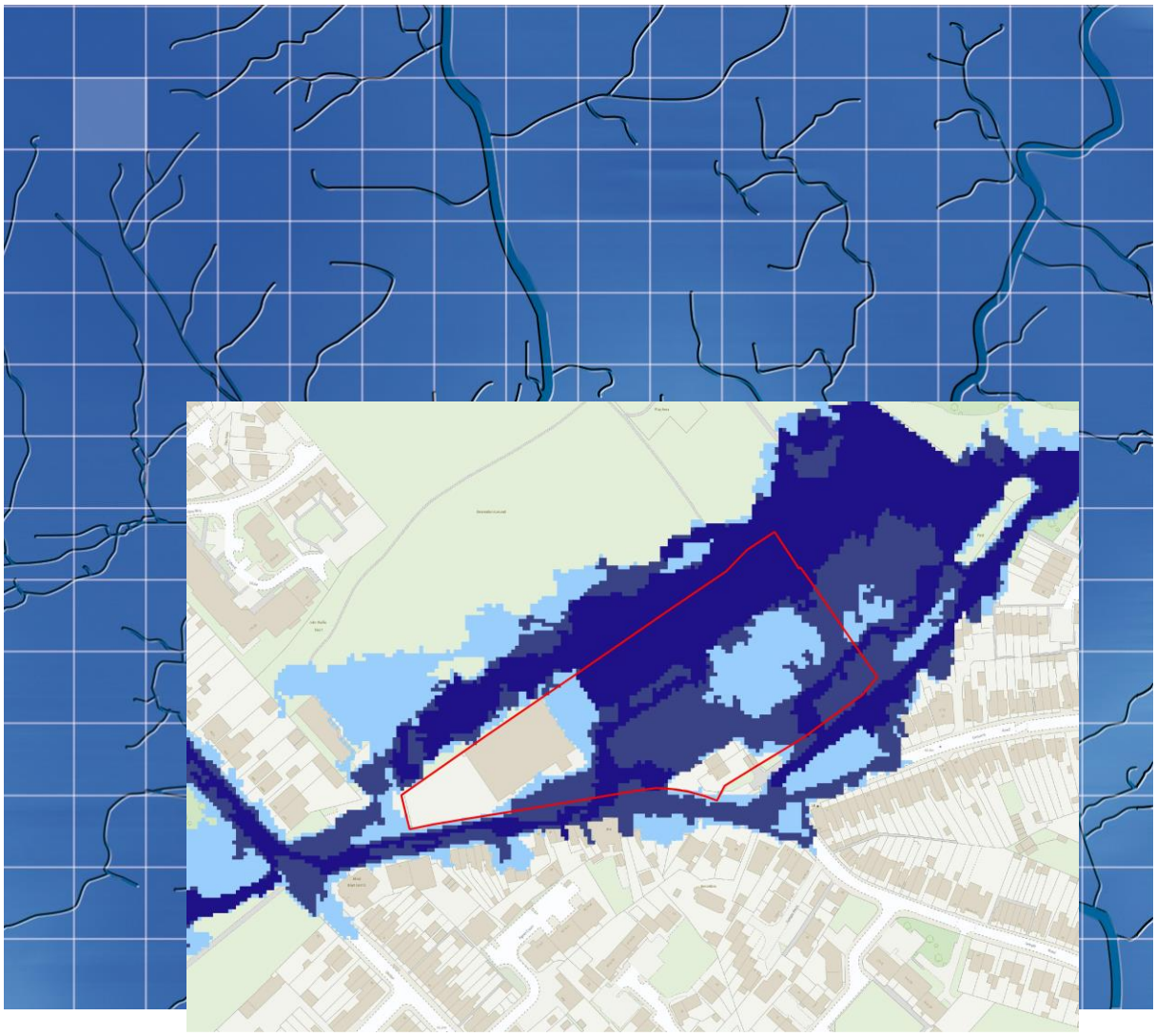
Oxford City Council

October 2025

Cowley Marsh Depot (16)
Level 2 Strategic Flood Risk Assessment



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Cowley Marsh Depot (16) Level 2 Strategic Flood Risk Assessment

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WHS10237

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1.0	09/10/2025	Draft	Lloyd Prytherch (*Graduate Consultant*) & Jasmine Lucas (*Consultant*)	Daniel Hamilton (*Principal Consultant*)

For and on behalf of Wallingford HydroSolutions Ltd.

The WHS Quality & Environmental Management system is certified as meeting the requirements of ISO 9001:2015 and ISO 14001:2015 providing environmental consultancy (including monitoring and surveying), the development of hydrological software and associated training.

Registered Office Maclean Building, Benson Lane, Wallingford OX10 8BB
www.hydrosolutions.co.uk

Cowley Marsh Depot (16) Level 2 SFRA
Flood Risk Overview

Fluvial Flood Risk	**H**
Pluvial Flood Risk	**M**
Other Sources of Flood Risk	**L**
Confidence in Assessment	**M**

Flood Risk

The site is predominantly at risk from fluvial sources.

The EA Flood Map for Planning shows 78.4% of the site is located within Flood Zone 2 and 60.0% of the site is located in Flood Zone 3a. An estimated design flood level (1.0% AEP + Climate Change Event) of 63.3 m AOD has been inferred from the 1.0% AEP + Climate Change EA Flood Map.

In terms of pluvial flood risk, for the design event (1.0% AEP + Climate Change Event) the Risk of Flooding from Surface Water (RoFSW) depth data shows a surface water flow route through the centre of the site flowing from the northeast towards Marsh Road. Maximum flood depths are 0.3 m.

The risk from other sources of flooding is considered to be low.

The overall confidence in the assessment is moderate. This is based on the fact that the EA's latest national scale modelling has informed the assessment of flood risk.

Conclusions and Recommendations

The development proposed is categorised as More Vulnerable Development. A sequential approach to the siting of the development should be used, with development prioritised first within Flood Zone 1 prior to consideration of any siting within Flood Zone 2 or 3a. More vulnerable development is permissible within Flood Zone 2 but must pass an exception test to be considered permissible within Flood Zone 3a. It is not permissible within Flood Zone 3b. The locations of surface water flood extents should also be used to inform the sequential siting of infrastructure prioritising development in the lowest areas of flood risk.

Given that Flood Zone 3b inundates approximately 30% of the site and is expected to inundate 58% of the site when considering climate change, development at the site may face significant barriers. However, there may be opportunities for the development to reduce flood risk by maintaining the culvert downstream of the site and ensuring that the existing development footprint in flood risk areas is either maintained or reduced.

Contents

1 Introduction

1.1 Background

Wallingford HydroSolutions Ltd has been commissioned by Oxford City Council (OCC) to undertake a Level 2 Strategic Flood Risk Assessment (SFRA) at Cowley Marsh Depot (reference: 16) in accordance with the National Planning Policy Framework (NPPF), Planning Practice Guidance (PPG) and associated guidance from the Environment Agency (EA).

Where there is a risk of flooding at the site, this risk has been quantified with the latest available datasets and any associated limitations with the assessment have been identified.

Where applicable, recommendations for improving our understanding of flood risk and/or mitigating the risk has also been included in this report.

1.2 Assessment of Flood Risk

For the site, a detailed assessment of the nature of flood hazard was undertaken. This included using the relevant fluvial modelling data to assess:

- The proportion of the site inundated for a range of return periods
- The speed of onset
- Flood depth
- Flood velocity
- Flood Hazard

The sites were assessed against a range of return periods, however the design event, the 100-year (plus central climate change) event, was considered most important for planning purposes.

In addition to the analysis of modelling data, the location, standard and condition of existing flood defences was assessed. Other sources of flooding were also reviewed at each site. This included an assessment of surface water flooding and an assessment of groundwater flooding based on available hydrogeological information from BGS and Soilscapes. Potential access/egress routes were identified with respect to the risk posed from all sources of flooding.

Following a review of flood risk, flood defences and the identification of access/egress routes, an assessment was made on whether a future site-specific FRA would be able to show that the site can be allocated for development. The assessment takes into account the flood risk vulnerability of the development, the scale of development proposed along with any requirements for the Exception Test. In this context, any mitigative actions in the form of ground raising and compensatory storage are identified.

The site assessments also include guidance for the preparation of FRAs, including information about the use of SuDS.

1.3 Report Structure

This FRA follows the structure summarised below:

1 - Introduction (this section)

2 - Site Description

3 - Flood Risk

4 – Detailed Review of Primary Flood Risk

5 – Development Viability and FRA Recommendations

2 Site Description

2.1 General Location Plan

Cowley Marsh Depot (16) is a 1.7 ha brownfield site located in the southeast of Oxford, see Figure 1. Current land use at the site is commercial, as the Oxford Direct Services group depot.

Proposed development at the site consists of redevelopment for 83 residential dwellings.

2.2 Topography

Based on 1 m LiDAR data, the site has a gentle south-westerly slope, see Figure 2. The ground levels within the site boundary range from 61.1 to 63.8 m AOD. The average ground level is approximately 62.3 m AOD.

2.3 Nearby Watercourses

Boundary Brook, a small tributary of the River Thames, flows east to west along the site's southeastern boundary for approximately 90 m, see Figure 1. The brook then enters a culvert at NGR: 454197, 204728, briefly flowing beneath the site before following the course of Marsh Road away from the site. The brook subsequently exits the culvert approximately 70 m to the southwest from the site near Cowley Road. Boundary Brook flows into the River Thames 1.6 km downstream of the site.

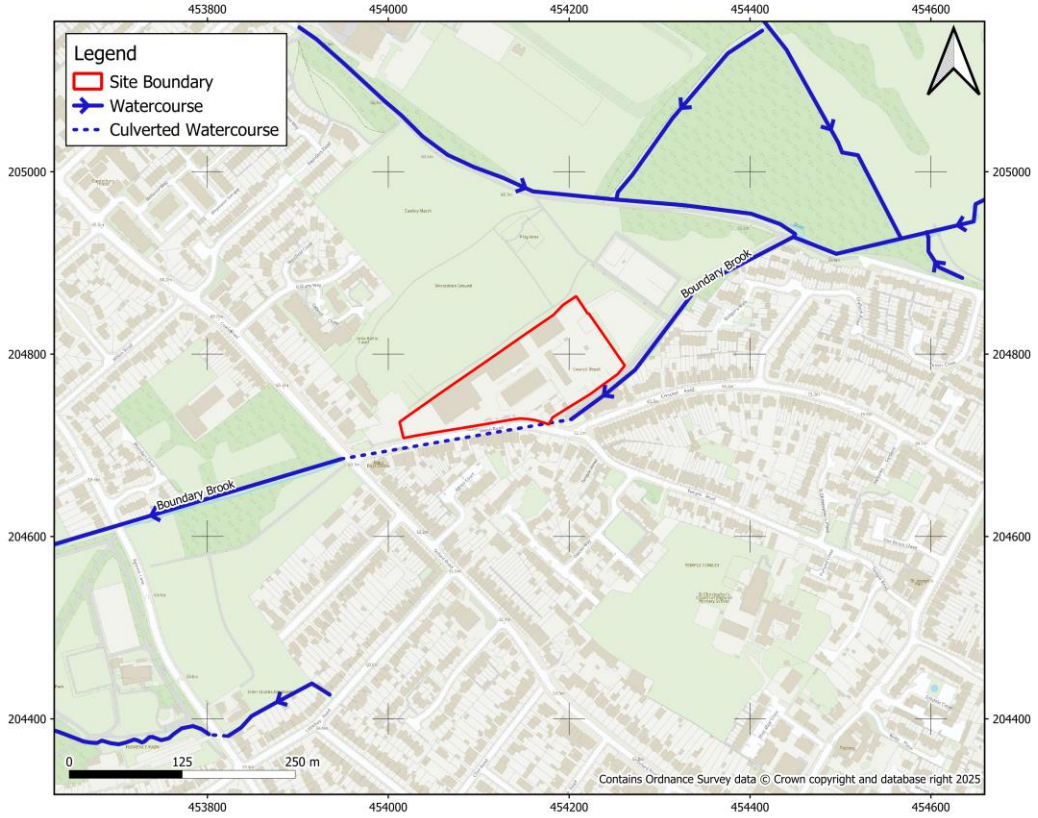

Figure 1 - Site Location

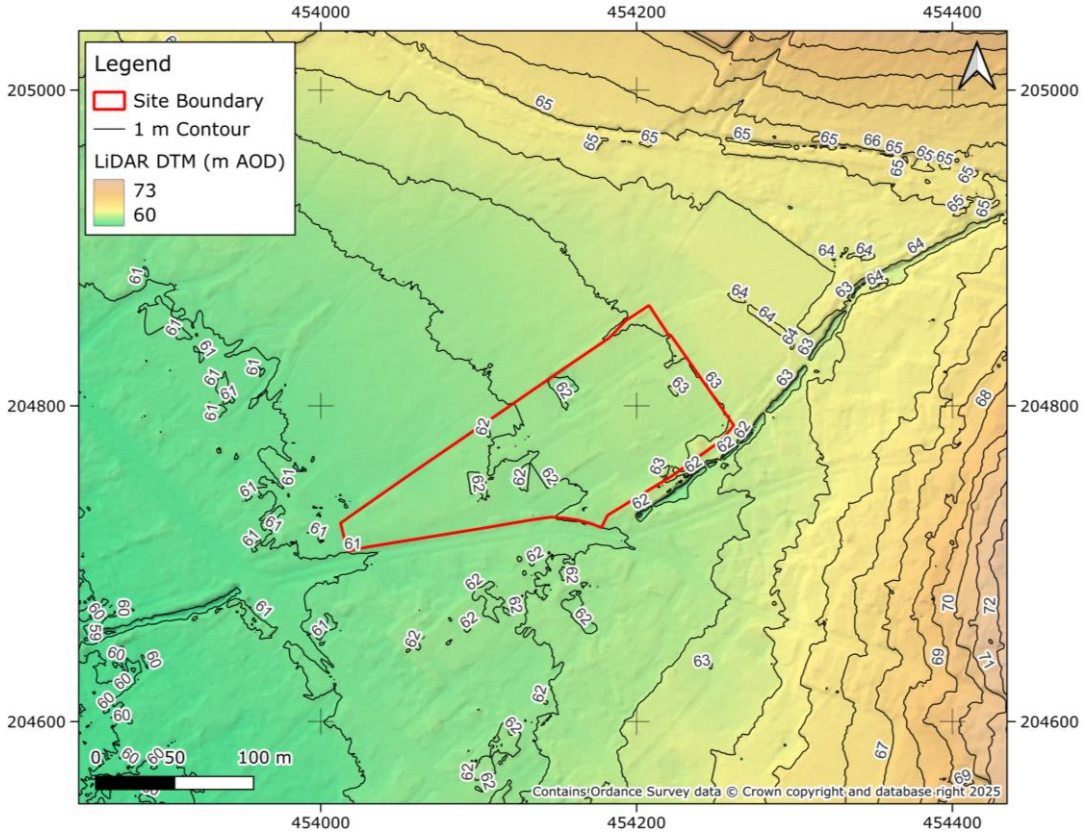

Figure 2 - Topography

3 Flood Risk

3.1 Historical Flooding

The EA has no records of historical flooding at the site. The nearest recorded flood extents are 800 m downstream along Boundary Brook, approximately 4 m AOD below the lowest ground level within the site. This event was associated with the 2013/14 winter flood of the River Thames and wider catchment area.

3.2 Fluvial Flood Risk

In the existing Flood Map for Planning (FMfP), 78.4% of the site is located within Flood Zone 2 (0.1% AEP), and 60.0% is located within Flood Zone 3a (1% AEP), see Figure 3. These Flood Zones consider the undefended scenario whereas Flood Zone 3b (3.3% AEP) considers the defended scenario. This extent shows 30.3% of the site is located within Flood Zone 3b.

The EA climate change fluvial outputs for the 0.1% and 1.0% AEP undefended events, and the 3.3% AEP defended event have also been assessed. The 0.1% AEP extent inundates 94.0% of the site, the 1.0% AEP extent inundates 74.2% of the site, and the 3.3% AEP extent inundates 58.0% of the site, see Figure 4.

Fluvial flood risk is considered to be high and is assessed in more detail in section 4.

3.3 Flood Defence Infrastructure

Along the Boundary Brook, there are no engineered flood defences that provide flood protection to the site. Therefore, no part of the site is an area associated with a reduction in risk of flooding from rivers nor is the site located within a flood storage area. More formal, maintained, engineered high ground embankments are present along the Boundary Brook, approximately 700m downstream.

3.4 Surface Water Flood Risk

The EA's surface water flood maps show 4.3% of the site to be inundated during a 3.3% AEP event, 8.6% is inundated during a 1.0% AEP event, and 22.4% is inundated during a 0.1% AEP event, see Figure 5. The areas at risk are generally associated with a surface water flow pathway along Marsh Road during each event, as well as several areas of pooling within the site.

When considering the effects of climate change, the proportion of the site at risk for each event increases to 5.8%, 11.6%, and 39.4% respectively, see Figure 6.

Overall, the surface water flood risk to the site is moderate and is assessed in more detail in Section 4.

3.5 Groundwater Flooding

The site is underlain by a bedrock of mudstone in the form of the West Walton formation. It is expected to permit low amounts of infiltration. Superficial deposits of alluvium are also present at this site; these are expected to have moderate permeability. The soils underlying the site are slowly permeable loamy and clayey soils.

Based on the data available there is unlikely to be a significant risk of groundwater flooding given that permeability is generally low to moderate, however more data is required at the planning stage to confirm this.

3.6 Reservoir Flood Risk

The FMfP shows no part of the site is at risk from reservoir flooding during either the wet and dry day scenarios, see Figure 7.

3.7 Flood Warning Service

The site is not located within or near to any EA Flood Warning Area.

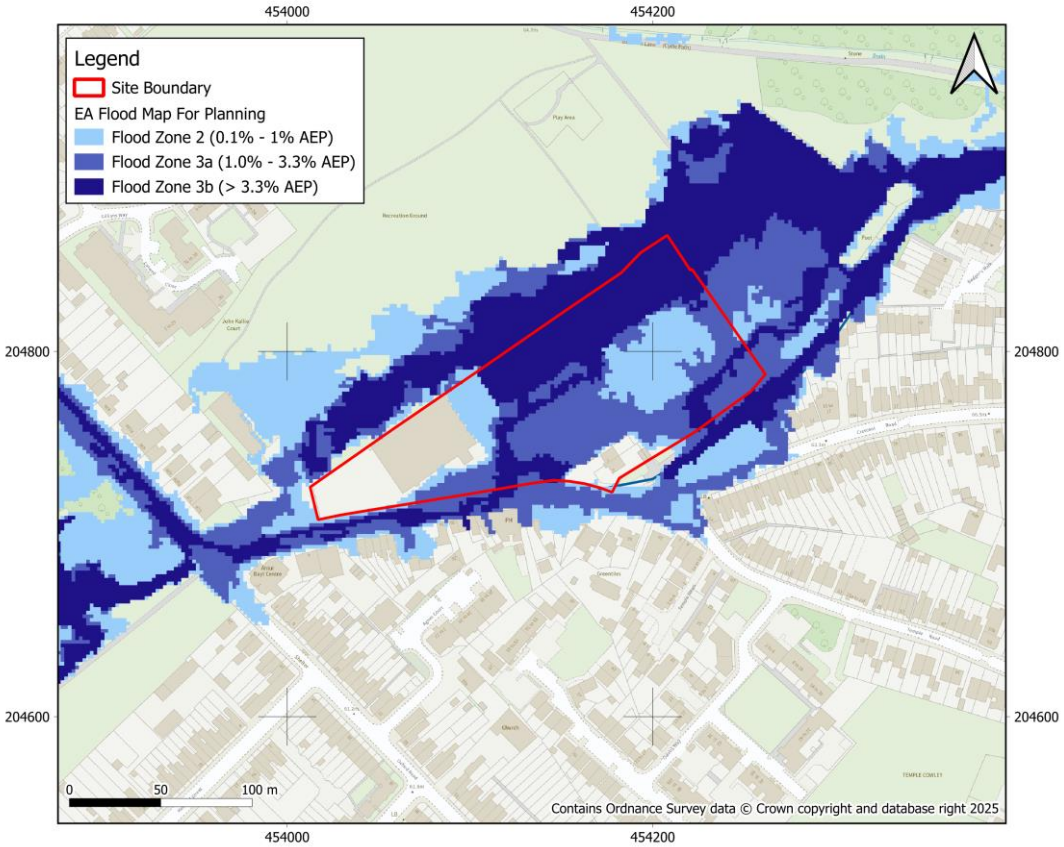

Figure 3 - Fluvial Flood Map

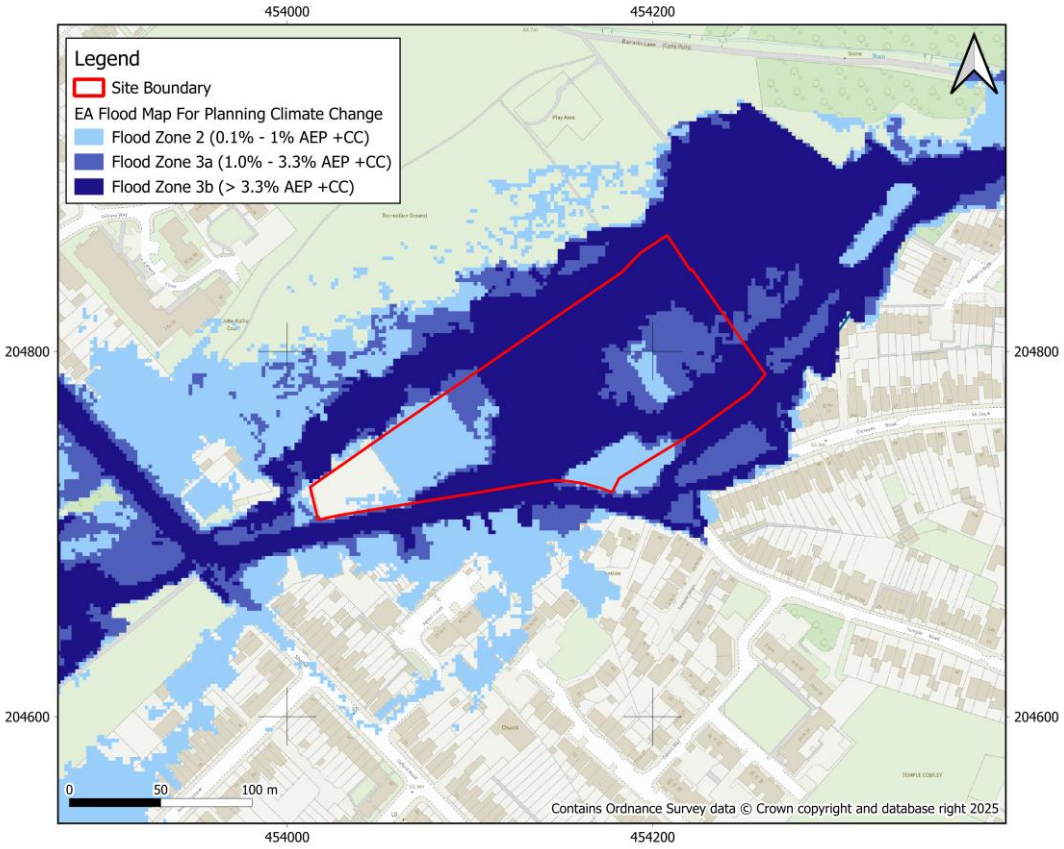

Figure 4 - Fluvial Climate Change Flood Map

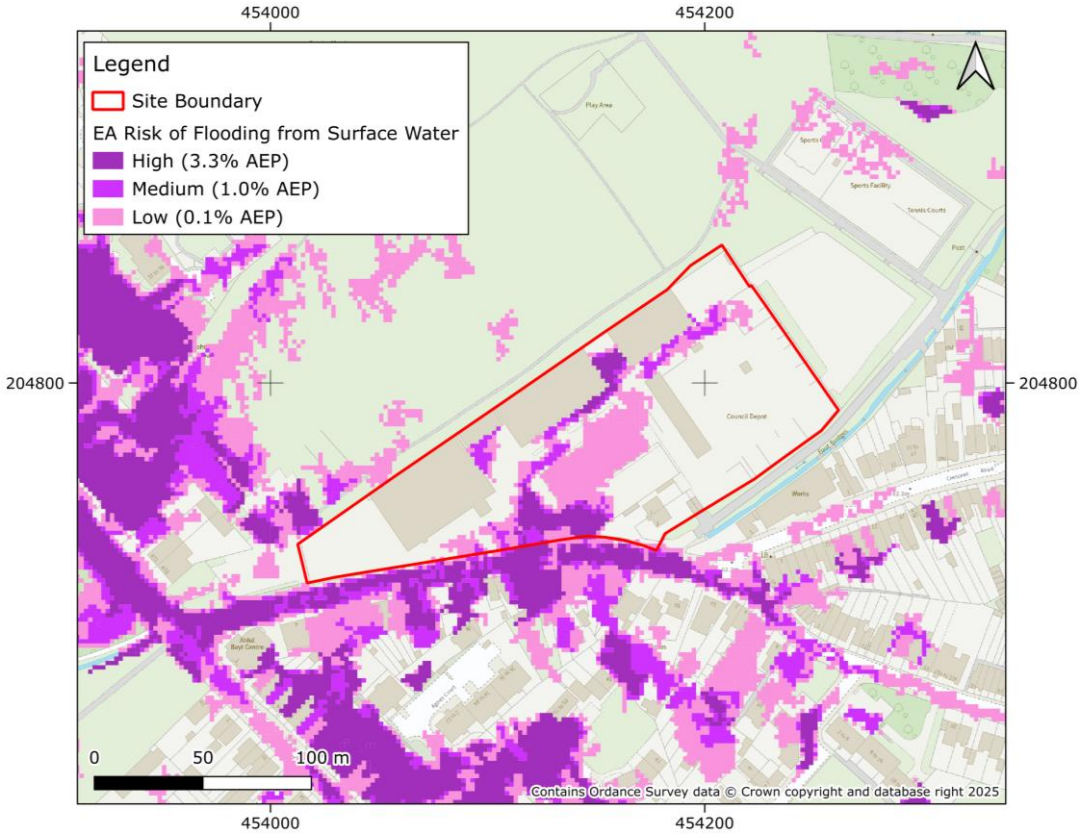

Figure 5 - Surface Water Flood Map

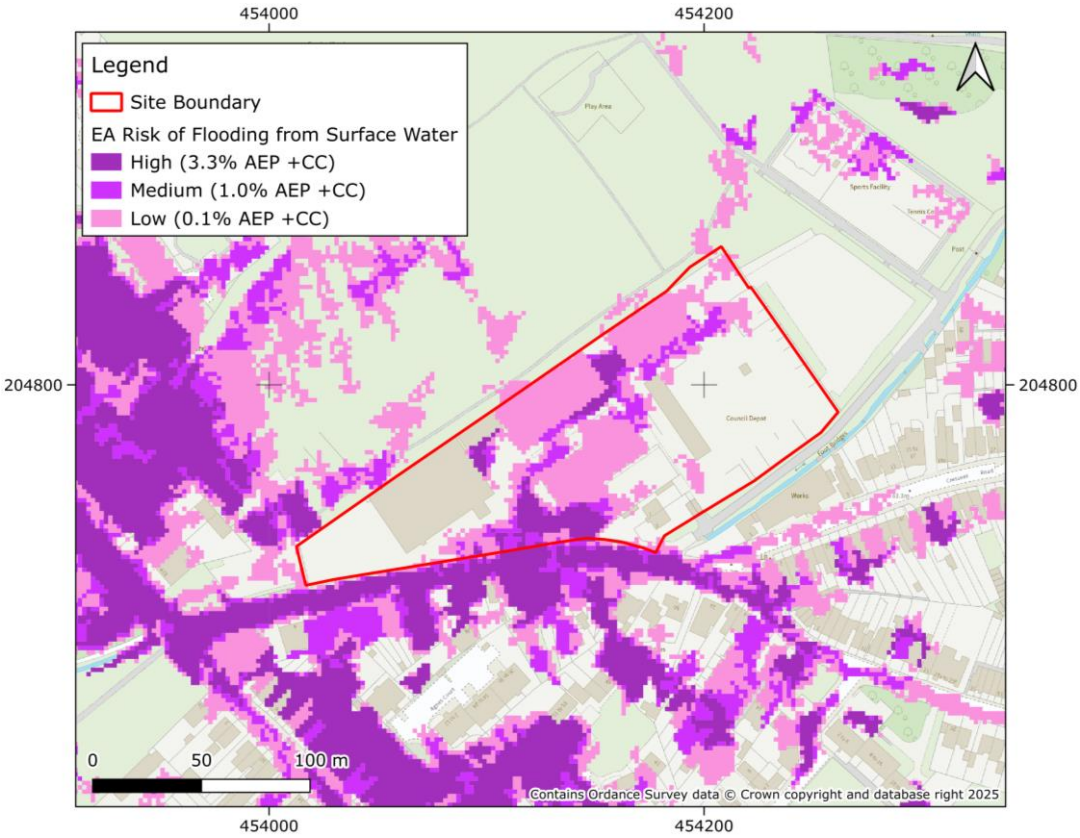

Figure 6 - Surface Water Climate Change Flood Map

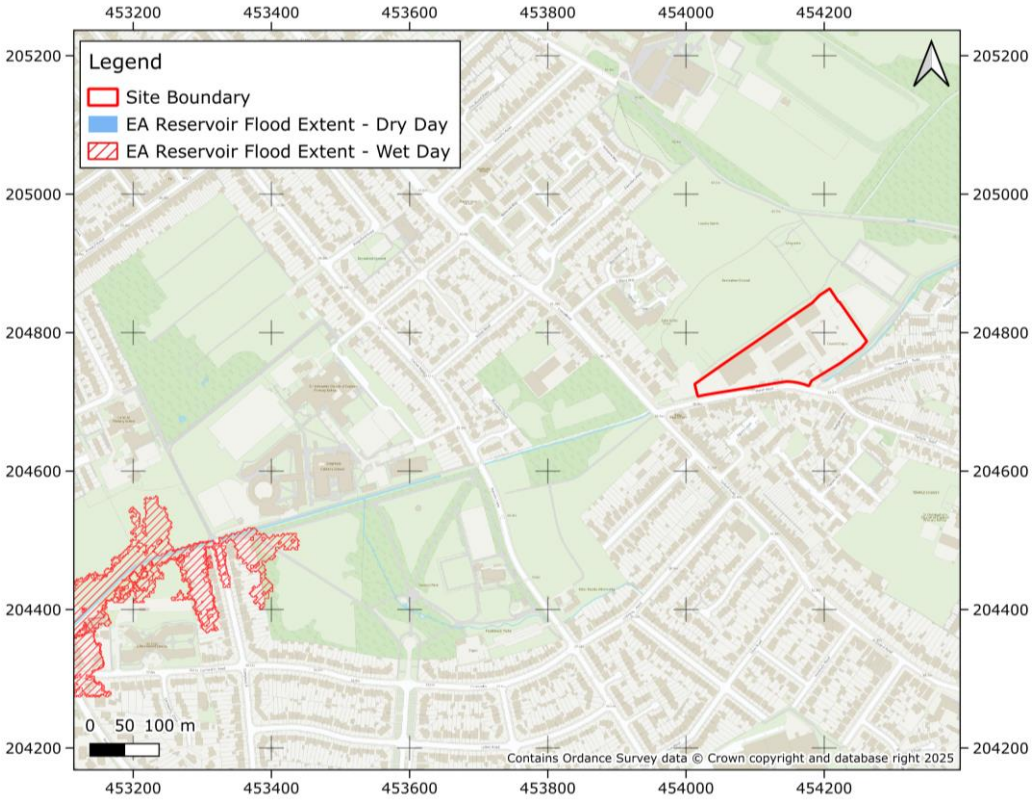

Figure 7 - Reservoir Flood Risk

4 Detailed Review of Primary Flood Risk

4.1 Primary Flood Risk

The primary flood risk mechanism at the site is fluvial, however, the site is also at risk from surface water flooding. Therefore, both sources of flood risk are assessed in further detail below.

4.2 Flood Risk Metrics

As the Boundary Brook (2009) model has been replaced by national mapping, the EA Flood Map for Planning undefended 1.0% AEP + Climate Change extent has been used to inform the assessment of flood risk.

Figure 8 shows the majority of the site to be inundated during the 1.0% AEP +Climate Change design event. Three areas of the site remain flood free located in the west, southeast, and east of the site. These are likely associated with localised areas of higher ground levels, or where flood waters are diverted around large structures. Comparing the flood extents to LiDAR mapping indicates an inferred design flood level of 63.3 m AOD. Due to the sloping topography at the site, flood depths are expected to vary with a maximum depth of 0.5 m expected in the northeast. Flood depths across the site are generally expected to be 0.2 m or less. It should be noted that, due to the absence of detailed hydraulic modelling, both the design flood level and estimated flood depths are uncertain. These should be verified through a site-specific Flood Risk Assessment (FRA), which is likely to require updated modelling of the Boundary Brook.

As part of this site lies in Flood Zone 3b, the EA Flood Map for Planning undefended 0.1% AEP + climate extent has been assessed as a proxy for the higher central climate change scenario to attain further detail on fluvial flood risk.

Figure 9 indicates that the 0.1% AEP +CC design event inundates approximately 94% of the site with only the most southwestern area of the site remaining flood free.

Comparing the flood extents to LiDAR mapping indicates an inferred design flood level of 63.5 m AOD. Compared to the 1.0% AEP +CC event, flood depths across the site are likely to be higher with more areas experiencing flood depths between 0.2 and 0.5 m. Velocities may also be higher. It should be noted that, due to the absence of detailed hydraulic modelling, both the design flood level and estimated flood depths are uncertain. These should be verified through a site-specific Flood Risk Assessment (FRA), which is likely to require updated modelling of the Boundary Brook.

The Risk of Flooding from Surface Water (RoFSW) depth data for the 100-yr plus climate change design event was assessed to attain further detail on surface water flooding.

The depth mapping (see Figure 10) shows surface water flooding is constrained to a flow route through the centre of the site, which runs from the northeast of the site towards Marsh Road along the southern site boundary. The maximum flood depth within the site is 0.3 m though flood depths within most of the inundated areas are 0.2 m or less. During the design event, the entire stretch of Marsh Road that borders the site to the south is inundated.

It should be noted that the climate change allowances used in RoFSW are based on the 2050's epoch (2041-2069) and reflect the median estimate of rainfall increases. If the development has a lifetime beyond this time period, a site-specific FRA should consider the climate change impacts for the 2080's epoch (2075-2125).

4.3 Access and Egress

It is assumed that access to the site will be via Marsh Road. Due to the extent of flooding during both the fluvial and pluvial design events along Marsh Road, no route can entirely

avoid inundated areas. The best route identified, travels from Marsh Road east via Crescent Road, it is shown in Figure 11. Though travelling via Temple Road may pass through a smaller proportion of inundated land, onward vehicle travel may be blocked by bollards past Purland Close. The hazard associated with this route should be assessed within a site-specific FRA using updated modelling results for the Boundary Brook.

Based on FEH catchment descriptors[1] extracted for the Boundary Brook, the catchment is relatively impermeable and heavily urbanised. Therefore, it is expected to have a flashy response to rainfall reducing the time for adequate flood warnings. It should be noted that the site is not currently located within an EA Flood Warning Area. However, other areas of Oxford are located within flood warning areas and so Flood Warnings from these should be considered when assessing the need for evacuation from the site.

Once the development layout is known, a site-specific FRA should consider onsite routes across the site and any infrastructure required to reach the proposed access route. The proposed route should also be reassessed in a site-specific FRA when all access points to the site are known, to ensure the route with the lowest hazard remains the same.

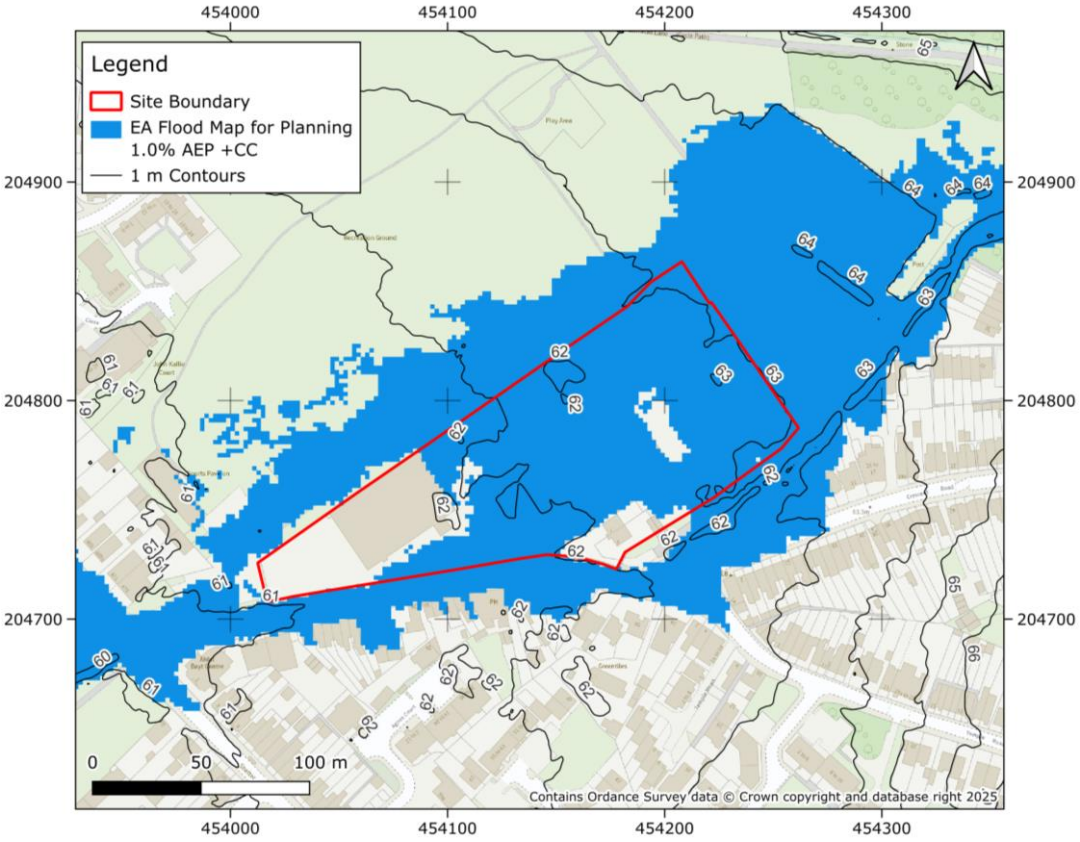

Figure 8 – EA Flood Map for Planning – 1.0% AEP +CC

[1] UKCEH (2025) *Flood Estimation Handbook Web Service* https://fehweb.ceh.ac.uk/

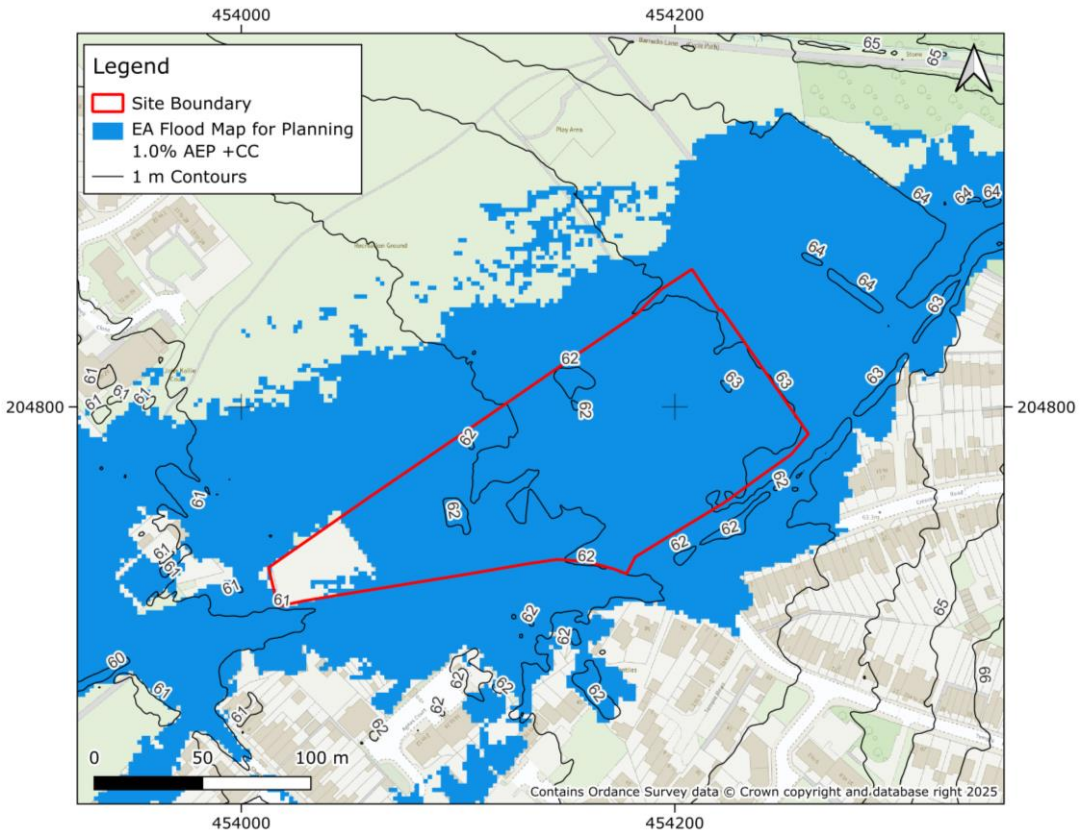

Figure 9 - EA Flood Map for Planning - 0.1% AEP +CC

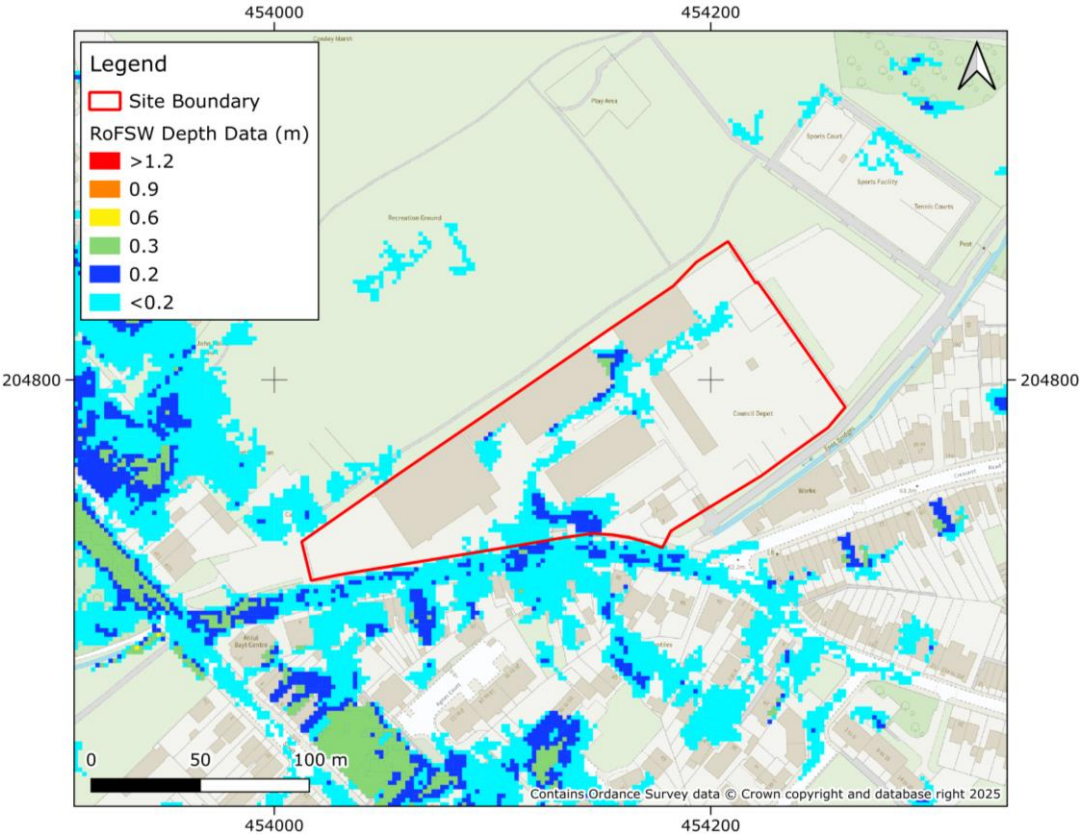

Figure 10 - Risk of Flooding from Surface Water - 1.0% AEP +CC depth data

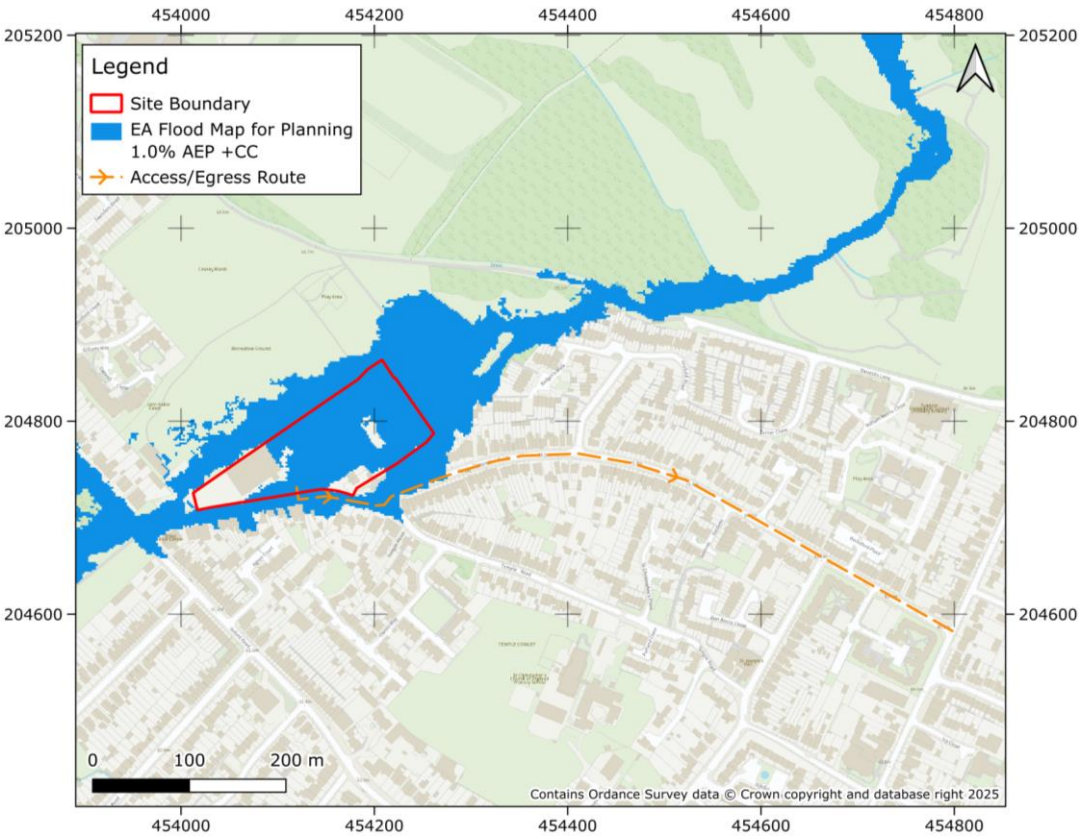

Figure 11 - Access and Egress

5 Development Viability and FRA recommendations

5.1 Development Categorisation

The development proposed is categorised as *More Vulnerable Development*. A sequential approach to the siting of the development should be used, with development prioritised first within Flood Zone 1 prior to consideration of any siting within Flood Zone 2 or 3a. More vulnerable development is permissible within Flood Zone 2 but must pass an exception test to be considered permissible within Flood Zone 3a. It is not permissible within Flood Zone 3b. The locations of surface water flood extents should also be used to inform the sequential siting of infrastructure prioritising development in the lowest areas of flood risk.

Given that Flood Zone 3b inundates approximately 30% of the site and is expected to inundate 58% of the site when considering climate change, development at the site may face significant barriers.

5.2 Scale of Development

The total site area is currently 1.71 ha; allocated for 83 dwellings, however at this stage the site layout has not been proposed.

Due to the extent of Flood Zone 3b within the site, the scale of development at the site should be proportional to the amount of land located outside of this area.

Any development located within the design flood extent may need to be set at a floor level to provide an appropriate freeboard above the design flood level. As no detailed modelling is currently available, a site-specific FRA should include updated modelling results to more accurately determine flood levels across the site, the degree of ground raising required and the compensatory storage required. It is important to highlight that development is already present at the site which will displace a volume of floodwater, any development should not exceed this volume or seek to reduce it.

5.3 Sequential Approach

It is important that a sequential approach is implemented at the site and when allocating sites for development. Priority for development should be given to areas within Flood Zone 1 wherever possible, followed by Flood Zone 2 and then Flood Zone 3a. As stated, no development should be located in Flood Zone 3b. Furthermore, a sequential approach should consider the impacts of climate change on flood zone extents and take into account all sources of flooding.

5.4 Other Site-Specific Considerations

Due to the flood extents at this site during both the current and future scenarios, development at this site may increase third-party flood risk by decreasing available floodplain volume and disrupting flow pathways. As a result, any development should consider reduce the current development footprint in the floodplain and/or providing compensatory storage.

Development will need to be set at a floor level to provide an appropriate freeboard (typically 300mm minimum) above the flood level for the defended 1.0% annual exceedance probability (plus central climate change allowance) design event. The extents and depths required to set this level should be estimated through updated modelling results for the Boundary Brook. If ground raising is implemented within the design flood extents, modelling will also need to be undertaken to assess 3rd party impacts and compensatory storage requirements.

Due to the presence of a culvert near to the site, it is recommended that the site-specific FRA also investigates the flood risk this feature presents and identifies the residual risks relating to the lack of maintenance or blockages of this watercourse. The findings of this should also inform the sequential test in order to avoid any areas of potential risks and allow room to maintain the watercourse in the future, potentially reducing existing flood risk associated with the structure.

Areas of significant flood risk are present along the main access route to the site. Given there is no advance flood warning provision for the site, the potential for evacuation before a more extreme fluvial or pluvial flood, considering the effects of climate change for the lifetime of the development, needs to be considered by a site-specific FRA with advice to be sought from the emergency services and Oxford City Council's emergency planner.

A site-specific FRA should also consider in more detail the nature of the surface water flood risk to determine how quickly it occurs and the degree of hazard on site. It should be noted that the climate change allowances used in the pluvial design event scenario are based on the 2050's epoch (2041-2069) and reflect the median estimate of rainfall increases. If the development has a lifetime beyond this time period, the site-specific FRA should consider the climate change impacts for the 2080's epoch (2075-2125).

The drainage strategy for the proposed development should be suitably designed to manage additional runoff arising from the development and ensure that surface water flood risk at the site and to third party land is not increased. In assessing and demonstrating the viability of any drainage solution for the site, a site-specific FRA should follow the national standards for SuDS and any relevant Local Authority Local Plan policies. The geology at the site has low permeability and this combined with soils which have naturally high groundwater, means the effectiveness of infiltration SuDS solutions may be limited. It is recommended that a geotechnical investigation is undertaken at this site to obtain further information relating to infiltration rates, this will confirm whether infiltration could be viable in some areas. Attenuated discharge to a watercourse or a sewer will also need to be considered as part of a site-specific FRA. Any activity near to the Boundary Brook at this site may require ordinary watercourse consent.