Forge Engineering Design Solutions

FLOOD RISK ASSESSMENT
GREATER THAN 1HA IN FLOOD ZONE 1

Proposed Recreation Ground,
Land Off Milton Road,
Adderbury, Banbury

Adderbury Parish Council
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List of Abbreviations:

CDC	Cherwell District Council
WODC	West Oxfordshire District Council
NPPF	National Planning Policy Framework
FRA	Flood Risk Assessment
SFRA	Strategic Flood Risk Assessment
LPA	Local Planning Authority
PPS25	Planning Policy Statement 25 'Development and Flood Risk' for England and Wales
PPG FRCC	Planning Practice Guidance Flood Risk and Coastal Change
SuDS	Sustainable Drainage Systems
IOH	Institute of Hydrology
SWMS	Surface Water Management Strategy
CIRIA	Construction Industry Research and Information Association
URBAN	Urbanisation factor
CIND	Catchment Index
CWI	Catchment Wetness Index
SAAR	Standard Average Annual Rainfall
NC	Rainfall Continentality Factor
QBAR	A Flood Studies Report denoting the Mean Annual Flood flow rate

1. Introduction

Forge Engineering Design Solutions Ltd was commissioned by Adderbury Parish Council, to carry out a Flood Risk Assessment (FRA) to support a planning application to Cherwell District Council (CDC) for the development of a recreational ground, building, amenities and parking in compliance with the National Planning Policy Framework1[1] (NPPF).

1.1. National Planning Policy Framework

When determining planning applications, paragraph 103 of the NPPF requires that local planning authorities should ensure flood risk is not increased elsewhere, and only consider development appropriate in areas at risk of flooding when informed by a site-specific FRA which is compliant with the technical guidance to the NPPF, "Planning Practice Guidance Flood Risk and Coastal Change[2]" (PPG FRCC), following the Sequential Test, and if required the Exception Test. More specifically, the site-specific FRA should seek to demonstrate that:

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

1.2. District Council's Strategic Flood Risk Assessment

Cherwell District Council and West Oxfordshire District Council commissioned Scott Wilson (Limited) to produce a joint Level 1 Strategic Flood Risk Assessment (SFRA) in April 2009. In April 2016, Cherwell District Council commissioned AECOM to produce an update to the Level 1 SFRA (2009) for it's administrative area, which was published in May 2017.

The level 1 SFRA (2017) update was produced as a tool to select appropriate sustainable development sites away from areas vulnerable to flood risk in accordance to changes in policy and guidance such as those laid down in the NPPF and associated Planning Practice Guidance on Flood Risk and Coastal Change.

The update was produced to provide appropriate supporting evidence to the Cherwell Local Plan and will be used to inform decisions on future development, and for guidance on the preparation of sustainable policies for the long-term management of flood risk. The SFRA (2017) includes revised datasets made available since the original SFRA Level 1 was published.

[1] Department for Communities and Local Government (2012) National Planning Policy Framework
[2] Communities and Local Government (2014) Planning Practice Guidance - Flood Risk and Coastal Change

However, the SFRA (2017) update advises that the information only provides an overview of flood risk within CDC and reiterates further investigation via an appropriate site-specific Flood Risk Assessment should be carried out where necessary. The aim of the SFRA is met through the following outputs:

- consideration of changes to policy
- guidance on the required content of and preparation of site specific FRAs to address flood risks and residual flood
- guidance on the application of Sustainable Drainage Systems (SuDS) in the District

In April 2016, AECOM was also commissioned by CDC to produce a Level 2 SFRA to compliment the Level 1 SFRA (2017) update. The Level 2 SFRA states that it provides additional information to inform on specific flood risk issues and the suitability of 8 potential strategic development sites put forward by CDC.

The proposed development was designed to comply with the above planning and flood risk mitigation requirements.

1.3. Environment Agency Standing Advice

The site covers an area greater than 1ha and consists of Outdoor sports and recreation and essential facilities such as changing rooms and parking. In accordance with the NPPFTG, the proposed development is classified as a Water Compatible Development, greater than 1ha located in Flood Zone 1.

This FRA has been carried out in accordance with the EA's Standing Advice for a Water Compatible Development, greater than 1ha located in Flood Zones 1. The Standing Advice states that FRAs must include the management of surface water run-off, including the feasibility of the use of infiltrating SuDS.

Therefore, this FRA and associated conclusions are focussed on preventing any increase in surface water run-off and where practical reducing the rate of run-off from the site through the utilization of sustainable drainage principles.
The FRA should address the following issues:

- Surface water run-off should not increase flood risk to the development or third parties. This should be done by using a SuDS to attenuate to at least pre-development runoff rates and volumes or where possible achieving betterment in the surface water run-off regime.
- An allowance for climate change needs to be incorporated, which means adding an extra amount to peak rainfall.
- The residual risk of flooding needs to be addressed should any drainage features fail or if they are subjected to an extreme flood event. Overland flow routes should not put people and property at unacceptable risk. This could include measures to manage residual risk such as raising ground or floor levels where appropriate.

2. Development Site Information:

In this section, site-specific information is presented in regard to the site location, main rivers, watercourses and flood zones. Data pertaining to both existing and proposed developments is shown, allowing a comparison of permeable and impermeable areas. Lastly, information is presented on ground levels through a topographical survey, descriptions of existing site drainage and site-specific geology, hydrogeology and permeability.

2.1. Site Location, Main Rivers, Watercourses and Flood Zones

The site is located on land to the north of Milton Road, which is situated west of Adderbury. The site is set to the west of the A4260, and to the east of the A361. The proposed development site covers an area of approximately 36,259m^2 (3.6259 ha). The site can be located by Grid Coordinates 446282mE, 235085mN. See site location maps in Appendix 1.

To the east of the site is a residential development site, and to the west is the horticultural company Ball Colegrave, and garden centre Florensis Flower Seeks UK Ltd. To the north of the site is undeveloped land. To the south is Milton Road and adjacent to Milton Road further south is undeveloped farmland.

The nearest Main River is the Sor Brook that is approximately 660m to the east of the site. The Environment Agency's (EA) Indicative Flood Zone Map indicates that the site is located in Flood Zone 1, which has a Low risk of fluvial flooding from Main Rivers. See EA's Indicative Flood Zone Maps in Appendix 1.

2.2. Existing Development

The existing site was undeveloped Greenfield with an impermeable area of approximately 0m^2 (0.00ha) and a permeable area of 36259m^2 (3.6295ha). Accordingly, 0.0% of the existing site was impermeable, while 100.0% is permeable. See Existing Site Plan in Appendix 2.

2.3. Proposed Development

The proposed development includes a recreational ground comprising of two 100m x 60m pitches, a 25m x 40m Multiuse Games Area (MUGA), construction of one amenity building, and parking. See Proposed Site Plan in Appendix 2.

The proposed site would have an impermeable area of approximately 1054.0m^2 (0.1054ha) and a permeable area of 35,205.0m^2 (3.5205ha). Accordingly, approximately 3% of the proposed site would be impermeable, while 97% would be permeable. See Proposed Site Plan in Appendix 2.

Table 1: Permeable and Impermeable areas for existing and proposed developments

	Existing Development	Proposed Development
Impermeable Area (m^2, ha)	0.0; 0.0	1054.0; 0.1054
Fraction of total site (%)	0.0%	3.0%
Permeable Area (m^2, ha)	36,259.0; 3.6259	35,205.0; 3.5205
Fraction of total site Area (%)	100.0%	97.0%

2.4. Topographical Survey

Ground levels at the site, Above Ordnance Datum (AOD), are shown on the topographical survey included in Appendix 3.

The site slopes gently downwards from the south-west to the north-east of the site with levels ranging from 102.690m AOD in the south-west of the site down to 97.114m AOD in the north-east of the site. The average site level is approximately 99.902m AOD.

2.5. Existing Site Drainage

As well as infiltrating into the ground at its source, surface water falling onto the site flows across the site, in a general south-west to north-east direction at the Greenfield run-off rate, via overland flow. See the Topographical survey in Appendix 3.

A feasibility study report was completed by sports turf consultancy STRI on 4th October 2017. STRI states that there is a drainage ditch to the north east of the site but advises that the ditch is overgrown with vegetation. STRI note that the drainage ditch connects to a surface water drainage network where it extends to the cemetery located north-east of the site.

There is a rising main to the south of the site running from west to east along Milton road, and going around the west of the site. See Thames Water Asset Location Plans in Appendix 4

There is a 150mm diameter gravity foul sewer to the east of the site in Milton Road, and a 150mm diameter gravity foul sewer to the south east of the site in St Mary's Road

See the Topographical survey in Appendix 3 and the Thames Water Asset Location Plans included in Appendix 4.

2.6. Geology, Hydrogeology and Permeability

The British Geological Survey[3] (BGS) published geological maps indicate that there is superficial geology of Alluvium comprising of clay, silt and sand at the site. The site is underlain by a bedrock geology of the Lias Group Formation, which consists of mudstone, siltstone, limestone and sandstone. See BGS Maps in Appendix 1.

This type of geology can typically have a moderate to good permeability within the region of $1x10^{-4}$m/s and $1x10^{-5}$m/s.

The SFRA (2017) notes the geology of the area to the south-east of Banbury to be mainly mudstone.

STRI (2017) completed a soil particle size analysis and confirmed the soil type to be Clay loam, however they have noted that the result is only relevant to the soil samples submitted for testing.

The published Aquifer Designation Maps identify that the site is underlain by a bedrock Secondary Aquifer A. The site is not underlain with a superficial Aquifer.

The SFRA (2017) shows the aquifer to be a Minor Aquifer – Intermediate, which correlates with the published Aquifer maps.

The Aquifer designation maps correlate with the BGS published geology data. Aquifer Designation Maps are included in Appendix 1.

A BRE 365 Infiltration Test was conducted. The test indicated a good infiltration rate, which would be suitable for all types of infiltrating SuDS techniques.

Three tests were carried out in the test pit that gave results of:

- $1.85x10^{-4}$m/s
- $1.67x10^{-4}$m/s
- $1.58x10^{-4}$m/s

The lowest permeability rate of $1.58x10^{-4}$m/s, which equates to 0.5688m/hr, was used for the Conceptual SuDS surface water management strategy design to prove feasibility of the utilization of infiltrating SuDS techniques.

See BRE 365 Test Results in Appendix 5.

[3] The British Geological Survey. Accessed at http://www.bgs.ac.uk/

3. Surface Water Management Strategy

3.1. The SuDS Manual and Sustainable Systems

The implementation of a surface water management strategy for new developments can ensure that there is no increase of flood risk as a result of the proposed development by avoiding the creation of, reducing and delaying the discharge of rainfall run-off to watercourses and public sewers using SuDS techniques.

The SuDS Management Train as set out in the SuDS Manual[4] (CIRIA C753), which provides best practice guidance on the planning, design, construction and maintenance of SuDS, should be utilized in the SuDS design to mimic natural catchment processes as closely as possible. It uses SuDS drainage techniques in series to incrementally reduce pollution, flow rates and volumes.

3.1.1. Hierarchical Approach to Design of Sustainable Systems

The hierarchy of techniques that should be considered in developing the management train are as follows:

1. **Prevention** – the use of good site design and site housekeeping measures to prevent run-off and pollution (e.g. sweeping to remove surface dust and detritus from car parks), and rainwater reuse/harvesting. Prevention policies should generally be included within the site management plan.
2. **Source control** – control of run-off at or very near its source (e.g. soakaways, other infiltration methods, green roofs, pervious pavements).
3. **Site control** – management of water in a local area or site (e.g. routing water from building roofs and car parks to a large soakaway, infiltration or detention basin).
4. **Regional control** – management of run-off from a site or several sites, typically in a balancing pond or wetland.

Wherever possible, storm water should be managed in small, cost-effective landscape features located within small sub-catchments rather than being conveyed to and managed in large systems at the bottom of drainage areas (end of pipe solutions).

The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at source should always be considered before site or regional controls.

The use of the SuDS management train and infiltration techniques also allows for the management of potential pollution to controlled waters, through sedimentation and infiltration.

[4] CIRIA 753 The SuDS Manual 2015

SuDS ensure that surface water run-off cannot discharge directly into controlled waters such as groundwater and watercourses, and consequently reduces the risk of pollution.

3.1.2. Types of SuDS Infiltration Techniques

The proposed site's existing surface water run-off rate can be maintained or reduced through the utilisation of SuDS. SuDS aim to mimic the natural drainage processes whilst also removing pollutants from urban run-off at the source before entering a watercourse. There are a wide range of SuDS infiltration techniques. These include, but are not limited to;

- Soakaways (Recharge groundwater/aquifer)
- Filter strips adjacent to roads (Re-charge groundwater/aquifer)
- Swales around the site and adjacent to roads (Re-charge groundwater/aquifer and biodiversity)
- Pervious paving of road and car parks (Re-charge groundwater/aquifer)

There are other forms of SuDS that do not use infiltration. These SuDS provide attenuation and controlled release of surface water, which can assist in the reduction of the post-development surface water run-off. Examples of these are;

- Rainwater harvesting tanks and rainwater harvesting butts (water conservation)
- Above ground attenuation ponds and detention basins (amenity and biodiversity areas)
- Below ground geo-cellular attenuation tanks
- Green Roof (attenuation)

3.1.3. Other Uses and Benefits of SuDS

SuDS, can be used to mitigate flooding or pollution. They also provide environmental benefits. Some of the environmental benefits are listed below:

- The hydraulic benefits, including peak flow rate reductions, storm run-off volume reductions, and enhancements to river base flow and aquifer recharge.
- The pollutant loading reductions achieved by the system, and associated benefits to in-stream ecology, human health, and human value perceptions.
- The amenity and recreational benefit enjoyed by those who live close to the SUDS scheme.
- The additional value of properties adjacent or within view of the SUDS scheme.
- The ecological value of the SUDS schemes themselves.

In conclusion, one or more of the above SuDS techniques should be utilized in the surface water management strategy to minimise the surface water run-off from the site and the impacts of the development on the surrounding area.

3.2. Climate Change

Climate change is expected to increase the risk of fluvial flooding due to increased river flows, and surface water run-off is expected to increase due to increased rainfall intensities (Environment Agency, 2016).

Developments should not increase flood risk at the site or the surrounding area and, where possible, they should aim to reduce existing flood risk by incorporating SuDS to reduce the surface water run-off rate of the site.

Paragraph 100 of the NPPF requires Climate Change to be considered with regards to flood risk and recommends the national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights that should be applied to new developments – these are shown in Table 2.

Table 2 Climate change allowances related to peak river flows, pluvial intensity, offshore wind speeds and extreme wave height. Source: Environment Agency[5], 2016.

Parameter	2015 to 2039	2040 to 2069	2070 to 2115
Peak Rainfall intensity – Upper End	10%	20%	40%
Peak Rainfall intensity - Central	5%	10%	20%
Thames Peak River Flow – Upper End	25%	35%	70%
Thames Peak River Flow – Higher Central	15%	25%	35%
Thames Peak River Flow – Central	10%	15%	25%
Offshore wind speed	5%		10%
Extreme wave height	5%		10%

The surface water management strategy should ensure that the new surface water drainage system at the site is capable of attenuating the 1 in 100-year storm event including a 40% allowance for climate change, while limiting the surface water discharge rate from the site to the site's existing run-off rate or where possible the Greenfield run-off rate or less.

[5] Adapting to Climate Change: advice for Flood and Coastal Erosion Risk Management 2016 Environment Agency

3.3. Development Contributing Areas – Existing and Proposed

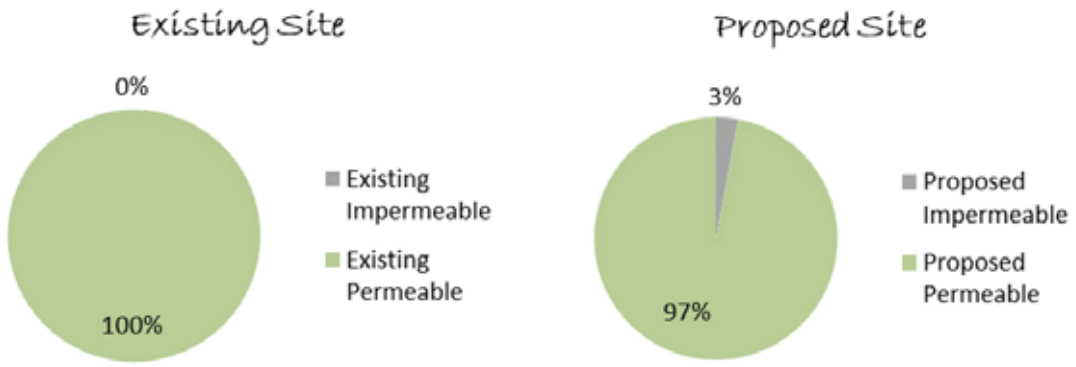
The existing site has an impermeable area of approximately 0.0m² (0.00ha) and a permeable area of 36259m² (3.6259ha). Accordingly, 0.0% of the existing site is impermeable, while 100.0% is permeable. See Existing Site Plan in Appendix 2.

The proposed development includes a recreational ground comprising of two 100m x 60m pitches, a 25m x 40m Multiuse Games Area, construction of one building, amenities and parking.

The proposed site has an impermeable area of approximately 1054m² (0.1054ha) and a permeable area of 35,205m² (3.5205ha). Accordingly, 3% of the proposed site is impermeable, while 97% is permeable. See Proposed Site Plan in Appendix 2.

Table 3: Permeable and Impermeable areas for existing and proposed developments

	Impermeable Area (m²; ha)	% of Total Site Area	Permeable Area (m²; ha)	% of Total Site Area
Existing Development	0; 0.00	0.0%	36259.0; 3.6259	100.0%
Proposed Development	1070.0; 0.1070	3.0%	35189.0; 3.5189	97.0%



Therefore, without mitigating SuDS, there could be an increase in the impermeable areas at the site, rising from 0.0% to 3.0% of the total site area. As such, this could potentially lead to an increase in the resultant surface water run-off from the site. Consequently, without mitigating SuDS, there could be an increase in flood risk to the site and the surrounding areas.

Therefore, the development proposals would incorporate SuDS to mitigate the potential impacts of any increase in impermeable area and Climate Change, as well as aiming to provide betterment where possible.

3.4. Surface Water Run-Off Calculations

3.4.1. Greenfield Run-off Rates

Greenfield run-off rates are calculated to determine the theoretical peak flow rates of discharge from the Greenfield site to surrounding areas and receiving watercourses in the vicinity, for 1, 30, 100 and 100 year plus a climate change allowance year return periods.

The calculation of peak rates of run-off from Greenfield areas is related to catchment characteristics which include size, soil index, annual rainfall and regional growth curves. Surface water volumes are calculated using a 6 hour storm duration.

As stated in the SuDS Manual, the existing site's estimated Greenfield run-off rate – denoted herein as QBarGreenfield - was calculated using the Institute of Hydrology's (IH) Report No. 124 methodology for sites with an area between 0 ha and 50 ha:

$$QBar_{Greenfield} = 0.00108\ AREA^{0.89}\ SAAR^{1.17}\ SOIL^{2.17} \qquad \text{(IHR 124 equation 7.1)}$$

where,

0.00108 is a conversion factor for the units used,
AREA is the site catchment area in km^2,
SAAR is the Standard Average Annual Rainfall in mm, and
SOIL is the soil index classification.

The run-off rate is calculated for a 50 ha ($0.50km^2$) catchment using the site's catchment details, and then interpolated using the site's total area to calculate the site's Greenfield run-off rate.

Using a SAAR of 654mm and SOIL of 0.150 (class 1 type soil with moderate to low permeability), the estimated existing site's Greenfield surface water run-off rate is:

$$QBar_{Greenfield} = 0.00108 \times 0.50^{0.89} \times 654^{1.17} \times 0.150^{2.17}$$
$$= 0.0187 \text{ cumecs/50 ha}$$

Multiplying the latter by 1000 yields:

$$QBar_{Greenfield} = 18.7 \text{ l/s/50 ha}$$

Dividing by 50 leads to:

$$QBar_{Greenfield} = 0.374 \text{ l/s/ha}$$

Thus, a site area of 3.6259 ha gives a site $QBar_{Greenfield} = 1.356$ l/s

For the site's catchment area of 3.6259ha and specified storm events, the site's estimated Greenfield run-off peak flow rates and volumes (without mitigating SuDS) for the 1, 30, 100 and 100 year with climate change allowance return periods are shown in Table 4.

Table 4: Shown are the site's estimated Greenfield peak run-off rates and volumes for the 1, 30, 100 and 100 year with climate change allowance return periods.

Storm Event 1 in n year	Growth Curve Factor	Estimated Site's Run-off Rate Peak Flows (l/s)	Estimated Site's Run-off Peak Volume (m^3)
$QBAR_{Greenfield}$	-	1.356	29.29
1 in 1 year	0.85	1.153	24.90
1 in 30 year	2.40	3.255	70.30
1 in 100 year	3.19	4.326	93.44
1 in 100 year + 40% CC	4.47	6.056	130.80

3.4.2. Brownfield Run-off Rates

3.4.2.1. Run-off Rates for Proposed Development

The IH 124 method requires that Brownfield run-off rates are calculated using the Greenfield Run-off rates and an adjustment for urbanisation, to allow for the Brownfield impermeable areas, which is demonstrated below for the proposed development site;

The ratio of $QBar_{Brownfield}$ to $QBar_{Greenfield}$, denoted herein as R, is defined as:

$$R = (1+URBAN)^{2NC} [1+URBAN((21/CIND)-0.3)]$$

where,
URBAN is the fraction of the catchment that is impermeable,
NC is the Rainfall continentality factor which is a function of SAAR,
CIND is the catchment index = 102.4 SOIL+0.28(CWI-125),
CWI is the Catchment Wetness Index which is a function of SAAR from FSR Report.

For the proposed site, these variable parameters are calculated as:

$$URBAN = 0.03$$
$$NC = 0.92-(0.00024 \times 654) = 0.76$$
$$CWI = 92.1$$
$$CIND = (102.4 \times 0.150) + 0.28(92.1 - 125) = 6.15$$

leads to a ratio

$$R_{Proposed} = QBar_{Brownfield\ Proposed} / QBar_{Greenfield}$$
$$= (1+0.03)^{1.52}[1+0.03((21/6.15)-0.3)]$$
$$= 1.14$$

For the site's catchment area of 3.6259 ha, $QBAR_{Proposed}$ of 1.548 l/s (1.14 x 1.356) and specified storm events, the proposed site's estimated Brownfield peak run-off rates and

volumes for the 1, 30, 100 and 100 year with climate change allowance return periods are shown in Table 5.

Table 5: Shown are the proposed site's estimated brownfield peak run-off rates and volumes for the 1, 30, 100 and 100 year with climate change allowance return periods.

Storm Event 1 in n year	Growth Curve Factor	Proposed Site's Run-off Rate Peak Flows (l/s)	Proposed Site's Run-off Peak Volume (m^3)
QBrown Existing	-	1.545	33.37
1 in 1 year	0.85	1.313	28.37
1 in 30 year	2.40	3.708	80.10
1 in 100 year	3.19	4.929	106.46
1 in 100 year +CC	4.47	6.900	149.04

3.4.2.2. Summary

In light of data presented in Tables 4 and 5, it can be see that the post development site's surface water run-off rates and volume could increase by approximately 14%.

Therefore, the development proposals must incorporate SuDS to mitigate any potential increase in surface water run-off due to increases in impermeable areas and climate change. Where possible betterment should be provided beyond the existing site's run-off rates and volumes.

4. Proposed Surface Water Management Strategy

The proposed conceptual surface water management strategy (SWMS) aims to not increase, and where practicable reduce the rate of run-off from the site as a result of the proposed development, in accordance with sustainable drainage principles and the published SFRA.

4.1. Preventative SuDS

Firstly, in accordance with the SuDS Management Train, it is proposed to mitigate any increase in surface water run-off by implementing conceptual preventative SuDS techniques, as per the hierarchy approach described in section 3.1.1.

Accordingly, it is proposed to include permeable hardstanding areas (e.g. pervious paving, porous asphalt, gravel paths) and maximise soft permeable landscaped areas (i.e. grass, planting etc) in order to minimise any increase in post development impermeable areas and their surface water run-off.

4.2. Source Control:

In addition to preventative SuDS, it is also proposed to implement “Source Control” infiltration techniques such as soakaways (crates, chambers) and pervious paving/asphalt to manage surface water run-off from roofs and roads at their source.

The Flood and Water Management Act 2010, Sewers for Adoption and The SuDS Manual require that, as a minimum, the SuDS should be designed to manage and attenuate the 1 in 30-year storm event so that there is no flooding of the site.

However, new developments should also mitigate Climate Change, so SuDS should be designed for exceedence and, be designed to manage and attenuate the 100-year storm event including an allowance for Climate Change.

4.2.1. Conceptual SuDS Design

Hardstandings are proposed to be constructed of either gravel or porous paving/asphalt, wherever possible and to suit the budget of the development, to enable impermeable areas and resultant surface water run-off to be kept to a minimum.

Roof water from the building is proposed to be discharged to a designated soakaway that would be located 5m from the structure. Surface water from the access road is proposed to be discharged to a designated soakaway in a landscaped area.

4.2.1.1. Amenity Building SuDS Design

The proposed new amenity building's total roof area is approximately 900m^2, which equates to a total contributing area of 0.0900ha.

Using MicroDrainage, an impermeable contributing area of 0.0900ha, the 6 hr 100 year storm event plus 40% Climate Change and a permeability rate of 1.58x10^{-4}m/s (0.570m/hr), the new building's soakaway would need to have a net storage capacity of approximately 29.6m^3.

Therefore, provide a soakaway with dimensions of 10.000m x 4.000 x 0.800m deep, which has a net storage capacity of 30.4m^3. See MicroDrainage calculations in Appendix 5 and proposed site plan in Appendix 2.

4.2.1.2. Access Road SuDS Design

The proposed new access road impermeable area is approximately 154m^2, which equates to a total contributing area of 0.0154ha.

Using MicroDrainage, an impermeable contributing area of 0.0154ha, the 6 hr 100 year storm event plus a 40% Climate Change and a permeability rate of 1.58x10^{-4}m/s (0.570m/hr), the new access soakaways would need to have a net storage capacity of approximately 4.2m^3.

Therefore, provide a soakaway with dimensions of 6.500m x 1.000 x 0.800m deep, which has a net storage capacity of 4.94m^3. See MicroDrainage calculations in Appendix 5.

4.2.1.3. Pitch Land Drainage

The proposed new pitches and MUGA would have a total area of 13,000m^2 and have perforated pipe land drainage below ground to maintain a usable pitch surface throughout the year. After surface water run-off, evaporation, infiltration and plant uptake losses the contributing area is perceived to be approximately 4500m^2, which equates to a total contributing area of 0.450ha. This assumes that just over 30% of rainfall will enter the land drainage, which would require attenuation and infiltration to prevent it leaving the site.

Using MicroDrainage, an impermeable contributing area of 0.450ha, the 6 hr 100 year storm event plus a 40% Climate Change and a permeability rate of 1.58x10^{-4}m/s (0.570m/hr), the new pitches and MUGA would need to have a net storage capacity of approximately 114.8m^3.

Therefore, provide an infiltration strip/basin with dimensions of 150.0m x 1.500m based width and 3.900m top width x 0.300m deep, which has storage capacity of 121.5m^3. See MicroDrainage calculations in Appendix 5. The infiltration strip should be located along the lowest boundary of the site, which is the northern boundary. See proposed site plan in Appendix 2.

4.2.2. Reduction in Post Development Site's Run-off

The above SuDS are sized to mitigate the 100 year storm plus a 40% allowance for climate change with a zero piped outflow, which is designing for exceedence.

All impermeable areas such as the access roads and roofs are proposed to discharge to infiltrating SuDS with a zero piped discharge.

Consequently, with the proposed mitigating SuDS 3% of the site (0.1054ha of impermeable roof and road areas) would not have a Greenfield or brownfield run-off rate as they would discharge to zero outflow SuDS.

Therefore, the site's post development run-off rate could be reduced by 0.041 l/s to approximately 1.315 l/s through the utilization of mitigating SuDS, which is less than the site's calculated Greenfield run-off rate of 1.356 l/s.

As only 97% of the post development site would discharge surface water at the Greenfield run-off, reducing the run-off rate to below the existing site's Greenfield run-off rate, and mitigating Climate Change would provide betterment as less water would be discharged to the existing drainage ditches and Main Rivers.

Therefore, the proposed SuDS could provide a reduction in flood risk at and around the site. See Proposed Site Plan in Appendix 2. The proposed SuDS surface water management strategy ensures that:

- there would be no increase in run-off as a result of the proposed development,
- there would be no increased flood risk as a result of the proposed development,
- there would be a decrease in the site's overall run-off rate and volume,
- the site's run-off rate would be reduced to less than the Greenfield run-off rate,
- betterment can be provided with regards to flood risk.

A combination of the SuDS infiltration techniques could be used with other techniques at the detailed design stage as long as there would be no increase in the site's post development surface water run-off rate and the SuDS mitigated Climate Change.

5. Assessment of Flood Risk from All Potential Sources

The Flooding of a site can occur from several sources, including, watercourses such as Main Rivers, Ordinary Watercourses and streams, tidal seas and estuaries, groundwater, sewers, surface water run-off and failure of water infrastructure. The risk of flooding to the site from each source has been assessed in turn.

5.1. Main Rivers

The nearest Main River is the Sor Brook tributary of the River Cherwell that is approximately 660m to the east of the site.

The SFRA (2009) notes that the most significant flood event recorded within the Cherwell District occurred in April 1998 when flood levels reached what were then considered to have a return period of greater than 1 in 100 years.

However, the SFRA advised that other events approaching a similar magnitude have occurred several times in the 25 years prior to publishing in 2009 and may indicate that severe flooding may be becoming more frequent.

The Banbury located gauging station confirms the 1998 flood levels to be the highest recorded since the station installation in 1966. Flooding was also recorded along the Cherwell corridor on July 2007, and January 2008.

However, The SFRA (2009) Appendix B, does not show the site to be within an area at risk of fluvial flooding. The SFRA (2009) does however consider the site to be within an area suitable for development.

The SFRA (2017) Appendix B, Part 2, Figure B4 shows that there have been no recorded flooding incidents from any source within the vicinity of the site.

The EA's Indicative Flood Zone Map indicates that the site is located in Flood Zone 1, which has a Low risk of fluvial flooding from Main Rivers. See EA's Indicative Flood Zone Maps included in Appendix 1. The SFRA (2017) Appendix B, Part 3 correlates with this data.

The Sequential Test looks at the Flood Risk Vulnerability and Flood Zone Compatibility of a development.

Table 3 of the PPG FRCC, identifies the development types that are appropriate in each flood zone, subject to the requirements of the EA National Standing Advice and the Application of the Sequential Test.

PPG FRCC Table 3:

Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	✓	Exception Test	✓	✓
Flood Zone 3a	Exception Test	✓	*X*	Exception Test	✓
Flood Zone 3b Functional FZ	Exception Test	✓	*X*	*X*	*X*

Key:
✓ Development is appropriate
X Development should not be permitted

Outdoor recreation and sports developments are classified as Water Compatible development, in accordance with Table 2: Flood Risk Classification of TGNPPF, which are suitable for Floods Zone 1.

Therefore, based on Table 3 of the PPG FRCC, the development classification and land use, the development proposals are appropriate for the flood zone at the site.

Based on available flooding records and the distance between the site and the main river it is unlikely that the site is at risk of flooding from Main Rivers.

Therefore, the site is perceived to have a Low risk of fluvial flooding from Main Rivers.

5.2. Ordinary Watercourses and Streams

There is a surface water ditch to the north of the site, however this has been observed to be overgrown with vegetation. There are no ordinary watercourses or streams within the site boundary. There are no records of watercourses and streams affecting the site.

The SFRA does not have any records of flooding at the site from ordinary watercourses or streams. Therefore, the site is perceived to have a low risk of flooding from ordinary watercourses and streams.

5.3. Coastal or Estuarine

The site is not located near the coastline or an estuary. Consequently, the site is at Low risk of tidal flooding.

5.4. Groundwater

Groundwater flooding is caused by the emergence of groundwater at the ground surface away from perennial river channels or the rising of groundwater into man-made ground, under conditions where the 'normal' ranges of groundwater level and groundwater flow are exceeded. The impact of groundwater flooding can occur before water levels reach the ground surface where there is inundation of building basements and buried services or other assets below ground level. Groundwater levels that rise above ground have the potential to reach low-lying areas protected from fluvial flooding.

The SFRA (2017) shows the site to be in an area where geological or hydrological conditions indicate a 25% - 50% risk of groundwater flooding occurring. However, the SFRA (2017) reports no instances of groundwater flooding within the site.

The SFRA (2017) Appendix B, figure B9 shows the site to underlain by a minor aquifer – Intermediate.

There are no known records, including anecdotal records, of the site being flooded due to groundwater. Therefore, the site is perceived to have a low risk of groundwater flooding.

5.5. Sewers and highway drains

Sewer flooding generally results in localised short term flooding caused by intense rainfall events overloading the capacity of sewers. Flooding can also occur as a result of blockage, poor maintenance or structural failure.

The SFRA (2009) advises that much of sewer network within the district dates back to Victorian times and therefore of an unknown capacity and condition. Therefore, it likely that parts of the sewer system within the district may become overloaded during large, high intensity rainfall events and result in sewer flooding.

The SFRA (2017) Appendix B, Part 5, Figure B10 shows the site to be within an area that has 5-10 reported incidents of sewer flooding. The figure illustrates Historical sewer flooding events in Cherwell as reported by Thames Water in their DG5 Sewer Flooding Register by postcode. However, the SFRA states that the map does not illustrate areas at risk of future flooding, and that maintenance work may have been completed since flooding incidents have occurred.

There are no known records of the site, being flooded due to surcharging of sewers. This indicates that the risk of sewer flooding at the site is low.

All new drainage on site should be constructed to comply with the current Building Regulations Approved Document H and Sewers for Adoption, to ensure that sewer surcharging is mitigated.

5.6. Surface water and Overland Flow

Flooding of land from surface water run-off is usually caused by intense rainfall that may only last a few hours, and usually occurs in lower lying areas often where the drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage or drainage blockage by debris and sewer flooding.

The SFRA (2017) indicates that there have been 973 reported pluvial flood incidents. However, there is no indication of what the sources of the flooding is. It is advised that there may be unreported incidents that have therefore gone unregistered, hence the results should be interpreted with caution.

The SFRA (2017) mentions several settlements that are at risk of surface water flooding due to being in large urban areas, or along watercourses. The site is not within any of these areas.

The SFRA (2017) indicates no historical cases of any flood event within the site. Appendix B, part 4, Figure B7-D of the SFRA does not show the site to be at risk from surface water flooding.

The site is perceived to have a low risk of surface water flooding.

The development proposals are required to ensure that there would be no increase in surface water volumes or peak flow rates, which could result in increased flood risk. The development proposals include the implementation of the SuDS philosophy to ensure there would be no increase in flood risk to the site and the surrounding areas.

5.7. Water Infrastructure Failure

Flooding may result from the failure of engineering installations such as flood defence, land drainage pumps, sluice gates and floodgates. Hard defences may fail through the slow deterioration of structural components such as the rusting of sheet piling, erosion of concrete reinforcement or the failure of ground anchors. Such deterioration is often difficult to detect, so that failure, when it occurs is often sudden and unexpected. Failure is more likely when the structure is under maximum stress, such as extreme fluvial events when pressures on the structure are at its most extreme.

There are no reservoirs, or major water infrastructure within close proximity to site. Therefore, the risk of flooding from water infrastructure failure impacting upon the site is perceived to be Low.

6. Main River Bylaw Distance

In accordance with the Land Drainage Act 1976, The Water Resources Act 1991 and the Environment Act 1995 a Flood Defence Consent must be separately obtained from the EA for any work in, over, under or within the Bylaw distance of a Main River.

This is to ensure that the work activities do not cause or make existing flood risk worse, interfere with the EA's work, and do not adversely affect the local environment, fisheries or wildlife.

The nearest Main River is Sor Brook that is 660m to the east of the site. Therefore, the proposed development works would not require a Flood Defence Consent to be granted by the EA.

7. Conclusions and Recommendations

Paragraph 103 of the National Planning Policy Framework (NPPF) requires that when determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific flood risk assessment (FRA), compliant with the technical guidance to the NPPF (PPG FRCC), following the Sequential Test, and if required the Exception Test, it can be demonstrated that:

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

The site is located on land to the north of Milton Road, which is situated west of Adderbury. The site is set to the west of the A4260, and to the east of the A361. The proposed development site covers an area of approximately 63259m^2 (3.6259 ha). The site can be located by Grid Coordinates 446282mE, 235085mN.

To the east of the site was a residential development site, and to the west is the horticultural company Ball Colegrave, and garden centre Florensis Flower Seeks UK Ltd. To the north of the site is undeveloped land. To the south is Milton Road and adjacent to Milton Road further south is undeveloped farmland.

The proposed development includes a recreational ground comprising of two 100m x 60m pitches, a 25m x 40m Multiuse Games Area, construction of one amenity building and parking.

The nearest Main River is Sor Brook that is approximately 660m to the east of the site.

The EA's Indicative Flood Zone Map indicates that the site is located in Flood Zone 1, which has a Low risk of fluvial flooding from Main Rivers.

Therefore, in accordance with the NPPF and based on Table 3 of the PPG FRCC the development's classification and land use, the development proposals would be appropriate for the flood zone at the site.

The site was at a low risk of flooding from main rivers, sewers, infrastructure failure and ordinary watercourses and streams.

The site was identified as having a low risk of surface water flooding.

The site was identified as having a medium risk of ground water flooding.

The existing site has an impermeable area of approximately 0.0m² (0.00ha) and a permeable area of 36259m² (3.6259ha). Accordingly, 0.0% of the existing site is impermeable, while 100.0% is permeable.

The proposed site would have an impermeable area of approximately 1054.0m² (0.1054ha) and a permeable area of 35,205.0m² (3.5205ha). Accordingly, approximately 3% of the proposed site would be impermeable, while 97% would be permeable.

Therefore, without mitigating SuDS, there could be an increase in the impermeable areas at the site, rising from 0.0% to 3.0% of total site area. As such, the development proposals would incorporate SuDS to mitigate the potential impacts of any increase in impermeable area and Climate Change, providing betterment where possible.

The SWMS has demonstrated that by utilising SuDS it is feasible to mitigate surface water run-off as a result of the proposed development.

Consequently, with the proposed mitigating SuDS 3% of the site (0.1054ha of impermeable roof and road areas) would not have a Greenfield or brownfield run-off rate as they would discharge to zero outflow SuDS. Therefore, the site's post development run-off rate could be reduced by 0.041 l/s to approximately 1.315 l/s through the utilization of mitigating SuDS, which is less than the site's calculated Greenfield run-off rate of 1.356 l/s.

As only 97% of the post development site would discharge surface water at the Greenfield run-off rate this would reduce the total site's run-off rate to below the existing site's Greenfield run-off rate, while also mitigating Climate Change. This would provide betterment as less water would be discharged to the existing surface water drainage ditches and Main Rivers.

Consequently, the proposed SuDS, which would be based on "Prevention" and "Source Control", would provide a reduction in flood risk at and surrounding areas.

This site-specific FRA has identified that the development proposals, which incorporate a feasible SuDS surface water management strategy, ensures that:

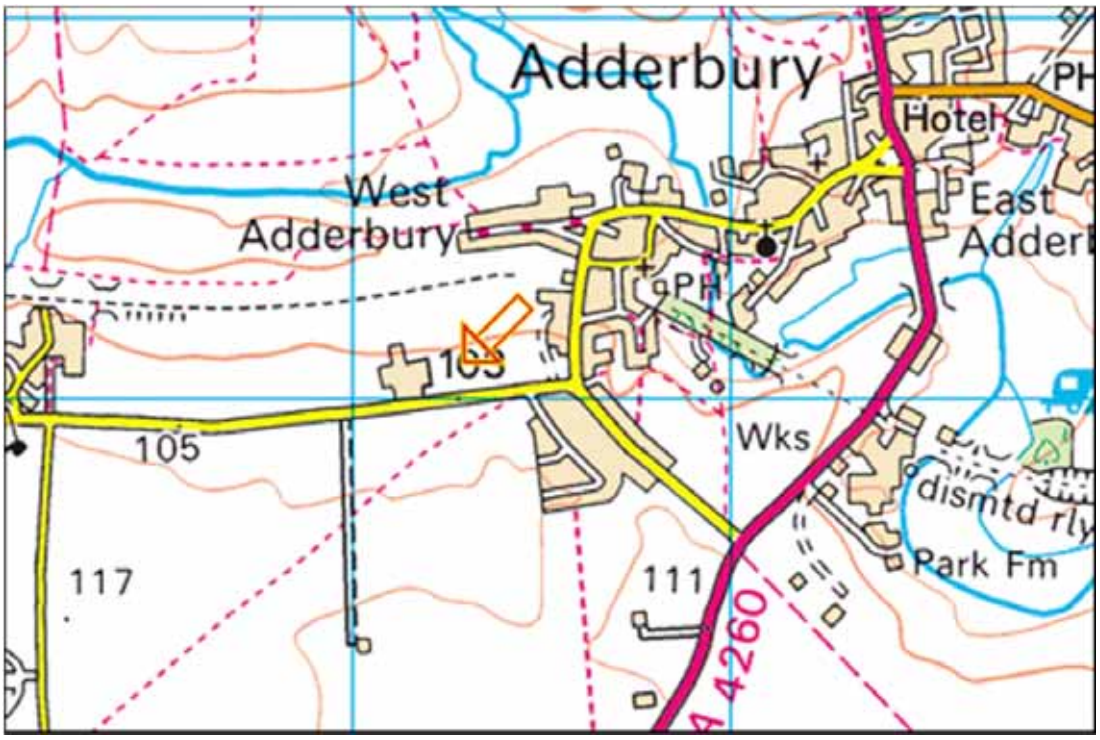
- there would be no increase in run-off as a result of the proposed development,
- there would be no increased flood risk as a result of the proposed development,
- there would be a decrease in the overall site's run-off rates and volumes,
- the site's run-off rate would be reduced to less than the Greenfield run-off rate,
- betterment could be provided with regards to reduction in flood risk,
- the development proposals would comply with the EA's requirements,
- the development proposals comply with the NPPF and the PPG FRCC.

Based on the findings of this site specific FRA, the proposed SuDS SWMS is feasible and consequently the development proposals are considered acceptable.

APPENDIX 1

Site Location

Proposed Recreation Ground Land Off Milton Road, Adderbury, Banbury Grid Reference Location 446282mE, 235085mN



Environment Agency Indicative Main River Flood Zone Maps

Key:

Flood Zone 3 – Medium to High Risk

Flood Zone 2 – Low to Medium Risk

Flood Zone 1 – None to Low

Flood Defence Protected Area

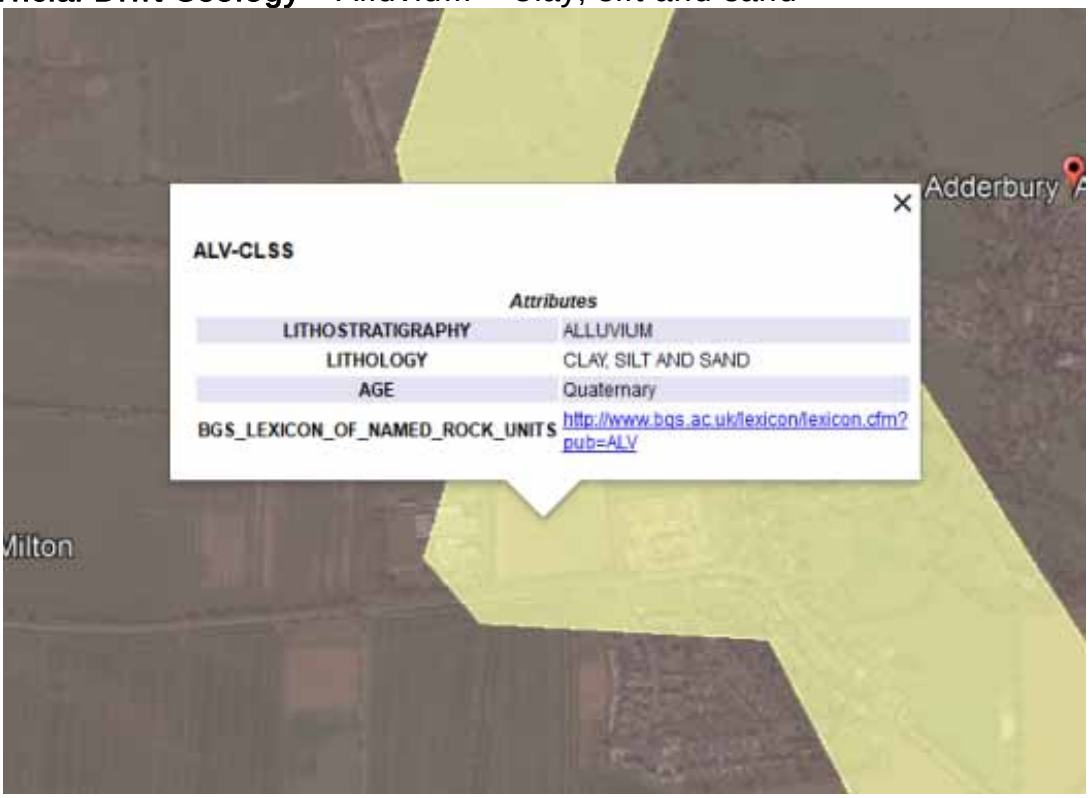
Flood Defence

Main River

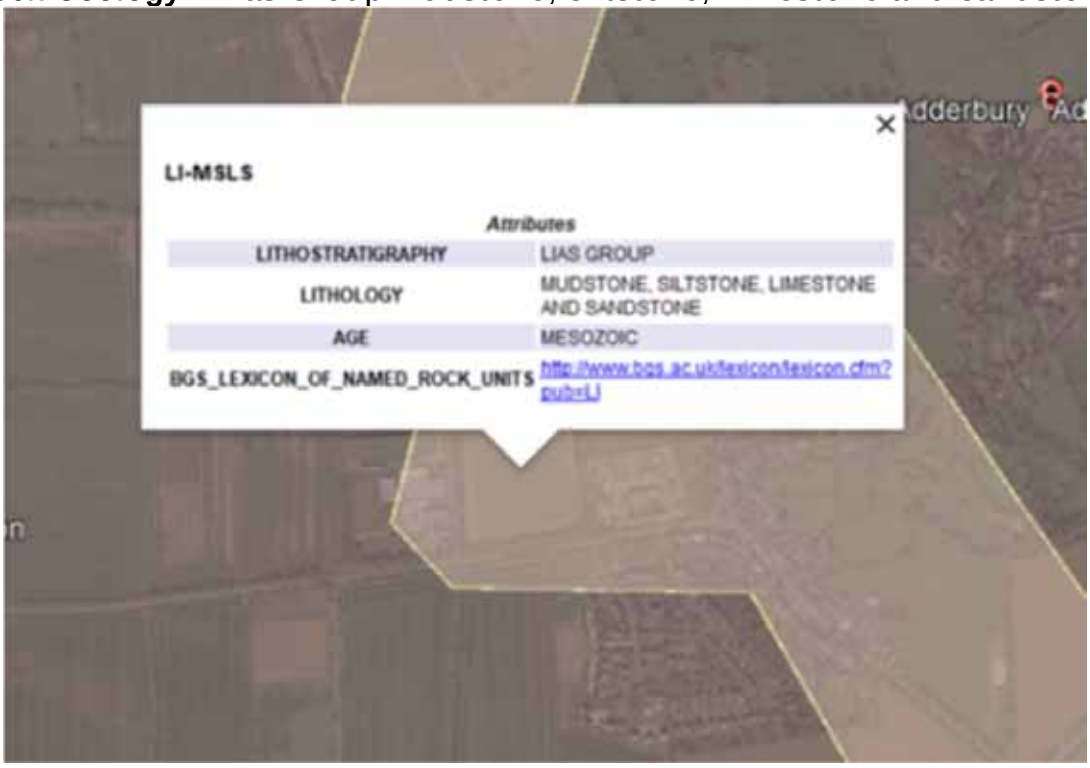
Approximate Site Location

British Geological Survey Published Geological Maps

Superficial Drift Geology – Alluvium - Clay, Silt and Sand

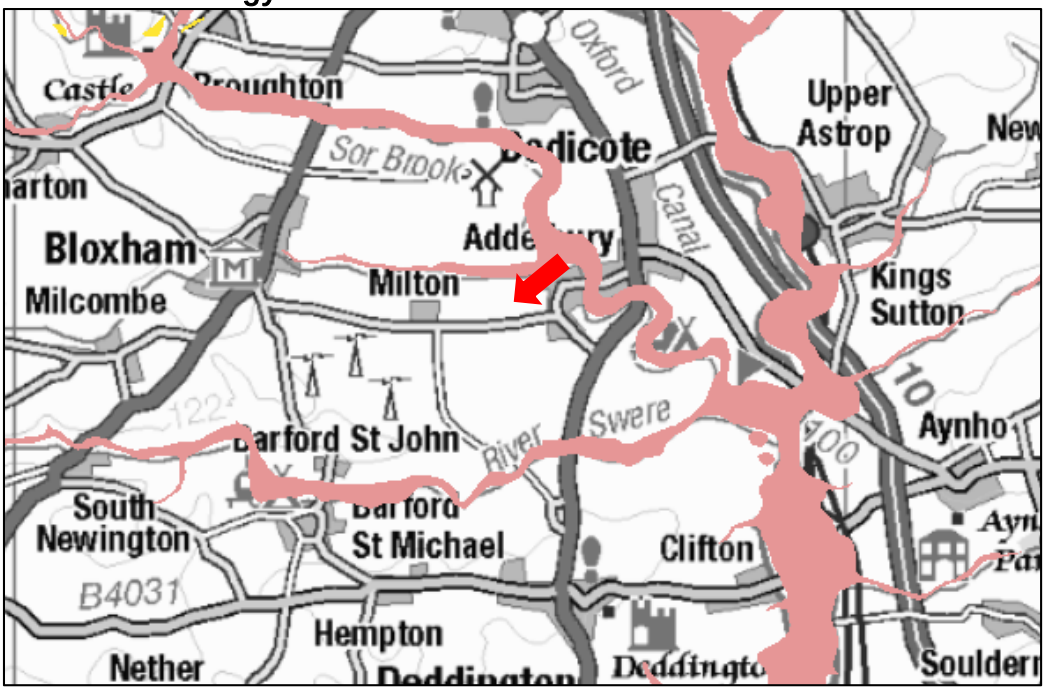


Bedrock Geology – Lias Group Mudstone, Siltstone, Limestone and Sandstone

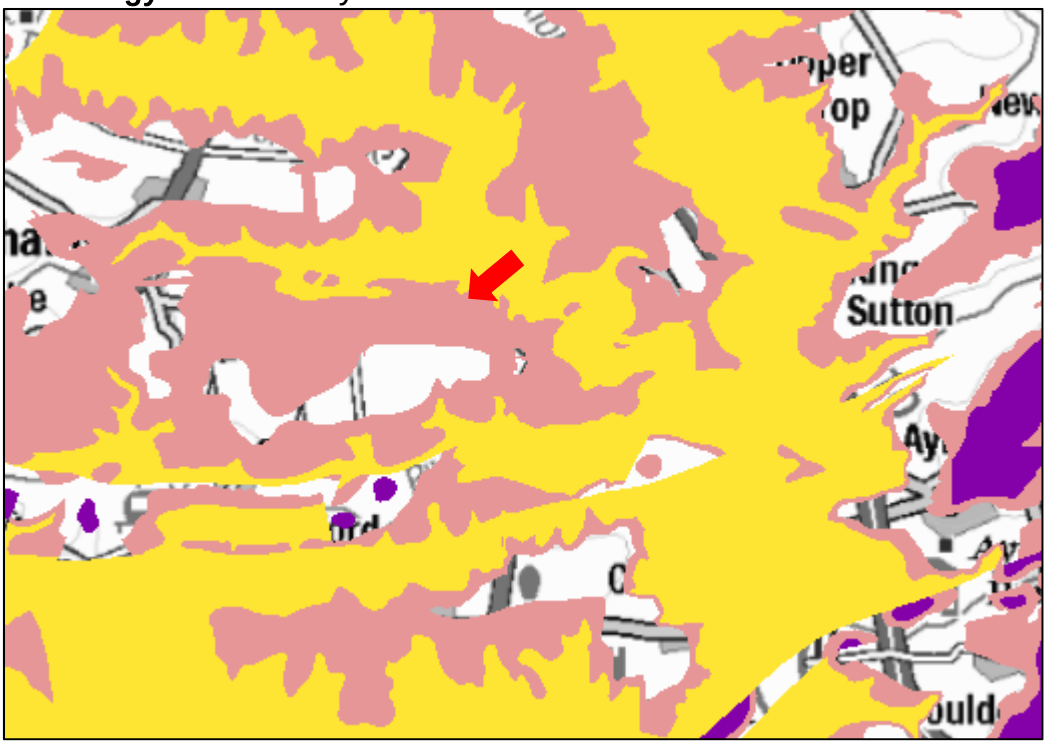


Published Aquifer Maps

Superficial Drift Geology –None



Bedrock Geology – Secondary A



EA Indicative Surface Water Flood Map

Key

- High
- Medium
- Low
- Very Low
- Site Location

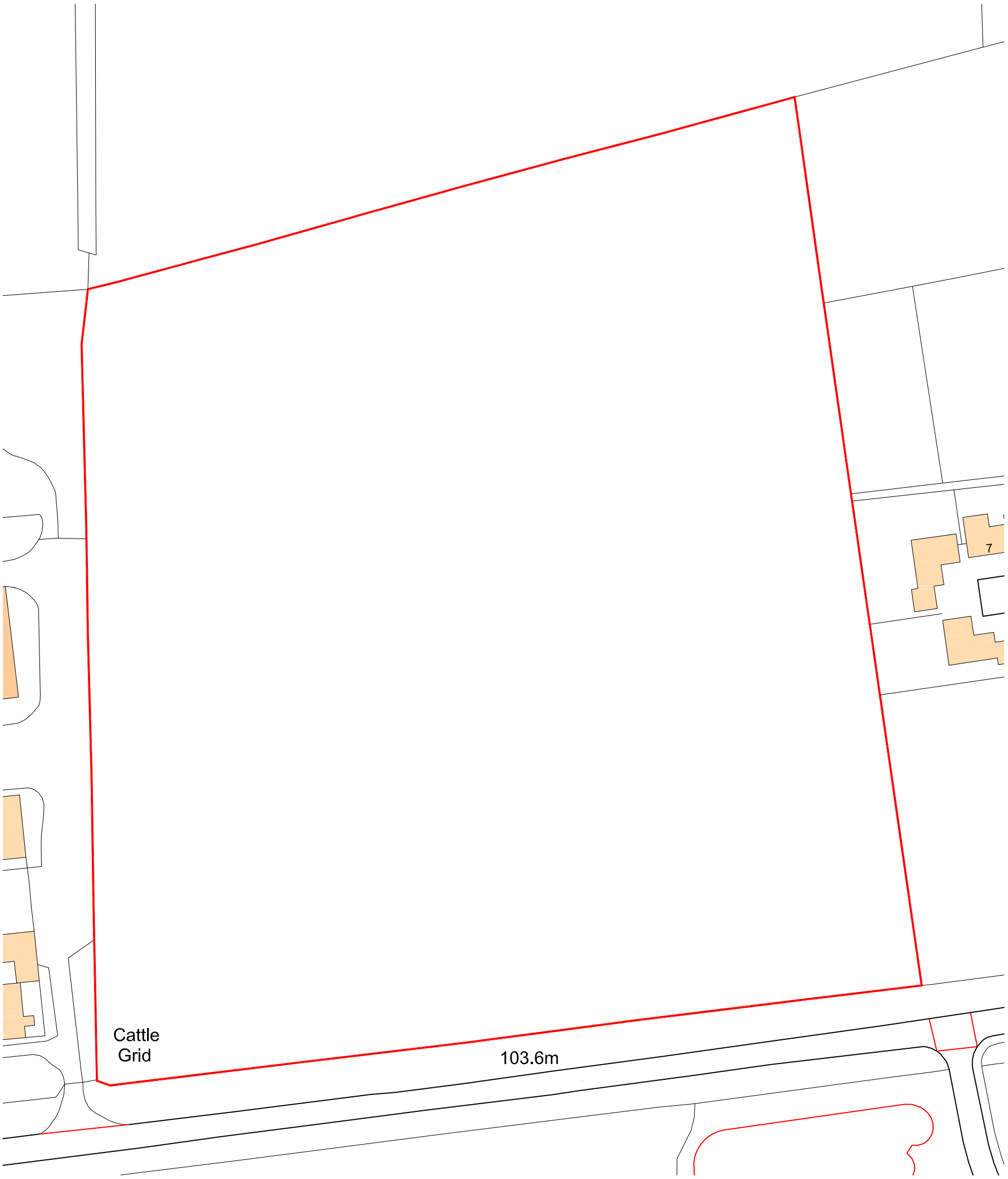
APPENDIX 2

Existing Permeable and Impermeable Areas Key:

	Impermeable Roof	0.0 m²	= 0.0 ha
	Impermeable Hard standing	0.0 m²	= 0.0 ha
	Permeable Hardstanding	0.0 m²	= 0.0 ha
	Permeable Landscaping	36,259 m²	= 3.6259 ha
	Total Site Area	36,259 m²	= 3.6259 ha

NOTES:

1.DO NOT SCALE - Use figured dimensions only.
2.All dimensions shown are in millimetres unless otherwise stated.
3.All levels are in metres above ordnance datum unless otherwise stated.
4.The Contractor is to verify all dimensions on site before commencing work.
5.This drawing is to be read in conjunction with all Engineers and Architects drawings.



Client: Adderbury Parish Council	Project: Recreation Ground Project Ref: FEDS-218041	Title: Existing Site Plan	Drawn by : AK Date: 20.07.18	Checked by: DKP Scale: 1:1000	Size: A3 Dwg.no: FEDS-218041-001 Rev: A

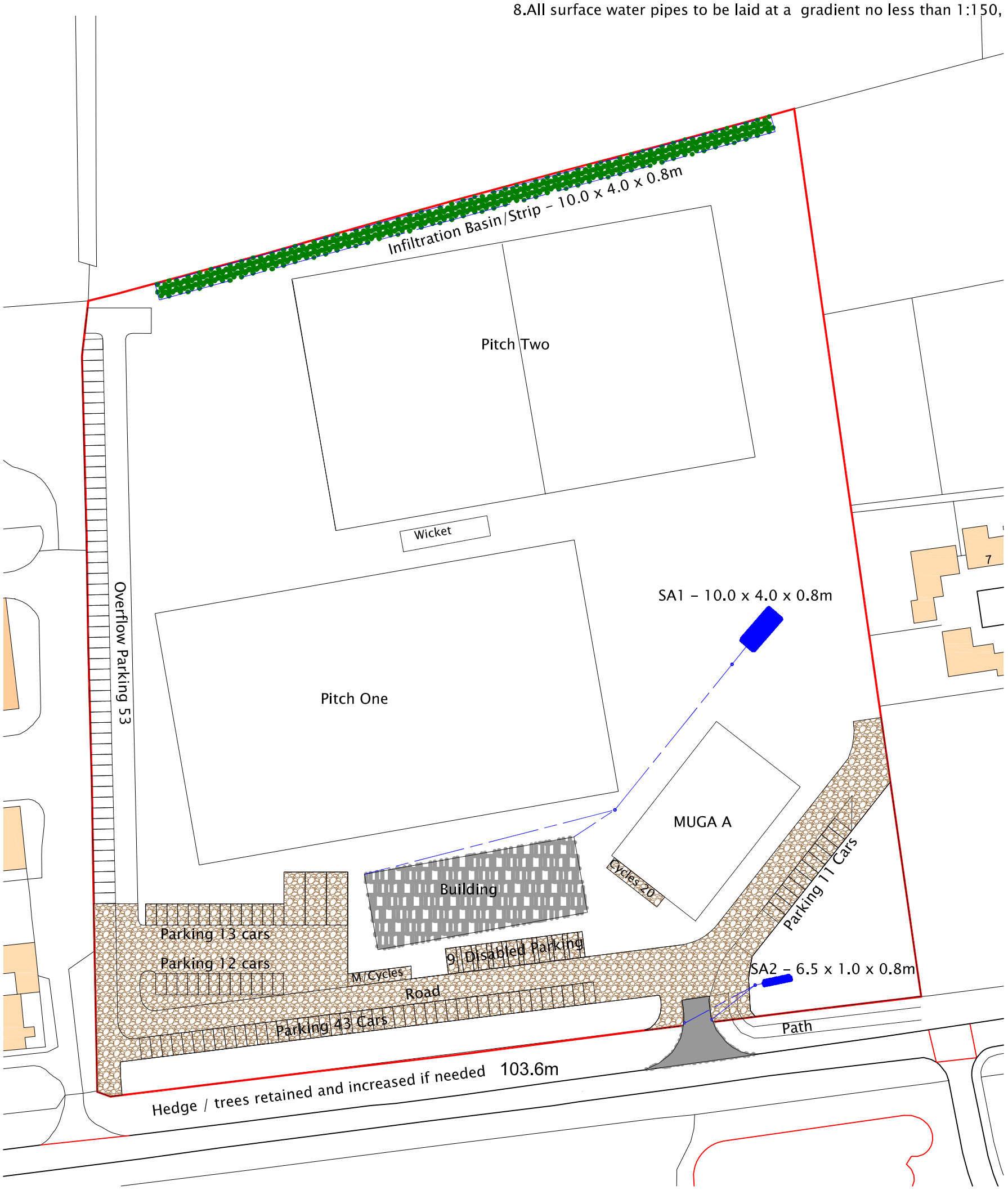
Forge Engineering Design Solutions
Forge House
30 Digging Lane
Fyfield, Abingdon
Oxfordshire, OX13 5LY
tel: 01865 362 780
info@f-eds.co.uk
www.f-eds.co.uk

Proposed Permeable and Impermeable Areas Key:

Impermeable Roof	900.0 m²	= 0.0900 ha
Impermeable Hard standing	154.0 m²	= 0.0154 ha
Permeable Hardstanding	4,310.9 m²	= 0.4311 ha
Permeable Landscaping	30,894.1 m²	= 3.1010 ha
Total Site Area	36,259.0 m	= 3.6259 ha

NOTES:

1.DO NOT SCALE – Use figured dimensions only.
2.All dimensions shown are in millimetres unless otherwise stated.
3.All levels are in metres above ordnance datum unless otherwise stated.
4.The Contractor is to verify all dimensions on site before commencing work.
5.This drawing is to be read in conjunction with all Engineers and Architects drawings.
6. All surface water manholes/inspection chambers to have 300mm sump silt trap for maintenance.
7.All surface water pipes to be 150mm diameter.
8.All surface water pipes to be laid at a gradient no less than 1:150,



Client: Adderbury Parish Council	Project: Recreation Ground Project Ref: FEDS-218041	Title: Proposed Site Plan	Drawn by: AK Date: 20.07.18	Checked by: DKP Scale: 1:1000 Size: A3 Dwg.no: FEDS-218041-002 Rev: A

Forge Engineering Design Solutions
Forge House
30 Digging Lane
Fyfield, Abingdon
Oxfordshire, OX13 5LY
tel: 01865 362 780
info@f-eds.co.uk
www.f-eds.co.uk

APPENDIX 3

NOTES:

1.DO NOT SCALE – Use figured dimensions only.
2.All dimensions shown are in millimetres unless otherwise stated.
3.All levels are in metres above ordnance datum unless otherwise stated.
4.The Contractor is to verify all dimensions on site before commencing work.
5.This drawing is to be read in conjunction with all Engineers and Architects drawings.

Client: Adderbury Parish Council	Project: Recreation Ground Project Ref: FEDS-218041	Title: Topographical Survey	Drawn by : AK Date: 20.07.18 Dwg.no: FEDS-218041-003	Checked by: DKP Scale: 1:1000 Rev: A	Size: A3

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www.f-eds.co.uk

APPENDIX 4

Asset location search

Property Searches

Alex Kegie
Forge Engineering Design Solutions Ltd
FYFIELD
ABINGDON
OX13 5LY

Search address supplied

446282 235085
GroundLand Off
Milton Road
Adderbury
Banbury
OX17

Your reference FEDS- 218041

Our reference ALS/ALS Standard/2018_3827440

Search date 2 July 2018

Keeping you up-to-date

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

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

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

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

0845 070 9148

searchcode

Asset location search

Property Searches

Search address supplied: 446282 235085, GroundLand Off, Milton Road, Adderbury, Banbury, OX17

Dear Sir / Madam

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

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

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

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

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

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

Contact Us

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

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

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

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

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

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

pressure test to be carried out for a fee.

For your guidance:

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

Payment for this Search

An invoice is enclosed. Please send remittance to Thames Water Utilities Ltd., PO Box 3189, Slough, SL1 4WW.

Further contacts:

Waste Water queries

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

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

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

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

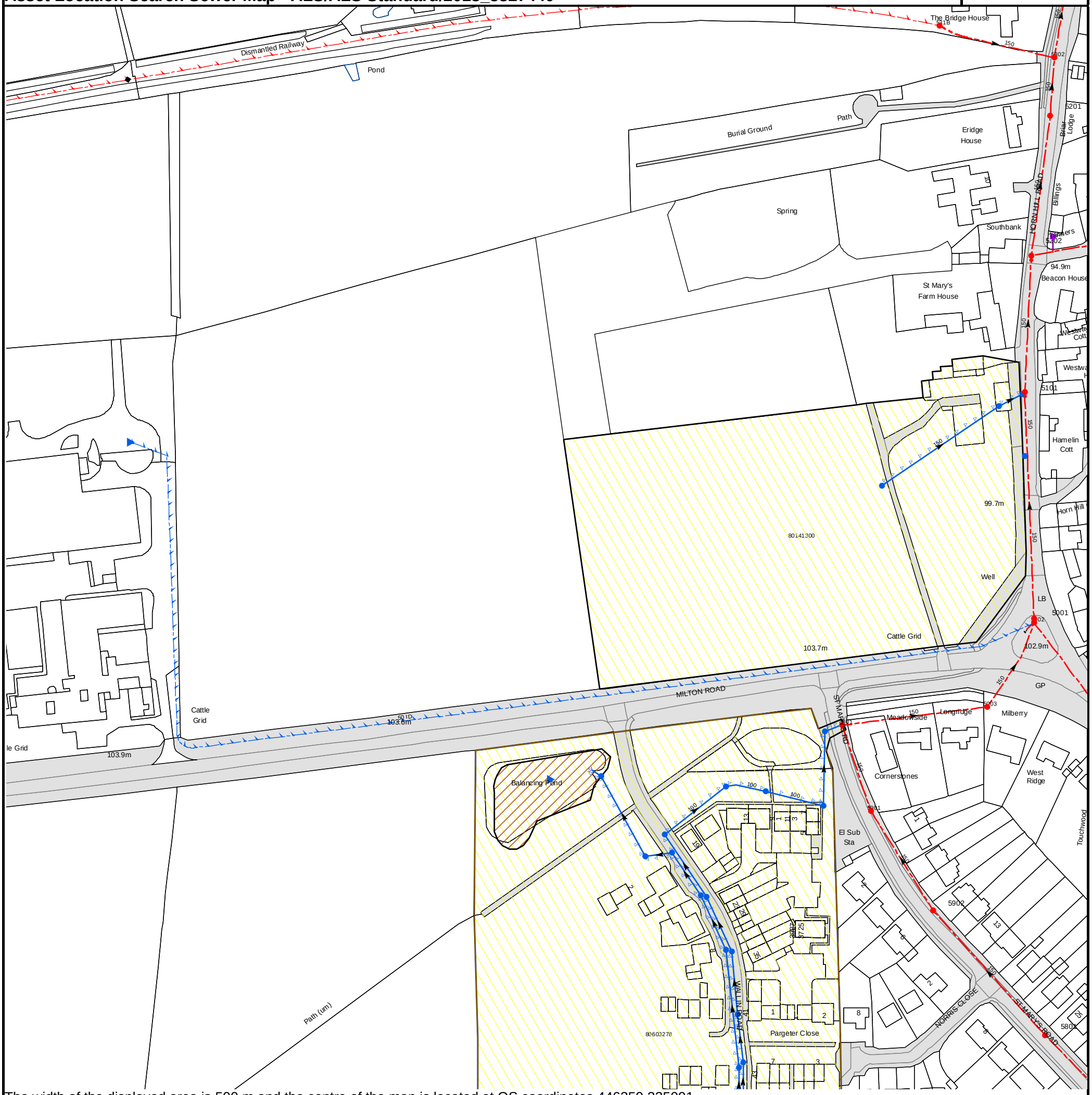
Clean Water queries

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

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

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

Asset Location Search Sewer Map - ALS/ALS Standard/2018_3827440



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 446359,235091

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
5101	97.12	94.66
5202	94.43	92.05
521A	n/a	n/a
5201	92.7	91.01
5302	92.58	90.5
531B	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
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n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
4001	104.67	103.38
5901	105.82	104.62
5902	106.73	105.47
5003	n/a	n/a
5001	101.94	97.61
5002	101.92	100.89
5801	107.83	106.58

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

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

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

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

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

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

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

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

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

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

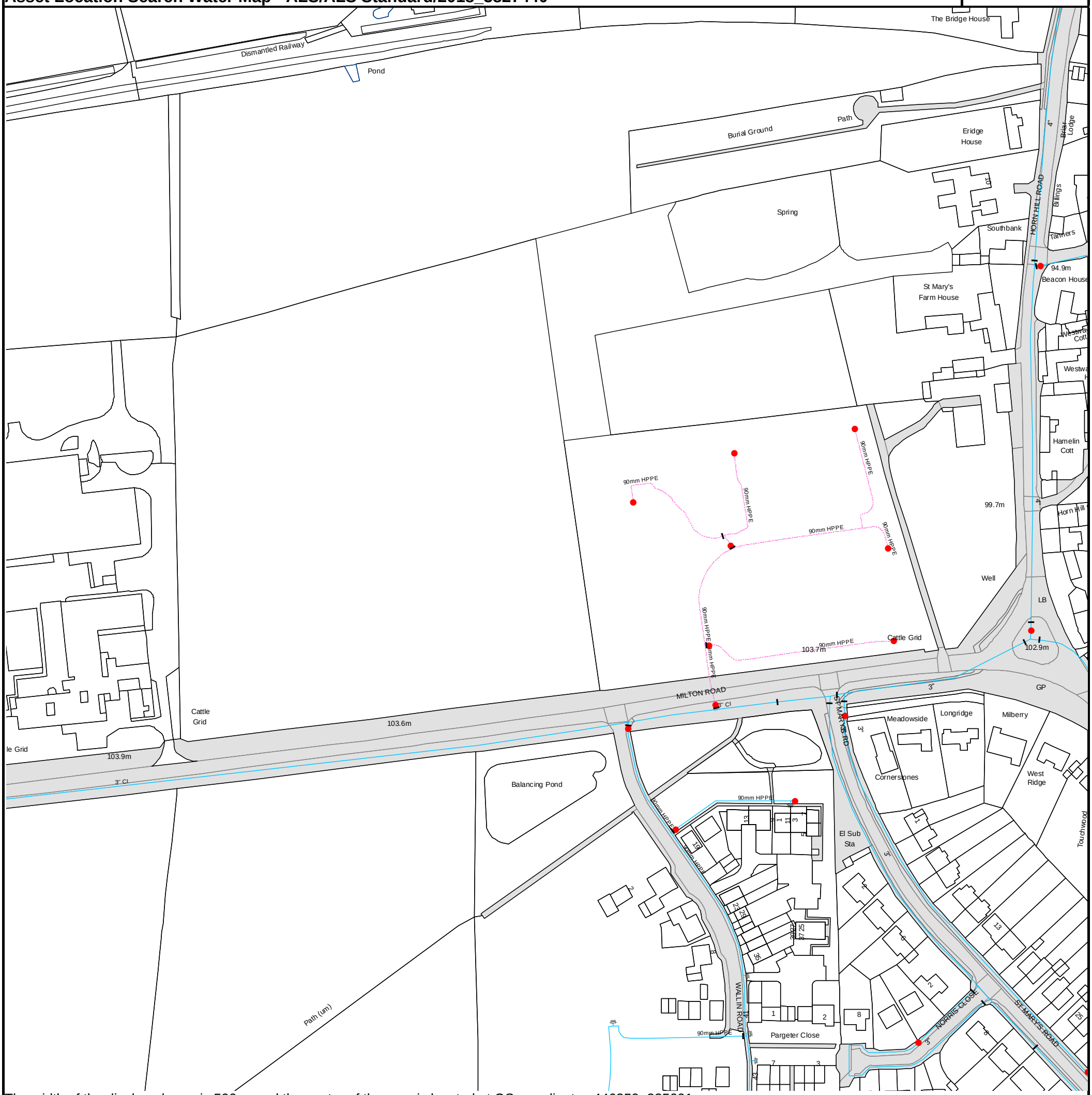
Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Asset Location Search Water Map - ALS/ALS Standard/2018_3827440



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 446359, 235091.

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

ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4"

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

16"

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

3" SUPPLY

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

3" FIRE

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

3" METERED

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

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

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

Valves

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

Hydrants

- Single Hydrant

Meters

- Meter

End Items

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

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

Operational Sites

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

Other Symbols

- Data Logger

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

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

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

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

Terms and Conditions

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

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

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

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

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

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

Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0845 070 9148** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

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

Invoice

Alex Kegie
Forge Engineering Design Solutions Ltd
30 Forge House
Digging Lane
Abingdon
OX13 5LY

Thames Water Utilities Ltd.
PO Box 3189
Slough
SL1 4WW

Invoice No: ADS18400183
Customer Reference: FEDS- 218041 **Our Ref:** ALS/ALS Standard/2018_3827440
Customer Number: ADS128186 **Posting Date:** 02-07-2018
Purchase Order No: **Due Date:** 16-07-2018

Search Address Supplied: 446282 235085, GroundLand Off, Milton Road, Adderbury, Banbury, OX17

Description of Charges	Qty	Unit Price	VAT (20%)	Amount (Inc VAT)
Asset Location Search	1	£48.27	£9.65	£57.92

OUTSTANDING AMOUNT (Inc. VAT) £57.92

Please send any outstanding amount to Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.

Your payment terms are within 14 days. Please see previous page for ways to pay.

For queries please contact the Property Searches Customer Support Team on Tel: 0845 070 9148.

VAT Reg. No GB 537456915

Girobank Transcash
Girobank plc Bootle Merseyside GIR 0AA

Payment slip **bank giro credit**

138 208 70

Reference (customer account number): ADS128186 / ADS18400183

Credit account number: 257 1706

Amount due (40p fee payable at PO counter): £ 57.92

Cheque NOT acceptable at Post Office

By transfer from Alliance and Leicester Giro account number

Cashiers stamp and initials

Signature

Date

Forge Engineering Design Solutions Ltd
30 Forge House
Digging Lane
Abingdon
OX13 5LY

NatWest
Collection Account
Thames Water
Utilities Ltd

Cash
Cheques
£

57-17-06

Items Fee

Please do not write or mark below this line and do not fold this counterfoil

Paragon 6630 01/2004

Search Code

IMPORTANT CONSUMER PROTECTION INFORMATION

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

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practise and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.

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

The Code's core principles

Firms which subscribe to the Search Code will:

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

Complaints

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

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

TPOs Contact Details

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

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

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

APPENDIX 5

Project No.	FEDS- 218041	**By:**	AK	**Chkd:**	DKP	**Notes:** Tests carried out on the 3rd June 2018
Title	Proposed Recreation GroundLand Off Milton Road, Adderbury, Banbury O					Weather conditions: Damp
Sheet No.	1	**Date:**	June 2018			Trial Pit 2

1. INPUTS

Trial Pit Dimensions

Length	1.500	m
Width	0.700	m
Depth	1.000	m
Inlet Depth	0.335	m
Effective Depth	0.665	m

Soil Infiltration Rate = $\frac{Vp_{75\text{-}25}}{ap_{50} \times tp_{75\text{-}25}}$

$Vp_{75\text{-}25}$ = the effective storage volume of water in the trial pit between 75% and 25% effective depth = 0.349 m^3

ap_{50} = the internal surface area of the trial pit up to 50% effective depth and including the base = 2.513 m^2

$tp_{75\text{-}25}$ = the time for the water level to fall from 75% and 25% effective depth = 14.6 minutes 876.66 seconds (lowest)

f = **Soil Infiltration Rate for Design** = **1.58E-04** m/s (lowest)

= **0.5705** m/hr (lowest)

2. INPUT OF PERMEABILITY TEST DATA

TEST 1

Time	Water level	Water Depth
0	383	617
10	683	317
20	896	104
30	978	22

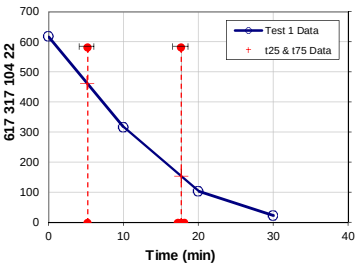
TEST 2

Time	Water level	Water Depth
0	355	645
10	662	338
20	856	144
30	978	22

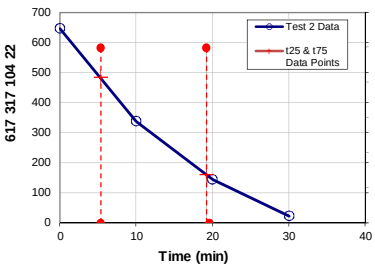
TEST 3

Time	Water level	Water Depth
0	335	665
10	654	346
20	837	163
30	978	22

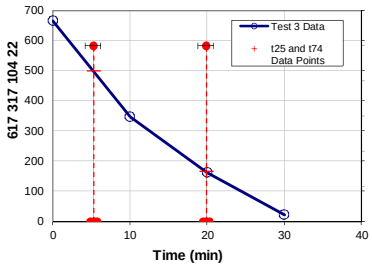
3. DATA ANALYSIS



Depth at t= 617
Depth 75% 462.75
Depth 25% 154.25
5.14155 462.75
17.641 154.25
tp75-25 12.49945 minutes 749.967 seconds
f1 = 1.85E-04 m/s



Depth at t=0 645
Depth 75% 483.75
Depth 25% 161.25
5.2525 483.75
19.111 161.25
tp75-25 13.8585 minutes 831.51 seconds
f2 = 1.67E-04 m/s

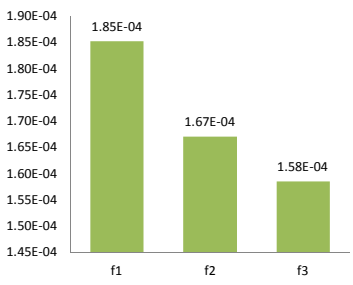


Depth at t=0 665
Depth 75% 498.75
Depth 25% 166.25
5.2115 498.75
19.8225 166.25
tp75-25 14.611 minutes 876.66 seconds
f2= 1.58E-04 m/s

4. SUMMARY

Infiltration Rate

f1	1.85E-04
f2	1.67E-04
f3	1.58E-04



Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 60 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	100.600	0.500	4.3	19.0	O K
30 min Summer	100.720	0.620	4.5	23.6	O K
60 min Summer	100.771	0.671	4.7	25.5	O K
120 min Summer	100.748	0.648	4.6	24.6	O K
180 min Summer	100.702	0.602	4.5	22.9	O K
240 min Summer	100.653	0.553	4.4	21.0	O K
360 min Summer	100.561	0.461	4.2	17.5	O K
480 min Summer	100.481	0.381	4.0	14.5	O K
600 min Summer	100.412	0.312	3.9	11.9	O K
720 min Summer	100.353	0.253	3.7	9.6	O K
960 min Summer	100.260	0.160	3.5	6.1	O K
1440 min Summer	100.160	0.060	3.3	2.3	O K
2160 min Summer	100.139	0.039	2.6	1.5	O K
2880 min Summer	100.131	0.031	2.0	1.2	O K
4320 min Summer	100.122	0.022	1.5	0.9	O K
5760 min Summer	100.118	0.018	1.2	0.7	O K
7200 min Summer	100.115	0.015	1.0	0.6	O K
8640 min Summer	100.113	0.013	0.8	0.5	O K
10080 min Summer	100.111	0.011	0.7	0.4	O K
15 min Winter	100.668	0.568	4.4	21.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	22
30 min Summer	90.705	0.0	34
60 min Summer	56.713	0.0	56
120 min Summer	34.246	0.0	90
180 min Summer	25.149	0.0	124
240 min Summer	20.078	0.0	158
360 min Summer	14.585	0.0	224
480 min Summer	11.622	0.0	288
600 min Summer	9.738	0.0	350
720 min Summer	8.424	0.0	410
960 min Summer	6.697	0.0	528
1440 min Summer	4.839	0.0	744
2160 min Summer	3.490	0.0	1096
2880 min Summer	2.766	0.0	1468
4320 min Summer	1.989	0.0	2200
5760 min Summer	1.573	0.0	2936
7200 min Summer	1.311	0.0	3640
8640 min Summer	1.129	0.0	4328
10080 min Summer	0.994	0.0	5112
15 min Winter	138.153	0.0	23

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	100.809	0.709	4.7	26.9	O K
60 min Winter	100.878	0.778	4.9	29.6	O K
120 min Winter	100.845	0.745	4.8	28.3	O K
180 min Winter	100.776	0.676	4.7	25.7	O K
240 min Winter	100.702	0.602	4.5	22.9	O K
360 min Winter	100.566	0.466	4.2	17.7	O K
480 min Winter	100.451	0.351	3.9	13.3	O K
600 min Winter	100.355	0.255	3.7	9.7	O K
720 min Winter	100.277	0.177	3.6	6.7	O K
960 min Winter	100.169	0.069	3.3	2.6	O K
1440 min Winter	100.139	0.039	2.6	1.5	O K
2160 min Winter	100.128	0.028	1.9	1.1	O K
2880 min Winter	100.123	0.023	1.5	0.9	O K
4320 min Winter	100.116	0.016	1.1	0.6	O K
5760 min Winter	100.113	0.013	0.8	0.5	O K
7200 min Winter	100.111	0.011	0.7	0.4	O K
8640 min Winter	100.109	0.009	0.6	0.3	O K
10080 min Winter	100.108	0.008	0.5	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	90.705	0.0	35
60 min Winter	56.713	0.0	58
120 min Winter	34.246	0.0	96
180 min Winter	25.149	0.0	134
240 min Winter	20.078	0.0	170
360 min Winter	14.585	0.0	238
480 min Winter	11.622	0.0	304
600 min Winter	9.738	0.0	366
720 min Winter	8.424	0.0	424
960 min Winter	6.697	0.0	524
1440 min Winter	4.839	0.0	736
2160 min Winter	3.490	0.0	1100
2880 min Winter	2.766	0.0	1452
4320 min Winter	1.989	0.0	2168
5760 min Winter	1.573	0.0	2832
7200 min Winter	1.311	0.0	3544
8640 min Winter	1.129	0.0	4368
10080 min Winter	0.994	0.0	5104

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.090

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.030	4	8	0.030	8	12	0.030

Model Details

Storage is Online Cover Level (m) 101.500

Cellular Storage Structure

Invert Level (m) 100.100 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.57000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.57000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	40.0	40.0	0.900	0.0	62.4
0.800	40.0	62.4			

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 38 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	101.380	0.480	1.1	3.0	O K
30 min Summer	101.479	0.579	1.2	3.6	O K
60 min Summer	101.505	0.605	1.2	3.7	O K
120 min Summer	101.465	0.565	1.2	3.5	O K
180 min Summer	101.409	0.509	1.1	3.1	O K
240 min Summer	101.355	0.455	1.1	2.8	O K
360 min Summer	101.265	0.365	0.9	2.3	O K
480 min Summer	101.194	0.294	0.9	1.8	O K
600 min Summer	101.138	0.238	0.8	1.5	O K
720 min Summer	101.092	0.192	0.7	1.2	O K
960 min Summer	101.023	0.123	0.7	0.8	O K
1440 min Summer	100.952	0.052	0.6	0.3	O K
2160 min Summer	100.937	0.037	0.4	0.2	O K
2880 min Summer	100.930	0.030	0.3	0.2	O K
4320 min Summer	100.921	0.021	0.2	0.1	O K
5760 min Summer	100.917	0.017	0.2	0.1	O K
7200 min Summer	100.914	0.014	0.2	0.1	O K
8640 min Summer	100.912	0.012	0.1	0.1	O K
10080 min Summer	100.911	0.011	0.1	0.1	O K
15 min Winter	101.444	0.544	1.2	3.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	21
30 min Summer	90.705	0.0	31
60 min Summer	56.713	0.0	50
120 min Summer	34.246	0.0	82
180 min Summer	25.149	0.0	116
240 min Summer	20.078	0.0	150
360 min Summer	14.585	0.0	214
480 min Summer	11.622	0.0	276
600 min Summer	9.738	0.0	336
720 min Summer	8.424	0.0	396
960 min Summer	6.697	0.0	514
1440 min Summer	4.839	0.0	738
2160 min Summer	3.490	0.0	1088
2880 min Summer	2.766	0.0	1468
4320 min Summer	1.989	0.0	2144
5760 min Summer	1.573	0.0	2936
7200 min Summer	1.311	0.0	3568
8640 min Summer	1.129	0.0	4280
10080 min Summer	0.994	0.0	5136
15 min Winter	138.153	0.0	22

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	101.559	0.659	1.3	4.1	O K
60 min Winter	101.587	0.687	1.3	4.2	O K
120 min Winter	101.521	0.621	1.3	3.8	O K
180 min Winter	101.437	0.537	1.2	3.3	O K
240 min Winter	101.360	0.460	1.1	2.8	O K
360 min Winter	101.237	0.337	0.9	2.1	O K
480 min Winter	101.146	0.246	0.8	1.5	O K
600 min Winter	101.077	0.177	0.7	1.1	O K
720 min Winter	101.023	0.123	0.7	0.8	O K
960 min Winter	100.954	0.054	0.6	0.3	O K
1440 min Winter	100.937	0.037	0.4	0.2	O K
2160 min Winter	100.927	0.027	0.3	0.2	O K
2880 min Winter	100.921	0.021	0.2	0.1	O K
4320 min Winter	100.916	0.016	0.2	0.1	O K
5760 min Winter	100.912	0.012	0.1	0.1	O K
7200 min Winter	100.910	0.010	0.1	0.1	O K
8640 min Winter	100.909	0.009	0.1	0.1	O K
10080 min Winter	100.908	0.008	0.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	90.705	0.0	32
60 min Winter	56.713	0.0	52
120 min Winter	34.246	0.0	88
180 min Winter	25.149	0.0	124
240 min Winter	20.078	0.0	158
360 min Winter	14.585	0.0	224
480 min Winter	11.622	0.0	286
600 min Winter	9.738	0.0	348
720 min Winter	8.424	0.0	406
960 min Winter	6.697	0.0	506
1440 min Winter	4.839	0.0	736
2160 min Winter	3.490	0.0	1092
2880 min Winter	2.766	0.0	1472
4320 min Winter	1.989	0.0	2164
5760 min Winter	1.573	0.0	2936
7200 min Winter	1.311	0.0	3576
8640 min Winter	1.129	0.0	4376
10080 min Winter	0.994	0.0	5136

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.015

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.005	4	8	0.005	8	12	0.005

Model Details

Storage is Online Cover Level (m) 102.300

Cellular Storage Structure

Invert Level (m) 100.900 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.57000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.57000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	6.5	6.5	0.900	0.0	18.5
0.800	6.5	18.5			

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 28 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	97.530	0.230	40.4	83.2	O K
30 min Summer	97.561	0.261	43.5	99.4	O K
60 min Summer	97.565	0.265	43.8	101.7	O K
120 min Summer	97.545	0.245	41.9	91.2	O K
180 min Summer	97.521	0.221	39.6	79.1	O K
240 min Summer	97.498	0.198	37.2	68.0	O K
360 min Summer	97.458	0.158	33.4	50.5	O K
480 min Summer	97.427	0.127	30.3	38.1	O K
600 min Summer	97.401	0.101	27.8	29.0	O K
720 min Summer	97.381	0.081	25.8	22.2	O K
960 min Summer	97.354	0.054	23.1	13.9	O K
1440 min Summer	97.339	0.039	17.6	9.6	O K
2160 min Summer	97.328	0.028	12.8	6.8	O K
2880 min Summer	97.323	0.023	10.3	5.4	O K
4320 min Summer	97.316	0.016	7.4	3.8	O K
5760 min Summer	97.313	0.013	5.8	3.0	O K
7200 min Summer	97.311	0.011	4.9	2.5	O K
8640 min Summer	97.309	0.009	4.2	2.1	O K
10080 min Summer	97.308	0.008	3.7	1.9	O K
15 min Winter	97.551	0.251	42.5	94.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	21
30 min Summer	90.705	0.0	31
60 min Summer	56.713	0.0	48
120 min Summer	34.246	0.0	80
180 min Summer	25.149	0.0	114
240 min Summer	20.078	0.0	146
360 min Summer	14.585	0.0	206
480 min Summer	11.622	0.0	266
600 min Summer	9.738	0.0	326
720 min Summer	8.424	0.0	384
960 min Summer	6.697	0.0	498
1440 min Summer	4.839	0.0	736
2160 min Summer	3.490	0.0	1088
2880 min Summer	2.766	0.0	1460
4320 min Summer	1.989	0.0	2164
5760 min Summer	1.573	0.0	2888
7200 min Summer	1.311	0.0	3624
8640 min Summer	1.129	0.0	4392
10080 min Summer	0.994	0.0	5024
15 min Winter	138.153	0.0	21

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	97.586	0.286	46.0	113.5	O K
60 min Winter	97.588	0.288	46.2	114.8	O K
120 min Winter	97.558	0.258	43.2	97.9	O K
180 min Winter	97.522	0.222	39.7	79.6	O K
240 min Winter	97.489	0.189	36.4	64.0	O K
360 min Winter	97.435	0.135	31.1	41.5	O K
480 min Winter	97.395	0.095	27.2	26.8	O K
600 min Winter	97.365	0.065	24.2	17.2	O K
720 min Winter	97.349	0.049	22.2	12.4	O K
960 min Winter	97.339	0.039	17.6	9.7	O K
1440 min Winter	97.328	0.028	12.8	6.8	O K
2160 min Winter	97.321	0.021	9.4	4.9	O K
2880 min Winter	97.316	0.016	7.4	3.8	O K
4320 min Winter	97.312	0.012	5.3	2.7	O K
5760 min Winter	97.309	0.009	4.2	2.1	O K
7200 min Winter	97.308	0.008	3.5	1.8	O K
8640 min Winter	97.307	0.007	3.1	1.5	O K
10080 min Winter	97.306	0.006	2.8	1.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	90.705	0.0	32
60 min Winter	56.713	0.0	50
120 min Winter	34.246	0.0	86
180 min Winter	25.149	0.0	120
240 min Winter	20.078	0.0	152
360 min Winter	14.585	0.0	214
480 min Winter	11.622	0.0	274
600 min Winter	9.738	0.0	328
720 min Winter	8.424	0.0	374
960 min Winter	6.697	0.0	498
1440 min Winter	4.839	0.0	736
2160 min Winter	3.490	0.0	1100
2880 min Winter	2.766	0.0	1428
4320 min Winter	1.989	0.0	2200
5760 min Winter	1.573	0.0	2912
7200 min Winter	1.311	0.0	3552
8640 min Winter	1.129	0.0	4360
10080 min Winter	0.994	0.0	5016

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.450

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.150	4	8	0.150	8	12	0.150

Model Details

Storage is Online Cover Level (m) 98.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.57000	Length (m)	150.0
Infiltration Coefficient Side (m/hr)	0.57000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	97.300	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.5		