Hall Place Farm

FLOOD RISK ASSESSMENT

FRA001
DECEMBER 2018

ISSUE

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TYPE OF DOCUMENT (VERSION): ISSUE

PROJECT NO. 70048292

OUR REF. NO. FRA001

DATE: DECEMBER 2018

Hall Place **Farm**

FLOOD RISK ASSESSMENT

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QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Draft for Comment	Updated Based on Client Comments	ISSUE	
Date	November 2018	December 2018	December 2018	
Prepared by	Phoebe Secker	Phoebe Secker	Phoebe Secker	
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Authorised by	Chris Slater	David Schofield	David Schofield	
Signature				
Project number	70048292	70048292	70048292	
Report number	FRA001	FRA001	FRA001	
File reference	70048292 FRA001 Rv0	70048292 FRA001 Rv1	70048292 FRA001 Rv2	

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EXECUTIVE SUMMARY

This Flood Risk Assessment (FRA) has been undertaken to support the outline application for the proposed development at Hall Place Farm in accordance with the guidelines set out in the National Planning Policy Framework (NPPF) published in July 2018 along with other relevant local and national guidance including CIRIA C624 Development and Flood Risk.

Item	Overview
Site Location	The site is located east of Tilehurst, northwest of the junction of Littleheath Road and Sulham Hill NGR: 465660,173843
Development Proposals	It is proposed to develop the site to a mixed residential and commercial development.
Environment Agency Flood Zone(s)	The site lies wholly within Flood Zone 1, outside the maximum extent of flooding from any nearby watercourses.
Vulnerability Classification(s)	Less Vulnerable – commercial uses More Vulnerable – residential properties
Fluvial Flood Risk	Very low risk
Tidal Flood Risk	Very low risk
Surface Water Flood Risk	Very low risk
Groundwater Flood Risk	Low risk
Sewer Flood Risk	Low risk
Artificial Flood Risk	Low risk
Storm Drainage	It is proposed to utilise a Sustainable Drainage Scheme (SuDS) to manage surface water run-off from the proposed development site in line with current best practice recommendations. Through utilisation of above ground attenuation, it is proposed to reduce run-off to a peak maximum discharge of 4.4l/s/ha from the site for all events up to, and including, the 100 years plus climate change event as agreed with the Lead Local Flood Authority.
Foul Drainage	Foul drainage will discharge to the existing Thames Water network south-east of the proposed development site.

1. INTRODUCTION

1.1. BACKGROUND

1.1.1. WSP has been appointed by The Sulham Estate to prepare a Flood Risk Assessment (FRA) and Drainage Strategy to support the planning application at the Hall Place Farm, (Post Code: RG51 5UB).

1.1.2. The objective of the study is to demonstrate that the site may be developed safely, without exposing the development to an unacceptable degree of flood risk or increasing the flood risk to third parties. The objectives are to:

- Confirm the sources of flooding which may affect the site;
- Provide a drainage strategy for the proposed development
- Provide an appraisal of the availability and adequacy of existing information; and
- Undertake an appraisal of the flood risk posed to the site and potential impact of the development on flood risk elsewhere.

1.2. LIMITATIONS

1.2.1. WSP has prepared this report in accordance with the instructions of their client, The Sulham Estate, for their sole and specific use. Any person who uses any information contained herein do so at their own risk.

1.2.2. The conclusions and recommendations contained herein are limited by the availability of background information and the planned use for the site.

1.2.3. Third party information has been used in the preparation of this report, which WSP UK Ltd, by necessity assumes is correct at the time of writing. Whilst all reasonable checks have been made on data sources and the accuracy of the data, WSP UK Ltd accepts no liability for same.

1.3. CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2015

1.3.1. The revised Construction (Design and Management) Regulations 2015 (CDM Regulations) came into force on April 2015 to update certain duties on all parties involved in a construction project, including those promoting the development. One of the designer's responsibilities under clause 9 (1) is to ensure that the client organisation, in this instance The Sulham Estate, is made aware of their duties under the CDM Regulations.

1.4. SCOPE OF ASSESSMENT

1.4.1. The assessment has been undertaken in accordance with the overarching national requirements for Flood Risk Assessments for proposed developments including, but not limited to, the following:

- National Planning Policy Framework (NPPF)
- Development and Flood Risk (CIRIA C624)
- The SuDS Manual (CIRIA C753)
- Flood Risk Assessments: Climate Change Allowances 2017
- DEFRA R&D Technical Report W5-074/A/TR/1 Revision D
- Rainfall Runoff Management for Developments Report – SC030219

1.4.2. The flood risk assessment is solely to be used to support the outline planning application for the mixed-use development at Hall Place Farm.

1.5. CONSULTATION

1.5.1. Ahead of production of this report, initial pre-application consultation requests were issued to the relevant stakeholders with the following responses received

Table 1 - Stakeholder Consultation Summary

Stakeholder	Date Received	Comments
West Berkshire Lead Local Flood Authority (LLFA)	04/07/2018	The LLFA hold no records of surface water or groundwater flooding in the area.
Environment Agency (EA)	06/08/2018	The Environment Agency confirmed the site is located wholly within Flood Zone 1 and confirmed there are no records of flooding within 500m of the site.
Thames Water	05/07/2018	Thames Water hold no incidents of flooding in the requested area as a result of surcharging public sewers.

1.5.2. The full consultation responses are contained in Appendix C and have been thereafter used, where relevant within the report.

2. SITE SETTING

2.1. LOCATION

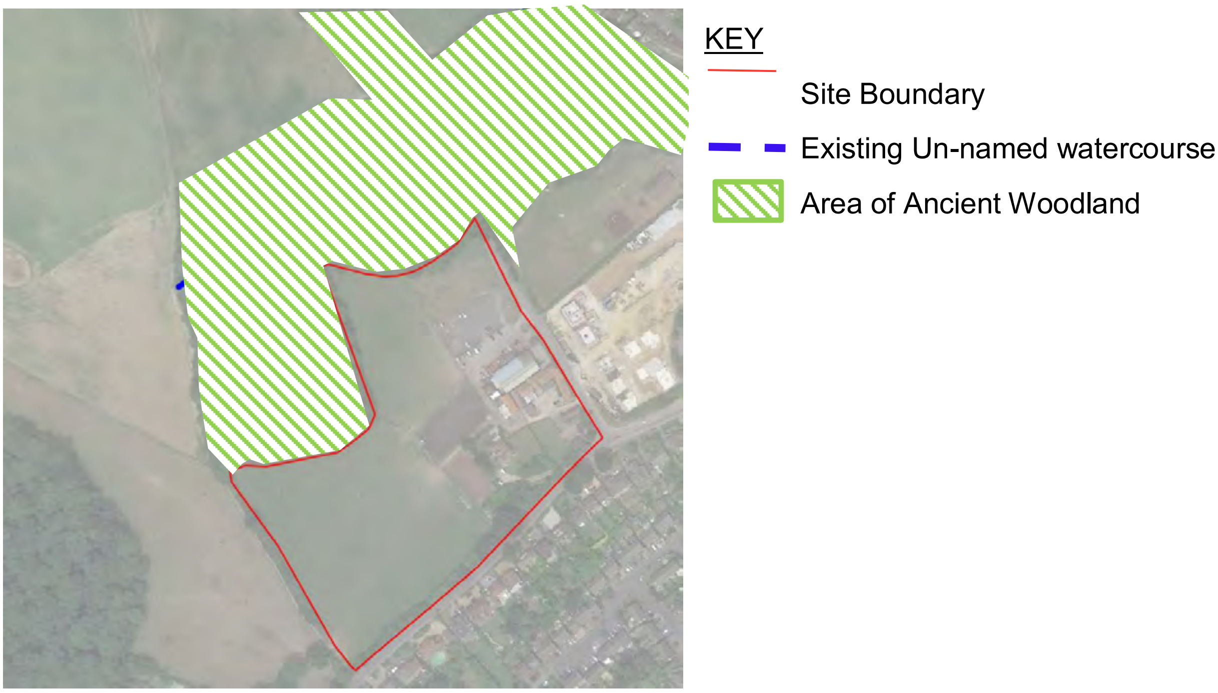
2.1.1. The site is bound by Little Heath Road to the south-west beyond which is a residential estate and by Sulham Hill to the north-east beyond which is a site with detailed planning consent (17/01807/RESMAJ), there is a large area of ancient woodland to the north of the site and in addition to this the west of the site is bound by an open field.

2.1.2. It should also be noted that there is an area of ancient woodland, north of the proposed development site, which is also owned by The Sulham Estate.

2.1.3. There is a small ditch (unnamed watercourse) which runs through the ancient woodland approximately 50m north of the site, which is assumed to eventually discharge into the River Thames which runs approximately 2km north-east of the proposed development site.

2.1.4. The site location plan is shown in Figure 1 below and is also included in Appendix A.

Figure 1 – Site Location



2.2. DEVELOPMENT PROPOSALS

2.2.1. It is proposed to develop the site with up to 80 residential dwellings and associated ancillary infrastructure that is complimentary and commensurate with the setting and environment. In addition to this, the existing Grade II listed building (Hall Place Farm House) in the south-east of the site will remain with proposed commercial development identified in the south-east of the site.

2.2.2. The development is proposed over a gross area of circa 4.6ha. A site masterplan is available in Appendix A.

2.3. TOPOGRAPHY

2.3.1. The site topographic survey produced by Glanville (03/07/2018) identifies that the site falls from a high point of 103.3mAOD in the south-west of the site to approximately 92.4mAOD in the north-east of the site.

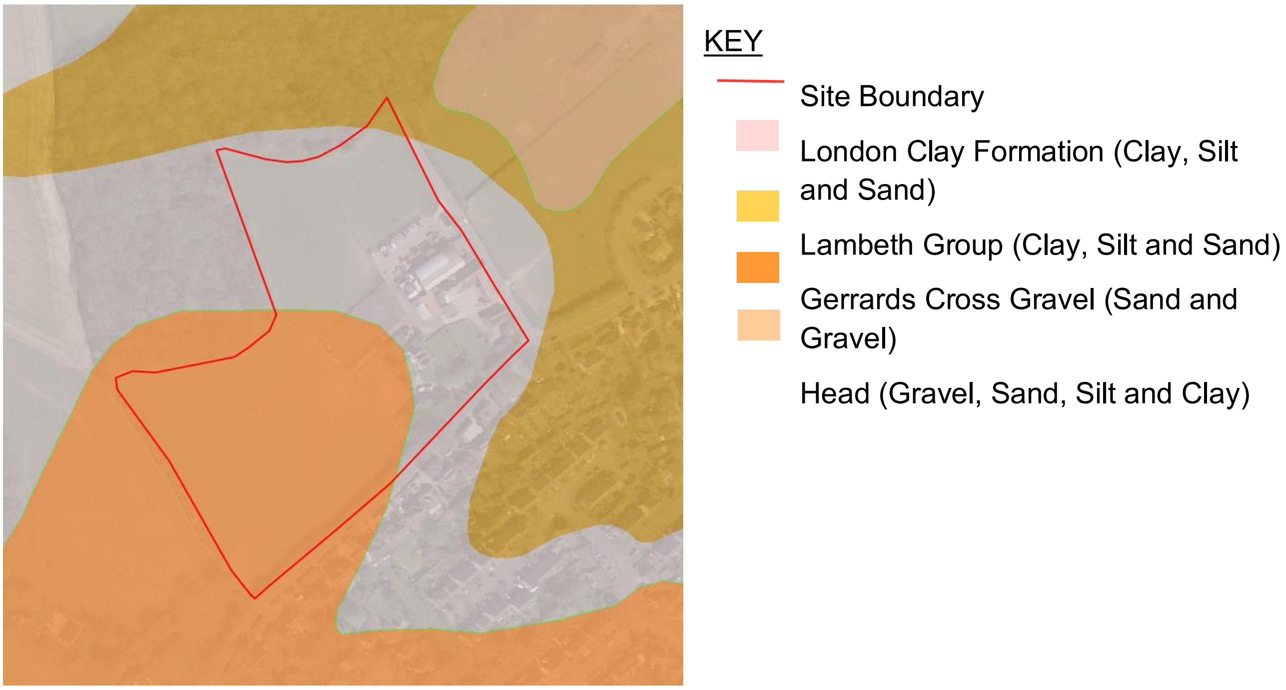
2.3.2. North of the site, the land continues to slope down within the area of ancient woodland to the unnamed watercourse located approximately 50m north of the site at its closest point.

2.4. GEOLOGICAL AND HYDROGEOLOGICAL CONTEXT

Geology

2.4.1. Reference to the BGS published mapping identifies the majority of the site to be underlain by bedrock of London Clay Formation (Clay, Silt and Sand), with a small area of the north-east of the site underlain by a bedrock of Lambeth Group (Clay, Silt and Sand). The south-west of the site is also underlain by superficial deposits of Gerrards Cross Gravel (Sand and Gravel). An extract of the BGS map is available in Figure 2.

Figure 2 – BGS Map Extract



2.4.2. BGS records identify a 50m deep borehole located south of the site, immediately south of the junction of Kiln Lane and Little Heath Road, which identifies the ground profile within Table 2.

Table 2 - BGS Borehole Summary

Description	Approximate Depth [mBGL]
Brown & Grey Clay	0 – 7
Grey Silty Clay	7 – 17
Brown Clayey Sand	17 – 25
Grey Sand	25 – 27
Multi Coloured Clay	27 – 37.5
Brown Sand & Pebbles	37.5 – 39
Chalk	39 - 50

2.4.3. Whilst the BGS borehole identifies chalk, this is only at depths of below 39mBGL, the majority of the depth is clay and therefore is likely to be impermeable.

Hydrogeology

2.4.4. According to the Source Protection Zone map provided by the Environment Agency, the site is underlain by 'Zone III - Total Catchment.' That is: "*the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. There is still the need to define individual source protection areas to assist operators in catchment management*"

2.4.5. The online BGS Aquifer Map (Bedrock Designation) indicates that the site is underlined by a 'Principal aquifer'. That is: *"layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer."*

2.4.6. The online BGS Aquifer Map (Superficial Drift Designation) indicates that the site comprises stratum that is considered a 'Secondary A' aquifer. That is: *"permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers."*

3. POLICY CONTEXT

3.1. NATIONAL PLANNING POLICY FRAMEWORK 2018

3.1.1. The updated National Planning Policy Framework (NPPF) was published in July 2018 and sets out the Government's national policies for flood risk management in a land use planning context within England.

3.1.2. Paragraph 155 of the NPPF states "*Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere*"

3.1.3. The guidance further states that local planning authorities should "*ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment.*"

3.1.4. Allocation and planning of development must therefore be considered against a risk based search sequence as provided by the guidance.

3.2. LOCAL PLANNING POLICY

West Berkshire Core Strategy (July 2012)

3.2.1. Policy CS 16 of the adopted West Berkshire Core Strategy relates to flood risk and states, development will only be permitted if:

- "*Through the sequential test and exception test (where required), it is demonstrated that the benefits of the development to the community outweigh the risk of flooding.*
- *It would not have an impact on the capacity of an area to store floodwater.*
- *It would not have a detrimental impact on the flow of fluvial flood water, surface water or obstruct the run-off of water due to high levels of groundwater.*
- *Appropriate measures required to manage any flood risk can be implemented.*
- *Provision is made for the long-term maintenance and management of any flood protection and or mitigation measures.*
- *Safe access and exit from the site can be provided for routine and emergency access under both frequent and extreme flood conditions.*"

3.2.2. As such, this report will demonstrate that the development proposals will not have a detrimental impact on flood risk and that the long-term management of on site features has been considered for the lifetime of the development.

West Berkshire Strategic Flood Risk Assessment (SFRA) Level 1 (May 2008)

3.2.3. West Berkshire's Level 1 SFRA states that developers should consider the following approaches to help mitigate flood risk:

- *"The integration of SUDS to reduce the runoff rate from the site;*
- *Where redeveloping an existing site, a change in land use to reduce the vulnerability of the proposed development;*
- *A reduction in the building platform area;*

- *The raising of internal floor levels and flood proofing (within existing buildings) to reduce potential flood damage;*
- *The rearrangement of buildings within the site to remove obstructions to overland flow paths;*
- *The placement of buildings to higher areas within the site to limit the risk of flood damage;*
- *The integration of landscaping for flood storage and flood resilience."*

3.2.4. Therefore, the use of sustainable drainage (SuDS) will be investigated through the flood risk assessment and drainage strategy report to help reduce post-development runoff rates from the site.

3.2.5. A Level 2 SFRA was produced in 2009 however, these do not mention the site or Tilehust.

West Berkshire Strategic Flood Risk Assessment (SFRA) Level Updated (October 2015)

3.2.6. In October 2015, a brief update was provided to the SFRA in which an updated overview of flood risk was provided however, it only identified one incident of reported flooding in Tilehurst (approximately 650m south-east of the site). In which, a small number of properties were flooded by surface water in 2007.

3.2.7. This updated information will be utilised to inform the flood risk assessment for the proposed development.

West Berkshire Flood Risk Management Strategy 2013-2017 (December 2013)

3.2.8. Despite now being outside of the stated plan period, the West Berkshire Flood Risk Management Strategy is still available through the LLFA. It identifies the need for local standards to be published for SuDS however, as Schedule 3 of the Flood & Water management Act (F&WMA) was not enacted, and subsequently West Berkshire Council is not a SuDS Adoption Body (SAB), it does not appear that these standards were bought forwards.

3.2.9. The SuDS design for the proposed development will therefore utilise the most up-to-date national and local policy to inform the surface water drainage strategy.

Sustainable Drainage Systems Supplementary Planning Document (SPD) (Draft) (June 2018)

3.2.10. Whilst it has not yet been formally adopted, the West Berkshire SuDS SPD provides useful guidance on how the LLFA expect SuDS to be designed and maintained as future developments are brought forward. This includes:

- Outfall location should follow the drainage hierarchy of; infiltration, discharge to a watercourse then discharge to a surface water sewer.
- SuDS should be designed to accommodate 40% climate change and 10% development creep.
- SuDS should be designed to be low-maintenance, robust and resilient. Plans for adoption and maintenance should be provided with SuDS design guides.

3.2.11. Therefore, these key points have been further investigated within Section 5 and 7 which identify a proposed surface water drainage strategy and give operation and maintenance information.

4. ASSESSMENT OF FLOOD RISK

4.1. OVERVIEW

4.1.1. A desk based assessment of the potential flooding mechanisms at the site has been undertaken and is summarised in Table 3.

Table 3 - Flood Risk Overview

Mechanism	Risk	Comment
Fluvial	Low	Reference to Environment Agency Flood Zone Mapping shows the site to lie within Flood Zones 1.
Tidal	Very Low	Due to the inland site location, the site is not considered to be a risk of tidal flooding.
Surface Water	Low	Reference to Surface Water Mapping identifies that the site lies outside any surface water flood risk extents.
Ground Water	Low	Local borehole records and historic flood records do not identify groundwater flooding within the vicinity of the site.
Sewers	Low	There are no sewers within the site boundary and there have been no reported incidents of sewer flooding to Thames Water within the vicinity of the site.
Artificial Sources	Low	There are no canals within the vicinity of the site the site lies outside the maximum extent of reservoir flooding on the Environment Agency Reservoir Flood Map.

4.2. HISTORIC FLOODING

4.2.1. Consultation with Thames Water and West Berkshire Council, as the Lead Local Flood Authority (LLFA), has been undertaken. Both Severn Trent Water and the LLFA have confirmed that they hold no records of flooding for the proposed development site.

4.2.2. The Environment Agency (EA) confirmed the site lies wholly within Flood Zone 1 and have also confirmed that there are no historic records of flooding within 500m of the site.

4.3. FLUVIAL FLOOD RISK

4.3.1. Reference to the EA Flood Map for Planning confirms that the site currently lies wholly outside both the 1 in 100 and 1 in 1,000 year flood events of nearby main rivers including the River Thames which lies approximately 2km north-east of the site and the River Pang east of the site. The EA Flood Map for Planning is reprinted as Figure 3.

Figure 3 - Environment Agency Flood Map for Planning

KEY

Main River

1 in 100 year (1%) event (Zone 3)

1 in 1,000 year (0.1%) event (Zone 2)

Flood Defences

Areas Benefiting From Defences

Flood Storage Area

Site Boundary

Vulnerability Classification

4.3.2. As the development is mixed use, there are commercial and residential elements. The residential development proposed on site is classified as 'More Vulnerable' under the NPPF, with the commercial development proposed on site classified as 'Less Vulnerable.' The NPPF definitions have been provided below:

"More Vulnerable

- *Hospitals*
- *Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.*
- *Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.*
- *Non–residential uses for health services, nurseries and educational establishments.*
- *Landfill* and sites used for waste management facilities for hazardous waste.*
- *Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan."*

"Less Vulnerable

- *Police, ambulance and fire stations which are not required to be operational during flooding*
- *Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in "More Vulnerable", and assemble and leisure*
- *Land and buildings used for agriculture and forestry*
- *Waste treatment (except landfill and hazardous waste facilities)*
- *Minerals working and processing (except for sand and gravel working)*
- *Water treatment works which do not need to remain operational during times of flood*

- *Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place)"*

4.3.3. Given the site is identified to be located within Flood Zone 1, , the site is not required to undertake the Sequential and Exception Tests and is considered to be in an appropriate location for development

Identified Fluvial Flood Risk: Low

4.4. TIDAL FLOOD RISK

4.4.1. Due to its inland location, tidal flooding is not considered a risk to this site.

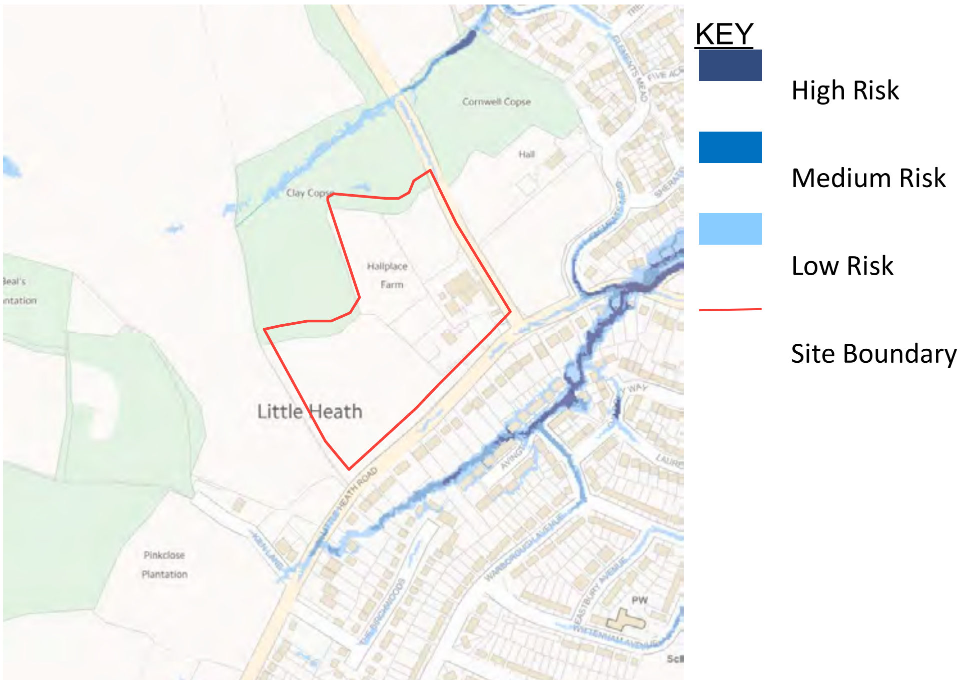
Identified Tidal Flood Risk: Very Low

4.5. SURFACE WATER FLOOD RISK

4.5.1. The 'Long Term Flood Risk Information,' in particular relating to the 'Flood Risk from Surface Water,' as published by the EA, has been reviewed and is shown in Figure 4.

4.5.2. This identifies that the site is at 'very low' flood risk with some small areas of low surface water flood risk ponding south of the site in Little Heath Road and in Sullham Hill north-east of the site. In addition to this there is a surface water flow path north of the site through the area of ancient woodland where a un-named watercourse runs from west to east.

Figure 4 – Surface Water Flood Risk Map



4.5.3. The production of this mapping has been undertaken at a national scale to provide the first publicly available generation of surface water flood risk mapping. The two previous generations were primarily developed for regulator use as the approach and risk was refined. For example, the first did not include any allowance for sewers, whilst the second incorporated a national loss coefficient.

4.5.4. Although this generation incorporates local estimates of the sewer infiltration loss, generally at a LLFA level along with various other refinements in runoff estimation, it does not allow for local improvements to the underlying Digital Terrain Model (DTM). This means that local features such as the adjoining highways are represented as determined from the LiDAR without any consideration to drainage features such as culverts or small watercourses (such as that which runs through the ancient woodland north of the site) which typically provide the associated surface water drainage.

4.5.5. As part of the final site design, to ensure that there is no increase to the flood risk to the development or third-party land, appropriate measures will be implemented in accordance with best practice guidance to ensure any surface water is directed away from the existing and proposed properties.

Identified Surface Water Flood Risk: Low

4.6. GROUND WATER FLOOD RISK

4.6.1. BGS records identify a 50m deep borehole located south of the site, immediately south of the junction of Kiln Lane and Little Heath Road, which does not identify any standing water in its length.

4.6.2. In addition to this, the Level 1 SFRA only identifies groundwater flooding issues within Purley on Thames, north of Tilehurst.

4.6.3. The EA have been consulted and, in an email dated 20th July 2018 (available in Appendix C), have confirmed that they held no historic flood records within 500m of the site nor did they provide any groundwater flood risk data.

Identified Groundwater Flood Risk: Low

4.7. SEWER FLOOD RISK

4.7.1. Sewer flooding occurs as a result of a number of influencing factors. It is most likely to occur during storms, when large volumes of rainwater enter the sewers. However, it can also occur when pipes become blocked or damaged.

4.7.2. Existing sewerage systems are present on land surrounding the site, by way of existing highway and adopted public sewers serving built development.

4.7.3. Thames Water have confirmed that there have been no reported incidents of flooding within the vicinity of the site. This correspondence is available in Appendix C.

Identified Sewer Flood Risk: Low

4.8. ARTIFICIAL SOURCE FLOOD RISK

Reservoirs

4.8.1. The Environment Agency Reservoir Flooding Map shows that the site lies outside of the zone of influence for the nearby reservoirs.

4.8.2. Given the nature of these features, flooding from this source is rare and indeed it has been confirmed by the Environment Agency that:

"Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, we ensure that reservoirs are inspected regularly and essential safety work is carried out"

4.8.3. There are no reservoirs within the vicinity of the site and therefore reservoir flooding is not considered a risk.

Identified Flood Risk from Reservoirs: Low

Canals

4.8.4. Canal flooding is generally rare and the canal network is designed in such a way so as to direct all additional water beyond the navigation capacity to impounding areas or surrounding watercourses to be conveyed downstream. The risk from canal flooding becomes more of a concern where the structure is elevated on an earth embankment and if there is a rare instance of a catastrophic breach, leading to a sudden drain-down of the pound and resultant overland flow flood risk to development immediately downstream.

4.8.5. There are no canals within the vicinity of the site and therefore canal flooding is not considered a risk.

Identified Flood Risk from Canals: Low

4.9. DEVELOPMENT EXCEEDANCE FLOWS

4.9.1. Careful regard has to be made in respect of potential exceedance flows, being events that are more extreme than current design criteria. Various national guidance has been published on the matter of exceedance flows and measures that should be incorporated into a development to ensure the safety of occupiers and those using the infrastructure.

4.9.2. Published guidance in the form of Sewers for Adoption 7th Edition and the Environment Agency document "Improving the Flood Performance of New Buildings: Flood Resilient Construction" advocate the design of developments that implement infrastructure routes that will safely convey flood waters resulting from sewer flooding or overland flows away from buildings and along defined corridors.

4.9.3. The principal aim is to direct exceedance flows away from properties and along defined corridors. At a local level, this may mean water being conveyed along a length of highway, as long as the predicted flow depths and velocities are acceptable. More strategically, the implementation of conveyance corridors are important in avoiding deep and high velocity flows that present a high risk.

4.9.4. Whilst many of the measures for dealing with exceedance flows must be dealt with at detailed design stage, the strategic layout for the site provides a framework that can effectively deal with any future exceedance flows.

4.9.5. Given the baseline site characteristics and further mitigation measures to be implemented, the risk of flooding from exceedance flows is considered low.

Identified Flood Risk from Exceedance Flows: Low

5. SURFACE WATER DRAINAGE

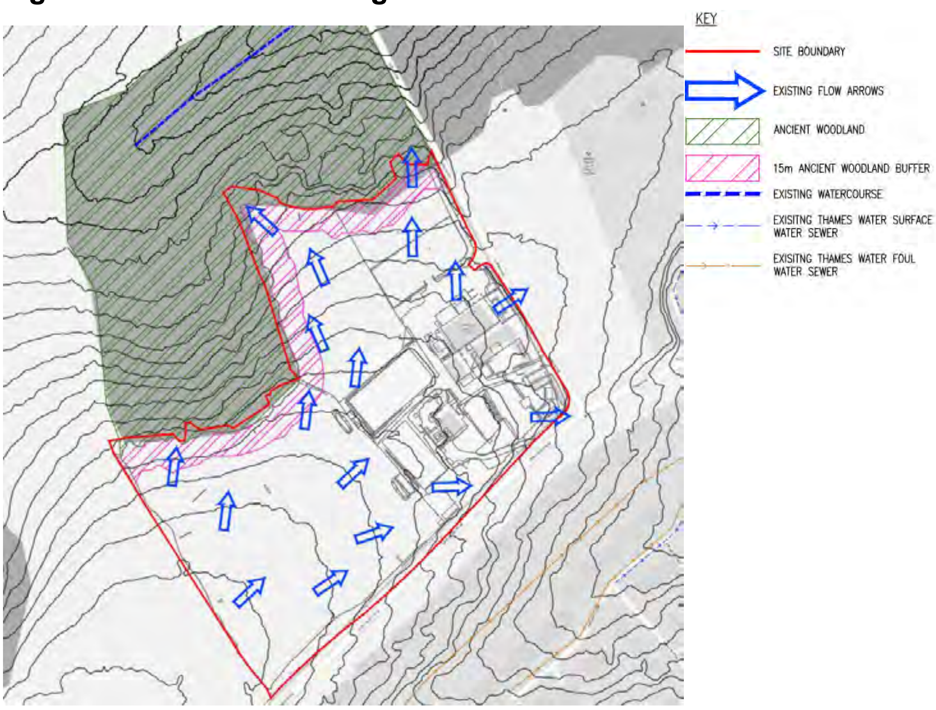
5.1. EXISTING SURFACE WATER DRAINAGE REGIME

5.1.1. The topography of the existing site identifies that surface water will flow north from the site into the unnamed watercourse located within the area of ancient woodland north of the site.

5.1.2. Thames Water asset maps do not identify that there are adopted drainage systems within the site boundary or serving the existing buildings located on site. The nearest Thames Water surface water sewers to the site are located within Chapel Hill south-east of the site.

5.1.3. The baseline drainage features described above are shown indicatively in Figure 5 and drawing D-001 contained in Appendix A.

Figure 5 – Baseline Drainage Features



5.2. DRAINAGE STRATEGY

Discharge Location

5.2.1. In order to determine the most appropriate receptor for storm water discharges from the proposed development, the new PPG guidance provides the following order of priority, supported by the Environment Agency and Local Authority:

Table 4 - SuDS Drainage Hierarchy

	Discharge Location	Availability	Comments
Search Sequence ↓	Re-Use	-	The re-use of water will be further investigated at the detailed design stage.
	Infiltration	-	BGS mapping identifies a bedrock of clay and therefore it is unlikely that the site has a potential for an infiltration led drainage strategy.
	Watercourse	✓	The unnamed watercourse north of the site is the current receptor of surface water flows from the site and therefore is the ideal location for surface water to continue to discharge.
	Surface Water Sewer	-	
	Combined Sewer	-	
	Foul Sewer	-	

5.2.2. Space for grey water harvesting and re-use may be further investigated prior to the detailed design stage.

5.2.3. BGS mapping identifies that the site is underlain by a bedrock of clay, as confirmed by nearby BGS borehole records, therefore an infiltration led surface water drainage strategy has been assumed unviable.

5.2.4. In accordance with the above search sequence, it is proposed to discharge surface water flows to the existing watercourse within the area of ancient woodland north of the site. The surface water outfall is in an area of Ancient Woodland and therefore the proposed site outfall will run alongside the existing highway east of the site to ensure minimum disturbance during construction.

5.2.5. It is understood that the land north of the site is within the ownership of The Sulham Estate and therefore there are no land ownership issues with this discharge location.

5.2.6. Thames Water Asset Mapping identifies that there are surface water sewers present in Chapel Hill south-east of the site that may be a feasible discharge location for surface water sewers on site should the need arise.

SuDS Proposals

5.2.7. Current guidance requires that all new developments implement Sustainable Drainage Systems (SuDS) as the primary means of controlling surface water run-off in order to maintain flow rates and volumes discharged to the identified receptor post development.

5.2.8. In addition to the water control benefits, The SuDS Manual (CIRIA C753) states that *"SuDS can treat and clean surface water runoff from urban areas so that the receiving environment is protected, while at the same time conveying, storing and infiltrating surface water to protect flood risk, river morphology and water resources, and delivering amenity and biodiversity value for the development."*

5.2.9. At the proposed site, a drainage strategy has been prepared in conjunction with the masterplan development thus making space for multi-function SuDS within the site boundary. Table 5 below provides a summary of the SuDS selection process and confirms the features that are proposed as part of the site drainage strategy.

Table 5 - Summary of SuDS Selection

Feature	Description	Selection
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation.	× The proposed development may contain buildings suitable for the inclusion of green roofs however, there use may be further investigated during the detailed design stage
Filter Strips	These are wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.	✓ / × While filter strips have not been formally proposed at this stage; further investigation into the potential use of filter strips may be undertaken in the next phase of design.
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.	✓ / × While permeable paving has not been formally proposed at this stage; further investigation into the potential use of it may be undertaken in the next phase of design.
Swales	Swales are broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff, and can infiltrate the water into the ground (if ground conditions allow).	✓ Conveyance swales have been proposed to help improve water quality throughout the proposed development site.
Infiltration Basins	Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value.	× As infiltration is assumed to be unviable, infiltration basins have not been proposed at this stage. Should site-specific infiltration testing demonstrate that discharge via infiltration is viable, infiltration basins may be incorporated into the design.
Wet Ponds	Wet ponds are basins that have a permanent pool of water for water quality treatment. They provide temporary storage for additional storm runoff above the permanent water level. Wet ponds	✓ An attenuation basin is proposed for the site to attenuate surface water runoff. The exact nature of any permanent water within the

	may provide amenity and wildlife benefits.	basins such as wet ponds will be confirmed during the later design stage.
Detention Basins	Detention basins are normally dry, though they may have small permanent pools at the inlet and outlet. They are designed to detain a certain volume of runoff as well as providing water quality treatment.	✓ An attenuation basin is proposed for the site to attenuate surface water runoff. The exact wet/dry type will be confirmed during the later design stage.

Greenfield Run-Off

5.2.10. National policy dictates that new developments control the peak discharge of storm water from a site to the baseline, undeveloped site conditions. Over very large development areas, the baseline rate of run-off is normally estimated using the Flood Estimation Handbook (FEH) methodologies. However, Paragraph 3.1.2 of the FEH guidance states:

"The frequency estimation procedures can be used on any catchment, gauged or ungauged, that drains an area of at least 0.5km². The flood estimation procedure can be applied on smaller catchments only where the catchment is gauged and offers simple flood peak or flood event data." As the site is under 0.5km², a different technique was sought.

5.2.11. In order to determine an appropriate discharge rate for the site, a number of sources were consulted in the writing of this report;

- BGS geology mapping; and,
  - Identifying the site to be underlain by bedrock of London Clay Formation. This can be found in Figure 2.
- BGS borehole records for the area,
  - Identified the nearest borehole to the site is located approximately 50m south of the site boundary, showing the geology to be comprised of brown & grey clay to a depth of 7m.

5.2.12. Despite sources identifying the underlying ground to be clay, Micro Drainage Software identifies that the soil index for the site is 0.15 which is associated with "*well drained permeable sandy or loamy soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts*" thereby generating a proposed discharge rate of 0.4l/s/ha.

5.2.13. These calculations have been included in Appendix B.

5.2.14. Given the information provided by BGS mapping and nearby borehole data, and local understanding that the site is underlain by clay, we propose to adjust the soil index for the site to 0.40 which is associated with "*Clayey, or loamy over clayey soils with an impermeable layer at shallow depth*". This would result in a proposed discharge rate of 4.4 l/s/ha.

5.2.15. Consultation with the LLFA has confirmed acceptance of this principle, with an agreed maximum peak discharge rate of 10.5l/s. The email correspondence with the LLFA has been included in Appendix C.

5.2.16. Calculations, in accordance with the revised QBar rate, have been attached for reference.

Development Run-Off & Attenuation

5.2.17. As the site is currently undeveloped, the proposals will result in an increase in impermeable area, which will increase the overall rate of water discharging from the site if left un-attenuated.

5.2.18. The strategy drawing 8292-D-002 in Appendix A indicates the site catchments based on the site topography as confirmed in Table 6 below.

Table 6 - Site Run-Off Assessment

Catchment	Developed Area (ha)	Impermeable Area (ha)	Revised QBar Runoff (l/s)
A	0.35	0.21	1.54
B	0.63	0.38	2.77
C	0.26	0.16	1.14
D	1.15	0.69	5.06
Total	**2.39**	**1.43**	**10.52**

5.2.19. Where long term storage is not proposed, in order to mitigate for the increased volume of run-off associated with built development, peak flows in the 1 in 100 year event must be attenuated to the mean annual flow (QBar).

5.2.20. Assessments have thereafter been completed to determine the characteristics of the SuDS features required. The Micro Drainage Source Control module has been utilised to provide routing calculations for the 1 in 100 year flood event to identify the size and nature of storage required, ensuring the peak outflows are in line with those identified in Table 6 above.

5.2.21. A summary of the nature of SuDS proposed is contained in Table 7 below whilst the drainage strategy is shown on 8292-D-002 in Appendix A and Micro Drainage summary calculations are contained in Appendix B.

Table 7 - Site Attenuation Requirements

Catchment	Proposed Discharge Rate (l/s)	Storage Volume Required (m^3)	SuDS Controls
A	10.5	90.00	Attenuation basins linked via conveyance swales
B		180.00	
C		170.00	
D		530.00	
Total	**10.5**	970.00	

5.2.22. In accordance with legislative requirements, the detention proposals have also been assessed for the potential effects of climate change. The 1 in 100 year return events have been modelled for 40% climate change (including peak rainfall intensity). Calculations for the climate change scenarios are also contained in the **Appendix B.**

5.2.23. Climate change assessments show each attenuation feature to perform adequately by retaining the additional flows within the system without overflow or unacceptable consequences.

5.2.24. The drainage system will be designed in accordance with Sewers for Adoption (7th Edition) such that the proposed network will not surcharge during the critical 1 in 2 year event and will not flood during the 1 in 30 year event. For the 1 in 100 year return period, the sewer network will be designed so that surface flooding will be contained and conveyed within the site boundary and directed to the attenuation basin.

5.2.25. The 1 in 30 year criterion meets the requirements of BS EN 752 and is also in accordance with Sewers for Adoption 7th Edition. However, the design of the system exceeds the requirements of these documents by accommodating the volumes and flow rates generated by the 1 in 100 year event.

5.2.26. The drainage strategy is based upon the site masterplanning details at the time of production. Changes to the site development profile, impermeable areas across the site or other such aspects of the scheme will result in the need to revise the calculations.

Development Creep

5.2.27. Over the lifetime of a development, it is possible that the overall impermeable area within the site could increase by as much as 10% through the house buyers undertaking activities such as property extensions and introducing paved gardens.

5.2.28. Table 8 below shows how this increase in impermeable area relates to the primary catchments within the site. The existing area of the Grade II listed building located on the proposed development site is assumed drained and will remain as existing and has therefore been excluded from the proposed drainage catchments.

Table 8 - Development Creep Assessment

Catchment	Impermeable Area (ha)	10% Creep (ha)	Total Impermeable Area (ha)
A	0.21	0.021	0.23
B	0.38	0.038	0.42
C	0.16	0.016	0.17
D	0.69	0.069	0.76
Total	**1.43**	**0.143**	**1.56**

5.2.29. Micro Drainage calculations contained in Appendix B confirm that the proposed SuDS system has sufficient capacity to accommodate a 10% increase in impermeable area during the 1 in 100 year + 40% climate change event without overflow.

5.2.30. As such, the impacts of development creep on the proposed SuDS system are not considered to pose a significant risk to the site.

5.2.31. Without the benefit of a detailed plot level masterplan, it is not possible to appraise the function of the individual source control systems down to plot level. During the detailed design phase, source control measures and the potential positive impacts of such measures (permeable paving et al.,) should be further considered and implemented as far as reasonably practicable.

Climate Change

5.2.32. The purpose of the proposed drainage strategy is to ensure that the proposed scheme does not exacerbate any existing flood risks upstream or downstream of the site, in accordance with the principles set out within the NPPF.

5.2.33. SuDS will be implemented throughout this development scheme. The conceptual SuDS strategy for the proposed development has been devised using the principles outlined within the current published guidance in the form of the NPPF, PPG and CIRIA amongst others.

5.2.34. The impact of climate change is a key factor when determining a drainage strategy. The NPPF and PPG guidance advocate a "development lifespan" approach for dealing with climate change allowances.

5.2.35. In light of this and in accordance with local requirements, an increase of 40% in peak rainfall intensity has been used as the allowance for climate change within the proposed drainage design to determine the performance of the drainage system.

5.2.36. Climate change assessments show each attenuation feature to perform adequately by retaining the additional flows within the system without overflow or unacceptable consequences. Calculations for the climate change scenarios are also contained in the Appendix B.

SuDS Management Train

5.2.37. The SuDS Manual (CIRIA C753) states the SuDS Management Train is a central design concept for SuDS. SuDS should not be thought of as an individual component, but as an interconnected system designed to manage, treat and make best use of surface water, from where it falls as rain to the point at which it is discharged into the receiving environment beyond the boundaries of the site.

5.2.38. There are six specific functions provided by SuDS components (rainwater harvesting, pervious surface systems, infiltration systems, conveyance systems, storage systems and treatment systems), which are not independent with one component being able to provide two or more functions.

5.2.39. There are many types of SuDS components which means that SuDS can be delivered anywhere, tailored to individual local contexts. Wherever possible, runoff should be managed at source with residual flows then conveyed downstream to further storage or treatment components.

5.2.40. Treatment design should implement SuDS components that use a range of treatment processes to reduce contaminant level in runoff to acceptable levels. This can be facilitated by the SuDS management train of a number of components in series that provide a range of treatment processes, delivering gradual improvement in water quality and providing an environmental buffer for accidental spills or unexpected high pollutant loadings from the site

5.2.41. The above has been considered in applying SuDS into the proposed development to help provide; prevention in terms of pollution, source control and site controls.

5.2.42. The proposed development will utilise an attenuation basin to provide storage of surface water runoff. Flows will be limited, via a flow control device (e.g. vortex flow control) to ensure that maximum peak discharge rates do not exceed 10. 5l/s for any event up to and including the 1 in 100 year plus climate change event.

Health and Safety

5.2.43. The proposed layout of the SuDS features will be designed in accordance with the best practice SuDS guidance documents and national standards, supplemented, where appropriate, with the West Berkshire County Council guidance and the requirements of the water company and maintenance company to ensure the features are effective not only in terms of their hydraulic design but also from a safety perspective during construction, operation and maintenance.

5.2.44. Outline health and safety risk assessments should be completed for the individual drainage features proposed as part of the final site design, setting out the risks and incorporating proposals for how these are to be managed.

6. FOUL WATER DRAINAGE

6.1. EXISTING FOUL WATER DRAINAGE REGIME

6.1.1. Thames Water asset maps are available in Appendix C and in Figure 6.

Figure 6 – Thames Water Asset Map

6.1.2. This identifies a foul network serving the existing residential development south and east of the proposed development site.

6.2. PROPOSED FOUL FLOWS

6.2.1. Peak design discharges have been calculated based on the current development criteria as described in Section 2 of this report and for the following:

- Residential = 3.7l/s (peak)

6.2.2. Assessed in accordance with Sewers for Adoption requirements, it is anticipated that the planned development will produce a peak flow discharge of approximately 3.7 l/s.

6.3. NETWORK CAPACITY AVAILABILITY

6.3.1. Discussions with Thames Water confirm that there is adequate capacity within their network to serve the proposed development of 80 dwellings.

6.3.2. Thames Water have provided a proposed foul water connection point of MH9901 in Chapel Hill which has an invert level of 83.79mAOD. This correspondence is available in Appendix C.

6.4. IMPLEMENTATION PROPOSALS

6.4.1. The proposed gravity network across the site will be designed to current Sewers for Adoption Standards, employing the identified point of connection.

7. OPERATION AND MAINTENANCE

7.1. SURFACE WATER FEATURES

7.1.1. The proposed on-site surface water and foul drainage sewerage networks will be designed to the current version of Sewers for Adoption and will be offered for adoption by Thames Water.

7.1.2. With regards to SuDS, it is likely that, should the SuDS be offered to the council for adoption and maintenance, commuted sums will be required for all adoptable SuDS processes.

7.1.3. As an alternative, it is becoming increasingly common for SuDS features to be operated and maintained by a third party private maintenance company. Should this be necessary, a third-party management company would be established to maintain the features in perpetuity. An adoption agreement between the final site developer and Maintenance Company would be based upon the CIRIA ICoP MA2 SuDS Maintenance Framework Agreement.

7.1.4. A typical maintenance schedule of the attenuation and flow control devices proposed on site are shown in Table 9, Table 10 and Table 11.

Table 9 - Flow Control (e.g. vortex flow control) Indicative Maintenance Schedule

FREQUENCY	ACTION
Monthly	• Inspect and identify any areas that are not operating correctly. If required, take remedial action (for three months following installation)
Six Monthly	• Inspect and identify any areas that are not operating correctly. If required, take remedial action. • Remove sediment from pre-treatment structures
Annually	• N/A
Following all significant storm events	• Inspect and carry out essential recovery works to return the feature to full working order.

Table 10 - Attenuation Basin Indicative Maintenance Schedule

FREQUENCY	ACTION
Monthly	• Litter and debris removal. • Mow grasses (where required to promote lateral runoff inflow) and remove resultant clippings (during growing season only). • Remove nuisance and invasive vegetation (for 12 months following installation). • Inspect/check all inlets, outlets, surface and overflows (where required) to ensure that they are in good condition, free from blockages and operating as designed. Take action where required.
Six Monthly	• Remove nuisance and invasive vegetation.
Annually	• Remove all dead growth prior to the start of growing season. • Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, where required. • Inspect and document the presence of wildlife. • Remove sediment from inlets, outlet and forebay • Manage wetland plants, where required
As-Required	• Prune and trim trees and remove cuttings. • Remove sediment from forebay, when 50% full and from micropools if volume reduced by more than 25% • Repair erosion or other damage by re-turfing or reseeding • Re-level uneven surfaces and reinstate design levels (typically once every 60 month period) • Remove and dispose of oils or petrol residues using safe standard practices
Following all significant storm events	• Inspect and carry out essential recovery works to return the feature to full working order.

Table 11 - Swale Indicative Maintenance Schedule

Frequency	Action
Monthly	• Litter and debris removal. • Mow grasses (where required to promote lateral runoff inflow) and remove resultant clippings (during growing season only). • Remove nuisance and invasive vegetation (for 12 months following installation). • Inspect/check all inlets, outlets, surface and overflows (where required) to ensure that they are in good condition, free from blockages and operating as designed. Take action where required.
Six Monthly	• Remove nuisance and invasive vegetation.
Annually	• Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter, and cut back adjacent vegetation where required. • Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, where required. • Inspect and document the presence of wildlife.
As-Required	• Repair erosion or other damage by re-turfing, reseeding or replacing filter material. • Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface where required. • (typically, every 60-month period). • Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip, where required. • Remove and dispose of oils or petrol residues using safe standard practices.
Following all significant storm events	• Inspect and carry out essential recovery works to return the feature to full working order.

7.1.5. The proposed maintenance regimes for the devices should be in accordance with The SuDS Manual (CIRIA C753) and other best practice guidelines and in accordance with manufacturer's recommendations. This will ensure the design performance, structural integrity and where applicable-appearance of each feature is maintained throughout its lifetime.

7.1.6. The details of the party responsible for maintenance of each feature will be confirmed prior to occupation of the proposed development.

7.2. FOUL DRAINAGE NETWORK

7.2.1. The foul drainage system will be offered for the adoption of Thames Water under S104 of the Water Industry Act 1991.

8. CONCLUSIONS

8.1.1. The risk of flooding to and from the proposed development has been assessed in accordance with the NPPF 2018.

8.1.2. This assessment demonstrates that the site lies within an appropriate location for the proposed land uses in accordance with the vulnerability classifications of the NPPF and supported by West Berkshire County Council and the Environment Agency.

8.1.3. Management of extreme event flood risk can be achieved through ensuring the finished floor levels of the proposed building are set at a minimum of 150mm above adjacent roads and open space levels in areas where designated overland flood routes are identified.

8.1.4. In addition to the NPPF, the proposed drainage strategy complies with local policy and site-specific requirements.

8.1.5. The proposed drainage strategy aims to mimic the behaviour of the site pre-development (greenfield), through the utilisation of attenuation basins, conveyance swales, and flow control devices. The maximum peak rate of discharge from the site will be 10.5l/s and the total storage volume required is 970m³ for the critical 1 in 100 year event plus climate change.

8.1.6. The responsibility for the operation and maintenance of each SuDS feature will be confirmed prior to construction. The SuDS used on site will be maintained in accordance with manufacturer's recommendations and current best practice and guidelines to ensure routine operation.

8.1.7. Safe access and egress will be available to and from the site for events up to and including the 1 in 100 year plus climate change (40%) rainfall events.

8.1.8. This report demonstrates that the proposed development can be undertaken in a sustainable manner without increasing the flood risk either at the site or to any third-party land in line with NPPF requirements.

Appendix A

DRAWINGS

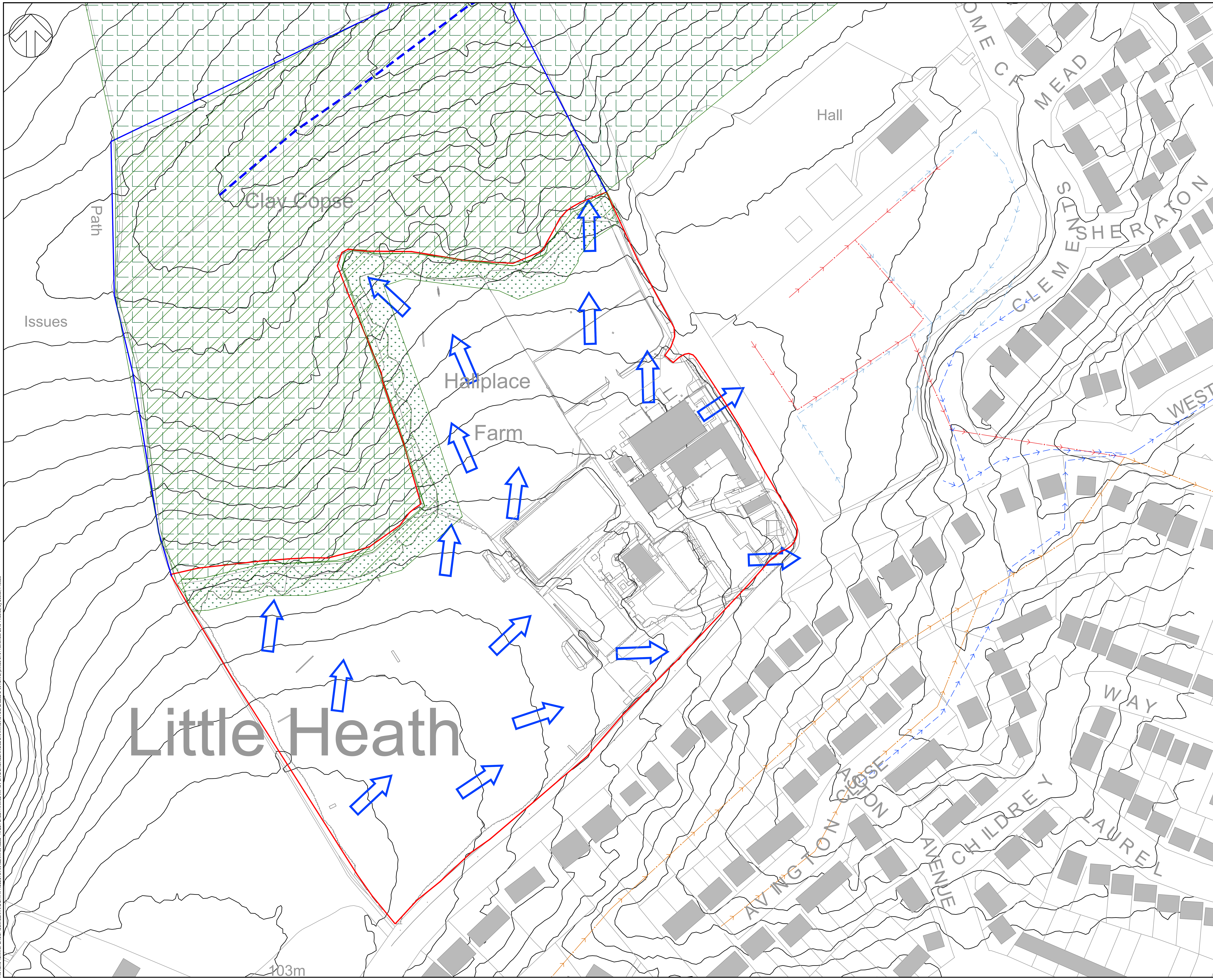
File: Created using iGIS, WSP's Online Mapping System Drawn By: UKPMS003 Date Modified: 02/07/2018 09:06

TITLE:

8292-LOC-001

FIGURE No:

Site Location Plan



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6. ILLUSTRATIVE DRAINAGE DRAWING BASED ON:
   6.1. TOPOGRAPHICAL SURVEY PRODUCED BY GLANVILLE DATED JULY 2017
   6.2. CONTOURS PRODUCED USING ENVIRONMENT AGENCY 1m DTM LiDAR (DOWNLOADED JULY 2018)
   6.3. BACKGROUND MAPPING CREDITED © OpenStreetMap CONTRIBUTORS
   6.4. THAMES WATER ASSET MAPS RECEIVED 03.07.2018

KEY

- SITE BOUNDARY
- LAND OWNERSHIP BOUNDARY
- EXISTING FLOW ARROWS
- EXISTING WATERCOURSE
- EXISITING THAMES WATER SURFACE WATER SEWER
- EXISITING THAMES WATER FOUL WATER SEWER
- INDICATIVE PROPOSED SURFACE WATER SEWER IN ADJACENT DEVELOPMENT SIT (17/01807/RESMAJ)
- INDICATIVE PROPOSED FOUL WATER SEWER IN ADJACENT DEVELOPMENT SIT (17/01807/RESMAJ)
- AREA OF ANCIENT WOODLAND
- 15 BUFFER FROM ANCIENT WOODLAND

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	01/11/2018	PS	FIRST ISSUE	AC	DW

DRAWING STATUS: S2 - FOR INFORMATION

wsp
One Queens Drive, Birmingham, B5 4PJ, UK
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CLIENT: THE SULLHAM ESTATE

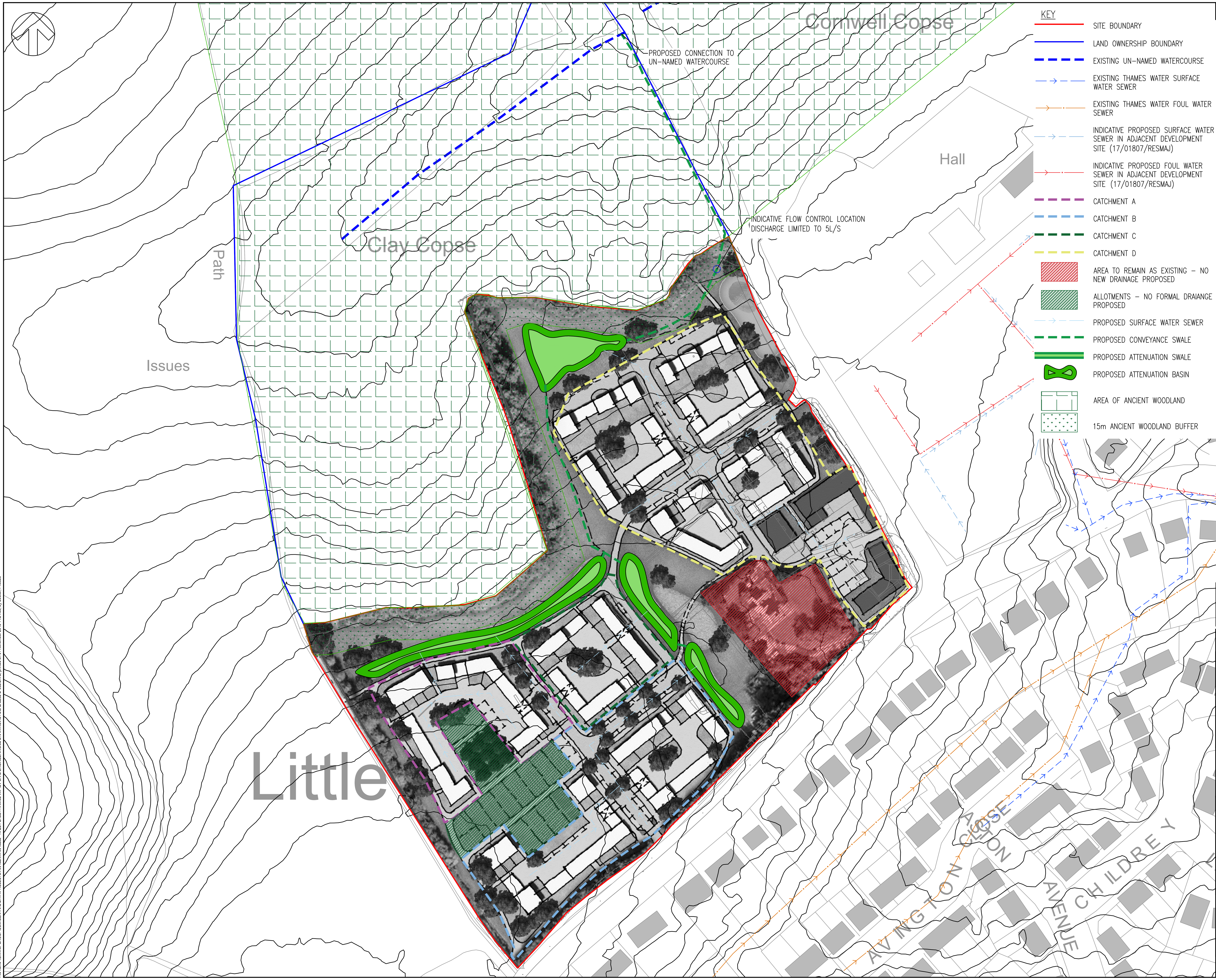
ARCHITECT: BARTON WILLMORE

SITE/PROJECT: HALL PLACE FARM

TITLE: EXISTING DRAINAGE FEATURES

SCALE @ A1: 1:750	CHECKED: AC		APPROVED: DS
PROJECT NO: 70048292	DESIGNED: PS	DRAWN: PS	DATE: August 18

DRAWING No: 8292-D-001 REV: P01



KEY

- SITE BOUNDARY
- LAND OWNERSHIP BOUNDARY
- EXISTING UN-NAMED WATERCOURSE
- EXISTING THAMES WATER SURFACE WATER SEWER
- EXISTING THAMES WATER FOUL WATER SEWER
- INDICATIVE PROPOSED SURFACE WATER SEWER IN ADJACENT DEVELOPMENT SITE (17/01807/RESMAJ)
- INDICATIVE PROPOSED FOUL WATER SEWER IN ADJACENT DEVELOPMENT SITE (17/01807/RESMAJ)
- CATCHMENT A
- CATCHMENT B
- CATCHMENT C
- CATCHMENT D
- AREA TO REMAIN AS EXISTING – NO NEW DRAINAGE PROPOSED
- ALLOTMENTS – NO FORMAL DRAIANGE PROPOSED
- PROPOSED SURFACE WATER SEWER
- PROPOSED CONVEYANCE SWALE
- PROPOSED ATTENUATION SWALE
- PROPOSED ATTENUATION BASIN
- AREA OF ANCIENT WOODLAND
- 15m ANCIENT WOODLAND BUFFER

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   6.3. MASTERPLAN FROM LAND USE PLAN PRODUCED BY BARTON WILLMORE DATED 13.09.2018
   6.4. THAMES WATER ASSET MAPS RECEIVED 03.07.2018
7. SURFACE WATER CALCULATIONS UNDERTAKEN USING MICRODRAINANGE SOURCE CONTROL AND ARE SUBJECT TO REFINEMENT AT DETAILED DESIGN.
8. PROPOSED OUTFALL LOCATION IS ON LAND WITHIN DEVELOPERS CONTROL.
9. DISCHRGE RATE SET TO 4.4L/S/HA AS AGREED WITH WEST BERKSHIRE COUNTY COUNCIL LLFA 24.08.2018.

DRAINAGE CATCHMENT DETAILS

CATCHMENT	CONTRIBUTING AREA [ha]	STORAGE VOLUME [m^3] REQUIRED FOR THE 1 IN 100 YEAR + CLIMATE CHANGE EVENT	STORAGE AREA [m^2]
A	0.21	90	960
B	0.38	180	340
C	0.16	170	430
D	0.69	530	800
TOTAL	1.43	970	2,530

REV	DATE	BY	DESCRIPTION	CHK	APP
P03	01/11/2018	PS	UPDATED MASTERPLAN	AC	AC
P02	30/08/2018	PS	UPDATED MASTERPLAN	AC	AC
P01	10/08/2018	PS	DRAFT FOR CLIENT COMMENT	AC	AC

DRAWING STATUS: S2 - FOR INFORMATION

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CLIENT: THE SULLHAM ESTATE

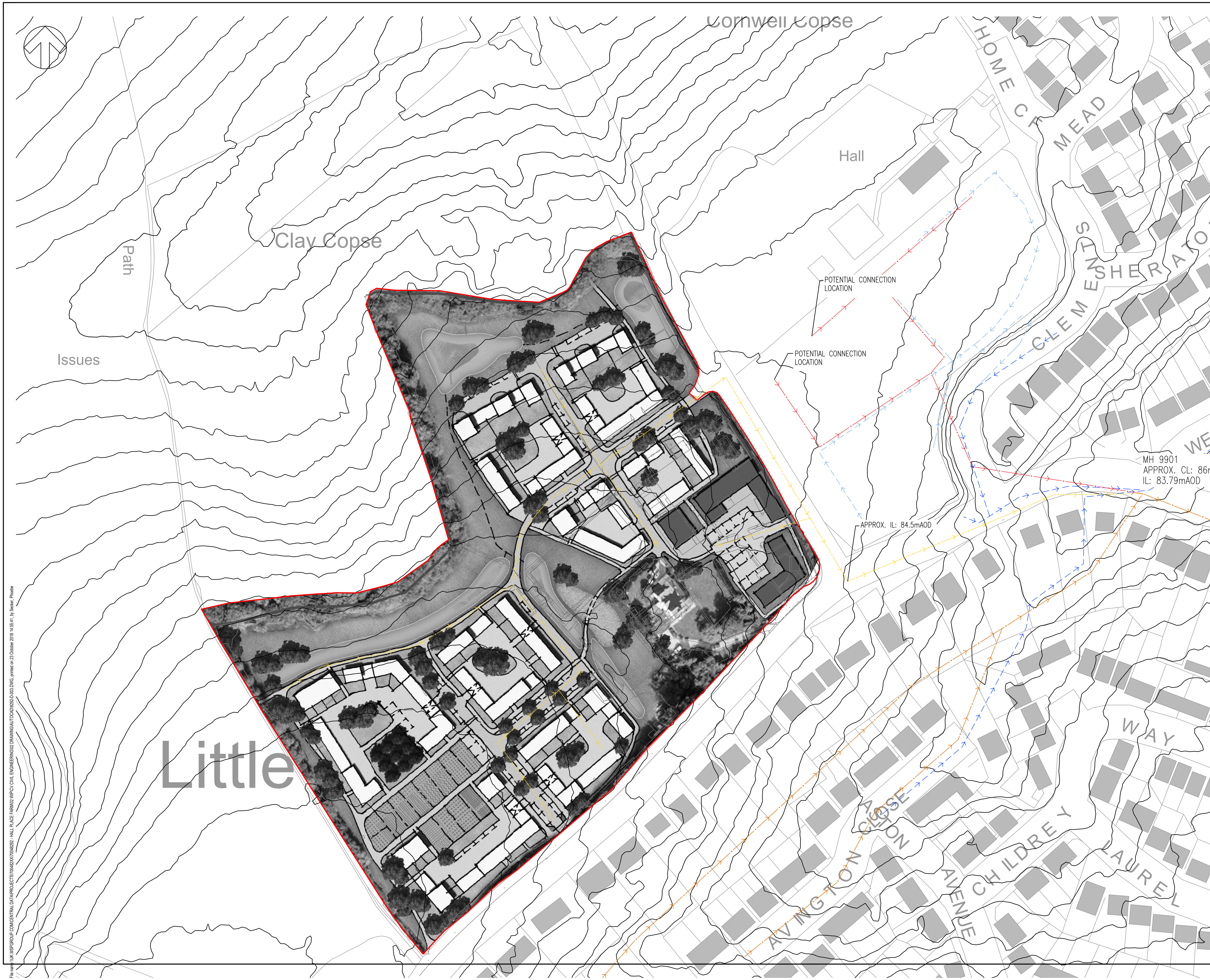
ARCHITECT: BARTON WILLMORE

SITE/PROJECT: HALL PLACE FARM

TITLE: INDICATIVE SURFACE WATER DRAINAGE STRATEGY

SCALE @ A1: 1:750	CHECKED: AC		APPROVED: DS
PROJECT NO: 70048292	DESIGNED: PS	DRAWN: PS	DATE: October 18

DRAWING No: 8292-D-002 REV: P01



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   6.3. MASTERPLAN FROM VISIONING DOCUMENT PRODUCED BY BARTON WILLMORE DATED MARCH 2018.
   6.4. THAMES WATER ASSET MAPS RECEIVED 03.07.2018

KEY
- SITE BOUNDARY
- EXISTING THAMES WATER FOUL WATER SEWER
- EXISTING THAMES WATER SURFACE WATER SEWER
- INDICATIVE PROPOSED SURFACE WATER SEWER IN ADJACENT DEVELOPMENT SIT (17/01807/RESMAJ)
- INDICATIVE PROPOSED FOUL WATER SEWER IN ADJACENT DEVELOPMENT SIT (17/01807/RESMAJ)
- INDICATIVE PROPOSED FOUL WATER SEWER

REV	DATE	BY	DESCRIPTION	CHK	APP
P02	23/10/2018	PS	UPDATED MASTERPLAN	AC	DS
P01	10/08/2018	PS	DRAFT FOR CLIENT COMMENT	AC	AC

DRAWING STATUS: S2 - FOR INFORMATION

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CLIENT: THE SULLHAM ESTATE
ARCHITECT: BARTON WILLMORE
SITE/PROJECT: HALL PLACE FARM
TITLE: INDICATIVE FOUL WATER DRAINAGE STRATEGY

SCALE @ A1: 1:750	CHECKED: AC	APPROVED: DS
PROJECT NO: 70048292	DESIGNED: PS / DRAWN: PS	DATE: August 18

DRAWING No: 8292-D-003 REV: P01

DRAINAGE CATCHMENT DETAILS

CATCHMENT	CONTRIBUTING AREA [ha]	STORAGE VOLUME [m³] REQUIRED FOR THE 1 IN 100 YEAR + CLIMATE CHANGE EVENT	STORAGE AREA [m²]
A	0.30	160	500
B	0.35	180	430
C	0.20	200	430
D	0.30	1,000	1,200
E	0.60	200	650
TOTAL	1.75	1,740	2,810

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   6.1. TOPOGRAPHICAL SURVEY PRODUCED BY GLANVILLE DATED JULY 2017.
   6.2. CONTOURS PRODUCED USING ENVIRONMENT AGENCY 1m DTM LiDAR (DOWNLOADED JULY 2018).
   6.3. MASTERPLAN FROM VISIONING DOCUMENT PRODUCED BY BARTON WILLMORE DATED MARCH 2018.
   6.4. THAMES WATER ASSET MAPS RECEIVED 03.07.2018
7. SURFACE WATER CALCULATIONS UNDERTAKEN USING MICRODRAINANGE SOURCE CONTROL AND ARE SUBJECT TO REFINEMENT AT DETAILED DESIGN,

KEY

- SITE BOUNDARY
- LAND OWNERSHIP BOUNDARY
- 15m ANCIENT WOODLAND BUFFER
- EXISTING WATERCOURSE
- EXISTING THAMES WATER SURFACE WATER SEWER
- EXISTING THAMES WATER FOUL WATER SEWER
- PROPOSED SURFACE WATER SEWER FC NEW DEVELOPMENT SITE
- PROPOSED FOUL WATER SEWER FOR NEW DEVELOPMENT SITE
- PROPOSED SURFACE WATER SEWER
- PROPOSED CONVEYANCE SWALE
- PROPOSED ATTENUATION SWALE
- PROPOSED ATTENUATION BASIN
- INDICATIVE EXCEEDANCE FLOW ROUTE
- ANCIENT WOODLAND
- 15m BUFFER FROM ANCIENT WOODLAN

REV	DATE	BY	DESCRIPTION	CHK	APP
P02	01/01/2018	PS	UPDATED MASTERPLAN	AC	DS
P01	10/08/2018	PS	DRAFT FOR CLIENT COMMENT	AC	AC

DRAWING STATUS: S2 - FOR INFORMATION

wsp
One Queens Drive, Birmingham, B5 4PJ, UK
T+ 44 (0) 121 352 4700, F+ 44 (0) 121 352 4701
wsp.com

CLIENT: THE SULLHAM ESTATE

ARCHITECT: BARTON WILLMORE

SITE/PROJECT: HALL PLACE FARM

TITLE: INDICATIVE SURFACE WATER EXCEEDANCE PLAN

SCALE @ A1: 1:750	CHECKED: AC		APPROVED: DS
PROJECT NO: 70048292	DESIGNED: PS	DRAWN: PS	DATE: October 18

DRAWING No: 8292-D-004 — REV: P01

Appendix B

CALCULATIONS

Appendix B.1

GREENFIELD RUN-OFF

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	50.000	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results	**l/s**
QBAR Rural	20.2
QBAR Urban	20.2
Q100 years	64.6
Q1 year	17.2
Q2 years	17.8
Q5 years	25.9
Q10 years	32.8
Q20 years	40.6
Q25 years	43.5
Q30 years	45.9
Q50 years	53.1
Q100 years	64.6
Q200 years	75.9
Q250 years	79.6
Q1000 years	104.5

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	50.000	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results	**l/s**
QBAR Rural	219.7
QBAR Urban	219.7
Q100 years	700.7
Q1 year	186.7
Q2 years	193.5
Q5 years	281.2
Q10 years	355.8
Q20 years	440.0
Q25 years	471.8
Q30 years	497.8
Q50 years	575.5
Q100 years	700.7
Q200 years	823.7
Q250 years	863.2
Q1000 years	1133.4

Appendix B.2

1 IN 100 YEAR

Cascade Summary of Results for Catchment A.srcx

Upstream Structures	Outflow To	Overflow To
(None)	Catchment D.srcx	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.647	0.147	4.7	33.4	O K
30 min Summer	98.680	0.180	4.9	42.3	O K
60 min Summer	98.703	0.203	4.9	49.3	O K
120 min Summer	98.714	0.214	4.9	52.4	O K
180 min Summer	98.714	0.214	4.9	52.6	O K
240 min Summer	98.711	0.211	4.9	51.5	O K
360 min Summer	98.700	0.200	4.9	48.1	O K
480 min Summer	98.687	0.187	4.9	44.5	O K
600 min Summer	98.675	0.175	4.8	41.0	O K
720 min Summer	98.663	0.163	4.8	37.7	O K
960 min Summer	98.643	0.143	4.7	32.2	O K
1440 min Summer	98.617	0.117	4.3	25.5	O K
2160 min Summer	98.595	0.095	3.5	20.4	O K
2880 min Summer	98.583	0.083	2.9	17.5	O K
4320 min Summer	98.569	0.069	2.2	14.3	O K
5760 min Summer	98.561	0.061	1.8	12.5	O K
7200 min Summer	98.555	0.055	1.5	11.2	O K
8640 min Summer	98.551	0.051	1.3	10.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	92.745	0.0	35.8	21
30 min Summer	60.955	0.0	47.2	34
60 min Summer	38.202	0.0	59.8	62
120 min Summer	23.163	0.0	72.6	98
180 min Summer	17.068	0.0	80.3	130
240 min Summer	13.668	0.0	85.7	164
360 min Summer	9.922	0.0	93.3	232
480 min Summer	7.910	0.0	99.2	298
600 min Summer	6.631	0.0	104.0	362
720 min Summer	5.738	0.0	108.0	424
960 min Summer	4.564	0.0	114.5	544
1440 min Summer	3.300	0.0	124.1	780
2160 min Summer	2.382	0.0	134.8	1132
2880 min Summer	1.889	0.0	142.5	1500
4320 min Summer	1.360	0.0	153.6	2208
5760 min Summer	1.076	0.0	162.5	2944
7200 min Summer	0.897	0.0	169.3	3672
8640 min Summer	0.773	0.0	174.9	4408

Cascade Summary of Results for Catchment A.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	98.547	0.047	1.1	9.6	O K
15 min Winter	98.663	0.163	4.8	37.7	O K
30 min Winter	98.699	0.199	4.9	47.9	O K
60 min Winter	98.726	0.226	5.0	56.1	O K
120 min Winter	98.736	0.236	5.0	59.4	O K
180 min Winter	98.735	0.235	5.0	59.0	O K
240 min Winter	98.729	0.229	5.0	57.1	O K
360 min Winter	98.711	0.211	4.9	51.5	O K
480 min Winter	98.691	0.191	4.9	45.8	O K
600 min Winter	98.673	0.173	4.8	40.4	O K
720 min Winter	98.656	0.156	4.7	35.7	O K
960 min Winter	98.629	0.129	4.6	28.6	O K
1440 min Winter	98.602	0.102	3.7	21.9	O K
2160 min Winter	98.582	0.082	2.8	17.1	O K
2880 min Winter	98.571	0.071	2.3	14.7	O K
4320 min Winter	98.558	0.058	1.7	11.9	O K
5760 min Winter	98.551	0.051	1.3	10.4	O K
7200 min Winter	98.546	0.046	1.1	9.3	O K
8640 min Winter	98.543	0.043	1.0	8.5	O K
10080 min Winter	98.540	0.040	0.8	7.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.681	0.0	179.6	5144
15 min Winter	92.745	0.0	40.1	21
30 min Winter	60.955	0.0	53.0	34
60 min Winter	38.202	0.0	67.0	62
120 min Winter	23.163	0.0	81.3	112
180 min Winter	17.068	0.0	89.9	140
240 min Winter	13.668	0.0	96.0	178
360 min Winter	9.922	0.0	104.6	252
480 min Winter	7.910	0.0	111.2	320
600 min Winter	6.631	0.0	116.5	384
720 min Winter	5.738	0.0	121.0	446
960 min Winter	4.564	0.0	128.3	560
1440 min Winter	3.300	0.0	139.1	794
2160 min Winter	2.382	0.0	151.0	1148
2880 min Winter	1.889	0.0	159.6	1504
4320 min Winter	1.360	0.0	172.1	2248
5760 min Winter	1.076	0.0	182.1	2944
7200 min Winter	0.897	0.0	189.6	3680
8640 min Winter	0.773	0.0	196.0	4320
10080 min Winter	0.681	0.0	201.3	5144

Cascade Rainfall Details for Catchment A.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.210

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.100	4	8	0.110

Cascade Model Details for Catchment A.srcx

Storage is Online Cover Level (m) 99.500

Tank or Pond Structure

Invert Level (m) 98.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	190.0	1.000	960.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0107-5000-0900-5000
Design Head (m)	0.900
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.0	Kick-Flo®	0.590	4.1
Flush-Flo™	0.271	5.0	Mean Flow over Head Range	-	4.3

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	3.6	1.200	5.7	3.000	8.8	7.000	13.1
0.200	4.9	1.400	6.1	3.500	9.4	7.500	13.6
0.300	5.0	1.600	6.5	4.000	10.1	8.000	14.0
0.400	4.9	1.800	6.9	4.500	10.6	8.500	14.4
0.500	4.6	2.000	7.2	5.000	11.2	9.000	14.8
0.600	4.1	2.200	7.6	5.500	11.7	9.500	15.2
0.800	4.7	2.400	7.9	6.000	12.2		
1.000	5.2	2.600	8.2	6.500	12.7		

Cascade Summary of Results for Catchment B.srcx

Upstream Structures	Outflow To	Overflow To
(None)	Catchment C.srcx	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.504	0.504	5.5	61.1	O K
30 min Summer	99.595	0.595	5.5	78.6	O K
60 min Summer	99.662	0.662	5.5	93.2	O K
120 min Summer	99.696	0.696	5.5	101.1	O K
180 min Summer	99.693	0.693	5.5	100.2	O K
240 min Summer	99.682	0.682	5.5	97.6	O K
360 min Summer	99.654	0.654	5.5	91.3	O K
480 min Summer	99.627	0.627	5.5	85.4	O K
600 min Summer	99.599	0.599	5.5	79.3	O K
720 min Summer	99.566	0.566	5.5	72.8	O K
960 min Summer	99.502	0.502	5.5	60.7	O K
1440 min Summer	99.383	0.383	5.5	41.0	O K
2160 min Summer	99.239	0.239	5.5	22.0	O K
2880 min Summer	99.156	0.156	5.2	13.1	O K
4320 min Summer	99.107	0.107	4.2	8.5	O K
5760 min Summer	99.089	0.089	3.3	6.9	O K
7200 min Summer	99.078	0.078	2.8	6.0	O K
8640 min Summer	99.071	0.071	2.4	5.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	92.745	0.0	66.0	21
30 min Summer	60.955	0.0	86.7	36
60 min Summer	38.202	0.0	108.8	64
120 min Summer	23.163	0.0	132.0	122
180 min Summer	17.068	0.0	145.9	170
240 min Summer	13.668	0.0	155.8	198
360 min Summer	9.922	0.0	169.6	262
480 min Summer	7.910	0.0	180.3	332
600 min Summer	6.631	0.0	188.9	400
720 min Summer	5.738	0.0	196.2	464
960 min Summer	4.564	0.0	208.0	590
1440 min Summer	3.300	0.0	225.6	836
2160 min Summer	2.382	0.0	244.4	1168
2880 min Summer	1.889	0.0	258.4	1500
4320 min Summer	1.360	0.0	279.0	2204
5760 min Summer	1.076	0.0	294.4	2936
7200 min Summer	0.897	0.0	306.7	3616
8640 min Summer	0.773	0.0	317.0	4384

Cascade Summary of Results for Catchment B.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	99.066	0.066	2.1	5.0	O K
15 min Winter	99.547	0.547	5.5	69.0	O K
30 min Winter	99.644	0.644	5.5	89.0	O K
60 min Winter	99.717	0.717	5.5	106.0	Flood Risk
120 min Winter	99.759	0.759	5.5	116.6	Flood Risk
180 min Winter	99.761	0.761	5.5	117.0	Flood Risk
240 min Winter	99.748	0.748	5.5	113.6	Flood Risk
360 min Winter	99.714	0.714	5.5	105.3	Flood Risk
480 min Winter	99.679	0.679	5.5	97.1	O K
600 min Winter	99.641	0.641	5.5	88.4	O K
720 min Winter	99.598	0.598	5.5	79.2	O K
960 min Winter	99.496	0.496	5.5	59.6	O K
1440 min Winter	99.310	0.310	5.5	30.8	O K
2160 min Winter	99.141	0.141	5.1	11.6	O K
2880 min Winter	99.108	0.108	4.2	8.5	O K
4320 min Winter	99.083	0.083	3.1	6.4	O K
5760 min Winter	99.072	0.072	2.4	5.5	O K
7200 min Winter	99.064	0.064	2.0	4.8	O K
8640 min Winter	99.059	0.059	1.7	4.4	O K
10080 min Winter	99.055	0.055	1.5	4.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.681	0.0	325.9	5112
15 min Winter	92.745	0.0	73.9	21
30 min Winter	60.955	0.0	97.2	35
60 min Winter	38.202	0.0	121.9	64
120 min Winter	23.163	0.0	147.8	120
180 min Winter	17.068	0.0	163.4	174
240 min Winter	13.668	0.0	174.5	226
360 min Winter	9.922	0.0	190.0	280
480 min Winter	7.910	0.0	201.9	358
600 min Winter	6.631	0.0	211.6	434
720 min Winter	5.738	0.0	219.7	510
960 min Winter	4.564	0.0	233.0	636
1440 min Winter	3.300	0.0	252.7	864
2160 min Winter	2.382	0.0	273.7	1148
2880 min Winter	1.889	0.0	289.4	1472
4320 min Winter	1.360	0.0	312.4	2196
5760 min Winter	1.076	0.0	329.7	2928
7200 min Winter	0.897	0.0	343.5	3608
8640 min Winter	0.773	0.0	355.1	4320
10080 min Winter	0.681	0.0	365.0	5112

Cascade Rainfall Details for Catchment B.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.380

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.190	4	8	0.190

Cascade Model Details for Catchment B.srcx

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	70.0	1.000	340.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0112-5500-0900-5500
Design Head (m)	0.900
Design Flow (l/s)	5.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	112
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.5	Kick-Flo®	0.592	4.5
Flush-Flo™	0.269	5.5	Mean Flow over Head Range	-	4.8

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	3.9	1.200	6.3	3.000	9.7	7.000	14.5
0.200	5.4	1.400	6.8	3.500	10.4	7.500	15.0
0.300	5.5	1.600	7.2	4.000	11.1	8.000	15.4
0.400	5.4	1.800	7.6	4.500	11.7	8.500	15.9
0.500	5.1	2.000	8.0	5.000	12.3	9.000	16.3
0.600	4.6	2.200	8.4	5.500	12.9	9.500	16.7
0.800	5.2	2.400	8.7	6.000	13.5		
1.000	5.8	2.600	9.0	6.500	14.0		

Cascade Summary of Results for Catchment C.srcx

Upstream Structures	Outflow To	Overflow To
Catchment B.srcx	Catchment D.srcx	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	92.206	0.206	4.9	33.6	O K
30 min Summer	92.247	0.247	5.0	41.5	O K
60 min Summer	92.292	0.292	5.0	50.9	O K
120 min Summer	92.349	0.349	5.0	63.2	O K
180 min Summer	92.382	0.382	5.0	70.9	O K
240 min Summer	92.404	0.404	5.0	76.0	O K
360 min Summer	92.426	0.426	5.0	81.5	O K
480 min Summer	92.440	0.440	5.0	84.8	O K
600 min Summer	92.455	0.455	5.0	88.6	O K
720 min Summer	92.474	0.474	5.0	93.7	O K
960 min Summer	92.482	0.482	5.0	95.7	O K
1440 min Summer	92.459	0.459	5.0	89.7	O K
2160 min Summer	92.400	0.400	5.0	75.1	O K
2880 min Summer	92.315	0.315	5.0	55.6	O K
4320 min Summer	92.183	0.183	4.9	29.5	O K
5760 min Summer	92.125	0.125	4.5	19.2	O K
7200 min Summer	92.106	0.106	3.9	16.0	O K
8640 min Summer	92.093	0.093	3.4	14.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	92.745	0.0	93.2	181
30 min Summer	60.955	0.0	122.7	255
60 min Summer	38.202	0.0	154.4	336
120 min Summer	23.163	0.0	187.3	422
180 min Summer	17.068	0.0	207.0	478
240 min Summer	13.668	0.0	221.1	524
360 min Summer	9.922	0.0	240.7	598
480 min Summer	7.910	0.0	255.9	668
600 min Summer	6.631	0.0	268.1	728
720 min Summer	5.738	0.0	278.5	780
960 min Summer	4.564	0.0	295.3	874
1440 min Summer	3.300	0.0	320.2	1048
2160 min Summer	2.382	0.0	347.1	1340
2880 min Summer	1.889	0.0	366.9	1652
4320 min Summer	1.360	0.0	396.0	2304
5760 min Summer	1.076	0.0	418.2	2952
7200 min Summer	0.897	0.0	435.7	3680
8640 min Summer	0.773	0.0	450.3	4408

Cascade Summary of Results for Catchment C.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	92.085	0.085	3.0	12.7	O K
15 min Winter	92.221	0.221	5.0	36.6	O K
30 min Winter	92.263	0.263	5.0	44.8	O K
60 min Winter	92.317	0.317	5.0	56.2	O K
120 min Winter	92.382	0.382	5.0	70.9	O K
180 min Winter	92.421	0.421	5.0	80.2	O K
240 min Winter	92.447	0.447	5.0	86.7	O K
360 min Winter	92.477	0.477	5.0	94.4	O K
480 min Winter	92.494	0.494	5.0	98.8	O K
600 min Winter	92.504	0.504	5.0	101.6	O K
720 min Winter	92.521	0.521	5.0	106.2	O K
960 min Winter	92.557	0.557	5.0	116.4	O K
1440 min Winter	92.512	0.512	5.0	103.7	O K
2160 min Winter	92.368	0.368	5.0	67.5	O K
2880 min Winter	92.229	0.229	5.0	38.1	O K
4320 min Winter	92.117	0.117	4.3	17.9	O K
5760 min Winter	92.094	0.094	3.4	14.2	O K
7200 min Winter	92.082	0.082	2.9	12.2	O K
8640 min Winter	92.074	0.074	2.5	11.0	O K
10080 min Winter	92.069	0.069	2.2	10.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.681	0.0	462.8	5136
15 min Winter	92.745	0.0	104.5	207
30 min Winter	60.955	0.0	137.5	292
60 min Winter	38.202	0.0	173.0	380
120 min Winter	23.163	0.0	209.8	472
180 min Winter	17.068	0.0	231.9	532
240 min Winter	13.668	0.0	247.6	578
360 min Winter	9.922	0.0	269.6	654
480 min Winter	7.910	0.0	286.7	722
600 min Winter	6.631	0.0	300.4	786
720 min Winter	5.738	0.0	311.9	838
960 min Winter	4.564	0.0	330.8	932
1440 min Winter	3.300	0.0	358.7	1074
2160 min Winter	2.382	0.0	388.8	1364
2880 min Winter	1.889	0.0	411.0	1676
4320 min Winter	1.360	0.0	443.6	2252
5760 min Winter	1.076	0.0	468.4	2944
7200 min Winter	0.897	0.0	488.0	3696
8640 min Winter	0.773	0.0	504.4	4408
10080 min Winter	0.681	0.0	518.4	5088

Cascade Rainfall Details for Catchment C.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.160

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.080	4	8	0.080

Cascade Model Details for Catchment C.srcx

Storage is Online Cover Level (m) 93.000

Tank or Pond Structure

Invert Level (m) 92.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	140.0	1.000	440.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0107-5000-0900-5000
Design Head (m)	0.900
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	92.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.0	Kick-Flo®	0.590	4.1
Flush-Flo™	0.271	5.0	Mean Flow over Head Range	-	4.3

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	3.6	1.200	5.7	3.000	8.8	7.000	13.1
0.200	4.9	1.400	6.1	3.500	9.4	7.500	13.6
0.300	5.0	1.600	6.5	4.000	10.1	8.000	14.0
0.400	4.9	1.800	6.9	4.500	10.6	8.500	14.4
0.500	4.6	2.000	7.2	5.000	11.2	9.000	14.8
0.600	4.1	2.200	7.6	5.500	11.7	9.500	15.2
0.800	4.7	2.400	7.9	6.000	12.2		
1.000	5.2	2.600	8.2	6.500	12.7		

Cascade Summary of Results for Catchment D.srcx

Upstream Structures	Outflow To	Overflow To
Catchment A.srcx	(None)	(None)
Catchment C.srcx		
Catchment B.srcx		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	92.248	0.248	10.5	119.1	O K
30 min Summer	92.318	0.318	10.5	156.6	O K
60 min Summer	92.389	0.389	10.5	196.2	O K
120 min Summer	92.461	0.461	10.5	237.9	O K
180 min Summer	92.502	0.502	10.5	262.6	O K
240 min Summer	92.529	0.529	10.5	279.7	O K
360 min Summer	92.564	0.564	10.5	301.4	O K
480 min Summer	92.580	0.580	10.5	311.9	O K
600 min Summer	92.580	0.580	10.5	311.4	O K
720 min Summer	92.571	0.571	10.5	305.7	O K
960 min Summer	92.551	0.551	10.5	293.4	O K
1440 min Summer	92.510	0.510	10.5	267.7	O K
2160 min Summer	92.449	0.449	10.5	231.0	O K
2880 min Summer	92.391	0.391	10.5	197.4	O K
4320 min Summer	92.284	0.284	10.5	137.9	O K
5760 min Summer	92.202	0.202	10.3	95.5	O K
7200 min Summer	92.159	0.159	9.8	74.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	92.745	0.0	244.1	23
30 min Summer	60.955	0.0	322.3	38
60 min Summer	38.202	0.0	409.5	68
120 min Summer	23.163	0.0	497.0	128
180 min Summer	17.068	0.0	549.6	188
240 min Summer	13.668	0.0	587.0	248
360 min Summer	9.922	0.0	639.3	368
480 min Summer	7.910	0.0	679.6	484
600 min Summer	6.631	0.0	712.1	600
720 min Summer	5.738	0.0	739.4	654
960 min Summer	4.564	0.0	784.0	758
1440 min Summer	3.300	0.0	849.7	996
2160 min Summer	2.382	0.0	924.2	1384
2880 min Summer	1.889	0.0	976.6	1764
4320 min Summer	1.360	0.0	1052.6	2468
5760 min Summer	1.076	0.0	1114.3	3088
7200 min Summer	0.897	0.0	1160.6	3744

Cascade Summary of Results for Catchment D.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Summer	92.141	0.141	8.6	65.1	O K
10080 min Summer	92.128	0.128	7.7	59.0	O K
15 min Winter	92.275	0.275	10.5	133.5	O K
30 min Winter	92.353	0.353	10.5	175.5	O K
60 min Winter	92.430	0.430	10.5	219.9	O K
120 min Winter	92.508	0.508	10.5	266.6	O K
180 min Winter	92.554	0.554	10.5	294.9	O K
240 min Winter	92.586	0.586	10.5	315.3	O K
360 min Winter	92.628	0.628	10.5	342.7	O K
480 min Winter	92.653	0.653	10.5	359.2	O K
600 min Winter	92.661	0.661	10.5	364.5	O K
720 min Winter	92.657	0.657	10.5	361.9	O K
960 min Winter	92.631	0.631	10.5	344.7	O K
1440 min Winter	92.566	0.566	10.5	302.6	O K
2160 min Winter	92.473	0.473	10.5	245.4	O K
2880 min Winter	92.378	0.378	10.5	189.5	O K
4320 min Winter	92.202	0.202	10.3	95.4	O K
5760 min Winter	92.146	0.146	8.9	67.4	O K
7200 min Winter	92.125	0.125	7.5	57.7	O K
8640 min Winter	92.113	0.113	6.5	51.7	O K
10080 min Winter	92.104	0.104	5.7	47.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.773	0.0	1199.0	4424
10080 min Summer	0.681	0.0	1230.9	5144
15 min Winter	92.745	0.0	273.9	23
30 min Winter	60.955	0.0	361.4	38
60 min Winter	38.202	0.0	458.9	68
120 min Winter	23.163	0.0	557.0	128
180 min Winter	17.068	0.0	615.9	232
240 min Winter	13.668	0.0	657.7	314
360 min Winter	9.922	0.0	716.2	402
480 min Winter	7.910	0.0	761.4	482
600 min Winter	6.631	0.0	797.7	590
720 min Winter	5.738	0.0	828.3	696
960 min Winter	4.564	0.0	878.3	880
1440 min Winter	3.300	0.0	952.0	1082
2160 min Winter	2.382	0.0	1035.4	1500
2880 min Winter	1.889	0.0	1094.1	1876
4320 min Winter	1.360	0.0	1179.7	2428
5760 min Winter	1.076	0.0	1248.2	3008
7200 min Winter	0.897	0.0	1300.2	3744
8640 min Winter	0.773	0.0	1343.3	4424
10080 min Winter	0.681	0.0	1379.4	5152

Cascade Rainfall Details for Catchment D.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.690

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.350	4	8	0.340

Cascade Model Details for Catchment D.srcx

Storage is Online Cover Level (m) 93.000

Tank or Pond Structure

Invert Level (m) 92.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	440.0	1.000	810.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0151-1050-0900-1050
Design Head (m)	0.900
Design Flow (l/s)	10.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	151
Invert Level (m)	92.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	10.5	Kick-Flo®	0.627	8.9
Flush-Flo™	0.284	10.5	Mean Flow over Head Range	-	8.9

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	5.4	1.200	12.0	3.000	18.6	7.000	27.9
0.200	10.3	1.400	12.9	3.500	20.0	7.500	28.9
0.300	10.5	1.600	13.8	4.000	21.3	8.000	29.8
0.400	10.3	1.800	14.6	4.500	22.6	8.500	30.7
0.500	10.0	2.000	15.3	5.000	23.7	9.000	31.5
0.600	9.3	2.200	16.0	5.500	24.9	9.500	32.3
0.800	9.9	2.400	16.7	6.000	25.9		
1.000	11.0	2.600	17.4	6.500	26.9		

Appendix B.3

1 IN 100 YEAR + CLIMATE CHANGE

Cascade Summary of Results for Catchment A.srcx

Upstream Structures	Outflow To	Overflow To
(None)	Catchment D.srcx	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.697	0.197	4.9	47.5	O K
30 min Summer	98.740	0.240	5.0	60.8	O K
60 min Summer	98.774	0.274	5.0	72.0	O K
120 min Summer	98.792	0.292	5.0	78.1	O K
180 min Summer	98.793	0.293	5.0	78.6	O K
240 min Summer	98.790	0.290	5.0	77.6	O K
360 min Summer	98.779	0.279	5.0	73.7	O K
480 min Summer	98.767	0.267	5.0	69.4	O K
600 min Summer	98.753	0.253	5.0	64.9	O K
720 min Summer	98.739	0.239	5.0	60.5	O K
960 min Summer	98.714	0.214	4.9	52.4	O K
1440 min Summer	98.670	0.170	4.8	39.7	O K
2160 min Summer	98.628	0.128	4.6	28.4	O K
2880 min Summer	98.608	0.108	4.0	23.4	O K
4320 min Summer	98.587	0.087	3.1	18.3	O K
5760 min Summer	98.575	0.075	2.5	15.6	O K
7200 min Summer	98.567	0.067	2.1	13.9	O K
8640 min Summer	98.562	0.062	1.8	12.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.843	0.0	50.3	21
30 min Summer	85.337	0.0	66.4	35
60 min Summer	53.483	0.0	83.9	64
120 min Summer	32.428	0.0	101.7	116
180 min Summer	23.896	0.0	112.5	146
240 min Summer	19.136	0.0	120.1	176
360 min Summer	13.890	0.0	130.8	244
480 min Summer	11.074	0.0	139.1	312
600 min Summer	9.283	0.0	145.7	380
720 min Summer	8.033	0.0	151.4	444
960 min Summer	6.389	0.0	160.5	572
1440 min Summer	4.620	0.0	174.0	810
2160 min Summer	3.335	0.0	188.9	1148
2880 min Summer	2.644	0.0	199.6	1500
4320 min Summer	1.904	0.0	215.3	2208
5760 min Summer	1.506	0.0	227.6	2936
7200 min Summer	1.256	0.0	237.1	3672
8640 min Summer	1.082	0.0	245.0	4408

Cascade Summary of Results for Catchment A.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	98.558	0.058	1.6	11.7	O K
15 min Winter	98.717	0.217	5.0	53.5	O K
30 min Winter	98.765	0.265	5.0	68.7	O K
60 min Winter	98.802	0.302	5.0	81.8	O K
120 min Winter	98.824	0.324	5.0	89.7	O K
180 min Winter	98.824	0.324	5.0	89.7	O K
240 min Winter	98.819	0.319	5.0	88.0	O K
360 min Winter	98.803	0.303	5.0	82.2	O K
480 min Winter	98.784	0.284	5.0	75.5	O K
600 min Winter	98.764	0.264	5.0	68.5	O K
720 min Winter	98.744	0.244	5.0	61.8	O K
960 min Winter	98.705	0.205	4.9	49.8	O K
1440 min Winter	98.645	0.145	4.7	32.9	O K
2160 min Winter	98.606	0.106	3.9	23.0	O K
2880 min Winter	98.589	0.089	3.2	18.9	O K
4320 min Winter	98.572	0.072	2.3	14.9	O K
5760 min Winter	98.562	0.062	1.9	12.8	O K
7200 min Winter	98.556	0.056	1.6	11.4	O K
8640 min Winter	98.552	0.052	1.3	10.4	O K
10080 min Winter	98.548	0.048	1.2	9.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.953	0.0	251.6	5136
15 min Winter	129.843	0.0	56.5	21
30 min Winter	85.337	0.0	74.4	35
60 min Winter	53.483	0.0	94.0	62
120 min Winter	32.428	0.0	114.0	118
180 min Winter	23.896	0.0	126.0	168
240 min Winter	19.136	0.0	134.6	190
360 min Winter	13.890	0.0	146.6	266
480 min Winter	11.074	0.0	155.8	340
600 min Winter	9.283	0.0	163.3	410
720 min Winter	8.033	0.0	169.6	478
960 min Winter	6.389	0.0	179.8	604
1440 min Winter	4.620	0.0	194.9	830
2160 min Winter	3.335	0.0	211.5	1168
2880 min Winter	2.644	0.0	223.6	1508
4320 min Winter	1.904	0.0	241.2	2212
5760 min Winter	1.506	0.0	254.9	2944
7200 min Winter	1.256	0.0	265.6	3640
8640 min Winter	1.082	0.0	274.4	4384
10080 min Winter	0.953	0.0	282.0	5136

Cascade Rainfall Details for Catchment A.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.210

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.100	4	8	0.110

Cascade Model Details for Catchment A.srcx

Storage is Online Cover Level (m) 99.500

Tank or Pond Structure

Invert Level (m) 98.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	190.0	1.000	960.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0107-5000-0900-5000
Design Head (m)	0.900
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.0	Kick-Flo®	0.590	4.1
Flush-Flo™	0.271	5.0	Mean Flow over Head Range	-	4.3

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	3.6	1.200	5.7	3.000	8.8	7.000	13.1
0.200	4.9	1.400	6.1	3.500	9.4	7.500	13.6
0.300	5.0	1.600	6.5	4.000	10.1	8.000	14.0
0.400	4.9	1.800	6.9	4.500	10.6	8.500	14.4
0.500	4.6	2.000	7.2	5.000	11.2	9.000	14.8
0.600	4.1	2.200	7.6	5.500	11.7	9.500	15.2
0.800	4.7	2.400	7.9	6.000	12.2		
1.000	5.2	2.600	8.2	6.500	12.7		

Cascade Summary of Results for Catchment B.srcx

Upstream Structures	Outflow To	Overflow To
(None)	Catchment C.srcx	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.637	0.637	5.5	87.5	O K
30 min Summer	99.744	0.744	5.5	112.7	Flood Risk
60 min Summer	99.828	0.828	5.5	135.1	Flood Risk
120 min Summer	99.882	0.882	5.5	150.4	Flood Risk
180 min Summer	99.890	0.890	5.5	152.9	Flood Risk
240 min Summer	99.882	0.882	5.5	150.5	Flood Risk
360 min Summer	99.858	0.858	5.5	143.4	Flood Risk
480 min Summer	99.836	0.836	5.5	137.2	Flood Risk
600 min Summer	99.815	0.815	5.5	131.2	Flood Risk
720 min Summer	99.793	0.793	5.5	125.5	Flood Risk
960 min Summer	99.751	0.751	5.5	114.4	Flood Risk
1440 min Summer	99.663	0.663	5.5	93.2	O K
2160 min Summer	99.499	0.499	5.5	60.2	O K
2880 min Summer	99.354	0.354	5.5	36.8	O K
4320 min Summer	99.173	0.173	5.3	14.8	O K
5760 min Summer	99.119	0.119	4.7	9.5	O K
7200 min Summer	99.100	0.100	3.9	7.9	O K
8640 min Summer	99.089	0.089	3.4	6.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.843	0.0	92.4	22
30 min Summer	85.337	0.0	121.5	36
60 min Summer	53.483	0.0	152.4	66
120 min Summer	32.428	0.0	184.8	122
180 min Summer	23.896	0.0	204.3	180
240 min Summer	19.136	0.0	218.1	224
360 min Summer	13.890	0.0	237.5	284
480 min Summer	11.074	0.0	252.4	348
600 min Summer	9.283	0.0	264.5	416
720 min Summer	8.033	0.0	274.7	486
960 min Summer	6.389	0.0	291.3	622
1440 min Summer	4.620	0.0	315.9	896
2160 min Summer	3.335	0.0	342.2	1260
2880 min Summer	2.644	0.0	361.7	1588
4320 min Summer	1.904	0.0	390.6	2248
5760 min Summer	1.506	0.0	412.1	2936
7200 min Summer	1.256	0.0	429.4	3648
8640 min Summer	1.082	0.0	443.9	4392

Cascade Summary of Results for Catchment B.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	99.082	0.082	3.0	6.3	O K
15 min Winter	99.686	0.686	5.5	98.5	O K
30 min Winter	99.800	0.800	5.5	127.2	Flood Risk
60 min Winter	99.892	0.892	5.5	153.4	Flood Risk
120 min Winter	99.953	0.953	5.6	172.6	Flood Risk
180 min Winter	99.968	0.968	5.7	177.5	Flood Risk
240 min Winter	99.965	0.965	5.7	176.4	Flood Risk
360 min Winter	99.937	0.937	5.6	167.3	Flood Risk
480 min Winter	99.911	0.911	5.5	159.4	Flood Risk
600 min Winter	99.884	0.884	5.5	151.1	Flood Risk
720 min Winter	99.855	0.855	5.5	142.6	Flood Risk
960 min Winter	99.795	0.795	5.5	125.9	Flood Risk
1440 min Winter	99.664	0.664	5.5	93.6	O K
2160 min Winter	99.399	0.399	5.5	43.5	O K
2880 min Winter	99.202	0.202	5.4	17.9	O K
4320 min Winter	99.109	0.109	4.3	8.6	O K
5760 min Winter	99.089	0.089	3.4	6.9	O K
7200 min Winter	99.079	0.079	2.8	6.1	O K
8640 min Winter	99.072	0.072	2.4	5.5	O K
10080 min Winter	99.067	0.067	2.2	5.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.953	0.0	456.3	5088
15 min Winter	129.843	0.0	103.5	22
30 min Winter	85.337	0.0	136.1	36
60 min Winter	53.483	0.0	170.7	64
120 min Winter	32.428	0.0	207.0	120
180 min Winter	23.896	0.0	228.8	178
240 min Winter	19.136	0.0	244.3	232
360 min Winter	13.890	0.0	266.0	300
480 min Winter	11.074	0.0	282.7	372
600 min Winter	9.283	0.0	296.2	450
720 min Winter	8.033	0.0	307.6	526
960 min Winter	6.389	0.0	326.2	676
1440 min Winter	4.620	0.0	353.8	968
2160 min Winter	3.335	0.0	383.3	1300
2880 min Winter	2.644	0.0	405.1	1584
4320 min Winter	1.904	0.0	437.5	2204
5760 min Winter	1.506	0.0	461.6	2936
7200 min Winter	1.256	0.0	480.9	3664
8640 min Winter	1.082	0.0	497.1	4280
10080 min Winter	0.953	0.0	511.1	5104

Cascade Rainfall Details for Catchment B.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.380

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.190	4	8	0.190

Cascade Model Details for Catchment B.srcx

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	70.0	1.000	340.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0112-5500-0900-5500
Design Head (m)	0.900
Design Flow (l/s)	5.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	112
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.5	Kick-Flo®	0.592	4.5
Flush-Flo™	0.269	5.5	Mean Flow over Head Range	-	4.8

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	3.9	1.200	6.3	3.000	9.7	7.000	14.5
0.200	5.4	1.400	6.8	3.500	10.4	7.500	15.0
0.300	5.5	1.600	7.2	4.000	11.1	8.000	15.4
0.400	5.4	1.800	7.6	4.500	11.7	8.500	15.9
0.500	5.1	2.000	8.0	5.000	12.3	9.000	16.3
0.600	4.6	2.200	8.4	5.500	12.9	9.500	16.7
0.800	5.2	2.400	8.7	6.000	13.5		
1.000	5.8	2.600	9.0	6.500	14.0		

Cascade Summary of Results for Catchment C.srcx

Upstream Structures	Outflow To	Overflow To
Catchment B.srcx	Catchment D.srcx	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	92.251	0.251	5.0	42.3	O K
30 min Summer	92.311	0.311	5.0	54.8	O K
60 min Summer	92.388	0.388	5.0	72.3	O K
120 min Summer	92.477	0.477	5.0	94.3	O K
180 min Summer	92.534	0.534	5.0	109.8	O K
240 min Summer	92.577	0.577	5.0	122.1	O K
360 min Summer	92.627	0.627	5.0	137.2	O K
480 min Summer	92.646	0.646	5.0	143.1	O K
600 min Summer	92.652	0.652	5.0	145.1	O K
720 min Summer	92.655	0.655	5.0	145.9	O K
960 min Summer	92.655	0.655	5.0	145.9	O K
1440 min Summer	92.651	0.651	5.0	144.8	O K
2160 min Summer	92.632	0.632	5.0	138.6	O K
2880 min Summer	92.580	0.580	5.0	123.0	O K
4320 min Summer	92.412	0.412	5.0	77.9	O K
5760 min Summer	92.266	0.266	5.0	45.3	O K
7200 min Summer	92.177	0.177	4.8	28.2	O K
8640 min Summer	92.130	0.130	4.6	20.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.843	0.0	130.7	273
30 min Summer	85.337	0.0	172.0	374
60 min Summer	53.483	0.0	216.3	476
120 min Summer	32.428	0.0	262.3	584
180 min Summer	23.896	0.0	289.9	652
240 min Summer	19.136	0.0	309.6	706
360 min Summer	13.890	0.0	337.1	788
480 min Summer	11.074	0.0	358.4	864
600 min Summer	9.283	0.0	375.5	936
720 min Summer	8.033	0.0	389.9	1008
960 min Summer	6.389	0.0	413.5	1144
1440 min Summer	4.620	0.0	448.4	1378
2160 min Summer	3.335	0.0	486.1	1596
2880 min Summer	2.644	0.0	513.8	1868
4320 min Summer	1.904	0.0	554.6	2472
5760 min Summer	1.506	0.0	585.6	3120
7200 min Summer	1.256	0.0	610.1	3760
8640 min Summer	1.082	0.0	630.5	4416

Cascade Summary of Results for Catchment C.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	92.114	0.114	4.2	17.4	O K
15 min Winter	92.270	0.270	5.0	46.3	O K
30 min Winter	92.343	0.343	5.0	61.8	O K
60 min Winter	92.433	0.433	5.0	83.1	O K
120 min Winter	92.542	0.542	5.0	112.0	O K
180 min Winter	92.622	0.622	5.0	135.5	O K
240 min Winter	92.659	0.659	5.0	147.1	O K
360 min Winter	92.688	0.688	5.0	156.7	O K
480 min Winter	92.705	0.705	5.0	162.1	Flood Risk
600 min Winter	92.714	0.714	5.0	165.2	Flood Risk
720 min Winter	92.719	0.719	5.0	166.8	Flood Risk
960 min Winter	92.722	0.722	5.0	167.9	Flood Risk
1440 min Winter	92.730	0.730	5.0	170.6	Flood Risk
2160 min Winter	92.703	0.703	5.0	161.7	Flood Risk
2880 min Winter	92.581	0.581	5.0	123.2	O K
4320 min Winter	92.281	0.281	5.0	48.5	O K
5760 min Winter	92.138	0.138	4.6	21.5	O K
7200 min Winter	92.109	0.109	4.0	16.5	O K
8640 min Winter	92.095	0.095	3.4	14.3	O K
10080 min Winter	92.086	0.086	3.0	12.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.953	0.0	648.1	5144
15 min Winter	129.843	0.0	146.5	311
30 min Winter	85.337	0.0	192.7	421
60 min Winter	53.483	0.0	242.2	532
120 min Winter	32.428	0.0	293.8	652
180 min Winter	23.896	0.0	324.8	726
240 min Winter	19.136	0.0	346.8	780
360 min Winter	13.890	0.0	377.6	864
480 min Winter	11.074	0.0	401.4	940
600 min Winter	9.283	0.0	420.5	1010
720 min Winter	8.033	0.0	436.7	1078
960 min Winter	6.389	0.0	463.1	1212
1440 min Winter	4.620	0.0	502.2	1450
2160 min Winter	3.335	0.0	544.4	1616
2880 min Winter	2.644	0.0	575.5	1920
4320 min Winter	1.904	0.0	621.3	2508
5760 min Winter	1.506	0.0	655.9	3048
7200 min Winter	1.256	0.0	683.3	3680
8640 min Winter	1.082	0.0	706.2	4408
10080 min Winter	0.953	0.0	725.9	5136

Cascade Rainfall Details for Catchment C.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.160

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.080	4	8	0.080

Cascade Model Details for Catchment C.srcx

Storage is Online Cover Level (m) 93.000

Tank or Pond Structure

Invert Level (m) 92.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	140.0	1.000	440.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0107-5000-0900-5000
Design Head (m)	0.900
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	92.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.0	Kick-Flo®	0.590	4.1
Flush-Flo™	0.271	5.0	Mean Flow over Head Range	-	4.3

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	3.6	1.200	5.7	3.000	8.8	7.000	13.1
0.200	4.9	1.400	6.1	3.500	9.4	7.500	13.6
0.300	5.0	1.600	6.5	4.000	10.1	8.000	14.0
0.400	4.9	1.800	6.9	4.500	10.6	8.500	14.4
0.500	4.6	2.000	7.2	5.000	11.2	9.000	14.8
0.600	4.1	2.200	7.6	5.500	11.7	9.500	15.2
0.800	4.7	2.400	7.9	6.000	12.2		
1.000	5.2	2.600	8.2	6.500	12.7		

Cascade Summary of Results for Catchment D.srcx

Upstream Structures	Outflow To	Overflow To
Catchment A.srcx	(None)	(None)
Catchment C.srcx		
Catchment B.srcx		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	92.338	0.338	10.5	167.2	O K
30 min Summer	92.430	0.430	10.5	220.0	O K
60 min Summer	92.523	0.523	10.5	275.9	O K
120 min Summer	92.628	0.628	10.5	343.2	O K
180 min Summer	92.677	0.677	10.5	375.7	O K
240 min Summer	92.709	0.709	10.5	397.5	Flood Risk
360 min Summer	92.753	0.753	10.5	428.1	Flood Risk
480 min Summer	92.781	0.781	10.5	448.5	Flood Risk
600 min Summer	92.799	0.799	10.5	461.0	Flood Risk
720 min Summer	92.803	0.803	10.5	464.5	Flood Risk
960 min Summer	92.790	0.790	10.5	454.9	Flood Risk
1440 min Summer	92.759	0.759	10.5	432.6	Flood Risk
2160 min Summer	92.707	0.707	10.5	395.9	Flood Risk
2880 min Summer	92.653	0.653	10.5	359.4	O K
4320 min Summer	92.531	0.531	10.5	280.8	O K
5760 min Summer	92.420	0.420	10.5	213.7	O K
7200 min Summer	92.315	0.315	10.5	154.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.843	0.0	343.6	23
30 min Summer	85.337	0.0	452.7	38
60 min Summer	53.483	0.0	574.2	104
120 min Summer	32.428	0.0	696.7	308
180 min Summer	23.896	0.0	770.2	350
240 min Summer	19.136	0.0	822.5	342
360 min Summer	13.890	0.0	895.6	368
480 min Summer	11.074	0.0	951.9	486
600 min Summer	9.283	0.0	997.3	606
720 min Summer	8.033	0.0	1035.5	722
960 min Summer	6.389	0.0	1097.6	846
1440 min Summer	4.620	0.0	1188.5	1086
2160 min Summer	3.335	0.0	1294.6	1472
2880 min Summer	2.644	0.0	1368.2	1900
4320 min Summer	1.904	0.0	1475.5	2680
5760 min Summer	1.506	0.0	1560.6	3400
7200 min Summer	1.256	0.0	1625.6	4024

Cascade Summary of Results for Catchment D.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Summer	92.234	0.234	10.4	112.0	O K
10080 min Summer	92.182	0.182	10.2	85.5	O K
15 min Winter	92.374	0.374	10.5	187.4	O K
30 min Winter	92.475	0.475	10.5	246.5	O K
60 min Winter	92.581	0.581	10.5	312.2	O K
120 min Winter	92.684	0.684	10.5	380.6	O K
180 min Winter	92.734	0.734	10.5	415.2	Flood Risk
240 min Winter	92.772	0.772	10.5	441.7	Flood Risk
360 min Winter	92.819	0.819	10.5	475.6	Flood Risk
480 min Winter	92.850	0.850	10.5	499.0	Flood Risk
600 min Winter	92.872	0.872	10.5	515.1	Flood Risk
720 min Winter	92.885	0.885	10.5	525.1	Flood Risk
960 min Winter	92.880	0.880	10.5	521.4	Flood Risk
1440 min Winter	92.838	0.838	10.5	490.3	Flood Risk
2160 min Winter	92.771	0.771	10.5	440.8	Flood Risk
2880 min Winter	92.697	0.697	10.5	389.5	O K
4320 min Winter	92.517	0.517	10.5	271.9	O K
5760 min Winter	92.307	0.307	10.5	150.3	O K
7200 min Winter	92.180	0.180	10.1	84.5	O K
8640 min Winter	92.148	0.148	9.1	68.6	O K
10080 min Winter	92.132	0.132	8.0	61.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.082	0.0	1679.6	4600
10080 min Summer	0.953	0.0	1724.9	5248
15 min Winter	129.843	0.0	385.3	23
30 min Winter	85.337	0.0	507.2	38
60 min Winter	53.483	0.0	643.4	240
120 min Winter	32.428	0.0	780.5	324
180 min Winter	23.896	0.0	862.8	188
240 min Winter	19.136	0.0	921.3	246
360 min Winter	13.890	0.0	1003.1	362
480 min Winter	11.074	0.0	1066.1	480
600 min Winter	9.283	0.0	1116.9	598
720 min Winter	8.033	0.0	1159.5	712
960 min Winter	6.389	0.0	1228.8	906
1440 min Winter	4.620	0.0	1329.3	1126
2160 min Winter	3.335	0.0	1450.2	1588
2880 min Winter	2.644	0.0	1532.7	2048
4320 min Winter	1.904	0.0	1653.3	2856
5760 min Winter	1.506	0.0	1748.0	3360
7200 min Winter	1.256	0.0	1820.9	3888
8640 min Winter	1.082	0.0	1881.6	4488
10080 min Winter	0.953	0.0	1932.7	5176

Cascade Rainfall Details for Catchment D.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.690

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.350	4	8	0.340

Cascade Model Details for Catchment D.srcx

Storage is Online Cover Level (m) 93.000

Tank or Pond Structure

Invert Level (m) 92.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	440.0	1.000	810.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0151-1050-0900-1050
Design Head (m)	0.900
Design Flow (l/s)	10.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	151
Invert Level (m)	92.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	10.5	Kick-Flo®	0.627	8.9
Flush-Flo™	0.284	10.5	Mean Flow over Head Range	-	8.9

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	5.4	1.200	12.0	3.000	18.6	7.000	27.9
0.200	10.3	1.400	12.9	3.500	20.0	7.500	28.9
0.300	10.5	1.600	13.8	4.000	21.3	8.000	29.8
0.400	10.3	1.800	14.6	4.500	22.6	8.500	30.7
0.500	10.0	2.000	15.3	5.000	23.7	9.000	31.5
0.600	9.3	2.200	16.0	5.500	24.9	9.500	32.3
0.800	9.9	2.400	16.7	6.000	25.9		
1.000	11.0	2.600	17.4	6.500	26.9		

Appendix B.4

1 IN 100 YEAR + CLIMATE CHANGE & CREEP

Cascade Summary of Results for Catchment A - Developmetn Creep.srcx

Upstream Structures	Outflow To	Overflow To
(None)	Catchment D - Development Creep.srcx	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.715	0.215	4.9	52.7	O K
30 min Summer	98.761	0.261	5.0	67.6	O K
60 min Summer	98.799	0.299	5.0	80.5	O K
120 min Summer	98.819	0.319	5.0	88.1	O K
180 min Summer	98.821	0.321	5.0	88.7	O K
240 min Summer	98.819	0.319	5.0	87.8	O K
360 min Summer	98.808	0.308	5.0	83.8	O K
480 min Summer	98.795	0.295	5.0	79.3	O K
600 min Summer	98.782	0.282	5.0	74.6	O K
720 min Summer	98.768	0.268	5.0	69.9	O K
960 min Summer	98.741	0.241	5.0	61.1	O K
1440 min Summer	98.695	0.195	4.9	46.7	O K
2160 min Summer	98.645	0.145	4.7	32.8	O K
2880 min Summer	98.618	0.118	4.3	25.9	O K
4320 min Summer	98.593	0.093	3.4	19.8	O K
5760 min Summer	98.580	0.080	2.8	16.8	O K
7200 min Summer	98.572	0.072	2.3	14.9	O K
8640 min Summer	98.566	0.066	2.0	13.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.843	0.0	55.7	21
30 min Summer	85.337	0.0	73.4	35
60 min Summer	53.483	0.0	92.7	64
120 min Summer	32.428	0.0	112.4	120
180 min Summer	23.896	0.0	124.3	152
240 min Summer	19.136	0.0	132.8	184
360 min Summer	13.890	0.0	144.6	250
480 min Summer	11.074	0.0	153.7	318
600 min Summer	9.283	0.0	161.1	384
720 min Summer	8.033	0.0	167.3	450
960 min Summer	6.389	0.0	177.4	580
1440 min Summer	4.620	0.0	192.3	824
2160 min Summer	3.335	0.0	208.7	1168
2880 min Summer	2.644	0.0	220.5	1504
4320 min Summer	1.904	0.0	237.9	2208
5760 min Summer	1.506	0.0	251.5	2936
7200 min Summer	1.256	0.0	262.0	3672
8640 min Summer	1.082	0.0	270.7	4408

Cascade Summary of Results for Catchment A - Developmetn Creep.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	98.561	0.061	1.8	12.5	O K
15 min Winter	98.736	0.236	5.0	59.4	O K
30 min Winter	98.787	0.287	5.0	76.4	O K
60 min Winter	98.828	0.328	5.0	91.3	O K
120 min Winter	98.853	0.353	5.0	101.1	O K
180 min Winter	98.856	0.356	5.0	102.0	O K
240 min Winter	98.851	0.351	5.0	100.0	O K
360 min Winter	98.836	0.336	5.0	94.3	O K
480 min Winter	98.818	0.318	5.0	87.5	O K
600 min Winter	98.798	0.298	5.0	80.3	O K
720 min Winter	98.777	0.277	5.0	73.1	O K
960 min Winter	98.738	0.238	5.0	59.8	O K
1440 min Winter	98.670	0.170	4.8	39.8	O K
2160 min Winter	98.617	0.117	4.3	25.6	O K
2880 min Winter	98.596	0.096	3.5	20.6	O K
4320 min Winter	98.577	0.077	2.6	16.0	O K
5760 min Winter	98.566	0.066	2.1	13.6	O K
7200 min Winter	98.559	0.059	1.7	12.2	O K
8640 min Winter	98.555	0.055	1.5	11.1	O K
10080 min Winter	98.551	0.051	1.3	10.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.953	0.0	278.1	5136
15 min Winter	129.843	0.0	62.4	21
30 min Winter	85.337	0.0	82.3	35
60 min Winter	53.483	0.0	103.8	64
120 min Winter	32.428	0.0	126.0	118
180 min Winter	23.896	0.0	139.3	172
240 min Winter	19.136	0.0	148.7	196
360 min Winter	13.890	0.0	162.0	272
480 min Winter	11.074	0.0	172.2	346
600 min Winter	9.283	0.0	180.4	418
720 min Winter	8.033	0.0	187.4	488
960 min Winter	6.389	0.0	198.7	618
1440 min Winter	4.620	0.0	215.4	854
2160 min Winter	3.335	0.0	233.7	1168
2880 min Winter	2.644	0.0	247.0	1524
4320 min Winter	1.904	0.0	266.5	2208
5760 min Winter	1.506	0.0	281.7	2944
7200 min Winter	1.256	0.0	293.4	3680
8640 min Winter	1.082	0.0	303.2	4392
10080 min Winter	0.953	0.0	311.5	5136

Cascade Rainfall Details for Catchment A - Developmetn Creep.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.232

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.116	4	8	0.116

Cascade Model Details for Catchment A - Developmetn Creep.srcx

Storage is Online Cover Level (m) 99.500

Tank or Pond Structure

Invert Level (m) 98.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	190.0	1.000	960.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0107-5000-0900-5000
Design Head (m)	0.900
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.0	Kick-Flo®	0.590	4.1
Flush-Flo™	0.271	5.0	Mean Flow over Head Range	-	4.3

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	3.6	1.200	5.7	3.000	8.8	7.000	13.1
0.200	4.9	1.400	6.1	3.500	9.4	7.500	13.6
0.300	5.0	1.600	6.5	4.000	10.1	8.000	14.0
0.400	4.9	1.800	6.9	4.500	10.6	8.500	14.4
0.500	4.6	2.000	7.2	5.000	11.2	9.000	14.8
0.600	4.1	2.200	7.6	5.500	11.7	9.500	15.2
0.800	4.7	2.400	7.9	6.000	12.2		
1.000	5.2	2.600	8.2	6.500	12.7		

Cascade Summary of Results for Catchment B - Development Creep.srcx

Upstream Structures	Outflow To	Overflow To
(None)	Catchment C - Development Creep.srcx	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.644	0.644	6.0	96.3	O K
30 min Summer	99.757	0.757	6.0	124.3	Flood Risk
60 min Summer	99.845	0.845	6.0	149.3	Flood Risk
120 min Summer	99.903	0.903	6.0	166.8	Flood Risk
180 min Summer	99.914	0.914	6.0	170.2	Flood Risk
240 min Summer	99.907	0.907	6.0	168.0	Flood Risk
360 min Summer	99.882	0.882	6.0	160.3	Flood Risk
480 min Summer	99.860	0.860	6.0	153.5	Flood Risk
600 min Summer	99.838	0.838	6.0	147.0	Flood Risk
720 min Summer	99.816	0.816	6.0	140.7	Flood Risk
960 min Summer	99.772	0.772	6.0	128.5	Flood Risk
1440 min Summer	99.680	0.680	6.0	104.7	O K
2160 min Summer	99.510	0.510	6.0	67.8	O K
2880 min Summer	99.367	0.367	6.0	42.6	O K
4320 min Summer	99.186	0.186	5.8	18.1	O K
5760 min Summer	99.125	0.125	5.1	11.5	O K
7200 min Summer	99.105	0.105	4.3	9.4	O K
8640 min Summer	99.093	0.093	3.7	8.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.843	0.0	101.6	22
30 min Summer	85.337	0.0	133.6	36
60 min Summer	53.483	0.0	167.6	66
120 min Summer	32.428	0.0	203.2	124
180 min Summer	23.896	0.0	224.7	182
240 min Summer	19.136	0.0	239.9	232
360 min Summer	13.890	0.0	261.2	290
480 min Summer	11.074	0.0	277.7	352
600 min Summer	9.283	0.0	290.9	420
720 min Summer	8.033	0.0	302.1	490
960 min Summer	6.389	0.0	320.4	628
1440 min Summer	4.620	0.0	347.5	900
2160 min Summer	3.335	0.0	376.4	1256
2880 min Summer	2.644	0.0	397.9	1588
4320 min Summer	1.904	0.0	429.6	2248
5760 min Summer	1.506	0.0	453.3	2936
7200 min Summer	1.256	0.0	472.3	3672
8640 min Summer	1.082	0.0	488.2	4336

Cascade Summary of Results for Catchment B - Development Creep.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	99.085	0.085	3.3	7.5	O K
15 min Winter	99.695	0.695	6.0	108.5	O K
30 min Winter	99.815	0.815	6.0	140.3	Flood Risk
60 min Winter	99.911	0.911	6.0	169.4	Flood Risk
120 min Winter	99.977	0.977	6.0	191.2	Flood Risk
180 min Winter	99.994	0.994	6.0	197.2	Flood Risk
240 min Winter	99.993	0.993	6.0	196.5	Flood Risk
360 min Winter	99.965	0.965	6.0	187.1	Flood Risk
480 min Winter	99.939	0.939	6.0	178.4	Flood Risk
600 min Winter	99.911	0.911	6.0	169.4	Flood Risk
720 min Winter	99.882	0.882	6.0	160.3	Flood Risk
960 min Winter	99.821	0.821	6.0	142.0	Flood Risk
1440 min Winter	99.683	0.683	6.0	105.5	O K
2160 min Winter	99.414	0.414	6.0	50.4	O K
2880 min Winter	99.220	0.220	5.9	22.2	O K
4320 min Winter	99.115	0.115	4.7	10.4	O K
5760 min Winter	99.094	0.094	3.7	8.3	O K
7200 min Winter	99.083	0.083	3.1	7.2	O K
8640 min Winter	99.075	0.075	2.7	6.5	O K
10080 min Winter	99.069	0.069	2.3	6.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.953	0.0	501.9	5136
15 min Winter	129.843	0.0	113.8	22
30 min Winter	85.337	0.0	149.6	36
60 min Winter	53.483	0.0	187.7	64
120 min Winter	32.428	0.0	227.6	122
180 min Winter	23.896	0.0	251.6	178
240 min Winter	19.136	0.0	268.7	232
360 min Winter	13.890	0.0	292.5	330
480 min Winter	11.074	0.0	311.0	376
600 min Winter	9.283	0.0	325.8	452
720 min Winter	8.033	0.0	338.4	530
960 min Winter	6.389	0.0	358.8	682
1440 min Winter	4.620	0.0	389.2	974
2160 min Winter	3.335	0.0	421.6	1300
2880 min Winter	2.644	0.0	445.6	1588
4320 min Winter	1.904	0.0	481.2	2204
5760 min Winter	1.506	0.0	507.7	2880
7200 min Winter	1.256	0.0	529.0	3608
8640 min Winter	1.082	0.0	546.8	4392
10080 min Winter	0.953	0.0	562.2	5136

Cascade Rainfall Details for Catchment B - Development Creep.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.418

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.209	4	8	0.209

Cascade Model Details for Catchment B - Development Creep.srcx

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	80.0	1.000	350.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0115-6000-1000-6000
Design Head (m)	1.000
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	115
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	6.0	Kick-Flo®	0.647	4.9
Flush-Flo™	0.298	6.0	Mean Flow over Head Range	-	5.2

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	4.0	1.200	6.5	3.000	10.0	7.000	15.0
0.200	5.8	1.400	7.0	3.500	10.8	7.500	15.5
0.300	6.0	1.600	7.5	4.000	11.5	8.000	16.0
0.400	5.9	1.800	7.9	4.500	12.2	8.500	16.5
0.500	5.7	2.000	8.3	5.000	12.8	9.000	17.0
0.600	5.3	2.200	8.7	5.500	13.4	9.500	17.4
0.800	5.4	2.400	9.0	6.000	14.0		
1.000	6.0	2.600	9.4	6.500	14.5		

Cascade Summary of Results for Catchment C - Development Creep.srcx

Upstream Structures	Outflow To	Overflow To
Catchment B - Development Creep.srcx	Catchment D - Development Creep.srcx	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	92.309	0.309	5.0	54.4	O K
30 min Summer	92.380	0.380	5.0	70.3	O K
60 min Summer	92.467	0.467	5.0	91.9	O K
120 min Summer	92.575	0.575	5.0	121.5	O K
180 min Summer	92.645	0.645	5.0	142.7	O K
240 min Summer	92.680	0.680	5.0	153.9	O K
360 min Summer	92.709	0.709	5.0	163.7	Flood Risk
480 min Summer	92.725	0.725	5.0	169.1	Flood Risk
600 min Summer	92.734	0.734	5.0	172.1	Flood Risk
720 min Summer	92.739	0.739	5.0	173.8	Flood Risk
960 min Summer	92.745	0.745	5.0	176.0	Flood Risk
1440 min Summer	92.759	0.759	5.0	180.6	Flood Risk
2160 min Summer	92.736	0.736	5.0	172.7	Flood Risk
2880 min Summer	92.688	0.688	5.0	156.7	O K
4320 min Summer	92.513	0.513	5.0	104.1	O K
5760 min Summer	92.346	0.346	5.0	62.5	O K
7200 min Summer	92.229	0.229	5.0	38.1	O K
8640 min Summer	92.161	0.161	4.8	25.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.843	0.0	143.8	273
30 min Summer	85.337	0.0	189.2	380
60 min Summer	53.483	0.0	237.9	488
120 min Summer	32.428	0.0	288.5	604
180 min Summer	23.896	0.0	318.9	672
240 min Summer	19.136	0.0	340.5	724
360 min Summer	13.890	0.0	370.8	806
480 min Summer	11.074	0.0	394.2	884
600 min Summer	9.283	0.0	413.0	956
720 min Summer	8.033	0.0	428.9	1026
960 min Summer	6.389	0.0	454.8	1160
1440 min Summer	4.620	0.0	493.2	1390
2160 min Summer	3.335	0.0	534.7	1604
2880 min Summer	2.644	0.0	565.2	1884
4320 min Summer	1.904	0.0	610.1	2540
5760 min Summer	1.506	0.0	644.1	3184
7200 min Summer	1.256	0.0	671.1	3824
8640 min Summer	1.082	0.0	693.6	4496

Cascade Summary of Results for Catchment C - Development Creep.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	92.126	0.126	4.5	19.3	O K
15 min Winter	92.333	0.333	5.0	59.6	O K
30 min Winter	92.417	0.417	5.0	79.2	O K
60 min Winter	92.521	0.521	5.0	106.3	O K
120 min Winter	92.654	0.654	5.0	145.7	O K
180 min Winter	92.706	0.706	5.0	162.6	Flood Risk
240 min Winter	92.732	0.732	5.0	171.3	Flood Risk
360 min Winter	92.762	0.762	5.0	181.9	Flood Risk
480 min Winter	92.781	0.781	5.0	188.6	Flood Risk
600 min Winter	92.793	0.793	5.0	192.9	Flood Risk
720 min Winter	92.800	0.800	5.0	195.6	Flood Risk
960 min Winter	92.808	0.808	5.0	198.4	Flood Risk
1440 min Winter	92.828	0.828	5.0	206.0	Flood Risk
2160 min Winter	92.807	0.807	5.0	198.2	Flood Risk
2880 min Winter	92.704	0.704	5.0	162.0	Flood Risk
4320 min Winter	92.393	0.393	5.0	73.4	O K
5760 min Winter	92.188	0.188	4.9	30.3	O K
7200 min Winter	92.120	0.120	4.4	18.4	O K
8640 min Winter	92.103	0.103	3.8	15.7	O K
10080 min Winter	92.093	0.093	3.3	13.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.953	0.0	712.9	5144
15 min Winter	129.843	0.0	161.1	314
30 min Winter	85.337	0.0	211.9	430
60 min Winter	53.483	0.0	266.5	548
120 min Winter	32.428	0.0	323.2	670
180 min Winter	23.896	0.0	357.2	744
240 min Winter	19.136	0.0	381.4	800
360 min Winter	13.890	0.0	415.3	886
480 min Winter	11.074	0.0	441.5	962
600 min Winter	9.283	0.0	462.6	1032
720 min Winter	8.033	0.0	480.3	1100
960 min Winter	6.389	0.0	509.3	1232
1440 min Winter	4.620	0.0	552.3	1462
2160 min Winter	3.335	0.0	598.9	1632
2880 min Winter	2.644	0.0	633.0	1936
4320 min Winter	1.904	0.0	683.4	2600
5760 min Winter	1.506	0.0	721.5	3152
7200 min Winter	1.256	0.0	751.6	3688
8640 min Winter	1.082	0.0	776.9	4408
10080 min Winter	0.953	0.0	798.5	5152

Cascade Rainfall Details for Catchment C - Development Creep.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.176

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.088	4	8	0.088

Cascade Model Details for Catchment C - Development Creep.srcx

Storage is Online Cover Level (m) 93.000

Tank or Pond Structure

Invert Level (m) 92.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	140.0	1.000	440.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0107-5000-0900-5000
Design Head (m)	0.900
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	92.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.0	Kick-Flo®	0.590	4.1
Flush-Flo™	0.271	5.0	Mean Flow over Head Range	-	4.3

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	3.6	1.200	5.7	3.000	8.8	7.000	13.1
0.200	4.9	1.400	6.1	3.500	9.4	7.500	13.6
0.300	5.0	1.600	6.5	4.000	10.1	8.000	14.0
0.400	4.9	1.800	6.9	4.500	10.6	8.500	14.4
0.500	4.6	2.000	7.2	5.000	11.2	9.000	14.8
0.600	4.1	2.200	7.6	5.500	11.7	9.500	15.2
0.800	4.7	2.400	7.9	6.000	12.2		
1.000	5.2	2.600	8.2	6.500	12.7		

Cascade Summary of Results for Catchment D - Development Creep.srcx

Upstream Structures	Outflow To	Overflow To
Catchment A - Developmetn Creep.srcx Catchment C - Development Creep.srcx Catchment B - Development Creep.srcx	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	92.368	0.368	10.5	184.1	O K
30 min Summer	92.468	0.468	10.5	242.2	O K
60 min Summer	92.571	0.571	10.5	305.9	O K
120 min Summer	92.676	0.676	10.5	374.7	O K
180 min Summer	92.724	0.724	10.5	408.3	Flood Risk
240 min Summer	92.761	0.761	10.5	434.0	Flood Risk
360 min Summer	92.806	0.806	10.5	466.3	Flood Risk
480 min Summer	92.836	0.836	10.5	488.3	Flood Risk
600 min Summer	92.856	0.856	10.5	503.1	Flood Risk
720 min Summer	92.867	0.867	10.5	511.8	Flood Risk
960 min Summer	92.858	0.858	10.5	505.2	Flood Risk
1440 min Summer	92.826	0.826	10.5	481.2	Flood Risk
2160 min Summer	92.778	0.778	10.5	446.5	Flood Risk
2880 min Summer	92.730	0.730	10.5	412.0	Flood Risk
4320 min Summer	92.634	0.634	10.5	347.1	O K
5760 min Summer	92.512	0.512	10.5	269.1	O K
7200 min Summer	92.401	0.401	10.5	202.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.843	0.0	378.5	23
30 min Summer	85.337	0.0	498.4	38
60 min Summer	53.483	0.0	632.2	224
120 min Summer	32.428	0.0	767.0	326
180 min Summer	23.896	0.0	847.9	228
240 min Summer	19.136	0.0	905.4	248
360 min Summer	13.890	0.0	985.8	368
480 min Summer	11.074	0.0	1047.8	486
600 min Summer	9.283	0.0	1097.6	606
720 min Summer	8.033	0.0	1139.5	724
960 min Summer	6.389	0.0	1207.7	896
1440 min Summer	4.620	0.0	1306.5	1112
2160 min Summer	3.335	0.0	1425.1	1496
2880 min Summer	2.644	0.0	1506.1	1908
4320 min Summer	1.904	0.0	1624.4	2792
5760 min Summer	1.506	0.0	1717.8	3464
7200 min Summer	1.256	0.0	1789.4	4120

Cascade Summary of Results for Catchment D - Development Creep.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
8640 min Summer	92.302	0.302	10.5	147.6	O K
10080 min Summer	92.229	0.229	10.4	109.0	O K
15 min Winter	92.407	0.407	10.5	206.4	O K
30 min Winter	92.516	0.516	10.5	271.4	O K
60 min Winter	92.640	0.640	10.5	350.9	O K
120 min Winter	92.732	0.732	10.5	413.2	Flood Risk
180 min Winter	92.790	0.790	10.5	454.9	Flood Risk
240 min Winter	92.829	0.829	10.5	483.0	Flood Risk
360 min Winter	92.878	0.878	10.5	520.2	Flood Risk
480 min Winter	92.913	0.913	10.6	546.5	Flood Risk
600 min Winter	92.936	0.936	10.7	565.0	Flood Risk
720 min Winter	92.953	0.953	10.8	577.8	Flood Risk
960 min Winter	92.961	0.961	10.8	584.3	Flood Risk
1440 min Winter	92.921	0.921	10.6	553.3	Flood Risk
2160 min Winter	92.859	0.859	10.5	505.5	Flood Risk
2880 min Winter	92.788	0.788	10.5	453.2	Flood Risk
4320 min Winter	92.662	0.662	10.5	365.6	O K
5760 min Winter	92.429	0.429	10.5	219.4	O K
7200 min Winter	92.245	0.245	10.5	117.7	O K
8640 min Winter	92.162	0.162	10.0	75.7	O K
10080 min Winter	92.144	0.144	8.8	66.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
8640 min Summer	1.082	0.0	1849.0	4736
10080 min Summer	0.953	0.0	1898.9	5344
15 min Winter	129.843	0.0	424.4	23
30 min Winter	85.337	0.0	558.1	38
60 min Winter	53.483	0.0	708.3	290
120 min Winter	32.428	0.0	859.2	128
180 min Winter	23.896	0.0	949.8	186
240 min Winter	19.136	0.0	1014.1	244
360 min Winter	13.890	0.0	1104.0	362
480 min Winter	11.074	0.0	1173.3	480
600 min Winter	9.283	0.0	1229.0	598
720 min Winter	8.033	0.0	1275.7	716
960 min Winter	6.389	0.0	1351.4	924
1440 min Winter	4.620	0.0	1458.4	1154
2160 min Winter	3.335	0.0	1596.3	1604
2880 min Winter	2.644	0.0	1687.1	2048
4320 min Winter	1.904	0.0	1820.1	3032
5760 min Winter	1.506	0.0	1924.2	3552
7200 min Winter	1.256	0.0	2004.4	4032
8640 min Winter	1.082	0.0	2071.2	4496
10080 min Winter	0.953	0.0	2127.7	5152

Cascade Rainfall Details for Catchment D - Development Creep.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.759

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.379	4	8	0.380

Cascade Model Details for Catchment D - Development Creep.srcx

Storage is Online Cover Level (m) 93.000

Tank or Pond Structure

Invert Level (m) 92.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	440.0	1.000	810.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0151-1050-0900-1050
Design Head (m)	0.900
Design Flow (l/s)	10.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	151
Invert Level (m)	92.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	10.5	Kick-Flo®	0.627	8.9
Flush-Flo™	0.284	10.5	Mean Flow over Head Range	-	8.9

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	5.4	1.200	12.0	3.000	18.6	7.000	27.9
0.200	10.3	1.400	12.9	3.500	20.0	7.500	28.9
0.300	10.5	1.600	13.8	4.000	21.3	8.000	29.8
0.400	10.3	1.800	14.6	4.500	22.6	8.500	30.7
0.500	10.0	2.000	15.3	5.000	23.7	9.000	31.5
0.600	9.3	2.200	16.0	5.500	24.9	9.500	32.3
0.800	9.9	2.400	16.7	6.000	25.9		
1.000	11.0	2.600	17.4	6.500	26.9		

Appendix C

CORRESPONDENCE

Asset location search

Thames Water Property Searches

WSP UK Ltd
1

BIRMINGHAM
B5 4PJ

Search address supplied	1 Little Heath Road Tilehurst Reading RG31 5TY
Your reference	Hallplace Farm
Our reference	ALS/ALS Standard/2018_3827535
Search date	3 July 2018

Keeping you up-to-date

Knowledge of features below the surface is essential in every development. The benefits of this not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility for any commercial or residential project.

An asset location search provides information on the location of known Thames Water clean and/or wastewater assets, including details of pipe sizes, direction of flow and depth. Please note that information on cover and invert levels will only be provided where the data is available.

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

Asset location search

Thames Water Property Searches

Search address supplied: 1, Little Heath Road, Tilehurst, Reading, RG31 5TY

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 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.

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

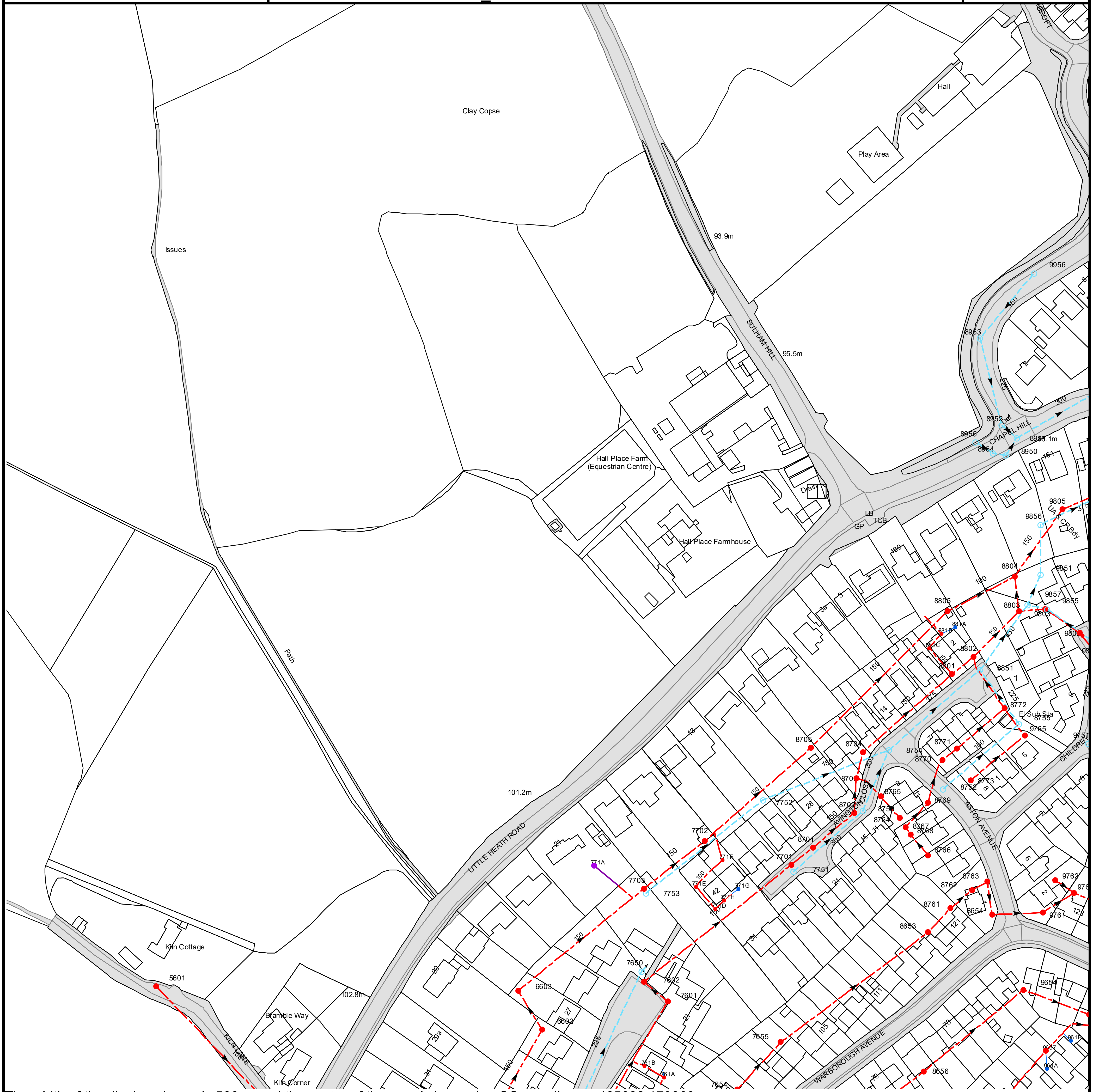
Clean Water queries

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/2018_3827535



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 465682,173869

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
8770	n/a	n/a
8754	90.83	88.53
8771	n/a	n/a
9751	92.34	90.22
9765	n/a	n/a
8755	90.53	89.47
8772	n/a	n/a
8801	90.02	88.47
8851	89.55	87.86
8802	89.63	88.15
9850	91.49	88.19
9802	n/a	n/a
8803	n/a	n/a
8805	n/a	n/a
9803	90.02	88.18
9855	n/a	n/a
9857	n/a	n/a
961A	n/a	n/a
9762	n/a	n/a
9764	n/a	n/a
9655	n/a	n/a
8764	n/a	n/a
8767	n/a	n/a
8768	n/a	n/a
8656	n/a	n/a
8769	n/a	n/a
8766	n/a	n/a
8653	n/a	n/a
8752	92.33	90.93
8761	n/a	n/a
8773	n/a	n/a
8762	n/a	n/a
8763	n/a	n/a
8654	n/a	n/a
9654	n/a	n/a
9761	n/a	n/a
9657	n/a	n/a
8804	88.6	87.49
9851	88.72	87
9856	n/a	n/a
9805	87.56	85.81
8950	89.3	87.76
8954	89.5	n/a
8955	89.76	88.94
8951	88.43	87.15
8952	88.86	87.41
8953	89.9	88.44
9956	90.52	89.07
7655	n/a	n/a
6602	100.38	n/a
7601	99.56	98.17
6603	n/a	n/a
7602	99.32	97.06
7650	99.14	97.26
771D	n/a	n/a
7753	n/a	n/a
7703	n/a	n/a
771E	n/a	n/a
7751	94.11	91.28
771A	n/a	n/a
7701	94.02	92.38
771F	n/a	n/a
8701	93.22	91.63
7702	94.49	92.91
8702	91.85	90.25
8753	91.84	89.51
7752	n/a	n/a
8765	n/a	n/a
8703	91.55	89.91
8704	91.4	89.7
8705	92.44	91.36
5601	104.01	102.64
881C	n/a	n/a
771H	n/a	n/a
771G	n/a	n/a
881B	n/a	n/a
881A	n/a	n/a
961B	n/a	n/a
761B	n/a	n/a
761A	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

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

Gulley

Culverted Watercourse

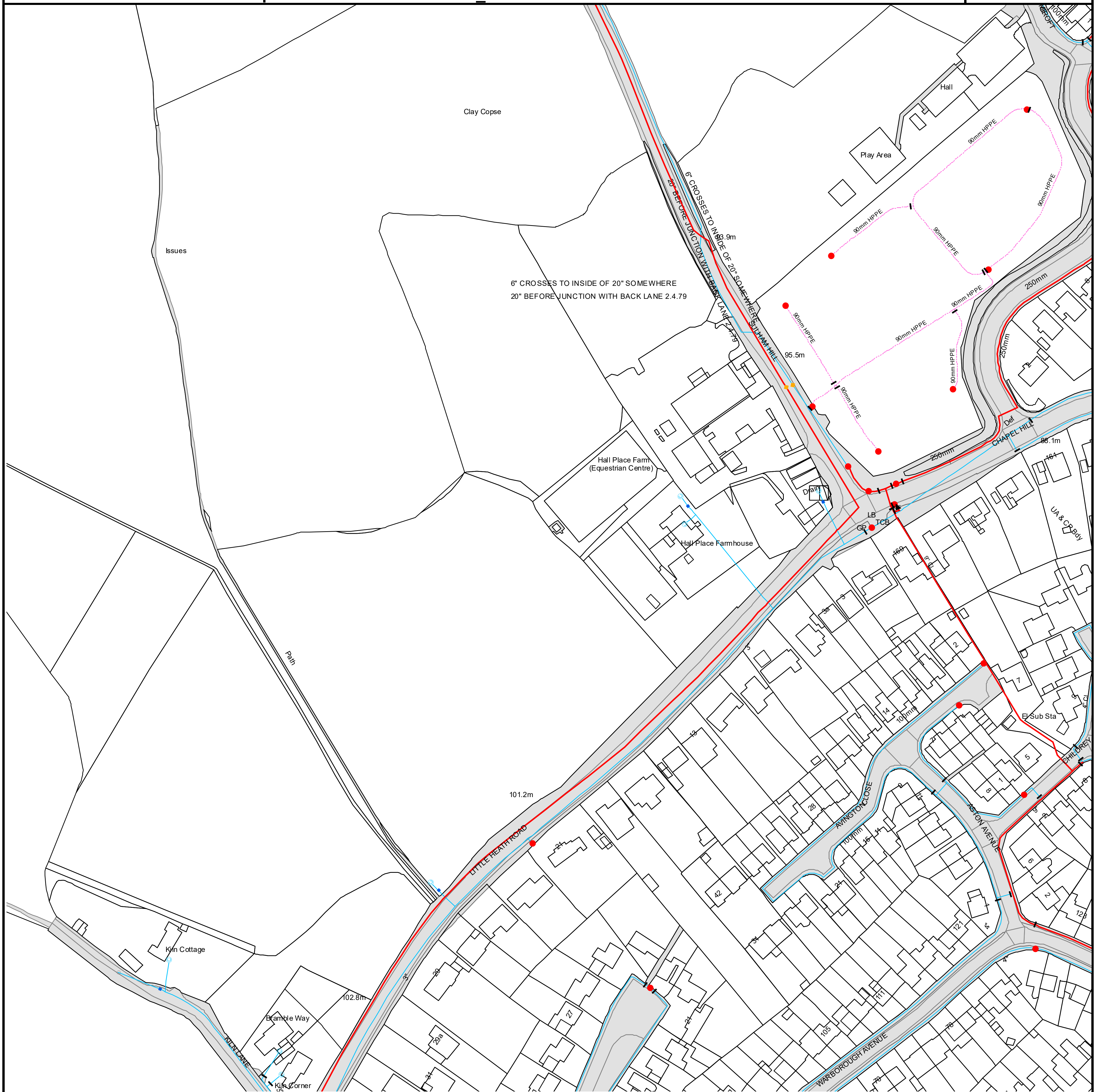
Proposed

Abandoned Sewer

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.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. 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.

Asset Location Search Water Map - ALS/ALS Standard/2018_3827535



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 465682, 173869.

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 Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4"

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

16"

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.

3" SUPPLY

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

3" FIRE

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

3" METERED

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

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 **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**

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

Search Code

IMPORTANT CONSUMER PROTECTION INFORMATION

This search has been produced by Thames Water Property Searches, Clearwater Court, Vastern Road, Reading RG1 8DB, which is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- 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.

By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports
- act with integrity and carry out work with due skill, care and diligence
- at all times maintain adequate and appropriate insurance to protect consumers
- conduct business in an honest, fair and professional manner
- handle complaints speedily and fairly
- ensure that products and services comply with industry registration rules and standards and relevant laws
- monitor their compliance with the Code

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award compensation of up to £5,000 to you if he finds that you have suffered actual loss as a result of your search provider failing to keep to the Code.

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
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

Sewer Flooding
History Enquiry

Thames Water Property Searches

WSP UK Ltd

Search address supplied	Hall Place Farm Sulham Hill Reading RG31 5UB

Your reference	Hallplace Farm
Our reference	SFH/SFH Standard/2018_3827536
Received date	**3 July 2018**
Search date	**5 July 2018**

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: Hall Place Farm,Sulham Hill,Reading,RG31 5UB

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

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

Property Searches

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

Miss Phoebe Secker
One Queens Drive
Birmingham
B5 4PJ

Wastewater pre-planning
Our ref DS6050556

23 July 2018

Pre-planning enquiry: Confirmation of sufficient capacity

Dear Miss Secker

Thank you for providing information on your development at **Hallplace Farm, Tilehurst, Reading, RG31 5UB.**

Residential development comprising 80 units. Foul Water discharging by gravity into MH9901. Surface Water discharging by gravity into MH8955 at max 5l/s for range of storms. No existing waste water connections.

We're pleased to confirm that there will be sufficient foul and surface water capacity in our sewerage network to serve your development, so long as your phasing follows the timescale you've suggested.

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 577 8082.

Yours sincerely

Artur Jaroma

Thames Water

Secker, Phoebe

From:	Enquiries_THM <enquiries_THM@environment-agency.gov.uk>
Sent:	20 July 2018 14:39
To:	Secker, Phoebe
Subject:	THM93227 - Product 4 Request - Hallplace Farm, Reading
Attachments:	FM.pdf
Filed:	-1
Filed Location:	\\Uk.wspgroup.com\central data\Projects\700482xx\70048292 - Hall Place Farm \01 Manage\05 Correspondence\02 Email\180720 143912 - Enquiries_THM - THM93227 - Product 4 Request - Hallplace Farm, Rea....msg
Filed Location Folder:	\\Uk.wspgroup.com\central data\Projects\700482xx\70048292 - Hall Place Farm \01 Manage\05 Correspondence\02 Email

Dear Phoebe,

Reference: THM93227

Thank you for your email requesting Product 4 data.

We unfortunately do not have any detailed flood risk modelling in this location.

We are sorry that we are therefore unable to provide modelled flood levels and extents for your site.

We have attached a copy of our Flood Map for Planning. There are no records of historic flood events within 500 metres of t the development sits. For further information on flood risk for the area in which the property sits, please visit: https://flood- information.service.gov.uk/long-term-flood-risk

For more information about how surface water flooding is managed in your local area or if they have other relevant local floo please contact West Berkshire Council.

I trust this is helpful.

How we have considered your request
We have considered your request under the provisions of the Freedom of Information Act 2000 / Environmental Information Regulations 2004 (EIR). The Act requires that we respond to requests by advising you whether or not information is held, and if so by providing you with that information.

EIR Regulation 3(2) states that information is held if it is in our possession and has been produced or received by us, or it is held by another person on our behalf at the time the request is received.

Information not held
In this case, the information you have requested is not held by the Environment Agency, and we are therefore refusing your request on the grounds that there is no information we can provide.

Where a request is for environmental information, the Regulations allow us to refuse to disclose it if the exception at EIR Regulation 12(4)(a) applies. The regulation states that a public authority may refuse to disclose environmental information to the extent that it does not hold that information when an applicant's request is received.

It is not possible for us to conduct a public interest balancing test because the reason for non-disclosure is that the information is not held.

I hope that we have correctly interpreted your request. Please refer to our Open Government License for the permitted use of the supplied data: http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

Please be aware that many of our datasets are now available online. Simply visit environment.data.gov.uk

We respond to requests for recorded information that we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

Kind regards,

Miss. Mehvish Maghribi
Customers and Engagement Team Officer
Environment Agency – Thames
T: 0203 0259 804
E: Enquiries_THM@environment-agency.gov.uk

Creating a better place for people and wildlife

From: Secker, Phoebe [mailto:Phoebe.Secker@wsp.com]
Sent: 02 July 2018 09:21
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>
Subject: 180703/KV06 Product 4 Request - Hallplace Farm, Reading

Dear Sir / Madam,

WSP has been appointed to undertake a flood risk assessment and drainage strategy for a site at Hallplace Farm an approximate postcode is RG31 5TY and co-ordinated are 465660,173843. A site location plan is attached.

Please would you be able to provide the following details as well as a Product 4?

Watercourses

- Details of any watercourses / culverted watercourses in the vicinity that the Environment Agency are responsible for maintaining – we are aware from the Flood Map for Planning the site lies wholly within Flood Zone 1.
- Minimum set back distances from these watercourse and what statutes / byelaws govern them.

Flood Defences / Other Structures

- Details of any flood defences in the area that are maintained by the Environment Agency including standard of protection, condition, type.
- Whether the maintenance includes climate change allowances.
- Details of any proposals for any future flood alleviation scheme that could affect the site and if so, provide details and timescales.
- Details of any other man-made structures / sources of flood risk that could affect the site.

Previous Flooding Records

- Any previous flooding records for the site or the surrounding area including dates, source, depth, extent and any further detail.

Groundwater

- Details of any groundwater levels in the vicinity of the site.
- Whether or not the site lies within a Groundwater Source Protection Zone.
- Details of any groundwater flooding issues in the area.

Reservoir Flood Risk

- Confirmation that the site is not located within an area susceptible to reservoir flooding, and provide a copy of the Reservoir Flood Map to confirm this.

We would appreciate an early response, therefore if you require any further information regarding the site to assist with our queries, please do not hesitate to contact me.

Kind regards,
Phoebe

Phoebe Secker *BSc (Hons)*
Graduate Engineer

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F +44 (0) 121 352 4701

WSP, One Queens Drive
Birmingham
B5 4PJ

wsp.com

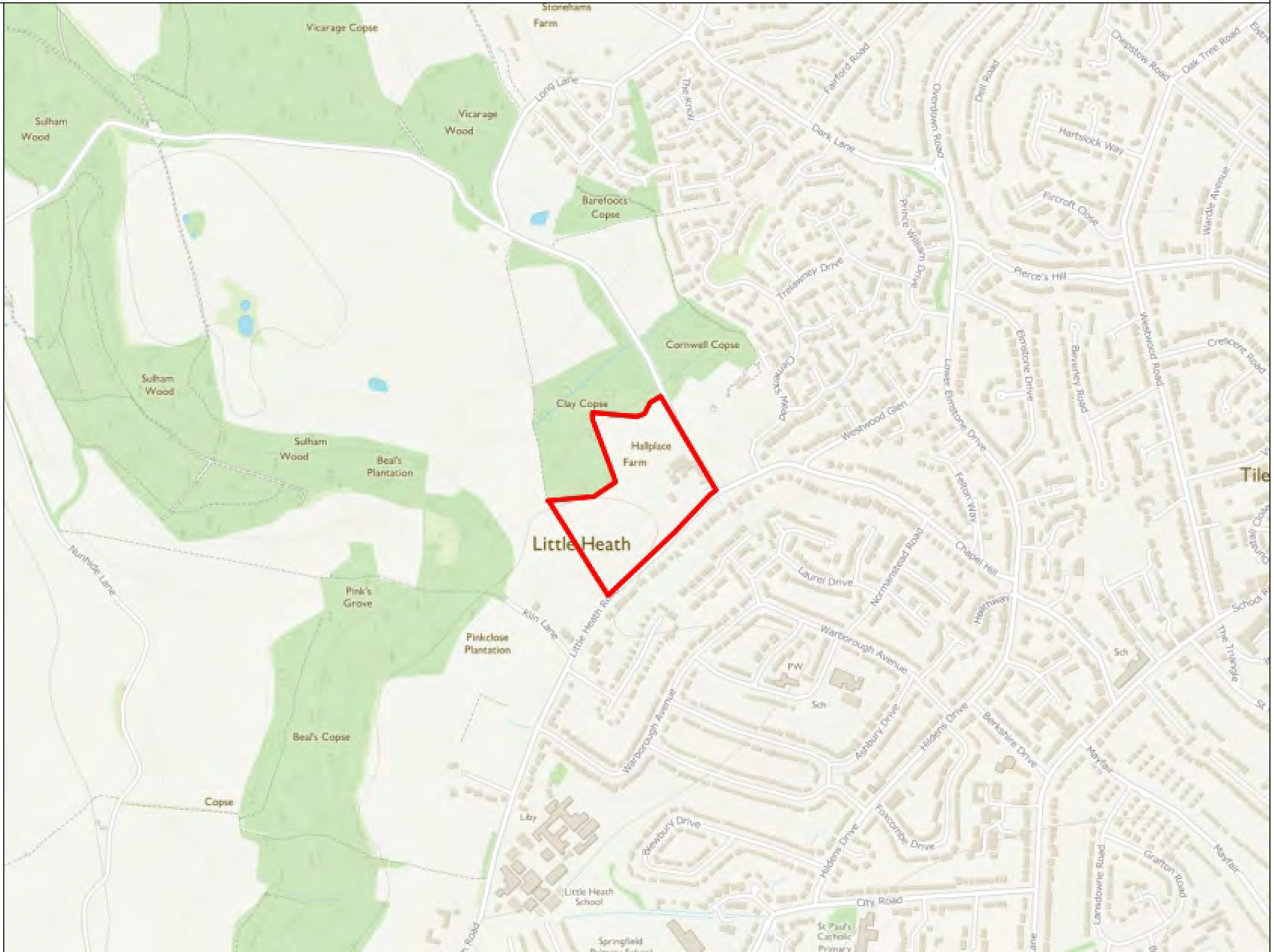
Click here to report this email as spam

THM93227 Flood Map for Planning centred on RG31 5TY

Environment Agency

Legend

- Sealed Main Rivers
- Defences
- Flood Storage Areas
- Areas benefiting from flood defence
- Flood Zone 3
- Flood Zone 2



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Secker, Phoebe

From:	Stuart Clark <Stuart.Clark@westberks.gov.uk>
Sent:	03 July 2018 13:57
To:	Secker, Phoebe
Subject:	RE: Flood Risk Information - Site at Hallplace Farm
Filed:	-1
Filed Location:	\\Uk.wspgroup.com\central data\Projects\700482xx\70048292 - Hall Place Farm \01 Manage\05 Correspondence\02 Email\180703 135631 - Stuart Clark - RE Flood Risk Information - Site at Hallplace Far....msg
Filed Location Folder:	\\Uk.wspgroup.com\central data\Projects\700482xx\70048292 - Hall Place Farm \01 Manage\05 Correspondence\02 Email

Dear Phoebe
We have no records of surface water or groundwater flooding in the area. However, I suggest you take a look at the EA's surface water flood maps. I believe our Planning department charge £350 for pre-planning advice but if it just concerns SuDs and/or flooding there is no charge.

Kind regards
Stuart

Stuart Clark Principal Engineer
West Berkshire Council
Highways & Transport | Council Offices | Market Street | Newbury | Berkshire | RG14 5LD
Tel : 01635 519857 | Fax : 01635 519637

From: Secker, Phoebe [mailto:Phoebe.Secker@wsp.com]
Sent: 02 July 2018 09:28
To: Stuart Clark <Stuart.Clark@westberks.gov.uk>
Subject: Flood Risk Information - Site at Hallplace Farm

Dear Stuart,

WSP has been appointed to undertake a flood risk assessment and drainage strategy for a site at Hallplace Farm an approximate postcode is RG31 5TY and co-ordinated are 465660,173843. A site location plan is attached.

We would like to request any historic flood records you hold for the site and would also like any policy you hold on surface water drainage.

We would welcome your comments on any additional issues or concerns you may have involving this site.

Please could you provide me with any associated costs with pre-planning advice?

We would appreciate an early response, therefore if you require any further information regarding the site to assist with our queries, please do not hesitate to contact on Phoebe.Secker@wsp.com or on 0121 352 4926.

Kind regards,
Phoebe

Phoebe Secker ***BSc (Hons)***
Graduate Engineer

T +44 (0) 121 352 4926
F +44 (0) 121 352 4701

WSP, One Queens Drive
Birmingham
B5 4PJ

wsp.com

Secker, Phoebe

From:	Stuart Clark <Stuart.Clark@westberks.gov.uk>
Sent:	22 August 2018 15:12
To:	Secker, Phoebe
Subject:	RE: Site at Hallplace Farm - Permissible Discharge Rate
Follow Up Flag:	Follow up
Flag Status:	Completed
Filed:	-1
Filed Location:	\\Uk.wspgroup.com\central data\Projects\700482xx\70048292 - Hall Place Farm \01 Manage\05 Correspondence\02 Email\180822 151141 - Stuart Clark - RE Site at Hallplace Farm - Permissible Discharge....msg
Filed Location Folder:	\\Uk.wspgroup.com\central data\Projects\700482xx\70048292 - Hall Place Farm \01 Manage\05 Correspondence\02 Email

Hi Phoebe
I am very sorry for the late reply.
I confirm that the proposed discharge rate of 4.4l/s/ha is acceptable. Where would the water be directed to?
Kind regards
Stuart

Stuart Clark Principal Engineer
West Berkshire Council
Highways & Transport | Council Offices | Market Street | Newbury | Berkshire | RG14 5LD
Tel : 01635 519857 | Fax : 01635 519637

From: Secker, Phoebe [mailto:Phoebe.Secker@wsp.com]
Sent: 10 August 2018 13:42
To: Stuart Clark <Stuart.Clark@westberks.gov.uk>
Cc: Caldwell, Alison <Alison.Caldwell@wsp.com>
Subject: Site at Hallplace Farm - Permissible Discharge Rate

Dear Stuart,

WSP has been appointed to undertake a flood risk assessment and drainage strategy for a site at Hallplace Farm an approximate postcode is RG31 5TY and co-ordinated are 465660,173843. A site location plan is attached.

In order to determine an appropriate discharge rate for the site, assumed to be greenfield, we have consulted a number of sources including:

- BGS geology mapping;
  - Identifying the site to be underlain by bedrock of bedrock of London Clay Formation (Clay, Silt and Sand), with a small area of the north-east of the site underlain by a bedrock of Lambeth Group (Clay, Silt and Sand). An extract of the BGS Geology Bedrock Map has been attached for your reference.
- BGS borehole records for the area; and,

- o Identified the nearest borehole to the site is located approximately 50m south of the site boundary, showing the geology to be comprised of brown & grey clay to a depth of 7m. A scan of the borehole record has been attached for your reference.

Despite sources identifying the ground to be clay, Microdrainage Software identifies that the soil index for the site is 0.15 which is associated with “well drained permeable sandy or loamy soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts” thereby generating a proposed discharge rate of 0.4l/s/ha. Given the information provided by BGS, and local understanding that the site is underlain by clay, we propose to adjust the soil index for the site to 0.40 which is associated with “Clayey, or loamy over clayey soils with an impermeable layer at shallow depth”. This would result in a proposed discharge rate of 4.4 l/s/ha. These calculations have been attached for your reference.

It should be noted that ground investigation, and infiltration testing, may be undertaken at the next stage of design to demonstrate that infiltration is not viable.

Given the proposed design principle outlined above, we would appreciate confirmation that this is an acceptable approach for the proposed development site.

Should you have any comments or queries, please do not hesitate to contact me.

Many thanks,
Phoebe

Phoebe Secker *BSc (Hons)*
Graduate Engineer

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