ADC INFRASTRUCTURE

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

LAND WEST OF BLOXHAM ROAD, BANBURY

DOCUMENT CONTROL

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CONTENTS

APPENDICES

1.0 INTRODUCTION

1.1 Barwood Development Securities Ltd have commissioned ADC Infrastructure Limited to produce a joint Flood Risk Assessment (FRA) and Drainage Strategy report in support of an Outline planning application with all matters reserved, except for access, for a residential development of up to 65 dwellings at a greenfield site on land west of Bloxham Road, Banbury.

1.2 This report assesses the flood risk to the site and proposes an appropriate foul and surface water drainage strategy for the proposed development. It has been carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) and associated Planning Practice Guidance (PPG). It investigates the flood risk posed to the site from fluvial, pluvial, sewer and groundwater-based sources. A section in this report provides recommendations for mitigation and an analysis of any likely residual risks.

1.3 An initial drainage strategy for both foul and surface water seeks to identify the potential constraints that need to be considered as the development proposals progress. Oxfordshire County Council Lead Local Flood Authority (LLFA) standing guidance has been consulted, and correspondence with Thames Water, as the relevant sewerage provider for the site and surrounding catchment, has been sought.

2.0 SOURCES OF INFORMATION

2.1 The report has been based upon a variety of information sources as listed below:

- CIRIA SuDS Manual C753 (2015)
    - Part E, chapter 26, pp.568, Table 26.2
    - Part E, chapter 26, pp.568, Table 26.3
- Cherwell District Council Level 1 Strategic Flood Risk Assessment (2017)
- DEFRA non-statutory technical standards for sustainable drainage techniques (2015)
    - Pp.2, clause 4
    - Pp.2, clause 7
    - Pp.2, clause 9
- Design and Construction Guidance for foul and surface water sewers (2020)
    - Section B3.1, pp.12
- Environmental Agency Flood Maps
    - Long term flood risk mapping
    - Flood mapping for planning
- Flood and Water Management act (2010)
    - Chapter 2, section 9
- National Planning Policy Framework (2021)
    - Annex 3
    - Chapter 14, pp.46, paragraph 159
    - Chapter 14, pp.47, paragraph 163
    - Chapter 14, pp.47, paragraph 164
    - Chapter 14, pp.48 paragraph 167
- Planning Practice Guidance, Flood risk and coastal change. Flood Zone and flood risk tables (2014)
    - Table 1
    - Table 2

3.0 SITE DESCRIPTION

3.1 The site is located to the west of Bloxham Road, Banbury, and is situated within the jurisdiction of Cherwell District Council and Oxfordshire County Council.

3.2 The site forms phase 3 of a multi-phase residential development;

- Phase 1: Sep 2013 outline planning application granted at appeal for up to 145 with associated access (12/00080/OUT – east of Bloxham Road, north-east of the site).
- Phase 2: Nov 2015 outline planning application granted for the development of up to 350 dwellings, associated public open space and associated infrastructure (14/01188/OUT – west of Bloxham Road, north of the site).

3.3 The location of the phase 3 site is included within Figure 1 and is centred upon grid reference 443895, 238695, the site comprises of an almost rectangular field parcel with access provision from Bloxham Road in the north-east.

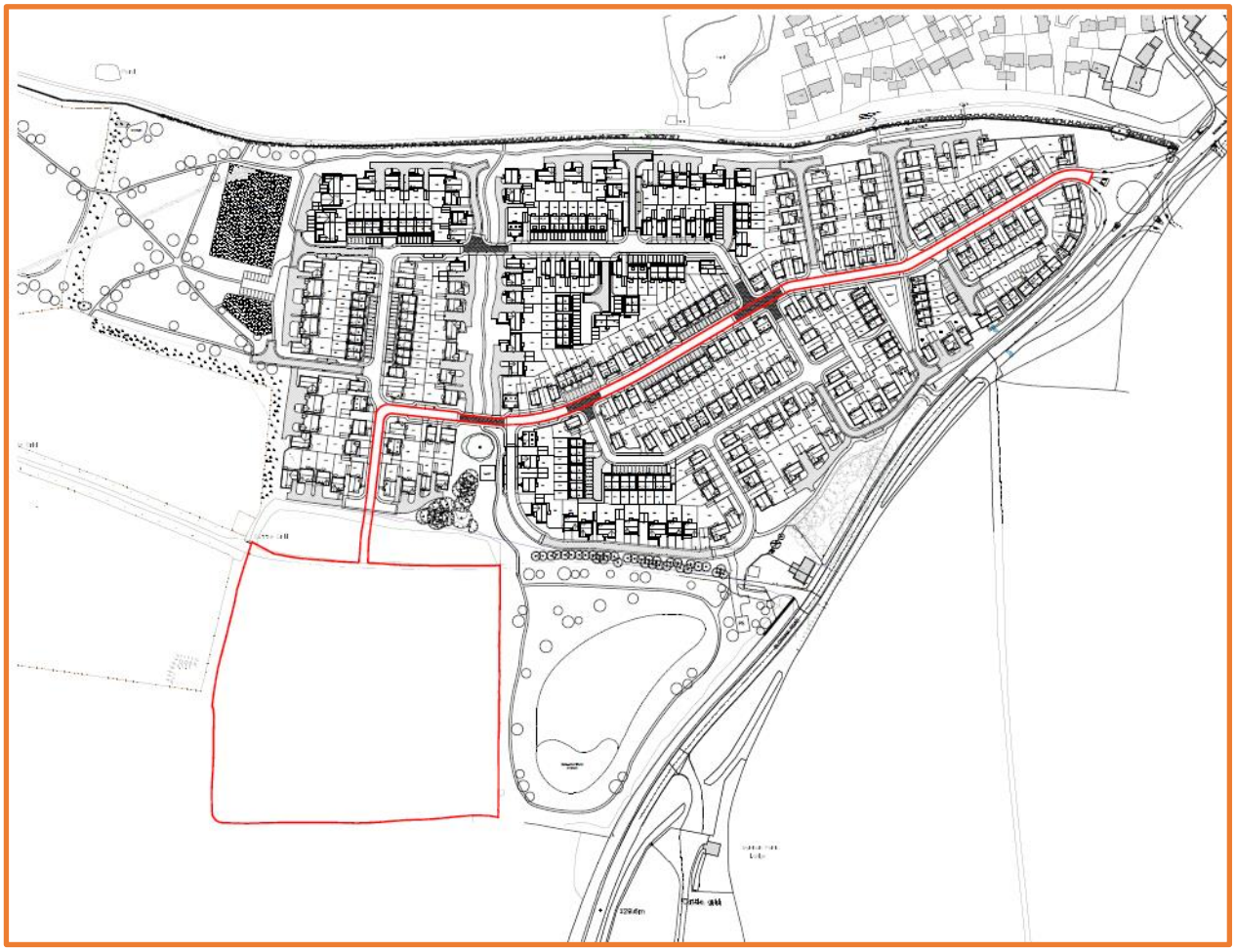

Figure 1: Site location.

Topography

3.4 A topographical survey shown in **Appendix A** has been undertaken, the survey demonstrates the ground levels within the development parcel. Ground levels are shown to decline in a south-easterly direction, the high point is located within the parcel's north-western corner at

approximately 136.0m AOD, and the parcel's low point is located within the south-eastern corner at approximately 133.0m AOD. There is a ground level change of approximately 3m across the land parcel.

3.5 An extracted digital elevation model has been formed from publicly available GOV LiDAR datasets, see Figure 2 below.

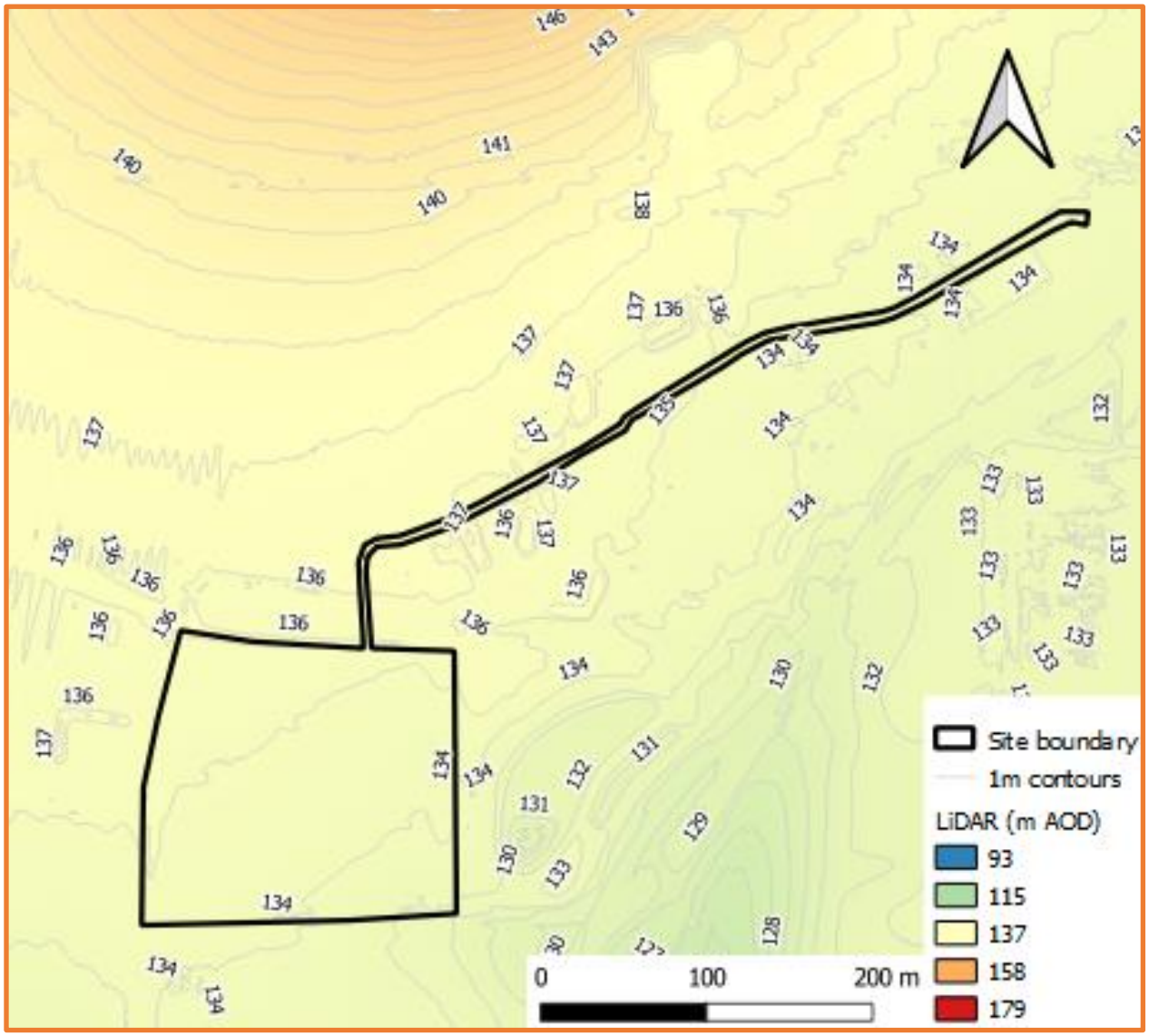

Figure 2: LiDAR map showing the site's elevation.

3.6 The LiDAR demonstrates ground levels to vary by approximately 3m along the site's access, the low point along the access is at its most north-eastern point off Bloxham Road, ground levels then begin to incline along the access towards the site before declining in a south-easterly direction within the development parcel.

3.7 Looking at the wider catchment the LiDAR demonstrates ground levels to incline to the north towards Crouch Hill and decline to the south, east and west.

Existing drainage

3.8 The site is greenfield in nature and therefore is not currently served by a formal drainage network. A sewer asset search by Thames Water demonstrated there to be no public assets within the site, see **Appendix B**.

3.9 The topographical survey, see **Appendix A**, demonstrates a drainage ditch adjacent to the site's southern boundary, this is approximately 0.5m deep and 3m wide throughout its course within the site. The ditch flows west to east and is temporarily piped via a 225mm culvert beneath a field access, the ditch continues to flow in an easterly direction beyond the site's boundaries before becoming culverted beneath the A361 (Bloxham Road) via a 225mm pipe.

3.10 The survey demonstrates an additional drainage ditch adjacent to the site's eastern boundary, this is approximately 0.5m deep and 2.5m wide throughout its course adjacent to the site. The ditch flows north to south and forms a confluence with the southern drainage ditch.

3.11 It is anticipated that existing surface water runoff produced onsite is conveyed via a combination of slow infiltration into the surrounding soils and by overland flow into the surrounding ditches.

3.12 A site walkover conducted by ADC Infrastructure in November 2022, identified the presence of the existing ditches within/adjacent to the site, the course of the ditches downstream of the site, culverted sections of the watercourse, as stated above, and the general topography of the site, see images from the walkover in **Appendix C**.

3.13 Correspondence with Cherwell District Council's Flood risk and land drainage department, see **Appendix D**, demonstrates the ditches within the site to possess 3m easements, within which no development should occur.

Geology

3.14 The British Geological Survey (BGS) online mapping was reviewed to give an indication of the underlying ground conditions on site. The online mapping showed that the bedrock geology and superficial deposits were as follows:

- ***Bedrock Geology:***
    - Whitby Mudstone Formation - Mudstone. Sedimentary bedrock formed between 182.7 and 174.1 million years ago during the Jurassic period (north).
    - Marlstone Rock Formation - Ferruginous limestone and ironstone. Sedimentary bedrock formed between 190.8 and 174.1 million years ago during the Jurassic period (south).
- ***Superficial Deposits:***
    - None recorded

Soils

3.15 The Cranfield Soil and Agrifood Institute Soilscapes mapping for the site was also reviewed. The mapping defined the underlying soil classification as:

- **Soilscape 7:** Freely draining slightly acid but base-rich soils

Onsite drainage implications

3.16 A phase 1 Ground Investigation has been conducted for the site, the investigation concluded that the ground conditions are likely to comprise of variable weathered strata (clay/clayey sand) over solid strata associated with Whitby Mudstone Formation – mudstone and the Marlstone Rock Formation - Ferruginous Limestone and Ironstone.

3.17 Infiltration testing conducted for phase 2 of the wider development scheme, which is sited to the north of the site, demonstrated infiltration rates to be unfavourable for the use of infiltration devices.

3.18 Based on the available data on the nature of the underlying soils and geology, it appears as though the site will possess low infiltration rates.

3.19 However, further investigation into ground conditions are required to make an informed judgement upon the true nature of onsite infiltration capacities. It is advised that any infiltration testing should be undertaken following BRE365 guidance.

3.20 Should infiltration be found not to be a viable option, then surface water runoff will look to make a restricted discharge into the watercourse which flows in an easterly direction along the site's southern boundary. The surface water drainage strategy, which includes further details of the proposed surface water discharge, is discussed in further detail in Section 7.

Flood warnings/flood alert

3.21 Publicly available mapping demonstrates that the site is not located within a catchment that receives the EA flood warning service.

4.0 PROPOSED DEVELOPMENT

4.1 The development proposals are for the construction of up to 65 dwellings, with associated infrastructure and landscaping.

4.2 Figure 3 below demonstrates the proposed site layout

Figure 3: The proposed site layout.

5.0 PLANNING CONTEXT

Flood and Water Management Act

5.1 In combination with the Flood Risk Regulations, 2010 (which enact the EU Floods Directive in England and Wales), the Flood and Water Management Act places significantly greater responsibility on Local Authorities to manage and lead on local flooding issues. The Act and Regulations together raise the requirements and targets that Local Authorities need to meet; this includes:

- To play an active role in leading flood risk management in an area.
- The development of a Local Flood Risk Management Strategy.
- To prepare preliminary flood risk assessments (PFRAs), flood hazard and risk maps, and flood risk management plans (FRMPs).
- To develop and implement drainage and flood risk management strategies.
- To be responsible for the approval, adoption, and subsequent maintenance of Sustainable Urban Drainage Systems (SuDs).[1]

5.2 The Lead Local Flood Authority (LLFA) for the site are Oxfordshire County Council (OCC), who have the responsibility for the management of flood risk for the local area. OCC standard guidance has been reviewed in the preparation of this flood risk assessment and drainage strategy.

The National Planning Policy Framework (NPPF)

5.3 The NPPF sets out the government's planning policies for England and the expectations of how these policies should be applied. It acts as guidance for local planning authorities and decision-makers, both in drawing up plans and making decisions about individual planning applications.

5.4 Chapter 14 of the NPPF sets out how the government intends decision-making authorities to meet the challenge of climate change plus flooding and coastal change. Paragraph 159 sets out how inappropriate development in areas at risk of flooding should be avoided by directing development away from these areas, but where development is necessary, making it safe for its lifetime without increasing the flood risk elsewhere2.

5.5 Paragraph 163 advises:

"If it is not possible for development to be located in areas with a lower risk of flooding, the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification."[3]

5.6 Paragraph 164 advises that:

"The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. To pass the exception test it should be demonstrated that:

[1] GOV UK (2010). Flood and Water Management Act. Chapter 2. Section 9.
[2]GOV UK (2021). National Planning Policy Framework. Chapter 14. Pg.46. Paragraph 159
[3] GOV UK (2021). National Planning Policy Framework. Chapter 14. Pg.47. Paragraph 163.

a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and
b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall."[4]

5.7 Paragraph 167 continues to advise that:

"When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a) 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.
b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment.
c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate.
d) any residual risk can be safely managed;
e) and safe access and escape routes are included where appropriate, as part of an agreed emergency plan."[5]

5.8 Paragraph 169 further advises that:

"Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) take account of advice from the lead local flood authority;
b) have appropriate proposed minimum operational standards;
c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
d) where possible, provide multifunctional benefits."[6]

[4] GOV UK (2021). National Planning Policy Framework. Chapter 14. Pg.47. Paragraph 164.
[5] GOV UK (2021). National Planning Policy Framework. Chapter 14. Pg.48. Paragraph 167.
[6] GOV UK (2021). National Planning Policy Framework. Chapter 14. Pg.48. Paragraph 169.

Planning Practice Guidance (PPG)

5.9 The PPG associated with the NPPF provides more detailed guidance on how the requirements of the NPPF can be met in practice. It includes recommendations on the allowances for climate change and for the application the sequential and exception tests. Three critically important tables are included within the PPG that set the framework for discussion and analysis of site-specific flood risk.

5.10 Table 1 of the Planning Practice Guidance defines flood zones based upon event return probability and is used to steer development and classify land for development. The table is produced below.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (shown as 'clear' on the Flood Map – all land outside Zones 2, 3a and 3b)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (not separately distinguished from Zone 3a on the Flood Map)

5.11 It is important to note that land in Flood Zone 3b is categorized as;[7]

- Land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or
- Land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding)

5.12 Areas within the functional floodplain should be identified by local planning authorities within their Strategic Flood Risk Assessments.

5.13 Annex 3 of the NPPF defines development type by associated vulnerability to flooding and is reproduced in the table below.

[7] GOV UK (2014). Planning Practice Guidance- Flood risk and coastal change. Chapter: Flood Zone and flood risk tables. Table 1.

Vulnerability Classification	Definition
Essential Infrastructure	Essential transport infrastructure (including mass evacuation routes) which must cross the area at risk. Essential utility infrastructure which must be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines. Solar farms
Highly Vulnerable	Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes, and park homes intended for permanent residential use. Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More Vulnerable	Hospitals Residential institutions such as residential care homes, children's homes, social services homes, prisons, and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs, and hotels. Non–residential uses for health services, nurseries, and educational establishments. Landfill* and sites used for waste management facilities for hazardous waste. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	Police, ambulance, and fire stations which are not required to be operational during flooding. Buildings used for shops; financial, professional, and other services; restaurants, cafes, and hot food takeaways; offices; general industry, storage, and distribution; non-residential institutions not included in the 'More Vulnerable' class; and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill* and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment works which do not need to remain operational during times of flood. Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place. Car parks

Water Compatible Development	Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel working. Docks, marinas, and wharves. Navigation facilities. Ministry of Defence installations. Ship building, repairing, and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

5.14 Table 2 of the Planning Practice Guidance (Flood Risk Vulnerability and flood zone 'compatibility') outlines the circumstances in which development may or may not be appropriate and when an Exception Test will be required. The table is reproduced below.

Flood Zones	**Flood Risk Vulnerability Classification**				
	Essential Infrastructure	**Highly Vulnerable**	**More Vulnerable**	**Less Vulnerable**	**Water Compatible**
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test Required.	✓	✓	✓
Zone 3a	Exception Test Required †	×	Exception Test Required	✓	✓
Zone 3b	Exception Test Required*	×	×	×	✓*
† *In Flood Zone 3a – essential infrastructure should be designed and constructed to remain operational and safe in times of flood.* * *In Flood Zone 3b (functional flood plain) essential infrastructure that must be there and has passed the Exception Test, and water- compatible uses, should be designed to:* *remain operational and safe for users in times of flood* *result in no net loss of flood plain storage* *not impede water flows and not increase flood risk elsewhere.*					

5.15 Given the above the proposed development is deemed to be appropriate from a flood risk perspective, and the exception test is not required.

5.16 The NPPF states that the proposed development should remain safe throughout its lifetime without increasing flood risk elsewhere.

5.17 The PPG states that;

"Residential development can be assumed to have a lifetime of at least 100 years, unless there is a specific justification for considering a different period… the life time of a non-residential development depends on the characteristics of that development but a period of at least 75 years is likely to form a starting point for assessment"

5.18 Given the above the proposed development is anticipated to possess a design lifetime of 100 years.

5.19 To assess whether the proposed development would remain safe throughout its design lifetime the proposals are to be assessed against the following design flood events, plus a forecasted allowance for climate change.

- river flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year); or
- tidal flooding with a 0.5% annual probability (1 in 200 chance each year); or
- surface water flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year),

Climate change

5.20 This flood risk assessment and drainage strategy has been conducted in line with the most current EA guidance on climate change allowances.

5.21 Climate change allowances are predictions of anticipated change for:

- Peak river flow
- Peak rainfall intensity
- Sea level rise
- Offshore wind speed and extreme wave height

5.22 The most appropriate climate change allowance for use in assessing the proposed development is peak rainfall intensity.

Peak rainfall intensity[8]

5.23 Peak rainfall intensity allowances should be utilised in small catchments (less than 5km2), or urbanised drainage catchments.

5.24 For flood risk assessments and strategic flood risk assessments, both the central and upper end allowances should be assessed.

5.25 The proposed site is situated within the Cherwell and Ray Management catchment, the table below, outlines the peak rainfall intensity allowances for a range of periods.

[8] EA (2021). Flood Risk Assessments: climate change allowances.

Cherwell and Ray Management catchment	3.3% annual exceedance rainfall epoch (2050s)	3.3% annual exceedance rainfall epoch (2070s onwards)	1% annual exceedance rainfall epoch (2050s)	1% annual exceedance rainfall epoch (2070s onwards)
Upper end	35%	35%	40%	40%
Central	20%	25%	20%	25%

5.26 Given the anticipated life span of the development the site should be assessed via the 2070s epoch allowances; this is up to a 1 in 100-year+40% event.

Local planning context

Cherwell Level 1 Strategic Flood Risk Assessment[9]

5.27 The SFRA investigates flood risk within the district, the relevant information to the site and surrounding catchment has been extracted from the SFRA and is summarised within this section of the report.

5.28 There are several key watercourses which flow within and via Banbury, these include;

- River Cherwell
- River Swere
- Sor Brook

5.29 As part of the SFRA a series of flood risk maps have been produced, these are presented within **Appendix E**, included within this is a map demonstrating watercourses within the district, this includes the aforementioned waterbodies and all other watercourses within the district.

5.30 Banbury is identified as a cluster of properties being at risk of widespread flooding, a number of historic flood events have been recorded within Banbury, the majority of which originate from fluvial flooding from the River Cherwell.

5.31 To mitigate flooding within Banbury an online flood storage reservoir was constructed in 2012 and protects the area of Banbury from up to a 1 in 200 chance of flooding in any given year.

5.32 The most recent flood events within Banbury include the following;

- October-December 2012, properties and highways flooded
- January-March 2013, highways flooded
- January-February 2014, road closures

5.33 The development site however is shown to be outside of any recorded historical flood extents, as demonstrated within the historical flooding incidents SFRA mapping presented in **Appendix E**, this is discussed further in a latter section of this report.

[9] Aecom (2017). Cherwell Level 1 Strategic Flood Risk Assessment

5.34 Within the Level 1 SFRA the proposed site was identified as a potential development site and is referred to as 'SFRA15, Land at Crouch Farm, Banbury', the site was categorised as being at a low risk of flooding, the site however was not considered in the subsequent Level 2 SFRA.

Flood risk status

5.35 The Environment Agency online flood mapping shows that the site lies wholly within Flood Zone 1 (see Figure 4 below).

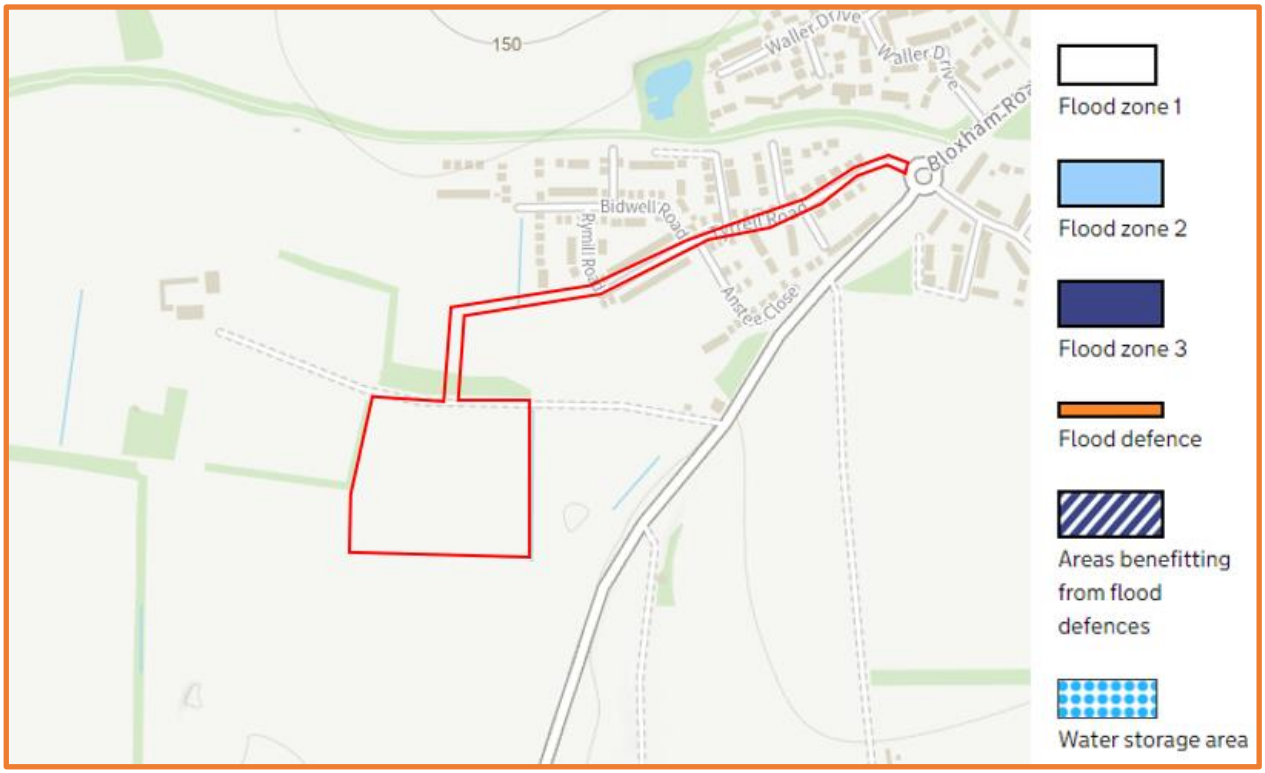

Figure 4: EA Flood Map for Planning extract.

5.36 In Annex 3 of the NPPF residential development is categorised as a 'more vulnerable' development type. In accordance with Table 2 of the PPG, the development is deemed appropriate, and as such there is no requirement for the Sequential and Exception Tests to be carried out.

5.37 A summary of the flood risk status of the development proposals is provided in the table below.

Flood Zone	Flood Zone 1
Development Vulnerability Classification	More vulnerable
Flood Zone Compatibility	Sequential and Exception Test are not required

Previous flood history

5.38 Oxfordshire County Council as the LLFA for the local area are required under section 19 of the Flood Risk and Water Management act to investigate all flooding incidents that occur within the county's boundaries.

5.39 Historic Flooding Incidents mapping produced by Aecom on Behalf of Cherwell District Council, as part of the level 1 SFRA, see **Appendix E**, demonstrates no recorded flood extents within the site's boundaries.

5.40 Publicly available Environment Agency (EA) recorded flood outline datasets have been reviewed and the relevant extract is demonstrated within Figure 5 below, the blue hatching demonstrates the extents of recorded flood events.

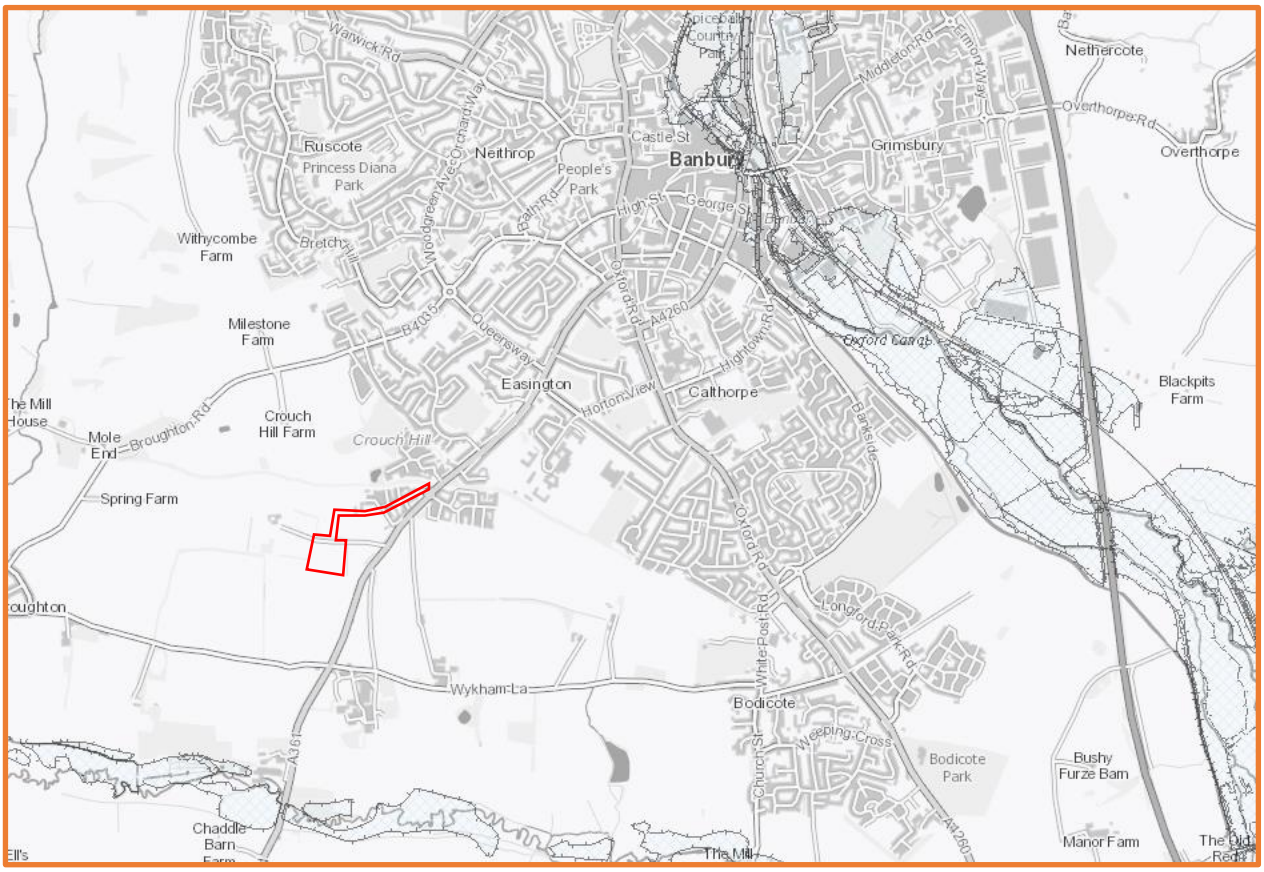

Figure 5: Recorded flood extents mapping extract.

5.41 The mapping demonstrates there to be no recorded flood extents either within the site or within immediate proximity to the site. The nearest recorded flood extent is associated with the Sor Brook and is sited at approximately a 1km straight line distance from the site's southern boundary.

6.0 FLOOD RISK ASSESSMENT

6.1 In accordance with the NPPF and local planning guidance, this Flood Risk Assessment considers the risk posed to the development from a range of flooding sources. This section of the report details the investigation of flood risk from all pertinent sources; a subsequent section provides recommended mitigation where the risk is deemed significant.

6.2 The flood risks that may be posed to any site are summarised in the table below. The degree of risk to the site is indicated in the table below and site-specific factors are outlined and described in greater detail within the forthcoming sections.

Flooding Source	Degree of Risk	Source of Risk
Fluvial	Low	EA mapping demonstrates that the site lies in Flood Zone 1 and so is at a low risk of fluvial flooding.
Tidal	None	There are no tidal influences in the area.
Canals	Low	The site is over 100m away from the nearest canal and so canal flooding is considered to be low.
Groundwater	Low	A desktop review of the underlying geology infers that the lack of bedrock permeability onsite would render groundwater flooding to be unlikely. The Areas Susceptible to Groundwater Flooding map demonstrates that the site is located within an area not deemed to be susceptible to groundwater flooding.
Sewers	Low	The site is greenfield in nature and there are no known public sewerage assets within the site. The nearest sewers to the site are a segregated foul and surface water sewer network to the north of the site, this serves phase 2 of the wider development scheme. The phase 2 sewerage network is sited at a higher elevation in comparison to onsite ground levels , and therefore there is a residual risk of sewer flooding, this risk however is deemed to be low.
Pluvial (Surface Water) runoff	Low	The EA mapping demonstrates that the majority of the site has a very low risk of pluvial flooding.
Reservoirs and Waterbodies	None	The EA mapping demonstrates that the site is at minimal risk of reservoir flooding.

Fluvial risk

6.3 The online Environment Agency mapping has been reviewed and it shows that the site lies within Flood Zone 1 and is deemed to have a low probability of fluvial flooding.

6.4 There are no known recorded fluvial flood extents within the site nor within a close proximity to the site.

6.5 There are two drainage ditches within proximity to the site; one adjacent to the site's eastern boundary, and another along the site's southern boundary. The drainage ditches are both intuitively located within low points within the site. Given the topography of the site and the current site layout, which designates land immediately next to the ditches as public open space, the risk of flooding to the development from the existing ditches is deemed to be low.

6.6 Given the above the risk of fluvial flooding to the site is deemed to be low.

Tidal flooding

6.7 The site is not located within an area that is tidally influenced. Therefore, it is deemed at a negligible risk from tidal or coastal flooding.

Canal flooding

6.8 There are no canals within the immediate vicinity of the site, the nearest canal network is the Oxford Canal which flows through the eastern side of Banbury at an approximate 2.85km straight line distance north-east of the site.

6.9 Given the above the risk of canal flooding to the site is deemed to be low.

Groundwater flooding

6.10 Groundwater flooding occurs when the water table rises following a period of prolonged rainfall and emerges on the ground surface. It is most likely to occur in low-lying areas that are underlain by a permeable bedrock and superficial deposits.

6.11 A desk-based review of onsite geology however reveals that the promotion of groundwater movement may be impeded by the presence of a predominant mudstone bedrock.

6.12 SFRA mapping, see **Appendix E**, demonstrates the site to be outside of areas with a susceptibility to groundwater flooding.

6.13 A phase 1 Ground Investigation (GI) has been conducted for the site the GI concluded the following;

- There is one recorded groundwater abstraction license within 250m of the site area and is associated with Crouch Farm. The record is for groundwater extraction for General Farming and Domestic Use and is located 212m to the west
- The site is not recorded to be within 250m of a Groundwater Source Protection Zone
- The BGS Groundwater Flooding Susceptibility data indicates that the area of the site underlain by the Marlstone Rock Formation (central and southern portion) has a “Limited Potential for Groundwater Flooding to occur”

6.14 It is recommended that as the planning proposals progress a phase 2 ground investigation is undertaken to confirm the underlying ground conditions on site. Infiltration measurements should be conducted in accordance with BRE365 guidance. This would provide more detailed information on the ground conditions and henceforth provide further enlightenment on the site’s vulnerability to groundwater flooding.

6.15 Given the available information the risk of groundwater flooding to the site is deemed to be low.

Pluvial risk

6.16 The EA publish pluvial (surface water) flood maps which show the route of surface water runoff across the ground. Typically, these flood maps identify overland drainage paths that are often part of a historic natural land drainage system. An overview of the surface water flood risk to the site is shown in Figure 6.

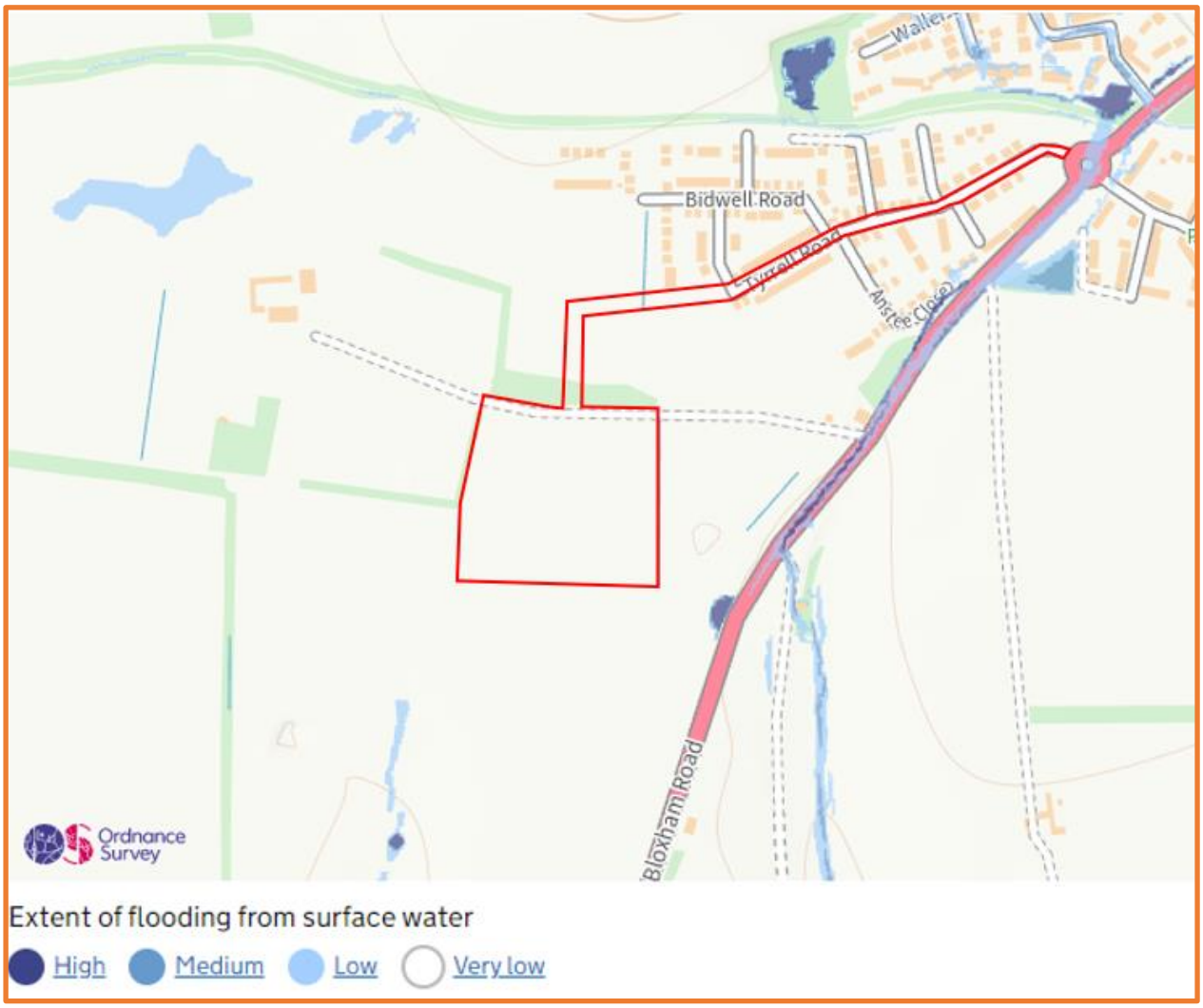

Figure 6: Pluvial flood risk extents.

6.17 The mapping shows that the site possesses a very low risk of pluvial flooding, there are no modelled pluvial flood risk extents within the site.

6.18 The EA also publish mapping which demonstrates modelled pluvial flood depths and velocities during the 1 in 30-year, 1 in 100-year and, 1 in 1000-year pluvial flood events. Since there are no modelled pluvial flood risk extents within the site there are no mapped depths nor velocities for the aforementioned range of return periods.

6.19 Given the above the risk of pluvial flooding to the site is deemed to be low.

Sewer flooding

6.20 Sewer flooding occurs when the conveyed flows exceed the available capacity of the system. This may be due to intense rainfall events, restricted discharges to watercourses with high water levels, blockages, collapses, or equipment failure.

6.21 Sewer plans, shown in **Appendix B** , demonstrate a segregated gravity conveyed surface water and foul water sewerage network within Bloxham Road. The surface water sewer flows in a southernly direction adjacent to Bloxham Road and is presumed to discharge into the Sor Brook. The foul network alternatively flows in a north-easterly direction along Bloxham Road towards central Banbury. The sewer plans also demonstrate a sewer network serving phase 2 of the wider development scheme, which is shown on the asset plans to be under agreement.

6.22 Planning application documents submitted for the phase 2 site (14/01188/OUT) (17-00448-DISC relating to foul water) (17-00505-DISC relating to surface water), which is sited directly to the north and east of the proposed site, demonstrates a segregated foul and surface water network. The phase 2 foul network drains via a pumped flow to the public sewers within Bloxham Road, surface water alternatively drains via a gravity regime and discharges into a basin which is located to the east of the site, see plans in **Appendix H**.

6.23 The aforementioned networks are generally located at a higher elevation when compared to onsite ground levels, therefore in the instance of a sewer flood event there would be a residual risk of flooding to the site. However, the phase 2 site sewer network will have been designed to meet current standards and therefore this risk is deemed to be low.

6.24 Historical sewer flood mapping produced as part of Cherwell District's Level 1 SFRA, see **Appendix E**, demonstrates there to be approximately 5-10 recorded flood events within the relevant postcode region. This covers a vast area and is not reflective of the site alone. Since there are no formal public sewerage assets within the site, and the phase 2 sewer network has only recently been constructed, it is unlikely that there are any recorded sewer flood incidents within the site's boundaries.

6.25 Given the above the risk of sewer flooding to the site is deemed to be low.

Reservoirs and waterbodies

6.26 The EA has prepared reservoir failure flood risk mapping to show the largest area that might be flooded if a reservoir were to fail. The site is shown to be outside areas considered at potential risk of reservoir flooding, see Figure 7.

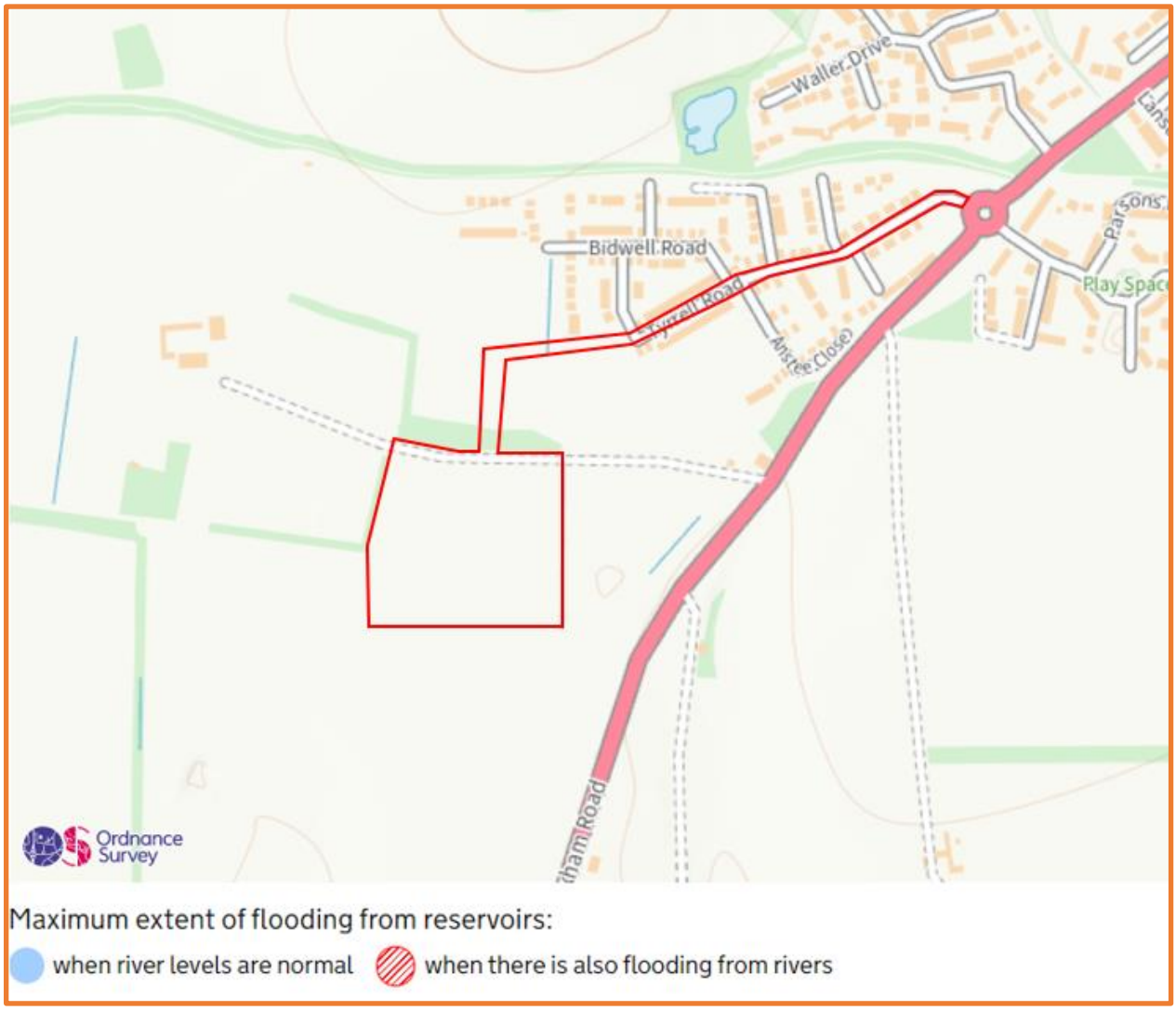

Figure 7: Flood risk from reservoirs to the site.

Proposed mitigation

6.27 The risk of flooding to the site from a variety of sources has been investigated. The evidence expressed above demonstrates that the site is situated within Flood Zone 1 and possesses a very low risk of pluvial flooding.

6.28 Flood risk as a result of tidal, canal, sewer, groundwater, and reservoir influences have all been deemed as low and so no further mitigation is recommended.

6.29 Although the flood risk to the site from the variety of sources investigated has been deemed to be low; to alleviate any residual flood risk to the site the following are analysed.

Access and Egress

6.30 The PPG states that to ensure a development is safe for its lifetime the ability of residents and users to safely access and exit a building during a design flood and to evacuate before an extreme flood (0.1% annual probability of flooding plus climate change) must be considered[10]

[10] GOV UK (2022). Planning Practice Guidance. Flood risk and coastal change.

6.31 The access and egress route from the development is shown to be in Flood Zone 1 and possesses a very low risk of pluvial flooding.

Drainage system design

6.32 The Non-statutory Technical Standard for SuDS has a series of recommendations in relation to the design of prospective drainage systems for new developments. These are to ensure that drainage systems on new developments are designed to a standard to negate the additional flood risk that may arise from the development. The recommendations to be implemented for the site are as follows:

- *"The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30-year (3.3% AEP) event."*[11]
- *"The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100-year (1% AEP) rainfall event in any part of: a building (including basement); or in any utility plant susceptible to water (e.g., pumping station or electricity substation) within the development."*[12]

Exceedance routes

6.33 The Non-statutory Technical Standard for SuDS guidance also specifies that:

"The design of the site must ensure that, so far as is reasonably practicable, flows resulting from the rainfall in excess of a 1 in 100-year rainfall event are managed in exceedance routes that minimise the risks to people and property."[13]

6.34 Exceedance routes within the proposed development are shown to flow in a south-easterly direction towards the proposed basin, public open space, and drainage ditches.

Finished floor levels

6.35 The site is not located within an area where there is a residual flood risk, however finished floor levels according to the gov.uk website should be a minimum of whichever is higher of; 300mm above the general ground level of the site or 600mm above the estimated river or sea flood level[14].

6.36 Since the site is in Flood Zone 1 and is at a low risk of flooding it is recommended that on site finished floor levels are set to a minimum of 300mm above general site ground levels.

External site levels

6.37 External site levels should be designed to route any excess runoff away from buildings, and into landscaped areas or drainage outlets. Any raising of levels onsite should be designed to ensure that there is no increase in surface water runoff onto neighbouring third-party land.

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[11] DEFRA (2015). Non-statutory technical standards for sustainable drainage systems. Pp.2. Clause S7.
[12] DEFRA (2015). Non-statutory technical standards for sustainable drainage systems. Pp.2. Clause S8.
[13] DEFRA (2015). Non-statutory technical standards for sustainable drainage systems. Pp.2. Clause S9.
[14] GOV UK (2019). Flood risk assessment standing advice.

6.38 Likewise, similar design considerations to minimise any potential risk from sewer flooding arising from the onsite drainage network should be considered, to prevent foul effluent from entering the proposed dwellings.

Flood compensatory storage

6.39 The cumulative impacts of development have the potential to reduce floodplain storage, where flood storage from any source of flooding is to be lost as a result of development, on-site level-for-level compensatory storage, accounting for the predicted impacts of climate change over the lifetime of a development, should be provided. Where it is not possible to provide compensatory storage onsite, it may be acceptable to provide it off-site if it is hydraulically and hydrologically linked[15].

6.40 The development proposals do not reduce any floodplain storage and therefore no further mitigation is required.

[15] GOV UK (2022). Planning Practice Guidance. Flood risk and coastal change.

7.0 SURFACE WATER DRAINAGE STATEMENT

Existing discharge rate

7.1 Current proposals comprise of plans for residential development upon greenfield land.

7.2 The existing greenfield runoff rate has been calculated using the rural runoff tool within Microdrainage and is based upon the proposed developable area (1.91ha).

7.3 The full outputs are included within **Appendix F** and a summary of the results is provided in the table below.

Return Period	Site Area (ha)	Runoff Rate (l/s)
QBar	1.91	6.5
1 in 1 Year	1.91	5.4
1 in 30 Year	1.91	12.7
1 in 100 Year	1.91	16.7

Discharge options

7.4 In accordance with the Building Regulations Part H, the newly published Non-Statutory Technical Standards for SuDS and prevailing best practice, surface water should look to be discharged according to the following preferential hierarchy:

- Infiltration drainage techniques, such as swales and soakaways
- An open watercourse, river, or ditch
- A surface water sewer
- A combined sewer

7.5 A desktop review and Phase 1 ground investigation demonstrates that the majority of the site's geological composition may limit the viability of the use of infiltration onsite, however the presence of limestone within the southern reaches of the site may offer a degree of infiltration potential. As such it is advised that a ground investigation that includes infiltration testing is undertaken to determine whether there is any soakage potential across the site.

7.6 OCC, as the LLFA, require that sufficient evidence is provided to prove whether infiltration is a viable option to dispose of surface water runoff or not. Should the use of infiltration features be found not to be suitable, then preference should be given to the disposal of surface water runoff into the nearest watercourse or ditch.

7.7 The topographical survey, see **Appendix A**, and a site walkover, see **Appendix C**, confirms the presence of a drainage ditch along the site's southern boundary. The ditch flows in an easterly direction before becoming culverted beneath Bloxham Road.

Onsite surface water strategy

7.8 Surface water runoff is to drain from the proposed impermeable areas onsite i.e. roofs and driveways, via a gravity conveyed surface water sewer network which will discharge flows into a wet pond.

7.9 The wet pond is to be located towards the south-eastern site corner, where ground levels are the lowest.

7.10 An indicative pond has been sized using the Micro Drainage Source Control module to a design standard of a 1 in 100-year+40% storm event. An impermeable area of 75% (inclusive of a +10% consideration for urban creep) of the developable area has been assumed, see calculations in **Appendix G**.

7.11 The calculations demonstrate a surface water storage volume of 1100m^3 is required to serve the development, this could be provided by a 1m deep pond (inclusive of a 0.3m freeboard) with a top of bank area of 1900m^2 and a base area of 1450m^2. Additional areas of embankment surrounding the perimeter of the pond will be required to meet existing ground levels.

7.12 The pond is to possess a permanently wet area within its structure; this will provide additional benefits to the development site beyond the remits of flood risk and drainage, such as habitat creation and pollution control.

7.13 It is recommended that each dwelling will have individual water butts to allow for a means of onsite rainwater harvesting. Since water butts are dependent upon the user emptying the device prior to a storm event, the attenuation provided by the water butts have not been included within the site surface water storage calculations.

7.14 As part of the development proposals the perimeter of the site is to be predominantly landscaped, It is advised that swales should be utilised within the landscaped areas where feasible, to provide an additional element of surface water treatment onsite and a further means of conveyance. Streets trees should also be incorporated into the development design where possible.

Drainage Layout

7.15 A drainage layout plan, drawing ADC3114-DR-050, has prepared by ADC Infrastructure, a copy of which can be found in **Appendix I**.

8.0 FOUL WATER DRAINAGE STRATEGY

Proposed discharge rate

8.1 Based upon the current development proposals, it is anticipated that there will up to 65 residential dwellings constructed on site.

8.2 In line with Section B3.1 of the guidance within the Design and Construction Guidance for foul and surface water sewers[16], the peak design foul flow rate is 4000 litres per dwelling per day. This is a design peak foul water flow rate and not a daily average water usage.

8.3 The peak foul flow rate has been calculated as follows:

65 x 4000 = 260,000 l/day
260,000/ (24 x 60 x 60) = 3.01l/s

Proposed discharge strategy

8.4 In accordance with the guidance specified within the Building Regulations Part H, foul water effluent should look to be discharged according to the following preferential hierarchy:

- a foul water sewer
- a combined sewer
- a septic tank
- a cesspool

8.5 Sewer asset plans, see **Appendix B**, demonstrates a gravity foul water sewer network to the north of the development site towards the junction of Waller Drive and Bloxham Road. The foul sewer network is shown to flow in a north-easterly direction towards central Banbury, serving a series of residential streets off Bloxham Road.

8.6 Planning application documents submitted for the phase 2 site (14/01188/OUT) (17-00448-DISC relating to foul water) (17-00505-DISC relating to surface water), which is sited directly to the north and east of the proposed site, demonstrates a segregated foul and surface water network. The phase 2 foul network drains via a pumped flow to the public sewers at the junction of Waller Drive and Bloxham Road, see **Appendix H**.

8.7 Correspondence with Thames Water, see **Appendix B**, states the following;

"we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent foul water sewer network to serve your development."

8.8 Given the above it is proposed the foul water effluent onsite shall drain from the proposed dwellings via a gravity conveyed sewer network to a pumping station, which is to be sited within the site's south-eastern corner where ground levels are the lowest.

8.9 Provision should be made within the development design to ensure that there is a means of access to the pumping station sufficient for a tanker.

[16] Sewer Sector Guidance (2020). Design and construction guidance for foul and surface water sewers. Section B3.1.

8.10 The pumping station will then convey flows via a rising main connection into the adjacent foul water sewer network. A connection into the existing foul network could be made by;

- Option A- A pumped discharge into the phase 2 network
- Option B- A pumped discharge into the existing public sewer network within Bloxham drive via MH4001

8.11 Option A would result in a shorter rising main length which would reduce the extent of work required within the highway on the adjacent development. However, the phase 2 foul network is believed to be undergoing the adoption process with Thames Water/ part of the network is still being built out, and therefore a connection into the network would not be feasible until the foul water sewer network has been adopted and made a public asset. Should the phase 2 foul sewerage network become fully adopted the capacity of the phase 2 foul drainage network would need to be assessed to determine whether the network could accept foul flows from the proposed site.

8.12 Option B would result in a longer rising main, this would present a greater length of main which would extend through the access road and through the adjacent phase 2 development to Bloxham Road. However, option B presents an alternative option for the discharge of foul flows into the public network.

8.13 Correspondence with Thames Water presented in **Appendix B** acknowledges both discharge options and confirms capacity within the public system within Bloxham Road.

8.14 A solution for foul drainage onsite has been presented, the final strategy including the point of connection of onsite foul flows into the public network should be confirmed as the planning proposals progress.

Drainage layout

8.15 A drainage strategy layout plan, drawing ADC3114-DR-050, has been developed by ADC Infrastructure to show the proposed foul drainage layout. The plan shows a foul water drainage network for the site and details of the proposed offsite connection. A copy of the drainage layout plan can be found in **Appendix I**.

9.0 SUSTAINABLE DRAINAGE ASSESSMENT

9.1 Sustainable Drainage Systems (SuDS) remove, store, re-use, and intercept surface water by mimicking the natural water cycle. In turn this not only alleviates flood risk but also promotes benefits for water quality, amenity, recreation, health, and the local ecology[17].

9.2 A variety of SuDS options are available to reduce or temporarily hold back the discharge of surface water runoff. The proposed development will see an increase in flows and therefore will require a drainage strategy which incorporates SuDS to ensure that flows are balanced, and that flood risk is not increased elsewhere.

9.3 The table below outlines the applicability of the use of a range of SuDS devices in relation to the proposals detailed in this report, this is in accordance with the hierarchical approach outlined in The SuDS Manual (CIRIA C753).

[17] CIRIA (2015). The SuDS Manual C753. Part B. Chapter 1.

SuDS type	Device	Description	Reason for use	Applicability ✗ / ✓)
Source control	Living roofs	Provide soft landscaping at roof level, intercepting and reducing surface water runoff.	The structural design of the proposed buildings are not conducive for the use of living roofs.	✗
	Infiltration devices	Store runoff and allow water to percolate into the ground via natural infiltration.	A desktop review of the underlying ground conditions demonstrate that the site is not suitable for the use of infiltration features. This is subject to further testing.	✗
	Pervious surfaces	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and/or slowly release to sewers.	Pervious paving could be incorporated into the proposed individual driveways. However, the amount of attenuation provided by this method would be minimal, and the inclusion of pervious paving onsite would be subject to the outcome of a phase 2 ground condition assessment.	✓
	Rainwater harvesting	Reduces the annual average rate of runoff from the site by reusing water for non-potable uses e.g., toilet flushing.	The capacity for the use of rainwater harvesting on site is limited. However individual water butts could be used onsite as a means of rainwater harvesting.	✓
	Street trees	Storm water is conveyed to trees located adjacent to the internal roads, the tree pits attenuate and treat runoff	The final site layout could incorporate street tress adjacent to the internal spine road.	✓

SuDS type	Device	Description	Reason for use	Applicability ✗ / ✓)
Permeable conveyance	Swales	Broad shallow channels that convey /store runoff and allow infiltration when ground conditions are permitting.	Due to the topography of the site combined with proposed areas of landscaping short swale lengths could be used to convey surface water runoff onsite.	✓
	Bioretention area/ Rain garden	Shallow landscaped depression which are under drained and rely on engineered soils and enhanced vegetation and filtration to remove pollution and reduce runoff downstream.	Spatial constraints onsite, and the lack of attenuation provided by this method mean that the inclusion of a rain garden onsite is not deemed to be feasible.	✗
	Filter strips	Wide gently sloping areas of grass or dense vegetation that remove pollutants from run-off from adjacent areas.	A desktop review of the underlying ground conditions and spatial layout of the proposed development demonstrates that the site is not suitable for the use of filter strips. This is subject to further testing.	✗

SuDS type	Device	Description	Reason for use	Applicability ✗ / ✓)
	Filter drains and perforated pipes	Trenches filled with granular materials (which are designed to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	A desktop review of the underlying ground conditions and spatial layout of the proposed development demonstrates that the site is not conducive for the use of filter drains and perforated pipes. This is subject to further testing.	✗
End of pipe treatment	Infiltration basins	Depressions in the surface designed to store runoff and allow infiltration.	A desktop review of the underlying ground conditions demonstrates that the site is not suitable for the use of infiltration basins. This is subject to further testing.	✗
	Wet ponds	Provide water quality treatment &temporary storage above the permanent water level.	The site layout and quantity of onsite surface water storage needed means that the use of wet ponds are conducive for use within the site's surface water drainage strategy.	✓

SuDS type	Device	Description	Reason for use	Applicability (× / ✓)
	Attenuation tanks	Oversized pipes or geo-cellular tanks designed to store water below ground level.	An attenuation tank could provide the surface water storage required onsite, however given the SuDS hierarchy alternative methods are preferred.	×

9.4 Given the table above the most applicable SuDS device for providing the required attenuation and surface water treatment onsite is a wet pond.

9.5 It is also advised in order to provide a treatment train onsite the following SuDS should also be incorporated within the drainage design; this is subject to detailed design;

- Individual water butts to allow a means of rainwater harvesting
- Swales in landscaped areas
- Street trees adjacent to the internal spine road

9.6 The site's proposed drainage combination has been selected due to spatial and topographical aspects of the site, its proposed layout, and the need to attenuate and convey onsite surface water runoff.

9.7 Any such development can give rise to pollution during both the construction and occupation phases in relation to hydrocarbons, suspended soils, and general waste. Careful consideration of the treatment of surface water runoff should provide confidence that the proposed development will not result in any detriment to the receiving waters.

9.8 The proposed impermeable areas on the site are currently divided into residential roofs, residential driveways, and low traffic roads. In accordance with the CIRIA SuDS Manual C753 (2015), the attributed pollution 'hazard' levels associated with these classifications of hardstanding are between very low and low risk.

Land Use	Pollution Hazard Level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Private driveways, residential car parks and low traffic roads.	Low	0.5	0.4	0.4

9.9 As the pollution hazard risk from the development is deemed to be very low-low, then the simple index approach (SIA) is applicable. SIA uses a source to receptor pathway approach which considers three pollutants: total suspended solids (TSS), heavy metals and hydrocarbons. For the selected SuDs components, total pollution indices based on the reduction in pollution, are assigned (see CIRIA SuDs Manual Table 26.3 extract).

9.10 The selected SuDS components and the associated total pollution mitigation indexes are outlined in the table below (CIRIA SuDS Manual Table 26.3 extract). The proposed SuDS treatment train has been designed to exceed the pollution values/risk occurring from proposed land uses highlighted in the table above.

Type of SuDS component	TSS	Metals	Hydrocarbons
Pond	0.7	0.7	0.5

9.11 Based upon the pollution mitigation indices highlighted in the table above, it is anticipated that the proposed pond will provide more than enough mitigation for the anticipated pollutants that will be generated by the development.

9.12 The incorporation of swales and street trees into the detailed design of the development will also provide an increased element of surface water treatment onsite.

Biodiversity

9.13 Ponds features can both provide habitats for a range of species, this can heavily assist in boosting the ecological value of a site and offer much more support for the ecosystem in comparison to alternative grey solutions.

9.14 The following extract regards the biodiversity and alternative benefits that can be reaped from ponds and has been obtained from the CIRIA SuDS Manual (C753);

"They can support emergent and submerged aquatic vegetation along their shoreline and in shallow, marshy zones, which helps enhance treatment processes and has amenity and biodiversity benefits. Dense stands of vegetation facilitate the adhesion of contaminant to vegetation, aerobic decomposition of pollutants and can also help stabilise settled sediment and prevent resuspension"

Alternative benefits

9.15 In addition to the water quality and biodiversity benefits mentioned above the proposed SuDS combination can offer a range of benefits, these include aesthetic enhancements.

9.16 The design of the SuDS incorporated within the drainage design will develop as the planning proposals progress, to boost the multifunctionality of the proposed components it is advised that the proposed SuDS are constructed in accordance with the CIRIA SuDS Manual (C753) and Oxfordshire County Council Guidance.

10.0 MAINTENANCE AND ADOPTION

10.1 The proposed drainage network will require consistent maintenance to ensure that the efficiency of the systems are sustained.

10.2 The proposed drainage network will be entirely contained within the site and will be constructed to adoptable standards. It is expected that the proposed onsite drainage network will be adopted by Thames Water, from the point of adoption the maintenance of the proposed network will be the responsibility of Thames Water.

10.3 Prior to adoption the pond and associated pipework will be maintained by the developer or their nominated Management Company.

10.4 The onsite drainage system including the pond and associated inlets/outlets, headwalls and pipework will be subject to routine monitoring and maintenance, a record of this should be upheld.

Maintenance schedules

10.5 The sections below express the minimum standards for the onsite maintenance regime and have been prepared from recommendations contained within the CIRIA SuDS Manual (C753).

10.6 It should be noted that any invasive maintenance work such as silt or vegetation removal is only required intermittently but it should be planned to be sympathetic to the requirements of the ecosystem. The window for carrying out maintenance to achieve this is usually towards the end of the growing season (September/October) although this varies with species[18].

Storage and attenuation

10.7 Surface water runoff from the site is to be attenuated by a pond. The proposed maintenance regime for the pond is expressed in the table below.

[18] CIRIA SuDS Manual (C753) (2015). Part D. Chapter 23. Pg 500.

Operation and maintenance requirements for detention basins/ponds		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin.	Half yearly (spring before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets, and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool –where provided	Annually (as set out in CIRIA SuDs guidance)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim ant trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial action	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of riprap	As required
	Repair/ rehabilitation of inlets, outlets, and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required
source: CIRIA SuDs Manual (C753) (2015) Part D. Chapter 22, pg. 483		

Conveyance, pipework, and flow control

10.8 Surface water runoff is to drain from impermeable surfaces onsite via a gravity conveyed surface water sewer.

10.9 A flow control device is to restrict flows to greenfield discharge rates via a new surface water outfall into the existing drainage ditch on the site's southern boundary.

10.10 The associated maintenance regime required to sustain the aforementioned drainage features are expressed within the table below.

Drainage Component	Maintenance Task	Frequency
Drainage Network	Inspect for blockages to ensure network is free running	Every 3 months and after any significant storm event
Surface water gullies/ Linear drainage features	Inspect for blockages and ensure that the drainage feature is free running Jet or vacuum as appropriate	Every 3 months and after any significant storm event
Catchpits	Inspect for and remove silt	Every 6 months and after any significant storm event
Discharge Control	Inspect for blockage and correct operation	Every 3 months and after any significant storm event

Connections

10.11 Surface water is to discharge into an existing drainage ditch via an outfall pipe. The proposed maintenance regime for these components are expressed in the table below.

Drainage Component	Maintenance Task	Frequency
Outfall pipe	Regular maintenance and monitoring to ensure sufficient operation.	Annually or as required
Drainage ditch	Monitoring of watercourse levels	Frequently post development then as required/after any storm event

Design life

10.12 The design life of the development may exceed the design life of certain components of the surface water network, this however is based upon numerous unpredictable variables.

10.13 During the maintenance regime it should be assessed whether any repairs are required and whether drainage components have reached the end of their functional lifetime. The proposed drainage network is to be built to adoptable standards and it is anticipated that the network will

be adopted by Thames Water, thus the responsibility to replace/repair any unfunctional components of the drainage network will lie with Thames Water. Should any components fail prior to adoption the responsibility would lie with the developer or their nominated Management Company.

11.0 CONCLUSIONS AND RECOMMENDATIONS

11.1 This Flood Risk Assessment and Drainage Strategy has been carried out on behalf of Barwood Development Securities Ltd and regards the construction of up to 65 dwellings on land west of Bloxham Road, Banbury. The assessment has been conducted in accordance with the requirements of the NPPF and the associated Planning Practice guidance.

11.2 The site has been found to not be at any direct flood risk from flooding associated with fluvial, pluvial, sewer, tidal, canal or groundwater sources. The development site is entirely within Flood Zone 1 and the EA mapping highlights the site to possess a very low risk of pluvial flooding.

11.3 The surface water drainage strategy has been considered and a calculation of the anticipated discharge rates and attenuation volumes has been carried out. The proposed development shall look to discharge surface water runoff into the existing drainage ditch which flows in an easterly direction along the site's southern boundary.

11.4 Attenuation is proposed via the use of a pond that will be sited towards the site's south-eastern corner to suit the onsite topography, development proposals and other onsite constraints. The basin has been designed to attenuate surface water runoff for all storm events up to and including the 1 in 100 year plus 40% climate change storm event, in line with local planning guidance. The provisional design for the basin is a feature that is 1m deep (including a 300mm freeboard), with a surface water storage volume of 1100m^3, and a discharge rate restricted to 6.5l/s.

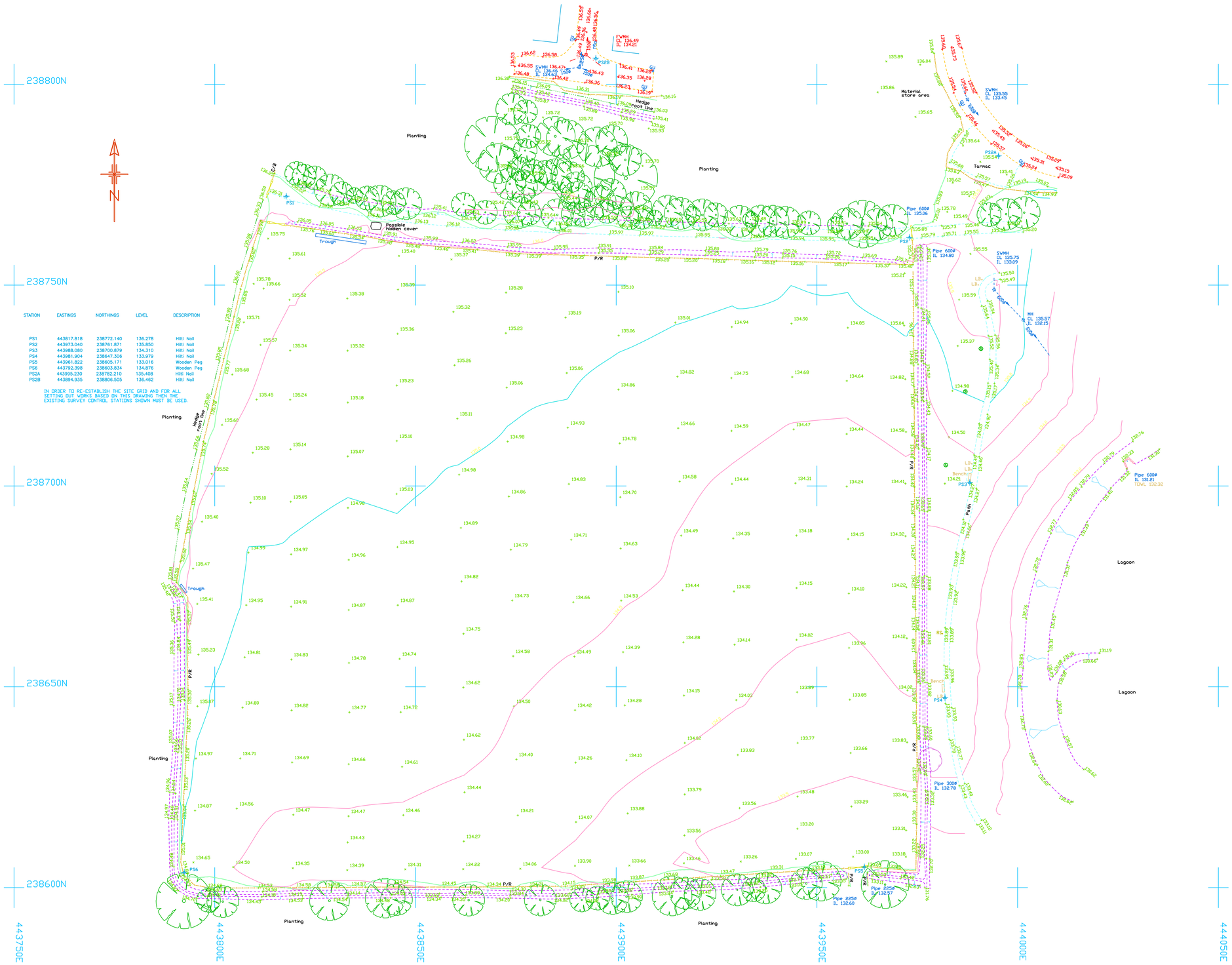
11.5 Foul effluent shall look to be conveyed via a gravity sewer network that will discharge into a pumping station, which is to be sited towards the site's south-eastern corner, where ground levels are lowest. The pumping station is to convey flows via a rising main connection into the adjacent foul water sewerage network. The point of connection is to be confirmed as the development proposals progress. However, Thames Water have confirmed that there is capacity in the existing off-site network to receive foul flows form the development.

11.6 The proposed onsite foul and surface water drainage networks shall be put forward for adoption by Thames Water under a Section 104 agreement to maintain on an ongoing basis.

11.7 Provided that the recommendations of this report are followed, then the development can proceed without being at any significant flood risk and without increasing flood risk elsewhere. The development proposals are considered sustainable from a flood risk and drainage perspective.

APPENDIX A

TOPOGRAPHICAL SURVEY



STATION	EASTINGS	NORTHINGS	LEVEL	DESCRIPTION
PS1	443817.818	238772.140	136.278	Hilti Nail
PS2	443973.040	238761.871	135.850	Hilti Nail
PS3	443988.080	238700.879	134.310	Hilti Nail
PS4	443981.904	238647.306	133.979	Hilti Nail
PS5	443961.822	238605.171	133.016	Wooden Peg
PS6	443792.398	238603.834	134.876	Wooden Peg
PS2A	443995.230	238782.210	135.408	Hilti Nail
PS2B	443894.935	238806.505	136.462	Hilti Nail

IN ORDER TO RE-ESTABLISH THE SITE GRID AND FOR ALL SETTING OUT WORKS BASED ON THIS DRAWING THEN THE EXISTING SURVEY CONTROL STATIONS SHOWN MUST BE USED.

SURVEY NOTES

1. THE SURVEY GRID (OSGB36) WAS ESTABLISHED WITH GPS AND THEN A ONE POINT SITE CENTRED TRANSFORMATION CARRIED OUT TO ELIMINATE SCALE FACTOR. IN ORDER TO RE-ESTABLISH THE SITE GRID THEN THE EXISTING SURVEY CONTROL STATIONS SHOWN MUST BE USED
2. SURVEY LEVELS ESTABLISHED BY GPS TO OS DATUM

SURVEY KEY

- House — Building
- Wall — Wall
- R/Wall — Retaining Wall
- P/W — Fence (with description)
- Survey Control Station
- Hedge
- Kerbline
- Verge/Edge of Track etc
- Overhead Line
- Footpath
- Sewer Line
- Water/Ditch etc
- Gate
- Stile

Chestnut Paling	C/P
Close Boarded	C/B
Corrugated Iron	C/I
Chain Link	C/L
Crash Barrier	CB\
Concrete Panel	Con/P
Hit and Miss	H/M
Interwoven	Iwn
Paling	Pal
Post & Wire	P/W
Post & Rail	P/R
Post & Chain	P/C
Overlap	O/L
Iron Railings	I/R
Post & Barbed Wire	P/Bw
Electric	Elc
Hoarding	Hrd
Post & Wire Mesh	P/M
Picket (Wooden)	P/K
Trip Rail	T/R
Trellis Fence	T/F
Palisade Fence	P/F
Floor Level	FL
Eaves Level	EL
Ridge Level	RL
Tarmac Surface	Tarmac
Grass/Lawn	Grass
Paving Slabs	Paving

Individual Tree

Unable To Raise	UTR
Fire Escape	F/Esc
Drop Kerb	DK
Stone Surface	Stone
Gravel Surface	Gravel
Concrete Surface	Conc
Rough Ground	R/Grnd
Granite Setts/Cobbles	Cobbles
Tactile Paving	T/Pav

STREET FURNITURE

Belisha Beacon	BB	Marker Post	Mkr
Borehole	BH	Mile Post	MP
Bollard	BL	Pillar Box	PB
Bus Stop	BS	Pipe	PI
Drain	Dr	Parking Meter	PM
Electric Pole	EP	Post	PO
Flood Light	FL	Reading Eye	RE
Flagstaff	FS	Reflector Post	RP
Gate Post	GP	Road Sign	RS
Gully	GU	Stop Cock	SC
Gas Valve	GV	Stop Tap	ST
Inspection Cover	IC	Sign	SI
Litter Bin	LB	Stump	SU
Lamp Post	LP	Stop Valve	SV
Traffic Light	TL	Telegraph Pole	TP
Manhole	MH	Vent Pipe	VP
Name Plate	NP	Telecommunication	TC
Fire Hydrant	FH	Water Tap	WT
Wash Out	WO	Kerb Outlet	KO
Water Meter	WM	Air Valve	AV
Cable Television	TV	Tel Call Box	TCB
Earth Rod	ER	Trial Pit	T/P
Speed Camera	SPD	Closed Circuit TV	CT
Cellar Light	Ce/L	Multi Utility Pole (EP,LP,&TP)	MUP

TECHNICAL NOTES

- INFORMATION SHOWN ON THIS DRAWING IS SURVEYED TO THE ACCURACY OF THE BASE SCALE SHOWN IN THE LEGEND.
- MAN ENTRY TO SEWERS HAS NOT BEEN UNDERTAKEN. DEPTHS, PIPE SIZES ARE MEASURED/ESTIMATED FROM THE GROUND. ALL SEWER DETAILS TO BE CHECKED WITH LOCAL AUTHORITY RECORDS OR ON SITE PRIOR TO COMMENCEMENT OF WORKS.
- BOUNDARIES SHOWN ARE PHYSICAL FEATURES AND MAY NOT REPRESENT LEGALLY CONVEYED OWNERSHIP
- ALL TREE HEIGHTS AND SPREADS ARE APPROXIMATE. TREE TYPES WHICH HAVE BEEN IDENTIFIED SHOULD BE CHECKED BY A TREE SPECIALIST.
- WHERE ADJACENT BUILDINGS HAVE BEEN SURVEYED REMOTELY NOT ALL EXTERNAL WALLS MAYBE SHOWN DUE TO OBSTRUCTIONS ALONG LINE OF SIGHT

REV	DATE	DESCRIPTION	BY	APP.

Phoenix Survey Services Ltd.
49 William Road, Long Buckby, Northampton NN6 7YS
Tel 07876 658389 or 07810 752133
Email info@phoenixsurveyservices.co.uk

Client: Barwood

Project Title: Bloxham Road Banbury

Drawing Title: Topographical Survey Sheet 1 of 1

Drawn	Checked	Approved
ALB	GRA	GRA
Date	**Scale**	**Sheet Size**
25/10/2022	1/500	A1

Drg. No. S5027/01

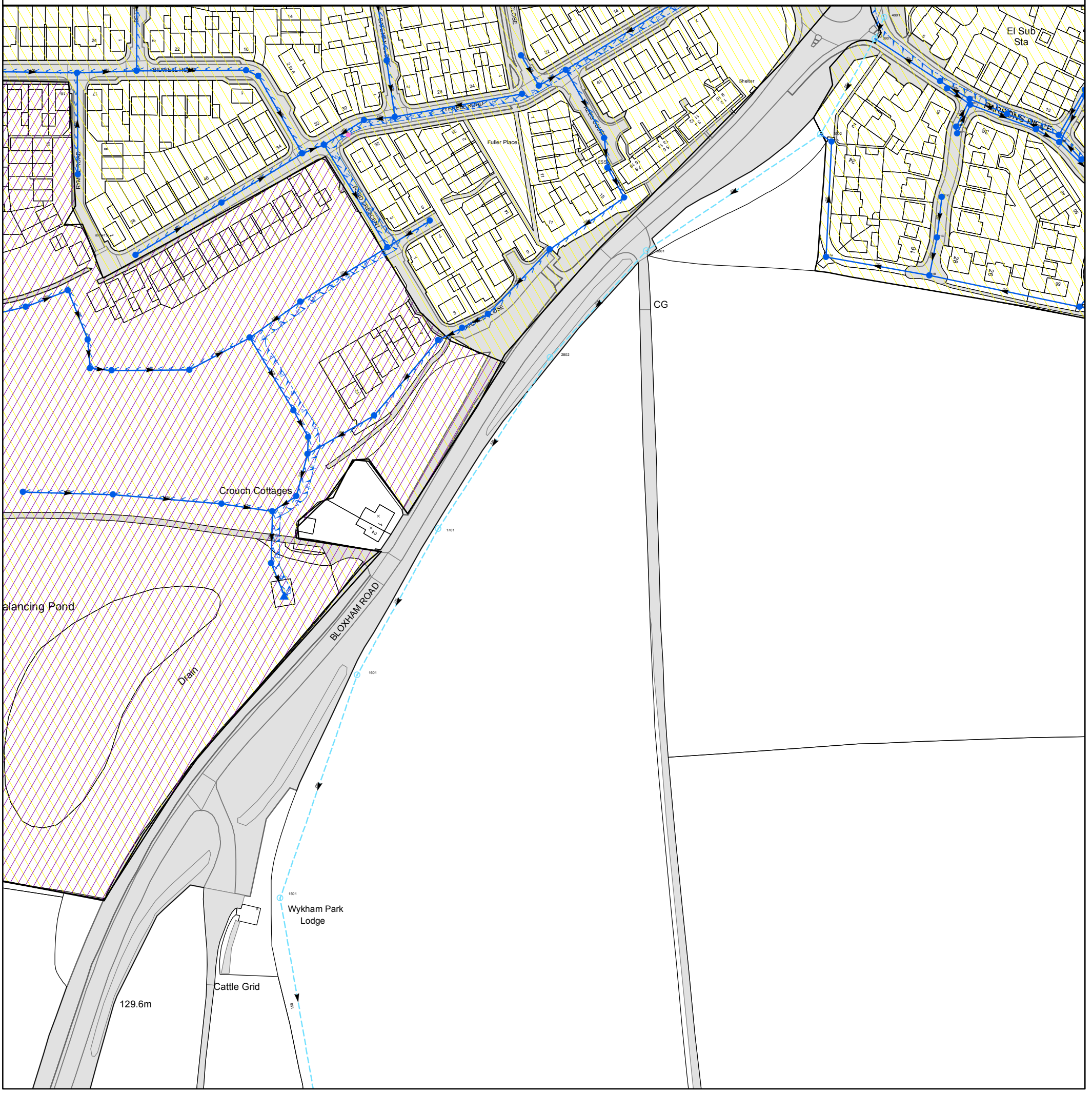
Rev

APPENDIX B

SEWER ASSET PLANS AND THAMES WATER CORRESPONDENCE

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

ALS/ALS Standard/2022_4756079



0 10 20 40 60 80 Meters

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

Scale:	1:1791
Width:	500m
Printed By:	Skrishna1
Print Date:	25/11/2022
Map Centre:	444250,238750
Grid Reference:	SP4438NW

Comments:

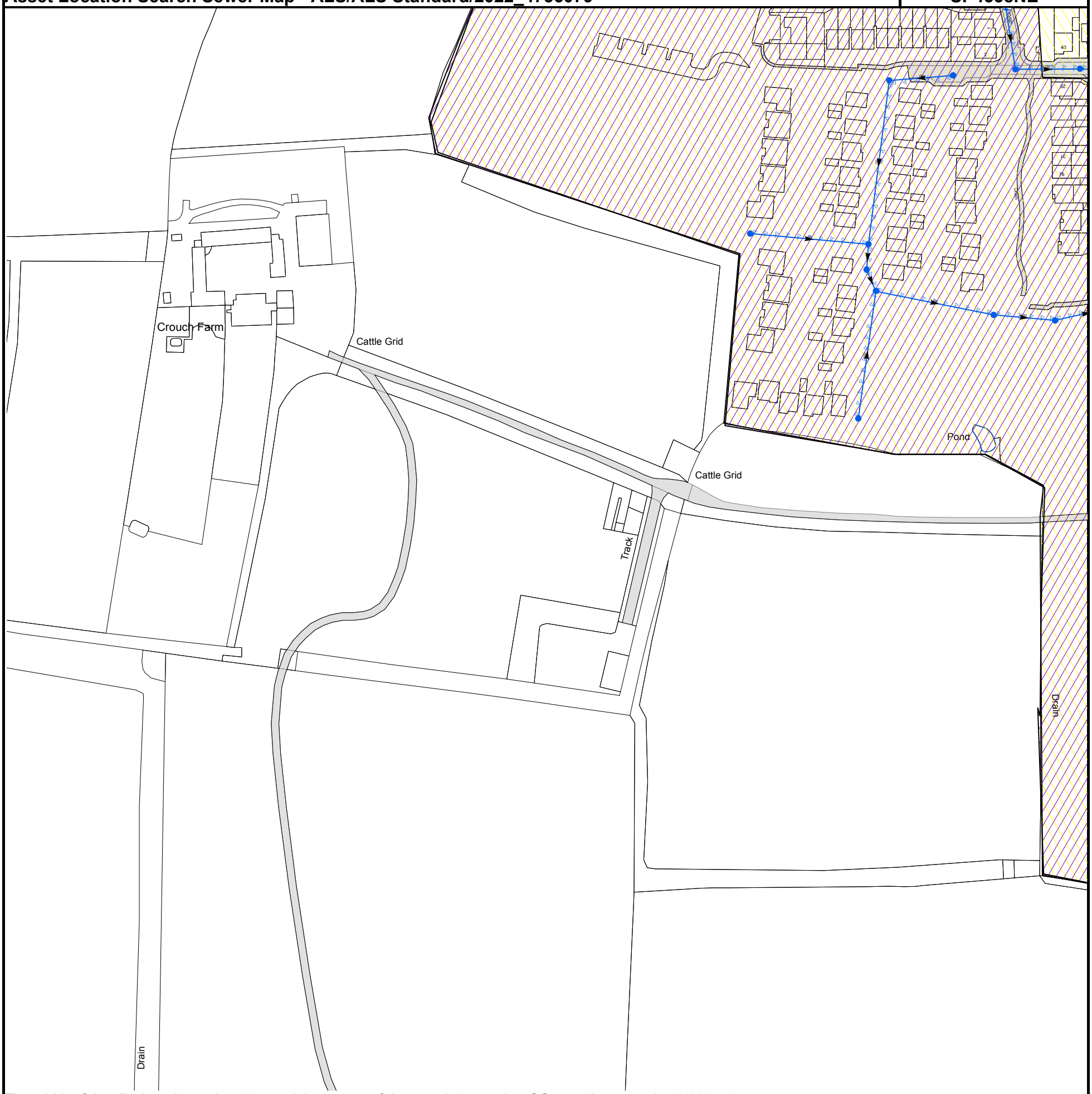
ALS/ALS Standard/2022_4756079

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

REFERENCE	COVER LEVEL	INVERT LEVEL
3901	133.07	129.98
1601	129.791	126.431
2801	132.48	129.62
2802	131.7	129.2
481A	131.81	129.8
491D	132.96	130.55
481C	132.18	130.26
491J	132.73	130.05
381A	132.46	129.62
491I	132.16	130.35
491L	132.62	130.11
491E	132.51	130.71
491K	132	130.45

REFERENCE	COVER LEVEL	INVERT LEVEL
4901		
1701	130.55	128.72
3902	132.77	129.55
1501	124.84	122.97
591O	132	130.38
491G	132.39	130.24
491A	132.25	129.37
491F	132.7	129.77
491B	132.18	129.25
491C	132.53	129.57
481B	132.5	129.72
391A	132.81	129.58
491H	132.41	129.66

Asset Location Search Sewer Map - ALS/ALS Standard/2022_4756079 | **SP4338NE**



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 443750,238750

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.

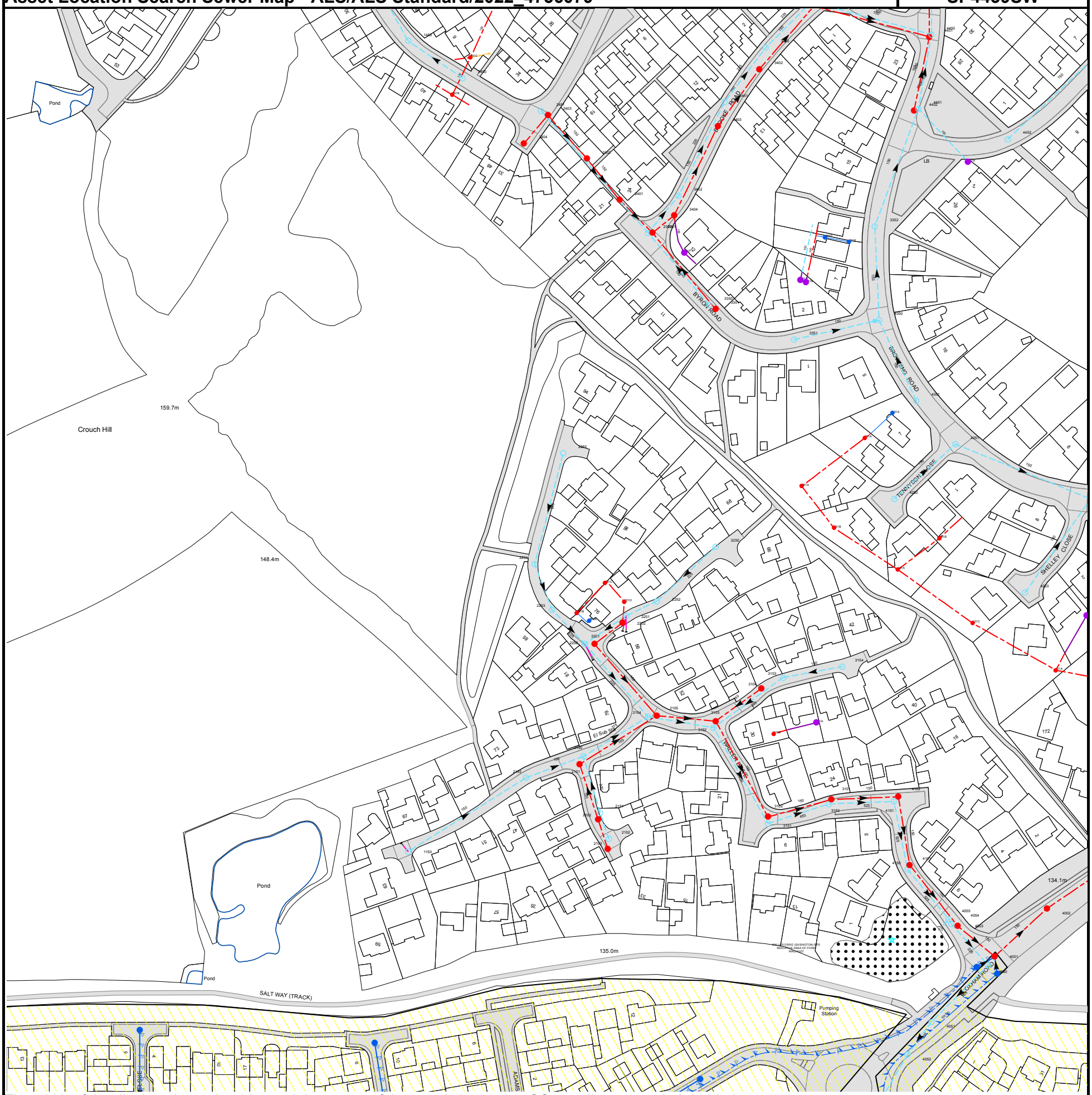
NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

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
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
n/a	n/a	n/a

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

Asset Location Search Sewer Map - ALS/ALS Standard/2022_4756079

SP4439SW



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 444250,239250

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
401A	n/a	n/a
4050	133.86	130.94
4001	133.9	131.19
4002	134.18	130.92
411A	n/a	n/a
441A	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
4003	133.83	131.31
n/a	n/a	n/a
1450	139.9	138.08
2403	137.14	136.09
2451	137.2	135.83
241B	n/a	n/a
2450	138.67	n/a
241C	n/a	n/a
331D	n/a	n/a
2350	136.45	134.81
2301	136.42	135.17
3352	136.27	133.35
3404	135.97	134.63
3452	135.72	134.24
4452	135.26	133.36
3403	134.58	133.09
4402	134.15	130.9
4451	134.14	130.55
3451	134	132.55
3402	133.3	131.89
3450	133.1	131.47
4401	133.04	128.85
4450	133.05	128.43
3401	132.55	130.16
421C	n/a	n/a
421G	n/a	n/a
2252	137.23	135.33
4253	137.38	136.25
421A	n/a	n/a
3250	136.93	135.6
421B	n/a	n/a
321B	n/a	n/a
4250	137.98	135.57
4252	137.8	136.62
321A	n/a	n/a
4251	138.31	136.42
331A	n/a	n/a
431A	n/a	n/a
4351	138.03	135.95
3351	137.14	136.17
4350	137.3	134.53
3301	136.79	135.61
3350	136.78	135.23
331B	n/a	n/a
331C	n/a	n/a
331F	n/a	n/a
331E	n/a	n/a
2150	136.75	133.53
2201	137.57	134.69
2250	137.63	135.01
2202	137.35	134.77
221A	n/a	n/a
2251	137.37	135.2
221B	n/a	n/a
2253	138.41	136.8
221D	n/a	n/a
221C	n/a	n/a
2254	139.01	137.02
2255	138.8	137.45
2401	136.55	135.45
2402	136.52	135.68
2404	137.84	136.43
1150	138.05	136.67
2103	135.55	133.7
2152	135.65	133.95
2102	135.97	133.46
2151	136.01	133.81
2153	137.15	135.7
2101	136.7	133.25
2154	n/a	n/a
2105	n/a	n/a
3152	135.44	133.08
3103	135.49	132.74
3104	135.74	133.47
3151	134.75	132.85
3102	134.76	132.38
311B	n/a	n/a
3153	135.75	133.95
311A	n/a	n/a
3150	134.57	132.64
3101	134.57	132.18

Manhole Reference	Manhole Cover Level	Manhole Invert Level
3154	135.88	134.56
4151	134.53	132.46
4102	134.54	131.89
4150	134.18	132.16
4052	133.55	130.68
4101	134.15	131.61
4051	133.69	130.74
4055	133.84	131.32
4054	133.83	131.31

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.

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

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

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

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

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

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
- Meter
- Dam Chase
- Vent
- Fitting

Operational Controls

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

- Ancillary
- Drop Pipe
- Control Valve
- 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.

- Inlet
- Outfall
- Undefined End

Other Symbols

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

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

Ducts or Crossings

- Casement
- Conduit Bridge
- Subway
- Tunnel

Ducts may contain high voltage cables. Please check with Thames Water.

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plan are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the 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 indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. 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, please contact Property Searches on 0800 009 4540.

Alice Kirsz,

ADC Infrastructure
4th Floor City Building
34-36 Carrington Street Nottingham
G17FG

Wastewater pre-planning
Our ref DS6100094

11 November 2022

Pre-planning enquiry: Confirmation of sufficient capacity (For Foul Only)

Dear Alice,

Thank you for providing information on your development on Crouch Farm, Easington, Banbury, OX16 9ZD for the proposed developments of 60 general Housing units to be build.

Proposed Foul water to be discharged into Foul water manhole SP44394001 or Foul water manhole F6 on the North of the site via pump at a flow rate of 3.8 l/s

Proposed Surface water is to be discharged to ditch on site.

We have completed the assessment of the foul water flows based on the information submitted in your application with the purpose of assessing sewerage capacity within the existing Thames Water sewer network.

Foul Water

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent foul water sewer network to serve your development.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.

Surface Water

In accordance with the Building Act 2000 Clause H3.3, positive connection of surface water to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable. Before we can consider your surface water needs, you'll need written approval from the lead local flood authority that you have followed the sequential approach to the disposal of surface water and considered all practical means.

The disposal hierarchy being:

1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
2) rainwater infiltration to ground at or close to source
3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
4) rainwater discharge direct to a watercourse (unless not appropriate)
5) controlled rainwater discharge to a surface water sewer or drain
6) controlled rainwater discharge to a combined sewer.

Where connection to the public sewerage network is required to manage surface water flows we will accept these flows at a discharge rate in line with CIRIA's best practice guide on SuDS or that stated within the sites planning approval.

Please see the attached 'Planning your wastewater' leaflet for additional information.

What happens next?
Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

If you've any further questions, please contact me on 0747642636.

Yours sincerely

Nathanael Bryant Sanjaya.
Adoption Engineer
Developer Services

APPENDIX C

SITE WALKOVER PHOTOS

Figure 1: Ditch adjacent to site’s eastern boundary

Figure 2: Eastern ditch culverted beneath field access

Figure 3: View across the site looking south

Figure 4: View across the site looking south-east

Figure 5: Ditch along site's southern boundary

Figure 6: Southern ditch culverted beneath field entrance

Figure 7: Ditch on site's southern boundary, looking upstream

Figure 8: Ditch downstream of the site prior to being culverted beneath Bloxham Road, and phase 2 outfall headwall