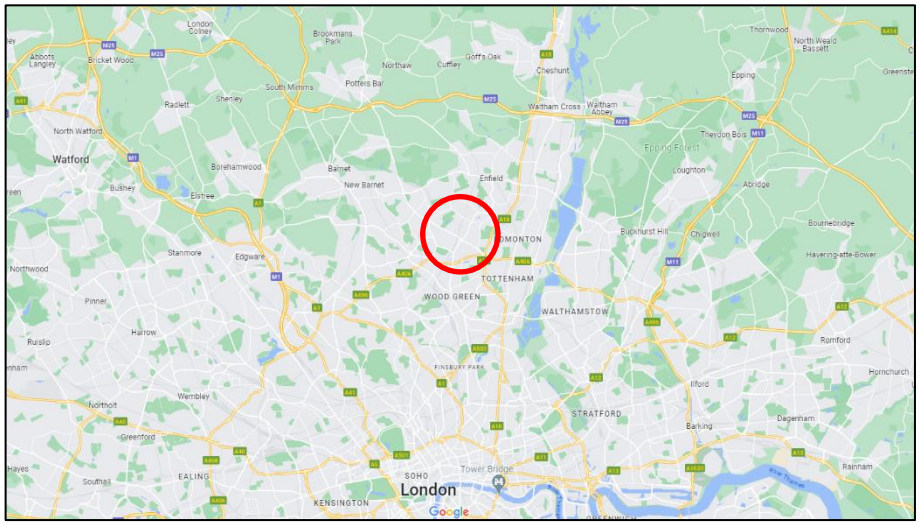


Figure 2.1 – Site location general area. Location shown by red circle. © Google Maps

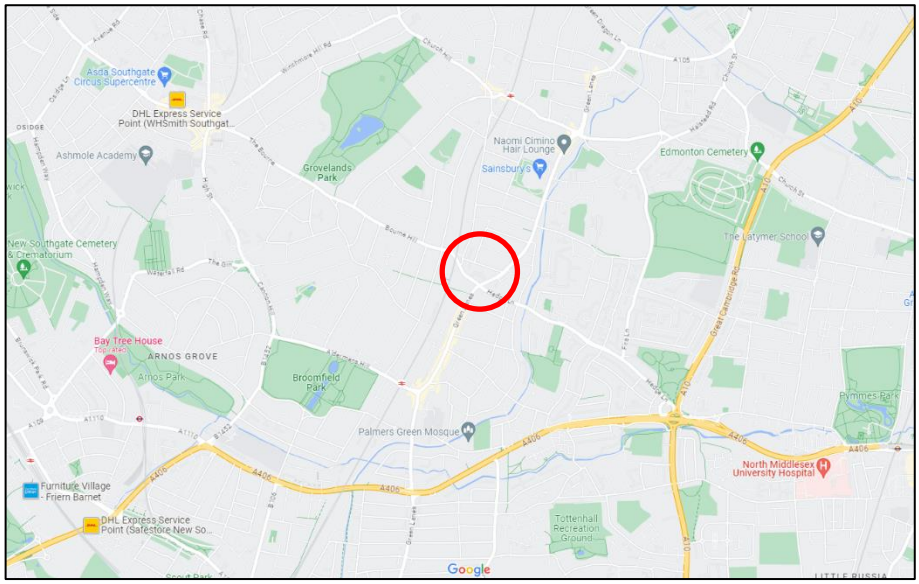


Figure 2.2 – Site Location shown by red circle. © Google Maps

The following aerial image provides additional information about the context of the site and surrounding areas.

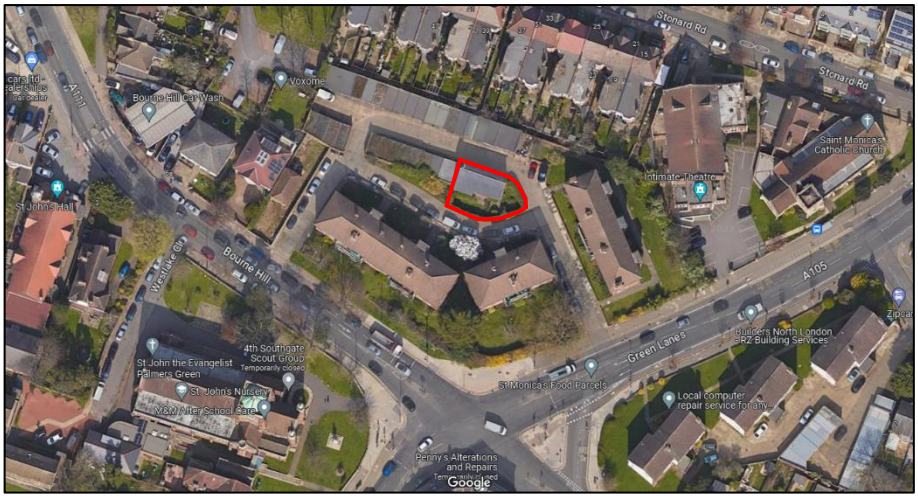


Figure 2.3 – Aerial image of site © Google Maps. Approximate site boundary shown in red.

The site currently comprises four garages with a flat above with an access path and surrounding grass. It is bounded by Herford Court and a number of residential dwellings on all boundaries.

The existing development impermeable areas are summarised as follows:

	Area (m^2)
Total Site Area:	198
Existing Roof Area:	89
Existing Fully Permeable Hardstandings (Type A):	0
Existing Permeable Hardstandings (Type B/C):	0
Existing Impermeable Hardstandings (Not Positively Drained):	0
Existing Impermeable Hardstandings (Positively Drained):	16
Total Existing Drained Area:	105

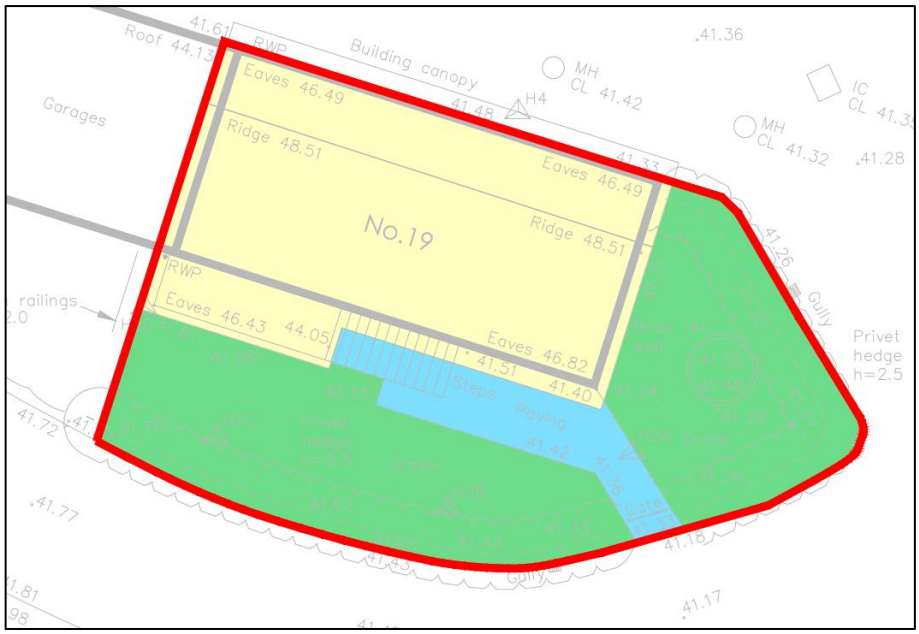


Figure 2.4 – Drained Areas Analysis Extract (Pre-Development)

2.2 Site Topography

A review of the topographical survey indicates that the site is generally flat.

2.3 Site Geology

A review of the BGS online bedrock mapping tool has identified that the development site is likely underlain by the London Clay Formation (Clay). This formation is described by BGS as 'The London Clay mainly comprises bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay'.

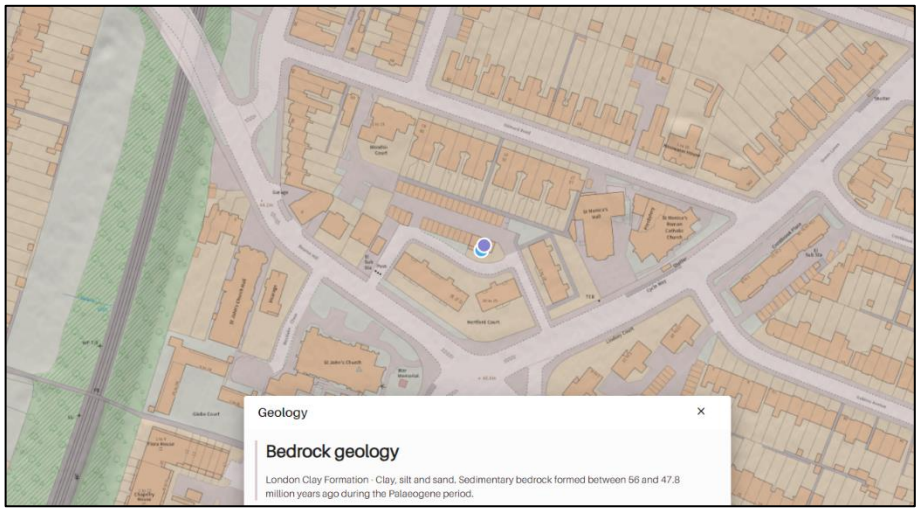


Figure 2.5 – BGS Extracts: Bedrock Geology © BGS

A review of the BGS online superficial deposits mapping tool has identified no known superficial deposits.

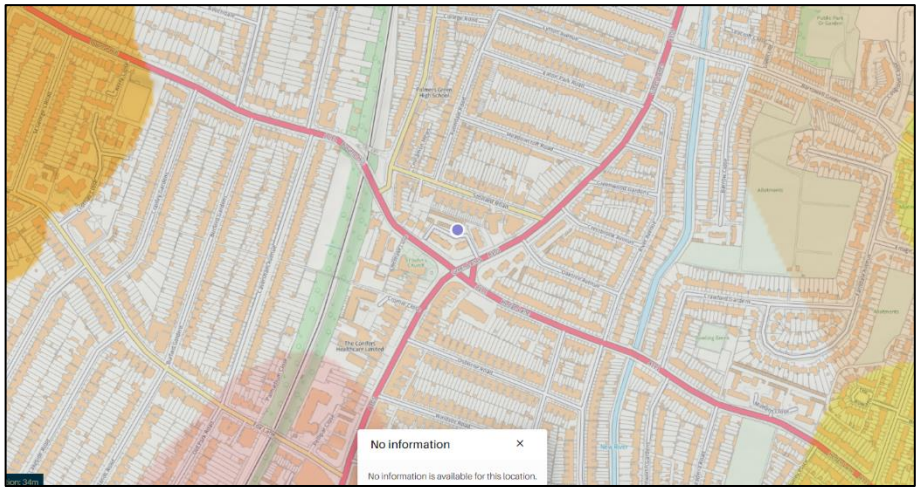


Figure 2.6 – BGS Extracts: Superficial Geology © BGS

At the time of writing, no site investigation has been undertaken to confirm the site geology.

2.4 Hydrogeology and Hydrology

The Environment Agency provide information about the groundwater and aquifers. Review of that information confirms that the site is within Groundwater Source Protection Zone 1. It is not located over an Aquifer in terms of the Bedrock, nor it is also located within a Groundwater Vulnerability Zone. The following EA Extracts identify the zoning for the site.

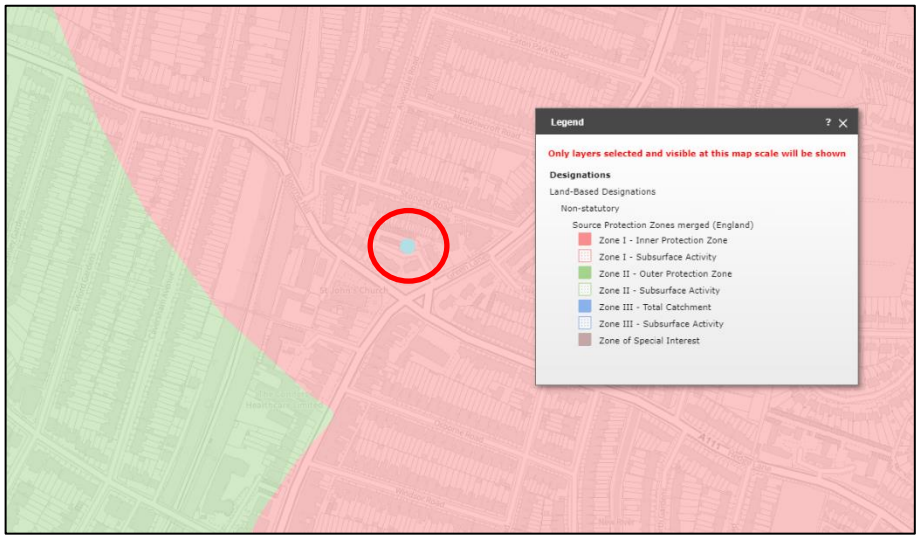


Figure 2.7 – Groundwater Source Protection Zone © Environment Agency

As defined within the figure above, the site is within Groundwater Source Protection Zone 1. This zone is defined by a travel time of 50-days or less from any point within the zone at, or below, the water table. Additionally, the zone has as a minimum a 50-metre radius. It is based principally on biological decay criteria and is designed to protect against the transmission of toxic chemicals and water-borne disease.

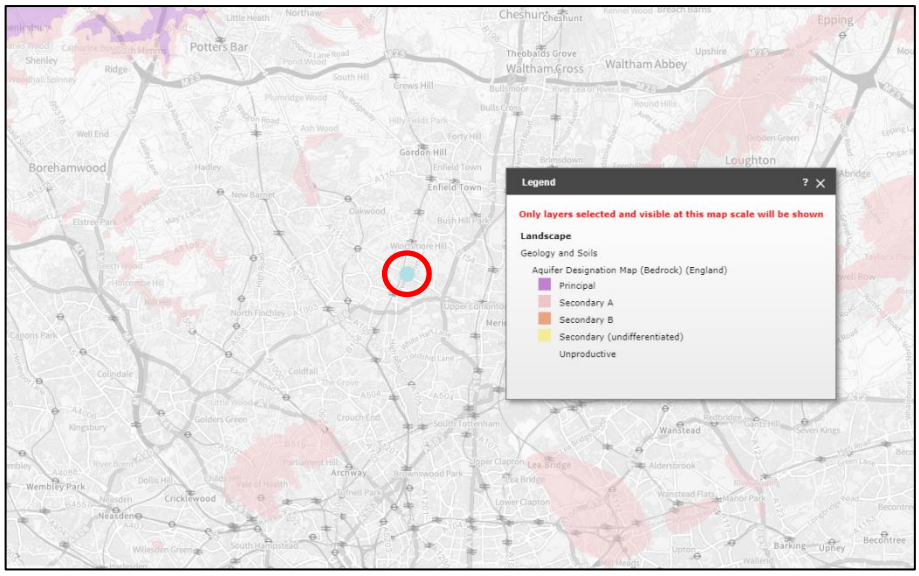


Figure 2.8 – Aquifer Designations Map (Bedrock) © Environment Agency

As noted within the figure above, the site is not above an Aquifer.

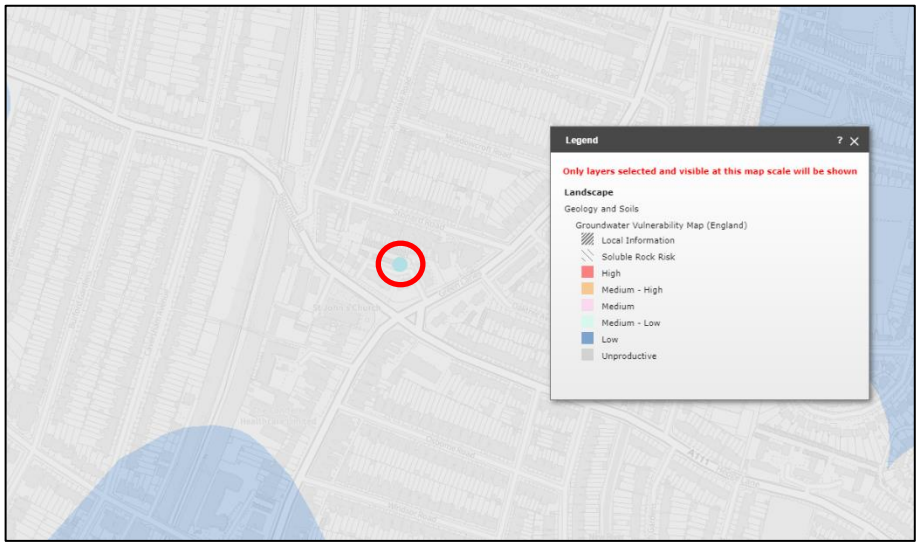


Figure 2.9 – Groundwater Vulnerability Zone Map © Environment Agency

As noted within the above figure, the site is not within a Groundwater Vulnerability Zone.

It is important though to understand that pollution risks are an issue for the underlying geology. As such the risk of Pollution can be assessed using the Source, Pathway, Receptor model as follows.

Source – there are two sources of potential contamination on the site. Firstly, contamination as a result of current and previous site activities and secondly from the proposed site activities. The current site comprises four garages and a flat with little contamination risk. The proposed development is for residential purposes. Therefore, the risk of contamination is still considered low.

Pathway – the pathway is the vertical movement of water through the subsoils and the bedrock. This can be by direct surface down soakage or from drainage features such as soakaways or other infiltration systems. The infiltration potential at ground level is low at the site, and therefore the opportunities for ingress of contaminants is also low.

Receptor – the receptor is the actual uses of groundwater that receives flow from the vicinity of the discharge, such as groundwater, watercourses etc. There is little opportunity for infiltration, therefore the risk is considered low.

Water Quality and Surface Water runoff is addressed later in this report.

3. Proposed Development

The proposal is to demolish four garages with a flat above and to construct two dwellings in their place. The figure below shows the Architect's current proposals.

Figure 3.1 – Proposed Site Plan – full drawing within Appendix 1.

The proposed development impermeable areas are shown in the figure below and are summarised as follows:

	Area (m^2)
Total Site Area:	198
Proposed Roof Area:	130
Proposed Fully Permeable Hardstandings (Type A):	0
Proposed Permeable Hardstandings (Type B/C):	0
Proposed Impermeable Hardstandings (Not Positively Drained):	10
Proposed Impermeable Hardstandings (Positively Drained):	0
Total Proposed Drained Area:	140

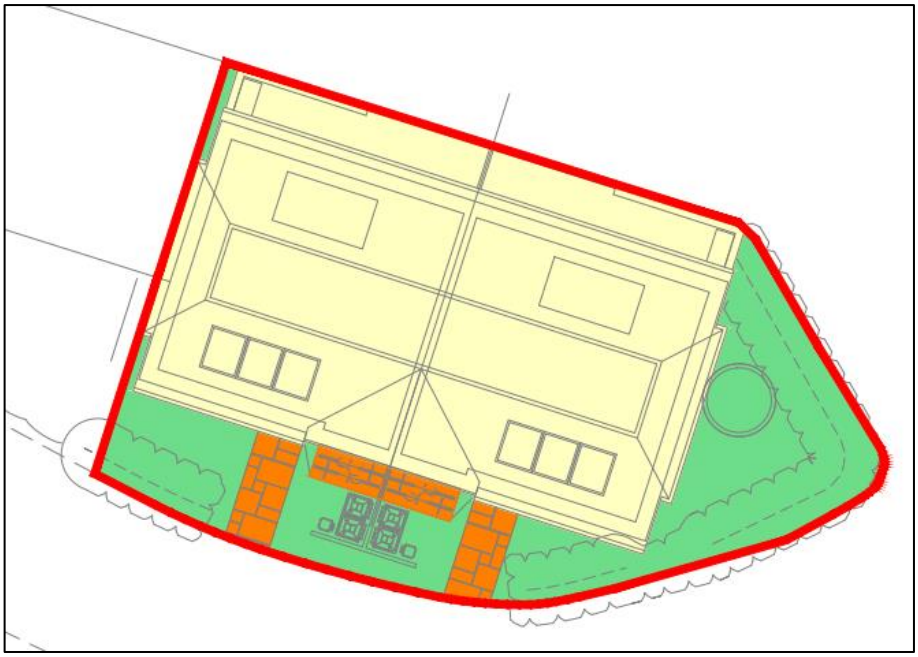


Figure 3.2 – Drained Areas Analysis Extract (Post-Development)

It is evident that the proposals increase the impermeable areas by 35m^2.

4. Proposed Foul Water Strategy

4.1 Existing Development Foul Water System

Thames Water sewer assets indicate that the adjoining road, Bourne Hill has a 300mmØ public foul pipe to the east and a 375mmØ public foul pipe to the east, but the topographical survey suggests sewer networks in Hertford Court.

It is assumed that there is an existing on-site foul network that connects to the public sewer.

4.2 Capacity Check

Since the OFWAT Regulation changes of April 2018 it is no longer a requisite to check available capacity. The new requirement is for the sewer authority to accept all discharge from new development sites into their nearest available sewer. In exchange they receive an enhanced connection payment per dwelling in order to fund network improvements. If the local network does not have available capacity and the improvement programme is not going to be completed until sometime after the development is complete, then the sewer authority (Thames Water Services) can work with the developers to agree temporary solutions to the capacity issue – these measures can include on site storage or timed pumping.

The proposal is to demolish four garages with a flat above and to construct two dwellings in their place.

4.2.1 Existing Occupancy

The site is brownfield currently serving four garages with a flat above. Therefore, foul discharge is expected and has been approximated as follows.

The Foul Water expected to be generated by the existing site has a peak flow of approximately 0.042 litres per second with an average flow of 0.007 litres per second.

Residential Load

2 bed unit = 1 x 4P = 4P
Total residential population (P) = 4P

Total occupancy of 4 persons @150 litres per day (Flows and Loads) = 600 l/day.
600 / (24x60x60) = 600 / 86,400 = 0.007 l/s average which is 0.042 l/s peak flow.

4.2.2 Proposed Occupancy

The Foul Water expected to be generated by the site has a peak flow of approximately 5.787 litres per second with an average flow of 0.965 litres per second. This is calculated as follows: -

Residential Load

2 bed unit = 2 x 4P = 8P
Total residential population (P) = 8P

Total occupancy of 8 persons @150 litres per day (Flows and Loads) = 1200 l/day.
1200 / (24x60x60) = 1200 / 86,400 = 0.014 l/s average which is 0.084 l/s peak flow.

This is an increase in peak flow by approximately 0.042 l/s. It is a requirement that the local drainage authority is consulted to approve the means and mode of connecting the new development to the public sewer network under a formal Section 106 connection agreement.

4.3 Foul Water Strategy

On the basis of the above, it is proposed that the foul network is connected to the existing public foul sewer via the network in Hertford Court. A drainage survey will be required to distinguish between the foul and surface water networks.

Detailed site investigation shall be required prior to detailed design, to ascertain the opportunities and constraints of a gravity connection.

A formal Section 106 connection approval will be required from the sewer authority.

5. Proposed Surface Water Strategy

5.1 Existing Surface Water Strategy

A review of the BGS online bedrock mapping tool has identified that the development site is likely underlain by the London Clay Formation (Clay).

Thames Water sewer indicate that the adjoining road, Bourne Hill has a 450mmØ public surface water pipe to the west and a 225mmØ public foul pipe to the east. However, the topographical survey suggests sewer networks in Hertford Court.

The existing site likely drains to the sewer network in Hertford Court.

Further investigation of the existing run off rates have been explored below.

5.2 Existing Run Off Rates

The existing site comprises four garages with a flat above with an access path with surrounding grass. The site is considered as brownfield in nature.

The underlying geology from review of BGS data indicates that the site is likely impermeable in terms of infiltration. Accordingly, the existing runoff rates have been calculated using Innovyze: MicroDrainage using the IH124 methodology.

The Interim Code of Practice recommends that the IH124 method is applied with 50ha, and the resulting discharge is linearly interpolated for the required area. MicroDrainage ICP SuDS Mean Annual Flood tool allows for the aforementioned requirement, and has been used accordingly. The table below outlines the Greenfield Runoff rates for the existing site.

Table 6.1 - Summary of Greenfield Runoff Rates obtained from MicroDrainage.

Greenfield Runoff Rates		
	Greenfield Site (0.020 ha)	Greenfield Runoff for Proposed Impermeable Area (0.016ha)
Qbar	0.1	0.1
1 in 1 year (l/s)	0.1	0.1
1 in 30 years (l/s)	0.2	0.1
1 in 100 years (l/s)	0.3	0.2

As the site is actually brownfield in nature, the existing runoff rates from the developed site have also been assessed.

The brownfield site has been assessed using the modified rational method to understand the pre-development and post-development discharge rates and volumes. The following tables highlight the findings of this assessment, and the calculations can be found within the Appendices.
Table 6.2 - Summary of Brownfield Runoff Rates.

	Pre-Development Runoff Rates	Post-Development Runoff Rates	Post-Development Runoff Rates (+40% CC)
1 in 2 year (l/s)	1.017	1.463	2.0482
1 in 30 years (l/s)	2.567	3.691	5.1676
1 in 100 years (l/s)	3.384	4.867	6.8131

The previous table defines the pre-development and post-development runoff rates, based on the average intensity for a 15min storm for the respective events and assuming no restriction within the proposed drainage network. It is evident that there shall be a net increase from the proposed development.

Table 6.3 - Summary of Brownfield Runoff Volumes.

	Pre-Development Runoff Volumes	Post-Development Runoff Volumes	Post-Development Runoff Volumes (Whole Site +40% CC
1 in 100 years (m^3)	8.46	12.17	17.04

The previous table defines the pre-development and post-development runoff volume, based on the average intensity for a 360min storm for the respective event and assuming no restriction within the proposed drainage network. It is evident that there shall be a minor net increase from the proposed development.

In accordance with LLFA requirements, brownfield sites should be restricted to 50% of the predevelopment brownfield runoff rate. The pre-development runoff rate for the 1 in 2 year event is 1.017l/s. Generally, flow control devices are compromised when discharging at rates less than 2l/s due to the required orifice sizes and risk of blockage.

Methods for managing surface water are discussed in the following sections.

5.3 Managing Surface Water

The management of surface water has been assessed in accordance with the guidance set out in CIRIA report C753 'The SuDS Manual 2015'.

To mimic the natural catchment processes as closely as possible, a "management train" is required. This concept is fundamental to successful management of surface water and employs drainage techniques in series to incrementally reduce pollution, flow rates and volumes.

The hierarchy of techniques and processes that should be considered in developing the management train are as follows:

- Prevention. The use of good site design and housekeeping measures to prevent run off transporting pollutants to the drainage system.

- Source Control. Control of run off at or very near to its source. This includes disposal methods that comprise green roofs, permeable pavements, rainwater harvesting or other permeable surfaces.

- Site Control. Management of surface water locally within a development site. This includes disposal techniques that comprise infiltration structures and detention basins.

- Regional Control. Management of run off from a site, or series of sites, typically in a balancing pond or wetland. However, for this development regional controls do not apply.

5.4 Managing Surface Water – Scheme Proposals

Wherever possible, surface water should be managed in small cost-effective landscaped features located within small sub catchments rather than being conveyed to and managed in large systems at the bottom of the drained area. The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at source should always be considered before site or regional controls. However, where upstream opportunities are restricted, a number of lower hierarchy options should be used in series and water should only be conveyed elsewhere if it cannot be dealt with on site.

5.4.1 Prevention & Water Quality

There are a number of factors that contribute to pollution incidents and water quality issues such as sediments, oil, fertilisers, pesticides, animal waste and litter, but improvements can be made by managing surface water and stormwater particularly during extreme weather events.
Sustainable drainage systems mimic natural drainage and help to improve water quality by reducing sediment and contaminants from runoff leading to a number of benefits such as aesthetic, health, and opportunities for wildlife and biodiversity.

It is proposed to utilise raingardens and catchpits to maximise pollution control at the site.

A CIRIA C753 Pollution Indices table has been produced and can be found in the Appendices. It is evident that using the aforementioned features shall not increase the risk of polluting downstream waters.

5.4.2 Source Control

As already noted, source control features include permeable pavements and other infiltration structures which are explored further as follows.

Permeable Pavements (Type A & B)

The site does not lend itself to the use of permeable paving due to the limited hardstanding proposed, and therefore Type A & B permeable pavements have been discounted from this development.

Green Roofs

The roof lines do not naturally lend themselves to utilising green roofs. Therefore, green roofs have been discounted from this development.

Rainwater Harvesting

As rainwater harvesting is considered full for a storm event, no rainwater harvesting has been proposed at this stage; water butts could be considered at detailed design stage.

5.4.3 Site Control

As previously mentioned, site control includes disposal techniques that comprise infiltration structures and detention basins. The opportunities of utilising these have been explored below.

Soakaways

The site is unlikely suitable for concentrated infiltration techniques such as soakaways due to the anticipated strata. Therefore, soakaways have been discounted at this stage.

Attenuation Tanks

As infiltration is unlikely viable, it is proposed that an attenuation tank is utilised to assist with a restricted offsite discharge of surface water.

Ponds

The site use does not naturally lend itself to the use of ponds. Therefore, ponds have been discounted from this development.

Detention Basins

The site use does not naturally lend itself to the use of detention basins. Therefore, detention basins have been discounted from this development.

Permeable Pavements (Type C)

The site does not lend itself to the use of permeable paving due to the limited hardstanding proposed, and therefore Type C permeable pavements have been discounted from this development.

Swales

The site use does not naturally lend itself to the use of swales. Therefore, swales have been discounted from this development.

5.4.4 Strategy Proposals & Preliminary Sizing Estimations

An element of site control must include provision for Climate Change.

National policy for climate change allowance changed in 2022, requiring developments to consider the 1:30 year event plus climate change allowance and the 1:100 year event plus climate change allowance, in addition to all events previously considered. The climate change allowance varies between areas and a site specific assessment of the required climate change allowance is required by referring to the Department for Environment, Food and Rural Affairs (DEFRA) online tool. Designs should consider the upper end climate change allowance for the relevant epoch.

A summary of the allowances for this particular site can be found within the following table.

Table 6.4 – Climate Change Allowances

Peak Rainfall Climate Change Allowances		
Epoch	2050s	2070s
1:30 year event (3.3% AEP)	35%	35%
1:100 year event (1% AEP)	40%	40%

Based on the previous table, the following events and respective climate change allowance should be considered for the development: 1:30 year event plus 35% climate change allowance, and the 1:100 year event plus 40% climate change allowance.

As previously calculated, the brownfield pre-development runoff rate for the 1 in 2 year event is 1.017l/s. Generally, flow control devices are compromised when discharging at rates less than 2l/s due to the required orifice sizes and risk of blockage. Therefore, it is proposed that the offsite discharge is restricted to 2l/s for the 1:100-year event plus a 40% climate change allowance. This shall still be an improvement on the anticipated pre-development scenario, as the site had no restricted discharge.

It is proposed that the site connects to the existing public sewer, Thames Water sewer assets will need to be obtained to confirm the point of connection, and that the flow is restricted through a flow control such as Hydro-Brake. A geocellular attenuation tank shall provide storage sufficient for the 1:100-year event plus 40% climate change allowance.

It is proposed that the connection to the public sewer is made via gravity, but this should be confirmed through detailed investigations at the detailed design stage.

The individual elements have been explored further below:

Geocellular Attenuation Tank

As previously mentioned, the offsite discharge is to be restricted to 2l/s for the 1:100-year event, plus a 40% climate change allowance. As can be seen by the appended MicroDrainage calculations, a geocellular attenuation tank with effective dimensions of 5m x 1m x 0.8m deep can fully accommodate the 1:100-year event with a 40% climate change allowance. The attenuation tank requires a minimum of 95% voids.

Raingardens

As rainwater pipes tend to discharge directly into the below ground drainage, this bypasses the proposed permeable paving. Therefore, raingardens are proposed for each rainwater pipe which allows the water to filter through in a similar way to permeable pavement but with even better pollution control. The water then enters the below ground drainage via a perforated pipe.

5.5 Exceedance and Surface Water Conveyance

Exceedance routes shall be provided by appropriate external levels design during the detailed design stage. The exceedance routes shall need to accommodate system failure and events greater than the 1:100-year event inclusive of a 40% climate change allowance.

5.6 Surface Water Strategy Summary

The existing site comprises four garages with a flat above with an access path with surrounding grass. The site is considered as brownfield in nature.

The proposal is to utilise rainwater gardens, catchpits, a geocellular attenuation tank, and a Hydro-Brake. Accordingly, all storm events up to and including the critical 100-year event with a 40% allowance for climate change will be assessed when considering the volume for the attenuation structures.

The attenuation structures will be sized to accommodate a 1 in 100-year storm event with a 40% allowance for future climate change. It is proposed that the site connects to the existing public surface water sewer via the network in Hertford Court. A drainage survey will be required to distinguish between the foul and surface water networks.

It is anticipated that a condition will be imposed on a planning permission requiring further details of the surface water drainage system to be submitted for approval.

It is evident from the aforementioned that a suitable surface water network can be provided that accords with National and Local Planning Policy Guidance.

6. Conclusions

This document has been produced in accordance with current best practice and recommendations and guidance set out in the National Planning Policy Framework (NPPF) and as required by Kent County Council's Drainage and Planning Policy Statement (2017).

The report concludes:

- The site currently comprises four garages with a flat above with an access path and surrounding grass. It is bounded by Herford Court and a number of residential dwellings on all boundaries.

- A review of the BGS online superficial deposits mapping tool has identified no known superficial deposits.

- A review of the BGS online bedrock mapping tool has identified that the development site is likely underlain by the London Clay Formation (Clay).

- The proposal is to demolish four garages and a flat and to construct two dwellings.

- An assessment of peak foul water flow has been carried out in accordance with 'British Water Flows and Loads'. It is anticipated that there shall be an increase in peak flow by approximately 0.042 l/s.

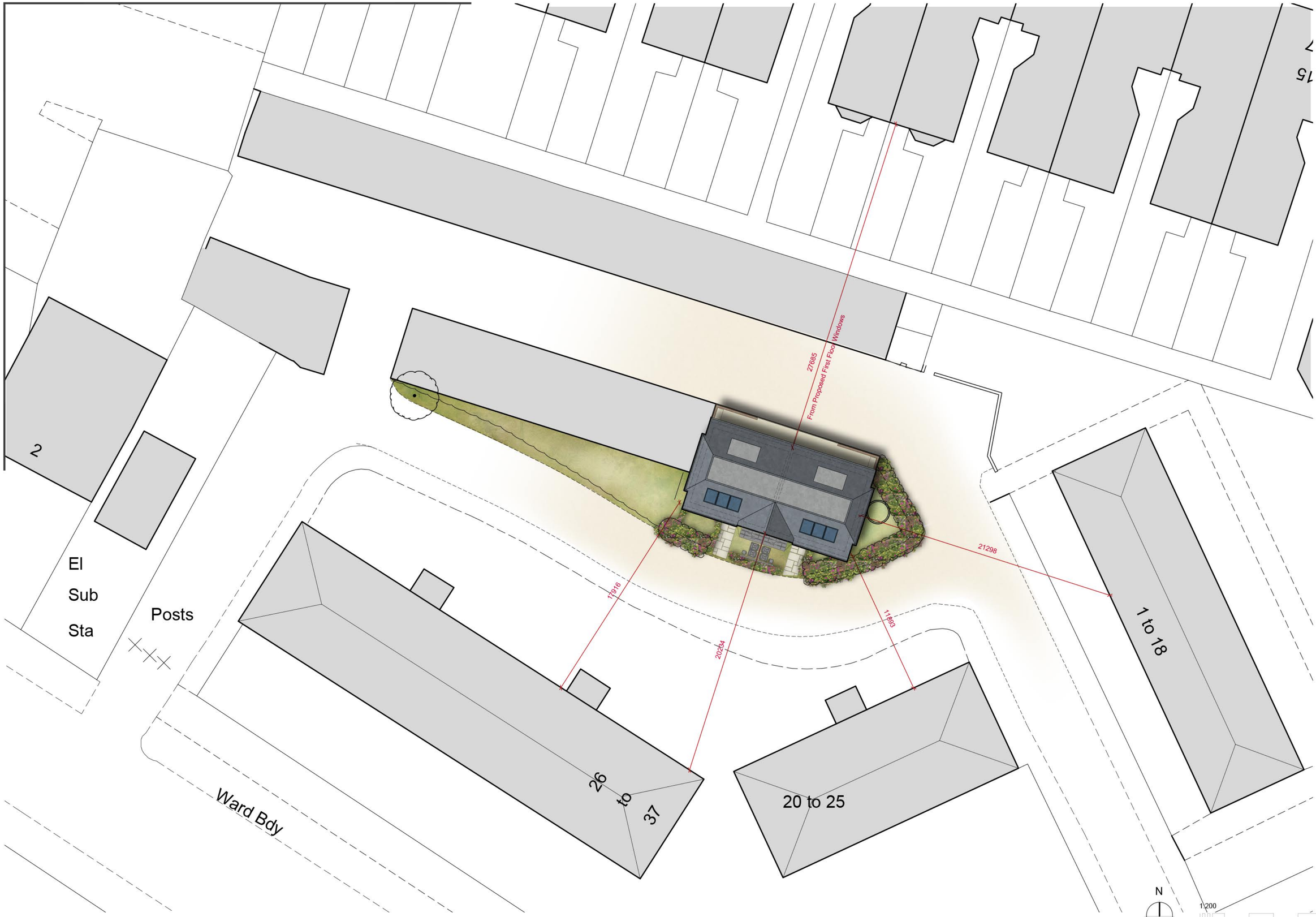
- It is proposed that the foul network is connected to the existing public foul water sewer via the network in Hertford Court. A drainage survey will be required to distinguish between the foul and surface water networks. A connection is subject to a formal Section 106 connection agreement with Thames Water.

- The proposal is to utilise rainwater gardens, catchpits, a geocellular attenuation tank, and a Hydro-Brake.

- The surface water drainage strategy will include a 40% allowance from increased rainfall intensities as a direct result of climate change.

- It is evident that the site can be drained satisfactorily in accordance with Local and National Planning Policy Guidance. The details of the drainage systems should be the subject of suitably worded Planning Conditions which would require the schemes to be submitted to the local authority for approval prior to construction work commencing.

Appendix 1 – Proposed Site Plan



URBAN & RURAL LTD
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Proposed Residential Development
19 Herrford Court, Enfield, N13 4DD

Project Name;

Drawing Name; Proposed Site Plan

A2

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NOTE;

Do Not Scale.
Report all discrepancies, errors and omissions.
Verify all dimensions on site before commencing any work on site or preparing shop drawings.
All materials, components and workmanship are to comply with the relevant British & European Standards, Codes of Practice, and appropriate manufacturers recommendations that from time to time shall apply.
For all specialist work, see relevant drawings.

Revision;

date	note
26.06.23	P1 - Issued in draft for initial comment
12.07.23	P2 - Updated following receipt of survey information
10.08.23	P3 - Updated following discussions with planning consultant

Drawing No;A1649-09
Revision; P3
Date; June 23
Scale; 1:200@A2
PLANNING

Appendix 2 – Foul Water & Surface Water Drainage Strategy

KEY:

- Proposed Private Surface Water Pipe Ø as stated
- Proposed Private Foul Water Pipe Ø as stated
- Proposed Private Surface Water PPIC
- Proposed Private Foul Water PPIC
- Proposed Private Surface Water Manhole - Pre-Cast Concrete - Ring
- CP Proposed Catchpit
- HB Proposed Hydro-Brake
- Proposed Geo-Cellular Attenuation
- Further Significant Information Required

DO NOT SCALE THIS DRAWING. ALL SETTING OUT TO ARCHITECT'S DETAILS AND DRAWINGS

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWING ISSUES AND THE SPECIFICATION.

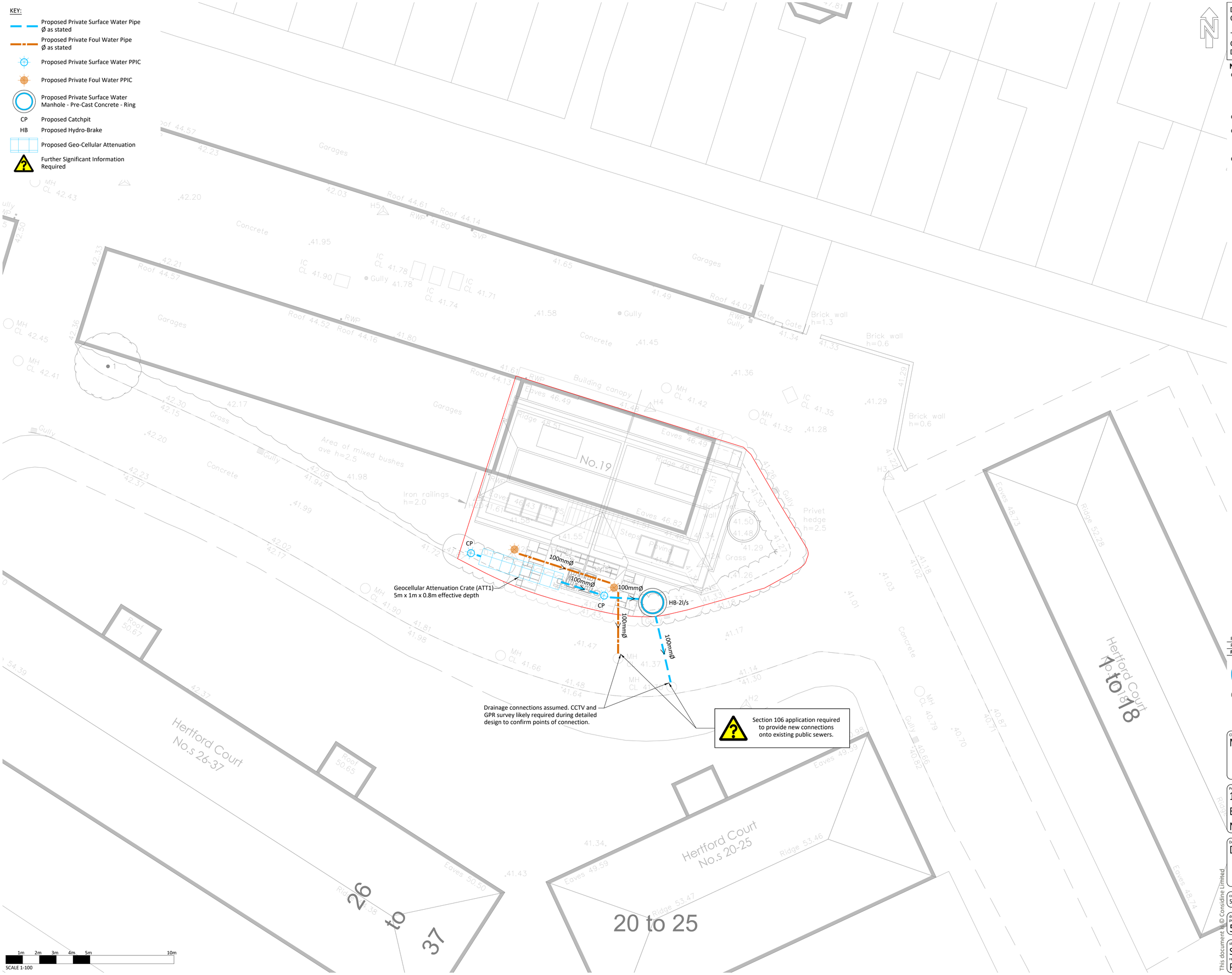
Notes:

G1. All building materials, components and workmanship to comply with the appropriate public health acts, building regulations, british standards and codes of practice and the appropriate manufacturer's recommendations.

G2. For all specialist work see relevant drawings.

G3. Any discrepancies, errors or omissions to be reported to the project co-ordinator for further instructions before commencement of works.

G4. The Engineer is not responsible for dimensions, except where shown on his drawings. All setting out information, dimensions, etc, shall be calculated from the Architect's drawings.



Rev	Amendment	Drn	Chk	Date
P02	Client name amended.	KC	JEM	13.12.23
P01	Preliminary Issue.	KC	JEM	06.12.23

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Client:
MS G. THEODOROU

Project:
19 HERTFORD COURT
ENFIELD
N13 4DD

Drawing Title:
DRAINAGE STRATEGY

considine ref	drawn by	date	drawing scales	original paper size
5918	KC	DEC' 23	1:100@A1, 1:200@A3	A1

drawing reference : project - originator - volume - level - type - role - number
5918 - CON - 00 - XX - DR - C - 1810

status :	status description :
S0	SUITABLE FOR INFORMATION
revision :	revision status :
P02	PRELIMINARY

Appendix 3 – Drained Areas Analysis

PRE DEVELOPMENT DRAINED AREAS

- SOFT LANDSCAPING AREA = 93m^2
- IMPERMEABLE HARDSTANDING AREA (POSITIVELY DRAINED) = 16m^2
- IMPERMEABLE HARDSTANDING AREA (NOT POSITIVELY DRAINED) = 0m^2
- PERMEABLE HARDSTANDING AREA (TYPE A) = 0m^2
- PERMEABLE HARDSTANDING AREA (TYPE B/C) = 0m^2
- ROOF AREA = 89m^2

TOTAL IMPERMEABLE AREA = 105m^2

TOTAL AREA = 198m^2

DO NOT SCALE THIS DRAWING. ALL SETTING OUT TO ARCHITECT'S DETAILS AND DRAWINGS

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWING ISSUES AND THE SPECIFICATION.

Notes:

G1. All building materials, components and workmanship to comply with the appropriate public health acts, building regulations, british standards and codes of practice and the appropriate manufacturer's recommendations.

G2. For all specialist work see relevant drawings.

G3. Any discrepancies, errors or omissions to be reported to the project co-ordinator for further instructions before commencement of works.

G4. The Engineer is not responsible for dimensions, except where shown on his drawings. All setting out information, dimensions, etc, shall be calculated from the Architect's drawings.

Rev	Amendment	Drn	Chk	Date
P02	Client name amended.	KC	JEM	13.12.23
P01	Preliminary Issue.	KC	JEM	06.12.23

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Project: 19 HERTFORD COURT
ENFIELD
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Drawing Title: DRAINED AREA ANALYSIS
PRE DEVELOPMENT

considine ref	drawn by	date	drawing scales	original paper size
5918	KC	DEC' 23	1:100@A1, 1:200@A3	A1

drawing reference: 5918 - CON - 00 - XX - DR - C - 1830

status: S0 — SUITABLE FOR INFORMATION

revision: P02 — PRELIMINARY

POST DEVELOPMENT DRAINED AREAS

- SOFT LANDSCAPING AREA = 58m²
- IMPERMEABLE HARDSTANDING AREA (POSITIVELY DRAINED) = 0m²
- IMPERMEABLE HARDSTANDING AREA (NOT POSITIVELY DRAINED) = 10m²
- PERMEABLE HARDSTANDING AREA (TYPE A) = 0m²
- PERMEABLE HARDSTANDING AREA (TYPE B/C) = 0m²
- ROOF AREA = 130m²

TOTAL IMPERMEABLE AREA = 140m²

TOTAL AREA = 198m²

1m 2m 3m 4m 5m 10m
SCALE 1-100

DO NOT SCALE THIS DRAWING. ALL SETTING OUT TO ARCHITECT'S DETAILS AND DRAWINGS

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWING ISSUES AND THE SPECIFICATION.

Notes:

G1. All building materials, components and workmanship to comply with the appropriate public health acts, building regulations, british standards and codes of practice and the appropriate manufacturer's recommendations.

G2. For all specialist work see relevant drawings.

G3. Any discrepancies, errors or omissions to be reported to the project co-ordinator for further instructions before commencement of works.

G4. The Engineer is not responsible for dimensions, except where shown on his drawings. All setting out information, dimensions, etc, shall be calculated from the Architect's drawings.

Rev	Amendment	Drn	Chk	Date
P02	Client name amended.	KC	JEM	13.12.23
P01	Preliminary Issue.	KC	JEM	06.12.23

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Project:
19 HERTFORD COURT
ENFIELD
N13 4DD

Drawing Title:
DRAINED AREA ANALYSIS
POST DEVELOPMENT

considine ref	drawn by	date	drawing scales	original paper size
5918	KC	DEC' 23	1:100@A1, 1:200@A3	A1

drawing reference :

project	originator	volume	level	type	role	number
5918 -	CON -	00 -	XX -	DR -	C -	1831

status :	status description :
S0	SUITABLE FOR INFORMATION
revision :	revision status :
P02	PRELIMINARY

Appendix 4 – CIRIA C753 Pollution Indices

CIRIA C753
POLLUTION INDICES

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Project No:	**5918**	Sheet No.	1
Made By:	**KC**	Revision:	P01
Date:	**17/11/2023**	Project:	19 Hertford Court, Enfield

Land Use	Pollution Hazard Level	Total Suspended Suspended Solids (TSS)	Metals	Hydrocarbons	Applicable
Residential Roofs	Very Low	0.20	0.20	0.05	**x**
Other Roofs (typically commercial/industrial roofs)	Low	0.30	0.20	0.05	
Individual property driveways, residential car parks, low traffic roads, (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.50	0.40	0.40	
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.70	0.60	0.70	
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored used or manufactured; industrial sites; trunk roads and motorways.	High	0.80	0.80	0.90	

Up to 0.8 where there is potential for metals to leach from the roof

These should only be used if considered appropriate as part of a detailed risk assessment. Refer to CIRIA C753

	Total Suspended Suspended Solids (TSS)	Metals	Hydrocarbons
Total Polution Hazard Indices	0.20	0.20	0.05

CIRIA C753
POLLUTION INDICES

considine
civil + structural engineers

Project No:	**5918**	Sheet No.	2
Made By:	**KC**	Revision:	P01
Date:	**17/11/2023**	Project:	19 Hertford Court, Enfield

Type of SuDS Component	Total Suspended Suspended Solids (TSS)	Metals	Hydrocarbons	Applicable
Filter Strip	0.40	0.40	0.50	
Filter Drain	0.40	0.40	0.40	
Swale	0.50	0.60	0.60	
Bioretention System	0.80	0.80	0.80	x
Permeable Pavement	0.70	0.60	0.70	
Detention Basin	0.50	0.50	0.60	
Pond	0.70	0.70	0.50	
Wetland	0.80	0.80	0.80	
Downstream Defender® Vortex	0.30	0.20	0.20	
Downstream Defender® Vortex Plus	0.50	0.40	0.50	
Downstream Defender® Advanced Vortex	0.50	0.40	0.50	
Klargester AquaTreat®	0.80	0.60	0.90	
Standard Catchpit	0.10	0.00	0.00	x

Select Primary Mitigation: Bioretention System

	Total Suspended Suspended Solids (TSS)	Metals	Hydrocarbons
Total Mitigation Indices	0.85	0.80	0.80
Total Polution Hazard Indices	0.20	0.20	0.05
Indices Balance	-0.65	-0.6	-0.75
	ACCEPTABLE	**ACCEPTABLE**	**ACCEPTABLE**

Appendix 5 – Preliminary Surface Water Network Calculations

Summary of Results for 2 year Return Period

Half Drain Time : 4 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	98.583	0.083	0.0	1.6	1.6	0.4	O K
30 min Summer	98.578	0.078	0.0	1.5	1.5	0.4	O K
60 min Summer	98.562	0.062	0.0	1.2	1.2	0.3	O K
120 min Summer	98.555	0.055	0.0	1.0	1.0	0.3	O K
180 min Summer	98.549	0.049	0.0	0.8	0.8	0.2	O K
240 min Summer	98.544	0.044	0.0	0.7	0.7	0.2	O K
360 min Summer	98.538	0.038	0.0	0.6	0.6	0.2	O K
480 min Summer	98.534	0.034	0.0	0.5	0.5	0.2	O K
600 min Summer	98.531	0.031	0.0	0.4	0.4	0.1	O K
720 min Summer	98.528	0.028	0.0	0.3	0.3	0.1	O K
960 min Summer	98.525	0.025	0.0	0.3	0.3	0.1	O K
1440 min Summer	98.521	0.021	0.0	0.2	0.2	0.1	O K
2160 min Summer	98.518	0.018	0.0	0.1	0.1	0.1	O K
2880 min Summer	98.516	0.016	0.0	0.1	0.1	0.1	O K
4320 min Summer	98.514	0.014	0.0	0.1	0.1	0.1	O K
5760 min Summer	98.512	0.012	0.0	0.1	0.1	0.1	O K
7200 min Summer	98.511	0.011	0.0	0.1	0.1	0.1	O K
8640 min Summer	98.511	0.011	0.0	0.1	0.1	0.1	O K
10080 min Summer	98.510	0.010	0.0	0.0	0.0	0.0	O K
15 min Winter	98.588	0.088	0.0	1.7	1.7	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	35.773	0.0	0.9	12
30 min Summer	22.507	0.0	1.2	19
60 min Summer	13.637	0.0	1.4	34
120 min Summer	9.985	0.0	2.1	64
180 min Summer	7.960	0.0	2.5	94
240 min Summer	6.653	0.0	2.8	124
360 min Summer	5.033	0.0	3.2	184
480 min Summer	4.064	0.0	3.4	244
600 min Summer	3.421	0.0	3.6	306
720 min Summer	2.962	0.0	3.7	368
960 min Summer	2.349	0.0	3.9	488
1440 min Summer	1.682	0.0	4.2	726
2160 min Summer	1.211	0.0	4.6	1080
2880 min Summer	0.966	0.0	4.9	1464
4320 min Summer	0.714	0.0	5.4	2148
5760 min Summer	0.583	0.0	5.9	2920
7200 min Summer	0.504	0.0	6.3	3592
8640 min Summer	0.451	0.0	6.8	4344
10080 min Summer	0.412	0.0	7.3	5048
15 min Winter	35.773	0.0	1.0	12

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 Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	98.575	0.075	0.0	1.4	1.4	0.4	O K
60 min Winter	98.556	0.056	0.0	1.0	1.0	0.3	O K
120 min Winter	98.547	0.047	0.0	0.8	0.8	0.2	O K
180 min Winter	98.541	0.041	0.0	0.6	0.6	0.2	O K
240 min Winter	98.537	0.037	0.0	0.5	0.5	0.2	O K
360 min Winter	98.532	0.032	0.0	0.4	0.4	0.2	O K
480 min Winter	98.528	0.028	0.0	0.3	0.3	0.1	O K
600 min Winter	98.526	0.026	0.0	0.3	0.3	0.1	O K
720 min Winter	98.524	0.024	0.0	0.2	0.2	0.1	O K
960 min Winter	98.521	0.021	0.0	0.2	0.2	0.1	O K
1440 min Winter	98.518	0.018	0.0	0.1	0.1	0.1	O K
2160 min Winter	98.515	0.015	0.0	0.1	0.1	0.1	O K
2880 min Winter	98.513	0.013	0.0	0.1	0.1	0.1	O K
4320 min Winter	98.512	0.012	0.0	0.1	0.1	0.1	O K
5760 min Winter	98.510	0.010	0.0	0.0	0.0	0.0	O K
7200 min Winter	98.510	0.010	0.0	0.0	0.0	0.0	O K
8640 min Winter	98.509	0.009	0.0	0.0	0.0	0.0	O K
10080 min Winter	98.509	0.009	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	22.507	0.0	1.3	20
60 min Winter	13.637	0.0	1.6	34
120 min Winter	9.985	0.0	2.3	64
180 min Winter	7.960	0.0	2.8	94
240 min Winter	6.653	0.0	3.1	124
360 min Winter	5.033	0.0	3.5	186
480 min Winter	4.064	0.0	3.8	246
600 min Winter	3.421	0.0	4.0	296
720 min Winter	2.962	0.0	4.2	368
960 min Winter	2.349	0.0	4.4	480
1440 min Winter	1.682	0.0	4.7	734
2160 min Winter	1.211	0.0	5.1	1092
2880 min Winter	0.966	0.0	5.5	1456
4320 min Winter	0.714	0.0	6.0	2188
5760 min Winter	0.583	0.0	6.6	2880
7200 min Winter	0.504	0.0	7.1	3528
8640 min Winter	0.451	0.0	7.6	4288
10080 min Winter	0.412	0.0	8.1	5088

Rainfall Details

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 531366 193408 TQ 31366 93408
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.014

Time (mins) From:	To:	Area (ha)
0	4	0.014

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	5.0	0.0	0.801	0.0	0.0
0.800	5.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.0
Flush-Flo™	0.240	2.0
Kick-Flo®	0.504	1.6
Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.0	1.600	2.7	4.000	4.2	8.000	5.8
0.400	1.9	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.6	2.000	3.0	5.000	4.7	9.000	6.2
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.3		

Summary of Results for 30 year Return Period

Half Drain Time : 8 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	98.771	0.271	0.0	2.0	2.0	1.3	O K
30 min Summer	98.765	0.265	0.0	2.0	2.0	1.3	O K
60 min Summer	98.700	0.200	0.0	2.0	2.0	1.0	O K
120 min Summer	98.633	0.133	0.0	1.9	1.9	0.6	O K
180 min Summer	98.594	0.094	0.0	1.7	1.7	0.4	O K
240 min Summer	98.577	0.077	0.0	1.5	1.5	0.4	O K
360 min Summer	98.560	0.060	0.0	1.1	1.1	0.3	O K
480 min Summer	98.551	0.051	0.0	0.9	0.9	0.2	O K
600 min Summer	98.545	0.045	0.0	0.8	0.8	0.2	O K
720 min Summer	98.541	0.041	0.0	0.6	0.6	0.2	O K
960 min Summer	98.536	0.036	0.0	0.5	0.5	0.2	O K
1440 min Summer	98.530	0.030	0.0	0.4	0.4	0.1	O K
2160 min Summer	98.524	0.024	0.0	0.3	0.3	0.1	O K
2880 min Summer	98.521	0.021	0.0	0.2	0.2	0.1	O K
4320 min Summer	98.518	0.018	0.0	0.1	0.1	0.1	O K
5760 min Summer	98.516	0.016	0.0	0.1	0.1	0.1	O K
7200 min Summer	98.515	0.015	0.0	0.1	0.1	0.1	O K
8640 min Summer	98.514	0.014	0.0	0.1	0.1	0.1	O K
10080 min Summer	98.513	0.013	0.0	0.1	0.1	0.1	O K
15 min Winter	98.810	0.310	0.0	2.0	2.0	1.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	90.257	0.0	2.4	13
30 min Summer	57.524	0.0	3.0	21
60 min Summer	34.985	0.0	3.7	38
120 min Summer	22.603	0.0	4.7	66
180 min Summer	17.091	0.0	5.4	96
240 min Summer	13.861	0.0	5.8	124
360 min Summer	10.147	0.0	6.4	184
480 min Summer	8.041	0.0	6.8	244
600 min Summer	6.680	0.0	7.0	306
720 min Summer	5.727	0.0	7.2	366
960 min Summer	4.474	0.0	7.5	490
1440 min Summer	3.137	0.0	7.9	730
2160 min Summer	2.203	0.0	8.3	1096
2880 min Summer	1.722	0.0	8.7	1432
4320 min Summer	1.229	0.0	9.3	2128
5760 min Summer	0.977	0.0	9.8	2840
7200 min Summer	0.825	0.0	10.4	3608
8640 min Summer	0.722	0.0	10.9	4408
10080 min Summer	0.649	0.0	11.4	5088
15 min Winter	90.257	0.0	2.7	14

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 Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	98.786	0.286	0.0	2.0	2.0	1.4	O K
60 min Winter	98.684	0.184	0.0	2.0	2.0	0.9	O K
120 min Winter	98.596	0.096	0.0	1.7	1.7	0.5	O K
180 min Winter	98.572	0.072	0.0	1.4	1.4	0.3	O K
240 min Winter	98.560	0.060	0.0	1.1	1.1	0.3	O K
360 min Winter	98.548	0.048	0.0	0.8	0.8	0.2	O K
480 min Winter	98.542	0.042	0.0	0.7	0.7	0.2	O K
600 min Winter	98.538	0.038	0.0	0.6	0.6	0.2	O K
720 min Winter	98.534	0.034	0.0	0.5	0.5	0.2	O K
960 min Winter	98.530	0.030	0.0	0.4	0.4	0.1	O K
1440 min Winter	98.525	0.025	0.0	0.3	0.3	0.1	O K
2160 min Winter	98.521	0.021	0.0	0.2	0.2	0.1	O K
2880 min Winter	98.518	0.018	0.0	0.1	0.1	0.1	O K
4320 min Winter	98.515	0.015	0.0	0.1	0.1	0.1	O K
5760 min Winter	98.514	0.014	0.0	0.1	0.1	0.1	O K
7200 min Winter	98.512	0.012	0.0	0.1	0.1	0.1	O K
8640 min Winter	98.512	0.012	0.0	0.1	0.1	0.1	O K
10080 min Winter	98.511	0.011	0.0	0.1	0.1	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	57.524	0.0	3.4	23
60 min Winter	34.985	0.0	4.1	38
120 min Winter	22.603	0.0	5.3	66
180 min Winter	17.091	0.0	6.0	96
240 min Winter	13.861	0.0	6.5	124
360 min Winter	10.147	0.0	7.2	184
480 min Winter	8.041	0.0	7.6	246
600 min Winter	6.680	0.0	7.9	308
720 min Winter	5.727	0.0	8.1	368
960 min Winter	4.474	0.0	8.4	486
1440 min Winter	3.137	0.0	8.9	714
2160 min Winter	2.203	0.0	9.3	1084
2880 min Winter	1.722	0.0	9.7	1452
4320 min Winter	1.229	0.0	10.4	2224
5760 min Winter	0.977	0.0	11.0	2912
7200 min Winter	0.825	0.0	11.6	3672
8640 min Winter	0.722	0.0	12.2	4432
10080 min Winter	0.649	0.0	12.8	5136

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 531366 193408 TQ 31366 93408
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.014

Time (mins) From:	To:	Area (ha)
0	4	0.014

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	5.0	0.0	0.801	0.0	0.0
0.800	5.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.0
Flush-Flo™	0.240	2.0
Kick-Flo®	0.504	1.6
Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.0	1.600	2.7	4.000	4.2	8.000	5.8
0.400	1.9	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.6	2.000	3.0	5.000	4.7	9.000	6.2
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.3		

Summary of Results for 30 year Return Period (+35%)

Half Drain Time : 10 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	98.913	0.413	0.0	2.0	2.0	2.0	O K
30 min Summer	98.919	0.419	0.0	2.0	2.0	2.0	O K
60 min Summer	98.843	0.343	0.0	2.0	2.0	1.6	O K
120 min Summer	98.749	0.249	0.0	2.0	2.0	1.2	O K
180 min Summer	98.667	0.167	0.0	1.9	1.9	0.8	O K
240 min Summer	98.617	0.117	0.0	1.8	1.8	0.6	O K
360 min Summer	98.579	0.079	0.0	1.5	1.5	0.4	O K
480 min Summer	98.564	0.064	0.0	1.2	1.2	0.3	O K
600 min Summer	98.555	0.055	0.0	1.0	1.0	0.3	O K
720 min Summer	98.550	0.050	0.0	0.9	0.9	0.2	O K
960 min Summer	98.543	0.043	0.0	0.7	0.7	0.2	O K
1440 min Summer	98.535	0.035	0.0	0.5	0.5	0.2	O K
2160 min Summer	98.529	0.029	0.0	0.3	0.3	0.1	O K
2880 min Summer	98.525	0.025	0.0	0.3	0.3	0.1	O K
4320 min Summer	98.521	0.021	0.0	0.2	0.2	0.1	O K
5760 min Summer	98.519	0.019	0.0	0.2	0.2	0.1	O K
7200 min Summer	98.517	0.017	0.0	0.1	0.1	0.1	O K
8640 min Summer	98.516	0.016	0.0	0.1	0.1	0.1	O K
10080 min Summer	98.515	0.015	0.0	0.1	0.1	0.1	O K
15 min Winter	98.983	0.483	0.0	2.0	2.0	2.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	121.848	0.0	3.2	14
30 min Summer	77.658	0.0	4.1	22
60 min Summer	47.229	0.0	5.0	38
120 min Summer	30.515	0.0	6.4	70
180 min Summer	23.072	0.0	7.3	100
240 min Summer	18.712	0.0	7.9	128
360 min Summer	13.698	0.0	8.6	186
480 min Summer	10.855	0.0	9.1	246
600 min Summer	9.019	0.0	9.5	306
720 min Summer	7.731	0.0	9.7	366
960 min Summer	6.040	0.0	10.1	488
1440 min Summer	4.234	0.0	10.7	716
2160 min Summer	2.974	0.0	11.2	1068
2880 min Summer	2.324	0.0	11.7	1428
4320 min Summer	1.659	0.0	12.5	2188
5760 min Summer	1.319	0.0	13.3	2912
7200 min Summer	1.113	0.0	14.0	3656
8640 min Summer	0.975	0.0	14.7	4336
10080 min Summer	0.876	0.0	15.5	5000
15 min Winter	121.848	0.0	3.6	15

Summary of Results for 30 year Return Period (+35%)

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
30 min Winter	98.979	0.479	0.0	2.0	2.0	2.3	O K
60 min Winter	98.851	0.351	0.0	2.0	2.0	1.7	O K
120 min Winter	98.694	0.194	0.0	2.0	2.0	0.9	O K
180 min Winter	98.606	0.106	0.0	1.8	1.8	0.5	O K
240 min Winter	98.580	0.080	0.0	1.5	1.5	0.4	O K
360 min Winter	98.560	0.060	0.0	1.1	1.1	0.3	O K
480 min Winter	98.551	0.051	0.0	0.9	0.9	0.2	O K
600 min Winter	98.545	0.045	0.0	0.8	0.8	0.2	O K
720 min Winter	98.541	0.041	0.0	0.6	0.6	0.2	O K
960 min Winter	98.535	0.035	0.0	0.5	0.5	0.2	O K
1440 min Winter	98.529	0.029	0.0	0.4	0.4	0.1	O K
2160 min Winter	98.524	0.024	0.0	0.3	0.3	0.1	O K
2880 min Winter	98.521	0.021	0.0	0.2	0.2	0.1	O K
4320 min Winter	98.518	0.018	0.0	0.1	0.1	0.1	O K
5760 min Winter	98.516	0.016	0.0	0.1	0.1	0.1	O K
7200 min Winter	98.514	0.014	0.0	0.1	0.1	0.1	O K
8640 min Winter	98.514	0.014	0.0	0.1	0.1	0.1	O K
10080 min Winter	98.513	0.013	0.0	0.1	0.1	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	77.658	0.0	4.6	24
60 min Winter	47.229	0.0	5.6	42
120 min Winter	30.515	0.0	7.2	72
180 min Winter	23.072	0.0	8.1	98
240 min Winter	18.712	0.0	8.8	126
360 min Winter	13.698	0.0	9.7	184
480 min Winter	10.855	0.0	10.2	248
600 min Winter	9.019	0.0	10.6	306
720 min Winter	7.731	0.0	10.9	368
960 min Winter	6.040	0.0	11.4	490
1440 min Winter	4.234	0.0	11.9	720
2160 min Winter	2.974	0.0	12.6	1072
2880 min Winter	2.324	0.0	13.1	1464
4320 min Winter	1.659	0.0	14.0	2252
5760 min Winter	1.319	0.0	14.9	3024
7200 min Winter	1.113	0.0	15.7	3648
8640 min Winter	0.975	0.0	16.5	4320
10080 min Winter	0.876	0.0	17.3	5016

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 531366 193408 TQ 31366 93408
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+35

Time Area Diagram

Total Area (ha) 0.014

Time (mins) From:	To:	Area (ha)
0	4	0.014

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	5.0	0.0	0.801	0.0	0.0
0.800	5.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.0
Flush-Flo™	0.240	2.0
Kick-Flo®	0.504	1.6
Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.0	1.600	2.7	4.000	4.2	8.000	5.8
0.400	1.9	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.6	2.000	3.0	5.000	4.7	9.000	6.2
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.3		

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 14 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	99.021	0.521	0.0	2.0	2.0	2.5	O K
30 min Summer	99.045	0.545	0.0	2.0	2.0	2.6	O K
60 min Summer	98.971	0.471	0.0	2.0	2.0	2.2	O K
120 min Summer	98.864	0.364	0.0	2.0	2.0	1.7	O K
180 min Summer	98.756	0.256	0.0	2.0	2.0	1.2	O K
240 min Summer	98.678	0.178	0.0	2.0	2.0	0.8	O K
360 min Summer	98.600	0.100	0.0	1.8	1.8	0.5	O K
480 min Summer	98.577	0.077	0.0	1.5	1.5	0.4	O K
600 min Summer	98.565	0.065	0.0	1.2	1.2	0.3	O K
720 min Summer	98.557	0.057	0.0	1.1	1.1	0.3	O K
960 min Summer	98.549	0.049	0.0	0.8	0.8	0.2	O K
1440 min Summer	98.539	0.039	0.0	0.6	0.6	0.2	O K
2160 min Summer	98.532	0.032	0.0	0.4	0.4	0.2	O K
2880 min Summer	98.527	0.027	0.0	0.3	0.3	0.1	O K
4320 min Summer	98.523	0.023	0.0	0.2	0.2	0.1	O K
5760 min Summer	98.520	0.020	0.0	0.2	0.2	0.1	O K
7200 min Summer	98.518	0.018	0.0	0.1	0.1	0.1	O K
8640 min Summer	98.517	0.017	0.0	0.1	0.1	0.1	O K
10080 min Summer	98.516	0.016	0.0	0.1	0.1	0.1	O K
15 min Winter	99.103	0.603	0.0	2.0	2.0	2.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	142.798	0.0	3.7	15
30 min Summer	91.767	0.0	4.8	24
60 min Summer	55.977	0.0	5.9	40
120 min Summer	36.122	0.0	7.6	72
180 min Summer	27.491	0.0	8.7	102
240 min Summer	22.423	0.0	9.4	130
360 min Summer	16.538	0.0	10.4	186
480 min Summer	13.169	0.0	11.1	246
600 min Summer	10.966	0.0	11.5	306
720 min Summer	9.407	0.0	11.9	366
960 min Summer	7.338	0.0	12.3	486
1440 min Summer	5.108	0.0	12.9	716
2160 min Summer	3.538	0.0	13.4	1100
2880 min Summer	2.728	0.0	13.8	1444
4320 min Summer	1.898	0.0	14.4	2192
5760 min Summer	1.476	0.0	14.9	2848
7200 min Summer	1.224	0.0	15.4	3608
8640 min Summer	1.056	0.0	16.0	4344
10080 min Summer	0.936	0.0	16.5	5008
15 min Winter	142.798	0.0	4.2	15

Summary of Results for 100 year Return Period (+20%)

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
30 min Winter	99.125	0.625	0.0	2.0	2.0	3.0	O K
60 min Winter	99.016	0.516	0.0	2.0	2.0	2.5	O K
120 min Winter	98.814	0.314	0.0	2.0	2.0	1.5	O K
180 min Winter	98.670	0.170	0.0	1.9	1.9	0.8	O K
240 min Winter	98.603	0.103	0.0	1.8	1.8	0.5	O K
360 min Winter	98.571	0.071	0.0	1.4	1.4	0.3	O K
480 min Winter	98.558	0.058	0.0	1.1	1.1	0.3	O K
600 min Winter	98.551	0.051	0.0	0.9	0.9	0.2	O K
720 min Winter	98.546	0.046	0.0	0.8	0.8	0.2	O K
960 min Winter	98.540	0.040	0.0	0.6	0.6	0.2	O K
1440 min Winter	98.532	0.032	0.0	0.4	0.4	0.2	O K
2160 min Winter	98.526	0.026	0.0	0.3	0.3	0.1	O K
2880 min Winter	98.523	0.023	0.0	0.2	0.2	0.1	O K
4320 min Winter	98.519	0.019	0.0	0.2	0.2	0.1	O K
5760 min Winter	98.517	0.017	0.0	0.1	0.1	0.1	O K
7200 min Winter	98.515	0.015	0.0	0.1	0.1	0.1	O K
8640 min Winter	98.514	0.014	0.0	0.1	0.1	0.1	O K
10080 min Winter	98.513	0.013	0.0	0.1	0.1	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	91.767	0.0	5.4	25
60 min Winter	55.977	0.0	6.6	44
120 min Winter	36.122	0.0	8.5	76
180 min Winter	27.491	0.0	9.7	104
240 min Winter	22.423	0.0	10.5	130
360 min Winter	16.538	0.0	11.7	186
480 min Winter	13.169	0.0	12.4	246
600 min Winter	10.966	0.0	12.9	304
720 min Winter	9.407	0.0	13.3	370
960 min Winter	7.338	0.0	13.8	484
1440 min Winter	5.108	0.0	14.4	722
2160 min Winter	3.538	0.0	15.0	1092
2880 min Winter	2.728	0.0	15.4	1468
4320 min Winter	1.898	0.0	16.1	2200
5760 min Winter	1.476	0.0	16.7	2984
7200 min Winter	1.224	0.0	17.3	3528
8640 min Winter	1.056	0.0	17.9	4264
10080 min Winter	0.936	0.0	18.5	5192

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 531366 193408 TQ 31366 93408
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.014

Time (mins) From:	To:	Area (ha)
0	4	0.014

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	5.0	0.0	0.801	0.0	0.0
0.800	5.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.0
Flush-Flo™	0.240	2.0
Kick-Flo®	0.504	1.6
Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.0	1.600	2.7	4.000	4.2	8.000	5.8
0.400	1.9	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.6	2.000	3.0	5.000	4.7	9.000	6.2
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.3		

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

Half Drain Time : 17 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	99.137	0.637	0.0	2.0	2.0	3.0	O K
30 min Summer	99.173	0.673	0.0	2.0	2.0	3.2	O K
60 min Summer	99.114	0.614	0.0	2.0	2.0	2.9	O K
120 min Summer	99.030	0.530	0.0	2.0	2.0	2.5	O K
180 min Summer	98.884	0.384	0.0	2.0	2.0	1.8	O K
240 min Summer	98.771	0.271	0.0	2.0	2.0	1.3	O K
360 min Summer	98.641	0.141	0.0	1.9	1.9	0.7	O K
480 min Summer	98.591	0.091	0.0	1.7	1.7	0.4	O K
600 min Summer	98.575	0.075	0.0	1.4	1.4	0.4	O K
720 min Summer	98.565	0.065	0.0	1.2	1.2	0.3	O K
960 min Summer	98.554	0.054	0.0	1.0	1.0	0.3	O K
1440 min Summer	98.543	0.043	0.0	0.7	0.7	0.2	O K
2160 min Summer	98.534	0.034	0.0	0.5	0.5	0.2	O K
2880 min Summer	98.530	0.030	0.0	0.4	0.4	0.1	O K
4320 min Summer	98.524	0.024	0.0	0.3	0.3	0.1	O K
5760 min Summer	98.521	0.021	0.0	0.2	0.2	0.1	O K
7200 min Summer	98.519	0.019	0.0	0.2	0.2	0.1	O K
8640 min Summer	98.518	0.018	0.0	0.1	0.1	0.1	O K
10080 min Summer	98.517	0.017	0.0	0.1	0.1	0.1	O K
15 min Winter	99.231	0.731	0.0	2.0	2.0	3.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	166.597	0.0	4.4	15
30 min Summer	107.061	0.0	5.6	24
60 min Summer	65.307	0.0	6.9	42
120 min Summer	42.142	0.0	8.8	76
180 min Summer	32.072	0.0	10.1	106
240 min Summer	26.161	0.0	11.0	134
360 min Summer	19.294	0.0	12.2	190
480 min Summer	15.364	0.0	12.9	246
600 min Summer	12.793	0.0	13.4	306
720 min Summer	10.975	0.0	13.8	366
960 min Summer	8.561	0.0	14.4	484
1440 min Summer	5.960	0.0	15.0	724
2160 min Summer	4.128	0.0	15.6	1072
2880 min Summer	3.183	0.0	16.0	1428
4320 min Summer	2.215	0.0	16.7	2200
5760 min Summer	1.722	0.0	17.4	2904
7200 min Summer	1.428	0.0	18.0	3616
8640 min Summer	1.232	0.0	18.6	4400
10080 min Summer	1.092	0.0	19.3	5056
15 min Winter	166.597	0.0	4.9	16

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
30 min Winter	99.273	0.773	0.0	2.0	2.0	3.7	O K
60 min Winter	99.179	0.679	0.0	2.0	2.0	3.2	O K
120 min Winter	99.012	0.512	0.0	2.0	2.0	2.4	O K
180 min Winter	98.786	0.286	0.0	2.0	2.0	1.4	O K
240 min Winter	98.661	0.161	0.0	1.9	1.9	0.8	O K
360 min Winter	98.583	0.083	0.0	1.6	1.6	0.4	O K
480 min Winter	98.566	0.066	0.0	1.3	1.3	0.3	O K
600 min Winter	98.557	0.057	0.0	1.1	1.1	0.3	O K
720 min Winter	98.551	0.051	0.0	0.9	0.9	0.2	O K
960 min Winter	98.544	0.044	0.0	0.7	0.7	0.2	O K
1440 min Winter	98.535	0.035	0.0	0.5	0.5	0.2	O K
2160 min Winter	98.529	0.029	0.0	0.3	0.3	0.1	O K
2880 min Winter	98.525	0.025	0.0	0.3	0.3	0.1	O K
4320 min Winter	98.521	0.021	0.0	0.2	0.2	0.1	O K
5760 min Winter	98.518	0.018	0.0	0.1	0.1	0.1	O K
7200 min Winter	98.516	0.016	0.0	0.1	0.1	0.1	O K
8640 min Winter	98.515	0.015	0.0	0.1	0.1	0.1	O K
10080 min Winter	98.514	0.014	0.0	0.1	0.1	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	107.061	0.0	6.3	25
60 min Winter	65.307	0.0	7.7	44
120 min Winter	42.142	0.0	9.9	82
180 min Winter	32.072	0.0	11.3	108
240 min Winter	26.161	0.0	12.3	134
360 min Winter	19.294	0.0	13.6	186
480 min Winter	15.364	0.0	14.5	246
600 min Winter	12.793	0.0	15.0	310
720 min Winter	10.975	0.0	15.5	362
960 min Winter	8.561	0.0	16.1	484
1440 min Winter	5.960	0.0	16.8	720
2160 min Winter	4.128	0.0	17.5	1092
2880 min Winter	3.183	0.0	18.0	1492
4320 min Winter	2.215	0.0	18.8	2196
5760 min Winter	1.722	0.0	19.4	2928
7200 min Winter	1.428	0.0	20.1	3584
8640 min Winter	1.232	0.0	20.9	4440
10080 min Winter	1.092	0.0	21.6	5008

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 531366 193408 TQ 31366 93408
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.014

Time (mins) From:	To:	Area (ha)
0	4	0.014

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	5.0	0.0	0.801	0.0	0.0
0.800	5.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.0
Flush-Flo™	0.240	2.0
Kick-Flo®	0.504	1.6
Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.0	1.600	2.7	4.000	4.2	8.000	5.8
0.400	1.9	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.6	2.000	3.0	5.000	4.7	9.000	6.2
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.3		

Appendix 6 – Greenfield Runoff Rates

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	0.140	Urban	0.000
SAAR (mm)	664	Region Number	Region 6

Results l/s

QBAR Rural	0.6
QBAR Urban	0.6
Q100 years	1.8
Q1 year	0.5
Q30 years	1.3
Q100 years	1.8

Area used is 10 times greater than drained areas.

Results divided by 10 to obtain results.

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	0.020	Urban	0.000
SAAR (mm)	664	Region Number	Region 6

Results l/s

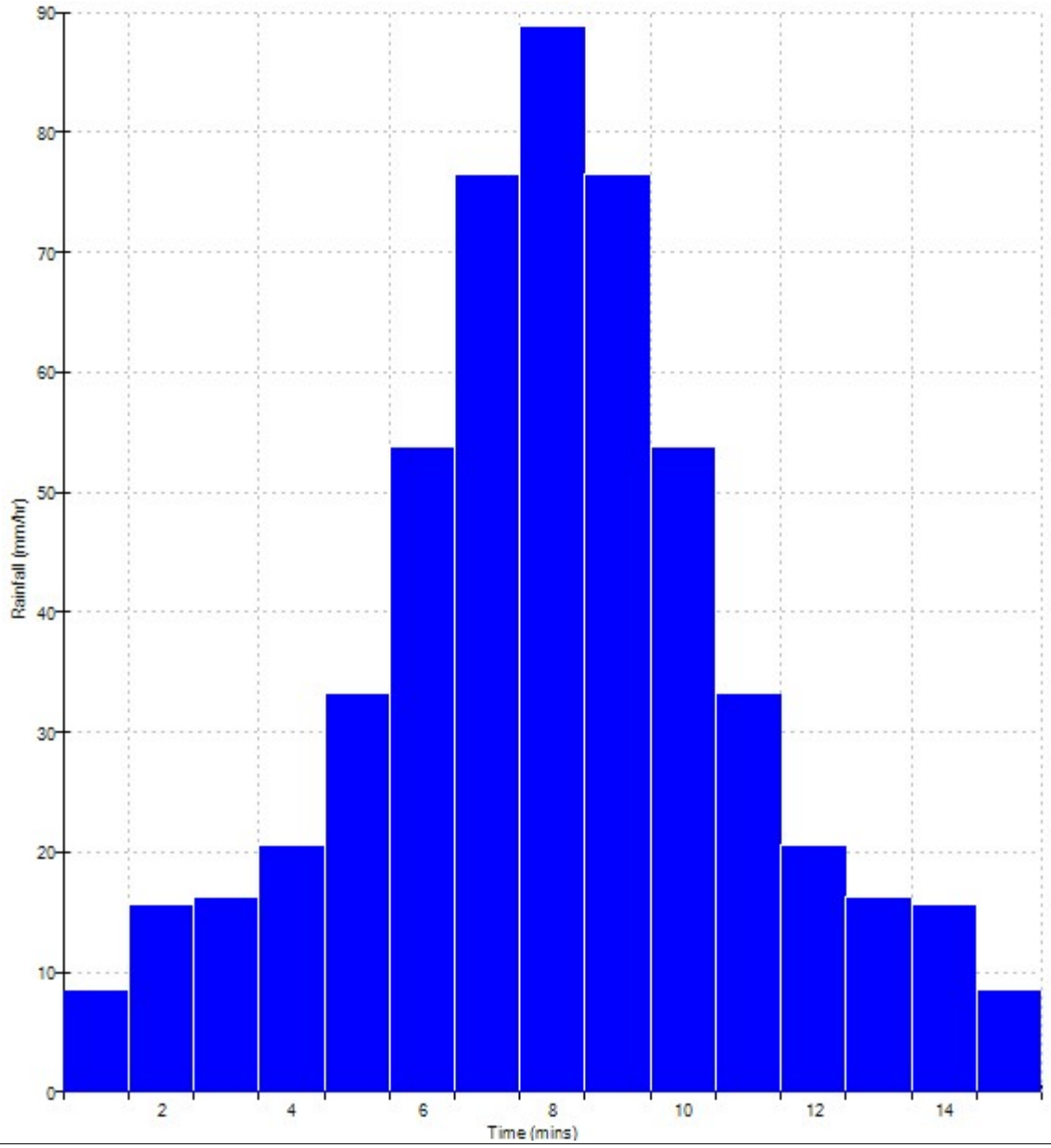
QBAR Rural	0.1
QBAR Urban	0.1
Q100 years	0.3
Q1 year	0.1
Q30 years	0.2
Q100 years	0.3

Appendix 7 – Brownfield Runoff Rates

Rainfall profile

Storm duration (mins) 15

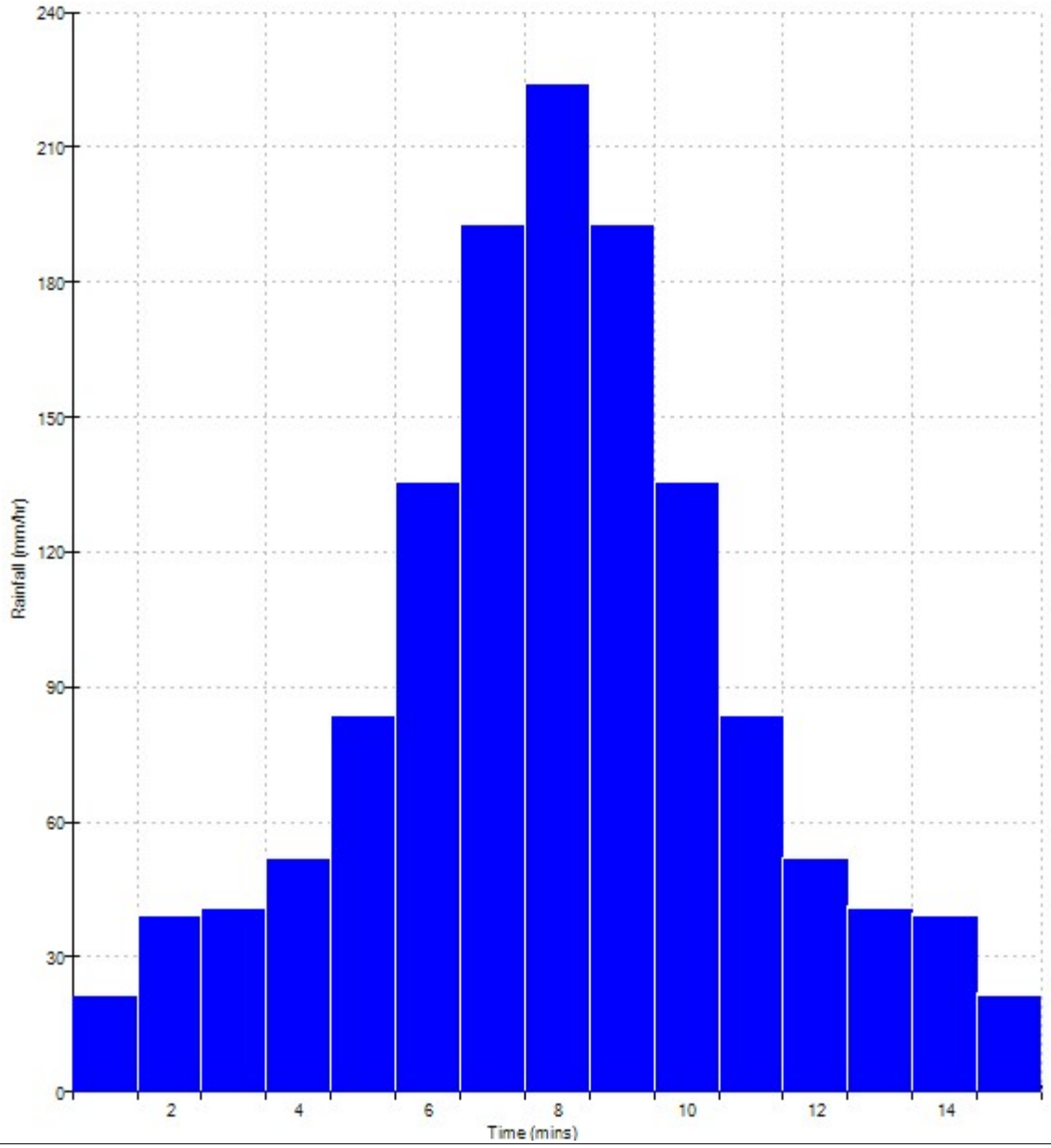
FEH Data	
FEH Rainfall Version	2013
Site Location	GB 531366 193408 TQ 31366 93408
Data Type	Point
Peak Intensity (mm/hr)	88.716
Ave. Intensity (mm/hr)	35.773
Return Period (years)	2.0



Rainfall profile

Storm duration (mins) 15

FEH Data	
FEH Rainfall Version	2013
Site Location	GB 531366 193408 TQ 31366 93408
Data Type	Point
Peak Intensity (mm/hr)	223.836
Ave. Intensity (mm/hr)	90.257
Return Period (years)	30.0

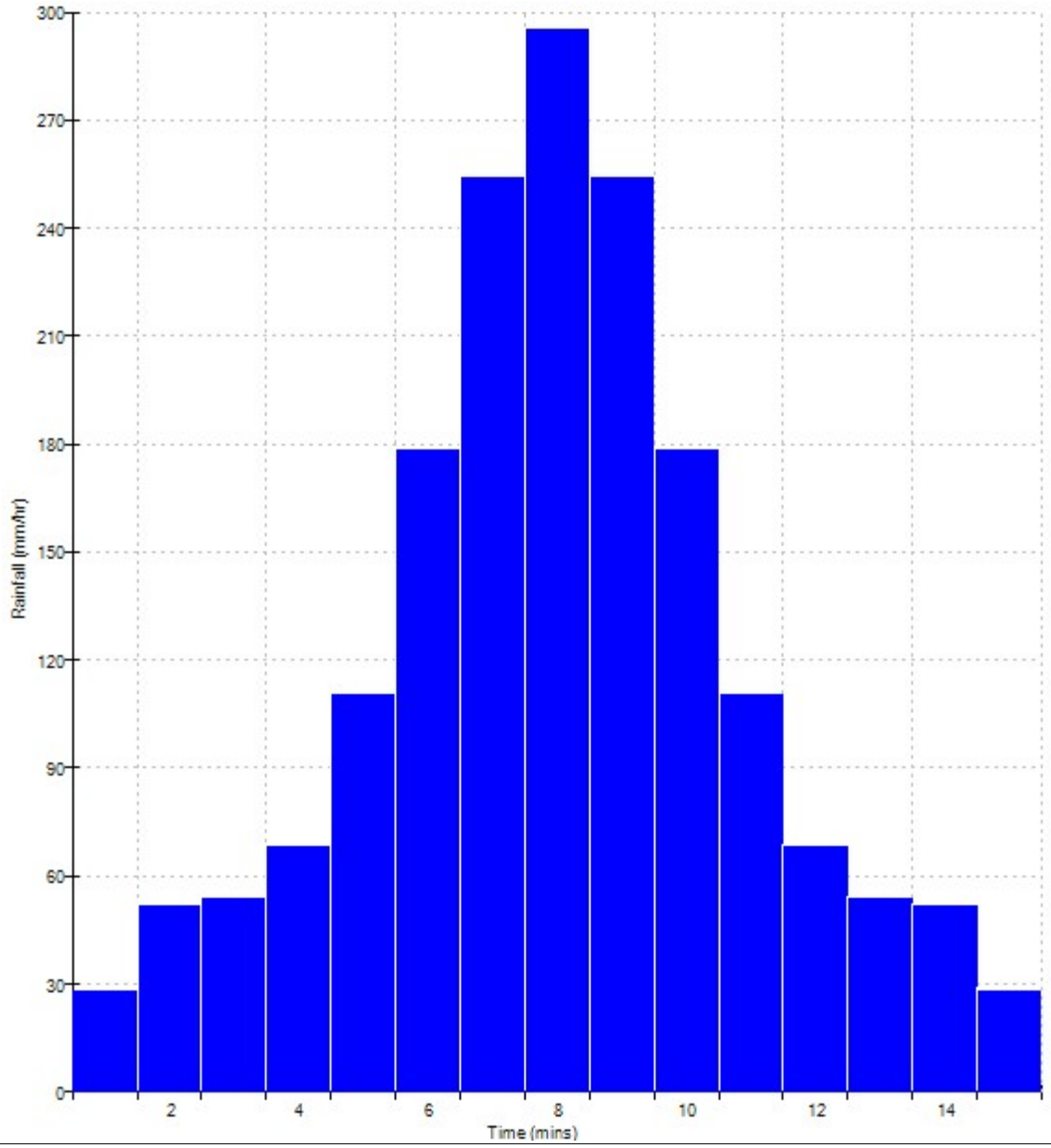


Rainfall profile

Storm duration (mins) 15

FEH Data

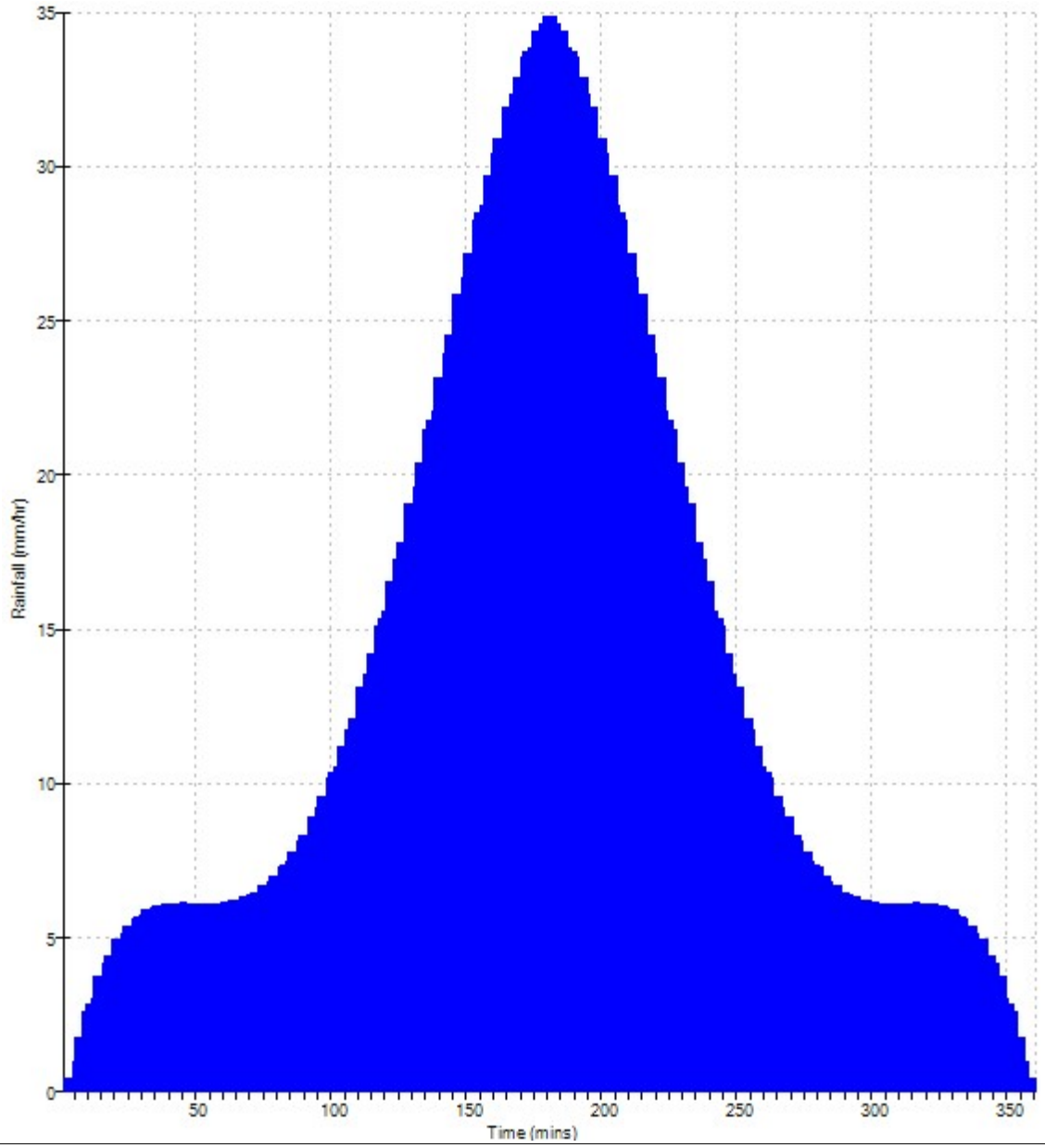
FEH Rainfall Version	2013
Site Location	GB 531366 193408 TQ 31366 93408
Data Type	Point
Peak Intensity (mm/hr)	295.113
Ave. Intensity (mm/hr)	118.998
Return Period (years)	100.0



Rainfall profile

Storm duration (mins) 360

FEH Data	
FEH Rainfall Version	2013
Site Location	GB 531366 193408 TQ 31366 93408
Data Type	Point
Peak Intensity (mm/hr)	34.855
Ave. Intensity (mm/hr)	13.781
Return Period (years)	100.0



considine

Civil + Structural Engineers

Title	19 Hertford Court, Enfield	Job No:	5918
Decription :	Estimate of Existing and Proposed	By:	KC
	Peak Run-Off Rate and Volume	Date:	16/11/2023
		Sheet No:	1

Climate Change Allowance 40%

Existing Site

Pre-Developed Site: Estimate Surface Water Run-Off Using the Modified Rational Method

Site Area = 198 m^2

Existing Impermeable Area = 105 m^2

Average Rate of Rainfall (Obtained from MicroDrainage using FEH data)

2 Year 15 Minute Event (M2-15D) =	35.773	mm/hr (i)	+	40%	50.082	mm/hr (i)
30 Year 15 Minute Event (M30-15D) =	90.257	mm/hr (i)	+	40%	126.36	mm/hr (i)
100 Year 15 Minute Event (M100-15D) =	118.998	mm/hr (i)	+	40%	166.6	mm/hr (i)

FEH Rainfall data source:
Version 2013 FEH Data Set, Site: GB 531366 193408 (Point)

Peak Rate of Run-Off (Q_P)

$Q_P = C \cdot A_P \cdot i$ Where $C = C_V \cdot C_R$

C_V = 0.75 (Volumetric Co-efficient)

C_R = 1.3 (Routing Co-efficient)

Q_{P2} =	1.017 l/s	+	40%	1.4242	l/s
Q_{P30} =	2.567 l/s	+	40%	3.5934	l/s
Q_{P100} =	3.384 l/s	+	40%	4.7376	l/s

Title	19 Hertford Court, Enfield	Job No:	5918
Decription :	Estimate of Existing and Proposed	By:	KC
	Peak Run-Off Rate and Volume	Date:	16/11/2023
		Sheet No:	2

Proposed Development

Total Impermeable Area = 151 m^2

Adjust Average Rainfall for Climate Change in Accordance with National Planning Policy, for the upper end of the epoch that the development is designed for:

M2 - 15D + 40% = 50.082 mm/hr (i)

M30 - 15D + 40% = 126.360 mm/hr (i)

M100 - 15D + 40% = 166.597 mm/hr (i)

Proposed Peak Rate of Run-Off (Q_P)

Q_{P2} =	1.463 l/s	+ 40%	2.0482 l/s
Q_{P30} =	3.691 l/s	+ 40%	5.1676 l/s
Q_{P100} =	4.867 l/s	+ 40%	6.8131 l/s

Peak Volume Run-Off

This is calculated using the 100 Year return period, 360 minute storm event

Average rainfall (M100-360D) =	13.781 mm/hr	+ 40%	19.293 mm/hr
Average depth of rainfall =	82.686 mm (i_d)		115.76 mm (i_d)

Existing Volume Run-Off

$V = C \cdot A_p \cdot i$	V = 8.46 m^3	+ 40%	11.85 m^3

Title	19 Hertford Court, Enfield	Job No:	5918
Decription :	Estimate of Existing and Proposed	By:	KC
	Peak Run-Off Rate and Volume	Date:	16/11/2023
		Sheet No:	3

Proposed Volume Run-Off

Allowance for Climate Change = 40%

Average Rainfall (M100-360D) + 40% = 19.293 mm/hr

Average Depth of Rainfall = 115.760 mm(i_d)

Proposed Volume Run-Off

V = C . AP . i = 12.17 m^3 + 40% 17.04 m^3

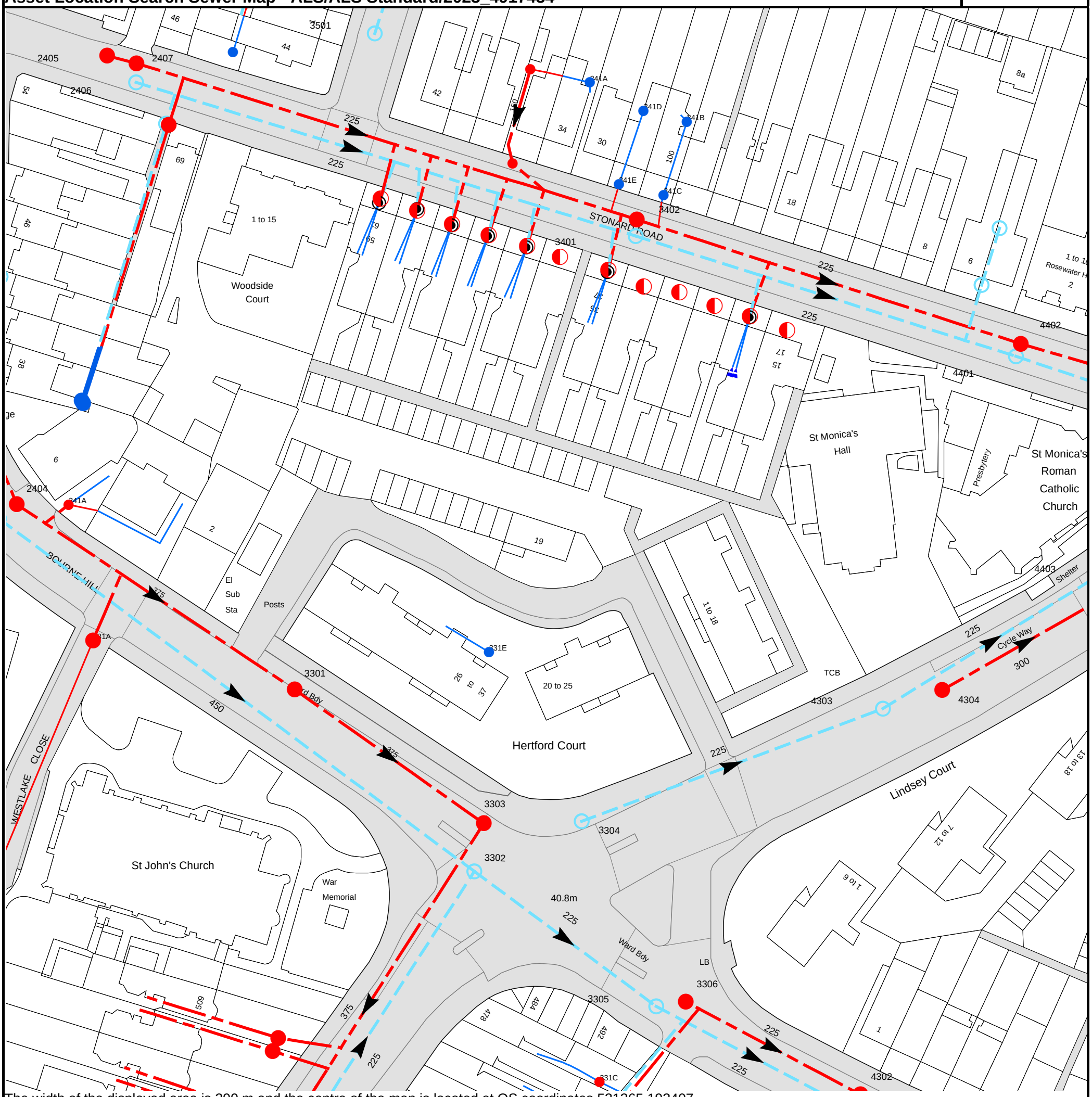
Additonal Volume

V_{add} = V(Proposed) - V(Existing)

V_{add} = 3.71 m^3

Appendix 8 – Sewer Records

Asset Location Search Sewer Map - ALS/ALS Standard/2023_4917434



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 531365,193407

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 (2020) 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
4304	38.93	36.88
44BA	n/a	n/a
44BB	n/a	n/a
4401	39.06	36.28
4402	39.08	36.36
331C	n/a	n/a
3305	39.44	37.42
3306	38.7	36.1
3302	41.13	37.74
3303	40.91	36.72
3304	40.38	37.23
4303	39.25	36.51
3301	41.52	36.81
331E	n/a	n/a
4405	n/a	n/a
4404	n/a	n/a
3410	n/a	n/a
3409	n/a	n/a
3408	n/a	n/a
3407	n/a	n/a
3419	n/a	n/a
3418	n/a	n/a
3401	41.2	38.02
3417	n/a	n/a
3416	n/a	n/a
3402	41.2	38.93
3415	n/a	n/a
3414	n/a	n/a
341C	n/a	n/a
341E	n/a	n/a
3403	n/a	n/a
341B	n/a	n/a
341D	n/a	n/a
341A	n/a	n/a
3405	n/a	n/a
3309	n/a	n/a
3310	n/a	n/a
2404	43.82	37.01
241A	n/a	n/a
24BC	n/a	n/a
24AI	n/a	n/a
231A	n/a	n/a
2405	43.52	41.52
2406	43.46	40.26
2407	n/a	n/a
24BE	n/a	n/a
24BA	n/a	n/a
34AD	n/a	n/a
3501	42.25	40.04

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

Foul Sewer: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water Sewer: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined Sewer: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

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.

- Air Valve
- Meter
- Dam Chase
- Vent
- Fitting

Operational Controls

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

- Ancillary
- Drop Pipe
- Control Valve
- Weir

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.

- Inlet
- Outfall
- Undefined End

Other Symbols

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

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

Ducts or Crossings

- Casement

Ducts may contain high voltage cables. Please check with Thames Water.

- Conduit Bridge
- Subway
- Tunnel

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plan are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the 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 indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. 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, please contact Property Searches on 0800 009 4540.