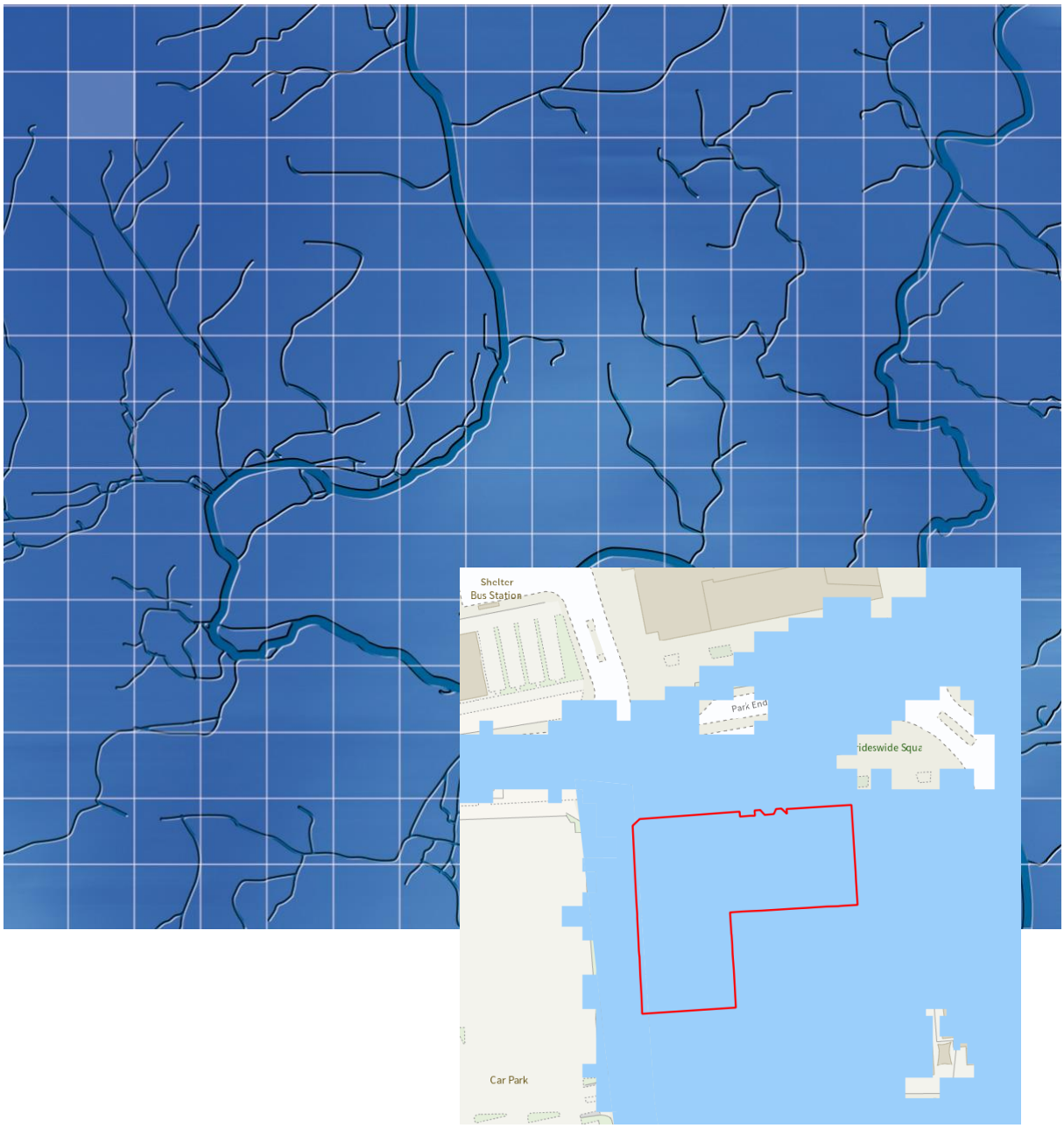
Oxford City Council

October 2025

# Land south of Frideswide Square (624)

## Level 2 Strategic Flood Risk Assessment



# Oxford City Council

# Land south of Frideswide Square (624) Level 2 Strategic Flood Risk Assessment

## Document issue details

WHS10237

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For and on behalf of Wallingford HydroSolutions Ltd.





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# Land south of Frideswide Square (624) Level 2 SFRA
# Flood Risk Overview

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

## Flood Risk

The EA Flood Map for Planning shows 100% of the site is located with Flood Zone 2 (0.1% AEP) and none of the site is located within Flood Zones 3a and 3b (1% AEP and 3.3% AEP respectively).

The River Thames Model (2018) 1.0% AEP + 26% CC design event covers all of the site area. Depths in the areas on inundation are generally 0.3m, however in some areas depths exceed 0.7m. The design flood level at the site is 57.29m AOD. Overall fluvial flood risk is considered to be high.

Pluvial flooding affects the south and centre of the site and is considered to be moderate.

The risk from other sources of flooding is considered to be moderate with the potential for groundwater and reservoir flooding at the site.

The overall confidence in the assessment is moderate as although a detailed hydraulic model has been used to inform the assessment of fluvial flood risk, EA national mapping has been used to assess pluvial flood risk.

## Conclusions and Recommendations

The development proposed is residential categorised as more vulnerable development. A sequential approach to development is required, with development first prioritised within areas of Flood Zone 1 prior to consideration in higher flood risk zones. More vulnerable development is permissible within Flood Zone 2 but must pass an exception test to be deemed permissible within Flood Zone 3a. Only open space and/or water compatible development can be incorporated into Flood Zone 3b.

Flood Zone 3a and 3b do not inundate the site, however, the site faces significant barriers given that the site falls within the design flood extent (1.0% AEP + 26% Climate Change event). Any development located within the design flood extent may need to be raised with compensatory storage required to offset as loss in floodplain storage.

The current development at the site displaces floodwater during the 1.0% AEP +26% CC design event. Therefore, the proposed development should not exceed the existing volume displaced and may look to reduce the volume of flood waters displaced to reduce flood risk to third parties.

# 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 Land South of Frideswide Square (reference: 624) 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

Land south of Frideswide Square (624) is a 0.26 ha site located near Oxford train station and the city centre, see Figure 1. Current land use at the site is mixed including retail and residential.

Proposed development at the site is residential with an identified capacity of 59 houses.

## 2.2 Topography

Based on 1m LiDAR data, the site is relatively flat, with a small slope from north to south, see Figure 2. The ground levels within the site boundary range from 56.4m to 57.5m AOD. The average ground level is approximately 57.0 m AOD.

## 2.3 Nearby Watercourses

The River Thames flows from north to south approximately 240m west of the site. The Wareham Stream, a tributary of the Castle Mill Stream, flows from north to south approximately 180m east of the site, see Figure 1.

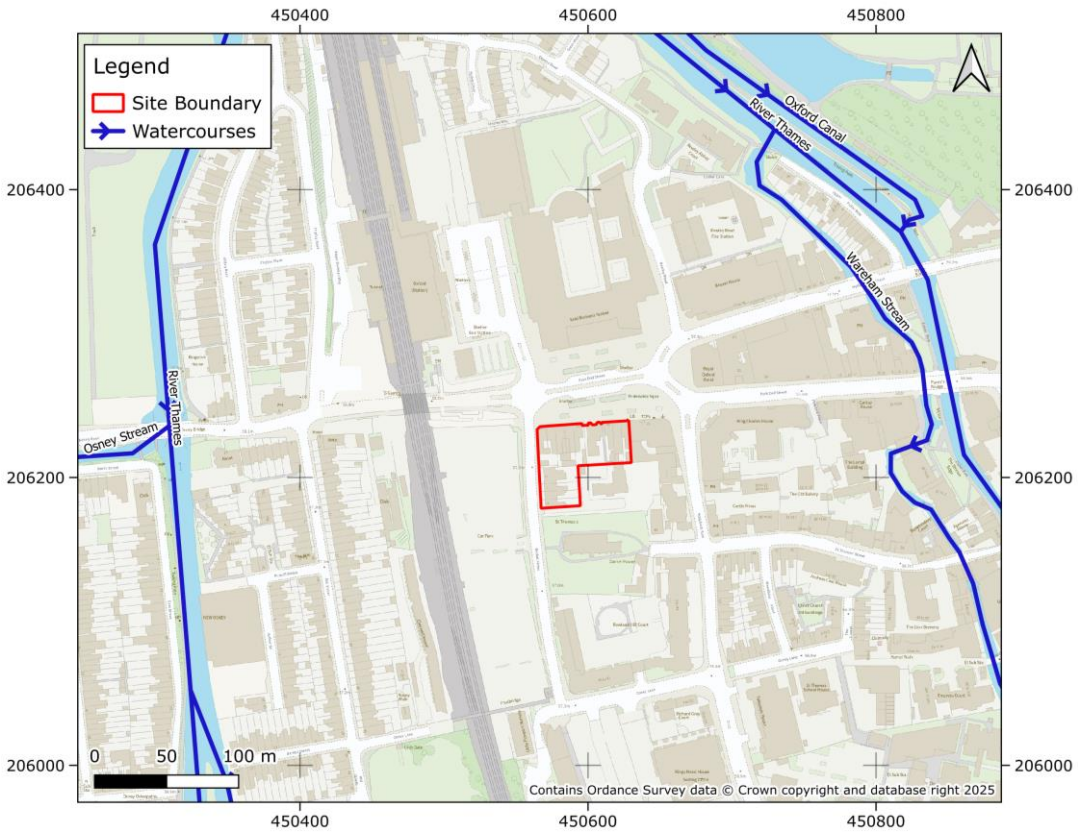


Figure 1 - Site Location

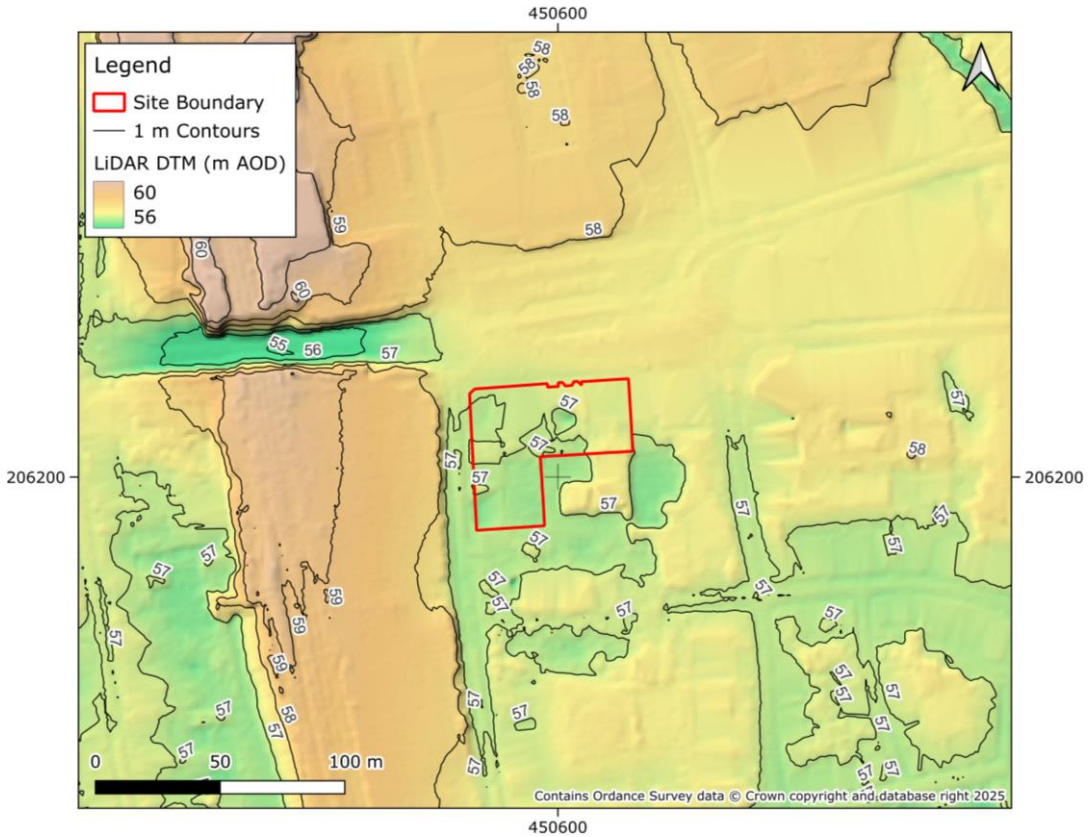


Figure 2 – Topography

# 3 Flood Risk

## 3.1 Historical Flooding

The EA has one record of historical flooding at the site. This occurred in July 2007 and was associated with the River Thames to the west of the site, see Figure 3.

## 3.2 Fluvial Flood Risk

In the existing Flood Map for Planning (FMfP), 100% of the site is located within Flood Zone 2 (0.1 AEP) and 0% is located in Flood Zones 3a (1.0% AEP), see Figure 4. Viewing the River Thames 2018 model results for the undefended 3.3% AEP event, 0% 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, 100% of the site is located within both extents. Viewing the River Thames 2018 model results for the undefended 3.3% AEP plus 26% climate change event, 96% of the site is located within Flood Zone 3b, see Figure 5.

Fluvial flood risk in the present day is considered moderate, however under climate change it is considered to be high and is assessed in more detail in section 4.

## 3.3 Flood Defence Infrastructure

The site is not located within an area with flood defence infrastructure

## 3.4 Surface Water Flood Risk

The EA's surface water flood maps show 24.7% of the site to be inundated during a 3.3% AEP event, 43.2% is inundated during a 1.0% AEP event, and 76.1% is inundated during a 0.1% AEP event, see Figure 6.

When considering the effects of climate change, the proportion of the site at risk for each event increases to 41.7%, 54.1% and 84.9% respectively, see Figure 7.

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 Oxford Clay Formation and West Walton Formation. It is expected to permit low amounts of infiltration. Superficial deposits of alluvium, sand and gravel; these are expected to have variable permeabilities. The underlying soils are loamy and clayey floodplain soils with naturally high groundwater.

Based on the data available the potential for high groundwater presents a moderate risk of groundwater flooding, however more data is required at the planning stage to confirm this.

## 3.6 Reservoir Flood Risk

The FMfP shows that the site is at risk from reservoir flooding during both the wet and dry day scenarios, see Figure 8. 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 not located within an EA Flood Warning Area.

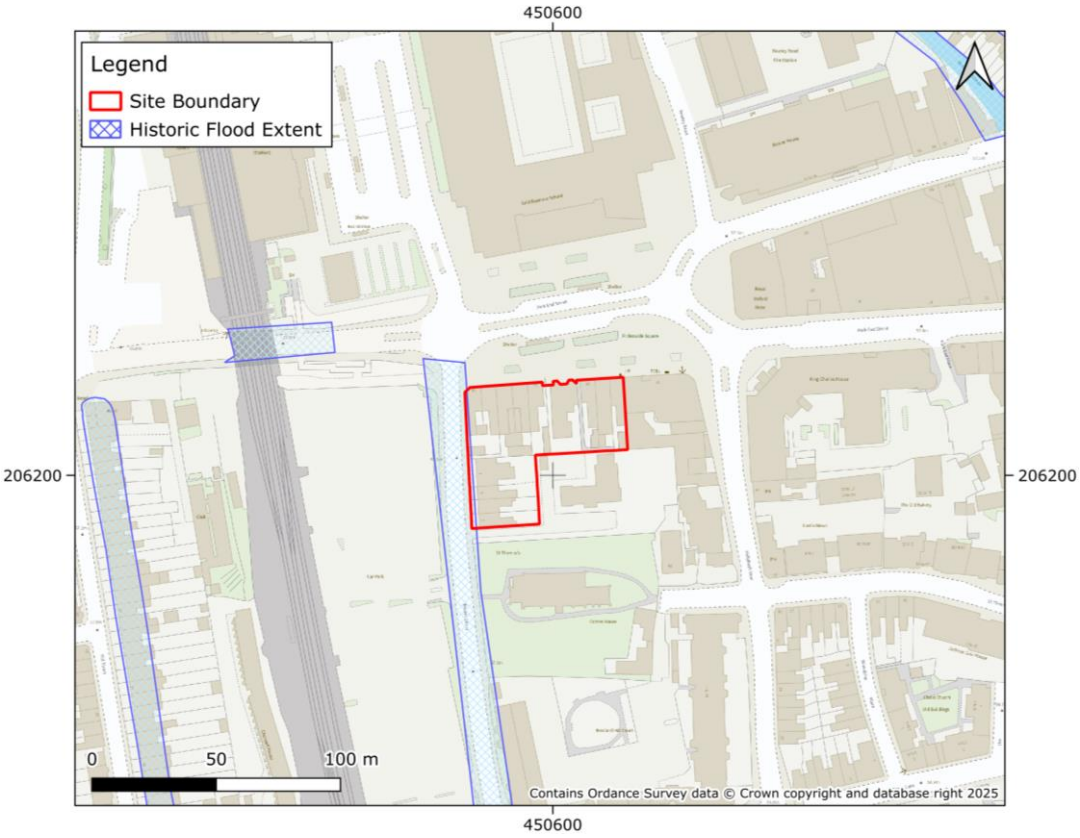


Figure 3 - Recorded Flood Outlines

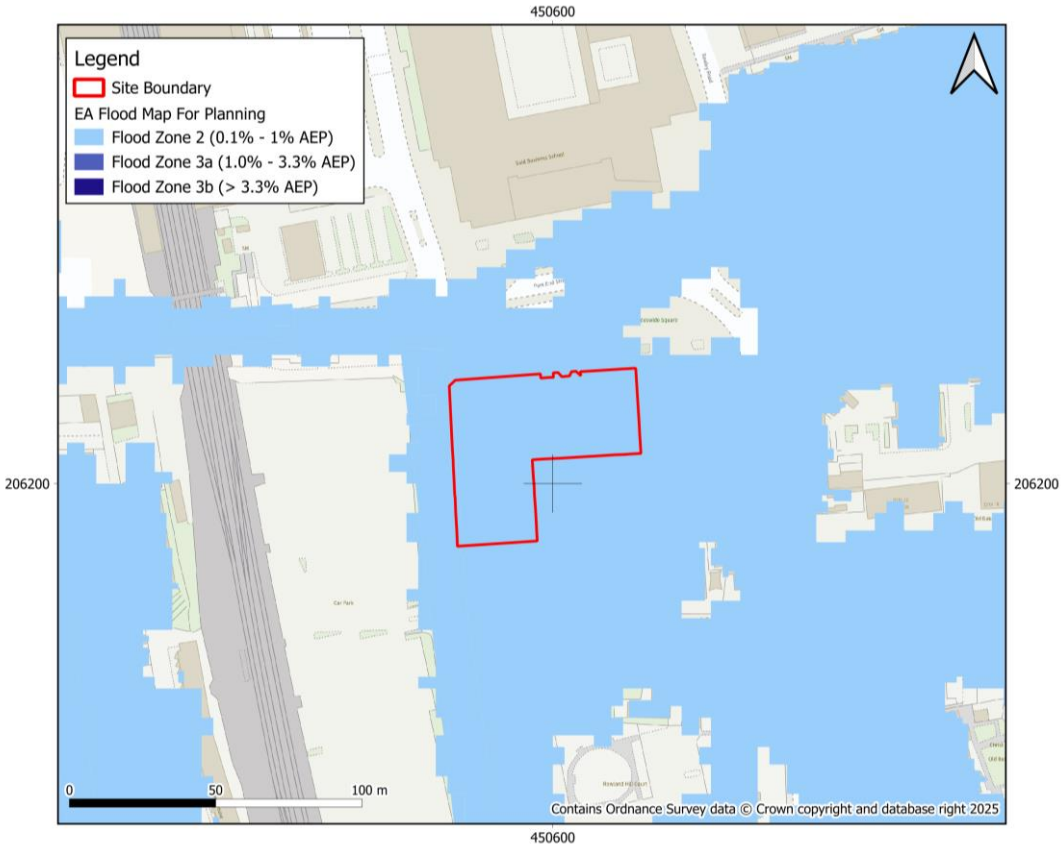


Figure 4 - Fluvial Flood Map

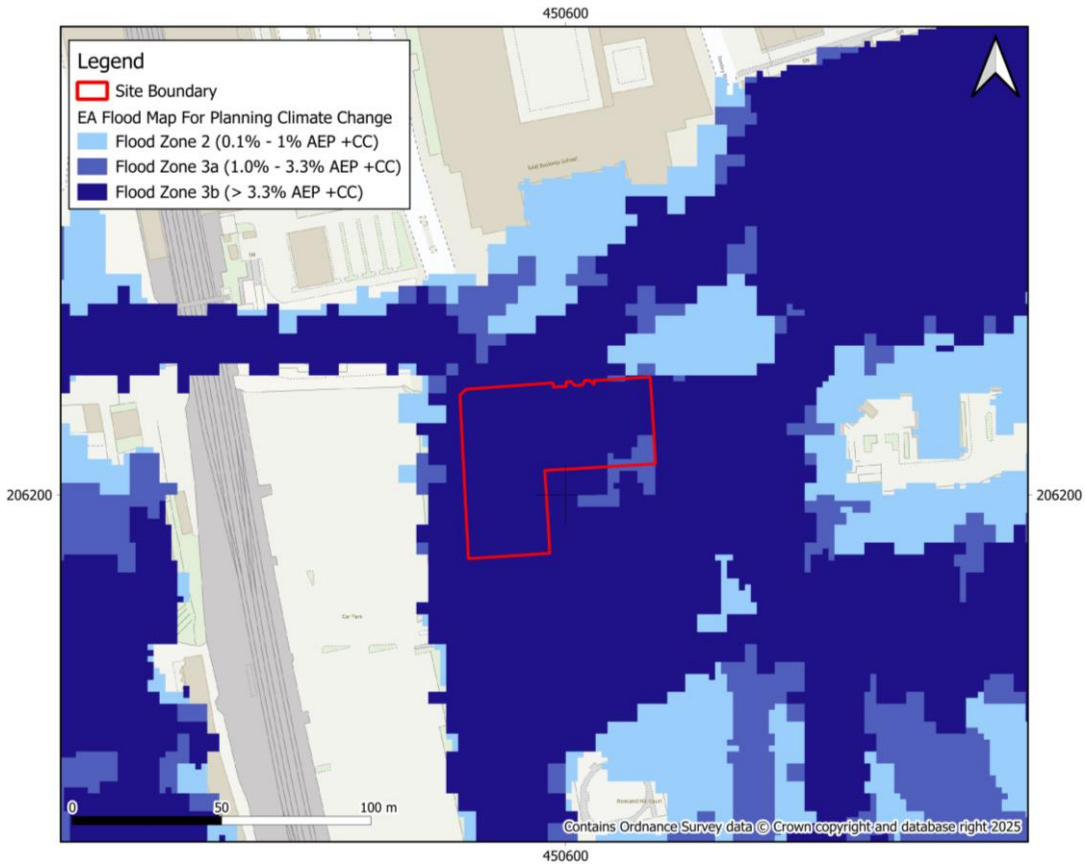


Figure 5 – Fluvial Climate Change Flood Map

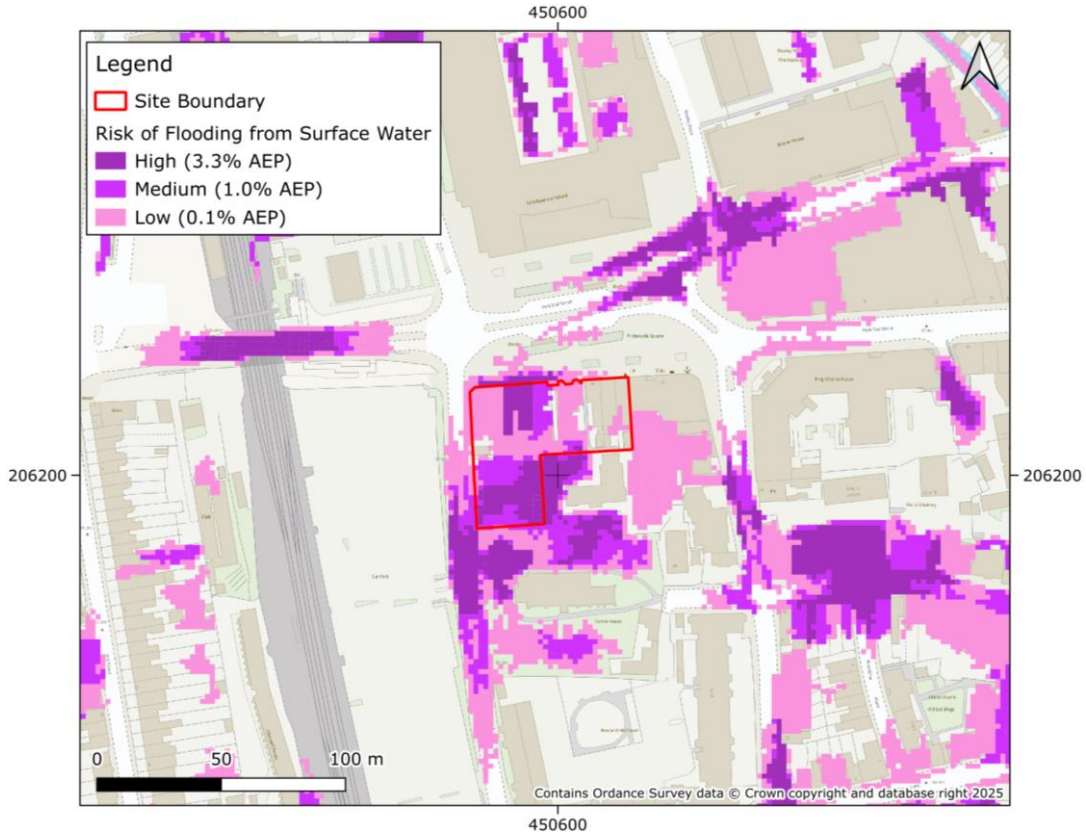


Figure 6 – Surface Water Flood Map


Figure 7 -Surface Water Climate Change Flood Map

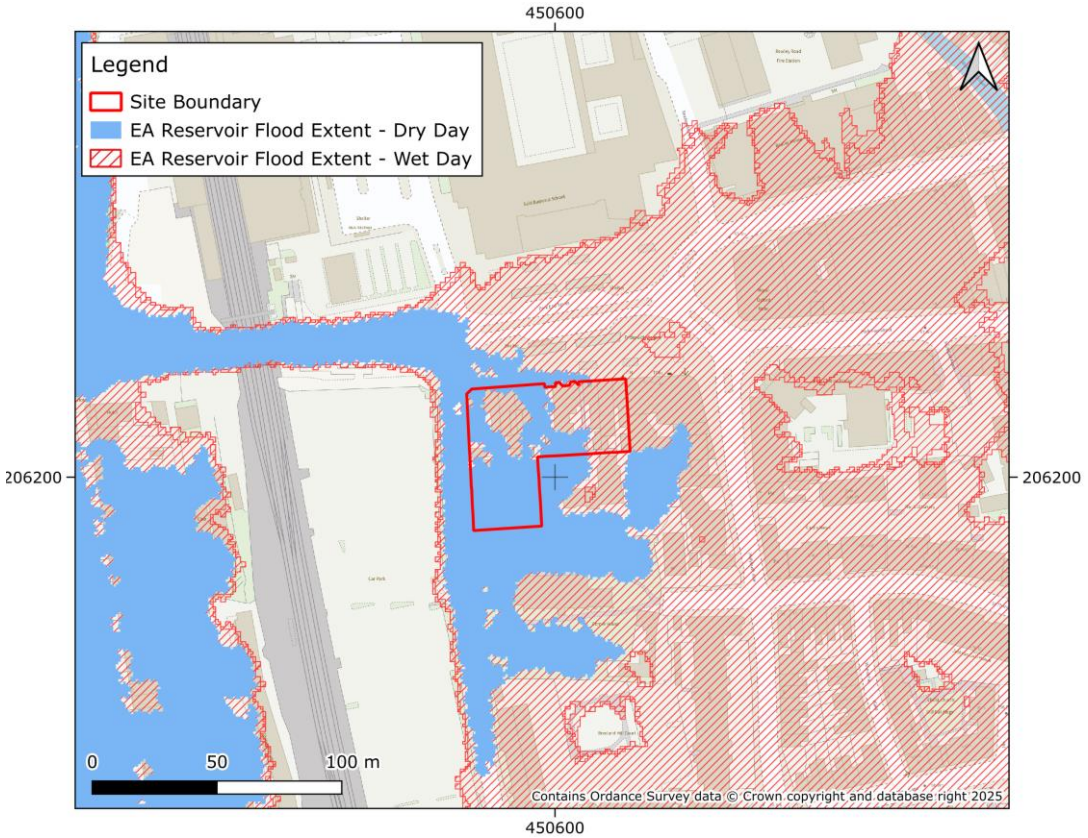


Figure 8 - Reservoir Failure Flood Map

# 4 Detailed Review of Primary Flood Risk

## 4.1 Primary Flood Risk

The primary flood risk at the site is fluvial. However, as there is a significant risk from pluvial flooding across south of the site, the flood risk generated by both mechanisms is quantitively 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, although the impact at this site is expected to be minimal.

The depth mapping for the design event (see Figure 9) shows flooding across the site. The maximum flood depth within the site is 0.76m, located along the southernmost boundary of the site behind the houses on Becket Street. Flood depths tend to be lower in the north of the site. Overall, the average depth across the site is 0.32m. The design flood level for the 1.0% AEP +26% CC event is 57.29m AOD, higher than the average ground level on the site based on LiDAR data (56.99m AOD).

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

During this event, inundation is present across approximately 54.2% of the site, with the most extensive surface water flooding occurring in the south of the site, see Figure 10. The area is at risk due to surface water runoff from Becket Street, Frideswide Square and the surrounding built up areas to the east of the site. The depth mapping indicates that depths are generally less than 0.2m in the north of the site and between 0.2m and 0.3m in the south of the site with the exception of a small area that reaches 0.6m. Flooding during the design pluvial event is less widespread than during the design fluvial event.

## 4.3 Access and egress

Current access to the site is assumed to be via Becket Street and Park End Street (through Frideswide Square). Due to the risk of flooding to the majority of the site, with greatest depths in the south of the site by Becket Street, the best route of access and egress is to head east via Park End Street at the north end of the site, see Figure 11.

This route travels through the smallest area of inundated land. In the section of inundated land closest to the site a maximum depth and velocity of 0.17m and 0.38 m/s is reached. The hazard rating along this section in the design event is *Low.* There is a very small area of high hazard where the route crosses Castle Mill Stream.

Whilst hazard is generally limited in extent early flood warning will be vital site to ensure that the access route can be utilised before floodwater inundates it especially given the high hazard modelled close to Castle Mill Stream. 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.

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.

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.

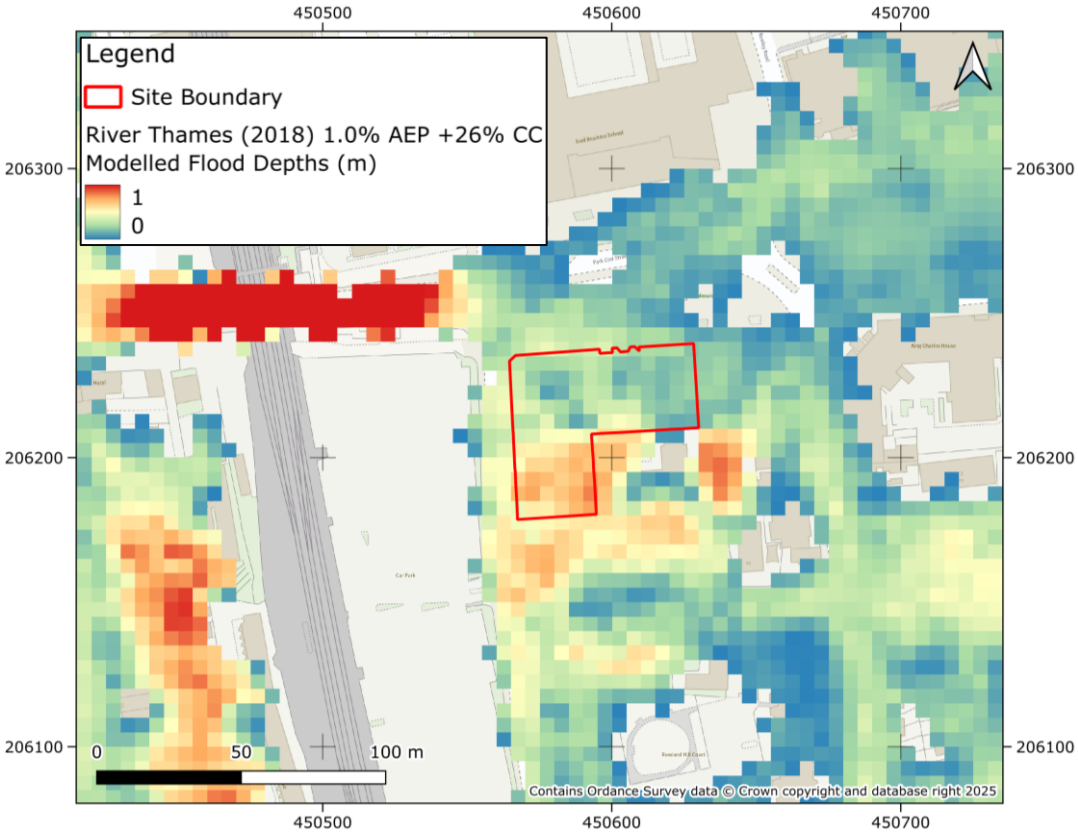


Figure 9 – River Thames (2018) 1.0% AEP +26% CC Modelled Flood Depths (m)

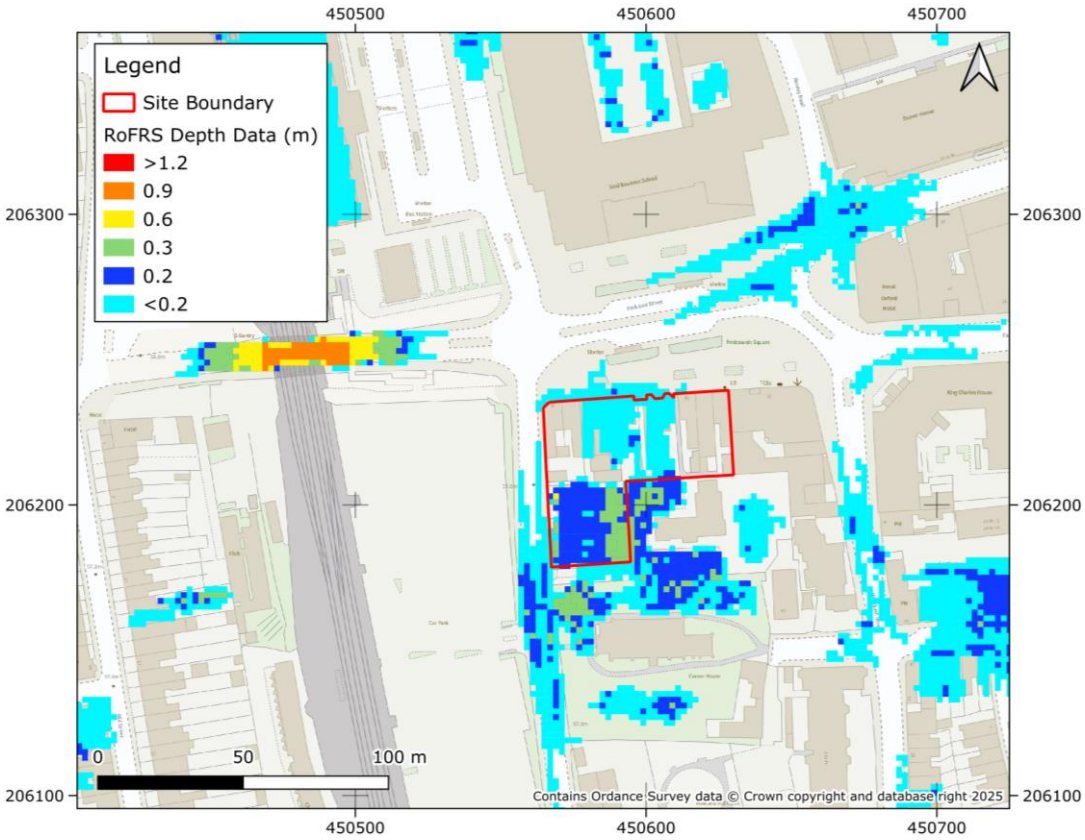


Figure 10 – ROFSW Depth Data for 1.0% AEP + Climate Change Event

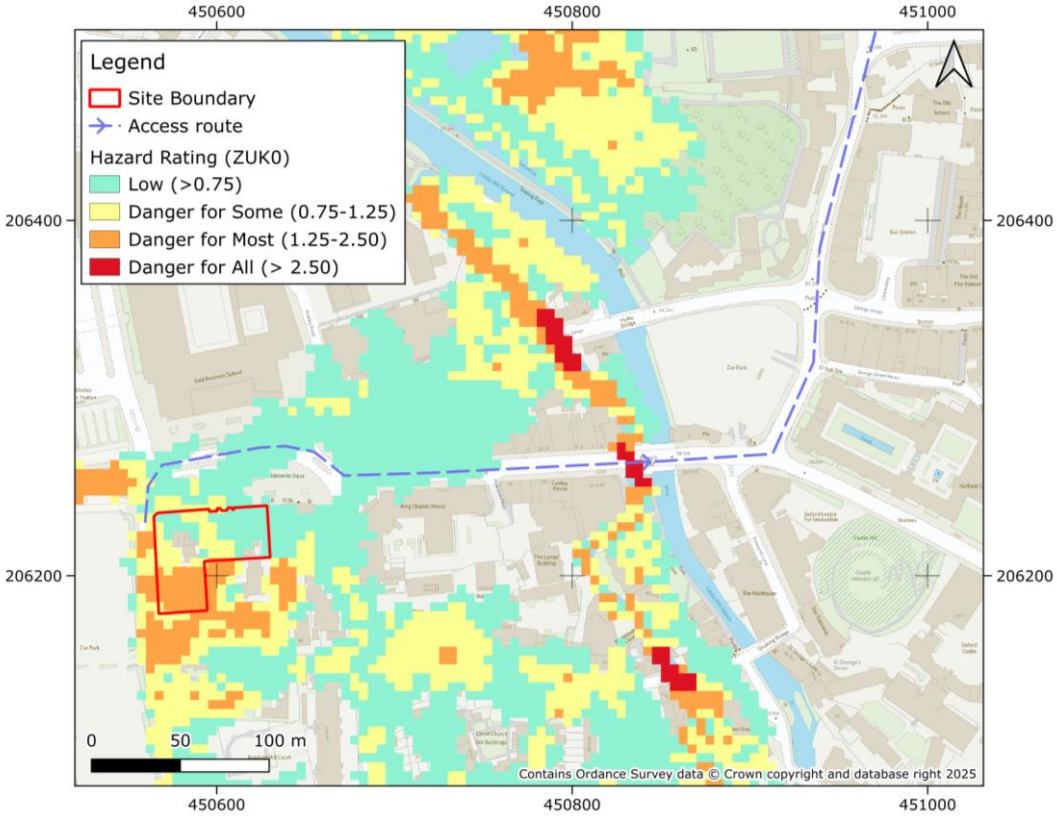


Figure 11 – Access/Egress Routes showing Flood Hazard (ZUK0) for the 1.0% AEP + 26% CC Event

# 5 Development Viability and FRA recommendations

## 5.1 Development Categorisation

The development proposed is residential categorised as more vulnerable development. A sequential approach to development is required, with development first prioritised within areas of Flood Zone 1 prior to consideration in higher flood risk zones. More vulnerable development is permissible within Flood Zone 2 but must pass an exception test to be deemed permissible within Flood Zone 3a. Only open space and/or water compatible development can be incorporated into Flood Zone 3b.

Flood Zone 3a and 3b do not inundate the site, however, the site faces significant barriers given that the site falls within the design flood extent (1.0% AEP + 26% Climate Change event). Any development located within the design flood extent may need to be raised with compensatory storage required to offset as loss in floodplain storage.

## 5.2 Scale of Development

The total site area is currently 0.26; allocated for residential development. At the site, 59 residential dwellings are proposed which would require high density housing.

Any development located within the design flood extent may need to be set at a floor level to provide an appropriate freeboard above the flood level for the 100-year (+26% climate change) design event, estimated at 57.29 m AOD. A large amount of the site is sited below this level, so ground raising may be significant. As compensatory storage will be required to offset any ground raising, this site may only provide opportunities for small scale developments. However, it is important to highlight that development is already present at the site which takes up natural floodplain storage. The proposed development should not exceed this and may be minded to incorporate open space or water compatible development to reduce this volume.

## 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 however this is not possible at this site which lies entirely within Flood Zone 2. Following consideration of Flood Zone 2, development in Flood Zone 3a should be considered. As stated, no development aside from open space or water compatible 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

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% annual exceedance probability (plus central climate change allowance) design event. If ground raising is implemented within the design flood extents, modelling may need to be undertaken to assess 3rd party impacts and compensatory storage requirements. A site-specific FRA should confirm any modelling requirements with the EA to assess 3rd party impacts, including the need 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 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 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 River Thames at this site may require Flood Risk Activity Permits, due to its designation as a main river.

Due to the site's location within both the dry and wet day reservoir failure inundation extents, any development in this area could affect the reservoirs risk designation, design category and how it is operated with potential cost implications for developers.