



STAR PUBLIC HOUSE, HILLINGDON

Flood Risk Assessment and Drainage Strategy – Scheme A Revision A

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STAR PUBLIC HOUSE, HILLINGDON
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Revision A

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Revision	Amendment Details	Revision Prepared By	Revision Approved By
A 21/11/19	Amended as per client comments	JJ	GS

1.0 INTRODUCTION

Brief

- 1.1 Create Consulting Engineers Ltd was instructed by PPM Planning on behalf of Crossier Properties Ltd to undertake a Flood Risk Assessment (FRA) and drainage strategy to inform a residential development at the former Star Public House, Hillingdon, UB10 0LZ.

Project Context

- 1.2 The Site was previously occupied by The Star Public House. This building along with a number of ancillary buildings has now been demolished leaving the Site derelict and boarded as shown in Figure 1.1.



Figure 1.1: Site Location

- 1.3 The Client plans to submit a planning application for a combined commercial and residential development. This would incorporate a ground floor commercial unit, with 10No. flats over four storeys and associated residential covered parking as well as 2No. individual houses with associated parking bays. A total of 12No. residential units are proposed in the development. Architect's Layouts showing the proposed scheme are included on Drawings 1664_A_01 - 1664_A_17.

Planning Policy Context

- 1.4 The potential consequences of inappropriate development in a flood risk area for occupiers, either of the development or elsewhere, pose significant risks in terms of personal safety and damage to property.
- 1.5 The National Planning Policy Framework¹ includes Government policy on development and flood risk stating that:

When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific flood risk assessment following the Sequential Test, and if required the Exception Test, it can be demonstrated that:

- *within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and*
- *development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including my emergency planning; and it gives priority to the use of sustainable drainage systems.*

Local Planning Policy

Local Policy

- 1.6 The Development Plan for the London Borough of Hillingdon consists of The Hillingdon Local Plan: Part 1 – Strategic Policies, The Hillingdon Local Plan: Part 2, The West London Waste Plan and The London Plan.
- 1.7 The relevant policies from The Hillingdon Local Plan: Part 1 (London Borough of Hillingdon, 2012) are:
- Policy EM1 – Climate Change Adaptation and Mitigation
 - Policy EM6 – Flood Risk Management
- 1.8 The relevant policies from The Hillingdon Local Plan: Part 2 (London Borough of Hillingdon, 2015) are:
- Policy DMEI 1 – Living Walls and Roofs and Onsite Vegetation
 - Policy DMEI 9 – Management of Flood Risk
 - Policy DMEI 10 – Water Management, Efficiency and Quality

¹ NPPF accessed online (July, 2019) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

1.9 The relevant policies from the London Plan (Greater London Authority, 2016) are:

- Policy 5.12 – Flood Risk Management
- Policy 5.13 – Sustainable Drainage
- Policy 5.14 – Water Quality and Wastewater Infrastructure

1.10 The relevant policies from the local planning documents have been considered as part of this flood risk assessment and drainage strategy.

1.11 The West London Strategic Flood Risk Assessment (SFRA) (Metis Consultants, 2018) provides a summary of the flood risks for the local area.

Climate Change

1.12 Climate change has important implications for the assessment and management of flood risk. The NPPF requires that climate change is considered when making an assessment of flood risk posed to future development.

1.13 Climate change has the potential to affect all identified sources of flooding at the site. The likely impacts of climate change include increased severity of rainfall events as well as wetter winters leading to higher groundwater levels and increased frequency and severity of surface water flooding.

1.14 The influence of climate change on rainfall intensity has been taken into account by the surface water drainage strategy here as an inclusion of 40% has been made for climate change for all rainfall events up to and including the 1 in 100 year event in accordance with NPPF requirements, and 'Flood Risk Assessments: Climate Change Allowances'².

Objectives

1.15 The following specific objectives were set by Create Consulting Engineers Ltd after a review of the available data:

- To assess the suitability of the scheme in relation to all sources of flooding;
- To assess the flood risk posed by the scheme once it is complete and operational;
- To suggest mitigation measures in order to reduce any residual risks to acceptable levels.

² Environment Agency (2016) *Flood Risk Assessments: Climate Change Allowances*.

Constraints and Limitations

- 1.16 The copyright of this report is vested in Create Consulting Engineers Ltd and the Client, Crossier Properties Ltd. The Client, or his appointed representatives, may copy the report for purposes in connection with the development described herein. It shall not be copied by any other party or used for any other purposes without the written consent of Create Consulting Engineers Ltd or the Client.
- 1.17 Create Consulting Engineers Ltd accepts no responsibility whatsoever to other parties to whom this report, or any part thereof, is made known. Any such other parties rely upon the report at their own risk.
- 1.18 The flood risk assessment addresses the flood risk posed to and from the proposed development, the extent of which is shown by the site boundary, as indicated by the location plan attached with this report.
- 1.19 This report has been undertaken with the assumption that the site will be developed in accordance with the above proposals without significant change. The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.
- 1.20 Create Consulting Engineers Ltd has endeavoured to assess all information provided to them during this appraisal. The report summarises information from a number of external sources and cannot offer any guarantees or warranties for the completeness or accuracy or information relied upon. Information from third parties has not been verified by Create Consulting Engineers Ltd unless otherwise stated in this report.

2.0 SOURCES OF INFORMATION

- 2.1 The information contained in this report is based on a review of existing information and consultation with interested parties.

Records Review

- 2.2 Key reports and websites reviewed as part of this study are listed in Table 2.1 below.

Document/Website	Author/Publisher	Date
Fluvial/Tidal Flood Maps, Surface Water, and Reservoir Flood Mapping – flood-warning-information.service.gov.uk	Environment Agency (EA)	Accessed November 2019
Groundwater Mapping (Magic Map) - https://magic.defra.gov.uk/magicmap.aspx	DEFRA	Accessed November 2019
West London Strategic Flood Risk Assessment (SFRA)	Metis Consultants	2018
London Plan	Greater London Authority	2016
The Draft New London Plan	Mayor of London	2017
The Lost Rivers of London	Nicholas Barton	1992
Architect layout plans (Drawings 1664_A_01 - 1664_A_17)	Chassay Studio	Undated
Topographic Survey data (Drawing: 18887_01_P)	Greenhatch Group	September 2013
Thames Water asset plans (included as Appendix A) and Pre-Development Enquiry Report (included as Appendix B)	Thames Water	June/July 2019

Table 2.1: Key Information Sources

Consultation

- 2.3 The agencies and individuals consulted as part of this exercise to obtain records or seek input to the proposals as part of this FRA are listed in Table 2.2 and key records are included in the appendices.

Consultee	Form of Consultation	Topics Discussed and Actions Agreed
Thames Water Developer Services Team	Request for Waste Water Asset Plans	Asset plans were requested in order to inform the foul and surface water drainage strategies. The asset plans (Appendix A), dated 20 June 2019 show foul water assets in the vicinity of the Site. Both foul and surface water sewers are shown in Star Road to the east of the Site.
	Request for Sewer Flooding History Enquiry	A sewer flooding history enquiry was requested in order to inform the flood risk assessment.

Consultee	Form of Consultation	Topics Discussed and Actions Agreed
		The sewer flooding history report (included in Appendix B) was received on 24 June 2019 and confirms that Thames Water hold no records of sewer flooding at the Site.
	Request for Pre-planning report	A Pre-Planning Assessment Report (included in Appendix C) was received on 4 July 2019. This confirms there is sufficient foul and surface water capacity in the Thames Water sewer network to serve the Site.
Affinity Water	Request for Clean Water Asset Plans	Asset plans were requested in order to inform FRA. The asset plans (Appendix A), dated 25th July 2019 show potable water assets in the vicinity of the Site.

Table 2.2: List of Parties Consulted

3.0 SITE SETTING

Site Location

- 3.1 The Site consists a parcel of land located on the northern side of Uxbridge Road, Hillingdon, UB10 0LZ, set back from the main road on a slip road known as Marlborough Parade. The centre of the Site lies at Ordnance Survey grid reference 507969E, 182311N with its boundary shown on Drawing 1664_A_01 and Figure 3.1.



Figure 3.1: Site Location

Description of Site and Surroundings

- 3.2 The Site comprises a corner plot of brownfield land of approximately 0.1 ha in size which was previously occupied by The Star Public House. This building along with a number of ancillary buildings has now been demolished leaving the site derelict and boarded.
- 3.3 The Site is bounded by Marlborough Parade to the south and Star Road to the east. Residential development surrounds the Site with commercial frontage onto Marlborough Parade.
- 3.4 The Topographic Survey, included with this report on Drawing 18887_01_P, summarises elevations in the area of the Site. The Site is predominantly flat, with a gentle slope from the north to south towards Marlborough Parade and Uxbridge Road. Levels in the north are approximately 50.8 mAOD and fall to approximately 49.8 mAOD in the south.

Geological / Hydrological Setting

Ground Conditions

- 3.5 BGS mapping (accessed online at www.bgs.ac.uk/geoindex, November 2019) shows the bedrock geology at the Site to be comprised of London Clay Formation (clay, silt and sand). Superficial deposits across the southern two thirds of the Site comprise the Boyn Hill Gravel Member (sand and gravel). There are no superficial deposits underlying the northern part of the Site.
- 3.6 A BGS borehole record, located approximately 212.0 m west of the Site, recorded made ground and drift to a depth of approximately 8.8 m below ground level (bgl) with London Clay below to the end at the borehole at approximately 9.1 mbgl. Another borehole approximately 273.0 m south east of the Site records drift to the end of the borehole at approximately 7.8 mbgl.

Surface Watercourses

- 3.7 The River Pinn is located approximately 2.0 km to the west of the Site, and the Paddington Branch of the Grand Union Canal is located approximately 2.5 km south of the Site.

Groundwater

- 3.8 The Site does not lie in any groundwater source protection zones, as identified by DEFRA's online mapping (Magic Map Application, accessed November 2019).
- 3.9 The rest water level in the BGS borehole to the west of the Site was recorded at 6.7 m below ground level (mbgl) whilst in the BGS borehole to the south east of the Site rest water level was recorded at 4.67 mbgl.

Artificial Waterbodies

- 3.10 There are no artificial waterbodies located within the vicinity of the Site other than the Paddington Branch of the Grand Union Canal mentioned in section 3.7.

4.0 SCHEME DESCRIPTION

The Scheme

- 4.1 The Client plans to submit a planning application for a combined commercial and residential development. This would incorporate a ground floor commercial unit, with 10No. flats over four storeys and associated residential covered parking as well as 2No. individual houses with associated parking bays. A total of 12No. residential units are proposed in the development.
- 4.2 Architect's Layouts showing the proposed scheme are included on Drawings 1664_A_01-1664_A_17.

Proposed Land use Vulnerability Classification

- 4.3 The development is proposed to include residential which is defined as a 'more vulnerable' use according to the NPPF.
- 4.4 Given the proposed land use classification and the location of the Site within Flood Zone 1 (as noted in Chapter 5 below), the Sequential and Exception Tests will not need to be undertaken for the purposes of the proposed development.

5.0 FLOOD RISK ASSESSMENT

Scope of Work

- 5.1 The scope of this FRA was refined to meet the brief outlined in Chapter 1 of this report and considers the following:
- Flood risk to the development from all sources;
 - Potential for the design, construction and operation of the Site to increase the risk of flooding to neighbouring properties;
 - Any necessary mitigation measures to mitigate identified potential flood risks;
 - Climate change;
 - Residual flood risks.
- 5.2 The approach is consistent with the NPPF and associated Technical Guidance and the requirements of local planning policy.

Flood Risk to the Proposed Development

Flood Risk from Fluvial & Tidal Sources

- 5.3 The Site is located within the Environment Agency's Flood Zone 1, as shown in Figure 5.1, which is described within the NPPF Technical Guidance as having a 1 in 1000 or less (<0.1%) probability of flooding from rivers or the sea in any one year.

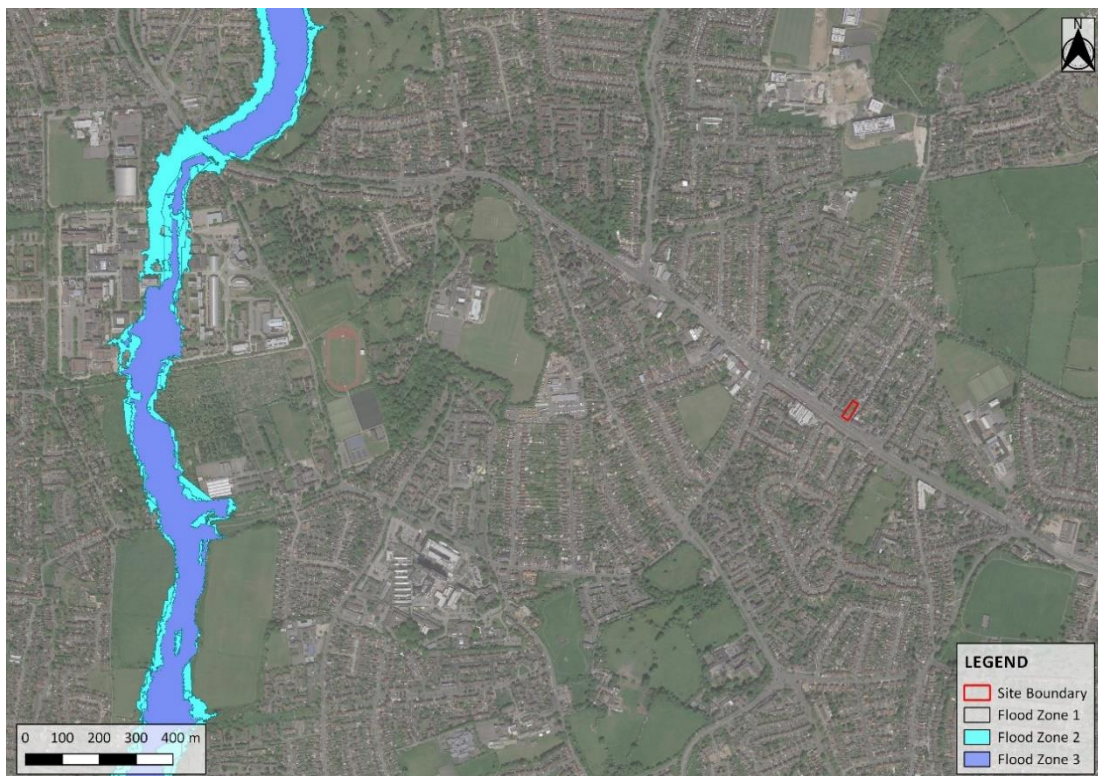


Figure 5.1: Environment Agency Fluvial Flood Map

(Source: Environment Agency WMS Layers)

- 5.4 The Site is therefore considered to be at a low risk of fluvial/tidal flooding, therefore this source is not considered further in this report.

Flood Risk from Groundwater

- 5.5 The rest water level in the BGS borehole to the west of the Site was recorded at 6.7 m below ground level (mbgl) whilst in the BGS borehole to the south east of the Site rest water level was recorded at 4.67 mbgl. Given that the proposals do not include a basement the risk is considered to be low, however, appropriate mitigation measures are discussed in Table 7.2.

Flood Risk from Artificial Water bodies

- 5.6 There are no artificial water bodies within the vicinity of the site. Environment Agency mapping shows that the Site is not at risk of flooding from reservoirs as shown in Figure 5.2 (EA website, accessed November 2019).



Figure 5.2: Environment Agency Reservoir Flood Map

(Source: Environment Agency WMS Layers)

- 5.7 The Site is therefore considered to be at a low risk of flooding from artificial waterbodies, therefore this source is not considered further in this report.

Flood Risk from Public Sewers

- 5.8 A Thames Water Asset Location Search is included in Appendix A. A 225 mm foul water sewer is shown to drain in a south westerly direction along Star Road adjacent to the Site. This

adjoins to a 225 foul water sewer which drains in a south easterly direction along Uxbridge Road.

- 5.9 A 225 mm surface water sewer also drains in a south westerly direction along Star Road and adjoins to a 225 mm surface water sewer which drains in a south easterly direction along Marlborough Parade.
- 5.10 A Thames Water Sewer Flooding History Enquiry (Appendix B) confirms no historic records of any surcharging sewers in the vicinity of the Site.
- 5.11 Sewer flooding from blockage of internal building drainage as well as the Thames Water network is, however, a residual risk managed by the design of the Site drainage and regular inspection and maintenance of the public and private sewer network. The flood risk associated with this source may also increase over time due to the effects of climate change. Appropriate mitigation measures are included in Table 7.1 of this report.

Flood Risk from Surface Water Flooding

Surface Water Flood Mapping

- 5.12 The EA Surface Water Flood Maps (Figure 5.3) show that the Site is at 'very low' risk of surface water flooding from extreme rainfall, which is defined as having a less than 1 in 1000 (0.1%) chance of flooding in any given year.



Figure 5.3: Environment Agency Surface Water Flood Map (Source: Environment Agency WMS Layers)

- 5.13 Star Road adjacent to the east of the Site is at a 'low' to 'medium' risk of flooding. Marlborough Parade and the eastbound carriage way of Uxbridge Road to the south of the Site are shown to be at 'low' to 'high' risk of surface water flooding. In areas at 'low' risk of surface water flooding maximum flood depths reach up to 600 mm in a small number of areas but largely remain below 300 mm along the roads (Figure 5.4).



Figure 5.4: Environment Agency Surface Water Flood Depth Map Low Risk (0.1%) Event

(Source: Environment Agency WMS Layers)

- 5.14 In the areas at medium risk of flooding depths remain largely below 300 mm, reaching up to 600 mm in a small number of areas along Marlborough Parade to the south of the Site (Figure 5.5).



Figure 5.5: Environment Agency Surface Water Flood Depth Map Medium Risk (1.0%) Event

(Source: Environment Agency WMS Layers)

- 5.15 In the areas at 'high' risk of surface water along Marlborough Parade flooding depths remain below 300 mm (Figure 5.6).



Figure 5.6: Environment Agency Surface Water Flood Depth Map High Risk (3.3%) Event

(Source: Environment Agency WMS Layers)

- 5.16 After a review of The West London SFRA it highlights that the Hillingdon London Borough Council's assessment of surface water flood risk is based upon the EA surface water flood maps. No alternative mapping is provided in The West London SFRA and therefore assessment of surface water flood risk has been made on the EA mapping as shown in Figures 5.3 to 5.6.

Critical Drainage Area

- 5.17 The Site is not located within a Critical Drainage Area as defined by the Hillingdon London Borough Council.

Flood Risk

- 5.18 Given the Site itself is at a 'very low' risk of surface water flooding and the depths of flooding shown on the EA's flood maps primarily remain below 300 mm for all events along Star Road and Marlborough Parade, the Site is considered to be at a 'low' risk of surface water flooding. Appropriate flood resilient and resistant design as noted in Table 7.2, is proposed for the residual risk of surface water flooding of the Site.

Flood Risk from Water Mains

- 5.19 An Affinity Water Asset Location Search is included in Appendix A. A 3 inch clean water main is located along Star Road adjacent to the eastern boundary of the Site, which connects to a 6 inch clean water main which runs along Marlborough Parade, adjacent to the southern boundary of the Site. There are several other water mains that run along Uxbridge Road, including a 12 inch main and a 3 inch main.
- 5.20 Flood risk from this source is considered to be a residual risk with the main threat being from internal pipe work during any building works. Flooding from this source poses a residual risk to the proposed development.

Flood History

- 5.21 A review of the SFRA and PFRA confirms no records of historical flooding that has impacted the Site from any source.
- 5.22 A Thames Water Sewer Flooding History confirms there are no records of sewer flooding at the Site.

Flood Risk Summary

- 5.23 In summary, the risk of flooding from all sources is generally considered to be low, however, a number of mitigation measures are recommended to address and manage the residual risk from these forms of flooding in Table 7.2.

6.0 DRAINAGE STRATEGY

- 6.1 The NPPF states that flood risk should not be increased elsewhere by the development, therefore, adequate drainage from the proposed new buildings should be provided. In accordance with best practice, all events up to and including the 30 year event will be kept below ground, whilst making a 30% inclusion for climate change. Further to this the 100 year event (with a 40% inclusion for climate change in line with EA Guidance) should be kept on the site with no flooding of the ground floors of the buildings.
- 6.2 Best practice requires that where feasible site drainage should utilise sustainable drainage techniques (SUDS). In accordance with the SUDS hierarchy, infiltration forms of SUDS (permeable paving, soakaways, swales) should be used where viable, followed by attenuation systems (ponds/belowground storage) with traditional discharge to surface water sewers and then combined sewers being a last resort.
- 6.3 The London Plan Sustainable Design and Construction Supplementary Planning Guidance (Mayor of London, 2014) states that equivalent site greenfield runoff rates should be targeted where possible and where they are not proposed a full justification as to why they cannot be achieved should be provided with runoff rates reduced as low as possible. In such instances a 50% reduction in existing runoff rates should be achieved as an absolute minimum.

Potential for Soakage Systems

- 6.4 The Building Regulations Part H state that no soakage device can be placed within 5.0 m of a building or adoptable road. Given the Site has less than a 5.0 m easement from neighbouring buildings and highways it is not possible to include soakaways in the scheme.

Drainage from the Proposed Development

- 6.5 All new onsite drainage will be separated until the point of connection to the public sewer in order to meet Thames Water requirements. To inform the detailed design of the drainage, a drainage survey will be carried out (with CCTV if necessary) to determine if there are any existing points of connection that can be reused as part of the development and to confirm any necessary diversions to any existing private drainage crossing the Site.

Existing Surface Water Drainage

- 6.6 Existing brownfield flows for the Site (which is currently approximately 59% impermeable) are summarised in Table 6.1 with calculations shown in Appendix D.

Storm Event	Existing Brownfield Flow Rate (l/s)
1 year (15 minute)	6.56
30 year (15 minute)	16.08
100 year (15 minute)	20.74

Table 6.1. Existing Critical Brownfield Flow Rates

- 6.7 Existing greenfield flows for the remainder of the Site are summarised in Table 6.2 with calculations shown in Appendix E.

Storm Event	Existing Greenfield Flow Rate (l/s)
1 year (15 minute)	0.1
30 year (15 minute)	0.1
100 year (15 minute)	0.2

Table 6.2. Existing Greenfield Flow Rates

- 6.8 Given that the Site has previously been occupied by a public house, which has now been demolished, it is assumed there is some form of existing surface water drainage onsite. It is assumed that surface water either discharges directly to the surface water sewer on Star Road, runs off into Star Road/Marlborough Parade, or infiltrates.
- 6.9 The extent and condition of the existing onsite surface water drainage is currently unknown. A CCTV survey will be required at the detailed design stage to confirm if there is any reusable existing surface water drainage.

Proposed Greenfield Run Off Rates

- 6.10 Estimated runoff rates based on the proposed impermeable area (approximately 82% of the Site) are summarised in Table 6.3 with calculations shown in Appendix F.

Rainfall Event	Equivalent Greenfield Runoff Rate (l/s)
Q 1 year	0.1
Q 30 year	0.3
Q 100 year	0.4

Table 6.3: Greenfield Runoff Rates from the Site for Various Rainfall Events.

Proposed Surface Water Drainage Strategy

- 6.11 The following provides a summary of the proposed method of management and disposal of surface water runoff from the Site:

- As part of the design process sustainable drainage methods have been included where practicable, to provide the required attenuation in accordance with the SUDS hierarchy (see Table 6.4).
- There is little potential for infiltration forms of SUDS (i.e. soakaways) to be viable due to space constraints on Site which do not allow for the inclusion of infiltration systems under the Buildings Regulations Part H. On the basis that infiltration systems are not viable the following forms of SUDS are proposed, as shown on Drawing 1780/02/001:
 - 353 m² of combined green/blue roof system will be provided on the roof of the block of flats and as a part of the communal roof garden over the covered parking;
 - 62.0 m² of tanked permeable paving will be provided on the driveways of the two houses to provide appropriate pollution control;
 - Rainwater butts will be included with each of the two houses to provide rainwater harvesting from the roof areas which can be re-used for irrigation of the private gardens;
 - The private garden/front areas will comprise grassed areas with shrubbery and planted areas. These will equate to approximately 177.0 m² and will act as informally drained garden areas.
 - A 10.5 m x 7.0 m attenuation tank with an effective depth of 0.8 m will be included beneath the covered parking area providing approximately 52.8 m³ of storage. Micro Drainage calculations are included in Appendix G. The volume should be considered to be approximate at this stage, calculations undertaken as part of the detailed design will confirm the storage volumes required as the design progresses;
 - A flow control restricting runoff from the attenuation tank to the greenfield equivalent rate of 1.0 l/s for the Site will be included prior to discharge into the Thames Water surface water sewer on Star Road. This will restrict flows to this level for all events up to and including the 1 in 100 year plus 40% climate change event;
- A Thames Water Pre Development Enquiry has confirmed there is sufficient capacity to take the surface water flows from the Site at the proposed discharge rate.
- The 1.0 l/s restricting flow rate is the minimum standard operable flow allowed to avoid blockage making this rate as near to greenfield as can be practically achieved.
- All new onsite drainage will be separated until the point of connection to the public sewer in order to meet Thames Water requirements.

6.12 It is recommended that overflow pipes are included in the scheme to drain excess runoff from the private gardens. Green/blue roof areas will also be positively drained with overflows constructed in line with modern design standards.

6.13 In summary, SuDS measures have been implemented where possible within the bounds of the scheme. Overall there will be a significant reduction in peak runoff rates over the existing

brownfield scenario as it is proposed to restrict the runoff rate to 1.0 l/s through the introduction of an appropriate flow control device (a Hydrobrake or similar).

- 6.14 Micro Drainage calculations included in Appendix D show that the 1 in 100 year plus 40 % climate change event will need to be accommodated below ground in a 52.8 m³ attenuation tank (with an effective depth of 0.8 m and 0.6 m cover above).
- 6.15 A summary of the potential SUDS options which led to the above drainage strategy is included in Table 6.2.

SUDS Option	Suitability/Included in the Scheme?	Comments
Soakaways	X	Not suitable for use given the constraints of the Site.
Porous paving (storage)	✓	62.0 m ² of tanked permeable paving will be included on the driveways of the two houses.
Rainwater Harvesting	✓	Two rainwater butts will be included with each of the two houses.
Swales	X	Not suitable for use given the constraints of the Site.
Attenuation Ponds (above ground storage)	X	Not suitable for use given the constraints of the Site.
Below ground storage in cellular systems	✓	An attenuation tank providing 52.8 m ³ of storage is included within the scheme.
Green Roofs/Brown Roofs/Blue Roofs	✓	Two areas of green/blue roof are included in the scheme, totalling approximately 353 m ² . In addition, several areas of landscaping with planting at the front of the Site and the rear gardens totalling 177 m ² is proposed.

Table 6.2: SUDS Options

Key:

✓ *Suitable for use and included in the scheme*

* *Possibly suitable for use – not included in the client and architect design proposal at present – should be considered further as part of the detailed design*

X *Unlikely to be suitable for use*

Pollution Control Measures

- 6.16 Pollution control requirements are determined by the using the Simple Index Approach as detailed in the CIRIA SuDS Manual.
- 6.17 Suitable pollution hazard indices are allocated for the proposed land uses. The indices range from 0 (no pollution hazard for this contaminant type) to 1 (high pollution hazard for this contaminant type).

- 6.18 From the designated hazard indices a total SuDS mitigation index is calculated for each of suspended solids, metals and hydrocarbons using:

$$\text{Total SuDS mitigation index} = \text{mitigation index}_1 + 0.5(\text{mitigation index}_2)$$

Where:

Mitigation index_n = mitigation index for component n

- 6.19 To deliver adequate treatment the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type).

$$\text{Total SuDS mitigation index} \geq \text{pollution hazard index}$$

- 6.20 In this case the SuDS mitigation indexes are detailed in Table 6.4.

Land Use	Total Suspended Solids	Metals	Hydrocarbons
Residential roofs	0.2	0.2	0.05
Individual Property Driveways	0.5	0.4	0.4
TOTAL MITIGATION INDEX	0.45	0.4	0.25

Table 6.4: Calculated SuDS pollution mitigation indexes for the Site

- 6.21 Excluding planted areas which will drain through themselves, all external areas will be formed of tanked permeable paving whilst all other roof areas will drain through the proposed green/blue roofs. Permeable paving provides mitigation indices that equal or exceed those required for the Site in all cases (Table 6.5) and therefore is considered an appropriate method to deliver adequate pollution mitigation treatment. The green/blue roofs will provide appropriate pollution control for the roof drainage.

SuDS Component	Total Suspended Solids	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7
Green/blue Roofs	No mitigation indices provided by the CIRIA SuDS Manual		

Table 6.5: Indicative SuDS mitigation indices

- 6.22 It should be noted that SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the CIRIA SuDS Manual.

Foul Water

- 6.23 Foul water flows from the Site will be designed to drain to the foul sewer located within Star Road via gravity either via the existing connection or a new connection. Surveys / consultation will be required at the detailed design stage to understand whether there still is an existing connection and whether this can be maintained.
- 6.24 Foul water flows from the Site will increase with peak flows anticipated to be approximately 0.58 l/s, compared to the existing scenario whereby there is currently no foul water connection from the Site.
- 6.25 A Thames Water Pre Development Enquiry has confirmed there is sufficient capacity to take the foul water flows from the Site (Appendix C).

Maintenance

- 6.26 Regular inspection and maintenance of highway drainage, public and private drainage by Hillingdon Borough Council, Thames Water, and site management respectively, will minimise the residual risks associated with surface water/sewers.

Drainage Impact from the Proposed Development

- 6.27 There will be changes to foul water runoff rates from the Site, however, due to the scale of the development and the significant reductions in surface water flows, these changes are unlikely to have a significant impact on the local public sewer network due to the scale of the development.

7.0 MITIGATION MEASURES

7.1 Table 7.2 sets out appropriate mitigation measures to minimise the identified flood risks.

Type of Flooding	Issue	Mitigation Measures	Justification	Residual Risk *
Flooding from surface and foul water – sewer blockage/surcharging and intense rainfall	Blockages or surcharges in the Site drainage or the public sewer network in the Site vicinity may result in flooding of the Site.	• Routine inspection and maintenance of the Site and public drainage systems by the site owner and Thames Water. • Monitor flood risk throughout the life of the development in order to confirm the risk posed to the scheme over time. • A drainage survey should be undertaken to confirm the route and condition of any existing site drainage (if necessary) to inform the need for any upgrades to the network; • The detailed design should confirm if necessary whether any drainage (below ground) that might be serving the Site is appropriately sized and any necessary upgrades to the current drainage is undertaken and agreed with Thames Water and building control as necessary.	These measures will ensure flood risk from these sources is minimised.	Low
Flooding from Water mains (internal water supply system).	Flooding of the water supply and distribution system may result in flooding of the internal building.	• Routine inspection of the Site and public water supply and distribution system by the site owner and Thames Water.	Will ensure the risk of flooding is minimised.	Low
Flooding from Surface Water	EA mapping indicates that flooding from as a result of extreme rainfall and runoff from overland flow is confined to the road adjacent to the Site. EA mapping indicates that surface water could reach up to 300mm. The Site however will remain dry.	• Raise the dropped kerb in front of the Site to reflect the existing level of the pavement. • External areas will be profiled so as any runoff will be directed away from the building and into the roads. • Floor levels/thresholds of the proposed buildings will be raised as high as reasonably practicable. • Inclusion of sustainable drainage to ensure attenuation is provided to ensure the Site or surrounding area does not flood during the 100 year plus 40% climate change event.	Will ensure the consequences of any flooding is minimised	Low

Table 7.2. Mitigation Measures
*Following adoption of the mitigation measures

8.0 RESIDUAL FLOOD RISKS AND IMPACTS TO SURROUNDING AREAS

Residual Risks

- 8.1 A number of residual risks have been identified, associated with public sewers, site drainage and water supply pipes, and intense rainfall.
- 8.2 As long as the public sewer networks, site drainage/water supply infrastructure are regularly inspected by maintained by Thames Water and site management respectively then the residual risk will be minimised.

Impact to Flood Risk of Surrounding Areas

- 8.3 Given the low flood risk present on site and the drainage improvements proposed, it is considered that the development of the Site will not increase the risk of flooding in other areas, surrounding the Site.

9.0 CONCLUSIONS AND RECOMMENDATIONS

- 9.1 Based on our understanding of the Site setting and the development proposals, it is considered that the risk of flooding from all sources is generally low, and the development can be operated safely and without significantly increasing flood risk elsewhere. However a number of residual risks have been identified, associated with public sewers, site drainage and water supply pipes, groundwater and intense rainfall. Appropriate mitigation measures have been provided in Table 7.2 to address and manage the residual risk from these forms of flooding.
- 9.2 Providing the mitigation measures detailed in Table 7.2 are adhered to the flood risk on the Site is considered to be low. Given this and the proposed drainage improvements, it is considered that the development of the Site will not increase the risk of flooding in other areas, surrounding the Site.
- 9.3 As long as the public sewer networks, site drainage/water supply infrastructure are regularly inspected by maintained by Thames Water and site management respectively then the residual risks will be minimised.
- 9.4 We recommend that the assessment of residual risks should be reviewed by site owners as new flood risk information becomes available, and the flood risk associated with adjacent sewers may also increase over time in the area due to climate change.

10.0 REFERENCES

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- ii. British Geological Survey Geoindex. (2016). Available from: www.bgs.ac.uk/geoindex. (Accessed: November 2019).
- i. Environment Agency Flood Maps. (2019). Available from: <https://flood-map-for-planning.service.gov.uk/>. (Accessed November 2019).
- ii. Environment Agency Surface Water Flood Maps and Reservoir Flood Maps. (Available from: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/>). Accessed November 2019.
- iii. DEFRA. (2019). Groundwater Mapping. Available from: [Surface Water and Reservoir Flood Mapping – flood-warning-information.service.gov.uk](https://flood-warning-information.service.gov.uk/surface-water-and-reservoir-flood-mapping). (Accessed November 2019).
- iv. London Borough of Hillingdon (2012). *The Hillingdon Local Plan: Part 1 – Strategic Policies*.
- v. London Borough of Hillingdon (2015). *The Hillingdon Local Plan: Part 2*.
- vi. Mayor of London. (2014). *London Plan Sustainable Design and Construction Supplementary Planning Guidance*. Mayor of London.
- vii. Mayor of London. (2016). *London Sustainable Drainage Action Plan*.
- viii. Metis Consultants (2018). *West London Strategic Flood Risk Assessment (SFRA)*.

APPENDICES

APPENDIX A

Asset location search



Property Searches

Create Consulting Engineers Ltd
NORWICH
NR3 1AF

Search address supplied 1
Uxbridge Road
Byron Parade
Uxbridge
UB10 0LZ

Your reference P19-1780

Our reference ALS/ALS Standard/2019_4024778

Search date 20 June 2019

Keeping you up-to-date

Notification of Price Changes

From 1 September 2018 Thames Water Property Searches will be increasing the price of its Asset Location Search in line with RPI at 3.23%.

For further details on the price increase please visit our website: www.thameswater-propertysearches.co.uk
Please note that any orders received with a higher payment prior to the 1 September 2018 will be non-refundable.



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



0845 070 9148



Search address supplied: 1, Uxbridge Road, Byron Parade, Uxbridge, UB10 0LZ

Dear Sir / Madam

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

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

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

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

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

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

Contact Us

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

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

Email: searches@thameswater.co.uk

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.

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

Affinity Water Ltd
Tamblin Way
Hatfield
AL10 9EZ
Tel: 0845 7823333



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

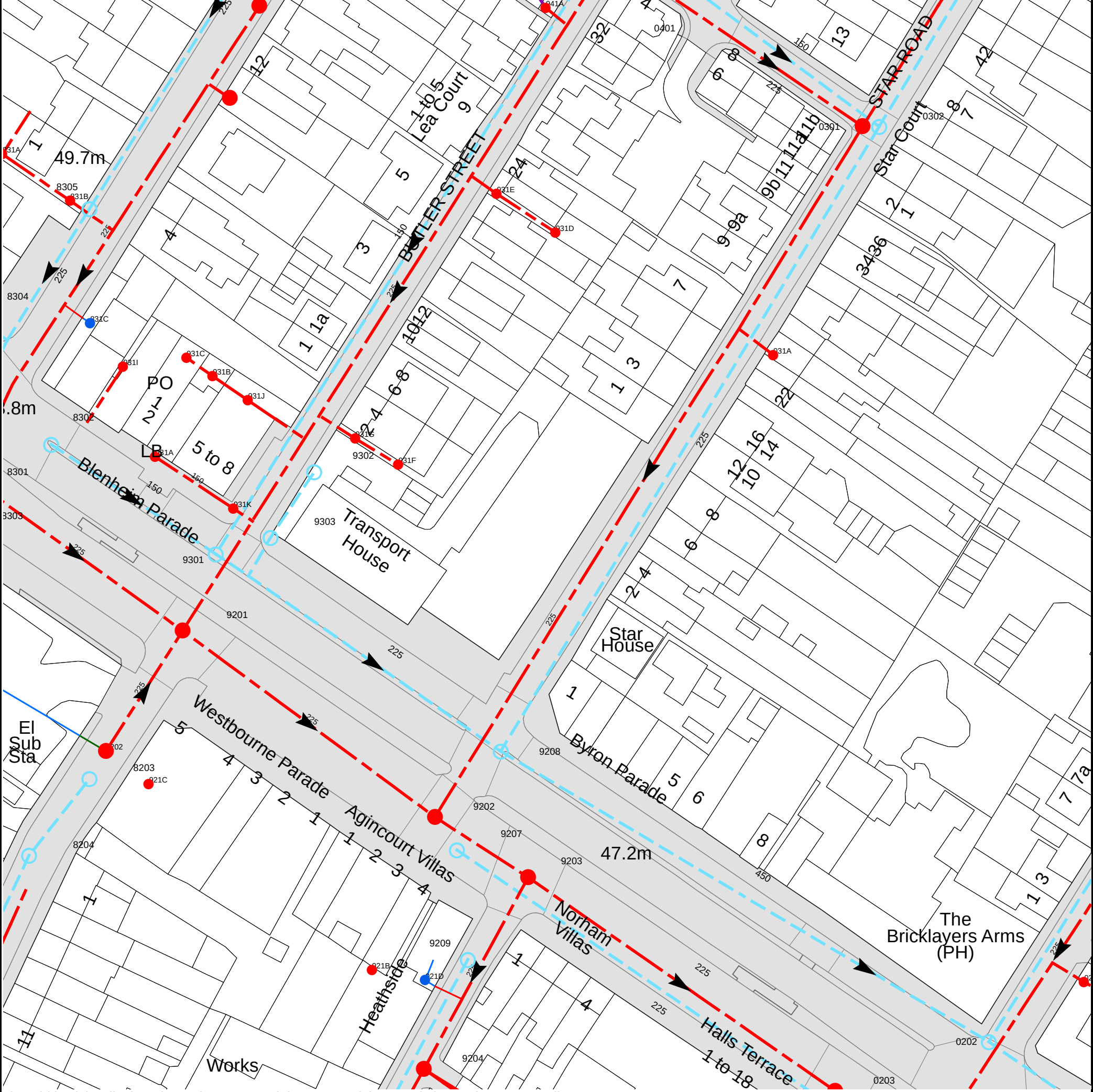
Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

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



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 507977,182314
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
0301	50.33	48.5
0302	50.31	49.23
031A	n/a	n/a
0203	46.95	44.89
0202	46.79	45.1
021D	n/a	n/a
921C	n/a	n/a
931A	n/a	n/a
9201	48.31	46.12
931C	n/a	n/a
931B	n/a	n/a
9301	48.48	47.27
9303	48.66	47.49
9302	48.96	47.74
931G	n/a	n/a
921B	n/a	n/a
931F	n/a	n/a
9204	47.18	45.22
9202	47.86	45.72
9207	47.86	46.57
9209	47.57	46.51
931E	n/a	n/a
9208	47.81	46.45
9203	47.64	45.47
931D	n/a	n/a
9304	n/a	n/a
9401	50.62	48.33
941A	n/a	n/a
831A	n/a	n/a
8204	47.88	46.71
8203	49.06	47.92
8202	48.07	46.7
8302	48.66	47.67
931I	n/a	n/a
831C	n/a	n/a
8305	49.63	48.75
831B	n/a	n/a
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.		



ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

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

Notes:

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

Sewer Fittings

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

	Air Valve
	Dam Chase
	Fitting
	Meter
	Vent Column

Operational Controls

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

	Control Valve
	Drop Pipe
	Ancillary
	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.

	Outfall
	Undefined End
	Inlet

Other Symbols

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

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

Areas

Lines denoting areas of underground surveys, etc.

	Agreement
	Operational Site
	Chamber
	Tunnel
	Conduit Bridge

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

	Foul Sewer
	Surface Water Sewer
	Combined Sewer
	Gully
	Culverted Watercourse
	Proposed
	Abandoned Sewer

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

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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.
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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 0845 070 9148 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

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- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practise and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.

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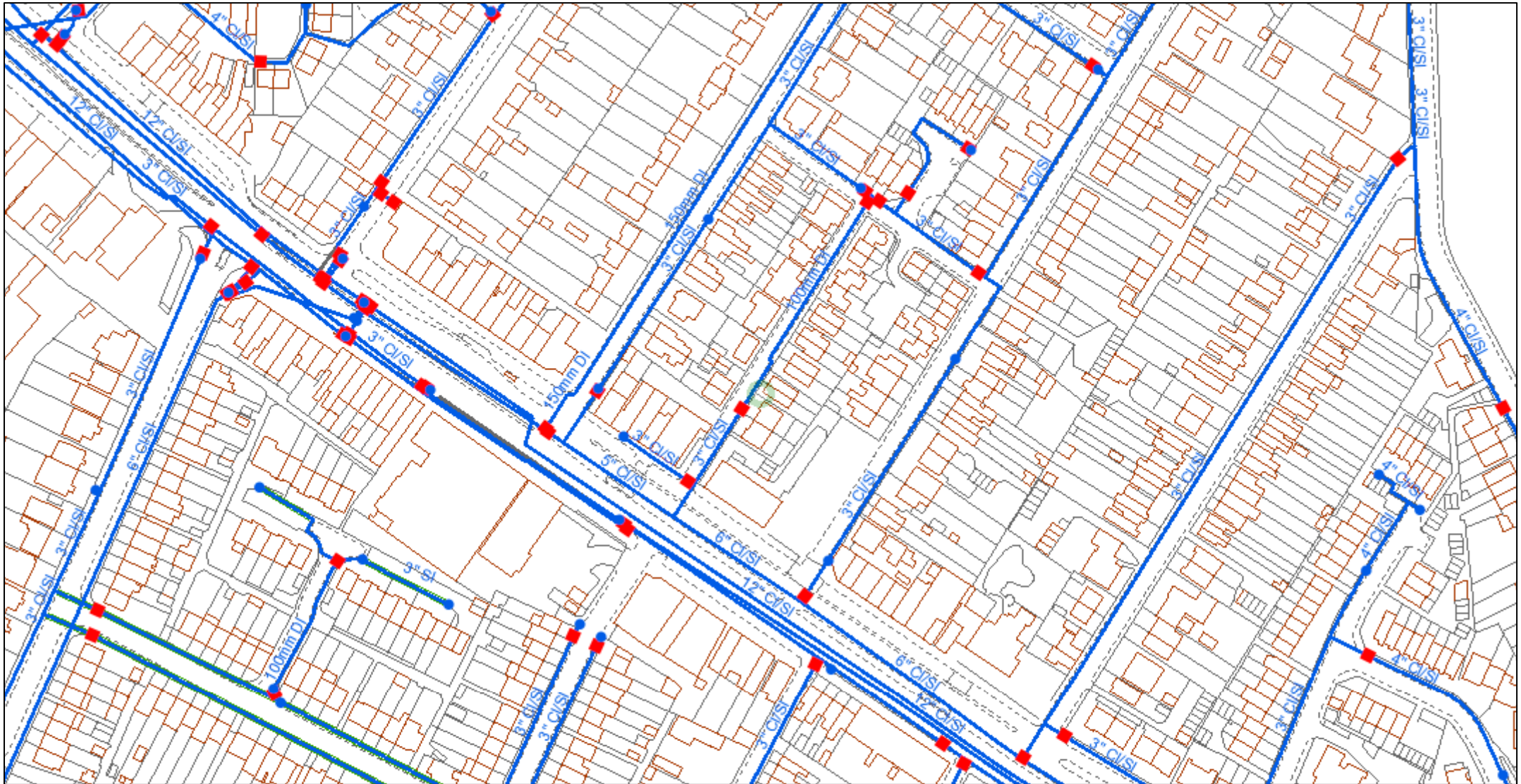
Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs Contact Details

The Property Ombudsman scheme
Milford House
43-55 Milford Street
Salisbury
Wiltshire SP1 2BP
Tel: 01722 333306
Fax: 01722 332296
Web site: www.tpos.co.uk
Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk

PLEASE ASK YOUR SEARCH PROVIDER IF YOU WOULD LIKE A COPY OF THE SEARCH CODE



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1:2,025

	Distribution Main		Hydrant
	Asbestos Distribution Main		Fitting
	Abandoned Main		Easement
	Asbestos Abandoned Main		Company Boundary
	Adit / Tunnel		
	Cable		
	Searched Location		

APPENDIX B

Sewer Flooding

History Enquiry



Property
Searches

Create Consulting Engineers Ltd
Norwich Norwich

Search address supplied The Star Inn
Uxbridge Road
Uxbridge
UB10 0LY

Your reference P19-1780

Our reference SFH/SFH Standard/2019_4026576

Received date **21 June 2019**

Search date **21 June 2019**



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



0845 070 9148

Search address supplied: The Star Inn,Uxbridge Road,Uxbridge,UB10 0LY

This search is recommended to check for any sewer flooding in a specific address or area

TWUL, trading as Property Searches, are responsible in respect of the following:-

- (i) any negligent or incorrect entry in the records searched;
- (ii) any negligent or incorrect interpretation of the records searched;
- (iii) and any negligent or incorrect recording of that interpretation in the search report
- (iv) compensation payments



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0845 070 9148

History of Sewer Flooding

Is the requested address or area at risk of flooding due to overloaded public sewers?

The flooding records held by Thames Water indicate that there have been no incidents of flooding in the requested area as a result of surcharging public sewers.

For your guidance:

- A sewer is “overloaded” when the flow from a storm is unable to pass through it due to a permanent problem (e.g. flat gradient, small diameter). Flooding as a result of temporary problems such as blockages, siltation, collapses and equipment or operational failures are excluded.
- “Internal flooding” from public sewers is defined as flooding, which enters a building or passes below a suspended floor. For reporting purposes, buildings are restricted to those normally occupied and used for residential, public, commercial, business or industrial purposes.
- “At Risk” properties are those that the water company is required to include in the Regulatory Register that is presented annually to the Director General of Water Services. These are defined as properties that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system more frequently than the relevant reference period (either once or twice in ten years) as determined by the Company’s reporting procedure.
- Flooding as a result of storm events proven to be exceptional and beyond the reference period of one in ten years are not included on the At Risk Register.
- Properties may be at risk of flooding but not included on the Register where flooding incidents have not been reported to the Company.
- Public Sewers are defined as those for which the Company holds statutory responsibility under the Water Industry Act 1991.
- It should be noted that flooding can occur from private sewers and drains which are not the responsibility of the Company. This report excludes flooding from private sewers and drains and the Company makes no comment upon this matter.
- For further information please contact Thames Water on Tel: 0800 316 9800 or website www.thameswater.co.uk



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



0845 070 9148

APPENDIX C



Miss Elen Wyatt
Create Consulting Engineers
109-112 Temple Chambers
3-7 Temple Avenue
London
EC4Y 0HP



04th July 2019

Pre-planning enquiry: Confirmation of sufficient capacity

Site Address: The Star Inn, Uxbridge Road, Uxbridge - UB10 0LY

Dear Miss Wyatt,

Thank you for providing information on your development for the proposed 9no. general housing, 7no. flats and 65m² shopping centre on previously Brownfield land.

Proposed foul water discharge via gravity into 225mm foul sewer between MH 9301 and MH 9208. Proposed surface water discharge via gravity into 225mm surface water sewer between MH 9201 and MH 9202. Surface water run-off to be restricted to 1.0litres/second. Total impermeable area – 0.0544ha.

We're pleased to confirm that there will be sufficient foul and surface water capacity in our sewerage network to serve your development. This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

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

What happens next?

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

If you've any further questions, please contact me on 0203 5778 102.

Yours sincerely

Rahim Khan

Thames Water

APPENDIX D

Location : **Star PH**

M5-60 : 20 mm
r : 0.425

Wallingford Method - maps

[\\cre001-net01\company data\Reference\Technical Library\wallingford](#)

For different durations,

From Table 1

Duration, D	Z1			
15 min	0.65	M5-15:	Z1 x M5-60	13.00 mm
30 min	0.82	M5-30:	Z1 x M5-60	16.40 mm
60 min	1	M5-60:	Z1 x M5-60	20.00 mm
6hr	1.51	M5-360:	Z1 x M5-60	30.20 mm

For different return intervals,

From Table 2*

Duration, D	M1	Z2	
		M30	M100
15 min	0.62	1.52	1.96
30 min	0.62	1.53	2.00
60 min	0.64	1.54	2.03
6 hr	0.68	1.51	1.97

Average point intensity, API = I/(D/60)

	D min	Calculation	I mm	API mm/hr
M 1-15	15	M5-15*Z2(M1)	8.06	32.24
M 1-30	30	M5-30*Z2(M1)	10.17	20.34
M 1-60	30	M5-360*Z2(M1)	12.80	25.60
M1-360	360	M5-360*Z2(M1)	20.54	3.42
M 30-15	15	M5-15*Z2(M30)	19.76	79.04
M 30-30	30	M5-30*Z2(M30)	25.09	50.18
M 30-60	60	M5-60*Z2(M30)	30.80	30.80
M30-360	360	M5-360*Z2(M30)	45.60	7.60
M 100-15	15	M5-15*Z2(M100)	25.48	101.92
M 100-30	30	M5-30*Z2(M100)	32.80	65.60
M100-60	60	M5-60*Z2(M100)	40.60	40.60
M100-360	360	M5-360*Z2(M100)	59.49	9.92

Peak Runoff

Q=2.78CiA Rational Method, SUDS Manual Section 4.3.3

where:

(1) C = Cv Cr

Cv = 1 **

Cr = 1.3 constant value for design purposes

therefore , C = 1.3

(2) i = API, defined above

Q=2.78CiA

(3) A = areas measured for subcatchments

		Contributing Impermeable Area Ha	
	i mm/hr	Site	Per hectare
		0.0563	1
M 1-15	32.24	6.56	116.52
M 1-30	20.34	4.14	73.49
M 1-60	25.60	5.21	73.49
M1-360	3.42	0.70	12.37
M 30-15	79.04	16.08	285.65
M 30-30	50.18	10.21	181.36

Table 1

Rainfall Duration D											
Minutes r	5	10	15	30	Hours 1	2	4	6	10	24	
0.12	0.22	0.34	0.45	0.67	1.00	1.48	2.17	2.75	3.70	6.00	
0.15	0.25	0.38	0.48	0.69	1.00	1.42	2.02	2.46	3.32	4.90	
0.18	0.27	0.41	0.51	0.71	1.00	1.36	1.86	2.25	2.86	4.30	
0.21	0.29	0.43	0.54	0.73	1.00	1.33	1.77	2.12	2.62	3.60	
0.24	0.31	0.46	0.56	0.75	1.00	1.30	1.71	2.00	2.40	3.35	
0.27	0.33	0.48	0.58	0.76	1.00	1.27	1.64	1.88	2.24	3.10	
0.30	0.34	0.49	0.59	0.77	1.00	1.25	1.57	1.78	2.12	2.84	
0.33	0.35	0.50	0.61	0.78	1.00	1.23	1.53	1.73	2.04	2.60	
0.36	0.36	0.51	0.62	0.79	1.00	1.22	1.48	1.67	1.90	2.42	
0.39	0.37	0.52	0.63	0.80	1.00	1.21	1.46	1.62	1.82	2.28	
0.42	0.38	0.53	0.64	0.81	1.00	1.20	1.42	1.57	1.74	2.16	
0.45	0.39	0.54	0.65	0.82	1.00	1.19	1.38	1.51	1.68	2.03	

Table 2 - England and Wales

Growth Factor Z2											
M5 rainfall	M1	M2	M3	M4	M5	M10	M20	M50	M100	M30 interpolated	
5.00	0.62	0.79	0.89	0.97	1.02	1.19	1.36	1.56	1.79	1.25	
10.00	0.61	0.79	0.90	0.97	1.03	1.22	1.41	1.65	1.91	1.49	
15.00	0.62	0.80	0.90	0.97	1.03	1.24	1.44	1.70	1.99	1.53	
20.00	0.64	0.81	0.90	0.97	1.03	1.24	1.45	1.73	2.03	1.54	
25.00	0.66	0.82	0.91	0.97	1.03	1.24	1.44	1.72	2.01	1.53	
30.00	0.68	0.83	0.91	0.97	1.03	1.22	1.42	1.70	1.97	1.51	
40.00	0.70	0.84	0.92	0.97	1.02	1.19	1.38	1.64	1.89	1.47	
50.00	0.72	0.85	0.93	0.98	1.02	1.17	1.34	1.58	1.81	1.42	
75.00	0.76	0.87	0.93	0.98	1.02	1.14	1.28	1.47	1.64	1.34	
100.00	0.78	0.88	0.94	0.98	1.02	1.13	1.25	1.40	1.54	1.30	
150.00	0.78	0.88	0.94	0.98	1.01	1.12	1.21	1.33	1.45	1.25	
200.00	0.78	0.88	0.94	0.98	1.01	1.11	1.19	1.30	1.40	1.23	

* The rainfall depths from cells E8-E11 are compared with the depths given in cells J29-J40 and Z2 interpolated accordingly for each return period

** Cv varies between 0.6 (rapidly draining soils) and 0.9 (heavy clay) with an average of 0.75 taken if ground conditions not known.
2.78*C= 3.614

		Contributing Impermeable Area Ha	
	i mm/hr	Site	Per hectare
		2.28	1
M 30-60	30.80	6.27	181.36
M30-360	7.60	1.55	27.47
M 100-15	101.92	20.74	368.34
M 100-30	65.60	13.35	237.08
M 100-60	40.60	8.26	237.08
M100-360	9.92	2.02	35.84

APPENDIX E

IoH 124 Calculation of Greenfield Runoff Rate

Date: 26/07/2019

By: EW

Star PH - Existing

OS Location 507972 182304

SAAR 625 mm See Wallingford Map
Site area = 50 ha Always assume 50ha and prorata for specific site
0.5 km²
Soil WRA Class 2 See Wallingford Map
Soil Type SPR Value 0.3 Conversion to SPR

$$Q_{\text{bar}_{\text{rural}}} = 0.00108 \times (\text{AREA})^{0.89} \times (\text{SAAR})^{1.17} \times (\text{SOIL})^{2.17}$$

$$Q_{\text{bar-50ha}} = 0.080 \text{ m}^3/\text{s}$$

From Regional Growth Curve Factor

Region: 6

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.88	1.28	1.62	2.14	2.24	2.62	3.19	4.49

Q ₁ 50ha =	0.068 m ³ /s	=	67.84 l/s	=	1.357 l/s/ha
Q ₂ 50ha =	0.070 m ³ /s	=	70.23 l/s	=	1.405 l/s/ha
Q ₅ 50ha =	0.102 m ³ /s	=	102.15 l/s	=	2.043 l/s/ha
Q ₁₀ 50ha =	0.129 m ³ /s	=	129.29 l/s	=	2.586 l/s/ha
Q ₂₅ 50ha =	0.171 m ³ /s	=	170.79 l/s	=	3.416 l/s/ha
Q ₃₀ 50ha =	0.179 m ³ /s	=	178.77 l/s	=	3.575 l/s/ha
Q ₅₀ 50ha =	0.209 m ³ /s	=	209.09 l/s	=	4.182 l/s/ha
Q ₁₀₀ 50ha =	0.255 m ³ /s	=	254.58 l/s	=	5.092 l/s/ha
Q ₅₀₀ 50ha =	0.358 m ³ /s	=	358.33 l/s	=	7.167 l/s/ha

Factored for Development Impermeable Area

Site area = 0.0394 ha

Q _{bar} site =	0.000 m ³ /s	=	0.1 l/s	=	1.6 l/s/ha
Q ₁ site =	0.000 m ³ /s	=	0.1 l/s	=	1.4 l/s/ha
Q ₂ site =	0.000 m ³ /s	=	0.1 l/s	=	1.4 l/s/ha
Q ₅ site =	0.000 m ³ /s	=	0.1 l/s	=	2.0 l/s/ha
Q ₁₀ site =	0.000 m ³ /s	=	0.1 l/s	=	2.6 l/s/ha
Q ₂₅ site =	0.000 m ³ /s	=	0.1 l/s	=	3.4 l/s/ha
Q ₃₀ site =	0.000 m ³ /s	=	0.1 l/s	=	3.6 l/s/ha
Q ₅₀ site =	0.000 m ³ /s	=	0.2 l/s	=	4.2 l/s/ha
Q ₁₀₀ site =	0.000 m ³ /s	=	0.2 l/s	=	5.1 l/s/ha
Q ₅₀₀ site =	0.000 m ³ /s	=	0.3 l/s	=	7.2 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

APPENDIX F

IoH 124 Calculation of Greenfield Runoff Rate

Date: 20/11/2019

By: EW

Star PH - Proposed

OS Location 507972 182304

SAAR 625 mm See Wallingford Map
Site area = 50 ha Always assume 50ha and prorata for specific site
0.5 km²
Soil WRA Class 2 See Wallingford Map
Soil Type SPR Value 0.3 Conversion to SPR

$$Q_{\text{bar}_{\text{rural}}} = 0.00108 \times (\text{AREA})^{0.89} \times (\text{SAAR})^{1.17} \times (\text{SOIL})^{2.17}$$

$$Q_{\text{bar-50ha}} = 0.080 \text{ m}^3/\text{s}$$

From Regional Growth Curve Factor

Region: 6

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.88	1.28	1.62	2.14	2.24	2.62	3.19	4.49

Q ₁ 50ha =	0.068 m ³ /s	=	67.84 l/s	=	1.357 l/s/ha
Q ₂ 50ha =	0.070 m ³ /s	=	70.23 l/s	=	1.405 l/s/ha
Q ₅ 50ha =	0.102 m ³ /s	=	102.15 l/s	=	2.043 l/s/ha
Q ₁₀ 50ha =	0.129 m ³ /s	=	129.29 l/s	=	2.586 l/s/ha
Q ₂₅ 50ha =	0.171 m ³ /s	=	170.79 l/s	=	3.416 l/s/ha
Q ₃₀ 50ha =	0.179 m ³ /s	=	178.77 l/s	=	3.575 l/s/ha
Q ₅₀ 50ha =	0.209 m ³ /s	=	209.09 l/s	=	4.182 l/s/ha
Q ₁₀₀ 50ha =	0.255 m ³ /s	=	254.58 l/s	=	5.092 l/s/ha
Q ₅₀₀ 50ha =	0.358 m ³ /s	=	358.33 l/s	=	7.167 l/s/ha

Factored for Development Impermeable Area

Site area = 0.079 ha

Q _{bar} site =	0.000 m ³ /s	=	0.1 l/s	=	1.6 l/s/ha
Q ₁ site =	0.000 m ³ /s	=	0.1 l/s	=	1.4 l/s/ha
Q ₂ site =	0.000 m ³ /s	=	0.1 l/s	=	1.4 l/s/ha
Q ₅ site =	0.000 m ³ /s	=	0.2 l/s	=	2.0 l/s/ha
Q ₁₀ site =	0.000 m ³ /s	=	0.2 l/s	=	2.6 l/s/ha
Q ₂₅ site =	0.000 m ³ /s	=	0.3 l/s	=	3.4 l/s/ha
Q ₃₀ site =	0.000 m ³ /s	=	0.3 l/s	=	3.6 l/s/ha
Q ₅₀ site =	0.000 m ³ /s	=	0.3 l/s	=	4.2 l/s/ha
Q ₁₀₀ site =	0.000 m ³ /s	=	0.4 l/s	=	5.1 l/s/ha
Q ₅₀₀ site =	0.001 m ³ /s	=	0.6 l/s	=	7.2 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

APPENDIX G

Create Consulting				Page 1	
15 Princes Street Norwich NR3 1AF		Star PH 1 in 100 year + 40% CC			
Date 20/11/2019 File STAR_PH_MD_CALCS_SCHEME...		Designed by JJ Checked by GS			
Innovyze		Source Control 2018.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	48.836	0.236	0.9	17.3	O K
30 min Summer	48.928	0.328	0.9	24.1	O K
60 min Summer	49.024	0.424	0.9	31.1	O K
120 min Summer	49.139	0.539	0.9	39.6	O K
180 min Summer	49.194	0.594	0.9	43.7	O K
240 min Summer	49.219	0.619	0.9	45.5	O K
360 min Summer	49.224	0.624	0.9	45.9	O K
480 min Summer	49.208	0.608	0.9	44.7	O K
600 min Summer	49.188	0.588	0.9	43.2	O K
720 min Summer	49.167	0.567	0.9	41.7	O K
960 min Summer	49.125	0.525	0.9	38.6	O K
1440 min Summer	49.046	0.446	0.9	32.8	O K
2160 min Summer	48.934	0.334	0.9	24.5	O K
2880 min Summer	48.852	0.252	0.9	18.5	O K
4320 min Summer	48.749	0.149	0.9	11.0	O K
5760 min Summer	48.699	0.099	0.8	7.2	O K
7200 min Summer	48.600	0.000	0.0	0.0	O K
8640 min Summer	48.600	0.000	0.0	0.0	O K
10080 min Summer	48.600	0.000	0.0	0.0	O K
15 min Winter	48.871	0.271	0.9	19.9	O K
30 min Winter	48.975	0.375	0.9	27.6	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	151.424	0.0	20.5	52	
30 min Summer	100.044	0.0	27.7	66	
60 min Summer	62.734	0.0	35.3	90	
120 min Summer	39.802	0.0	45.3	134	
180 min Summer	29.923	0.0	51.3	188	
240 min Summer	24.178	0.0	55.4	246	
360 min Summer	17.591	0.0	60.5	362	
480 min Summer	13.886	0.0	63.8	430	
600 min Summer	11.502	0.0	66.0	490	
720 min Summer	9.836	0.0	67.7	554	
960 min Summer	7.648	0.0	70.1	684	
1440 min Summer	5.357	0.0	73.4	962	
2160 min Summer	3.736	0.0	76.5	1324	
2880 min Summer	2.894	0.0	78.6	1684	
4320 min Summer	2.026	0.0	81.6	2376	
5760 min Summer	1.582	0.0	84.3	3048	
7200 min Summer	-0.012	0.0	-0.5	0	
8640 min Summer	-0.010	0.0	-0.5	0	
10080 min Summer	-0.008	0.0	-0.5	0	
15 min Winter	151.424	0.0	23.1	54	
30 min Winter	100.044	0.0	31.2	69	
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Create Consulting				Page 2	
15 Princes Street Norwich NR3 1AF		Star PH 1 in 100 year + 40% CC			
Date 20/11/2019 File STAR_PH_MD_CALCS_SCHEME...		Designed by JJ Checked by GS			
Innovyze		Source Control 2018.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	49.083	0.483	0.9	35.5	O K
120 min Winter	49.211	0.611	0.9	44.9	O K
180 min Winter	49.275	0.675	0.9	49.6	O K
240 min Winter	49.306	0.706	0.9	51.9	O K
360 min Winter	49.319	0.719	1.0	52.8	O K
480 min Winter	49.303	0.703	0.9	51.7	O K
600 min Winter	49.277	0.677	0.9	49.7	O K
720 min Winter	49.251	0.651	0.9	47.9	O K
960 min Winter	49.198	0.598	0.9	44.0	O K
1440 min Winter	49.094	0.494	0.9	36.3	O K
2160 min Winter	48.930	0.330	0.9	24.2	O K
2880 min Winter	48.815	0.215	0.9	15.8	O K
4320 min Winter	48.700	0.100	0.8	7.3	O K
5760 min Winter	48.666	0.066	0.7	4.8	O K
7200 min Winter	48.600	0.000	0.0	0.0	O K
8640 min Winter	48.600	0.000	0.0	0.0	O K
10080 min Winter	48.600	0.000	0.0	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	62.734	0.0	39.8	92	
120 min Winter	39.802	0.0	51.0	136	
180 min Winter	29.923	0.0	57.7	186	
240 min Winter	24.178	0.0	62.3	242	
360 min Winter	17.591	0.0	68.1	354	
480 min Winter	13.886	0.0	71.7	460	
600 min Winter	11.502	0.0	74.2	550	
720 min Winter	9.836	0.0	76.1	582	
960 min Winter	7.647	0.0	78.8	732	
1440 min Winter	5.357	0.0	82.6	1040	
2160 min Winter	3.736	0.0	86.2	1424	
2880 min Winter	2.894	0.0	88.6	1764	
4320 min Winter	2.026	0.0	92.1	2384	
5760 min Winter	1.582	0.0	95.2	3000	
7200 min Winter	-0.012	0.0	-0.5	0	
8640 min Winter	-0.010	0.0	-0.5	0	
10080 min Winter	-0.008	0.0	-0.5	0	
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Create Consulting		Page 4
15 Princes Street Norwich NR3 1AF	Star PH 1 in 100 year + 40% CC	
Date 20/11/2019 File STAR_PH_MD_CALCS_SCHEME...	Designed by JJ Checked by GS	
Innovyze Source Control 2018.1		

Model Details

Storage is Online Cover Level (m) 50.000

Tank or Pond Structure

Invert Level (m) 48.600

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	73.5	0.800	73.5	0.801	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0049-1000-0800-1000
Design Head (m)	0.800
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	49
Invert Level (m)	48.600
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	1.0
Flush-Flo™	0.215	0.9
Kick-Flo®	0.437	0.8
Mean Flow over Head Range	-	0.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	1.200	1.2	3.000	1.8	7.000	2.7
0.200	0.9	1.400	1.3	3.500	1.9	7.500	2.8
0.300	0.9	1.600	1.4	4.000	2.1	8.000	2.9
0.400	0.8	1.800	1.4	4.500	2.2	8.500	2.9
0.500	0.8	2.000	1.5	5.000	2.3	9.000	3.0
0.600	0.9	2.200	1.6	5.500	2.4	9.500	3.1
0.800	1.0	2.400	1.6	6.000	2.5		
1.000	1.1	2.600	1.7	6.500	2.6		

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