



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

Site details

Address	Harpenden Station Car Park
Area	1.24ha
Current land use	Car park
Proposed land use	Residential
Flood Risk Vulnerability	More Vulnerable

Sources of flood risk

Location of the site within the catchment	<p>The site is situated in Harpenden, a town to the north of St Albans. The site is the current Harpenden Station Car Park, which lies on the eastern side of the Thames Link Railway next to the station, the railway line makes up the site's western boundary. The northern boundary consists of Station Road with residential housing to the east and south of the site.</p> <p>The site is within the Upper Colne and Ellen Brook catchment, which covers an area of 95.5km², with the River Colne located approximately 10.3 km to the south of the site. The site is within the upper catchment, which is a mixture of rural and urban. The site is situated within the urban area of the catchment as its located in central Harpenden. The River Colne is part of the Colne Management Catchment, which covers a much larger area of 1,040 km².</p>
Topography	<p>Environment Agency 1m resolution LIDAR across the site shows that topography varies. The site's elevation is between 112.9 – 117.0mAOD. The highest elevations located along the site's eastern boundary. The lowest elevation is by the current entrance to the site, in the northeastern corner at 112.9mAOD. From this point the elevation then raises to the south to 115.4mAOD where the current access road meets the carpark. The elevation for the remaining carpark is then primarily between 113.3 – 114.6mAOD.</p>
Existing drainage features	<p>There are no existing drainage features within the site that are visible on topographic mapping or aerial imagery. Given that the site is within central Harpenden, an urban area, it is likely to be drained by the surface water drainage network.</p>
Fluvial	<p>The proportion of site at risk FMFP: FZ3b – 0% FZ3a – 0% FZ2 – 0% FZ1 – 100%</p>

	<p>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%).</p> <p>Available data:</p> <p>The Environment Agency's Flood Zone mapping has been used in this assessment. No detailed hydraulic modelling was available for this site.</p> <p>Flood characteristics:</p> <p>The site is located within Flood Zone 1 and is therefore at negligible risk of fluvial flooding.</p>
<p>Surface Water</p>	<p>Proportion of site at risk (RoFSW):</p> <p>3.3% AEP – 0% Max depth – N/A Max velocity – N/A</p> <p>1% AEP – 1% Max depth – 0.15 – 0.30m Max velocity – 1.00 – 2.00m/s</p> <p>0.1% AEP – 12% Max depth – 0.30 – 0.60 Max velocity – 1.00 – 2.00m/s</p> <p>Available data:</p> <p>The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment.</p> <p>Description of surface water flow paths:</p> <p>There is no risk of flooding from surface water within the site during the 3.3% AEP event.</p> <p>During the 1% AEP event, there is minimal surface water flooding with the site with a small flow path flowing along part of the western boundary. The flood depths for the flow path are predominantly <0.15m with the maximum flood depths between 0.15 to 0.30m. The flow velocity varies, with the maximum velocity between 1.00 to 2.00m/s. The flood hazard is categorized as 'Very Low'.</p> <p>During the 0.1% AEP event, the surface flow route along part of the western boundary that was present in the 1% AEP event has extended, affecting a larger area. There is an additional flow route in the northeastern corner, flowing along the access road onto Station Road. A further two surface water flow paths enter the site from the east. The main flow route along the sites western boundary has a flood depth between 0.15 to 0.30m, with a maximum depth of between 0.30 to 0.60 where the flow route exits the site. The flow velocities along this route reaches a maximum of between 1.00 -2.00m/s. The associated flood hazard although is mainly classed as 'Very low' there are areas that are classified as</p>

	'Danger for some' and 'Danger for most'. The remaining flow routes within the site have flood depths <0.15m and varying velocities mainly between 0.50 – 0.1m/s. The flood hazard is classified as 'Very low'.
Reservoir	The Environment Agency's reservoir maps show the site is not at risk of flooding from reservoir.
Groundwater	The JBA Groundwater mapping, shows that the whole site is shown to have ground water levels at least 5m below ground level. As a result, groundwater flooding risk to the site is not likely.
Sewers	The site is located within a postcode area with 21 historic incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register.
Flood history	There are no reported flood incidents reported by the Environment Agency, St Albans District Council or Hertfordshire County Council within the site.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is not protected by any formal flood defences.
Residual risk	The site is not at residual risk of flooding.
Emergency planning	
Flood warning	The site is not located within any Environment Agency Flood Warning or Alert Areas.
Access and egress	<p>Access and egress to the site is currently via a road into the site off Station Road. Station road has multiple minor and main roads connecting into it.</p> <p>During the 3.3% AEP surface water event, there is a flow route along Station Road from just east of the sites access road to where it meets the A1081. The flood depths vary from <0.15m at the start of the flow route to between 0.30 to 0.60m to the west. The velocities are mainly between 1.00 to 2.00m/s. The flood hazard is classed as 'very low', with a small area at the western end of the flow route, where it meets the A1081 classified as 'Danger for some'. Vehicular and pedestrian access and egress to the site is possible.</p> <p>During the 1% AEP surface water event, the flow route along Station Road has extended to the east with the route now starting by Devonshire Road. The flood depths from the Devonshire Road to where Station Road goes under the railway are <0.15m. However, the depths increase under the railway to between 0.30 to 0.60m. The maximum flood depths for this route is located to the west where it meets High Street/A1081m with depths between 0.60 to 0.90m. The velocity of the flow route is primarily between 1.00 to 2.00m/s. The flood hazard although is mainly 'Very low', under the railway it is classed as 'Danger for most' so access and egress to the site via Station Road from the west is not possible. Vehicular access and egress to the site from Station Road from the east is still possible. There is</p>

	<p>also vehicular access and egress to the site from Carlton Road which joins station road to the north of the sites current entrance. As flood depths are <0.15m and the flood hazard is classified as 'Very low'.</p> <p>During the 0.1% AEP surface water event, access and egress to the site via Station Road from the west is not possible. As where the road goes under the railway line there is an area of ponding with flood depths reaching between 0.60 to 0.90m. Additionally where Station Road meets the A1081 flood depths are >1.20m, with velocities >2.00m/s. As a result, the flood hazard along Station Road to the west is categorizes between 'Danger for most' to Danger for all'. Vehicular access and egress is still possible to the site via Station Road from the east and Carl0oton Road. As flood hazard is classed as 'Very low' to 'Danger for some'. Due to flood depths ranging from <0.15m to between 0.15 to 0.30m, although velocities reach a maximum of >2.00m/s.</p>
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Dry Islands	The site is not located on a dry island.
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Climate change	
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Implications for the site	<p>Management Catchment: Colne Management Catchment</p> <p>Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding</p> <p>Fluvial:</p> <p>As the site is situated outside of any area of present-day fluvial risk, Flood Zone 2 has been used as an indicative assessment of climate change. Mapping shows that the site remains outside of these extents, this indicates that fluvial flood risk to the site remains negligible.</p> <p>Surface Water:</p> <p>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.</p> <p>In the 1% AEP plus 40% climate change event the flood extent is similar to that in the 0.1% AEP event, with a surface flow routes along the western boundary and additional small routes in the northeastern corner and entering the site from the east. Within the site the maximum flood depth, velocity and hazard is 0.30m, 1.23m/s and 'Danger for some'.</p> <p>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.</p>
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Requirements for surface water drainage and integrated flood risk management

Broad-scale assessment of potential SuDS

Geology & Soils

- Geology at the site consist of:
 - Bedrock – Bedrock geology of the site is Lewes Nodular Chalk Formation and Seaford Chalk Formation – chalk. This is a sedimentary bedrock.
- Soils at the site consist of:
 - Slightly acid loamy and clayey soils with impeded drainage

Sustainable Drainage Systems (SuDS)

- Groundwater levels are indicated to be at least 5m below ground level and groundwater flooding is not likely, however below ground development such as basements may still be susceptible to groundwater flooding.
- BGS data indicates that the underlying geology is Chalk 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 entire site is mostly located within Groundwater Source Protection Zone 1 (SPZ) and infiltration techniques may not appropriate for anything other than clean roof drainage. If infiltration is proposed for anything other than clean roof drainage a hydrogeological risk assessment should be undertaken, to ensure that the system does not pose an unacceptable risk to the source of supply. 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 guidance 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.
- Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation 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 1% and 0.1% AEP events. 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

- Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality,

<p>sustainability benefits and integrated flood risk management</p>	<p>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, and the Environment Agency) at an early stage to understand possible constraints.</p> <ul style="list-style-type: none"> • 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.
<p>NPPF and planning implications</p>	
<p>Exception Test requirements</p>	<p>The site is within Flood Zone 1 but at risk from surface water flooding. The Sequential Test must be passed, the criteria for which is highlighted within the Level 1 Assessment. The Exception Test is not required under the NPPF. However, it must be shown that the development will be safe for its lifetime and the risk can be managed through a sequential approach to design.</p>
<p>Requirements and guidance for site-specific Flood Risk Assessment</p>	<p>Flood Risk Assessment:</p> <ul style="list-style-type: none"> • At the planning application stage, a site-specific FRA will be required as the site is: <ul style="list-style-type: none"> ○ Greater than one hectare ○ At risk of flooding from surface water • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the St Albans City and District Council, Hertfordshire County Council, 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).
- 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.
- Planning permission is required to surface more than 5 square metres of unpaved ground using a material that cannot absorb water.
- Should built development be proposed within the 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
- Arrangements for safe access and egress will need to be demonstrated for the 1% and 0.1% surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
- 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 site is in Flood Zone 1 however has some significant risk of surface water flooding. Development is likely to be able to proceed if:

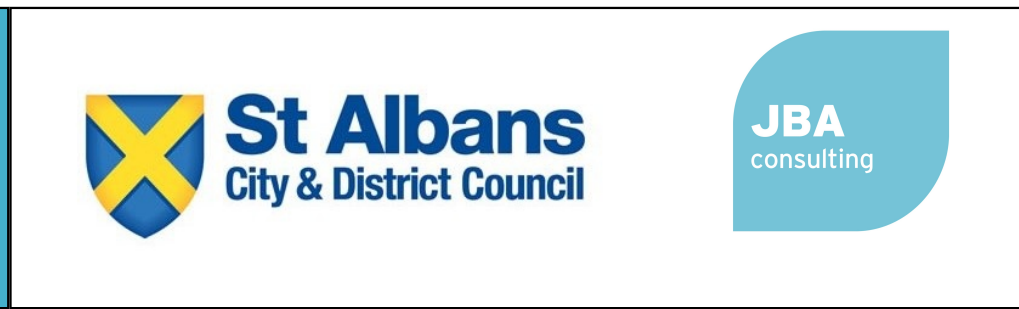
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development steered away from the areas identified to be at risk of surface water flooding across the site.
- Safe access and egress can be demonstrated in the surface water plus climate change events. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring areas.
- 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. There is no detailed hydraulic modelling available at this location.
Climate change	In the absence of detailed hydraulic modelling, Flood Zone 2 has been used as an indicative assessment of future fluvial risk at 0.1% AEP. The latest climate change allowances have been applied to the Environment Agency's RoFSW map to indicate the impact on surface water flood risk.
Fluvial depth, velocity and hazard mapping	There is no detailed hydraulic modelling available at this location.
Surface Water	The Environment Agency's Risk of Flooding from Surface Water dataset has been used for this assessment.
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.

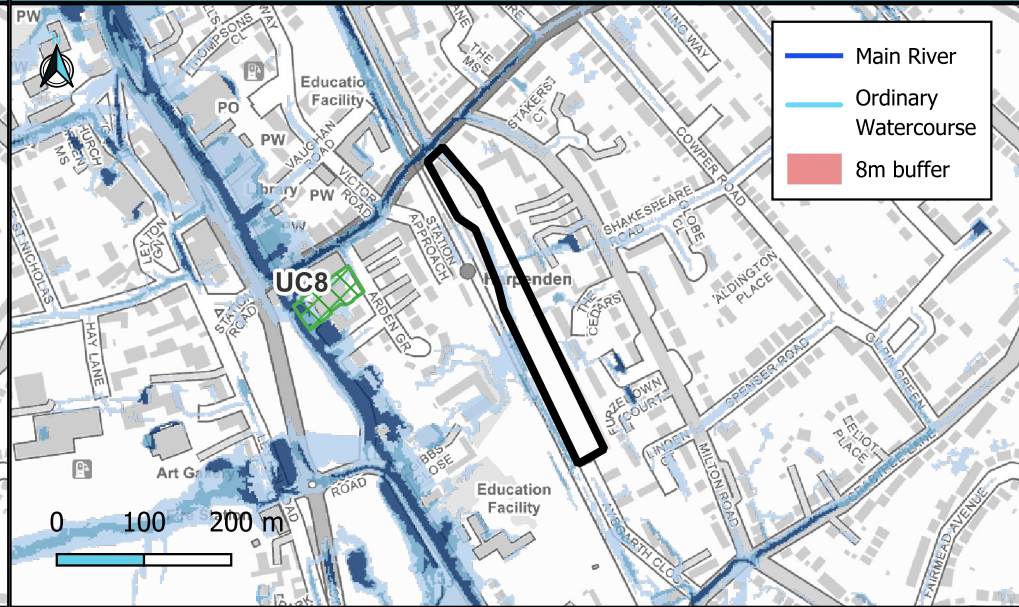
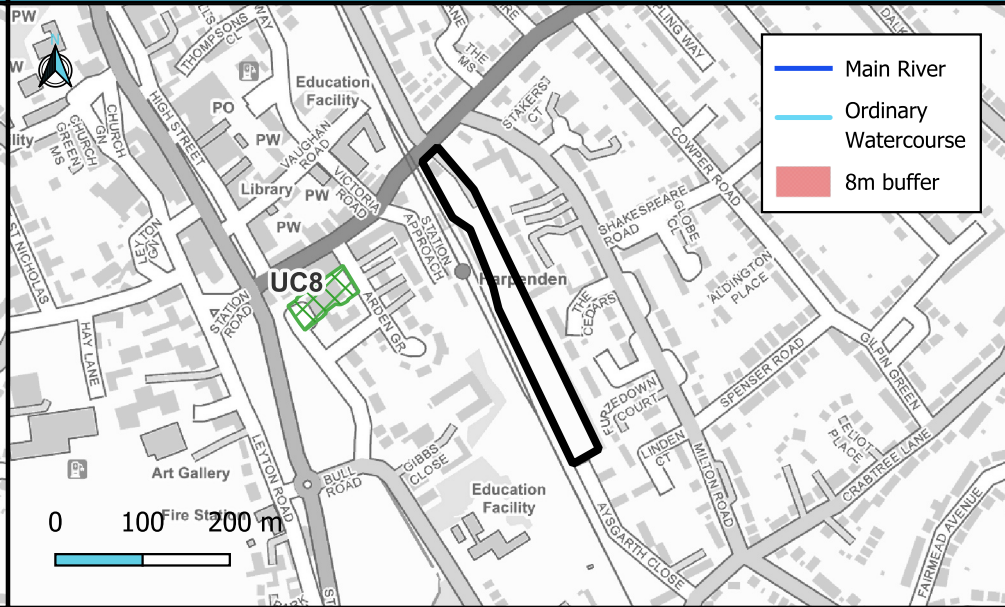
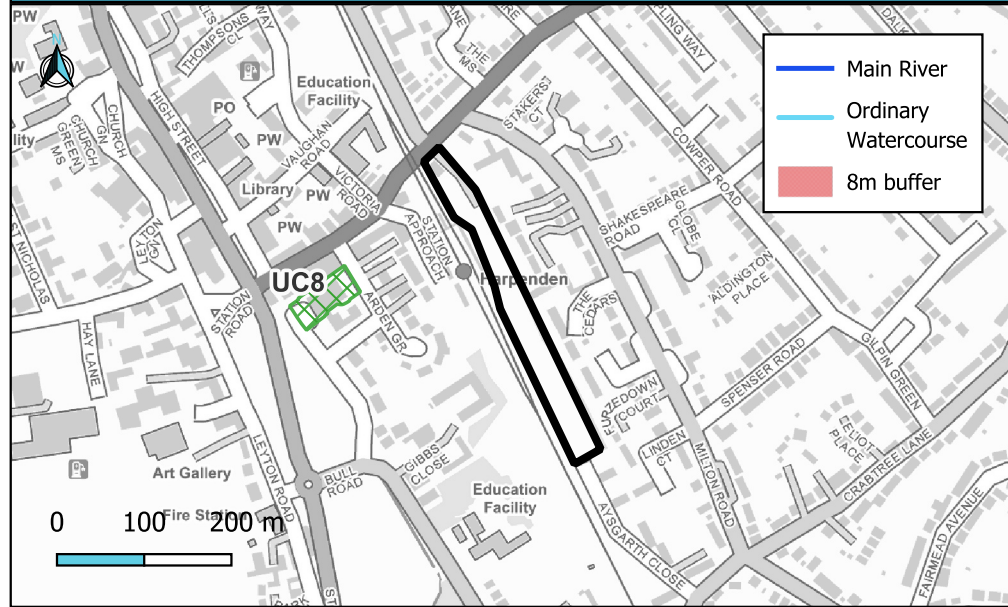
Site Reference	
Site Name	Harpenden Station Car Park

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Flood Zone Map (present day)	Flood Zone 3b + Climate Change	Surface Water Map (RoFSW)
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- Flood Zone 2 (Between 1% and 0.1% AEP)
- Flood Zone 3a (Between 3.33% and 1% AEP)
- Flood Zone 3b (Less than 3.33% AEP)
- Site boundary
- Other site

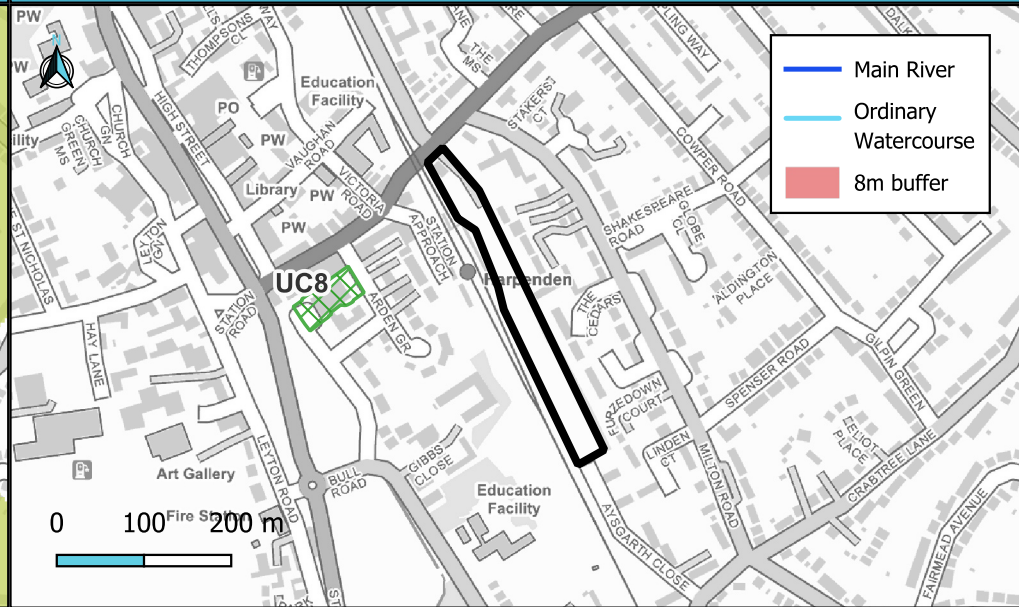
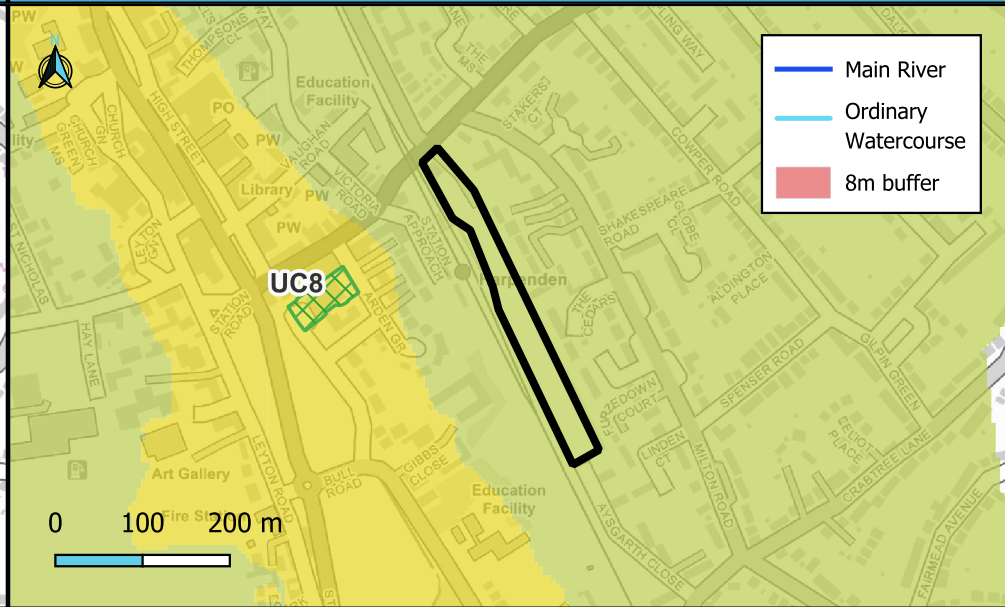
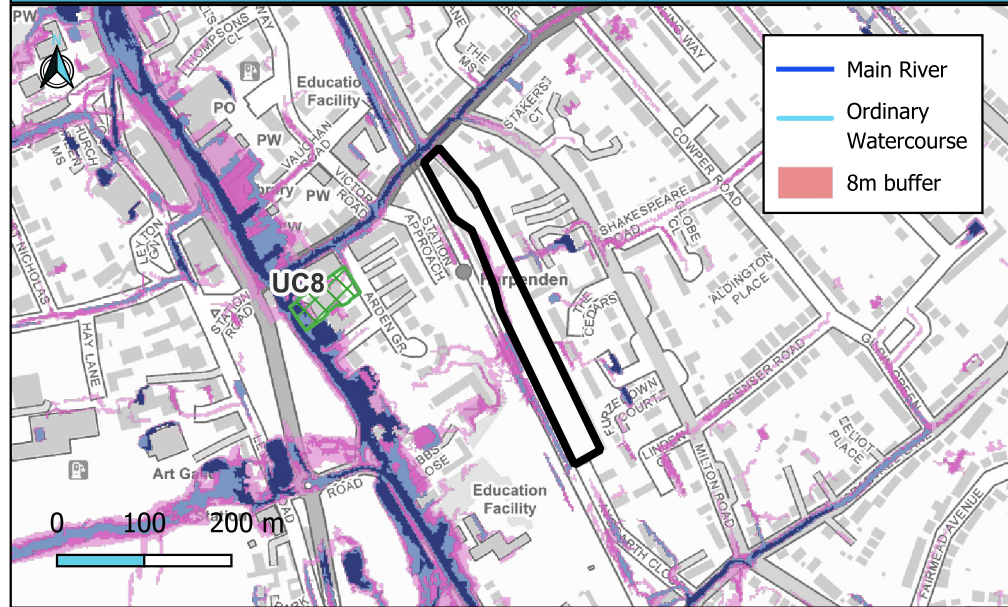
- Flood Zone 3b + 21% (Central allowance)
- Flood Zone 3b + 35% (Higher allowance)
- Flood Zone 3b
- Site boundary
- Other site

- RoFSW 1 in 30-year (3.33% AEP)
- RoFSW 1 in 100-year (1% AEP)
- RoFSW 1 in 1000-year (0.1% AEP)
- Site boundary
- Other site

Surface Water Map + Climate Change

Groundwater (Gw) Flood Risk 1% AEP

Reservoir Flood Risk



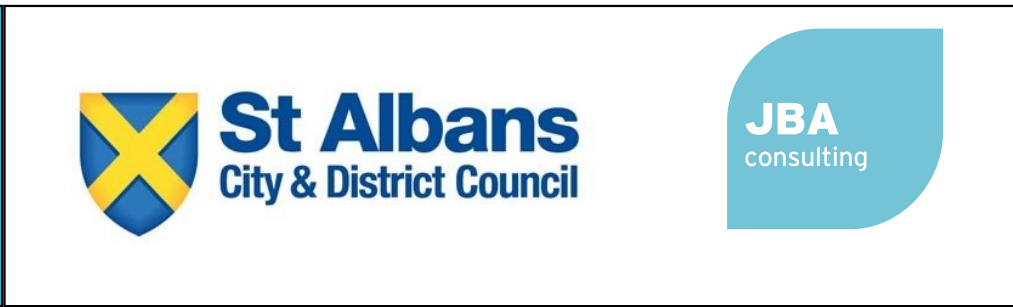
- RoFSW 1 in 30-year (3.33% AEP)
- RoFSW 1 in 30-year (3.33% AEP) plus 40%
- RoFSW 1 in 100-year (1% AEP)
- RoFSW 1 in 100-year 1% AEP plus 40%
- Site boundary
- Other site

- GW levels <0.025m below ground
- GW levels 0.025m to 0.5m below ground
- GW levels 0.5 to 5m below ground
- Site boundary
- Other site
- GW levels at least 5m below ground

- Reservoir 'Dry Day' flood extent
- Reservoir 'Wet Day' flood extent
- Reservoir - Fluvial contribution to flood extent
- Site boundary
- Other site

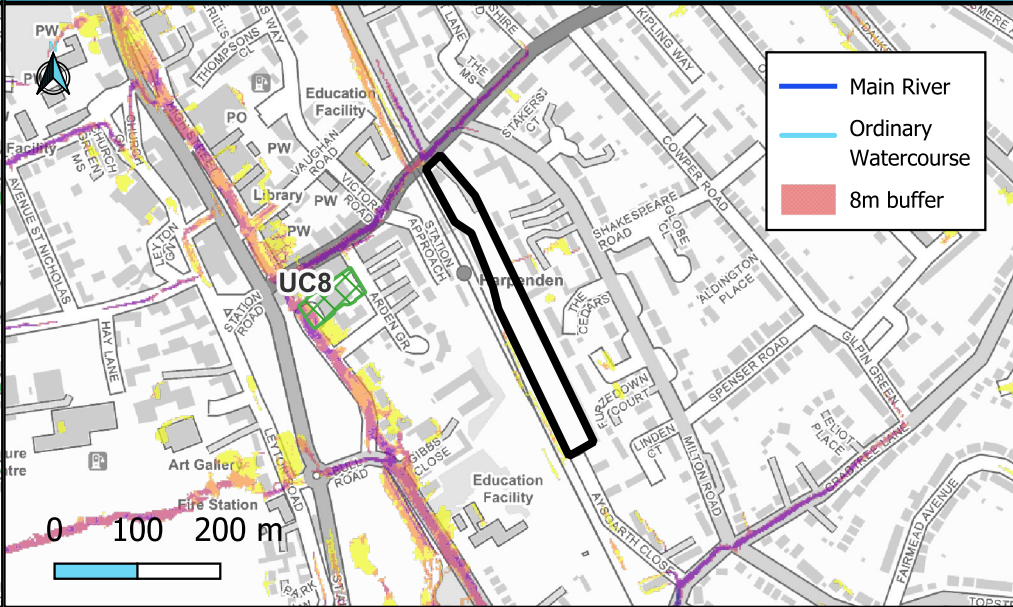
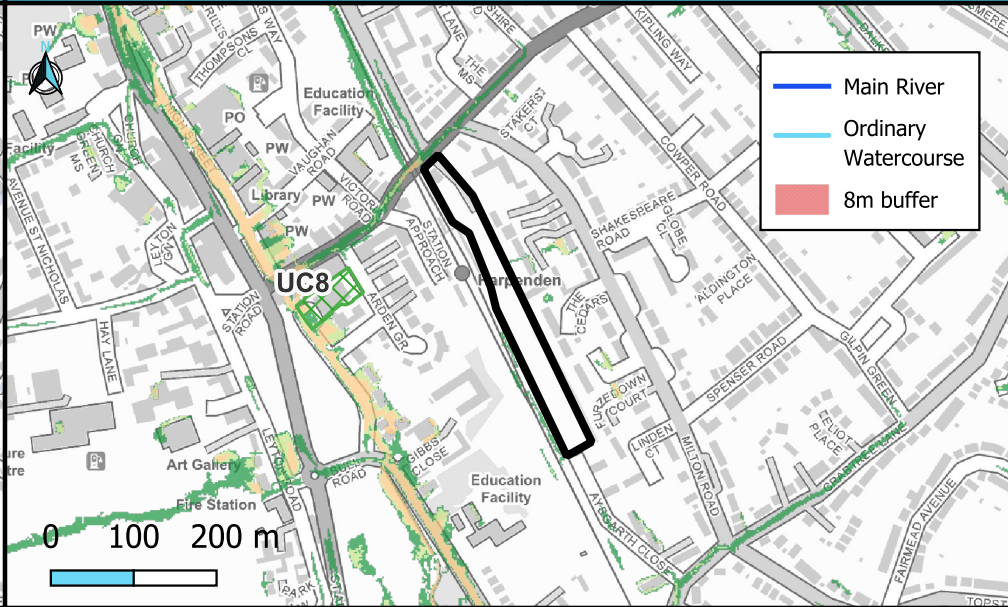
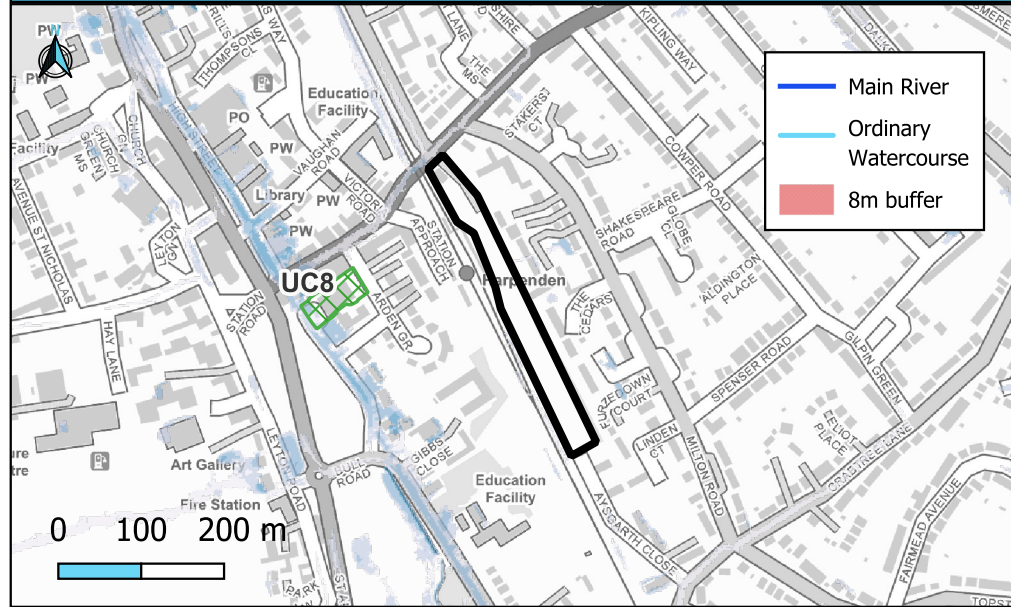
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RoFSW Max Depth - 1% AEP	RoFSW Max Hazard - 1% AEP	RoFSW Max Velocity - 1% AEP
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Depth (m)	0.00 - 0.15	0.15 - 0.30	0.30 - 0.60	0.60 - 0.90	0.90 - 1.20	> 1.20	Site boundary	Other site
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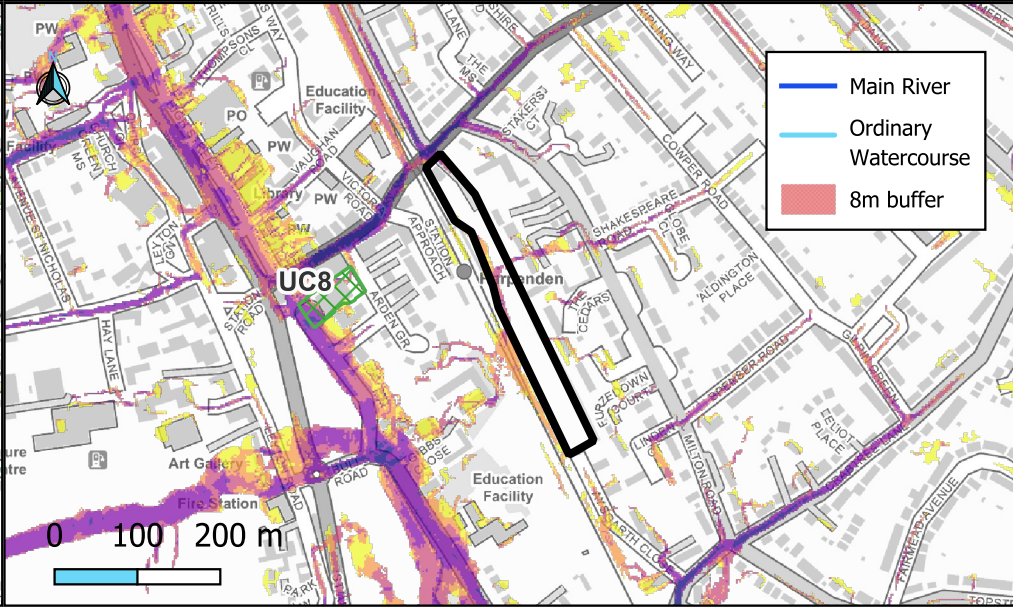
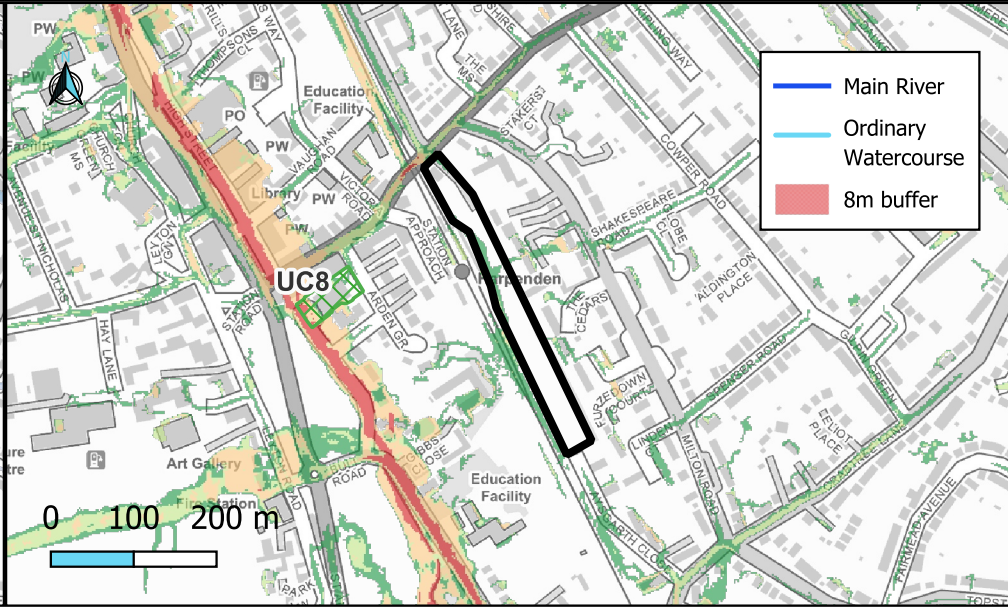
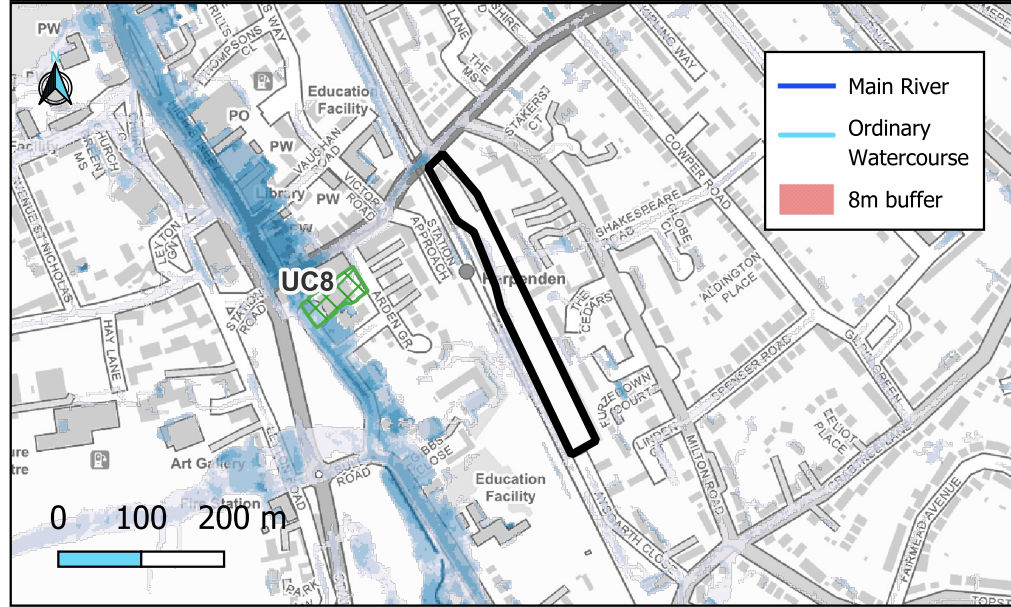
Hazard	< 0.75: Low	0.75 - 1.25: Moderate	1.25 - 2.00: Significant	> 2.00: Extreme	Site boundary	Other site
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Velocity (m/s)	0.00 - 0.25	0.25 - 0.50	0.50 - 1.00	1.00 - 2.00	> 2.00	Site boundary	Other site
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RoFSW Max Depth - 1% AEP + 40% CC

RoFSW Max Hazard - 1% AEP + 40% CC

RoFSW Max Velocity - 1% AEP + 40% CC



Depth (m)	<= 0.15	0.15 - 0.30	0.30 - 0.60	0.60 - 0.90	0.90 - 1.20	> 1.20	Site boundary	Other site
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Hazard	< 0.75: Low	0.75 - 1.25: Moderate	1.25 - 2.00: Significant	> 2.00: Extreme	Site boundary	Other site
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Velocity (m/s)	0.00 - 0.25	0.25 - 0.50	0.50 - 1.00	1.00 - 2.00	> 2.00	Site boundary	Other site
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