stomor
CIVIL ENGINEERING CONSULTANTS

FLOOD RISK ASSESSMENT

GRID REF: 505759E, 191614N

HAREFIELD GROVE

RICKMANSWORTH ROAD, HAREFIELD, UB9 6JH

Prepared for

COMER HOMES GROUP

SEPTEMBER 2021

REFERENCE: ST3118/FRA-2109
REVISION 0

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Revision	*Author*	*Checked by*	*Issue Date*
0	*JD*	*SJB*	*30.09.21*

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APPENDICES

1 Introduction

1.1 Stomor Ltd have been commissioned by Comer Homes Group to prepare a Flood Risk Assessment (FRA) associated with the proposed redevelopment of Harefield Grove off Rickmansworth Road in Harefield. A Site Location Plan is provided in **Appendix A**.

1.2 The overall area of the site is approximately 7.48 hectares (ha) and comprises an existing manor house with outbuildings, associated car parking and landscaping and an existing Lodge House at the site access.

1.3 Development proposals comprise conversion of the existing manor house and outbuildings into residential apartments, in addition to the demolition and reconstruction of the existing stable block and several new dwellings to provide a total of 41no. residential units.

1.4 The site was subject to an Outline Planning Application (Ref: 28301/APP/2013/3104) relating to the conversion of the historic main house and associated outbuildings to provide a total of 24no. residentials units. The application was submitted in 2013 and granted planning permission in April 2015.

1.5 An FRA was previously prepared by Cole Easdon Consultants (CEC) to support the 2013 planning application. No objections to the FRA or the accompanying documents were received from the statutory consultees.

1.6 Policy Context

1.6.1 The FRA has been prepared in accordance with the relevant national, regional and local planning policy as follows:

- The National Planning Policy Framework (NPPF) by the Ministry of Housing, Communities and Local Government, and accompanying National Planning Practice Guidance (NPPG).
- Department for Environment, Food and Rural Affairs (DEFRA) and The Environment Agency (EA) published Guidance for Planning Applications: Assessing Flood Risk.
- The EA Flood Risk Standing Advice (FRSA) version 3.1 (April 2012).
- The EA's Approach to Groundwater Protection (March 2017).

- The London Plan (March 2021).
- West London Strategic Flood Risk Assessment (SFRA).
- London Borough of Hillingdon (LBH) Surface Water Management Plan.

1.6.2 Furthermore, the FRA follows the methodology prescribed in Construction Industry Research and Information Association (CIRIA) document C624: Development and Flood Risk (2004), Guidance for the Construction Industry.

1.7 Vulnerability and the NPPF Sequential Test

1.7.1 The NPPF follows a sequential risk based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas.

1.7.2 The indicative floodplain map obtained from the EA website is provided in **Figure 1.1**. This shows the site to be located within Flood Zone 1.

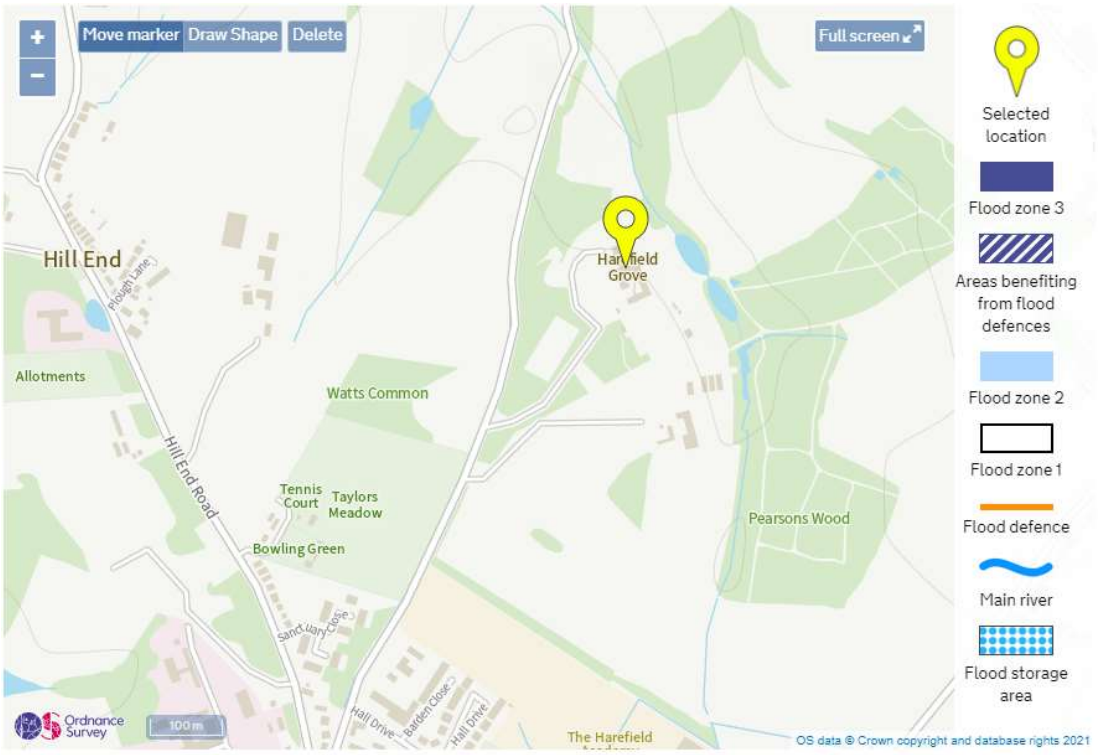

Figure 1.1 - Environment Agency Indicative Floodplain Map

1.7.3 The difference between Flood Zones 1, 2 and 3 are described in the table below:

Zone 1 Low Probability	Land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)
Zone 2 Medium Probability	Land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.55% – 0.1%) in any year.
Zone 3a High Probability	Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Zone 3b The Functional Floodplain	Land where water has to flow or be stored in times of flood. (Land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood or at another probability to be agreed between the LPA and the EA including water conveyance routes).

1.7.4 The Flood Risk and Coastal Change Category (ID 7) of the PPG and associated documents identifies that a Flood Risk Assessment is required for areas at risk of flooding, or for developments of more than 1ha within Flood Zone 1.

1.7.5 The Flood Risk and Coastal Change Category of the NPPG and associated documents identifies that site-specific flood risk assessments should identify and assess the risks of all forms of flooding to and from the development and demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account.

1.7.6 The development would have a NPPF flood risk vulnerability classification of ‘More Vulnerable’ and will be situated within Flood Zone 1. NPPG identifies that ‘More Vulnerable’ uses of land are appropriate within Flood Zones 1.

2 Site Location

2.1 The application site comprises 7.48ha of previously developed land, to the north east of Harefield. Of this, a net developable area of 1.20ha has been identified.

2.2 Access to the site is currently taken from Rickmansworth Road to the west. The access road leads to a parking area associated with the existing Main House.

2.3 The development boundary is defined by Rickmansworth Road to the west, Pearsons Wood to the north and east and existing farm buildings to the south.

2.4 The site levels generally slope from south west to north east. The highest point of the site is about 87.82m Above Ordnance Datum (AOD), towards the existing site access, and the lowest point is about 69.52m AOD to the north east of the site, adjacent to the unnamed watercourse passing through the site. A copy of the topographical survey is attached in **Appendix B.**

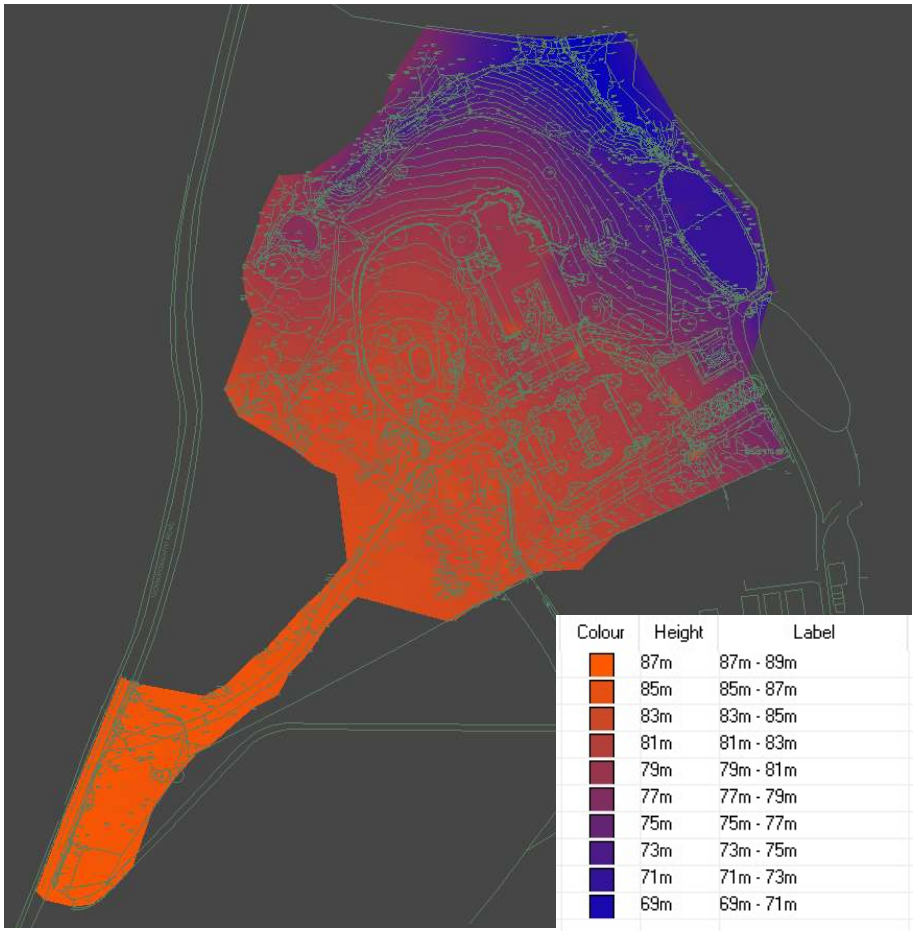

Figure 2.1: Contour shaded topographical survey of site.

2.5 An Ordinary Watercourse passes through the east side of the site from south to north. The nearest EA Statutory Main River is the River Colne, located approximately 1.6km west of the site, which runs from south to north in the area.

2.6 The site is located within a Groundwater Source Protection Zone 2. Therefore, there should be no restrictions on the area discharging via infiltration methods, subject to suitable infiltration rates and levels of water treatment.

3 Site Background

3.1 A level 1 Strategic Flood Risk Assessment (SFRA) for the area was prepared by Metis Consultants Ltd. in April 2018. The SFRA is used as a desk-based study to map all forms of flood risk to provide an evidence basis to locate new development primarily within low risk areas. The information allows the planning authority to identify the level of detail required for site-specific Flood Risk Assessments.

3.2 Inspection of the British Geological Survey (BGS) website identifies that the underlying ground conditions of the site comprise superficial deposits of Gerrards Cross Gravel underlain by Lambeth Group bedrock.

3.3 Inspection of Cranfield University's Soilscapes Map, obtained from the Land Information System (LandIS) website, identifies that the soil at the application site is base rich, loamy and clayey with impeded drainage. A copy of the Soilscapes map is provided in **Appendix C.**

3.4 Soil infiltration test results in accordance with BRE Digest 365 have been provided to Stomor by the Client which identified varying levels of infiltration potential across the site. Infiltration rates in the vicinity of the Main House were recorded at $3.6x10^{-8}ms^{-1}$ which would suggest infiltration in this area may not be feasible. Copies of the soakage test results are provided in **Appendix D.**

4 Existing Drainage

4.1 Investigations into the existing drainage of the site have been carried out using the above information in conjunction with the topographical survey and site inspection. In addition, existing Thames Water Utilities (TWU) drainage records have been obtained in order to identify the available public sewer networks in the vicinity of the site. A copy of the TWU records is provided in **Appendix E**.

4.2 Surface Water Drainage

4.2.1 TWU sewer records have identified that there are no public surface water sewers within the vicinity of the site. Inspection of the topographical survey suggests surface water runoff from the current site would appear to discharge to the unnamed Ordinary Watercourse to the east.

4.2.2 Inspection of the BGS website indicates that the underlying soil conditions may provide a suitable infiltration rate, although this would need to be confirmed by soil infiltration testing, in accordance with BRE Digest 365.

4.2.3 Considering an existing impermeable area of 0.73ha, based upon the topographical survey, brownfield runoff rates for the site during various storm events have been calculated, based upon the Modified Rational Method, as follows:

Storm Event	Rainfall Intensity	Peak Runoff Rate
1 in 1 year	50mm/h	101.5/s
1 in 30 years	126mm/h	255.6l/s
1 in 100 years	152mm/h	308.5l/s

4.2.4 Greenfield runoff rates have been calculated based upon IH124 Method, using a developable area of 1.20ha to be positively drained. Geotechnical information indicates that the underlying soil conditions would reflect Winter Rain Acceptance Potential (WRAP) Soil Class 3. A copy of the calculation sheet is provided in **Appendix F**, which gives flow rates as follows:

Greenfield Runoff (l/s)		
Qbar	-	5.5
1 in 1 year	Q1	4.7
1 in 30 years	Q30	12.7
1 in 100 years	Q100	17.7

4.3 Foul Drainage

4.3.1 TWU sewer records have identified no public foul water sewers in the immediate vicinity of the site. The nearest public foul water sewer is located on Rickmansworth Road, approximately 445m south west of the site access.

5 Proposed Development

5.1.1 Development proposals comprise conversion of the existing manor house and outbuildings into residential apartments, in addition to the demolition and reconstruction of the existing stable block and several new dwellings to provide a total of 41no. residential units.

5.1.2 As part of the redevelopment, the existing impermeable internal roads are to be replaced with free draining gravel, leading to an overall reduction in impermeable area associated with the site. It is anticipated that the redevelopment will generate a total impermeable area of 0.48ha to be positively drained, a reduction of 0.25ha from the existing 0.73ha.

5.1.3 Vehicular access to the site will be taken from Rickmansworth Road to the east of the application site, via the existing access.

5.1.4 The proposed development would have a NPPF flood risk vulnerability classification of ‘More Vulnerable’, which NPPG guidance deems appropriate within Flood Zones 1.

6 Proposed Site Drainage

6.1 General

6.1.1 Environment Agency (EA) Flood Risk Assessment (FRA) Guidance Note 1 - Development within a Critical Drainage area or greater than 1 hectare (ha) in Flood Zone 1 (Dated April 2012) states that the applicant should submit, "*Proposals for surface water management that aims to not increase, and where practicable reduce the rate of runoff from the site as a result of the development"*.

6.2 Surface Water Drainage

6.2.1 Surface water runoff from the site is likely to discharge into the unnamed Ordinary Watercourse to the east, either directly or via existing on-site drainage infrastructure.

6.2.2 For the purposes of this assessment, it is anticipated that redevelopment proposals will generate a total impermeable area of 0.48ha to be positively drained. A 10% allowance for increases in impermeable area due to Urban Creep has been allowed for in this assessment.

6.2.3 In accordance with EA Guidance, the order of consideration for the disposal of surface water runoff from a development should be as follows; infiltration methods, watercourses then public sewer network.

6.2.4 Inspection of the British Geological Survey (BGS) website identifies that the underlying ground conditions of the site comprise superficial deposits of Gerrards Cross Gravel, which indicates that there may be a suitable infiltration rate for the use of SuDS.

6.2.5 Soakage test results undertaken on site in accordance with BRE Digest 365 have been provided to Stomor Ltd by the Client and indicate varying levels of soil infiltration rates across the site. In the vicinity of the Main House, infiltration rates of $3.6x10^{-8}$ ms^{-1} were identified, which would suggest a positive outfall will likely be required.

6.2.6 Therefore, a connection to the adjacent unnamed Ordinary Watercourse would appear to be the most feasible point of discharge.

6.2.7 An indicative Drainage Strategy for the development is provided in **Appendix G.** The strategy demonstrates a proposed layout of SuDS to provide sufficient source control and storage to avoid flooding within the site during all storms up to and including the 1 in 100 year storm event plus 40% allowance for climate change.

6.2.8 The proposed SuDS solutions will need to have clear, enforceable maintenance regimes in place so that they provide effective flood protection and water treatment for the long term.

6.2.9 The CIRIA SuDS Manual C753 promotes the use of the Simple Index Approach as a method of determining water quality risk management and is generally regarded as the accepted method within the industry.

6.2.10 Table 26.2 of The SuDS Manual C753 gives pollution hazard indices for different land use classifications:

Land use	**Pollution hazard level**	**Total suspended solids (TSS)**	**Metals**	**Hydro-carbons**
Residential Roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. <300 traffic movements/day.	Low	0.5	0.4	0.4

6.2.11 Table 26.3 of The SuDS Manual provides typical treatments levels for discharge to surface waters. The proposed drainage strategy for the site incorporates permeable pavement, filter drains and a detention basin. An extract of the relevant sections of the table is reproduced below:

	Mitigation indices		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter Drain	0.4	0.4	0.4
Permeable Pavement	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6

6.2.12 To deliver adequate treatment, the selected SuDS components should have a total mitigation indices that equals or is greater than the pollution hazard index. Where a single SuDS component is insufficient, additional components in a series would be required where:

$$\textbf{Total SuDS mitigation index} = \textbf{mitigation index}_1 + 0.5\ (\textbf{mitigation index}_n)$$

6.2.13 Surface water runoff from residential roofs will, as a minimum, pass through the granular filter drains proposed across the site. Based on this, the total SuDS mitigation would be as follows:

	Mitigation indices		
SuDS components	**TSS**	**Metals**	**Hydrocarbons**
1) Filter Drain	0.4	0.4	0.4
Total	**0.4**	**0.4**	**0.4**

6.2.14 Surface water runoff from the remaining areas of hardstanding will, as a minimum, pass through the granular filter drain and detention basin. The total SuDS mitigation would be as follows:

	Mitigation indices		
SuDS components	**TSS**	**Metals**	**Hydrocarbons**
1) Filter Drain	0.4	0.4	0.4
2) Detention Basin	0.25	0.25	0.3
Total	**0.65**	**0.65**	**0.7**

6.2.15 From the above tables, it can be seen that the SuDS proposed on the development would provide more than the adequate treatment for the potential pollution hazards generated by the land uses.

6.2.16 In order to provide a robust assessment, drainage proposals will retain the 1 in 100 year storm event within the site, without generating flood risk to proposed buildings within or adjacent to the development, while also making provision for climate change, relating to a 40% increase in rainfall intensity. A Drainage Areas Plan, is provided in **Appendix H.**

6.2.17 The proposed drainage strategy has been modelled using Micro Drainage. Copies of Micro Drainage output files for the development are provided in **Appendix I**, demonstrating that the proposed SuDS features provide sufficient storage to avoid flooding during the 1 in 100 year storm event plus 40% allowance for climate change.

6.2.18 The above strategy must not be used for construction purposes and it is anticipated that the indicative proposals will be designed in detail. Storage volumes and drainage features must be confirmed by detailed design.

6.3 Foul Drainage

6.3.1 As previously stated, TWU sewer records have identified no public foul water sewers in the vicinity of the site. Therefore, foul water flows are to be directed to a package treatment

plant located on the site, before ultimately discharging to the Ordinary Watercourse to the east of the site.

6.3.2 A proposed strategy for the discharge of foul water flows from the development has been prepared and is attached in **Appendix G.** This drawing shows an illustrative drainage layout to demonstrate that the site can be drained based upon the proposed development. This drawing is a strategy only and must not be used for construction purposes.

6.4 Detailed Design and Approvals

6.4.1 The drainage strategy is subject to approval by LBH, where connections to the existing watercourse are proposed.

6.4.2 Approval from the EA will be required where foul flows are proposed to discharge to an Ordinary Watercourse, via a package treatment plant.

6.4.3 Proposed drainage systems will need to be modelled in MicroDrainage to confirm required pipe sizes and storage volumes.

6.4.4 Overland flow routes have been shown on the drainage strategy through the development to identify proposed flow paths for surface runoff during extreme storm events. Final external levels will be designed to prevent overland flow routes from entering buildings.

6.5 Maintenance of Drainage Features

6.5.1 The design process should consider the maintenance of the components including any corrective maintenance to repair defects or improve performance of SuDS. Inlets, outlets, control structures or other below ground features should be as shallow as reasonably possible to allow easy access for maintenance and to reduce safety risks, while ensuring that sufficient depth is maintained for structural stability.

6.5.2 A SuDS Management Plan will be provided at detailed design stage which will identify the following:

- The function of SuDS;
- How and why it works on the site;
- Impacts on amenity and wildlife, indicating how they can be enhanced;
- Health and safety issues;

6.5.3 Usually, SuDS components are on or near the surface and most can be managed using landscape maintenance techniques. Typical inspection and maintenance requirements for surface SuDS features are identified below:

Activity	Indicative frequency	Typical tasks
Routine/regular maintenance	Monthly (for normal care of SuDS)	• litter picking • grass cutting (cuttings to compost, wildlife piles or removed from site) Height and frequency dependent upon amenity of grass area. • inspection of inlets, outlets and control structures.
Occasional maintenance	Annually (dependent on the design)	• silt control around components • vegetation management around components • suction sweeping of permeable paving in autumn after leaf fall • silt and debris removal from inlets, outlets, gratings, catchpits, control chambers, soakaways and cellular storage. • strim wet swale or pond edges in September to October or 3-year rotation for wildlife value • wetland vegetation to be cut to 30% height annually and to 100mm on a 3 year rotation • remove overhanging trees or growth within SuDS features
Remedial maintenance	As required (tasks to repair problems due to damage or vandalism)	• inlet/outlet repair • erosion repairs • reinstatement of edgings • reinstatement following pollution • removal of silt build up.

6.5.4 For below-ground SuDS, such as permeable paving, the manufacturer or designer should provide maintenance advice. This should include routine and long-term actions that can be incorporated into the SuDS Management Plan.

6.5.5 Funding for the maintenance of SuDS features on the site should be resolved at the start of the development process to ensure that there are sufficient resources to maintain the systems in the long-term.

6.5.6 If the development is to be constructed in phases, the proposed surface water drainage system is established as soon as reasonably practicable. It will be necessary to ensure sufficient storage is provided for earlier phases of development to avoid flooding during the 1 in 100 year storm event plus 40% allowance for climate change.

7 Potential Sources of Flooding

7.1 Flooding from Rivers or Sea

7.1.1 The site levels vary significantly across the site, with existing levels falling towards the north eastern boundary. The highest point of the site is about 87.82m AOD, located adjacent to the existing site access to the south west. The lowest recorded level within the site is 69.52m AOD, located on the Ordinary Watercourse to the north east of the site.

7.1.2 The EA Indicative Floodplain Map, shown in **Figure 1.1**, identifies that the site lies wholly within Flood Zone 1; land considered to have a Very Low probability of flooding and defined as land having less than 1 in 1,1000 annual probability of river or sea flooding.

7.1.3 The primary source of fluvial flooding from the site would be the Ordinary Watercourse, which passes through the east side of the site from south to north.

7.1.4 The SFRA does not identify any recorded flood incidents within the vicinity of the site.

7.1.5 The EA indicative Floodplain Map identifies that fluvial flooding associated with the unnamed Ordinary Watercourse, or the River Colne located 1.6km away, would not affect any areas in the immediate vicinity of the site.

7.2 Flooding from Land (Surface Water)

7.2.1 Flooding from land occurs when intense rainfall is unable to soak into the ground or enter drainage systems. Local topography and built form can have a strong influence on the direction and depth of flow.

7.2.2 The EA indicative surface water flood map identifies most of the site as being at very low risk of surface water flooding. Land adjacent to the Ordinary Watercourse to the east of the site, as well as land adjacent to a ditch to the north of the site are considered to be at a high risk of surface water flooding.

7.2.3 Small sections of land around the existing manor house are also considered to be at medium/ high risk of surface water flooding. An extract from the EA website is provided in **Figure 7.1** below.

Figure 7.1 – Environment Agency Indicative Surface Water Flood Map

7.2.4 Overland flow paths will be taken into account in design of levels for the proposed development to direct overland flows away from buildings.

7.2.5 On-site drainage systems will be designed to accommodate runoff volume from a 1 in 100 year plus 40% climate change rainfall event, so as to minimise overland flow routes during such storm events.

7.3 Flooding from Groundwater

7.3.1 Groundwater flooding occurs when water levels in the ground rise above surface elevations. Groundwater flooding events are most likely to occur in low lying areas underlain by permeable rocks (aquifers).

7.3.2 The SFRA identifies the site as being <25% susceptible to groundwater flooding. A copy the Susceptibility to Groundwater Flooding map from the West London SFRA is provided in **Appendix J**.

7.3.3 It is anticipated that groundwater flooding should not be an issue to the proposed development. However, overland flow routes will be taken into account in the design of

levels for the proposed development and, should groundwater flooding occur on the site, flows will tend to run overland towards ponds situated at the low areas of the site.

7.4 Flooding from Sewers

7.4.1 The SFRA identified no historical recorded flooding events which can be related to sewers within the vicinity of the site. A sewer flooding history enquiry was submitted to TWU who confirmed that they have no historic recorded flooding incidents for the area in the vicinity of the site.

7.4.2 The development layout will be designed with consideration of flood routing, to ensure that new buildings and occupants of the site will not be subject to detrimental impacts in the event of flooding from infrastructure failure within or upstream of the site.

7.5 Flooding from Reservoirs, Canals and Other Artificial Sources

7.5.1 Inspection of the EA flood maps confirms that the unnamed Ordinary Watercourse passing through the site is considered to be at risk of flooding due to reservoirs. However, the extent of this flood risk is not shown to affect the proposed developable area of the site.

7.5.2 No other non-natural or artificial sources of flooding where water is retained above natural ground level, operational and redundant industrial processes including mining, quarrying and sand and gravel extraction, would appear to be located in the vicinity of the site which may cause increase floodwater depths or velocities.

8.0 Summary and Recommendations

8.1 Stomor Ltd have been commissioned by Comer Homes Group to prepare a Flood Risk Assessment associated with proposed redevelopment of the Harefield Grove site on Rickmansworth Road in Harefield.

8.2 The overall area of the site is approximately 7.48 hectares (ha) and comprises an existing manor house, outbuildings with associated access and landscaping. Development proposals comprise conversion of the existing manor house and outbuildings into residential apartments, in addition to the demolition and reconstruction of the existing stable block and several new dwellings to provide a total of 41no. residential units.

8.3 The nearest watercourse to the site is an Ordinary Watercourse, which passes through the site from south to north. The nearest EA Designated Main River is the River Colne, located approximately 1.6km to the west of the site.

8.4 The proposed development would have a NPPF flood risk vulnerability classification of 'More Vulnerable'. Based on EA data, the site is situated wholly within Flood Zone 1. NPPG identifies more vulnerable uses of land are permitted within Flood Zone 1.

8.5 The EA indicative surface water flood map identifies most of the site as being at very low risk of surface water flooding. Land adjacent to the Ordinary Watercourse to the east of the site, as well as land adjacent to a ditch to the north of the site and are considered to be at high risk of surface water flooding. Small sections of land around the existing manor house are also considered to be at medium/ high risk of surface water flooding.

8.6 Infiltration tests to BRE Digest 365 have been undertaken on site, which show soil infiltration rates to vary considerably. Infiltration rates in the vicinity of the existing manor house mean a positive outfall will likely be required. A connection to the adjacent Ordinary Watercourse would appear to be the most feasible point of discharge.

8.7 The proposed surface water drainage strategy demonstrates a system of SuDS and attenuation features to provide sufficient storage to avoid flooding within the site during the 1 in 100 year storm event + 40% allowance for climate change.

8.8 Overland flow paths will be taken into account in design of levels for the proposed development to direct overland flows away from buildings.

Existing Impermeable Areas
= 0.45ha
(to be removed as part of
proposed development)

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Client
Comer Homes Ltd

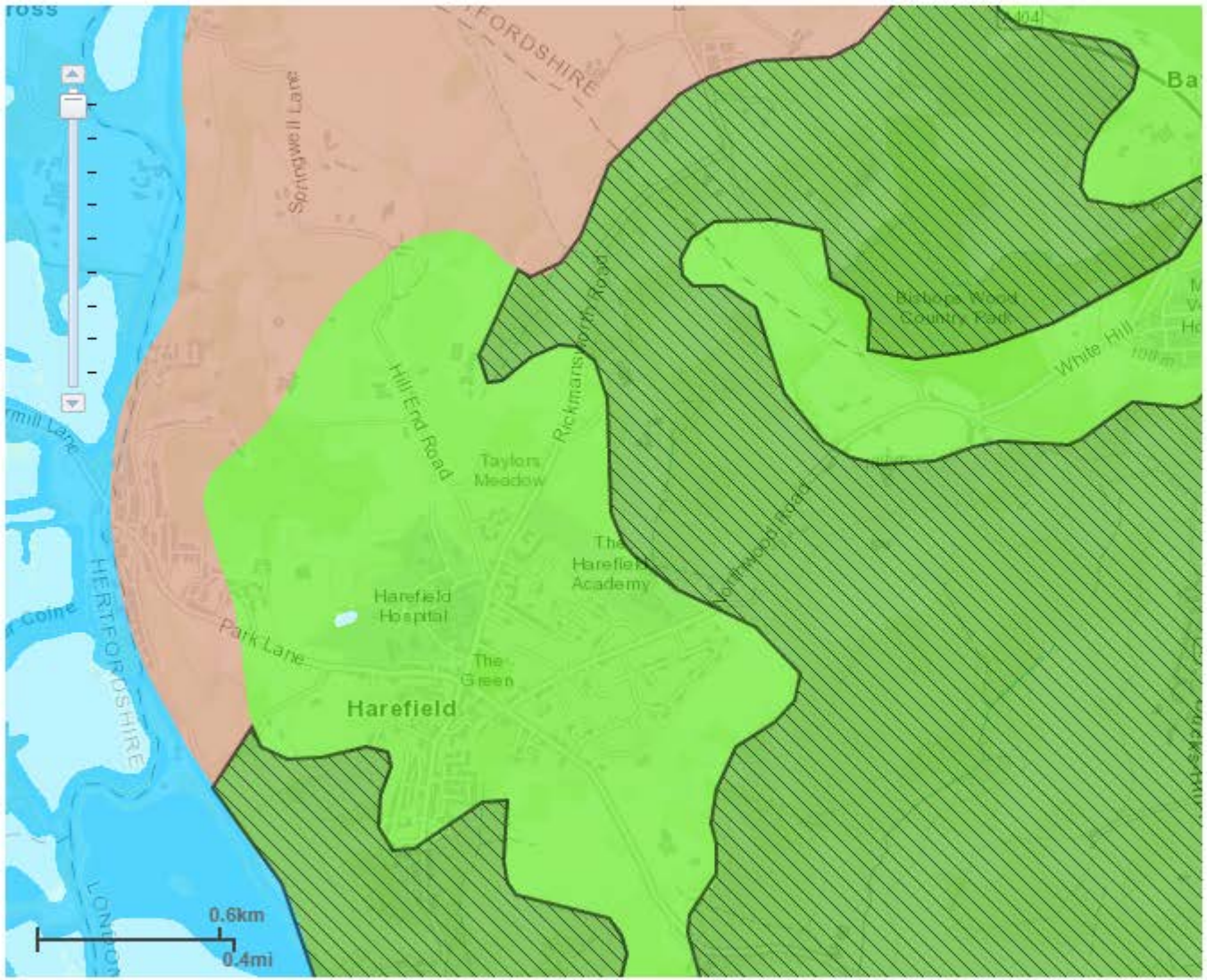
Job Title
Harefield Grove

Drawing Title
Existing Site and
Impermeable Areas

Designed by:	Drawn by:	Checked by:
RK	RK	DF

Date	Scale
15-06-12	1:500 @ A0

Drg. No.	Rev.
3482/500	



Adjust transparency

Legend

Search

Soil information

Soilscape 18:
Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils

Texture:
Loamy and clayey

Coverage:
England: 19.9% Wales: 2.4%
England & Wales: 17.5%

Selected area:
483km^2

Drainage:
Impeded drainage

Fertility:
Moderate

Habitats:
Seasonally wet pastures and woodlands

Landcover:
Grassland and arable some woodland

Carbon:
Low

Drains to:


TP1
TP2
TP3
TP4
TP5

Falling Head Permeability Test

Location TP1 – Harefield Grove Infiltration Tests in Accordance with BRE 365

Length of test section	2.0m
Width of test section	2.0m
Depth of test section	2.0m
Test Duration	2mins
Depth of Water at Commencement of Test	0.0m
Permeability	5.41×10^{-3}m/s

Time Elapsed (mins)	Depth of Water Top (m)	Time Elapsed (mins)	Depth of Water Top (m)
0.00	0.0	10.00	-
1.00	1.6	15.00	-
2.00	2.0	30.00	-
3.00	-	60.00	-
4.00	-		
5.00	-		

Falling Head Permeability Test

Location TP2 – Harefield Grove Infiltration Tests in Accordance with BRE 365

Length of test section	2.0m
Width of test section	2.0m
Depth of test section	2.0m
Test Duration	2mins
Depth of Water at Commencement of Test	0.0m
Permeability	7.23×10^{-3}m/s

Time Elapsed (mins)	Depth of Water Top (m)	Time Elapsed (mins)	Depth of Water Top (m)
0.00	0.0	10.00	-
1.00	1.2	15.00	-
2.00	1.9	30.00	-
3.00	2.0	60.00	-
4.00	-		
5.00	-		

Falling Head Permeability Test

Location TP3 – Harefield Grove Infiltration Tests in Accordance with BRE 365

Length of test section	2.0m
Width of test section	2.0m
Depth of test section	2.0m
Test Duration	2mins
Depth of Water at Commencement of Test	0.0m
Permeability	8.11×10^{-7}m/s

Time Elapsed (mins)	Depth of Water Top (m)	Time Elapsed (mins)	Depth of Water Top (m)
0.00	0.0	10.00	0.03
1.00	0.0	15.00	0.09
2.00	0.0	30.00	0.16
3.00	0.0	60.00	0.28
4.00	0.0		
5.00	0.0		

Falling Head Permeability Test

Location TP4 – Harefield Grove Infiltration Tests in Accordance with BRE 365

Length of test section	2.0m
Width of test section	2.0m
Depth of test section	2.0m
Test Duration	2mins
Depth of Water at Commencement of Test	0.0m
Permeability	3.60×10^{-8}m/s

Time Elapsed (mins)	Depth of Water Top (m)	Time Elapsed (mins)	Depth of Water Top (m)
0.00	0.0	10.00	0.02
1.00	0.0	15.00	0.03
2.00	0.0	30.00	0.06
3.00	0.0	60.00	0.10
4.00	0.0		
5.00	0.0		

Falling Head Permeability Test

Location TP5 – Harefield Grove Infiltration Tests in Accordance with BRE 365

Length of test section	2.0m
Width of test section	2.0m
Depth of test section	2.0m
Test Duration	60mins
Depth of Water at Commencement of Test	0.0m
Permeability	4.87×10^{-7}m/s

Time Elapsed (mins)	Depth of Water Top (m)	Time Elapsed (mins)	Depth of Water Top (m)
0.00	0.0	10.00	0.02
1.00	0.0	15.00	0.02
2.00	0.0	30.00	0.07
3.00	0.0	60.00	0.12
4.00	0.0		
5.00	0.0		

Asset location search

Property Searches

Stomor Ltd
19

HITCHIN
SG4 9SP

Search address supplied

Cube Metals Ltd
Harefield Grove
Rickmansworth Road
Harefield
Uxbridge
UB9 6JY

Your reference st-3118

Our reference ALS/ALS Standard/2021_4476564

Search date 28 July 2021

Knowledge of features below the surface is essential for every development

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

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

Contact us to find out more.

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

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0800 009 4540

Asset location search

Property Searches

Search address supplied: Cube Metals Ltd, Harefield Grove, Rickmansworth Road, Harefield, Uxbridge, UB9 6JY

Dear Sir / Madam

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

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

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

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

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

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

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

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

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Asset location search

Thames Water Property Searches

Waste Water Services

Please provide a copy extract from the public sewer map.

The following quartiles have not been printed as they contain no assets:

TQ0591NE
TQ0591SE

Following examination of our statutory maps, Thames Water has been unable to find any record of public sewerage within this area. However, there may be other sewerage pipework within the area that is not owned by the company. You may be able to obtain records of such pipework from the building control department of your local authority, from property deeds or from neighbouring landowners.

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.

Following examination of our statutory maps, Thames Water has been unable to find any plans of water mains within this area. If you require a connection to the public water supply system, please write to:

New Connections / Diversions
Thames Water
Network Services Business Centre
Brentford
Middlesex
TW8 0EE

Tel: 0845 850 2777
Fax: 0207 713 3858
Email: developer.services@thameswater.co.uk

Asset location search

Property Searches

The following quartiles have not been printed as they are out of Thames' water catchment area. For details of the assets requested please contact the water company indicated below:

TQ0591NE Affinity Water
TQ0591SE Affinity Water

Affinity Water Ltd
Tamblin Way
Hatfield
AL10 9EZ

Tel: 0345 3572401

For your guidance:

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

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

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

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

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

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

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

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

ALS/ALS Standard/2021_4476564

0 10 20 40 60 80
Meters

Scale:	1:1792
Width:	500m
Printed By:	G1KANAGA
Print Date:	28/07/2021
Map Centre:	505711,191560
Grid Reference:	TQ0591NE

Comments:

ALS/ALS Standard/2021_4476564

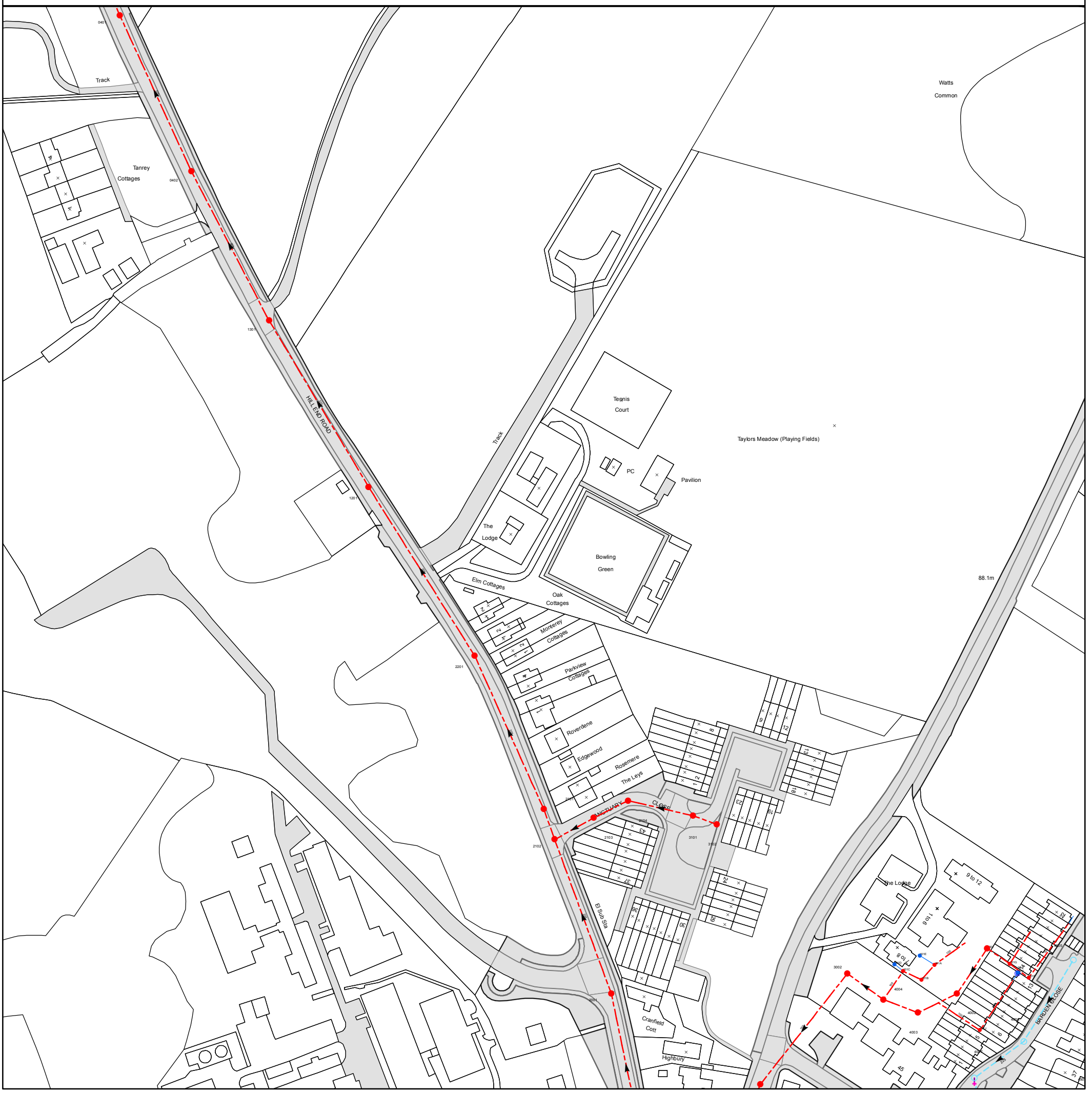
NB: Level quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no Survey information is available.

REFERENCE	COVER LEVEL	INVERT LEVEL

REFERENCE	COVER LEVEL	INVERT LEVEL

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

ALS/ALS Standard/2021_4476564



0 10 20 40 60 80 Meters

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 before any works are undertaken. Crown copyright Reserved

Scale:	1:1792
Width:	500m
Printed By:	G1KANAGA
Print Date:	28/07/2021
Map Centre:	505250,191250
Grid Reference:	TQ0591SW

Comments:

ALS/ALS Standard/2021_4476564

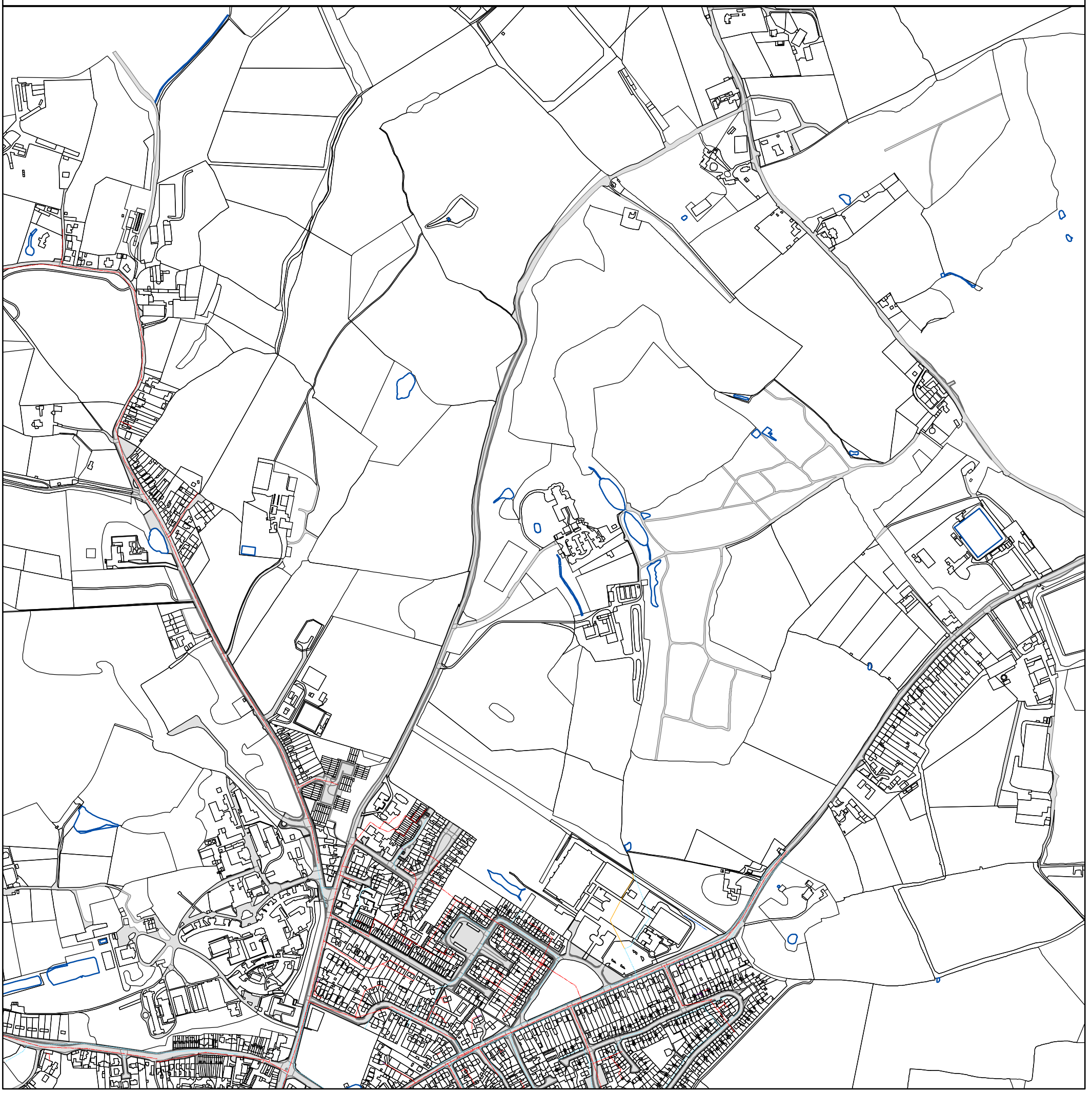
NB: Level quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no Survey information is available.

REFERENCE	COVER LEVEL	INVERT LEVEL
4006		
401I		
2201	87.2	86.31
3001	88.65	87.28
4004		
4002		
3002		
4003		
2102		
3102		
2104		
401A		
401B		
4001		
401F		

REFERENCE	COVER LEVEL	INVERT LEVEL
4007		
4005		
2103		
0401		
1301	86.87	85.47
1201	87.13	86.03
0402	87.58	85.47
2101	87.63	86.56
3101		
2001	88.04	86.74
401J		
401D		
401C		
401E		
401G		

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

ALS/ALS Standard/2021_4476564



0 45 90 180 270 360
Meters

Scale:	1:7158
Width:	2000m
Printed By:	G1KANAGA
Print Date:	28/07/2021
Map Centre:	505711,191560
Grid Reference:	TQ0591NE

Comments:

Terms and Conditions

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

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

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

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

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

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

Ways to pay your bill

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

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

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Jack Dudmish
Site name:	Harefield Grove
Site location:	Harefield

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.61317° N
Longitude:	0.474° W
Reference:	2738209797
Date:	Aug 18 2021 14:37

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 1.2

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	673	673
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

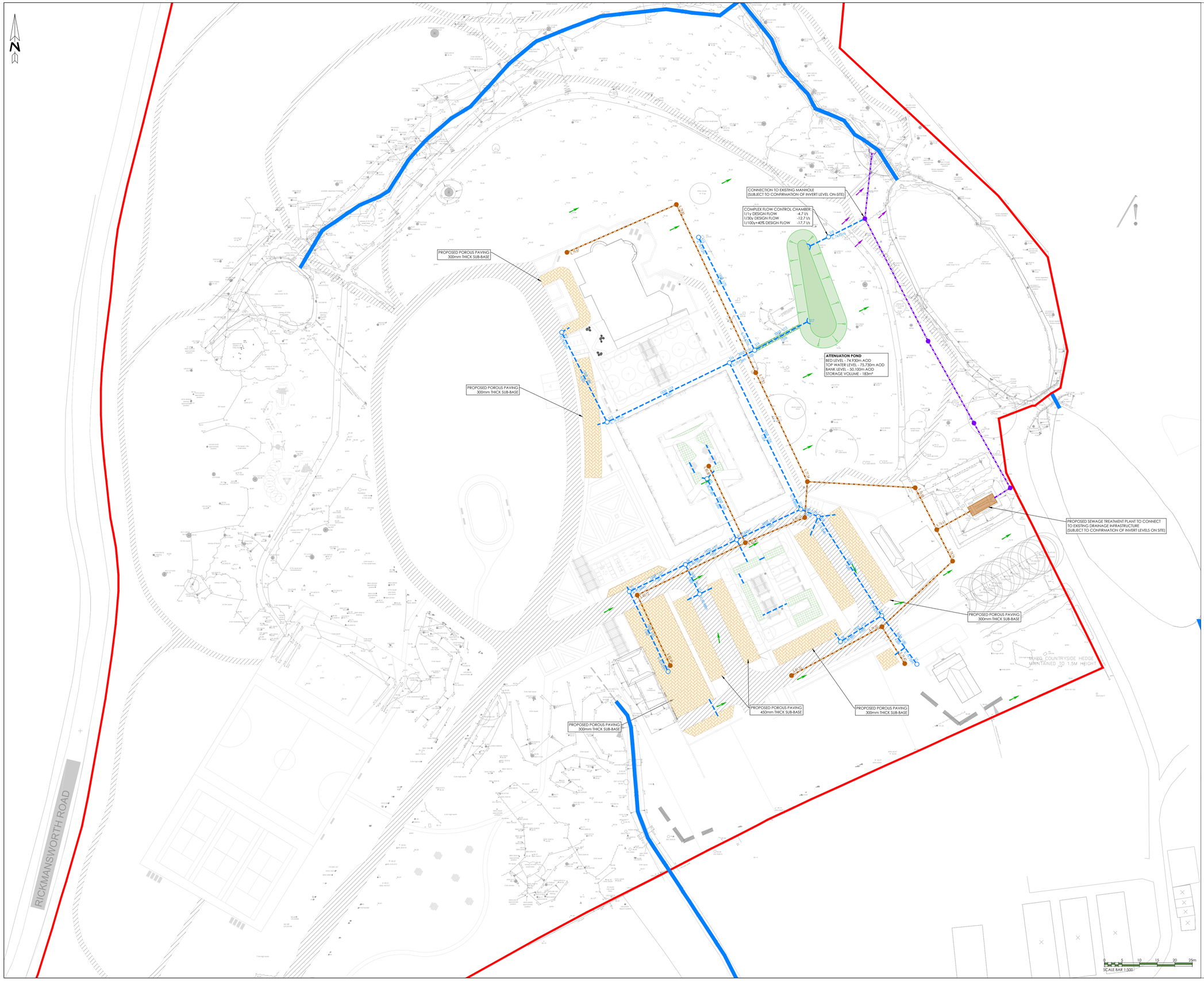
Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	5.53	5.53
1 in 1 year (l/s):	4.7	4.7
1 in 30 years (l/s):	12.73	12.73
1 in 100 year (l/s):	17.65	17.65
1 in 200 years (l/s):	20.69	20.69



KEY

- SITE BOUNDARY
- EXISTING WATERCOURSE
- EXTENT OF EXISTING HARDSTANDING TO BE REPLACED WITH PERMEABLE GRAVEL
- PROPOSED INFILTRATION TRENCH / FILTER DRAIN
- PROPOSED RAIN GARDEN/ BIO-RETENTION AREA
- PROPOSED POROUS PAVING
- PROPOSED DETENTION BASIN
- OVERLAND FLOW ROUTES
- EXCEEDANCE FLOW ROUTES
- PROPOSED SURFACE WATER PIPE RUN
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED FOUL WATER PIPE RUN
- PROPOSED FOUL WATER MANHOLE
- PROPOSED FOUL WATER PACKAGE TREATMENT PLANT
- EXISTING DRAINAGE RUN TO BE UTILISED
- EXISTING MANHOLE TO BE UTILISED

THIS IS AN INDICATIVE DRAINAGE & LEVELS STRATEGY AND SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES. DRAINAGE PROPOSALS ARE SUBJECT TO DETAILED DESIGN. THE ACTUAL POSITION AND DETAILS OF ANY EXISTING SERVICES ARE SUBJECT TO A DETAILED SURVEY.

NOTES

TOTAL SITE AREA = 7.48ha
NET DEVELOPABLE AREA = 1.20ha
PROPOSED IMPERMEABLE AREA = 0.48ha

PROPOSED IMPEREMABLE AREA + 10% URBAN CREEP = 0.53ha

GREENFIELD RUN OFF RATES:

- 1 IN 1 YEAR STORM EVENT = 4.7l/s
- 1 IN 30 YEAR STORM EVENT = 12.7/s
- 1 IN 100 YEAR STORM EVENT + 40% CLIMATE CHANGE ALLOWANCE = 17.7l/s

THE PROPOSED DISCHARGE RATE FOR ALL STORM EVENTS HAS BEEN RESTRICTED TO THE CORRESPONDING GREENFIELD RUNOFF RATE FOR THAT STORM EVENT.

EXTERNAL LEVELS TO BE DESIGNED TO GUIDE OVERLAND FLOWS AWAY FROM BUILDINGS AND TOWARDS THE SUDS FEATURES ACROSS THE SITE.

PROPOSED POROUS PAVING TO BE LINED UNLESS INFILTRATION RATES DEMONSTRATE SOAKAGE IS FEASIBLE.

ALL SUDS FEATURES ACROSS SITE TO UTILISE HYDROSEEDING TO ENSURE ESTABLISHED GROWTH PRIOR TO USE.

Rev	Description	Date	Drawn	Checked	Apvd.

Project

HAREFIELD GROVE, HAREFIELD

Drawing Description

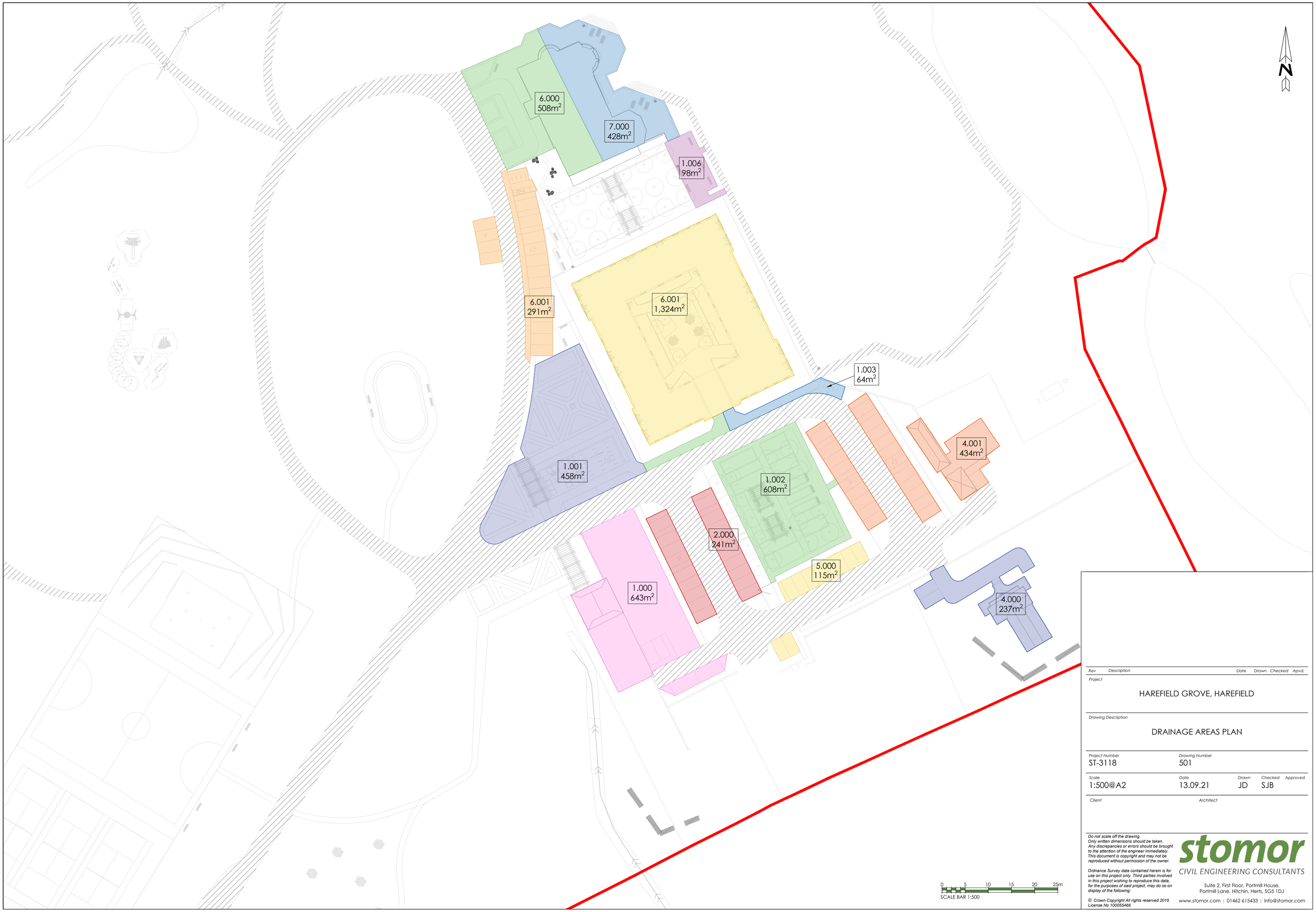
INDICATIVE DRAINAGE STRATEGY

Project Number	Drawing Number			
ST-3118	500			
Scale	**Date**	**Drawn**	**Checked**	**Approved**
1:500@A1	13.09.21	JD	SJB	

Client

Architect

stomor
CIVIL ENGINEERING CONSULTANTS
Suite 2, First Floor, Portmill House,
Portmill Lane, Hitchin, Herts, SG5 1DJ
www.stomor.com | 01462 615433 | info@stomor.com



Rev	Description	Date	Drawn	Checked	Apvd.

Project

HAREFIELD GROVE, HAREFIELD

Drawing Description

DRAINAGE AREAS PLAN

Project Number	*Drawing Number*			
ST-3118	501			
Scale	*Date*	*Drawn*	*Checked*	*Approved*
1:500@A2	13.09.21	JD	SJB	

Client *Architect*

Do not scale off the drawing.
Only written dimensions should be taken.
Any discrepancies or errors should be brought to the attention of the engineer immediately.
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stomor
CIVIL ENGINEERING CONSULTANTS
Suite 2, First Floor, Portmill House,
Portmill Lane, Hitchin, Herts, SG5 1DJ
www.stomor.com | 01462 615433 | info@stomor.com

Existing Network Details for Surface Network 1

* - Indicates pipe has been modified outside of System 1
\# - Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
* 1.000	25.256	0.995	25.4	0.064	5.00	0.600	o	150	Pipe/Conduit
1.001	17.651	0.859	20.5	0.046	0.00	0.600	o	150	Pipe/Conduit
2.000	9.301	0.203	45.8	0.024	5.00	0.600	o	150	Pipe/Conduit
* 1.002	16.838	0.792	21.3	0.061	0.00	0.600	o	150	Pipe/Conduit
* 3.000	22.304	0.372	60.0	0.132	5.00	0.600	o	300	Pipe/Conduit
* 1.003	19.496	0.957	20.4	0.006	0.00	0.600	o	300	Pipe/Conduit
4.000	17.037	0.214	79.6	0.024	5.00	0.600	o	150	Pipe/Conduit
5.000	13.832	0.859	16.1	0.012	5.00	0.600	o	150	Pipe/Conduit
4.001	33.431	0.417	80.2	0.043	0.00	0.600	o	150	Pipe/Conduit
4.002	5.403	0.068	79.5	0.000	0.00	0.600	o	150	Pipe/Conduit

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
* 1.000	S1	83.309	82.639	0.520	83.157	81.644	1.363		1200
1.001	S2	83.157	81.644	1.363	82.135	80.785	1.200	Orifice	1200
2.000	S3	82.338	80.988	1.200	82.135	80.785	1.200		1200
* 1.002	S4	82.135	80.785	1.200	81.584	79.993	1.441	Orifice	1200
* 3.000	S5	81.565	80.215	1.050	81.584	79.843	1.441		1200
* 1.003	S6	81.584	79.843	1.441	81.596	78.886	2.410		1200
4.000	S7	81.085	79.735	1.200	81.469	79.521	1.798		1200
5.000	S8	81.980	80.380	1.450	81.469	79.521	1.798		1200
4.001	S9	81.469	79.521	1.798	81.605	79.104	2.351		1200
4.002	S10	81.605	79.104	2.351	81.596	79.036	2.410		1200

Existing Network Details for Surface Network 1

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
*	1.004	45.591	1.750	26.1	0.000	0.00	0.600	o	300	Pipe/Conduit
	6.000	29.160	0.364	80.1	0.051	5.00	0.600	o	150	Pipe/Conduit
*	6.001	38.624	2.025	19.1	0.029	0.00	0.600	o	150	Pipe/Conduit
*	1.005	13.331	0.659	20.2	0.000	0.00	0.600	o	300	Pipe/Conduit
*	7.000	27.600	0.345	80.0	0.043	5.00	0.600	o	150	Pipe/Conduit
*	1.006	10.619	0.822	12.9	0.009	0.00	0.600	o	300	Pipe/Conduit
*	1.007	26.221	0.734	35.7	0.000	0.00	0.600	o	300	Pipe/Conduit
*	1.008	32.344#	4.231	7.6	0.000	0.00	0.600	o	300	Pipe/Conduit

	PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
*	1.004	S11	81.596	78.886	2.410	78.486	77.136	1.050		1200
	6.000	S12	81.026	79.676	1.200	81.668	79.312	2.206		1200
*	6.001	S13	81.668	79.311	2.207	78.486	77.286	1.050		1200
*	1.005	S14	78.486	77.136	1.050	78.096	76.477	1.319		900 x 675
*	7.000	S15	78.322	76.972	1.200	78.096	76.627	1.319		1200
*	1.006	S16	78.096	76.477	1.319	77.004	75.655	1.049		1200
*	1.007	S17	77.004	75.655	1.049	76.271	74.921	1.050		1200
*	1.008	S18	76.271	74.921	1.050	72.040	70.690	1.050	Complex	1200

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008	S21	72.040	70.690	0.000	0	0

Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	3.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 3	Number of Storage Structures 6	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.409		

Online Controls for Surface Network 1

Orifice Manhole: S2, DS/PN: 1.001, Volume (m³): 2.1

Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 81.644

Orifice Manhole: S4, DS/PN: 1.002, Volume (m³): 2.0

Diameter (m) 0.070 Discharge Coefficient 0.600 Invert Level (m) 80.785

Complex Manhole: S18, DS/PN: 1.008, Volume (m³): 3.3

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0102-4700-1000-4700
Design Head (m)	1.000
Design Flow (l/s)	4.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	74.921
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	4.7	Kick-Flo®	0.640	3.8
Flush-Flo™	0.299	4.7	Mean Flow over Head Range	-	4.1

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	3.4	1.200	5.1	3.000	7.9	7.000	11.7
0.200	4.6	1.400	5.5	3.500	8.4	7.500	12.1
0.300	4.7	1.600	5.8	4.000	9.0	8.000	12.5
0.400	4.6	1.800	6.2	4.500	9.5	8.500	12.9
0.500	4.5	2.000	6.5	5.000	10.0	9.000	13.2
0.600	4.1	2.200	6.8	5.500	10.5	9.500	13.6
0.800	4.2	2.400	7.1	6.000	10.9		
1.000	4.7	2.600	7.3	6.500	11.3		

Orifice

Diameter (m) 0.095 Discharge Coefficient 0.600 Invert Level (m) 75.186

Orifice

Diameter (m) 0.045 Discharge Coefficient 0.600 Invert Level (m) 75.721

Storage Structures for Surface Network 1

Porous Car Park Manhole: S1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.5
Membrane Percolation (mm/hr)	1000	Length (m)	33.3
Max Percolation (l/s)	115.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	82.639	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: S3, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.5
Membrane Percolation (mm/hr)	1000	Length (m)	25.2
Max Percolation (l/s)	66.5	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	80.838	Cap Volume Depth (m)	0.450

Porous Car Park Manhole: S8, DS/PN: 5.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.5
Membrane Percolation (mm/hr)	1000	Length (m)	15.8
Max Percolation (l/s)	24.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	80.380	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: S10, DS/PN: 4.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.6
Membrane Percolation (mm/hr)	1000	Length (m)	30.0
Max Percolation (l/s)	80.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	80.935	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: S12, DS/PN: 6.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	3.9
Membrane Percolation (mm/hr)	1000	Length (m)	22.0
Max Percolation (l/s)	23.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	80.506	Cap Volume Depth (m)	0.300

Tank or Pond Manhole: S18, DS/PN: 1.008

Invert Level (m) 74.930

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	143.0	1.250	360.0

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	3.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	50.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	120 Winter	1	+0%	100/15 Winter				82.661
1.001	S2	30 Winter	1	+0%	1/15 Summer	100/15 Summer			82.131
2.000	S3	1440 Winter	1	+0%	100/30 Summer				80.907
1.002	S4	15 Winter	1	+0%	1/15 Summer				81.157
3.000	S5	15 Winter	1	+0%					80.291
1.003	S6	15 Winter	1	+0%					79.911
4.000	S7	15 Winter	1	+0%	100/15 Summer				79.778
5.000	S8	60 Winter	1	+0%					80.390
4.001	S9	15 Winter	1	+0%	30/15 Summer				79.591
4.002	S10	15 Winter	1	+0%	30/15 Summer				79.180
1.004	S11	15 Winter	1	+0%					78.967
6.000	S12	15 Winter	1	+0%	100/15 Summer				79.740
6.001	S13	15 Winter	1	+0%	100/15 Summer				79.364
1.005	S14	15 Winter	1	+0%					77.230
7.000	S15	15 Winter	1	+0%	100/15 Summer				77.030

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.128	0.000	0.05		1.8	OK	
1.001	S2	0.337	0.000	0.10		3.5	SURCHARGED	2
2.000	S3	-0.231	0.000	0.00		0.0	OK	
1.002	S4	0.222	0.000	0.16		5.9	SURCHARGED	
3.000	S5	-0.224	0.000	0.15		18.4	OK	
1.003	S6	-0.232	0.000	0.11		24.6	OK	
4.000	S7	-0.107	0.000	0.18		3.3	OK	
5.000	S8	-0.140	0.000	0.01		0.6	OK	
4.001	S9	-0.080	0.000	0.44		8.4	OK	
4.002	S10	-0.074	0.000	0.51		8.4	OK	
1.004	S11	-0.219	0.000	0.16		33.1	OK	
6.000	S12	-0.086	0.000	0.37		7.0	OK	
6.001	S13	-0.097	0.000	0.27		10.5	OK	
1.005	S14	-0.206	0.000	0.21		43.6	OK	
7.000	S15	-0.092	0.000	0.31		6.0	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.006	S16	15 Winter	1	+0%					76.572
1.007	S17	15 Winter	1	+0%	100/15 Summer				75.767
1.008	S18	120 Winter	1	+0%	30/15 Summer				75.189

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.006	S16	-0.205	0.000	0.22		50.5	OK	
1.007	S17	-0.188	0.000	0.30		50.1	OK	
1.008	S18	-0.032	0.000	0.01		4.7	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	3.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	50.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	60 Winter	30	+0%	100/15 Winter				82.731
1.001	S2	15 Winter	30	+0%	1/15 Summer	100/15 Summer			82.902
2.000	S3	120 Winter	30	+0%	100/30 Summer				81.080
1.002	S4	15 Winter	30	+0%	1/15 Summer				81.287
3.000	S5	15 Winter	30	+0%					80.340
1.003	S6	15 Winter	30	+0%					79.946
4.000	S7	15 Winter	30	+0%	100/15 Summer				79.857
5.000	S8	15 Winter	30	+0%					80.405
4.001	S9	15 Winter	30	+0%	30/15 Summer				79.824
4.002	S10	15 Winter	30	+0%	30/15 Summer				79.295
1.004	S11	15 Winter	30	+0%					79.012
6.000	S12	15 Winter	30	+0%	100/15 Summer				79.790
6.001	S13	15 Winter	30	+0%	100/15 Summer				79.405
1.005	S14	15 Winter	30	+0%					77.288
7.000	S15	15 Winter	30	+0%	100/15 Summer				77.073

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.058	0.000	0.15		5.2	OK	
1.001	S2	1.108	0.000	0.16		5.8	SURCHARGED	2
2.000	S3	-0.058	0.000	0.16		3.7	OK	
1.002	S4	0.352	0.000	0.19		7.0	SURCHARGED	
3.000	S5	-0.175	0.000	0.36		45.3	OK	
1.003	S6	-0.197	0.000	0.25		54.0	OK	
4.000	S7	-0.028	0.000	0.42		7.8	OK	
5.000	S8	-0.125	0.000	0.07		2.7	OK	
4.001	S9	0.153	0.000	1.12		21.3	SURCHARGED	
4.002	S10	0.041	0.000	1.30		21.3	SURCHARGED	
1.004	S11	-0.174	0.000	0.36		74.3	OK	
6.000	S12	-0.036	0.000	0.91		17.2	OK	
6.001	S13	-0.056	0.000	0.69		27.1	OK	
1.005	S14	-0.148	0.000	0.50		101.9	OK	
7.000	S15	-0.049	0.000	0.77		14.6	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.006	S16	15 Winter	30	+0%					76.633
1.007	S17	15 Winter	30	+0%	100/15 Summer				75.843
1.008	S18	240 Winter	30	+0%	30/15 Summer				75.426

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.006	S16	-0.144	0.000	0.53		119.8	OK	
1.007	S17	-0.112	0.000	0.72		119.8	OK	
1.008	S18	0.205	0.000	0.03		12.7	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	3.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	50.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	60 Winter	100	+40%	100/15 Winter				82.883
1.001	S2	15 Winter	100	+40%	1/15 Summer	100/15 Summer			83.157
2.000	S3	240 Winter	100	+40%	100/30 Summer				81.539
1.002	S4	15 Winter	100	+40%	1/15 Summer				81.641
3.000	S5	15 Winter	100	+40%					80.393
1.003	S6	15 Winter	100	+40%					79.984
4.000	S7	15 Winter	100	+40%	100/15 Summer				80.674
5.000	S8	15 Winter	100	+40%					80.464
4.001	S9	15 Winter	100	+40%	30/15 Summer				80.566
4.002	S10	15 Winter	100	+40%	30/15 Summer				79.426
1.004	S11	15 Winter	100	+40%					79.056
6.000	S12	15 Winter	100	+40%	100/15 Summer				80.338
6.001	S13	15 Winter	100	+40%	100/15 Summer				79.596
1.005	S14	15 Winter	100	+40%					77.342
7.000	S15	15 Winter	100	+40%	100/15 Summer				77.372

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.094	0.000	0.16		5.6	SURCHARGED	
1.001	S2	1.363	0.369	0.17		6.4	FLOOD	2
2.000	S3	0.401	0.000	0.22		5.0	SURCHARGED	
1.002	S4	0.706	0.000	0.25		9.1	SURCHARGED	
3.000	S5	-0.122	0.000	0.65		82.4	OK	
1.003	S6	-0.159	0.000	0.44		94.6	OK	
4.000	S7	0.789	0.000	0.74		13.7	SURCHARGED	
5.000	S8	-0.066	0.000	0.30		12.4	OK	
4.001	S9	0.895	0.000	1.63		31.2	SURCHARGED	
4.002	S10	0.172	0.000	1.90		31.0	SURCHARGED	
1.004	S11	-0.130	0.000	0.60		123.2	OK	
6.000	S12	0.512	0.000	1.42		27.0	SURCHARGED	
6.001	S13	0.135	0.000	1.03		40.9	SURCHARGED	
1.005	S14	-0.094	0.000	0.81		164.0	OK	
7.000	S15	0.250	0.000	1.30		24.6	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.006	S16	15 Winter	100	+40%					76.761
1.007	S17	15 Winter	100	+40%	100/15 Summer				76.199
1.008	S18	120 Winter	100	+40%	30/15 Summer				75.735

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.006	S16	-0.016	0.000	0.84		189.8	OK	
1.007	S17	0.244	0.000	1.13		189.4	SURCHARGED	
1.008	S18	0.514	0.000	0.05		17.7	SURCHARGED	

Location Search

Legend

Borough Boundary

Study Area Boundary

Thames Water 2017 - Sewer Flooding Records (No. of Instances)

Total

- > 100
- 81 - 100
- 61 - 80
- 41 - 60
- 21 - 40
- 1 - 20
- 0

EA 2017 - Susceptiblity to Groundwater Flooding

- < 25%
- >= 25% <50%
- >= 50% <75%
- >= 75%
- others