STANSTED AIRPORT SOLAR FARM

Flood Risk Assessment and Sustainable Drainage Strategy

HLEF78850
Stansted Airport Solar Farm
3
January 2022

rpsgroup.com

Quality Management					
Version	**Status**	**Authored by**	**Reviewed by**	**Approved by**	**Review date**
1	Draft	Lauren Sims	Jonathan Morley	Jonathan Morley	September 21
2	Final Draft	Lauren Sims / Francesca Caggiano	Jonathan Morley	Jonathan Morley	November 21
3	Final	[redacted]			anuary 22

Prepared by:

RPS

20 Farringdon Street
London, EC4A 4AB

Prepared for:

Manchester Airports Group/Stanstead Airport Limited

Contents

Tables

Figures

Appendices

1 INTRODUCTION

1.1 RPS was commissioned to prepare a Flood Risk Assessment (FRA) of the *land east of Parsonage Lane, Bishops Stortford, CM22 6PT* in relation to the proposed solar farm development.

1.2 The aim of the FRA is to outline the potential for the site to be impacted by flooding, the impacts of the proposed development on flooding in the vicinity of the site, and the proposed measures which could be incorporated into the development to mitigate the identified risk. The report has been produced in accordance with the guidance detailed in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance (PPG). Reference has also been made to the CIRIA SuDS manual (C753), BRE Digest 365 Soakaway Design, the Uttlesford District Council Strategic Flood Risk Assessment (SFRA) and Preliminary Flood Risk Assessment (PFRA).

1.3 This report has been produced in consultation with the Environment Agency (EA) and the Lead Local Flood Authority (LLFA). The site is not located within an Internal Drainage Board (IDB) District.

1.4 This report is not intended to provide formal details of the final drainage design for the development. However, it provides information regarding the capabilities of the conceptual surface water drainage strategy to meet the requirements of the NPPF.

1.5 The desk study was undertaken by reference to information provided / published by the following bodies:

- Environment Agency (EA);
- Uttlesford District Council (UDC);
- Essex County Council (ECC);
- British Geological Survey (BGS);
- Ordnance Survey (OS); and
- Thames Water (TW).

2 PLANNING POLICY CONTEXT

National Planning Policy

2.1 The National Planning Policy Framework (NPPF) was released in March 2012 and was updated in July 2021. The document advises of the requirements for a site-specific Flood Risk Assessment (FRA) for any of the following cases (Planning and Flood Risk paragraph 167 (footnote 55)):

- All proposals (including minor development and change of use) located within the EA designated floodplain, recognised as either Flood Zone 2 (medium probability) or Flood Zone 3 (high probability);
- All proposals of 1 hectare (ha) or greater in an area located in Flood Zone 1 (low probability);
- All proposals within an area which has critical drainage problems (as notified to the Local Planning Authority by the EA);
- Land identified in a strategic flood risk assessment as being at increased flood risk in future; and
- Where proposed development may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

2.2 Paragraph 169 of the updated NPPF identifies that major developments (developments of 10 homes or more and to major commercial development) should incorporate Sustainable Drainage Systems unless there is clear evidence that this would be inappropriate. The systems used should:

a. Take account of advice from the Lead Local Flood Authority;

b. Have appropriate proposed minimum operational standards;

c. Have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and

d. Where possible, provide multifunctional benefits.

2.3 Defra published their 'Non-statutory technical standards for sustainable drainage systems' in March 2015. These are supported by the revised NPPF.

Local Planning Policy

2.4 The Uttlesford District Council are in the process of consulting a new Local Plan for which a draft is not yet available. The Council's 2005 Local Plan contains the following Policy relating to flood risk and drainage:

'Policy GEN3 – Flood Protection

2.5 Within the functional floodplain, buildings will not be permitted unless there is an exceptional need. Developments that exceptionally need to be located there will be permitted, subject to the outcome of flood risk assessment. Where existing sites are to be redeveloped, all opportunities to restore the natural flood flow areas should be sought.

2.6 Within areas of flood risk, within the development limit, development will normally be permitted where the conclusions of a flood risk assessment demonstrate an adequate standard of flood protection and there is no increased risk of flooding elsewhere.

2.7 Within areas of the floodplain beyond the settlement boundary, commercial industrial and new residential development will generally not be permitted. Other developments that exceptionally need to be located there will be permitted subject the outcome of a flood risk assessment.

2.8 *Outside flood risk areas development must not increase the risk of flooding through surface water run-off. A flood risk assessment will be required to demonstrate this. Sustainable Drainage Systems should also be considered as an appropriate flood mitigation measure in the first instance.*

2.9 *For all areas where development will be exposed to or may lead to an increase in the risk of flooding applications will be accompanied by a full Flood Risk Assessment (FRA) which sets out the level of risk associated with the proposed development. The FRA will show that the proposed development can be provided with the appropriate minimum standard of protection throughout its lifetime and will demonstrate the effectiveness of flood mitigation measures proposed.'*

2.10 The Uttlesford District Council SFRA identifies and maps flood risk from all sources at a boroughwide scale as well as providing guidance on producing site specific FRAs. Relevant information from the SFRA has been referenced throughout this FRA.

2.11 There are currently no Surface Water Management Plans (SWMPs) covering Uttlesford District. The settlement of Saffron Walden has been identified by Essex County Council as a Tier 2 area of local flood risk, to be completed in the future.

3 CONSULTATION

Environment Agency

3.1 The site is located within Flood Zone 1, therefore no consultation with the EA has been undertaken as part of the preparation of this report.

Water Authority

3.2 The public sewer network within the vicinity of the site is operated by Thames Water and Affinity Water. Preliminary consultation with Thames Water has identified there are no records of sewer flooding held at the site. Their response is included as Appendix A.

Lead Local Flood Authority

3.3 The LLFA is Essex Council. The LLFA has advised the following:

- In terms of surface water (overland) flows, they don't consider that the development is likely to have a significant impact.
- They would need to see a drainage strategy as part of a planning application to fully assess the impact the development would have. However, they do also acknowledge that the scale of the mitigation necessary would be lower than we would expect on other types of development because the amount of grassed surface that would remain after the development is completed.

3.4 Online guidance is available for solar farms, the key elements of this are summarised as follows:

- Research shows that solar panels themselves are only likely to contribute to a small increase in total runoff, approximately a 0.35% increase (Cook and McCuen, 2013).
- Solar farm applications should provide a drainage strategy as well as a land management strategy.
- Increased concentration of surface water flows can lead to soil erosion and channelisation, this can be mitigated by the inclusion of SuDS features such as buffers, swales, filter strips, and filter drains; maintaining vegetative areas in between the solar arrays at a long length; inclusion of infiltration basins and strips (where ground conditions allow); incorporation of bunds; and a land management plan.
- After construction the soil should be chisel ploughed, or similar, to mitigate soil compaction during construction. Furthermore, during the first few years it is important to hold frequent inspections of the planting and soil. Any remedial work should occur as soon as possible.

Internal Drainage Board

3.5 The site is not located within an IDB District.

4 SITE DESCRIPTION

Site Description

4.1 The site is located in Essex at National Grid Reference TL 56003 22918, is irregular in shape and occupies an area of approximately 22 hectares (ha). The site location is presented in Figure 1.

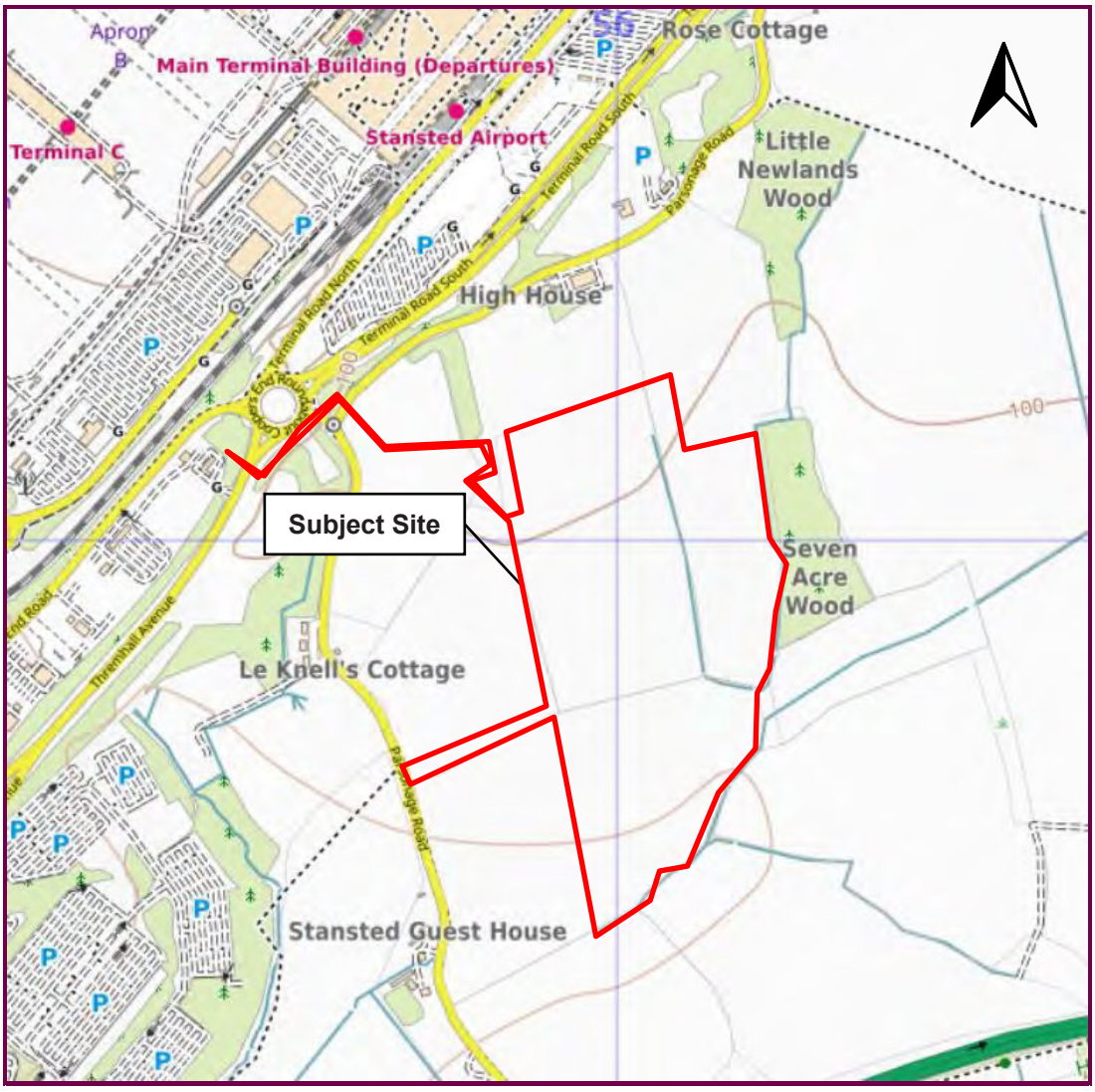


Figure 1. Site Location

4.2 The site is currently comprised of arable agricultural land, enclosed by trees and other mature vegetation. There are no current building structures present on the site.

4.3 Site access can be obtained from the east via a gate on Parsonage Road and an unsurfaced, unnamed track.

Surrounding Land Uses

4.4 Surrounding land use is predominantly agricultural to the east and south with the villages of Takeley and Little Canfield approximately 1 km south and 1.4 km south east from the site respectively. Approximately 280 m west is Parsonage Road with a few, sporadic residential dwellings. Stansted Airport exists approximately 440 m north west of the site.

4.5 There are no designated sensitive areas (e.g. Special Area of Conservation (SAC), Special Protection Area (SPA) or Site of Special Scientific Interest (SSSI)) within close proximity to the site.

Topography

4.6 A topographic survey was completed by RPS in October 2019, reference JKK10624_02, and indicates that the site slopes to the south/south east. Elevations reach around 103 metres above ordnance datum (m AOD) in the north of the site and fall to around 87.8 m AOD in the south and 90 m AOD in the south east. The unnamed track to the west of the site is elevated to 93 m AOD. The topographic survey is located in Appendix B.

Existing Drainage

4.7 Thames Water plans of public sewers, included as Appendix A, indicates that there is a foul water sewer (FW) approximately 310 m west of the site boundary. The sewer travels south into Manhole 5802 and then travels in a north westerly direction. No invert or cover levels were available for this manhole.

5 PROPOSED DEVELOPMENT

5.1 The development proposes to construct a solar photovoltaic (PV) system. Development plans are shown in Appendix C.

5.2 Site access will remain from the unnamed track to the west via Parsonage Road.

5.3 While the solar panels will not increase the impermeable area, as soft landscaping will remain beneath them, the proposed proportions are approximately as follows:

- 80% solar panels above soft landscaping;
- 20% open soft landscaping.

5.4 The development is proposing an area reserved for battery and energy storage which accounts for approximately 1057m^2 (~0.5% of the total site area). The units will be installed on gravel and they are elevated from ground levels. One substation of approximately 65m^2 is proposed as part of the development.

5.5 The proposed use of the site is classified as 'less vulnerable' within the PPG.

5.6 The potential to provide surface water attenuation, including the use of Sustainable Drainage Systems (SuDS), has been considered as part of the preliminary design process (see Section 10 – Surface Water Management).

6 HYDROLOGICAL SETTING

Nearby Watercourses

6.1 OS Mapping indicates that the nearest surface water feature is an ordinary watercourse present in the eastern portion of the site. A Phase 1 Preliminary Risk Assessment conducted by RPS in November 2019 (Ref: 191120-P-JER8224-NT) identified various drainage ditches on site.

6.2 The nearest EA main watercourse is Pincey Brook which is present approximately 500 m west of the site boundary and flows south from London Stansted Airport. No significant artificial watercourses / features (e.g. canals, reservoirs) have been identified within 1km of the site.

Fluvial / Tidal Flood Risk Classification

6.3 The EA Flood Map for Planning, which is available online, indicates that the site is located within Flood Zone 1, whereby the annual probability of flooding from fluvial or tidal sources is classified as up to 1 in 1,000 (0.1%). The EA Flood Map for Planning is provided in Figure 2.

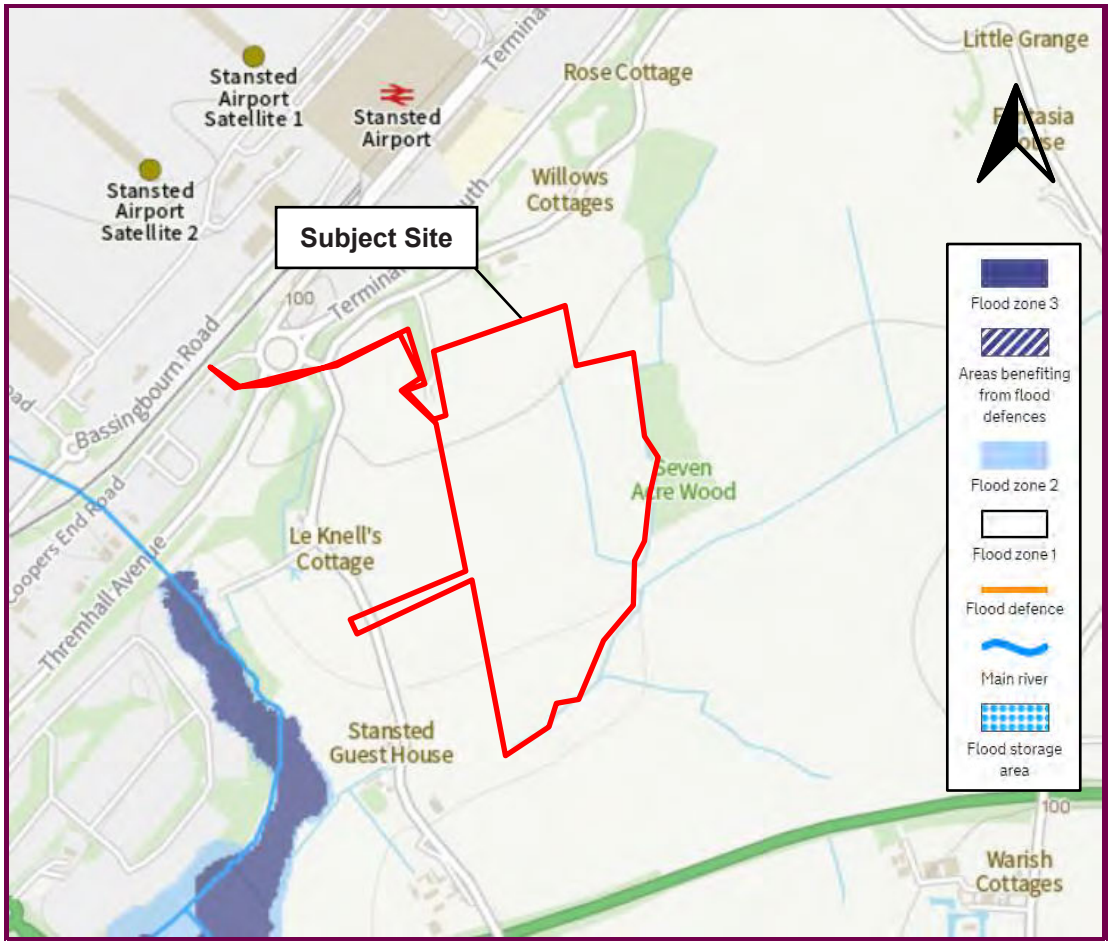


Figure 2. EA Flood Map for Planning

EA Flood Warning Area

6.4 The EA defines a Flood Warning Area as "*geographical areas where we expect flooding to occur and where we provide a Flood Warning Service. They generally contain properties that are expected to flood from rivers or the sea and in some areas, from groundwater.*"

6.5 The site is not located in an EA Flood Warning Area.

Surface Water Flood Risk Classification

6.6 The EA's updated Flood Map for Surface Water, which is available online, indicates that the north western portion of site is at 'very low' risk of surface water flooding. This corresponds with an annual probability of flooding that is up to 1 in 1,000 (0.1%). The land at the east of the site and portions of the southern extent, are identified as having 'low' risk of surface water flooding, corresponding to an annual probability between 1 in 1,000 and 1 in 100 (1%). Additionally, there are areas of 'medium' and 'high' risk near the southern site boundary. This relates to an annual probability of surface water flooding that is between 1 in 100 and 1 in 30 (3.3%) or greater than 1 in 30, respectively. The updated Flood Map for Surface Water is presented in Figure 3.

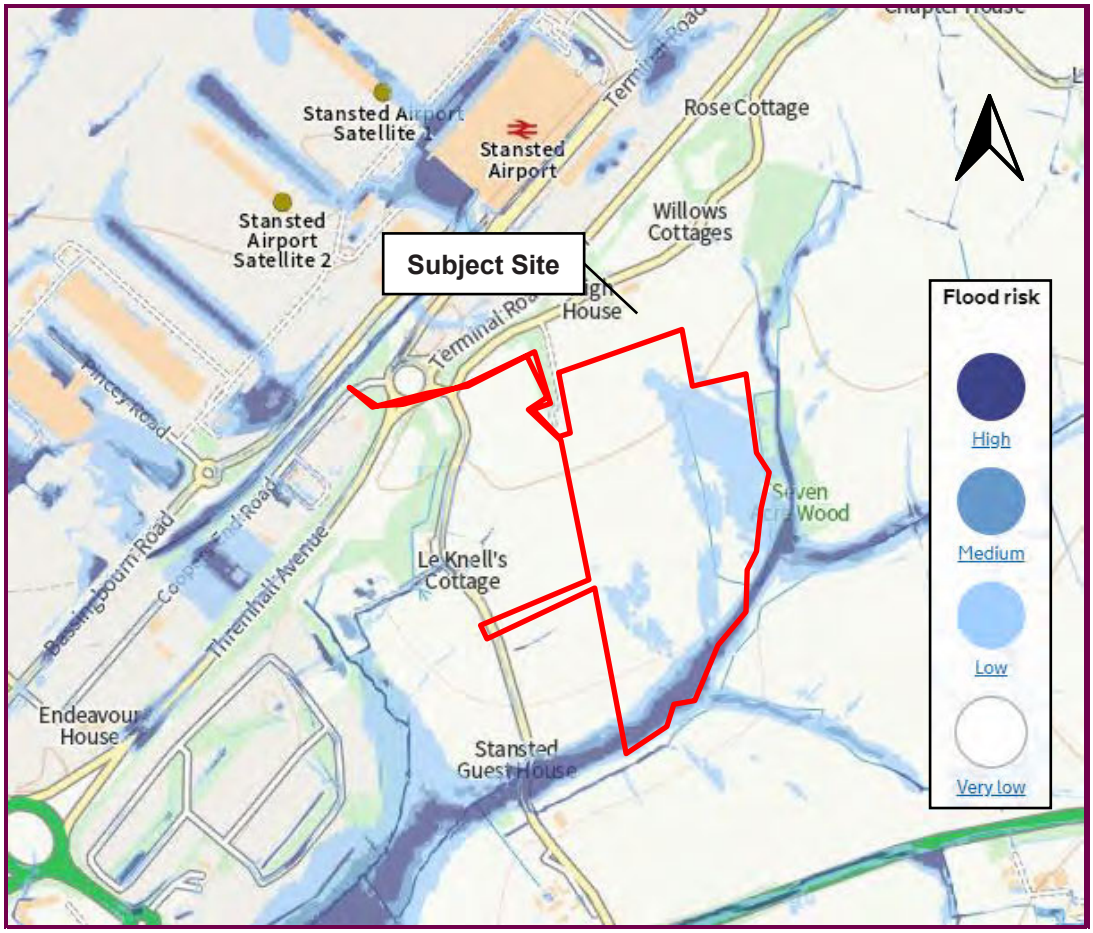


Figure 3. Updated Flood Map for Surface Water

6.7 During a 'low' risk flood event, surface water flood depths are expected to remain below 300mm in the central and eastern portions of the site. Depths greater than 300mm can be expected along the site's south eastern boundary. Velocities during this event are expected to be over 0.25 m/s (metres/second). Water is anticipated to travel south along the site's eastern boundary, and then curve west.

6.8 During a 'medium' risk event, surface water is modelled to be reduced, travelling across the southern portion of the site from Seven Acre Wood to Stansted Guest House.

Reservoir Flood Risk Classification

6.9 EA mapping also indicates that the site is not located within an area potentially at risk from reservoir flooding.

Local Authority Flood Risk Assessment

6.10 The Uttlesford District Council SFRA was published in May 2016. It provides an overview of flood risk from various sources within the borough. Information relevant to this assessment is summarised below:

- The site is Flood Zone 1;
- There are culverted watercourses to the north/west of the site;
- The site is outside the mapped EA historic flood outline;
- The SFRA identifies that there are 1-5 properties in the 'CM22 6' postcode location that are on the sewer flooding register;
- A 1 in 30-year surface flood event is identified to flow through the across the southern boundary of the site. In addition, the eastern half of the site is identified to be affected by a 1 in 1,000-year surface water flood event;
- SFRA mapping indicates the site is located on superficial diamicton deposits and Thames Group bedrock comprising clay, silt, sand and gravel; and
- The site area is identified as having up to 25% chance susceptibility to groundwater flooding.

7 HYDROGEOLOGICAL SETTING

7.1 British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the site is situated on the diamicton Lowestoft Formation. This is underlain by London Clay Formation bedrock comprising clay, silt and sand.

7.2 There is no readily available BGS borehole data at the site vicinity with information on groundwater levels.

7.3 The soils are described as 'lime-rich loamy and clayey soils with impeded drainage' by the National Soils Research Institute.

7.4 According to the EA's Aquifer Designation Mapping, the diamicton strata at the surface are classified as a Secondary (undifferentiated) Aquifer. These formations have varying characteristics in different locations. The London Clay Bedrock is an Unproductive Aquifer and these formations have a low permeability and negligible significance for water supply or base flow.

7.5 EA online groundwater Source Protection Zone (SPZ) mapping indicates that the site is not located within a groundwater SPZ.

8 FLOOD RISK AND MITIGATION

8.1 The key sources of flooding that could potentially impact the site are discussed below:

Fluvial / Tidal Flooding

8.2 The EA Flood Map for Planning, as seen in Figure 2, indicates that the site is located within Flood Zone 1. The annual probability of flooding is classified as less than 1 in 1,000 (0.1%) in the absence of any defences.

8.3 EA mapping indicates there are no flood defences in the vicinity of the site and the area is not identified to be in any of the mapped historic flood events.

8.4 A route of dry access / egress remains available west from the site and north along Parsonage Road during a 1 in 1,000-year event.

8.5 The PPG details the suitability of different land uses within each flood zone. The proposed land use is classified as 'less vulnerable' and such uses are generally considered appropriate within Flood Zone 1.

8.6 Overall, the fluvial and tidal flood risk at the site is considered to be low.

Flooding from Sewers

8.7 Sewer flooding can occur during periods of heavy rainfall when a sewer becomes blocked or is of inadequate capacity. At present, no formal drainage system exists at the site.

8.8 Despite 1-5 properties in the 'CM22 6' postcode location acknowledged in the Uttlesford SFRA sewer flooding map; Thames Water have confirmed there have been no recorded incidents of sewer flooding in the site vicinity as a result of surcharging public sewers.

8.9 There are no public sewers at the site vicinity and therefore sewer surcharging can be considered unlikely.

8.10 Overall, the flood risk from sewers is considered low.

Surface Water Flooding (Overland Flow)

8.11 This can occur during intense rainfall events, when water cannot soak into the ground or enter drainage systems.

8.12 SFRA and EA mapping note that there is an area of 'low' risk in the east of the site and an overland flow route through the southern portion of the site. The route appears to connect to Pincey Brook, a southern flowing watercourse approximately 500 m west of the site. This overland flow route is expected to have flood depths greater than 300 mm during a 1 in 1,000-year event.

8.13 Proposed development plans indicate that the solar panel elevation will be a minimum of 800 mm above ground level. As such, the development is unlikely to cause an obstruction to the flow paths, nor will the panels themselves be at risk of being submerged from the overland flow. The remainder of the site is not indicated to be at risk of surface water flooding.

8.14 Overall, the surface water flood risk to the proposed development is considered to be low.

8.15 Surface water flooding from on-site sources is considered in Section 10 of this report.

Groundwater Flooding

8.16 This can occur in low-lying areas when groundwater levels rise above surface levels, or within underground structures. BGS mapping indicates that the site is underlain by Lowestoft Formation and then subsequently London Clay Formation.

8.17 The SFRA shows that the site is located in an area identified as having up to 25% chance susceptibility to groundwater flooding.

8.18 There are no below-ground structures at depth in the proposed scheme. The solar panels will be elevated at least 800mm above ground level therefore the risk of groundwater flooding is considered to be low.

Other Sources

8.19 There is a limited risk of flooding occurring as a result of a break in a water main. As the site is currently agricultural land, it is unlikely there are any water mains in the immediate vicinity of the site.

8.20 EA mapping doesn't identify the site to be at risk of reservoir flooding.

8.21 The risk of flooding associated with reservoirs, canals and other artificial structures is considered to be low given the absence of any such structures in the site vicinity.

Proposed Mitigation

8.22 The elevation of the solar panels by a minimum of 0.8m above ground level affords a significant degree of protection against surface water flooding and other residual flood risks.

Event Exceedance

8.23 The mitigation measures proposed as part of the development scheme are considered appropriate to help mitigate against event exceedance scenarios.

9 SOIL MANAGEMENT

9.1 The management of soil is essential to ensure the natural drainage of the site is maintained and avoid an increase in surface water flooding.

9.2 The nature of the development means that precipitation is intercepted by the solar panels, if the site is inappropriately managed there is the potential for hydrological characteristics of the site to change, increasing surface water flow.

9.3 In the absence of site management, integrated drainage systems could develop with the field. This unmanaged drainage network can lead to soil storage being bypassed and rapidly convey off-site into the wider fluvial network.

9.4 There is no UK environmental guidance for managing runoff from solar panel installations. US guidance, for example Maryland Department for the Environment Storm water Design Guidance for solar panel installations (MDE 2010) recommends 'non-structural techniques like disconnecting impervious cover' to reduce runoff by promoting overland filtering and infiltration. The following must also be considered:

- Runoff must sheet flow onto and across vegetated areas to maintain the disconnection.
- Disconnecting impervious surfaces works best in undisturbed soils. To minimise disturbance and compaction, construction vehicles and equipment should avoid areas used for disconnection during installation of the solar panels. Where disturbance is unavoidable, post construction soil treatment (deep ploughing) to restore soil condition may be required.
- Groundcover vegetation must be maintained in good condition in those areas receiving disconnected runoff. Typically this maintenance is no different than other lawn or landscaped areas. However, areas receiving runoff should be protected (e.g., planting shrubs or trees along the perimeter) from future compaction.

9.5 Cook and McCuen (2013) recommend that the vegetation cover beneath the panels is well maintained or that a buffer strip be placed after the most down gradient row of panels.

9.6 To minimise the potential impacts from soil compaction and changes in flow pathways a number of mitigation techniques have been suggested as follows. To meet soil protection guidance, DEFRA objectives of Construction Code of Practice for the Sustainable Use of Soils on Construction Sites are recommended.

9.7 Soil compaction will be limited during the construction phase by a number of measures;

- Using only light machinery to install the solar panels and low ground pressure vehicles to be used during extreme rainfall events.
- Where construction has resulted in soil compaction, the areas between panel rows would be tilled / scarified to an appropriate depth and then re-seeded with an appropriate vegetation cover.
- During the first few years there should be frequent inspections of the planting and soil to ensure it is growing properly, isn't bare and isn't compacted. Any remedial work should occur as soon as possible.
- During operation, maintenance of infrastructure will be limited and only require light machinery, therefore no change in the existing permeability of the soil would be caused.

9.8 The presence of appropriately maintained vegetation at all times across the site will mitigate potential increases in runoff and soil erosion, which can be a contributing factor to greater runoff.

9.9 Any existing field or tile drainage system would be restored where affected by construction.

9.10 All access tracks will be made out of granular material and will therefore be permeable, reducing the potential increase in surface runoff.

10 SURFACE WATER MANAGEMENT

Introduction

10.1 The proposed development comprises the construction of a solar array which will not result in an increase in impermeable area beneath the solar panels themselves. An area of approximately 1057m^2 has been reserved within the development plan for battery/energy storage. The units will be placed on gravel and elevated above ground levels. A very limited area of hardstanding, 65 m^2, will be created beneath the proposed substation.

10.2 Generally, this type of development is considered to have a design life of 30 years. Therefore, for the purposes of this assessment, taking into account the Environment Agency's climate change allowances (published in July 2021), a 20% increase in peak rainfall intensity has been included as climate change allowance, which caters up to the year 2069 (upper end).

10.3 The LLFA has published advice for surface water drainage with respect to solar arrays. This acknowledges the minimal increase in runoff caused by the installation of elevated solar panels and focuses predominantly on the mitigation of channelisation, through sustainable land management practises. Surface water attenuation is not required specifically for the solar panels.

Existing Surface Water Runoff Rates

10.4 The existing greenfield runoff rates for the site area have been calculated using the Interim Code of Practice for Sustainable Drainage Systems (ICP SuDS) Method. Existing greenfield runoff rates presented in Table 1 below. ICP SuDS calculations are included as Appendix D.

Table 1. Equivalent greenfield runoff rates

Return Period (years)	Runoff Rate (l/s)
1 in 1	53.5
Q_{BAR}	63.0
1 in 30	142.7
1 in 100	200.9

Q_{BAR} = mean annual flood low
l/s = litres per second

Post-Development Water Runoff Rates

10.5 The proposed development will result in the creation of some hardstanding associated with the proposed sub-station.

10.6 Using the Modified Rational Method and rainfall data from the Flood Estimation Handbook (FEH), the pre and post development runoff rates and volumes for the site have been evaluated in order to assess the potential impact of the proposed hardstanding area. Calculations are included in full in Appendix D. It is noted that the pre-development scenario runoff rates calculated via this method are higher than the greenfield rates calculated above.

10.7 The post development scenario takes into account 65m^2 of proposed impermeable area and illustrates that there would only be a 0.07% increase in surface water runoff rates and volumes. Given there is no tarmac or building footprint proposed – and as the lifespan of the development is less than 30 years – it is not considered appropriate to include an allowance for urban creep.

Consideration of Drainage Hierarchy

10.8 The PPG advises of the following hierarchy for the disposal of surface water;

1. Infiltration;
2. To a surface water body;
3. To a surface water sewer, highway drain or another drainage system; or
4. To a combined sewer.

10.9 The drainage hierarchy has been considered as follows:

10.10 The site is underlain by London Clay Formation classified as being 'lime-rich loamy and clayey soils with impeded drainage'. As such, limited infiltration may occur naturally but the incorporation of point of infiltration features such as soakaways would not be appropriate.

10.11 An ordinary watercourse is present in the eastern portion of the site, this is the most likely outfall location for the site at present given that it runs in a southerly direction.

10.12 There are no surface water sewers or formal surface water drainage infrastructure in the vicinity fo the site. There are no combined sewers in the vicinity of the site.

Consideration of Sustainable Drainage Systems

10.13 The potential for the use of Sustainable Drainage Systems (SuDS) has been considered. Point infiltration techniques, such as soakaways, are unlikely to be suitable for use given the presence of clay formations. The inclusion of rainwater harvesting and green roofs is unsuitable given the nature of the proposed development. Furthermore there will be no new paved roads as part of the scheme. The proposed access track will be made of clean permeable surfaces. It will comprise of 130mm of MOT Type 1 permeable hard core aggregate base underlain by 250mm of aggregate sub-base.

10.14 On the basis that there is a very limited increase in hardstanding, it is disproportionate to include swales, detention basins / ponds or underground attenuation crates.

Conceptual Surface Water Drainage Strategy

10.15 The proposed development predominantly comprises the erection of solar panels within the site. The solar panels will be situated on ground mounted frames and will be raised above surrounding ground. The majority of the solar panels are proposed along the ground contours so that natural overland flows are encouraged and channelisation of flows are minimised.

10.16 As result of the construction of the solar panels, some rainfall will be intercepted by the surface of the solar panels before reaching ground level. Intercepted rainfall will either run down the face of the solar panels, due to the angle at which they are positioned, and drip onto the round below or will be lost due to evaporation from the face of the panels.

10.17 Where rainwater drips onto the ground below, the energy of the flow from the surface of the panels is likely to be greater than that of the rainfall (especially where rainwater collects at the bottom edge of the solar array before dripping onto the ground below) which could result in erosion of the ground on which rainwater drips without appropriate mitigation. The erosion of the ground could then result in the formation of rivulets which could increase the speed at which runoff discharges to the watercourse.

10.18 In order to mitigate the potential for erosion to occur, appropriate seeded vegetation will be provided below the solar panels to act as a level spreader/energy dissipater to promote low erosivity sheet flow during operation of the solar farm. The vegetation will be managed organically and will either be mowed or used for light grazing.

10.19 The proposed solar panels will be pitched at approximately 20 degrees, thereby reducing the speed at which water flows across the surface of the panels. Moreover, the panels forming the solar array are not tightly compacted and do not form one continuous surface. Instead, small gaps are provided between each panel, as indicated by the arrows in Figure 4, which allows water to drip onto the ground below from several locations rather than as concentrated runoff from the bottom edge of the array thereby reducing the potential for erosion to occur.

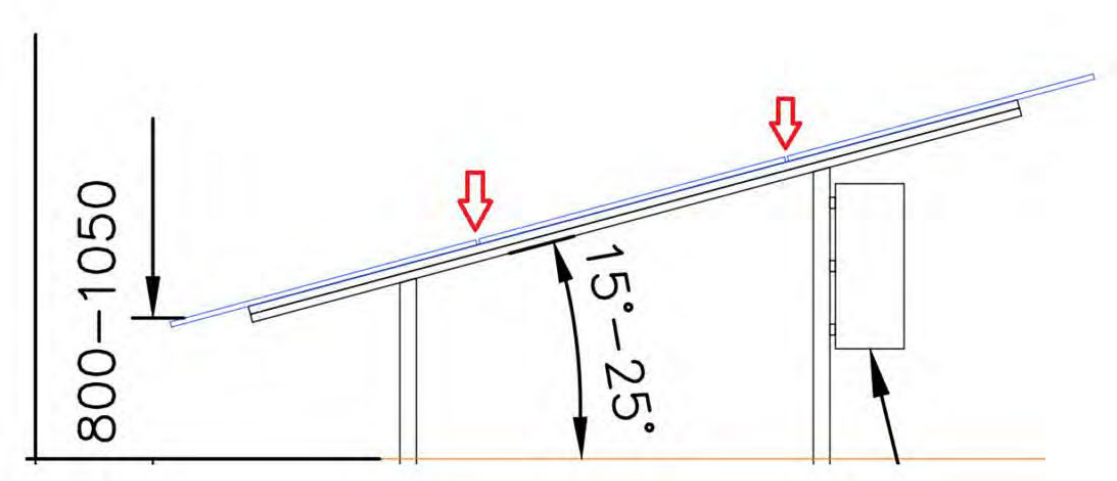


Figure 4. Extract from array elevation plan indicating gaps between panels

10.20 It is not proposed to provide formal attenuation for the minimal overall increase in impermeable area, given that the distance between said area and the likely outfall for the site (to the south east), the runoff would likely infiltrate or significantly diminish in flow. Therefore, incorporation of a flow control device is also considered to be inappropriate.

10.21 It is however proposed to provide a filter strip along the northern boundary of the southern solar panel compound. This, in addition to the screening planting, will help intercept the overland flow that could be caused by the new storage and energy facilities, providing limited attenuation and increased infiltration potential. This, in combination to the existing grassland vegetated strip located along the south boundary of the site, will help reduce erosion, enhancing interception and evapotranspiration. The new trees proposed will have a similar positive effect. The conceptual drainage strategy is provided in Appendix E.

10.22 Further attenuation will be available within the gravel cover that will surround the units within the area reserved for energy and battery storage. Proposed inverters and battery storage units will be situated upon 300 mm deep gravel bases that will allow runoff to infiltrate into the ground. Surface water attenuation will be provided within the gravel base. Based on an assumed 30% porosity and an overall area of 0.01057 ha, the gravel sub-base has the potential to provide up to 95m^3 of additional attenuation. Surface water would be stored within the gravel sub- base prior to infiltrating into the ground, subject to confirmation of site-specific infiltration rates.

10.23 The access tracks is designed to be permeable, thereby allowing surface water runoff to percolate into the ground below. During construction of the proposed a temporary construction lay-down area will be provided. It is recommended that temporary drainage measures are implemented within the lay-down area to ensure there is no increase in surface water runoff as a result of the construction compound.

10.24 In addition, construction of the proposed development has the potential to result in the compaction of soils thereby reducing the soil's ability to accept surface water runoff. It is recommended that the movement of large vehicles is limited to proposed access tracks in order to reduce the potential for

soil compaction to occur. Vehicles should be fitted with low pressure tyres to further reduce the impact on the underlying soil.

10.25 The aforementioned techniques will discourage soil erosion within the site, whilst maintaining the existing overland flow paths.

Water Quality

10.26 The proposed development comprises the construction of a solar farm upon land that is currently intensively farmed. The ceasing of intensive agricultural practices during operation of the solar farm will likely result in an improvement in the quality of surface water runoff generated within the site as a result of reduced sediment loadings, phosphorous and nutrients.

Event Exceedance

10.27 Whilst formal surface water attenuation has not been proposed, an event exceedance drawing has been included in Appendix F to demonstrate the existing and proposed flow paths in extreme rainfall events. In the absence of any proposed buildings at the site, as the solar panels will be elevated at least 800mm above ground level, there will be no alteration to the flow paths.

Maintenance of Sustainable Drainage Systems

10.28 As described in the CIRIA SuDS Manual C753, regular inspection and maintenance will be required following construction to allow effective operation of the proposed SuDS features. An indicative SuDS Maintenance Plan for the proposed SuDS features is included as Appendix G.

SuDS Proforma

10.29 Details of the drainage strategy are given in the LLFA Drainage Assessment form, included in full as Appendix H.

11 SEQUENTIAL TEST AND EXCEPTION TEST

Sequential Test

11.1 The NPPF requires the Local Authority to apply the Sequential Test in consideration of new development. The aim of the Test is to steer new development to areas at the lowest probability of flooding.

11.2 Given that the subject site has not been allocated as one of the Council's proposed future development sites, it has not been specifically assessed within the SFRA. Therefore, the Sequential Test is based on the EA Flood Zones and information contained within the SFRA.

11.3 The site is located within Flood Zone 1 and therefore is at low fluvial and tidal flood risk. No other significant risks have been identified from any of the other flood risk sources assessed – whilst limited surface water flow paths could occur it would be of shallow depth. On this basis, the site is considered to be at a low overall risk of flooding and is therefore sequentially preferable. As such, the site passes the Sequential Test.

The Exception Test

11.4 According to Table 3 of the PPG to the NPPF, 'less vulnerable' developments are considered appropriate within Flood Zone 1 without the requirement to apply the Exception Test. Therefore, application of the Exception Test is not required for the proposed development.

12 SUMMARY AND CONCLUSIONS

12.1 The aim of the FRA is to outline the potential for the site to be impacted by flooding, the potential impacts of the development on flooding both onsite and in the vicinity, and the proposed measures which can be incorporated into the development to mitigate the identified risks. The report has been produced in accordance with the guidance detailed in the NPPF. Reference has also been made to the CIRIA SuDS manual (C753), the SFRA and the SWMP and following consultation with the EA's Partnership and Strategic Overview Team.

12.2 The potential flood risks to the site, and the measures proposed to mitigate the identified risks, are summarised in Table 2.

Table 2. Proposed mitigation

Source of Flooding	Identified Risk			Mitigation Proposed	Residual Risk		
	L	M	H		L	M	H
Fluvial	✓			None required	✓		
Tidal	✓			Not applicable	✓		
Sewers	✓			None required	✓		
Surface Water	✓			Solar panels will be elevated at least 800mm above ground level	✓		
Groundwater	✓			None required	✓		
Other Sources (e.g. reservoirs, water mains)	✓			None required	✓		

12.3 The site is located within Flood Zone 1 (low risk of fluvial and tidal flooding). Whilst there is an overland flow route through the site, no significant risks have been identified from any other sources. In order to help mitigate the impacts of channelised flows it is proposed to elevate the solar panels 800 mm above ground level. No flood risk mitigation – beyond the aforementioned integral aspects of the proposed design – is required.

12.4 It has been demonstrated that the development meets the Sequential and Exception Tests imposed under the NPPF.

12.5 Overall, it has been demonstrated that the development would be safe, without increasing flood risk elsewhere, and that a surface water run-off management would be enhanced compared to the existing scenario.

APPENDICES

Appendix A

Thames Water

Asset location search

Thames Water Property Searches

RPS

LONDON
EC4A 4EN

Search address supplied [redacted]

Your reference	HLEF78850
Our reference	ALS/ALS Standard/2021_4510264
Search date	27 September 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

[redacted]

0800 009 4540

Asset location search

Property Searches

Search address supplied: Le Knell Cottage, Coopers End, Takeley, Bishop'S Stortford, CM22 6PT

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

[redacted]

[redacted]

Waste Water Services

Please provide a copy extract from the public sewer map.

The following quartiles have been printed as they fall within Thames' sewerage area:

TL5522NE

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.

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

TL5523SE
TL5622SW
TL5623SW
TL5622NW

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.

[redacted]

Asset location search

Thames Water Property Searches

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

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:

TL5523SE	Affinity Water
TL5522NE	Affinity Water
TL5622SW	Affinity Water
TL5623SW	Affinity Water
TL5622NW	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.

[redacted]

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: [redacted]

Clean Water queries

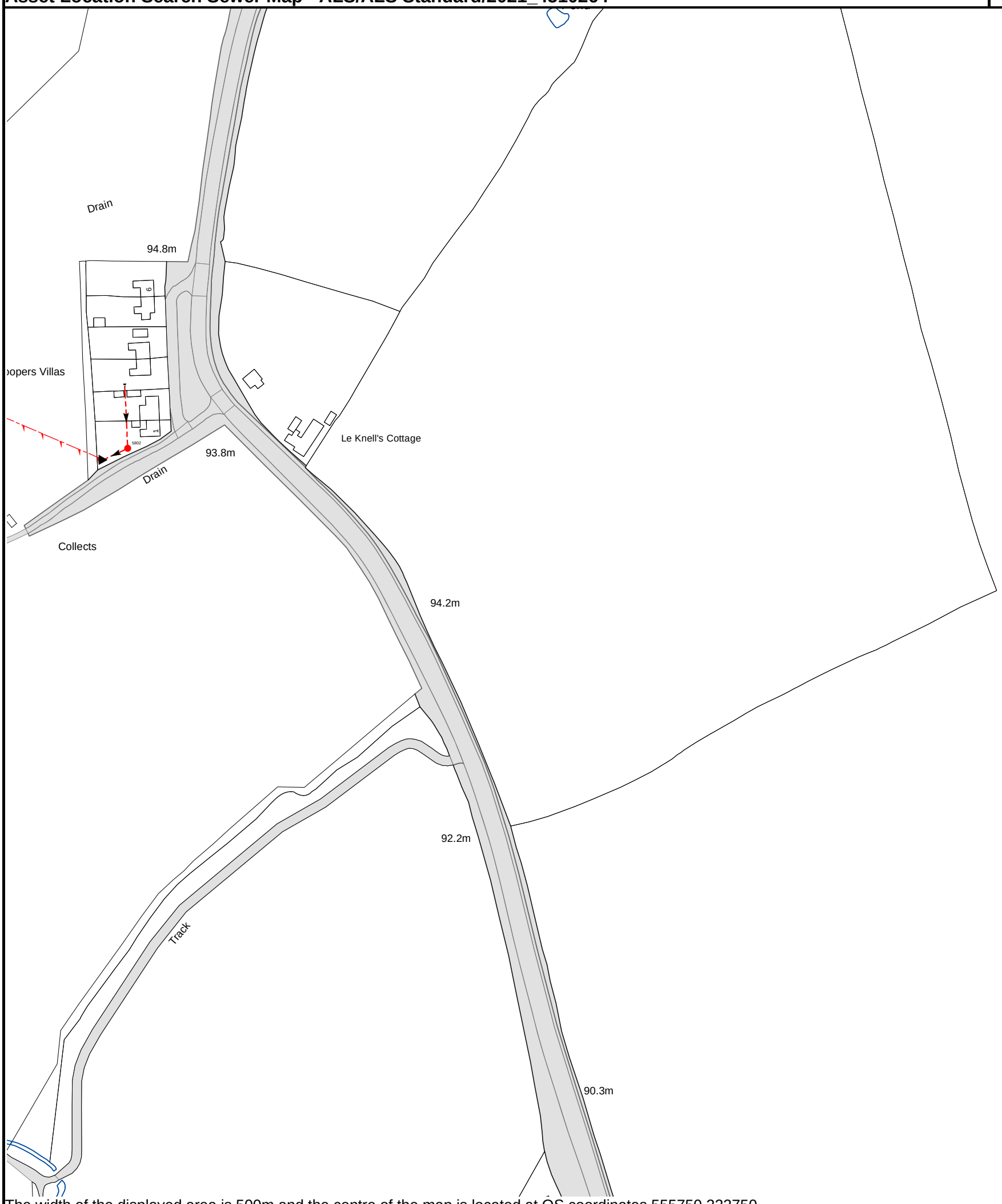
Should you require any advice concerning clean water operational issues or clean water connections, please contact:

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

Tel: 0800 009 3921
Email: [redacted]

[redacted]

Asset Location Search Sewer Map - ALS/ALS Standard/2021_4510264	TL5522NE



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 555750,222750

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.

[redacted]

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

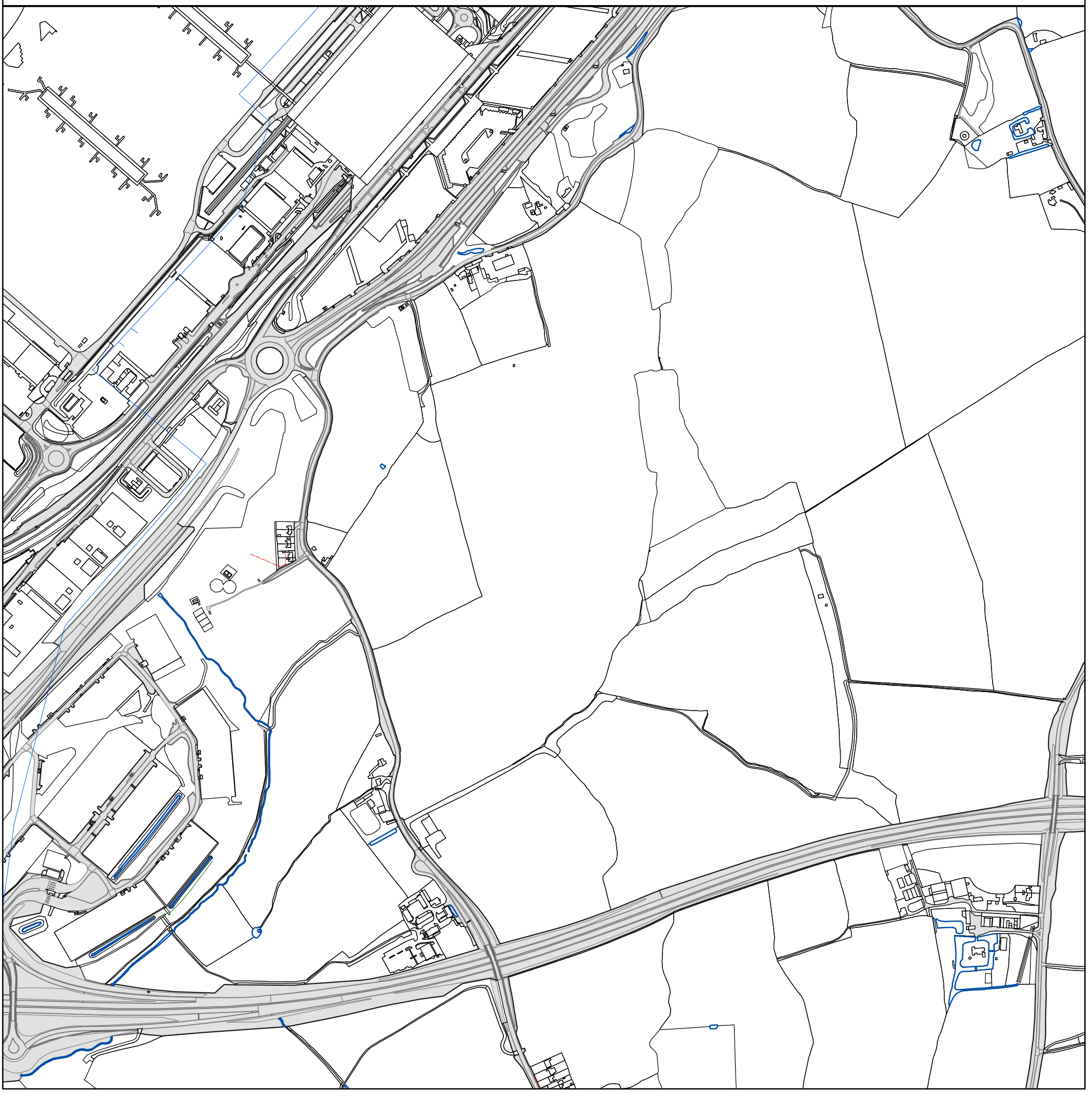
Manhole Reference	Manhole Cover Level	Manhole Invert Level
5802	n/a	n/a

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.

[redacted]

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

ALS/ALS Standard/2021_4510264



0 45 90 180 270 360
Meters

Scale:	1:7161
Width:	2000m
Printed By:	Rveldhur
Print Date:	27/09/2021
Map Centre:	556029,222844
Grid Reference:	TL5622NW

Comments:

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 Searches on 0800 009 4540.

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 [redacted]	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**

Sewer Flooding
History Enquiry

Thames Water Property Searches

RPS

Search address supplied [redacted]

Your reference	HLEF78850
Our reference	SFH/SFH Standard/2021_4510267
Received date	**24 September 2021**
Search date	**24 September 2021**

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

[redacted]

0800 009 4540

Sewer Flooding
History Enquiry

Thames Water Property Searches

Search address supplied: [redacted]

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

[redacted]

0800 009 4540

Sewer Flooding
History Enquiry

Thames Water 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

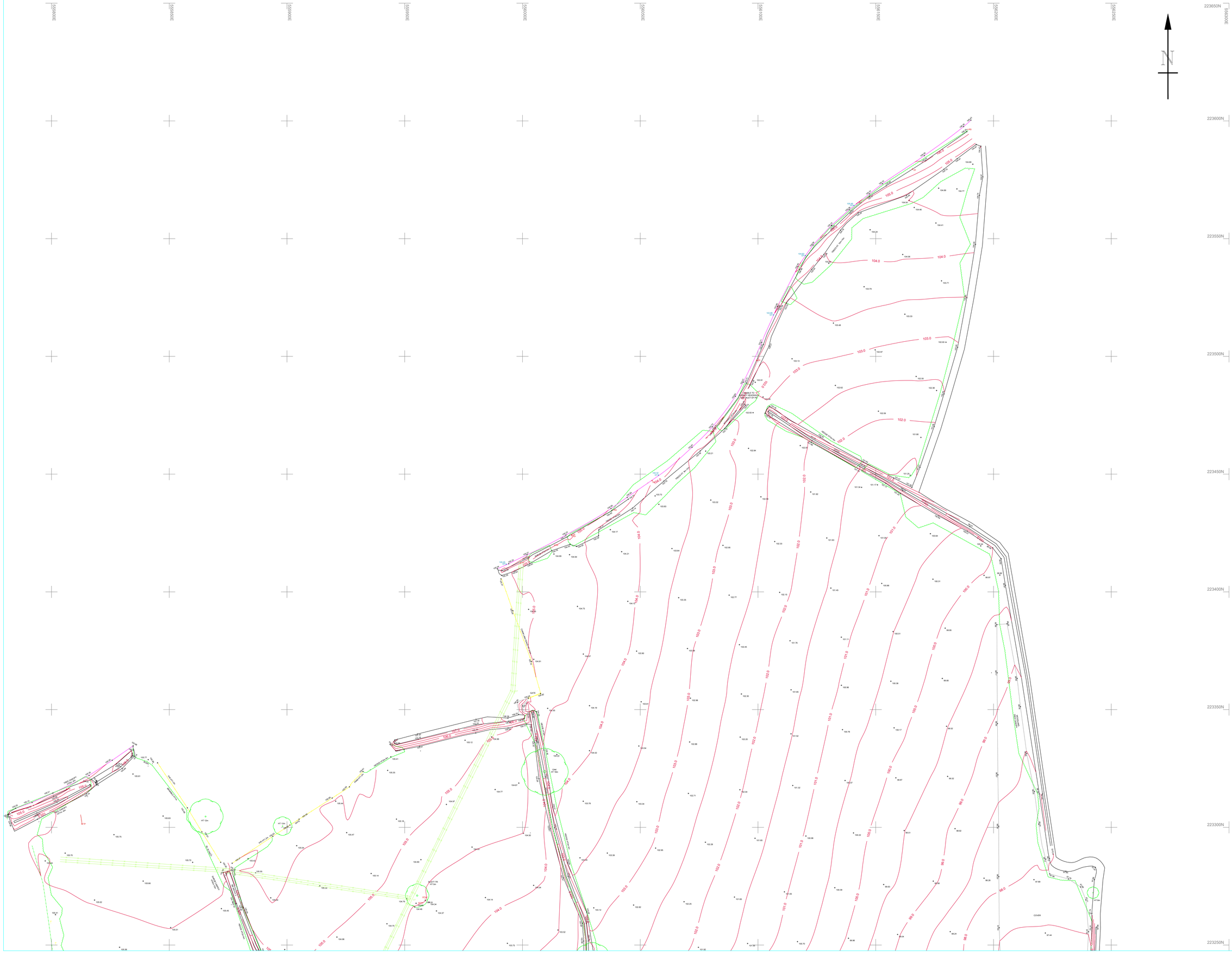
Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

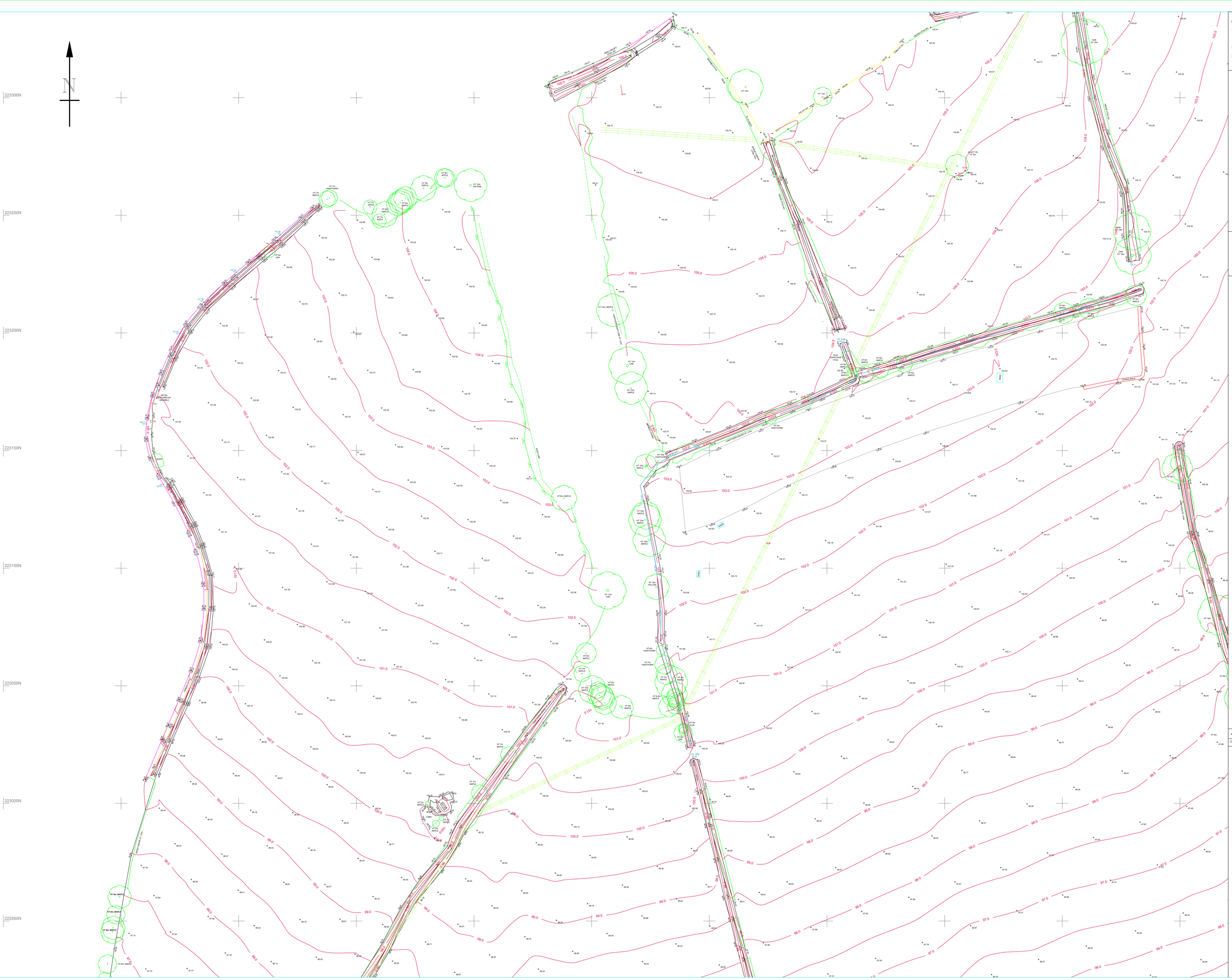
[redacted]

0800 009 4540

Appendix B

Topographic Survey


556800E
556850E
556900E
556950E
557000E
557050E
557100E
557150E
557200E
557250E
557300E
223650N
223600N
223550N
223500N
223450N
223400N
223350N
223300N
223250N
N
Notes
© 2019 RPS Group
1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.
SURVEY KEY
AV AIR VALVE
BL BOLLARD
BM BENCH MARK
BN BEACON
BS BUS STOP SIGN
BT BRITISH TELECOM COVER
B/W BARBED WIRE
CB CONTROL BOX
CCTV CLOSED CIRCUIT TV
CL COVER LEVEL
C/I CORRUGATED IRON
C/L CHAIN LINK
CONC CONCRETE
CPS CONCRETE PAVING SLABS
COL COLUMN
C/B CLOSE BOARDED
C/P CONCRETE PALING
CP CRASH PANEL
CTV CABLE TV
D TRUNK DIAMETER
DP DOWN PIPE
DPC DAMP PROOF COURSE
EB ELECTRICITY BOX
EC ELECTRICITY COVER
EP ELECTRICITY POLE
ER EARTH ROD
FL FINISHED FLOOR LEVEL
FH FIRE HYDRANT
FW FOUL WATER
GL GARAGE LIGHT
GM GAS METER
GP GATE POST
GV GAS VALVE
GY GULLY
IC INSPECTION COVER
IL INVERT LEVEL
INV DITCH INVERT LEVEL
I/R IRON RAIL
KO KERB OUTLET
LB LETTER BOX
LP LAMP POST
L/L LARCH LAP
MB MULTI BORE
MH MANHOLE
MK MARKER POST
MW MONITORING WELL
NP NAME PLATE
P POST
PM PARKING METER
P/R POST AND RAIL
P/W POST AND WIRE
RE RODDING EYE
RS ROAD SIGN
RWP RAIN WATER PIPE
SC STOP COCK
SF SOFFIT LEVEL
SP SIGN POST
S/R STEEL RAILING
ST STUMP
SV STOP VALVE
SW SURFACE WATER
TACT TACTILE PAVING
TCB TELEPHONE CALL BOX
TL TRAFFIC LIGHT
TLC TRAFFIC LIGHT IC COVER
TP TELEPHONE POLE
TW TOP WATER LEVEL
UTL UNABLE TO LIFT
VC UNKNOWN VALVE COVER
VP VENT PIPE
WCL WINDOW CILL LEVEL
WHL WINDOW HEAD LEVEL
WL WATER LEVEL
WM WATER METER
W/M WIRE MESH
WO WASH OUT VALVE
W/P WOOD PANEL
1. UNDERGROUND DRAINAGE INFORMATION HAS BEEN MEASURED FROM SURFACE INSPECTION ONLY AND SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
3. SURVEY GRID & LEVELS RELATED TO ORDNANCE SURVEY NATIONAL GRID. OBTAINED THROUGH REAL TIME GPS OBSERVATIONS.
A ORIGINAL DRAWING ISSUE MM AHP 26.10.19
Rev Description By CB Date
MAKING COMPLEX EASY
Noble House, Capital Drive, Linford Wood, Milton Keynes MK14 6QP
T: +44 (0)1908 669 898 E: rpsmks@rpsgroup.com
Client
Project LAND OFF PARSONAGE ROAD, STANSTED, CM22 6PT
Title TOPOGRAPHICAL SURVEY
Status FINAL
Drawn By MM
PM/Checked by AHP
Project Number JKK10624
Scale 1:500 @A0
Date Created 26.10.19
RPS Drawing/Figure Number JKK10624 _01
Rev A
rpsgroup.com



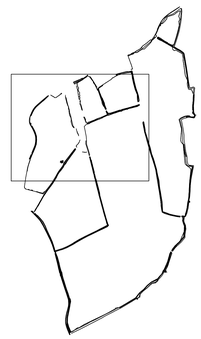
Notes

1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.

SURVEY KEY

AV	AIR VALVE	LB	LETTER BOX
BL	BOLLARD	LP	LAMP POST
BM	BENCH MARK	L/L	LATCH LAP
BN	BEACON	MB	MULTI BORE
BS	BUS STOP SIGN	MH	MANHOLE
BT	BRITISH TELECOM COVER	MK	MARKER POST
B/W	BARBED WIRE	MW	MONITORING WELL
CH	CENTRE HEIGHT	NP	NAME PLATE
CCTV	CLOSED CIRCUIT TV	OF	OAK
CL	COVER LEVEL	PM	PARKING METER
C/I	CORRUGATED IRON	P/R	POST AND RAIL
C/L	CHAIN LINK	P/W	POST AND WIRE
CONC	CONCRETE	RE	RODDING EYE
CPS	CONCRETE PAVING SLABS	RS	ROAD SIGN
COL	COLUMN	RWP	RAIN WATER PIPE
C/B	CLOSE BOARDED	SC	STOP COCK
CNP	CHESTNUT PALING	SF	SOFFIT LEVEL
C/P	CONCRETE PANEL	SP	SIGN POST
CTV	CABLE TV	S/R	STEEL RAILING
D	TRUNK DIAMETER	ST	STUMP
DP	DOWN PIPE	SV	STOP VALVE
DPC	DAMP PROOF COURSE	TM	TRAFFIC LIGHT
EB	ELECTRICITY BOX	TRET	TRETEL PAVING
EC	ELECTRICITY COVER	TKB	TELEPHONE CALL BOX
EP	ELECTRICITY POLE	TL	TRAFFIC LIGHT
ER	EARTH ROD	TLC	TRAFFIC LIGHT IC COVER
FL	FINISHED FLOOR LEVEL	TP	TELEPHONE POLE
FH	FIRE HYDRANT	T/W	TOP OF WALL LEVEL
FW	FOUL WATER	UTL	UNABLE TO LIFT
GL	GROUND LIGHT	VC	UNKNOWN VALVE COVER
GM	GAS METER	VP	VENT PIPE
GP	GATE POST	WCL	WINDOW CILL LEVEL
GV	GAS VALVE	WHL	WINDOW HEAD LEVEL
GY	GULLY	WL	WATER LEVEL
IC	INSPECTION COVER	WM	WATER METER
IL	INVERT LEVEL	W/W	WIRE MESH
INV	DITCH INVERT LEVEL	W/V	WASH OUT VALVE
I/R	IRON RAIL	W/P	WOOD PANEL
KO	KERB OUTLET		

1. UNDERGROUND DRAINAGE INFORMATION HAS BEEN MEASURED FROM SURFACE INSPECTION ONLY AND SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
3. SURVEY GRID & LEVELS RELATED TO ORDNANCE SURVEY NATIONAL GRID. OBTAINED THROUGH REAL TIME GPS OBSERVATIONS.



Rev	Description	By	CB	Date
A	ORIGINAL DRAWING ISSUE	MM	AHP	26.10.19

MAKING COMPLEX EASY

Noble House, Capital Drive, Linford Wood, Milton Keynes MK14 6QP
T: +44 (0)1908 669 898 E: rpsmks@rpsgroup.com

Client

Project: LAND OFF PARSONAGE ROAD, STANSTED, CM22 6PT

Title: TOPOGRAPHICAL SURVEY

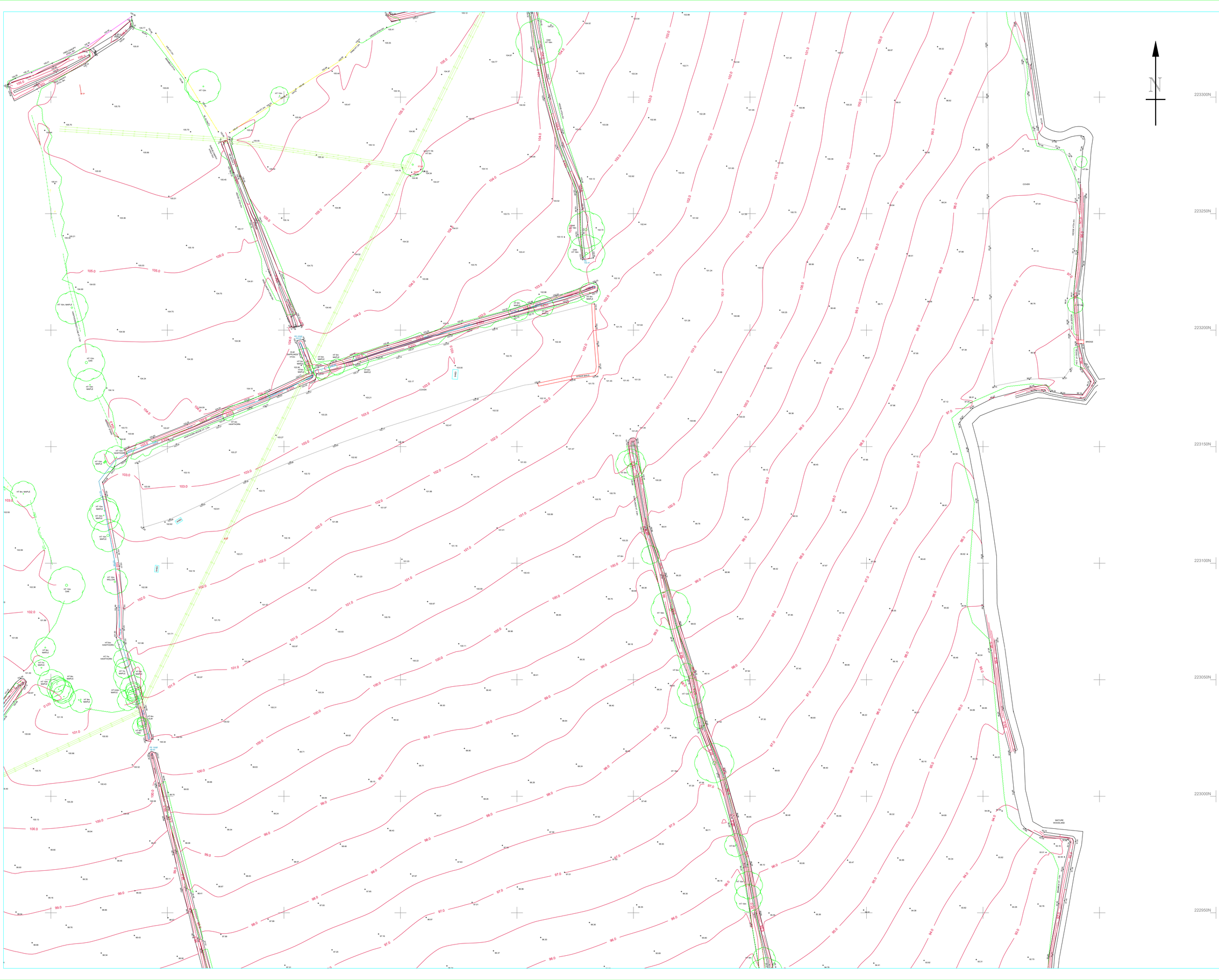
Status	Drawn By	PM/Checked by
FINAL	MM	AHP

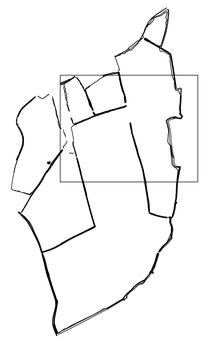
Project Number	Scale	Date Created
JKK10624	1:500 @A0	26.10.19

RPS Drawing/Figure Number: JKK10624 _02

Rev: A

rpsgroup.com





Notes

1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.

SURVEY KEY

AV	AIR VALVE	LB	LETTER BOX
BL	BOLLARD	LP	LAMP POST
BM	BENCH MARK	L/L	LATCH LAP
BN	BEACON	MB	MULTI BORE
BS	BUS STOP SIGN	MH	MANHOLE
BT	BRITISH TELECOM COVER	MK	MARKER POST
B/W	BARBED WIRE	MW	MONITORING WELL
CH	CHAINAGE	NP	NAME PLATE
CCTV	CLOSED CIRCUIT TV	O	OAK
CL	COVER LEVEL	PM	PARKING METER
C/I	CORRUGATED IRON	P/R	POST AND RAIL
C/L	CHAIN LINK	P/W	POST AND WIRE
CONC	CONCRETE	RE	RODDING EYE
CPS	CONCRETE PAVING SLABS	RS	ROAD SIGN
COL	COLUMN	RWP	RAIN WATER PIPE
C/B	CLOSE BOARDED	SC	STOP COCK
CNP	CHESTNUT PALING	SF	SOFFIT LEVEL
C/P	CONCRETE PANEL	SP	SIGN POST
CTV	CABLE TV	S/R	STEEL RAILING
D	TRUNK DIAMETER	ST	STUMP
DP	DOWN PIPE	SV	STOP VALVE
DPC	DAMP PROOF COURSE	TM	TRAFFIC METER
EB	ELECTRICITY BOX	TWT	TWISTLE PARKING
EC	ELECTRICITY COVER	TCB	TELEPHONE CALL BOX
EP	ELECTRICITY POLE	TL	TRAFFIC LIGHT
ER	EARTH ROD	TLC	TRAFFIC LIGHT IC COVER
FL	FINISHED FLOOR LEVEL	TP	TELEPHONE POLE
FH	FIRE HYDRANT	T/W	TOP OF WALL LEVEL
FW	FOUL WATER	UTL	UNABLE TO LIFT
GL	GROUND LIGHT	VC	UNKNOWN VALVE COVER
GM	GAS METER	VP	VENT PIPE
GP	GATE POST	WCL	WINDOW CILL LEVEL
GV	GAS VALVE	WHL	WINDOW HEAD LEVEL
GY	GULLY	WL	WATER LEVEL
IC	INSPECTION COVER	WM	WATER METER
IL	INVERT LEVEL	W/W	WIRE MESH
INV	DITCH INVERT LEVEL	WO	WASH OUT VALVE
I/R	IRON RAIL	W/P	WOOD PANEL
KO	KERB OUTLET		

1. UNDERGROUND DRAINAGE INFORMATION HAS BEEN MEASURED FROM SURFACE INSPECTION ONLY AND SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
3. SURVEY GRID & LEVELS RELATED TO ORDNANCE SURVEY NATIONAL GRID. OBTAINED THROUGH REAL TIME GPS OBSERVATIONS.

Rev	Description	By	Ckb	Date
A	ORIGINAL DRAWING ISSUE	MM	AHP	26.10.19

MAKING COMPLEX EASY

Noble House, Capital Drive, Linford Wood, Milton Keynes MK14 6QP
T: +44 (0)1908 669 898 E: rpsmks@rpsgroup.com

Client

Project: LAND OFF PARSONAGE ROAD, STANSTED, CM22 6PT

Title: TOPOGRAPHICAL SURVEY

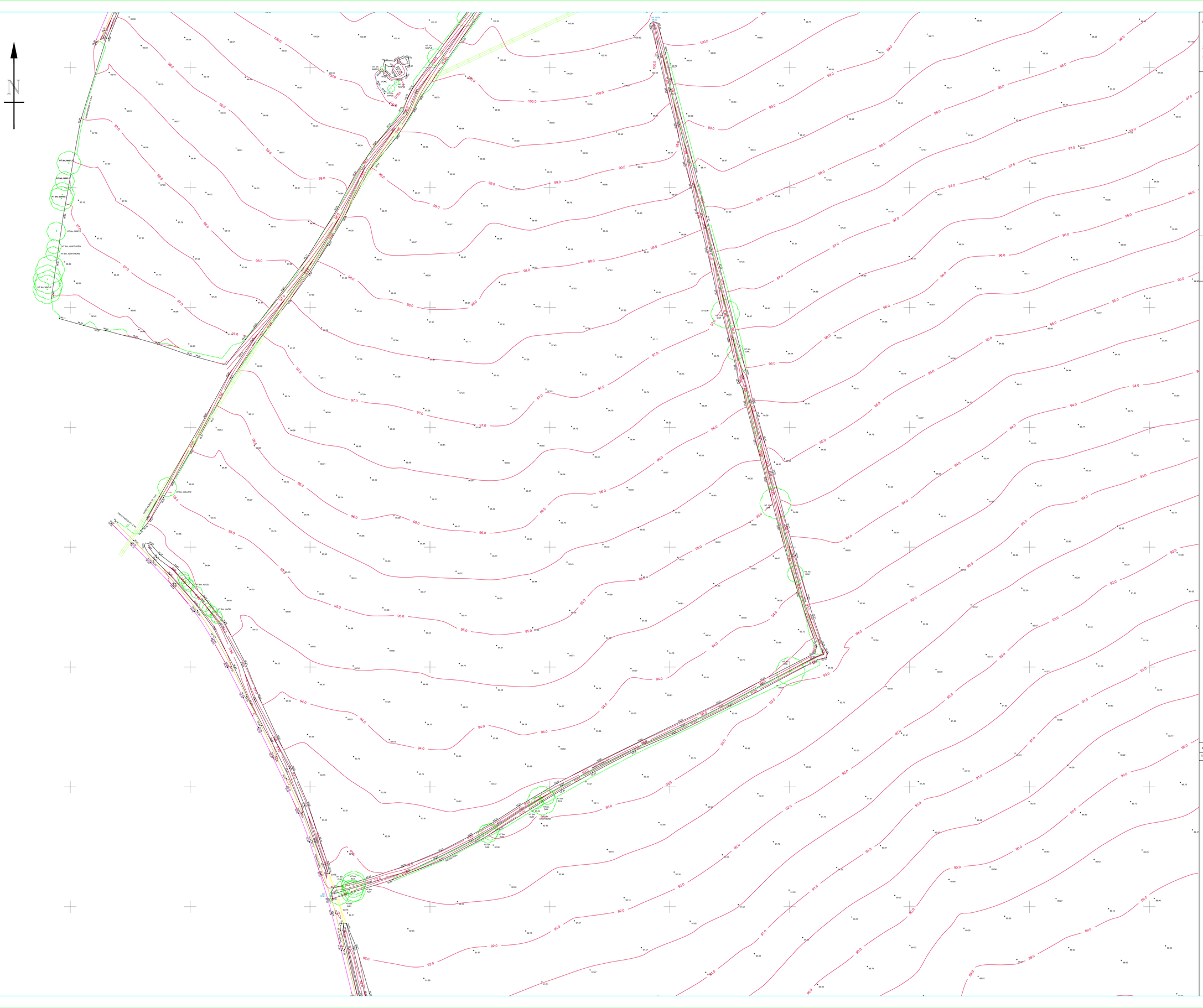
Status	Drawn By	PM/Checked by
FINAL	MM	AHP

Project Number	Scale	Date Created
JKK10624	1:500 @A0	26.10.19

RPS Drawing/Figure Number: JKK10624 _03

Rev: A

rpsgroup.com



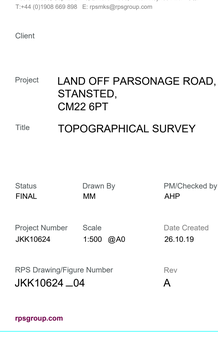
Notes

1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.

SURVEY KEY

AV	AIR VALVE	LB	LETTER BOX
BL	BOLLARD	LP	LAMP POST
BM	BENCH MARK	L/L	LATCH LAP
BN	BEACON	MB	MULTI BORE
BS	BUS STOP SIGN	MH	MANHOLE
BT	BRITISH TELECOM COVER	MK	MARKER POST
B/W	BARBED WIRE	MW	MONITORING WELL
CH	CENTRE LINE	NP	NAME PLATE
CCTV	CLOSED CIRCUIT TV	OL	OIL
CL	COVER LEVEL	PM	PARKING METER
C/I	CORRUGATED IRON	P/R	POST AND RAIL
C/L	CHAIN LINK	P/W	POST AND WIRE
CONC	CONCRETE	RE	RODDING EYE
CPS	CONCRETE PAVING SLABS	RS	ROAD SIGN
COL	COLUMN	RWP	RAIN WATER PIPE
C/B	CLOSE BOARDED	SC	STOP COCK
CNP	CHESTNUT PALING	SF	SOFFIT LEVEL
C/P	CONCRETE PANEL	SP	SIGN POST
CTV	CABLE TV	S/R	STEEL RAILING
D	TRUNK DIAMETER	ST	STUMP
DP	DOWN PIPE	SV	STOP VALVE
DPC	DAMP PROOF COURSE	TM	TRAFFIC METER
EB	ELECTRICITY BOX	TRIP	TRIPOD
EC	ELECTRICITY COVER	TKB	TELEPHONE CALL BOX
EP	ELECTRICITY POLE	TL	TRAFFIC LIGHT
ER	EARTH ROD	TLC	TRAFFIC LIGHT IC COVER
FL	FINISHED FLOOR LEVEL	TP	TELEPHONE POLE
FH	FIRE HYDRANT	TW	TOP OF WALL LEVEL
FW	FOUL WATER	UTL	UNABLE TO LIFT
GL	GROUND LIGHT	VC	UNKNOWN VALVE COVER
GM	GAS METER	VP	VENT PIPE
GP	GATE POST	WCL	WINDOW CILL LEVEL
GV	GAS VALVE	WHL	WINDOW HEAD LEVEL
GY	GULLY	WL	WATER LEVEL
IC	INSPECTION COVER	WM	WATER METER
IL	INVERT LEVEL	W/M	WIRE MESH
INV	DITCH INVERT LEVEL	W/O	WASH OUT VALVE
I/R	IRON RAIL	W/P	WOOD PANEL
KO	KERB OUTLET		

1. UNDERGROUND DRAINAGE INFORMATION HAS BEEN MEASURED FROM SURFACE INSPECTION ONLY AND SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
3. SURVEY GRID & LEVELS RELATED TO ORDNANCE SURVEY NATIONAL GRID. OBTAINED THROUGH REAL TIME GPS OBSERVATIONS.



Rev	Description	By	Date
A	ORIGINAL DRAWING ISSUE	MM AHP	26.10.19

MAKING COMPLEX EASY

Noble House, Capital Drive, Linford Wood, Milton Keynes MK14 6QP
T+44 (0)1908 669 898 E: rpsmkx@rpsgroup.com

Client

Project LAND OFF PARSONAGE ROAD, STANSTED, CM22 6PT

Title TOPOGRAPHICAL SURVEY

Status	Drawn By	PM/Checked by
FINAL	MM	AHP

Project Number	Scale	Date Created
JKK10624	1:500 @A0	26.10.19

RPS Drawing/Figure Number: JKK10624 _04

Rev: A

rpsgroup.com

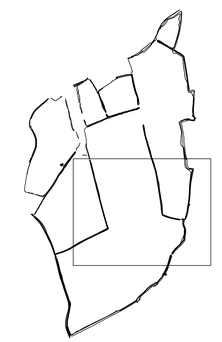
Notes

1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.

SURVEY KEY

AV	AIR VALVE	LB	LETTER BOX
BL	BOLLARD	LP	LAMP POST
BM	BENCH MARK	L/L	LAITCH LAP
BN	BEACON	MB	MULTI BORE
BS	BUS STOP SIGN	MH	MANHOLE
BT	BRITISH TELECOM COVER	MK	MARKER POST
B/W	BARBED WIRE	MW	MONITORING WELL
BY	BOLLARD LIGHT	NP	NAME PLATE
CCTV	CLOSED CIRCUIT TV	OL	OIL
CL	COVER LEVEL	PM	PARKING METER
C/I	CORRUGATED IRON	P/R	POST AND RAIL
C/L	CHAIN LINK	P/W	POST AND WIRE
CONC	CONCRETE	RE	RODDING EYE
CPS	CONCRETE PAVING SLABS	RS	ROAD SIGN
COL	COLUMN	RWP	RAIN WATER PIPE
C/B	CLOSE BOARDED	SC	STOP COCK
CNP	CHESTNUT PALING	SF	SOFFIT LEVEL
C/P	CONCRETE PANEL	SP	SIGN POST
CTV	CABLE TV	S/R	STEEL RAILING
D	TRUNK DIAMETER	ST	STUMP
DP	DOWN PIPE	SV	STOP VALVE
DPC	DAMP PROOF COURSE	TM	TRIAL HOLE METER
EB	ELECTRICITY BOX	TRET	TRETMENT
EC	ELECTRICITY COVER	TKB	TELEPHONE CALL BOX
EP	ELECTRICITY POLE	TL	TRAFFIC LIGHT
ER	EARTH ROD	TLC	TRAFFIC LIGHT IC COVER
FL	FINISHED FLOOR LEVEL	TP	TELEPHONE POLE
FH	FIRE HYDRANT	T/W	TOP OF WALL LEVEL
FW	FOUL WATER	UTL	UNABLE TO LIFT
GL	GROUND LIGHT	VC	UNKNOWN VALVE COVER
GM	GAS METER	VP	VENT PIPE
GP	GATE POST	WCL	WINDOW CILL LEVEL
GV	GAS VALVE	WHL	WINDOW HEAD LEVEL
GY	GULLY	WL	WATER LEVEL
IC	INSPECTION COVER	WM	WATER METER
IL	INVERT LEVEL	W/M	WIRE MESH
INV	DITCH INVERT LEVEL	W/O	WASH OUT VALVE
I/R	IRON RAIL	W/P	WOOD PANEL
KO	KERB OUTLET		

1. UNDERGROUND DRAINAGE INFORMATION HAS BEEN MEASURED FROM SURFACE INSPECTION ONLY AND SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
3. SURVEY GRID & LEVELS RELATED TO ORDNANCE SURVEY NATIONAL GRID. OBTAINED THROUGH REAL TIME GPS OBSERVATIONS.



Rev	Description	By	CB	Date
A	ORIGINAL DRAWING ISSUE	MM	AHP	26.10.19

MAKING COMPLEX EASY

Noble House, Capital Drive, Linford Wood, Milton Keynes MK14 6QP
T: +44 (0)1908 669 898 E: rpsmks@rpsgroup.com

Client

Project LAND OFF PARSONAGE ROAD, STANSTED, CM22 6PT

Title TOPOGRAPHICAL SURVEY

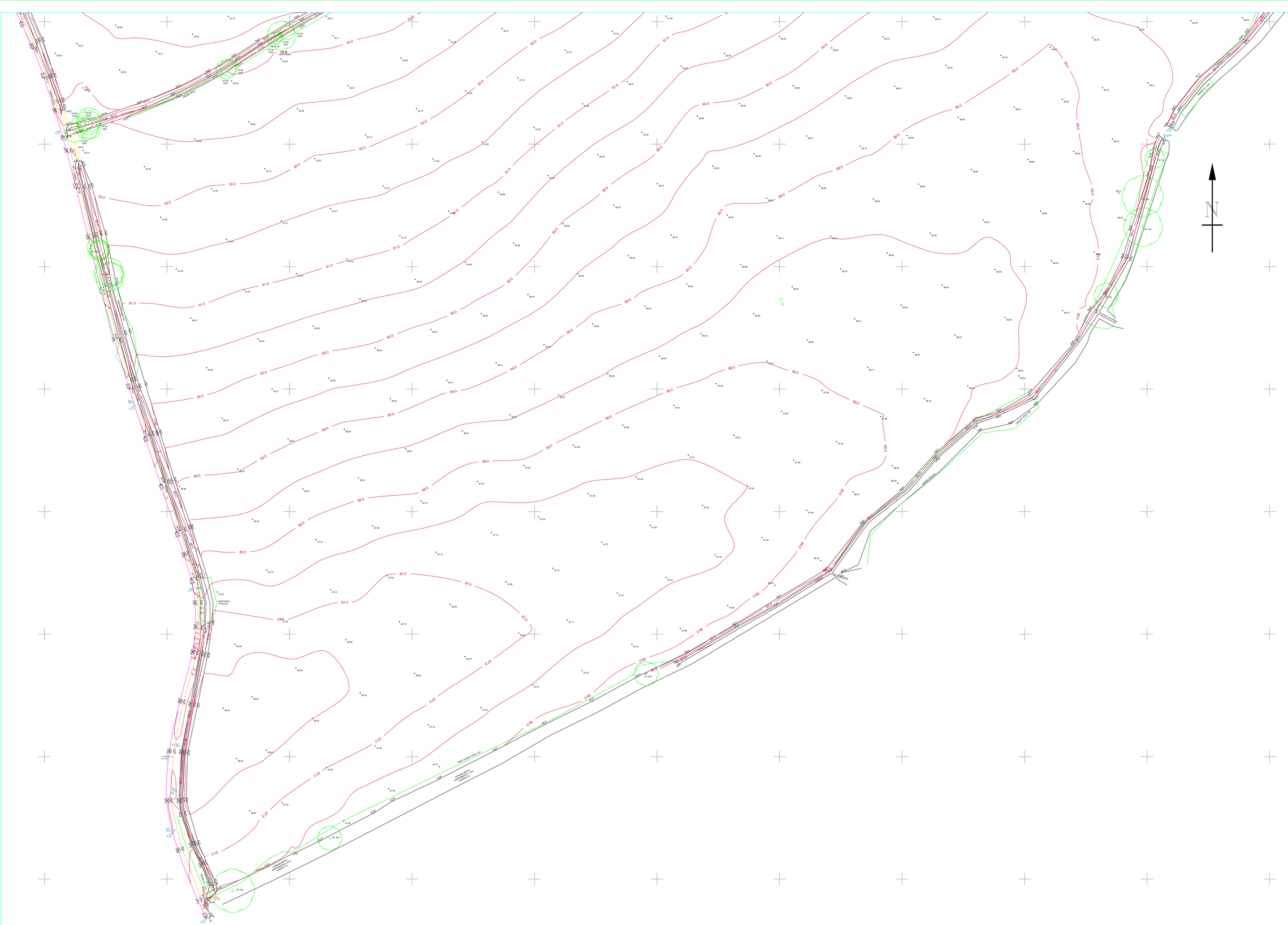
Status	Drawn By	PM/Checked by
FINAL	MM	AHP

Project Number	Scale	Date Created
JKK10624	1:500 @A0	26.10.19

RPS Drawing/Figure Number: JKK10624 _05

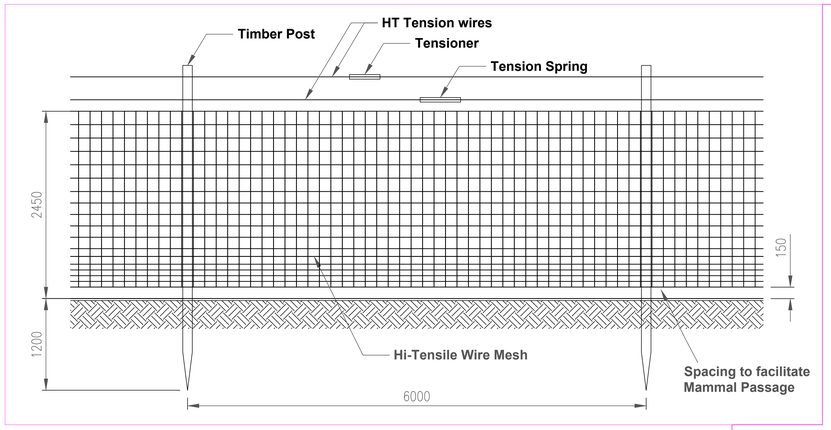
Rev: A

rpsgroup.com


N
Notes
© 2019 RPS Group
1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.
SURVEY KEY
AV AIR VALVE
BL BOLLARD
BM BENCH MARK
BN BEACON
BS BUS STOP SIGN
BT BRITISH TELECOM COVER
B/W BARBED WIRE
CH CHAMBER
CCTV CLOSED CIRCUIT TV
CL COVER LEVEL
C/I CORRUGATED IRON
C/L CHAIN LINK
CONC CONCRETE
CPS CONCRETE PAVING SLABS
COL COLUMN
C/B CLOSE BOARDED
CNP CHESTNUT PALING
C/P CONCRETE PANEL
CTV CABLE TV
D TRUNK DIAMETER
DP DOWN PIPE
DPC DAMP PROOF COURSE
EB ELECTRICITY BOX
EC ELECTRICITY COVER
EP ELECTRICITY POLE
ER EARTH ROD
FL FINISHED FLOOR LEVEL
FH FIRE HYDRANT
FW FOUL WATER
GL GROUND LIGHT
GM GAS METER
GP GATE POST
GV GAS VALVE
GY GULLY
IC INSPECTION COVER
IL INVERT LEVEL
INV DITCH INVERT LEVEL
I/R IRON RAIL
KO KERB OUTLET
LB LETTER BOX
LP LAMP POST
L/L LATCH LAP
MB MULTI BORE
MH MANHOLE
MK MARKER POST
MW MONITORING WELL
NP NAME PLATE
OP OPEN
PM PARKING METER
P/R POST AND RAIL
P/W POST AND WIRE
RE RODDING EYE
RS ROAD SIGN
RWP RAIN WATER PIPE
SC STOP COCK
SF SOFFIT LEVEL
SP SIGN POST
S/R STEEL RAILING
ST STUMP
SV STOP VALVE
TM TRIAL HOLE
TRP TACTILE PAVING
TKB TELEPHONE CALL BOX
TL TRAFFIC LIGHT
TLC TRAFFIC LIGHT IC COVER
TP TELEPHONE POLE
TW TOP OF WALL LEVEL
UTL UNABLE TO LIFT
VC UNKNOWN VALVE COVER
VP VENT PIPE
WCL WINDOW CILL LEVEL
WHL WINDOW HEAD LEVEL
WL WATER LEVEL
WM WATER METER
W/M WIRE MESH
WO WASH OUT VALVE
W/P WOOD PANEL
1. UNDERGROUND DRAINAGE INFORMATION HAS BEEN MEASURED FROM SURFACE INSPECTION ONLY AND SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
3. SURVEY GRID & LEVELS RELATED TO ORDNANCE SURVEY NATIONAL GRID. OBTAINED THROUGH REAL TIME GPS OBSERVATIONS.
A ORIGINAL DRAWING ISSUE MM AHP 26.10.19
Rev Description By CB Date
MAKING COMPLEX EASY
Noble House, Capital Drive, Linford Wood, Milton Keynes MK14 6QP
T: +44 (0)1908 669 898 E: rpsmks@rpsgroup.com
Client
Project LAND OFF PARSONAGE ROAD, STANSTED, CM22 6PT
Title TOPOGRAPHICAL SURVEY
Status FINAL
Drawn By MM
PM/Checked by AHP
Project Number JKK10624
Scale 1:500 @A0
Date Created 26.10.19
RPS Drawing/Figure Number JKK10624 _06
Rev A
rpsgroup.com

Appendix C

Development Plans

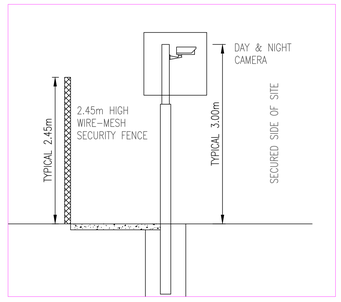


TYPICAL SECURITY DEER FENCE DETAILS

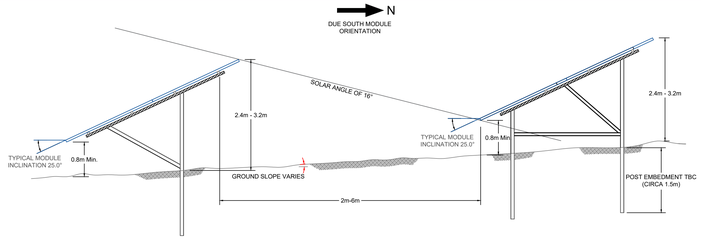
TYPICAL IMAGE OF DEER FENCE

EXISTING VIEW ALONG ROAD

TYPICAL DESIRED HEDGEROW AND TREE
PLANTING TO SCREEN FROM ROAD



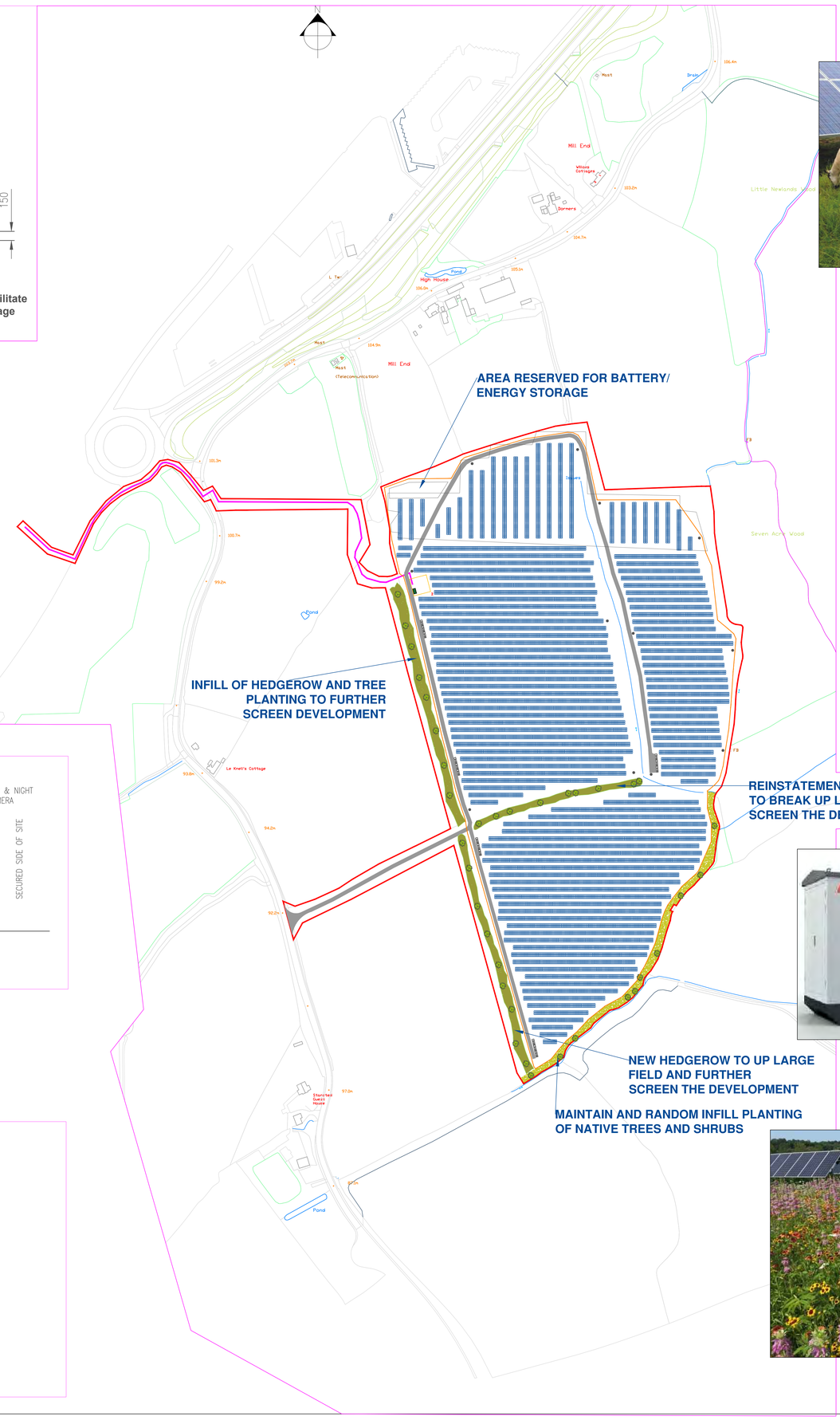
CCTV CAMERA DETAILS
TYPICAL SECTION



SINGLE POST TYPE TABLE POST TYPE

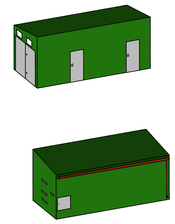
TYPICAL SECTION THROUGH VARIOUS MODULE OPTIONS

SCALE 1:50



SHEEP GRAZING

STEEL BUILDING
NOT TO SCALE



TYPICAL PRIMARY SUBSTATION
TYPICAL DIMENSIONS 6m x 3.2m x 3.4m HIGH.
ALL SUBJECT TO FINAL DESIGN

TYPICAL INVERTOR SUBSTATION
DIMENSIONS: 7m x 2.5m x 3m HIGH.
ALL SUBJECT TO FINAL DESIGN

EXAMPLE WILD FLOWER GRASSLAND

Notes
1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.

LEGEND

- SITE BOUNDARY
- 2 x 12 = 24 MODULE PANEL (12m) & 2 x 24 = 48 MODULE PANEL (24m)
- CABLE ROUTE
- 4m ACCESS TRACK (clean permeable material used)
- INVERTER SUBSTATION
- SECURITY FENCE
- CCTV
- PROPOSED MITIGATION SCREEN PLANTING COMPRISED OF LOCALLY APPROPRIATE HEDGEROW PLANTING WITH RANDOM TREES AND WILDFLOWER GRASSLAND
- MAINTAIN EXISTING GRASSLAND EDGE AND RANDOM INFILL PLANTING OF NATIVE TREES AND SHRUBS

NOTES:

- Typical panels shown are 2.2m x 1.3m approx.
- Typical module cross section shows two panels in portrait. However, based on best available technology, three panels in portrait, four panels in landscape and six panels in landscape may also be required and will be subject to final design.
- Number and type of inverters are subject to final design and technology, as a worst case, inverter buildings have been used and maybe replaced by string inverters.

Rev	Description	By	CB	Date
G	Layout updated to reflect Glint and Glare	GG	AL	30/01/2022
F	Typos and general style amendments	GG	AL	02/11/2021
E	Phasing added	GG	AL	19/08/2021
D	Amended Red line	GG	AL	06/08/2021
C	Amended Layout	GG	AL	26/07/2021
B	Amended Layout	GG	AL	26/07/2021
A	Amended Layout	GG	AL	23/07/2021

MAKING COMPLEX EASY

Park House, Greyfriars Road, Cardiff, CF10 3AF
T: 02920 668 662 E: rpsca@rpsgroup.com

Client MAG

Project STANSTED SOLAR PROJECT

Title DRAFT PLANNING DRAWING

Status	Drawn By	PM/Checked by
DRAFT	GG	AL

Job Ref	Scale @ A0	Date Created
JPW1799	1:2000	MAY 2021

RPS Drawing/Figure Number: JPW1799-001 Rev: G

rpsgroup.com

O:\04 JOBS\01 OPEN JOBS\JPW1?xx\JPW1799 - Stansted Airport Solar Planning Layout (GG)\4. Drawings\1. RPS Drawings\DWG\JPW1799-001RevG_D220131_(Stansted Solar Layout).dwg

Appendix D

Pre and Post Development Runoff Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	22.164	Urban	0.000
SAAR (mm)	600	Region Number	Region 6

Results l/s

QBAR Rural	63.0
QBAR Urban	63.0
Q100 years	200.9
Q1 year	53.5
Q30 years	142.7
Q100 years	200.9

Our ref: HLEF78850

Site Information

1.1 The application site is centred at National Grid Reference TL 55953 22982. The proposed development red line boundary extends to approximately 22.1639 ha.

Design Rainfall

1.2 The rainfall used to derive the surface water runoff rates and volumes was obtained from the Flood Estimation Handbook (FEH) Web Service[1], depth-duration-frequency model. This provides design rainfall intensities for a range of return periods and storm durations, which are presented in Table 1.

Table 1 - Design Rainfall Intensities (mm)

	Storm Durations (hr)								
	0.25	0.5	1	2	3	5	12	24	48
1	24.44	15.42	9.41	7.11	5.69	4.08	2.10	1.21	0.71
2	34.64	21.96	13.38	9.50	7.42	5.20	2.62	1.48	0.86
5	49.64	31.24	19.01	12.78	9.78	6.73	3.31	1.84	1.05
10	60.44	38.36	23.44	15.31	11.60	7.90	3.82	2.11	1.20
30	78.96	50.64	30.9	19.65	14.67	9.89	4.73	2.58	1.45
50	88.08	56.56	34.7	21.88	16.32	10.99	5.24	2.85	1.58
100	101.8	65.74	40.38	25.55	19.10	12.92	6.21	3.36	1.82
100+5%	106.89	69.027	42.399	26.82	20.06	13.57	6.52	3.53	1.91
100+10%	111.98	72.314	44.418	28.10	21.01	14.21	6.83	3.70	2.00
100+20%	122.16	78.888	48.456	30.65	22.92	15.50	7.45	4.03	2.19

[1] **Centre for Ecology & Hydrology (2016), Flood Estimation Handbook (FEH)** [Accessed online on 13/05/2021 at https://fehweb.ceh.ac.uk/]

Climate Change

1.3 Climate change is currently predicted to increase the wetness of winters and the dryness of summers. The intensity of storm events is anticipated to increase by 20% up to 2069 using the upper end allowance.

Existing Surface Water Runoff Rates

1.4 It has been estimated that the site currently consists of 22.16 ha of soft landscaping.

1.5 The Wallingford Modified Rational Method has been used to estimate the surface water runoff generated during peak rainfall events based on the nature of the ground surface (hard standing, vegetation, etc) and rainfall depth, duration and frequency information for the immediate area. A runoff coefficient of 1 and 0.3 was applied for the impermeable and permeable areas respectively in line with best practise for surface water runoff estimation.

1.6 The results of this calculation for a range of return periods, including climate change, are presented in Table 2.

Table 2 – Existing Surface Water Runoff Rates (l/s)

	Storm Durations (hr)								
	0.25	0.5	1	2	3	5	12	24	48
1	455.0	287.1	175.2	132.3	105.9	76.0	39.1	22.4	13.2
2	644.9	408.8	249.1	176.9	138.1	96.9	48.8	27.6	16.0
5	924.2	581.6	353.9	237.9	182.1	125.3	61.5	34.2	19.6
10	1125.3	714.2	436.4	285.0	215.9	147.0	71.2	39.3	22.3
30	1470.1	942.8	575.3	365.7	273.2	184.1	88.0	48.0	26.9
50	1639.8	1053.0	646.0	407.3	303.8	204.6	97.6	53.1	29.4
100	1895.3	1223.9	751.8	475.6	355.7	240.5	115.5	62.6	33.9
100+5%	1990.0	1285.1	789.4	499.4	373.4	252.6	121.3	65.7	35.6
100+10%	2084.8	1346.3	827.0	523.1	391.2	264.6	127.1	68.8	37.3
100+20%	2274.3	1468.7	902.1	570.7	426.8	288.6	138.6	75.1	40.7

1.7 The surface water runoff volume for the existing site are presented in Table 3.

Table 3 – Existing Surface Water Runoff Volume (m^3)

	Storm Durations (hr)								
	0.25	0.5	1	2	3	5	12	24	48
1	409.5	516.8	630.7	952.4	1143.4	1368.6	1689.7	1938.3	2280.1
2	580.4	735.9	896.8	1273.4	1491.9	1744.0	2106.6	2383.4	2758.0
5	831.8	1046.9	1274.1	1713.1	1966.5	2254.7	2658.8	2957.8	3388.7
10	1012.7	1285.5	1571.0	2052.3	2331.8	2646.8	3075.0	3391.4	3861.9
30	1323.0	1697.0	2071.0	2633.4	2950.4	3313.0	3802.9	4150.8	4651.4
50	1475.9	1895.4	2325.7	2932.3	3281.5	3682.3	4215.8	4585.8	5072.3
100	1705.8	2203.1	2706.4	3424.2	3841.1	4329.7	4990.6	5405.5	5860.5
100+5%	1791.0	2313.2	2841.7	3595.4	4033.2	4546.2	5240.1	5675.7	6153.6
100+10%	1876.3	2423.4	2977.1	3766.7	4225.2	4762.7	5489.6	5946.0	6446.6
100+20%	2046.9	2643.7	3247.7	4109.1	4609.3	5195.7	5988.7	6486.5	7032.7

Post-Development Surface Water Runoff Rates & Volume

1.8 The proposed development will increase the impermeable area, with a total of approximately 0.00065 ha (65m^2) of hardstanding and 22.1574 ha of soft landscaping. The only structure which will be placed on hardstanding is a substation of approximately 65m^2. The impermeable area post-development is therefore not considered to be significant.

1.9 The post development runoff rates and volumes are provided in Tables 4 and 5, **these are on the basis that no mitigation is included.**

Table 4 – Post Development Surface Water Runoff Rates (l/s) – not including mitigation

	Storm Durations (hr)								
	0.25	0.5	1	2	3	5	12	24	48
1	455.3	287.3	175.3	132.4	105.9	76.1	39.1	22.4	13.2
2	645.4	409.1	249.3	177.0	138.2	97.0	48.8	27.6	16.0
5	924.8	582.0	354.2	238.1	182.2	125.3	61.6	34.3	19.6
10	1126.0	714.7	436.7	285.2	216.1	147.1	71.2	39.3	22.4
30	1471.1	943.4	575.7	366.0	273.4	184.2	88.1	48.1	26.9
50	1641.0	1053.7	646.5	407.5	304.0	204.7	97.7	53.1	29.4
100	1896.6	1224.8	752.3	475.9	355.9	240.7	115.6	62.6	33.9
100+5%	1991.4	1286.0	789.9	499.7	373.7	252.7	121.4	65.7	35.6
100+10%	2086.2	1347.2	827.5	523.5	391.5	264.8	127.2	68.9	37.3
100+20%	2275.9	1469.7	902.8	571.1	427.1	288.8	138.7	75.1	40.7

Table 5 – Post Development Surface Water Runoff Volume (m^3) – not including mitigation

	Storm Durations (hr)								
	0.25	0.5	1	2	3	5	12	24	48
1	409.8	517.1	631.1	953.1	1144.2	1369.6	1690.8	1939.6	2281.7
2	580.8	736.4	897.4	1274.3	1493.0	1745.1	2108.0	2385.0	2759.9
5	832.3	1047.6	1275.0	1714.3	1967.8	2256.2	2660.6	2959.8	3391.0
10	1013.4	1286.4	1572.1	2053.7	2333.3	2648.6	3077.1	3393.7	3864.5
30	1324.0	1698.2	2072.4	2635.2	2952.4	3315.2	3805.5	4153.6	4654.6
50	1476.9	1896.7	2327.3	2934.3	3283.7	3684.8	4218.7	4588.9	5075.8
100	1706.9	2204.6	2708.3	3426.6	3843.8	4332.7	4994.0	5409.2	5864.6
100+5%	1792.3	2314.8	2843.7	3597.9	4035.9	4549.3	5243.7	5679.6	6157.8
100+10%	1877.6	2425.0	2979.1	3769.2	4228.1	4766.0	5493.4	5950.1	6451.0
100+20%	2048.3	2645.5	3249.9	4111.9	4612.5	5199.2	5992.8	6491.0	7037.5

1.10 Comparison of the information in Tables 2 and 3 with that in Tables 4 and 5 demonstrates that there is less than 0.1% increase in the surface water runoff rate and volume between the existing and proposed scenarios. This equates, for example, to a 0.3m^3 increase in runoff volume in the 15 minute 1 in 1 year event, and a 1.4m^3 increase in runoff volume in the 15 minute 1 in 100 year plus 20% climate change event.

Appendix E

Conceptual Surface Water Drainage Layout

ENERGY STORAGE

INFILL OF HEDGEROW AND TREE PLANTING TO FURTHER SCREEN DEVELOPMENT

REINSTATEMENT OF AN OLD FIELD BOUNDARY TO BREAK UP LARGE FIELD AND FURTHER SCREEN THE DEVELOPMENT

NEW HEDGEROW TO UP LARGE FIELD AND FURTHER SCREEN THE DEVELOPMENT

FILTER STRIP:
It will help intercept and slow channelised surface water flows and promote infiltration.

14m

Issues

Pond

Le Knell's Cottage

Seven Acre Wood

101.3m

100.7m

99.2m

93.8m

94.2m

92.2m

FB

Notes

1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.

KEY

Filter Strip

Rev	Description	By	Ckd	Date
B	Updated solar layout plan	LS		31.01.22
A	First Issue	FC	JM	01.11.21

MAKING COMPLEX EASY

321 Bradford Street, Birmingham,
West Midlands B5 6ET
T: +44 121 622 8520 E: rpswlv@rpsgroup.com

Client: Manchester Airports Group / Stansted Airport Limited

Project: Stansted Airport Solar Farm

Title: Conceptual Drainage Strategy

Status	Scale	Date Created
Preliminary	1:1000 @A0	01.11.2021

Task Team Manager	Information Author	Task Information Manager
FC	FC	JM

Document Number: D01

RPS Project Number: HLEF78850

Revision: B

rpsgroup.com

Appendix F

Event Exceedance Plan

Notes

1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.

KEY

Indicative overland flow exceedance route

INFILL OF HEDGEROW AND TREE PLANTING TO FURTHER SCREEN DEVELOPMENT

REINSTATEMENT OF AN OLD FIELD BOUNDARY TO BREAK UP LARGE FIELD AND FURTHER SCREEN THE DEVELOPMENT

NEW HEDGEROW TO UP LARGE FIELD AND FURTHER SCREEN THE DEVELOPMENT

Seven Acre Wood

Pond

Le Knell's Cottage

Stansted Guest House

101.3m

100.7m

99.2m

93.8m

94.2m

92.2m

97.0m

FB

Rev	Description	By	Ckd	Date
B	Updated solar layout.	LS		31/01/2022
A	First Issue	FC		28/10/2021

MAKING COMPLEX EASY

321 Bradford Street, Birmingham,
West Midlands B5 6ET
T: +44 121 622 8520 E: rpswlv@rpsgroup.com

Client: Manchester Airports Group / Stansted Airport Limited

Project: Stansted Airport Solar Farm

Title: Flow Exceedance Plan

Status	Scale	Date Created
For Information	1:1000 @A0	28.10.2021

Task Team Manager	Information Author	Task Information Manager
FC	FC	JM

Document Number: HLEF78850-RPS-FlowExceedancePlan-A0

RPS Project Number: HLEF78850

Revision: B

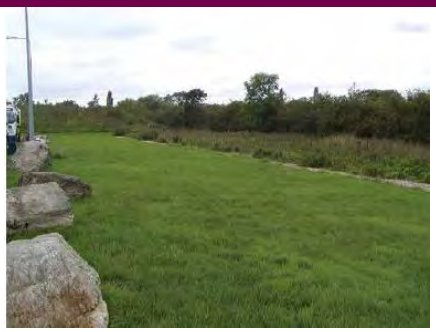
rpsgroup.com

Appendix G

SuDS Maintenance Plan

SuDS Maintenance Plan

This Maintenance Plan has been produced in order to ensure that the SuDS incorporated at the site remain functional for the lifetime of the development. These will help avoid channelisation caused by concentrated surface water run-off. It is proposed to provide filter drains around the compound and filter strips downslope of the solar panels. This plan demonstrates that the maintenance and operation requirements of the SuDS are economically proportionate to the development.

Type of SuDS	Illustration	Maintenance Required	Regularity	Indicative Cost
Filter strips	 Filter strips are uniformly graded and gently sloping strips of grass / dense vegetation that are designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration and infiltration. These processes are enabled by the slowing of flows caused by the vegetation.	Removal of plants or replanting if necessary	Annual, or as required	Can be undertaken as part of landscape maintenance
		Removal of litter, weeds and debris	Monthly, or as required	Can be undertaken as part of landscape maintenance
		Remove and replace filter material (if used) and vegetation	Every 20-25 years	c. £500 - £2000
Filter Drains		Remove litter (including leaf litter) and debris from filter drain suface, access chambers and pre-treatment devices	Monthly (if required)	See below
		Inspect filter drain surface	Monthly	See below

Type of SuDS	Illustration	Maintenance Required	Regularity	Indicative Cost
	Filter drains are shallow trenches filled with stone/gravel that create temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff. Filter drains may be lined or may allow infiltration depending on the suitability of the underlying soils. A perforated pipe may be built into the base of the trench to convey the water to other parts of a site. Replacement of filter material (10 – 15 years)	and inlet / outlet pipework for blockages, clogging, standing water and structural damage		
		Inspect inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly	See below
		Remove sediment from pre-treatment devices	Six monthly, or as required	See below
		Indicative annual maintenance cost £0.2 - £1 / m^2 of filter surface area		

This document was compiled with reference to the Ciria Susdrain website, the CIRIA SuDS Manual (2015) and to 'Cost estimation for SUDS - summary of evidence' (Environment Agency, March 2015) and references therein.

Appendix H

SuDS Proforma

Essex County Council

SuDS Water quantity and Quality – LLFA Technical Assessment Proforma

Introduction

This proforma identifies the information required by Essex LLFA to enable technical assessment the Designers approach to water quantity and water quality as part of SuDS design approach in compliance with Essex SuDS Design Guide.

Completion of the proforma will also allow for technical assessment against Non-statutory technical standards (NSTS) for Sustainable Drainage. The proforma will accompany the site specific Flood Risk Assessment and Drainage Strategy submitted as part of the planning application.

Please complete this form in full for full applications and the coloured sections for outline appllications. This will help us identify what information has been included and will assist with a smoother and quicker application.

Instructions for use

Use the units defined for input of figures

Numbers in brackets refer to accompanying notes.

Where ……m³ .....m³/m² are noted – both values should be filled in.

Site details

1.1	Planning application reference (if known)		
1.2	Site name		
1.3	Total application site area (1)	22.16	ha
1.4	Predevelopment use (4)	Greenfield	
1.5	Post development use	Other	
	If other, please sepcify	Solar Farm / Green Energy	
1.6	Urban creep applicable	No	if yes, factor applied:
1.7	Proposed design life / planning application life	35 years	
1.8	Method(s) of discharge: (5)		

☐ *Reuse* ☑ *Infiltration* ☐ *Hybrid* ☐ *Waterbody* ☐ *Storm sewer* ☐ *Combined sewer*

1.9	Is discharge direct to estuary / sea	No	
1.10	Have agreements in principle (where applicable) for discharge been provided	No	

Essex County Council

SuDS Water quantity and Quality – LLFA Technical Assessment

Calculation inputs

2.1	Area within site which is drained by SuDS (2)	N/A	m^2
2.2	Impermeable area drained pre development (3)	0	m^2
2.3	Impermeable area drained post development (3)	0	m^2
2.4	Additional impermeable area (2.3 minus 2.2)	0	m^2
2.5	Method for assessing greenfield runoff rate	ICP SUDS	
2.6	Method for assessing brownfield runoff rate	N/A	
2.7	Coefficient of runoff (Cv) (6)	N/A	
2.8	Source of rainfall data (FEH Preferred)	FEH	
2.9	Climate change factor applied 20	%	

Attenuation (positive outlet)

2.10 Drainage outlet at risk of drowning (tidal locking, elevated water levels in watercourse/sewer)
Note: Vortex controls require conditions of free discharge to operate as per manufacturers specification.

2.11 Invert level at final outlet N/A mAOD

2.12 Design level used for surcharge water level at point of discharge (16) N/A mAOD

Infiltration (Discharge to Ground)

2.13 Have infiltration tests been undertaken No

2.14 If yes, which method has been used

2.15 Infiltration rate (where applicable) N/A m/s

2.16 Depth to highest known ground water table N/A mAOD

2.17 If there are multiple infiltration features please specify where they can be found in the FRA N/A

2.18 Depth of infiltration feature N/A mAOD

2.19 Factor of safety used for sizing infiltration storage N/A

Essex County Council

SuDS Water quantity and Quality – LLFA Technical Assessment Proforma

Calculation outputs

Sections 3 and 4 refer to site where storage is provided by full attenuation or partial infiltration. Where all flows are infiltrated to ground go straight to Section 6.

3.0	**Greenfield runoff rates** (incl. Urban Creep)			
3.1	1 in 1 year rainfall	l/s/ha, 53.5	l/s for the site	
3.2	1 in 30 year rainfall	l/s/ha, 142.7	l/s for the site	
3.3	1 in 100 year rainfall + CCA	l/s/ha, 200.9	l/s for the site	
4.0	**Brownfield runoff rates** (incl. Urban Creep)			
4.1	1 in 1 year rainfall	l/s/ha,	l/s for the site	
4.2	1 in 30 year rainfall	l/s/ha,	l/s for the site	
4.3	1 in 100 year rainfall + CCA	l/s/ha,	l/s for the site	
5.0	Proposed maximum rate of runoff from site (incl. Urban Creep) (7)			
5.1	1 in 1 year rainfall	l/s/ha,	l/s for the site	
5.2	1 in 30 year rainfall	l/s/ha,	l/s for the site	
5.3	1 in 100 year rainfall + CCA	l/s/ha,	l/s for the site	
6.0	Attenuation storage to manage flow rates from site (incl. **Climate Change Allowance** (CCA) and Urban Creep)			
6.1	Storage - 1 in 100 year + CCA (9)	N/A	m^3	m^3/m^2
6.2	50% storage drain down time 1 in 30 years		hours	
7.0	Controlling volume of runoff from the site(10)			
7.1	Pre development runoff volume(12) (development area)	N/A	m^3 for the site	
7.2	Post development runoff volume (unmitigated) (12)	N/A	m^3 for the site	
7.3	Volume to be controlled (5.2 - 5.1)	N/A	m^3 for the site	

Essex County Council

7.4 Volume control provided by:

- Interception losses[13] m^3
- Rain harvesting [14] m^3
- Infiltration m^3
- Attenuation m^3
- Separate volume designated as long term storage[15] N/A m^3

7.5 Total volume control (sum of inputs for 5.4) N/A m^3 [17]

8.0 Site storage volumes (full infiltration only)

8.1	Storage - 1in 30 year + CCA [8]	N/A	m^3		m^3/m^2 (of developed impermeable area)
8.2	Storage - 1 in 100 year + CCA [11]	N/AN/A	m^3	N/AN/A	m^3/m^2

SuDS Water quantity and Quality – LLFA Technical Assessment Proforma

Design Inputs

Proposed site use SOLAR FARM

Pollution hazard category (see C753 Table 26.2) LOW

High risk area defined as area storing fuels chemicals, refuelling area, washdown area, loading bay.

Design Outputs

List order of SuDS techniques proposed for treatment FILTER STRIPS AND FILTER DRAINS

Note that gully pots, pipes and tanks are not accepted by Essex LLFA as a form of treatment (for justification see C753 Section 4.1, Table 26.15 and Box B.2)

Are very high pollution risk areas drained separate from SuDS to foul system No

Other

Please include any other information that is relevant to your application

Essex County Council

SuDS Water quantity and Quality – LLFA Technical Assessment Proforma

Notes

1. All area with the proposed application site boundary to be included.
2. The site area which is positively drained includes all green areas which drain to the SuDS system and area of surface SuDS features. It excludes large open green spaces which do not drain to the SuDS system.
3. Impermeable area should be measured pre and post development. Impermeable surfaces include, roofs, pavements, driveways and paths where runoff is conveyed to the drainage system.
4. Predevelopment use may impact on the allowable discharge rate. The LLFA will seek for reduction in flow rates to GF (Essex SuDS Design Guide).
5. Runoff may be discharge via one or more methods.
6. Sewers for Adoption 6th Edition recommends a Cv of 100% when designing drainage for impermeable area (assumes no loss of runoff from impermeable surfaces) and 0% for permeable areas. Where lower Cv's are used the applicant should justify the selection of Cv.
7. It is Essex County Council's preference that discharge rates for all events up to the 1 in 100 year event plus climate change are limited to the 1 in 1 greenfield rate. This is also considered to mitigate the increased runoff volumes that occur with the introduction of impermeable surfaces. If discharge rates are limited to a range of matched greenfield flows then it is necessary to provide additional mitigation of increased runoff volumes by the provision of Long-term Storage.
8. Storage for the 1 in 30 year must be fully contained within the SuDS components. Note that standing water within SuDS components such as ponds, basins and swales is not classified as flooding. Storage should be calculated for the critical duration rainfall event.
9. Runoff generated from rainfall events up to the 1 in 100 year will not be allowed to leave the site in an uncontrolled way. Temporary flooding of designated areas to shallow depths and velocities may be acceptable.
10. The following information should only be provided if increased runoff volumes are not mitigated by limiting all discharge rates back to the greenfield 1 in 1 year rate.
11. Climate change is specified as 40% increase to rainfall intensity, unless otherwise agreed with the LLFA / EA.
12. To be determined using the 100 year return period 6 hour duration winter rainfall event.
13. Where Source Control is provided Interception losses will occur. An allowance of 5mm rainfall depth can be subtracted from the net inflow to the storage calculation where interception losses are demonstrated. The Applicant should demonstrate use of subcatchments and source control techniques. Further information is available in the SuDS Design Guide.
14. Please refer to Rain harvesting BS for guidance on available storage.
15. Flows within long term storage areas should be infiltrated to the ground or discharged at low flow rate of maximum 2 l/s/ha.
16. Careful consideration should be used for calculations where flow control / storage is likely to be influenced by surcharged sewer or peak levels within a watercourse. Outlets can be tidally locked where discharge is direct to estuary or sea. Calculations should demonstrate that risk of downed outlet has been taken into consideration. Vortex controls require conditions of free discharge to operate as per specification.
17. In controlling the volume of runoff the total volume from mitigation measures should be greater than or equal to the additional volume generated.