BLENHEIM ESTATE

HOMES

Land East of Park View Woodstock

Flood Risk Assessment and Drainage Statement





June 2022

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FLOOD RISK ASSESSMENT AND FOUL & SURFACE WATER DRAINAGE STRATEGY

Scheme name:
Land East of Park View, Woodstock

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Draft	RJW	29th April 2022	Initial Issue
A	MBD	20th May 202	Drainage design amended as per latest architectural layout

Foreword

This document has been prepared solely as a Flood Risk Assessment and Drainage Statement for the Client, Blenheim Estate Homes. No responsibility or liability will be accepted for any use that is made of this document other than by the Client for the purpose it was written. The conclusions resulting from this study and contained within this report are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

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Some of the information presented within this report is based on third party information which is believed to be correct; no liability will be accepted for any discrepancies inaccuracy, mistakes or omissions in such information. The report also assesses the flood risk in relation to the requirements of the Environment Agency and as such assesses the site for a specific flood event and not all flood events. The contents of this document must not be copied or reproduced in whole or in part without the written consent of Infrastruct CS Ltd

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1.0 Summary

A Flood Risk Assessment (FRA) and drainage strategy has been undertaken to accompany the planning application for the proposed development at the land East of Park View, Woodstock. This report has been prepared by Infrastruct CS Ltd on behalf of Blenheim Estate Homes in accordance with the guidelines set out in the National Planning Policy Framework.

The following table is an overview of the flood risk and drainage strategy for the proposed development of the site, based upon currently available information and finds the following –

ITEM	RESPONSE
Site Location	The site is in in southeast Woodstock, bound by Shipton Road to the North, Oxford Road to the south, the A4095 to the East and another residential development (Park View) to the West. Nearest postcode is OX20 1QF. The approximate grid reference is 445815E, 216030N (Nat Grid SP 45815 16030).
Size and Current Land Usage	The site covers a greenfield area of 48.6Ha.
Flood Zone	The development site falls entirely within Flood Zone 1, which is classified as low probability of flooding.
Fluvial Flood Risk	**Low** – Refer to Section 6.1
Overland Flood Risk	**Low** – Refer to Section 7.1
Groundwater Flood Risk	**Low** – Refer to Section 7.2
Sewerage Flood Risk	**Low** – Refer to Section 7.3
Artificial Flood Risk	**Low** – Refer to Section 7.4
Proposed Development	The current architectural proposals involve the construction of up to 500 dwellings with associated access, open space and infrastructure.
SuDS Features proposed for this scheme	The proposed SuDS features for the development of land include infiltration basins, swales, rainwater gardens, cellular soakaways and trenches.

Based on this assessment, it is concluded that in accordance with the Flood risk vulnerability and flood zone compatibility table in Section 6.6 from the Planning Practice Guidance document, the report considers the proposed development appropriate.

2.0 Introduction

2.1 Commission

Blenheim Estate Homes has commissioned Infrastruct CS Ltd, to prepare a Flood Risk Assessment (FRA) and a foul and surface water drainage statement to support a planning application for the development at the Land East of Park View, Woodstock.

2.2 Guidance

This flood risk assessment has been compiled in accordance with the recommendations of the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG).

2.3 Aims and Objectives

The purpose of this flood risk assessment is to assess the potential flood risks by and to the proposed development. It will identify the flood risk zone, potential sources of flood risk, consider the proposed drainage and will be used to support the proposed planning application.

3.0 Site Details

3.1 Location

The site is in southeast Woodstock, bound by Shipton Road to the North, A44 Oxford Road to the South, the A4095 to the East and another residential development (Park View) to the West. The nearest postcode is OX20 1QF.

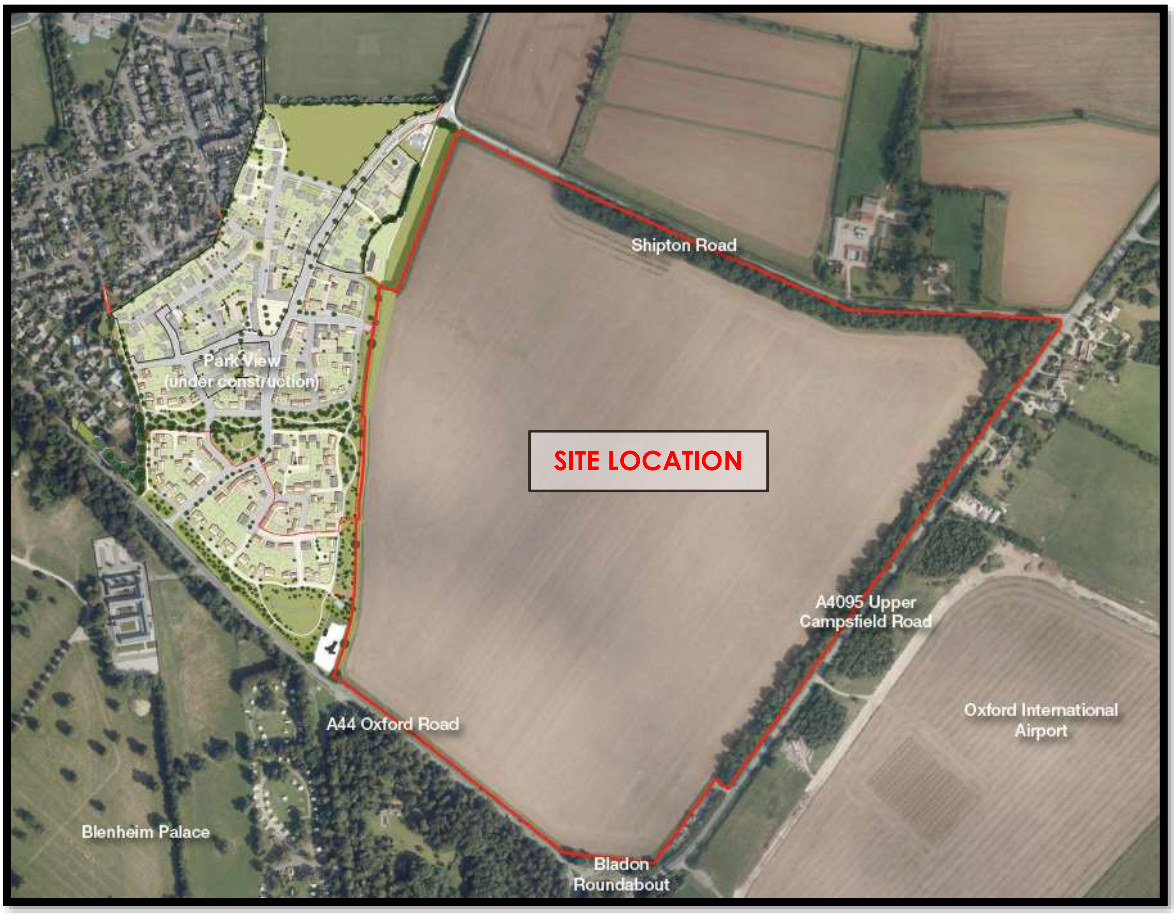


Figure 3.1.1 - Site Context

Figure 3.1.2 - Site location

3.2 Grid Reference

The Ordnance Survey National grid reference for the centre of the site is:

445815E, 216030N (Nat Grid SP 45815 16030)

3.3 Topography and Site Description

The site covers a greenfield area of 48.6Ha although the developable area is only an approximate 35% of the total.

Levels vary within the site between 92.58mAOD to the north-western corner and 84.34mAOD to the south-eastern corner. There is a consistent fall towards the East-Southeast towards the A4095. The maximum fall across the site is 8.24m over 925m, giving a gradient of 1 in 110 (0.9%).

The surrounding roads are higher than the site itself, with level differences ranging between from 0.5m to 1.5m and are separated by a 30m buffer of existing trees, to be largely retained, except for where removal is required for the proposed site access. See Refer to Appendix D for a copy of the topographic survey.

Figure 3.3 – Picture facing north, with the tree area in between the developable area and the A4095.

3.4 Ground Conditions

A Site Investigation Report, Ref: 22.02.031 and dated March 2022, has been undertaken on site by Listers Geotechnics and found the following with regards to the underlying ground conditions;

Superficial deposits: Topsoil. Encountered at each test location from ground level down to depths of 0.4m, typically 0.3m. It comprised brown gravely clayey organic fine to medium sand, with the gravel generally consisting of coarse angular limestone.

Bedrock geology: Cornbrash Formation – Encountered at each location beneath the topsoil to the base of the trial pits down to 1.2m bgl. It generally consisted of medium strong fractured light brown limestone, which was recovered as gravel and cobbles. With depth it became less weathered until trial pits were terminated in solid rock.

3.5 Ground Water

The mentioned site Investigation Report, Ref: 22.02.031 and dated March 2022, encountered no seepages during the fieldwork. Previous investigations in the area (14.08.005a) found groundwater at depths ranging from 4.31m to 9.53m bgl.

3.6 Existing Site Drainage

There are no sewers within the developable part of this site, only a Ø375mm drain along Oxford Road that collects runoff from the neighbouring site (Park View) and conveys it towards the southwest, across the roundabout and into a ditch. Thames Water sewer records show no assets within the site boundary or nearby. Please refer to Appendix C for a copy of the sewer asset map.

3.7 Existing Watercourses

The nearest main river watercourse to the site is the River Glyme, a tributary of the River Evenlode, and is located 120m to the west of the site. It rises about 1 mile (1.6 km) east of Chipping Norton, and flows southeast past Old Chalford, Enstone, Kiddington, Glympton and Wootton, Woodstock and through Blenheim Park.

The Glyme joins the Evenlode just south of the park near Bladon. At Blenheim, "Capability" Brown used the river to form the lake in front of Blenheim Palace, which is 1mile west of the site.

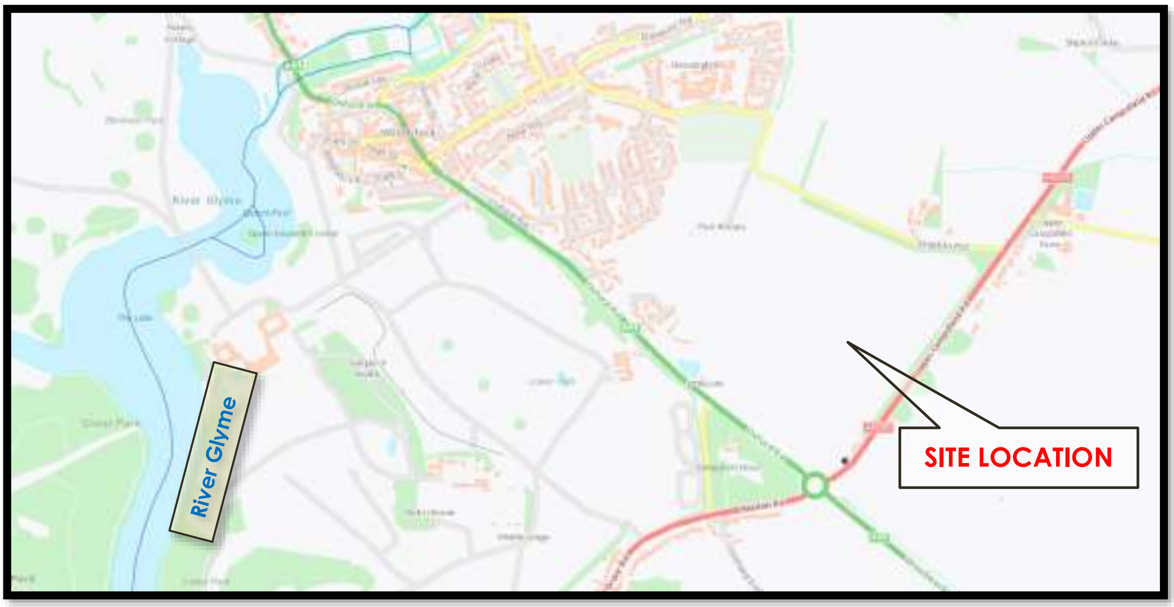


Figure 3.7 – Local Rivers

3.8 Environment Agency Groundwater and Aquifer Protection

Reference to the Environment Agency Groundwater Protection Zone Map shows the area is sited outside all groundwater protection zone. The Environment Agency have defined Source Protection Zones (SPZs) for groundwater sources such as wells, boreholes, and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk.

Figure 3.8.1 – Groundwater Protection Zones

KEY:

- **Zone I** – Inner Protection Zone
- **Zone I** – Subsurface Activity
- **Zone II** – Outer Protection Zone
- **Zone II** – Subsurface Activity
- **Zone III** – Total Catchment
- **Zone III** – Subsurface Activity
- **Zone of Special Interest**

The Environment Agency use the zones to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby.

A study of the aquifer maps on the Environment Agency website revealed the site to be located within Secondary A bedrock aquifer, which is designated as geology capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;

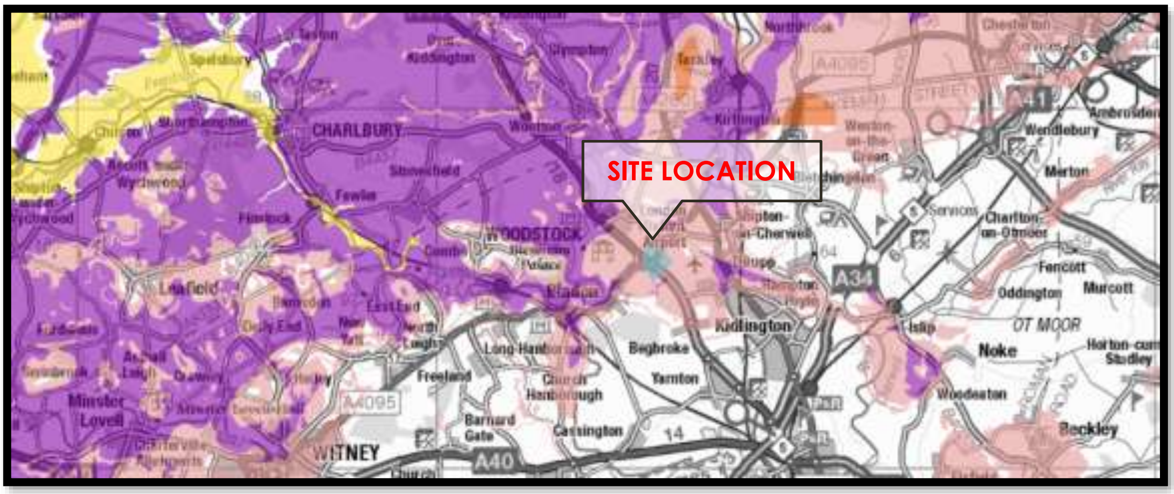


Figure 3.8.3 – Aquifer Designation Map – Bedrock

KEY:

- **Principal**
- **Secondary A**
- **Secondary B**
- **Secondary (undifferentiated)**
- **Unknown (Lakes & Landslip)**
- **Unproductive**

4.0 Proposed Development

The current architectural proposals involve the construction of up to 500 dwellings with associated access, open space and infrastructure. The proposed development plans can be found in Appendix B.

5.0 Local Planning Policy and Guidance

5.1 Local Strategic Flood Risk Assessment

A strategic flood risk assessment Level 1(SFRA) was undertaken for Cherwell District Council by AECOM in May 2017 and the report covers the Woodstock area.

Flood Risk Objective 1: To Seek Flood Risk Reduction through Spatial Planning and Site Design:

- Use the Sequential Test to locate new development in areas of lowest risk, giving highest priority to Flood Zone 1;

- Within Flood Zone 1 highest priority should be given to areas with the lowest level of flood risk from all sources within the Flood Zone;

- Use the Sequential approach within development sites to inform site layout by locating the most vulnerable elements of a development in the lowest risk areas. For example, the use of low-lying ground in waterside areas for recreation, amenity and environmental purposes can provide an effective means of flood risk management as well as providing connected green spaces with consequent social and environmental benefits;

- Avoid development immediately downstream of flood storage reservoirs which will be high hazard areas in the event of failure;

- Seek opportunities for new development to achieve reductions to wider flood risk issues where possible, e.g. larger developments may be able to make provisions for flow balancing within new attenuation SuDS features as part of a large scale land management scheme;

- Identify long-term opportunities to remove development from the floodplain through land swapping.

- Build resilience into a site's design (e.g. flood resistant or resilient design, raised floor levels); and

- Ensure development is 'safe'. Dry pedestrian egress out of the floodplain and emergency vehicular access should be possible. The Environment Agency states that dry pedestrian access/egress should be possible for the 1 in 100-year return period event, and residual risk, i.e. the risks remaining after taking the sequential approach and taking mitigating actions, during the 1 in 1000 year event, should also be 'safe'. In areas of surface water flood risk in Flood Zone 1, access and egress should be provided in areas where flood waters pose a hazard no greater than "very low" in accordance with Defra / Environment Agency document FD2320/TR251. Internal flooding should be avoided through application of the sequential approach to location of development within a site, raising of finished floor levels and/or incorporation of flood resilient/resistant measures.

Flood Risk Objective 2: To Ensure Surface Water Runoff from New Developments remains at Greenfield Rates:

- The NPPF and PPG set out the requirement in future for all major development to include SuDS, enforced through the planning system.

- All sites require the following:

  - Use of SuDS (where possible strategic SuDS should be implemented);
  - Post development surface water runoff and peak flow rates for all sites should be restricted to the greenfield discharge rate plus a reduction of at least 20% to take account of climate change;

- Brownfield sites should seek to discharge surface water from the redeveloped site at greenfield rates wherever possible. At the least, betterment should be offered (in terms of reduced runoff) for all redeveloped sites. Developers proposing to develop brownfield sites should contact the LLFA to further discuss acceptable runoff rates at the earliest opportunity;
- 1 in 100-year attenuation taking into account climate change.

- Space should be specifically set aside for SuDS and used to inform the overall layout of development sites;

- Promote environmental stewardship schemes to reduce water and soil runoff from agricultural land;

- Surface water drainage proposals should have a clear plan for the long-term maintenance and adoption of the systems, prior to approval of any planning permission.

Flood Risk Objective 3: To Enhance and Restore the River Corridor

- Those proposing development should look for opportunities to undertake river restoration and enhancement as part of a development to make space for water. Enhancement opportunities should be sought when renewing assets (e.g. de-culverting, the use of bio-engineered river walls, raising bridge soffits to take into account climate change);

- Avoid further culverting and building over culverts. Where practical, all new developments with culverts running through their site should seek to de-culvert rivers for flood risk management and conservation benefit. Any culverting or works affecting the flow of a watercourse requires the prior written consent of either the Environment Agency (for Main Rivers), or OCC (for ordinary watercourses) under the terms of the Land Drainage/Water Resources Act 1991 and FWMA.

- Set development back from rivers, seeking an 8 metre wide undeveloped buffer strip for development by all Main Rivers including those where the Flood Zone does not exist. Under the terms of the Water Resources Act 1991 and/or the Environment Agency Byelaws the prior written consent of the Environment Agency is required for any proposed works or structures in, under, over or within 8 m from a Main River asset or structure. This is to allow easy maintenance of the watercourse, and includes consent for fencing, planting and temporary structures;

- It is encouraged, where possible, to retain a 5 m wide undeveloped strip along all ordinary watercourses.

Flood Risk Objective 4: To Protect and Promote Areas for Future Flood Alleviation Schemes:

- Safeguard greenfield functional floodplain (our greatest flood risk management asset) from future development, and reinstate areas of functional floodplain which have been previously developed (e.g. reduce building footprints or relocate to lower flood risk zones). This will help to utilise its potential to influence and alleviate flooding elsewhere within the river catchment;

- Develop appropriate flood risk management policies for the brownfield functional floodplain, focusing on risk reduction;

- Identify sites where developer contributions could be used to fund future flood risk management schemes or can reduce risk for surrounding areas;

- Seek opportunities to make space for water to accommodate climate change.

Flood Risk Objective 5: To Improve Flood Awareness and Emergency Planning:

- Encourage communities near high flood risk areas to plan and prepare for flooding;

- Seek to improve the emergency planning process within CDC and OCC using the outputs from the SFRA;

- Encourage all those within existing Flood Zone 3a and 3b (residential and commercial occupiers) to sign up to the FWD service operated by the Environment Agency;

- Ensure robust emergency evacuation plans for new developments in flood risk areas.

5.2 Local Planning Policy and Guidance

Cherwell Local Plan - Policy ESD1: Mitigating and Adapting to Climate Change:

Measures will be taken to mitigate the impact of development within the District on climate change. At a strategic level, this will include:

- Distributing growth to the most sustainable locations as defined in this Local Plan
- Delivering development that seeks to reduce the need to travel and which encourages sustainable travel options including walking, cycling and public transport to reduce dependence on private cars
- Designing developments to reduce carbon emissions and use resources more efficiently, including water (see Policy ESD 3 Sustainable Construction)
- Promoting the use of decentralised and renewable or low carbon energy where appropriate (see Policies ESD 4 Decentralised Energy Systems and ESD 5 Renewable Energy).

The incorporation of suitable adaptation measures in new development to ensure that development is more resilient to climate change impacts will include consideration of the following:

- Taking into account the known physical and environmental constraints when identifying locations for development
- Demonstration of design approaches that are resilient to climate change impacts including the use of passive solar design for heating and cooling
- Minimising the risk of flooding and making use of sustainable drainage methods, and
- Reducing the effects of development on the microclimate (through the provision of green infrastructure including open space and water, planting, and green roofs).

Adaptation through design approaches will be considered in more locally specific detail in the Sustainable Buildings in Cherwell Supplementary Planning Document (SPD).

Cherwell Local Plan - Policy ESD6: Sustainable Flood Risk Management:

The Council will manage and reduce flood risk in the District through using a sequential approach to development; locating vulnerable developments in areas at lower risk of flooding. Development proposals will be assessed according to the sequential approach and where necessary the exceptions test as set out in the NPPF and NPPG. Development will only be permitted in areas of flood risk when there are no reasonably available sites in areas of lower flood risk and the benefits of the development outweigh the risks from flooding.

In addition to safeguarding floodplains from development, opportunities will be sought to restore natural river flows and floodplains, increasing their amenity and biodiversity value. Building over or culverting of watercourses should be avoided and the removal of existing culverts will be encouraged.

Existing flood defences will be protected from damaging development and where development is considered appropriate in areas protected by such defences it must allow for the maintenance and management of the defences and be designed to be resilient to flooding.

Site specific flood risk assessments will be required to accompany development proposals in the following situations:

- All development proposals located in flood zones 2 or 3
- Development proposals of 1 hectare or more located in flood zone 1
- Development sites located in an area known to have experienced flooding problems
- Development sites located within 9m of any watercourses.

Flood risk assessments should assess all sources of flood risk and demonstrate that:
There will be no increase in surface water discharge rates or volumes during storm events up to and including the 1 in 100 year storm event with an allowance for climate change (the design storm event)
Developments will not flood from surface water up to and including the design storm event or any surface water flooding beyond the 1 in 30 year storm event, up to and including the design storm event will be safely contained on site.

Development should be safe and remain operational (where necessary) and proposals should demonstrate that surface water will be managed effectively on site and that the development will not increase flood risk elsewhere, including sewer flooding.

Cherwell Local Plan - Policy ESD7: Sustainable Drainage Systems:

All development will be required to use sustainable drainage systems (SuDS) for the management of surface water run-off.

Where site specific Flood Risk Assessments are required in association with development proposals, they should be used to determine how SuDS can be used on particular sites and to design appropriate systems. In considering SuDS solutions, the need to protect ground water quality must be taken into account, especially where infiltration techniques are proposed.

Where possible, SuDS should seek to reduce flood risk, reduce pollution and provide landscape and wildlife benefits. SuDS will require the approval of Oxfordshire County Council as LLFA and SuDS Approval Body, and proposals must include an agreement on the future management, maintenance and replacement of the SuDS features.

6.0 Flood Risk Policy

6.1 Environment Agency Flood Map

The flood map for the development site shown below suggests that the site wholly falls within Flood zone 1, which is defined as land assessed as having a less than 1 in 1,000 annual probability of river flooding in any one year.

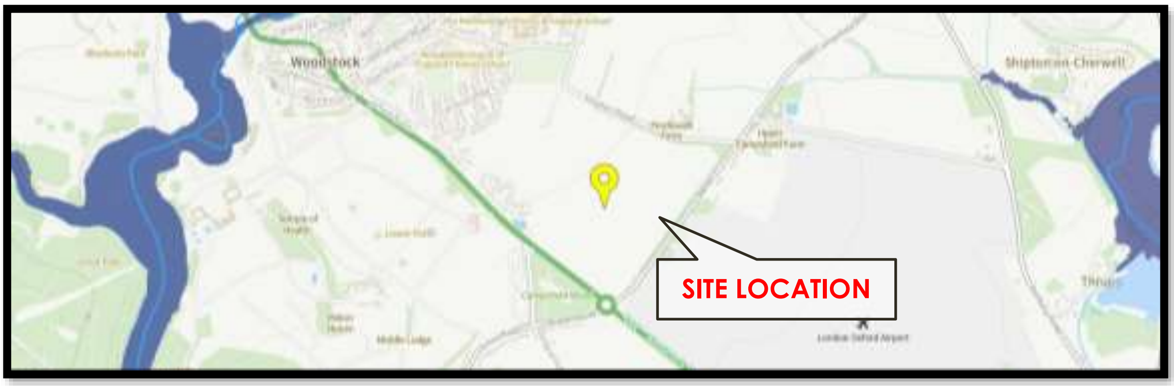


Figure 6.1 - Environment Agency © 2017 - Flood Zone map

KEY:

	Flood Zone 3		Flood defence
	Areas Benefiting from flood defences		Main river
	Flood Zone 2		Flood storage area
	Food Zone 1		

It is, therefore, the consideration of this FRA that the site has a low risk of flooding from fluvial sources.

6.2 The National Planning Policy Framework

The National Planning Policy Framework (NPPF) and the accompanying Planning Practice Guidance (PPG) gives direction for development with respect to flooding. These documents promote a sequential approach to encourage development away from areas that may be or are susceptible to flooding. In doing so it categorizes flood zones in the context of their probability of flooding, as shown in the table within Section 6.3 below.

6.3 Flood Zone Definition

The National Planning Policy Framework Definition of Flood Zones

Flood zone	Fluvial	Tidal	Probability of flooding
1	< 1 in 1000 year	<1 in 1000 year	Low probability
2	Between < 1 in 1000 year and 1 in 100 year	Between <1 in 1000 year and 1 in 200 year	Medium Probability
3a	> 1 in 100 year	> 1 in 200 year	High probability
3b	Either > 1 in 20 or as agreed between the EA and the LPA	Either > 1 in 20 or as agreed between the EA and the LPA	Functional flood plain

6.4 Flood Zones – Table 1 PPG

(Note: These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences)

Zone 1 - Low Probability
Definition
This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Appropriate uses
All uses of land are appropriate in this zone.
FRA requirements
For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention.
Policy aims
In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

6.5 Flood Risk Vulnerability Classification - Extract from Table 2 PPG

More Vulnerable

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

6.6 Flood Risk Vulnerability & Flood Zone Compatibility Table

Vulnerability classification flood zone	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
1	√	√	√	√	√
2	√	√	Exception test required	√	√
3a	Exception test required	√	x	Exception test required	√
3b	Exception test required	√	x	x	x

√ Development is appropriate x development is not appropriate

The above table, taken from PPG (Table 3), confirms that residential properties within flood zones 1 is appropriate development.

6.7 Other Flooding Mechanisms

In addition to the potential for assessing flooding from fluvial and tidal sources NPPF also requires that consideration is given to other mechanisms for flooding:

- Flooding from land – intense rainfall, often in short duration, that is unable to soak into the ground or enter drainage systems, can run rapidly off land and result in local flooding.
- Flooding from groundwater – occurs when water levels in the ground rise above the surface elevations.
- Flooding from sewers – In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and wastewater sewers known as combined sewers. Flooding can result causing surcharging when the sewer is overwhelmed by heavy rainfall.
- Flooding from reservoirs, canals and other artificial sources – Non-natural or artificial sources of flooding can result from sources such as reservoirs, canals lakes etc, where water is held above natural ground levels.

7.0 Other Sources of Flood Risk to The Development

7.1 Flooding from Overland Flows

The risk of flooding due to overland flood flows is considered low by the Environment Agency. The surface water flood data for the site, shown below, indicates that there is very low risk within the whole site.

Fig7.1 – Environment Agency © 2017 - Flood Risk from Surface Water map

KEY:

High (Greater than 3.3% chance of flooding)

Medium (Between 1% and 3.3% chance of flooding)

Low (Between 0.1% and 1% chance of flooding)

Very Low (Less than 0.1% chance of flooding)

It is, therefore, the consideration of this FRA that the site has a low risk of flooding from overland flows.

7.2 Flooding from Rising Groundwater

Groundwater flooding is dependent on local variations in topography, geology and soils. The causes of groundwater flooding are generally understood; however it is difficult to predict the actual location, timing and extent of groundwater flooding without comprehensive datasets.

There is a lack of reliable measured datasets to undertake flood frequency analysis and even with datasets, this analysis is complicated due to the non-independence of groundwater level data. Surface water flooding incidents are sometimes mistaken for groundwater flooding incidents, such as where runoff via infiltration seeps from an embankment, rather than locally high groundwater levels.

'Susceptibility to Groundwater Flooding' is a dataset produced by the BGS showing areas susceptible to groundwater flooding on the basis of geological and hydrogeological conditions. This layer is divided into three classes – High, Medium and Low risk. The highest risk areas are those with the potential for groundwater flooding to occur at the surface, medium risk are those which may experience groundwater flooding of property situated below the ground surface i.e. basements; and low risk are those with limited potential for groundwater flooding to occur. In this case, the site is within an area <25% of susceptibility. See Appendix G.

The site investigations undertaken by Lister Geotechnics (Ref: 22.02.031, Dated March 2022), included 8 trial holes across the development site and found no seepage in any of them.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding from rising groundwater levels.

7.3 Flooding from the Local Sewerage Network

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

As discussed in Section 3.6, there are no public sewers in the vicinity. The Ø375mm drain along Oxford Road is at much lower elevation than the developable area and would not reach the dwellings in a flooding event.

The closest sewers to the development site relate to the new foul and surface water networks serving the new phased development to the West called Park View (see Section 3.1), and which is yet to be added to the Asset Location Map by Thames Water. The foul water network pumps into Hedge End, to the north, whereas the surface water discharges, by gravity and at an attenuated rate, into the ditch to the south. None of these will affect the development discussed in this document.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding by surcharging of the local sewer network.

7.4 Flooding from Reservoirs, Canals & Other Artificial Sources

Reservoirs in the UK have an extremely good safety record. The EA is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers. It is assumed that these reservoirs are regularly inspected, and essential safety work is carried out. These reservoirs therefore present a minimal risk.

Flooding may result from the failure of engineering installations including 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 and toe protection or the failure of ground anchors. This deterioration can be 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.

Review of location plans for the development site show there to be no signs of large manmade water sources within the local area.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding by reservoirs, canals or other artificial sources.

8.0 Flood Risk as a Result of the Development

8.1 Effect of The Development Generally

Development by its nature usually has the potential to increase the impermeable area with a resultant increased risk of causing rapid surface water runoff to watercourses and sewers, thereby causing surcharging and potential flooding. There is also the potential for pollutants to be mobilised and consequently flushed into the receiving surface water system.

Increases in both the peak runoff rate (usually measured in litres per second l/s) and runoff volume (cubic metres m^3) can result.

8.2 Surface Water Drainage & Sustainable Drainage Systems

Sustainable Drainage techniques (SuDS) covers a range of approaches to manage surface water runoff so that-

'Surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account. This should be demonstrated as part of the flood risk assessment.'

8.3 Peak Storm Design Criteria

The proposed sustainable drainage techniques for the development should accommodate the peak rainfall event for a 1 in 100 year storm event with an additional allowance for climate change. Table 5 of NPPG recommends for developments that have a life expectancy beyond 2085, that an additional factor of 40% is applied to the peak volume of runoff.

8.4 Existing Surface Water Runoff Rates

The development site comprises an approximately area of 48.6Ha, all greenfield, although the developable area is only 17.4Ha. The existing runoff rates calculated for this latter value are highlighted below:

Return Period	Greenfield Runoff Rate l/s
1 in 1 year	44.8
Qbar	52.7
1 in 30 year	119.5
1 in 100 year	168.2

Table 8.4 Existing Runoff rates

Greenfield runoff rates were calculated using the ICP SuDS Method within MicroDrainage Software. Calculations can be found in Appendix H.

8.5 Infiltration Testing

As part of the site investigation carried out by Listers Geo in March 2022, infiltration testing was undertaken in eight trial pits in accordance with BRE 365. Results varied across the site although in general the infiltration rates can be considered moderately good.

The lowest soakage potential (<1.0x10-6 m/s) was recorded outside the development area, to the southeast near the Bladon roundabout. All results should be viewed with caution until the full report is made available.

Location/Depth		Infiltration Rate f (m/s)		
		Test 1	Test 2	Test 3
TP01	1.0	2.3x10-5	-	-
TP02	1.2	1.7x10-4	TBC	TBC
TP03	1.1	6.8x10-6	TBC	-
TP04	1.2	2.1x10-5	TBC	TBC
TP05	0.7	2.6x10-5	TBC	TBC
TP06	1.1	2.9x10-5	TBC	-
TP07	1.1	1.4x10-5	TBC	-
TP08	0.7	2.6x10-7	-	-

Table 8.5 Recorded Soakage rates.

8.6 Sustainable Drainage Hierarchy

A hierarchical approach has been undertaken in consideration of the application of SuDS in relation to the development. This is in order to meet the design philosophy of ensuring that surface water run-off is managed as close to its source as possible, and the existing situation is replicated as closely as possible.

The following drainage hierarchy has been undertaken with reference to the procedures set out in the SuDS Manual (CIRIA C753, 2015) to assess the viability of the application of SuDS techniques to this scheme:

Store rainwater for later use: The surface water proposals will allow for storing rainwater for later use in rainwater harvesting tanks and water butts. The location and size of these features is still to be agreed. This water will be used for irrigation purposes and will represent a significant benefit compared to alternatives like water mains or borehole extraction.

- **Use infiltration techniques, such as porous surfaces in permeable strata areas:** Shallow infiltration techniques such as permeable paving, swales, rainwater gardens, trenches, soakaways, etc. are suitable to reduce the runoff leaving the site and address it at source. A combination of these features will be used in this scheme and the arrangement is explained in section 8.7 below.

- **Attenuate rainwater in ponds or open water features for gradual release to a watercourse.** N/A. Infiltration techniques are sufficient to deal with the runoff on site.

- **Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse.** N/A. Above solutions are sufficient to manage runoff.

- **Attenuate rainwater by storing in tanks or sealed water features for gradual release to a surface water drain.** N/A. Above solutions are sufficient to manage runoff.

- **Attenuate rainwater by storing in tanks or sealed water features for gradual release to a combined water drain.** N/A. Above solutions are sufficient to manage runoff.

- **Discharge rainwater to the combined sewer.** Not applicable to the proposed development.

The sustainable drainage hierarchy shown above is intended to ensure that all practical and reasonable measures are taken to manage surface water higher up the hierarchy (1 being the highest) and that the amount of surface water managed at the bottom of the hierarchy is minimised.

Storing rainwater for later use might be an option but it is not sufficient to accommodate the runoff from the whole development. The site-specific drainage hierarchy checklist considered for the drainage design for this development is detailed in Table 8.6.

SUDS OPTIONS	Comments	Potential for flow rate control	Volume reduction	Maintenance requirement	Space requirement	Cost	Included in final detailed design
Rainwater harvesting	Rainwater from roof runoff collected for re-use. Cost-benefit considerations	L	M	H	L	H	N
Water butts	Rainwater collection from roof runoff. Included in final design	L	L	L	L	L	Y
Living roofs	Vegetated roofs that reduce runoff volume and rate	M	L	M	L	H	N
Bio-retention	Shallow vegetated areas to retain and treat runoff.	L	L	M	M	L	Y
Constructed wetlands	Waterlogged areas that can support aquatic vegetation. Replicates existing conditions and provides ecological benefit.	M	L	H	H/M	M	N
Swales	Shallow grassed drainage channels. Replicates existing conditions	H	M	L	M/H	L	Y
Soakaways	Subsurface structures that dispose of water via infiltration.	H	H	L	L	M	Y
Permeable pavements	Surface that infiltrate through surface. Retains pollutants.	H	H	M	L	M	Y
Tanked storage systems	Oversized pipes or cellular storage.	H	L	L	M	M/H	N
Infiltration basins	Depressions in the ground to store and release water through infiltration	H	H	H/M	H	M/L	Y
Detention basins	Temporary retention of runoff with controlled discharge	H	L	M	H	M/L	N

Table 8.6 Drainage design hierarchy (SuDS techniques considered for use in this scheme)

It should be noted that where the SuDS techniques are noted as feasible or possible it does not necessarily follow that they will all be used. Reference should be made to the drainage strategy drawing in Appendix E which indicates the drainage proposals.

8.7 SUDS Techniques Employed

The proposed sustainable drainage techniques for the development will accommodate the peak rainfall event for a 1 in 100 year storm event with an additional allowance for climate change. Table 2 of NPPG recommends for developments that have a life expectancy beyond 2085 and that an additional factor of 40% is applied to the peak volume of runoff, which is in line with the Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire. Calculations will use the latest FEH data as well as a Cv runoff coefficient of 0.95 for all roof and paved areas.

The parking bays will be permeable paved surfaces because this is where oil spillage is most likely to occur, and with adequate aggregate sub-bases, permeable paving can provide water quality treatment as it breaks down hydrocarbons.

For the main access roads, it is proposed to use dry swales and rainwater gardens to collect the runoff and discharge it into the ground. Where there is no room for this arrangement, a pipe network will be used to convey the water into infiltration basins. Runoff from roofs will be collected within individual groups of houses and conveyed via pipe networks into cellular soakaways. Potential sediments will be trapped using catchpits.

Urban creep has been considered when sizing the system. Catchment areas for each type are highlighted below.

SuDS Technique	Catchment Area (m^2)	Area + 10 % Urban Creep (m^2)
Cellular Soakaways + Rainwater gardens	30,340	33,374
Permeable Paving Areas	3,656	3,656*
Infiltration basins	10,282	10.282*
Swales / Dry swales	33,656	33,656*

Table 8.7.A Existing and proposed runoff rates. *Not expected for roads and driveways.

As mentioned above in 8.4, the development site comprises an approximately area of 48.6Ha, all greenfield, although the developable area is only 17.4Ha.

The existing and proposed runoff rates calculated for this latter value are highlighted below:

Return Period	Existing Runoff Rate (l/s)	Proposed Runoff Rate (l/s)	Reduction (%)
1 in 1 year	44.8	0	100%
Qbar	52.7	0	100%
1 in 30 year	119.5	0	100%
1 in 100 year	168.2	0	100%
1 in 100 year + 40%CC	-	0	100%

Table 8.7.B Existing and proposed runoff rates

Therefore, the site runoff is negligible as the rainwater remains within the SuDS features until it finally percolates into the ground. This arrangement improves the existing situation. Detailed calculations can be found in Appendix H.

8.8 Residual Flood Risk & Exceedance

It is proposed that finished floor levels will be raised 150mm above the average ground level to mitigate against the risk of any surface water flooding.

The proposed surface water drainage measures will however be designed to contain the peak storm event that can be expected for a 1 in 100 year situation. A 40% allowance has already been applied to the site to account for future climate change.

8.9 Flood Risk Management

Unlike conventional drainage systems, SuDS features are visible, and their function should be easily understood by those responsible for maintenance. When problems occur, they are generally obvious and can be remedied simply, using standard landscaping practice.

During the first year of operation of all types of SuDS, inspections should usually be carried out at least monthly (and after significant storm events) to ensure that the system is functioning as designed and that no damage is evident. A full SuDS management and maintenance guidance has be produced separately.

8.10 Water Quality

According to the CIRIA SUDS Manual, see below, the pollution hazard level for car parks and low traffic roads is low, and the simple index approach should be used. Residential roofs have a very low hazard level and periodic sediment removal is sufficient.

TABLE 4.3 Minimum water quality management requirements for discharges to receiving surface waters and groundwater

Land use	Pollution hazard level	Requirements for discharge to surface waters, including coasts and estuaries[2]	Requirements for discharge to groundwater
Residential roofs	Very low	Removal of gross solids and sediments only	
Individual property driveways, roofs (excluding residential), residential car parks, low traffic roads (eg cul de sacs, home zones, general access roads), non-residential car parking with infrequent change (eg schools, offices)	Low	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources*[1]	
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources*[1]	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources1* In England and Wales, Risk Screening[4] must be undertaken first to determine whether consultation with the environmental regulator is required. In Northern Ireland, the need for risk screening should be agreed with the environmental regulator.
Trunk roads and motorways	High	Follow the guidance and risk assessment process set out in HA (2009)	
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured, industrial sites	High	Discharges may require an environmental licence or permit[3]. Obtain pre-permitting advice from the environmental regulator. Risk assessment is likely to be required[5].	

Table 4.3 of the SUDS Manual CIRIA C753. Page 63.

The method is guided by the land use and SuDS performance evidence. The steps to be followed are outlined below.

BOX 26.2 Steps of the simple index approach

Step 1 – Allocate suitable pollution hazard indices for the proposed land use

Step 2 – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index

Step 3 – Where the discharge is to protected[1] surface waters or groundwater, consider the need for a more precautionary approach

Note:

1 Designated as those protected for the supply of drinking water (Table 4.3).

Box 26.2 of the SUDS Manual CIRIA C753. Page 567.

Step 1: Pollution hazard indices are presented in table 26.2 below. These indices range from 0 (no pollution hazard for this contaminant) to 1 (high pollution hazard for this contaminant type).

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Table 26.2 of the SUDS Manual CIRIA C753. Page 568.

Step 2: To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index for each contaminant type that equals or exceeds the pollution hazard index. Where the mitigation index of an individual component is insufficient, two components, or more, in series will be required. A factor of 0.5 is used to account for the reduced performance of secondary or tertiary components.

In this case the principal destination of the runoff is the groundwater, so table 26.4 should be used.

TABLE 26.4 Indicative SuDS mitigation indices for discharges to groundwater

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.6[4]	0.5	0.6
A soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.8[4]	0.8	0.8
Proprietary treatment systems[5, 6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

Table 26.4 of the SUDS Manual CIRIA C753. Page 570.

Pollution Hazard Vs Mitigation Measure	TSS		Metals		Hydrocarbons		Mitigation > Hazard
Residential Roofs / Soakaways	0.2	0.4	0.2	0.3	0.05	0.3	✓
Driveways / Permeable Paving	0.5	0.7	0.5	0.6	0.4	0.7	✓
Main Road / Bioretention	0.7	0.8	0.6	0.8	0.7	0.8	✓
Main Road / Infiltration Basins	0.7	0.8*	0.6	0.8*	0.7	0.9*	✓

*Bypass separator to be used for water treatment. SPEL ESR Stormceptor or similar.

In this case, the mitigation indices are above the hazard indices which means the water quality treatment is adequate.

Step 3: Where the discharge is to protected groundwater, a more precautionary approach is needed. As stated in 3.8, the site falls outside Source Protection Zone 1 and therefore no extra protection measures are needed.

9.0 Proposed Foul Water Drainage System

Foul water will be conveyed by a gravity pipe network towards a pumping station located along the eastern boundary, north of the entrance. From there, water will be pumped into the existing foul water sewer running westwards along Shipton Rd, 1Km to the northwest.

This will be subject to a Section 106 consents from Local Water Authority, Thames Water.

A capacity enquiry has been made to Thames Water which concluded that the sewerage network will not have enough capacity for the full development at this time. However, since it is phased project, modelling work is being undertaken to establish the appropriate upgrades required to accommodate it.

The on-site foul system should be offered for adoption to Thames Water under a Section 104 Agreement.

10.0 Recommendations and Conclusion

The development proposals together with the site layout have been assessed in relation to the provision of SuDS drainage associated with the works.

The report has assessed the feasibility of implementing the SuDS hierarchal approach and has confirmed that this development is likely to be able to install suitable drainage measures into the design proposals.

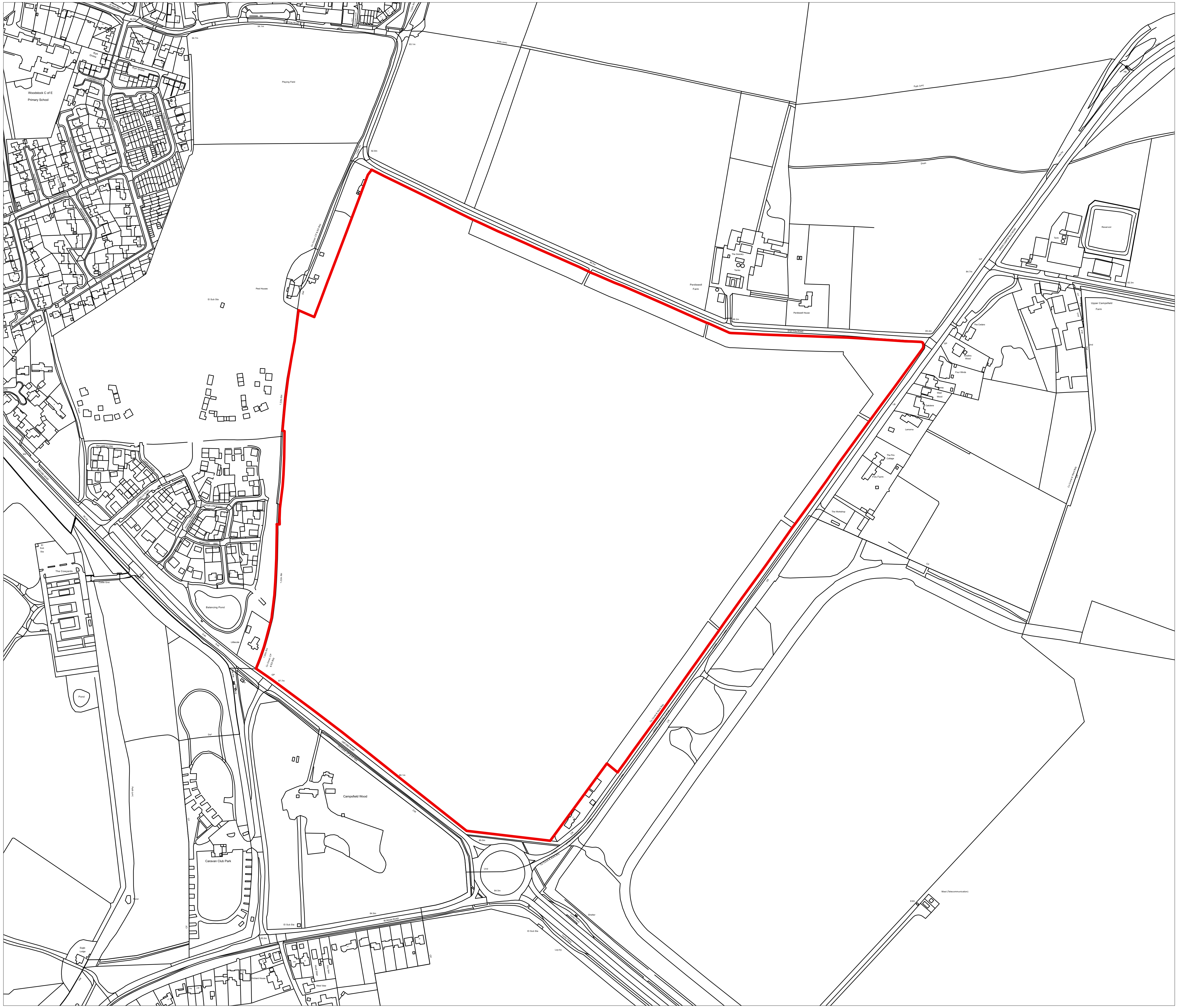
Therefore, in line with the recommendations of the National Planning Policy Framework, the development site lies within land classified as flood zone 1, which is considered at a low risk of flooding, and therefore appropriate for a development of this nature.

Having assessed the other forms of flood risk to and from the development site, this report finds that the site is not considered at high risk from any other sources of flooding.

11.0 References & Bibliography

- The National Planning Policy Framework July 2021
- Planning Practice Guidance.
- Environment Agency - Rainfall-Runoff Management for Developments
- Environment Agency indicative flood maps https://flood-map-for-planning.service.gov.uk/
- Environment Agency indicative groundwater source protection zone maps http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx
- Environment Agency indicative Aquifer designation maps http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx
- CIRIA 2015, The Sustainable Drainage Systems (SUDS) Manual C753
- Sewers for Adoption Code
- Cherwell District Council Level 2 Strategic Flood Risk Assessment.
- The Cherwell Local Plan 2011-2031
- Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire
- Flood Estimation Handbook
- Environment Agency - Adapting to Climate Change: Advice for the Flood and Coastal Erosion Management Authorities March 2016

Appendix A - Location Plan



Key

Site boundary

Revisions

Cherwell Site (PR10)

Blenheim Strategic Partners

Location Plan

Status:		Drawn by:	Checked by:
DRAFT		FH	MP
Project Number: 226403	Scale @ A3: 1:5000		Date: 08/04/2022
Drawing Number: TOR-SK001			Revision:

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Appendix B - Development Proposals

Key

Site boundary

Notes/Revisions

A 10/05/2022 Layout update

Land East of Park View, Woodstock

Blenheim Strategic Partners

N

Illustrative Masterplan

Status:		Drawn by:	Checked by:
DRAFT		MP	MP
Project Number: 226403	Scale @ A3: 1:4000		Date: 10/05/2022
Drawing Number: TOR-SK010			Revision: A

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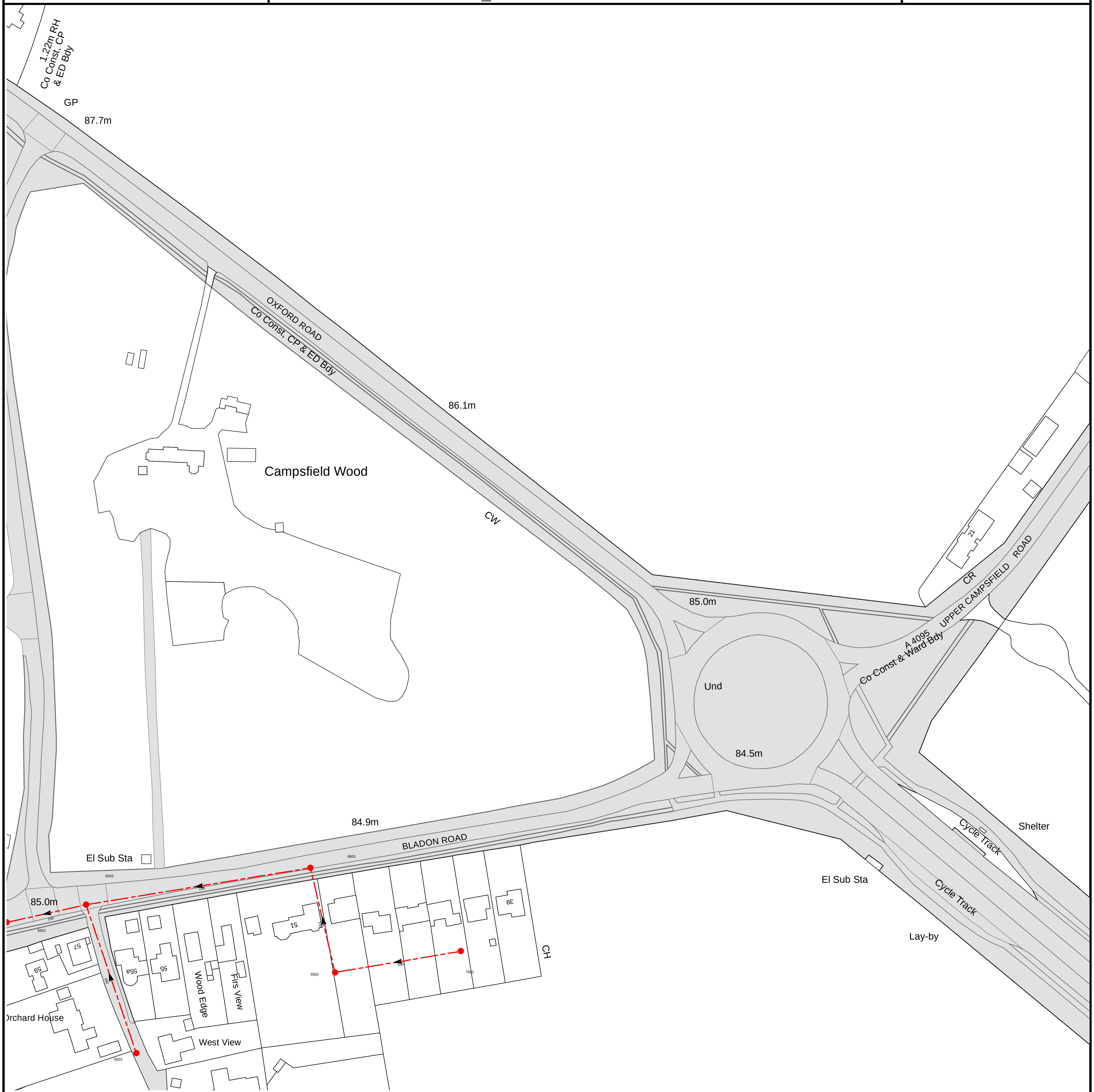
Appendix C - Thames Water Sewer Records

Asset Location Search Sewer Map - ALS/ALS Standard/2022_4599761	SP4515NE



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 445750,215750

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
6501	n/a	n/a
7501	n/a	n/a
5501	84.54	n/a
5502	85.18	81.78
6601	84.71	81.81
5503	84.75	83.31

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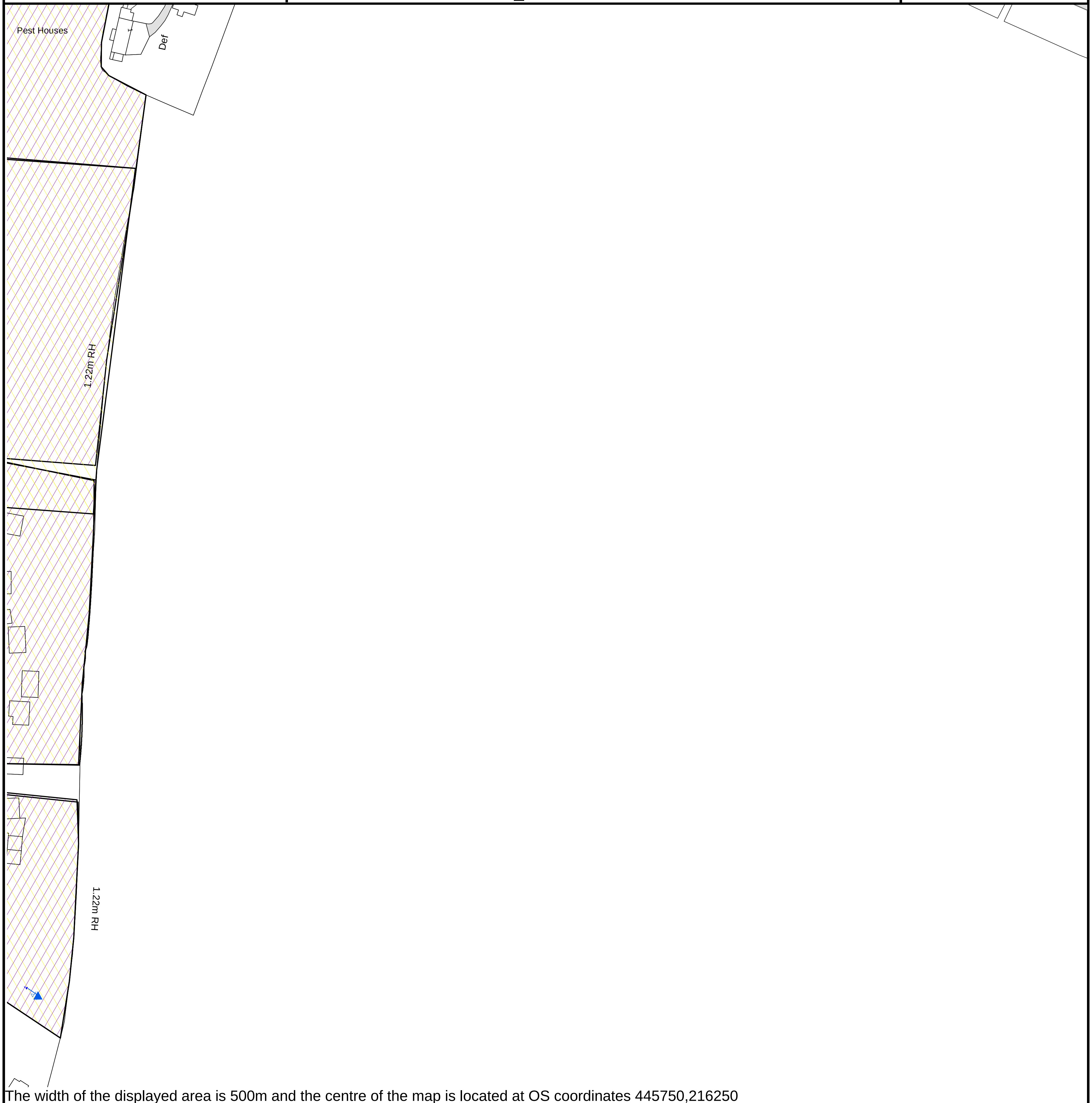
Asset Location Search Sewer Map - ALS/ALS Standard/2022_4599761	SP4516SE



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 445750,216250

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

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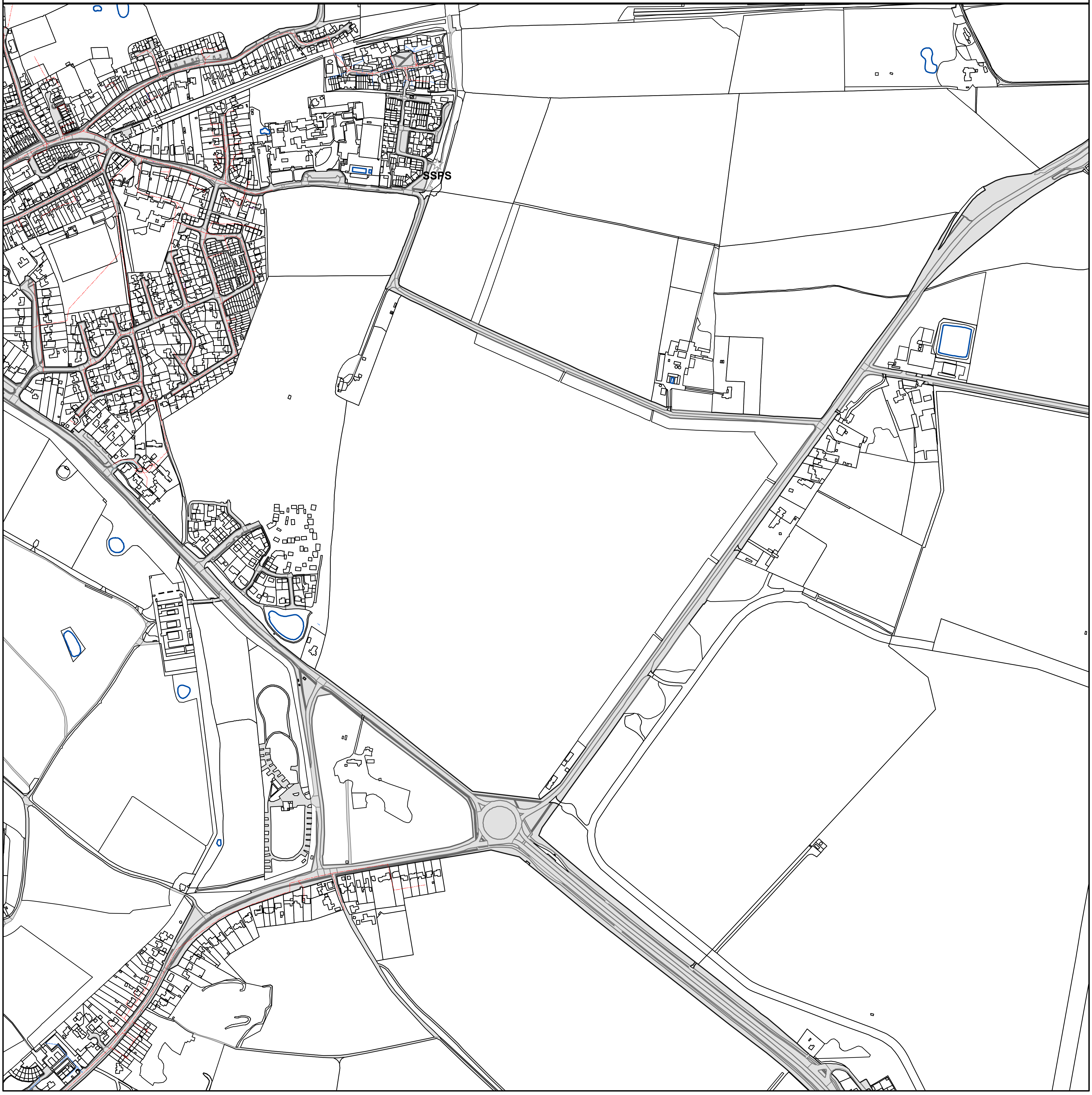
Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

ALS/ALS Standard/2022_4599761



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Meters

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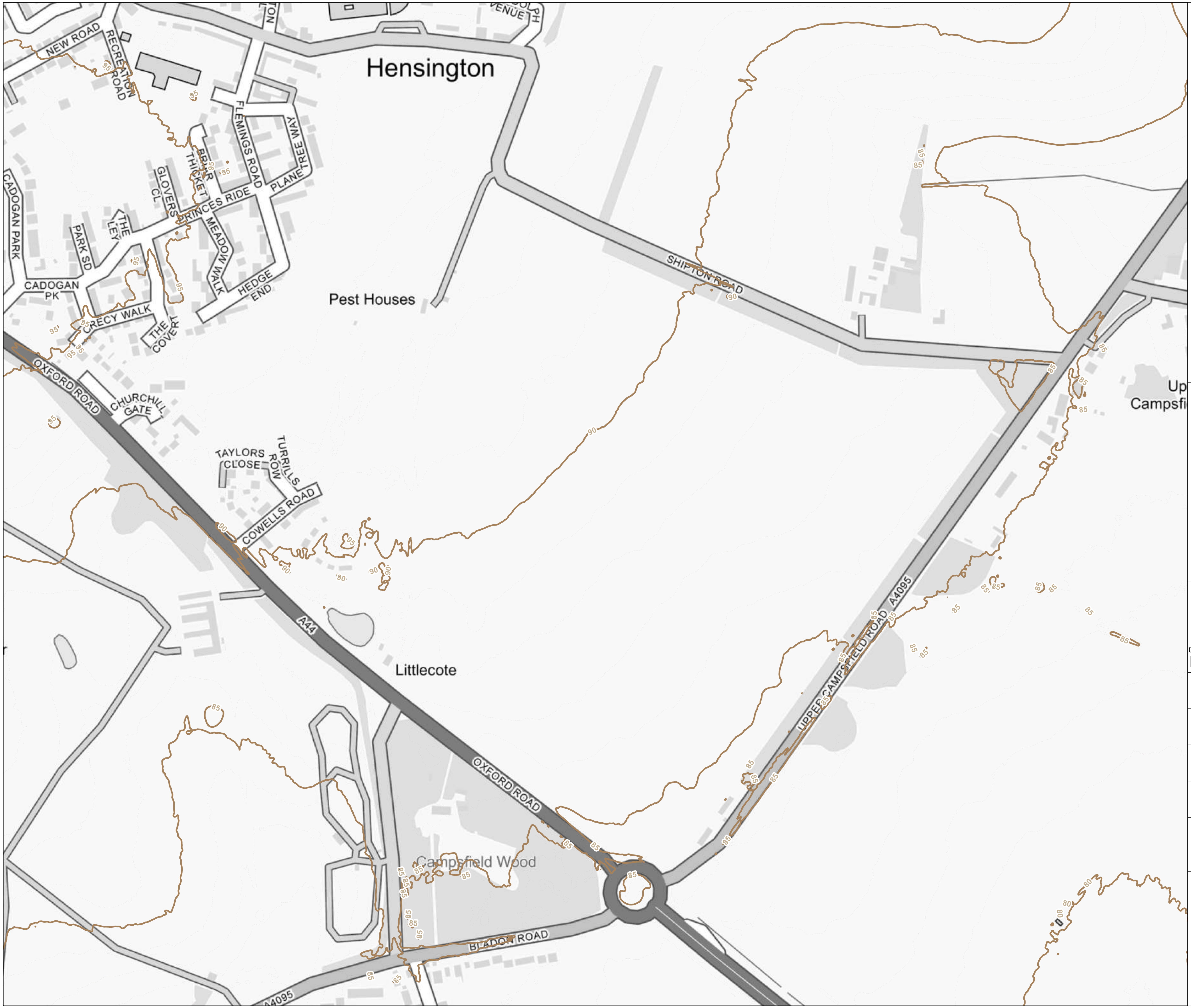
Scale: 1:7162
Width: 2000m
Printed By: Rveldhur
Print Date: 14/03/2022
Map Centre: 445932,216186
Grid Reference: SP4516SE

Comments:

Appendix D - Topographic Survey



Key

Notes/Revision

Woodstock Pr10

Blenheim Strategic

0 100 200 m

N

Topography: Contours

Status:	Drawn by:	Checked by:
Draft	SL	--

Project number:	Scale @A3:	Date created:
--	1:5,000	2021/10/11

Drawing number:	Revision:
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