SHEAR design
Consulting Civil and Structural Engineers

22055-D100

DRAINAGE STRATEGY

WITH COMMENTARY ON FRA

CALTHORPE STREET, BANBURY,

OX16 5EX

MAY 2023

22055.D100

CONTENTS

APPENDICES

ISSUE	PREPARED BY	CHECKED BY	NOTES	DATE
-	EB	DKK	FIRST ISSUE	5 JUNE 2023

1.0 INTRODUCTION

This report has been prepared by Shear Design Ltd on behalf of their client, TR17 Banbury LLP for the site at Calthorpe Street, Banbury, OX16 5EX (National Grid Reference: SP 45491 40311). The proposed development is a brownfield site in Oxfordshire, is entirely within Flood Zone 1 and occupies an area of 1.6ha. A site location plan is included in Appendix A. A Flood Risk Assessment has been conducted by Hydrock and located in Appendix G.

This drainage strategy will detail the drainage measures proposed for this development. It will describe the existing site and associated drainage infrastructure and identify a sustainable solution for the proposed surface water drainage.

The drainage strategy proposes to restrict runoff rates, will consider allowances for climate change at a level of 40% and urban creep at 10%. This is in accordance with the guidance from the Lead Local Flood Authority for Banbury: *Oxfordshire Lead Local Flood Authority Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire – December 2021*.

This report will also discuss flood risk to the proposed site in the context of the Flood Risk Assessment produced by Hydrock and provide additional commentary/analysis based upon the requirements of the LLFA for Banbury.

Shear Design Ltd have prepared this report in accordance with the instructions of its client, TR17 Banbury LLP for its Client's sole and specific use. This report is not assignable without the prior written permission of Shear Design Ltd. This report should not be relied upon exclusively for decision making purposes and should be read in conjunction with other Engineer's reports, specifications and drawings in addition to all other relevant reports, drawings and specifications.

2.0 PLANNING POLICY

The National Planning Policy Framework (revised, July 2021) details the strategy for "meeting the challenge of Climate Change, flooding and coastal change" (Ministry of Housing, Communities & Local Government: National Planning Policy Framework. Crown Copyright 2021).

The relevant objectives of design as indicated in the July 2021 revision are:

169. *Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:*

- *a) take account of advice from the lead local flood authority*
- *b) have appropriate proposed minimum operational standards*
- *c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and*
- *d) where possible, provide multifunctional benefits."*

The site is in Banbury, Oxfordshire and is therefore subject to the remit of Oxfordshire County Council. The Oxfordshire Lead Local Flood Authority have produced a guidance document for surface water drainage: "*Oxfordshire County Council - Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire*" (December 2021). This document gives the detail required for drainage strategies submitted as part of a full planning application and can be viewed online.

All relevant guidance has been followed in the design process and in the preparation of this report.

3.0 TOPOGRAPHY AND SITE DESCRIPTION

The proposed site is in Banbury, Oxfordshire, and is occupied by retail premises and a "Pay and Display" car park. The total site area is 1.6ha which is a combination of commercial buildings, macadam, and soft landscaping. The total area of soft landscaping is approximately 0.013ha with the remainder being hard landscaping/roofs; the existing ratio of hard to soft landscaping is approximately 15:1. The soft landscaping areas are assumed to be self-draining.

The site slopes from the south west to the north east with an overall level range of approximately 7m, ranging from 104m AOD to 97m AOD. These levels have been taken from the topographical survey conducted by Greenhatch Group (Sep 2016) – please refer to Appendix B.

To the north of the site there are two business premises and a private car park. The car park is separated from the rest of the site by a brick retaining wall. The business premises to the north are outside of the proposed site boundary; however, the private car park is within the boundary and lower than the main site by 1-2m.

There is a business premises to the south-west and residential properties to the south-east on Marlborough Place and to the south-east on Dashwood Road. On the eastern boundary, the site is bordered by Marlborough Road with Marlborough Road Methodist Church immediately adjacent to the site. The church is separated from the site by a retaining wall of unknown height (the height was not recorded on the topographical survey).

The existing pay and display car park that covers most of the site is accessible to pedestrians and vehicles. There are two entrances for cars, one by Marlborough Road Methodist Church on Marlborough Road another from Calthorpe Street. There are also pedestrian steps allowing access from Marlborough Road.

The site borders Calthorpe Street and Calthorpe House to the west; the Calthorpe House car park is approximately 1.5m higher than the proposed site with a retaining wall at the site boundary. To the south-west there are two more parking areas within the site boundary, one serving the commercial premises and the other is a "Pay and Display" car park; these are only accessible from Calthorpe Street. In addition to the car parks in the south-west, there is also an electrical substation in this area which resides within the site boundary.

The nearest watercourses to the site are the Oxford Canal, approximately 400m to the east and Grimsbury Reservoir which is approximately 1.5km to the north.

4.0 EXISTING DRAINAGE AND SITE INVESTIGATIONS

The Thames Water sewer records indicate the presence of adopted sewers in the roads to the north, east and west of the site as well as an adopted foul water sewer crossing the site in the south-west (refer to Appendix D). The cover levels of the existing manholes are known, or can be interpolated from the topographical survey. There is also preliminary information regarding the existing site drainage from an initial drainage survey; however a CCTV survey will be required to determine chamber invert levels and the condition of different pipes. This should be a limited scope survey to prove connections to the existing adopted network and the conditions of the connections.

The topographical survey indicates the presence of existing foul and surface water drainage within the site boundary (see Appendix B); and a ground radar survey has been conducted on the existing drainage (see Appendix E). The data from these surveys located the adopted foul water sewer that crosses the site to the south-west and private foul and surface water networks that serve the existing retail units, running south-to-north and discharging to adopted sewers under High Street to the north. There is also surface water drainage serving the existing retail units and the car park.

The adopted foul sewer that crosses the site appears to discharge into foul water manhole 4302 in Calthorpe Street, however a CCTV survey will be required to confirm the discharge location. This drainage run may be subject to a proposed Section 185 Agreement with Thames Water to allow for it to be diverted around the edge of the site and to make room for aspects of the development.

The private foul and surface water sewers both appear to discharge into manholes in the private car park to the north before discharging into the existing foul and surface water sewers within High Street. At the time of writing this report, a detailed CCTV survey has not been conducted to fully ascertain the condition of the existing drainage outfalls. This should be conducted prior to detailed design stage.

The British Geological Survey (BGS) indicates that the bedrock geology is formed of:

Charmouth Mudstone Formation - Mudstone. Sedimentary bedrock formed between 199.3 and 182.7 million years ago during the Jurassic period. Dark grey laminated shales, and dark, pale and bluish grey mudstones; locally concretionary and tabular limestone beds; abundant argillaceous limestone, phosphatic or ironstone (sideritic mudstone) nodules in some areas; organic-rich paper shales at some levels; finely sandy beds in lower part in some areas.

The British Geological Survey Infiltration SuDS Map holds no data currently regarding the potential efficacy of SuDS or the depth to groundwater for this site or the surrounding area.

A Desktop Site Investigation was commissioned with RSK Geosciences (1922759-R01-00 – February 2023) and indicates the presence of made ground across the site due to previous developments. Furthermore, the report notes the presence of clay and mudstones underlying the site, and groundwater at 1-5m depth. As a result, the desktop study concludes that an infiltration solution is not suitable for this site. Refer to Appendix F for the full report. If invasive infiltration testing is required to confirm that an infiltration solution is not viable, it is expected that this will be conditioned as part of the Planning process.

5.0 DEVELOPMENT DESCRIPTION

The proposed development is the demolition of the existing buildings and site infrastructure and the construction of residential premises and associated car parking to include green infrastructure/SuDS features.

The development proposes to increase the number of green spaces throughout the site by utilising self-draining, soft-landscaped areas across the site, including a play area and amenity areas. There will also be soft landscaping, such as roof terraces, that will drain to the private surface water network. The total area of soft landscaping will be approximately 10% of the site area which is an improvement on the existing ratio of hard-to-soft landscaping.

In addition to the new green spaces, it is also proposed to utilise blue and green roofs across the site. Blue roofs may be able to provide storage for surface water runoff, while green roofs will provide treatment. The exact arrangement of blue/green roofs is still subject to detailed design, however the overall strategy is to use a combination of these features to provide treatment and storage for this development.

In order to ensure that the proposed drainage design will be sufficient for this site, this report will not utilise the storage available in the potential blue roofs. When these are confirmed, it may be possible to rationalise the drainage design further.

The proposed drainage strategy will involve the use of a series of geo-cellular attenuation tanks for storage, therefore there may be a need to divert the existing foul water sewer under a S185 Agreement to avoid the proposed location of one of the attenuation tanks.

The two existing vehicular accesses are to be retained. The access from Marlborough Road is to be retained with possible minor changes at the interface with the existing footway. The existing access via Calthorpe Street is also to be retained but will be directed to the proposed underground parking area at lower ground floor level which may also require amendments to the existing footway. A further vehicle access is proposed from Calthorpe Street to the south-west of the site which will allow access for residents of the proposed town houses. The proposed southern access will also create a new pedestrian route from Calthorpe Street.

6.0 FLOOD RISK

A Flood Risk Assessment (FRA) has been prepared by Hydrock Consultants Limited. The report shows that the site is entirely in Flood Zone 1, at low risk of fluvial and groundwater flooding. Furthermore, the report concludes that the risk of surface and sewer flooding is low and that tidal flooding was discounted. The report also notes that sequential/exception tests are not required and the risk of infrastructure flooding was also assessed as low. Overall, the report concludes that the application meets the flood risk requirements of the National Planning Policy Framework. Recommendations for the proposed site are also made within the FRA and these can be reviewed within the report (refer to Appendix F.)

As the Flood Risk Assessment was conducted prior to the completion of the drainage design, the section on infrastructure failure does not cover the risk of the proposed drainage system failing. As per the guidance from Oxfordshire County Council for Sustainable Drainage Systems, there is no surcharging of any manholes for the 1 in 2-year storm event and no flooding from any manholes for the 1 in 30-year storm event. Furthermore, there is no flooding from any manholes for the 1 in 100-year +40% climate change storm event.

The risk of system failure has also been analysed by using the drainage model created for the design within Causeway Flow and increasing the modelled return period until the system floods.

For the southern catchment of the site, the drainage network floods in the 1 in 109-year +40% storm event at manholes within the southern access road and the garden of one of the town houses. In this scenario, the flood exceedance route would be away from the townhouses and out of the site to the west onto Calthorpe Street.

For the north catchment, due to the proposed levels of the site, the area that will flood first is the area with the lowest cover level. This is the proposed lowered terrace area by the border of the site with Marlborough Road Methodist Church to the east. In this scenario, the flood exceedance route would be past the Methodist Church and onto Marlborough Road to the east.

As the system has been modelled to exceedance over the required design standards, the modelled flooding does not affect the overall drainage design. However, the manholes which flood can be used to determine a safe egress route in the event of a serious flood event or system failure. The recommendation is that the safe egress route from the site would be to exit via the vehicular route to the north-east or the pedestrian routes to the north/north-west. Refer to Appendix C for the proposed drainage layout showing expected flood exceedance routes for the scenarios described above.

7.0 PROPOSED DRAINAGE STRATEGY

7.1 Surface Water Drainage

A SuDS Strategy for surface water drainage works is required for this site and should be designed in accordance with Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) to ensure proper drainage and manage the risk of flooding and pollution. Best current practice has been used to determine suitable Sustainable Drainage Systems (SuDS) selection where possible.

Surface water runoff generated from the proposed impermeable areas seeks to meet the following design objectives:

- Infiltration to ground as close as possible to source to recharge the groundwater and watercourse base flows (depending on ground condition and existing site uses),
- Attenuate and control surface water runoff from proposed impermeable areas to the equivalent of the Greenfield runoff rate or to an agreed betterment of the Brownfield runoff rate.
- Manage surface water runoff from the site so that it does not increase and where possible, reduces flood risk to third parties.
- Improve the quality of surface water discharge.

Several SuDS features should be ideally used throughout a site, linked together to form a SuDS train providing treatment, control and attenuation processes.

As part of the Oxfordshire Lead Local Flood Authority SuDS guidance for developers, development drainage design should consider urban creep at 10% (*Oxfordshire Lead Local Flood Authority Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire – December 2021).*

The SuDS hierarchy gives guidance as to the priority or preference of different solutions:

- Rainwater re-use (rainwater harvesting/greywater recycling)
- Into the ground (infiltration)
- To a surface water body (e.g., an ordinary watercourse)
- To a surface water sewer, highway drain, or other drainage system
- To a combined sewer

These options have been considered as follows:

- Rainwater re-use has been discounted due to the associated cost with maintaining such a system while also expecting the benefit of such a system to be minimal to the development.
- An infiltration drainage solution has been discounted for this site due to the desktop site investigation study conducted (RKS: March 2023). The report concluded that infiltration is not viable due to the presence of Charmouth Mudstone formation which is described as a "low permeability soil".
    - It is currently not planned to conduct an invasive site investigation prior to the submission of this drainage strategy as the site is still live. However, if such a survey was required in the future, then it would be expected that this would be conditioned as part of the planning response.
- A hybrid solution involving infiltration has also been discounted for the reasons noted above.
- There is no surface water body located close enough to the site to allow for discharge. The closest surface water body is the Oxford canal, approximately 400m away. It would not be practical or feasible to discharge to a body so far away.
- There are surface water sewers in the roads that bound the site that can receive surface water runoff. Therefore, it is proposed to discharge surface water runoff to the existing surface water sewers located in Calthorpe Street and/or High Street.
- As this strategy seeks to achieve a higher priority level, discharge to a combined sewer has not been considered.

In order to proceed with a design for a surface water drainage system, it is necessary to design a solution that, in addition to directing surface water runoff to an eventual location, it will also solve the problem of storing excess runoff prior to discharge.

Surface water attenuation in the form of an above-ground pond has been discounted due to lack of space onsite as there is no suitable location for a pond that would be large enough to provide the required storage. Furthermore, a large above-ground pond would be detrimental to the character of the area (an urban site within a town centre location) and it is therefore considered that a combination of other SuDS features would be a more appropriate solution. It would be possible to utilise below-ground storage in the form of geo-cellular tanks combined with other SuDS features.

This drainage strategy proposes to use underground attenuation with restricted discharge into the Thames Water surface water sewer. The proposed attenuation has been designed to attenuate peak flows from all storm events, up to and including the critical 1 in 100-year storm with a 40% allowance for climate change and a coefficient of runoff (C_v) value of 0.95 (as per the *Oxfordshire County Council - Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire*) which assumes that 95% of surface water runoff will enter the system. Refer to Appendix C for the proposed drainage layout (*22074-106 – Proposed Drainage Layout).*

The existing site brownfield runoff rate has been estimated by modelling the site in MicroDrainage and has been estimated as approximately 150 L/s. However as noted above, developments should aim to reach greenfield runoff rates where possible. Refer to Appendix J for greenfield runoff rate calculations.

A pre-application consultation was submitted to Thames Water; who have indicated that a discharge rate of 5 L/s/ha for surface water runoff is acceptable. Therefore, based upon a site are of 1.6ha and approximately 10% proposed permeable area the proposed site runoff is to be 7.2 L/s. As the requirement for urban creep is given as 10%, the total area considered for the drainage calculations will be 1.6ha. Contact has also been made with the Oxfordshire Lead Local Flood Authority to request confirmation of acceptance of the proposed surface water flow rate but at the time of writing this report, a response has not yet been received.

The surface water drainage strategy is to discharge at an overall flow rate of 7.2 L/s into the Thames Water surface water sewers that are located in Calthorpe Street to the west and High Street to the north. To avoid overly deep drainage at the north of the site, and due to a 3m level difference between the north and south of the site, it is proposed to split the site into two "catchments" - north & south, with the 7.2 L/s discharge rate being proportioned to the two catchments, with each one discharging separately.

The south catchment is proposed to discharge into surface water manhole 4250 (Thames Water sewer records) at a rate of 3.2 L/s. The northern catchment of the site is proposed to discharge either into surface water manhole 4350 in Calthorpe Street, or into the existing discharge point to the north of the site at a rate of 4.0 L/s. The proposal of discharging surface water runoff into multiple points of the surface water sewer has been agreed in principle with Thames Water (See Appendix K).

It should be noted that the surface water discharge rates mentioned above are preliminary only and subject to detailed design. Any new connection to an adopted sewer is subject to a Section 106 Agreement with the relevant drainage authority. Through discussions with Thames Water, it is unlikely that they would intend to adopt any of the proposed surface water drainage, however if this changes then a S104 Agreement would also be required.

For information relating to the existing adopted sewer layout refer to Appendix D. Further confirmation will be required to confirm the viability of the proposed connection(s) and a determination can be made after a site CCTV survey has been completed.

7.1.1 Proposed Sustainable Drainage Systems (SUDS)

The overall drainage strategy is to use attenuation and restricted discharge; this is intended to be used in conjunction with other SuDS features that aim to meet requirements of interception, treatment, and biodiversity.

The proposed SuDS features are:

- Green roofs
- Blue roofs
- Permeable paving
- Geo-cellular tanks

It is proposed to utilise a system of green and blue roofs across the site that provide treatment and possibly also storage respectively. These will include the additional benefit of slowing the rate at which surface water runoff will enter the main drainage system, as well as, in the case of green roofs, treating surface water runoff at source.

As the proposal for this site is still at the Planning stage, the current drainage design for the site will not account for the additional storage provided by blue roofs. This will ensure that the site has sufficient storage available if the blue roofs were to be changed to green roofs at a later stage.

A green roof is roof covered by plants or other vegetation; they can provide treatment at source to surface water. The proposed green roofs will have discharge points that will convey surface water to the drainage network.

A blue roof stores surface water runoff at source, which provides hydraulic control by slowing the rate at which it enters the drainage system. A blue roof can either have a paved or vegetative surface; a paved surface can be beneficial to allow the use of plant equipment on the roof area. The proposed blue roofs will have discharge points that will convey surface water to the drainage network.

Surface water runoff that lands on proposed pitched roofs will be collected by a system of gutters and rainwater pipes and discharge into the proposed permeable paving via diffuser boxes.

A lined permeable paving system is a block-paved surface with a filter medium beneath it that contains surface water runoff. This provides the benefit from a SuDS perspective of treating surface water runoff at source. Permeable paving can be flush to the edge of a building due to the use of a lined system with an impermeable "*apron*" to prevent water ingress into the ground around the foundations, thereby maximising space.

It is proposed to utilise permeable paving to receive runoff that lands directly on the paving and to receive runoff from the proposed pitched roof areas via the use of gutter, rainwater pipes and diffuser boxes. Block paving will also provide hydraulic control by slowing the rate at which surface water runoff discharges into the drainage network. Permeable block paving will not be used in areas above the proposed basement parking area due to a need to reduce the construction height in line with the required headroom needed in the basement. These areas will use linear drainage channels or fin drains to convey surface runoff to the rest of the surface water network.

The site levels currently fall from the south-east of site to the north. There is an existing surface water manhole which would create a suitable connection to the existing surface water sewer for the north catchment, subject to CCTV survey.

The proposed drainage network has been modelled in Causeway Flow; this has shown that the required storage for the north catchment, with a discharge rate of 4.0 L/s is 750m^3, which is proposed to be split between two geo-cellular attenuation tanks. The required storage for the south catchment, with a discharge rate of 3.2 L/s, is 453m^3, which will also be split between two attenuation tanks. Therefore, the total storage required for this site is approximately 1,203m^3 (please refer to Appendix I).

When considering the required storage and designing the site layout, the proposed attenuation volume will be taken as the value within the Flow network model. However, it should be noted that the required volume of storage may change as the design process progresses and is subject to detailed design.

One factor that is likely to influence the required storage provided by the geo-cellular tanks is the provision of blue roofs. As the exact arrangement of blue and green roofs has not yet been finalised, any additional storage that may be provided by blue roofs has not been accounted for. When the detailed design is undertaken, the additional storage provision should be factored into the drainage network model to allow for consideration of reducing the size of the underground attenuation tanks.

7.1.2 Pollution Control

In keeping with best practice, consideration must be given to pollution control of surface water runoff. Permeable paving and green roofs are to be used to treat surface water runoff at source and in line with the Simple Index Approach within CIRIA Report C753, *The SuDS Manual.* The Simple Index Approach (CIRIA: *The SuDS Manual C753*) allows for an analysis of the required treatment. All treatment trains have been considered when designing for pollution control. The tables shown below represent each treatment scenario. As all the total index values above exceed the minimum pollution hazard indices, it is deemed that the development has sufficient treatment.

Treatment Train: Green Roof					
Residential Roofs (Pollution Hazard Level: Very Low)	**Pollution Hazard Indices (minimum)**	**Mitigation Indices**	**Total Index**	**Index Score**	**Pass/Fail**
		Green Roofs	**$= x_1 + 0.5(x_2)$**		
Total suspended solids (TSS)	0.3	0.8	**0.8**	**0.5**	**Pass**
Metals	0.2	0.8	**0.8**	**0.6**	**Pass**
Hydrocarbons	0.4	0.8	**0.8**	**0.4**	**Pass**

Treatment Train: Residential (Pitched) Roof to Permeable Pavement					
Residential Roofs (Pollution Hazard Level: Very Low)	**Pollution Hazard Indices (minimum)**	**Mitigation Indices**	**Total Index**	**Index Score**	**Pass/Fail**
		Permeable Pavement	**$= x_1 + 0.5(x_2)$**		
Total suspended solids (TSS)	0.3	0.7	**0.7**	**0.4**	**Pass**
Metals	0.2	0.6	**0.6**	**0.4**	**Pass**
Hydrocarbons	0.4	0.7	**0.7**	**0.3**	**Pass**

Treatment Train: Permeable Paving					
Individual Property Driveways, Cul de Sac & General Access Roads (Pollution Hazard Level: Low)	**Pollution Hazard Indices (minimum)**	**Mitigation Indices**	**Total Index = $x_1 + 0.5(x_2)$**	**Index Score**	**Pass/Fail**
		Permeable Pavement			
Total suspended solids (TSS)	0.3	0.7	**0.70**	**0.4**	**Pass**
Metals	0.2	0.6	**0.60**	**0.4**	**Pass**
Hydrocarbons	0.05	0.7	**0.70**	**0.65**	**Pass**

7.2 Foul Water Drainage

The site is currently assumed to be discharging foul flows into the foul network in the road adjacent to the application site. The proposed residential foul water flows can be estimated using the *British Water Code of Practice, Flows and Loads – 4.*

Based upon the planning proposals of 260 units and an estimated number of 560 residents and an additional 50 visitors, therefore, the total number of people is circa 610.

Flows and Loads Design Criteria:

- Occupants: 610
- Peak flow per person: 150 L/day
- Dry Weather Flow: Factor of 6
- Infiltration: 10%

Therefore, the peak foul flow for the proposed site is:

$$Q_{\text{Foul}} = \frac{610 \times 150 \times 6 \times 1.1}{86{,}400}$$

Therefore, the peak foul flow from the proposed site will be 7.0 L/s. This rate has been agreed with Thames Water as per the confirmation letter in Appendix K.

It should be noted that the foul discharge rate noted above is preliminary only and subject to detailed design. Any new connection to an adopted sewer is subject to a Section 106 Agreement with the relevant drainage authority. A Section 104 Agreement may also be required.

8.0 CONCLUSION

This Flood Risk Assessment and Drainage Strategy has been prepared by Shear Design Ltd on behalf of their client, TR17 Banbury LLP for the site at Calthorpe Street, Banbury, OX16 5EX. The site is a brownfield site and is approximately 1.6ha.

The proposed site is located entirely within Flood Zone 1 and is therefore at a low risk of flooding, no sequential or exception test is required.

Site surveys confirmed the presence of existing drainage that drains from south to north and likely discharges to the adopted surface water sewer to the north. There is also an adopted foul sewer in the south-west of the site that will need to be diverted to allow room for proposed drainage. The suitability of any existing drainage onsite that is intended to be reused will only be fully understood once a drainage CCTV survey has been completed. This should be commissioned prior to detailed design.

The overall surface water drainage strategy for this site is to use attenuation with restricted discharge to the existing adopted sewers around the site. The site will utilise various SuDS features including, permeable paving, blue & green roofs, soft landscaping, and geo-cellular attenuation tanks. A surface water discharge rate has been agreed with Thames Water as 5 L/s/ha. With a proposed site area of approximately 1.6 ha, factoring in the provision of soft landscaping, the proposed surface water runoff for this site will be 7.2 L/s; this rate has also been agreed with Thames Water. The required storage volume for surface water runoff for both drainage strategy options is approximately 1,203m^3.

The site will be split into two “catchments” which will discharge surface water to separate locations. The north catchment is expected to discharge via the existing manhole in the private car park to the north and the south catchment is expected to discharge into the existing adopted sewer in Calthorpe Street (to the west of the site). The north catchment will require an estimated storage volume of 750m^3 and the south will require approximately 453m^3.

The proposed foul water drainage strategy is to discharge foul water flows into foul water sewers, in Calthorpe Street and High Street. The estimated peak foul water flow for this development is 7.0 L/s. Thames Water have confirmed that the adopted sewer network has capacity to receive these flows.

It should be noted that any foul or surface water discharge rates and drainage design information provided herein are preliminary only and are subject to detailed design.

Report prepared by: -

[redacted]

ON BEHALF OF SHEAR DESIGN LTD
ED BACZYNSKI
GRADUATE CIVIL ENGINEER

Approved by: -

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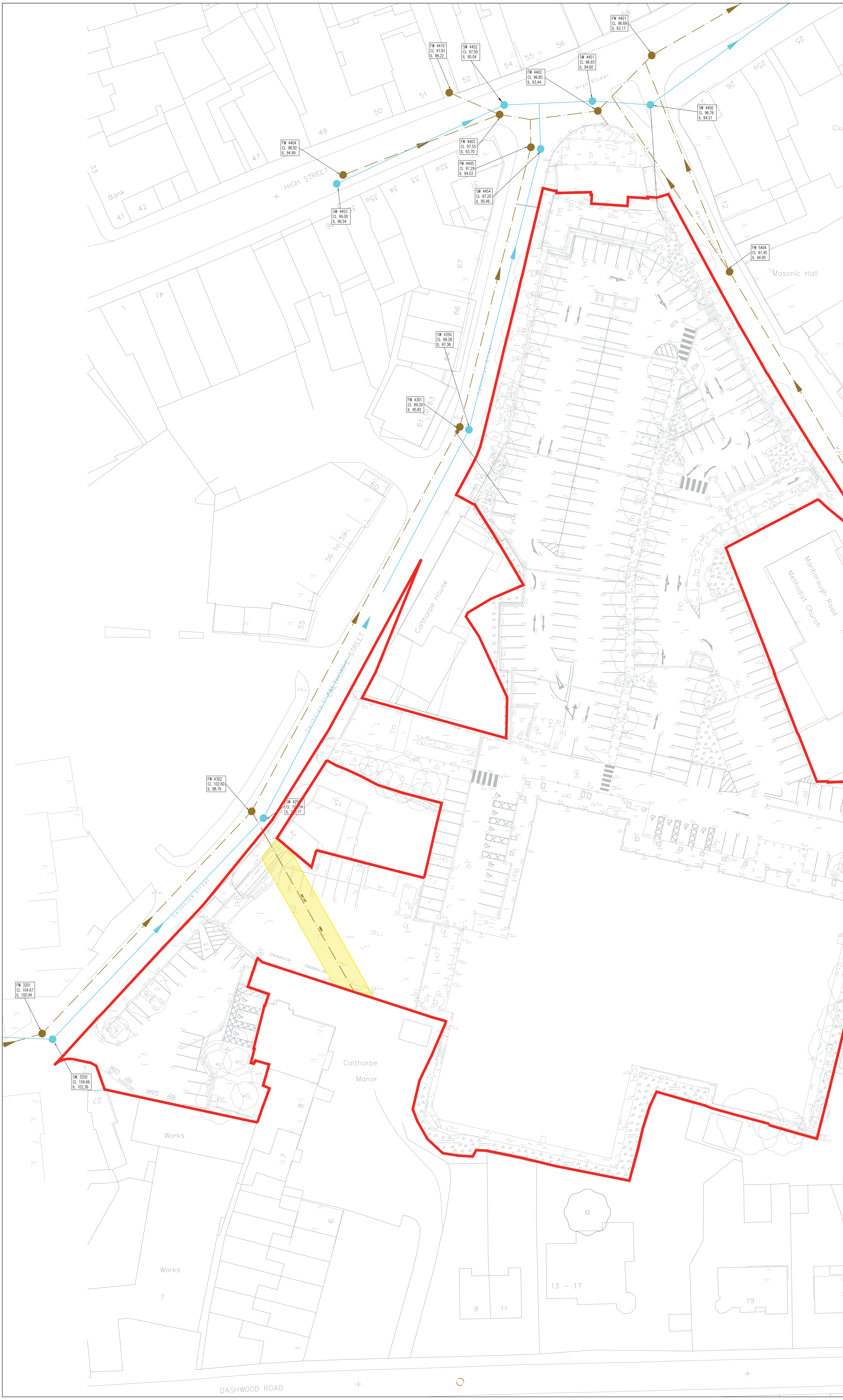
ON BEHALF OF SHEAR DESIGN LTD
DAMEON KILGOUR
ASSOCIATE
CIVIL ENGINEER

APPENDIX A

SITE LOCATION PLAN



NOTES

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KEY

- REDLINE BOUNDARY (TBC)
- EXISTING SITE SURFACE WATER DRAINAGE
- EXISTING SITE FOUL WATER DRAINAGE
- EXISTING SURFACE WATER OVERLAND FLOW ROUTE
- ADOPTED SURFACE WATER DRAINAGE
- ADOPTED FOUL WATER DRAINAGE

NOTES

1. EXISTING SITE LEVELS BASED ON TOPOGRAPHICAL SURVEY (36919_T GREENHATCH GROUP 09.06.2020).
2. EXISTING ONSITE DRAINAGE BASED ON UTILITIES SURVEY (EDI SEPTEMBER 2022 – 20688/U/01-02 & 20688/U/02-02)
3. EXISTING ADOPTED DRAINAGE BASED ON THAMES WATER PROPERTY SEARCHES SEWER RECORDS – 2022/4688157
4. ADOPTED DRAINAGE HAS NOT BEEN PROPERLY SURVEYED – LOCATIONS OF ADOPTED DRAINAGE ARE FOR ILLUSTRATIVE PURPOSES ONLY AND SHOULD BE VERIFIED PRIOR TO DETAILED DESIGN

REV	DATE	DESCRIPTION	BY	CHK

AMENDMENTS

CLIENT: TR17 BANBURY LLP

PROJECT: CALTHORPE STREET, BANBURY

TITLE: PROPOSED SITE LAYOUT

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DRAWN:	CHECKED:	DATE:	SCALE:
EB	-	FEBRUARY 2023	1:250 @ A0

SHEAR DESIGN REF:	DRAWING NUMBER:	REVISION:	STATUS:
22055	22055-102	-	P

APPENDIX B

TOPOGRAPHICAL SURVEY

NOTES

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5. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, SUBCONTRACTORS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.
6. THIS DRAWING IS COPYRIGHT © PROPERTY OF SHEAR DESIGN LIMITED.

KEY

- REDLINE BOUNDARY (TBC)
- EXISTING SITE SURFACE WATER DRAINAGE
- EXISTING SITE FOUL WATER DRAINAGE

NOTES

1. EXISTING SITE LEVELS BASED ON TOPOGRAPHICAL SURVEY (36919_T GREENHATCH GROUP 09.06.2020).
2. EXISTING ONSITE DRAINAGE BASED ON UTILITIES SURVEY (EDI SEPTEMBER 2022 – 20688/U/01-02 & 20688/U/02-02).

REV	DATE	DESCRIPTION	BY	CHK

AMENDMENTS

CLIENT: TR17 BANBURY LLP

PROJECT: CALTHORPE STREET, BANBURY

TITLE: SITE TOPOGRAPHY PLAN

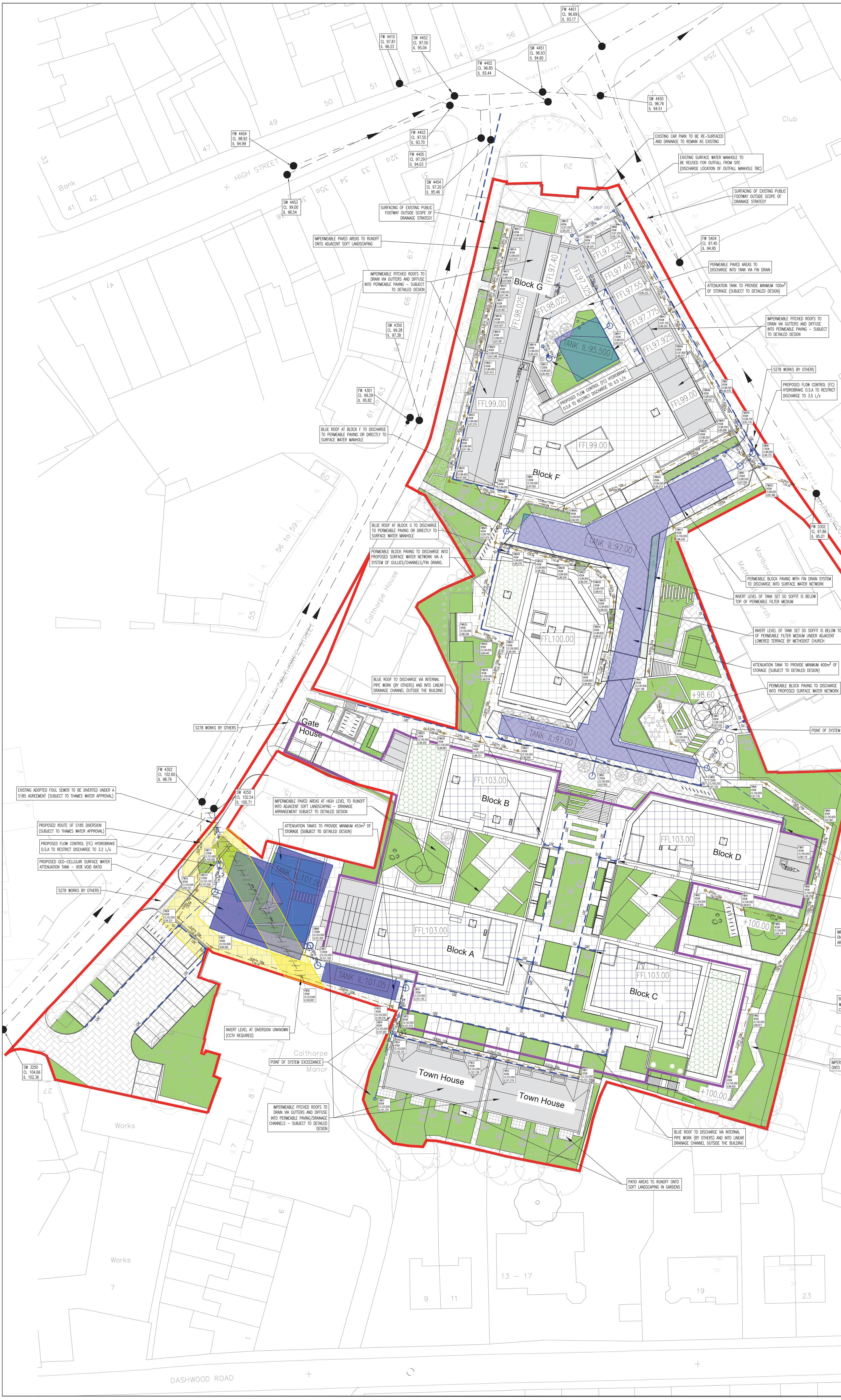
SHEAR design
Consulting Civil and Structural Engineers
7 Ashtree Court - Woodsy Close - Cardiff Gate Business Park - Cardiff - CF23 8RW
Tel: 029 2054 7000 - Fax: 029 2054 7001 - www.shear-design.com - enquiries@shear-design.com

DRAWN:	CHECKED:	DATE:	SCALE:
EB	EB	MARCH 2023	1:250 @ A0

SHEAR DESIGN REF:	DRAWING NUMBER:	REVISION:	STATUS:
22055	22055-101	-	P

APPENDIX C

PROPOSED DRAINAGE LAYOUT



NOTES

GENERAL

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE. ALL LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS RELATE TO ORDNANCE DATUM UNLESS NOTED OTHERWISE.
3. DO NOT SCALE FROM THIS DRAWING. USE FIGURED DIMENSIONS ONLY.
4. ANY DISCREPANCIES TO BE REPORTED IMMEDIATELY TO THE ENGINEER.
5. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, SUBCONTRACTORS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.
6. THIS DRAWING IS COPYRIGHT © PROPERTY OF SHEAR DESIGN LIMITED.

KEY

- SITE BOUNDARY (TBC BY ARCHITECT)
- EXTENT OF LOWER GROUND FLOOR AREA (FFL100.00)
- PROPOSED IMPERMEABLE ROOF AREA
- PROPOSED IMPERMEABLE PAVING – VEHICLE & PEDESTRIAN LOADING (FINISHES TO MATCH OTHER BLOCK PAVING OR TO ARCHITECT'S SPECIFICATION)
- PROPOSED PERMEABLE PAVING – VEHICLE & PEDESTRIAN LOADING (FINISHES TO MATCH OTHER BLOCK PAVING OR TO ARCHITECT'S SPECIFICATION)
- 3m EASEMENT FOR PROPOSED FOUL WATER DRAINAGE DIVERSION (SUBJECT TO S185 APPROVAL)
- PROPOSED RAIN GARDEN
- PROPOSED BLUE ROOF (BAUDER STORMCELL WITH PAVED FINISH O.S.A.)
- PROPOSED BIODIVERSE GREEN ROOF (BAUDER BIODIVERSE ROOF O.S.A.)
- PROPOSED SOFT LANDSCAPING (SELF-DRAINING) BY OTHERS
- PROPOSED ATTENUATION TANK
- PROPOSED SURFACE WATER DRAINAGE
- LDC PROPOSED LINEAR DRAINAGE CHANNEL
- FD PROPOSED FIN DRAIN
- SU PROPOSED SUMP UNIT
- FC PROPOSED FLOW CONTROL (HYDROBRAKE O.S.A.)
- PROPOSED FOUL WATER DRAINAGE
- EXISTING ADOPTED FOUL WATER DRAINAGE
- EXISTING ADOPTED SURFACE WATER DRAINAGE

NOTES

1. THIS DRAWING IS INDICATIVE AND SUBJECT TO DETAILED DESIGN.
2. PROPOSED GREEN & BLUE ROOFS TO BE BAUDER PRODUCTS AS NOTED IN KEY OR SIMILAR APPROVED PRODUCTS.
3. LOCATION AND INVERTS OF EXISTING ADOPTED FOUL/SURFACE WATER DRAINAGE IS INDICATIVE AND BASED ON THAMES WATER PDF – EXISTING ADOPTED DRAINAGE SHOULD BE SURVEYED PRIOR TO DETAILED DESIGN AND INVERTS CONFIRMED ONSITE PRIOR TO CONSTRUCTION AND/OR ORDERING OF MATERIALS WITH RESULTS REPORTED BACK TO ENGINEER.
4. INVERTS OF EXISTING SITE DRAINAGE BASED ON SURVEY BY EDI LTD (SEPTEMBER 2022)
5. SURFACE WATER DRAINAGE CHANNEL SIZES TO BE CONFIRMED AFTER PLANNING STAGE AS PART OF DETAILED DESIGN.
6. ALL DRAINAGE INCLUDING COVER/INVERT LEVELS IS INDICATIVE AND SUBJECT TO DETAILED DESIGN
7. LEVELS ARE AS PER LANDSCAPE ARCHITECT'S LAYOUT AND MAY BE SUBJECT TO DETAILED DESIGN.
8. FINISHES MAY DIFFER WITHIN TYPES OF SURFACE AND ARE TO LANDSCAPE ARCHITECT'S SPECIFICATION.
9. PROPOSED LEVELS TO LANDSCAPE ARCHITECT'S SPECIFICATION.
10. PLANT LAYOUT OVER PAVED BLUE ROOFS TO M&E SPECIFICATION.

REV	DATE	DESCRIPTION	BY	CHK

AMENDMENTS

CLIENT: TR17 BANBURY LLP

PROJECT: CALTHORPE STREET, BANBURY

TITLE: PROPOSED DRAINAGE LAYOUT

SHEAR design
Consulting Civil and Structural Engineers
7 Ashtree Court - Woodsy Close - Cardiff Gate Business Park - Cardiff - CF23 8RW
Tel: 029 2054 7000 - Fax: 029 2054 7001 - www.shear-design.com - enquiries@shear-design.com

DRAWN:	CHECKED:	DATE:	SCALE:
EB	EB	FEBRUARY 2023	1:250 @ A0

SHEAR DESIGN REF:	DRAWING NUMBER:	REVISION:	STATUS:
22055	22055-106	-	P

APPENDIX D

THAMES WATER SERVICES PLAN

Asset location search

Thames Water Property Searches

Your reference CALTHORPE CENTRE

Our reference ALS/ALS Standard/2022_4688157

Search date 21 July 2022

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
www.thameswater-propertysearches.co.uk

0800 009 4540

Asset location search

Thames Water Property Searches

Search address supplied: Iceland Foods Plc, 56-60, Calthorpe Street, Banbury, OX16 5EX

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 searchprovides 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 0800 009 4540, or use the address below:

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

Email: searches@thameswater.co.uk
Web: 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.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.

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

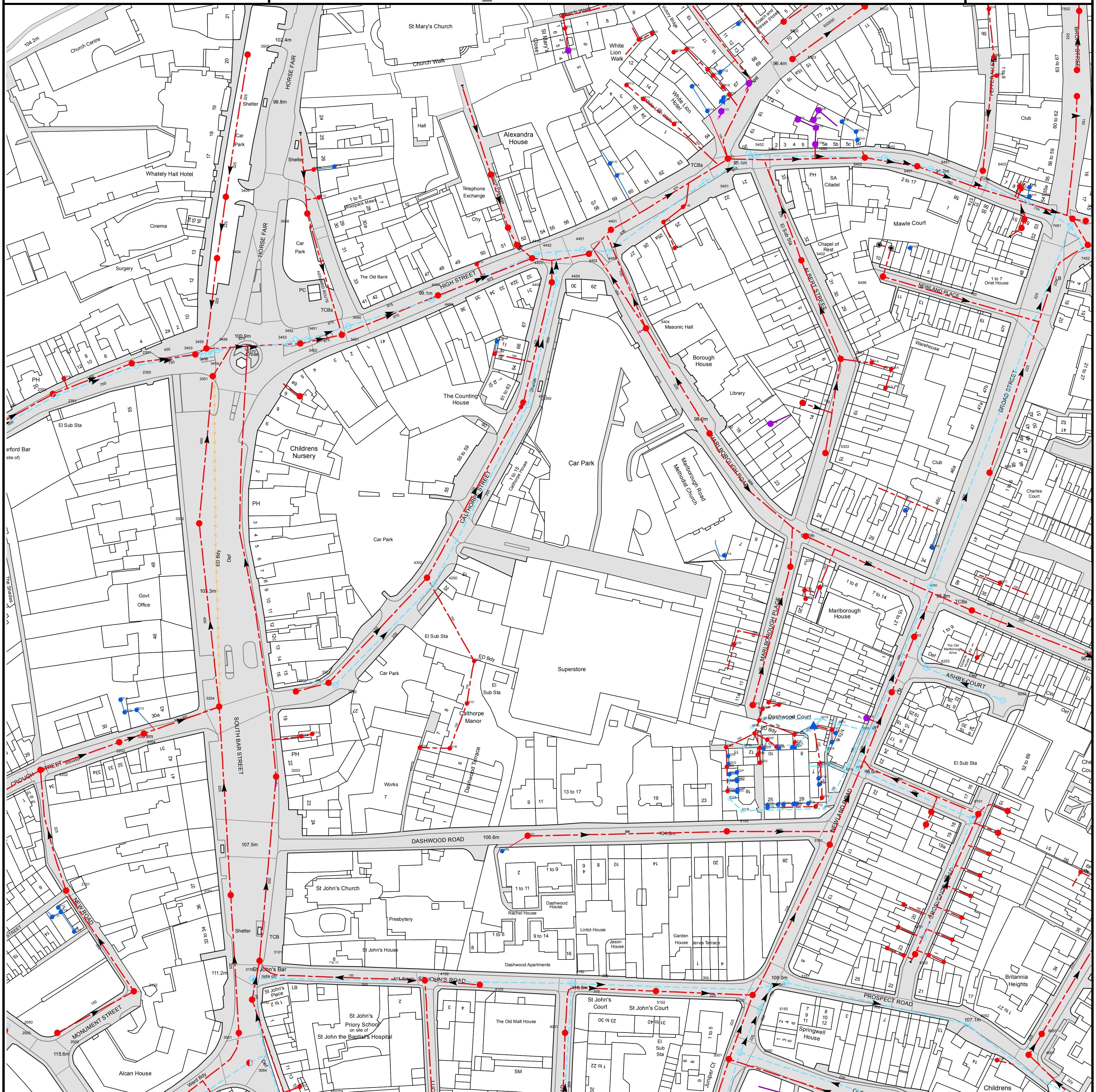
Clean Water queries

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

Asset Location Search Sewer Map - ALS/ALS Standard/2022_4688157



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 445466,240315

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.

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
6502	96.27	92.78
651F	n/a	n/a
541A	n/a	n/a
551W	n/a	n/a
541B	n/a	n/a
5502	96.49	93.87
5503	96.46	93.4
5402	95.5	93.16
551Z	n/a	n/a
651G	n/a	n/a
651H	n/a	n/a
6402	94.39	91.12
6456	n/a	n/a
6452	94.33	92.04
641G	n/a	n/a
6401	94.23	90.73
6451	94.2	91.74
6403	94.03	91.6
6503	95.29	92.46
651E	n/a	n/a
641C	n/a	n/a
7452	93.25	90.75
7402	93.39	89.83
6454	n/a	n/a
7451	93.5	91.01
7404	93.57	90.01
6455	n/a	n/a
7403	93.43	89.97
6450	93.6	91.1
641F	n/a	n/a
641D	n/a	n/a
641E	n/a	n/a
7503	94.36	91.8
7506	94.47	91.97
7502	94.35	91.22
711A	n/a	n/a
611K	n/a	n/a
6153	n/a	n/a
6158	n/a	n/a
6150	99.55	98.39
6101	99.38	98.14
6157	n/a	n/a
6152	n/a	n/a
621E	99.03	97.75
6251	n/a	n/a
621B	97.55	95.64
621F	96.8	95.5
621D	n/a	n/a
6252	96.7	95.78
621A	n/a	n/a
6253	94.45	n/a
621H	n/a	n/a
6202	96.52	93.97
6201	95.61	92.68
522V	n/a	n/a
6250	95.78	94.24
621C	n/a	n/a
631C	n/a	n/a
631B	n/a	n/a
6301	94.38	92.34
531B	n/a	n/a
631D	n/a	n/a
631A	n/a	n/a
641A	n/a	n/a
601A	n/a	n/a
6001	106.45	104.74
6053	n/a	n/a
6052	106.94	105.22
611F	n/a	n/a
611D	n/a	n/a
611E	n/a	n/a
6102	104.82	102.99
611A	n/a	n/a
611G	n/a	n/a
6151	103.63	102.01
611B	n/a	n/a
611H	n/a	n/a
611C	n/a	n/a
611I	n/a	n/a
711B	n/a	n/a
611J	n/a	n/a
4405	97.29	94.03
4454	97.2	95.46
451C	n/a	n/a
451E	n/a	n/a
451D	n/a	n/a
4451	96.93	94.6
4402	96.85	93.44
4450	96.76	94.51
441D	n/a	n/a
4401	96.69	93.17

Manhole Reference	Manhole Cover Level	Manhole Invert Level
441E	n/a	n/a
451F	n/a	n/a
551U	n/a	n/a
551S	n/a	n/a
551V	n/a	n/a
541C	n/a	n/a
5401	95.54	91.83
551Y	n/a	n/a
552A	n/a	n/a
541D	n/a	n/a
551X	n/a	n/a
552B	n/a	n/a
3404	101.71	98.9
3405	n/a	n/a
3502	102.57	100.16
3458	n/a	n/a
341B	n/a	n/a
341C	n/a	n/a
341A	n/a	n/a
4453	99	96.54
4404	98.92	94.99
441F	n/a	n/a
441A	n/a	n/a
4409	98.22	n/a
4410	97.81	96.22
4403	97.55	93.7
4452	97.5	95.04
2302	103.34	99.53
2351	103.35	101.07
231B	n/a	n/a
2301	102.35	98.32
2350	102.37	99.71
3403	101.33	97.13
3302	102.05	n/a
3455	101.3	98.77
4302	102.6	98.79
4350	99.28	97.38
4301	99.29	95.82
331A	n/a	n/a
3301	101.04	98.28
3456	101.22	99.1
441C	n/a	n/a
3454	101.04	98.38
3459	n/a	n/a
3453	100.5	98.05
3402	100.39	96.31
441B	n/a	n/a
3452	100.37	97.93
3451	100.35	97.93
3401	99.91	95.82
3450	99.85	97.3
521M	100.5	99.6
521L	99.35	98.6
521Y	99.3	98.85
521T	n/a	n/a
522F	99.6	99
521D	99.29	98.75
522B	99.67	98.8
521S	n/a	n/a
521P	98.5	95.7
521N	99.5	98.75
521J	97.7	95.75
521E	99.42	98.53
521O	99.4	98.66
521K	98.7	97.8
521C	99.34	98.43
5201	99.18	96.86
522T	99.3	n/a
522U	n/a	n/a
521B	n/a	n/a
521A	n/a	n/a
522W	n/a	n/a
5304	97.55	95.03
531A	n/a	n/a
5301	97.21	94.39
5303	96.78	94.44
5302	97.86	95.01
5308	n/a	n/a
5403	95.97	93.89
5404	97.45	94.95
511A	100.74	99.8
521V	99.6	98.62
522L	n/a	n/a
522K	100.74	100
522M	n/a	n/a
521X	n/a	n/a
522N	n/a	n/a
522O	n/a	n/a
521W	n/a	n/a
521F	100.55	100
522P	n/a	n/a
522S	100.48	99.43
521G	99.55	98.8

Manhole Reference	Manhole Cover Level	Manhole Invert Level
522Q	n/a	n/a
521H	99.2	98.45
521U	99.2	98.45
522D	100.85	99.95
522R	n/a	n/a
522E	n/a	n/a
521R	98.47	96.95
522H	n/a	n/a
522I	n/a	n/a
522C	100.87	99.67
521Z	n/a	n/a
522A	n/a	n/a
522J	100.23	99.23
522G	n/a	n/a
3151	n/a	n/a
411A	n/a	n/a
4101	105.91	103.04
3203	105.9	103.11
421B	n/a	n/a
421A	n/a	n/a
321B	n/a	n/a
321A	n/a	n/a
3204	104.87	102.5
421C	n/a	n/a
3202	104.63	101.63
3250	104.66	102.36
3201	104.67	100.94
421D	n/a	n/a
4250	102.54	100.71
2202	n/a	n/a
211D	n/a	n/a
211C	n/a	n/a
211B	n/a	n/a
2101	110.51	108.21
211A	n/a	n/a
2203	n/a	n/a
221A	n/a	n/a
221B	n/a	n/a
221D	n/a	n/a
2204	n/a	n/a
2003	115.31	113.54
2050	115.32	113.72
2002	115.37	113.68
2102	113.86	111.08
3001	115.1	113.25
3054	n/a	n/a
5001	n/a	n/a
5050	110.35	108.64
5150	108.47	106.11
5102	108.43	106.33
5152	n/a	n/a
4150	110.87	109.19
5151	107.21	105.79
5101	101.79	99.26
5103	103.72	100.52
511B	100.8	99.7
511C	99.55	98.8
511E	100.05	99.45
511D	99.9	98.7
511F	n/a	n/a
511G	n/a	n/a
511H	n/a	n/a
511I	n/a	n/a
511J	n/a	n/a
511K	n/a	n/a
301D	n/a	n/a
4001	113.16	110.54
3152	n/a	n/a
4103	111.45	110.47
4102	111.88	110.17
3150	111.52	110.33
3101	110.81	107.85
551I	n/a	n/a
551G	n/a	n/a
551H	n/a	n/a
5508	n/a	n/a
551A	n/a	n/a
5451	95.6	93.35
551B	n/a	n/a
551C	n/a	n/a
551D	n/a	n/a
551Q	n/a	n/a
551O	n/a	n/a
551M	n/a	n/a
551E	n/a	n/a
551N	n/a	n/a
551F	n/a	n/a
551J	n/a	n/a
5452	95.41	93.66
551P	n/a	n/a
5450	95.31	93

Manhole Reference	Manhole Cover Level	Manhole Invert Level

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.

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

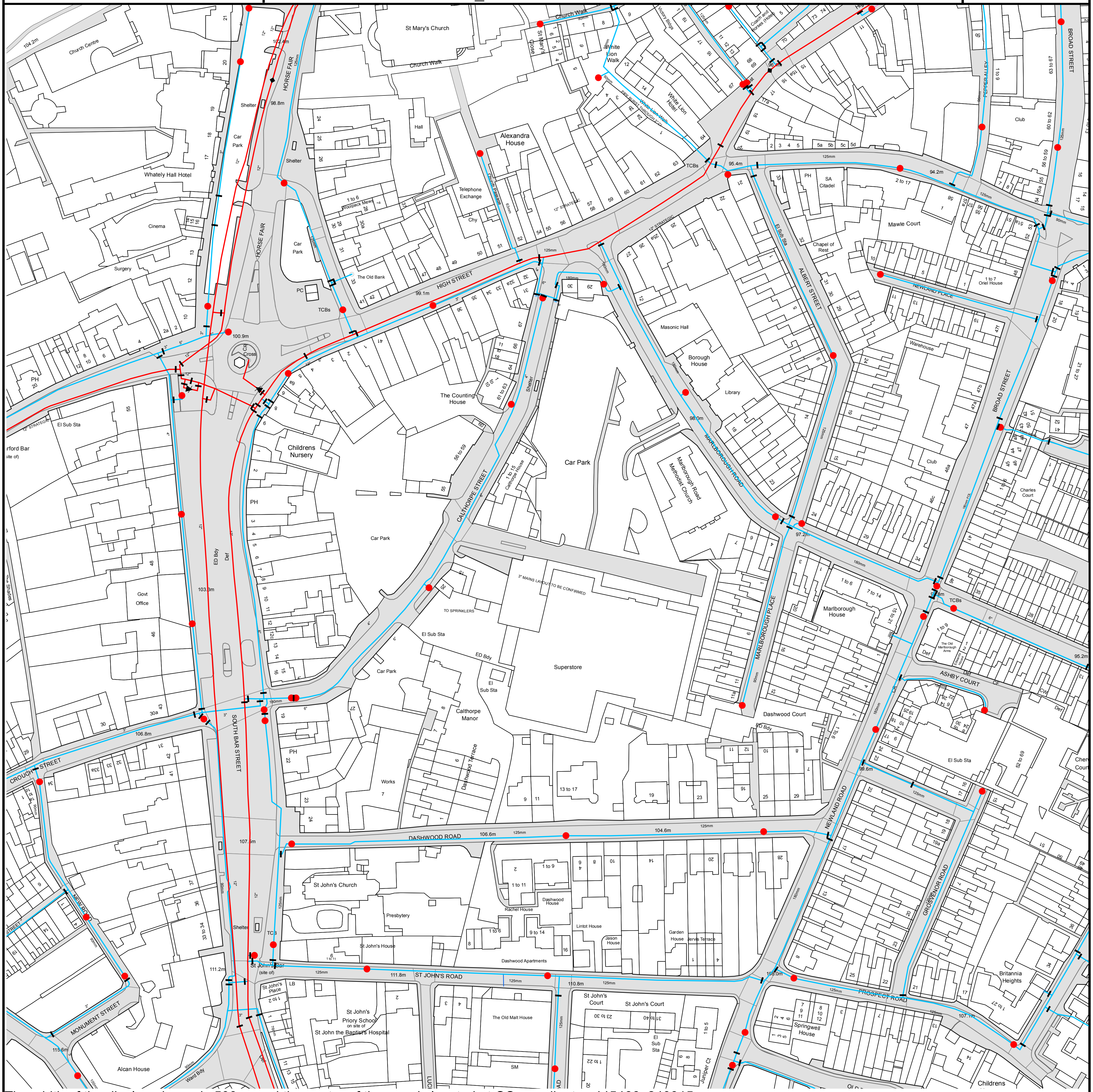
- Casement
- Conduit Bridge
- Subway
- Tunnel

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

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.

Asset Location Search Water Map - ALS/ALS Standard/2022_4688157



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 445466, 240315.

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.

Asset Location Search - Water Key

Water Pipes (Operated & Maintained by Thames Water)

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger

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

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

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.

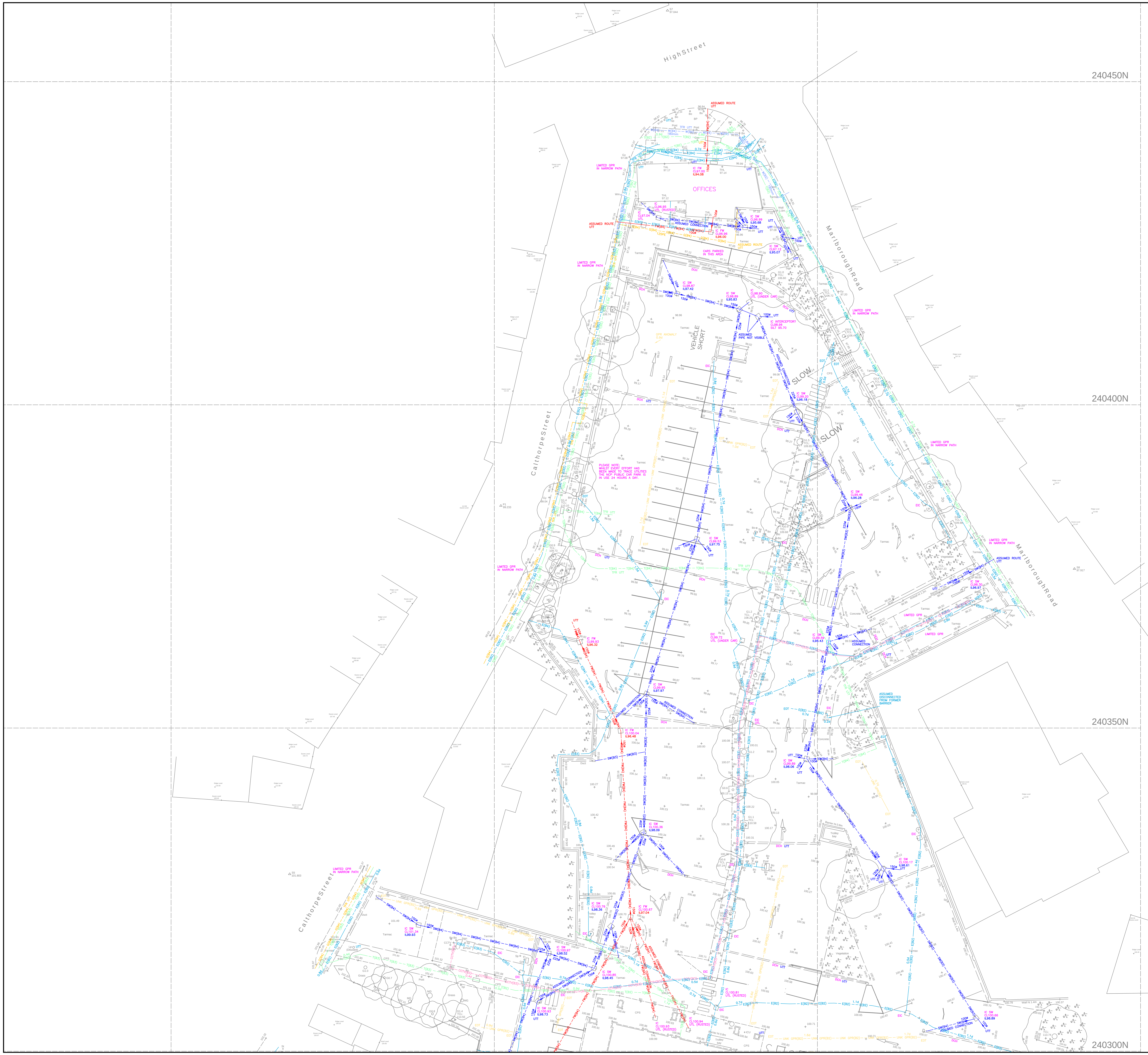
Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0800 009 4540** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

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

APPENDIX E

DRAINAGE SURVEY



GRID NORTH

This Survey has been carried out to PAS 128 Detection Method M2
Orthogonal search transects at less than 5m intervals for Electro Magnetic Location (EML) and 2m for Ground Penetrating Radar (GPR) techniques.

The Quality levels achieved are indicated on service lines as B1, B2 B3 or B4.
B1 horizontal location accuracy ±150mm or ±15% of detected depth whichever is greater.
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B1 is achieved by horizontal and vertical location by multiple geophysical techniques.
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B3 horizontal location accuracy ±500mm.
B3 vertical location accuracy undefined (no reliable depth).
B3 is achieved by horizontal location only by one of the geophysical techniques used.
B4 horizontal location accuracy undefined.
B4 vertical location accuracy undefined.
B4 is a utility segment which is suspected to exist but has not been detected or taken from records and is an assumed route only.

Original Drawing Size: A0

NOTES:–

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LEGEND

Features:
AV Air Valve
AB Air Brick
BD Bollard
BH Borehole
BM Benchmark
BP Boundary Post
BS Bus Stop
BT British Telecom
CL Cover Level
COL Column
CTV Cable TV Cover
DCH Drainage Channel
DF Drinking Fountain
DIS Disused
DK Drop Kerb
DPC Damp proof Course
EIC Electricity IC
EJ Expansion Joint
ER Earth Rod
FH Fire Hydrant
FHR Fire Hose Reel
FS Flagstaff
G Gully
GV Gas Valve
IC Inspection Cover
IL Invert Level
JBX Junction Box
KO Kerb Outlet
LB Letter Box
LBN Litter Bin
LLP Low Level LP
LP Lamp Post
MP Marker Post
MS Mile Stone
MT Mercury Telecom
OHL Overhead Line
OP Overflow Pipe
PM Parking Meter
PP Power Pole
RAD Radiator
RE Rodding Eye
RNP Road Name Plate
RS Road Sign
RSD Roller Shutter Door
RWP Rain Water Pipe
SD Service Duct
SV Stop Valve
TCB Telephone Call Box
THL Threshold Level
TP Telegraph Pole
TS Traffic Signal
UB Universal Beam
UNK Unknown
UR Urinal
UTL Unable to lift
V Vent
VP Vent Pipe
WM Water Meter
WO Wash Out
WP Waste Pipe

Building Level Details:
D Door
EL Eave Level
FFL Floor Level
FRL Flat Roof Level
HL Head Level
PPL Parapet Level
RL Ridge Level
SL Sill Level
SP Springer of Arch
TA Top of Arch
W Window
12.34 Ceiling/Beam Soffit

Boundary Types:
BW Barbed Wire
CB Close Boarded
CH Chainlink
CI Corrugated Iron
CP Chestnut Paling
IR Iron Railing
IW Interwoven
LL Larch Lap
PAL Palisade
PR Post & Rail
PW Post & Wire
TKR Timber Knee Rail
RTW Retaining Wall
VSF Vehicle Safety Fence
WMF Wire Mesh Fence

Surfaces & Finishes:
B Brickwork
BB Breeze Block
C Concrete
CLT Ceiling Tiles
CP Carpet
CPS Concrete Paving Slabs
CPT Carpet Tiles
CR Concrete Render
CT Ceramic Tiles
FT Floor Tiles
HBD Hardboard
L Linoleum
P Plaster
PAV Brick Paviors
S Steel work
T Tarmac
TSP Textured Safety Paving
VT Vinyl Tiles

Services:
C(B*) CATV cables
CCTV(B*) CCTV cables
D(B*) Data cables
E(B*) Electricity cables
FO(B*) Fibre Optic
FW(B*) Foul water drain
FUEL(B*) Fuel pipes
G(B*) Gas pipes
HD(B*) Heating duct
SD(B*) Service ducts
SW(B*) Storm water drain
T(B*) Telecom cables
UNK GPR(B*) Unidentified GPR
UNK EML(B*) Unidentified EML
W(B*) Water pipes
150ø Pipe Diameter/Flow
Overhead Lines
EOT End Of Trace
TFR Taken From Records
UTT Unable To Trace

Survey Station
Fence
Gate
Painted Road Markings
Edge of Vegetation
Kerb/Drop Kerb
Tree
Top / Bottom — Banks
Building
Overhead Building Detail
Wall

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The services on this survey have been traced using a combination of RD4000 EML and Leica DS2000 Ground Penetrating Radar. Whilst every effort has been made to locate all services no system or equipment is able to locate 100% of services without excavation. GPR works well in moist soils which are relatively undisturbed but works less well in very wet or very dry soils and ground which has been generally disturbed or built up, and it also works better with larger diameter cables and pipes – for example it is difficult to trace small bore connections to individual properties. The vLoc3–Pro cannot distinguish between services if they are adjacent, cannot always distinguish small pipes/cables adjacent to large ones and can be swamped by radiation from buildings (when very close to them) or high voltage overhead lines. Inspection covers have been lifted where possible without damage to covers.

20688/U/01-02
20688/U/02-02
SHEET LAYOUT

Rev.	Job No.	Date	Revision Detail	Surveyor	Chkd

CLIENT
Rhomco Consulting Ltd
3 Queen Street
Mayair
W1J 5PA

PROJECT
Buried Utilities Survey
The Calthorpe Centre
Calthorpe Street
Banbury
OX16 5EX

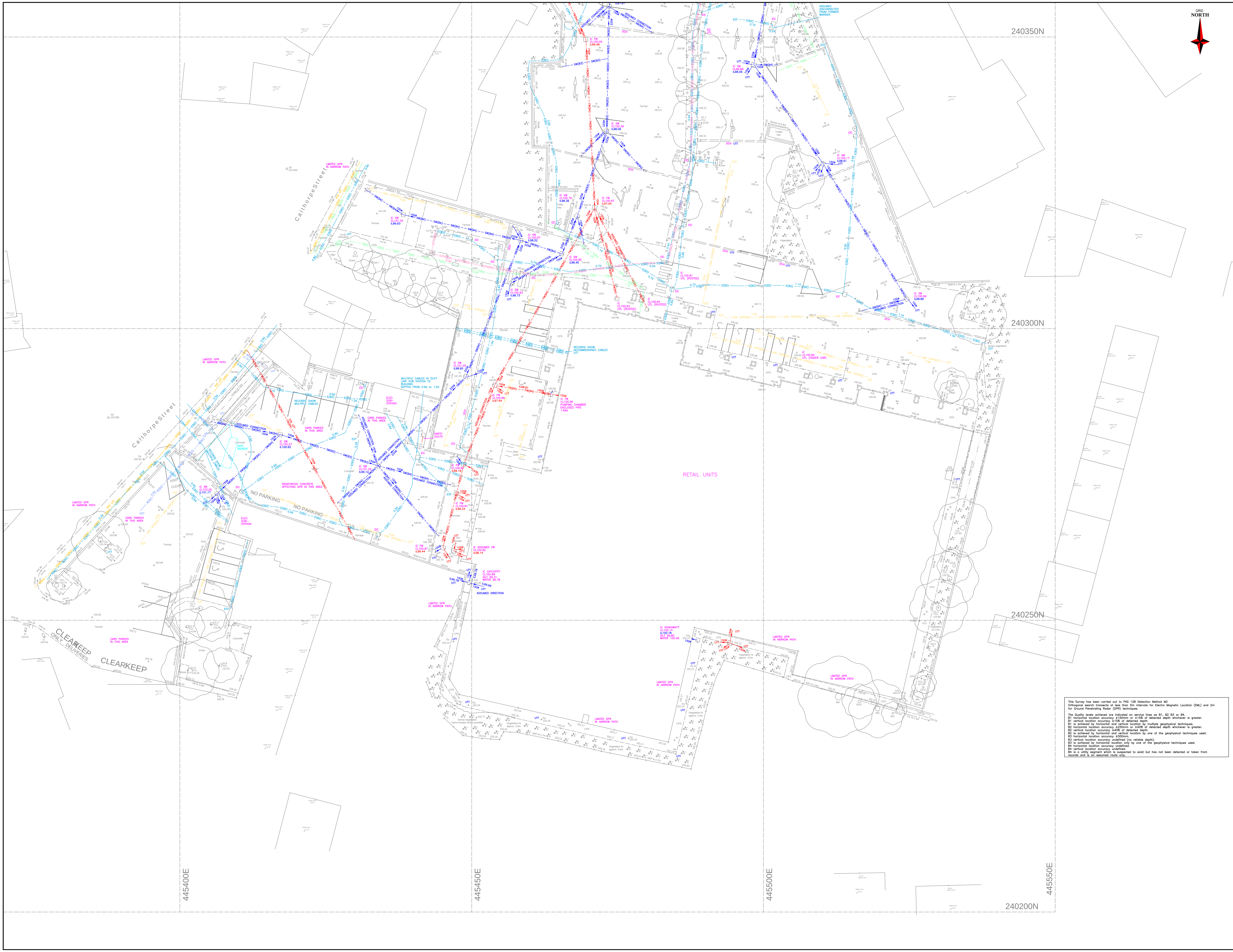
Job No.	Surveyor	Checked	Date	Scale
20688	NW	AR	Sept. 2022	1:200

EDI SURVEYS LTD
163–165 Ranelagh Road, Ipswich, Suffolk IP2 0AH
Telephone | 01473 211222
Email | admin@edisurveys.co.uk

Our Services:– Topographic Surveys, Measured Building Surveys, GPS Surveying and Control, 3D laser Scanning, Utility Surveying and Drainage Investigation.
Click the link below to visit our website and find out more.
www.edisurveys.co.uk

constructionline
THE SURVEY ASSOCIATION
ISO 9001 REGISTERED FIRM

DRAWING No. 20688/U/01–02
REV. –



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EJ Expansion Joint
ER Earth Rod
FH Fire Hydrant
FHR Fire Hose Reel
FS Flagstaff
G Gully
GV Gas Valve
IC Inspection Cover
IL Invert Level
JBX Junction Box
KO Kerb Outlet
LB Letter Box
LBN Litter Bin
LLP Low Level LP
LP Lamp Post
MP Marker Post
MS Mile Stone
MT Mercury Telecom
OHL Overhead Line
OP Overflow Pipe
PM Parking Meter
PP Power Pole
RAD Radiator
RE Rodding Eye
RNP Road Name Plate
RS Road Sign
RSD Roller Shutter Door
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SD Service Duct
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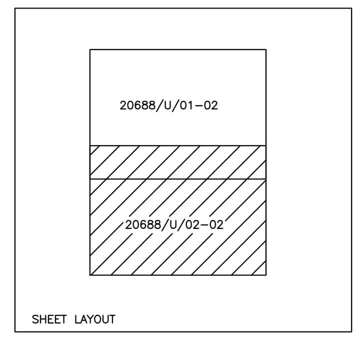

SHEET LAYOUT

Rev.	Job No.	Date	Revision Detail	Surveyor	Chkd

CLIENT

Rhomco Consulting Ltd
3 Queen Street
Mayair
W1J 5PA

PROJECT

Buried Utilities Survey
The Calthorpe Centre
Calthorpe Street
Banbury
OX16 5EX

Job No.	Surveyor	Checked	Date	Scale
20688	NW	AR	Sept. 2022	1:200

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163–165 Ranelagh Road, Ipswich, Suffolk IP2 0AH
Telephone | 01473 211222
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Our Services:– Topographic Surveys, Measured Building Surveys, GPS Surveying and Control, 3D laser Scanning, Utility Surveying and Drainage Investigation.
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constructionline
THE SURVEY ASSOCIATION
ISO 9001 REGISTERED FIRM

DRAWING No. 20688/U/02–02

REV. –

APPENDIX F

SITE INVESTIGATION – DESKTOP STUDY

APPENDIX G

FLOOD RISK ASSESSMENT

APPENDIX H

FLOOD EXCEEDANCE MODELLING

Design Settings

Rainfall Methodology	FEH-99	E (1km)	0.301	Connection Type	Level Soffits
Return Period (years)	100	F (1km)	2.480	Minimum Backdrop Height (m)	2.000
Additional Flow (%)	0	CV	0.950	Preferred Cover Depth (m)	0.900
C (1km)	-0.024	Time of Entry (mins)	5.00	Include Intermediate Ground	✓
D1 (1km)	0.315	Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
D2 (1km)	0.333	Maximum Rainfall (mm/hr)	50.0		
D3 (1km)	0.249	Minimum Velocity (m/s)	1.00		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.125	5.00	103.150	1350	445482.338	240296.665	1.350
2	0.245	5.00	103.150	1350	445473.173	240260.005	1.443
3	0.020	10.00	103.000	1350	445444.997	240239.532	1.275
4	0.034	5.00	103.000	1350	445448.219	240253.404	1.319
5			103.000	1350	445449.801	240256.862	1.425
6			103.000	1350	445451.163	240262.851	1.850
7			103.000	1350	445432.691	240267.561	1.900
8	0.088	5.00	103.000	1350	445431.118	240271.734	1.950
9	0.073	5.00	103.000	1200	445403.222	240271.945	1.200
10			103.150	1350	445411.122	240283.035	2.150
11			103.000	1350	445412.268	240288.552	2.100
11_OUT			102.540	1200	445410.990	240300.453	1.830

Simulation Settings

Rainfall Methodology	FEH-99	D3 (1km)	0.249	Winter CV	0.950	Additional Storage (m³/ha)	20.0
C (1km)	-0.024	E (1km)	0.301	Analysis Speed	Normal	Check Discharge Rate(s)	x
D1 (1km)	0.315	F (1km)	2.480	Skip Steady State	x	Check Discharge Volume	x
D2 (1km)	0.333	Summer CV	0.950	Drain Down Time (mins)	240		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440	2160	2880	4320	5760

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
109	40	0	0

Node 11 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	100.900	Product Number	CTL-SHE-0081-3200-1300-3200
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.2	Min Node Diameter (mm)	1200

Node 10 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	101.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	194.0	0.0	1.000	194.0	0.0	1.001	0.0	0.0

Node 7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	101.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	31.0	0.0	1.000	31.0	0.0	1.001	0.0	0.0

Node 8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	101.050
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	194.0	0.0	1.000	194.0	0.0	1.001	0.0	0.0

Node 6 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	101.150
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	34.0	0.0	1.000	34.0	0.0	1.001	0.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
109 year +40% CC 15 minute summer	731.544	207.002	109 year +40% CC 600 minute summer	39.936	10.923
109 year +40% CC 15 minute winter	513.364	207.002	109 year +40% CC 600 minute winter	27.287	10.923
109 year +40% CC 30 minute summer	420.895	119.099	109 year +40% CC 720 minute summer	35.242	9.445
109 year +40% CC 30 minute winter	295.365	119.099	109 year +40% CC 720 minute winter	23.685	9.445
109 year +40% CC 60 minute summer	259.294	68.524	109 year +40% CC 960 minute summer	28.664	7.548
109 year +40% CC 60 minute winter	172.269	68.524	109 year +40% CC 960 minute winter	18.988	7.548
109 year +40% CC 120 minute summer	149.186	39.425	109 year +40% CC 1440 minute summer	20.531	5.503
109 year +40% CC 120 minute winter	99.115	39.425	109 year +40% CC 1440 minute winter	13.798	5.503
109 year +40% CC 180 minute summer	110.879	28.533	109 year +40% CC 2160 minute summer	14.515	4.012
109 year +40% CC 180 minute winter	72.074	28.533	109 year +40% CC 2160 minute winter	10.001	4.012
109 year +40% CC 240 minute summer	85.834	22.683	109 year +40% CC 2880 minute summer	11.961	3.206
109 year +40% CC 240 minute winter	57.026	22.683	109 year +40% CC 2880 minute winter	8.039	3.206
109 year +40% CC 360 minute summer	63.794	16.416	109 year +40% CC 4320 minute summer	8.639	2.259
109 year +40% CC 360 minute winter	41.468	16.416	109 year +40% CC 4320 minute winter	5.689	2.259
109 year +40% CC 480 minute summer	49.385	13.051	109 year +40% CC 5760 minute summer	6.883	1.762
109 year +40% CC 480 minute winter	32.810	13.051	109 year +40% CC 5760 minute winter	4.455	1.762

Results for 109 year +40% CC Critical Storm Duration. Lowest mass balance: 93.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	1	900	102.998	1.198	6.3	3.9387	0.0000	FLOOD RISK
960 minute winter	2	900	102.998	1.291	18.6	6.2272	0.0000	FLOOD RISK
960 minute winter	3	900	103.000	1.275	1.0	2.2236	0.2044	FLOOD
960 minute winter	4	900	103.000	1.319	7.7	2.5773	0.0626	FLOOD
960 minute winter	5	900	102.999	1.424	6.5	2.0383	0.0000	FLOOD RISK
960 minute winter	6	900	103.000	1.850	21.3	36.6644	0.2858	FLOOD
960 minute winter	7	900	103.000	1.900	18.9	33.7341	0.2805	FLOOD
960 minute winter	8	900	102.998	1.948	22.8	198.6381	0.0000	FLOOD RISK
960 minute winter	9	900	102.997	1.197	3.7	2.8094	0.0000	FLOOD RISK
960 minute winter	10	900	102.997	1.997	13.9	196.9547	0.0000	FLOOD RISK
960 minute winter	11	900	102.997	2.097	12.0	3.0009	0.0000	FLOOD RISK
15 minute summer	11_OUT	1	100.710	0.000	3.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute winter	1	1.000	2	6.3	0.505	0.040	5.9873	
960 minute winter	2	1.001	6	18.6	0.746	0.036	3.5163	
960 minute winter	3	2.000	4	1.6	0.323	0.015	1.5707	
960 minute winter	4	2.001	5	-4.5	1.001	-0.013	0.4195	
960 minute winter	5	2.002	6	-6.5	0.180	-0.012	0.6774	
960 minute winter	6	1.002	7	18.9	0.644	0.115	3.0204	
960 minute winter	7	1.003	8	20.7	0.869	0.061	0.7067	
960 minute winter	8	1.004	10	10.2	0.574	0.068	3.6393	
960 minute winter	9	3.000	10	3.7	1.145	0.014	0.9588	
960 minute winter	10	1.005	11	12.0	0.415	0.028	0.8928	
960 minute winter	11	Hydro-Brake®	11_OUT	4.0				207.6

APPENDIX I

DRAINAGE NETWORK ANALYSIS

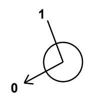
Design Settings

Rainfall Methodology	FEH-99	E (1km)	0.301	Connection Type	Level Soffits
Return Period (years)	100	F (1km)	2.480	Minimum Backdrop Height (m)	0.200
Additional Flow (%)	40	CV	0.750	Preferred Cover Depth (m)	1.200
C (1km)	-0.024	Time of Entry (mins)	12.00	Include Intermediate Ground	✓
D1 (1km)	0.315	Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
D2 (1km)	0.333	Maximum Rainfall (mm/hr)	50.0		
D3 (1km)	0.249	Minimum Velocity (m/s)	1.00		

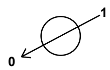
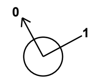
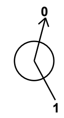
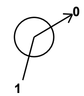
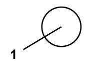
Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
10	0.110	12.00	97.175	600	445487.055	240419.728	0.650
11			98.025	1200	445493.916	240401.624	2.475
12			98.025	1200	445487.562	240398.223	2.518
13			98.025	1200	445481.213	240394.807	2.575
14			98.025	600	445479.848	240397.344	2.592
15			97.325	600	445485.961	240420.569	2.034
6_OUT			95.070	1200	445494.748	240425.789	1.351

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
10	445487.055	240419.728	97.175	0.650	600		0	1.000	96.525	225
11	445493.916	240401.624	98.025	2.475	1200		1	1.000	95.550	225
							0	1.001	95.550	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
12	445487.562	240398.223	98.025	2.518	1200		1	1.001	95.507	225
							0	1.002	95.507	225
13	445481.213	240394.807	98.025	2.575	1200		1	1.002	95.450	225
							0	1.003	95.450	225
14	445479.848	240397.344	98.025	2.592	600		1	1.003	95.433	225
							0	1.004	95.433	150
15	445485.961	240420.569	97.325	2.034	600		1	1.004	95.291	150
							0	1.005	95.291	150
6_OUT	445494.748	240425.789	95.070	1.351	1200		1	1.005	93.719	150

Simulation Settings

Rainfall Methodology	FEH-99	D3 (1km)	0.249	Winter CV	0.950	Additional Storage (m³/ha)	20.0
C (1km)	-0.024	E (1km)	0.301	Analysis Speed	Normal	Check Discharge Rate(s)	x
D1 (1km)	0.315	F (1km)	2.480	Skip Steady State	x	Check Discharge Volume	x
D2 (1km)	0.333	Summer CV	0.950	Drain Down Time (mins)	240		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	40	0	0
30	0	0	0				

Node 13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	95.450	Product Number	CTL-SHE-0032-5000-1000-5000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.5	Min Node Diameter (mm)	1200

Node 12 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	95.507
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	100.0	0.0	1.000	100.0	0.0	1.001	0.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	123.292	34.887	2 year 240 minute summer	19.284	5.096
2 year 15 minute winter	86.521	34.887	2 year 240 minute winter	12.812	5.096
2 year 30 minute summer	76.222	21.568	2 year 360 minute summer	14.948	3.847
2 year 30 minute winter	53.489	21.568	2 year 360 minute winter	9.717	3.847
2 year 60 minute summer	50.456	13.334	2 year 480 minute summer	11.922	3.151
2 year 60 minute winter	33.522	13.334	2 year 480 minute winter	7.921	3.151
2 year 120 minute summer	31.193	8.243	2 year 600 minute summer	9.867	2.699
2 year 120 minute winter	20.724	8.243	2 year 600 minute winter	6.742	2.699
2 year 180 minute summer	24.179	6.222	2 year 720 minute summer	8.873	2.378
2 year 180 minute winter	15.717	6.222	2 year 720 minute winter	5.963	2.378

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 960 minute summer	7.435	1.958
2 year 960 minute winter	4.925	1.958
2 year 1440 minute summer	5.554	1.489
2 year 1440 minute winter	3.733	1.489
2 year 2160 minute summer	4.096	1.132
2 year 2160 minute winter	2.822	1.132
2 year 2880 minute summer	3.477	0.932
2 year 2880 minute winter	2.337	0.932
2 year 4320 minute summer	2.619	0.685
2 year 4320 minute winter	1.725	0.685
2 year 5760 minute summer	2.150	0.550
2 year 5760 minute winter	1.392	0.550
2 year 7200 minute summer	1.821	0.465
2 year 7200 minute winter	1.175	0.465
2 year 8640 minute summer	1.585	0.404
2 year 8640 minute winter	1.023	0.404
2 year 10080 minute summer	1.410	0.360
2 year 10080 minute winter	0.910	0.360
30 year 15 minute summer	338.091	95.668
30 year 15 minute winter	237.257	95.668
30 year 30 minute summer	198.782	56.248
30 year 30 minute winter	139.496	56.248
30 year 60 minute summer	125.143	33.072
30 year 60 minute winter	83.142	33.072
30 year 120 minute summer	73.578	19.445
30 year 120 minute winter	48.884	19.445
30 year 180 minute summer	55.383	14.252
30 year 180 minute winter	36.000	14.252
30 year 240 minute summer	43.261	11.433
30 year 240 minute winter	28.741	11.433
30 year 360 minute summer	32.563	8.379
30 year 360 minute winter	21.167	8.379
30 year 480 minute summer	25.435	6.722
30 year 480 minute winter	16.899	6.722
30 year 600 minute summer	20.713	5.665
30 year 600 minute winter	14.152	5.665
30 year 720 minute summer	18.383	4.927
30 year 720 minute winter	12.354	4.927
30 year 960 minute summer	15.086	3.973
30 year 960 minute winter	9.994	3.973
30 year 1440 minute summer	10.944	2.933
30 year 1440 minute winter	7.355	2.933
30 year 2160 minute summer	7.836	2.166
30 year 2160 minute winter	5.399	2.166
30 year 2880 minute summer	6.515	1.746
30 year 2880 minute winter	4.379	1.746
30 year 4320 minute summer	4.766	1.246
30 year 4320 minute winter	3.139	1.246
30 year 5760 minute summer	3.831	0.981
30 year 5760 minute winter	2.480	0.981
30 year 7200 minute summer	3.193	0.815
30 year 7200 minute winter	2.061	0.815
30 year 8640 minute summer	2.743	0.700
30 year 8640 minute winter	1.771	0.700
30 year 10080 minute summer	2.413	0.616
30 year 10080 minute winter	1.557	0.616
100 year +40% CC 15 minute summer	710.672	201.096
100 year +40% CC 15 minute winter	498.717	201.096
100 year +40% CC 30 minute summer	409.476	115.868
100 year +40% CC 30 minute winter	287.352	115.868
100 year +40% CC 60 minute summer	252.623	66.761
100 year +40% CC 60 minute winter	167.837	66.761
100 year +40% CC 120 minute summer	145.557	38.466
100 year +40% CC 120 minute winter	96.705	38.466

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 180 minute summer	108.273	27.862	100 year +40% CC 1440 minute winter	13.532	5.397
100 year +40% CC 180 minute winter	70.380	27.862	100 year +40% CC 2160 minute summer	14.247	3.938
100 year +40% CC 240 minute summer	83.867	22.164	100 year +40% CC 2160 minute winter	9.817	3.938
100 year +40% CC 240 minute winter	55.719	22.164	100 year +40% CC 2880 minute summer	11.747	3.148
100 year +40% CC 360 minute summer	62.385	16.054	100 year +40% CC 2880 minute winter	7.895	3.148
100 year +40% CC 360 minute winter	40.552	16.054	100 year +40% CC 4320 minute summer	8.492	2.220
100 year +40% CC 480 minute summer	48.323	12.770	100 year +40% CC 4320 minute winter	5.592	2.220
100 year +40% CC 480 minute winter	32.105	12.770	100 year +40% CC 5760 minute summer	6.770	1.733
100 year +40% CC 600 minute summer	39.095	10.693	100 year +40% CC 5760 minute winter	4.382	1.733
100 year +40% CC 600 minute winter	26.712	10.693	100 year +40% CC 7200 minute summer	5.605	1.430
100 year +40% CC 720 minute summer	34.513	9.250	100 year +40% CC 7200 minute winter	3.618	1.430
100 year +40% CC 720 minute winter	23.195	9.250	100 year +40% CC 8640 minute summer	4.791	1.222
100 year +40% CC 960 minute summer	28.088	7.396	100 year +40% CC 8640 minute winter	3.092	1.222
100 year +40% CC 960 minute winter	18.606	7.396	100 year +40% CC 10080 minute summer	4.195	1.070
100 year +40% CC 1440 minute summer	20.136	5.397	100 year +40% CC 10080 minute winter	2.707	1.070

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	10	14	96.573	0.048	11.9	0.1769	0.0000	OK
15 minute summer	11	9	95.722	0.172	11.8	0.1945	0.0000	OK
480 minute winter	12	464	95.686	0.179	2.4	17.2056	0.0000	OK
480 minute winter	13	448	95.686	0.236	1.2	0.2674	0.0000	SURCHARGED
15 minute summer	14	27	95.451	0.018	0.3	0.0052	0.0000	OK
15 minute summer	15	28	95.299	0.008	0.3	0.0022	0.0000	OK
15 minute summer	6_OUT	28	93.727	0.008	0.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	10	1.000	11	11.9	1.183	0.101	0.3398	
15 minute summer	11	1.001	12	13.1	1.444	0.327	0.1187	
480 minute winter	12	1.002	13	1.2	0.152	0.025	0.2655	
480 minute winter	13	Hydro-Brake®	14	0.3				
15 minute summer	14	1.004	15	0.3	0.467	0.026	0.0189	
15 minute summer	15	1.005	6_OUT	0.3	1.022	0.005	0.0035	5.0

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	10	14	96.606	0.081	32.6	0.2961	0.0000	OK
960 minute winter	11	915	95.982	0.432	2.9	0.4890	0.0000	SURCHARGED
960 minute winter	12	915	95.982	0.475	2.8	45.6941	0.0000	SURCHARGED
960 minute winter	13	915	95.982	0.532	1.1	0.6021	0.0000	SURCHARGED
960 minute winter	14	915	95.452	0.019	0.4	0.0055	0.0000	OK
960 minute winter	15	915	95.299	0.008	0.4	0.0023	0.0000	OK
960 minute winter	6_OUT	915	93.727	0.008	0.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	10	1.000	11	32.6	1.573	0.278	0.4518	
960 minute winter	11	1.001	12	2.8	0.512	0.071	0.2866	
960 minute winter	12	1.002	13	1.1	0.146	0.023	0.2867	
960 minute winter	13	Hydro-Brake®	14	0.4				
960 minute winter	14	1.004	15	0.4	0.480	0.028	0.0202	
960 minute winter	15	1.005	6_OUT	0.4	1.051	0.005	0.0037	23.8

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	10	15	96.658	0.133	68.5	0.4881	0.0000	OK
960 minute winter	11	930	96.618	1.068	5.4	1.2075	0.0000	SURCHARGED
960 minute winter	12	930	96.618	1.111	5.3	96.3036	0.0000	SURCHARGED
960 minute winter	13	930	96.618	1.168	1.1	1.3206	0.0000	SURCHARGED
960 minute winter	14	930	95.456	0.023	0.5	0.0064	0.0000	OK
960 minute winter	15	930	95.301	0.010	0.5	0.0027	0.0000	OK
960 minute winter	6_OUT	930	93.728	0.009	0.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	10	1.000	11	68.2	1.922	0.581	0.6216	
960 minute winter	11	1.001	12	5.3	0.596	0.132	0.2866	
960 minute winter	12	1.002	13	1.1	0.157	0.024	0.2867	
960 minute winter	13	Hydro-Brake®	14	0.5				
960 minute winter	14	1.004	15	0.5	0.532	0.039	0.0256	
960 minute winter	15	1.005	6_OUT	0.5	1.166	0.008	0.0047	29.9

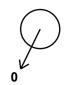
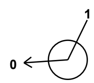
Design Settings

Rainfall Methodology	FEH-99	E (1km)	0.301	Connection Type	Level Soffits
Return Period (years)	100	F (1km)	2.480	Minimum Backdrop Height (m)	2.000
Additional Flow (%)	0	CV	0.950	Preferred Cover Depth (m)	0.900
C (1km)	-0.024	Time of Entry (mins)	5.00	Include Intermediate Ground	✓
D1 (1km)	0.315	Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
D2 (1km)	0.333	Maximum Rainfall (mm/hr)	50.0		
D3 (1km)	0.249	Minimum Velocity (m/s)	1.00		

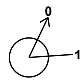
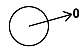
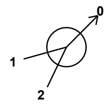
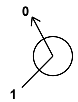
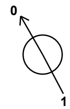
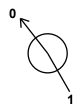
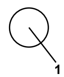
Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.061	5.00	98.700	600	445518.503	240317.583	1.150
2	0.064	5.00	100.250	1200	445514.270	240308.937	3.150
3	0.095	5.00	100.000	1350	445490.208	240307.301	2.950
4	0.107	5.00	100.000	1200	445472.216	240358.602	2.950
5	0.244	5.00	98.500	1350	445521.221	240372.222	1.500
6			98.000	1350	445523.913	240374.941	1.275
7			98.020	450	445517.101	240387.826	1.441
8			97.200	450	445497.019	240422.883	1.021
8_OUT			97.050	450	445494.748	240425.789	1.050

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
1	445518.503	240317.583	98.700	1.150	600		0	1.000	97.550	225
2	445514.270	240308.937	100.250	3.150	1200		1	1.000	97.100	225
							0	1.001	97.100	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
3	445490.208	240307.301	100.000	2.950	1350		1	1.001	97.050	225
							0	1.002	97.050	375
4	445472.216	240358.602	100.000	2.950	1200		0	2.000	97.050	300
5	445521.221	240372.222	98.500	1.500	1350		1	2.000	97.000	300
							2	1.002	97.000	375
							0	1.003	97.000	375
6	445523.913	240374.941	98.000	1.275	1350		1	1.003	96.725	375
							0	1.004	96.725	150
7	445517.101	240387.826	98.020	1.441	450		1	1.004	96.579	150
							0	1.005	96.579	150
8	445497.019	240422.883	97.200	1.021	450		1	1.005	96.179	150
							0	1.006	96.179	150
8_OUT	445494.748	240425.789	97.050	1.050	450		1	1.006	96.000	150

Simulation Settings

Rainfall Methodology	FEH-99	D3 (1km)	0.249	Winter CV	0.950	Additional Storage (m³/ha)	20.0
C (1km)	-0.024	E (1km)	0.301	Analysis Speed	Normal	Check Discharge Rate(s)	x
D1 (1km)	0.315	F (1km)	2.480	Skip Steady State	x	Check Discharge Volume	x
D2 (1km)	0.333	Summer CV	0.950	Drain Down Time (mins)	240		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	40	0	0
30	0	0	0				

Node 6 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	96.725	Product Number	CTL-SHE-0085-3500-1275-3500
Design Depth (m)	1.275	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.5	Min Node Diameter (mm)	1200

Node 5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	97.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	500.0	0.0	1.000	500.0	0.0	1.001	0.0	0.0

Node 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	97.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	165

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	75.0	0.0	1.000	75.0	0.0	1.001	0.0	0.0

Node 3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	97.050
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	75.0	0.0	1.000	75.0	0.0	1.001	0.0	0.0

Node 4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	97.050
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	100.0	0.0	1.000	100.0	0.0	1.001	0.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	123.292	34.887	2 year 240 minute summer	19.284	5.096
2 year 15 minute winter	86.521	34.887	2 year 240 minute winter	12.812	5.096
2 year 30 minute summer	76.222	21.568	2 year 360 minute summer	14.948	3.847
2 year 30 minute winter	53.489	21.568	2 year 360 minute winter	9.717	3.847
2 year 60 minute summer	50.456	13.334	2 year 480 minute summer	11.922	3.151
2 year 60 minute winter	33.522	13.334	2 year 480 minute winter	7.921	3.151
2 year 120 minute summer	31.193	8.243	2 year 600 minute summer	9.867	2.699
2 year 120 minute winter	20.724	8.243	2 year 600 minute winter	6.742	2.699
2 year 180 minute summer	24.179	6.222	2 year 720 minute summer	8.873	2.378
2 year 180 minute winter	15.717	6.222	2 year 720 minute winter	5.963	2.378

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 960 minute summer	7.435	1.958	30 year 480 minute summer	25.435	6.722
2 year 960 minute winter	4.925	1.958	30 year 480 minute winter	16.899	6.722
2 year 1440 minute summer	5.554	1.489	30 year 600 minute summer	20.713	5.665
2 year 1440 minute winter	3.733	1.489	30 year 600 minute winter	14.152	5.665
2 year 2160 minute summer	4.096	1.132	30 year 720 minute summer	18.383	4.927
2 year 2160 minute winter	2.822	1.132	30 year 720 minute winter	12.354	4.927
2 year 2880 minute summer	3.477	0.932	30 year 960 minute summer	15.086	3.973
2 year 2880 minute winter	2.337	0.932	30 year 960 minute winter	9.994	3.973
2 year 4320 minute summer	2.619	0.685	30 year 1440 minute summer	10.944	2.933
2 year 4320 minute winter	1.725	0.685	30 year 1440 minute winter	7.355	2.933
2 year 5760 minute summer	2.150	0.550	30 year 2160 minute summer	7.836	2.166
2 year 5760 minute winter	1.392	0.550	30 year 2160 minute winter	5.399	2.166
2 year 7200 minute summer	1.821	0.465	30 year 2880 minute summer	6.515	1.746
2 year 7200 minute winter	1.175	0.465	30 year 2880 minute winter	4.379	1.746
2 year 8640 minute summer	1.585	0.404	30 year 4320 minute summer	4.766	1.246
2 year 8640 minute winter	1.023	0.404	30 year 4320 minute winter	3.139	1.246
2 year 10080 minute summer	1.410	0.360	30 year 5760 minute summer	3.831	0.981
2 year 10080 minute winter	0.910	0.360	30 year 5760 minute winter	2.480	0.981
30 year 15 minute summer	338.091	95.668	30 year 7200 minute summer	3.193	0.815
30 year 15 minute winter	237.257	95.668	30 year 7200 minute winter	2.061	0.815
30 year 30 minute summer	198.782	56.248	30 year 8640 minute summer	2.743	0.700
30 year 30 minute winter	139.496	56.248	30 year 8640 minute winter	1.771	0.700
30 year 60 minute summer	125.143	33.072	30 year 10080 minute summer	2.413	0.616
30 year 60 minute winter	83.142	33.072	30 year 10080 minute winter	1.557	0.616
30 year 120 minute summer	73.578	19.445	100 year +40% CC 15 minute summer	710.672	201.096
30 year 120 minute winter	48.884	19.445	100 year +40% CC 15 minute winter	498.717	201.096
30 year 180 minute summer	55.383	14.252	100 year +40% CC 30 minute summer	409.476	115.868
30 year 180 minute winter	36.000	14.252	100 year +40% CC 30 minute winter	287.352	115.868
30 year 240 minute summer	43.261	11.433	100 year +40% CC 60 minute summer	252.623	66.761
30 year 240 minute winter	28.741	11.433	100 year +40% CC 60 minute winter	167.837	66.761
30 year 360 minute summer	32.563	8.379	100 year +40% CC 120 minute summer	145.557	38.466
30 year 360 minute winter	21.167	8.379	100 year +40% CC 120 minute winter	96.705	38.466

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 180 minute summer	108.273	27.862	100 year +40% CC 1440 minute winter	13.532	5.397
100 year +40% CC 180 minute winter	70.380	27.862	100 year +40% CC 2160 minute summer	14.247	3.938
100 year +40% CC 240 minute summer	83.867	22.164	100 year +40% CC 2160 minute winter	9.817	3.938
100 year +40% CC 240 minute winter	55.719	22.164	100 year +40% CC 2880 minute summer	11.747	3.148
100 year +40% CC 360 minute summer	62.385	16.054	100 year +40% CC 2880 minute winter	7.895	3.148
100 year +40% CC 360 minute winter	40.552	16.054	100 year +40% CC 4320 minute summer	8.492	2.220
100 year +40% CC 480 minute summer	48.323	12.770	100 year +40% CC 4320 minute winter	5.592	2.220
100 year +40% CC 480 minute winter	32.105	12.770	100 year +40% CC 5760 minute summer	6.770	1.733
100 year +40% CC 600 minute summer	39.095	10.693	100 year +40% CC 5760 minute winter	4.382	1.733
100 year +40% CC 600 minute winter	26.712	10.693	100 year +40% CC 7200 minute summer	5.605	1.430
100 year +40% CC 720 minute summer	34.513	9.250	100 year +40% CC 7200 minute winter	3.618	1.430
100 year +40% CC 720 minute winter	23.195	9.250	100 year +40% CC 8640 minute summer	4.791	1.222
100 year +40% CC 960 minute summer	28.088	7.396	100 year +40% CC 8640 minute winter	3.092	1.222
100 year +40% CC 960 minute winter	18.606	7.396	100 year +40% CC 10080 minute summer	4.195	1.070
100 year +40% CC 1440 minute summer	20.136	5.397	100 year +40% CC 10080 minute winter	2.707	1.070

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	9	97.601	0.051	11.7	0.0684	0.0000	OK
30 minute summer	2	22	97.198	0.098	20.3	7.5205	0.0000	OK
60 minute summer	3	41	97.172	0.122	18.0	9.4083	0.0000	OK
60 minute summer	4	40	97.131	0.081	12.8	8.2906	0.0000	OK
360 minute summer	5	272	97.122	0.122	28.7	61.7494	0.0000	OK
480 minute summer	6	312	97.148	0.423	19.8	0.6056	0.0000	SURCHARGED
180 minute summer	7	244	96.627	0.048	3.4	0.0076	0.0000	OK
180 minute summer	8	248	96.211	0.032	3.4	0.0051	0.0000	OK
180 minute summer	8_OUT	252	96.030	0.030	3.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	11.7	1.938	0.104	0.0938	
30 minute summer	2	1.001	3	8.9	0.523	0.378	0.4314	
60 minute summer	3	1.002	5	10.7	0.555	0.208	1.5417	
60 minute summer	4	2.000	5	4.8	0.406	0.140	0.6778	
360 minute summer	5	1.003	6	18.8	0.297	0.035	0.2705	
480 minute summer	6	Hydro-Brake®	7	3.4				
180 minute summer	7	1.005	8	3.4	0.911	0.194	0.1532	
180 minute summer	8	1.006	8_OUT	3.4	1.301	0.087	0.0097	72.1

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	97.633	0.083	32.1	0.1114	0.0000	OK
15 minute summer	2	14	97.325	0.225	65.8	17.2130	0.0000	OK
360 minute winter	3	352	97.289	0.239	11.4	18.3941	0.0000	OK
360 minute winter	4	352	97.289	0.239	6.0	24.3059	0.0000	OK
360 minute winter	5	352	97.289	0.289	34.5	145.6728	0.0000	OK
480 minute winter	6	448	97.294	0.569	15.6	0.8141	0.0000	SURCHARGED
2880 minute summer	7	2580	96.627	0.048	3.4	0.0076	0.0000	OK
4320 minute summer	8	3060	96.211	0.032	3.4	0.0051	0.0000	OK
4320 minute summer	8_OUT	3060	96.030	0.030	3.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	32.1	1.993	0.284	0.2394	
15 minute summer	2	1.001	3	25.9	0.694	1.107	0.9546	
360 minute winter	3	1.002	5	9.7	0.374	0.188	5.9367	
360 minute winter	4	2.000	5	4.0	0.299	0.118	3.2976	
360 minute winter	5	1.003	6	-12.7	0.259	-0.024	0.3852	
480 minute winter	6	Hydro-Brake®	7	3.4				
2880 minute summer	7	1.005	8	3.4	0.911	0.194	0.1532	
4320 minute summer	8	1.006	8_OUT	3.4	1.301	0.087	0.0097	478.9

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	11	97.717	0.167	67.4	0.2252	0.0000	OK
720 minute winter	2	705	97.635	0.535	7.6	40.9761	0.0000	SURCHARGED
720 minute winter	3	705	97.635	0.585	10.3	45.1145	0.0000	SURCHARGED
720 minute winter	4	705	97.635	0.585	6.5	59.6144	0.0000	SURCHARGED
720 minute winter	5	705	97.635	0.635	25.2	320.6230	0.0000	SURCHARGED
720 minute winter	6	720	97.640	0.915	15.6	1.3089	0.0000	SURCHARGED
15 minute winter	7	8	96.627	0.048	3.4	0.0076	0.0000	OK
5760 minute summer	8	5580	96.211	0.032	3.4	0.0051	0.0000	OK
5760 minute summer	8_OUT	5580	96.030	0.030	3.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	66.5	2.212	0.589	0.3439	
720 minute winter	2	1.001	3	4.5	0.323	0.192	0.9592	
720 minute winter	3	1.002	5	6.8	0.289	0.131	7.9357	
720 minute winter	4	2.000	5	2.3	0.244	0.068	3.5817	
720 minute winter	5	1.003	6	15.6	0.257	0.029	0.4220	
720 minute winter	6	Hydro-Brake®	7	3.4				
15 minute winter	7	1.005	8	3.4	0.917	0.194	0.1532	
5760 minute summer	8	1.006	8_OUT	3.4	1.301	0.087	0.0097	899.8

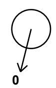
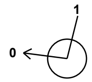
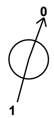
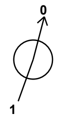
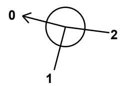
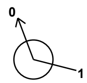
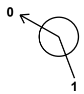
Design Settings

Rainfall Methodology	FEH-99	E (1km)	0.301	Connection Type	Level Soffits
Return Period (years)	100	F (1km)	2.480	Minimum Backdrop Height (m)	2.000
Additional Flow (%)	0	CV	0.950	Preferred Cover Depth (m)	0.900
C (1km)	-0.024	Time of Entry (mins)	5.00	Include Intermediate Ground	✓
D1 (1km)	0.315	Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
D2 (1km)	0.333	Maximum Rainfall (mm/hr)	50.0		
D3 (1km)	0.249	Minimum Velocity (m/s)	1.00		

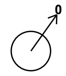
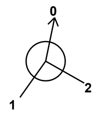
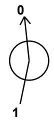
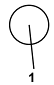
Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.125	5.00	103.150	1350	445482.338	240296.665	1.350
2	0.245	5.00	103.150	1350	445473.173	240260.005	1.443
3	0.020	10.00	103.000	600	445444.677	240239.606	1.275
4	0.034	5.00	103.000	600	445448.320	240253.390	1.319
5			103.000	600	445449.611	240256.955	1.425
6			103.000	1350	445451.163	240262.851	1.850
7			103.000	1350	445432.691	240267.561	1.900
8	0.088	5.00	103.000	1350	445431.118	240271.734	1.950
9	0.073	5.00	103.000	1200	445403.222	240271.945	1.200
10			103.150	1350	445411.122	240283.035	2.150
11			103.000	1350	445412.268	240288.552	2.100
11_OUT			102.540	1200	445410.990	240300.453	1.830

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
1	445482.338	240296.665	103.150	1.350	1350		0	1.000	101.800	450
2	445473.173	240260.005	103.150	1.443	1350		1	1.000	101.707	450
							0	1.001	101.707	450
3	445444.677	240239.606	103.000	1.275	600		0	2.000	101.725	300
4	445448.320	240253.390	103.000	1.319	600		1	2.000	101.681	300
							0	2.001	101.681	300
5	445449.611	240256.955	103.000	1.425	600		1	2.001	101.575	300
							0	2.002	101.575	300
6	445451.163	240262.851	103.000	1.850	1350		1	2.002	101.150	300
							2	1.001	101.150	450
							0	1.002	101.150	450
7	445432.691	240267.561	103.000	1.900	1350		1	1.002	101.100	450
							0	1.003	101.100	450
8	445431.118	240271.734	103.000	1.950	1350		1	1.003	101.050	450
							0	1.004	101.050	450

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
9	445403.222	240271.945	103.000	1.200	1200		0	3.000	101.800	300
10	445411.122	240283.035	103.150	2.150	1350		1	3.000	101.000	300
							2	1.004	101.000	450
							0	1.005	101.000	450
11	445412.268	240288.552	103.000	2.100	1350		1	1.005	100.900	450
							0	1.006	100.900	300
11_OUT	445410.990	240300.453	102.540	1.830	1200		1	1.006	100.710	300

Simulation Settings

Rainfall Methodology	FEH-99	D3 (1km)	0.249	Winter CV	0.950	Additional Storage (m³/ha)	20.0
C (1km)	-0.024	E (1km)	0.301	Analysis Speed	Normal	Check Discharge Rate(s)	x
D1 (1km)	0.315	F (1km)	2.480	Skip Steady State	x	Check Discharge Volume	x
D2 (1km)	0.333	Summer CV	0.950	Drain Down Time (mins)	240		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	40	0	0
30	0	0	0				

Node 11 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	100.900	Product Number	CTL-SHE-0081-3200-1300-3200
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.2	Min Node Diameter (mm)	1200

Node 10 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	101.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	194.0	0.0	1.000	194.0	0.0	1.001	0.0	0.0

Node 7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	101.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	31.0	0.0	1.000	31.0	0.0	1.001	0.0	0.0

Node 8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	101.050
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	194.0	0.0	1.000	194.0	0.0	1.001	0.0	0.0

Node 6 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	101.150
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	34.0	0.0	1.000	34.0	0.0	1.001	0.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	123.292	34.887	2 year 1440 minute winter	3.733	1.489
2 year 15 minute winter	86.521	34.887	2 year 2160 minute summer	4.096	1.132
2 year 30 minute summer	76.222	21.568	2 year 2160 minute winter	2.822	1.132
2 year 30 minute winter	53.489	21.568	2 year 2880 minute summer	3.477	0.932
2 year 60 minute summer	50.456	13.334	2 year 2880 minute winter	2.337	0.932
2 year 60 minute winter	33.522	13.334	2 year 4320 minute summer	2.619	0.685
2 year 120 minute summer	31.193	8.243	2 year 4320 minute winter	1.725	0.685
2 year 120 minute winter	20.724	8.243	2 year 5760 minute summer	2.150	0.550
2 year 180 minute summer	24.179	6.222	2 year 5760 minute winter	1.392	0.550
2 year 180 minute winter	15.717	6.222	2 year 7200 minute summer	1.821	0.465
2 year 240 minute summer	19.284	5.096	2 year 7200 minute winter	1.175	0.465
2 year 240 minute winter	12.812	5.096	2 year 8640 minute summer	1.585	0.404
2 year 360 minute summer	14.948	3.847	2 year 8640 minute winter	1.023	0.404
2 year 360 minute winter	9.717	3.847	2 year 10080 minute summer	1.410	0.360
2 year 480 minute summer	11.922	3.151	2 year 10080 minute winter	0.910	0.360
2 year 480 minute winter	7.921	3.151	30 year 15 minute summer	338.091	95.668
2 year 600 minute summer	9.867	2.699	30 year 15 minute winter	237.257	95.668
2 year 600 minute winter	6.742	2.699	30 year 30 minute summer	198.782	56.248
2 year 720 minute summer	8.873	2.378	30 year 30 minute winter	139.496	56.248
2 year 720 minute winter	5.963	2.378	30 year 60 minute summer	125.143	33.072
2 year 960 minute summer	7.435	1.958	30 year 60 minute winter	83.142	33.072
2 year 960 minute winter	4.925	1.958	30 year 120 minute summer	73.578	19.445
2 year 1440 minute summer	5.554	1.489	30 year 120 minute winter	48.884	19.445

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 180 minute summer	55.383	14.252	100 year +40% CC 30 minute summer	409.476	115.868
30 year 180 minute winter	36.000	14.252	100 year +40% CC 30 minute winter	287.352	115.868
30 year 240 minute summer	43.261	11.433	100 year +40% CC 60 minute summer	252.623	66.761
30 year 240 minute winter	28.741	11.433	100 year +40% CC 60 minute winter	167.837	66.761
30 year 360 minute summer	32.563	8.379	100 year +40% CC 120 minute summer	145.557	38.466
30 year 360 minute winter	21.167	8.379	100 year +40% CC 120 minute winter	96.705	38.466
30 year 480 minute summer	25.435	6.722	100 year +40% CC 180 minute summer	108.273	27.862
30 year 480 minute winter	16.899	6.722	100 year +40% CC 180 minute winter	70.380	27.862
30 year 600 minute summer	20.713	5.665	100 year +40% CC 240 minute summer	83.867	22.164
30 year 600 minute winter	14.152	5.665	100 year +40% CC 240 minute winter	55.719	22.164
30 year 720 minute summer	18.383	4.927	100 year +40% CC 360 minute summer	62.385	16.054
30 year 720 minute winter	12.354	4.927	100 year +40% CC 360 minute winter	40.552	16.054
30 year 960 minute summer	15.086	3.973	100 year +40% CC 480 minute summer	48.323	12.770
30 year 960 minute winter	9.994	3.973	100 year +40% CC 480 minute winter	32.105	12.770
30 year 1440 minute summer	10.944	2.933	100 year +40% CC 600 minute summer	39.095	10.693
30 year 1440 minute winter	7.355	2.933	100 year +40% CC 600 minute winter	26.712	10.693
30 year 2160 minute summer	7.836	2.166	100 year +40% CC 720 minute summer	34.513	9.250
30 year 2160 minute winter	5.399	2.166	100 year +40% CC 720 minute winter	23.195	9.250
30 year 2880 minute summer	6.515	1.746	100 year +40% CC 960 minute summer	28.088	7.396
30 year 2880 minute winter	4.379	1.746	100 year +40% CC 960 minute winter	18.606	7.396
30 year 4320 minute summer	4.766	1.246	100 year +40% CC 1440 minute summer	20.136	5.397
30 year 4320 minute winter	3.139	1.246	100 year +40% CC 1440 minute winter	13.532	5.397
30 year 5760 minute summer	3.831	0.981	100 year +40% CC 2160 minute summer	14.247	3.938
30 year 5760 minute winter	2.480	0.981	100 year +40% CC 2160 minute winter	9.817	3.938
30 year 7200 minute summer	3.193	0.815	100 year +40% CC 2880 minute summer	11.747	3.148
30 year 7200 minute winter	2.061	0.815	100 year +40% CC 2880 minute winter	7.895	3.148
30 year 8640 minute summer	2.743	0.700	100 year +40% CC 4320 minute summer	8.492	2.220
30 year 8640 minute winter	1.771	0.700	100 year +40% CC 4320 minute winter	5.592	2.220
30 year 10080 minute summer	2.413	0.616	100 year +40% CC 5760 minute summer	6.770	1.733
30 year 10080 minute winter	1.557	0.616	100 year +40% CC 5760 minute winter	4.382	1.733
100 year +40% CC 15 minute summer	710.672	201.096	100 year +40% CC 7200 minute summer	5.605	1.430
100 year +40% CC 15 minute winter	498.717	201.096	100 year +40% CC 7200 minute winter	3.618	1.430

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 8640 minute summer	4.791	1.222	100 year +40% CC 10080 minute summer	4.195	1.070
100 year +40% CC 8640 minute winter	3.092	1.222	100 year +40% CC 10080 minute winter	2.707	1.070

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	101.920	0.120	24.0	0.3954	0.0000	OK
15 minute summer	2	10	101.817	0.110	70.3	0.5325	0.0000	OK
15 minute summer	3	14	101.767	0.042	2.4	0.0248	0.0000	OK
15 minute summer	4	10	101.731	0.050	8.8	0.0405	0.0000	OK
15 minute summer	5	10	101.610	0.035	8.8	0.0100	0.0000	OK
15 minute summer	6	12	101.353	0.203	78.3	7.2058	0.0000	OK
15 minute summer	7	12	101.266	0.166	71.9	5.3936	0.0000	OK
480 minute summer	8	352	101.220	0.170	16.0	33.2938	0.0000	OK
15 minute summer	9	9	101.861	0.061	14.0	0.1425	0.0000	OK
480 minute summer	10	352	101.219	0.219	14.0	42.8262	0.0000	OK
480 minute summer	11	352	101.219	0.319	13.2	0.4567	0.0000	SURCHARGED
15 minute summer	11_OUT	1	100.710	0.000	2.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	23.6	0.743	0.148	1.2103	
15 minute summer	2	1.001	6	69.6	1.756	0.136	1.0905	
15 minute summer	3	2.000	4	2.4	0.483	0.039	0.0943	
15 minute summer	4	2.001	5	8.8	1.425	0.047	0.0235	
15 minute summer	5	2.002	6	8.7	1.215	0.030	0.1681	
15 minute summer	6	1.002	7	71.9	1.343	0.437	1.1699	
15 minute summer	7	1.003	8	72.8	2.204	0.212	0.1648	
480 minute summer	8	1.004	10	11.7	0.532	0.078	1.5069	
15 minute summer	9	3.000	10	14.1	2.895	0.052	0.2006	
480 minute summer	10	1.005	11	13.2	0.409	0.031	0.5545	
480 minute summer	11	Hydro-Brake®	11_OUT	3.0				103.8

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	102.010	0.210	65.8	0.6914	0.0000	OK
15 minute summer	2	10	101.914	0.207	193.2	0.9984	0.0000	OK
15 minute winter	3	13	101.794	0.069	6.7	0.0414	0.0000	OK
15 minute summer	4	10	101.769	0.088	24.3	0.0707	0.0000	OK
15 minute summer	5	10	101.633	0.058	24.1	0.0163	0.0000	OK
15 minute summer	6	12	101.536	0.386	214.7	13.6830	0.0000	OK
480 minute winter	7	472	101.518	0.418	17.5	13.5562	0.0000	OK
480 minute winter	8	472	101.518	0.468	23.3	91.8832	0.0000	SURCHARGED
15 minute summer	9	9	101.894	0.094	38.3	0.2216	0.0000	OK
480 minute winter	10	472	101.518	0.518	13.0	101.2330	0.0000	SURCHARGED
480 minute winter	11	464	101.518	0.618	9.3	0.8849	0.0000	SURCHARGED
15 minute summer	11_OUT	1	100.710	0.000	3.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	64.8	0.912	0.407	2.7161	
15 minute summer	2	1.001	6	190.7	2.073	0.371	2.3806	
15 minute winter	3	2.000	4	6.7	0.625	0.109	0.1997	
15 minute summer	4	2.001	5	24.1	1.836	0.130	0.0504	
15 minute summer	5	2.002	6	24.1	1.425	0.082	0.2435	
15 minute summer	6	1.002	7	200.6	1.604	1.219	2.4312	
480 minute winter	7	1.003	8	19.5	0.965	0.057	0.6957	
480 minute winter	8	1.004	10	9.9	0.562	0.066	3.6393	
15 minute summer	9	3.000	10	38.6	3.488	0.142	0.4933	
480 minute winter	10	1.005	11	9.3	0.373	0.022	0.8928	
480 minute winter	11	Hydro-Brake®	11_OUT	3.0				110.2

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute winter	1	705	102.756	0.956	7.7	3.1443	0.0000	SURCHARGED
960 minute winter	2	915	102.756	1.049	18.2	5.0625	0.0000	SURCHARGED
960 minute winter	3	915	102.757	1.032	1.0	0.6148	0.0000	FLOOD RISK
960 minute winter	4	915	102.757	1.075	3.1	0.8658	0.0000	FLOOD RISK
960 minute winter	5	915	102.756	1.181	7.5	0.3342	0.0000	FLOOD RISK
960 minute winter	6	915	102.756	1.606	25.1	36.3145	0.0000	FLOOD RISK
960 minute winter	7	915	102.760	1.660	18.6	33.3915	0.0000	FLOOD RISK
720 minute winter	8	705	102.757	1.707	26.7	198.0757	0.0000	FLOOD RISK
960 minute winter	9	915	102.759	0.959	3.6	2.2526	0.0000	FLOOD RISK
960 minute winter	10	915	102.759	1.759	13.7	196.6145	0.0000	SURCHARGED
720 minute winter	11	705	102.756	1.856	10.0	2.6552	0.0000	FLOOD RISK
15 minute summer	11_OUT	1	100.710	0.000	3.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute winter	1	1.000	2	7.7	0.536	0.048	5.9873	
960 minute winter	2	1.001	6	18.2	0.742	0.035	3.5163	
960 minute winter	3	2.000	4	1.3	0.335	0.022	1.0040	
960 minute winter	4	2.001	5	7.5	1.033	0.040	0.2670	
960 minute winter	5	2.002	6	8.8	0.207	0.030	0.4293	
960 minute winter	6	1.002	7	18.6	0.655	0.113	3.0204	
960 minute winter	7	1.003	8	23.4	0.861	0.068	0.7067	
720 minute winter	8	1.004	10	12.1	0.614	0.081	3.6393	
960 minute winter	9	3.000	10	3.6	1.145	0.013	0.9588	
960 minute winter	10	1.005	11	11.4	0.397	0.027	0.8928	
720 minute winter	11	Hydro-Brake®	11_OUT	3.8				160.2

APPENDIX J

GREENFIELD & BROWNFIELD RUNOFF RATE ESTIMATION

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 446100 240200 SP 46100 40200
Data Type	Catchment
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	1.000
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	14.810	0.550	26.9	0.160	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	17.590	1.500	11.7	0.540	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	21.430	0.220	97.4	0.080	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	25.210	0.170	148.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	7.430	0.070	106.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	7.000	0.090	77.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	15.410	0.270	57.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.007	21.360	0.120	178.0	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.008	25.160	0.220	114.4	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.009	35.560	1.920	18.5	0.067	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.13	101.170	0.160	0.0	0.0	0.0	1.95	34.4	28.9
1.001	50.00	5.23	100.620	0.700	0.0	0.0	0.0	2.96	52.3«	126.4
1.002	50.00	5.50	99.120	0.780	0.0	0.0	0.0	1.32	52.7«	140.8
1.003	50.00	5.89	98.900	0.780	0.0	0.0	0.0	1.07	42.6«	140.8
1.004	50.00	5.99	98.520	0.780	0.0	0.0	0.0	1.27	50.4«	140.8
1.005	50.00	6.06	98.450	0.780	0.0	0.0	0.0	1.48	59.0«	140.8
1.006	50.00	6.21	98.360	0.780	0.0	0.0	0.0	1.73	69.0«	140.8
1.007	50.00	6.58	98.090	0.800	0.0	0.0	0.0	0.98	38.8«	144.4
1.008	50.00	6.92	97.970	0.840	0.0	0.0	0.0	1.22	48.6«	151.7
1.009	50.00	7.11	97.750	0.907	0.0	0.0	0.0	3.05	121.5«	163.8

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.000	48.000	0.830	57.8	0.110	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	75.500	2.230	33.9	0.120	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.010	13.040	0.760	17.2	0.300	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.011	24.550	0.560	43.8	0.053	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.000	50.00	5.60	98.890	0.110	0.0	0.0	0.0	1.33	23.4	19.9
2.001	50.00	6.16	98.060	0.230	0.0	0.0	0.0	2.26	89.7	41.5
1.010	50.00	7.18	95.830	1.437	0.0	0.0	0.0	3.17	126.2«	259.5
1.011	50.00	7.31	95.070	1.490	0.0	0.0	0.0	3.08	489.4	269.0

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
1	103.250	2.080	Open Manhole	1200	1.000	101.170	150				
2	102.270	1.650	Open Manhole	1200	1.001	100.620	150	1.000	100.620	150	
3	101.220	2.100	Open Manhole	1200	1.002	99.120	225	1.001	99.120	150	
4	101.050	2.150	Open Manhole	1200	1.003	98.900	225	1.002	98.900	225	
5	100.970	2.450	Open Manhole	1200	1.004	98.520	225	1.003	98.730	225	210
6	100.850	2.400	Open Manhole	1200	1.005	98.450	225	1.004	98.450	225	
7	100.760	2.400	Open Manhole	1200	1.006	98.360	225	1.005	98.360	225	
8	99.950	1.860	Open Manhole	1200	1.007	98.090	225	1.006	98.090	225	
9	99.950	1.980	Open Manhole	1200	1.008	97.970	225	1.007	97.970	225	
10	99.530	1.780	Open Manhole	1200	1.009	97.750	225	1.008	97.750	225	
21	100.660	1.770	Open Manhole	1200	2.000	98.890	150				
20	99.890	1.830	Open Manhole	1200	2.001	98.060	225	2.000	98.060	150	
11	97.120	1.290	Open Manhole	1200	1.010	95.830	225	1.009	95.830	225	
								2.001	95.830	225	
DRAIN OUT	97.120	2.050	Open Manhole	1350	1.011	95.070	450	1.010	95.070	225	
	96.760	2.250	Open Manhole	0		OUTFALL		1.011	94.510	450	

No coordinates have been specified, layout information cannot be produced.

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011		96.760	94.510	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	2	Winter Storms	No
FEH Rainfall Version	2013	Cv (Summer)	1.000
Site Location	GB 446100 240200 SP 46100 40200	Cv (Winter)	1.000
Data Type	Catchment	Storm Duration (mins)	30

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
FEH Rainfall Version 2013 Cv (Summer) 1.000
Site Location GB 446100 240200 SP 46100 40200 Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)
1.000	1	15 Summer	2	+0%	2/15 Summer				102.442	1.122	0.000	0.73	
1.001	2	15 Summer	2	+0%	2/15 Summer	2/15 Summer			102.277	1.507	7.011	1.21	
1.002	3	30 Summer	2	+0%	2/15 Summer				100.266	0.921	0.000	1.35	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1		23.2	SURCHARGED	
1.001	2		59.0	FLOOD	4
1.002	3		65.0	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)
1.003	4	30 Summer	2	+0%	2/15 Summer				99.895	0.770	0.000	1.61	
1.004	5	30 Summer	2	+0%	2/15 Summer				99.474	0.729	0.000	1.67	
1.005	6	30 Summer	2	+0%	2/15 Summer				99.280	0.605	0.000	1.47	
1.006	7	30 Summer	2	+0%	2/15 Summer				99.088	0.503	0.000	1.02	
1.007	8	30 Summer	2	+0%	2/15 Summer				98.808	0.493	0.000	1.78	
1.008	9	30 Summer	2	+0%	2/15 Summer				98.429	0.234	0.000	1.45	
1.009	10	30 Summer	2	+0%					97.878	-0.097	0.000	0.61	
2.000	21	15 Summer	2	+0%	2/15 Summer				99.062	0.022	0.000	1.01	
2.001	20	15 Summer	2	+0%					98.175	-0.110	0.000	0.51	
1.010	11	15 Summer	2	+0%	2/15 Summer				96.640	0.585	0.000	1.34	
1.011	DRAIN OUT	15 Summer	2	+0%					95.260	-0.260	0.000	0.37	

PN	US/MH Name	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	4		63.1	SURCHARGED	
1.004	5		62.2	SURCHARGED	
1.005	6		62.0	SURCHARGED	
1.006	7		62.0	SURCHARGED	
1.007	8		63.0	SURCHARGED	
1.008	9		65.1	SURCHARGED	
1.009	10		70.2	OK	
2.000	21		23.0	SURCHARGED	
2.001	20		44.3	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.010	11		145.7	SURCHARGED	
1.011	DRAIN OUT		152.7	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.700	Add Flow / Climate Change (%)	0
Ratio R	0.408	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	1.000	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

Network Design Table for Storm

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	14.810	0.550	26.9	0.160	5.00	0.0	0.600	o	150	Pipe/Conduit	🔒
1.001	17.590	1.500	11.7	0.540	0.00	0.0	0.600	o	150	Pipe/Conduit	🔒
1.002	21.430	0.220	97.4	0.080	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
1.003	25.210	0.170	148.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
1.004	7.430	0.070	106.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
1.005	7.000	0.090	77.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
1.006	15.410	0.270	57.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
1.007	21.360	0.120	178.0	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
1.008	25.160	0.220	114.4	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
1.009	35.560	1.920	18.5	0.067	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.13	101.170	0.160	0.0	0.0	0.0	1.95	34.4	28.9
1.001	50.00	5.23	100.620	0.700	0.0	0.0	0.0	2.96	52.3«	126.4
1.002	50.00	5.50	99.120	0.780	0.0	0.0	0.0	1.32	52.7«	140.8
1.003	50.00	5.89	98.900	0.780	0.0	0.0	0.0	1.07	42.6«	140.8
1.004	50.00	5.99	98.520	0.780	0.0	0.0	0.0	1.27	50.4«	140.8
1.005	49.85	6.06	98.450	0.780	0.0	0.0	0.0	1.48	59.0«	140.8
1.006	49.28	6.21	98.360	0.780	0.0	0.0	0.0	1.73	69.0«	140.8
1.007	47.93	6.58	98.090	0.800	0.0	0.0	0.0	0.98	38.8«	140.8
1.008	46.74	6.92	97.970	0.840	0.0	0.0	0.0	1.22	48.6«	141.8
1.009	46.09	7.11	97.750	0.907	0.0	0.0	0.0	3.05	121.5«	151.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.000	48.000	0.830	57.8	0.110	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	75.500	2.230	33.9	0.120	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.010	13.040	0.760	17.2	0.300	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.011	24.550	0.560	43.8	0.053	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.000	50.00	5.60	98.890	0.110	0.0	0.0	0.0	1.33	23.4	19.9
2.001	49.47	6.16	98.060	0.230	0.0	0.0	0.0	2.26	89.7	41.1
1.010	45.87	7.18	95.830	1.437	0.0	0.0	0.0	3.17	126.2«	238.0
1.011	45.44	7.31	95.070	1.490	0.0	0.0	0.0	3.08	489.4	244.5

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
1	103.250	2.080	Open Manhole	1200	1.000	101.170	150				
2	102.270	1.650	Open Manhole	1200	1.001	100.620	150	1.000	100.620	150	
3	101.220	2.100	Open Manhole	1200	1.002	99.120	225	1.001	99.120	150	
4	101.050	2.150	Open Manhole	1200	1.003	98.900	225	1.002	98.900	225	
5	100.970	2.450	Open Manhole	1200	1.004	98.520	225	1.003	98.730	225	210
6	100.850	2.400	Open Manhole	1200	1.005	98.450	225	1.004	98.450	225	
7	100.760	2.400	Open Manhole	1200	1.006	98.360	225	1.005	98.360	225	
8	99.950	1.860	Open Manhole	1200	1.007	98.090	225	1.006	98.090	225	
9	99.950	1.980	Open Manhole	1200	1.008	97.970	225	1.007	97.970	225	
10	99.530	1.780	Open Manhole	1200	1.009	97.750	225	1.008	97.750	225	
21	100.660	1.770	Open Manhole	1200	2.000	98.890	150				
20	99.890	1.830	Open Manhole	1200	2.001	98.060	225	2.000	98.060	150	
11	97.120	1.290	Open Manhole	1200	1.010	95.830	225	1.009	95.830	225	
								2.001	95.830	225	
DRAIN OUT	97.120	2.050	Open Manhole	1350	1.011	95.070	450	1.010	95.070	225	
	96.760	2.250	Open Manhole	0		OUTFALL		1.011	94.510	450	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	1	103.250	101.170	1.930	Open Manhole	1200
1.001	o	150	2	102.270	100.620	1.500	Open Manhole	1200
1.002	o	225	3	101.220	99.120	1.875	Open Manhole	1200
1.003	o	225	4	101.050	98.900	1.925	Open Manhole	1200
1.004	o	225	5	100.970	98.520	2.225	Open Manhole	1200
1.005	o	225	6	100.850	98.450	2.175	Open Manhole	1200
1.006	o	225	7	100.760	98.360	2.175	Open Manhole	1200
1.007	o	225	8	99.950	98.090	1.635	Open Manhole	1200
1.008	o	225	9	99.950	97.970	1.755	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	14.810	26.9	2	102.270	100.620	1.500	Open Manhole	1200
1.001	17.590	11.7	3	101.220	99.120	1.950	Open Manhole	1200
1.002	21.430	97.4	4	101.050	98.900	1.925	Open Manhole	1200
1.003	25.210	148.3	5	100.970	98.730	2.015	Open Manhole	1200
1.004	7.430	106.1	6	100.850	98.450	2.175	Open Manhole	1200
1.005	7.000	77.8	7	100.760	98.360	2.175	Open Manhole	1200
1.006	15.410	57.1	8	99.950	98.090	1.635	Open Manhole	1200
1.007	21.360	178.0	9	99.950	97.970	1.755	Open Manhole	1200
1.008	25.160	114.4	10	99.530	97.750	1.555	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.009	o	225	10	99.530	97.750	1.555	Open Manhole	1200
2.000	o	150	21	100.660	98.890	1.620	Open Manhole	1200
2.001	o	225	20	99.890	98.060	1.605	Open Manhole	1200
1.010	o	225	11	97.120	95.830	1.065	Open Manhole	1200
1.011	o	450	DRAIN OUT	97.120	95.070	1.600	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.009	35.560	18.5	11	97.120	95.830	1.065	Open Manhole	1200
2.000	48.000	57.8	20	99.890	98.060	1.680	Open Manhole	1200
2.001	75.500	33.9	11	97.120	95.830	1.065	Open Manhole	1200
1.010	13.040	17.2	DRAIN OUT	97.120	95.070	1.825	Open Manhole	1350
1.011	24.550	43.8		96.760	94.510	1.800	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011		96.760	94.510	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * $10m^3$/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	19.700	Cv (Summer)	1.000
Return Period (years)	1	Ratio R	0.409	Cv (Winter)	1.000
Region	England and Wales	Profile Type	Summer	Storm Duration (mins)	30

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.700 Cv (Summer) 1.000
Region England and Wales Ratio R 0.408 Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)
1.000	1	15 Summer	1	+0%	1/15 Summer				102.052	0.732	0.000	0.72	
1.001	2	15 Summer	1	+0%	1/15 Summer				102.029	1.259	0.000	1.17	
1.002	3	30 Summer	1	+0%	1/15 Summer				100.030	0.685	0.000	1.28	
1.003	4	30 Summer	1	+0%	1/15 Summer				99.696	0.571	0.000	1.52	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1		22.9	SURCHARGED	
1.001	2		57.1	FLOOD RISK	
1.002	3		61.4	SURCHARGED	
1.003	4		59.8	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)
1.004	5	30 Summer	1	+0%	1/15 Summer				99.315	0.570	0.000	1.59	
1.005	6	30 Summer	1	+0%	1/15 Summer				99.141	0.466	0.000	1.40	
1.006	7	30 Summer	1	+0%	1/15 Summer				98.967	0.382	0.000	0.97	
1.007	8	30 Summer	1	+0%	1/15 Summer				98.714	0.399	0.000	1.68	
1.008	9	30 Summer	1	+0%	1/15 Summer				98.373	0.178	0.000	1.36	
1.009	10	30 Summer	1	+0%					97.871	-0.104	0.000	0.56	
2.000	21	15 Summer	1	+0%					98.997	-0.043	0.000	0.83	
2.001	20	15 Summer	1	+0%					98.162	-0.123	0.000	0.41	
1.010	11	15 Summer	1	+0%	1/15 Summer				96.295	0.240	0.000	1.15	
1.011	DRAIN OUT	15 Summer	1	+0%					95.245	-0.275	0.000	0.32	

PN	US/MH Name	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.004	5		59.2	SURCHARGED	
1.005	6		59.0	SURCHARGED	
1.006	7		58.9	SURCHARGED	
1.007	8		59.6	SURCHARGED	
1.008	9		61.0	SURCHARGED	
1.009	10		64.3	OK	
2.000	21		19.0	OK	
2.001	20		35.9	OK	
1.010	11		125.5	SURCHARGED	
1.011	DRAIN OUT		131.2	OK	

APPENDIX K

CORRESPONDENCE WITH THAMES WATER