	St Albans City and District Council **Level 2 Strategic Flood Risk Assessment** **Detailed Site Summary Table**
Site details	
Site Code	**M25**
Address	Baulk Close, Harpenden, AL5 4LY
Area	0.53 ha
Current land use	Greenfield
Proposed land use	Residential
Flood Risk Vulnerability	More Vulnerable
Sources of flood risk	
Location of the site within the catchment	The site is located in the north fringe of Harpenden, a town to the north of St Albans. The site is situated to the south of the B653 – Lower Luton Road and approximately 1.8km north of Harpenden Station which is on the Thames Link Railway. The site is border to the north and east by small area of woodland which the River Lee flows through. The southern boundary is comprised of Baulk Close a small cul-der-sac off Westfield Road. The western boundary is comprised of the Harpenden – Luton Greenway. The River Lee (From Luton Hoo Lakes to Hertford) is 31.7km in length and covers a catchment area of 98.6km^2. The catchment is a mainly rural but also includes some urban areas such as the northeastern area of Harpenden and the eastern area of Hatfield. The River Lee is located within the wider Upper Lee Management Catchment, which covers an area of 1,025km^2.
Topography	Environment Agency 1m resolution LIDAR across the site shows that the topography varies. The LIDAR shows that the sites highest elevation is in the southwestern corner of the site at 94.3mOAD. The site then slopes gradually down in a northern and eastern direction, falling to elevations of between 88.9-90.6mAOD along the northern and eastern boundaries. The lowest elevation 88.9mAOD is located in the northern corner of the site.
Existing drainage features	While there are no existing drainage features within the site that are visible on topographic mapping or aerial imagery, the River Lee (Upper Reaches) runs parallel to site close to the site's eastern boundary.
Fluvial	**The proportion of site at risk FMFP:** FZ3b – 3% FZ3a – 3% FZ2 – 21%

	FZ1 – 79% The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Available data:** The Environment Agency's Flood Zone mapping has been used in this assessment, alongside the Upper Lee (2010) 1D hydraulic model. Only the modelled flood extents were available for the Upper Lee model, no hazard, depth or velocity grids were available as the model was 1D only over the study area. **Flood characteristics:** The sites northeastern boundary is within Flood Zone 2 with the northern corner also within Flood Zone 3a and 3b. The Flood Zones are based on historic flood outlines rather than detailed model results. The remaining area of the site is within Flood Zone 1, so at negligible fluvial risk. The defended 0.1% AEP event shows a slight reduction to the area flooded, as only the northern corner of the site is located within the flood extent. The southeastern corner of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. This means that this area is shown to benefit from defences (although may still be at some risk). However, it is unclear what defence has created this reduction, there are flood embankments either side of the River Lee at the downstream end of the Westfield Road culvert which could have may have resulted in this area of reduction in risk. The Environment Agency's Upper Lee model is undergoing a full revision. No results were available at the time of preparation of this report. It is possible that the predicted fluvial flood risk to the site may change as a result of this remodelling.
Surface Water	**Proportion of site at risk (RoFSW):** **3.3% AEP** – 0% Max depth – N/A Max velocity – N/A **1% AEP** – 0% Max depth – N/A Max velocity – N/A **0.1% AEP** – 9% Max depth – 0.30-0.60 m Max velocity – 0.50-1.00 m/s **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:**

	The Risk of Flooding from Surface Water for this site is minimal, with only one minor flow path present, in addition to a small area of ponding in the northern corner of the site for the 0.1% AEP event. The flow path is across an area in the north of the site from the southwest flowing north-eastwards towards the River Lee. This flow path has a maximum depth of <0.15m with a velocity between 0.50 to 1.00m/s. The flood hazard for this flow path is classified as 'Very low'. In comparison the area of ponding in the northern corner of the site has a maximum depth of 0.30 to 0.60m. The resulting flood hazard is 'Danger for most'.
Reservoir	The site is shown to be at risk of Dry Day and Wet Day reservoir flooding according to the Environment Agency's reservoir flood mapping. During the Wet Day scenario, flood risk is posed to north and northeastern boundaries of the site from the Luton Hoo Lake Lower managed and operated by Luton Hoo Park Limited. During the Dry Day, only the northern corner of the site at risk of flooding from Luton Hoo Lake Lower. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The JBA Groundwater mapping shows that the site is primarily at low risk of groundwater flooding, with 94% of the site having groundwater levels between 0.5 and 5 meters below ground level. However, the northern part of the site is at a higher risk of flooding, as 4% of the site has groundwater levels between 0.025 and 0.5m below ground level, and 1% of the site has groundwater within 0.025m of the ground level. The risk from groundwater will need to be investigated further as part of a site-specific flood risk assessment and is likely to require ground investigations to confirm the risk.
Sewers	The site is located within a postcode area with 13 historic incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register.
Flood history	The northeastern boundary of the site lies within an area affected by a historic flood event that occurred in the spring of 1947 due to the channel capacity being exceeded. There are no flood incidences reported within the site by either Hertfordshire County Council or St Albans District Council.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by no formal flood defences.
Residual risk	The site is potentially at residual fluvial flood risk from the River Lee as the river enters a culvert under the Westerfield Road approx. 70m downstream

	of the site. The culvert may become impounded, which could affect the site. Therefore, a site-specific Flood Risk Assessment should be carried out to investigate the impact of a blockage in the culvert under a climate change scenario. This assessment will confirm the risk to the site and help inform the finished floor levels.
Emergency planning	
Flood warning	The site's northeastern boundary is located in an Environment Agency Flood Warning Area, the northeastern boundary, 062FWF46Harpendn, River Lee at Harpenden and Wheathampstead including East Hyde. The site is also covered by the 062WAF46UpperLee, River Lee at Luton, Harpenden including Wheathampstead and East Hyde Flood Alert Area.
Access and egress	Access and egress to the site is currently By Baulk Close, to the south of the site. Vehicular access to Baulk Close is via Westfield Road. A proposed pedestrian route is being considered for the western side of the site off the Lee Valley Walk The majority of Baulk Close is covered by Flood Zone 2 making it at medium risk of fluvial flooding. Although Baulk Close isn't at risk of surface water, Westfield Road has several surface water flow paths present. During the 1% AEP surface water event Westfield Road has a flow path, with a flood depth <0.15m with a maximum velocity between 1.00 – 2.00m/s. The resulting flood hazard is 'Very Low', therefore vehicular and pedestrian access is still possible via this route. There is a flow path along the Lee Valley Walk on the site's western boundary, which reaches a maximum flood depth of >1.20m, to the south of the site with a flood hazard of 'Danger for all'. Therefore, currently pedestrian access via this route is not possible from the south. During the 0.1% AEP surface water event, the northern end of Westfield Road where it joins with the B653 flood depths reach between 0.30 to 0.6m, with velocities up to 1.00-2.00m/s. The associated flood hazard is 'Danger for most', therefore access and egress via the northern end of Westfield Road is not possible. Access and egress to the site from the south is possible via Westfield Road, as the flood hazard is classified as 'Very low' with flood depths <0.15m.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: Lee Upper Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard and frequency of both fluvial and surface water flooding.

	Fluvial: The Upper Lee 1% AEP fluvial event has been used as a proxy for the flood 3.3% AEP plus climate change event, as no results were available at the time of preparation of this report for the EA updated Upper Lee model. Thus, 3% of the site is affected by the 3.3% plus climate change event, specifically the northern corner of the site. The 0.1% AEP fluvial event has been used as a proxy for the 1% plus climate change event. As a result, 21% of the site, along the northeastern boundary is at risk of fluvial flooding. It is possible that the predicted fluvial flood risk to the site may change as a result of the Upper Lee remodelling. **Surface Water:** The latest climate change allowances have been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent is similar to that in the 0.1% AEP event, only affecting the sites northwestern corner. The maximum flood depth, velocity and hazard within the site is 0.52m, 0.23m/s and 'Danger for most'. This shows that the site is somewhat sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for surface water drainage and integrated flood risk management	

Broad-scale assessment of potential SuDS	**Geology & Soils**
	• Geology of the site consist of:
	  ○ Bedrock – Bedrock geology of the site is Sussex White Chalk Formation.
	• Soils at the site consist of:
	  ○ Slight acid loamy and clayey soils with impeded drainage.
	Sustainable Drainage Systems (SuDS)
	• Groundwater levels are indicated to be between 0.5 and 5m below ground level for the majority of the site (94%) and, there is a risk of flooding to subsurface assets and below ground development such as basements. However, groundwater flood risk is variable across the site from high to medium risk particularly areas closer to the River Lee. Groundwater monitoring is recommended to determine the seasonal variability of groundwater levels, as this may affect the design of the surface water drainage system.
	• The BGS data indicates that the underlying geology is Sussex White Chalk Formation which is likely to be free draining. This should be confirmed through infiltration testing, with the use of

	infiltration maximised as much as possible in accordance with the SuDS hierarchy. • The whole site is located within Groundwater Source Protection Zone 3. Proposed SuDS should be discussed with relevant stakeholders (St Albans City and District Council, Hertfordshire County Council (LLFA) and the Environment Agency) at an early stage to understand possible opportunities and constraints. The Groundwater Source Protection Zone guidence is currently undergoing review, therefore developers should ensure they are using the latest guidance available. • The site is not located within a historic landfill site. • Where possible, proposed attenuation features such as basins, ponds and tanks should be located outside of Flood Zone 2 to avoid the potential risks to the hydraulic capacity or structural integrity of these features. Surface water outfalls that discharge into the River Lee may be susceptible to surcharging due to water levels in the River Lee. The impacts of tide locking/flood flows will need to be considered in terms of the attenuation storage requirements of the site and placement of the outfalls. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (St Albans City and District Council, Hertfordshire County Council (LLFA) and the Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered.

	Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean and improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable'. The Exception Test is required for this site because in the northeastern area of the site there is a proportion of the site located within Flood Zone 2, 3a and 3b.

Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:**
	• At the planning application stage, a site-specific FRA will be required as the site is:
	  ○ Within fluvial flood zones 2, 3a, and 3b
	  ○ At risk of other sources of flooding (surface water, groundwater and reservoir)
	• All sources of flooding should be considered as part of a site-specific FRA. Ground investigations are likely to be necessary to confirm the risk from groundwater flooding to the site.
	• Consultation with St Albans City and District Council, Hertfordshire County Council (Lead Local Flood Authority), Thames Water, and the Environment Agency should be undertaken at an early stage.
	• Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); St Albans City and District Council's Local Plan Policies and Hertfordshire County Council's Guidance for Developers.
	• The development should be designed with mitigation measures in place where required.
	Guidance for site design and making development safe:
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the

development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).

- This development is proposed within Flood Zone 3b extent, careful consideration will need to be given to flood resistance and resilience measure and an appropriate Flood Warning and Evacuation Plan will be essential. Most forms of built development are not appropriate within Flood Zone 3b.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
- Mitigation for seasonal high groundwater levels must be considered for the northern area of the site (for example by raising finished floor levels to an appropriate height above ground level).
- The design of the development and its SuDS schemes must consider the seasonally high groundwater table, within the norther area of the site. Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.
- Planning permission is required to surface more than 5 square metres of unpaved ground using a material that cannot absorb water.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere.
    - raise them as much as possible
    - include extra flood resistance and resilience measures.
- Other examples of flood resistance and resilience measures include:
    - using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
    - making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
    - by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.

Key messages

The Exception Test will be required for this site, and St Albans City and District Council will need to carefully consider the benefits of developing the site against the flood risks from fluvial, surface water and groundwater. Development may be possible provided the flood risk part of the Exception Test can be satisfied as below:

- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future, that site users will be safe throughout the lifetime of the development, and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring areas.
- The northeastern boundary of the site located in Flood Zone 3b is left undeveloped.
- The development takes into account the adjacent Priority Habitat to the east, an area of deciduous woodland.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development steered away from the areas identified to be at risk of surface water flooding across the site.
- Safe access and egress can be demonstrated in the fluvial and surface water plus climate change events. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere. Given the close proximity to the watercourse, a flood warning and evacuation plan should be prepared for the site.
- If flood mitigation measures are implemented then they are tested to check that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

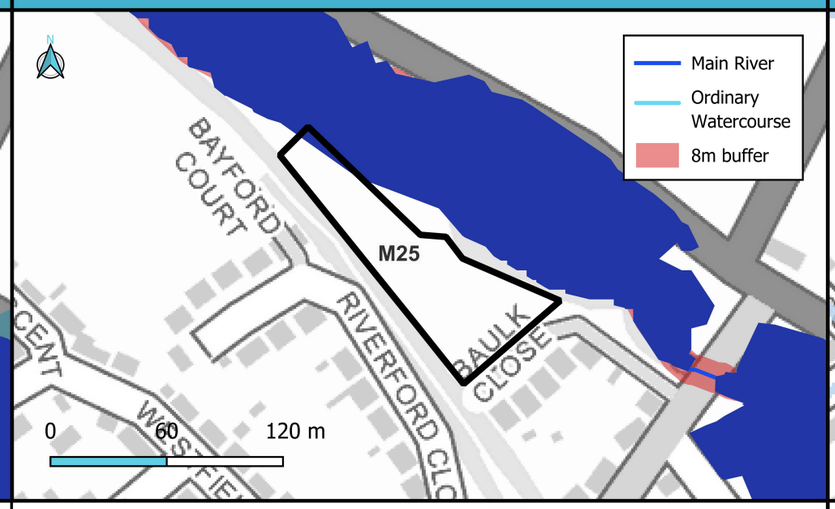
Mapping Information	
Flood Zones	Flood Zones 2 and 3a have been taken from the Environment Agency's Flood Map for Planning mapping. Flood Zone 3b has been created from the exsisting Flood Zone 3a (1 in 100 year) to represent the functional floodplain.
Climate change	The 1% AEP and 0.1% fluvial events from the Upper Lee (2010) model have been used as proxies for the climate change events. The 1% AEP event represents Flood Zone 3b plus climate change event and the 0.1% AEP event used to represent Flood Zone 3a plus climate change. The functional floodplain Flood Zone 3b will need to be reviewed and defined for development sites at the site-specific Flood Risk Assessment (FRA) stage, potentially through more detailed hydraulic modelling. The Environment Agency's Upper Lee model is undergoing a full revision, but was no results were available at the time of preparation of this report.
Fluvial depth, velocity and hazard mapping	No results are available at the time of preparation of this report.
Surface Water	The Environment Agency's Risk of Flooding from Surface Water dataset has been used for this assessment. The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW dataset.

Site Reference	M25
Site Name	Land accessed off Baulk Close, Harpenden

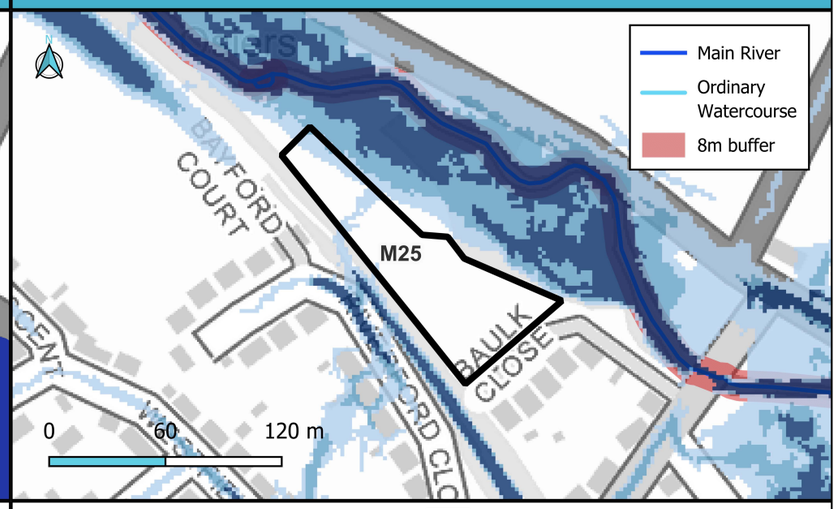
St Albans District Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary

Flood Zone Map (present day)

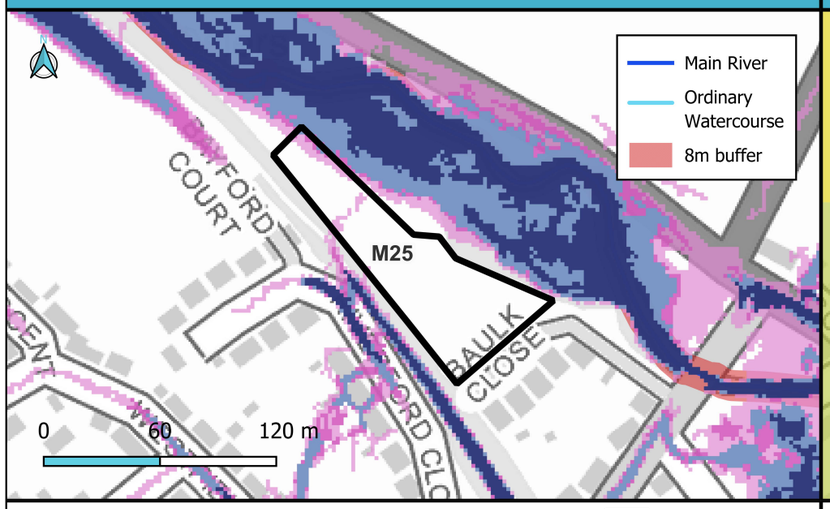
Flood Zone 3b + Climate Change



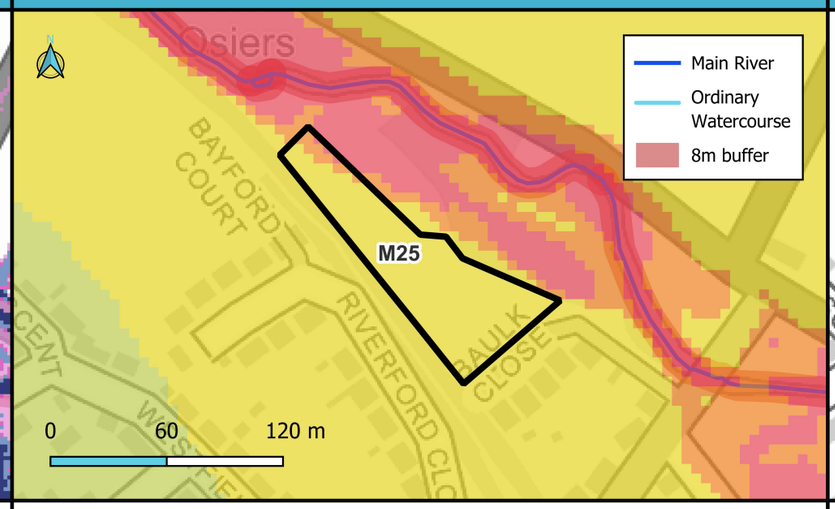
Surface Water Map (RoFSW)



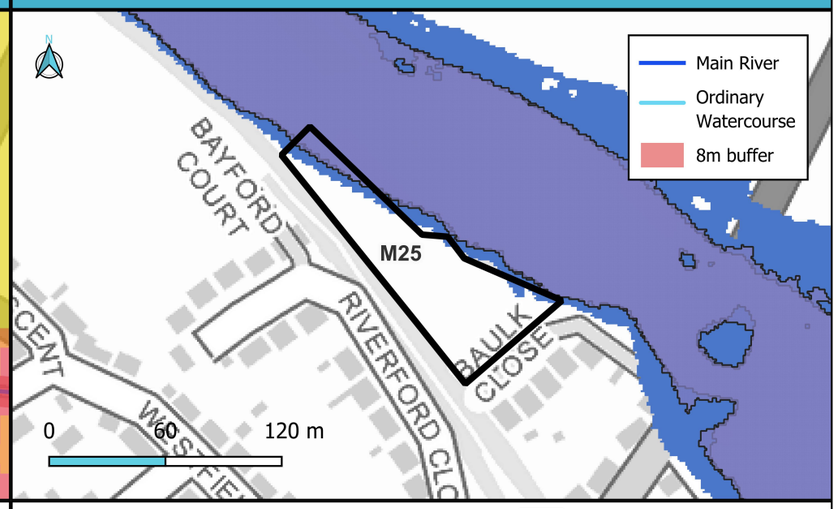
Surface Water Map + Climate Change



Groundwater (Gw) Flood Risk 1% AEP



Reservoir Flood Risk



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Site Name	Baulk Close, Harpenden, AL5 4LY

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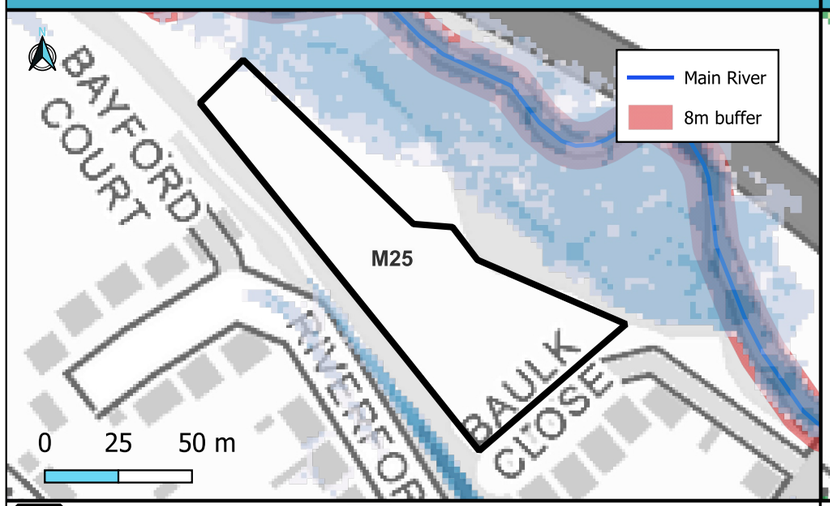
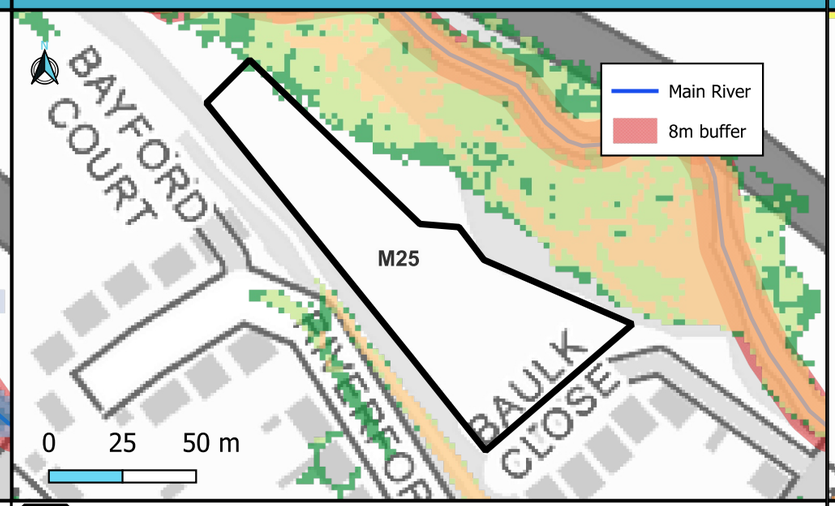
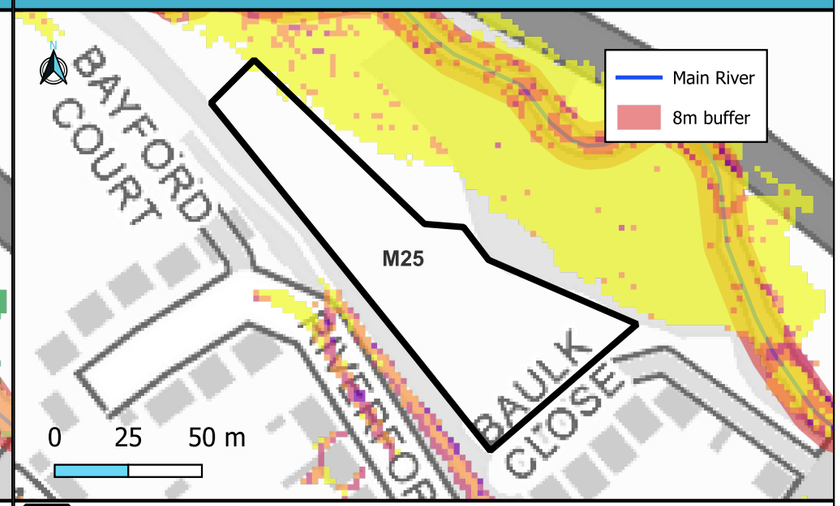
RoFSW Max Depth - 1% AEP



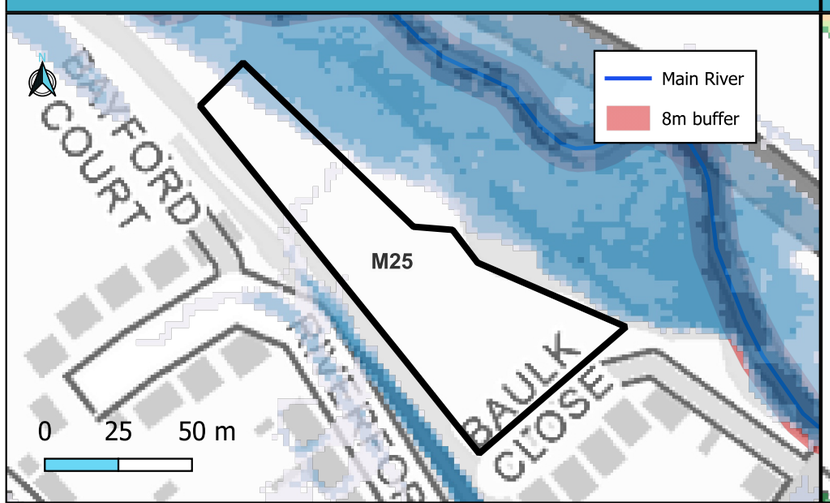
RoFSW Max Hazard - 1% AEP



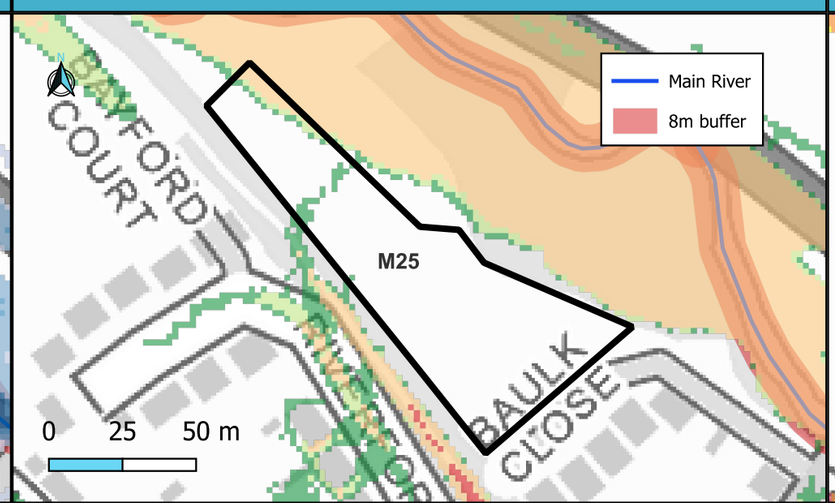
RoFSW Max Velocity - 1% AEP



RoFSW Max Depth - 1% AEP + 40% CC



RoFSW Max Hazard - 1% AEP + 40% CC



RoFSW Max Velocity - 1% AEP + 40% CC