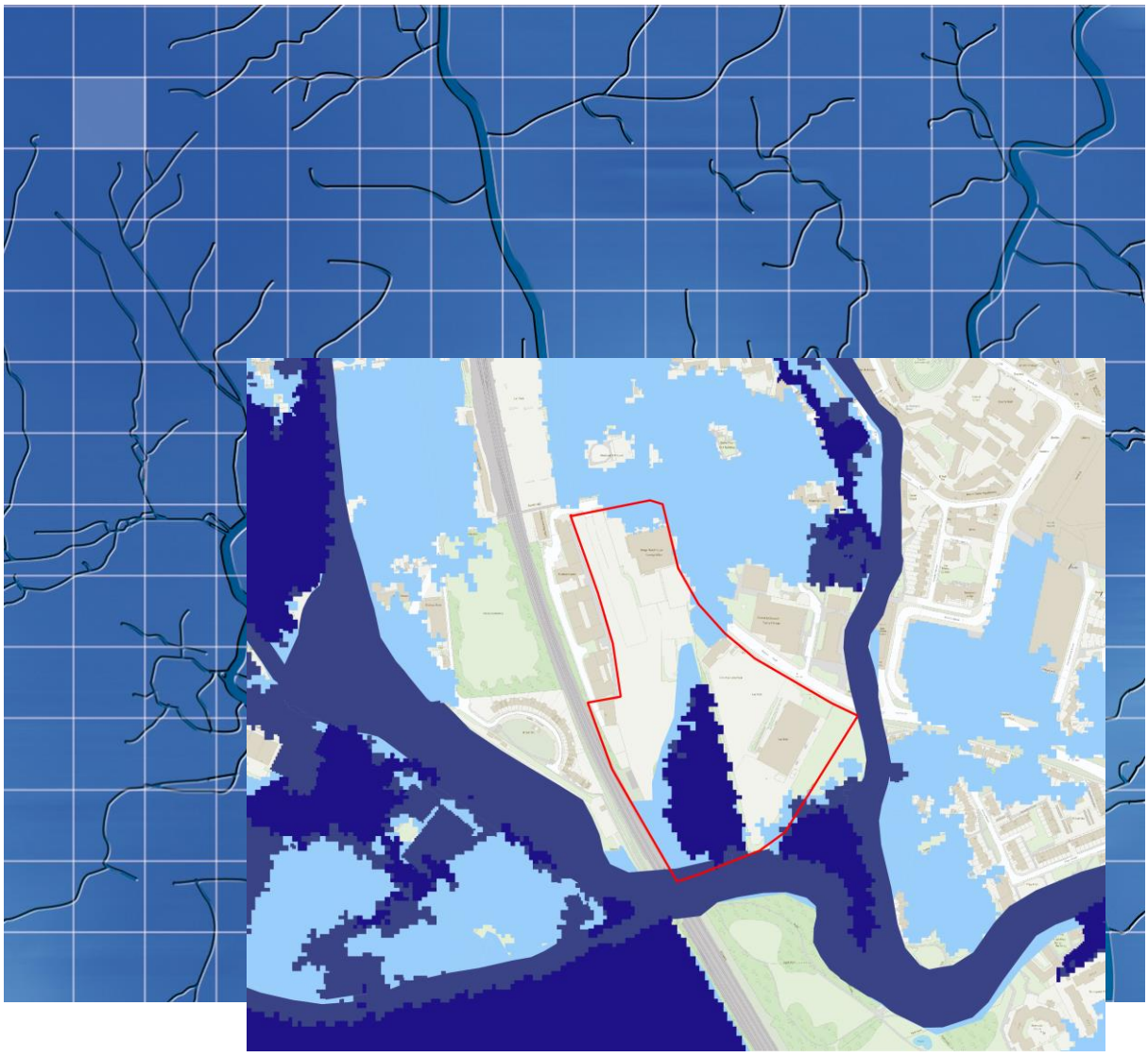
Oxford City Council

October 2025

Oxpens (76)

Level 2 Strategic Flood Risk Assessment



Oxford City Council

Oxpens (76) Level 2 Strategic Flood Risk Assessment

Document issue details

WHS10237

Version	Issue date	Issue status	Prepared By	Approved By
1.0	24/10/2025	Draft	Lloyd Prytherch (*Graduate 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

Oxpens (76) Level 2 SFRA
Flood Risk Overview

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

Flood Risk

The EA Flood Map for Planning shows 31.7% of the site is located within Flood Zone 2 (0.1% AEP), and 18.6% is located within Flood Zone 3a (1.0% AEP).

The River Thames Model (2018, re-run in 2023) 1.0% AEP + 26% CC design event extent covers 21.1% of the site area. Depths in the areas of inundation are generally less than 0.2 m in the north of the site, however, exceed 1.2m in the depression in the centre of the site. The design flood level at the site is between 56.66 – 57.08 m AOD. Overall fluvial flood risk is considered to be moderate.

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

The overall confidence in the assessment is high as a detailed hydraulic model has been used to inform the assessment of fluvial flood risk with the most up to date climate change uplifts.

Conclusions and Recommendations

The development should follow a sequential approach, prioritising sites in Flood Zone 1 before considering Zones 2 or 3a. The proposed housing-led mixed-use scheme includes More Vulnerable residential uses, which are acceptable in Zone 2 but require the Exception Test in Zone 3a. Less Vulnerable uses are allowed in Zones 2 and 3a without the test. Neither type is permitted in Zone 3b.

Flooding mainly affects a low-lying central area, with flood extents increasing slightly from 16.3% (Zone 3b) to 21.1% (design flood). If most of the more vulnerable development is located outside the flood extent, it should be acceptable. Any development within the flood zone must be raised above flood levels, and compensatory storage may be required to prevent increased flood risk elsewhere.

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 Oxpens (reference: 076) 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

Oxpens (76) is a 6.3 ha site located to the southwest of Oxford City Centre, see Figure 1. Current land use at the site is mixed and includes commercial premises, residential properties, the Oxford Royal Mail depot, the Oxford Ice Rink and a large area of impermeable hardstanding. Oxpens Meadow is located immediately to the southeast of the site.

The site is currently regarded as suitable for a mix of uses, including retail, residential, community and commercial uses. It has a listed capacity of 450 dwellings.

2.2 Topography

Based on 1m LiDAR data, the site is relatively flat except for an area of lower topography in the centre of the site, associated with historical excavations, see Figure 2. It is understood that the area of lowered ground plays a vital role for flood storage. The ground levels within the site boundary range from 55.3 to 60.0 m AOD. The average ground level is approximately 57.2 m AOD.

2.3 Nearby Watercourses

The southern boundary of the site runs along the River Thames, see Figure 1, which flows west to east. The Castle Mill Stream runs approximately 10m to the southeast of the site boundary at its closest point and flows into the Thames approximately 200m away from the site. Bulstake Stream flows into the River Thames 40m to the southwest of the site.

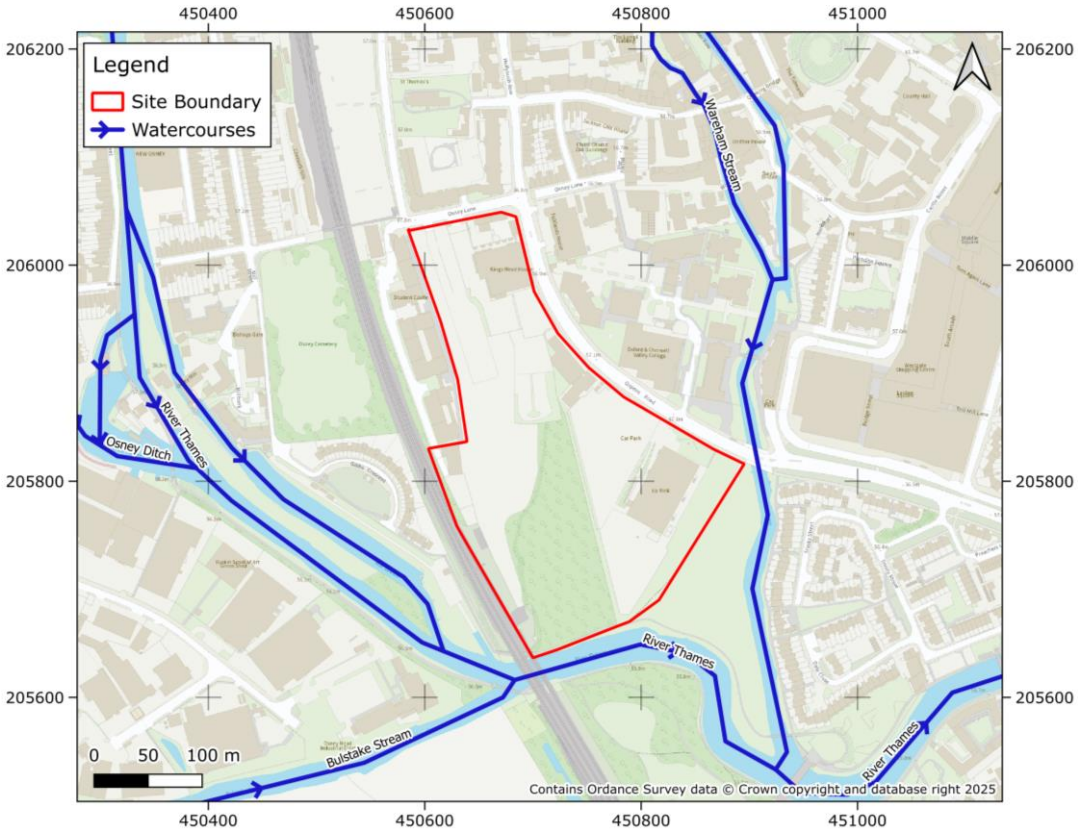


Figure 1 - Site Location

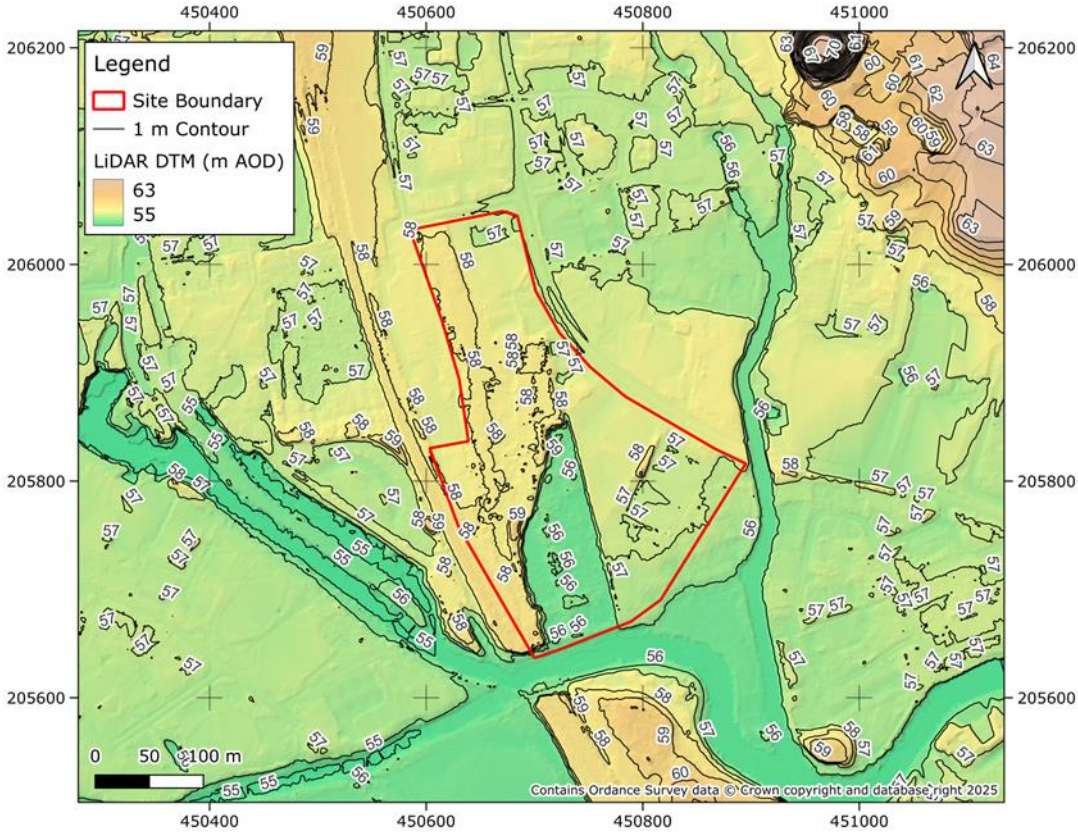


Figure 2 - Topography

3 Flood Risk

3.1 Historical Flooding

The EA has several records of historical flooding at the site, with varying extents. Four events have been recorded which were generally constrained to the lower topography in the centre of the site, see Figure 3. Three events were associated with winter fluvial events during 1947, 1977 and 2003. A pluvial event also affected the site during August 1977; this was associated with local drainage being overwhelmed during a thunderstorm event.

3.2 Fluvial Flood Risk

In the existing Flood Map for Planning (FMfP), 31.7% of the site is located within Flood Zone 2 (0.1% AEP), and 18.6% is located within Flood Zone 3a (1% AEP), see Figure 4. Viewing the River Thames 2018 model results for the undefended 3.3% AEP event, 16.2% of the site is located within Flood Zone 3b. At this location the FMfP is based on a combination of modelled extents and the maximum historical extent.

The EA climate change fluvial outputs for the 0.1% AEP and the 1.0% AEP extents have also been assessed, with 47.5% of the site located within the 0.1% AEP extent and 21.1% during the 1.0% AEP event. Viewing the River Thames 2018 model results for the undefended 3.3% AEP plus 26% climate change event, 18.0% of the site is located within Flood Zone 3b, see Figure 5.

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

3.3 Flood Defence Infrastructure

The River Thames along the site's southern boundary is bounded by an embankment. The standard of protection (SOP) offered by this embankment is not currently specified. However, the area of lower topography in the centre of the site is in an area associated with a Reduction in Risk of Flooding from Rivers so it is expected to offer some form of protection. The site is not located within or adjacent to a flood storage area.

3.4 Surface Water Flood Risk

The EA's surface water flood maps show 1.2% of the site to be inundated during a 3.3% AEP event, 2.8% is inundated during a 1.0% AEP event, and 11.5% is inundated during a 0.1% AEP event, see Figure 6. The areas at risk are generally associated with existing hardstanding areas including the car park, coach station and the ice rink.

When considering the effects of climate change, the proportion of the site at risk for each event increases to 2.4%, 3.7%, and 14.6% respectively, see Figure 7.

Overall, the surface water flood risk to the site is considered low.

3.5 Groundwater Flooding

The site is underlain by a bedrock of clay and mudstone in the form of the Oxford Clay Formation and West Walton Formation. It is expected to permit low amounts of infiltration. Superficial deposits of alluvium are also present across most of this site; these are expected to have variable permeabilities. The underlying soils across the south of the site are loamy and clayey floodplain soils, with naturally high groundwater.

Based on the data available there is unlikely to be a moderate risk of groundwater flooding, however more data is required at the planning stage to confirm this. Given the site's proximity to the River Thames groundwater flooding is expected to be heavily correlated with fluvial flooding.

3.6 Reservoir Flood Risk

The FMfP shows that the area of lower topography adjacent to the Thames in the centre of the site is at risk from reservoir flooding during the dry day scenario, see Figure 8. During the wet day scenario, this extent is more widespread and covers the majority of the western half of the site. Whilst the site is shown to be at risk, it should be noted that reservoir failure is a rare event with a very low probability of occurrence. Current reservoir regulations aim to make sure that all reservoirs are properly maintained and monitored to detect and repair any problem. If required, the local planning authority (LPA) can consult the local resilience forum for emergency planning advice in relation to reservoir failure.

3.7 Flood Warning Service

The site is partially located within the EA River Thames and tributaries at New Botley, New Hinksey, North Hinksey, South Hinksey and Grandpont Flood Warning area. The parts of the site included in the flood warning area generally reflects Flood Zone 2.

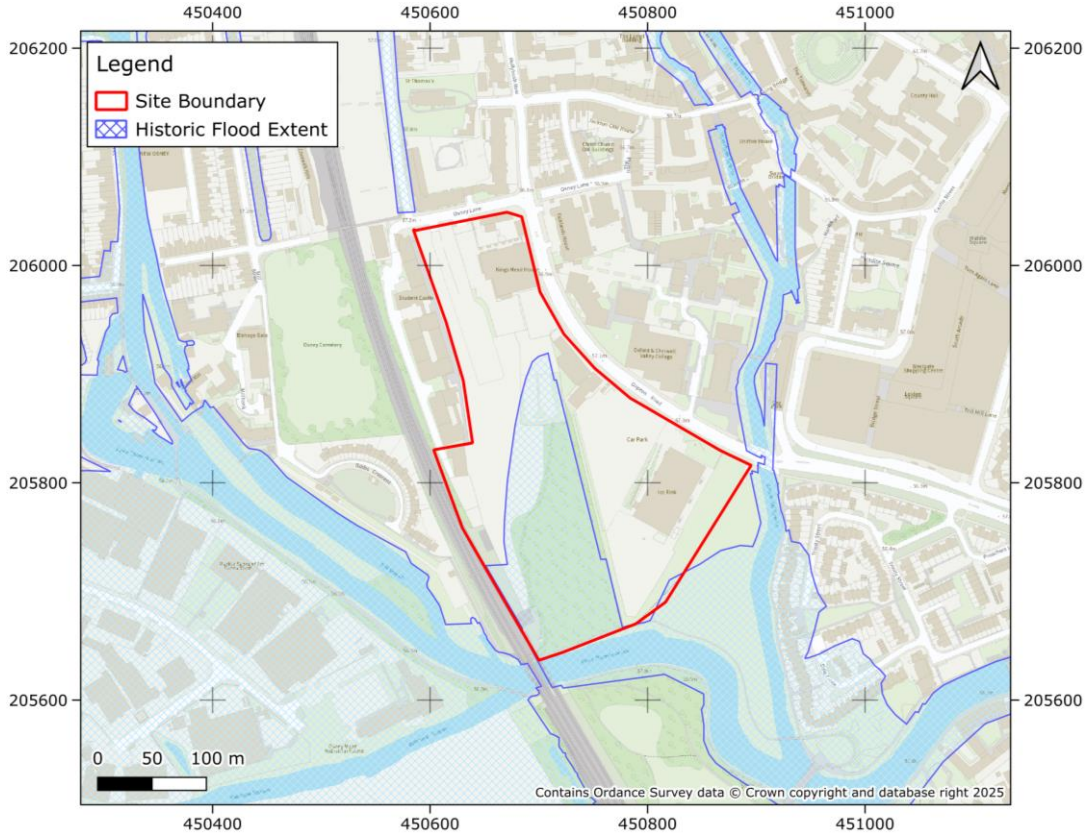


Figure 3 - Recorded Flood Outlines

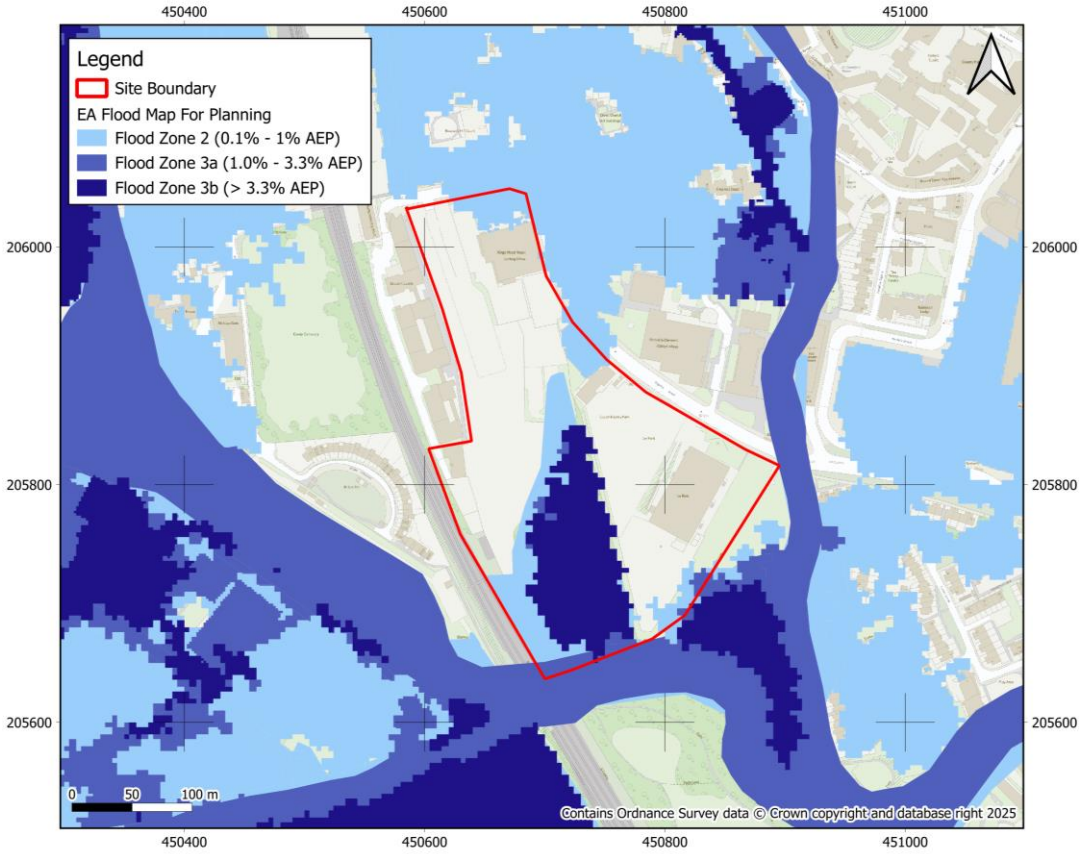


Figure 4 - Fluvial Flood Map

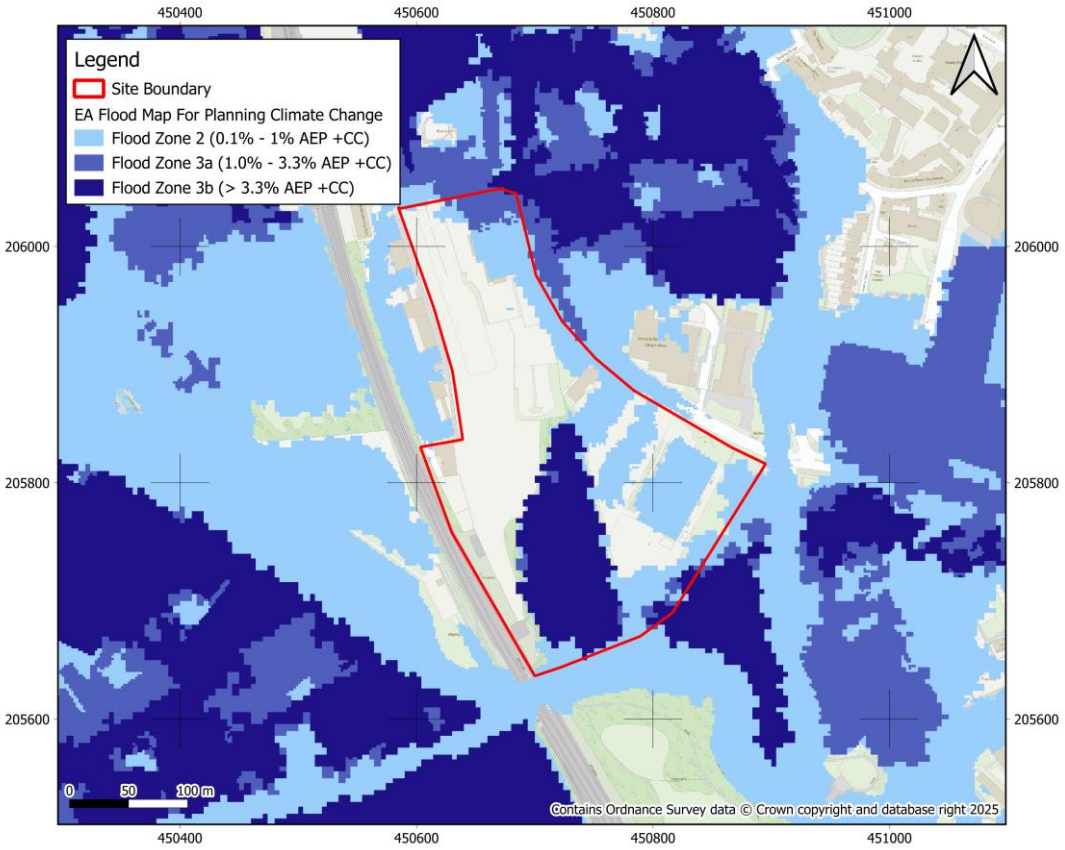


Figure 5 – Fluvial Climate Change Flood Map

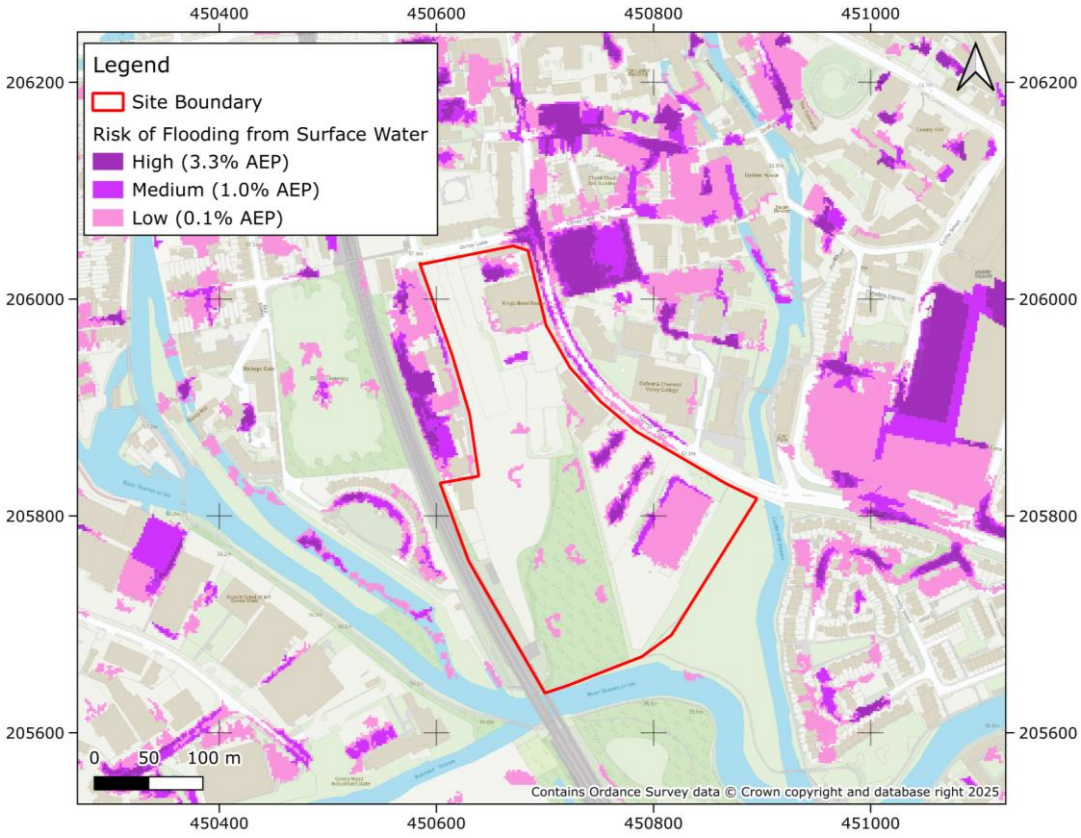


Figure 6 – Surface Water Flood Map

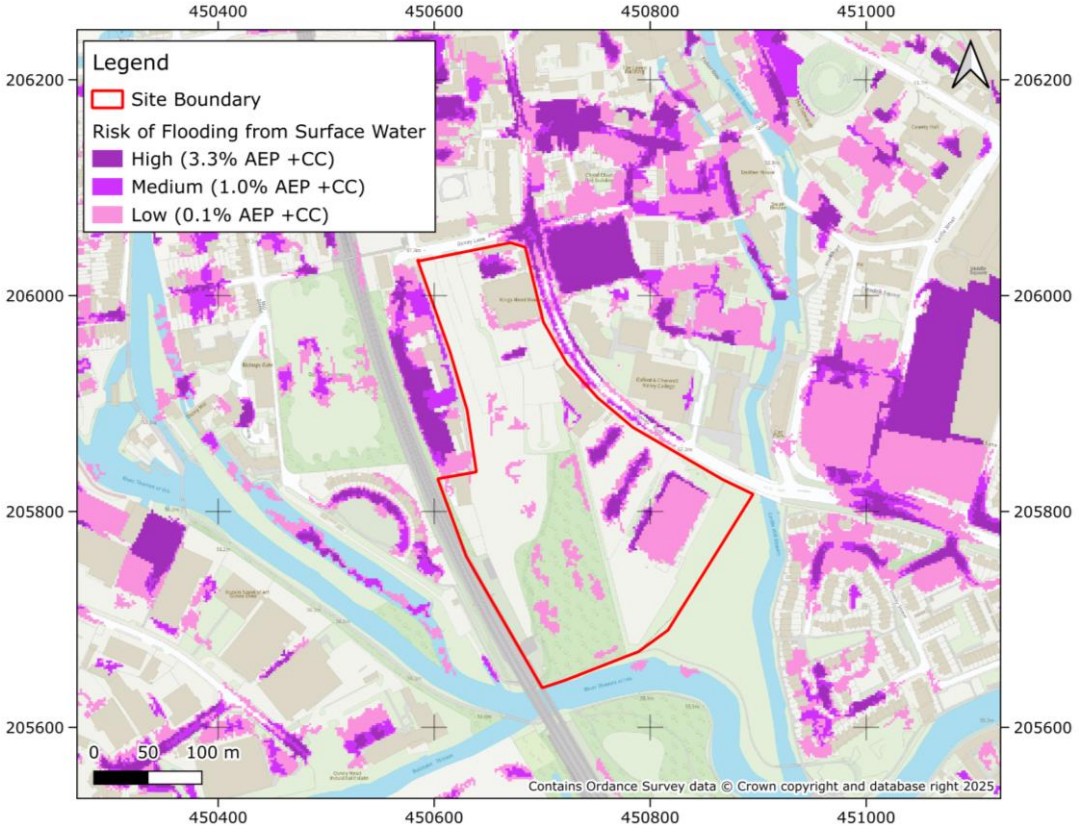


Figure 7 -Surface Water Climate Change Flood Map

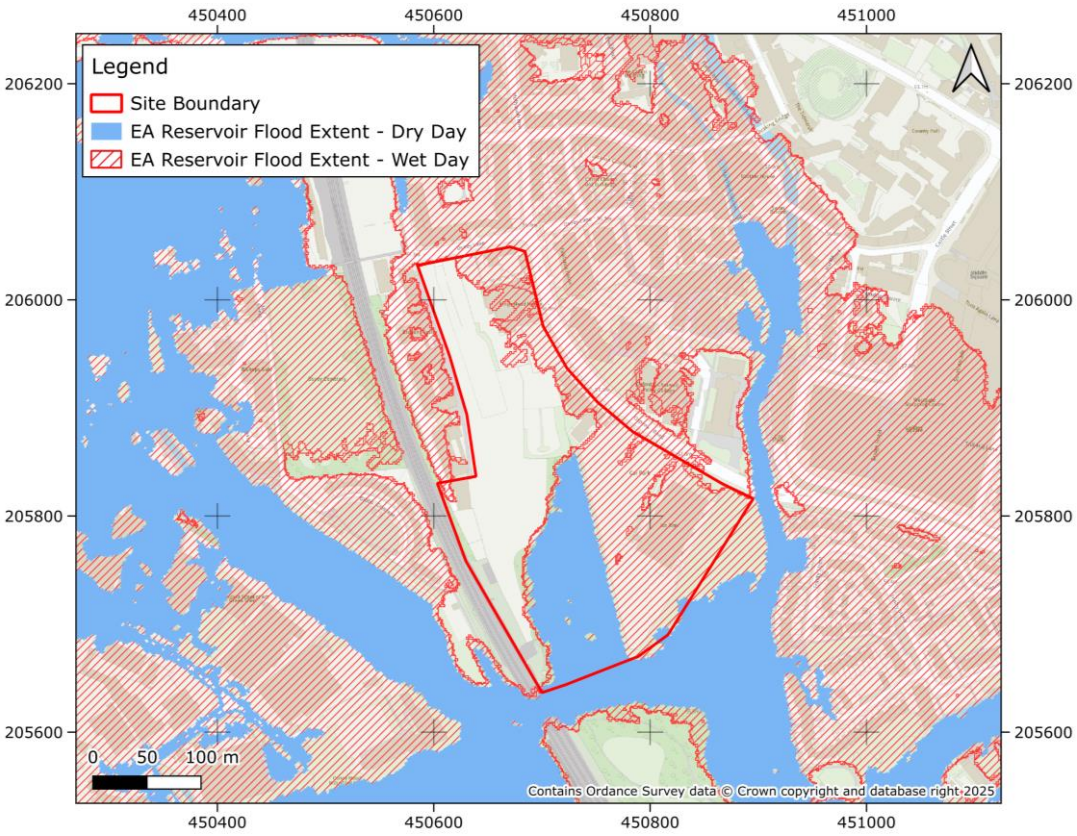


Figure 8 - Reservoir Failure Flood Map

4 Detailed Review of Primary Flood Risk

4.1 Primary Flood Risk

The primary flood risk to the site is fluvial in nature. The flood risk is quantitatively assessed in more detail below.

4.2 Flood Risk Metrics

The River Thames Model (2018) was re-run as part of the previous SFRA for Oxford City in 2023. This was to obtain results applying the latest climate change allowances.

Depth data for the 100-yr plus central (26%) climate change design event is first assessed to attain further detail on fluvial flooding. The modelled scenario considers the presence of flood defences unlike the FMfP data.

The depth mapping for the design event (see Figure 9) shows flooding to be most widespread in the southwest of the site, with further areas of inundation along the site's southeastern and northwestern boundaries. In total 21.1% of the site is inundated during the design event. The maximum flood depth within the site is 1.4m, located in the depression in the topography in the centre of the site. The depth of inundation across this area is generally 0.3 - 1.2m. Inundation is also expected adjacent to Oxpens Road and Osney Lane in the northernmost part of the site, with depths less than 0.3m. During the event, flooding occurs from two mechanisms. The north of the site is at risk from a flow rote from Botley Road, the design flood level associated with this is 57.08 m AOD. The inundation in the depression towards the south of the site is directly from the River Thames, with a design flood level in this area of 56.66m AOD. Both flood levels are just below the average ground level at the site based on LIDAR (57.2 m AOD).

As part of this site lies in Flood Zone 3b, the River Thames Model (2018) depth data for the 100-yr plus higher central (41%) climate change design event (re-run in 2023) was assessed to attain further detail on fluvial flooding. Once more, the modelled scenario considers the presence and condition of flood defences unlike the FMfP data.

The depth mapping across the site for this event (see Figure 10) shows an increase in flood extents with 22.7% of the site inundated. Generally, the areas at risk have remained the same, however the extents and depths increase slightly. The maximum flood depth within the site is 1.52m, again located within the depression in the centre of the site. The extent of flooding from Oxpens Meadow to the southeast of the site increases and encroaches further into the site, with depths generally between 0.1–0.3m. The design level in the north of the site is 57.15m AOD, whilst the design level is 56.75m AOD in the south of the site. These remain lower than the average ground level based on LIDAR.

4.3 Access and egress

Given the pre-existing road network near the site, current access and egress to the site is assumed to be along Osney Lane to the north of the site, and along Oxpens Road (A420) to the northeast of the site. Due to the number of watercourses in the area surrounding the site, no route can entirely avoid Flood Zone 2 or the design flood extents.

The preferred route shown in Figure 11 travels through the smallest area of inundated land, isolated to a length of approximately 200m along Osney Lane/Oxpens Road and a further 130m along Oxpens Road to the east of the site. In these sections a maximum depth and velocity of 0.36 m and 0.19 m/s are reached. Parts of Oxpens Road have a hazard rating of *Danger for Some*.

Whilst this risk is generally considered manageable, a site-specific FRA should consider in more detail the nature of the flood risk to determine how quickly it occurs and the degree of hazard.

Due to the hazard present along the route close to the site, early flood warning will be vital site to ensure that the access route can be utilised before floodwater inundates Oxpens Road. The River Thames catchment which the site falls within is dominated by chalk, it has relatively slow river response times to storm events, being groundwater, rather than surface water dominated. This increases the time taken for inundation and for adequate warnings and preparation in an extreme flood event.

The site is located within an EA Flood Warning Area and so it is essential that all households and businesses within the sites sign up to receive flood warnings from the Environment Agency.

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.

It should also be noted that areas of high surface water flood risk are present along both routes. Whilst this risk is generally considered manageable, a site-specific FRA should consider in more detail the nature of the flood risk to determine how quickly it occurs and the degree of hazard.

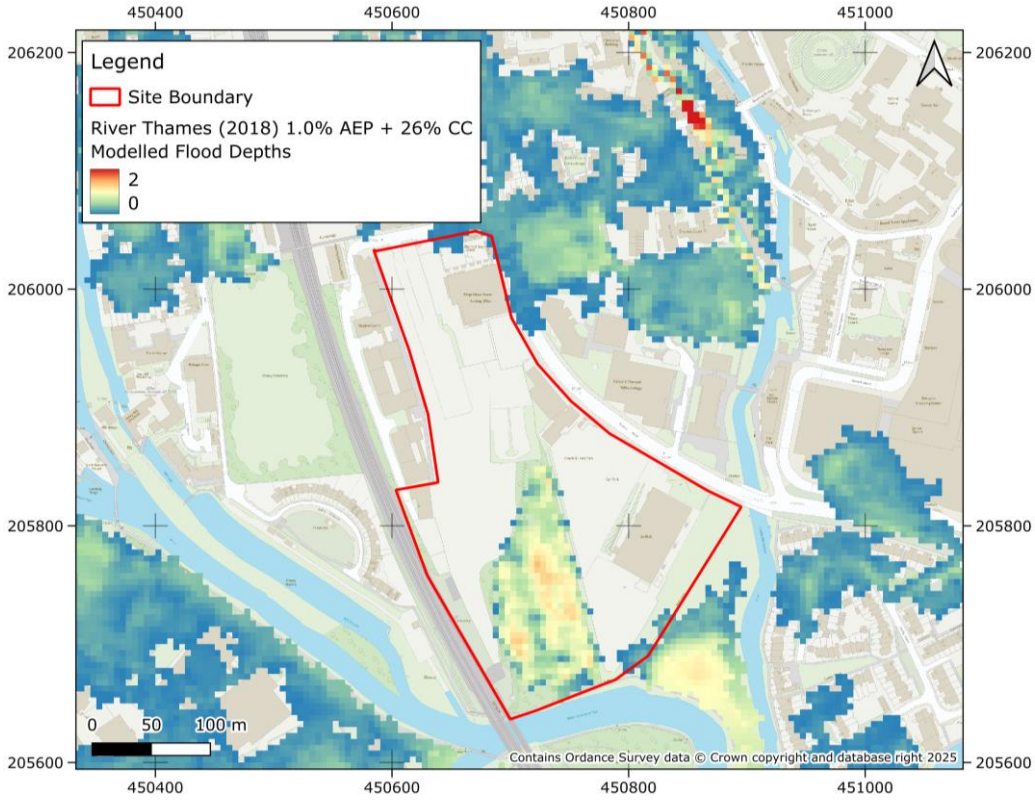


Figure 9 – River Thames (2018) 1.0% AEP +26% CC Modelled Flood Depths (m)

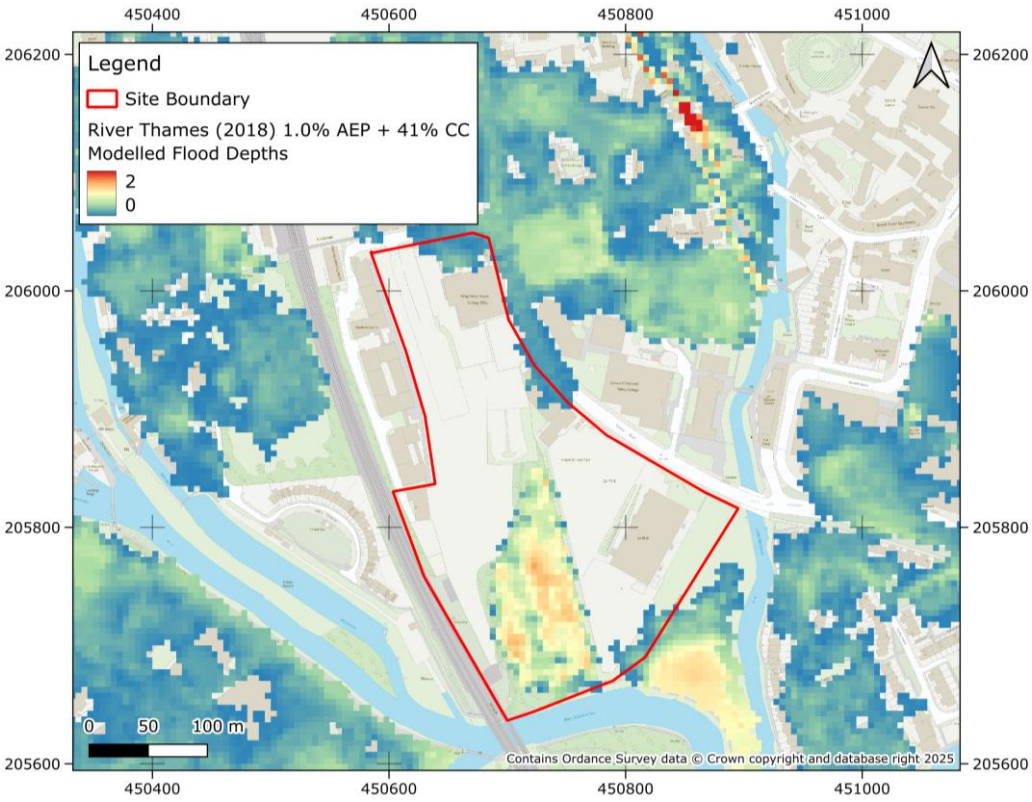


Figure 10 - River Thames (2018) 1.0% AEP +41% CC Modelled Flood Depths (m)

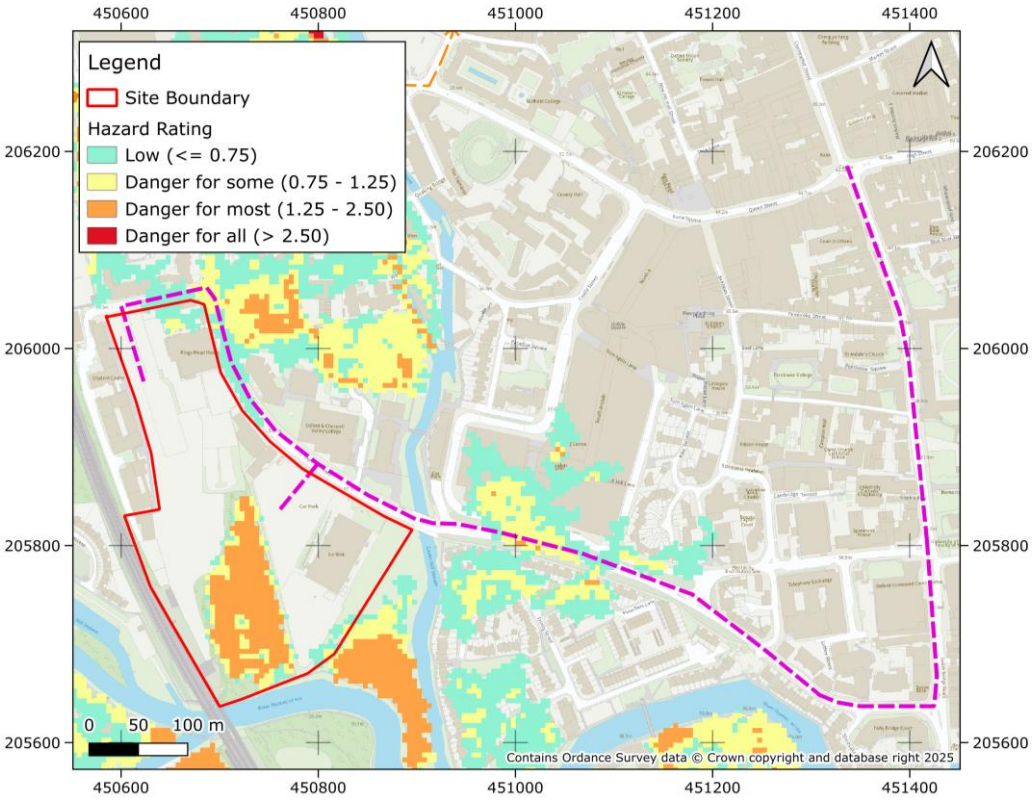


Figure 11 – Access/Egress Routes showing Flood Hazard (ZUK0) for the 1.0% AEP +26% CC Event

5 Development Viability and FRA recommendations

5.1 Development Categorisation

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.

The proposed development at the site is a housing led, mixed-use development. Residential areas are classed as More Vulnerable Development, which is permissible in Flood Zone 2, but needs to pass the Exception Test to justify development in Flood Zone 3a. Less vulnerable uses are permissible in Flood Zone 2 and 3a without the need to pass an exception test. Both types of development are not permissible in Flood Zone 3b.

Flooding onsite for the design event is largely limited to one area of lower topography in the centre of the site. There is little change between the extent of Flood Zone 3b (16.3%) and the design flood extent (21.1%). Provided the majority of more vulnerable development can be located outside of the design flood extent the development should be permissible. If development is located within the design flood extent it will need to be raised above the design flood level. Compensatory storage may need to be provided to offset any 3rd party flood risk impacts.

5.2 Scale of Development

The total site area is currently 6.3ha; allocated for residential redevelopment. At the site, 450 residential dwellings are proposed. If assuming medium density housing (60 dwellings per hectare) 450 dwellings would require 7.5 ha. To accommodate development the density of housing would need to be higher or the housing allocation reduced.

To reduce the impact on floodplain storage, building footprints and infrastructure should be sited outside of the modelled design flood extent within the depression in the centre of the site. This should in turn reduce the need for compensatory storage which could compromise the land available for development.

A site-specific FRA would need to assess in more detail the requirements for compensatory storage.

5.3 Sequential Approach

It is important that a sequential approach is implemented at the site, prioritising development in Flood Zone 1 wherever possible, followed by Flood Zone 2 and then Flood Zone 3a. As already stated, no development should be located in Flood Zone 3b. If required more vulnerable housing development should be prioritised in lower flood risk areas with employment development located in higher flood risk areas if required. This is on the assumption that it does not increase flood risk elsewhere and is designed to be appropriately resistant and resilient to flooding.

Note, surface water flood risk is also present in smaller areas across the centre and east of the site. Therefore, it should be used to inform the development layout with development located outside of high-risk areas if possible.

5.4 Other Site-Specific Considerations

Development will need to be set at a floor level to provide an appropriate freeboard (typically 300mm minimum) above the design flood levels for the defended 1.0% AEP (plus central climate change allowance) design event. If ground raising is implemented within the design flood extents, modelling will need to be undertaken to assess 3rd party impacts and compensatory storage requirements. To avoid this requirement, it is recommended that all development be located outside of the design flood extent. A site-specific FRA should confirm

any modelling requirements with the EA to assess 3rd party impacts, including the need to for breach analysis to further assess the protection provided by the flood defences in the vicinity of the site and confirm the finished floor levels (FFLs).

Areas of flood risk surround the site to the east, with no completely flood free egress options. A route with low hazard has been identified during the design event. A site-specific FRA should consider the evacuation requirements before the design event and a more extreme fluvial or pluvial event taking account of the site layout and advice to sought from the emergency services, including Oxford City Council's emergency planner. The EA Flood Warning area covering the south of the site should be used as a proxy for the entire site.

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. It is noted that the existing site is comprised of hard standing so there is potential for the site to offer a significant betterment on existing rates. 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.

Due to some parts of the site being in the wet and dry day reservoir failure inundation extent, any development in this area could affect the reservoirs risk designation, design category and how it is operated with potential cost implications for developers. However, it is noted that the quantum of development is very small in comparison to the existing development in Oxford already lying within the reservoir flood extents so any change in designation is assumed to be unlikely.