Bradford Level 2 Strategic Flood Risk Assessment - Site H217

Final Draft

July 2026

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

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Prepared by	Dominic Richardson BSc Analyst
Reviewed by	Mike Williamson BSc MSc CGeog FRGS EADA Principal Analyst
Authorised by	Krista Keating BSc MSc CEnv CSci MCIWEM C.WEM Associate Director

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Contract

JBA Project Manager	Mike Williamson
Address	Phoenix House, Lakeside Drive, Centre Park, Warrington, WA1 1RX
JBA Project Code	2024s1078

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H217. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the 'CBMDC Level 1 SFRA' (2023) and read the 'CBMDC Level 2 SFRA Main Report' (2024) and is therefore familiar with the terminology used in this report.

1.1 Site H217

- Location: Fulton Street/Sunbridge Road
- Existing site use: Brownfield
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 0.5 hectares
- Proposed development impermeable area: 0.45 hectares
- Watercourse: Bradford Beck
- CBMDC river model: Bradford Beck 2026
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Assessment of modelled fluvial flood depths, velocities and hazards
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk

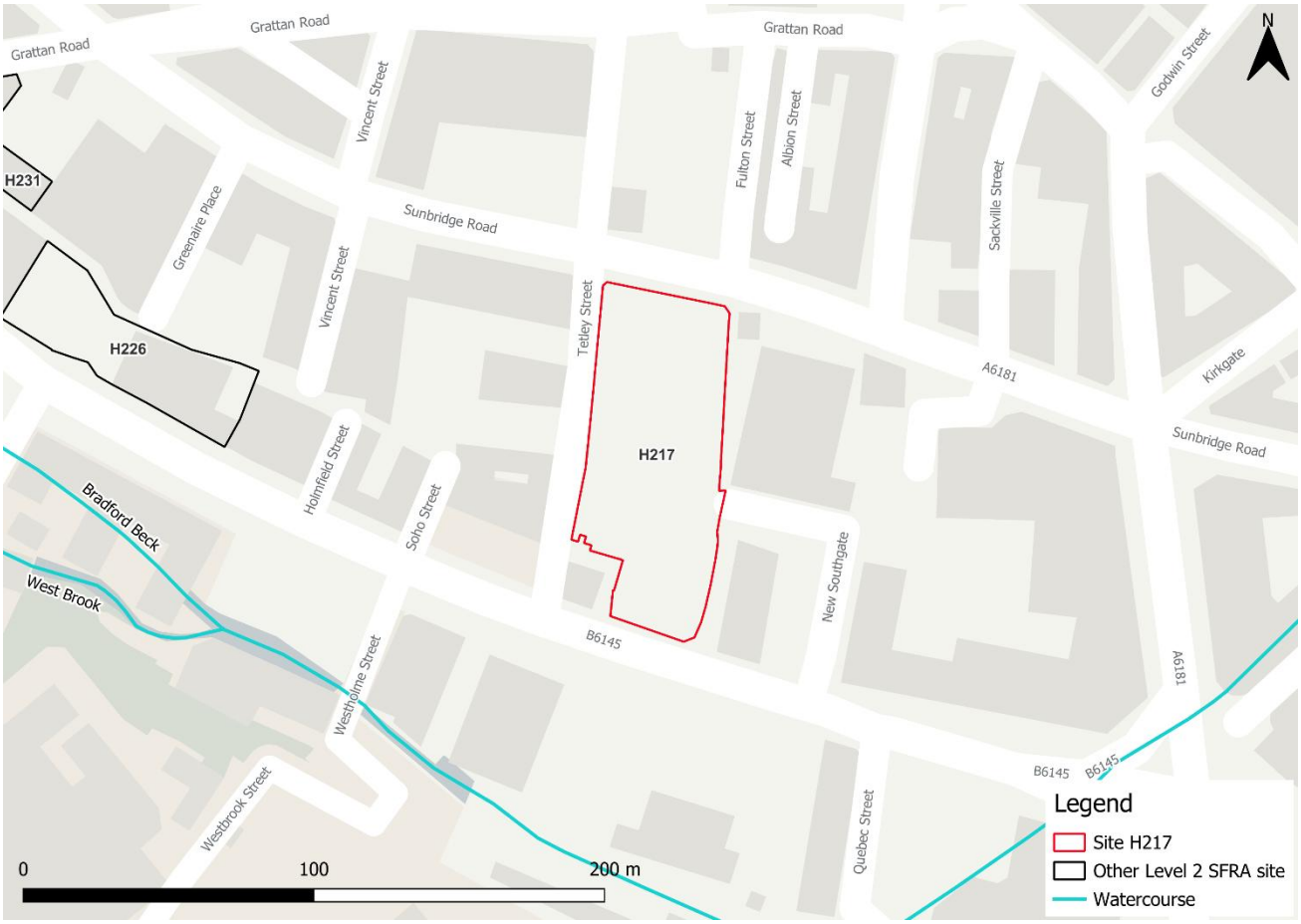


Figure 1-1: Existing site location boundary

There are areas of higher elevation within the north of the site, which slopes towards an area of lower elevation within the south (Figure 1-2).

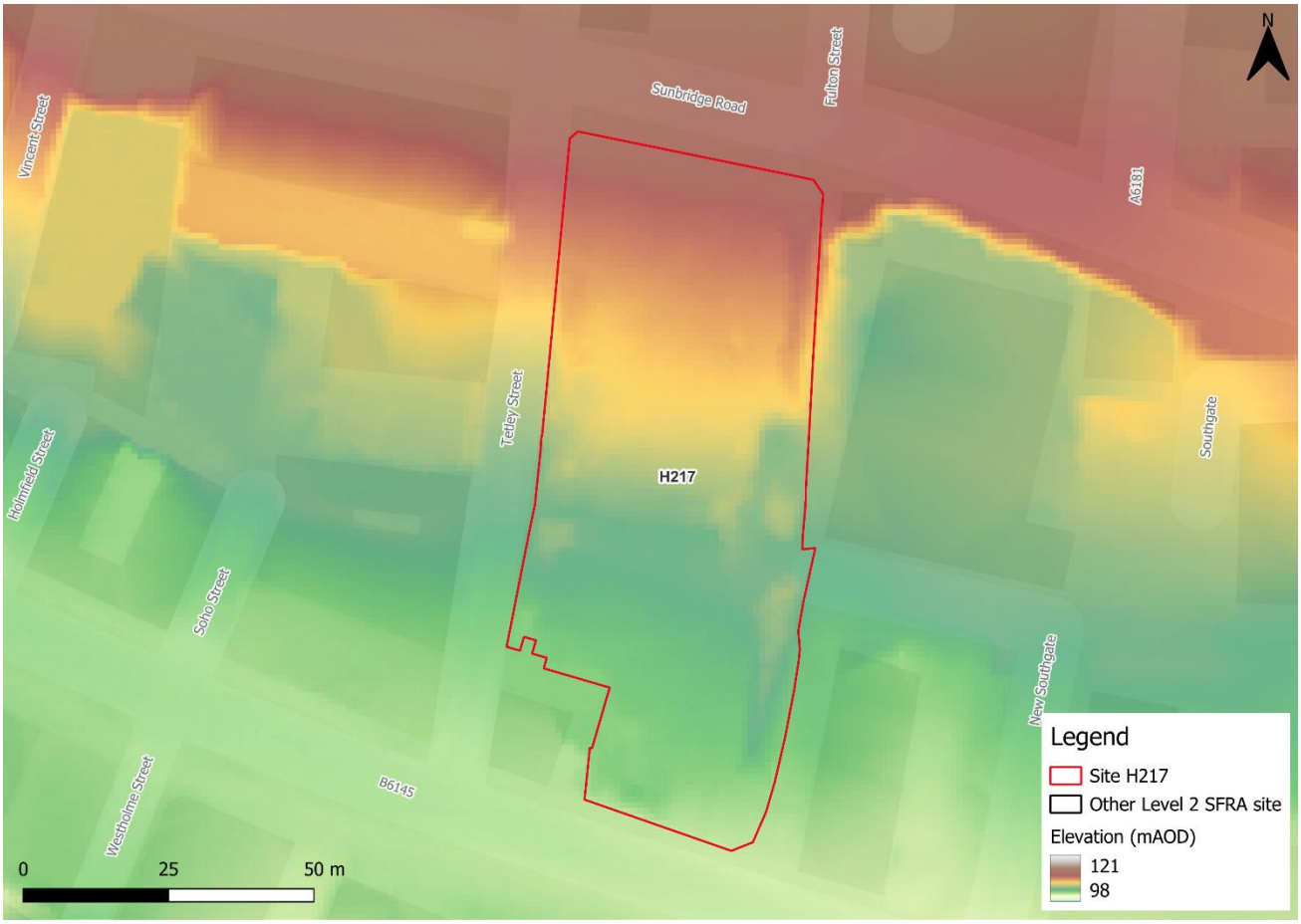


Figure 1-2: Topography

The underlying bedrock within the site is defined as 'Pennine Lower Coal Measures Formation', which comprises mudstone, siltstone, sandstone, coal, ironstone and ferricrete (Figure 1-3). This is overlain with superficial deposits of till. Mudstone, siltstone, coal, ironstone and ferricrete typically have low permeability, however this can be highly variable. Sandstone has a higher permeability.



Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning (January 2026) and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.3).

Fluvial flood risk to the site comes from Bradford Beck to the south of the site. The southern boundary of the site is within Flood Zone 2 and therefore at medium risk.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
92	8	0	0



Figure 2-1: Existing risk from rivers to the site

2.1.2 Bradford Beck 2026 model outputs - present day

Figure 2-2 shows the modelled flood depths for the 0.1% AEP undefended event. Modelled risk to the site is less than that shown by Flood Zone 2, however it is noted that the Flood Map for Planning has not been updated to account for the latest Bradford Beck model outputs. Maximum flood depths within the site are shallow between 0.15 and 0.3 m. Modelled flood velocities are between 1 and 2 m^3/s (Figure 2-3), with areas of hazard categorised as 'danger for some' (Figure 2-4). This indicates the floodwater within the site is likely to be fast moving, posing a greater risk to site users.

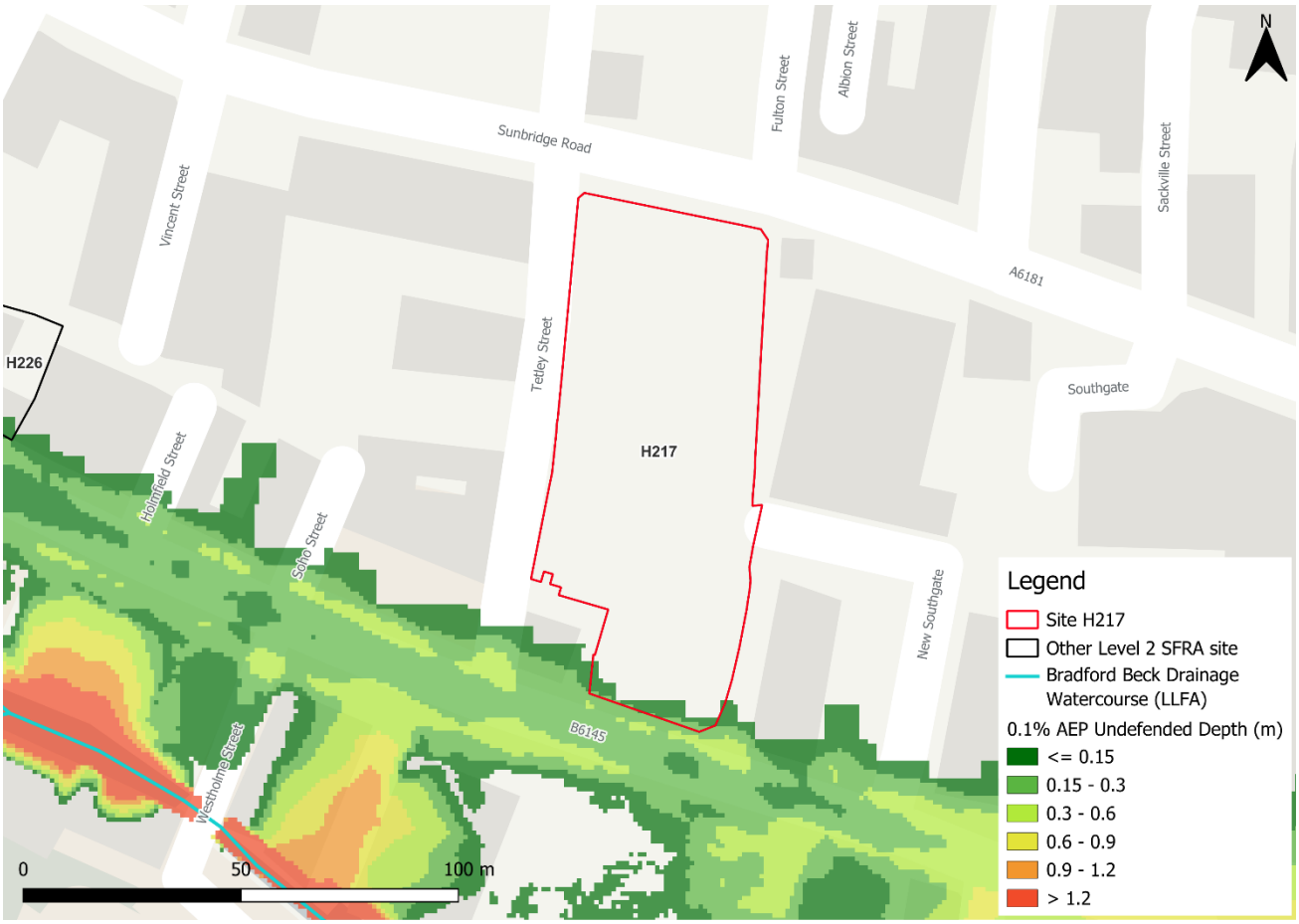


Figure 2-2: Flood depths for 0.1% AEP undefended flood event

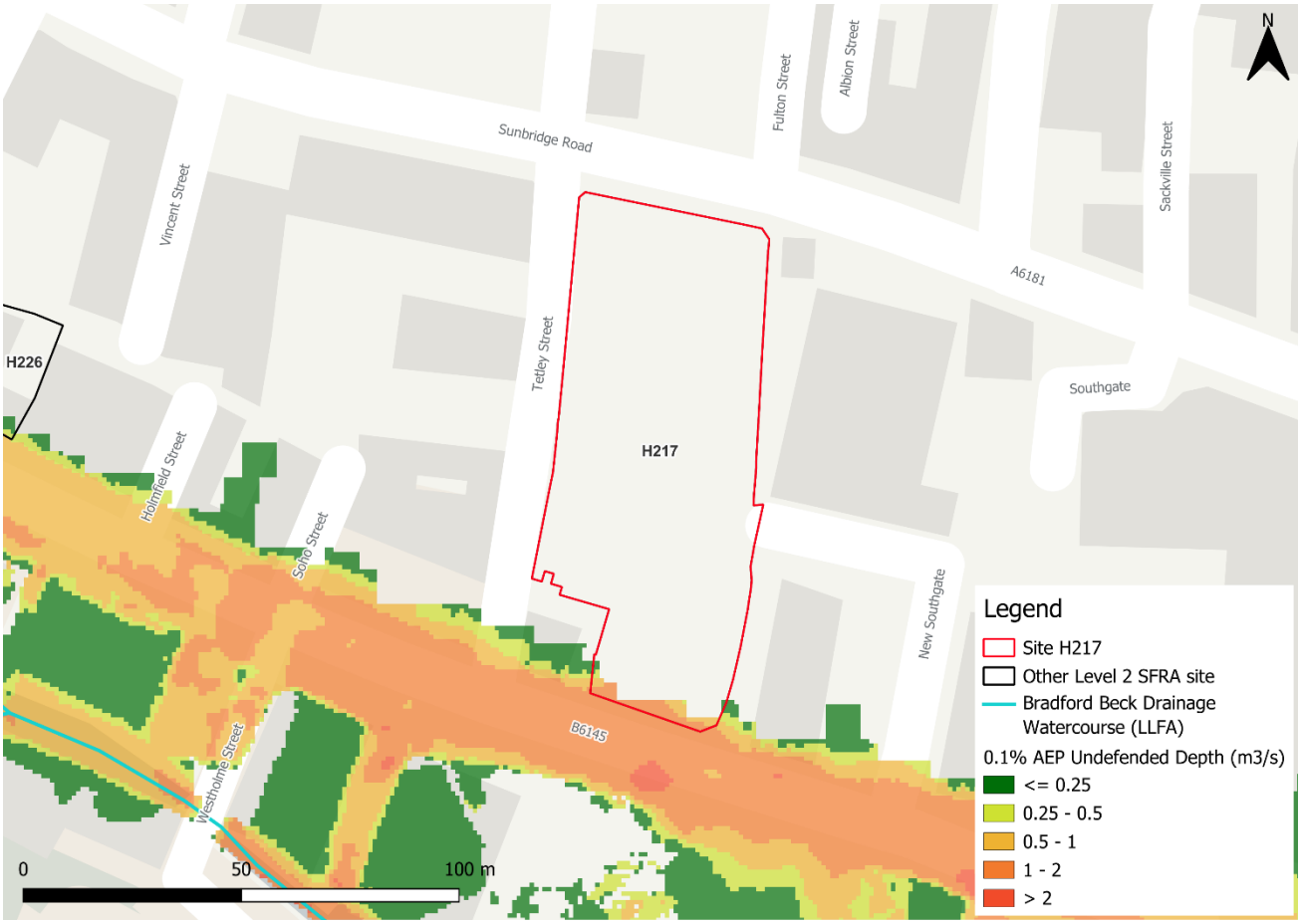


Figure 2-3: Flood velocities for 0.1% AEP undefended flood event

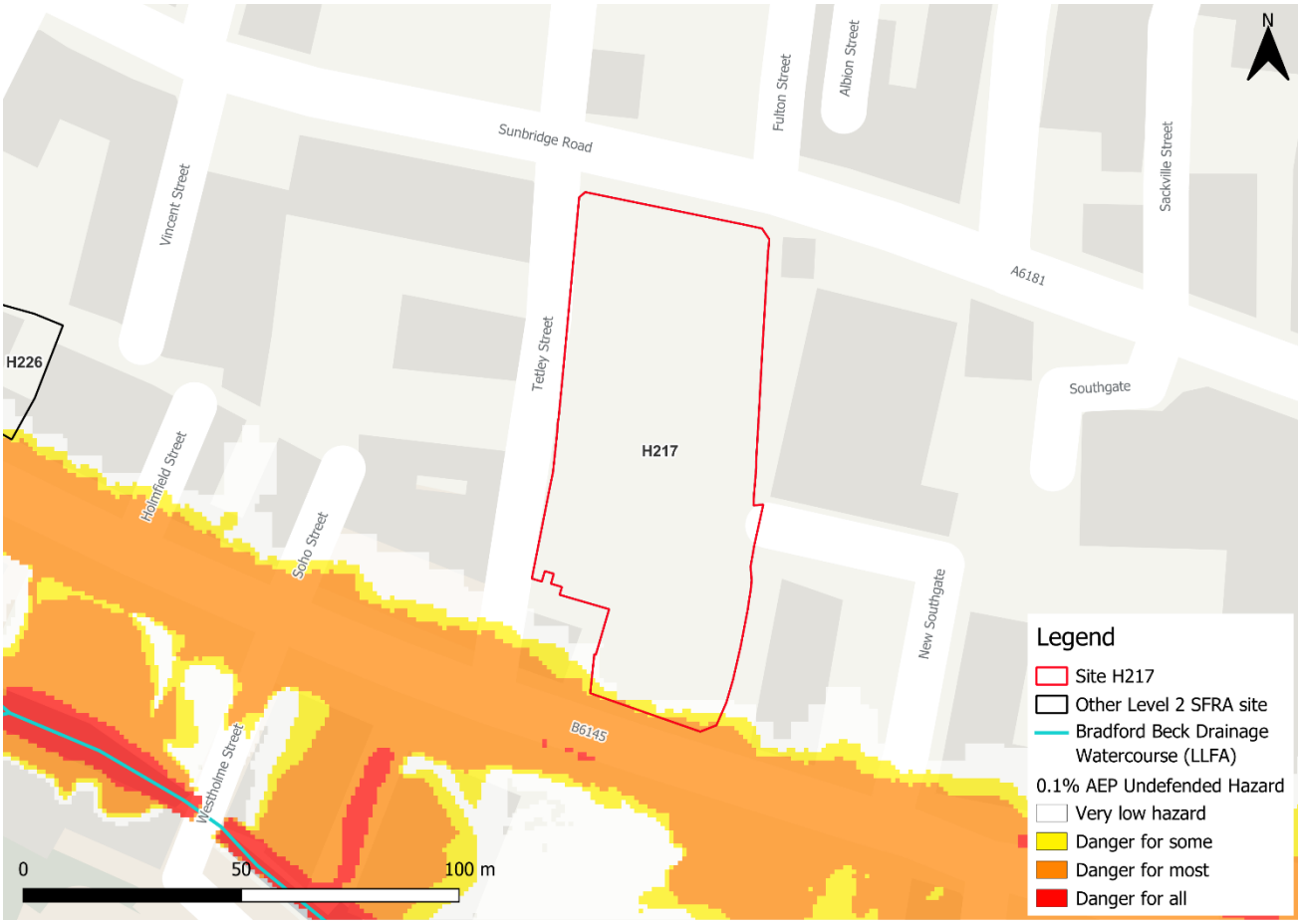


Figure 2-4: Flood hazard[1] for 0.1% AEP undefended flood event

2.2 Impacts from climate change

The EA's SFRA guidance states that SFRAs should assess the central allowance for less vulnerable, more vulnerable, highly vulnerable and water compatible development (Table 2-2). The impacts of climate change on flood risk from the Bradford Beck 2026 model have been modelled without flood defence infrastructure in place. As documented in Section 2.3.1, there are no formal engineered flood defences that would benefit the site.

1 Fluvial hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.

Table 2-2: Modelled climate change allowances for peak river flows for the Aire and Calder Management Catchment

Return period (AEP event)	Central allowance 2080s (% increase)	Higher central allowance 2080s (% increase)	Upper end allowance 2080s (% increase)
3.3% (functional floodplain)	23%	31%	51%
1%	23%	31%	51%
0.1%	23%	31%	51%

2.2.1 Bradford Beck 2026 model outputs - climate change

Figure 2-5 shows the onsite modelled flood depths for the 0.1% AEP undefended event plus the central allowance for climate change. Risk is modelled to be similar in extent to present day conditions. Maximum flood depths are modelled to remain shallow at between 0.15 and 0.3m. Modelled flood velocities are also modelled to remain at between 1 and 2 m^3/s (Figure 2-6), with areas of hazard categorised as 'danger for some' (Figure 2-7).



Figure 2-5: Flood depths for 0.1% AEP undefended flood event +23% (central climate change allowance)

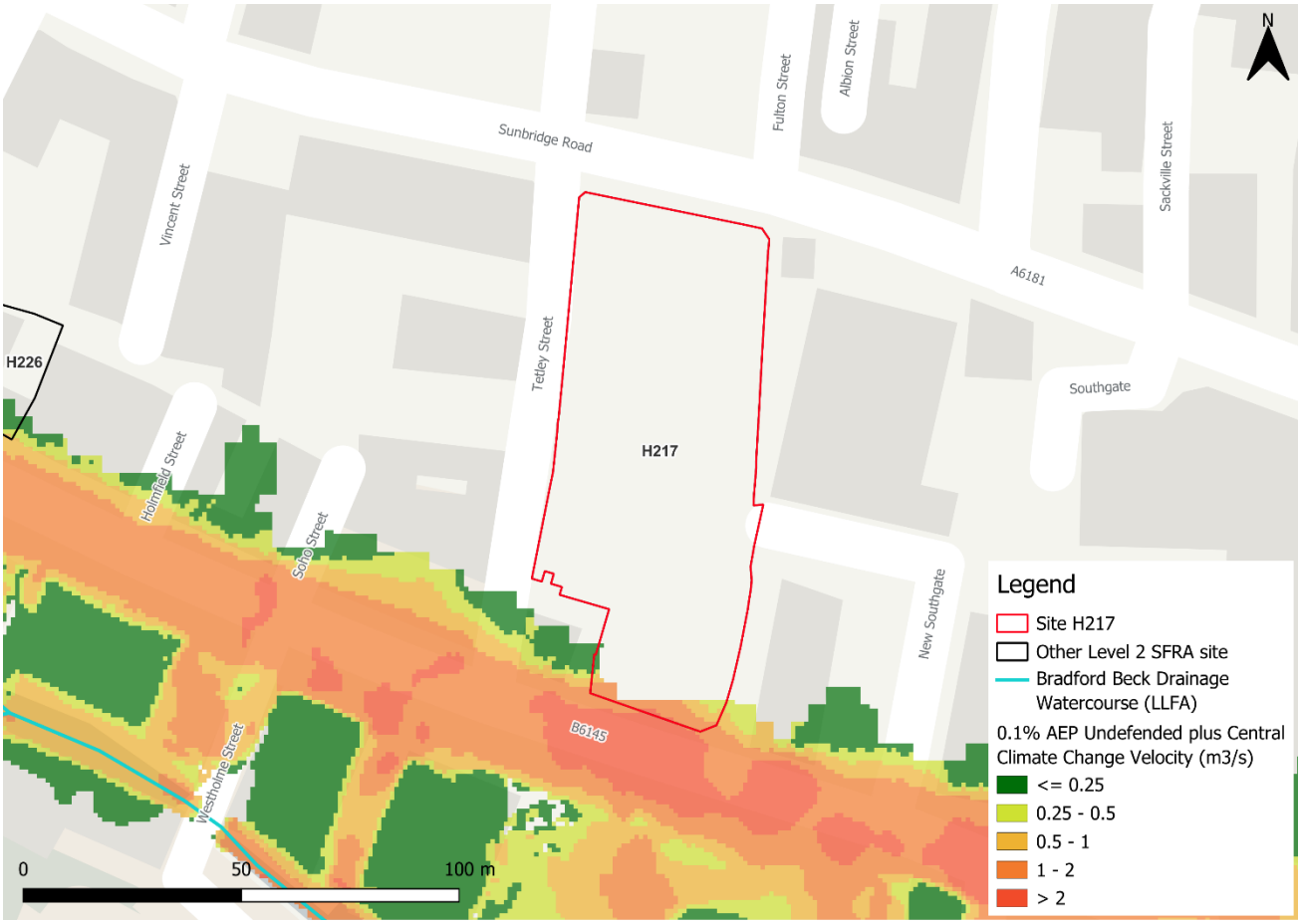


Figure 2-6: Flood velocities for 0.1% AEP undefended flood event +23% (central climate change allowance)

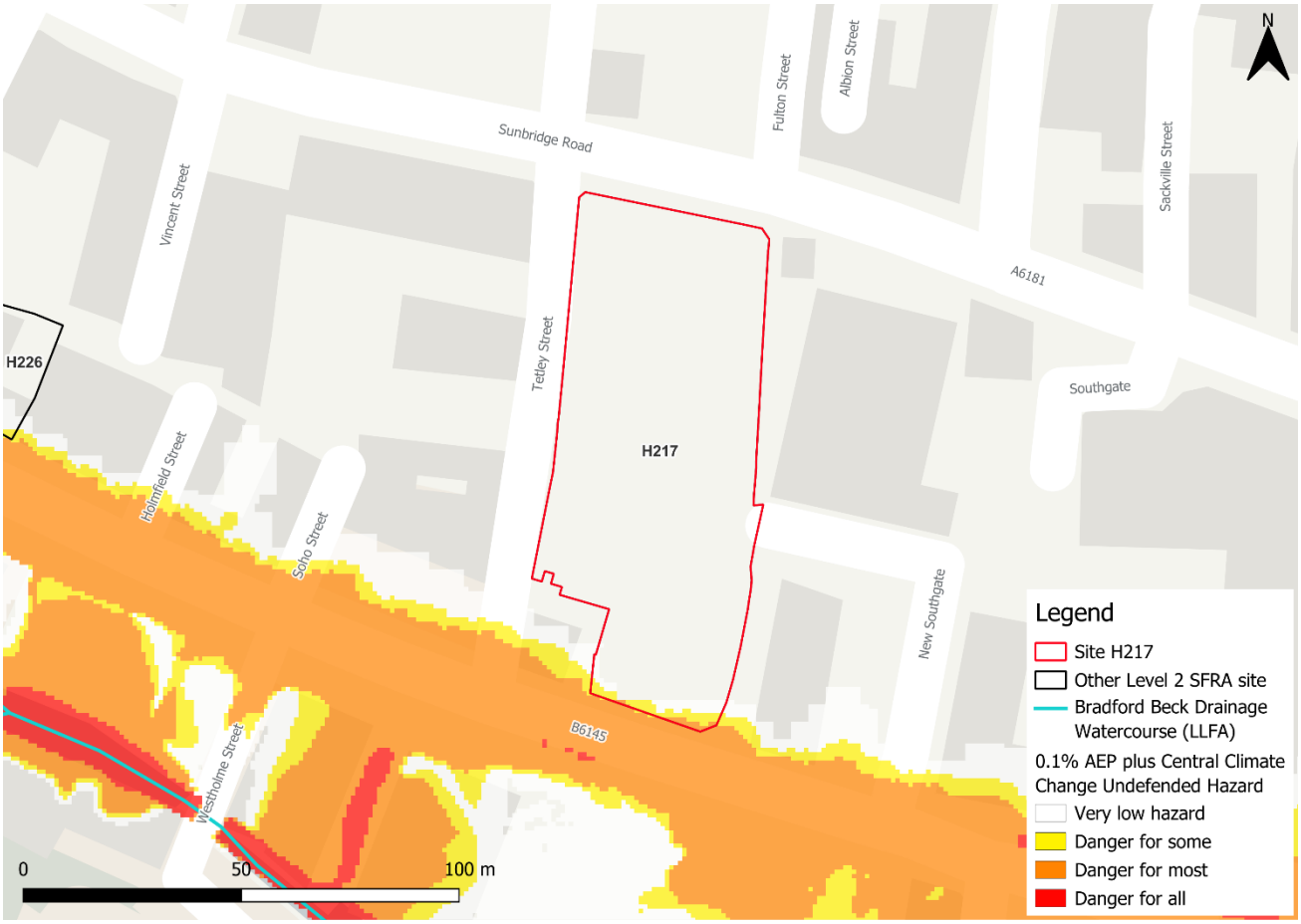


Figure 2-7: Flood hazard for 0.1% AEP undefended flood event +23% (central climate change allowance)

2.2.2 Flood Map for Planning - Climate Change

Climate change data in this area is unavailable from the EA's Flood Map for Planning plus Climate Change (2070-2125) dataset, as shown in Figure 2-8.

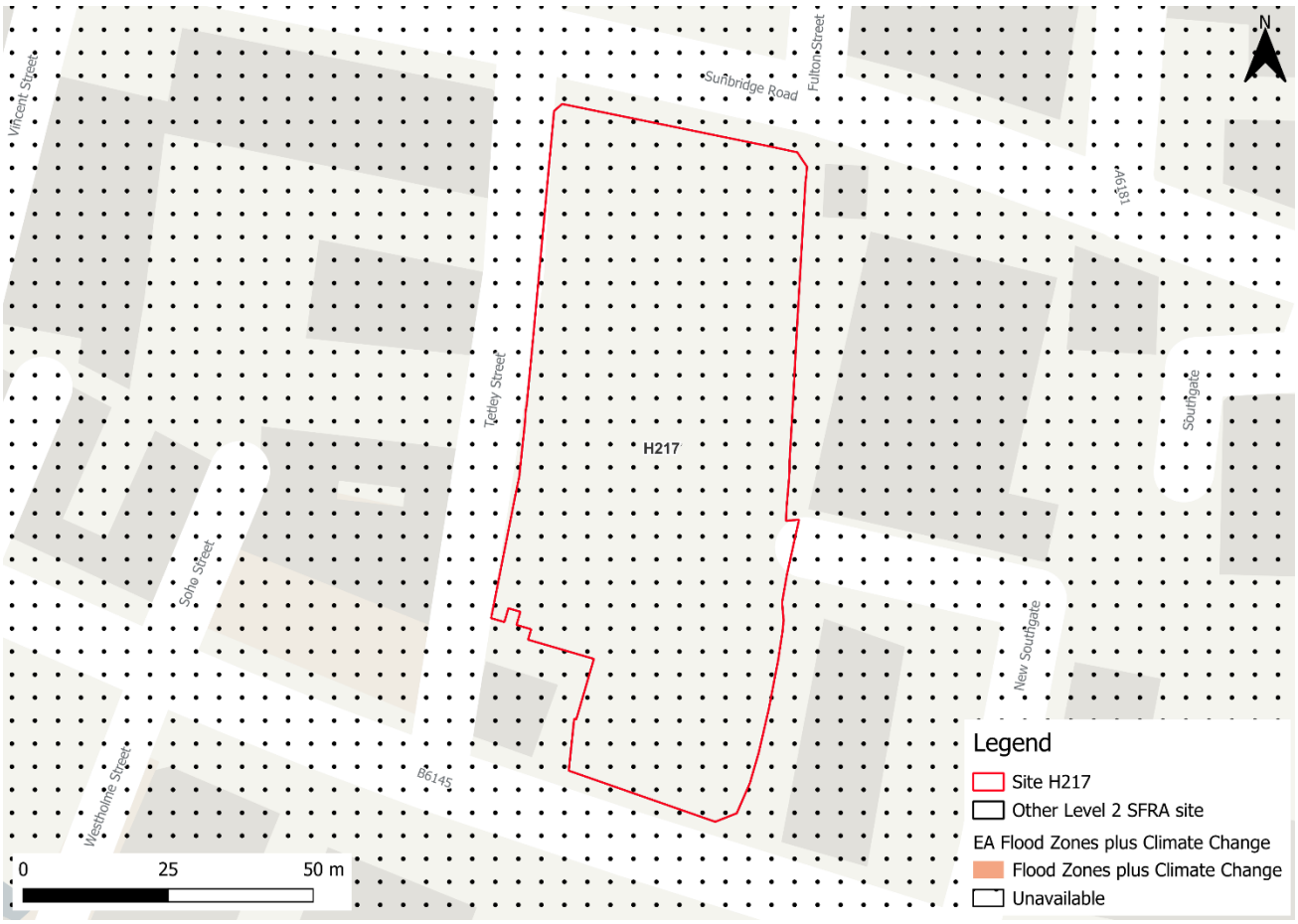


Figure 2-8: EA Flood Zones plus Climate Change

2.3 Flood risk management

2.3.1 Flood defences

The site does not benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset.

2.3.2 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) that may help to reduce flood risk to the site and surrounding areas. There are no applicable areas that could benefit the site.

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO) datasets have been considered. There are no recorded historic flood events at the site.

2.5 Emergency planning

2.5.1 Flood warnings

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The south of the site is located within a FWA, namely 123FWF785 - Bradford Beck and tributaries at Bradford.

Flood alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be issued when there is less confidence that flooding will occur in a FWA. This site is located within a FAA, namely 123WAF961 - Middle River Aire catchment.

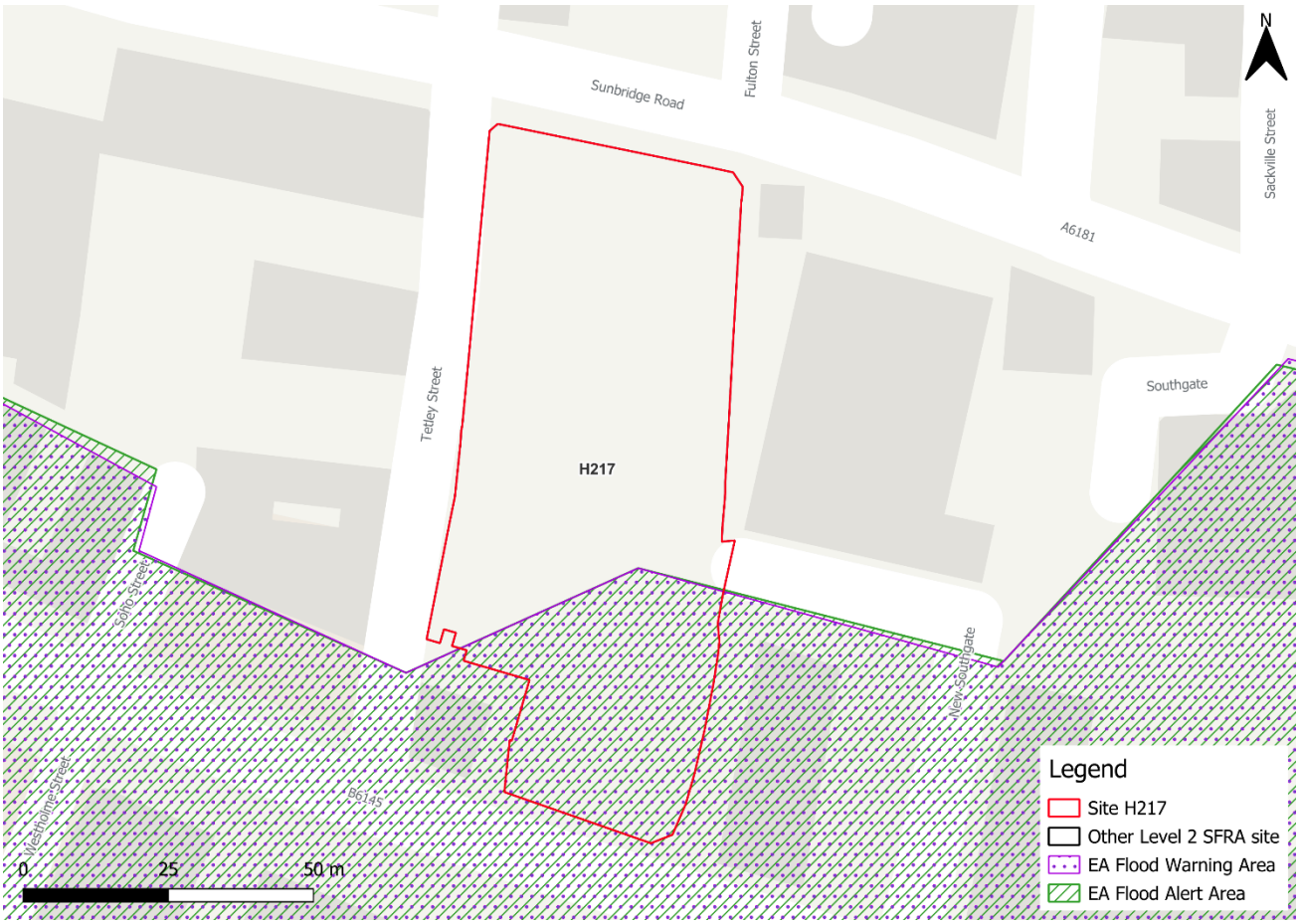


Figure 2-9: EA Flood Warning Areas and Flood Alert Areas

2.5.2 Access and escape routes

Based on available information, safe access and escape routes could likely be achieved during a flood event via Tetley Street and Sunbridge Road (Figure 2-10).

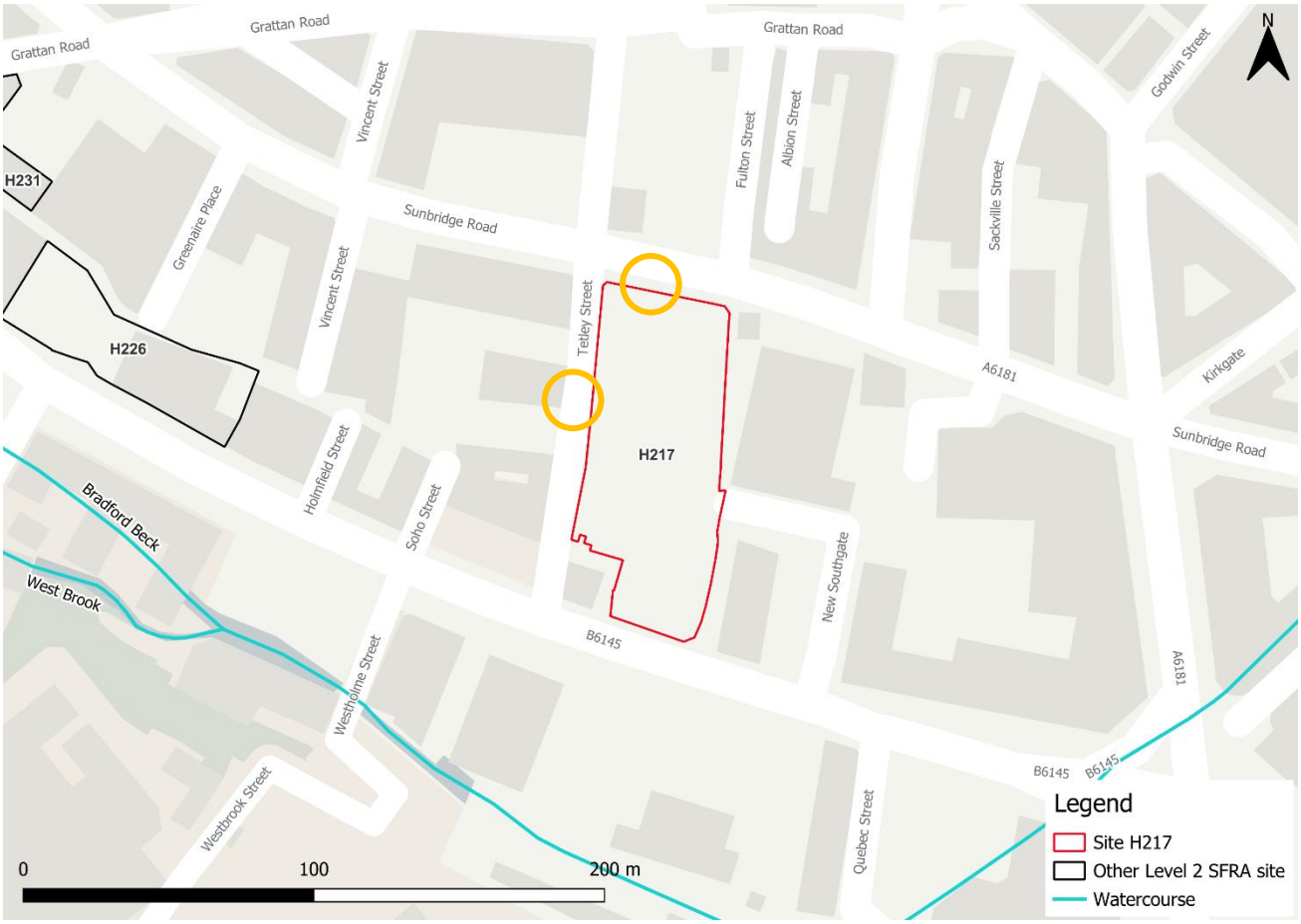


Figure 2-10: Potential access and escape routes

2.6 Observations, mitigation options, site suitability and sequential approach to development management - fluvial

- Observations:
  - The proposed development of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF.
  - Given the change in use and therefore vulnerability of the site, the LPA must consider whether the change of use is acceptable and whether the development can be designed to be safe, including for adequate emergency planning provision, accounting for the information provided in this Level 2 SFRA (para 014 FRCC-PPG).
  - Development should be directed to the areas of the site situated within Flood Zone 1.
  - The site is shown to be within Flood Zone 2, along the southern boundary of the site. This is also reflected in the modelled 0.1% AEP undefended event from the Bradford Beck 2026 model, however, to a lesser degree than that shown by Flood Zone 2. It is noted that the Flood Map for Planning has not yet been updated with the Bradford Beck 2026 model outputs.
  - The modelled 0.1% AEP undefended event plus the central allowance for climate change shows a similar level of risk to the present day event.

- Mitigation:
  - EA flood alerts should continue to be in place to ensure early evacuation of site users before an extreme flood event occurs.
- Access and escape:
  - Based on available information, safe access and escape routes could likely be achieved during a flood event via Tetley Street and Sunbridge Road.

3 Flood risk from surface water

3.1 Existing risk

At the time of writing, the EA's latest national Risk of Flooding from Surface Water (RoFSW) does not include depth and hazard information suitable for planning purposes. Therefore, this Level 2 SFRA considers the third generation RoFSW depth and hazard mapping in addition to the NaFRA2 extents, as agreed with the EA. Surface water depth and hazard should be confirmed at the site-specific FRA stage.

3.1.1 Risk of Flooding from Surface Water - NaFRA2 extents

Based on the EA's national scale RoFSW map (January 2026), surface water risk to the site is predominantly very low, as shown in Table 3-1.

Surface water risk is confined to an area of ponding in the centre of the site in the low risk event, and a flow path along the southern boundary of the site (Figure 3-1). Safe access and escape routes should be achievable via Tetley Street and Sunbridge Road.

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
94	5	1	0

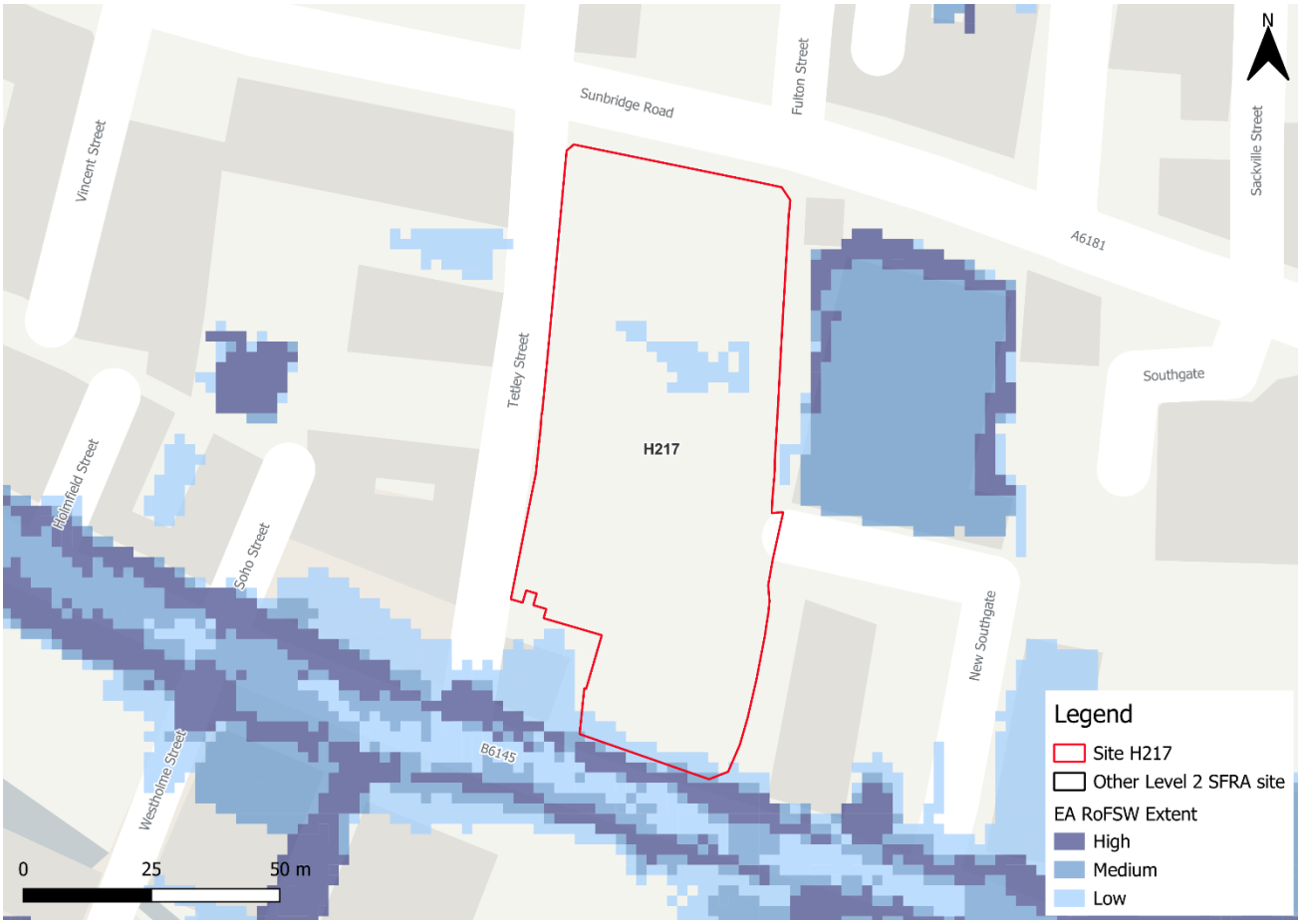


Figure 3-1: Surface water flood extents (NaFRA2 - Risk of Flooding from Surface Water map)

3.1.2 Risk of Flooding from Surface Water - third generation depths and hazards

Based on the EA's national scale third generation RoFSW map, the medium risk surface water event is confined to the flow path along the southern boundary, impacting a very small area of the site (Figure 3-2).

There are clear differences between the NaFRA2 RoFSW map and the third-generation depth and hazard mapping. The NaFRA2 RoFSW map does not include most watercourse channels. Additionally, the NaFRA2 RoFSW map does not map flooding less than 0.075m (7.5cm) in depth. Therefore, where the map may show no flooding, there may be shallow flooding up to a depth of 0.075m. In contrast, the third generation RoFSW does not map flooding with a hazard rating of less than 0.575. This could explain the differences observed between the NaFRA2 and third generation RoFSW. Assessment of surface water should be carried out at the site-specific FRA stage to robustly establish current and future surface water flood risk conditions.



Figure 3-2: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

At the time of writing, the available national surface water climate change mapping is unsuitable for consideration in development planning. This Level 2 SFRA considers the low risk surface water event as a conservative proxy for the medium risk event plus climate change, as agreed with the EA. The impact of climate change on surface water flood risk should be considered at the site-specific FRA stage.

Using the low risk event as a proxy, the medium risk surface water event is likely to increase in extent within the site when accounting for climate change (Figure 3-3). The third generation mapping indicates maximum flood depth are modelled to be between 0.15 and 0.3 m (Figure 3-4), with areas of hazard categorised as 'low' (Figure 3-5). Safe access and escape routes should remain achievable via Tetley Street and Sunbridge Road.

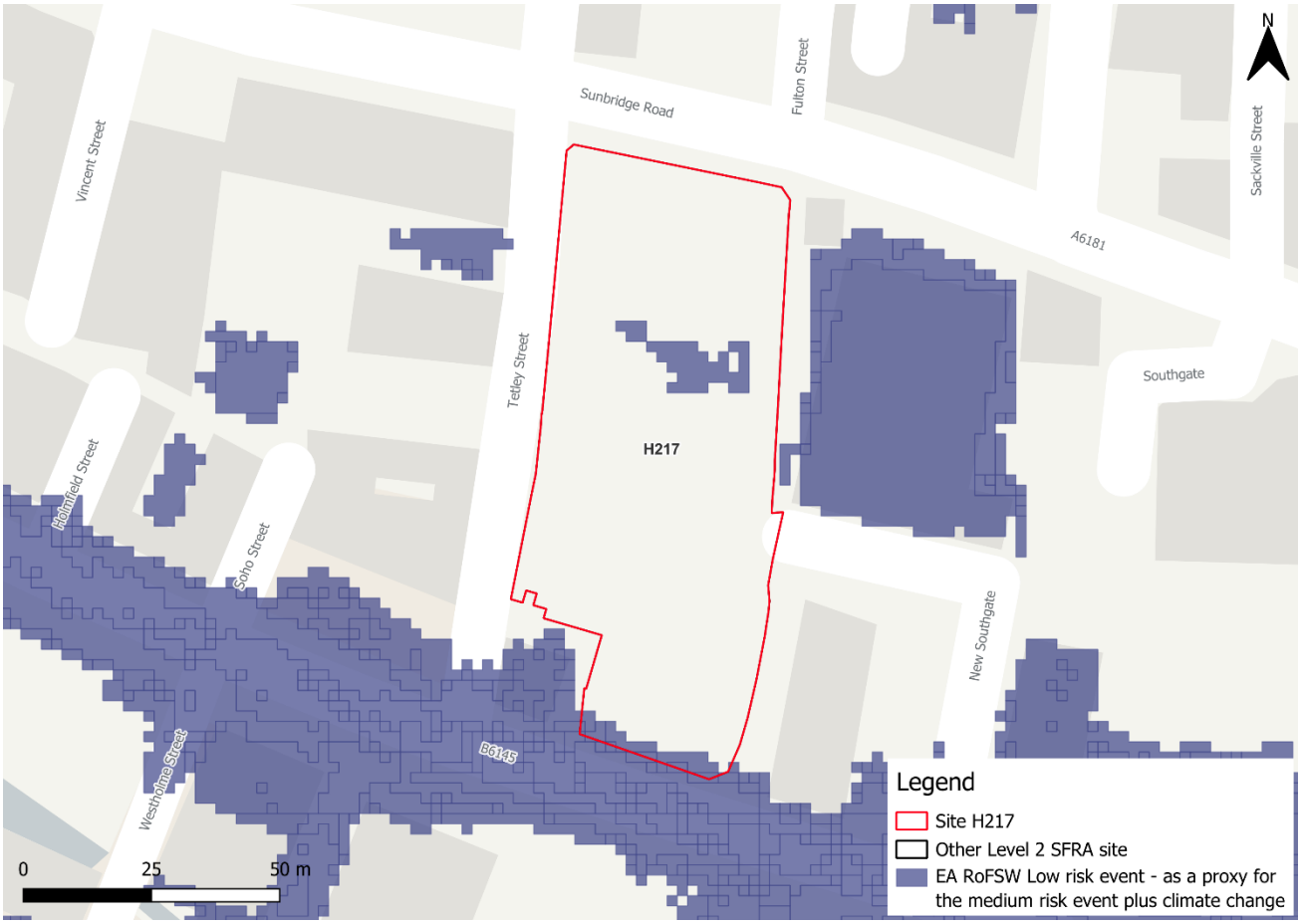


Figure 3-3: Low risk event surface water flood extent, as a proxy for the medium risk event plus climate change (NaFRA2 - Risk of Flooding from Surface Water map)



Figure 3-4: Low risk event surface water flood depths, as a proxy for the medium risk event plus climate change (Third generation - Risk of Flooding from Surface Water map)



Figure 3-5: Low risk event surface water flood hazard, as a proxy for the medium risk event plus climate change (Third generation - Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk to the site is predominantly very low, with approximately 94% of the site being at very low risk. Surface water risk in the present day low risk event is primarily confined to an area of ponding within the centre of the site.
- The effects of climate change on surface water have not been modelled for this SFRA, however the low risk surface water event has been used as a proxy for the medium risk event plus climate change. Surface water flood risk in this event is confined to areas of ponding within a topographic low spot on the site.
- Topographic flow routes and depressions should be considered and included in site design and ideally left in place to flood naturally when required. Any regrading of land must include for like for like volumes to ensure risk is contained safely onsite for the lifetime of development.
- Safe access and escape routes should be achievable via Tetley Street and Sunbridge Road.
- The drainage strategy must ensure there is no increase in surface water flood risk elsewhere as a result of new development. Existing brownfield rates will likely apply, though the developer should consult local LLFA guidance and the National SuDS guidance.

- Note that the RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[2]. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

The central area of the site is in an area where there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots. Groundwater conditions mean that the majority of the site is therefore unlikely to be suited to infiltration SuDS.

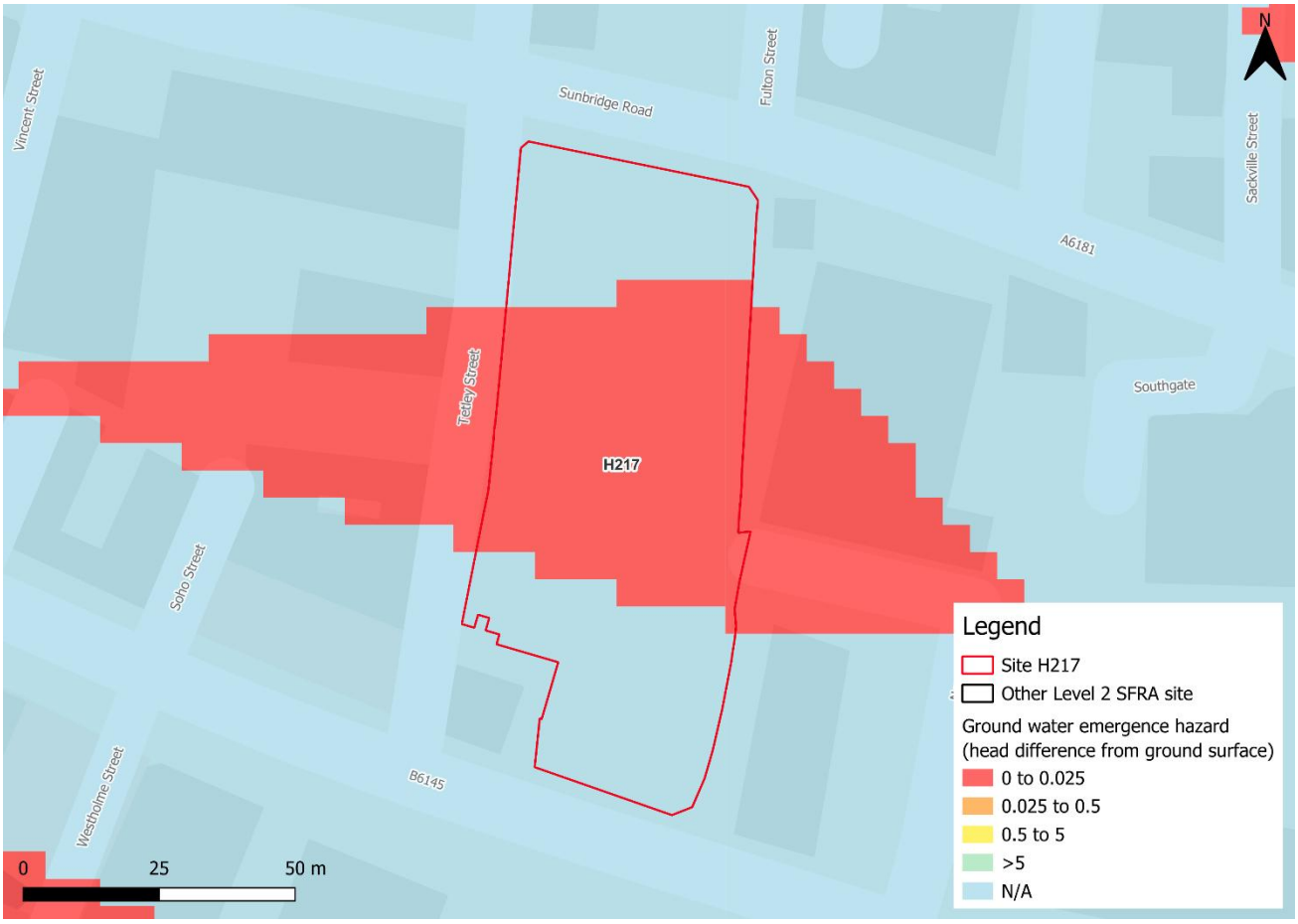


Figure 4-1: JBA 5m Groundwater Emergence Map

2 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

Although a site may be afforded some protection from defences and / or drainage infrastructure, there is always a residual risk of flooding from asset failure i.e. defence breaches, or blockages of culverts or drainage assets. Residual risk at this site comes from the potential blockage of the culvert structures along Bradford Beck to the south of the site.

5.1 Potential blockage

A blockage of the culvert structures along Bradford Beck to the south of the site may cause water in the channel to back up and cause flooding to the site, depending on the severity of the blockage and the magnitude of the flood event. Culvert course and condition surveys may be required, including for consultation with the culvert owner.

The Bradford Beck 2026 model includes for a scenario in which all culverts within the model are blocked. Figure 5-1 shows the modelled flood depths for this scenario. Flood risk to the site in the 1% AEP undefended event increases when considering a blockage of these structures. However, this event is only modelled to impact the southern boundary of the site and flood depths are shown to be low. Safe access and escape routes would likely remain achievable.

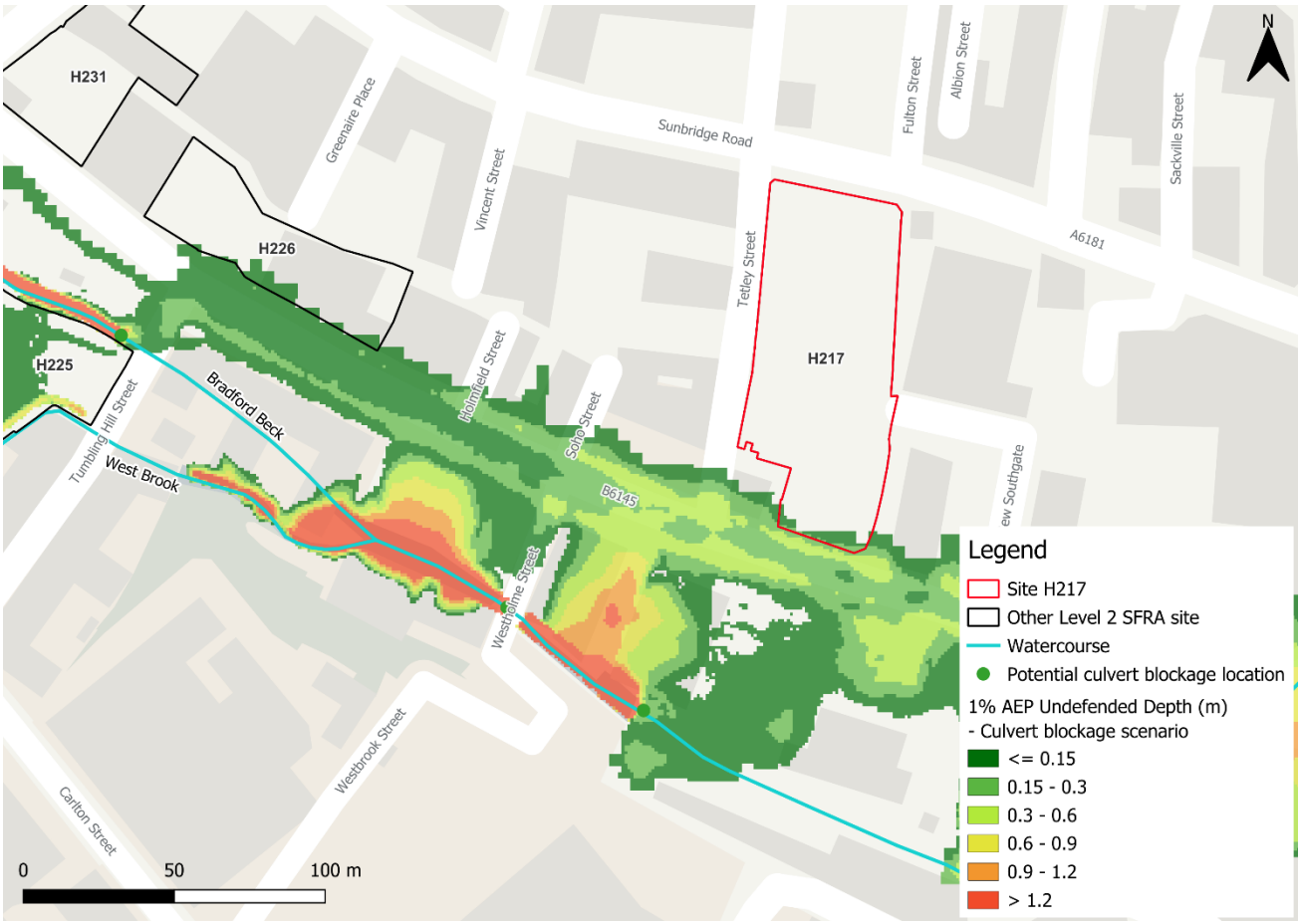


Figure 5-1: Flood depths for 1% AEP undefended flood event 50% culvert blockage scenario - structures along Bradford Beck

5.2 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. Figure 5-2 shows the RFM in a 'dry day' and 'wet day' scenario. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is potentially at risk from two reservoirs; namely the Lower Chellow and the Upper Chellow. Both reservoirs are located within Bradford and are operated by the City of Bradford Metropolitan District Council.

The EA's SFRA guidance states that where a proposed development site is at flood risk from a reservoir, then an assessment into whether the reservoir design or maintenance schedule needs improving should be carried out. Expert advice may be required from an all-reservoirs panel engineer. The Council should consult the relevant reservoir undertaker to ascertain whether the proposed development could affect the reservoir's risk designation, its design category or how it is operated. The Council, as category 1 responders, can access more detailed information about reservoir risk and reservoir owners using the Resilience Direct system.

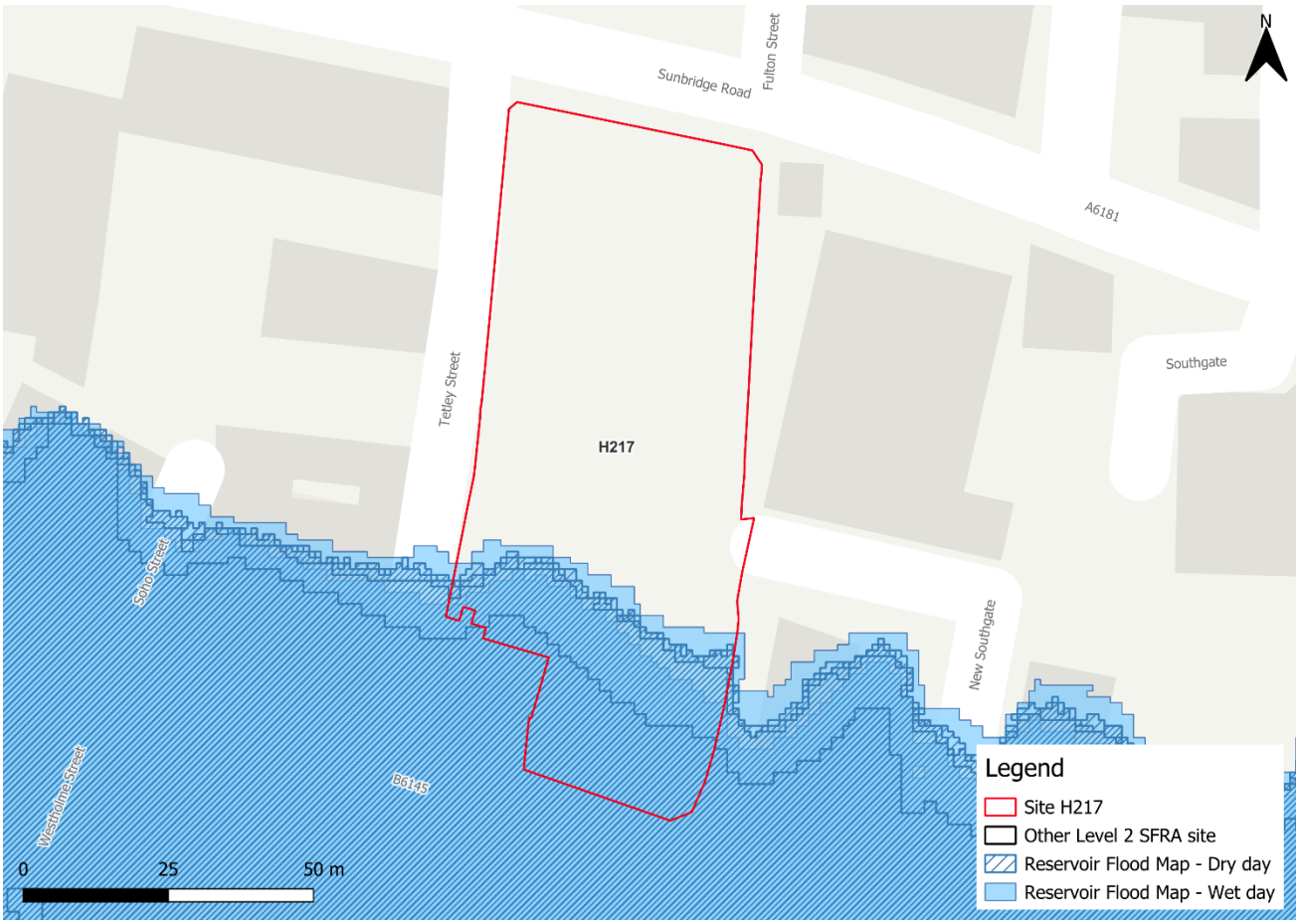


Figure 5-2: Flood risk from reservoirs

5.3 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a blockage of the culverts along Bradford Beck to the south of the site. The modelled 50% culvert blockage scenario indicates an increase in flood risk to the site in the 1% AEP undefended event, however only to the southern boundary of the site with low depths.
- Areas adjacent to culverts and bridges are at particular risk from the rapid onset of fast flowing and deep flooding, with little or no warning if structures become blocked. Emergency plans must be in place for such areas and safe access and escape routes must be in place for the lifetime of development. Resistance and resilience measures may also need to be put in place to manage residual flood risk when avoidance measures have been exhausted.
- The LPA should use the information on residual risk in this Level 2 SFRA to state in the local plan strategic policies a preferred mitigation strategy for ensuring development will be safe throughout its lifetime in relation to urban form, risk management and where flood mitigation measures are likely to have wider sustainable design implications (para 042, FRCC-PPG).
- The site is at potential residual risk from a breach of Lower Chellow and the Upper Chellow located within Bradford. However, the site is impacted by the 'wet day' flood extent only, which represents a prediction of the credible worst-case scenario, therefore it is unlikely that such an extreme flood event would occur.
- Given the potential reservoir risk to the site, developers should consider[3]:
    - Consulting with the local resilience forum for advice on emergency planning,
    - Consulting with relevant reservoir owners to understand the impact development may have on their reservoirs, and
    - Use this Level 2 SFRA to understand whether any proposed development will be safe throughout its lifetime.

3 Reservoir flood maps: when and how to use them | Environment Agency | 2021

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is not required to pass part b) of the exception test[4] as it is not located within Flood Zone 3a, however it must still be proven that the development can be safe for its lifetime, which is generally considered to be 100 years for residential development.

6.2 Recommendations summary

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

- It should be appropriate to develop this site given its location largely within Flood Zone 1 and very low surface water flood risk.
- The Flood Map for Planning requires updating to include for the 2026 model of Bradford Beck.

6.3 FRA requirements and further work

At the planning application stage, the following should be considered:

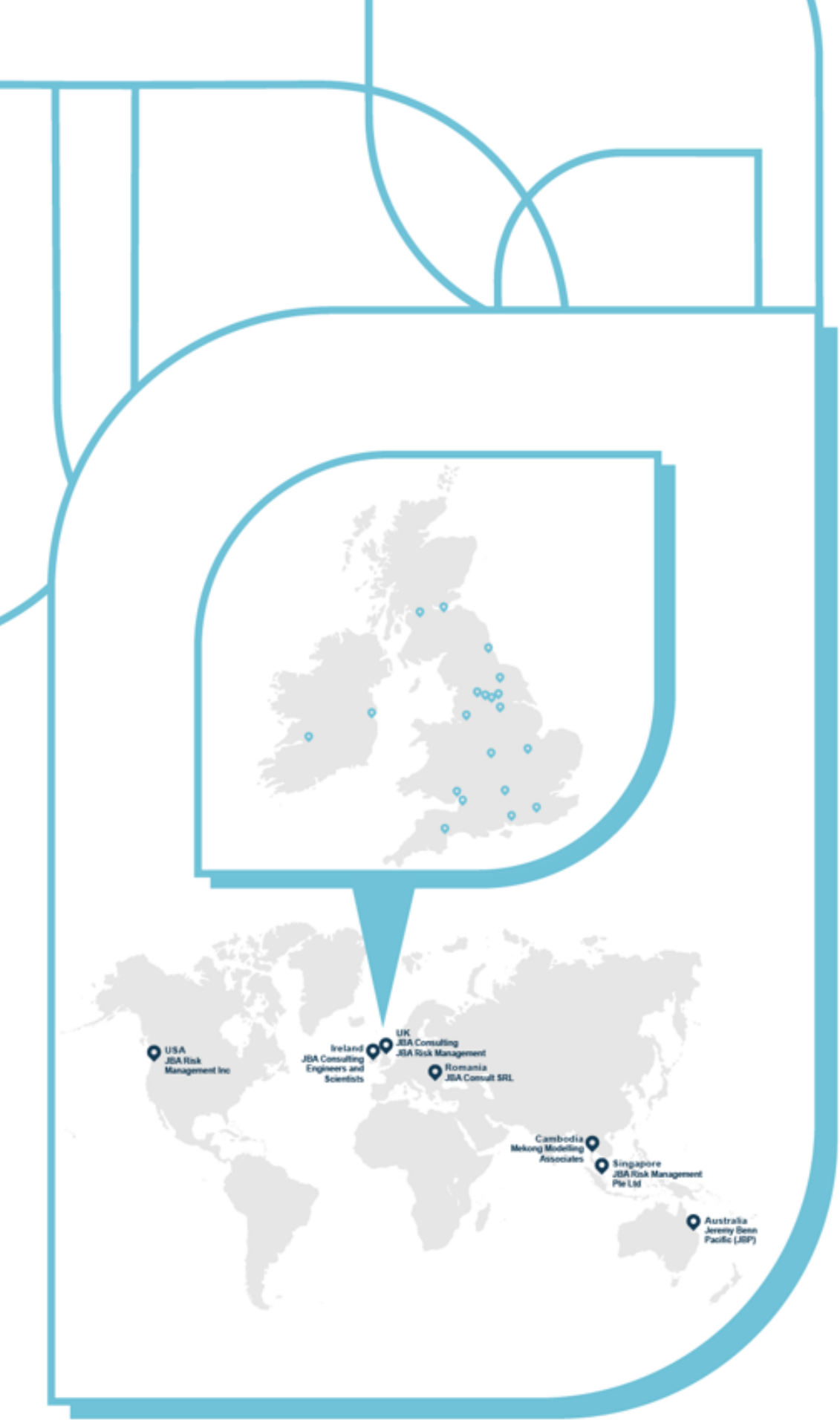
- Further modelling to understand the impacts of climate change on surface water flood risk to the site.
- A condition and capacity assessment of the culverts along Bradford Beck to the south of the site.
- Consultation with the relevant reservoir owners to understand the impact of development on reservoir risk designation.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA online guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

4 Para 178 National Planning Policy Framework 2024

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Bradford Level 2 Strategic Flood Risk Assessment - Site H221

Final Draft

July 2026

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

www.jbaconsulting.com

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Reviewed by	Mike Williamson BSc MSc CGeog FRGS EADA Principal Analyst
Authorised by	Krista Keating BSc MSc CEnv CSci MCIWEM C.WEM Associate Director

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Contract

JBA Project Manager	Mike Williamson
Address	Phoenix House, Lakeside Drive, Centre Park, Warrington, WA1 1RX
JBA Project Code	2024s1078

This report describes work commissioned by City of Bradford Metropolitan District Council (CBMDC) by an instruction dated 19 July 2024. The Client's representative for the contract was Jonathan Dicken of CBMDC. Georgina Williams of JBA Consulting carried out this work.

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H221. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the 'CBMDC Level 1 SFRA' (2023) and read the 'CBMDC Level 2 SFRA Main Report' (2026) and is therefore familiar with the terminology used in this report.

1.1 Site H221

- Location: George Street B
- Existing site use: Car park
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 1.0 hectares
- Proposed development impermeable area: 0.92 hectares
- Watercourse: East Brook
- CBMDC river model: Bradford Beck 2026
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Subject to the exception test as more vulnerable development proposed in Flood Zone 3a
    - Assessment of modelled fluvial flood depths, velocities and hazards
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk

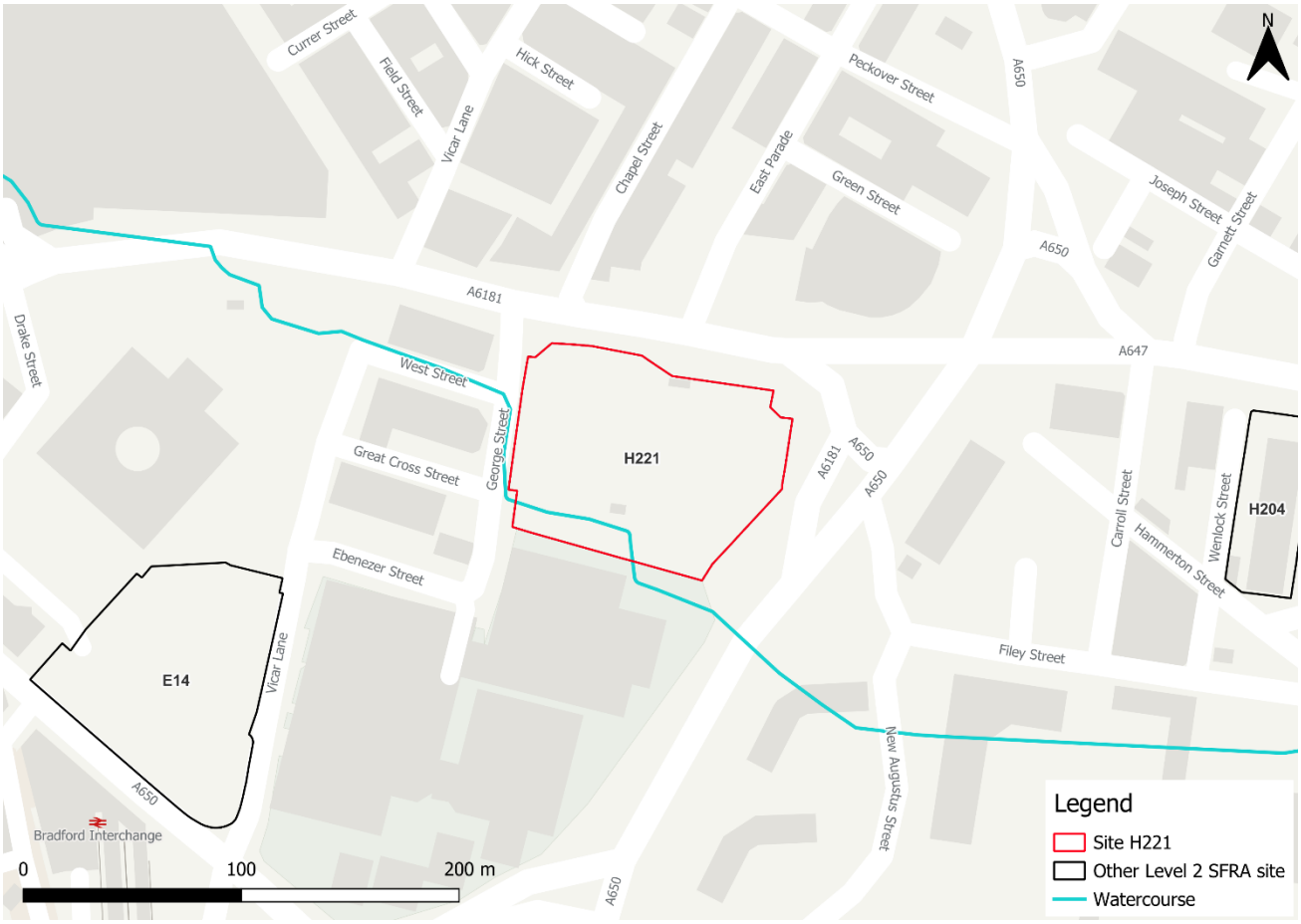


Figure 1-1: Existing site location boundary

The topography of the site is generally consistent throughout the site, with a variation of between 2 to 3 metres from the east of the site to the west (Figure 1-2).

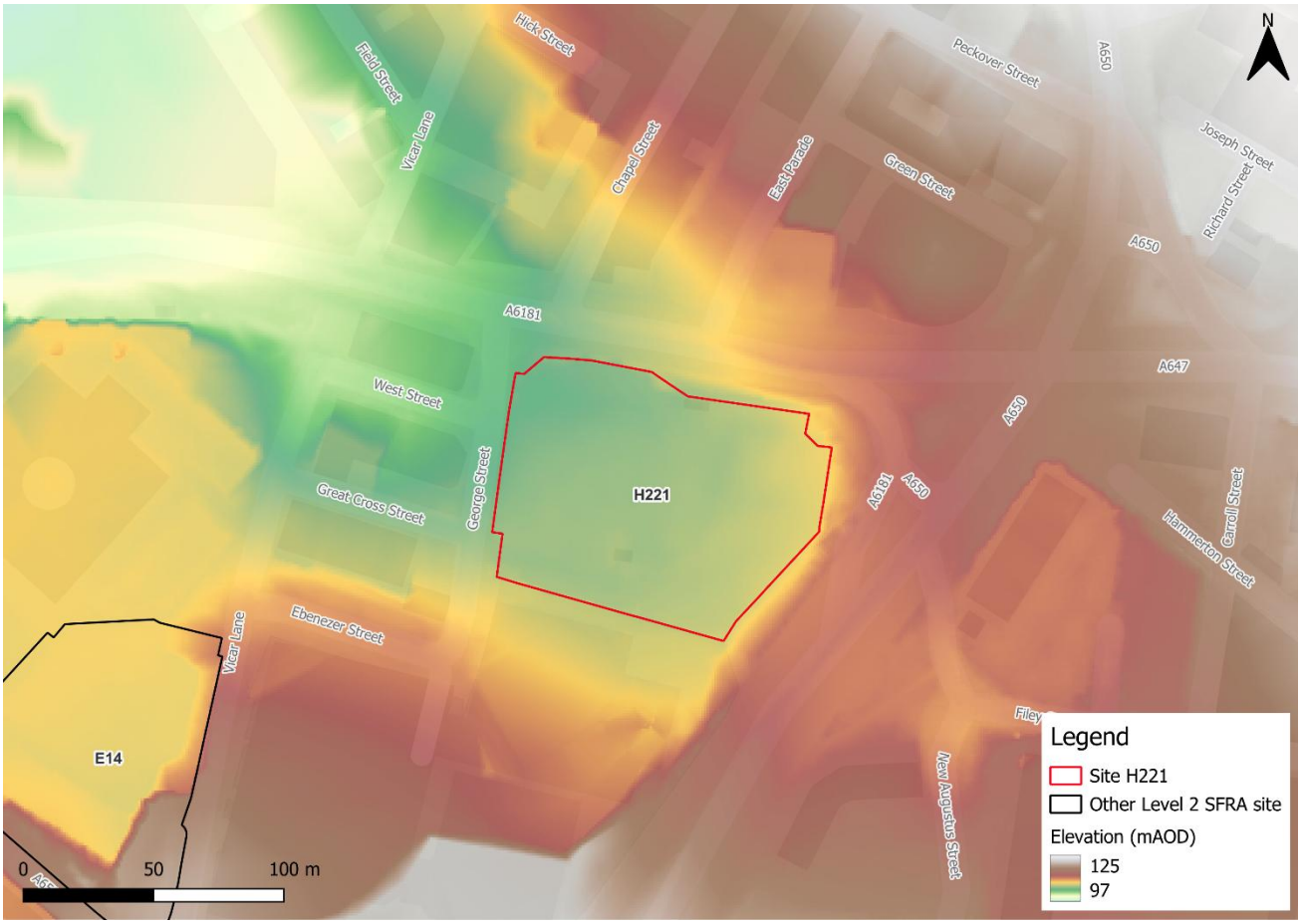


Figure 1-2: Topography

The underlying bedrock within the site is defined as 'Pennine Lower Coal Measures Formation', which comprises mudstone, siltstone, sandstone, coal, ironstone and ferricrete (Figure 1-3). This is overlain with superficial deposits of till. Mudstone, siltstone, coal, ironstone and ferricrete typically have low permeability, however this can be highly variable. Sandstone has a higher permeability.



Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning (January 2026) and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.3).

Fluvial flood risk to the site comes from East Brook, which is culverted beneath the site. Functional floodplain is present across the majority of the site. The functional floodplain in this location is based on the 3.33% AEP defended event from the Bradford Beck 2026 model and an 8m buffer of the culverted East Brook channel. However, this is based on an 8m buffered polygon of the East Brook culverted channel to indicate the presence of the watercourse beneath the site. The mapped watercourse location may not represent the actual location of the culverted channel. Noting that, functional floodplain policy applies to the path of the culvert beneath the site and not the mapping functional floodplain, where these differ. The path of the culverted channel should be confirmed through a survey as part of the site-specific FRA. There should be no development within the area of functional floodplain onsite.

The majority of the remaining area of the site is within Flood Zone 3a and is therefore at high risk from fluvial flooding. There are some areas within the northeast of the site that are within Flood Zone 2 and therefore at medium risk.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
3	5	45	47

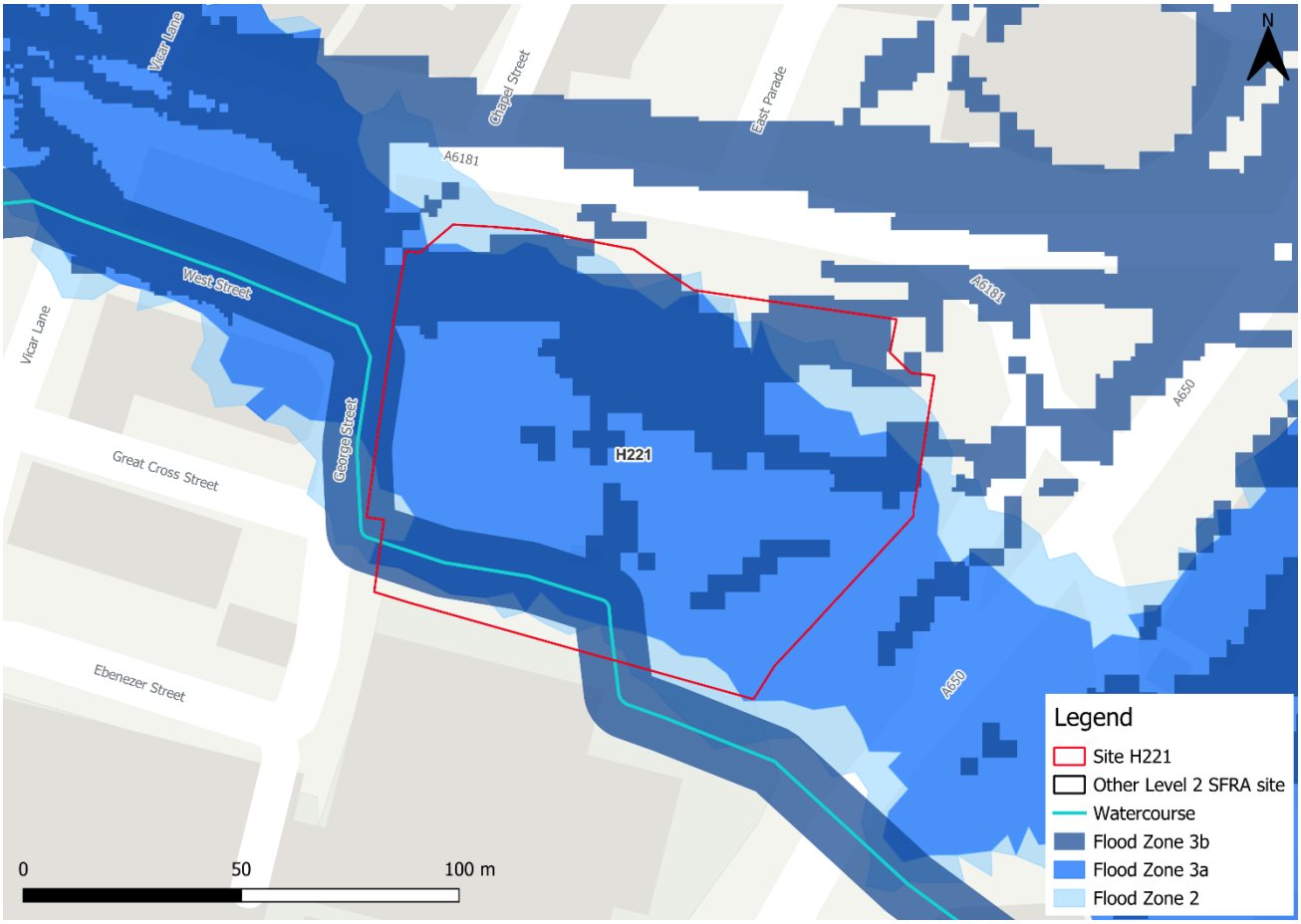


Figure 2-1: Existing risk from rivers to the site

2.1.2 Bradford Beck 2026 model outputs - present day

Figure 2-2 shows the modelled flood depths for the 1% AEP undefended event. Modelled risk to the site is less than that shown by Flood Zone 3a, impacting the northern and central areas of the site. However, it is noted that the current Flood Zone 3a does not yet account for the latest Bradford Beck model outputs. Maximum flood depths within the site are modelled to be shallow between 0.15 and 0.3 m, however this is only within a small area of the site. Flood depths across the majority of the site are less than 0.15 m. Maximum flood velocities are between 1 and 2 m^3/s (Figure 2-3), however this is only within a small area in the northeast of the site. Modelled flood hazard is categorised as 'very low' across the entire site (Figure 2-4). Safe access and escape routes would likely be available via George Street to the west of the site during this event, given the low modelled flood depths.

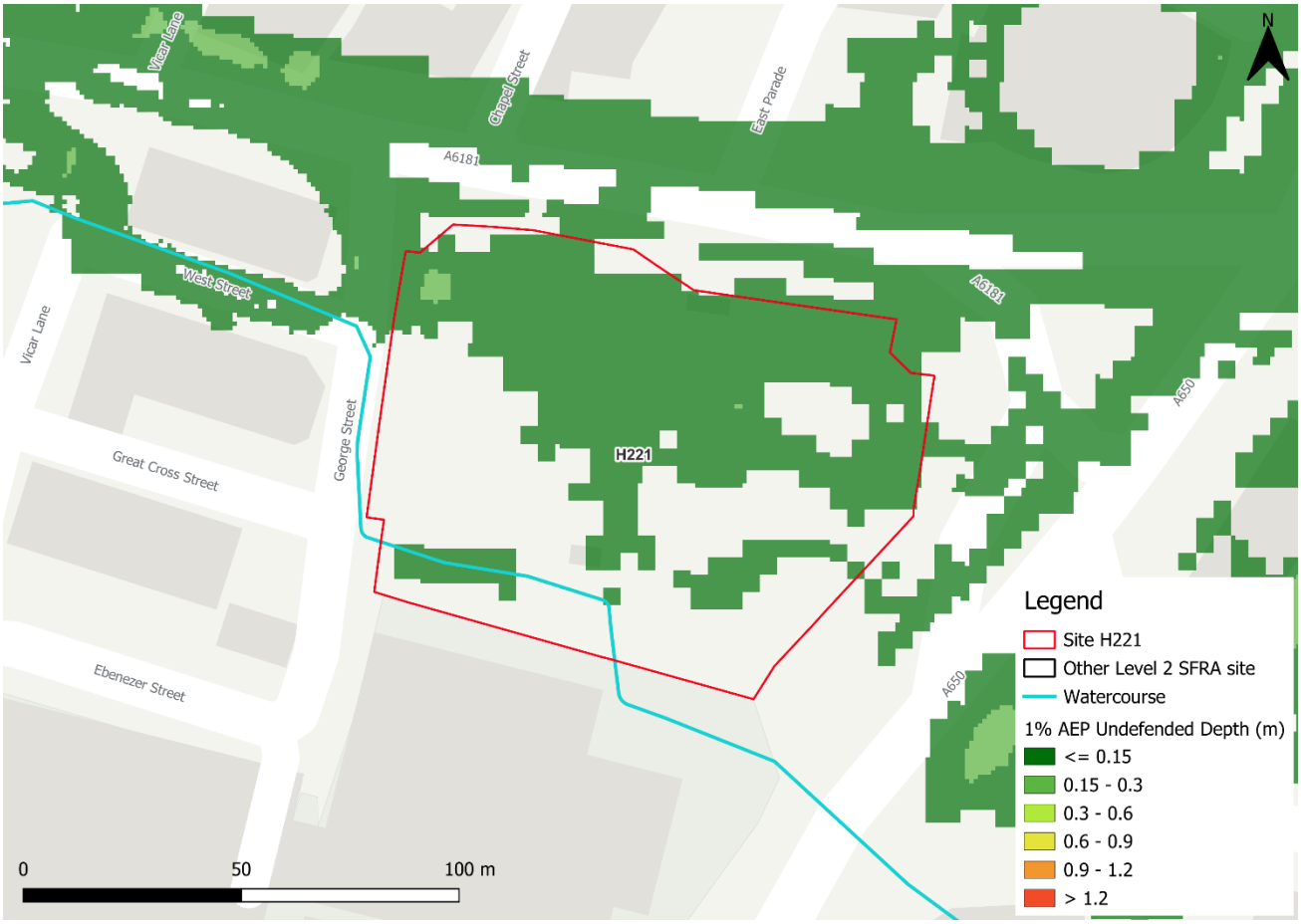


Figure 2-2: Flood depths for 1% AEP undefended flood event

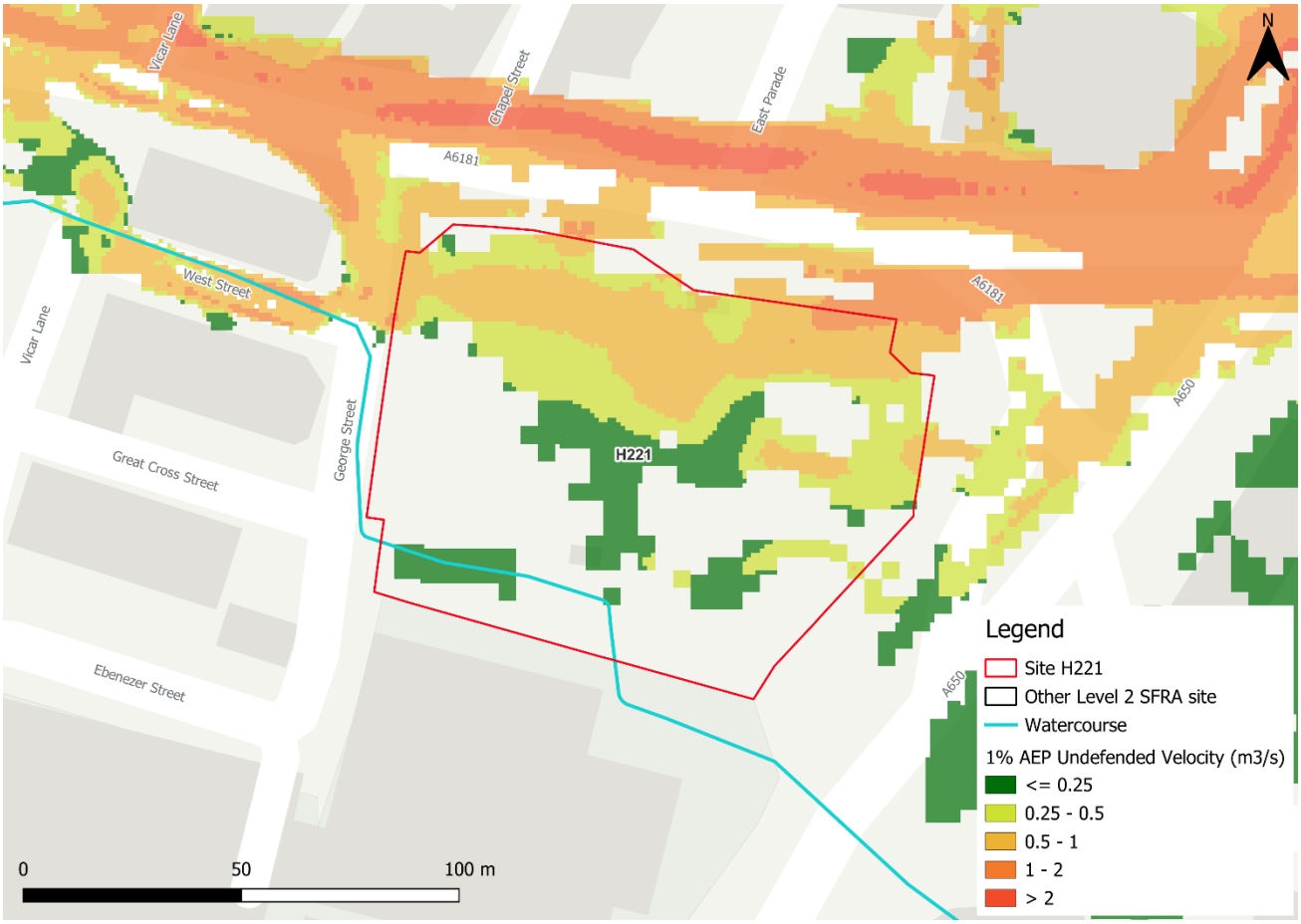


Figure 2-3: Flood velocities for 1% AEP undefended flood event

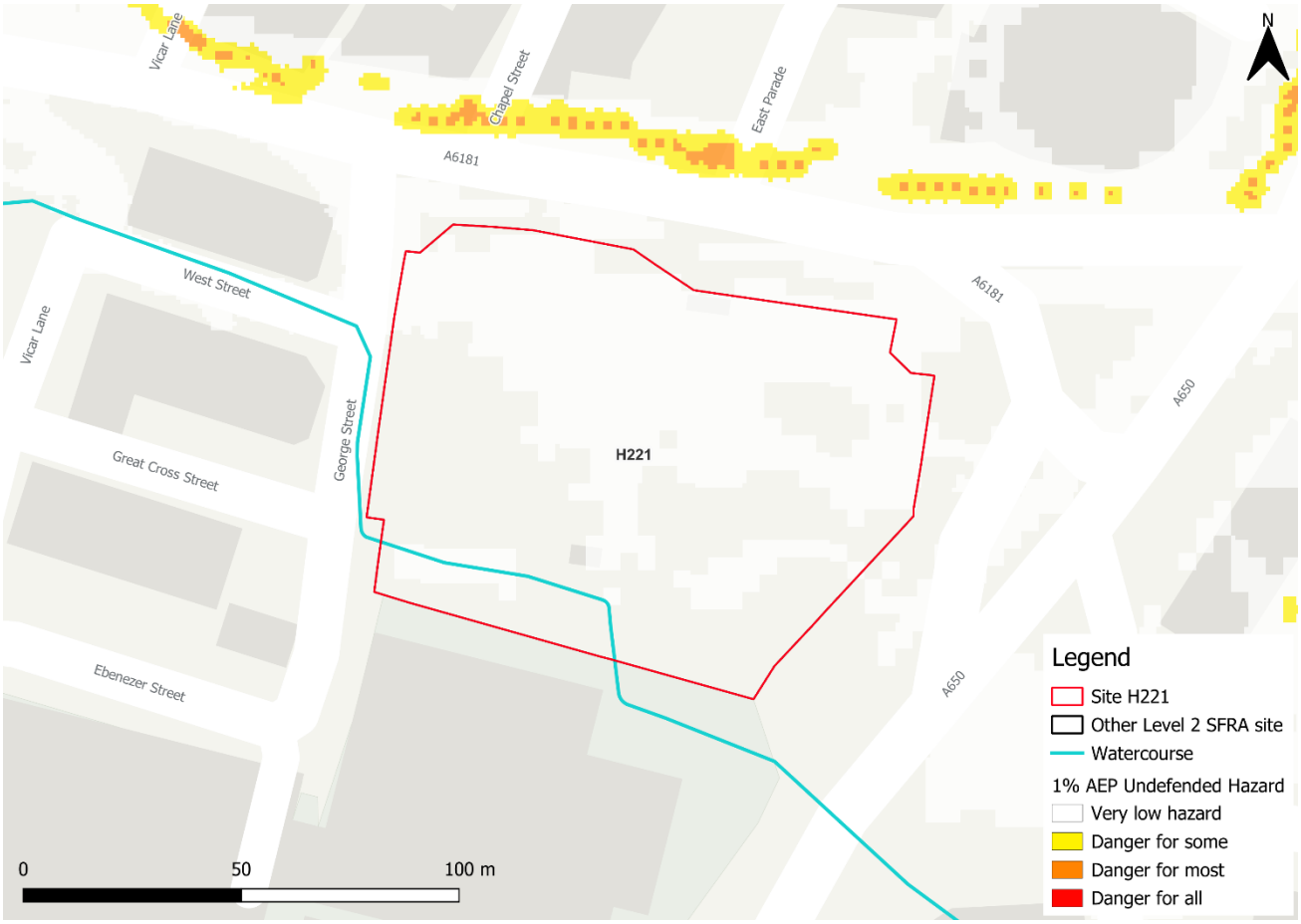


Figure 2-4: Flood hazard[1] for 1% AEP undefended flood event

2.2 Impacts from climate change

The EA's SFRA guidance states that SFRAs should assess the central allowance for less vulnerable, more vulnerable, highly vulnerable and water compatible development (Table 2-2). The impacts of climate change on flood risk from the Bradford Beck 2026 model have been modelled without flood defence infrastructure in place. As documented in Section 2.3.1, there are no formal engineered flood defences that would benefit the site.

1 Fluvial hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.

Table 2-2: Modelled climate change allowances for peak river flows for the Aire and Calder Management Catchment

Return period (AEP event)	Central allowance 2080s (% increase)	Higher central allowance 2080s (% increase)	Upper end allowance 2080s (% increase)
3.3% (functional floodplain)	23%	31%	51%
1%	23%	31%	51%

2.2.1 Bradford Beck 2026 model outputs - climate change

Figure 2-5 shows the onsite modelled flood depths for the 1% AEP undefended event +23% for climate change. Risk is modelled to be similar in both extent and depth in comparison to present day conditions. Maximum depths are shown to remain at between 0.15 and 0.3 m, with a slighter larger area of the site within this depth band. Flood velocities are modelled to remain similar, with maximum velocities between 1 and 2 m^3/s (Figure 2-6). The modelled flood hazard within the site is largely categorised as 'very low' (Figure 2-7), with a very small area categorised as 'danger for some' in the west of the site.

Safe access and escape routes would likely be available via George Street to the west of the site during this event, given the low modelled flood depths.

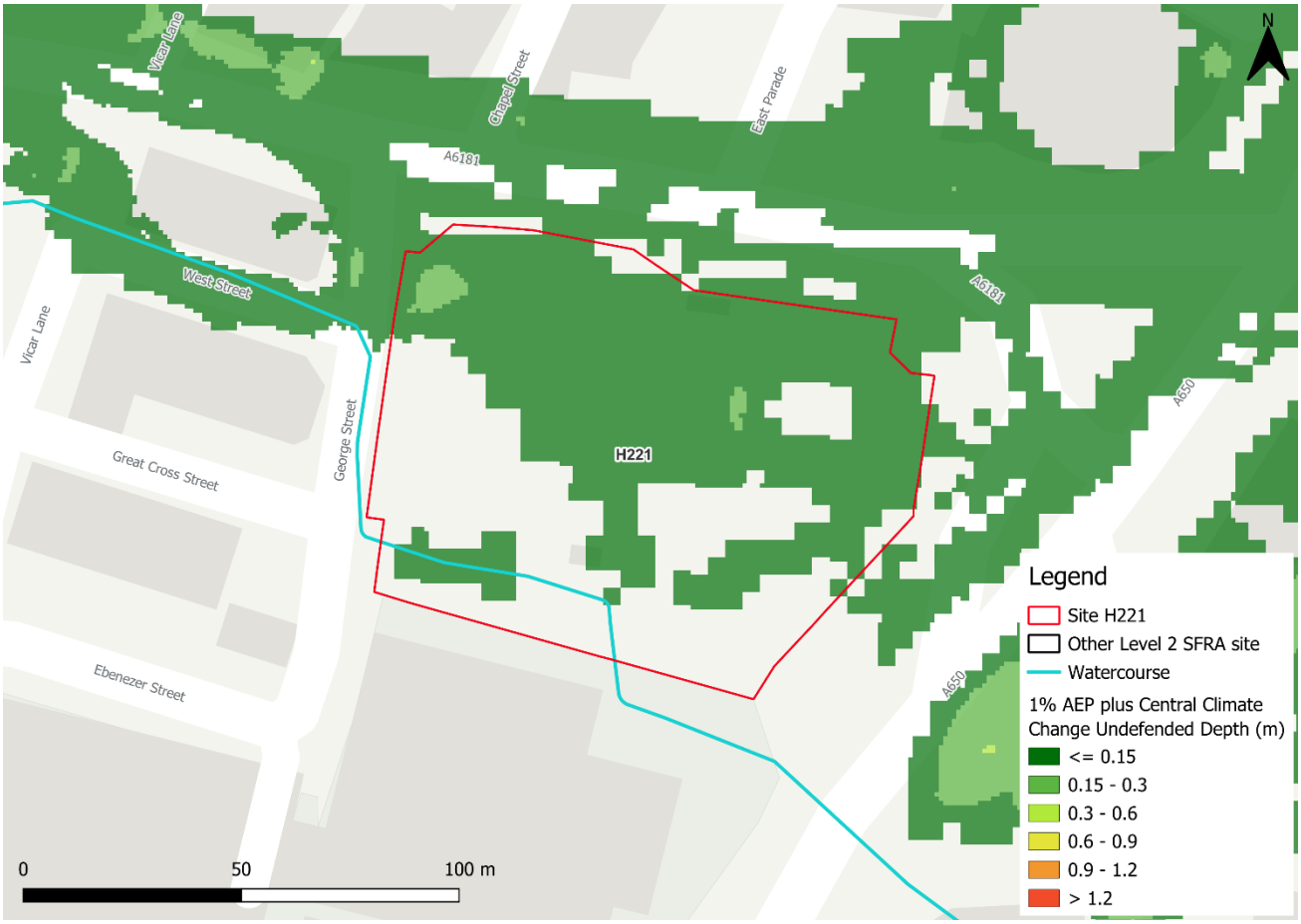


Figure 2-5: Flood depths for 1% AEP undefended flood event +23% (central climate change allowance)

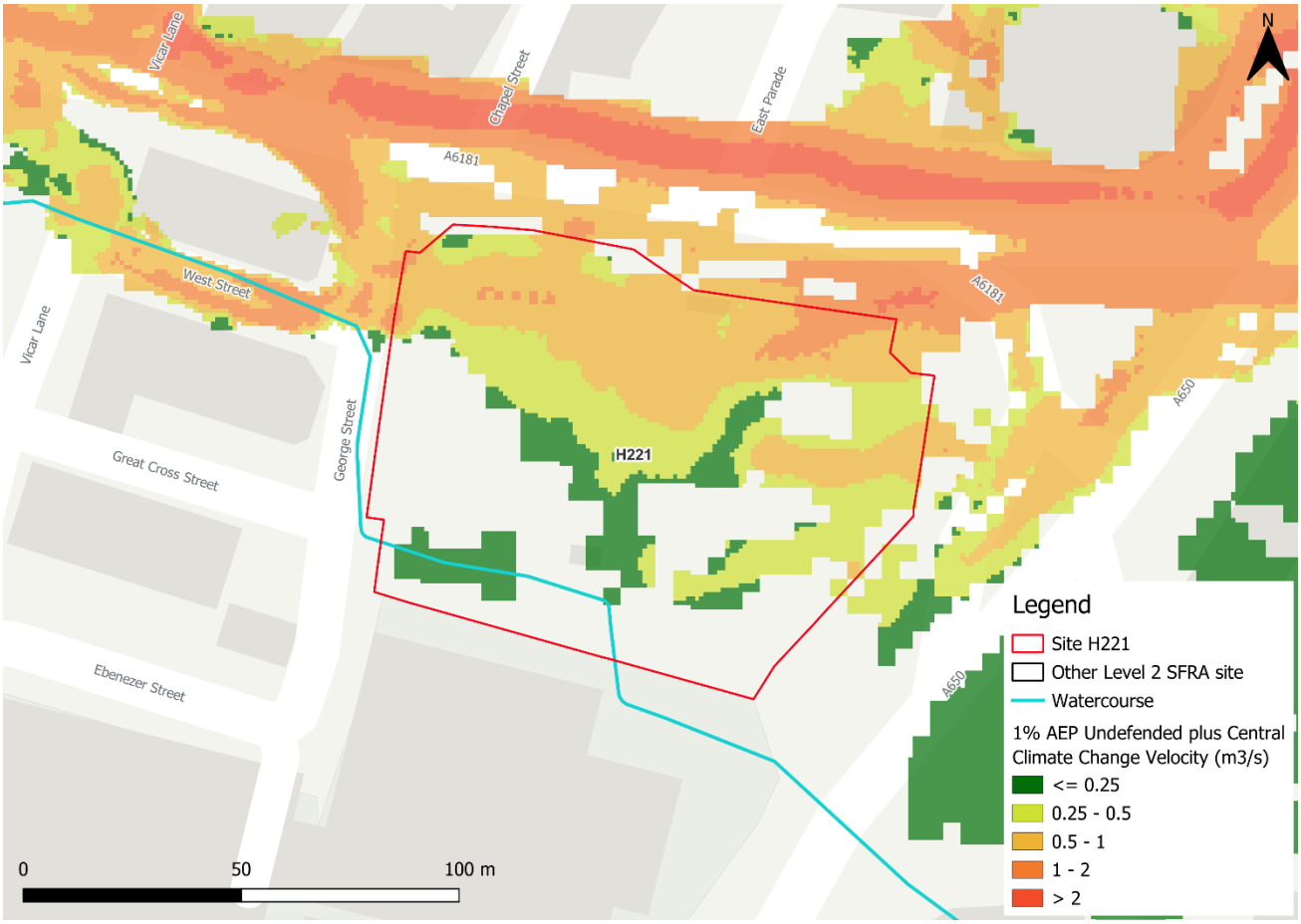


Figure 2-6: Flood velocities for 1% AEP undefended flood event +23% (central climate change allowance)

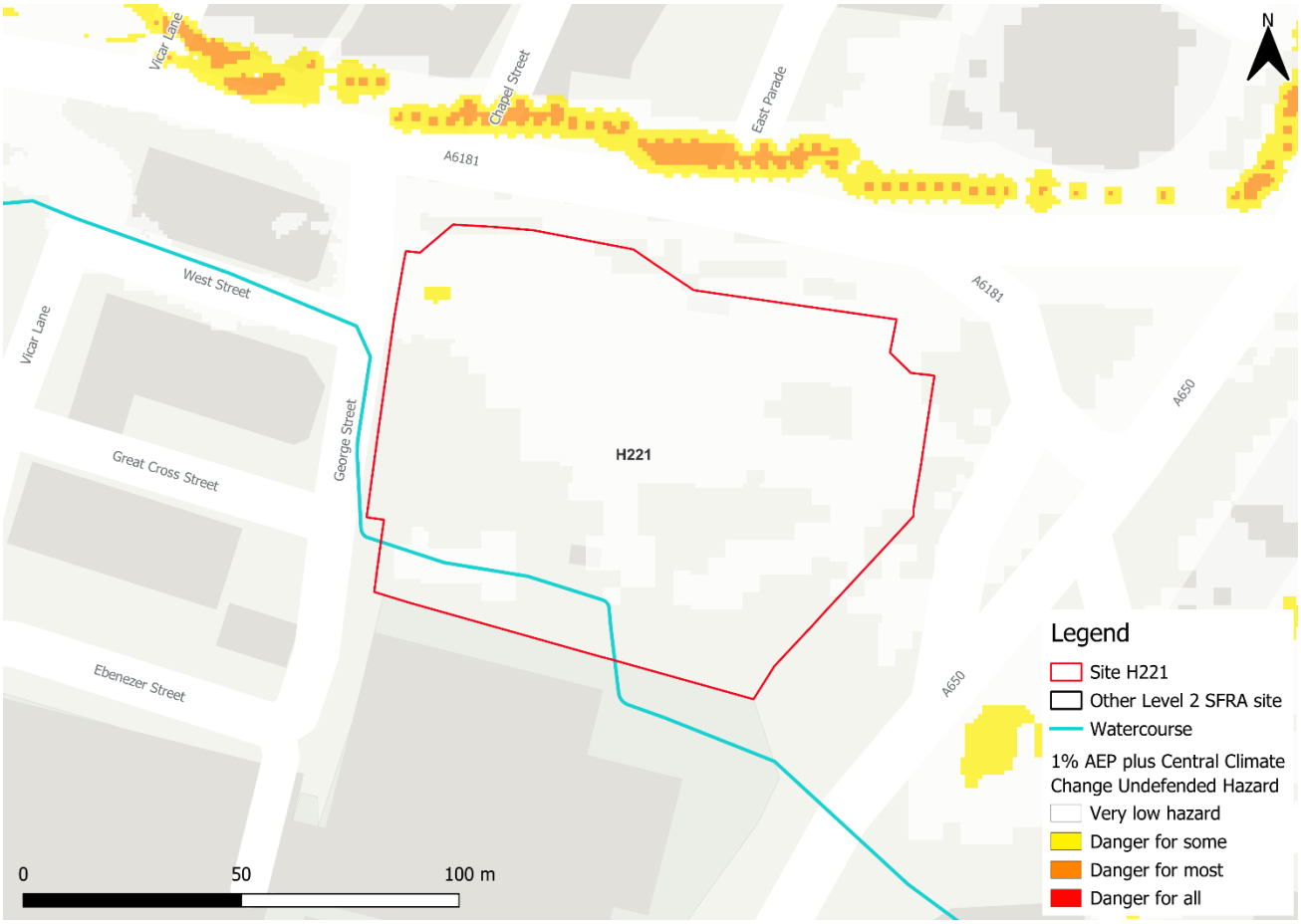


Figure 2-7: Flood hazard for 1% AEP undefended flood event +23% (central climate change allowance)

2.2.2 Flood Map for Planning - climate change

Climate change data in this area is unavailable from the EA's Flood Map for Planning plus Climate Change (2070-2125) dataset, as shown in Figure 2-8.

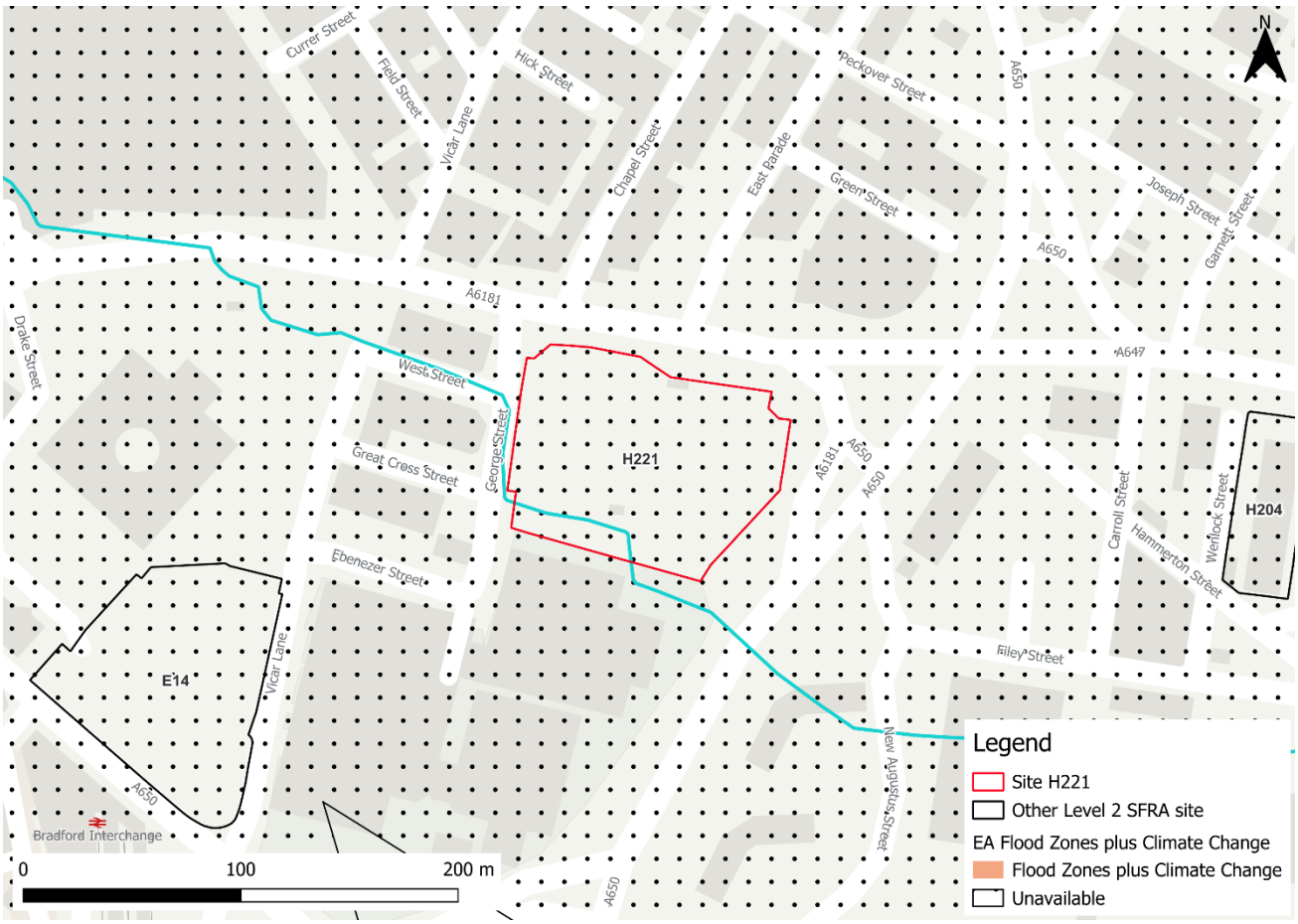


Figure 2-8: EA Flood Zones plus Climate Change

2.3 Flood risk management

2.3.1 Flood defences

The site does not benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset.

2.3.2 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) that may help to reduce flood risk to the site and surrounding areas. There are no applicable areas that could benefit the site.

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO) datasets have been considered. There are no recorded historic flood events within the vicinity of the site.

2.5 Emergency planning

2.5.1 Flood warnings

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The majority of the site is located within a FWA, namely 123FWF785 - Bradford Beck and tributaries at Bradford.

Flood alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be issued when there is less confidence that flooding will occur in a FWA. The majority of the site is also located within a FAA, namely 123WAF961 - Middle River Aire catchment.

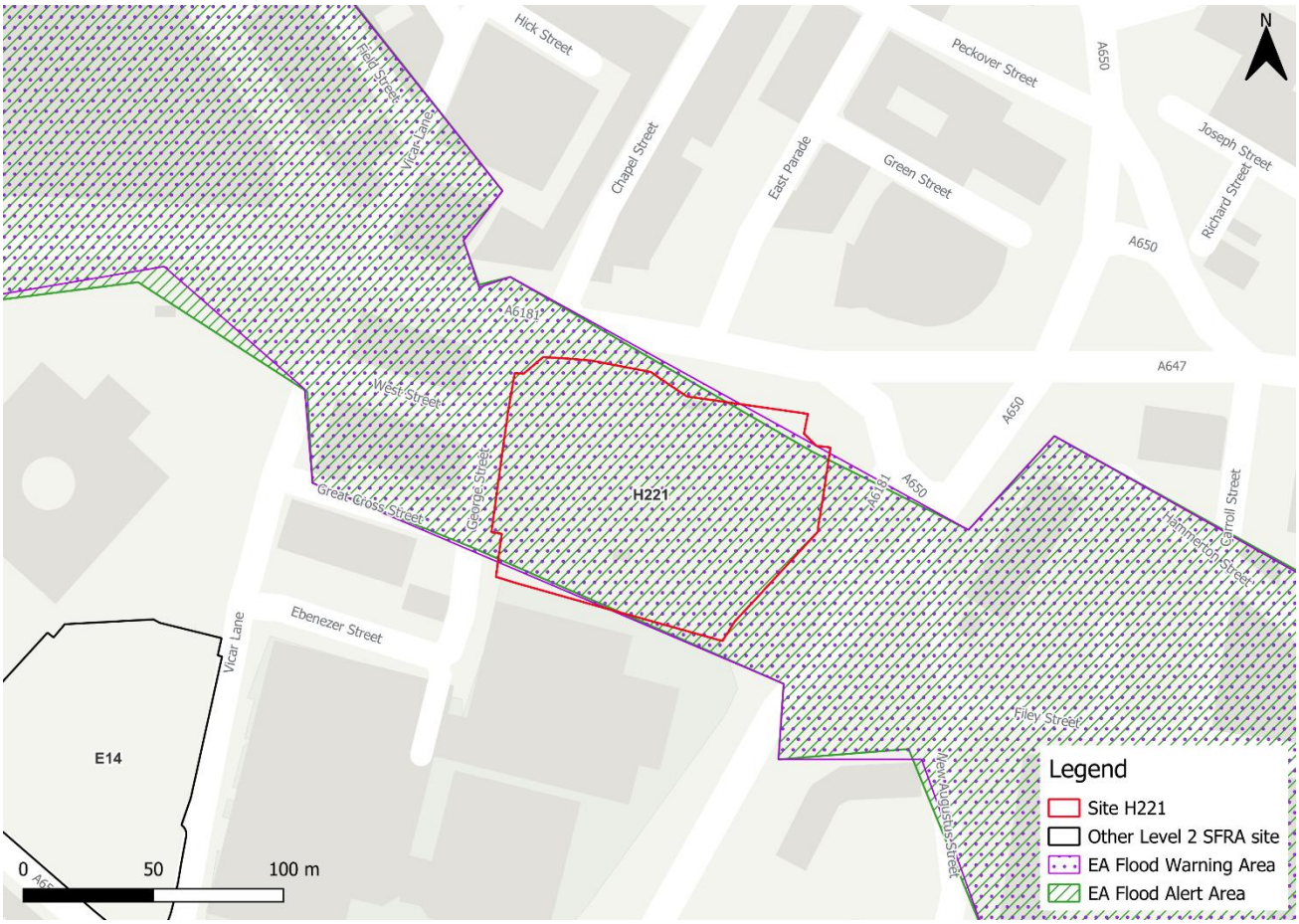


Figure 2-9: EA Flood Warning Areas and Flood Alert Areas

2.5.2 Access and escape routes

Based on available information on fluvial flood risk, safe access and escape routes would likely be available via George Street to the west of the site during a fluvial flood event, given the low modelled flood depths.

2.6 Observations, mitigation options, site suitability and sequential approach to development management - fluvial

- Observations:

- The proposed development of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF.
- Given the change in use and therefore vulnerability of the site, the LPA must consider whether the change of use is acceptable and whether the development can be designed to be safe, including for adequate emergency planning provision, accounting for the information provided in this Level 2 SFRA (para 014 FRCC-PPG).
- The site is modelled to be within the functional floodplain across the majority of the site, based on the Bradford Beck 2026 model. Development is not permitted within the functional floodplain.
- Consideration should be given as to whether deculverting and daylighting this section of culvert is feasible, supported by detailed modelling. The watercourse should be considered within site design and form a blue green corridor through the site.
- If East Brook remains culverted beneath the site, there should be no development above the culvert. The location and course of the culvert should be confirmed through a survey.
- If works are proposed on or near East Brook, a separate permission may be required. The type of permission needed from the Lead Local Flood Authority will depend on the activity and location proposed.
- Within the southeast of the site, there is a Yorkshire Water Combined Sewer Overflow (CSO) attenuation tank. There are also proposals for a larger CSO attenuation tank within the northeast of the site. This will effectively remove approximately 50% of the site area for development.
- Based on available information, ideally this site would be converted to open space offering multifunctional benefits alongside flood risk mitigation including Biodiversity Net Gain (BNG) contributions, and social and amenity benefits.

- Mitigation:
  - EA flood warnings and alerts should continue to be in place to ensure early evacuation of site users before an extreme flood event occurs.
- Access and escape:
  - Based on available information, safe access and escape routes should be available via George Street to the west of the site, given the low modelled flood depths.

3 Flood risk from surface water

3.1 Existing risk

At the time of writing, the EA's latest national Risk of Flooding from Surface Water (RoFSW) does not include depth and hazard information suitable for planning purposes. Therefore, this Level 2 SFRA considers the third generation RoFSW depth and hazard mapping in addition to the NaFRA2 extents, as agreed with the EA. Surface water depth and hazard should be confirmed at the site-specific FRA stage.

3.1.1 Risk of Flooding from Surface Water - NaFRA2 extents

Based on the EA's national scale RoFSW map (January 2026), surface water risk to the site is significant, as shown in Table 3-1 and Figure 3-1.

Surface water risk is shown to cover the majority of the site when considering the high and medium risk events, with a significant flow path through the centre of the site. Safe access and escape routes may be challenging to achieve, as George Street to the west of the site is inundated during a surface water flood event.

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
7	32	46	15

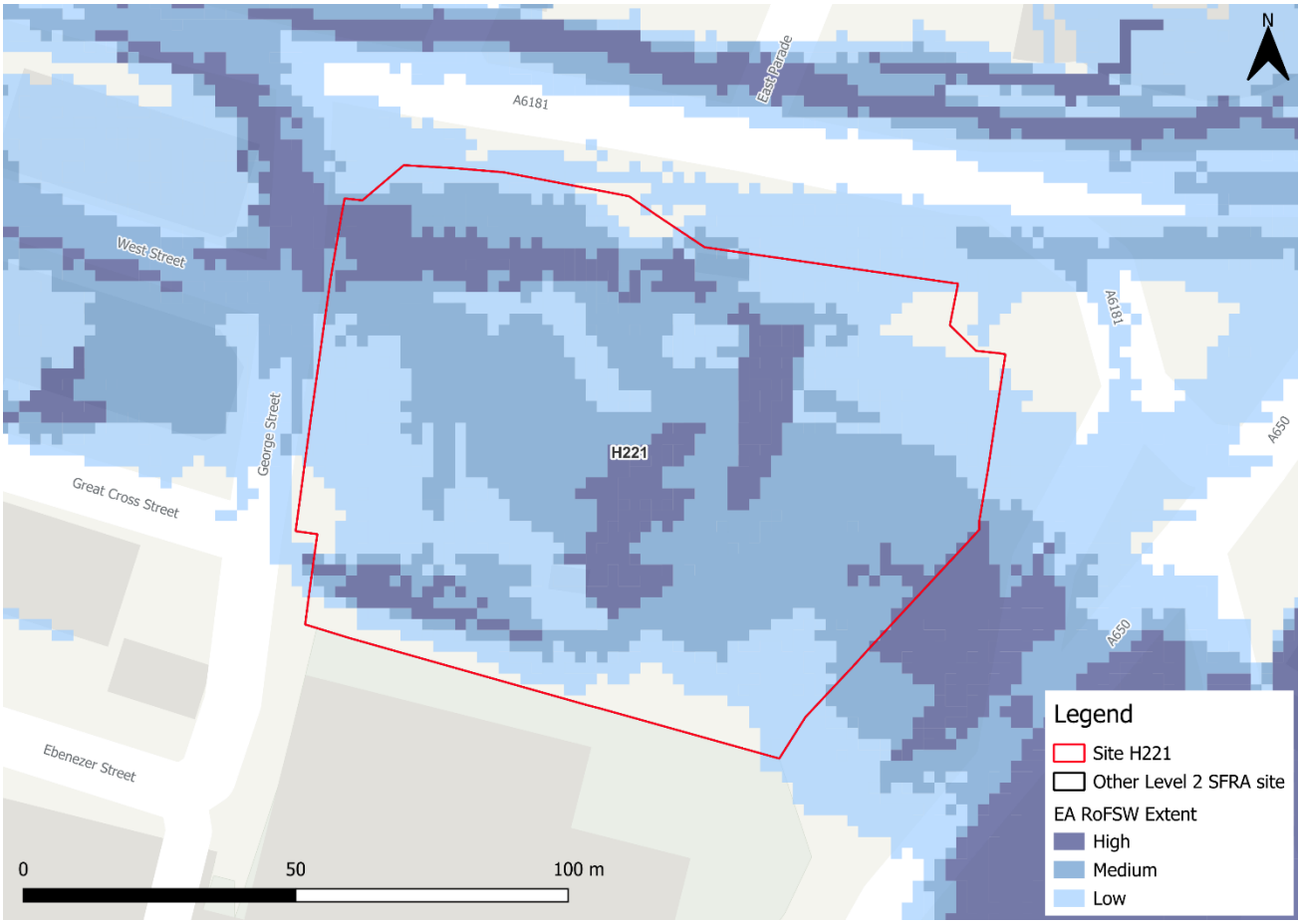


Figure 3-1: Surface water flood extents (NaFRA2 - Risk of Flooding from Surface Water map)

3.1.2 Risk of Flooding from Surface Water - third generation depths and hazards

Based on the EA's national scale third generation RoFSW map, the greatest flood depths within the site in the medium risk event are between 0.6 and 0.9 m (Figure 3-2), located within the centre of the site. There are large areas of the site where surface water flood hazard is categorised as 'significant' with the medium risk event (Figure 3-3).

Safe access and escape routes to the site may be challenging to achieve given the modelled surface water flood depths and hazards along the roads surrounding the site. However, this is based on the third generation mapping and therefore safe access and escape routes should be confirmed based on a drainage strategy through the FRA.

There are differences between the NaFRA2 RoFSW map and the third-generation depth and hazard mapping. The NaFRA2 RoFSW map does not map flooding less than 0.075m (7.5cm) in depth. Therefore, where the map may show no flooding, there may be shallow flooding up to a depth of 0.075m. In contrast, the third generation RoFSW does not map flooding with a hazard rating of less than 0.575. This could explain the differences observed between the NaFRA2 and third generation RoFSW. Assessment of surface water should be carried out at the site-specific FRA stage to robustly establish current and future surface water flood risk conditions.

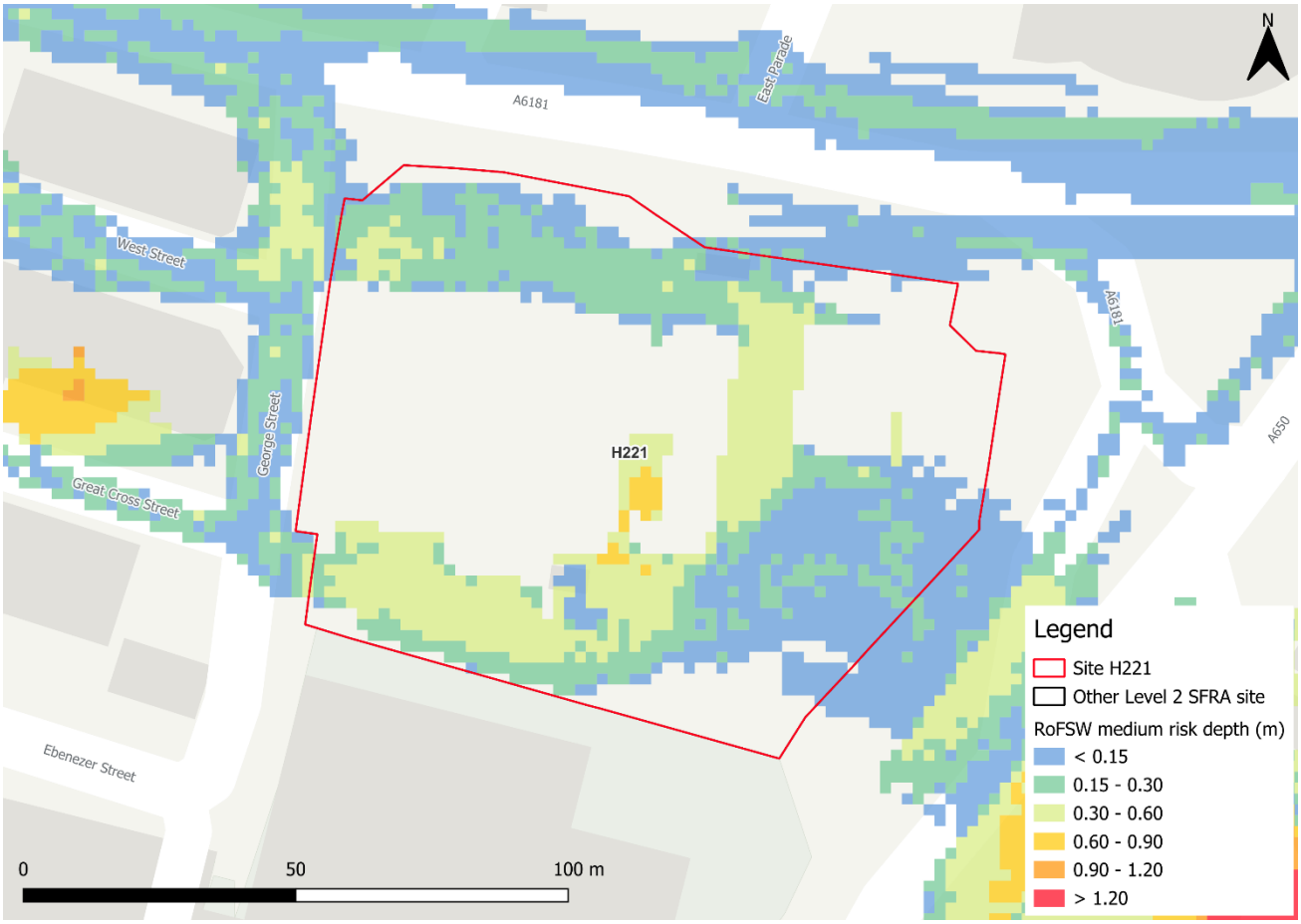


Figure 3-2: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

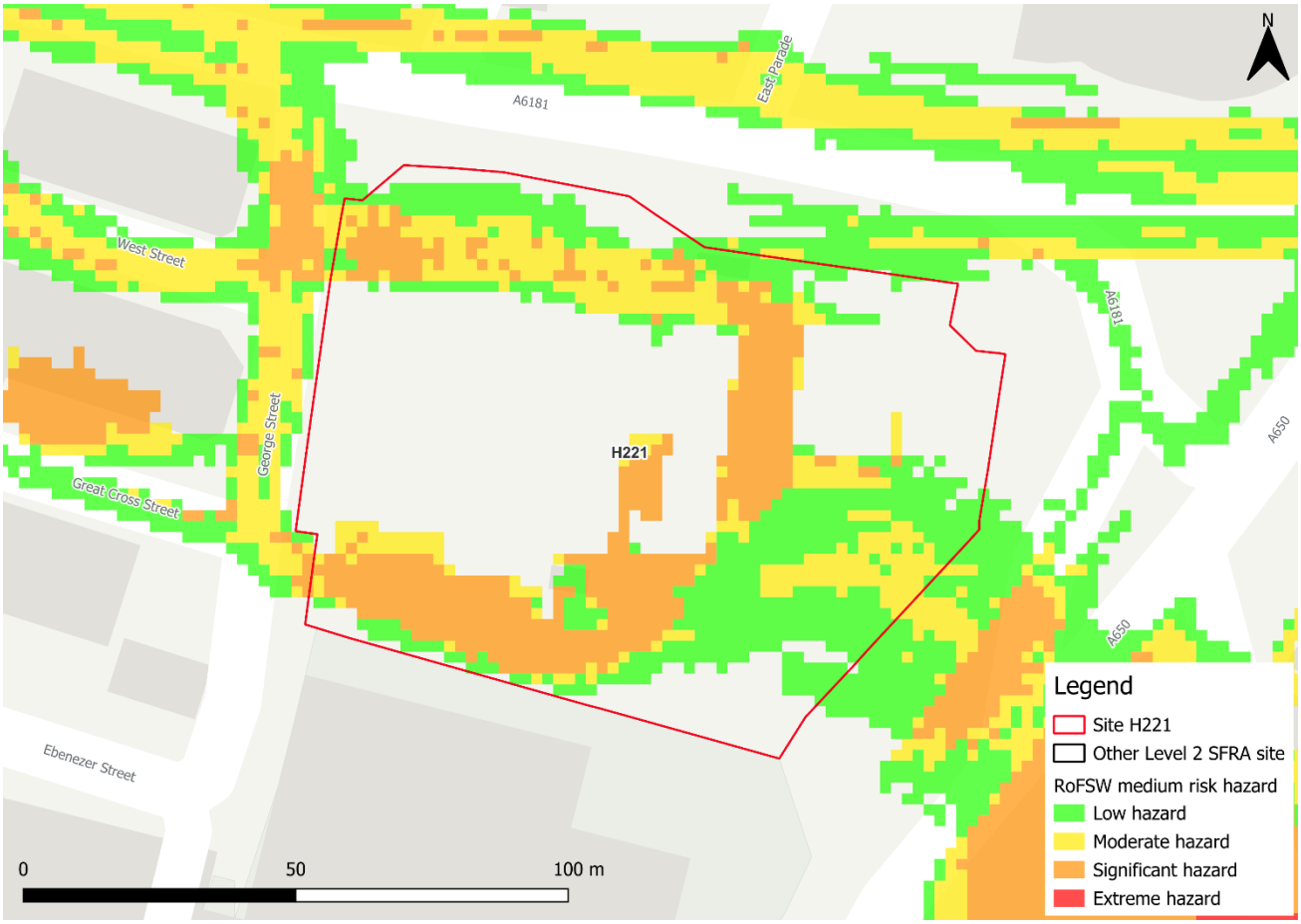


Figure 3-3: Medium risk event surface water flood hazard[2] (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

At the time of writing, the available national surface water climate change mapping is unsuitable for consideration in development planning. This Level 2 SFRA considers the low risk surface water event as a conservative proxy for the medium risk event plus climate change, as agreed with the EA. The impact of climate change on surface water flood risk should be considered at the site-specific FRA stage.

Using the low risk event as a proxy, the medium risk surface water event is likely to increase significantly in extent across the site when accounting for climate change (Figure 3-4). The third generation map indicates maximum flood depths are likely to increase to > 1.2 m in a small area in the centre of the site, with large areas of flood depths between 0.9 and 1.2 m (Figure 3-5). Surface water flood hazard in the medium risk event is categorised as 'extreme' across large areas of the site (Figure 3-6).

Safe access and escape routes will likely be challenging to achieve in the future, given the significant flood depths and hazards along the roads surrounding the site. However, this is

2 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

based on the third generation mapping and therefore safe access and escape routes should be confirmed based on a drainage strategy through the FRA.

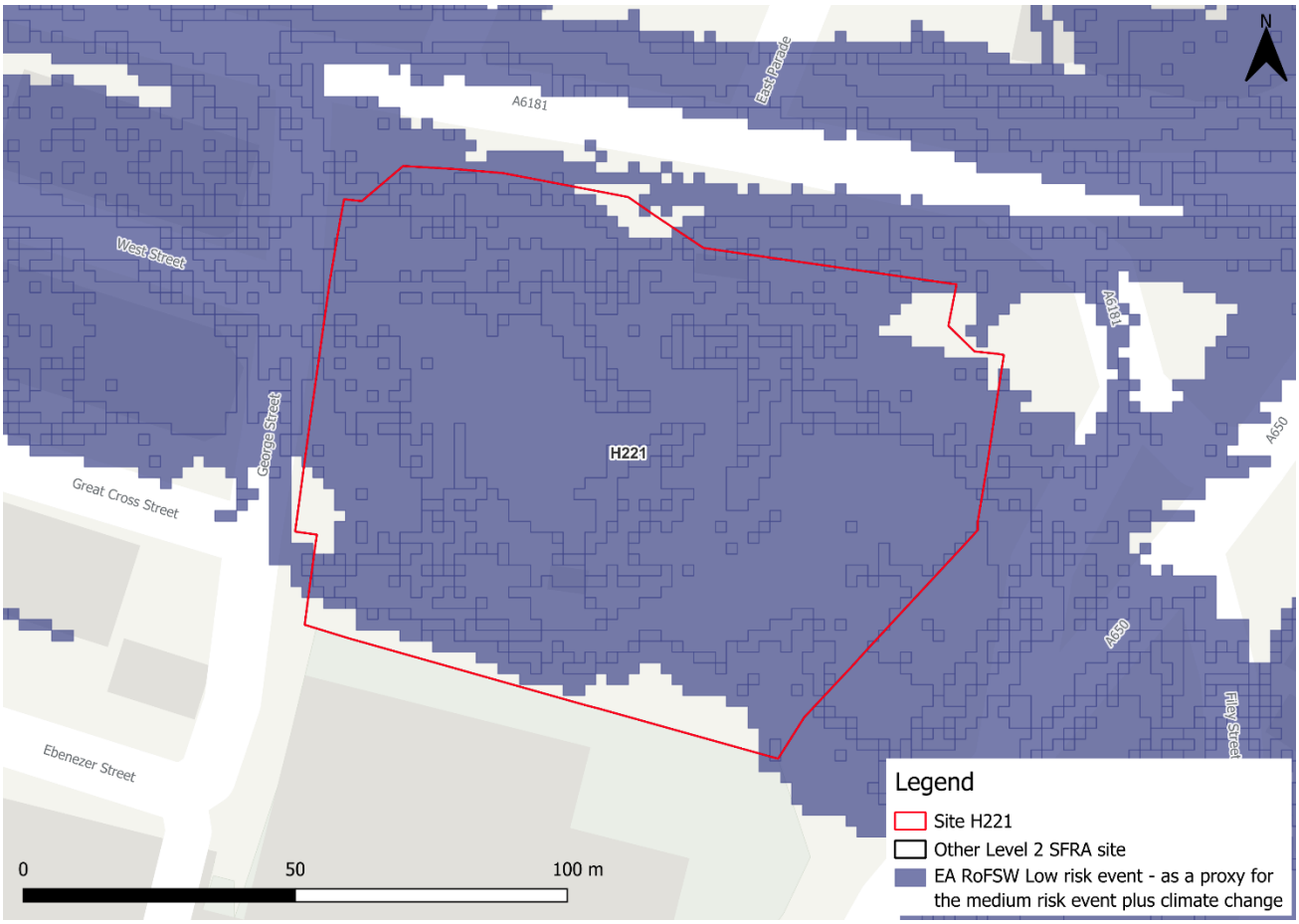


Figure 3-4: Low risk event surface water flood extent, as a proxy for the medium risk event plus climate change (NaFRA2 - Risk of Flooding from Surface Water map)

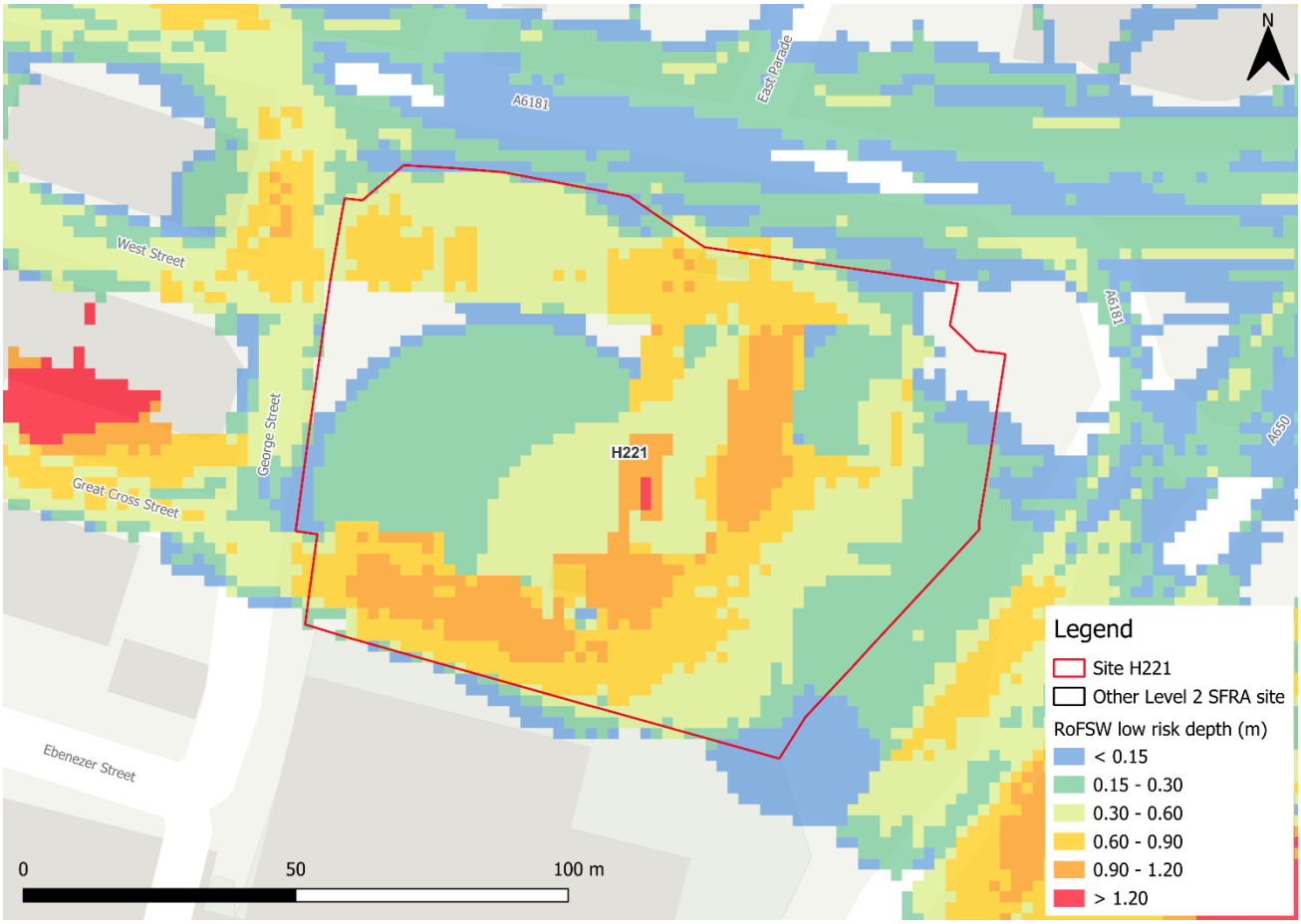


Figure 3-5: Low risk event surface water flood depths, as a proxy for the medium risk event plus climate change (Third generation - Risk of Flooding from Surface Water map)

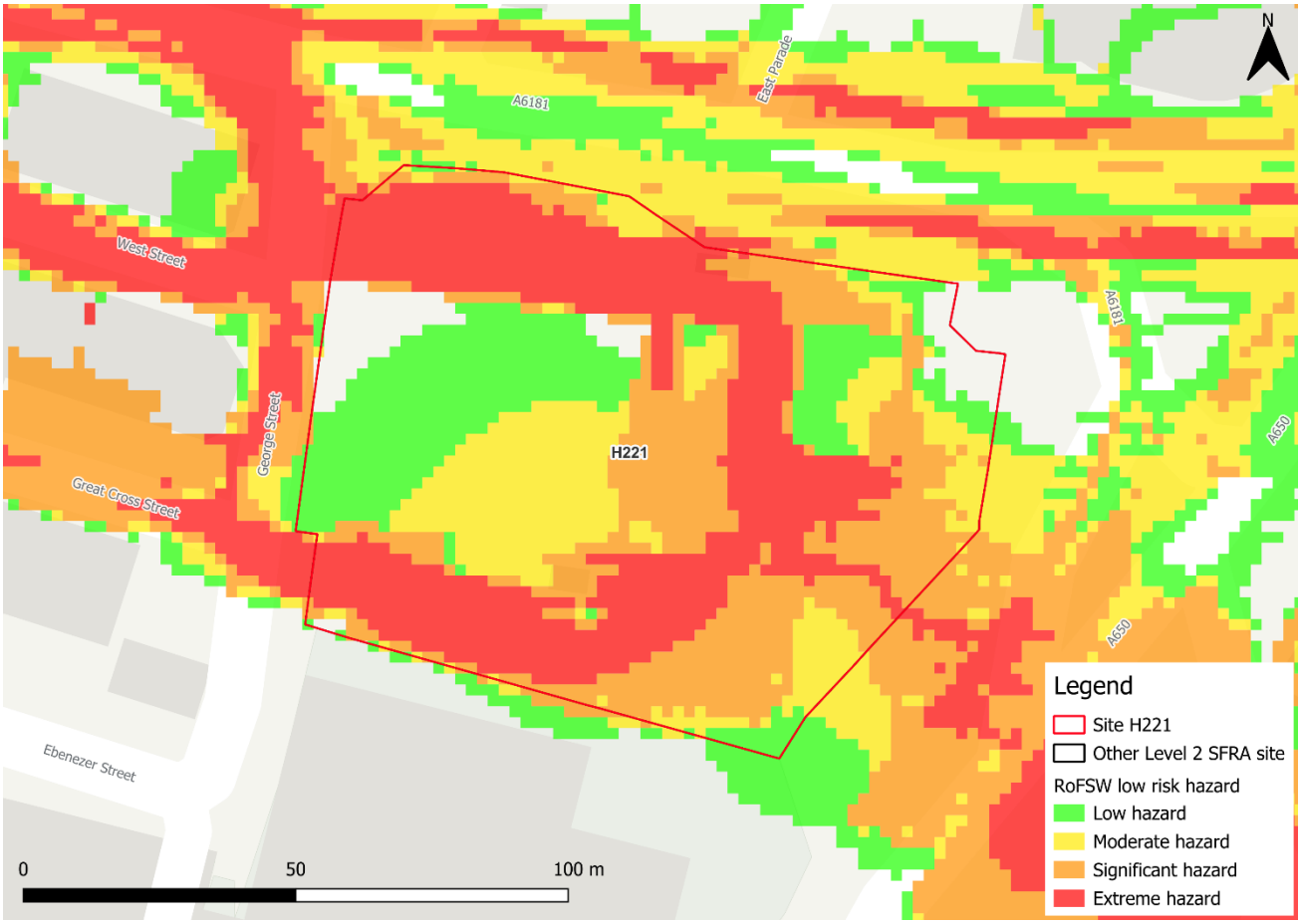


Figure 3-6: Low risk event surface water flood hazard, as a proxy for the medium risk event plus climate change (Third generation - Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk to the site is significant, with surface water risk covering the majority of the site when considering the high and medium risk events. There is a significant flow path through the centre of the site.
- The effects of climate change on surface water have not been modelled for this SFRA, however the low risk surface water event has been used as a proxy for the medium risk event plus climate change. In this event, there is significant risk across the entire site.
- Safe access and escape routes would likely be challenging to achieve based on the surface water risk surrounding the site.
- Given the significant onsite surface water flood risk, ideally this site would not be developed and would be left as open green space offering multifunctional benefits alongside flood risk mitigation including Biodiversity Net Gain (BNG) contributions, and social and amenity benefits.
- The RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of

risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[3]. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

The entire site is located within an area where there is no risk of groundwater emergence. Groundwater conditions may therefore be suited to infiltration SuDS, however the bedrock geology of the site indicates the permeability may be low (Figure 1-3). Therefore, the type of infiltration SuDS needs to be considered further through the drainage strategy.



Figure 4-1: JBA 5m Groundwater Emergence Map

3 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

Although a site may be afforded some protection from defences and / or drainage infrastructure, there is always a residual risk of flooding from asset failure i.e. defence breaches, or blockages of culverts or drainage assets. There is potential residual risk to the site from a structural failure of the culverted channel beneath the site (Figure 5-1).

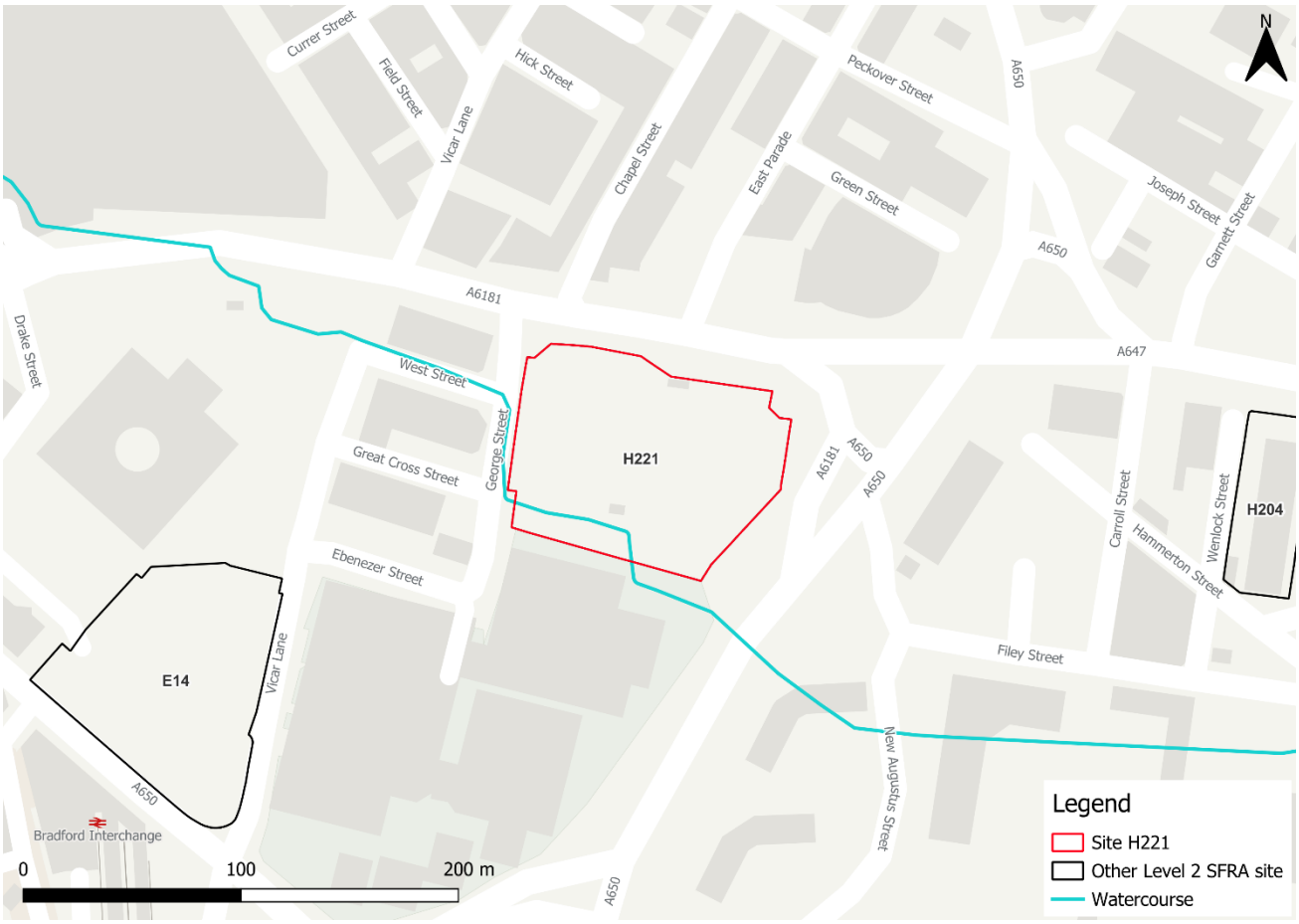


Figure 5-1: Potential residual risk - East Brook culvert beneath the site

5.1 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is not modelled to be at risk from reservoir flooding.

5.2 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a structural failure of the East Brook culvert beneath the site.
- Areas adjacent to culverts and bridges are at particular risk from the rapid onset of fast flowing and deep flooding, with little or no warning if structures fail. Emergency plans must be in place for such areas and safe access and escape routes must be in place for the lifetime of development. Resistance and resilience measures may also need to be put in place to manage residual flood risk when avoidance measures have been exhausted.
- The LPA should use the information on residual risk in this Level 2 SFRA to state in the local plan strategic policies a preferred mitigation strategy for ensuring development will be safe throughout its lifetime in relation to urban form, risk management and where flood mitigation measures are likely to have wider sustainable design implications (para 042, FRCC-PPG).

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is required to pass part b) of the exception test[4], given it is proposed for more vulnerable uses and is located within Flood Zone 3a. It must be proven that the development can be safe for its lifetime, which is generally considered to be 100 years for residential development. Based on the information presented in this Level 2 SFRA, the exception test cannot be passed, and the site should not be allocated.

6.2 Recommendations summary

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

- The majority of the site is located within the functional floodplain and Flood Zone 3a. Development is not permitted within the functional floodplain.
- It is recommended that this site is converted to open space and used as a multifunctional greenspace offering multifunctional benefits alongside flood risk mitigation including Biodiversity Net Gain (BNG) contributions, and social and amenity benefits.
- The Flood Map for Planning requires updating to include for the 2026 model of Bradford Beck.

6.3 Site-specific FRA requirements and further work

At the planning application stage, the following should be considered:

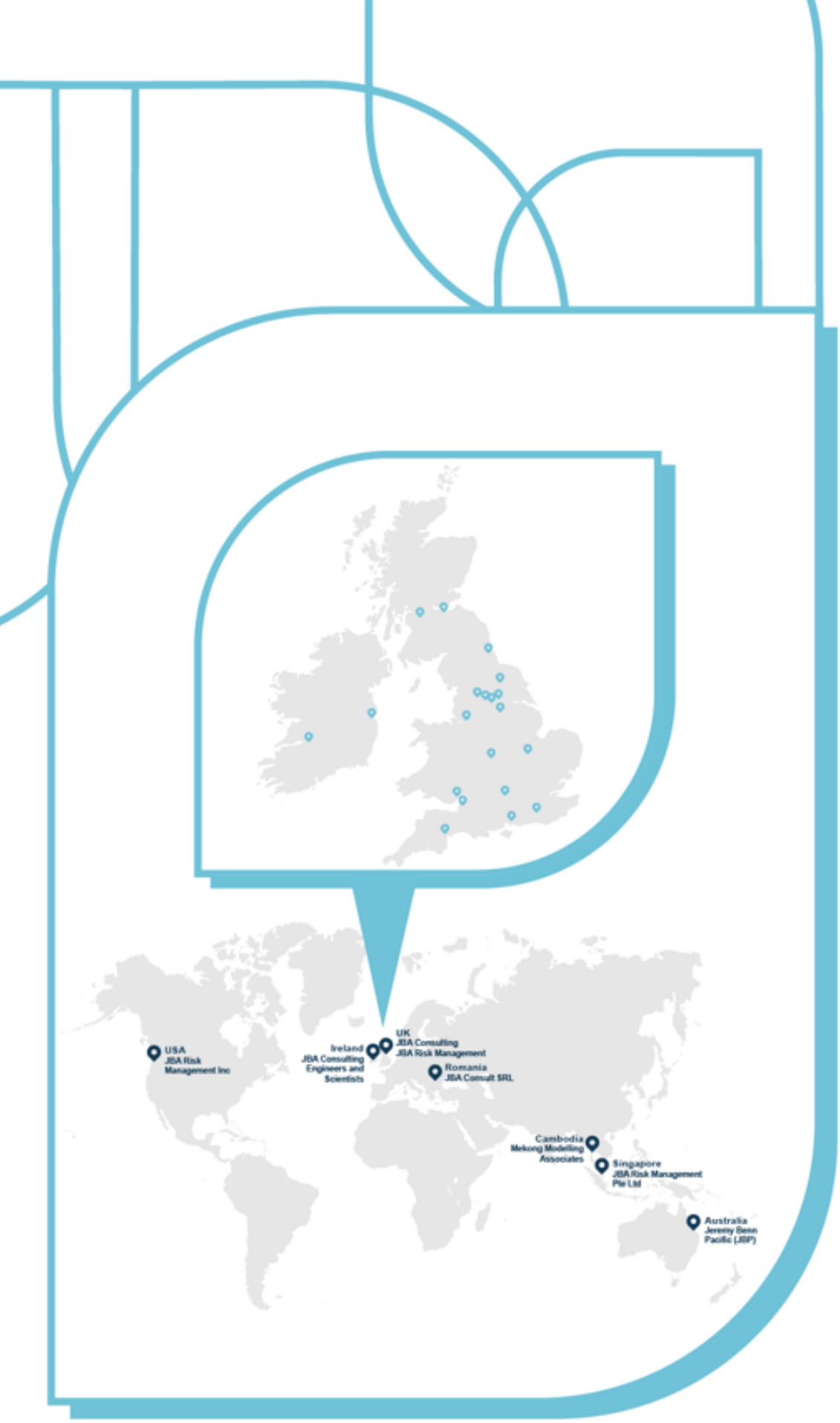
- A condition and capacity assessment of the culvert beneath the site.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

4 Para 178 National Planning Policy Framework 2024

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+44(0)1756 799919
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Bradford Level 2 Strategic Flood Risk Assessment - Site H222

Final Draft

July 2026

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

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Reviewed by	Mike Williamson BSc MSc CGeog FRGS EADA Principal Analyst
Authorised by	Krista Keating BSc MSc CEnv CSci MCIWEM C.WEM Associate Director

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Contract

JBA Project Manager	Mike Williamson
Address	Phoenix House, Lakeside Drive, Centre Park, Warrington, WA1 1RX
JBA Project Code	2024s1078

This report describes work commissioned by City of Bradford Metropolitan District Council (CBMDC) by an instruction dated 19 July 2024. The Client's representative for the contract was Jonathan Dicken of CBMDC. Georgina Williams of JBA Consulting carried out this work.

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We would like to thank the Environment Agency for their assistance with this work.

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H222. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the 'CBMDC Level 1 SFRA' (2023) and read the 'CBMDC Level 2 SFRA Main Report' (2026) and is therefore familiar with the terminology used in this report.

1.1 Site H222

- Location: Area West of Valley Road
- Existing site use: Industrial
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 1.7 hectares
- Proposed development impermeable area: 1.56 hectares
- Watercourse: Bradford Beck
- CBMDC river model: Bradford Beck 2026
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Subject to the exception test as more vulnerable development proposed in Flood Zone 3a
    - Assessment of modelled fluvial flood depths, velocities and hazards
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk
    - Modelling of residual risk from Bradford Beck culvert

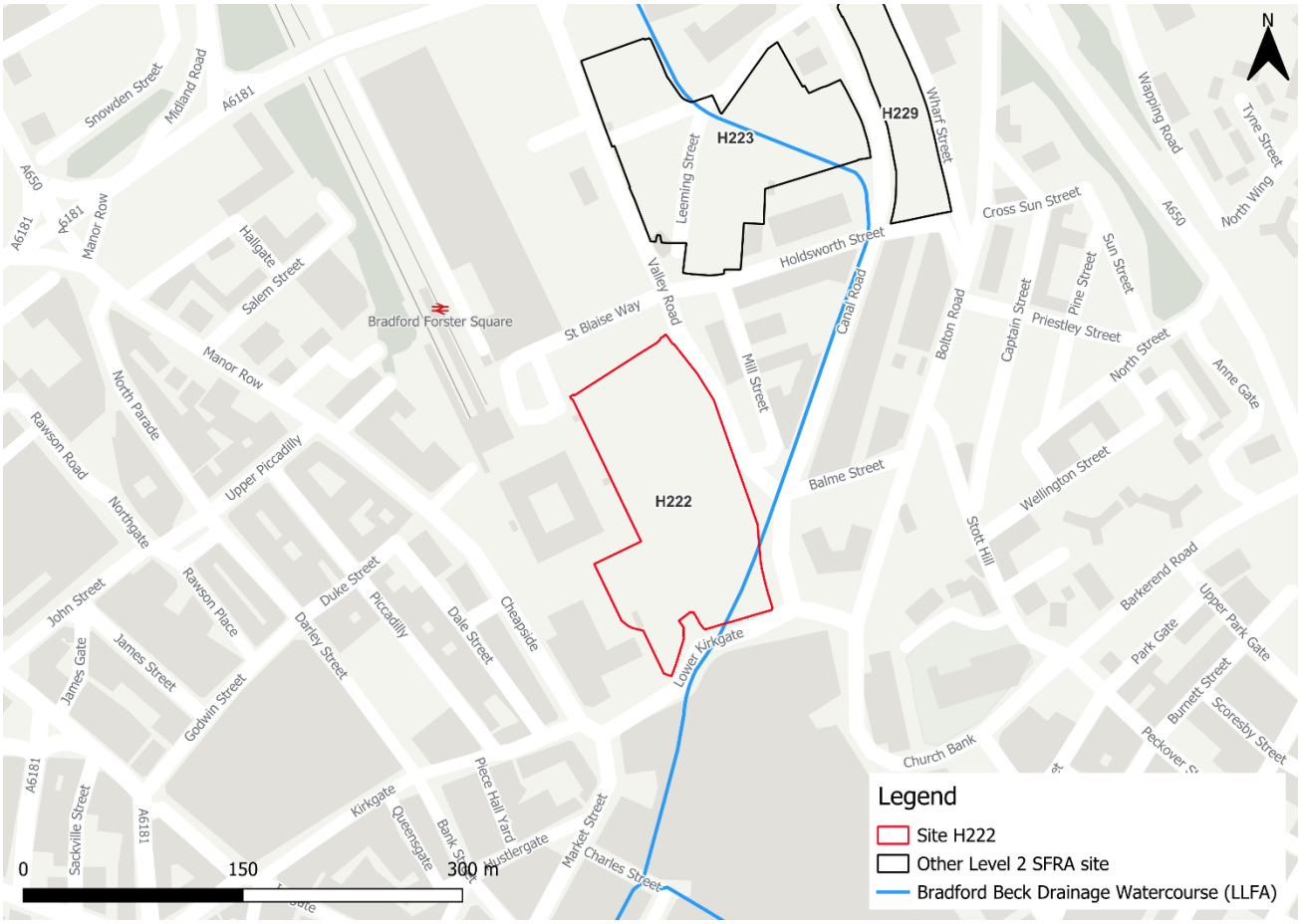


Figure 1-1: Existing site location boundary

The topography of the site is generally consistent across the entire site, with a slightly higher area of elevation to the south of the site (Figure 1-2).

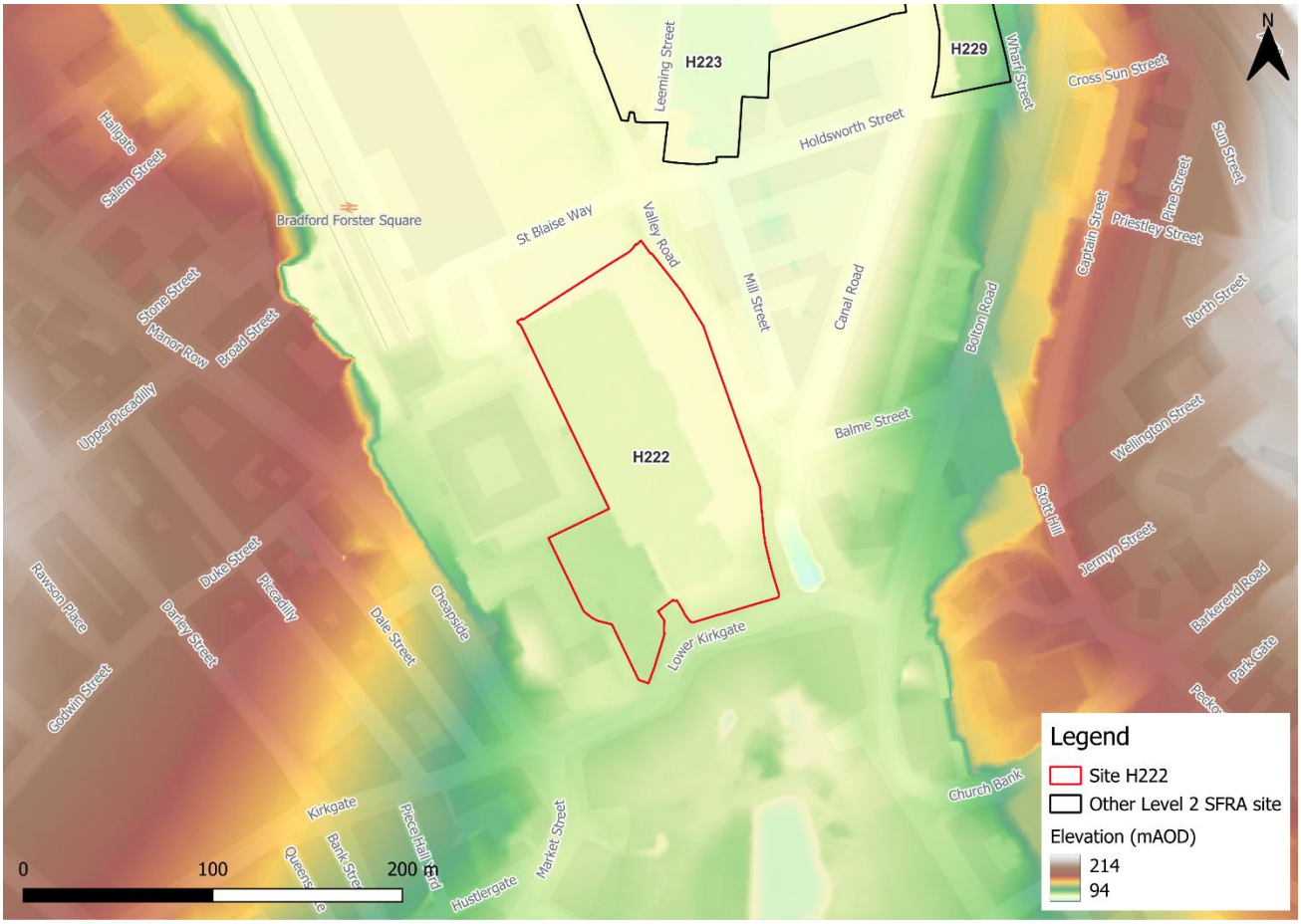


Figure 1-2: Topography

The underlying bedrock within the site is defined as 'Pennine Lower Coal Measures Formation', which comprises mudstone, siltstone, sandstone, coal, ironstone and ferricrete (Figure 1-3). This is overlain with superficial deposits of till. Mudstone, siltstone, coal, ironstone and ferricrete typically have low permeability, however this can be highly variable. Sandstone has a higher permeability.

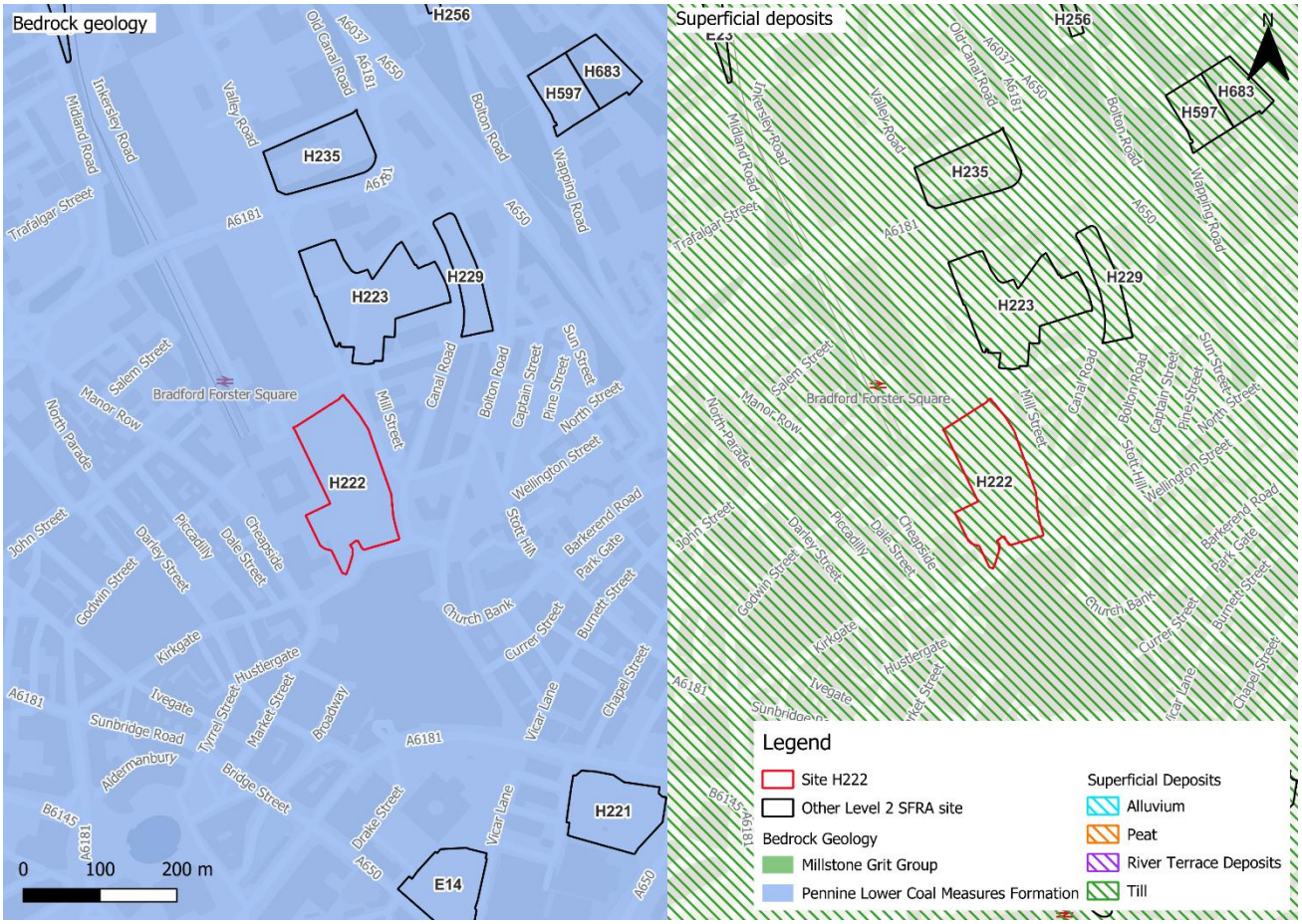


Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning (January 2026) and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.3).

Fluvial flood risk to the site comes from Bradford Beck which is assumed to be culverted beneath the south-eastern corner of the site. Functional floodplain is present within the south-eastern corner of the site. However, this is based on an 8m buffered polygon of the Bradford Beck channel to indicate the presence of the watercourse beneath the site. The mapped watercourse location may not represent the actual location of the culverted channel. Noting that, functional floodplain policy applies to the path of the culvert beneath the site and not the mapped functional floodplain, where these differ. The path of the culverted channel should be confirmed through a survey as part of the site-specific FRA.

The area of functional floodplain onsite should be left free of development. The eastern half of the site is situated within Flood Zone 3a and therefore at high risk of fluvial flooding. Much of the remaining area of the site is within Flood Zone 2 and therefore at medium risk of fluvial flooding.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
18	29	48	5

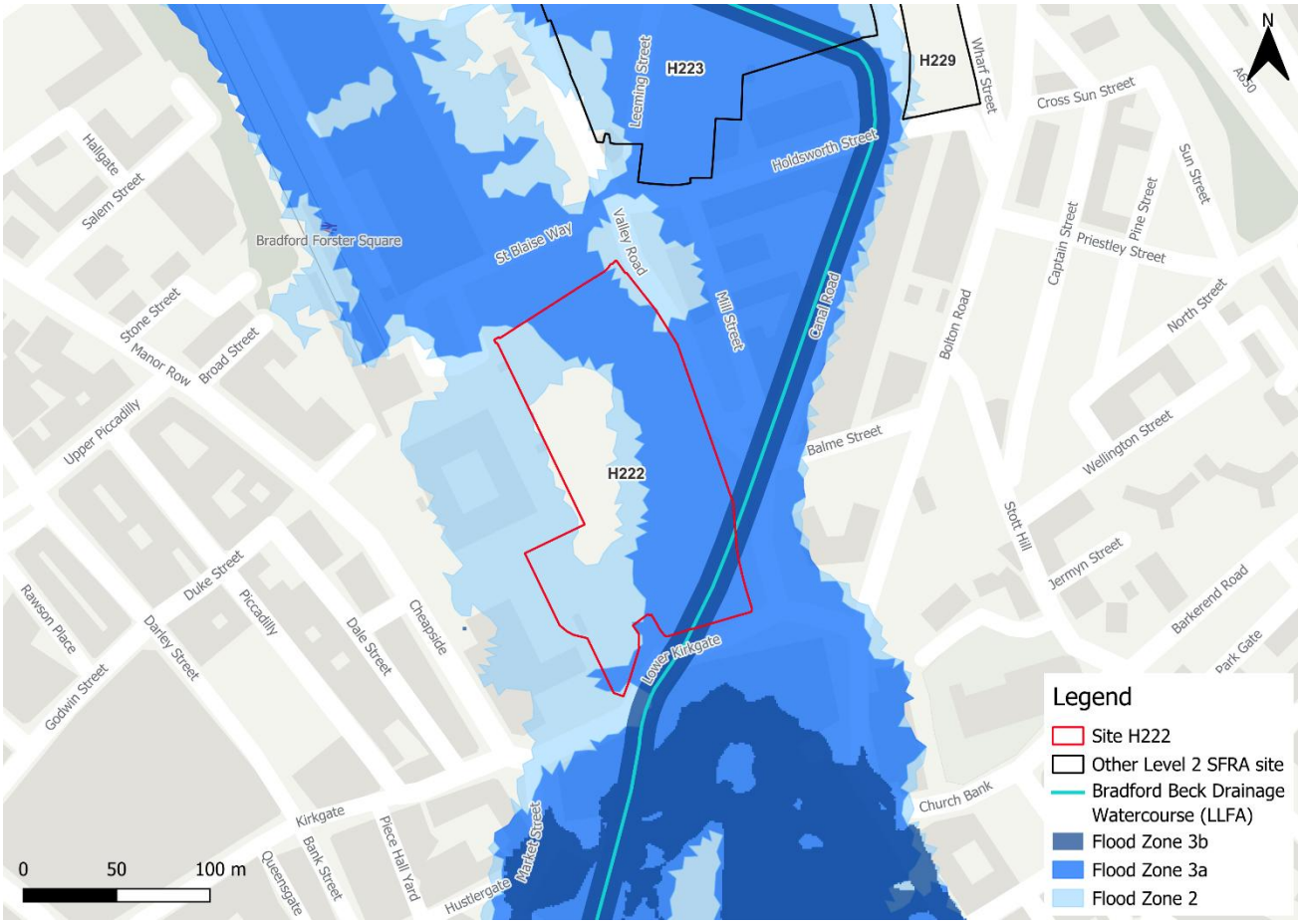


Figure 2-1: Existing risk from rivers to the site

2.1.2 Bradford Beck 2026 model outputs - present day

The Bradford Beck 2026 model does not show any flooding within the site during the 1% AEP event. Figure 2-2 shows the modelled flood depths for the 0.1% AEP undefended event.

The 2026 Bradford Beck model indicates widespread flooding across the site during the 0.1% AEP event. Modelled risk to the site varies compared to the flood extent shown in Flood Zone 2 of the FMfP. However, it is noted that the current Flood Zone 2 does not yet account for the latest Bradford Beck model outputs.

There is slightly less flooding shown within the north and west of the site, though the extent of flooding within the centre of the site is greater. Maximum flood depths within the site are modelled to be significant, between 0.3 and 0.6 m, however this is only within a small area (Figure 2-2). Modelled flood velocities are generally low across the centre and western side of the site (Figure 2-3), with velocity rarely exceeding 0.25 m^3/s. Water is modelled to flow at a greater velocity through the eastern side of the site and along part of the southern site boundary.

This is reflected in the modelled flood hazard being 'very low hazard' across most of the site but 'danger for some' or 'danger for most' within parts of the eastern side and southern area of the site (Figure 2-4). The areas where the greatest flood depths, velocities and hazards

are modelled appears (through satellite imagery) to be the current site access track. Safe access and escape routes may be achievable during this event via the south of the site onto Lower Kirkgate, travelling west.

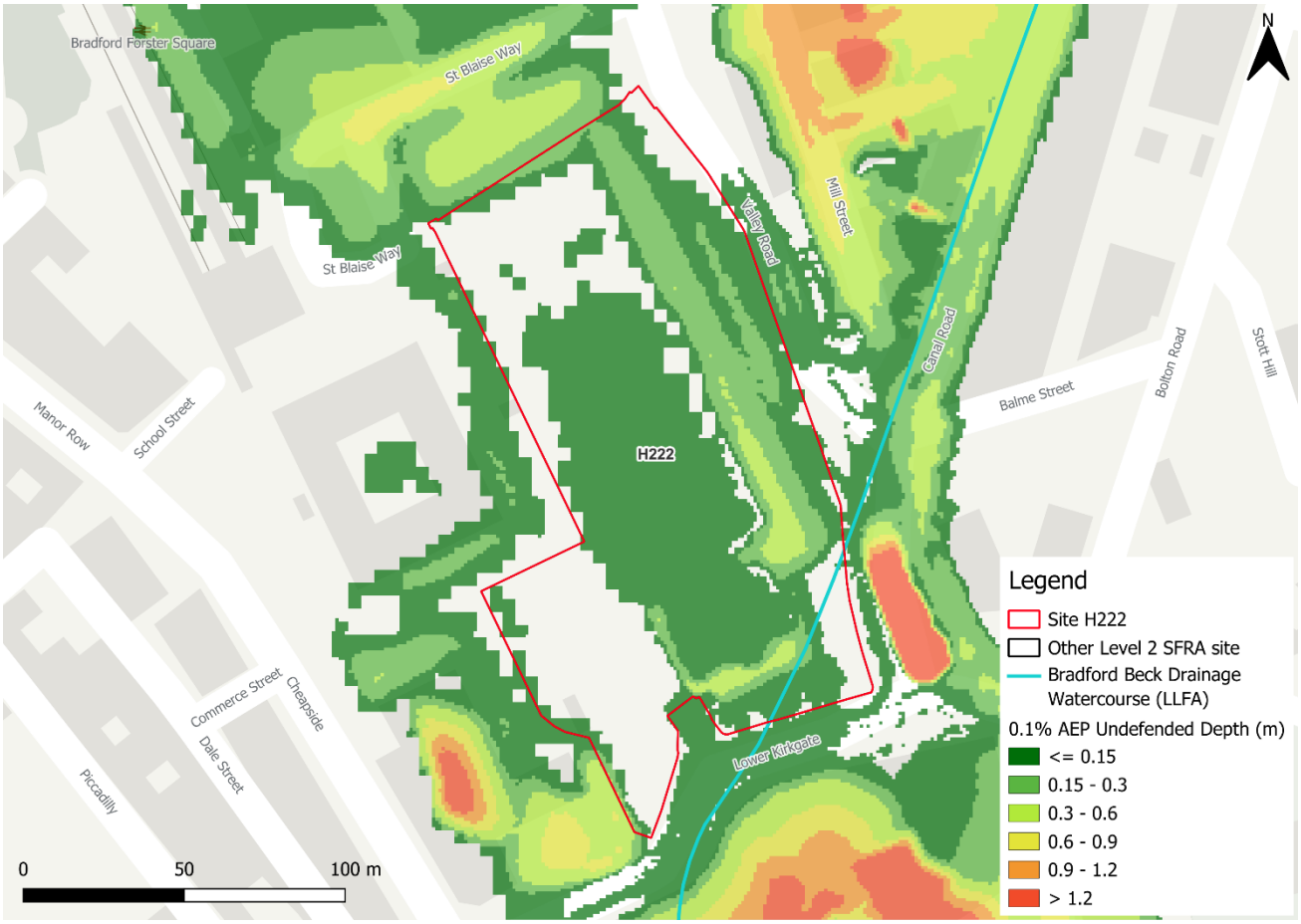


Figure 2-2: Flood depths for 0.1% AEP undefended flood event



Figure 2-3: Flood velocities for 0.1% AEP undefended flood event

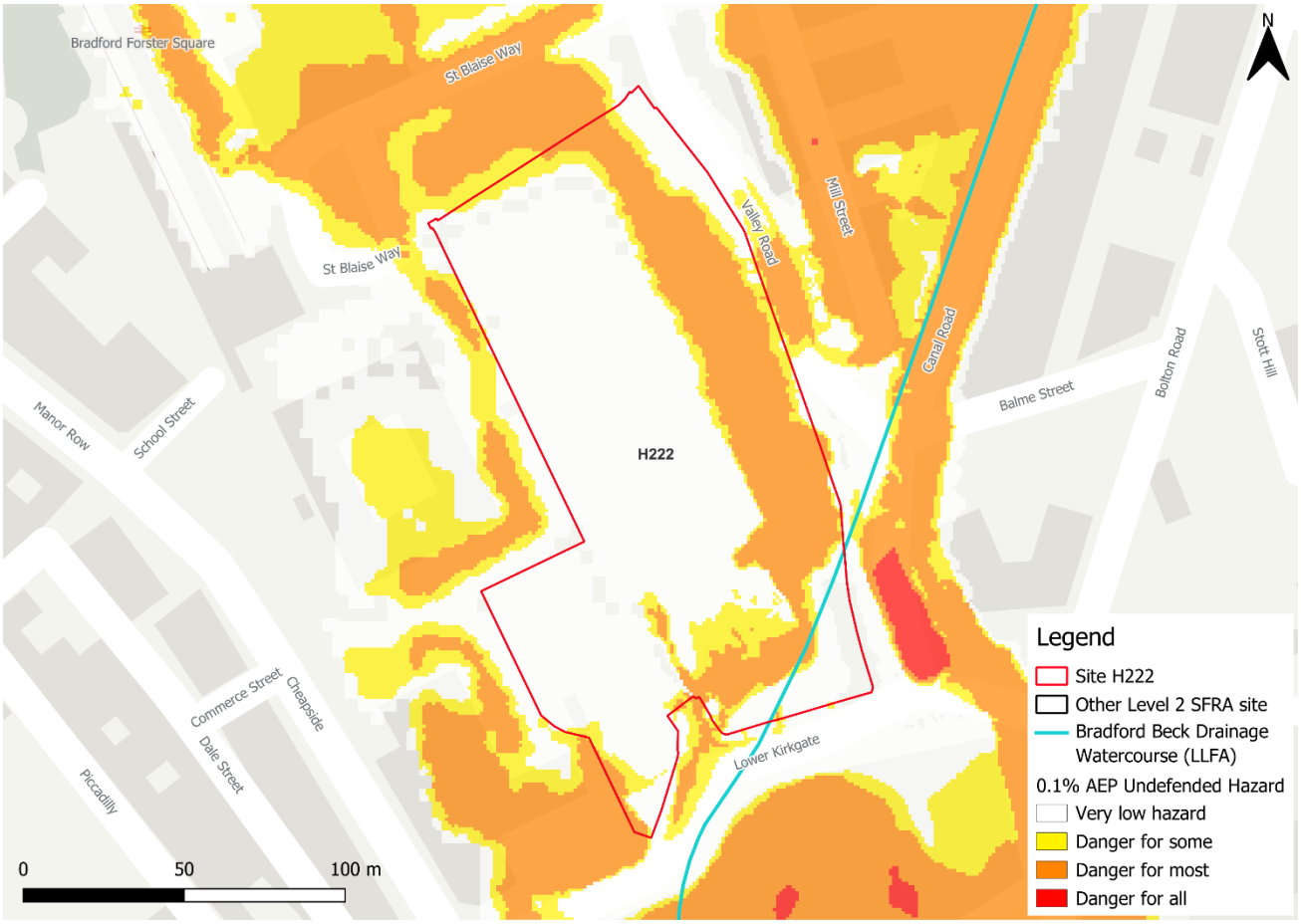


Figure 2-4: Flood hazard[1] for 0.1% AEP undefended flood event

2.2 Impacts from climate change

The EA's SFRA guidance states that SFRAs should assess the central allowance for less vulnerable, more vulnerable, highly vulnerable and water compatible development (Table 2-2). The impacts of climate change on flood risk from the Bradford Beck 2026 model have been modelled without flood defence infrastructure in place. As documented in Section 2.3.1, there are no formal engineered flood defences that would benefit the site.

1 Fluvial hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.

Table 2-2: Modelled climate change allowances for peak river flows for the Aire and Calder Management Catchment

Return period (AEP event)	Central allowance 2080s (% increase)	Higher central allowance 2080s (% increase)	Upper end allowance 2080s (% increase)
3.3% (functional floodplain)	23%	31%	51%
1%	23%	31%	51%

2.2.1 Bradford Beck 2026 model outputs - climate change

The 2026 Bradford Beck model does not show any flooding within the site during the 1% AEP undefended event +23% for climate change. Figure 2-5 shows the onsite modelled flood depths for the 0.1% AEP undefended event +23% for climate change. Risk is modelled to be greater in both extent and depth in comparison to present day conditions. Maximum depths within the area at risk are significant, between 0.6 and 0.9 m.

Flood velocities are modelled to increase significantly across the site, with maximum velocities between > 2 m^3/s (Figure 2-6). This indicates the flood water within the site is likely to be fast moving, particularly within the eastern side of the site, posing a greater risk to site users. The modelled flood hazard within the eastern side and south of the site is categorised as 'danger for most'. Elsewhere, flooding is largely categorised as 'very low hazard' (Figure 2-7). Safe access and escape routes would likely be challenging to achieve during the climate change event.

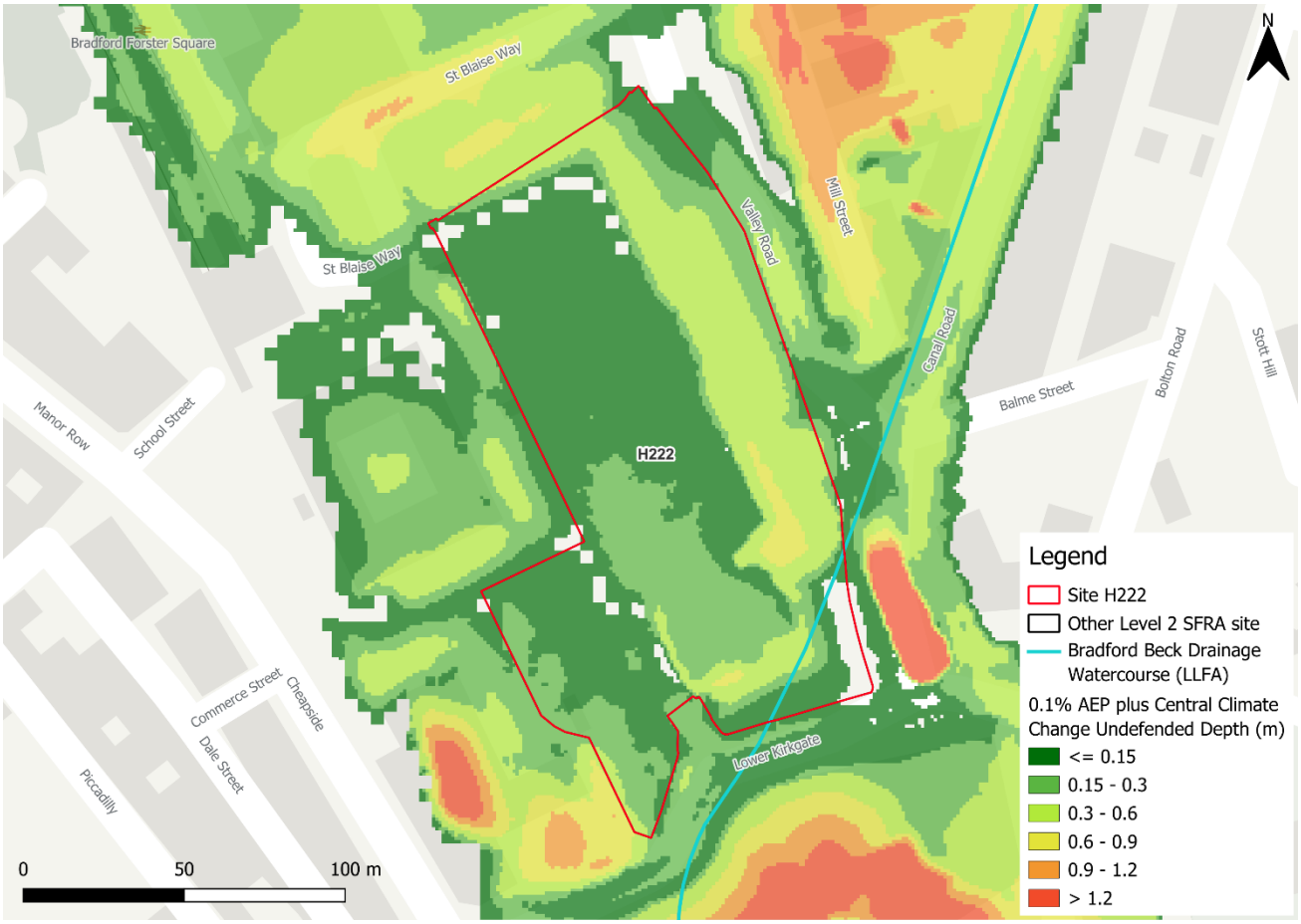


Figure 2-5: Flood depths for 0.1% AEP undefended flood event +23% (central climate change allowance)



Figure 2-6: Flood velocities for 0.1% AEP undefended flood event +23% (central climate change allowance)

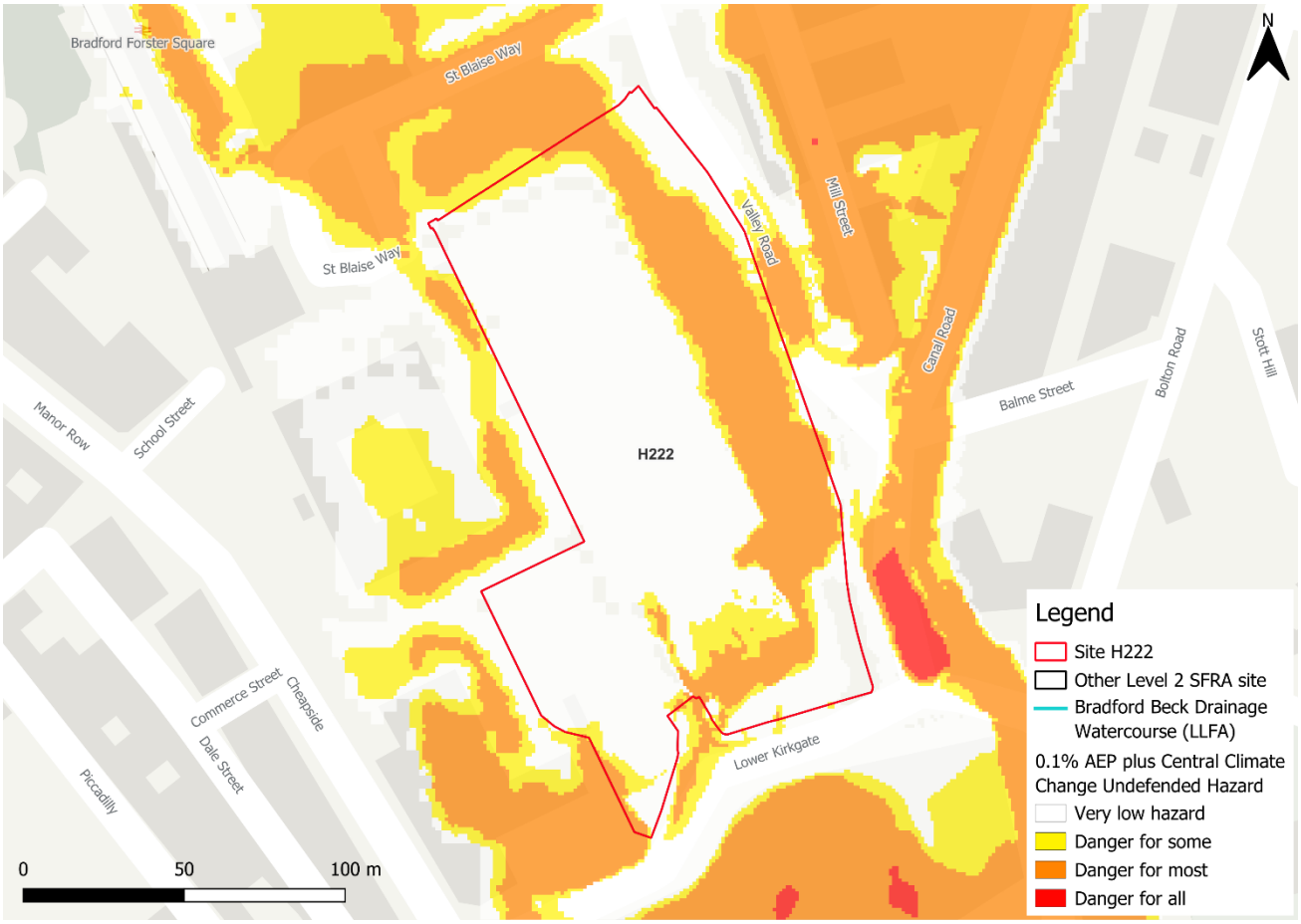


Figure 2-7: Flood hazard for 0.1% AEP undefended flood event +23% (central climate change allowance)

2.2.2 Flood Map for Planning - climate change

Climate change data in this area is unavailable from the EA's Flood Map for Planning plus Climate Change (2070-2125) dataset, as shown in Figure 2-8.

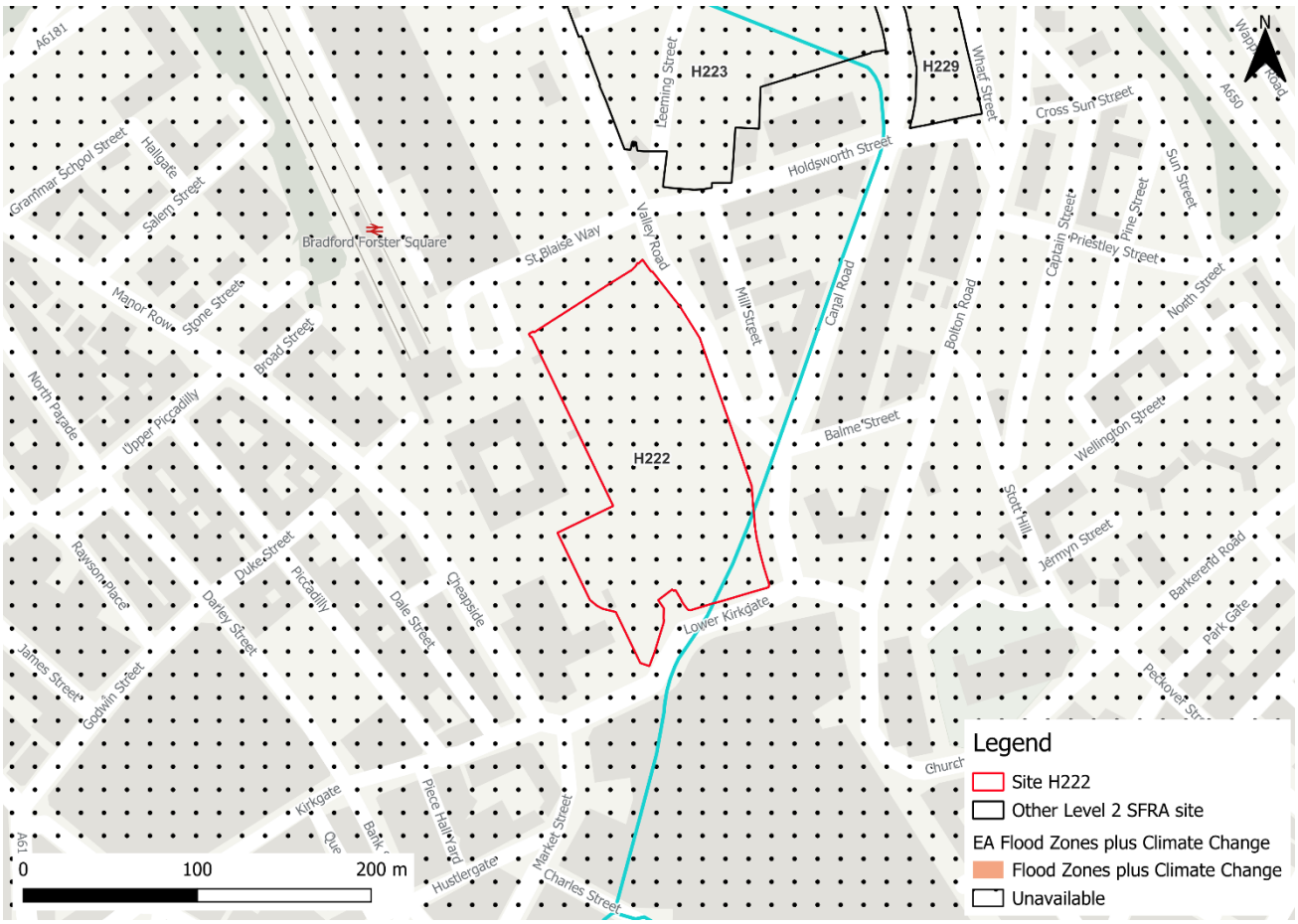


Figure 2-8: EA Flood Zones plus Climate Change

2.3 Flood risk management

2.3.1 Flood defences

The site does not benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset.

2.3.2 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) that may help to reduce flood risk to the site and surrounding areas. There are no applicable areas that could benefit the site.

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO) datasets have been considered. There are no recorded historic flood events at the site

2.5 Emergency planning

2.5.1 Flood warnings

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The entire site is located within a FWA, namely 123FWF785 - Bradford Beck and tributaries at Bradford.

Flood alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be issued when there is less confidence that flooding will occur in a FWA. The entire site is also located within a FAA, namely 123WAF961 - Middle River Aire catchment.

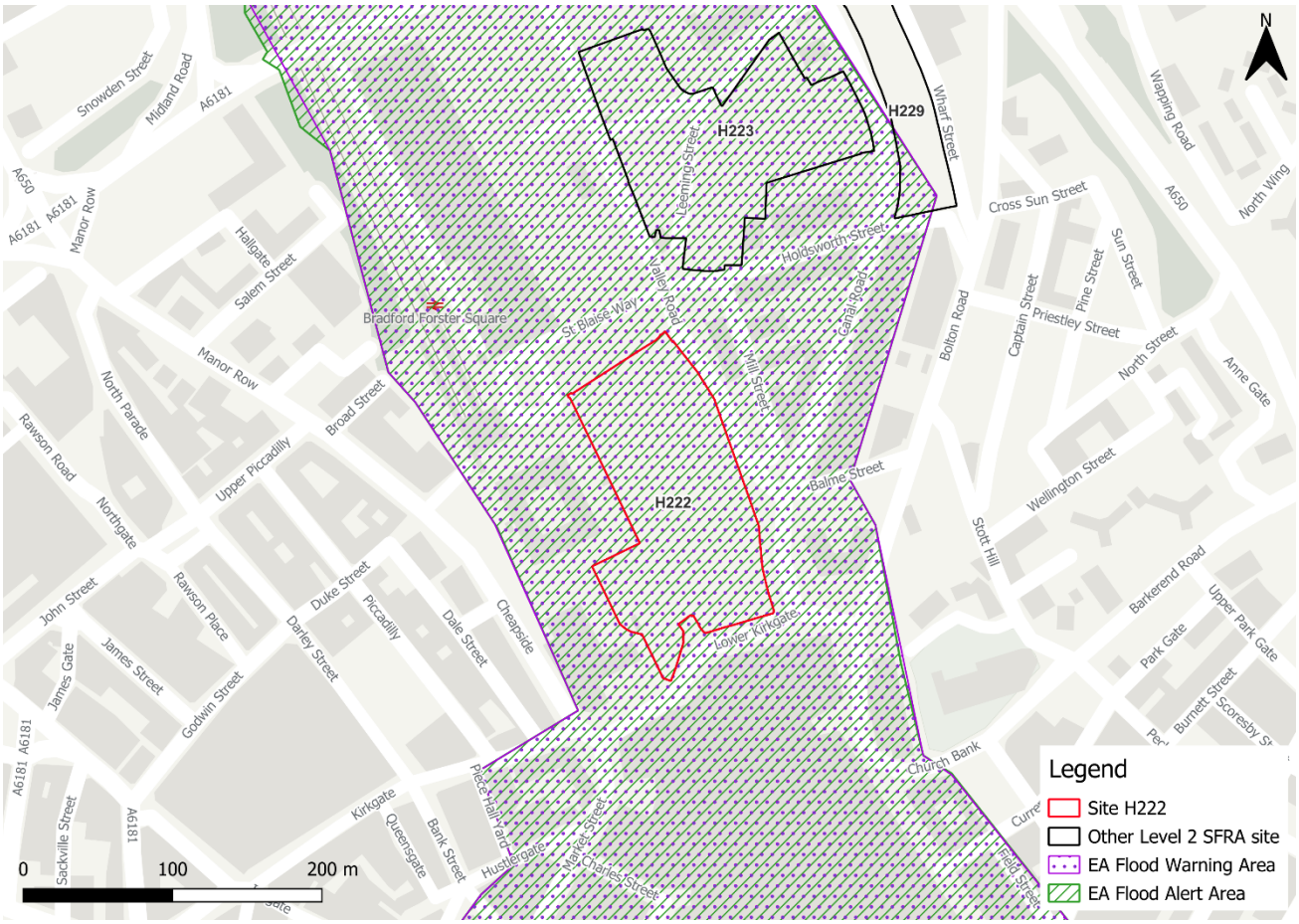


Figure 2-9: EA Flood Warning Areas and Flood Alert Areas

2.5.2 Access and escape routes

Based on available information, safe access and escape routes may be achievable during a 0.1% AEP flood event via the south of the site onto Lower Kirkgate, travelling west (Figure 2-10). Given the extent of flooding shown in the 0.1% AEP event plus 23% climate change, safe access and escape routes from the site are unlikely to be achievable during the extreme event with an allowance for climate change.

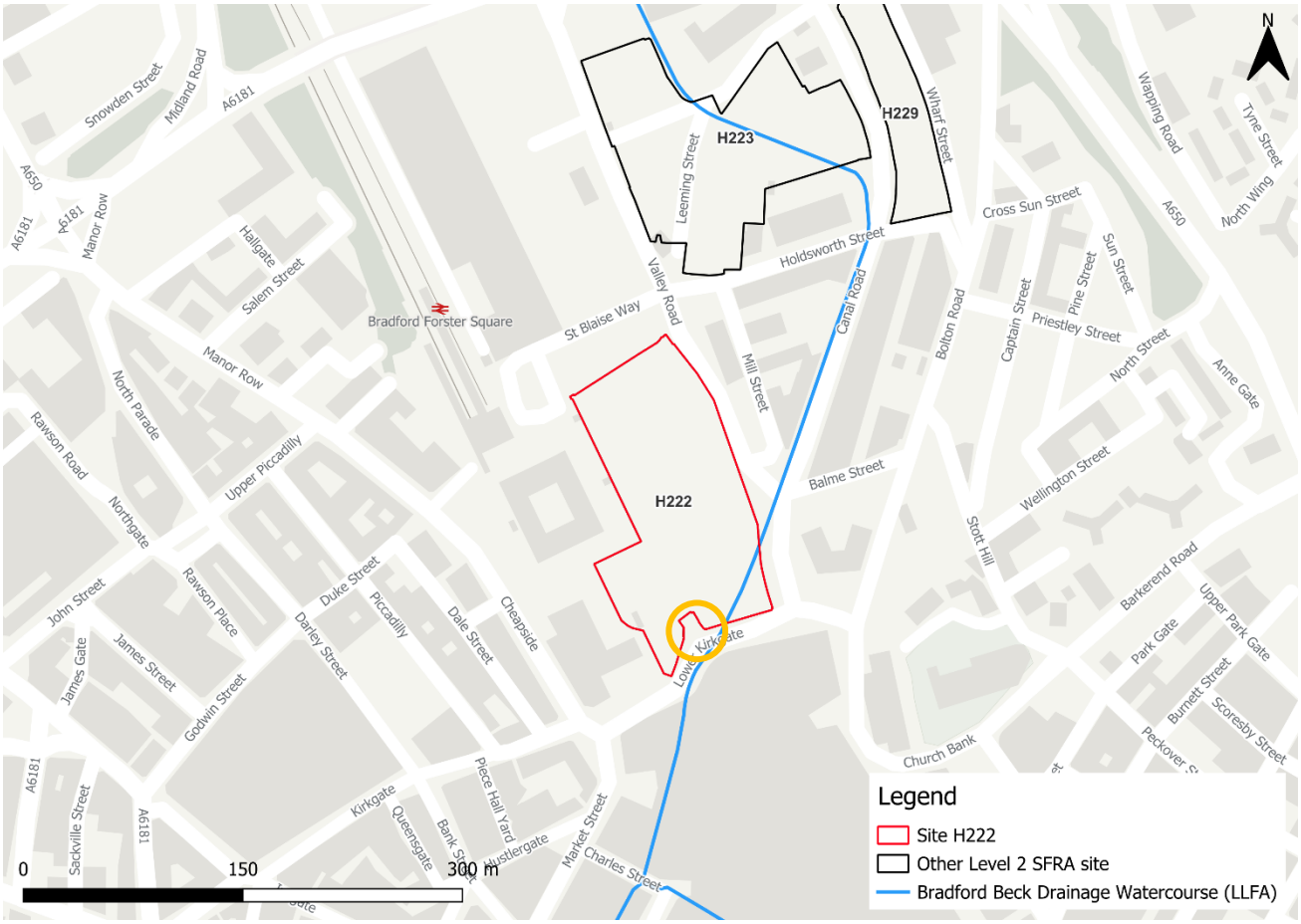


Figure 2-10: Potential access and escape routes

2.6 Observations, mitigation options, site suitability and sequential approach to development management - fluvial

- Observations:
  - The proposed development of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF.
  - Given the change in use and therefore vulnerability of the site, the LPA must consider whether the change of use is acceptable and whether the development can be designed to be safe, including for adequate emergency planning provision, accounting for the information provided in this Level 2 SFRA (para 014 FRCC-PPG).
  - The site is modelled to be within the functional floodplain within the southeast of the site, representing the presence of the culverted Bradford Beck watercourse beneath the site. Consideration should be given as to whether deculverting and daylighting this section of culvert is feasible, supported by detailed modelling. The watercourse should be considered within site design and form a blue green corridor through the site.
  - If Bradford Beck remains culverted beneath the site, there should be no development above the culvert. The location and course of the culvert should be confirmed through a survey.

- The site is modelled to be at risk from fluvial sources (according to 2026 Bradford Beck model) in the 0.1% AEP undefended scenario. The flood extents derived from the 2026 Bradford Beck model differs to those shown in the Flood Map for Planning (Flood Zone 3a and Flood Zone 2).
- Given the site is more vulnerable and within Flood Zone 3a, the site must be subject to and must pass the exception test. The site is however not shown to flood during the modelled 1% AEP undefended event according to the Bradford Beck 2026 model. The Flood Map for Planning requires updating in line with the latest modelling for Bradford Beck.
- Given the site is at medium risk from Bradford Beck (0.1% AEP event), and future risk with climate change is modelled to be significant, it is recommended that this site is not redeveloped for more vulnerable uses.
- The 1% AEP event with an allowance for climate change is what the EA considers to be the design event for a development to mitigate fluvial flood risk. The site is not shown to flood during the 1% AEP undefended +23% climate change event.
- If works are proposed on or near Bradford Beck, a separate permission may be required. The type of permission needed from the Lead Local Flood Authority will depend on the activity and location proposed.
- Were any plans for development to proceed, the site-specific FRA must show that development will be safe for its lifetime taking account of the vulnerability of its users, including for appropriate evacuation procedures and flood response infrastructure are in place to manage the fluvial risk associated with the extreme flood event.

- Mitigation:
  - EA flood warnings and alerts should continue to be in place to ensure early evacuation of site users before an extreme flood event occurs.
- Access and escape:
  - Based on available information site access and escape may be achievable in the 0.1% AEP event from the south of the site. However, given the extent of flooding, safe access and escape is unlikely to be achievable during the 0.1% AEP +23% climate change event.

3 Flood risk from surface water

3.1 Existing risk

At the time of writing, the EA's latest national Risk of Flooding from Surface Water (RoFSW) does not include depth and hazard information suitable for planning purposes. Therefore, this Level 2 SFRA considers the third generation RoFSW depth and hazard mapping in addition to the NaFRA2 extents, as agreed with the EA. Surface water depth and hazard should be confirmed at the site-specific FRA stage.

3.1.1 Risk of Flooding from Surface Water - NaFRA2 extents

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map (January 2026), surface water risk is shown to vary across the site. Approximately 23% of the site is at high surface water risk. A further 29% of the site is at medium risk and a further 32% is at low surface water risk, as shown in Table 3-1.

In the high risk event, surface water risk is largely confined to the eastern side of the site and part of the south of the site. This flow path is modelled to increase in extent across the site in the medium and low risk events. The risk area is within fluvial Flood Zone 3a (as based on the Flood Map for Planning). Mapping indicates ponding on Valley Road and Lower Kirkgate during the high and medium risk events. Flow paths are shown along these roads during the low risk event. Safe access and escape are unlikely to be achievable during the low risk event.

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
16	32	29	23

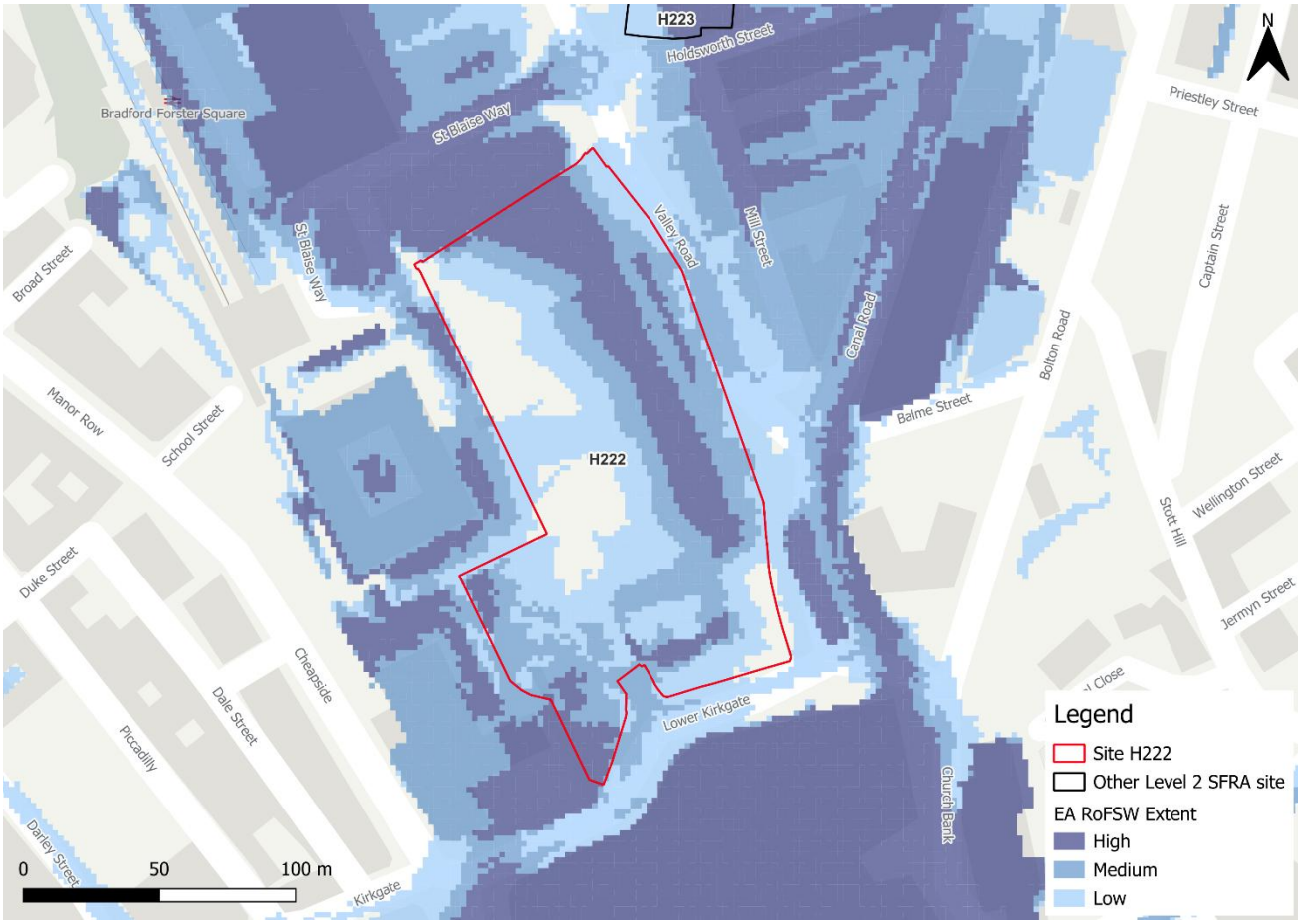


Figure 3-1: Surface water flood extents (NaFRA2 - Risk of Flooding from Surface Water map)

3.1.2 Risk of Flooding from Surface Water - third generation depths and hazards

Based on the EA's national scale third generation RoFSW map, the greatest flood depths within the site in the medium risk event are between 0.6 and 0.9m (Figure 3-2) with hazard categorised as 'significant' (Figure 3-3).

Safe access and escape routes may be achievable via Lower Kirkgate to the south in all events. This route does become inundated in the low risk event however depths remain largely low based on third generation mapping. Safe access and escape routes should be confirmed based on a drainage strategy through the FRA.

There are differences between the NaFRA2 RoFSW map and the third-generation depth and hazard mapping. The NaFRA2 RoFSW map does not map flooding less than 0.075m (7.5cm) in depth. Therefore, where the map may show no flooding, there may be shallow flooding up to a depth of 0.075m. In contrast, the third generation RoFSW does not map flooding with a hazard rating of less than 0.575. This could explain the differences observed between the NaFRA2 and third generation RoFSW. Assessment of surface water should be carried out at the site-specific FRA stage to robustly establish current and future surface water flood risk conditions.

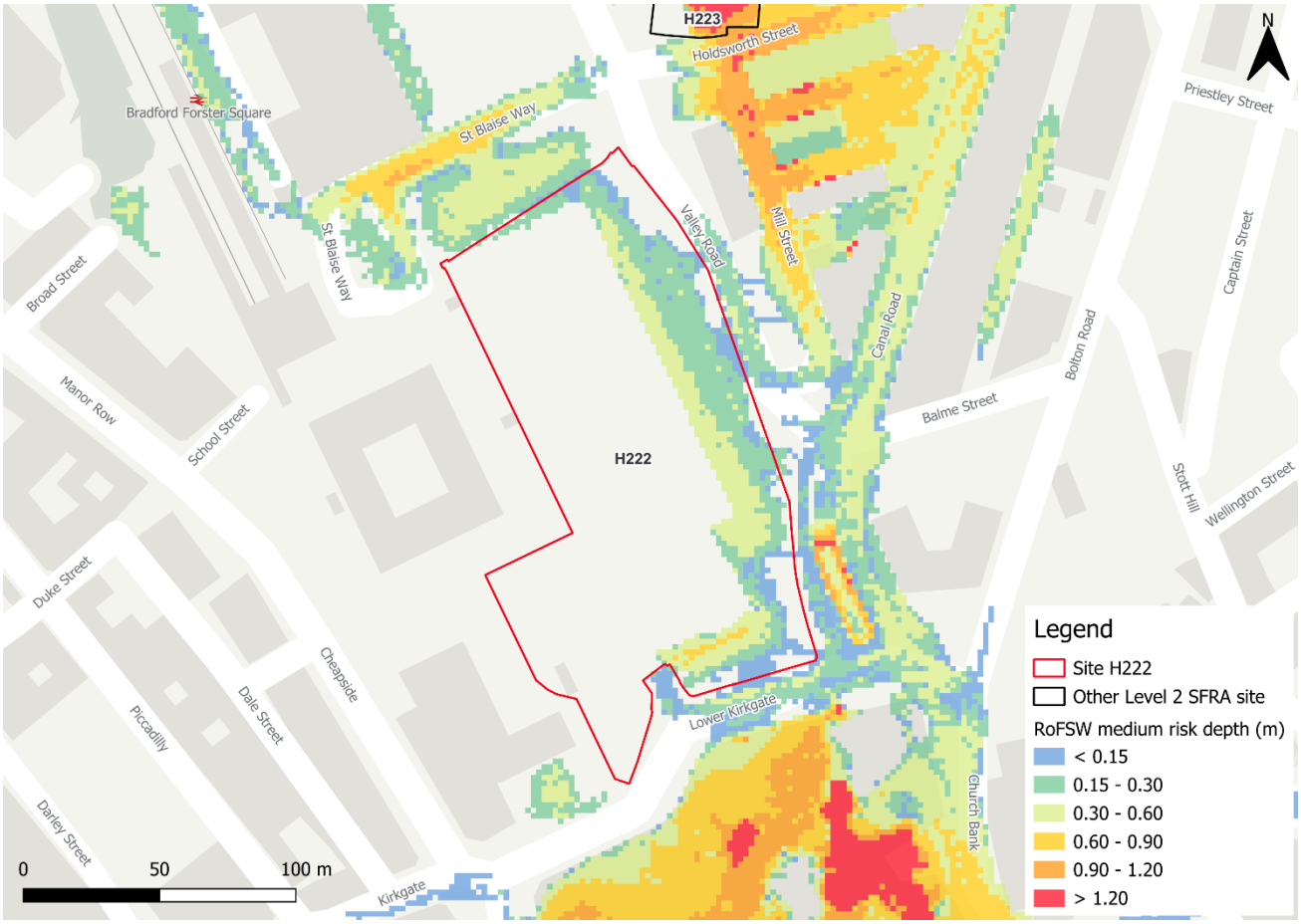


Figure 3-2: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)



Figure 3-3: Medium risk surface water flood hazards[2] (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

At the time of writing, the available national surface water climate change mapping is unsuitable for consideration in development planning. This Level 2 SFRA considers the low risk surface water event as a conservative proxy for the medium risk event plus climate change, as agreed with the EA. The impact of climate change on surface water flood risk should be considered at the site-specific FRA stage.

Using the low risk event as a proxy, the medium risk event is likely to increase in extent to cover much of the site when accounting for climate change (Figure 3-4). The third generation mapping indicates that maximum flood depths during the low risk event are modelled to be >1.2m (Figure 3-5), with much of the flooding within the site having a hazard categorised as 'significant' or 'extreme' (Figure 3-6). Safe access and escape routes are unlikely to be achievable during the climate change event. This should be confirmed through the site-specific FRA.

2 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

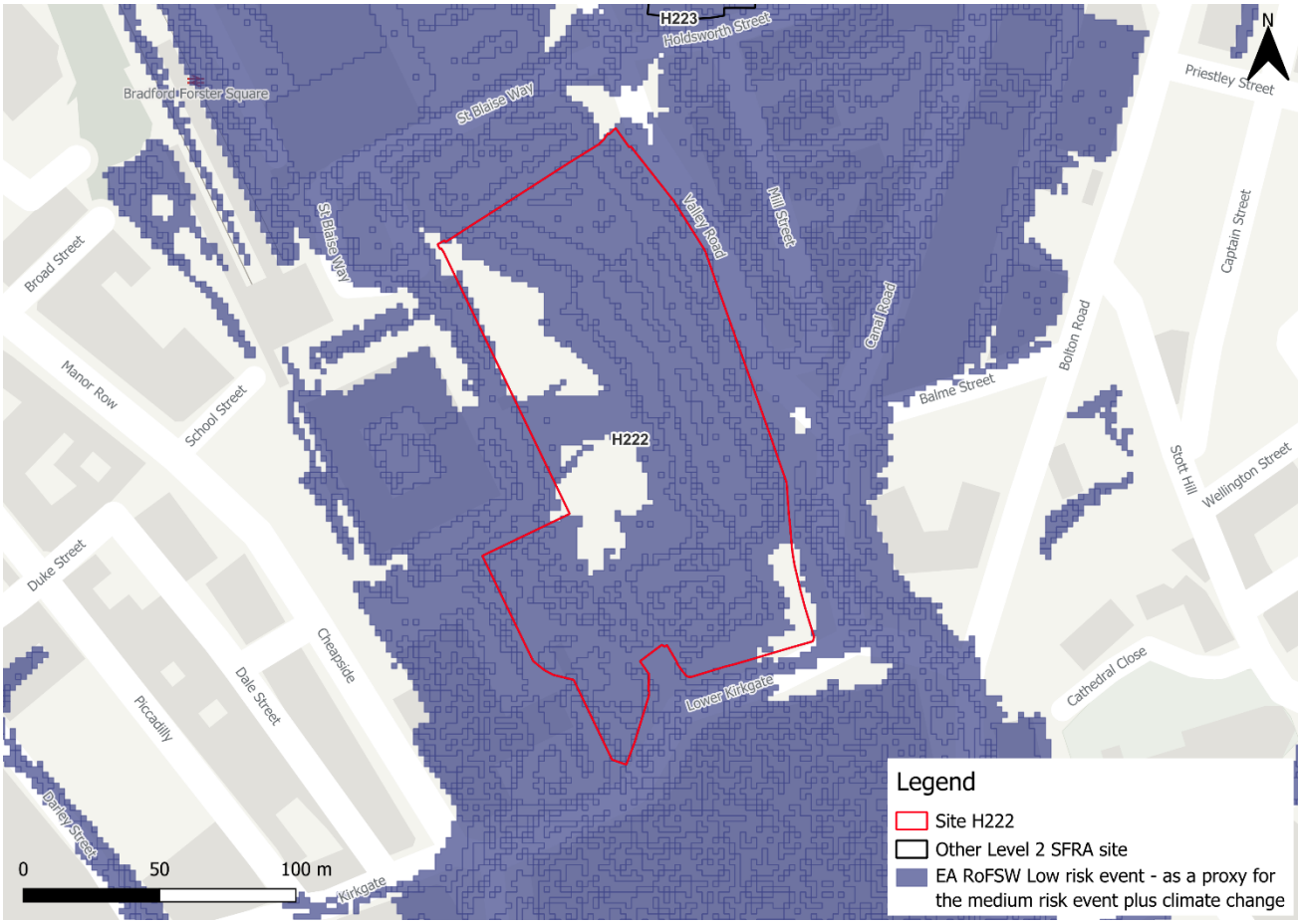


Figure 3-4: Low risk event surface water flood extent, as a proxy for the medium risk event plus climate change (NaFRA2 - Risk of Flooding from Surface Water map)

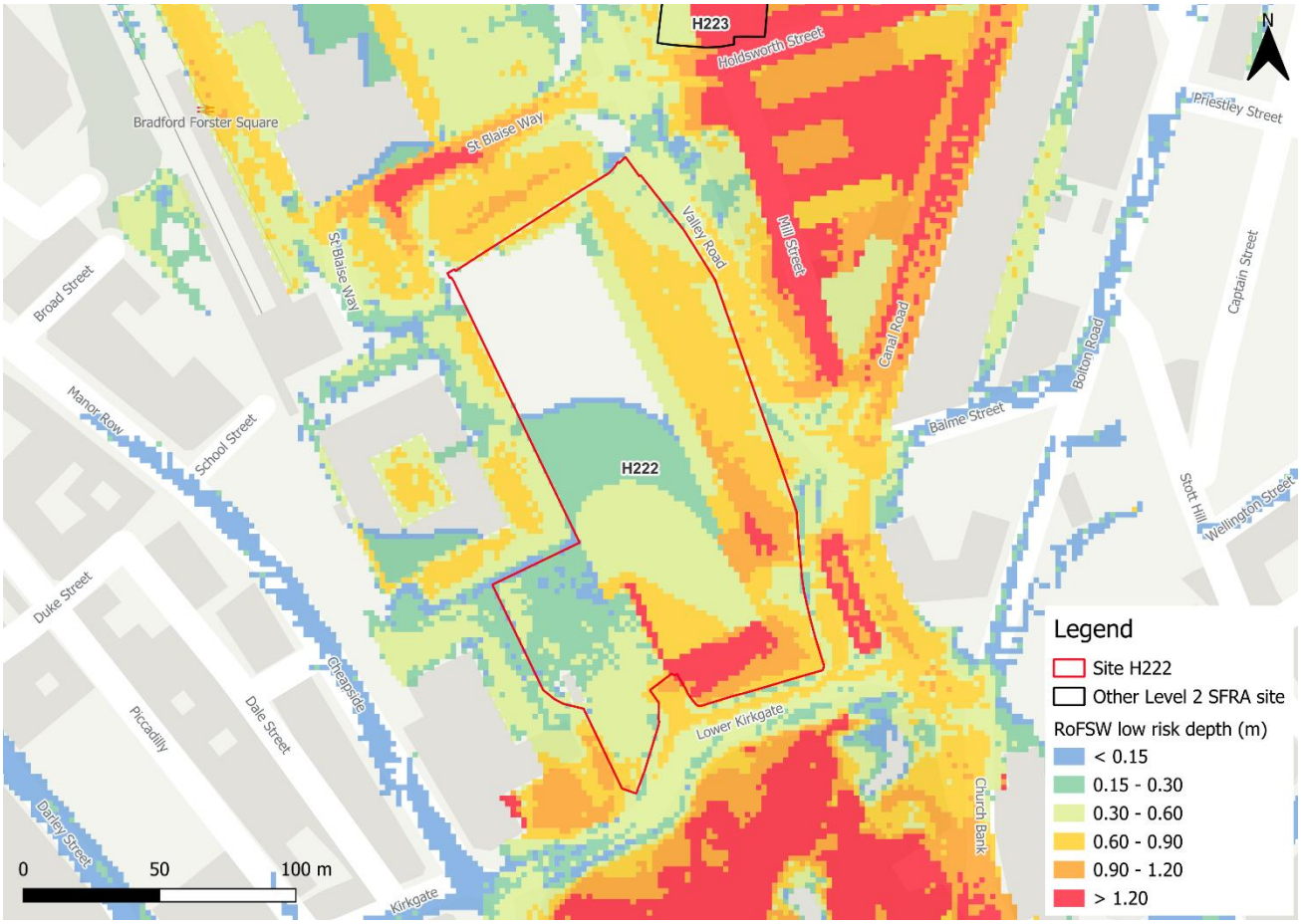


Figure 3-5: Low risk event surface water flood, as a proxy for the medium risk event plus climate change (Third generation - Risk of Flooding from Surface Water map)

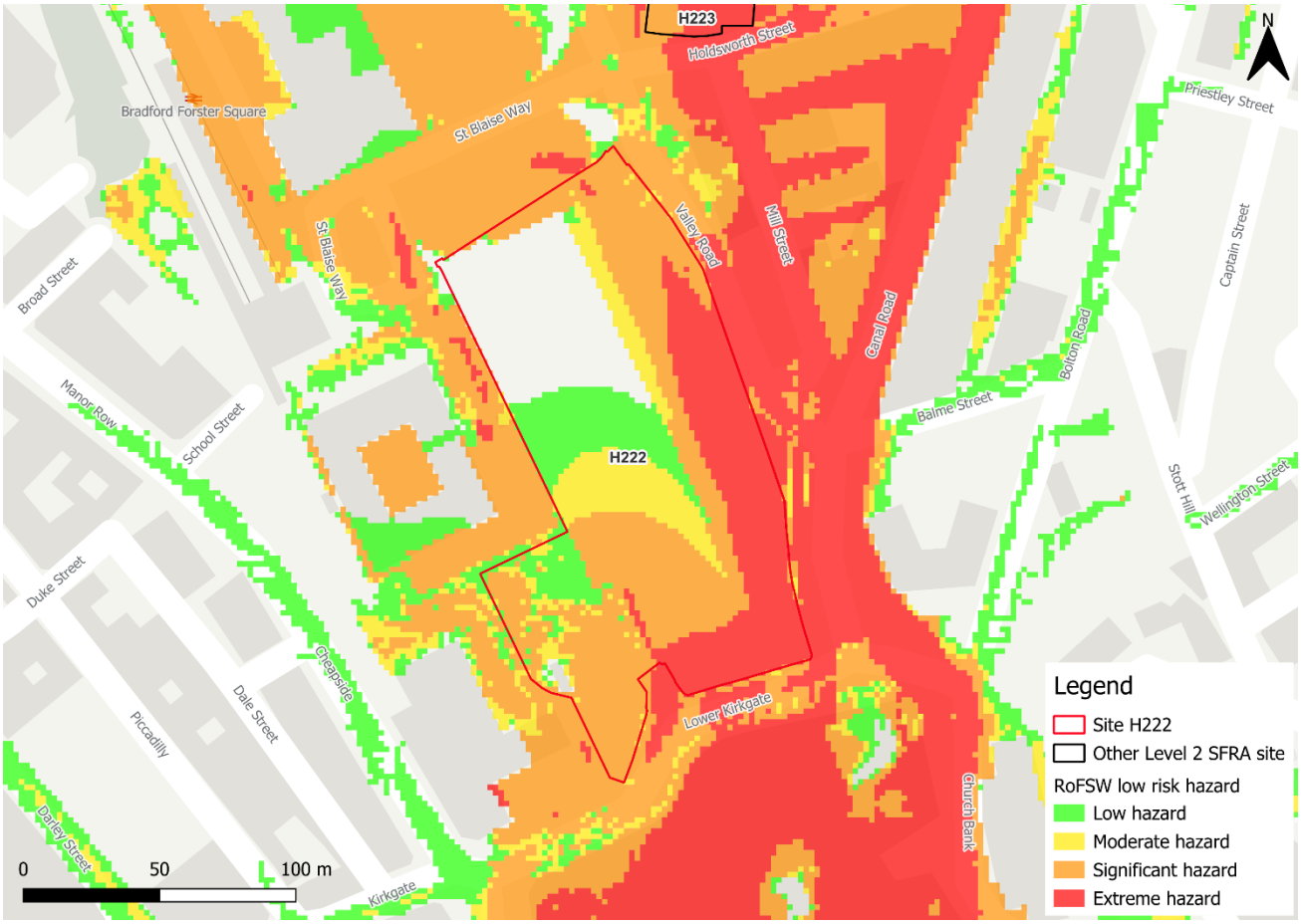


Figure 3-6: Low risk event surface water flood hazards[3], as a proxy for the medium risk event plus climate change (Third generation - Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk to the site is varied. Surface water in the present day medium risk event is primarily within the eastern side and south of the site.
- The effects of climate change on surface water have not been modelled for this SFRA however, the low risk surface water event has been used as a proxy for the medium risk event plus climate change. In this event, much of the site is modelled to flood.
- Safe access and escape routes are unlikely to be achievable in the low risk and climate change events based on the modelled surface water hazard within the site and along the surrounding roads. This should be confirmed based on site-specific surface water modelling through the FRA.
- Given the significant onsite surface water flood risk, ideally this site would not be developed and would be left as open green space offering multifunctional benefits alongside flood risk mitigation including Biodiversity Net Gain (BNG) contributions, and social and amenity benefits.

3 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

- The RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[4]. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

Risk of groundwater emergence varies across the site. Within the eastern half of the site, there is no risk of groundwater emergence. In the west of the site, groundwater may emerge at significant rates and has the capacity to flow overland and / or pond within any topographic low spots. In this area, ground investigations will be required through the site-specific FRA to ascertain groundwater levels and conditions. This is reflected in the geology of the site being comprised of largely impermeable bedrock (Figure 1-3).

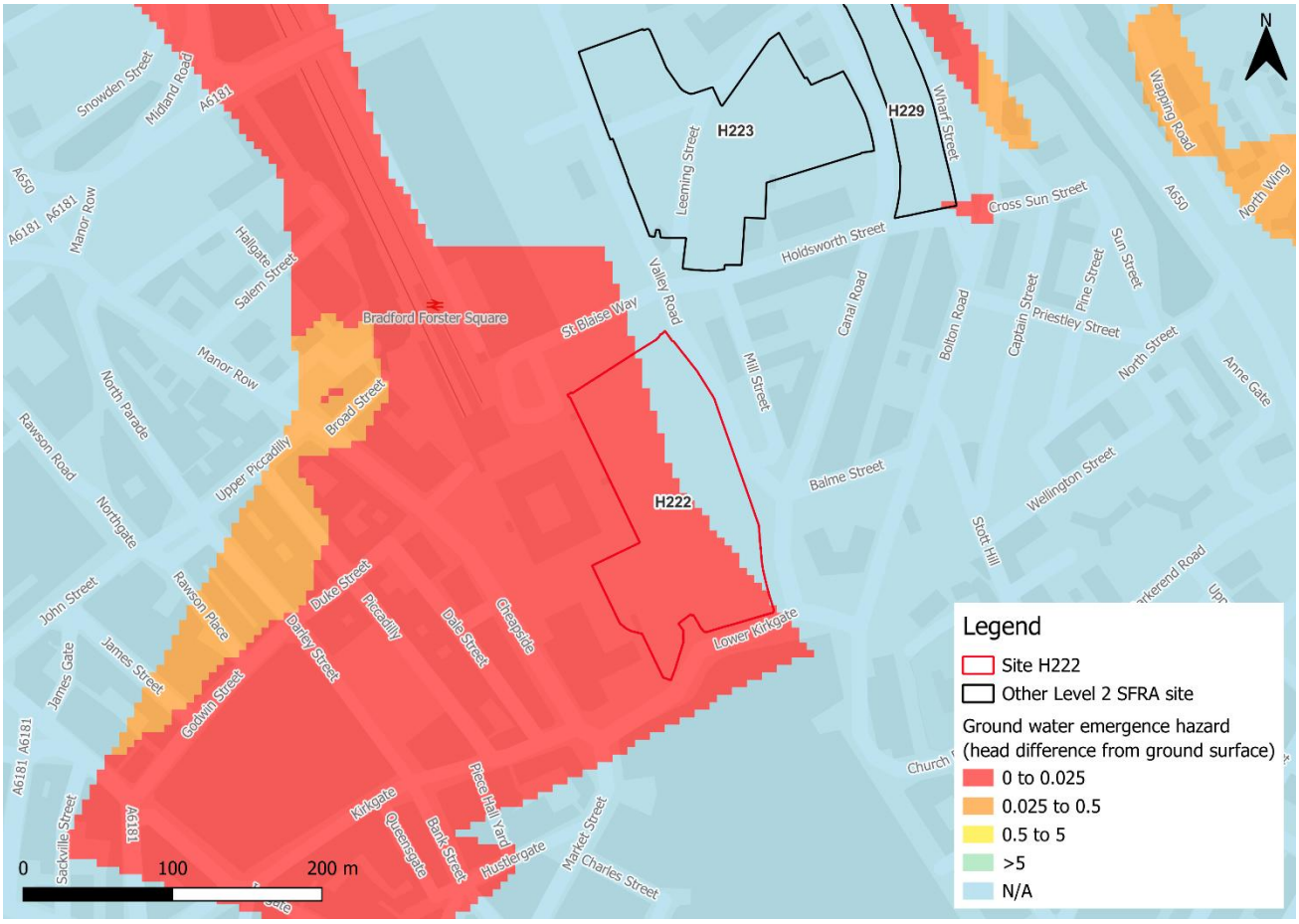


Figure 4-1: JBA 5m Groundwater Emergence Map

4 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

Although a site may be afforded some protection from defences and / or drainage infrastructure, there is always a residual risk of flooding from asset failure i.e. defence breaches, or blockages of culverts or drainage assets. Residual risk at this site comes from the potential blockage or structural failure of the culvert beneath the site.

5.1 Potential blockage

A blockage or structural failure of the culvert beneath the site may cause water in the channel to back up and cause flooding to the site, depending on the severity of the blockage and the magnitude of the flood event. Culvert course and condition surveys may be required, including for consultation with the culvert owner.

The Bradford Beck 2026 model includes for a scenario in which all culverts within the model are blocked by 50%. Figure 5-1 shows the modelled flood depths for this scenario. The site is not modelled to flood in the baseline 1% AEP undefended event. Flooding to the site caused by a 50% blockage to the culvert beneath the site is to depths similar to those modelled in the present day 0.1% AEP undefended event.

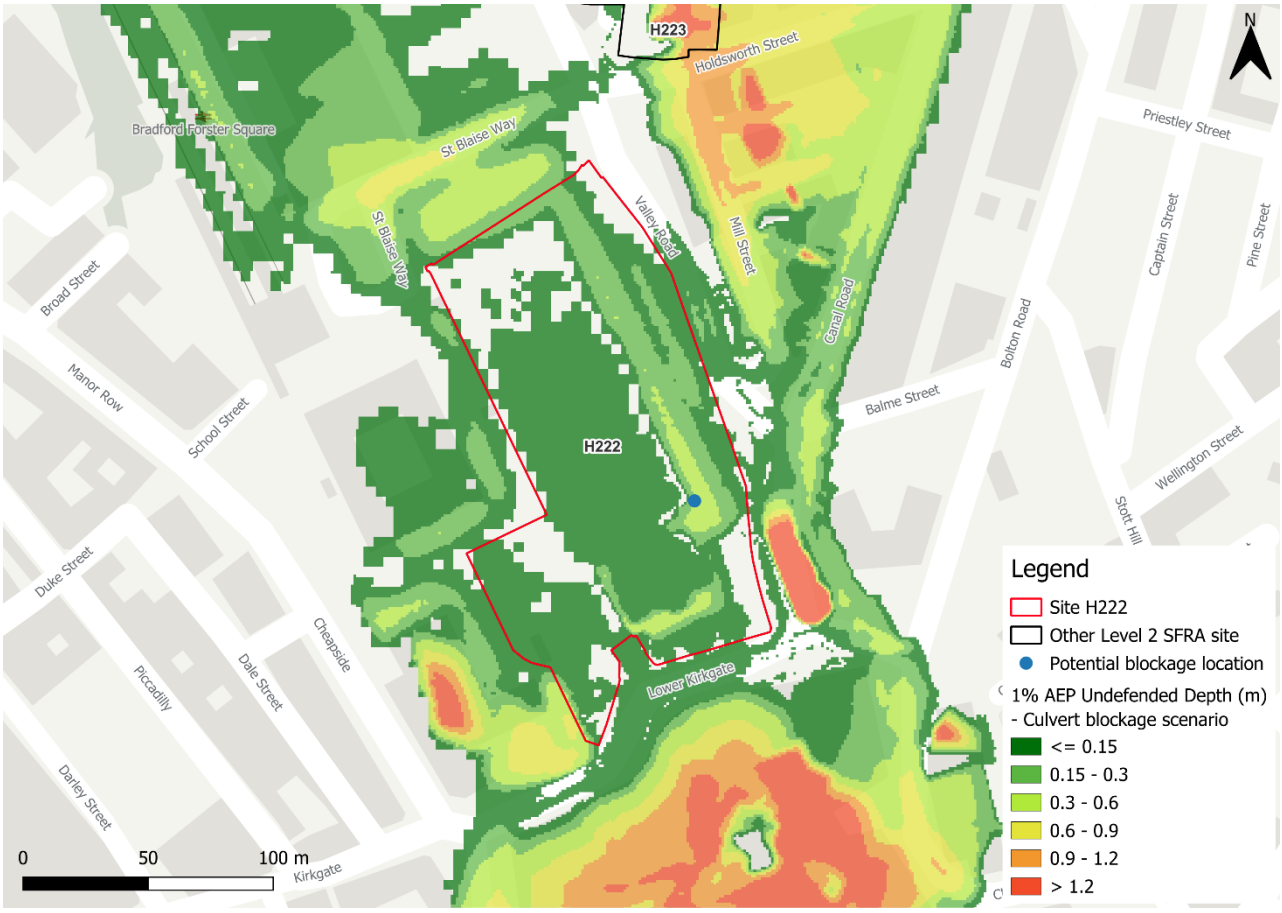


Figure 5-1: Flood depths for 1% AEP undefended flood event 50% culvert blockage scenario - structure beneath the site

5.2 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. Figure 5-2 shows the RFM in a 'dry day' and 'wet day' scenario. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is potentially at risk from four reservoirs located in Bradford. Of these four reservoirs, two are operated by either Yorkshire Water Services Ltd and two are operated by the City of Bradford Metropolitan District Council.

The EA's SFRA guidance states that where a proposed development site is at flood risk from a reservoir, then an assessment into whether the reservoir design or maintenance schedule needs improving should be carried out. Expert advice may be required from an all-reservoirs panel engineer. The Council should consult the relevant reservoir undertaker to ascertain whether the proposed development could affect the reservoir's risk designation, its design category or how it is operated. The Council, as category 1 responders, can access more detailed information about reservoir risk and reservoir owners using the Resilience Direct system.

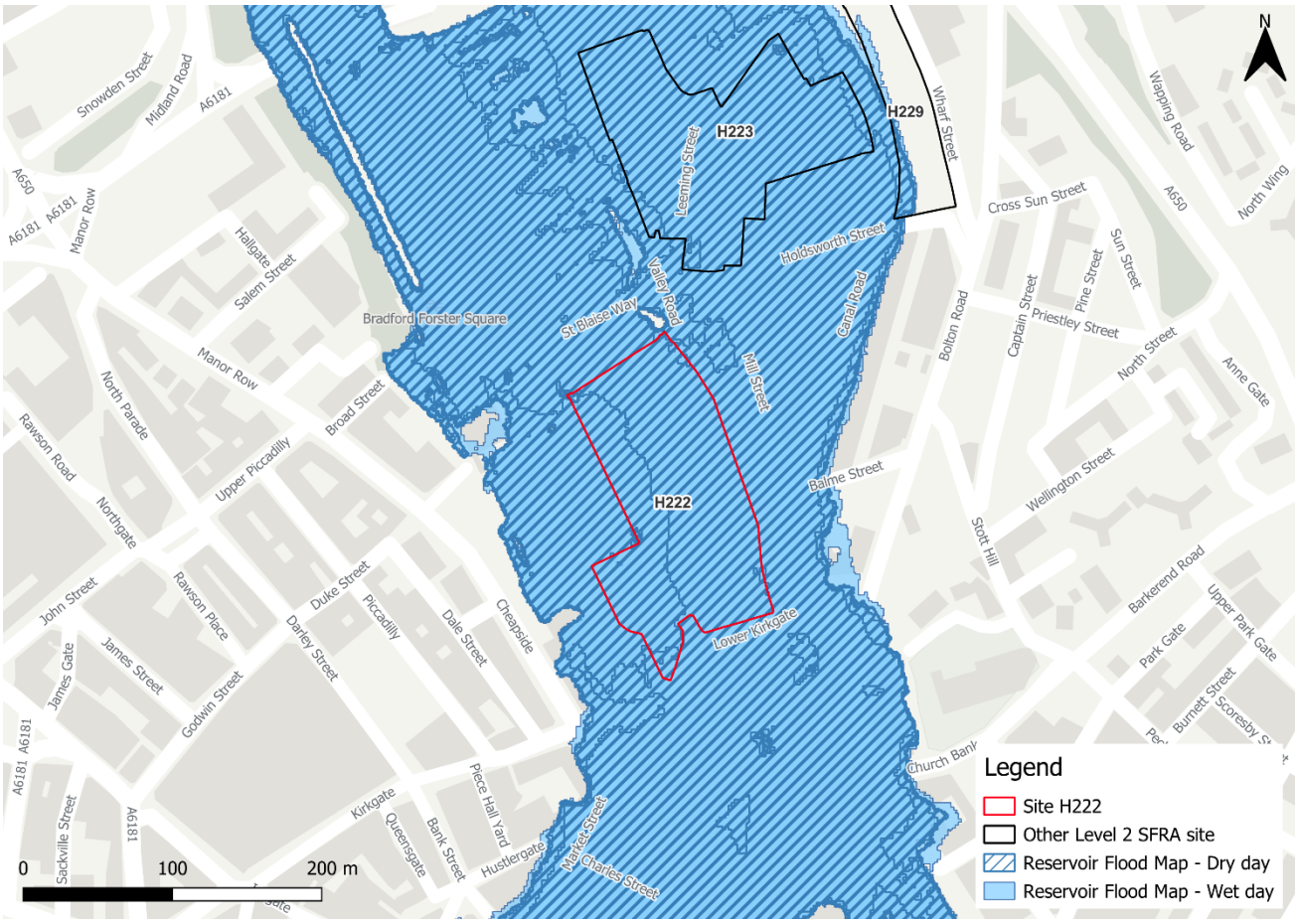


Figure 5-2: Flood risk from reservoirs

5.3 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a blockage or structural failure of the culvert beneath the site. The modelled 50% culvert blockage scenario indicates that there is likely to be significant additional impacts to the site (the site does not flood in the baseline 1% AEP undefended event). The site-specific FRA could consider modelling a higher blockage proportion to understand whether there would be any additional risk to the site. The site-specific FRA could also consider whether there are opportunities for deculverting and daylighting the culvert through the site.
- Areas adjacent to culverts and bridges are at particular risk from the rapid onset of fast flowing and deep flooding, with little or no warning if structures become blocked. Emergency plans must be in place for such areas and safe access and escape routes must be in place for the lifetime of development. Resistance and resilience measures may also need to be put in place to manage residual flood risk when avoidance measures have been exhausted.
- The LPA should use the information on residual risk in this Level 2 SFRA to state in the local plan strategic policies a preferred mitigation strategy for ensuring development will be safe throughout its lifetime in relation to urban form, risk management and where flood mitigation measures are likely to have wider sustainable design implications (para 042, FRCC-PPG).
- The site is also at potential residual risk from a breach of four reservoirs. All four reservoirs impact the site in the 'dry day' flood extent. However, only Upper Chellow and Lower Chellow, are modelled to impact the site based on the 'wet day' flood extent, which represents a prediction of the credible worst case scenario, therefore it's unlikely that such an extreme flood event would occur.
- Given the potential reservoir risk to the site, developers should consider[5]:
    - Consulting with the local resilience forum for advice on emergency planning,
    - Consulting with relevant reservoir owners to understand the impact development may have on their reservoirs, and
    - Using this Level 2 SFRA to understand whether any proposed development will be safe throughout its lifetime.

5 Reservoir flood maps: when and how to use them | Environment Agency | 2021

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is required to pass part b) of the exception test[6], given it is proposed for more vulnerable uses and is located within Flood Zone 3a. The site is not located within the 2026 Bradford Beck 1% AEP undefended modelled flood extent. It must be proven that the development can be safe for its lifetime, which is generally considered to be 100 years for residential development. Based on the available information documented within this Level 2 SFRA, safe access and escape is unlikely achievable and therefore the exception test cannot be passed, and the site should not be allocated.

6.2 Recommendations summary

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

- The majority of the site is located within Flood Zone 3a, with an area of functional floodplain present within the southeast, representing the Bradford Beck culvert beneath the site. Development is not permitted within the functional floodplain.
- It is recommended that this site is converted to open space and used as a multifunctional greenspace for flood storage, amenity use and to provide environmental / ecological benefits, given the significant fluvial risk to the site.
- The Flood Map for Planning requires updating to include for the 2026 model of Bradford Beck.

6.3 FRA requirements and further work

At the planning application stage, the following should be considered:

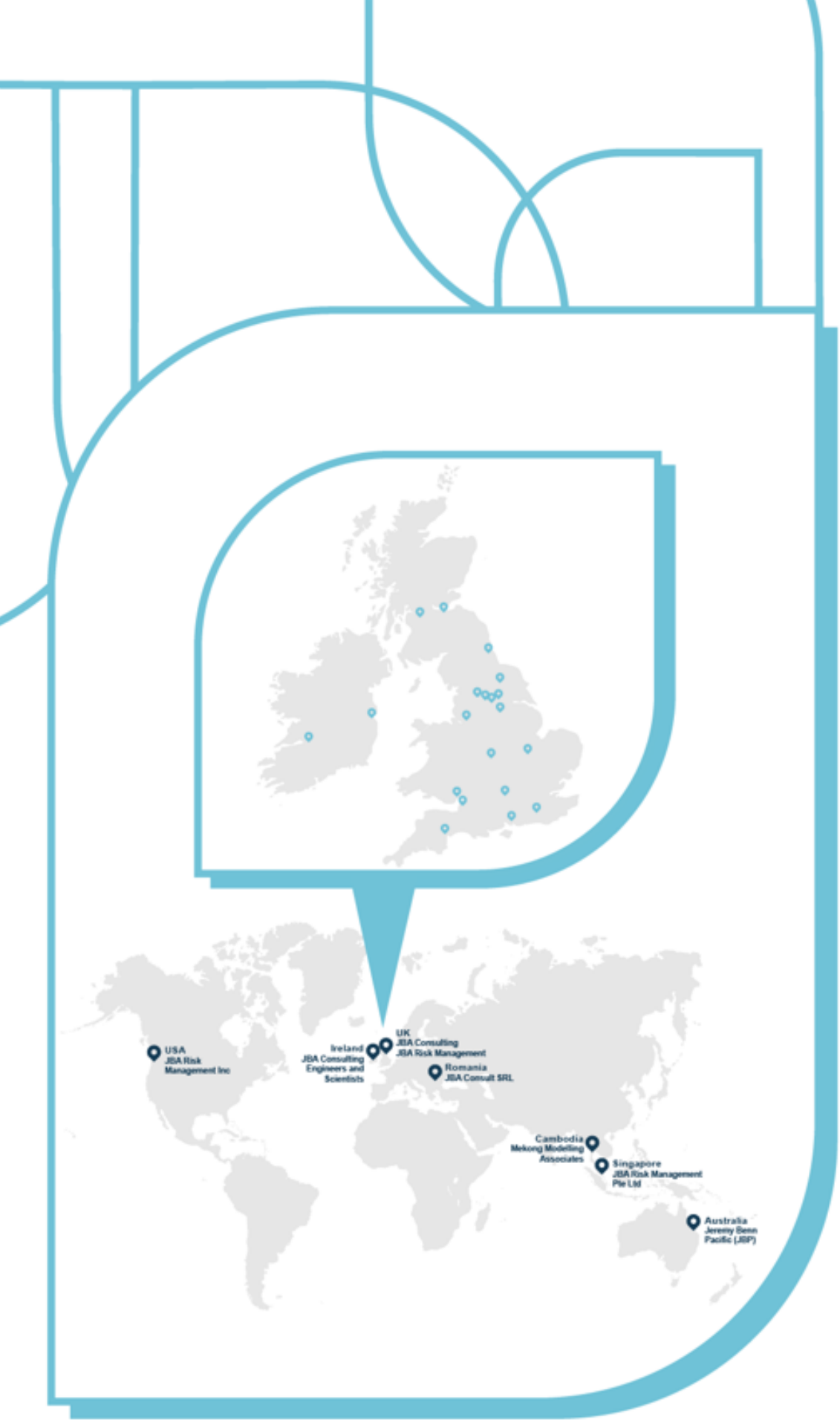
- A condition and capacity assessment of the culvert beneath the site.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

6 Para 178 National Planning Policy Framework 2024

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+44(0)1756 799919
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www.jbaconsulting.com
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Bradford Level 2 Strategic Flood Risk Assessment - Site H223

Final Draft

October 2026

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

www.jbaconsulting.com

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Reviewed by	Mike Williamson BSc MSc CGeog FRGS EADA Principal Analyst
Authorised by	Krista Keating BSc MSc CEnv CSci MCIWEM C.WEM Associate Director

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Contract

JBA Project Manager	Mike Williamson
Address	Phoenix House, Lakeside Drive, Centre Park, Warrington, WA1 1RX
JBA Project Code	2024s1078

This report describes work commissioned by City of Bradford Metropolitan District Council (CBMDC) by an instruction dated 19 July 2024. The Client's representative for the contract was Jonathan Dicken of CBMDC. Georgina Williams of JBA Consulting carried out this work.

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H223. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the 'CBMDC Level 1 SFRA' (2023) and read the 'CBMDC Level 2 SFRA Main Report' (2026) and is therefore familiar with the terminology used in this report.

1.1 Site H223

- Location: North Brook Street/Valley Road
- Existing site use: Industrial
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 1.7 hectares
- Proposed development impermeable area: 1.5 hectares
- Watercourse: Bradford Beck
- CBMDC river model: Bradford Beck 2026
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Subject to the exception test as more vulnerable development proposed in Flood Zone 3a
    - Assessment of modelled fluvial flood depths, velocities and hazards
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk



Figure 1-1: Existing site location boundary

The topography of the site is varied, with areas of higher elevation along the boundaries of the site, sloping towards the centre (Figure 1-2).



Figure 1-2: Topography

The underlying bedrock within the site is defined as 'Millstone Grit Group', which comprises mudstone, siltstone and sandstone (Figure 1-3). This is overlain with superficial deposits of till. Mudstone and siltstone typically have low permeability, whereas sandstone has a higher permeability.



Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning (January 2026) and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.3).

Fluvial flood risk to the site comes from Bradford Beck which appears to be culverted beneath the site, based on LLFA mapping. Functional floodplain is present on site. However, this is based on an 8m buffered polygon of the Bradford Beck culverted channel to indicate the presence of the watercourse beneath the site. The mapped watercourse location may not represent the actual location of the culverted channel. Noting that, functional floodplain policy applies to the path of the culvert beneath the site and not the mapped functional floodplain, where these differ. The path of the culverted channel should be confirmed through a survey as part of the site-specific FRA.

The majority of the site is within Flood Zone 3a and is therefore at high risk of fluvial flooding. The remaining area of the site is within Flood Zone 2 and is therefore at medium risk.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
0	11	77	12

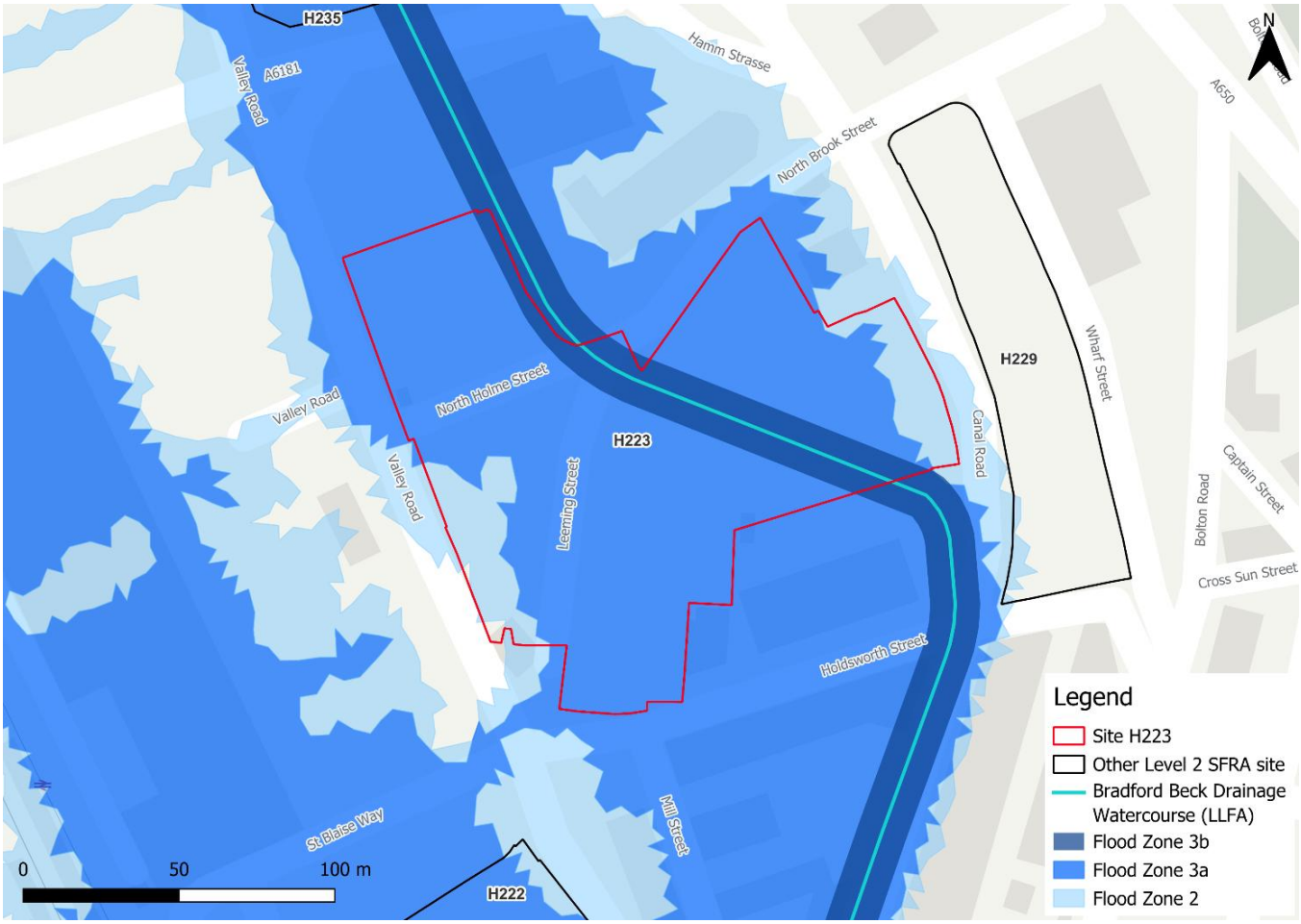


Figure 2-1: Existing risk from rivers to the site

2.1.2 Bradford Beck 2026 model outputs - present day

Figure 2-2 shows the modelled flood depths for the 1% AEP undefended event. Modelled risk to the site is less than that shown by Flood Zone 3a, however it is noted that the current Flood Zone 3a does not yet account for the latest Bradford Beck model outputs.

Maximum flood depths within the site are modelled to be between 0.6 and 0.9 m across the centre of the site. Modelled flood velocities are generally low across the area at risk (Figure 2-3), with velocity rarely exceeding 0.25 m^3/s. Modelled flood hazard is categorised as 'danger for most' across a large proportion of the site (Figure 2-4). Safe access and escape routes would likely be achievable via Valley Road to the west of the site and Canal Road to the east.

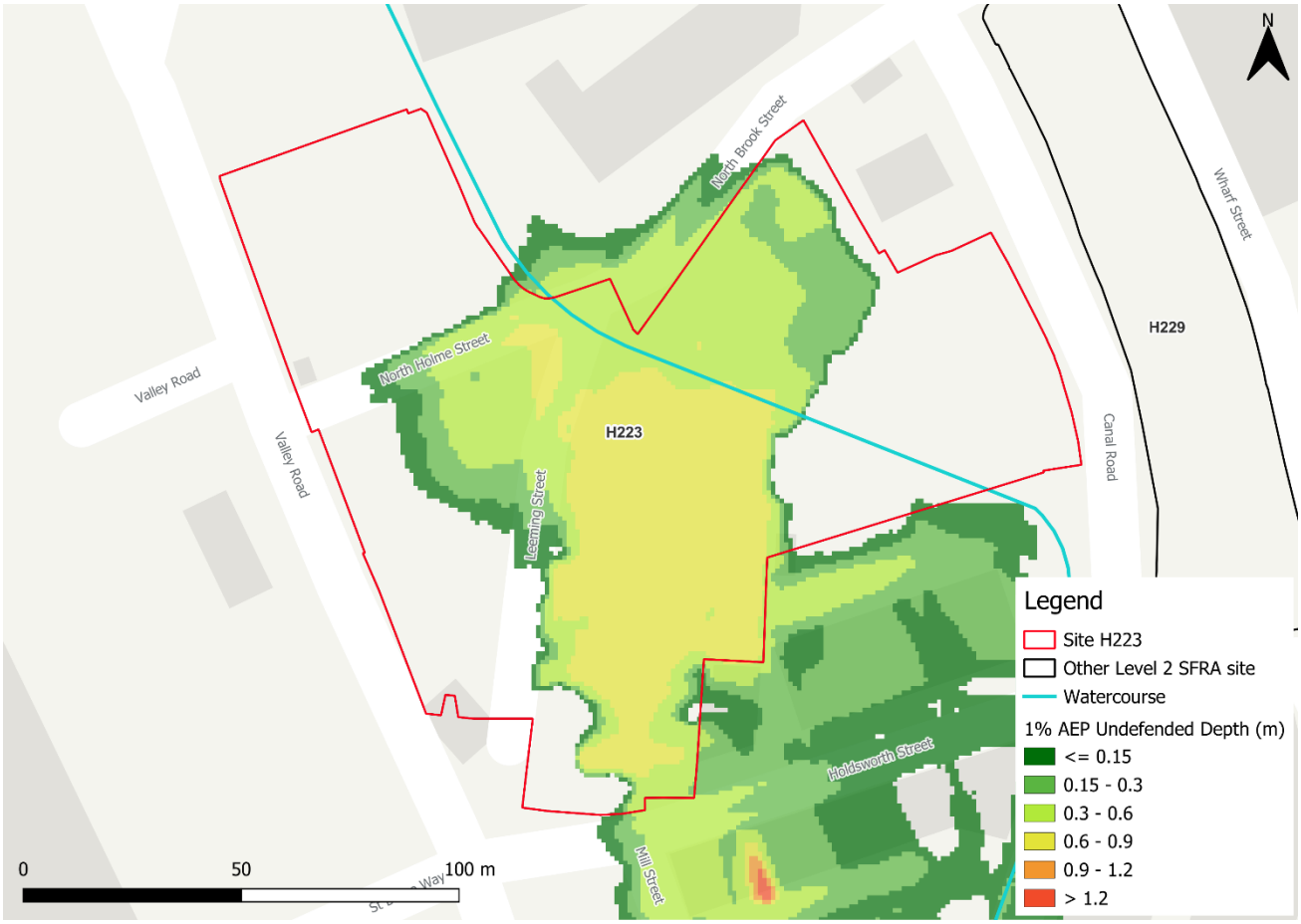


Figure 2-2: Flood depths for 1% AEP undefended flood event

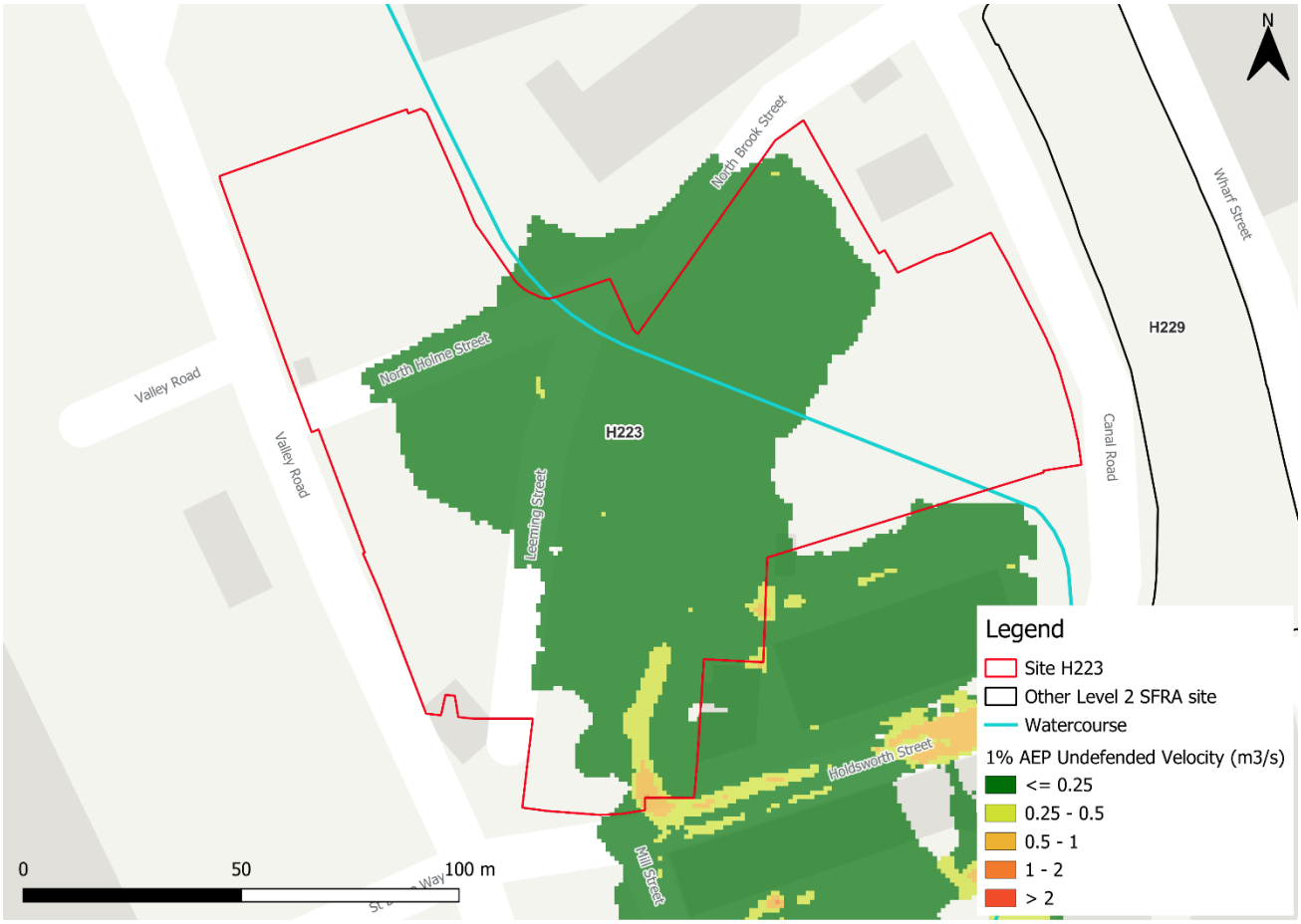


Figure 2-3: Flood velocities for 1% AEP undefended flood event

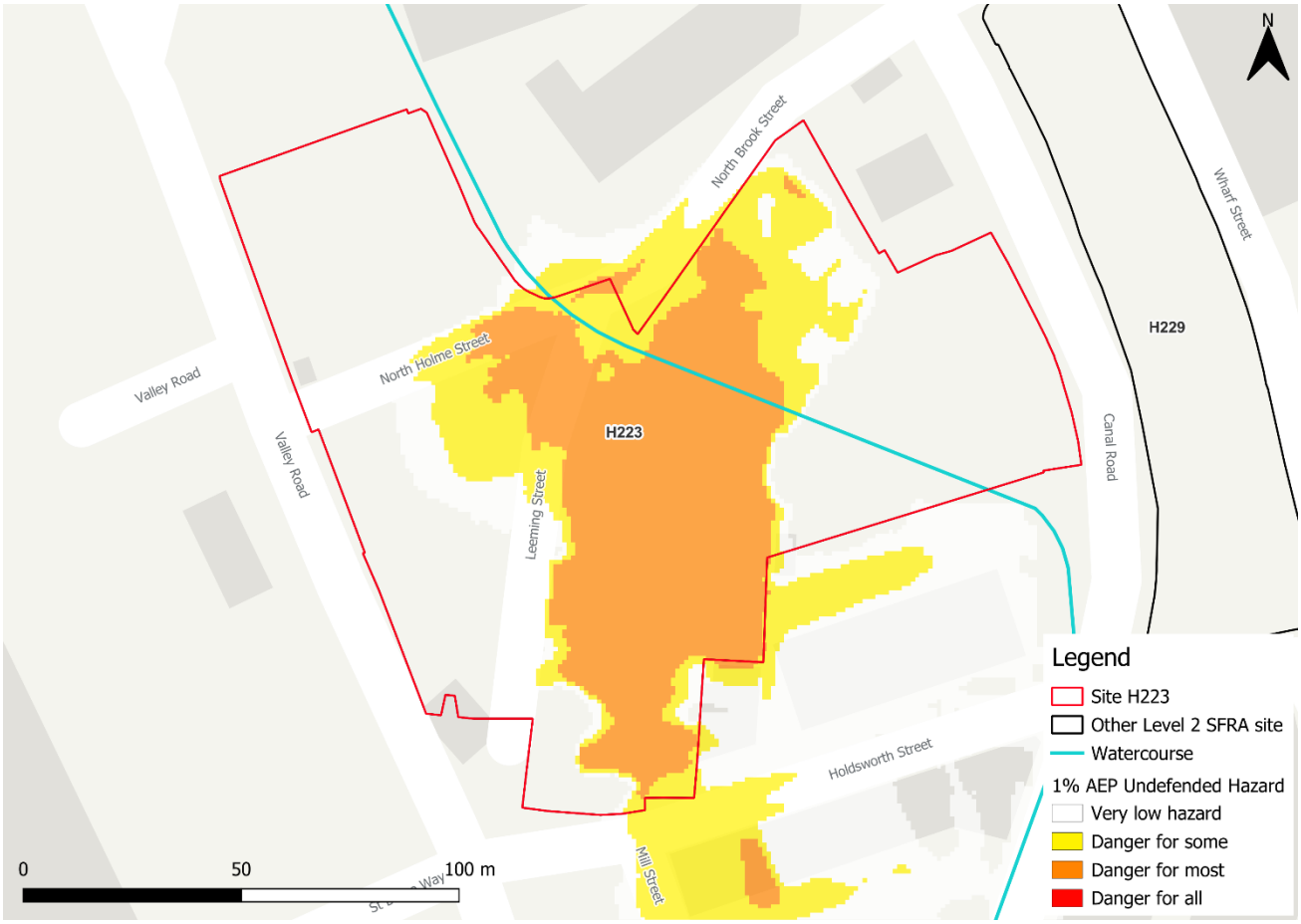


Figure 2-4: Flood hazard[1] for 1% AEP undefended flood event

2.2 Impacts from climate change

The EA's SFRA guidance states that SFRAs should assess the central allowance for less vulnerable, more vulnerable, highly vulnerable and water compatible development (Table 2-2). The impacts of climate change on flood risk from the Bradford Beck 2026 model have been modelled without flood defence infrastructure in place. As documented in Section 2.3.1, there are no formal engineered flood defences that would benefit the site.

1 Fluvial hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.

Table 2-2: Modelled climate change allowances for peak river flows for the Aire and Calder Management Catchment

Return period (AEP event)	Central allowance 2080s (% increase)	Higher central allowance 2080s (% increase)	Upper end allowance 2080s (% increase)
3.3% (functional floodplain)	23%	31%	51%
1%	23%	31%	51%

2.2.1 Bradford Beck 2026 model outputs - climate change

Figure 2-5 shows the onsite modelled flood depths for the 1% AEP undefended event +23% for climate change. Risk is modelled to be greater in both extent and depth in comparison to present day conditions. Maximum depths within the area at risk are significant, between 0.9 and 1.2 m. Flood velocities are modelled to remain low across the majority of the site, with maximum velocities between 1 and 2 m^3/s within a small area in the south of the site (Figure 2-6). The modelled flood hazard within the area at risk is largely categorised as 'danger for most' (Figure 2-7). Safe access and escape routes would likely remain achievable via Valley Road to the west of the site and Canal Road to the east during the climate change event.

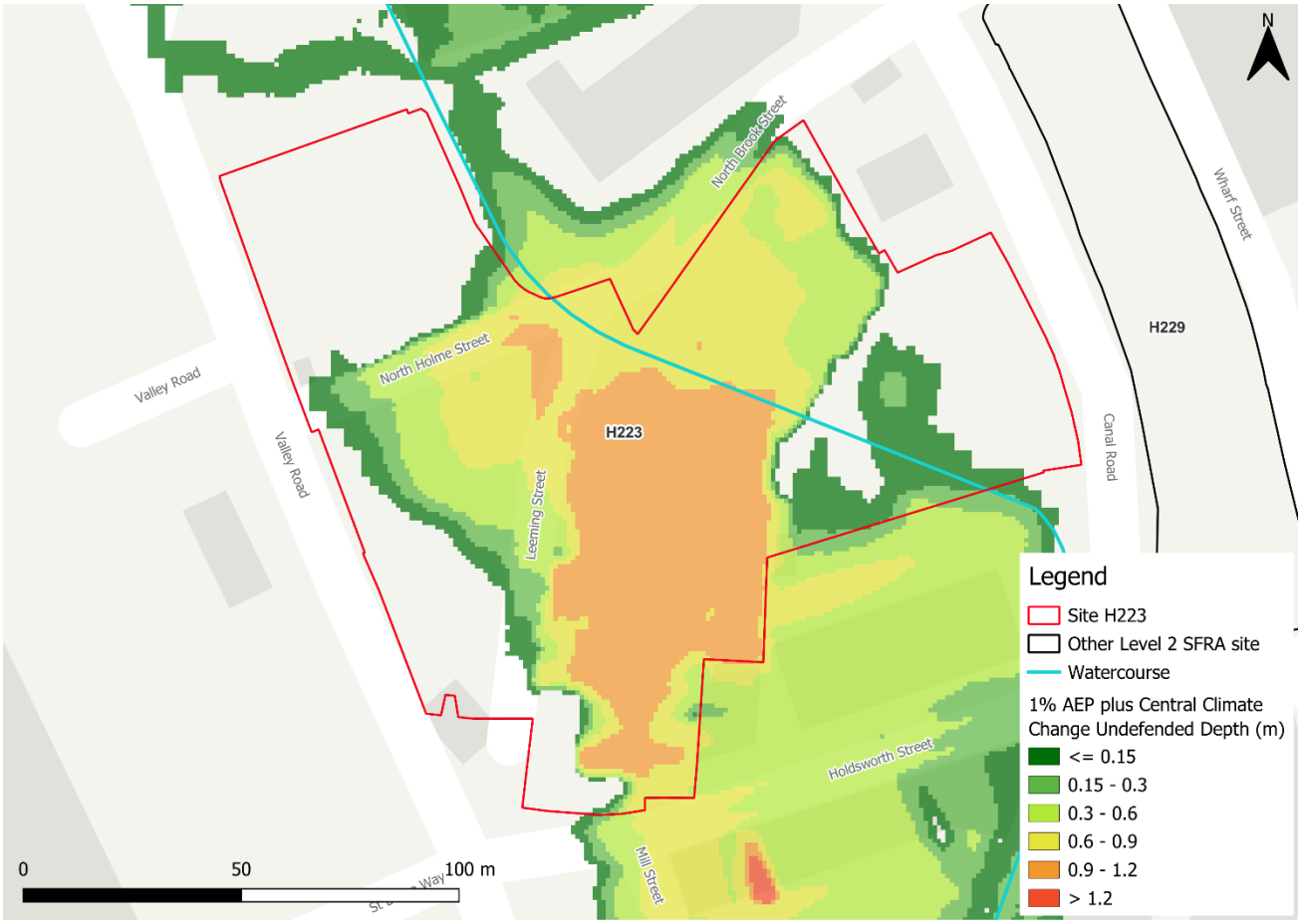


Figure 2-5: Flood depths for 1% AEP undefended flood event +23% (central climate change allowance)

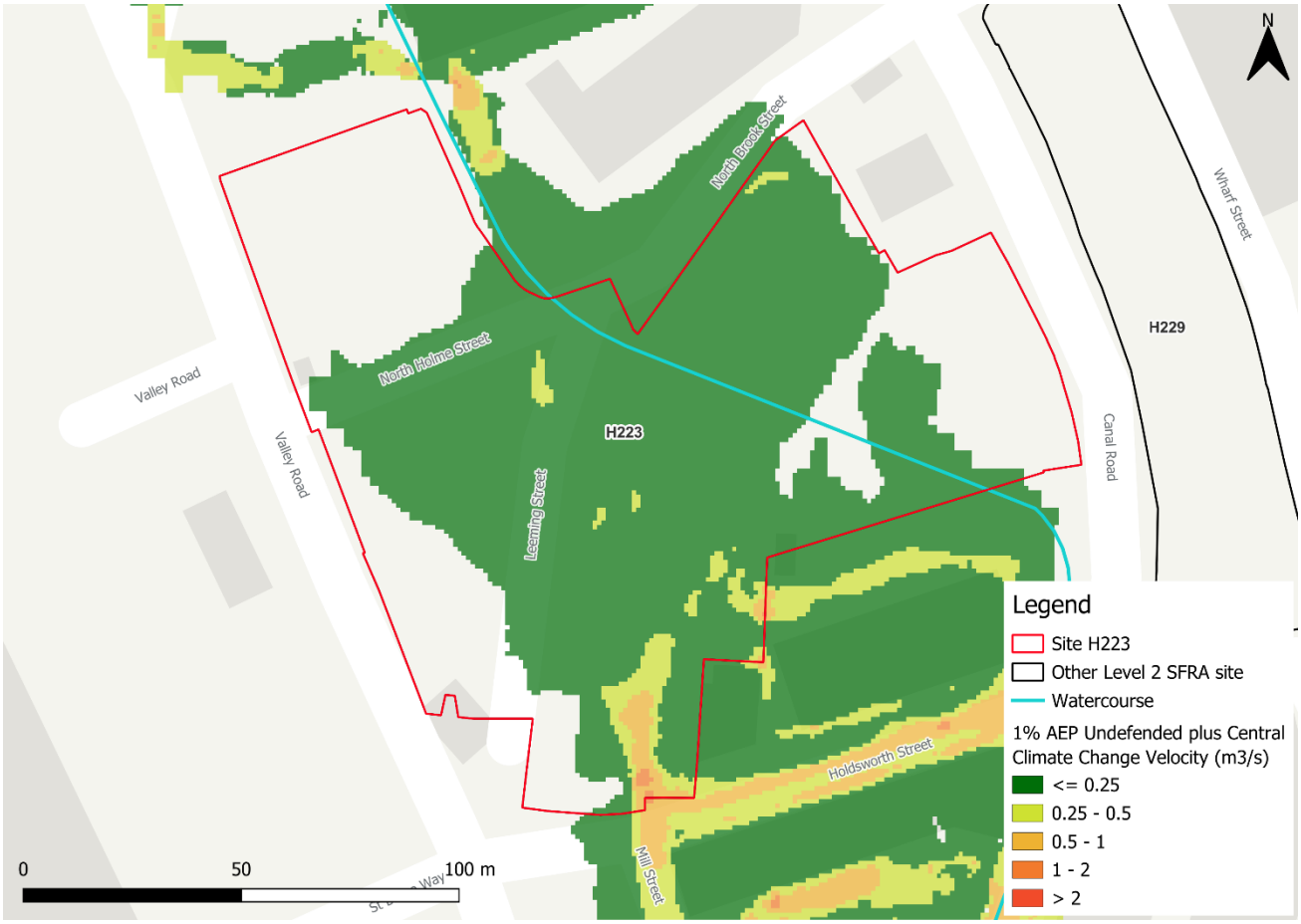


Figure 2-6: Flood velocities for 1% AEP undefended flood event +23% (central climate change allowance)

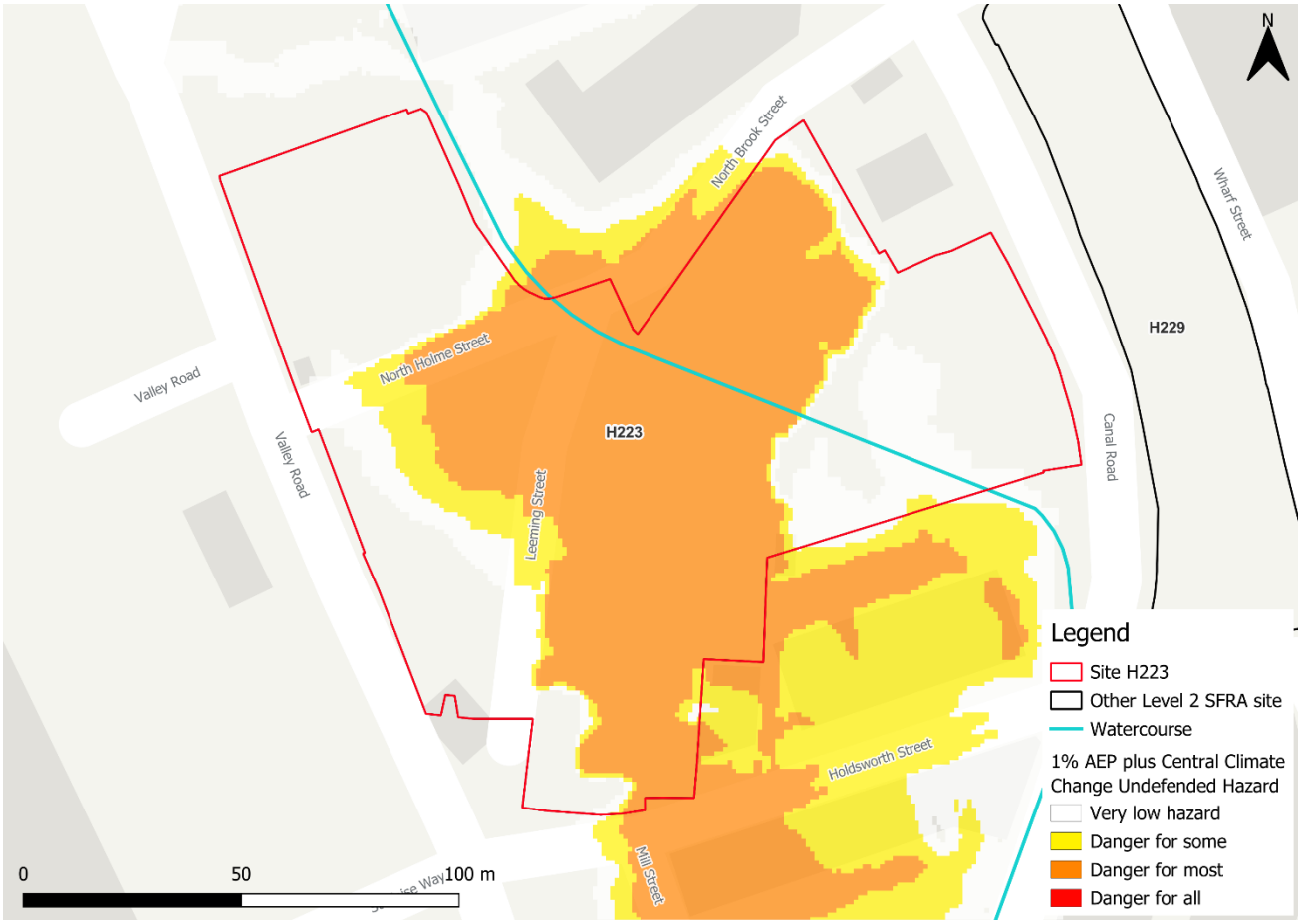


Figure 2-7: Flood hazard for 1% AEP undefended flood event +23% (central climate change allowance)

2.2.2 Flood Map for Planning - climate change

Climate change data in this area is unavailable from the EA's Flood Map for Planning plus Climate Change (2070-2125) dataset, as shown in Figure 2-8.

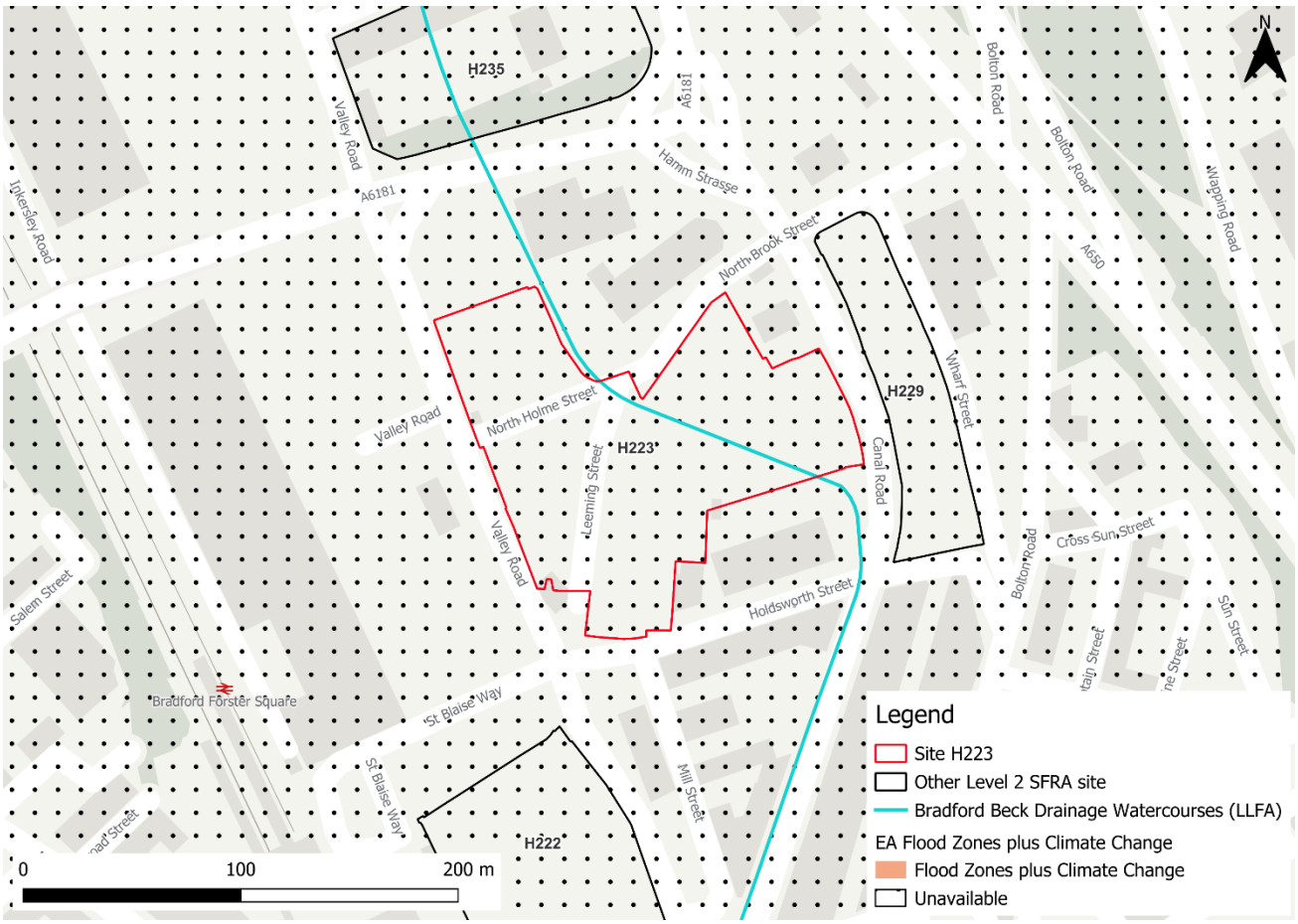


Figure 2-8: EA Flood Zones plus Climate Change

2.3 Flood risk management

2.3.1 Flood defences

The site does not benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset.

2.3.2 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) that may help to reduce flood risk to the site and surrounding areas. There are no applicable areas that could benefit the site.

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO) datasets have been considered. There are no recorded historic flood events at the site.

2.5 Emergency planning

2.5.1 Flood warnings

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The entire site is located within a FWA, namely 123FWF785 - Bradford Beck and tributaries at Bradford.

Flood alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be issued when there is less confidence that flooding will occur in a FWA. The entire site is also located within a FAA, namely 123WAF961 - Middle River Aire catchment.

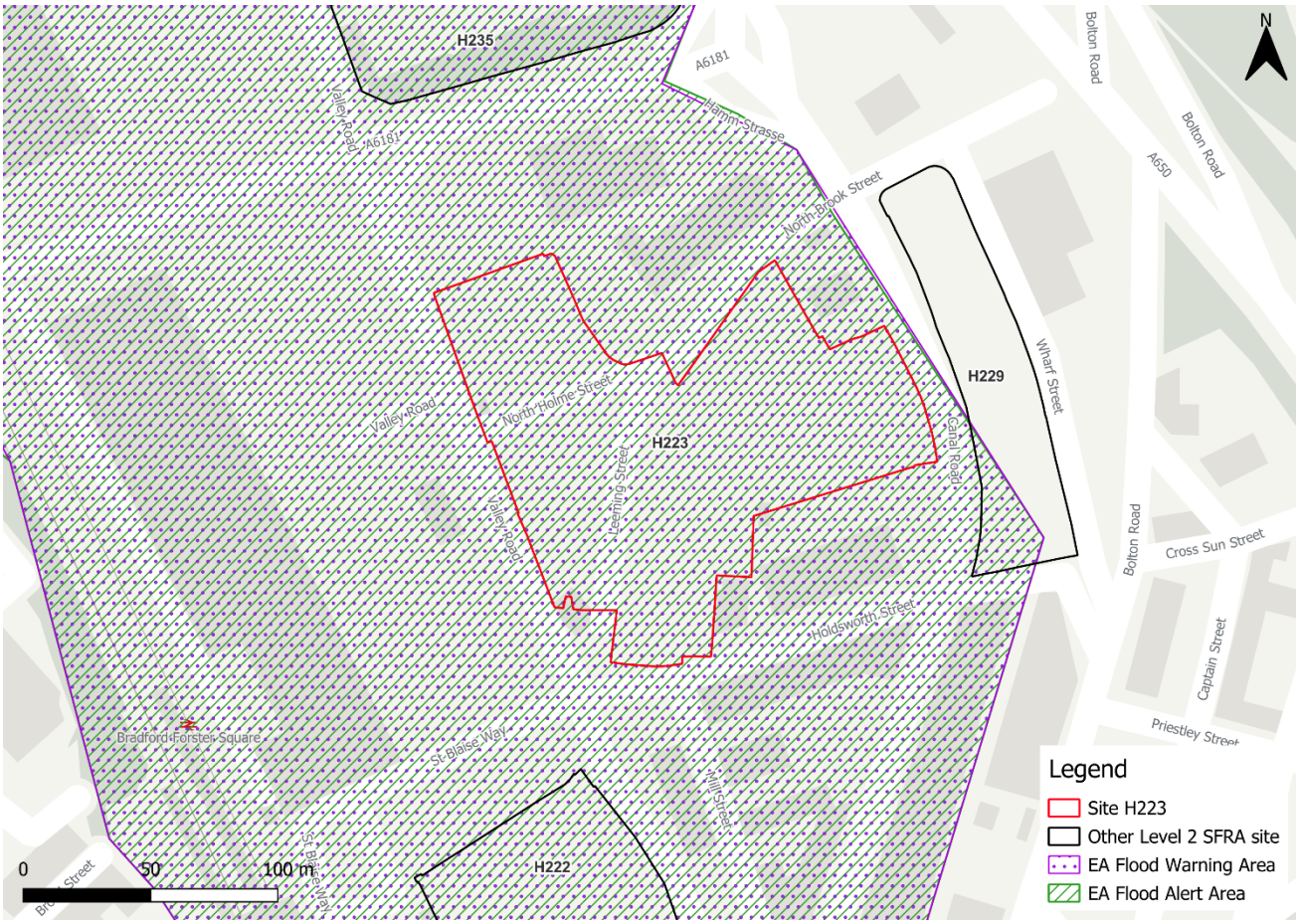


Figure 2-9: EA Flood Warning Areas and Flood Alert Areas

2.5.2 Access and escape routes

Based on available information on fluvial flood risk, safe access and escape routes would likely be achievable via Valley Road to the west of the site and Canal Road to the east.

2.6 Observations, mitigation options, site suitability and sequential approach to development management - fluvial

- Observations:

- The proposed development of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF.
- Given the change in use and therefore vulnerability of the site, the LPA must consider whether the change of use is acceptable and whether the development can be designed to be safe, including for adequate emergency planning provision, accounting for the information provided in this Level 2 SFRA (para 014 FRCC-PPG).
- The site is mapped to be within the functional floodplain through the centre of the site, 8m either side of the assumed Bradford Beck channel which is culverted beneath the site. Consideration should be given as to whether deculverting and daylighting this section of culvert is feasible, supported by detailed modelling. The watercourse should be considered within site design and form a blue green corridor through the site.
- If Bradford Beck remains culverted beneath the site, there should be no development above the culvert. The location and course of the culvert should be confirmed through a survey.
- If feasible, this area would be included as a green / blue corridor in site design offering multifunctional benefits alongside flood risk mitigation including Biodiversity Net Gain (BNG) contributions, and social and amenity benefits.
- If works are proposed on or near a river or flood defence, a separate permission may be required. The type of permission needed from the Lead Local Flood Authority will depend on the activity and location proposed.
- The central areas of the site are modelled to be at risk from fluvial sources (according to the Bradford Beck 2026 model) in the 1% AEP undefended scenario, to a lesser extent than the current Flood Zone 3a. The remainder of the site is within Flood Zone 2.
- Given the site is proposed for more vulnerable uses and within Flood Zone 3a, the site must be subject to and must pass the exception test.
- The 1% AEP event with an allowance for climate change is what the EA considers to be the design event for a development to mitigate fluvial flood risk. The majority of the site is shown to be at risk in the 1% AEP undefended plus central climate change event.
- Given the site is at high and medium risk from Bradford Beck, and future risk with climate change is modelled to be significant, it is recommended that this site is not redeveloped for more vulnerable uses. Ideally, this site would be converted to open greenspace for flood storage, amenity use and to provide environmental / ecological benefits.
- Were any plans for development to proceed, the site-specific FRA must show that development will be safe for its lifetime taking account of the vulnerability of its users, including for appropriate evacuation procedures and flood response infrastructure are in place to manage the fluvial risk associated with the extreme flood event.

- Mitigation:

- EA flood warnings and alerts should continue to be in place to ensure early evacuation of site users before an extreme flood event occurs.

- Access and escape:
  - Safe access and escape routes would likely be achievable via Valley Road to the west of the site and Canal Road to the east.

3 Flood risk from surface water

3.1 Existing risk

At the time of writing, the EA's latest national Risk of Flooding from Surface Water (RoFSW) does not include depth and hazard information suitable for planning purposes. Therefore, this Level 2 SFRA considers the third generation RoFSW depth and hazard mapping in addition to the NaFRA2 extents, as agreed with the EA. Surface water depth and hazard should be confirmed at the site-specific FRA stage.

3.1.1 Risk of Flooding from Surface Water - NaFRA2 extents

Based on the EA's national scale RoFSW map (January 2026), surface water risk to the site is predominantly high, as shown in Table 3-1.

Surface water risk is modelled to be significant across the entire site (Figure 3-1).

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
3	26	28	43

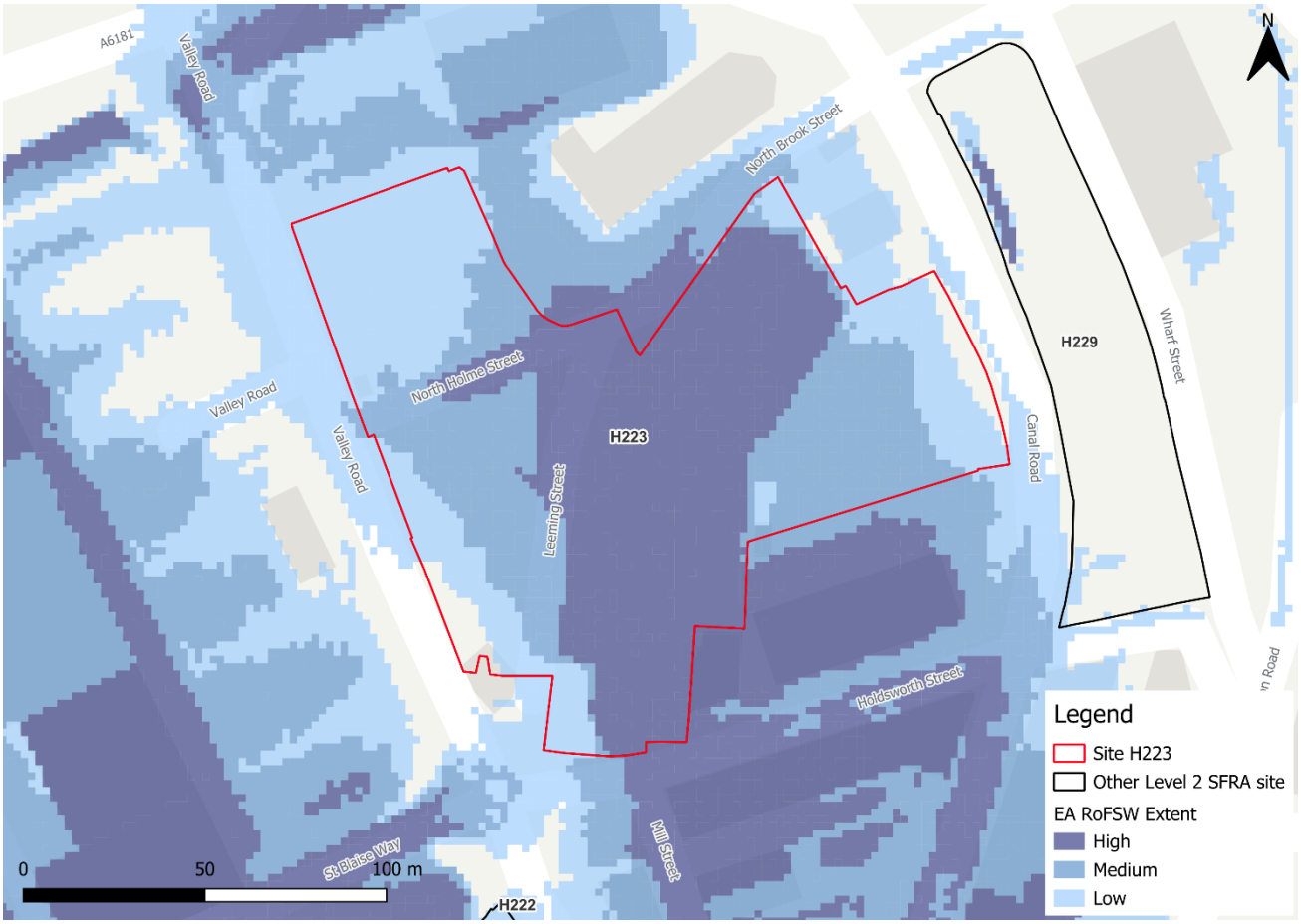


Figure 3-1: Surface water flood extents (NaFRA2 - Risk of Flooding from Surface Water map)

3.1.2 Risk of flooding from Surface Water - third generation depths and hazards

Based on the EA's national scale third generation RoFSW map, the greatest flood depths within the site in the medium risk event are > 1.2 m (Figure 3-2), with hazard categorised as 'extreme' in some areas of the site (Figure 3-3). Safe access and escape routes would likely be achievable via Canal Road to the east of the site, travelling towards the north, however Valley Road becomes inundated during the medium risk surface water event. Safe access and escape routes should be confirmed based on a drainage strategy through the FRA.

There are some differences between the NaFRA2 RoFSW map and the third-generation depth and hazard mapping. The NaFRA2 RoFSW map does not map flooding less than 0.075m (7.5cm) in depth. Therefore, where the map may show no flooding, there may be shallow flooding up to a depth of 0.075m. In contrast, the third generation RoFSW does not map flooding with a hazard rating of less than 0.575. This could explain the differences observed between the NaFRA2 and third generation RoFSW. Assessment of surface water should be carried out at the site-specific FRA stage to robustly establish current and future surface water flood risk conditions.

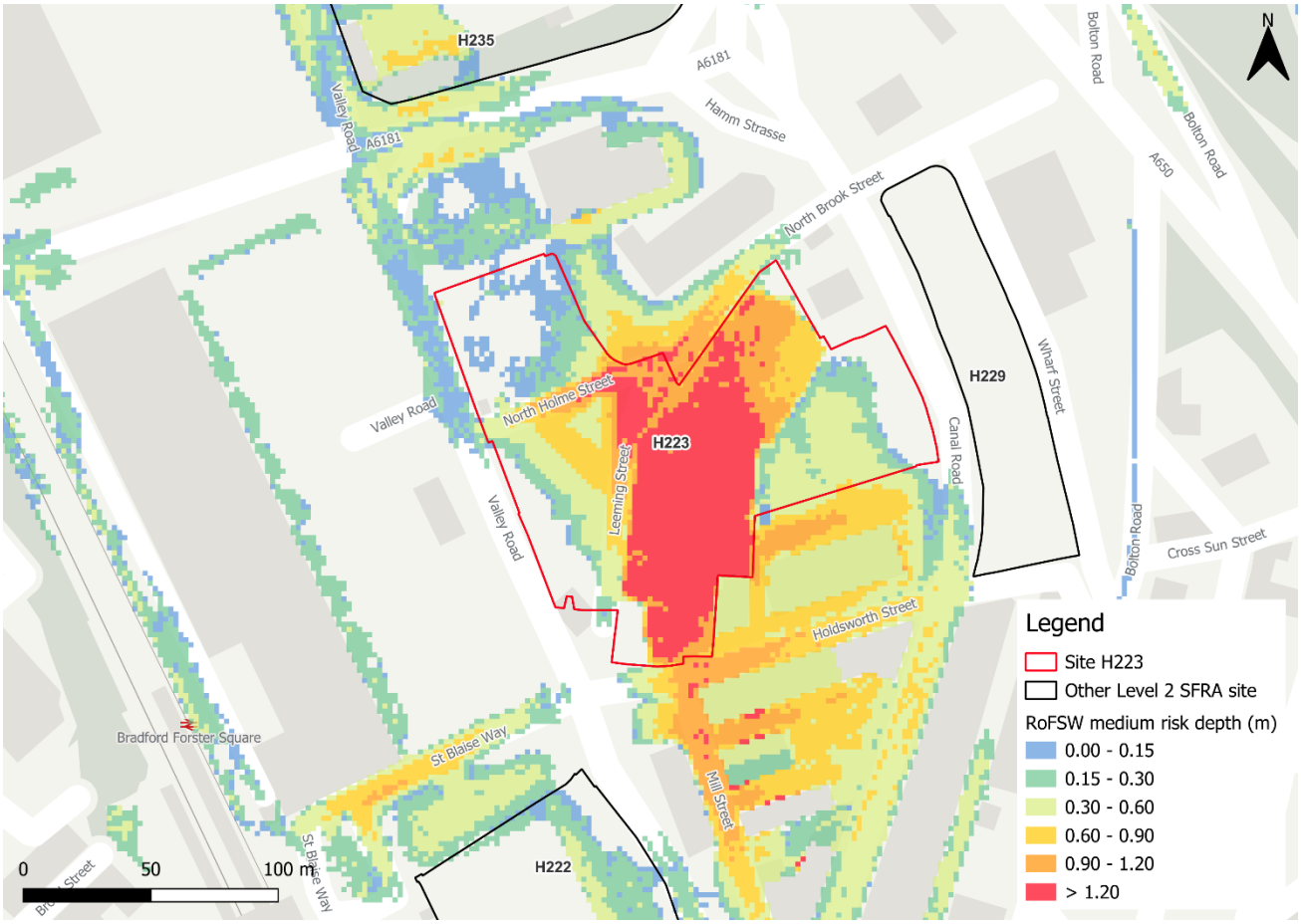


Figure 3-2: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

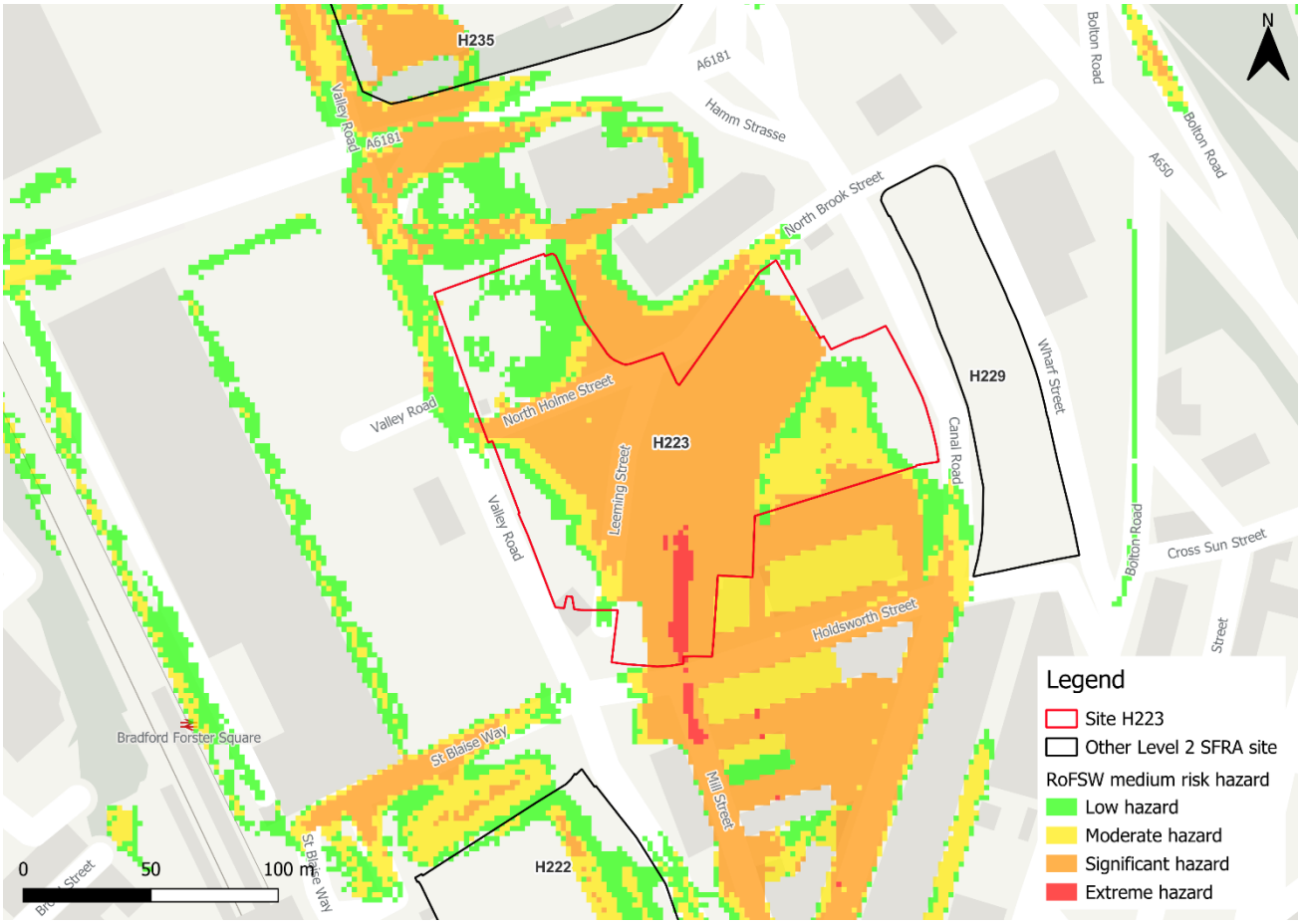


Figure 3-3: Medium risk event surface water flood hazard[2] (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

At the time of writing, the available national surface water climate change mapping is unsuitable for consideration in development planning. This Level 2 SFRA considers the low risk surface water event as a conservative proxy for the medium risk event plus climate change, as agreed with the EA. The impact of climate change on surface water flood risk should be considered at the site-specific FRA stage.

Using the low risk event as a proxy, the medium risk surface water event is likely to increase in extent within the site when accounting for climate change (Figure 3-4). The third generation mapping indicates maximum flood depths are likely to remain at > 1.2 m (Figure 3-5), with large areas of hazard categorised as 'extreme' (Figure 3-6). Safe access and escape routes may be challenging to achieve given the modelled flood depths and hazards along the main access routes to the site. This should be confirmed through the site-specific FRA.

2 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

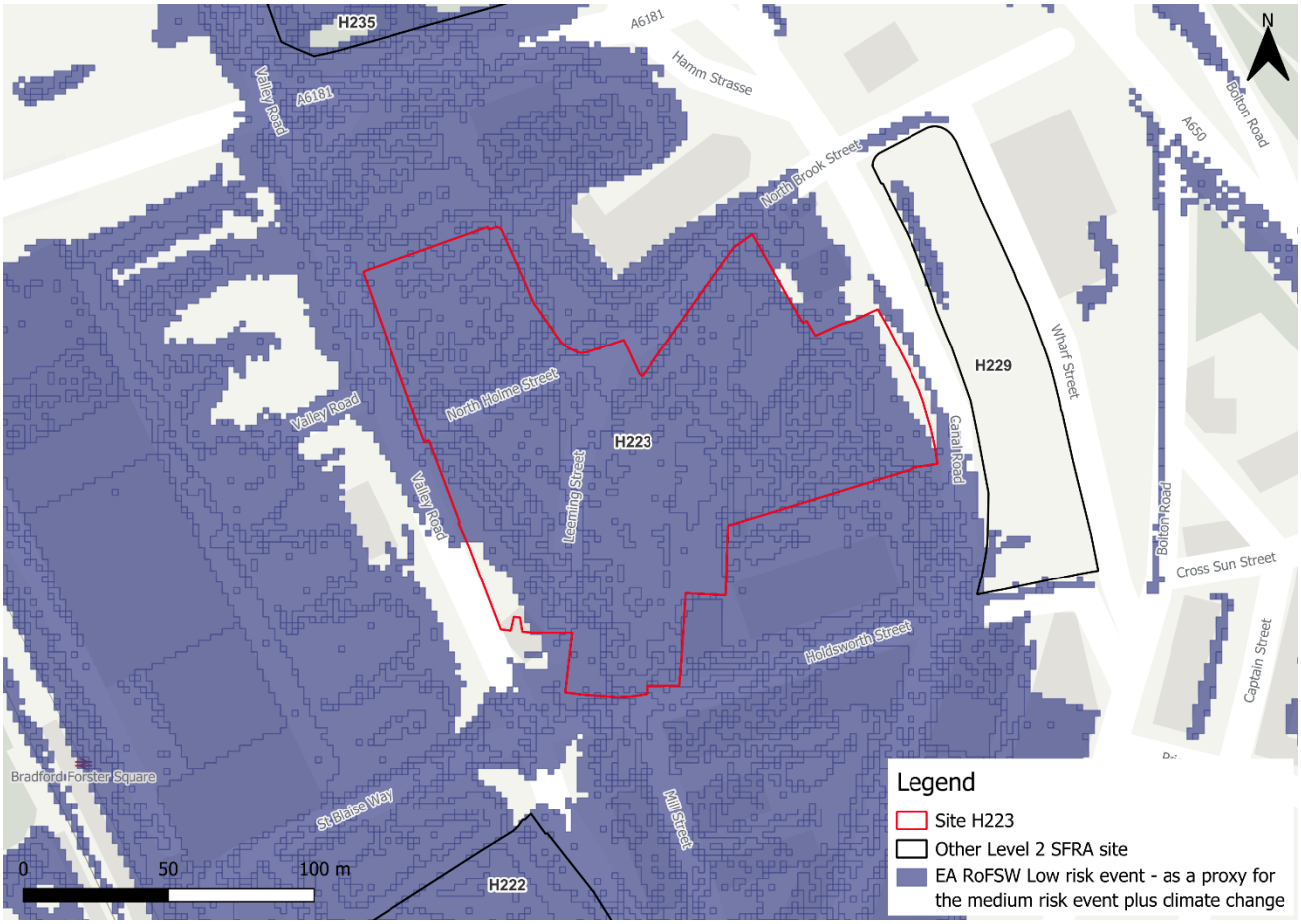


Figure 3-4: Low risk event surface water flood extent, as a proxy for the medium risk event plus climate change (NaFRA2 - Risk of Flooding from Surface Water map)

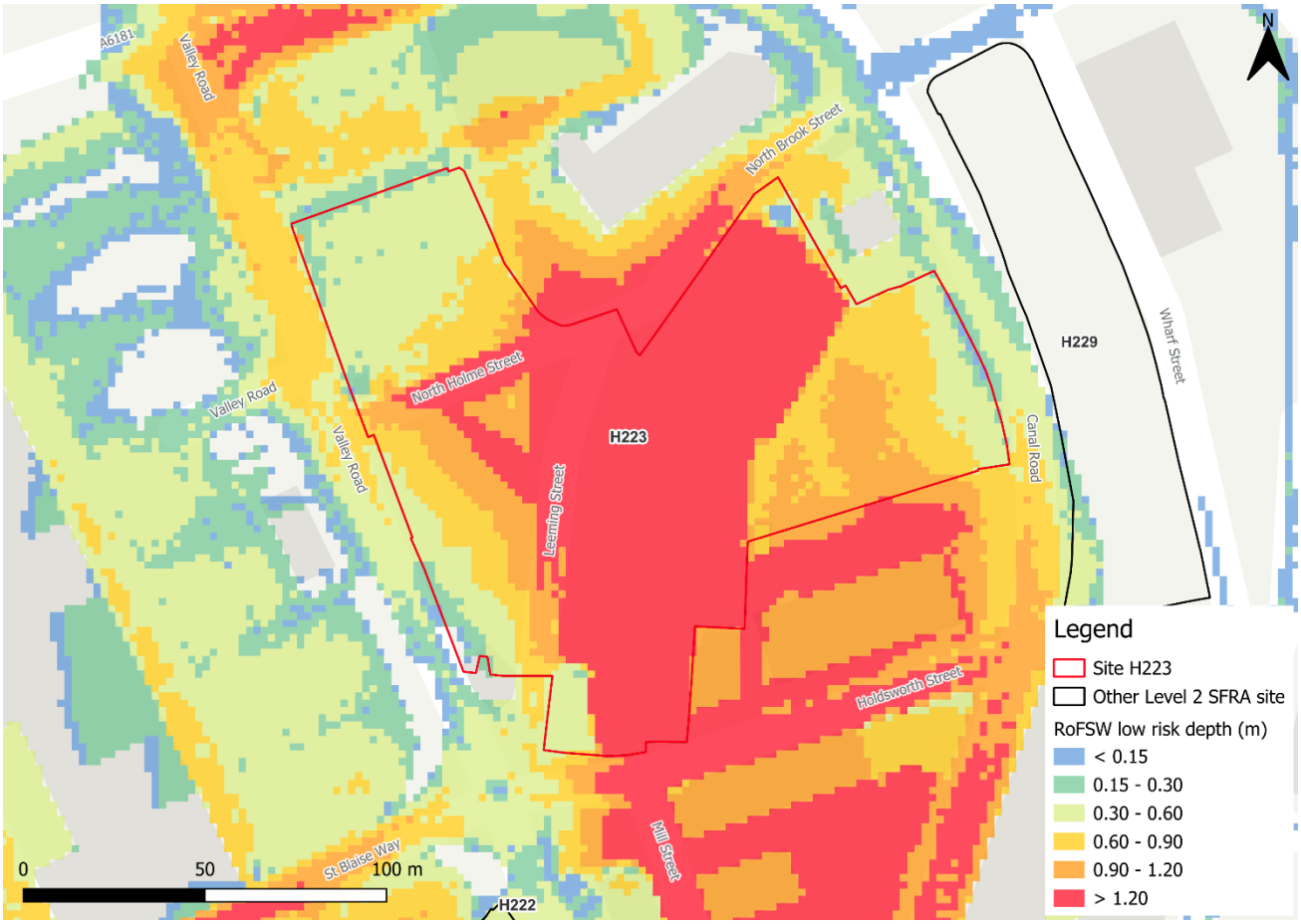


Figure 3-5: Low risk event surface water flood depths, as a proxy for the medium risk event plus climate change (Third generation - Risk of Flooding from Surface Water map)

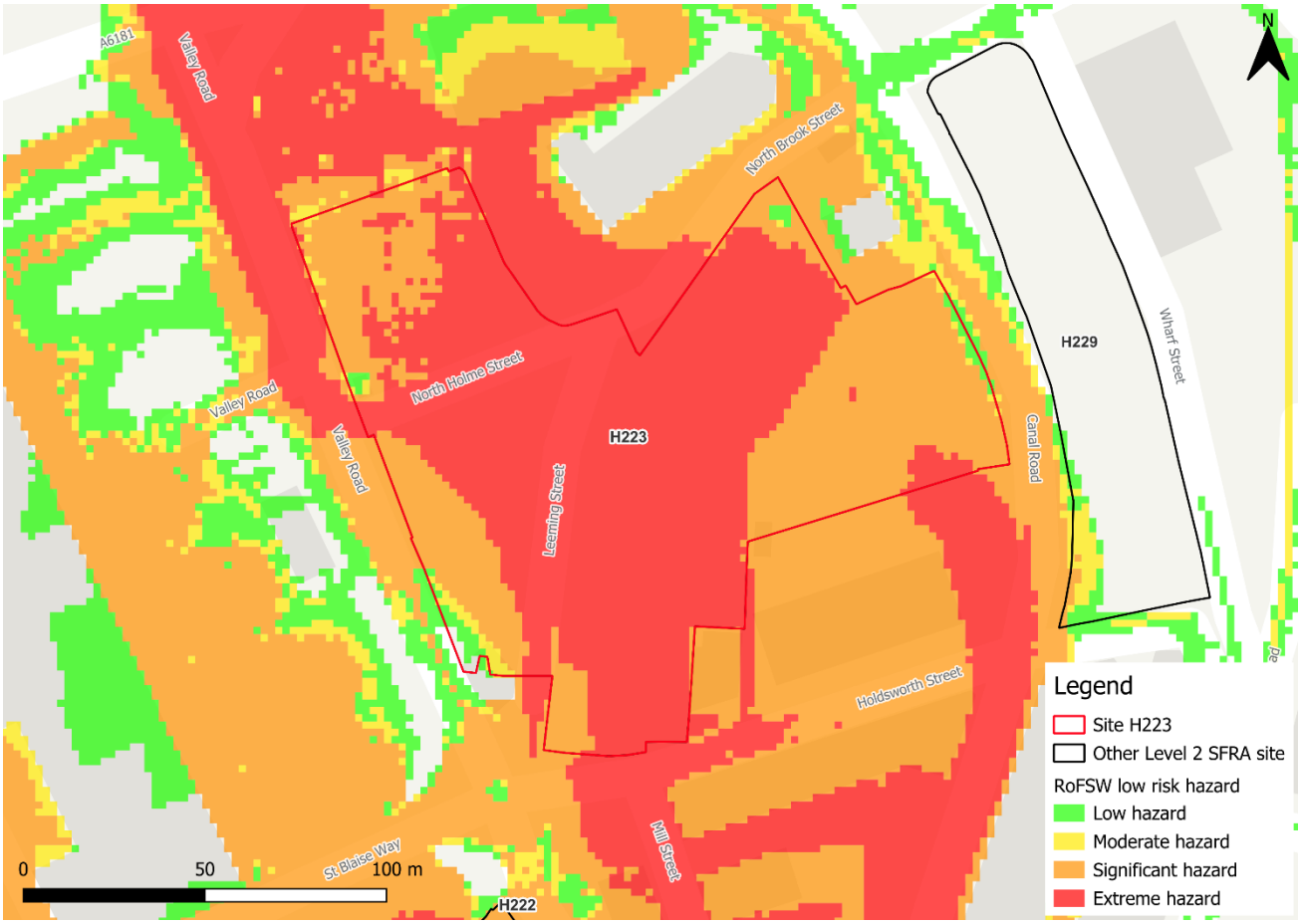


Figure 3-6: Low risk event surface water flood hazard, as a proxy for the medium risk event plus climate change (Third generation - Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk to the site is significant, with the majority of the site being located within either the high or medium risk surface water flood zones. Surface water flood depths are modelled to be > 1.2 m.
- The effects of climate change on surface water have not been modelled for this SFRA, however the low risk surface water event has been used as a proxy for the medium risk event plus climate change. Using this event, the medium risk surface water event is likely to increase in extent to cover almost the entire site.
- Safe access and escape routes would likely be challenging to achieve when considering climate change based on the modelled surface water flood depths along both Canal Road and Valley Road.
- Given the significant surface water risk across the site, it is recommended that this site is not developed and is converted to open greenspace for flood storage, amenity use and to provide environmental / ecological benefits.
- The RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of

risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[3]. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

The entire site is located within an area where there is no risk of groundwater emergence. Groundwater conditions may therefore be suited to infiltration SuDS, however this should be considered further through the drainage strategy given the low permeability of the underlying bedrock (Figure 1-3).

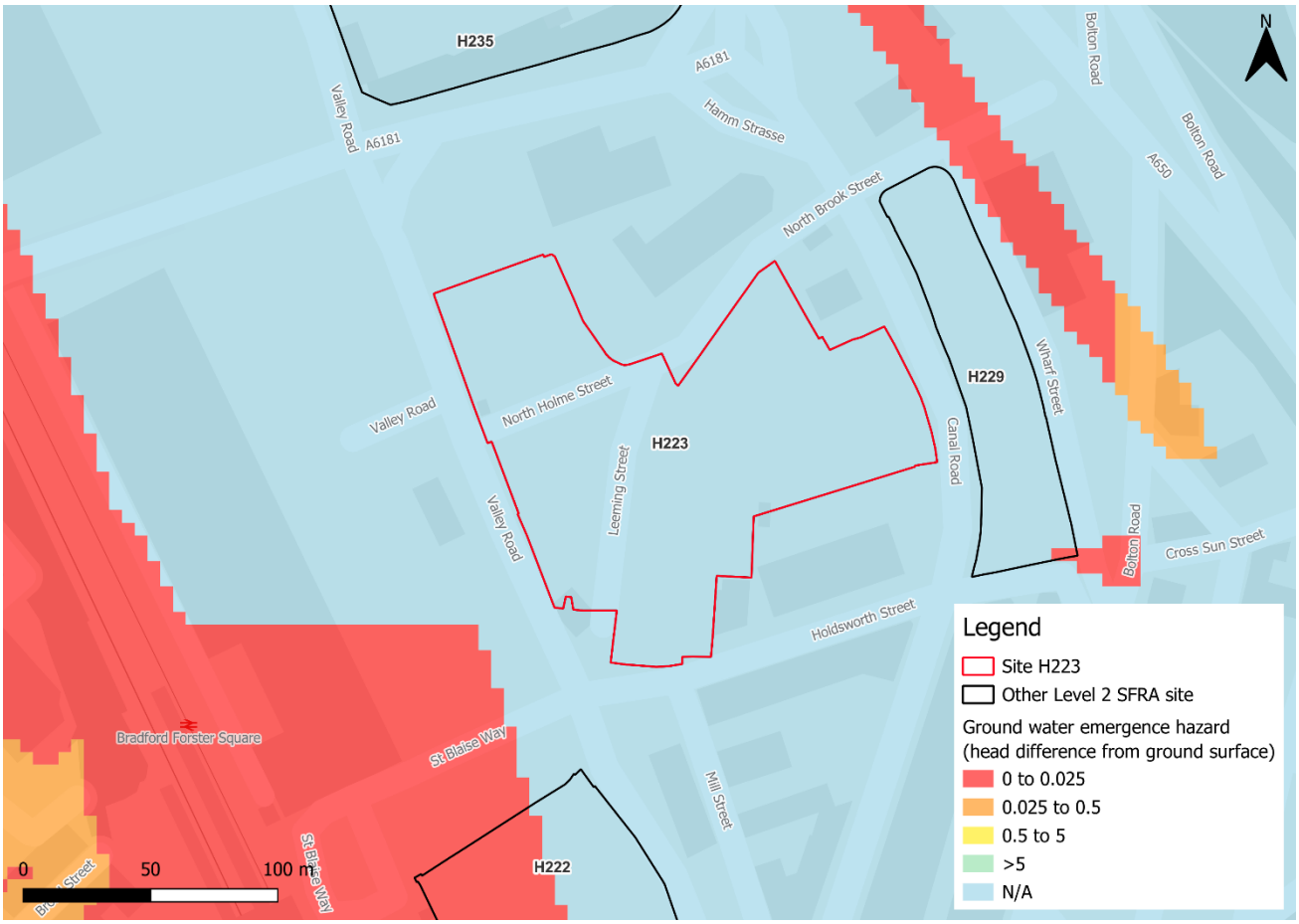


Figure 4-1: JBA 5m Groundwater Emergence Map

3 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

Although a site may be afforded some protection from defences and / or drainage infrastructure, there is always a residual risk of flooding from asset failure i.e. defence breaches, or blockages of culverts or drainage assets. There is potential residual risk to the site from a structural failure of the culverted channel beneath the site (Figure 5-1).



Figure 5-1: Potential residual risk - Bradford Beck culvert beneath the site

5.1 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. Figure 5-2 shows the RFM in a 'dry day' and 'wet day' scenario. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is potentially at risk from four reservoirs located in Bradford. Of these four reservoirs, two are operated by either Yorkshire Water Services Ltd and two are operated by the City of Bradford Metropolitan District Council.

The EA's SFRA guidance states that where a proposed development site is at flood risk from a reservoir, then an assessment into whether the reservoir design or maintenance schedule needs improving should be carried out. Expert advice may be required from an all-reservoirs panel engineer. The Council should consult the relevant reservoir undertaker to ascertain whether the proposed development could affect the reservoir's risk designation, its design category or how it is operated. The Council, as category 1 responders, can access more detailed information about reservoir risk and reservoir owners using the Resilience Direct system.

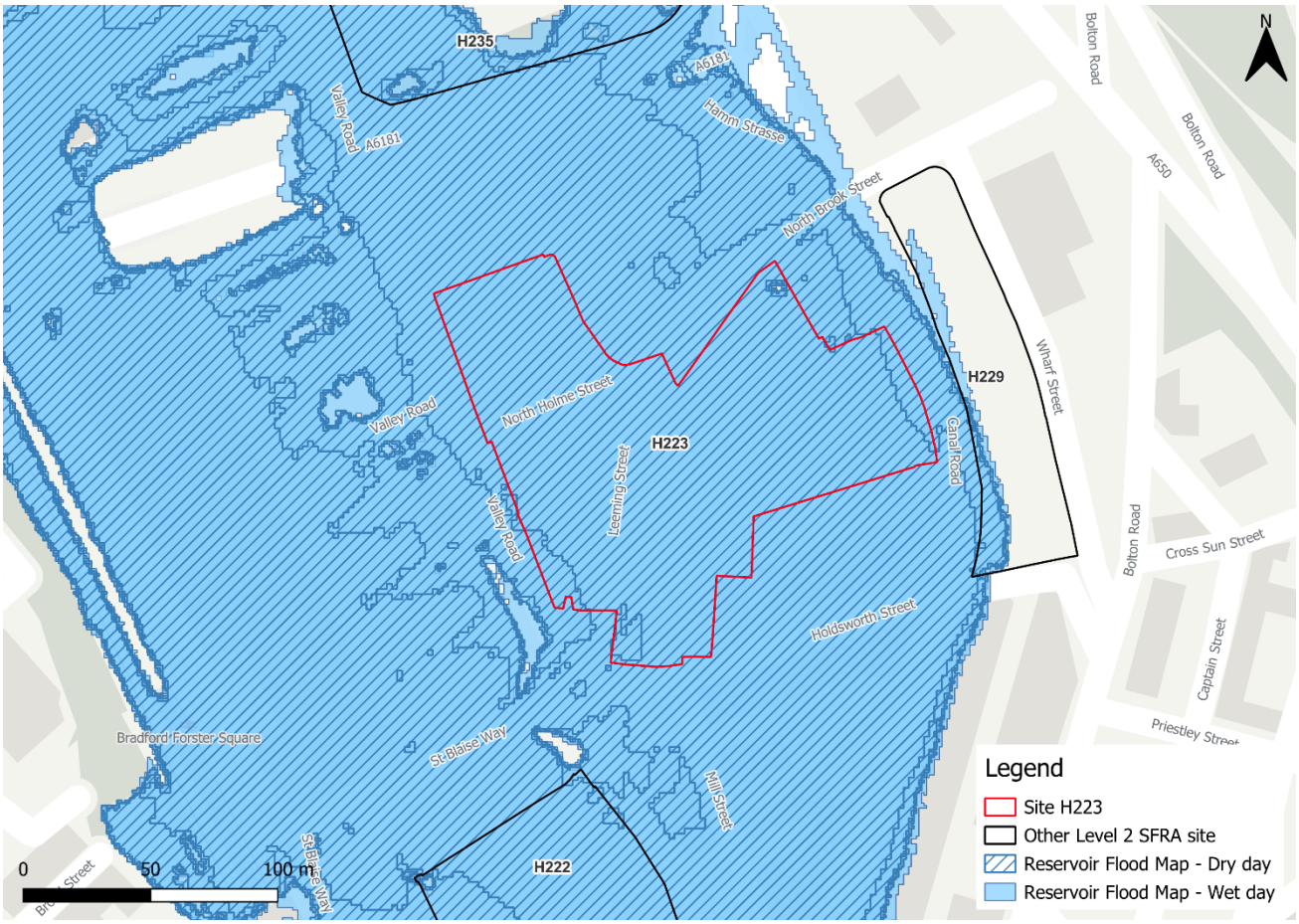


Figure 5-2: Flood risk from reservoirs

5.2 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a structural failure of the East Brook culvert beneath the site.
- Areas adjacent to culverts and bridges are at particular risk from the rapid onset of fast flowing and deep flooding, with little or no warning if structures fail. Emergency plans must be in place for such areas and safe access and escape routes must be in place for the lifetime of development. Resistance and resilience measures may also need to be put in place to manage residual flood risk when avoidance measures have been exhausted.

- The LPA should use the information on residual risk in this Level 2 SFRA to state in the local plan strategic policies a preferred mitigation strategy for ensuring development will be safe throughout its lifetime in relation to urban form, risk management and where flood mitigation measures are likely to have wider sustainable design implications (para 042, FRCC-PPG).
- The site is at potential residual risk from a breach of four reservoirs. All four reservoirs impact the site in the 'dry day' flood extent. However, only Upper Chellow and Lower Chellow, are modelled to impact the site based on the 'wet day' flood extent, which represents a prediction of the credible worst case scenario, therefore it is unlikely that such an extreme flood event would occur.
- Given the potential reservoir risk to the site, developers should consider[4]:
    - Consulting with the local resilience forum for advice on emergency planning,
    - Consulting with relevant reservoir owners to understand the impact development may have on their reservoirs, and
    - Using this Level 2 SFRA to understand whether any proposed development will be safe throughout its lifetime.

4 Reservoir flood maps: when and how to use them | Environment Agency | 2021

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is required to pass part b) of the exception test[5], given it is proposed for more vulnerable uses and is located within Flood Zone 3a. It must be proven that the development can be safe for its lifetime, which is generally considered to be 100 years for residential development. Based on the available information documented within this Level 2 SFRA, this site cannot pass the exception test given both the 1% AEP event modelled present day and future fluvial risk.

6.2 Recommendations summary

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

- This site is located within a major regeneration area of Bradford City Centre which may be subject to investment to deliver new transport infrastructure, housing and employment and is likely to involve a significant re-engineering of parts of the city over the lifetime of the Local Plan.
- A comprehensive approach to managing flood risk within the Bradford Beck corridor will need to be carried out, which may include watercourse and flood engineering, alleviation works including green and blue infrastructure investment as part of a package of measures to reduce flood risk across the city. This context should be used to inform further work on flood risk assessment(s).
- The majority of the site is located within the functional floodplain and Flood Zone 3a. Development is not permitted within the functional floodplain.
- It is recommended that this site is converted to open space and used as a multifunctional greenspace for flood storage, amenity use and to provide environmental / ecological benefits, given the significant fluvial risk to the site.
- The Flood Map for Planning requires updating to include for the 2026 model of Bradford Beck.

6.3 Site-specific requirements and further work

At the planning application stage, the following should be considered:

- A condition and capacity assessment of the culvert beneath the site.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood

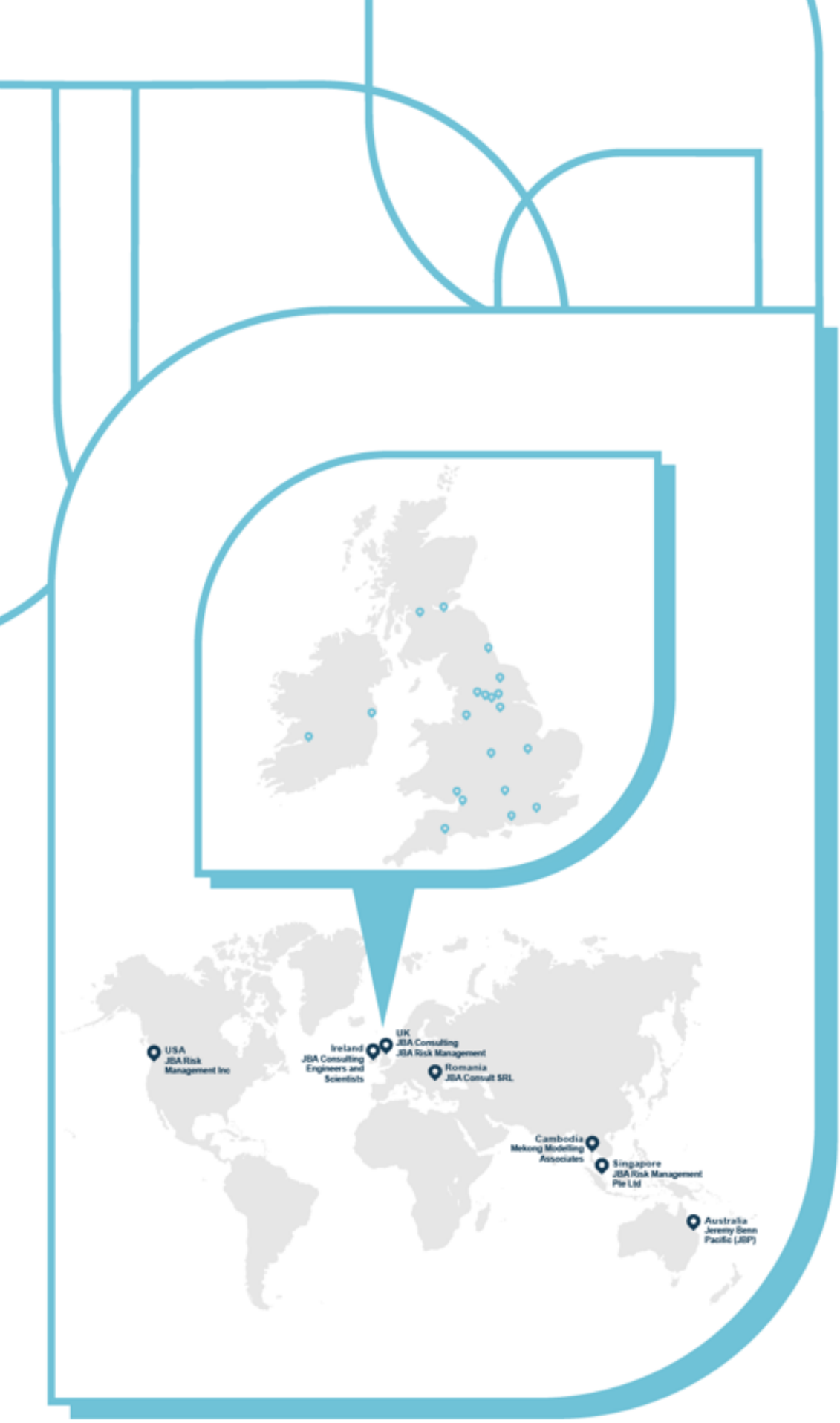
5 Para 178 National Planning Policy Framework 2024

authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

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Bradford Level 2 Strategic Flood Risk Assessment - Site H225

Final Draft

October 2026

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

www.jbaconsulting.com

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Reviewed by	Mike Williamson BSc MSc CGeog FRGS EADA Principal Analyst
Authorised by	Krista Keating BSc MSc CEnv CSci MCIWEM C.WEM Associate Director

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Contract

JBA Project Manager	Mike Williamson
Address	Phoenix House, Lakeside Drive, Centre Park, Warrington, WA1 1RX
JBA Project Code	2024s1078

This report describes work commissioned by City of Bradford Metropolitan District Council (CBMDC) by an instruction dated 19 July 2024. The Client's representative for the contract was Jonathan Dicken of CBMDC. Georgina Williams of JBA Consulting carried out this work.

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Acknowledgements

We would like to thank the Environment Agency for their assistance with this work.

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H225. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the 'CBMDC Level 1 SFRA' (2023) and read the 'CBMDC Level 2 SFRA Main Report' (2026) and is therefore familiar with the terminology used in this report.

1.1 Site H225

- Location: Former Bee Hive Mills, Smith Street
- Existing site use: Brownfield
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 0.8 hectares
- Proposed development impermeable area: 0.69 hectares
- Watercourse: Bradford Beck / West Brook
- CBMDC river model: Bradford Beck 2026
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Assessment of modelled fluvial flood depths, velocities and hazards
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk

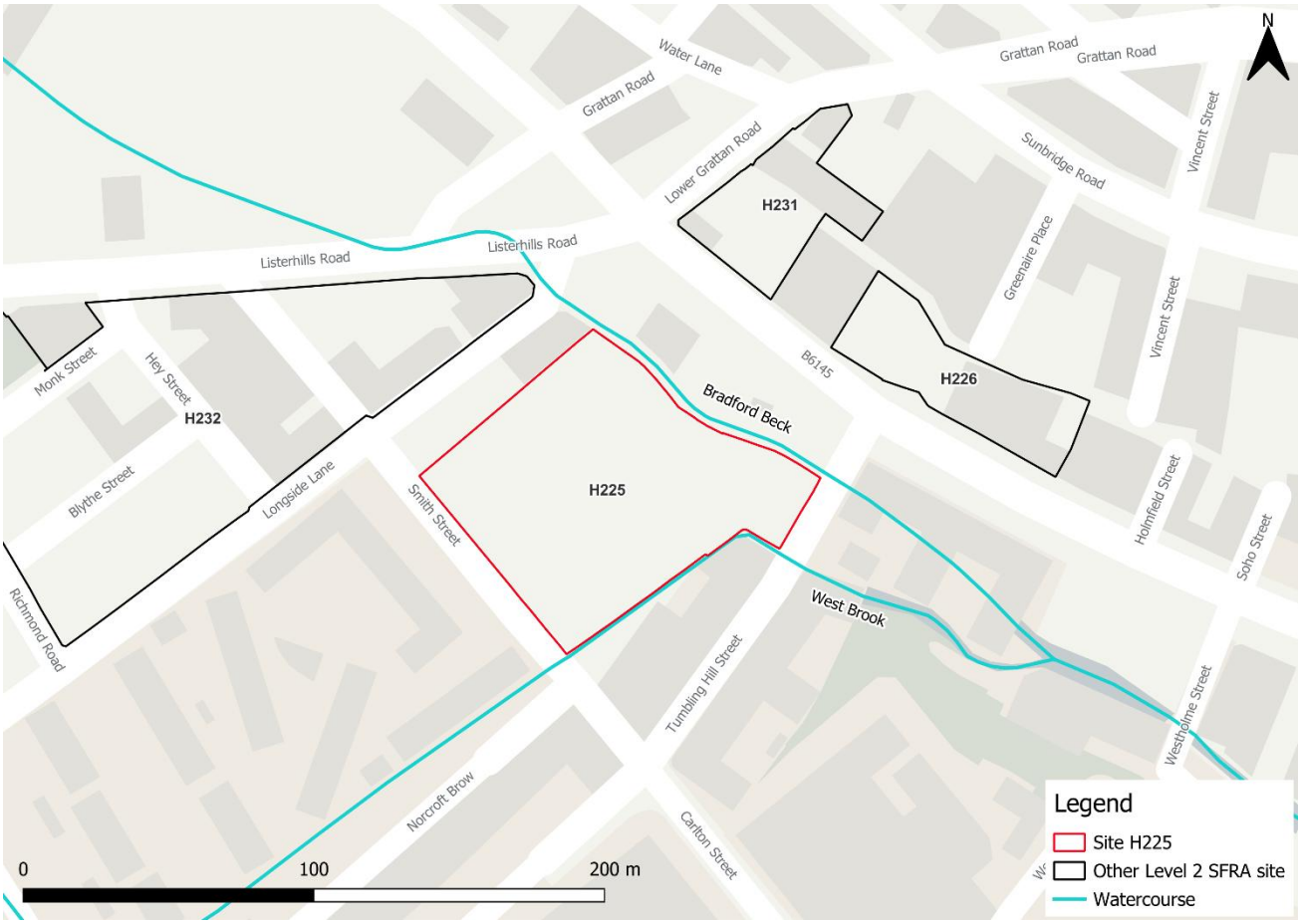


Figure 1-1: Existing site location boundary

The topography of the site is generally consistent throughout the site (Figure 1-2).

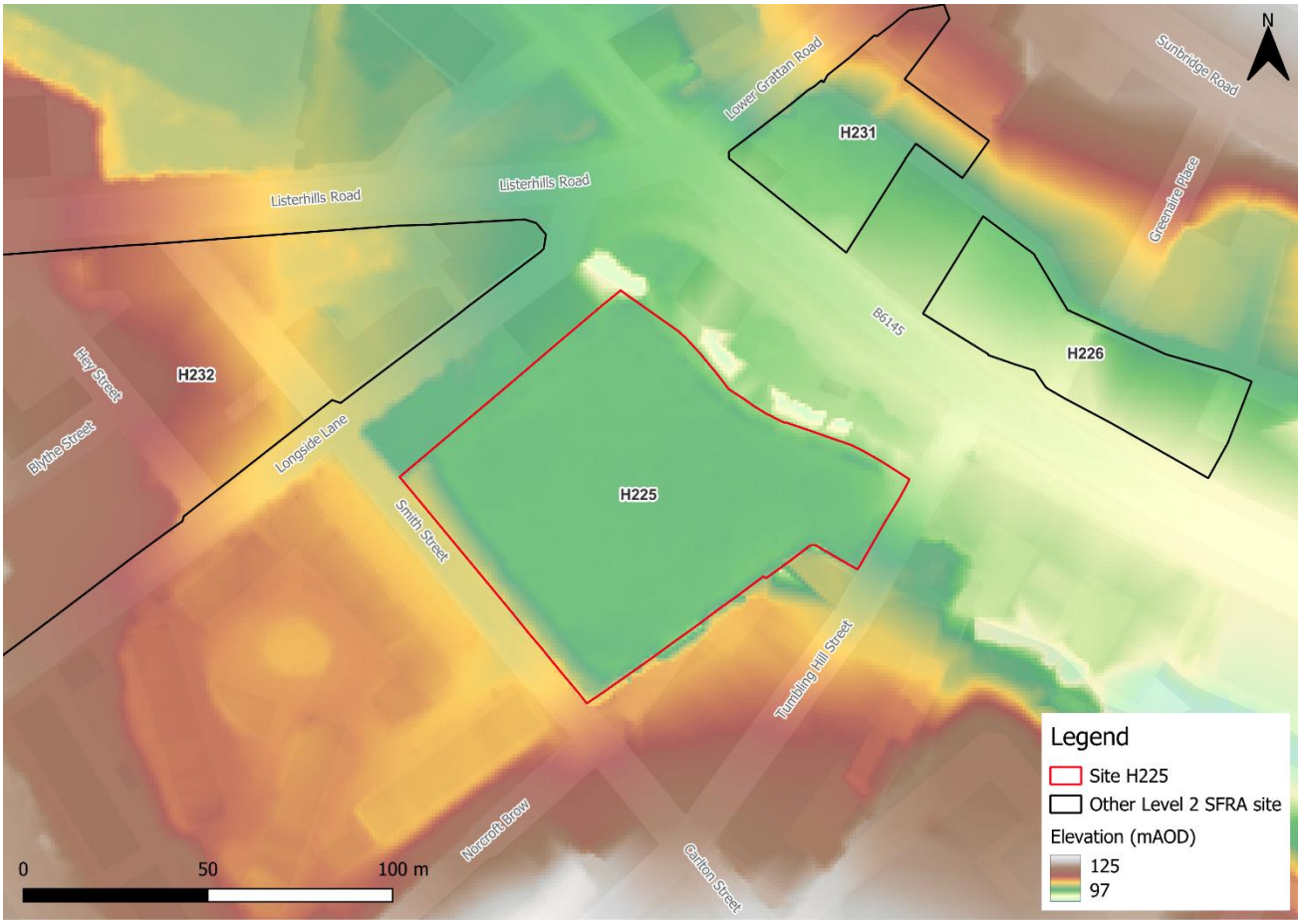


Figure 1-2: Topography

The underlying bedrock within the site is defined as 'Pennine Lower Coal Measures Formation', which comprises mudstone, siltstone, sandstone, coal, ironstone and ferricrete (Figure 1-3). This is overlain with superficial deposits of till. Mudstone, siltstone, coal, ironstone and ferricrete typically have low permeability, however this can be highly variable. Sandstone has a higher permeability.



Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning (January 2026) and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.3).

Fluvial flood risk to the site comes from Bradford Beck and the culverted West Brook, which flow adjacent to the northern and southern site boundaries respectively. Functional floodplain is present across the majority of the site. There should be no development within the area of functional floodplain onsite. However, this is partially based on an 8m buffered polygon of the West Brook culverted channel beneath the site. The mapped watercourse location may not represent the actual location of the culverted channel. Noting that, functional floodplain policy applies to the path of the culvert beneath the site and not the mapped functional floodplain, where these differ. The path of the culverted channel should be confirmed through a survey as part of the site-specific FRA.

A very small proportion of the site is within Flood Zone 2 and therefore at medium risk of fluvial flooding.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
27	1	0	72

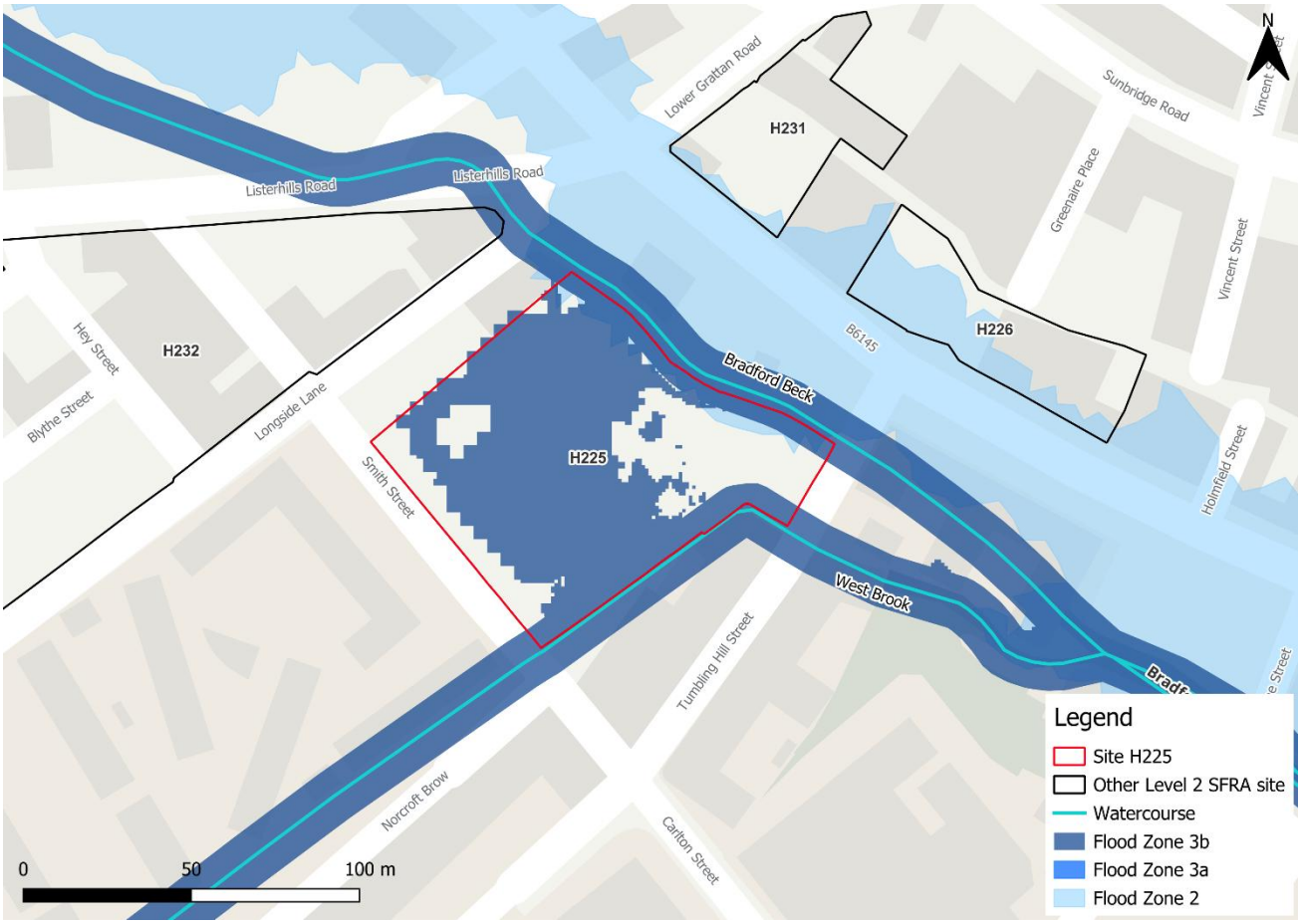


Figure 2-1: Existing risk from rivers to the site

2.1.2 Bradford Beck 2026 model outputs - present day

Figure 2-2 shows the modelled flood depths for the 1% AEP undefended event. Modelled risk to the site is greater than that shown by Flood Zone 3a, impacting the majority of the site. However, it is noted that the current Flood Zone 3a does not yet account for the latest Bradford Beck model outputs.

Flood depths across the majority of the site are very low, at less than 0.15 m (Figure 2-2). Maximum flood depths are shown to be between 0.9 and 1.2 m, located in the southeast of the site. Modelled flood velocities are also generally very low, with velocity rarely exceeding 0.25 m^3/s (Figure 2-3). There are some areas within the south of the site where flood velocities are shown to exceed 2 m^3/s. The very low modelled depth and velocity is reflected in the modelled flood hazard largely being 'very low hazard' across the site (Figure 2-4). There is a flow path within the south of the site categorised as 'danger for all'.

Safe access and escape routes would likely be achievable via Tumbling Hill Street during this event.



Figure 2-2: Flood depths for 1% AEP undefended flood event

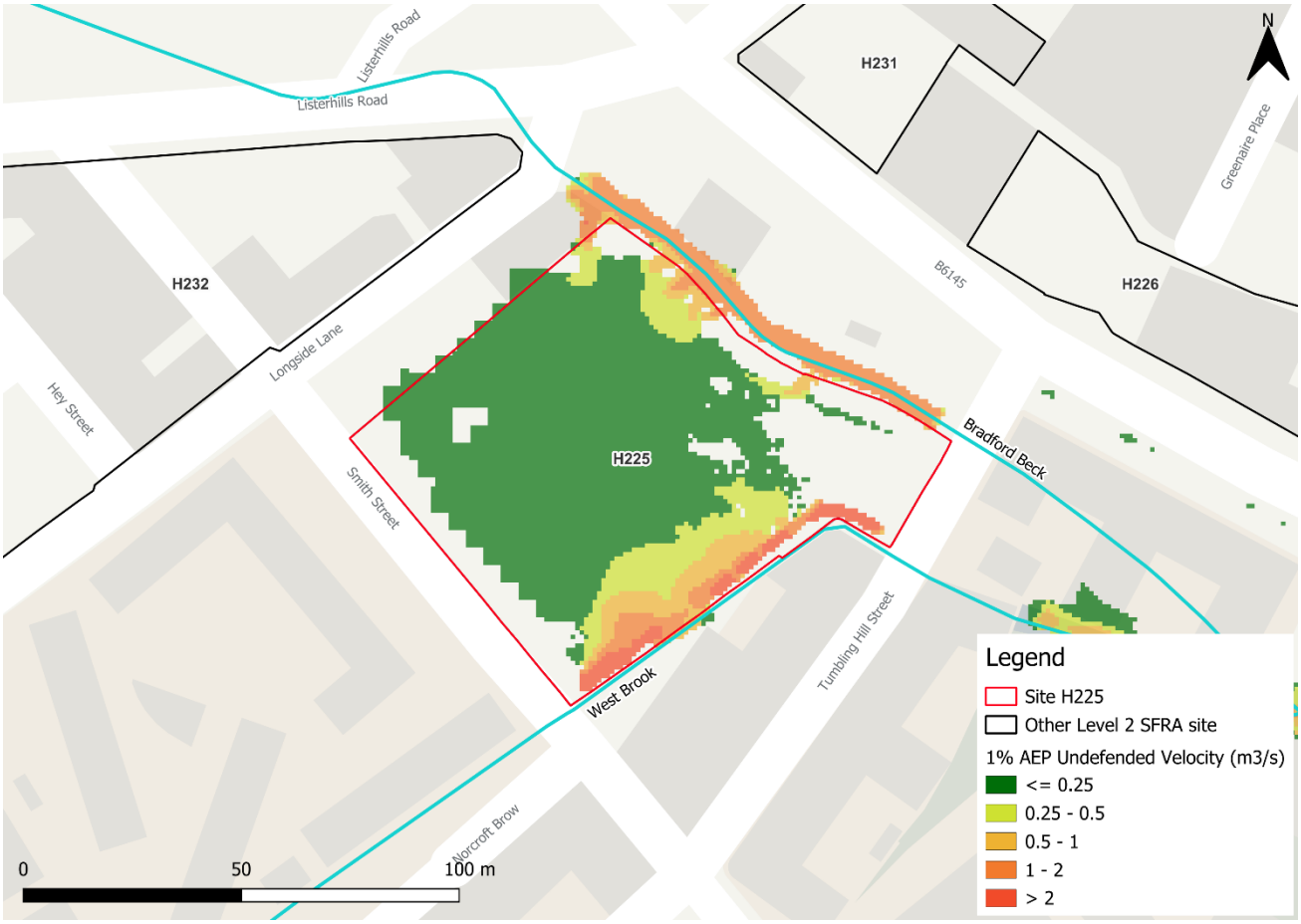


Figure 2-3: Flood velocities for 1% AEP undefended flood event

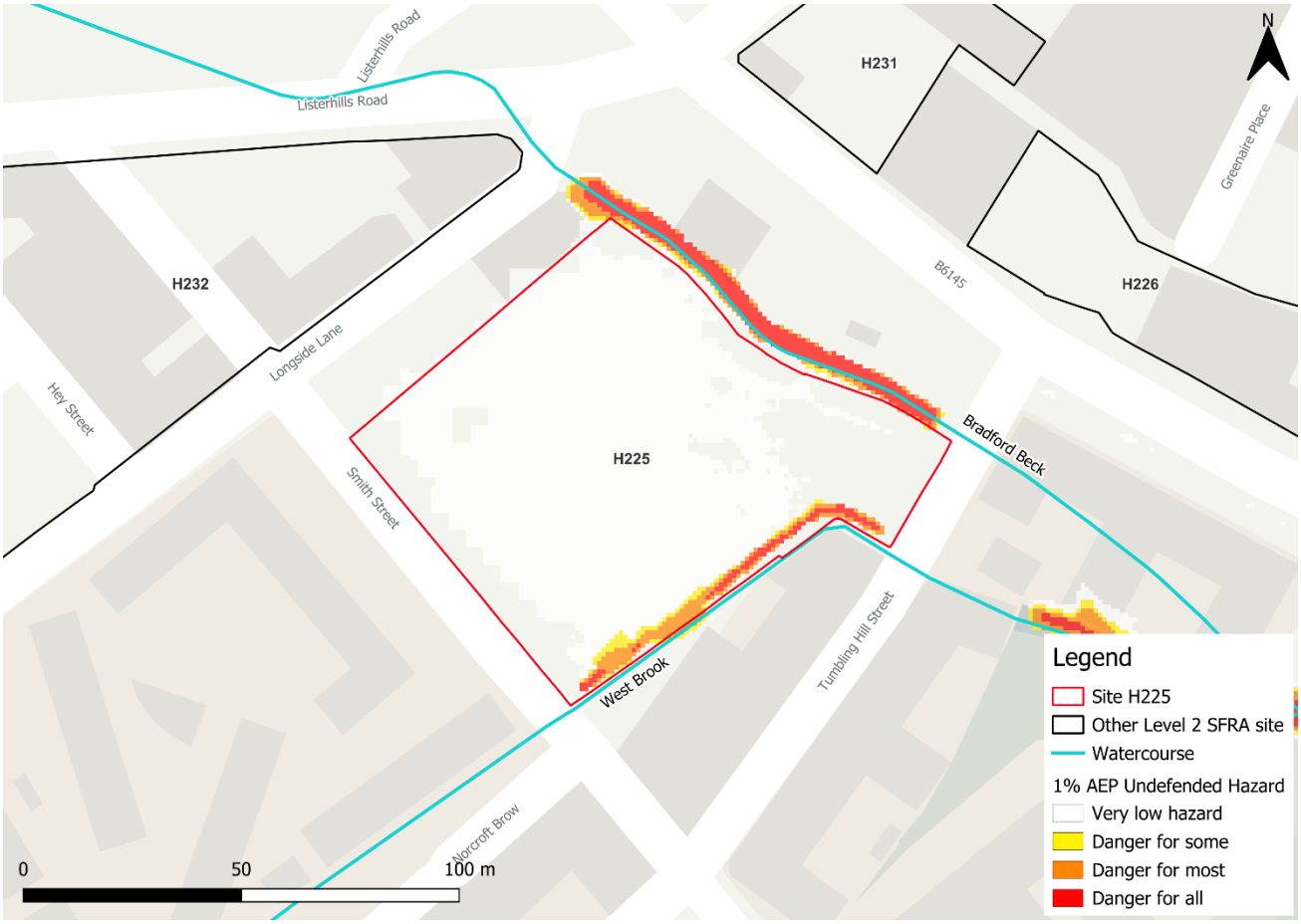


Figure 2-4: Flood hazard[1] for 1% AEP undefended flood event

2.2 Impacts from climate change

The EA's SFRA guidance states that SFRAs should assess the central allowance for less vulnerable, more vulnerable, highly vulnerable and water compatible development (Table 2-2). The impacts of climate change on flood risk from the Bradford Beck 2026 model have been modelled without flood defence infrastructure in place. As documented in Section 2.3.1, there are no formal engineered defences that would benefit the site.

1 Fluvial hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.

Table 2-2: Modelled climate change allowances for peak river flows for the Aire and Calder Management Catchment

Return period (AEP event)	Central allowance 2080s (% increase)	Higher central allowance 2080s (% increase)	Upper end allowance 2080s (% increase)
3.3% (functional floodplain)	23%	31%	51%
1%	23%	31%	51%

2.2.1 Bradford Beck 2026 model outputs - climate change

Figure 2-5 shows the onsite modelled flood depths for the 1% AEP undefended event plus central climate change allowance. Risk is modelled to be similar in extent to present day conditions. Maximum flood depths are shown to remain at between 0.9 and 1.2 m within the southeast of the site, however there is a larger area of the site with depths of up to 0.3 m. Flood velocities are modelled to increase across the site, with the majority of the site shown to have velocities of between 0.25 and 0.5 m^3/s (Figure 2-6).

Maximum flood velocities are shown to exceed 2 m^3/s within the south of the site. The modelled flood hazard within the area at risk is largely shown to remain categorised as 'very low hazard', with a slightly greater area categorised as 'danger for some', in comparison to present day conditions (Figure 2-7).



Figure 2-5: Flood depths for 1% AEP undefended flood event +23% (central climate change allowance)

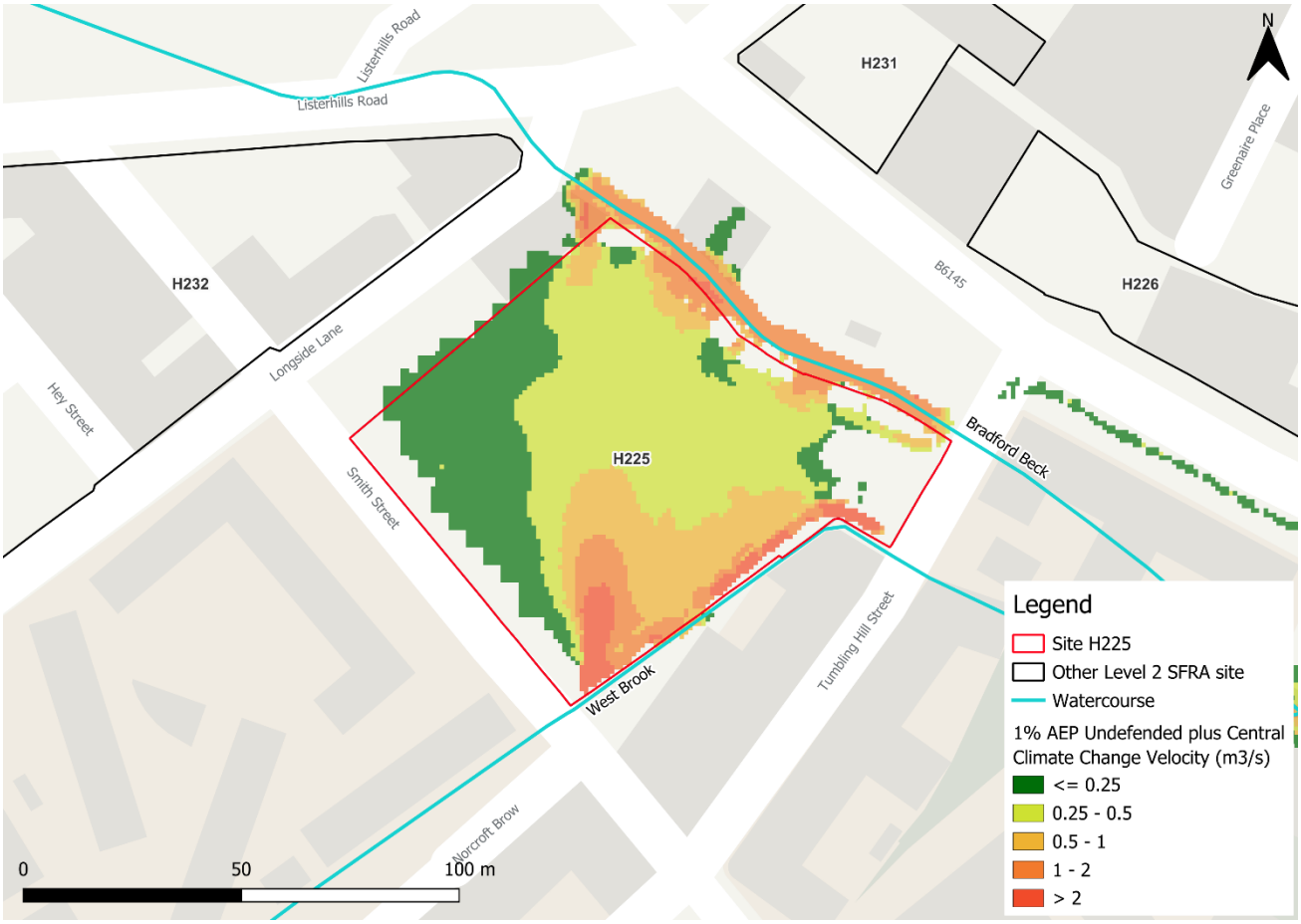


Figure 2-6: Flood velocities for 1% AEP undefended flood event +23% (central climate change allowance)

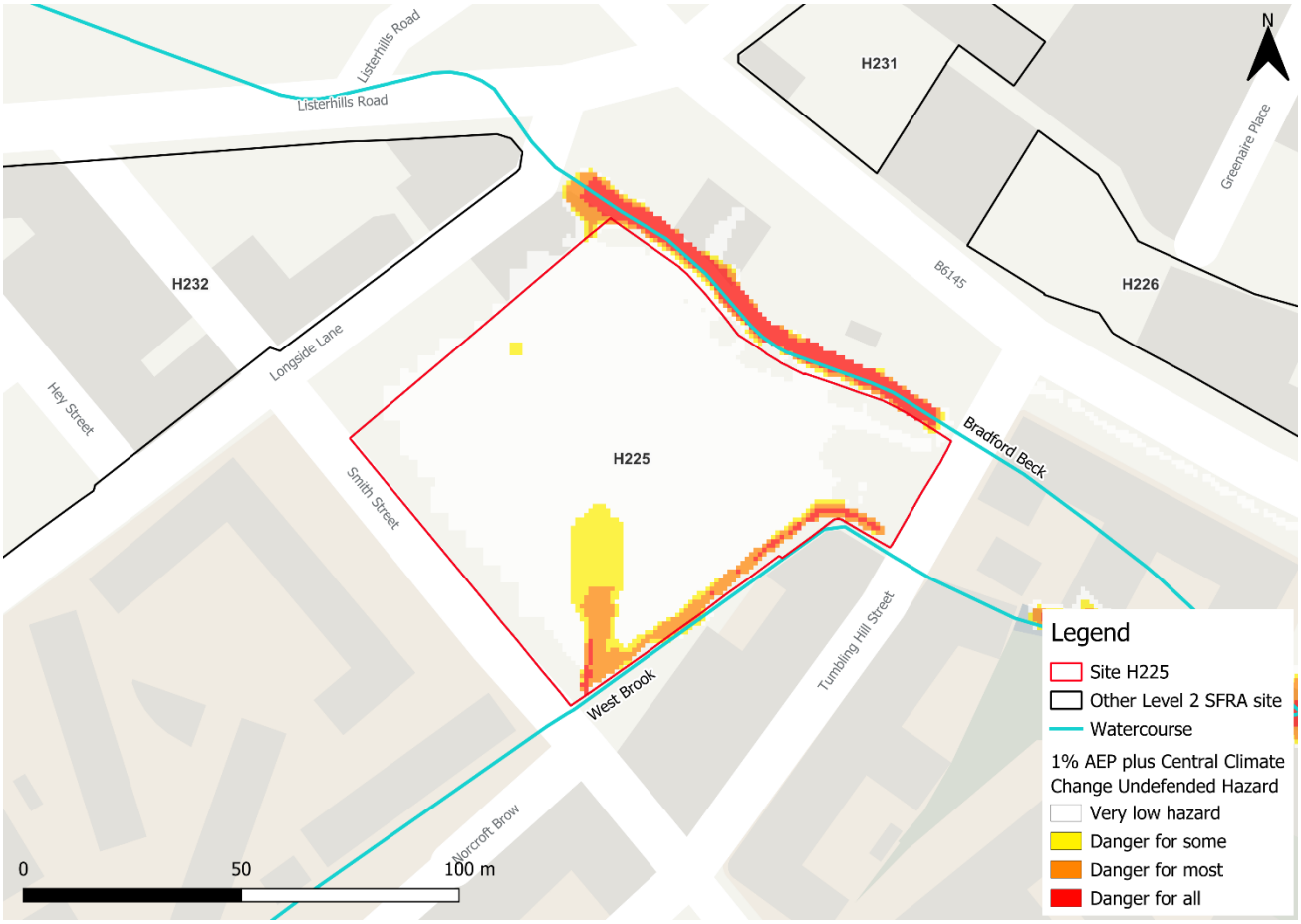


Figure 2-7: Flood hazard for 1% AEP undefended flood event +23% (central climate change allowance)

2.2.2 Flood Map for Planning - climate change

Climate change data in this area is unavailable from the EA's Flood Map for Planning plus Climate Change (2070-2125) dataset, as shown in Figure 2-8.

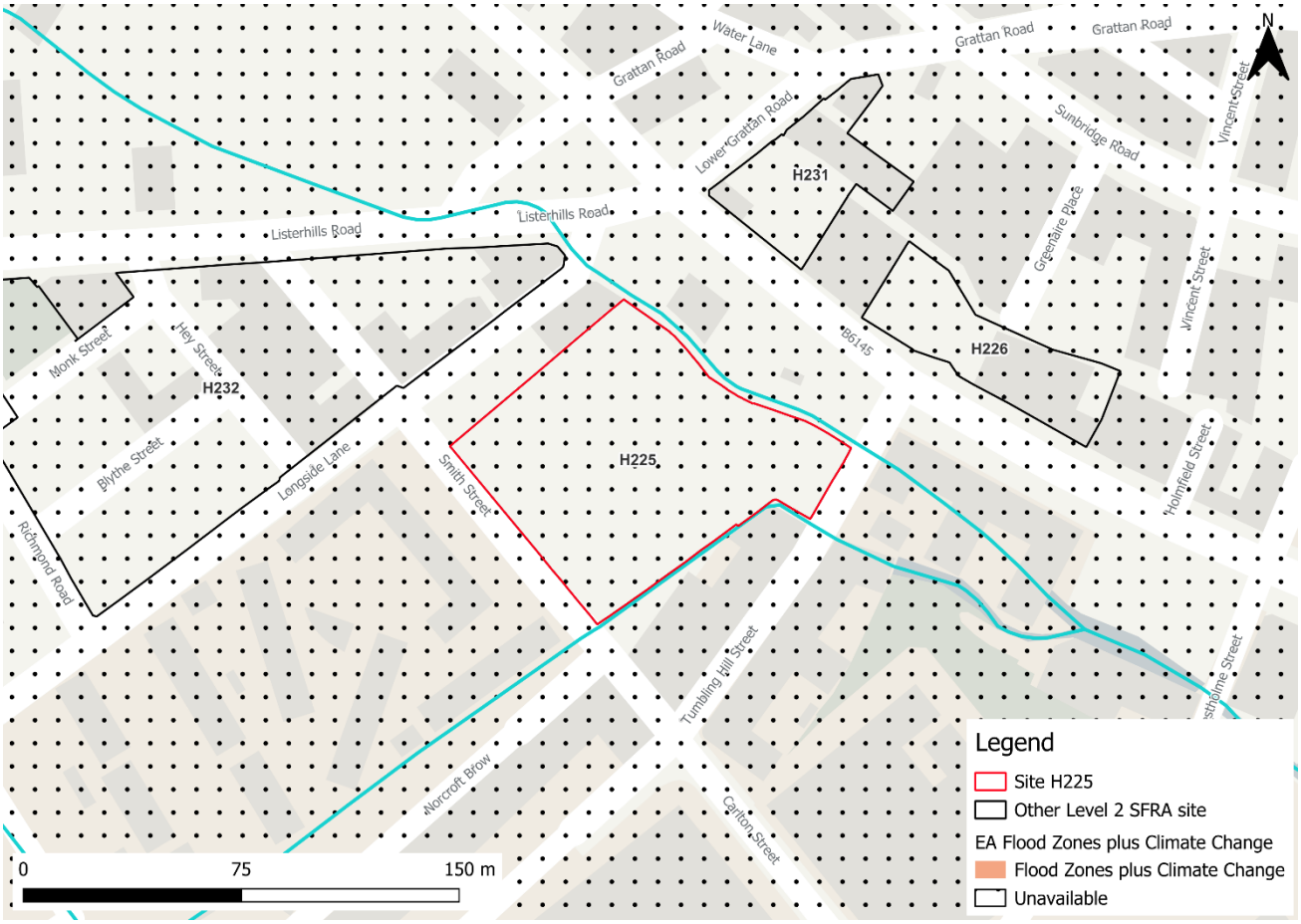


Figure 2-8: EA Flood Zones plus Climate Change

2.3 Flood risk management

2.3.1 Flood defences

The site does not benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset.

2.3.2 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) that may help to reduce flood risk to the site and surrounding areas. There are no opportunity areas within the site, however, upstream of the site there is potential for wider catchment woodland planting (Figure 2-9). This area indicates where scrub and tree planting may be most effective to increase infiltration and hydrological losses. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

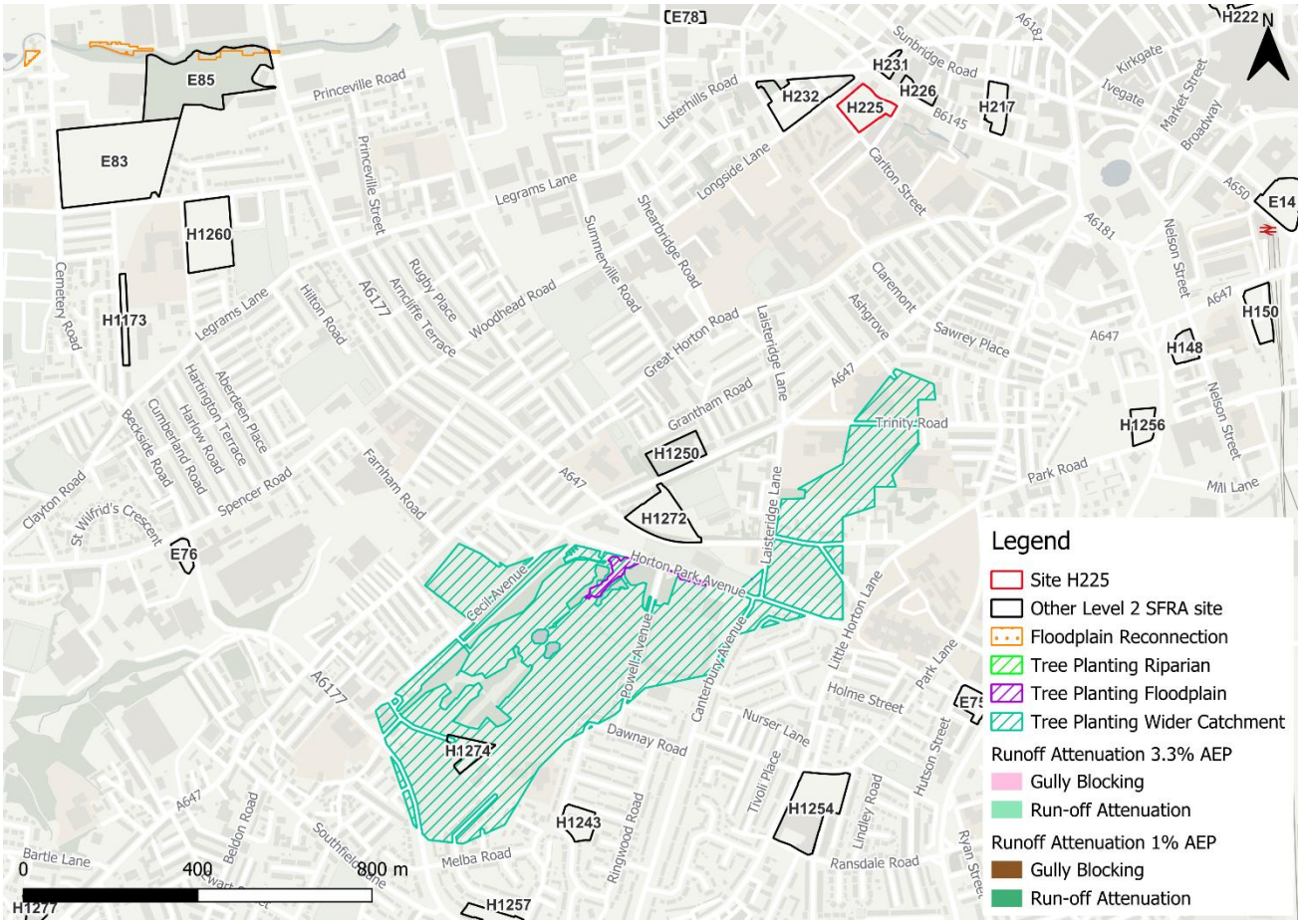


Figure 2-9: Natural Flood Management (NFM) potential mapping

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO) datasets have been considered. There are no recorded historic flood events within the vicinity of the site.

2.5 LLFA flood incidents

The LLFA have records of one flood incident occurring to the south of the site, which occurred in 2001. Developers should contact the LLFA for further information at the FRA stage, to assess potential flood risk to the site associated with this incident.

2.6 Emergency planning

2.6.1 Flood warnings

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The eastern corner of the site is located within a FWA, namely 123FWF785 - Bradford Beck and tributaries at Bradford.

Flood alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be issued when there is less confidence that flooding will occur in a FWA. The northeastern

boundary of the site is located within a FAA, namely 123WAF961 - Middle River Aire catchment.

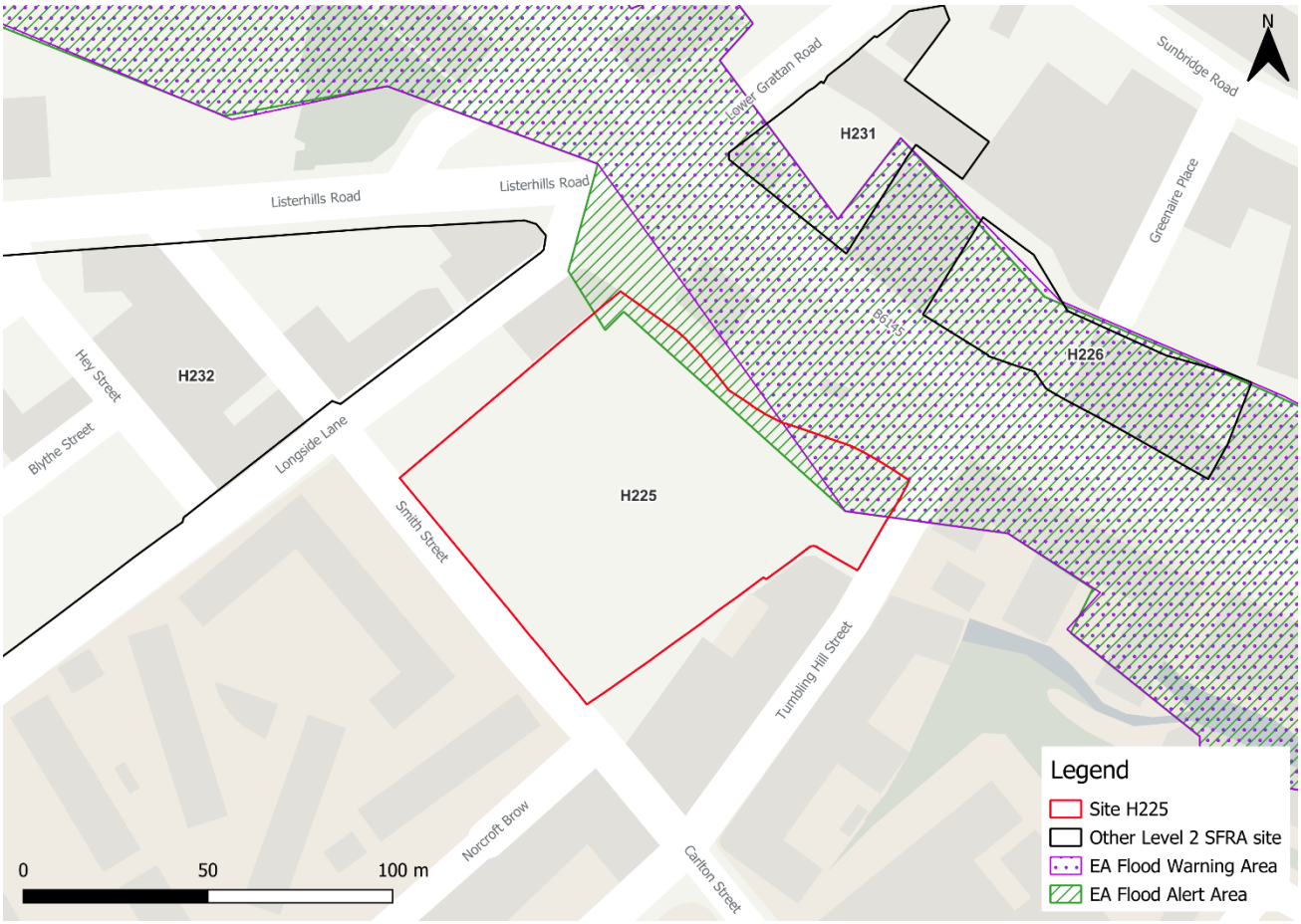


Figure 2-10: EA Flood Warning Areas and Flood Alert Areas

2.6.2 Access and escape routes

Based on available information, safe access and escape routes would likely be challenging to achieve given the significant risk across the site during this event.

2.7 Observations, mitigation options, site suitability and sequential approach to development management - fluvial

- Observations:
  - The proposed development of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF.
  - Given the change in use and therefore vulnerability of the site, the LPA must consider whether the change of use is acceptable and whether the development can be designed to be safe, including for adequate emergency planning provision, accounting for the information provided in this Level 2 SFRA (para 014 FRCC-PPG).
  - The site is modelled to be within the functional floodplain across the majority of the site, based on the Bradford Beck 2026 model and an 8m buffered

polygon of the West Brook channel, which is assumed to be culverted beneath the site.
    - Consideration should be given as to whether deculverting and daylighting this section of culvert is feasible, supported by detailed modelling. The watercourse should be considered within site design and form a blue green corridor through the site.
    - If West Brook remains culverted beneath the site, there should be no development above the culvert. The location and course of the culvert should be confirmed through a survey.
    - If works are proposed on or near West Brook, a separate permission may be required. The type of permission needed from the Lead Local Flood Authority will depend on the activity and location proposed.
    - Based on available information, ideally this site would be converted to open space offering multifunctional benefits alongside flood risk mitigation including Biodiversity Net Gain (BNG) contributions, and social and amenity benefits.
- Mitigation:
    - EA flood warnings and alerts should continue to be in place to ensure early evacuation of site users before an extreme flood event occurs.
- Access and escape:
    - Based on available information, safe access and escape routes would likely be challenging to achieve given the significant risk across the site during this event.

3 Flood risk from surface water

3.1 Existing risk

At the time of writing, the EA's latest national Risk of Flooding from Surface Water (RoFSW) does not include depth and hazard information suitable for planning purposes. Therefore, this Level 2 SFRA considers the third generation RoFSW depth and hazard mapping in addition to the NaFRA2 extents, as agreed with the EA. Surface water depth and hazard should be confirmed at the site-specific FRA stage.

3.1.1 Risk of Flooding from Surface Water - NaFRA2 extents

Based on the EA's national scale RoFSW map (January 2026), surface water risk is shown to vary across the site, as shown in Table 3-1 and Figure 3-1.

In the high risk event, surface water risk is confined to a large area of ponding within the west of the site, and a smaller area of ponding to the east. This is similar to the medium risk event, with an additional area of ponding within the south. Safe access and escape routes via Tumbling Hill Street would likely be achievable in the high and medium risk event. This may be challenging to achieve in the low risk event, depending on the modelled depths and hazards along this route.

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
51	19	11	19

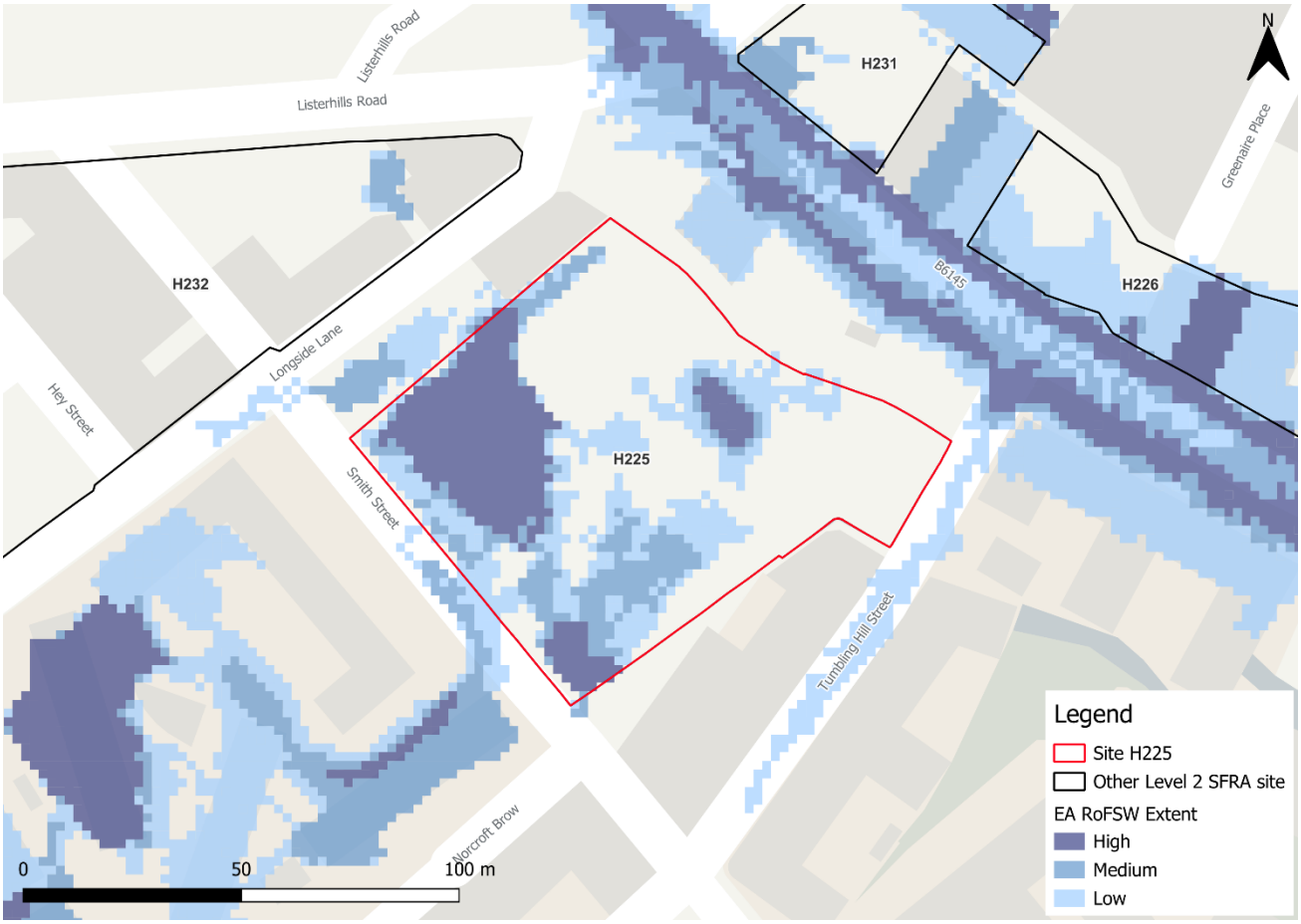


Figure 3-1: Surface water flood extents (NaFRA2 - Risk of Flooding from Surface Water map)

3.1.2 Risk of Flooding from Surface Water - third generation depths and hazards

Based on the EA's national scale third generation RoFSW map, the greatest flood depths within the site in the medium risk event are > 1.2 m within the area of ponding in the east of the site (Figure 3-2), with hazard categorised as 'significant' (Figure 3-3).

There are some differences between the NaFRA2 RoFSW map and the third-generation depth and hazard mapping. The NaFRA2 RoFSW map does not map flooding less than 0.075m (7.5cm) in depth. Therefore, where the map may show no flooding, there may be shallow flooding up to a depth of 0.075m. In contrast, the third generation RoFSW does not map flooding with a hazard rating of less than 0.575. This could explain the differences observed between the NaFRA2 and third generation RoFSW. Assessment of surface water should be carried out at the site-specific FRA stage to robustly establish current and future surface water flood risk conditions.

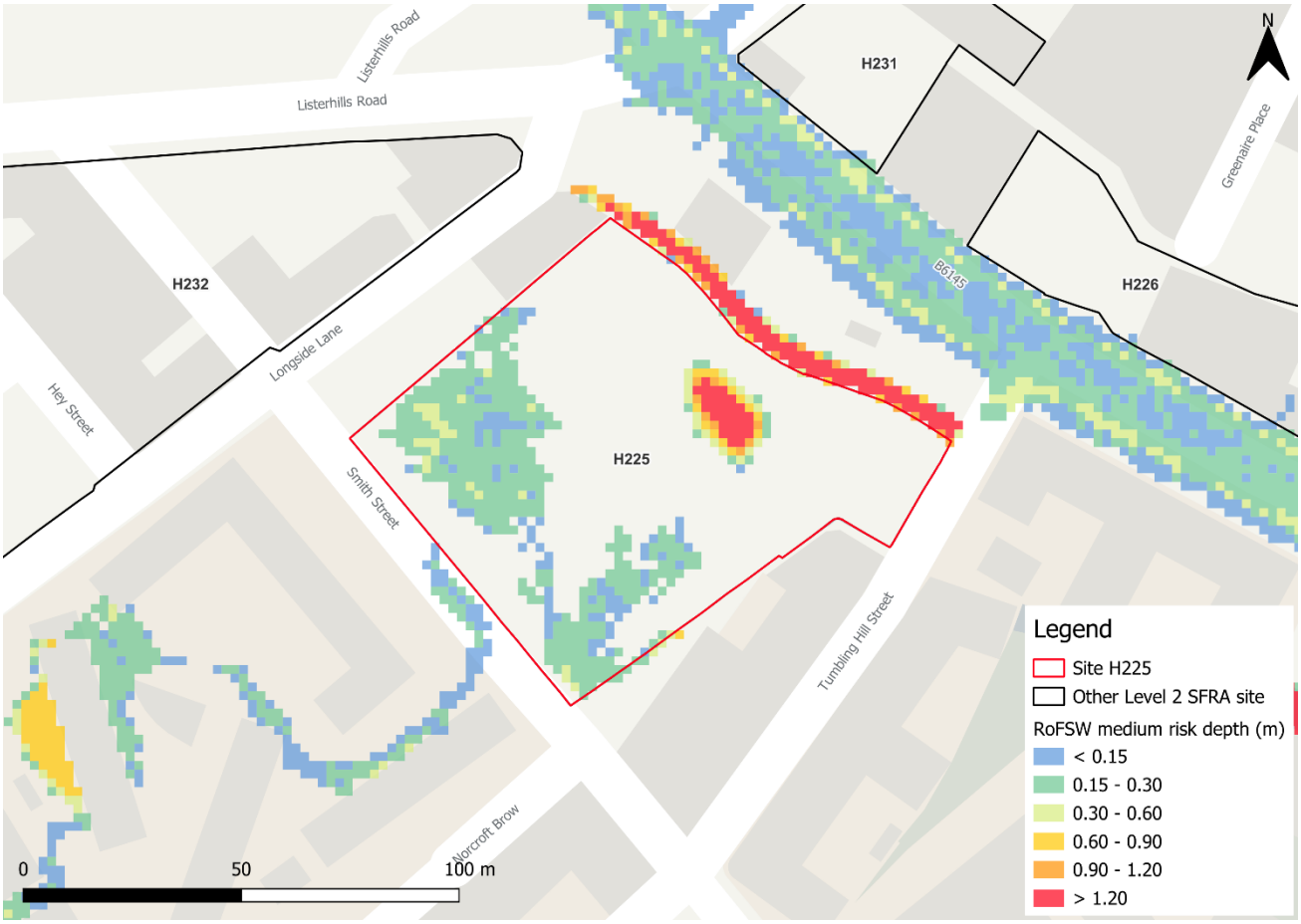


Figure 3-2: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

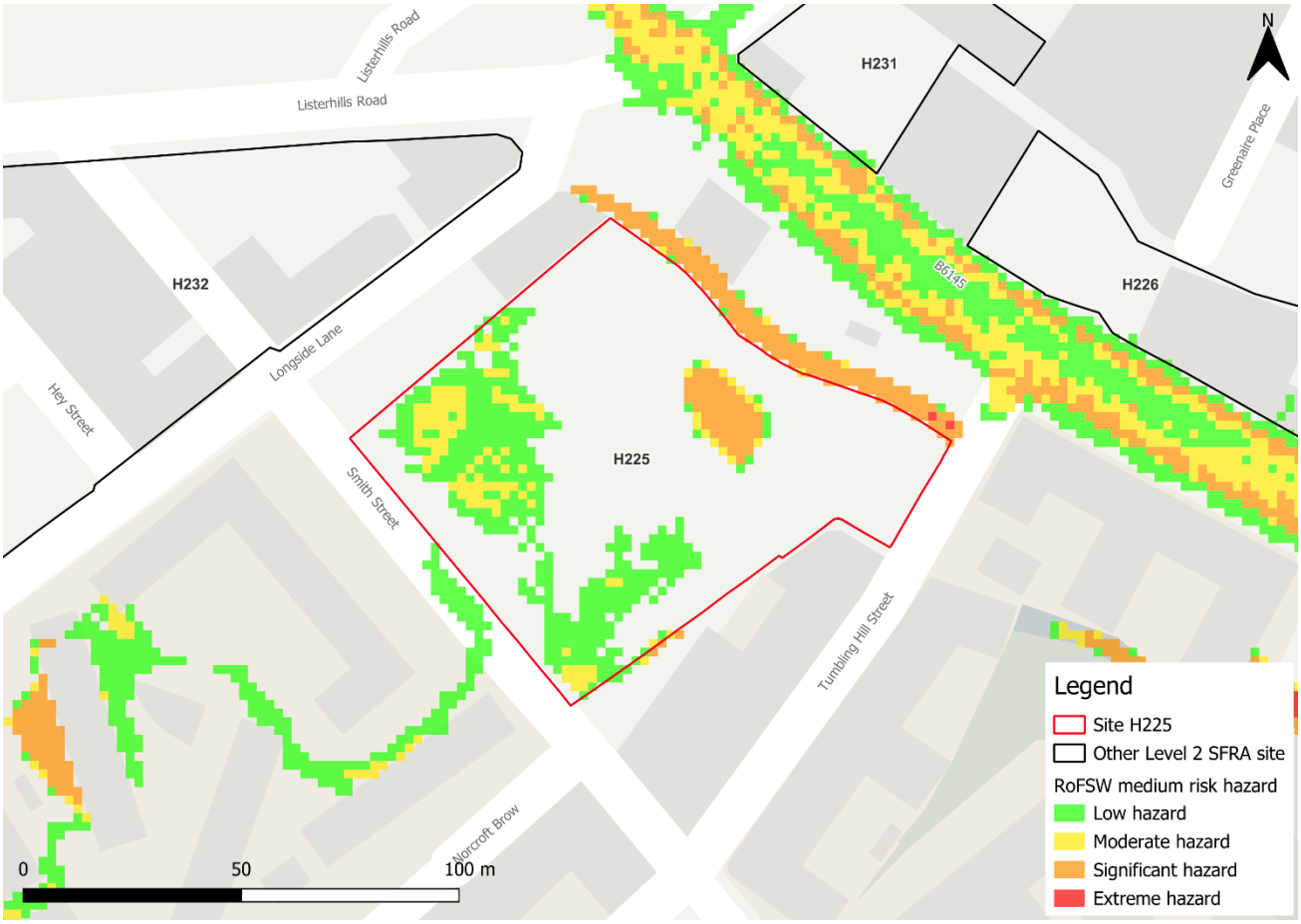


Figure 3-3: Medium risk event surface water flood hazard[2] (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

At the time of writing, the available national surface water climate change mapping is unsuitable for consideration in development planning. This Level 2 SFRA considers the low risk surface water event as a conservative proxy for the medium risk event plus climate change, as agreed with the EA. The impact of climate change on surface water flood risk should be considered at the site-specific FRA stage.

Using the low risk event as a proxy, the medium risk surface water event is likely to increase slightly in extent within the site when accounting for climate change (Figure 3-4). The third generation map indicates maximum flood depths are likely to remain at > 1.2 m within the east of the site (Figure 3-5), with areas of hazard categorised as 'extreme' (Figure 3-6).

Along Tumbling Hill Street, modelled flood depths are show to be < 0.15 m, with hazard largely categorised as 'low'. This indicates safe access and escape routes would likely be achievable via this route. However, this should be confirmed through the site-specific FRA.

2 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

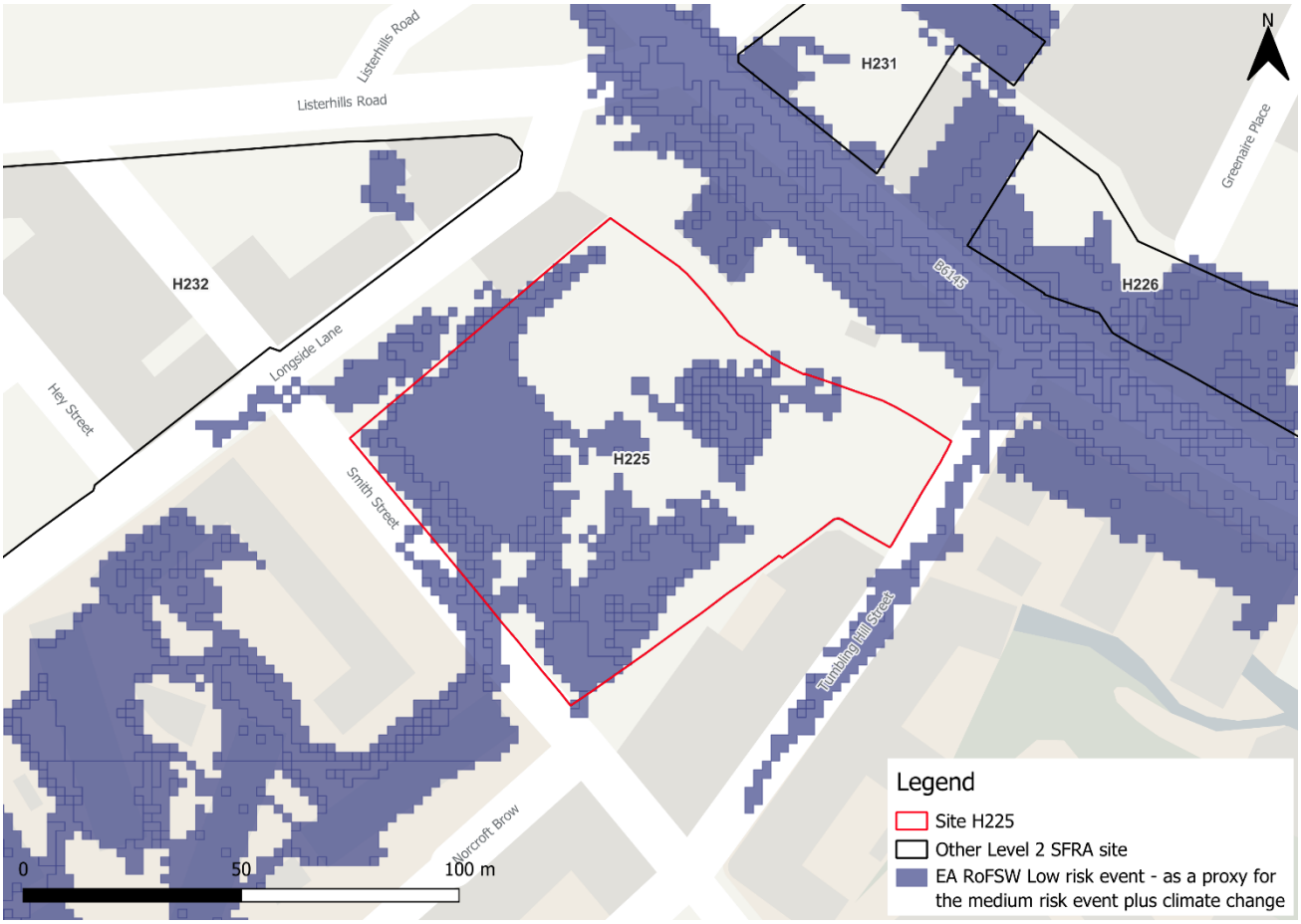


Figure 3-4: Low risk event surface water flood extent, as a proxy for the medium risk event plus climate change (NaFRA2 - Risk of Flooding from Surface Water map)

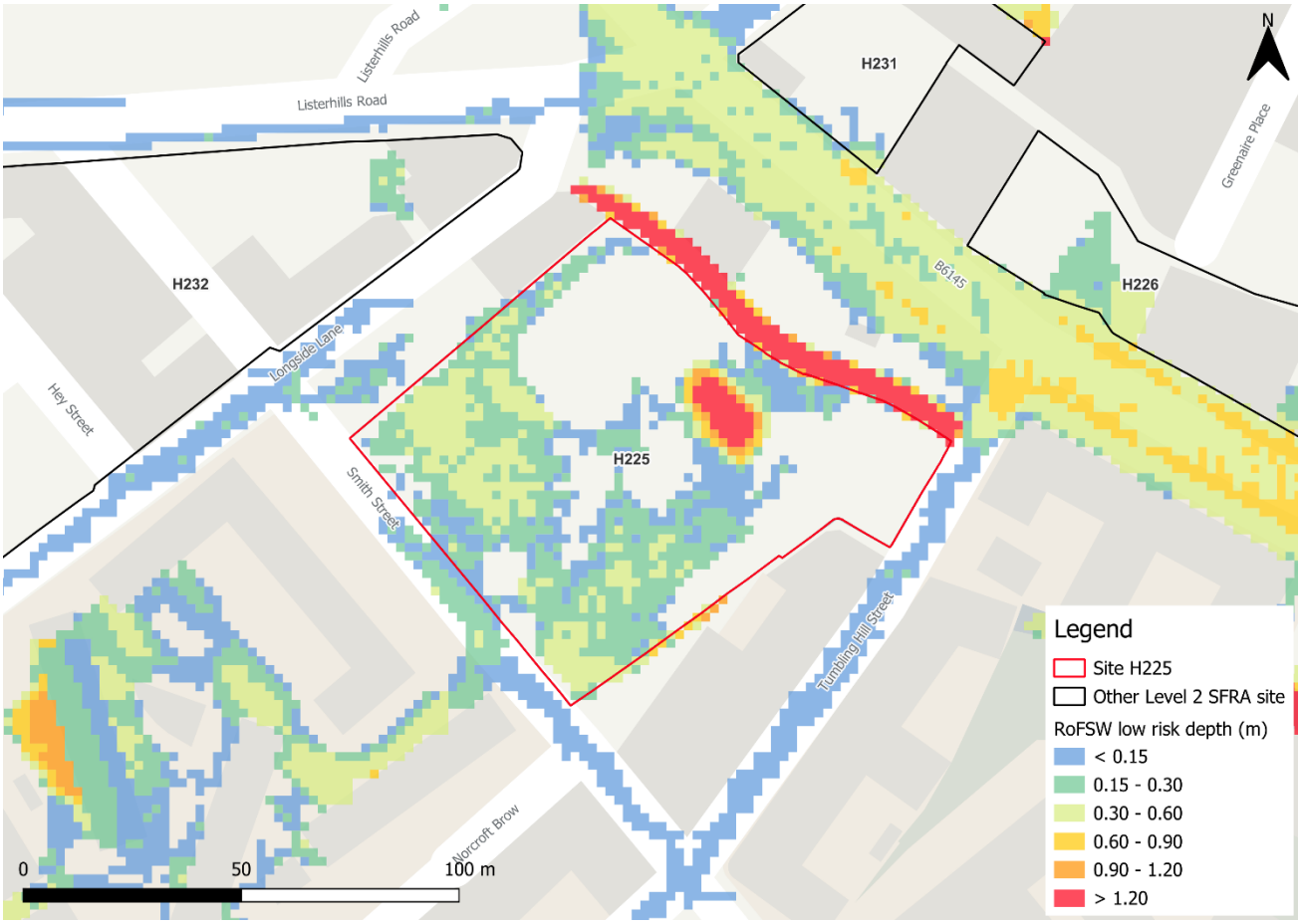


Figure 3-5: Low risk event surface water flood depths, as a proxy for the medium risk event plus climate change (Third generation - Risk of Flooding from Surface Water map)

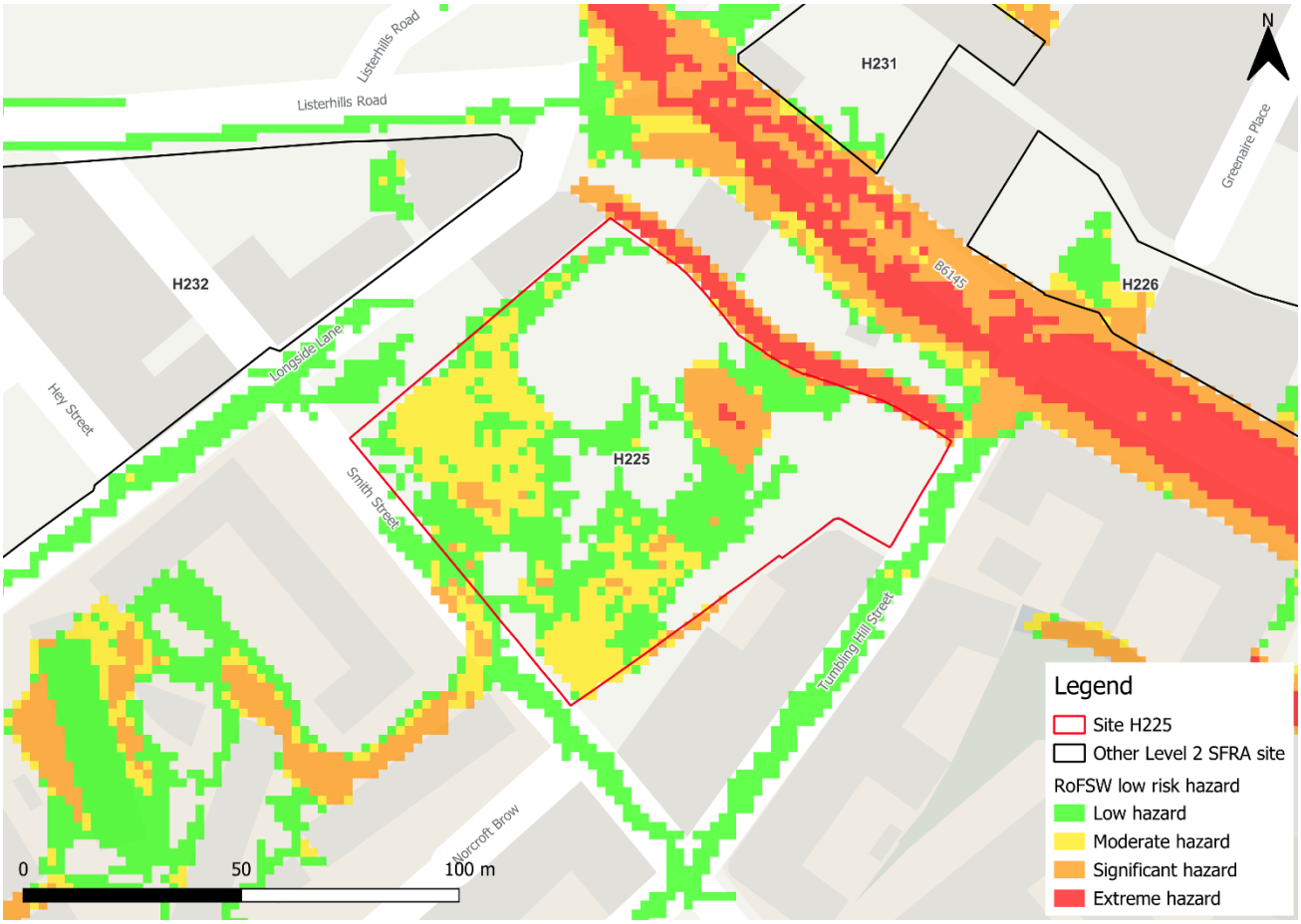


Figure 3-6: Low risk event surface water flood hazard, as a proxy for the medium risk event plus climate change (Third generation - Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk to the site is varied. In the high risk event, surface water risk is confined to a large area of ponding within the west of the site, and a smaller area of ponding to the east. This is similar to the medium risk event, with an additional area of ponding within the south.
- Topographic depressions should be considered and included in site design and ideally left in place to flood naturally when required. Any regrading of land must include like for like volumes to ensure risk is contained safely onsite for the lifetime of development.
- Safe access and escape routes should be possible via Tumbling Hill Street, given the low surface water depths and hazards. However, this is based on the third generation mapping and therefore safe access and escape routes should be confirmed based on site-specific surface water modelling through the FRA.
- Given the combined potentially significant risk from both fluvial and surface water sources, it is recommended that this site is not developed and is converted to open green space and allowed to flood.
- The drainage strategy must ensure there is no increase in surface water flood risk elsewhere as a result of new development. Existing brownfield rates will likely

apply, though the developer should consult local LLFA guidance and the National SuDS guidance.

- Assessment of the current drainage system in place should be carried out to ascertain any current capacity issues and whether the current system could accommodate the proposed residential development or whether further capacity will be required.
- The RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[3]. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

The north of the site is located within an area where there is no risk of groundwater emergence. Groundwater conditions may therefore be suited to infiltration SuDS in this area.

In the southern half of the site there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots. Groundwater conditions are therefore unlikely to be suited to infiltration SuDS in this area. This is reflected in the geology of the site being comprised of largely impermeable bedrock (Figure 1-3). A drainage strategy would have to include for ground and infiltration surveys and further investigation into groundwater levels.

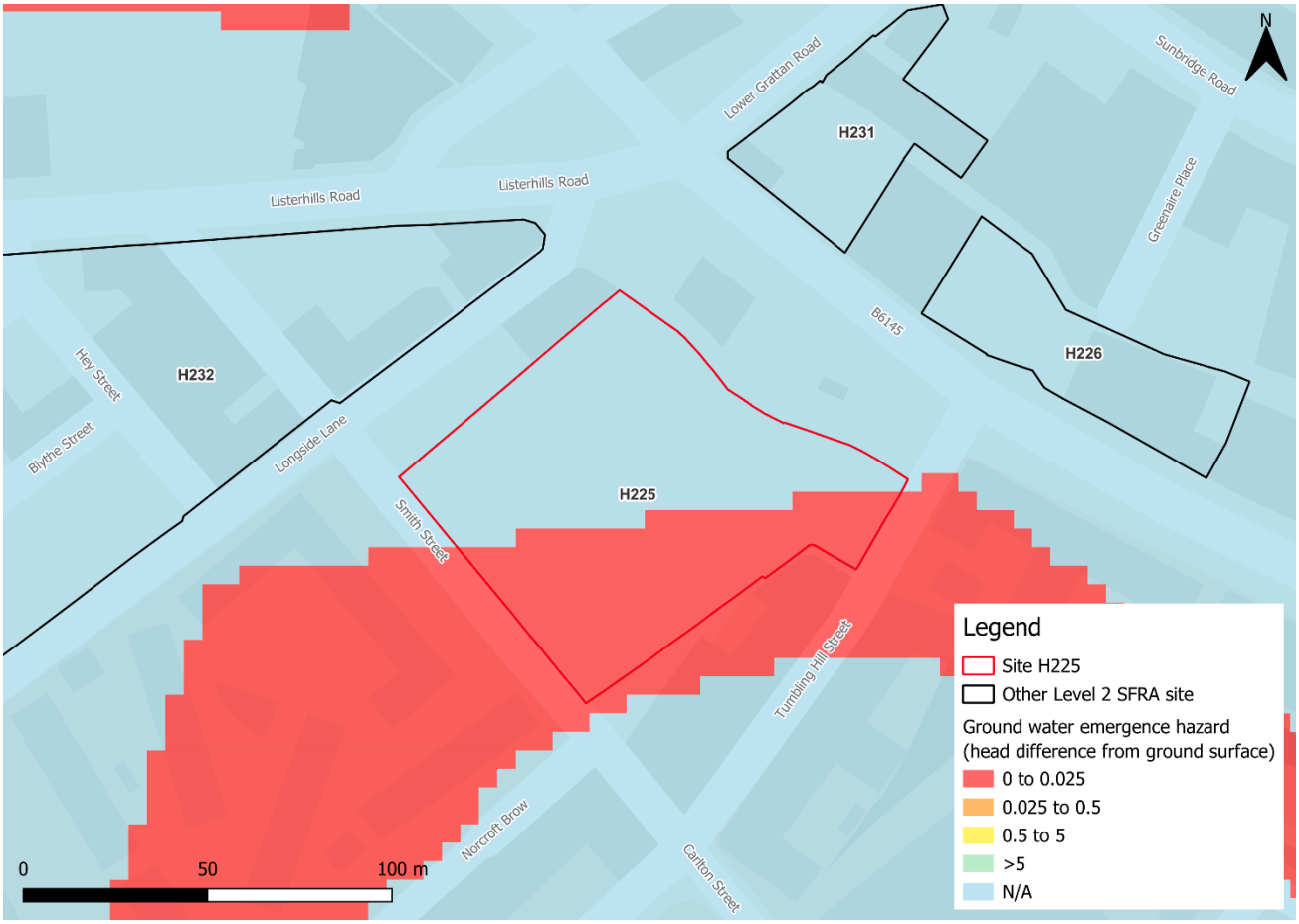


Figure 4-1: JBA 5m Groundwater Emergence Map

3 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

Although a site may be afforded some protection from defences and / or drainage infrastructure, there is always a residual risk of flooding from asset failure i.e. defence breaches, or blockages of culverts or drainage assets. Residual risk at this site comes from the potential blockage of the structure beneath Tumbling Hill Street to the east of the site or a structural failure of the West Brook culvert beneath the site.

5.1 Potential blockage / structural failure

A blockage or failure of the culvert beneath Tumbling Hill Street may cause water in the channel to back up and cause flooding to the site, depending on the severity of the blockage and the magnitude of the flood event. There is also potential residual risk to the site from structural failure of the West Brook culvert beneath the site. Culvert course and condition surveys may be required, including for consultation with the culvert owner.

The Bradford Beck 2026 model includes for a scenario in which all culverts within the model are blocked by 50%. Figure 5-1 shows the modelled flood depths for this scenario. There is a very minor increase in the extent of flooding in the east of the site caused by a 50% blockage to the culvert beneath Tumbling Hill Street. Flood depths remain at largely less than 0.15 m.



Figure 5-1: Flood depths for 1% AEP undefended flood event 50% culvert blockage scenario - structure beneath Tumbling Hill Street

5.2 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. Figure 5-2 shows the RFM in a 'dry day' and 'wet day' scenario. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is potentially at risk from four reservoirs located in Bradford. Of these four reservoirs, two are operated by Yorkshire Water Services Ltd and two are operated by the City of Bradford Metropolitan District Council.

The EA's SFRA guidance states that where a proposed development site is at flood risk from a reservoir, then an assessment into whether the reservoir design or maintenance schedule needs improving should be carried out. Expert advice may be required from an all-reservoirs panel engineer. The Council should consult the relevant reservoir undertaker to ascertain whether the proposed development could affect the reservoir's risk designation, its design category or how it is operated. The Council, as category 1 responders, can

access more detailed information about reservoir risk and reservoir owners using the Resilience Direct system.

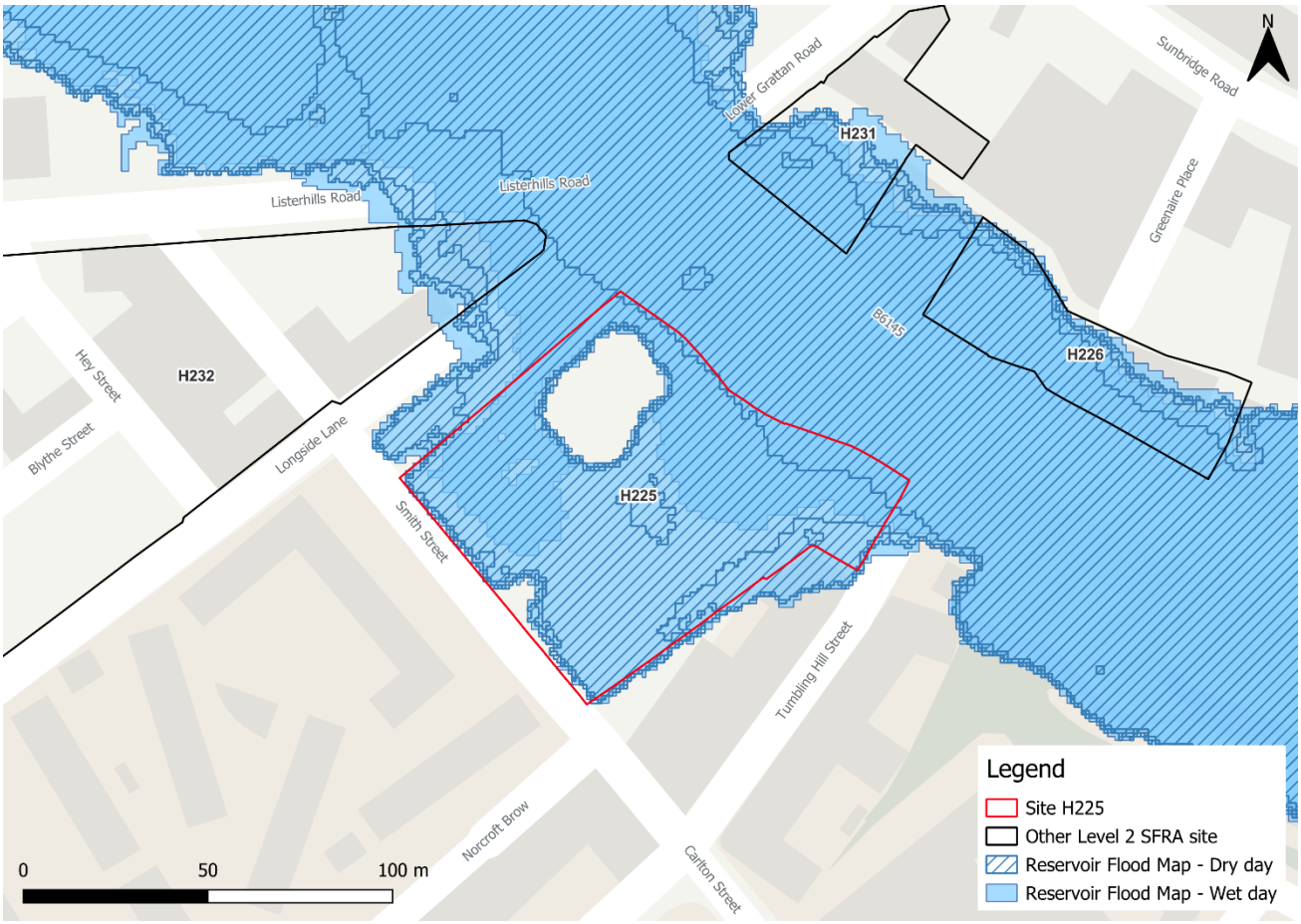


Figure 5-2: Flood risk from reservoirs

5.3 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a blockage of the culvert beneath Tumbling Hill Street to the east of the site. The modelled 50% culvert blockage scenario indicates that there is unlikely to be significant additional impacts to the site. The site-specific FRA could consider modelling a higher blockage proportion to understand whether there would be any additional risk to the site.
- The site is also at potential residual risk from a potential structural failure of the West Brook culvert, assumed to be located beneath the site.
- Areas adjacent to culverts and bridges are at particular risk from the rapid onset of fast flowing and deep flooding, with little or no warning if structures become blocked. Emergency plans must be in place for such areas and safe access and escape routes must be in place for the lifetime of development. Resistance and resilience measures may also need to be put in place to manage residual flood risk when avoidance measures have been exhausted.
- The LPA should use the information on residual risk in this Level 2 SFRA to state in the local plan strategic policies a preferred mitigation strategy for ensuring

development will be safe throughout its lifetime in relation to urban form, risk management and where flood mitigation measures are likely to have wider sustainable design implications (para 042, FRCC-PPG).

- The site is also at potential residual risk from a breach of four reservoirs. All four reservoirs impact the site in the 'dry day' flood extent. However, only Upper Chellow and Lower Chellow, are modelled to impact the site based on the 'wet day' flood extent, which represents a prediction of the credible worst case scenario, therefore it is unlikely that such an extreme flood event would occur.
- Given the potential reservoir risk to the site, developers should consider[4]:
  - Consulting with the local resilience forum for advice on emergency planning,
  - Consulting with relevant reservoir owners to understand the impact development may have on their reservoirs, and
  - Using this Level 2 SFRA to understand whether any proposed development will be safe throughout its lifetime.

4 Reservoir flood maps: when and how to use them | Environment Agency | 2021

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is required to pass part b) of the exception test[5], given it is proposed for more vulnerable uses and is located within the Bradford Beck 1% AEP undefended modelled flood extent. It must be proven that the development can be safe for its lifetime, which is generally considered to be 100 years for residential development. Based on the information presented in this Level 2 SFRA, the exception test cannot be passed, and the site should not be allocated.

6.2 Recommendations summary

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

- This site is located within a major regeneration area of Bradford City Centre which may be subject to investment to deliver new transport infrastructure, housing and employment and is likely to involve a significant re-engineering of parts of the city over the lifetime of the Local Plan.
- A comprehensive approach to managing flood risk within the Bradford Beck corridor will need to be carried out, which may include watercourse and flood engineering, alleviation works including green and blue infrastructure investment as part of a package of measures to reduce flood risk across the city. This context should be used to inform further work on flood risk assessment(s).
- The majority of the site is located within the functional floodplain. Development is not permitted within the functional floodplain.
- It is recommended that this site is converted to open space offering multifunctional benefits alongside flood risk mitigation including Biodiversity Net Gain (BNG) contributions, and social and amenity benefits, given the significant fluvial risk to the site.
- The Flood Map for Planning requires updating with the latest modelling for Bradford Beck.
- Groundwater conditions within the south of the site should be investigated further through the site-specific FRA to ascertain groundwater levels and conditions.

6.3 FRA requirements and further work

At the planning application stage, the following should be considered:

- Further modelling to understand the impacts of climate change on surface water flood risk to the site.
- A condition assessment of the culverts: Tumbling Hill Street culvert and the West Brook culvert beneath the site.

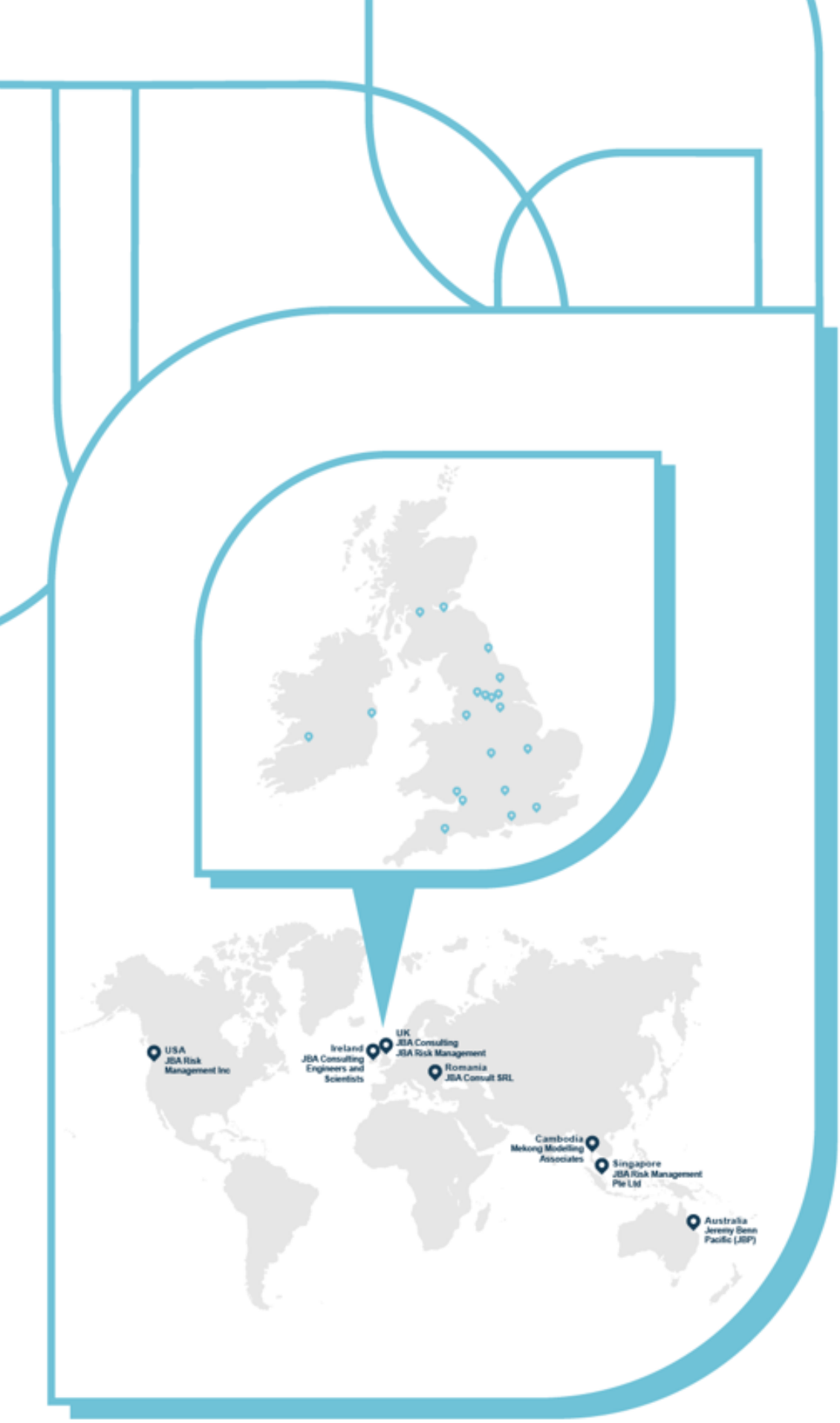
5 Para 178 National Planning Policy Framework 2024

- Consultation with the relevant reservoir owners to understand the impact of development on reservoir risk designation.
- FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

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Registered Office
1 Broughton Park
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Broughton
SKIPTON
North Yorkshire
BD23 3FD
United Kingdom

+44(0)1756 799919
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