

Bradford Level 2 Strategic Flood Risk Assessment - Site H9

Final Draft

May 2025

Prepared for:



City of
BRADFORD
METROPOLITAN DISTRICT COUNCIL

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Contract

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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. Freya Nation of JBA Consulting carried out this work.

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The methodology adopted and the sources of information used by JBA in providing its services are outlined in this Report. The work described in this Report was undertaken between 18 November 2024 and 16 May 2025 and is based on the conditions encountered and the information available during the said period. The scope of this Report and the services are accordingly factually limited by these circumstances.

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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 H9. 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 H9

- Location: Chapel Street, Addingham
- Existing site use: Green open space, scrub woodland, some hardstanding
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Residential
- Proposed site use vulnerability: More vulnerable
- Site area: 0.47 hectares
- Proposed development impermeable area: 0.42 hectares
- Watercourse: Back Beck
- Environment Agency (EA) river model: N/A
- 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

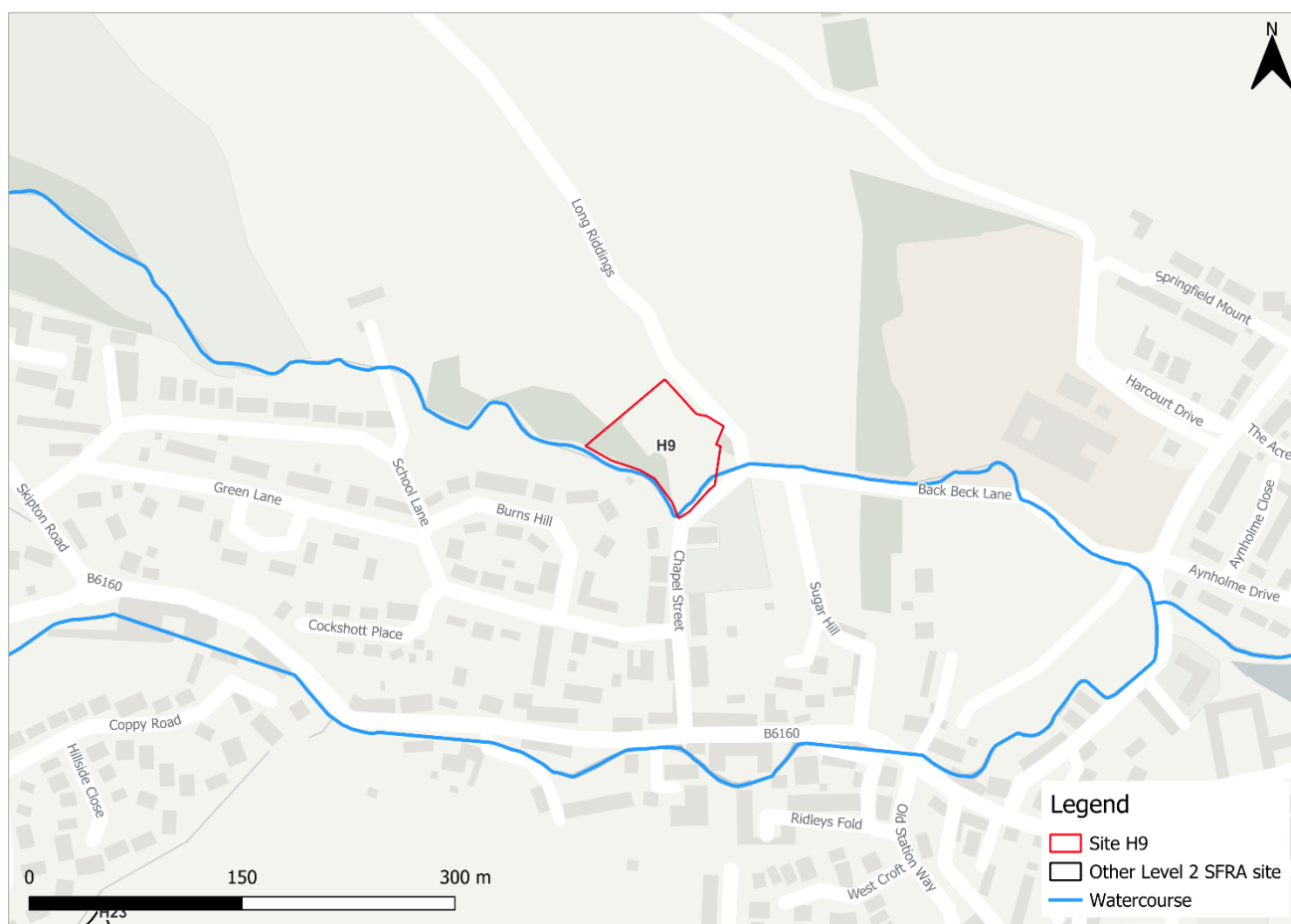


Figure 1-1: Existing site location boundary

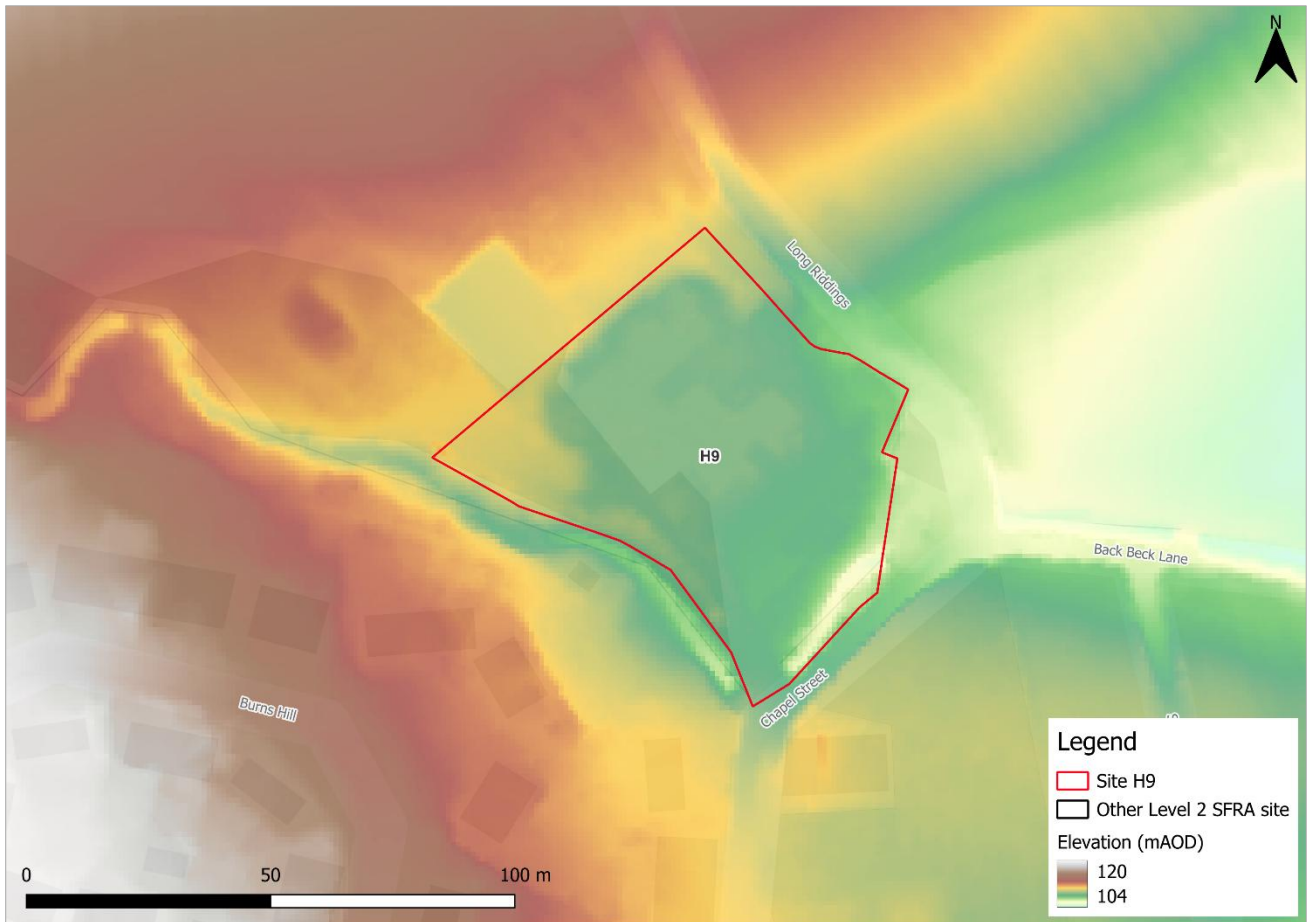


Figure 1-2: Topography



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 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) or the impacts of climate change (Section 2.2).

The site is modelled to be wholly within Flood Zone 1, indicating it is at low risk of flooding from rivers. However, the unmodelled ordinary watercourse, Back Beck, runs along the southwestern and southeastern boundaries of the site before joining Town Beck at Bolton Road, approximately 300m east of the site. Any site-specific FRA undertaken to inform a planning application at this site, should produce a detailed model of Back Beck to understand modelled flood extents, depths and hazards within the site.

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)
100	0	0	0

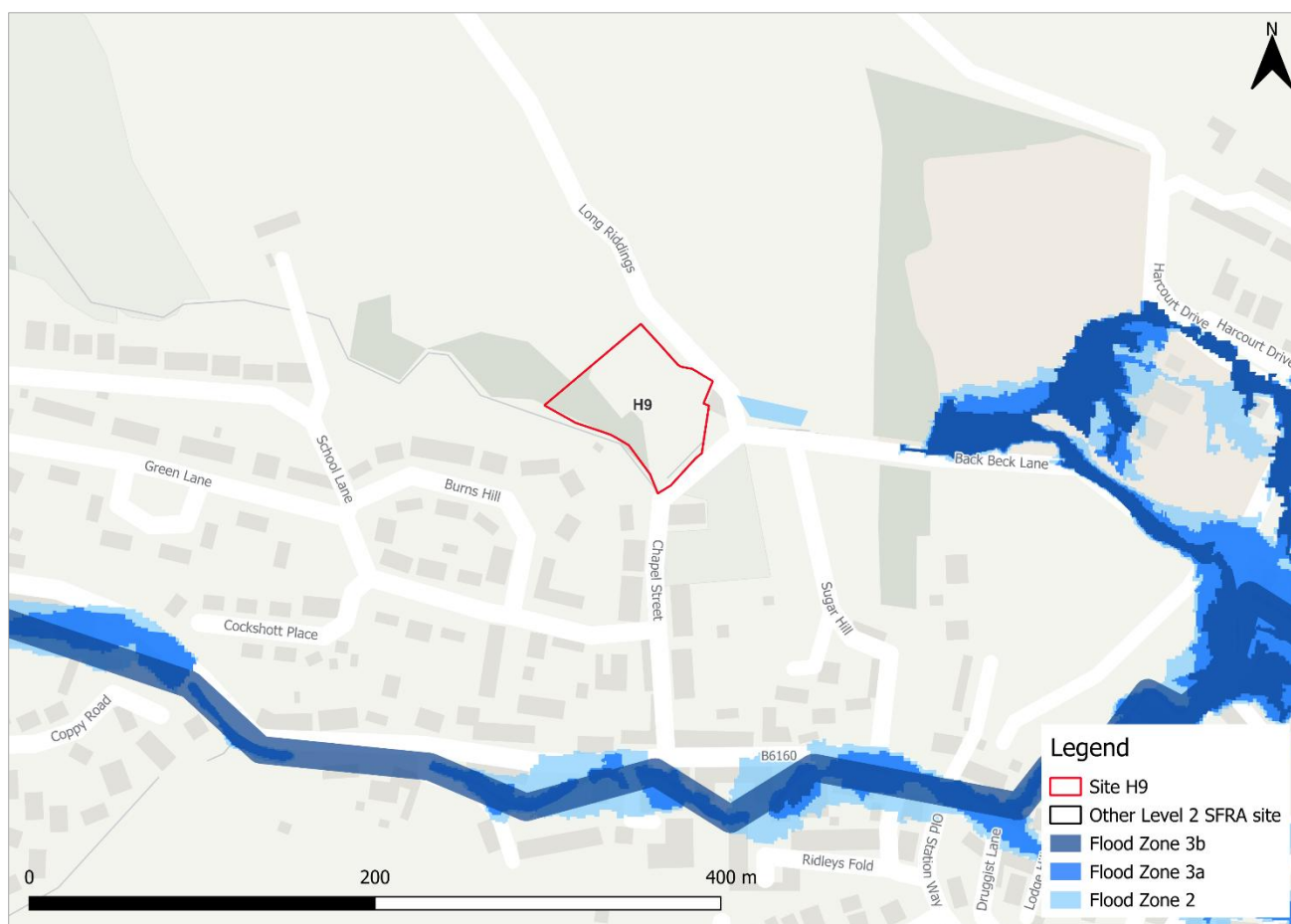


Figure 2-1: Existing risk from rivers to the site

2.2 Impacts from climate change

The impact of climate change on flood risk from Back Beck has not been modelled for this SFRA, as a model covering this watercourse is not available.

The impacts of climate change must be modelled using the EA's latest allowances for peak river flows to inform whether the site can be safe for its lifetime. Any site-specific FRA undertaken to inform a planning application at this site, should produce a detailed model of Back Beck to understand modelled flood extents, depths and hazards within the site and include the most up to date climate change allowances.

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) to reduce flood risk to the site and surrounding areas. Within the north of the site, there is an area with potential for surface water runoff attenuation in both the 3.3% and 1% AEP events. There is also a small area with potential for wider catchment tree planting which can intercept, slow, store and filter water. These areas are shown in Figure 2-2. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

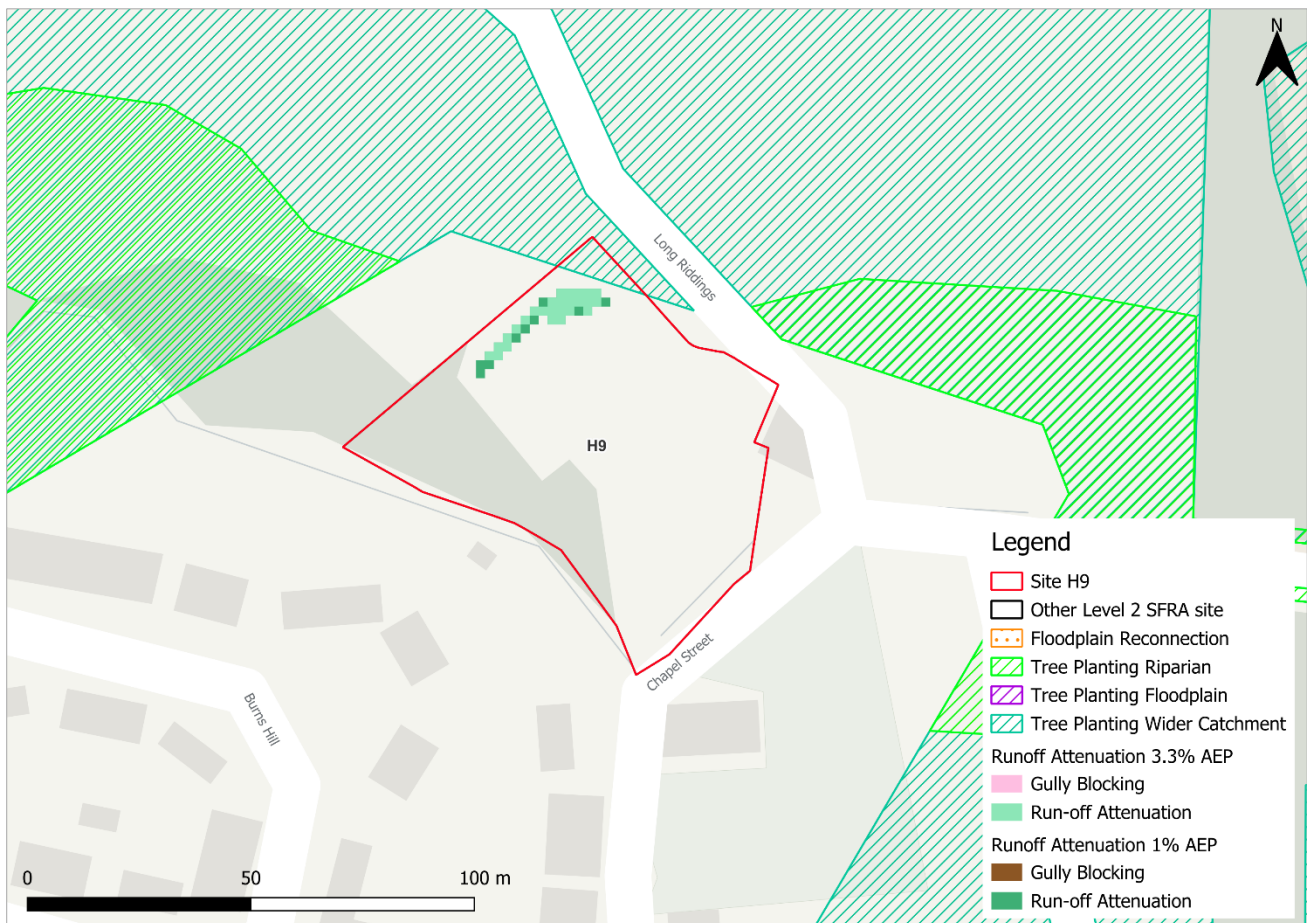


Figure 2-2: Natural Flood Management (NFM) potential mapping

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO) datasets have been considered and mapped in Figure 2-3 which shows a historic fluvial flood incident, east of the site. In Autumn 2000, the area north of Back Beck Lane flooded due to overtopping of defences along Back Beck. This flooding did not directly affect the site.

2.5 LLFA flood incidents

Properties to east of site on Chapel Street recorded internal flooding in 2014 and 2015. Developers should contact the LLFA for further information at the FRA stage to assess potential flood risk to the site associated with these incidents.



Figure 2-3: Recorded historic flood events onsite and around the site

2.6 Flood warning and access and escape routes

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 site is not located within a FWA.

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 site is located adjacent to FWA 122WAF942 - Upper River Wharfe, as shown in Figure 2-4.

Based on available information, safe access and escape routes could likely be achieved during a flood event via Chapel Street.

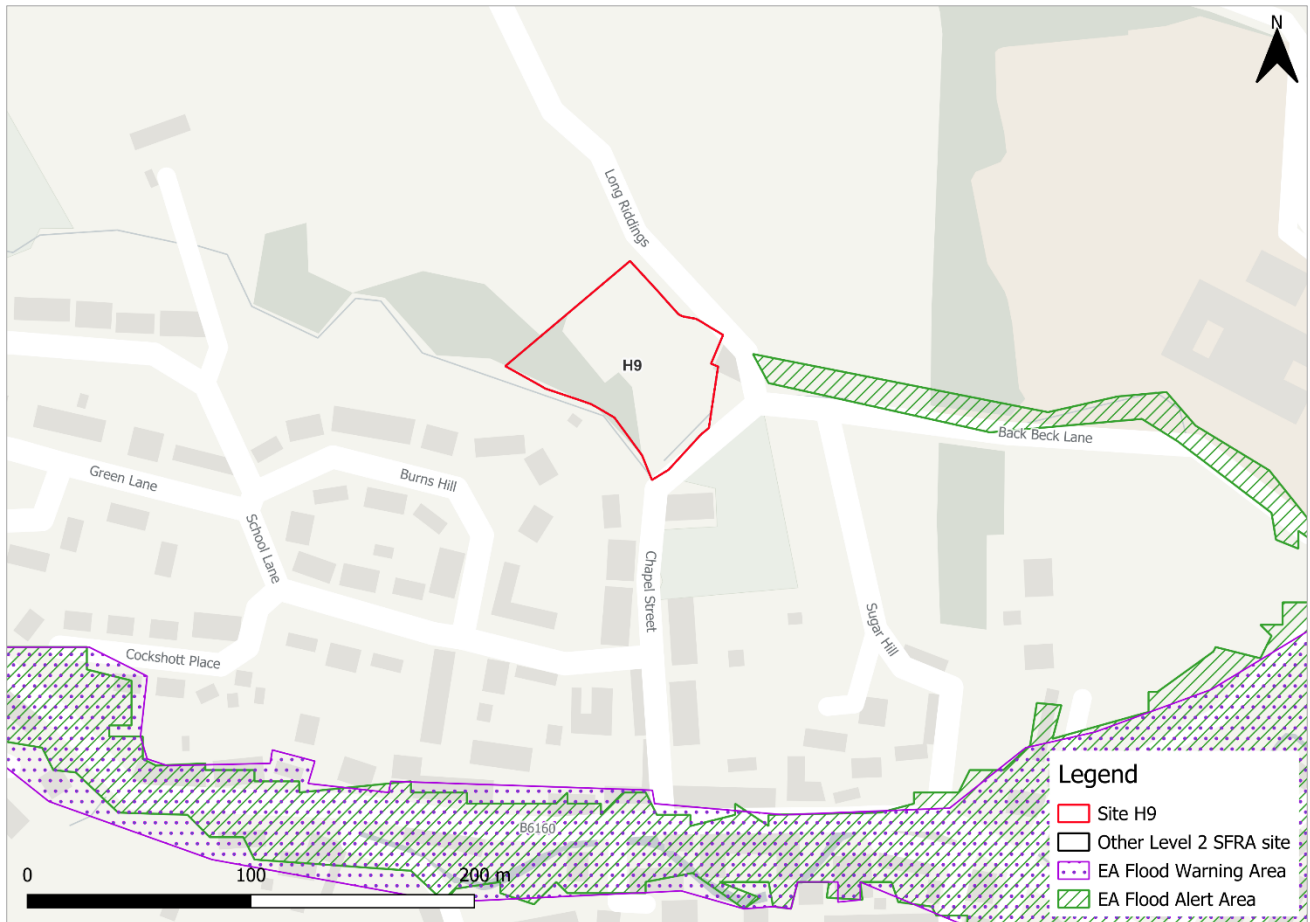


Figure 2-4: EA Flood Warning Areas and Flood Alert Areas

2.7 Observations, mitigation options and site suitability - fluvial

- 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 FRA must show that the development can be designed to be safe and that there is adequate emergency planning provision (para 014 FRCC-PPG).
- The unmodelled Back Beck flows through part of the site and along the southern boundary. Any site-specific FRA undertaken to inform a planning application at this site, should produce a detailed model of Back Beck to understand modelled flood extents, depths and hazards within the site and include the most up to date climate change allowances.
- Development is not permitted within the functional floodplain (which comprises land where water from rivers or the sea has to flow or be stored in times of flood). It is recommended that no development should take place within 8 metres of Back Beck. If feasible, this area would be used as a green / blue corridor which can provide multifunctional benefits providing ecological, social and amenity value.

- For any works on or near the ordinary watercourse, which have the potential to obstruct flow, the developer must apply for Ordinary Watercourse Consent from the LLFA.
- Mapping indicates that Back Beck is culverted beneath Chapel Street and Long Riddings Road, adjacent to the site. These culverts represent residual risk of flooding to the site through culvert failure or blockage. This may need to be further investigated and modelled at the FRA stage. Modelling should include for residual risk and options for culvert removal.
- No development should take place over the top of, nor within 8m either side of the culverted section of watercourse.
- The 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 residual risk associated with the extreme flood event.

3 Flood risk from surface water

3.1 Existing risk

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map surface water flood risk to the site is largely very low. However, 9% of the site is within the high surface water zone, 3% in the medium risk and 22% in the low risk zone, as shown in Table 3-1.

In the high risk event, surface water flooding is confined to the Back Beck channel and its banks. There is an additional area of ponding at the north of the site. In the medium risk event, these areas of flooding slightly expand. In the low risk event, flooding expands to cover approximately 22% of the site. The ponding at the north of the site expands into a flow path, joining to ponding along Long Riddings to the east of the site. Flooding adjacent to Back Beck also increases, covering the southern corner of the site.

Greatest flood depths within the site during the medium risk event are > 1.2 m, within the Back Beck channel (Figure 3-1). Greatest flood hazard rating is extreme (Figure 3-3). Safe access and escape via Chapel Lane may not be achievable due to the depth and hazard of flooding along the southern site boundary during all three events.

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)
66	22	3	9

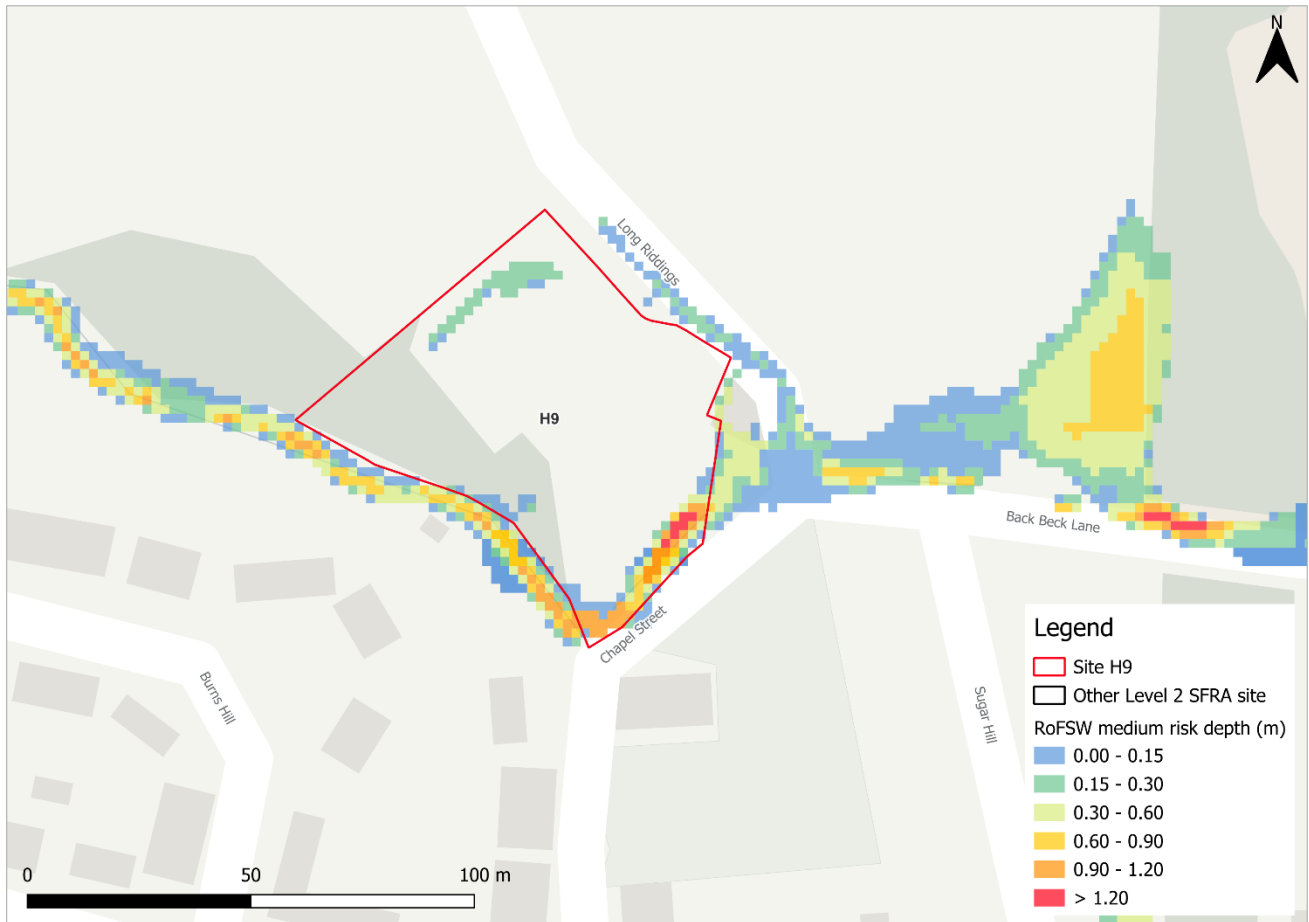


Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

Figure 3-2: Medium risk event surface water flood hazard¹ (Risk of Flooding from Surface Water map)

¹ 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 3-3: Medium risk event surface water flood hazard² (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

The impact of climate change on surface water flood risk has been modelled. This allows for direct comparison with the RoFSW map. With consideration of the EA's SFRA guidance, the latest climate change allowances have been modelled as shown in Table 3-2.

Table 3-2: Modelled climate change allowances for rainfall for the Wharfe and Lower Ouse management catchment

Return period	Central allowance 2070s (% increase)	Upper end allowance 2070s (% increase)
3.3% (high risk)	25%	40%
1% (medium risk)	30%	40%

Figure 3-4 shows modelled surface water flood depths for the medium risk event +40% climate change. Risk is modelled to be greater than for present day conditions, with the

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

medium risk climate change event showing a greater level of risk than the low risk present day event. The large flow path along Back Beck encroaches further into the site and the flow path through the north of the site also widens. Maximum flood depths remain > 1.2 m (Figure 3-4) and maximum flood hazard rating remains extreme (Figure 3-5). Safe access and escape routes are unlikely to be achievable during this event. Alternative emergency arrangements may need to be put in place to ensure site users of future development are safe during this event.

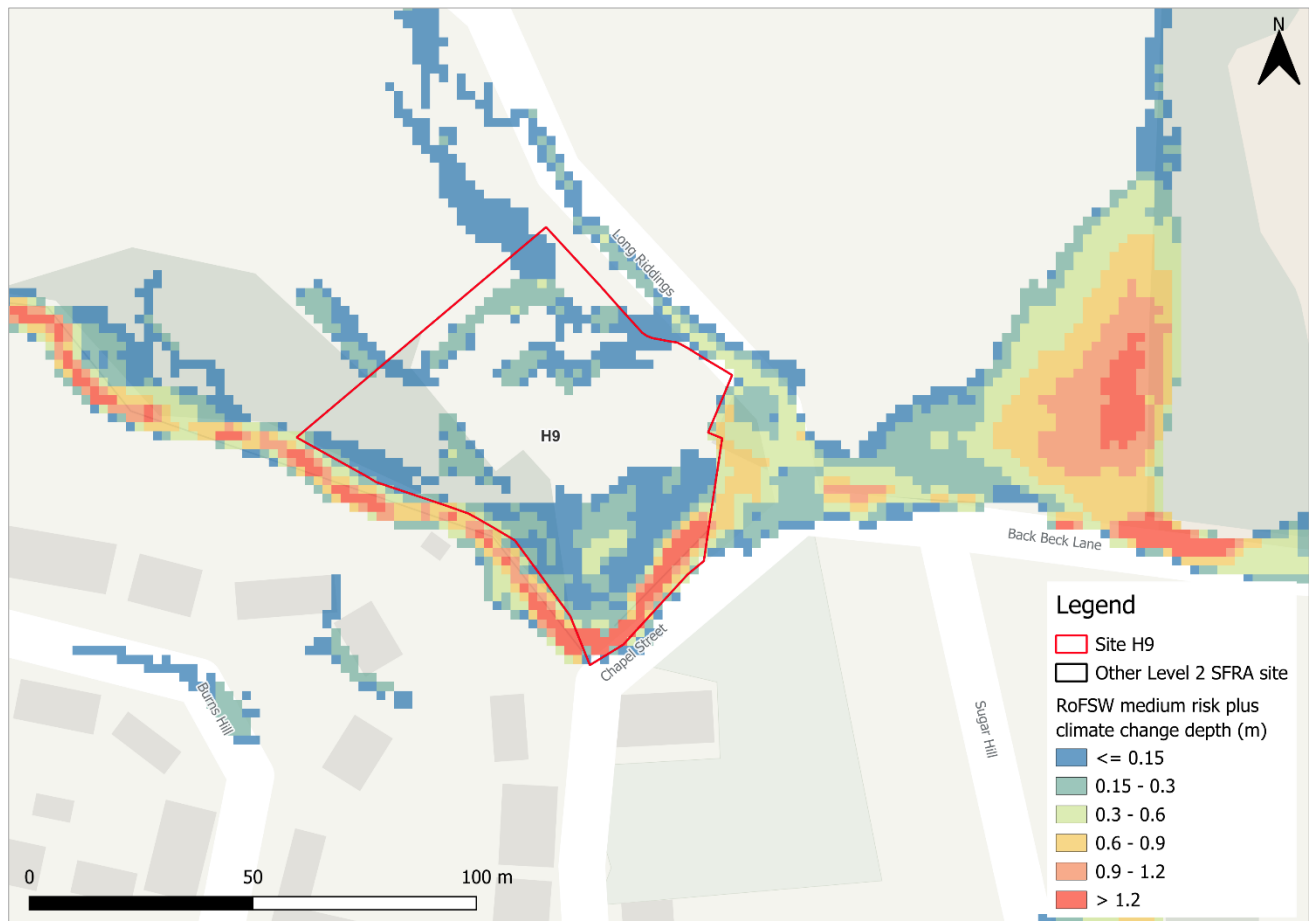


Figure 3-4: Medium risk event surface water flood depths plus 40% climate change (based on Risk of Flooding from Surface Water map)

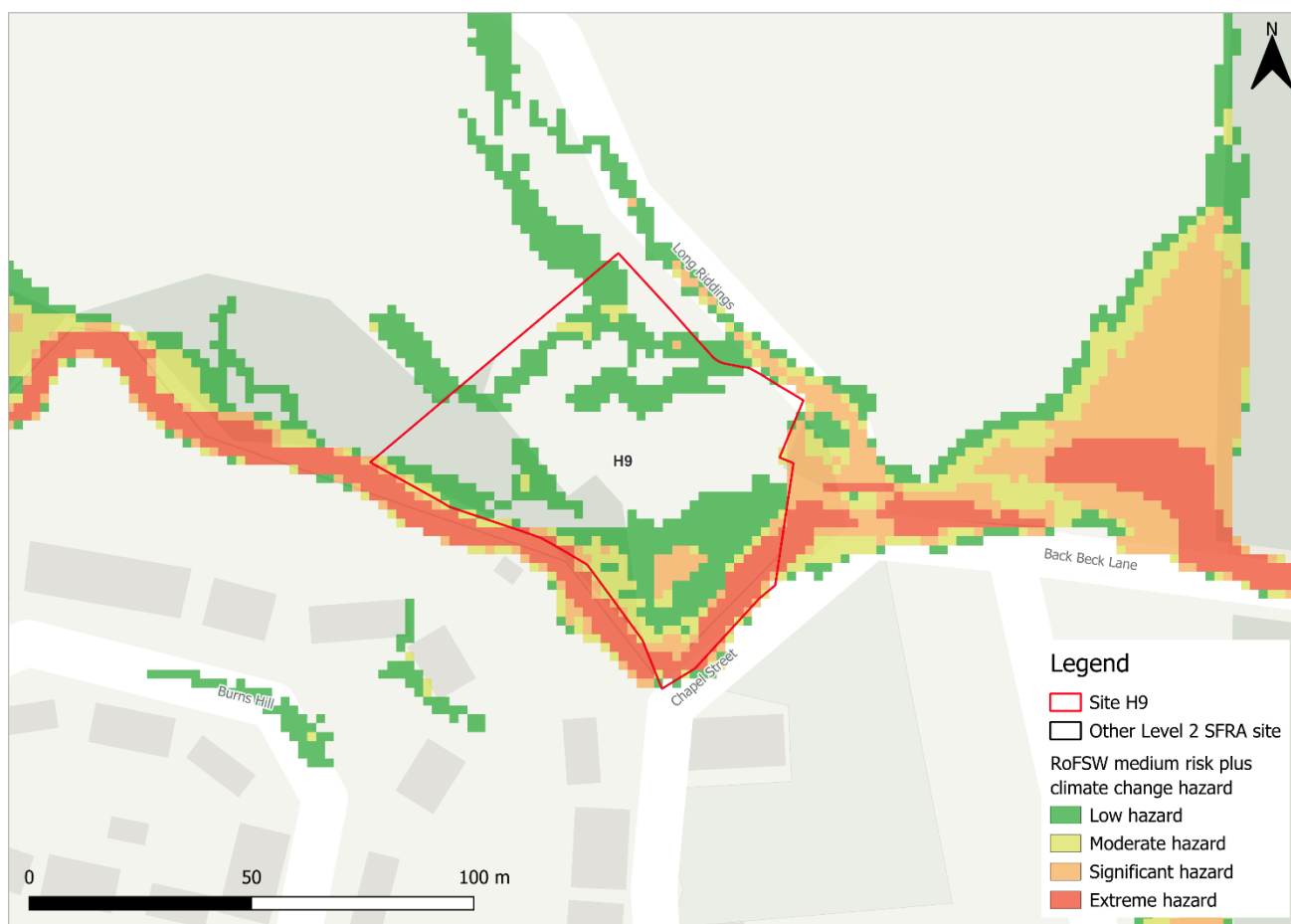


Figure 3-5: Medium risk event surface water flood hazards plus 40% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk to the site is largely very low. However, there is significant risk to the southwestern and southeastern site boundaries during all events along the floodplain of Back Beck. Safe access and escape may not be achievable due to the depth and hazard of flooding along the southern site boundary during all three events.
- The modelled medium risk surface water climate change outputs indicate a greater risk than the present day low risk event. Safe access and escape is unlikely to be achievable during this event. Alternative emergency arrangements may need to be put in place to ensure site users of future development are safe during this event.
- There should be no development within the risk areas along Back Beck. A blue green corridor should be in place along the watercourse to contain the flood risk.
- 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 like for like volumes to ensure risk is contained safely onsite for the lifetime of development.

- A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. Runoff rates will likely require restricting to greenfield rates or betterment on existing. This will require surface water modelling based on layout plans and detailed design and full consultation with the LLFA.
- The use of appropriate SuDS should be investigated. The groundwater table is likely to be high at the north of the site judging from the Groundwater Emergence Map in Figure 4-1, therefore infiltration SuDS are unlikely to be suitable across the entire site. Investigation into suitable SuDS will require appropriate ground and infiltration survey, and surface water modelling based on layout plans and detailed design and full consultation with the LLFA.
- 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 Guide³. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

The majority of the site is in an area where there is no risk of groundwater emergence. However, at the north 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 within the north of the site.



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. breaching / overtopping of flood defences, blockages of culverts or bridge openings.

Residual risk at this site comes from possible blockage of the culverts beneath Chapel Street and Long Riddings road, as shown in

Figure 5-1. Any site-specific FRA undertaken to inform a planning application at this site, should produce a detailed model of Back Beck to understand modelled flood extents, depths and hazards within the site during blockage scenarios and include the most up to date climate change allowances. This should include modelling of residual risk from the culverts.

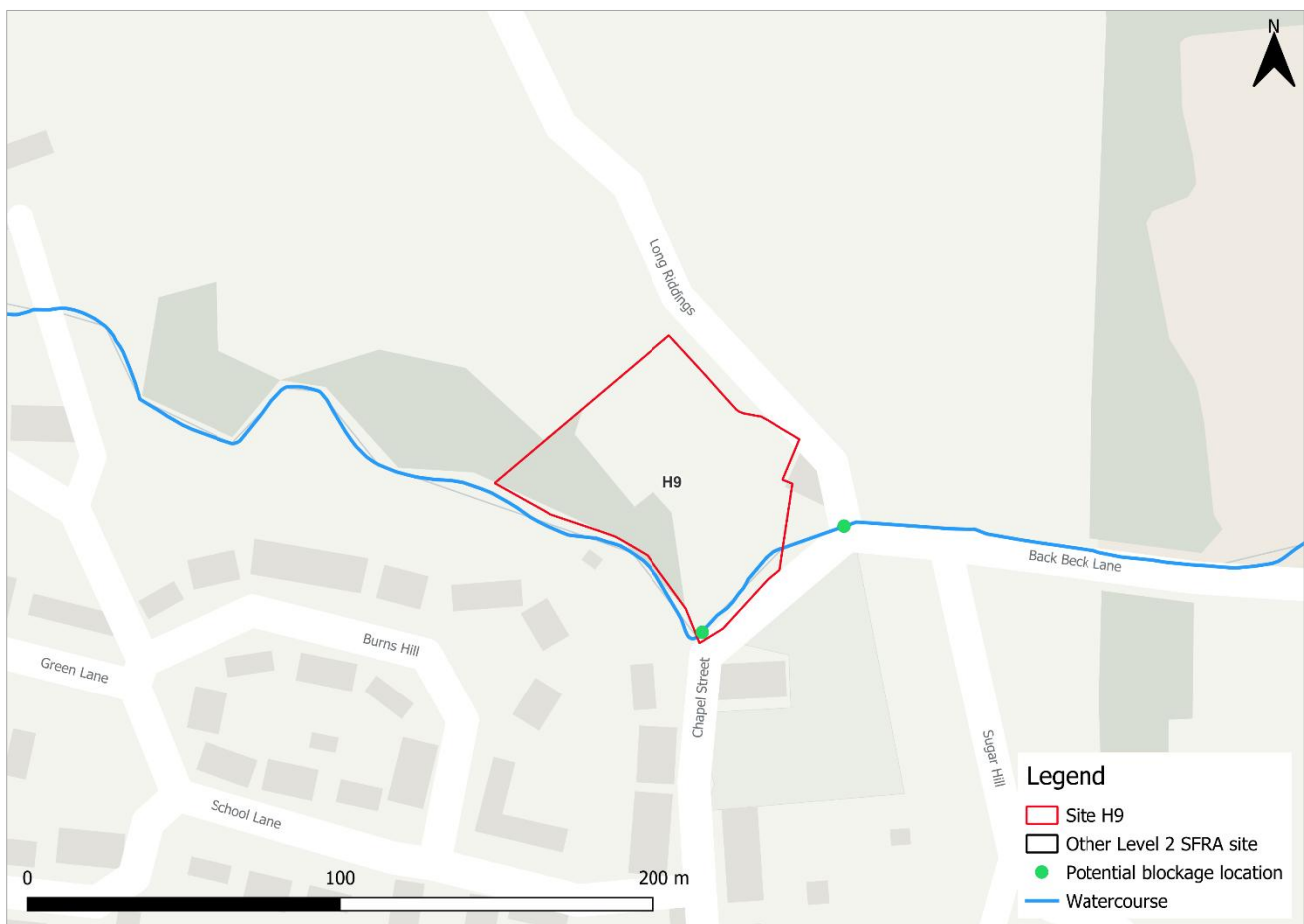


Figure 5-1: Potential blockage locations

5.1 Flood risk from canals

The site is not likely to be at risk from a canal breach.

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 Chelker Reservoir during both the wet and dry day scenarios. Chelker Reservoir is owned and operated by Yorkshire Water and is located within North Yorkshire.

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 Yorkshire Water 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 Flood risk from sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes overloaded or blocked, or it cannot discharge due to high water levels in the receiving watercourse.

According to Yorkshire Water's records, there have been no incidents of sewer flooding in the area over the last two years.

5.4 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a breach of Chelker Reservoir located in North Yorkshire.
- Given the potential reservoir risk to the site, developers should consider⁴:
 - 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.
- There is potential for residual risk to the site from a blockage of structures beneath Chapel Street and Long Riddings road. The owner of these structures is currently unknown. Once ownership information is established, the owner should be able to advise on funding and maintenance arrangements for this asset into the future. Consultation with the LLFA will also be required given this is an ordinary watercourse.
- No development should take place over the top of, nor within 8m either side of the culverted section of watercourse.
- The culverted watercourse represents potential residual risk of flooding to the site through culvert failure or blockage. This may need to be further investigated and modelled at the FRA stage. Modelling should include for residual risk and options for culvert removal.
- 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 egress routes must be in place for the lifetime of development. Resistance and resilience measures may also 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).

⁴ [Reservoir flood maps: when and how to use them | Environment Agency | 2021](#)

- Given the residual risk to this site, the following should be considered:
 - Use of flood resistance and resilience measures,
 - Provision of emergency escape routes including for vehicular access for emergency services. Judgements on whether the site can be regarded as safe will need to consider the feasibility and provision of evacuation from the site during a flood,
 - Provision of detailed emergency plans and signage for site users.

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 test⁵ as it is located within Flood Zone 1, however it must still be proven that the development can be safe for its lifetime, which is 100 years for residential development.

6.2 Recommendations, FRA requirements, and further work

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

- Mapping indicates that Back Beck is culverted beneath Chapel Street and Long Riddings Road, adjacent to the site. These culverts represent residual risk of flooding to the site through culvert failure or blockage. This may need to be further investigated and modelled at the FRA stage. Modelling should include for residual risk and options for culvert removal.
- No development should take place over the top of, nor within 8m either side of the culverted section of watercourse.
- Assuming the culvert is located beneath the site, opportunities for opening up the culvert should be explored for inclusion in site design as a blue green corridor. This would remove any residual risk of flooding to the site as a result of culvert failure or blockage.
- Updated present day and climate change modelling of Back Beck should be used to update this Level 2 SFRA at the earliest opportunity to provide an up-to-date strategic assessment of flood risk to this site and the surrounding areas.
- The area alongside Back Beck should be used as a blue green corridor. However, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on existing and future flood risk from Back Beck is fully ascertained.
- Any FRA should produce a detailed drainage strategy which should include ground investigation for infiltration SuDS suitability.
- 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.

⁵ Para 178 National Planning Policy Framework 2024

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The methodology adopted and the sources of information used by JBA in providing its services are outlined in this Report. The work described in this Report was undertaken between 18 November 2024 and 16 May 2025 and is based on the conditions encountered and the information available during the said period. The scope of this Report and the services are accordingly factually limited by these circumstances.

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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 H382. 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' (2025) and is therefore familiar with the terminology used in this report.

1.1 Site H382

- Location: Hadfield Farm, Skipton Road west, Ilkley
- Existing site use: predominantly grazing land (agriculture), multiple existing dwellings, therefore assessed as more vulnerable
- Existing site use vulnerability: More vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 33.1 hectares
- Proposed development impermeable area: 24.7 hectares
- Watercourse: River Wharfe (main river), several ordinary watercourses
- Environment Agency (EA) river model: Mid River Wharfe 2021
- 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 latest EA climate change allowances for peak river flows and peak rainfall intensities

Commented [JD1]: Is this the correct approach as the vast majority of the site is undeveloped land. There would be a marked change from less vulnerable to more vulnerable for a large proportion of the site.

Commented [FN2R1]: Unless the site boundary changed, to exclude the dwellings, the site vulnerability is based on the 'highest' vulnerable land use within the site boundary.



Figure 1-1: Existing site location boundary

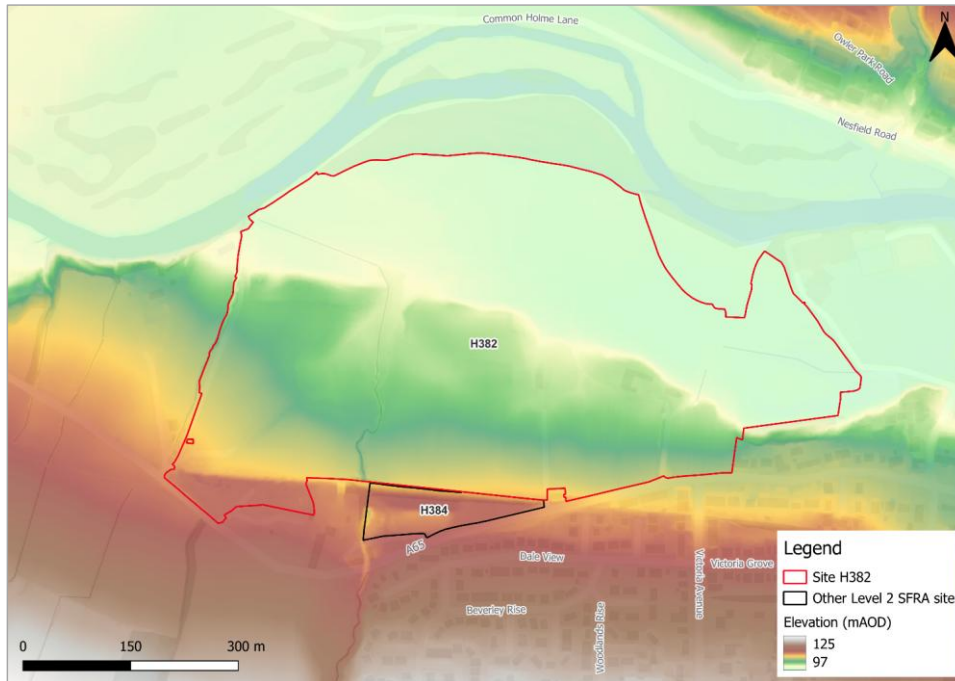


Figure 1-2: Topography

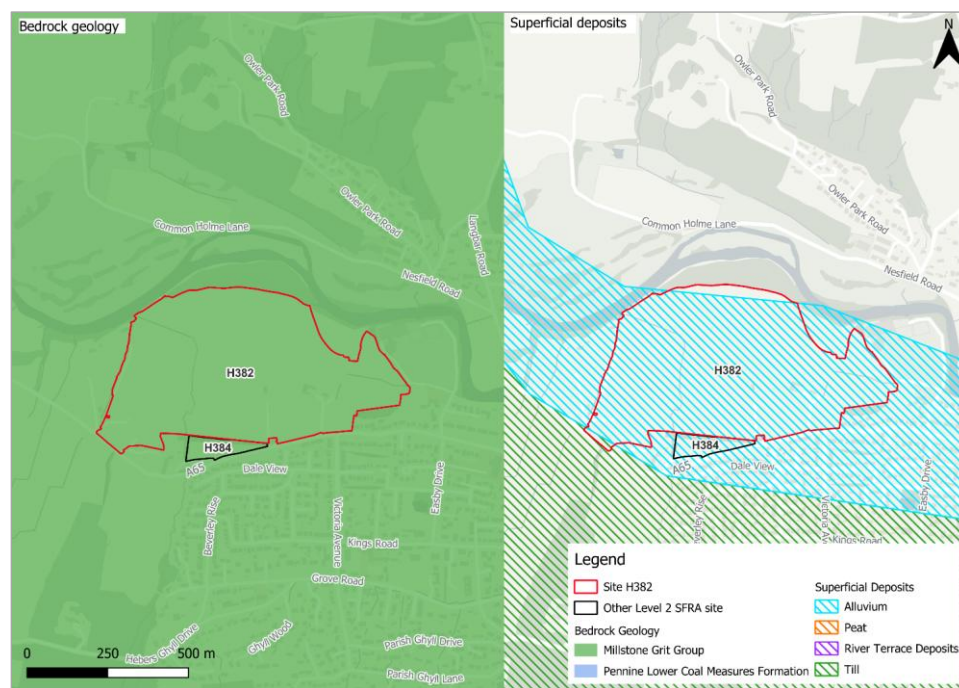


Figure 1-3: Soils and geology

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 (September 2024) 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) or the impacts of climate change (Section 2.2).

Fluvial flood risk to the site comes from the River Wharfe to the north. The River Wharfe is a designated main river. A large area of functional floodplain is present on the site (31% of the site area), primarily based on the 3.33% AEP defended event from the EA's Mid River Wharfe 2021 model. The area of functional floodplain onsite should be left free of development. An additional 4% of the site is within Flood Zone 3a, therefore at high risk, and an additional 9% is within Flood Zone 2 and therefore at medium risk. The remaining 56% of the site is within Flood Zone 1 and therefore at low risk.

Risk from the tributary of the River Wharfe which runs along the western site boundary before joining the Wharfe, as well as risk from Heber's Ghyll (another tributary of the Wharfe) which runs through the western half of the site before joining the Wharfe have not been modelled.

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)
56	9	4	31

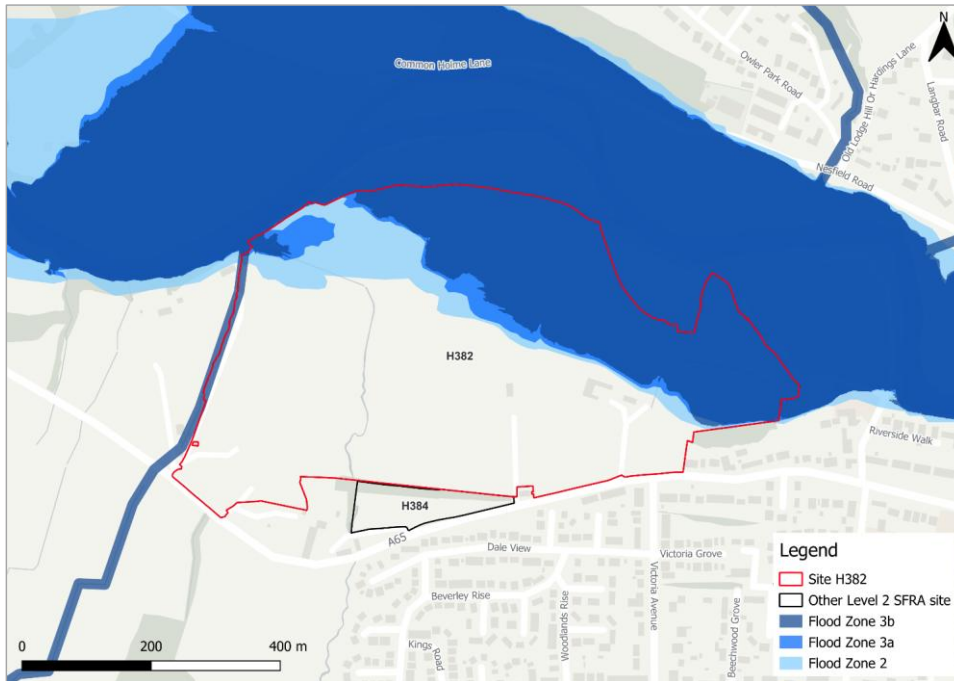


Figure 2-1: Existing risk from rivers to the site

2.1.2 Mid River Wharfe 2021 model outputs

The modelled flood depth information for the Mid River Wharfe model was derived through a 1D mapping process, which involves projecting 1D flood depths within the channel across a 2D LIDAR surface. This method assumes uniformity across each cross-section and does not account for the detailed variations in topography and flow behaviour that occur laterally. This process may lead to some differences between the resulting depth grid and the mapped flood extent provided by the Environment Agency, due to a different Digital Terrain Model (DTM) used to define the 2D floodplain. Modelled velocities and hazards were not available in this model.

Figure 2-2 shows the modelled flood depths for the 1% AEP undefended event which is the event Flood Zone 3 of the Flood Map for Planning is based on. Modelled risk to the site is the same as that shown by Flood Zone 3a, impacting the northern and central areas of the site. Maximum flood depths within the site are modelled to be significant, exceeding 1.2m in a significant area of the east and northeast of the site. Flood depths remain significant in the north of the site, often in the region of 0.6 - 0.9m. Safe access and escape routes are anticipated to remain achievable via the A65 in all events. Section 2.3.1 discusses the defended model outputs.

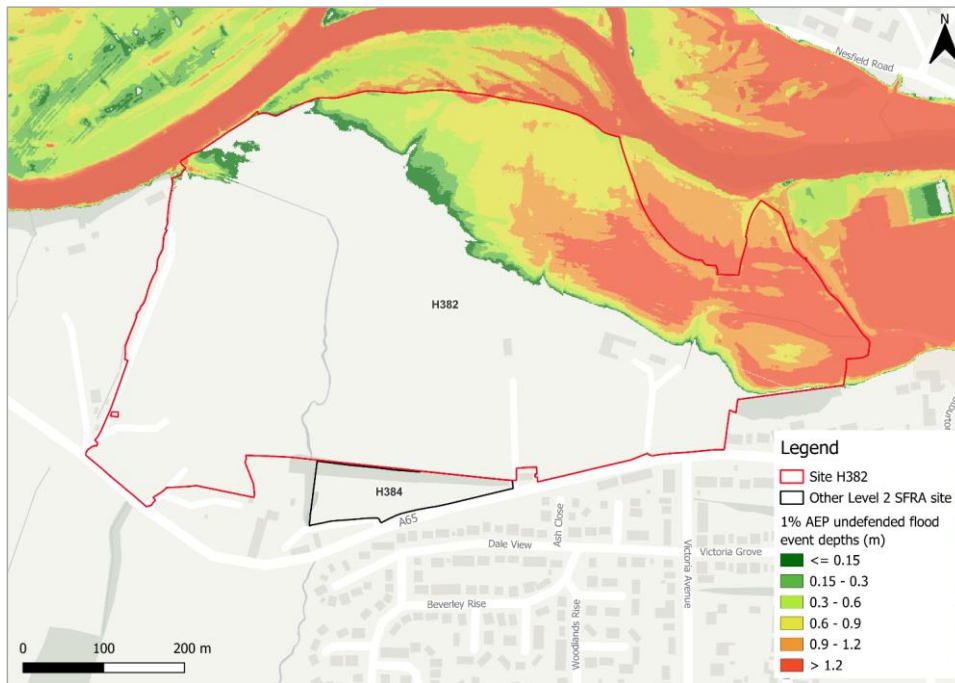


Figure 2-2: Flood depths for 1% AEP undefended flood event

2.2 Impacts from climate change

The impacts of climate change on flood risk from the River Wharfe have been modelled without flood defence infrastructure in place. This allows for direct comparison with the existing risk of the Flood Map for Planning. Section 2.3.1 discusses the defended model outputs.

With consideration of the EA's SFRA guidance, the latest climate change central and higher central allowances have been modelled as shown in



Table 2-2. The EA's SFRA guidance states that SFRAs should assess the central allowance for less, more, and highly vulnerable development, and also water compatible development. The higher central allowance should be assessed for essential infrastructure.

Table 2-2: Modelled climate change allowances for peak river flows for the Wharfe and Lower Ouse 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%	48%
1%	23%	31%	48%

The functional floodplain plus climate change dataset indicates that the area of functional floodplain onsite is likely to increase to a greater extent than the present-day Flood Zone 3a in the future.

Figure 2-3 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, exceeding 1.2m in large parts of the northern areas of the site. Safe access and escape routes are anticipated to remain viable via the A65 in the south of the site.

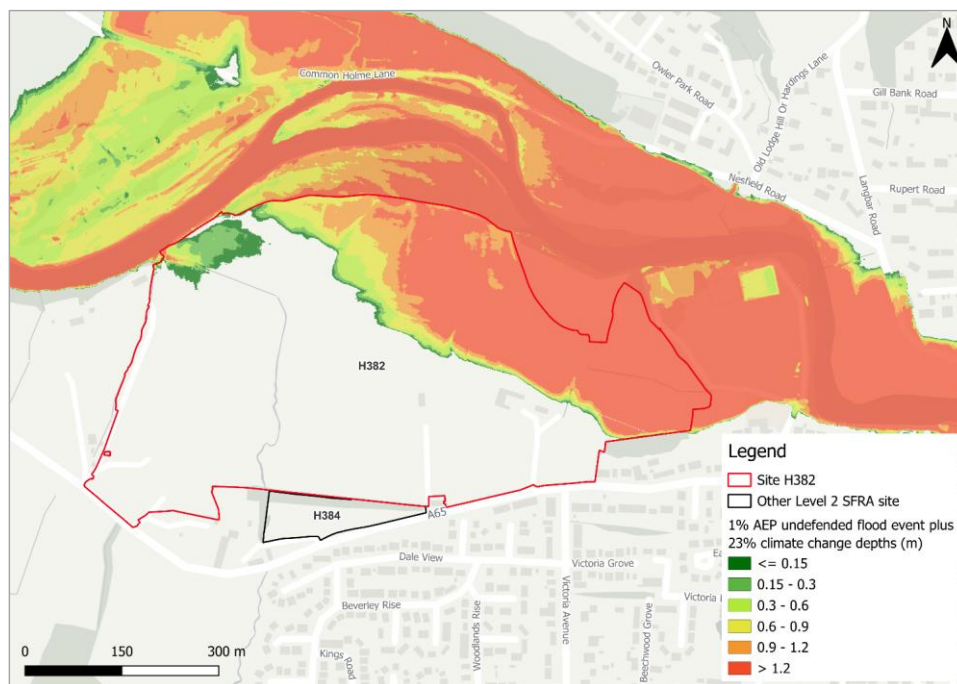


Figure 2-3: Flood depths for 1% AEP undefended flood event +23% (central climate change allowance)

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. This is reflected in the defended modelled flood extent and depths being very similar to the undefended event within the site (Figure 2-4). This is consistent with the modelled climate change events.

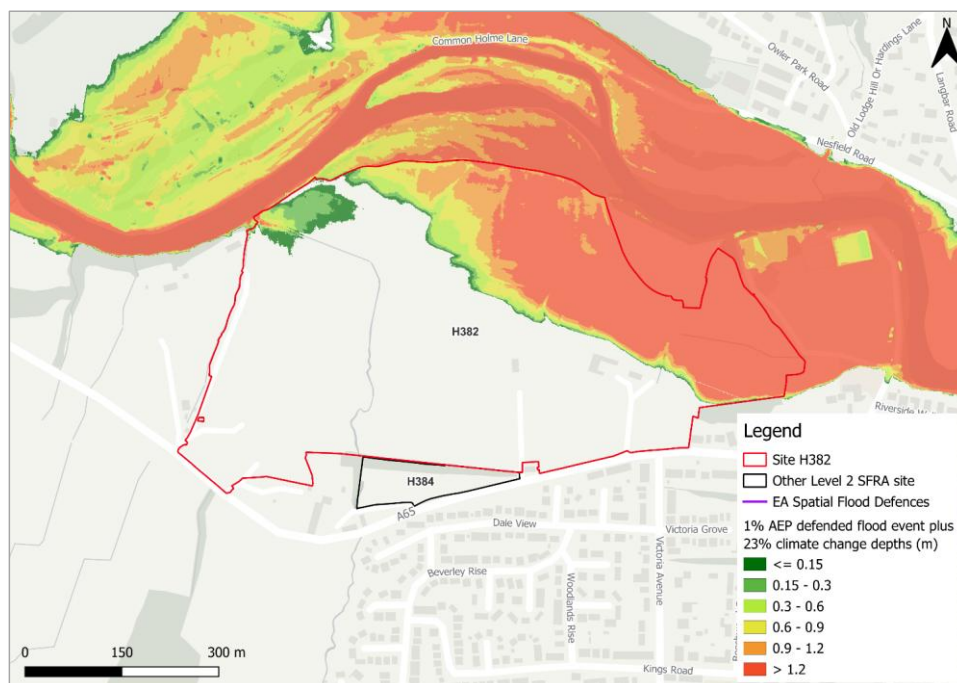


Figure 2-4: Flood depths for 1% AEP defended flood event

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. Within the site and to the west of the site, there are opportunities for riparian, floodplain and wider catchment tree planting, effective to increase infiltration and attenuate flooding. There are additionally opportunities for floodplain reconnection within the northwest, southeast and upstream of the site to the west. These areas are shown in Figure 2-5. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

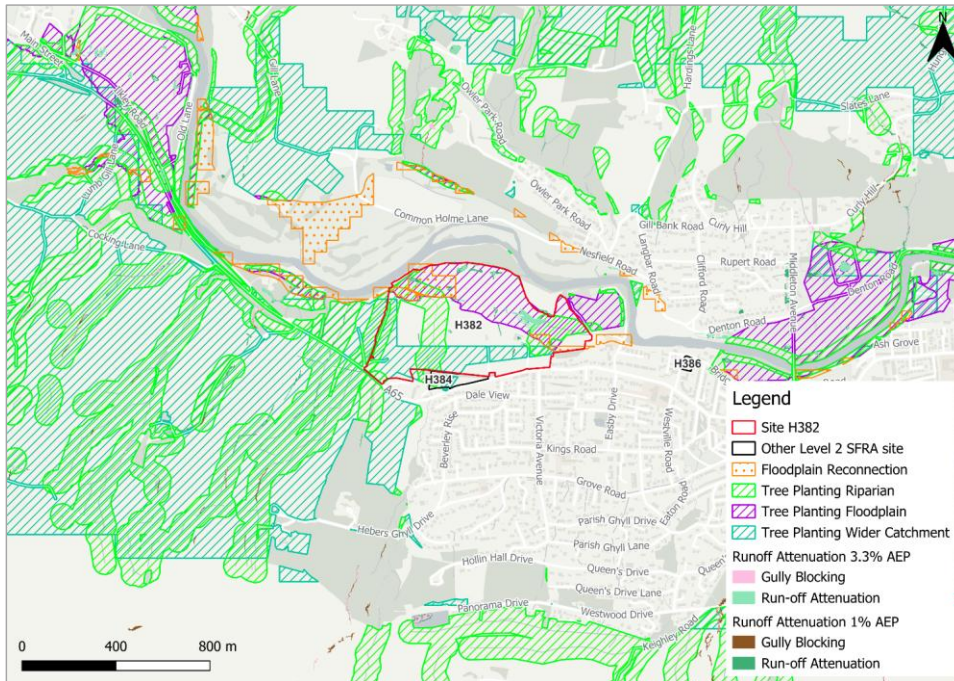


Figure 2-5: Natural Flood Management (NFM) potential mapping

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) has been considered and mapped in Figure 2-6 which shows the north of the site has been subject to flooding in the past. The RFO dataset indicates that these historic events have occurred as a result of the channel capacity of the River Wharfe being exceeded in 1982, 1991, 1995, 2000, 2002, 2015, and two separate occasions in 2020.

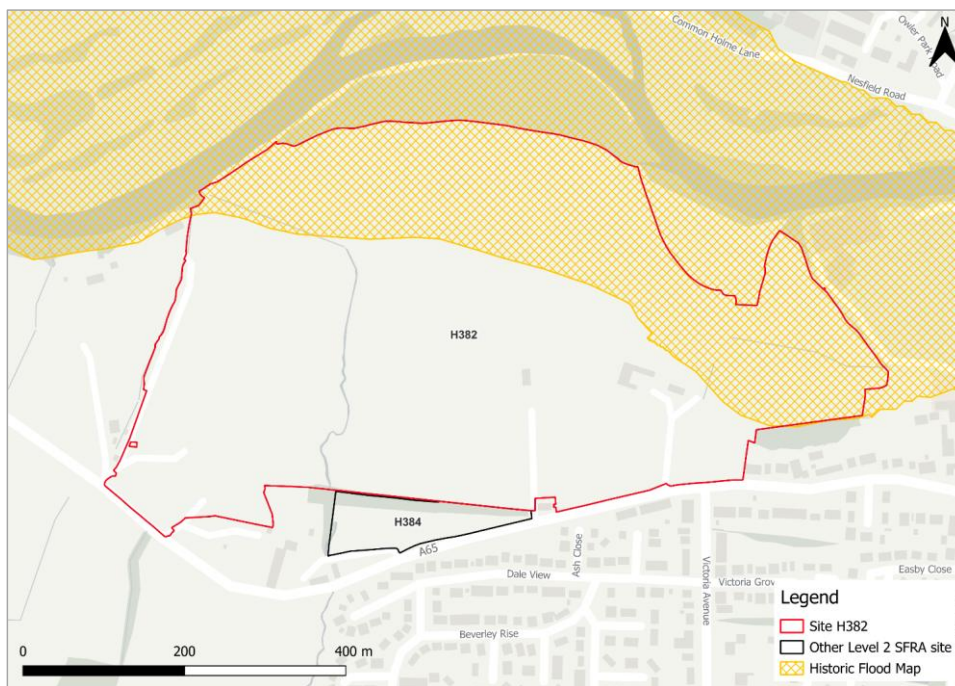


Figure 2-6: Recorded historic flood events onsite and around the site

2.5 LLFA flood incidents

The LLFA have records of one flood incident taking place south of the site, adjacent to Heber's Ghyll, which occurred in 2015. Developers should contact the LLFA for further information at the FRA stage, to assess potential flood risk to the site associated with these incidents.

2.6 Flood warning and access and escape routes

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 north of the site is located within a FWA, namely 122FWF530 - River Wharfe at Denton Road, Ilkley.

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 northeast of the site is also located within a FAA, namely 122WAF942 - Upper River Wharfe.

Based on available information, safe access and escape routes would be anticipated to remain viable at in the south of the site via the A65.

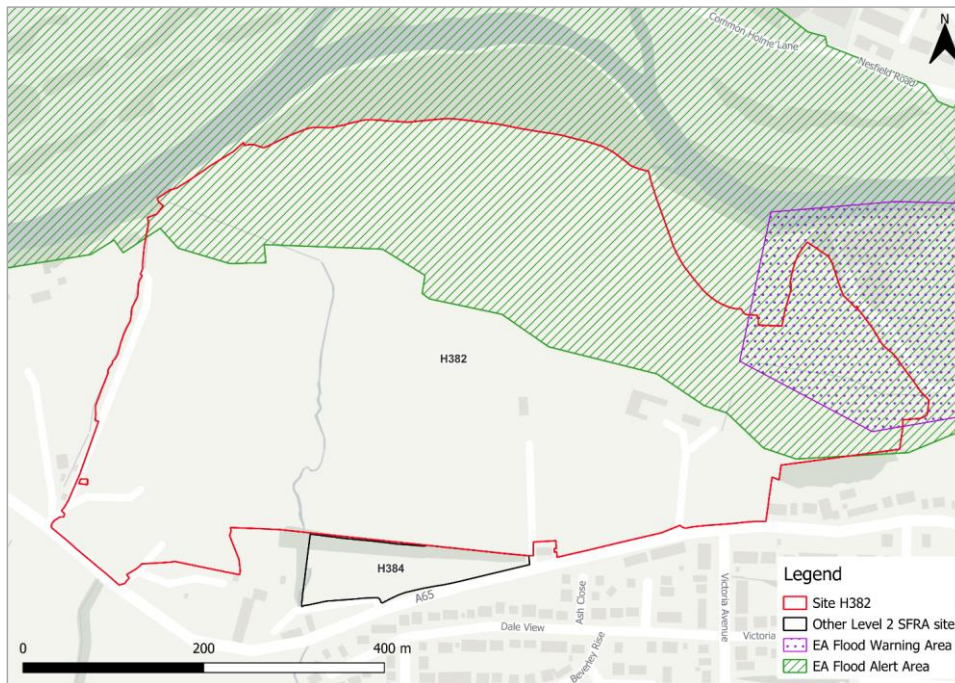


Figure 2-7: EA Flood Warning Areas and Flood Alert Areas

2.7 Observations, mitigation options and site suitability - fluvial

- The north, east and western boundary of the site is modelled to be within the functional floodplain. Development is not permitted within the functional floodplain. These areas should remain as open greenspace for flood storage, amenity use and to provide environmental / ecological benefits.
- If the development of the site involves any activity within 8 metres of the River Wharfe, a flood risk activity permit may be required from the EA in addition to planning permission. For non-tidal main rivers, a flood risk activity permit may be required if the development of the site is within 8 metres of a riverbank, flood defence structure or culvert.
- Given the site is more vulnerable and within Flood Zone 3a and at future risk from the modelled 1% AEP undefended event plus climate change, 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. Ideally, this area would be left free of more vulnerable development.
- Risk from the unmodelled ordinary watercourses must be ascertained at the FRA stage and considered in site layout and design.

- Any development considered in Flood Zone 2 must be accompanied by suitable emergency plans, property flood resilience, and continued flood alerts. 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.
- Were development of this site to proceed, given the proximity of this site to neighbouring site H384, it would be prudent for consultation between each developer to take place to ensure a joined-up approach for sustainable development is in place

3 Flood risk from surface water

3.1 Existing risk

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map (November 2024), surface water risk to the site is predominantly very low. Approximately 5% of the site is at high surface water risk. A further 5% of the site is at medium risk and a further 22% is at low surface water risk, as shown in Table 3-1.

In the high-risk event, surface water risk is confined to an area of ponding within a topographic low spot within the north of the site. This area of ponding is modelled to increase in extent in the medium and low risk events. The largest risk areas are within the fluvial risk areas. There are several flow paths flowing through the site north to the Wharfe, generally following the ordinary watercourses.

Greatest flood depths within the site in the medium risk event are over 1.2 m (Figure 3-1) with hazard categorised as extreme in central areas of the site (Figure 3-2) and significant in eastern areas of the site. Safe access and escape routes are partially inundated along the A65, however these are primarily of low hazard and anticipated to be viable in the southeast and southwest areas of the site.

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)
68	22	5	5

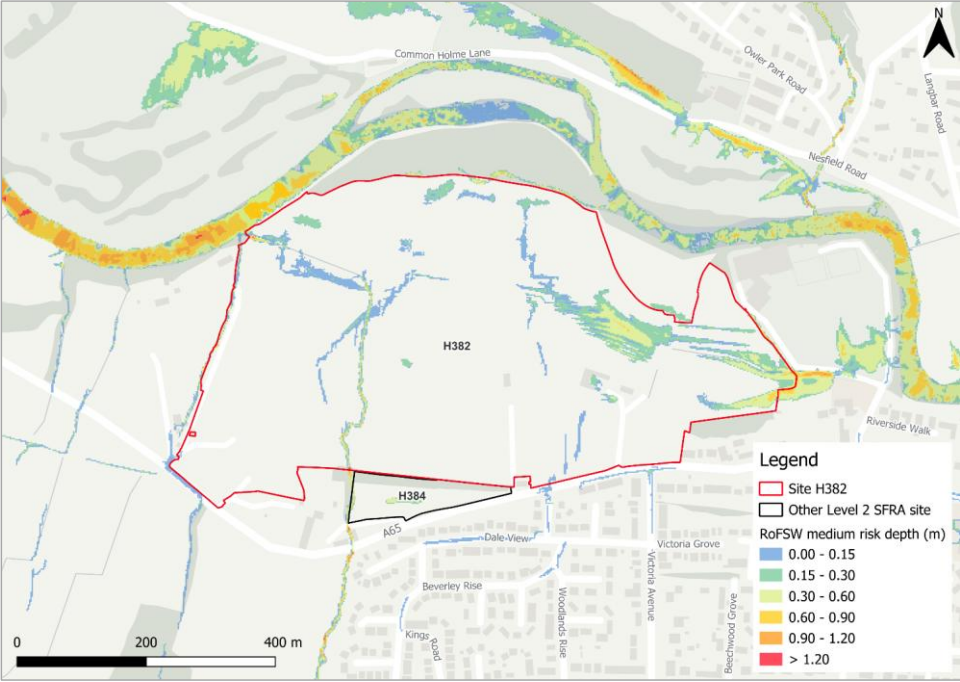


Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

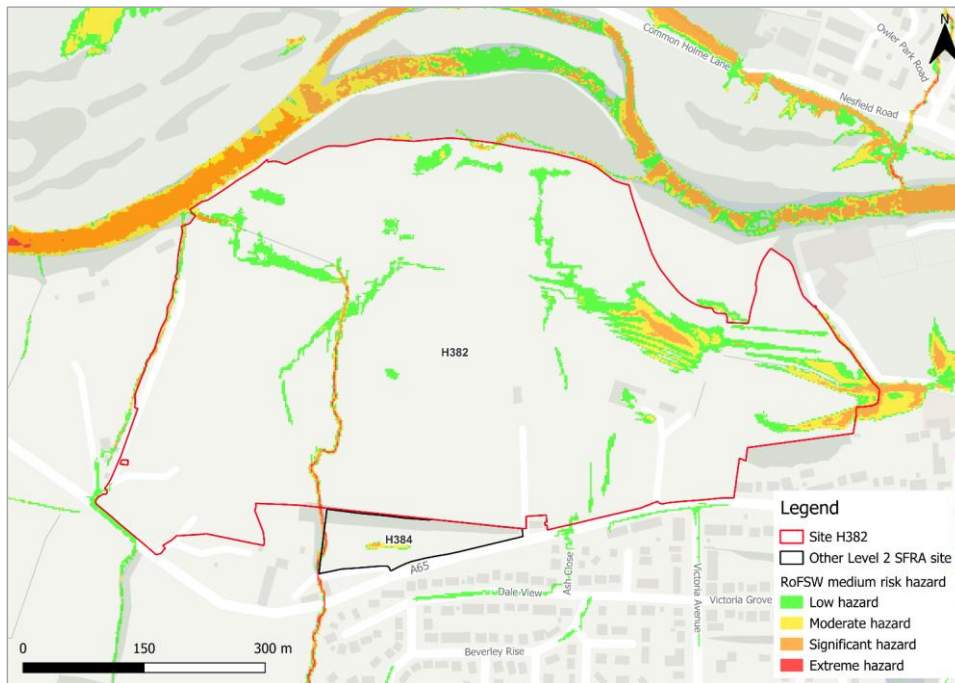


Figure 3-2: Medium risk event surface water flood hazard¹ (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

The impact of climate change on surface water flood risk has been modelled. This allows for direct comparison with the RoFSW map. With consideration of the EA's SFRA guidance, the latest climate change allowances have been modelled as shown in Table 3-2.

Table 3-2: Modelled climate change allowances for rainfall for the Wharfe and Lower Ouse Management Catchment

Return period	Central allowance 2070s (% increase)	Upper end allowance 2070s (% increase)
3.3% (high risk)	25%	40%
1% (medium risk)	30%	45%

Figure 3-3 shows the modelled surface water flood depths for the medium risk event plus 45% climate change. Risk is modelled to be significantly greater than for present day

¹ 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

conditions, with the medium risk climate change event showing a similar level of risk to the present day low risk event. Flow paths become much larger with much more of the site at risk. Maximum depths are modelled to be in excess of 1.2 m within the east of the site, with areas of hazard categorised as extreme in these areas (Figure 3-4). Safe access and escape routes may be challenging to achieve in the climate change event, with instances of surface water of 'Significant' hazard level in the southeast, southwest and central areas of the site.

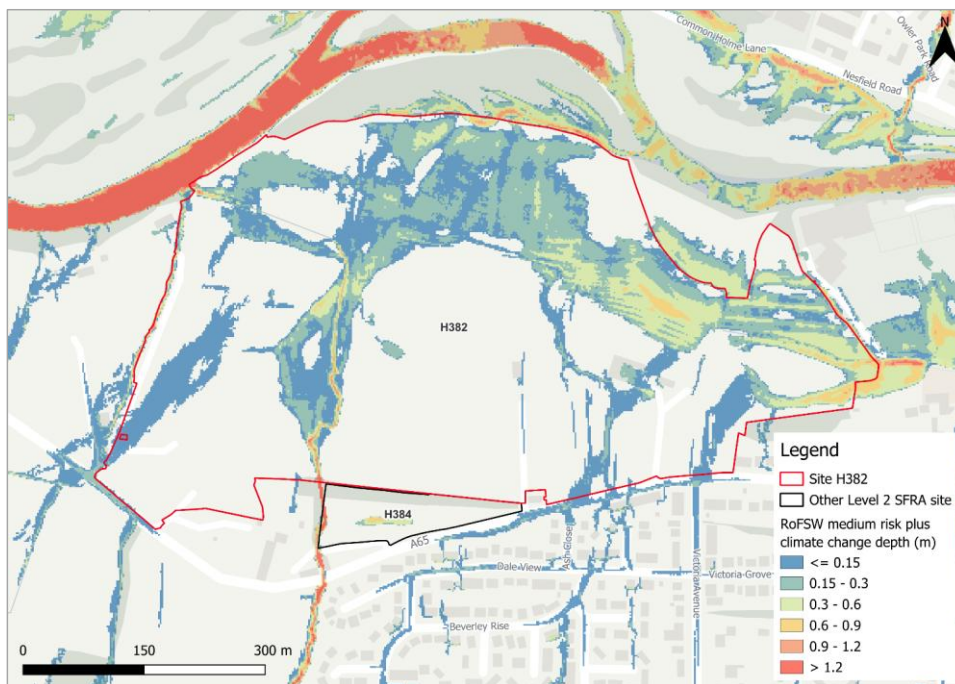


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

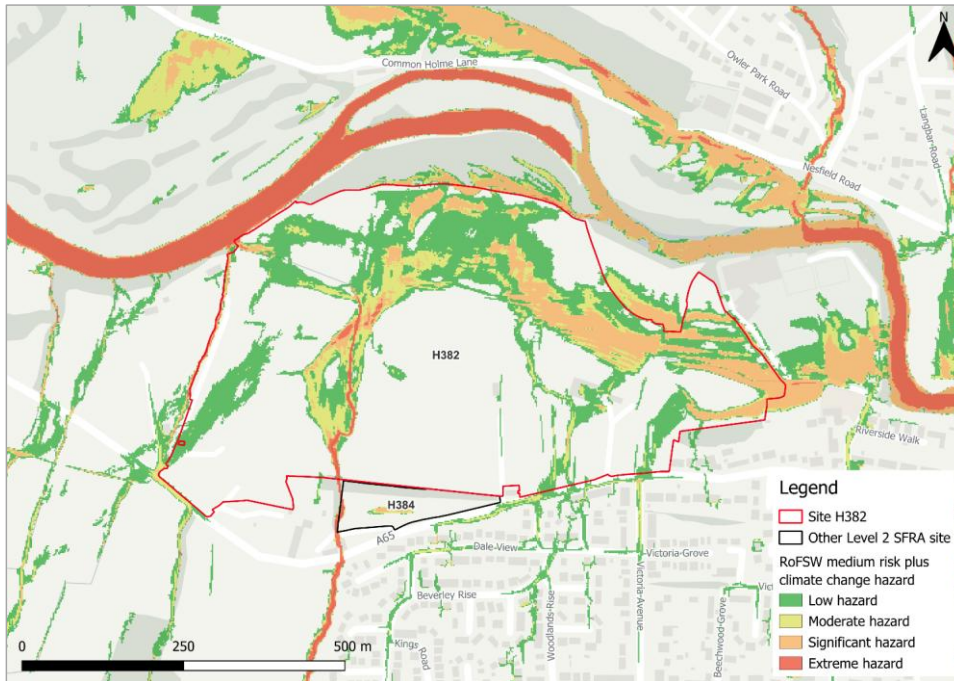


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk is observed along the unnamed watercourse in the centre of the site, as well as areas of topographic depression including in the northeast of the site.
- Topographic depressions and flow routes 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 flood volumes to ensure risk is contained safely onsite for the lifetime of development.
- Safe access and escape routes should be achievable in the southeast of the site during the present-day medium risk event, however this may be challenging in the medium risk plus climate change event based on the modelled surface water flood depths and hazards along the A65.
- A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This will require surface water modelling based on layout plans and detailed design and full consultation with the LLFA. Runoff volumes must not exceed existing greenfield rates and, if possible, betterment should be achieved.
- 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 Guide². Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

The risk of groundwater emergence varies across the site. There is no risk of groundwater emergence in the majority of the north of the site within the floodplain of the Wharfe. In central and southern areas of the site, there is a risk of groundwater flooding to both surface and subsurface assets. In these areas, groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots. Ground survey, including percolation testing may be required to fully ascertain groundwater conditions at the site and SuDS suitability.

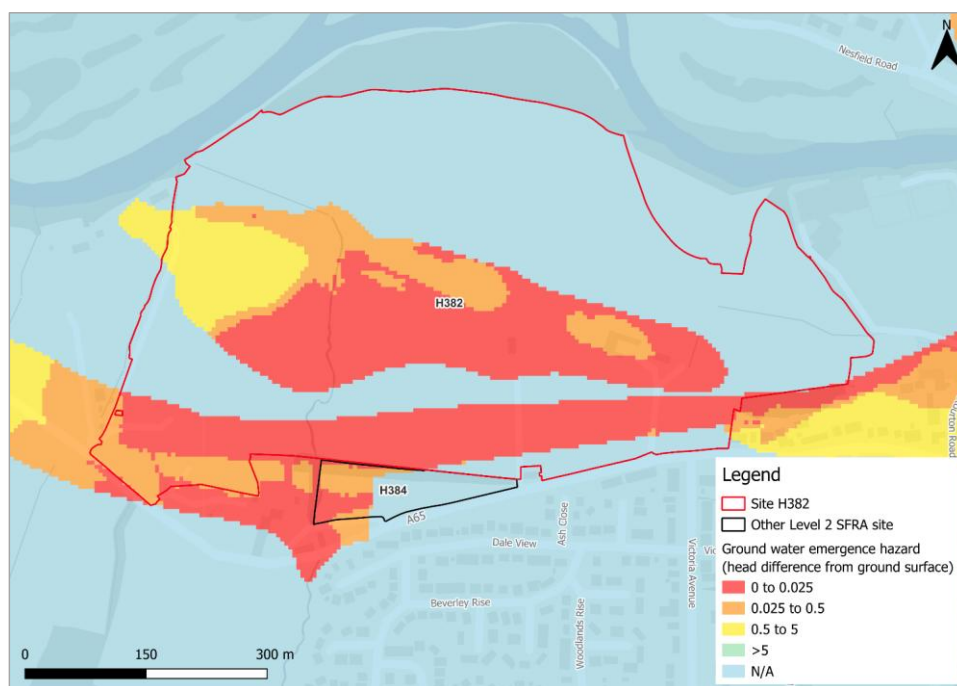


Figure 4-1: JBA 5m Groundwater Emergence Map

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

5.1 Blockage Events from unnamed watercourse and Heber's Ghyll

There are a number of ordinary watercourses indicated to be present on the site as shown by mapping and an assessment of satellite imagery for the site. A number of these appear to be culverted and have in channel structures. Culvert removal should be investigated at the planning stage. Hydraulic modelling based on river channel surveys, and where appropriate CCTV surveys, may be required to determine residual risk from these watercourses, including from blockage scenarios, were culverts to remain.

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 5-1 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 five reservoirs. Of these five reservoirs, one is located within Bradford and four are in North Yorkshire. These are operated by Yorkshire Water Services Ltd.

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.

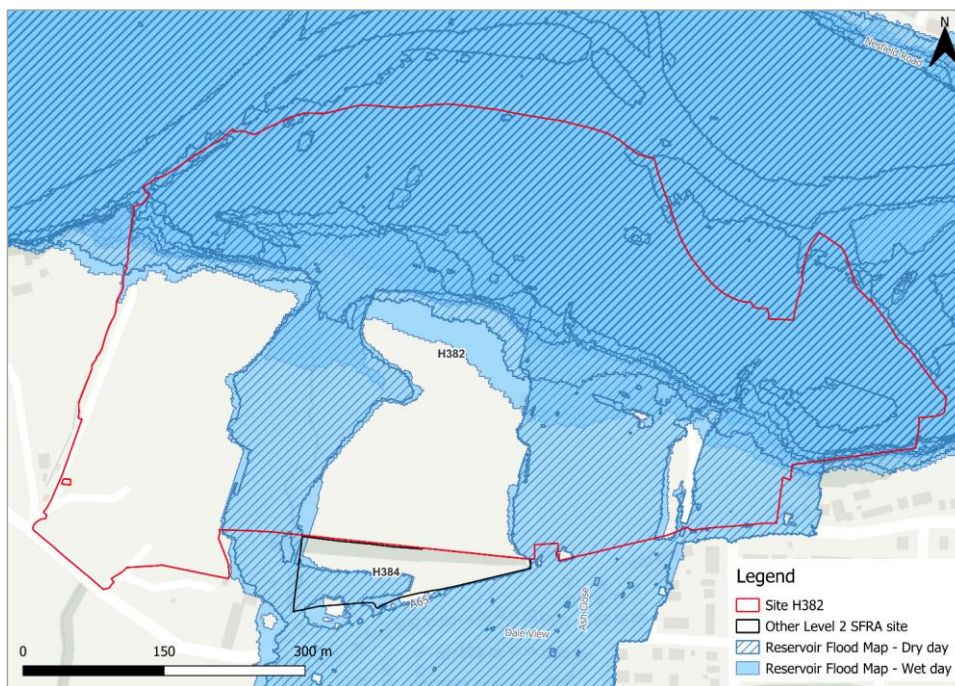


Figure 5-1: Flood risk from reservoirs

5.3 Flood risk from sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes overloaded or blocked, or it cannot discharge due to high water levels in the receiving watercourse.

According to Yorkshire Water's records, there have been no incidents of sewer flooding in the area over the last two years.

5.4 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a breach of five reservoirs, all of which impact the site in the 'dry day' flood extent.
- Given the potential reservoir risk to the site, developers should consider³:
 - 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

³ [Reservoir flood maps: when and how to use them | Environment Agency | 2021](#)

- Using this Level 2 SFRA to understand whether any proposed development will be safe throughout its lifetime.
- 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).
- Culvert removal should be considered. Alternatively, modelling may be required of the ordinary watercourse including for blockage scenarios of culverts.

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 test⁴, 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 100 years for residential development. Assuming all built development can be directed to areas of low (Flood Zone 1) and medium (Flood Zone 2) flood risk, and areas at high flood risk (Flood Zone 3) accounting for climate change left as open greenspace, the exception test can be passed.

6.2 Recommendations, FRA requirements, and further work

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

- It should be possible to develop areas of this site for more vulnerable uses. However, development yields may be impacted.
- It is recommended that the North of the 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 fluvial risk to the site in the 1% AEP plus climate change event and also the modelled impact of climate change on the functional floodplain.
- Any FRA should undertake new hydraulic modelling of the ordinary watercourses. This modelling should include for blockage scenarios to account for residual risk to the site.
- No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.
- Assuming there are culverted watercourses within the site, opportunities for opening up the culverts should be explored for inclusion in site design as a blue green corridor. This would remove any residual risk of flooding to the site as a result of culvert failure or blockage.
- Safe access and escape routes during the present day and climate change events must be considered further as part of a site-specific FRA.
- A detailed drainage strategy will be required. Surface water should be retained onsite where possible. Runoff volumes should not exceed current greenfield rates.
- 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

⁴ Para 178 National Planning Policy Framework 2024



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

7 Licencing

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Bradford Level 2 Strategic Flood Risk Assessment - Site H385

Final Draft

May 2025

Prepared for:



City of
BRADFORD
METROPOLITAN DISTRICT COUNCIL

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Contract

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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. Laura Thompson 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 H385. 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' (2025) and is therefore familiar with the terminology used in this report.

1.1 Site H385

- Location: Coutances Way, Ilkley
- Existing site use: Agriculture
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 7.4 hectares
- Proposed development impermeable area: 5.6 hectares
- Watercourse: River Wharfe (main river)
- Environment Agency (EA) river model: Mid River Wharfe 2021
- 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 latest EA climate change allowances for peak river flows and peak rainfall intensities

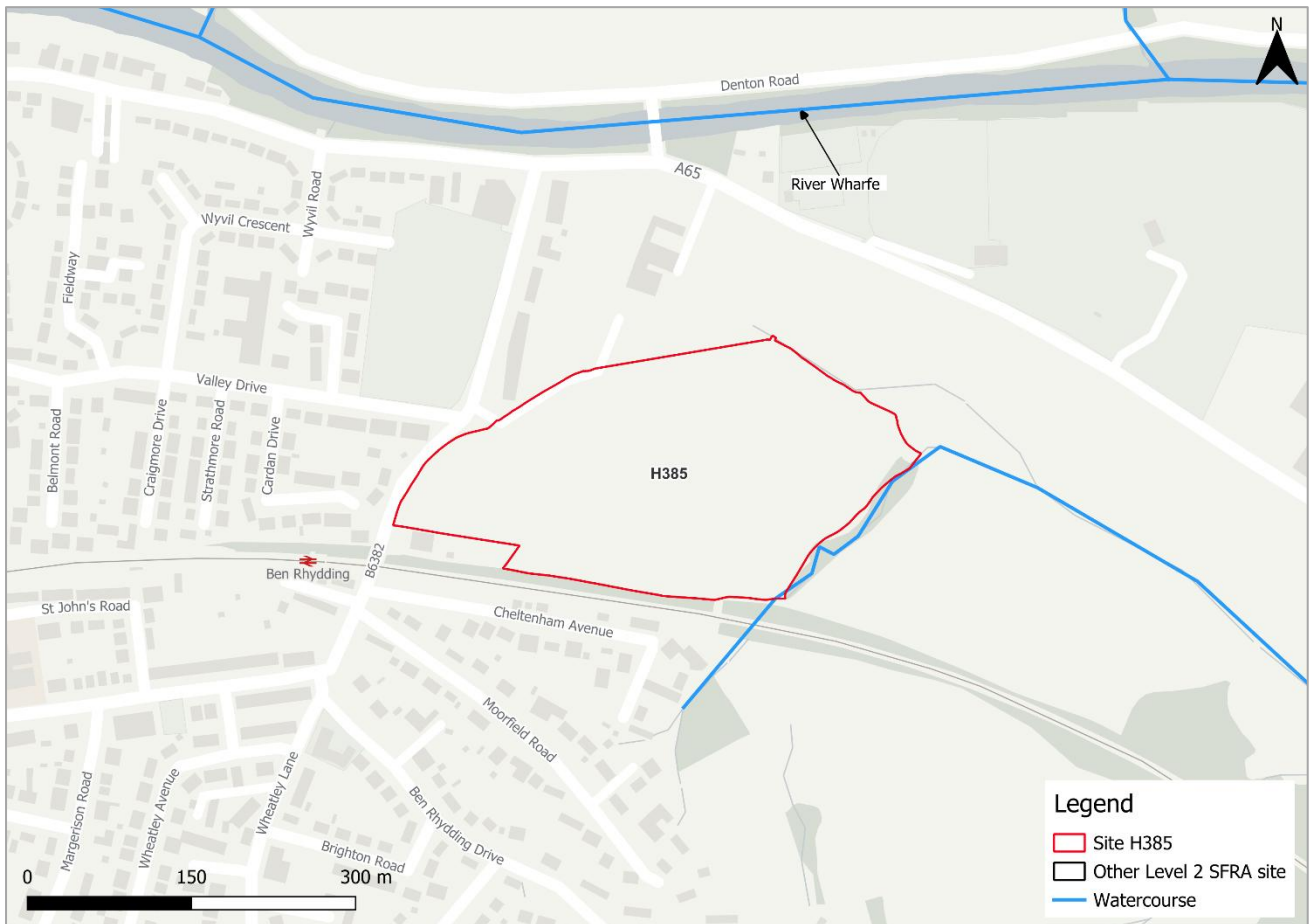


Figure 1-1: Existing site location boundary

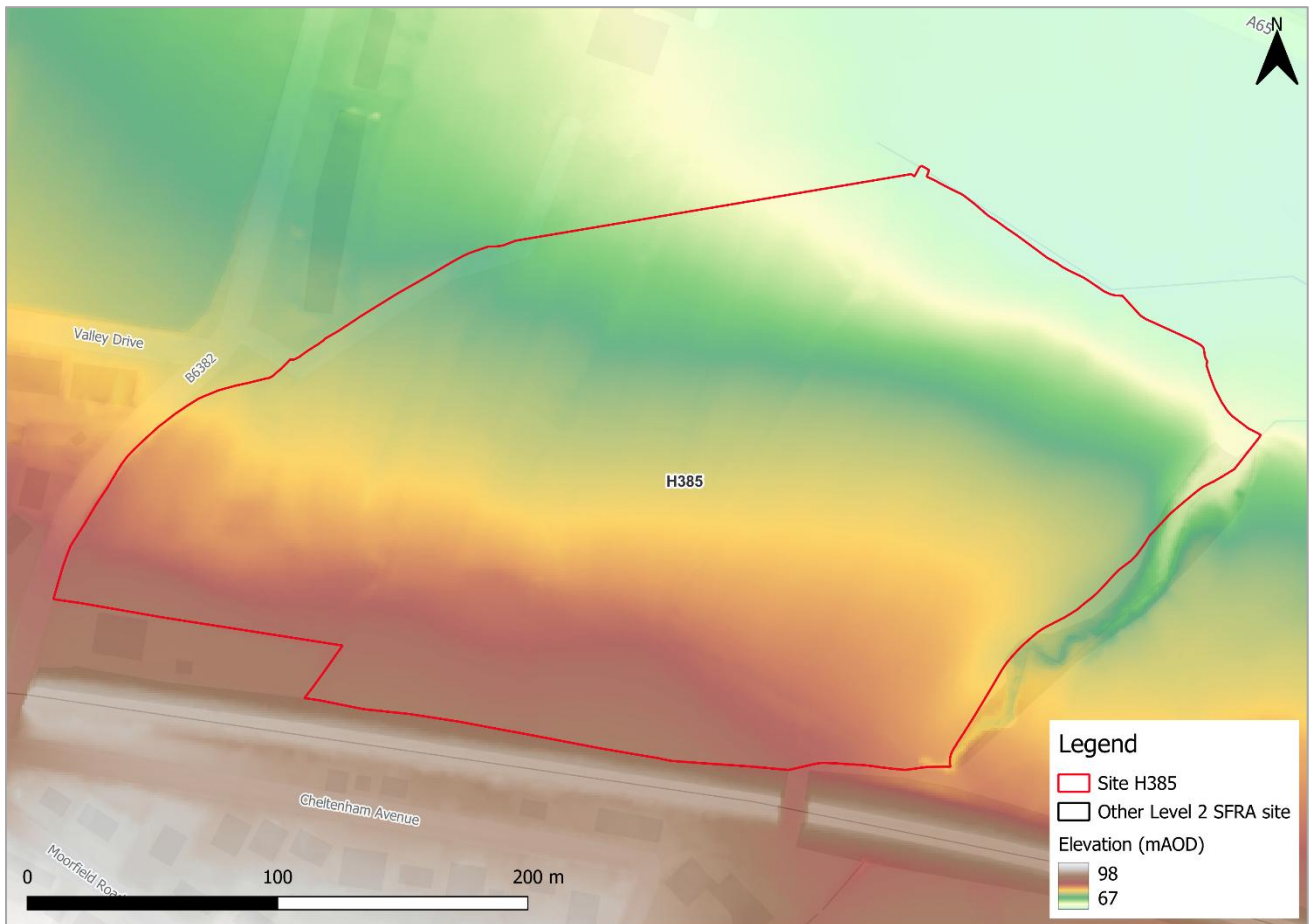


Figure 1-2: Topography



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 (September 2024) 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 2.4) or the impacts of climate change (Section 2.2).

Fluvial flood risk to the site comes from the River Wharfe located to the north of the site and potentially from the unnamed and unmodelled watercourse that runs along the eastern boundary of the site and into the Wharfe downstream. The River Wharfe is designated main river. Functional floodplain is present along the northeastern and eastern boundaries of the site. The functional floodplain in the north is based on the 3.33% AEP defended event from the Mid River Wharfe 2021 model. The functional floodplain along the eastern boundary represents the 8m buffer of the unnamed watercourse. The area of functional floodplain onsite should be left free of development. The north of the site is situated within Flood Zone 3a and therefore at high risk from the River Wharfe and 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)
91	2	4	3



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

2.1.2 Mid River Wharfe 2021 model outputs

The modelled flood depth information for the Mid River Wharfe model was derived through a 1D mapping process, which involves projecting 1D flood depths within the channel across a 2D LIDAR surface. This method assumes uniformity across each cross-section and does not account for the detailed variations in topography and flow behaviour that occur laterally. This process may lead to some differences between the resulting depth grid and the mapped flood extent provided by the Environment Agency, due to a different Digital Terrain Model (DTM) used to define the 2D floodplain.

Figure 2-2 shows the 1D mapped flood depths for the 1% AEP undefended event which is the event Flood Zone 3 of the Flood Map for Planning should be based on. However, modelled risk to the site is less than that shown by Flood Zone 3a, impacting the northeastern boundary of the site. Maximum flood depths within the site are modelled to be significant, between 0.9 and 1.2 m. Modelled flood velocities and hazards were not able to be derived through the 1D mapping process. Section 2.4.1 discusses the defended model outputs.

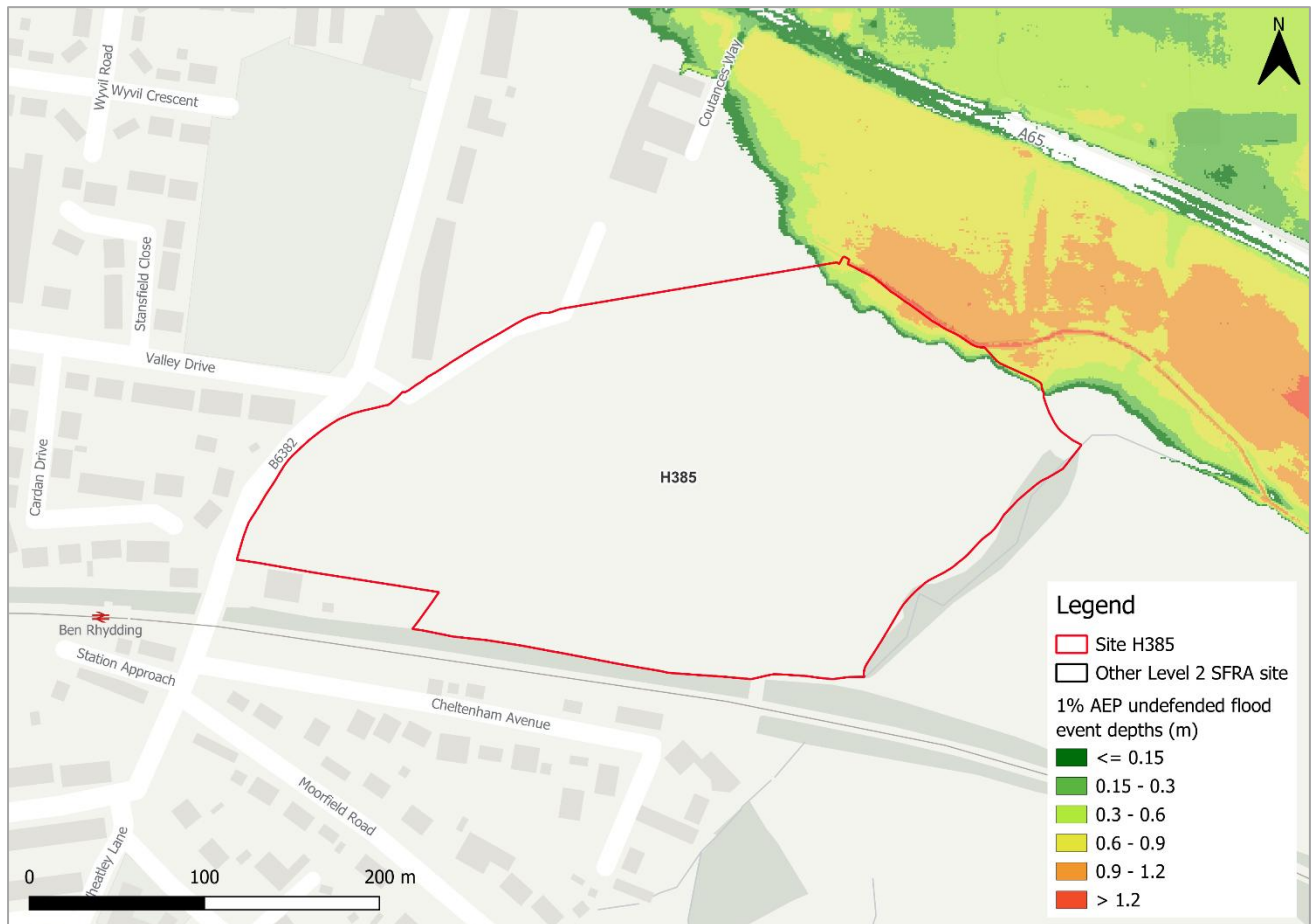


Figure 2-2: Flood depths for 1% AEP undefended flood event

2.2 Impacts from climate change

The impacts of climate change on flood risk from the River Wharfe have been modelled without flood defence infrastructure in place. This allows for direct comparison with the existing risk of the Flood Map for Planning. Section 2.4.1 discusses the defended model outputs.

With consideration of the EA's SFRA guidance, the latest climate change central and higher central allowances have been modelled as shown in Table 2-2. The site is situated within the Wharfe and Lower Ouse management catchment. However, for consistency, the Aire and Calder climate change allowances have been modelled across the entire Bradford authority area. The EA's SFRA guidance states that SFRAs should assess the central allowance for less, more, and highly vulnerable development, and also water compatible development. The higher central should be assessed for essential infrastructure.

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%

The functional floodplain plus climate change dataset indicates that the area of functional floodplain within the north of the site is likely to slightly increase in the future.

Figure 2-3 shows the onsite modelled flood depths for the 1% AEP undefended event +23% for climate change. Risk is modelled to be slightly greater in both extent and depth in comparison to present day conditions. Maximum depths within the area at risk are > 1.2 m and therefore significant, however this remains confined to the northeastern site boundary. Modelled flood velocities and hazards were not able to be derived through the 1D mapping process.

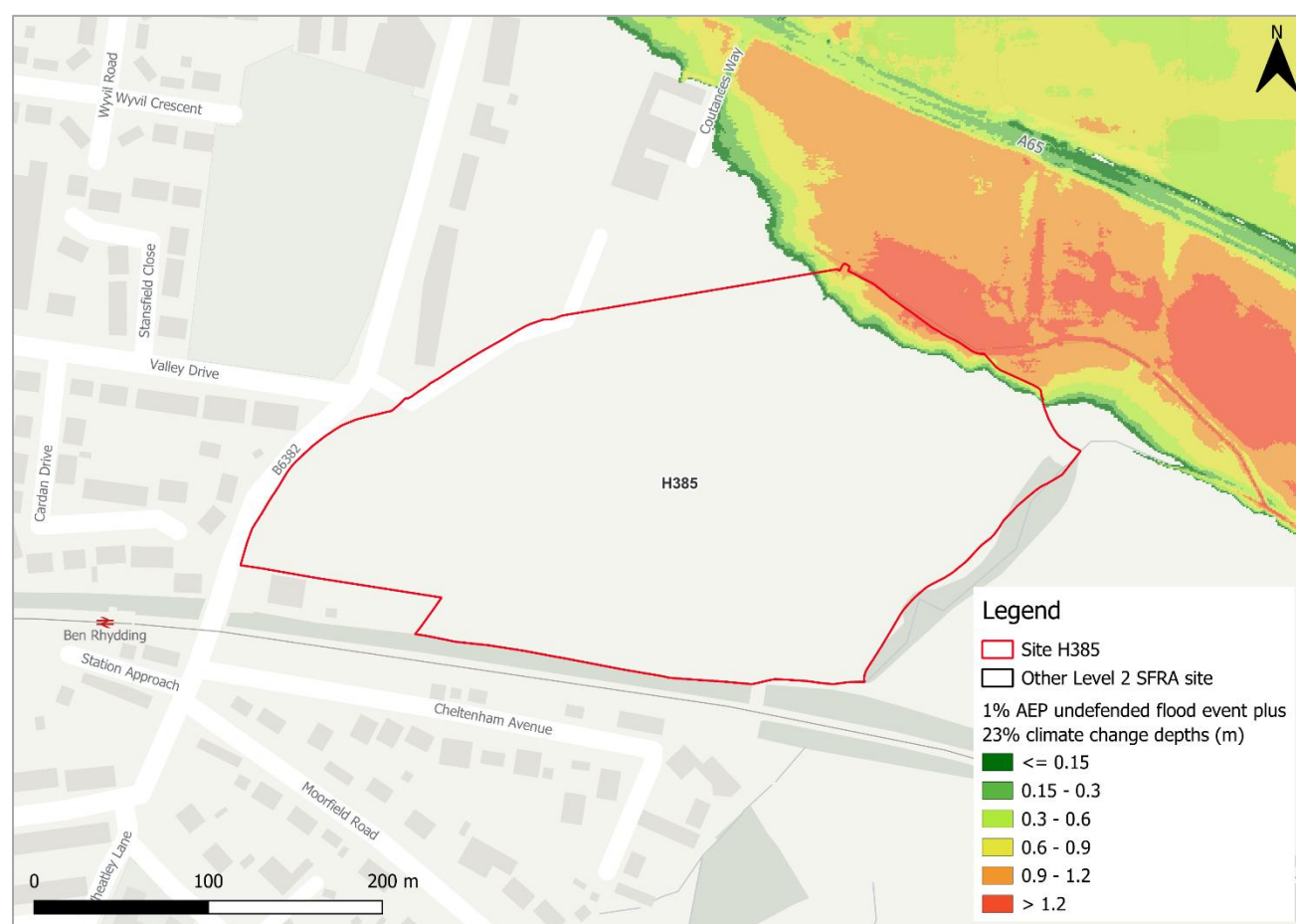


Figure 2-3: Flood depths for 1% AEP undefended flood event +23% (central climate change allowance)

2.3 Historic land-use mapping

Historic land-use mapping held by the LLFA indicates a watercourse along the western boundary of the site, which flows into the River Wharfe. This mapping also indicates a watercourse perpendicular to the northwestern site boundary and another perpendicular to the southern site boundary. This should be confirmed, and the exact locations ascertained, through site investigation. Potential flood risk from these watercourses may need to be ascertained at the FRA stage. No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.

2.4 Flood risk management

2.4.1 Flood defences

The site does not benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset. This is reflected in the defended modelled flood extent and depths being very similar to the undefended event within the site (Figure 2-4). This is consistent with the modelled climate change events. However, there are areas of natural high ground along the banks of the River Wharfe.

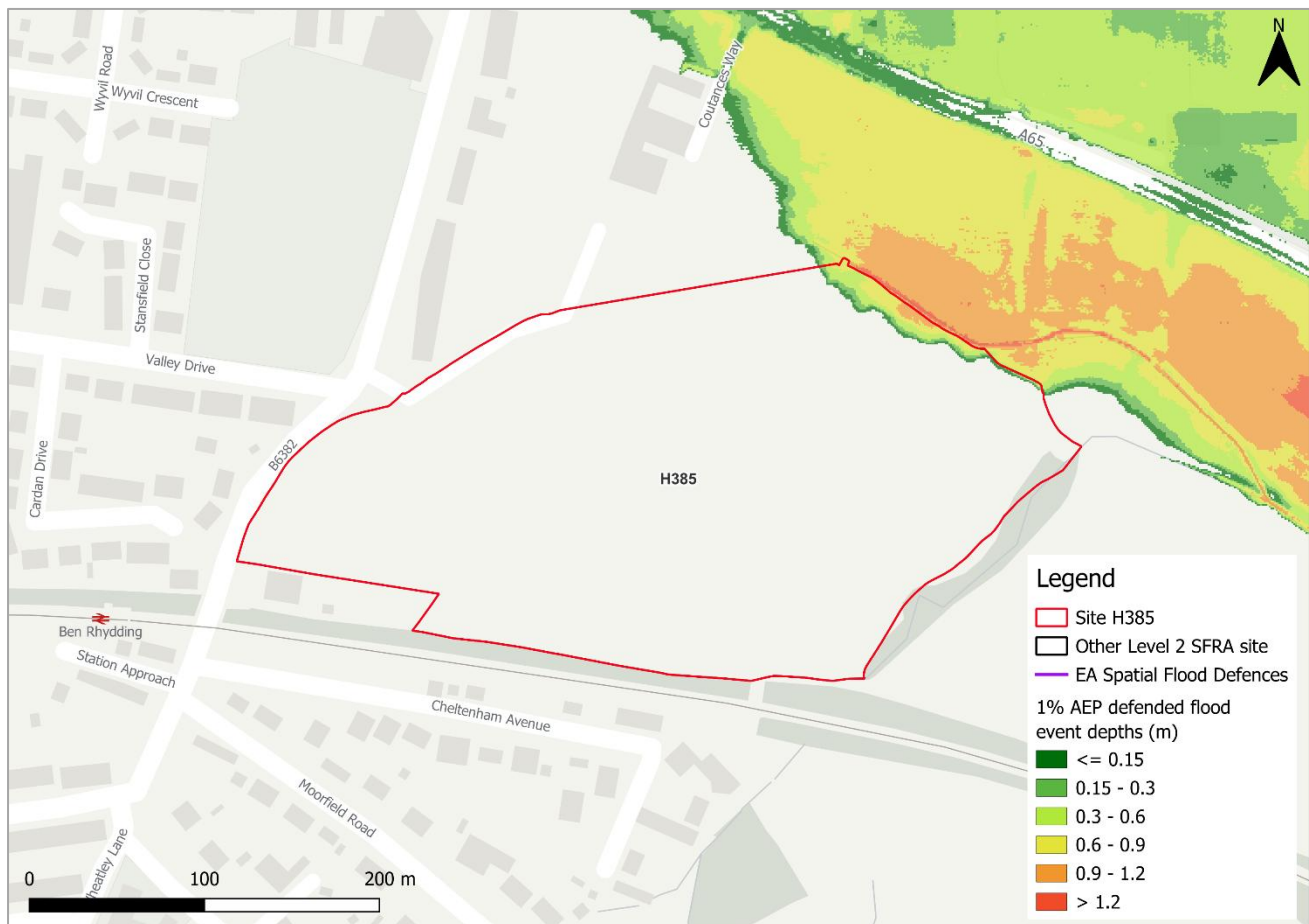


Figure 2-4: Flood depths for 1% AEP defended flood event

2.4.2 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. Within the site, there are opportunities for riparian, floodplain and wider catchment tree planting, effective to increase infiltration and attenuate flooding. These areas are shown in Figure 2-5. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

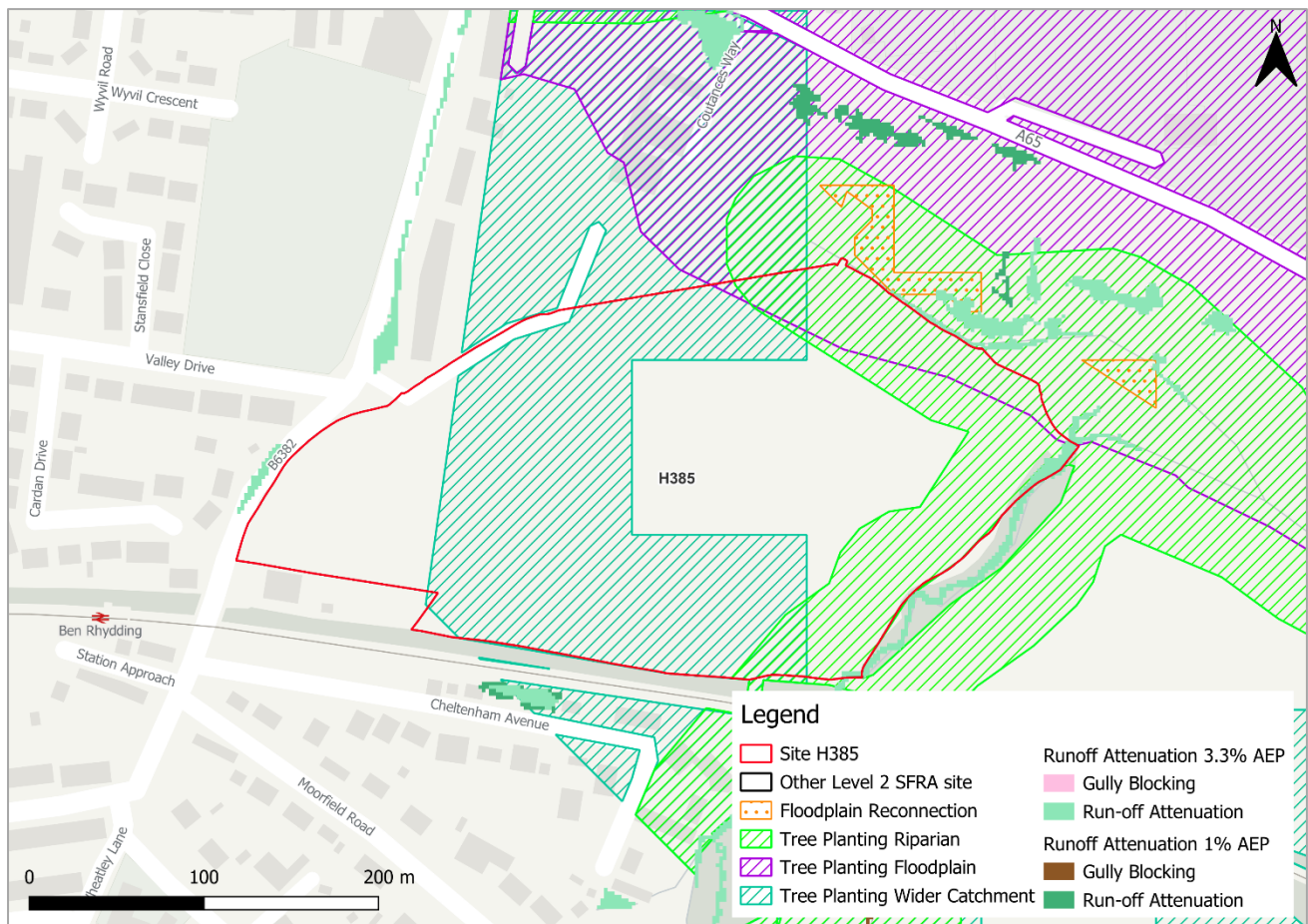


Figure 2-5: Natural Flood Management (NFM) potential mapping

2.5 Historic flood incidents

The EA's Historic Flood Map (HFM) has been considered. There are no recorded historic flood events within the site.

2.6 LLFA flood incidents

The LLFA have records of one flood incident taking place to the northwest of the site, which occurred in 2003. Developers should contact the LLFA for further information at the FRA stage, to assess potential flood risk to the site associated with these incidents.

2.7 Flood warning and access and escape routes

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 site is not located within a FWA.

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 site is partially located within a FAA, namely 122WAF942 - Upper River Wharfe.

Based on available information, safe access and escape routes would likely be achievable via the B6382 during a flood event.

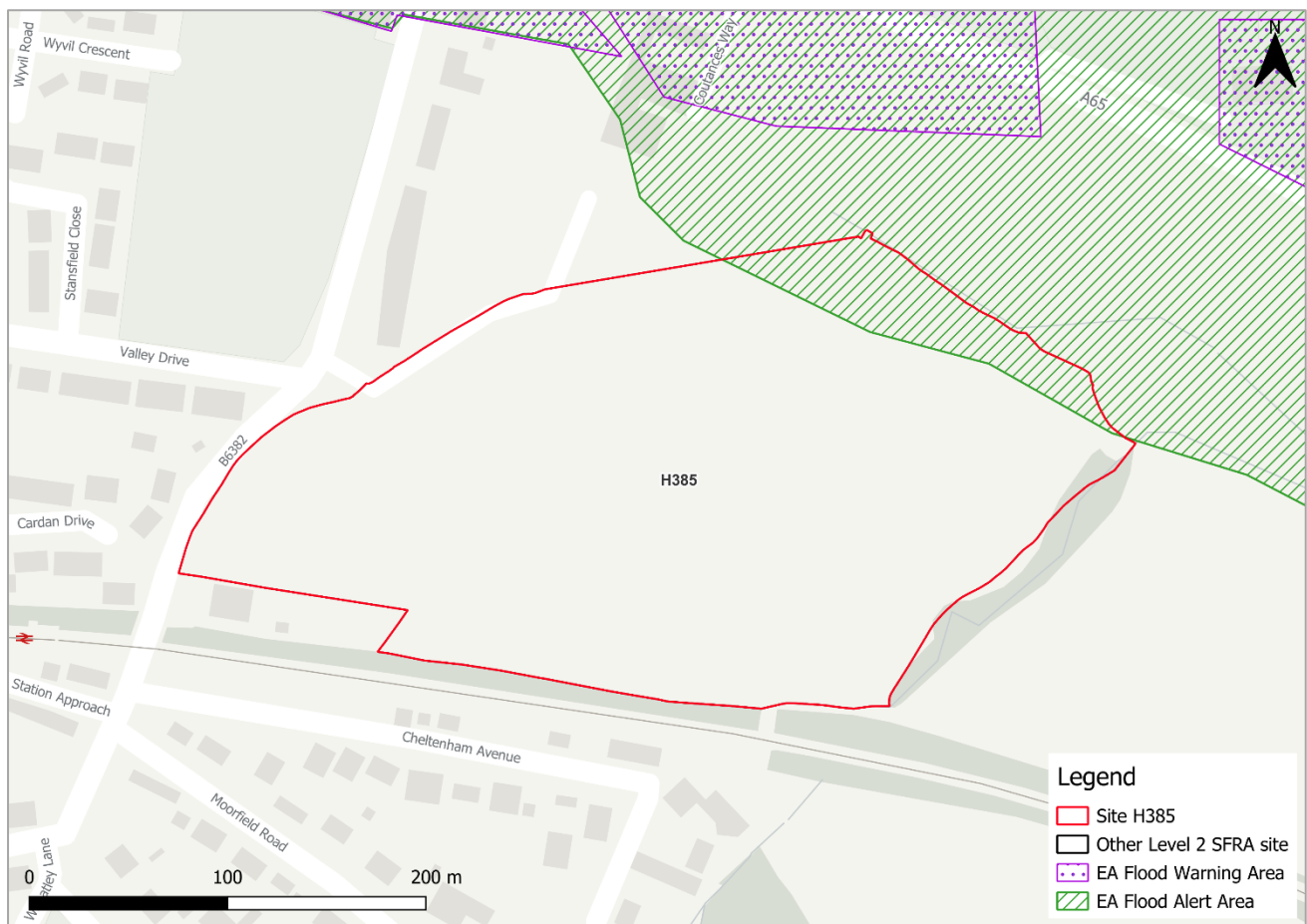


Figure 2-6: EA Flood Warning Areas and Flood Alert Areas

2.8 Observations, mitigation options and site suitability - fluvial

- 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 FRA must show that the development can be designed to be safe and that there is adequate emergency planning provision (para 014 FRCC-PPG).

- The site is partially located within the functional floodplain along the northern and eastern boundaries of the site. Development is not permitted within the functional floodplain, therefore the area at modelled risk within the north of the site and the buffer zone along the eastern boundary should remain free of development.
- An area along the northeastern boundary of the site is modelled to be at risk from fluvial sources (according to the Mid River Wharfe 2021 model) in the 1% AEP undefended scenario, to a lesser extent than Flood Zone 3a.
- Given the site is more vulnerable and within Flood Zone 3a, and also within the 1% AEP undefended event modelled flood outline, the site must be subject to and must pass the exception test. It should be possible to direct all development to Flood Zone 1, including for climate change, and therefore satisfy the requirements of 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 area of the site shown to be at risk in the 1% AEP undefended +23% climate change event is slightly greater than present day conditions and should be left free of development.
- Ideally, Flood Zone 2 would also remain free of more vulnerable development. this should be possible given 91% of the site is within Flood Zone 1.
- 2D flood modelling of the River Wharfe should be carried out at the FRA stage to understand the onsite hazards and velocities associated with a flood event.
- Modelling of the unnamed watercourses may be required to ascertain risk at the FRA stage. No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.
- Assuming a culvert is located beneath the site, opportunities for opening up the culvert should be explored for inclusion in site design as a blue green corridor. This would remove any residual risk of flooding to the site as a result of culvert failure or blockage.
- EA flood alerts should continue to be in place to ensure early evacuation of site users before an extreme flood event occurs.

3 Flood risk from surface water

3.1 Existing risk

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map (November 2024), surface water risk to the site is predominantly very low. Approximately 1% of the site is at high surface water risk. A further 1% of the site is at medium risk and a further 8% is at low surface water risk, as shown in Table 3-1.

In the high and medium risk events, surface water risk is confined to the channel of the unnamed watercourse present within the east of the site. An additional shallow flow path is modelled to develop adjacent to the existing watercourse. The medium risk area is within the fluvial Flood Zone 3b area onsite. The flow path appears to originate offsite south of the railway line before flowing through a culvert under the railway and downhill to the floodplain of the Wharfe.

Greatest flood depths within the site in the medium risk event are > 1.2 m (Figure 3-1) with areas of extreme hazard (Figure 3-2), however these are confined to the existing watercourse present adjacent to the eastern site boundary. Outside of the watercourse, maximum depths are modelled to be < 0.15 m with hazard categorised as low. Safe access and escape routes via the B6382 should be achievable in the high and medium risk events. In the low risk event, safe routes may be challenging to achieve given the modelled surface water flood 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)
90	8	1	1

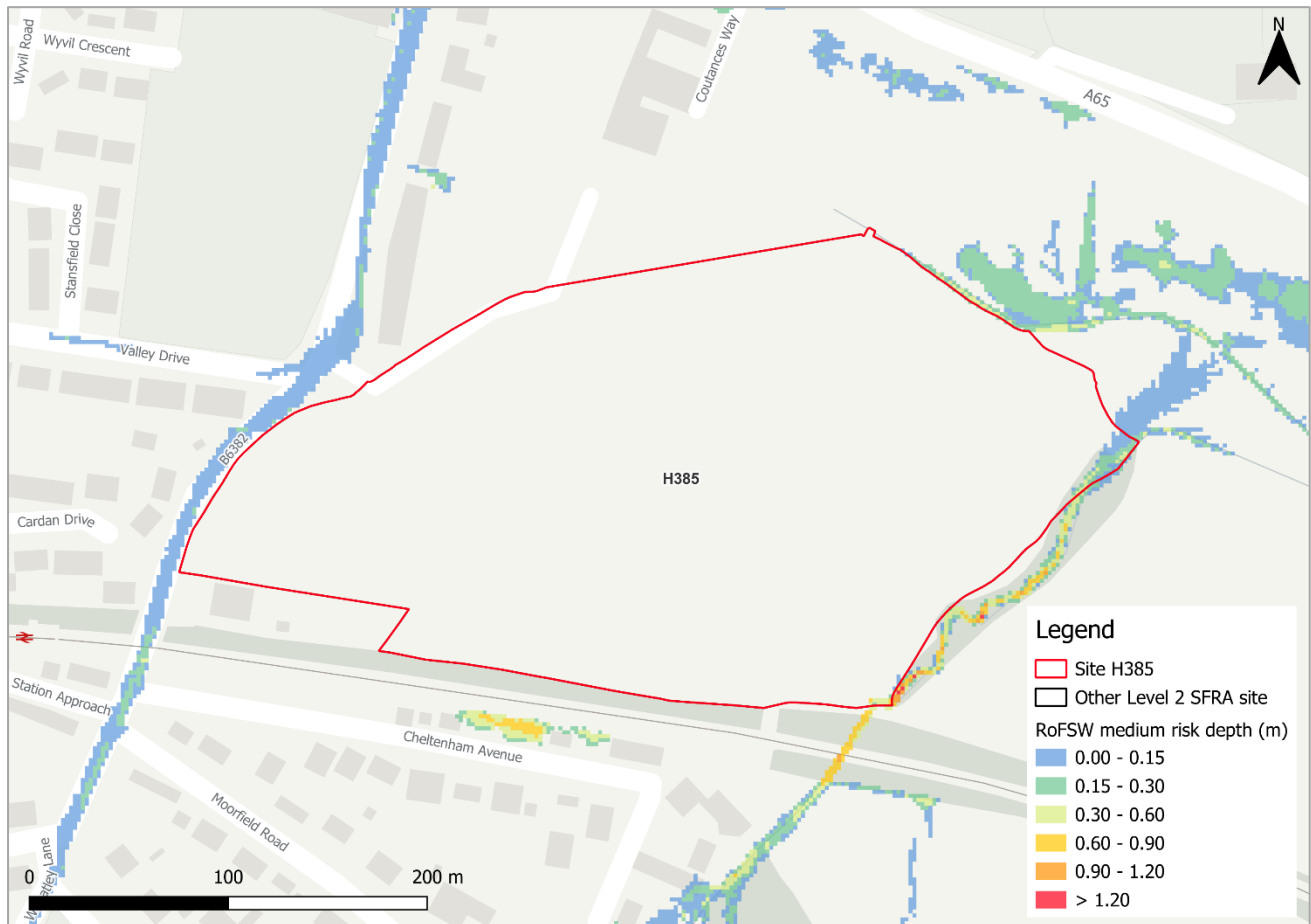


Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)



Figure 3-2: Medium risk event surface water flood hazard¹ (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

The impact of climate change on surface water flood risk has been modelled. This allows for direct comparison with the RoFSW map. With consideration of the EA's SFRA guidance, the latest climate change allowances have been modelled as shown in Table 3-2. The site is situated within the Wharfe and Lower Ouse management catchment. However, for consistency, the Aire and Calder climate change allowances have been modelled across the entire Bradford authority area.

Table 3-2: Modelled climate change allowances for rainfall for the Aire and Calder management catchment

Return period	Central allowance 2070s (% increase)	Upper end allowance 2070s (% increase)
3.3% (high risk)	25%	40%
1% (medium risk)	30%	45%

¹ 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 3-3 shows the modelled surface water flood depths for the medium risk event plus 45% climate change. Risk is modelled to be greater than for present day conditions, with the medium risk climate change event showing a similar level of risk to the present day low risk event. A shallow flow path forms and flows through the east of the site to the Wharfe floodplain. Maximum depths outside of the existing watercourse on site are modelled to be between 0.15 and 0.3 m, with areas of hazard categorised as moderate (Figure 3-4). Safe access and escape routes may be challenging to achieve during the climate change event though depths are predominantly shallow and hazards moderate.

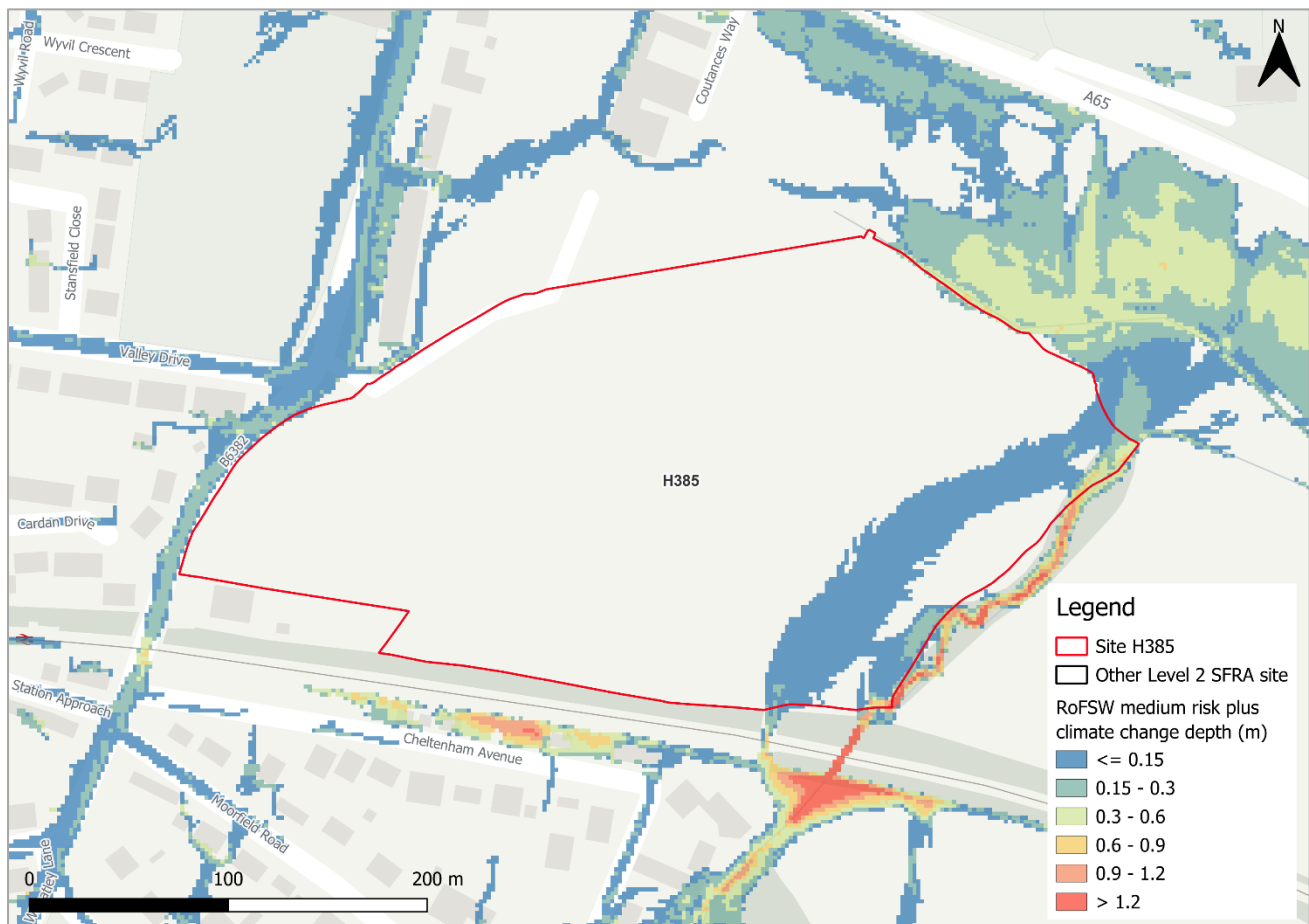


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

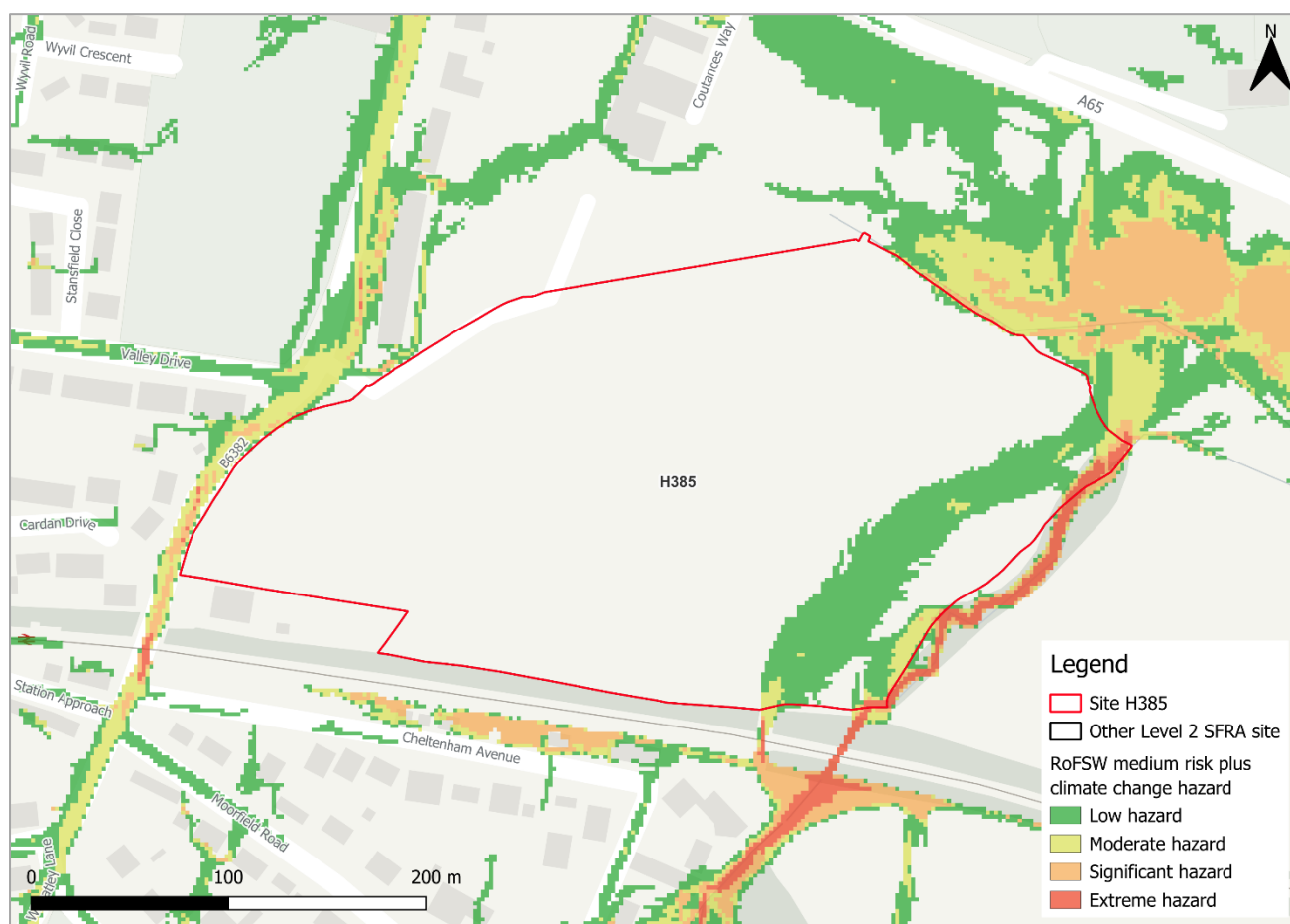


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk is largely confined to the unnamed watercourse onsite, and a shallow surface water flow path through the east of the site in the low risk event. Topographic flow paths 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.
- The unnamed watercourse should be maintained and included within the landscaping design of the residential development. Appropriate flood modelling may be required.
- Safe access and escape routes may be challenging to achieve in the present day low risk event and medium risk plus climate change event based on the modelled surface water flood depths and hazards along the B6382 (Wheatley Lane).
- A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This may require surface water modelling based on layout plans and detailed design and full consultation with the LLFA. Runoff volumes must not exceed existing greenfield rates and, if possible, betterment should be achieved.

- 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 Guide². Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

The risk of groundwater emergence varies across the site. The majority of the site is within an area where there is no risk of groundwater emergence. Groundwater conditions may therefore be suited to infiltration SuDS in these areas. Within the east of the site, where there are surface water flow paths present, there is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely. There are also some small areas within the east where there is a risk of groundwater flooding to surface and subsurface assets. Ground survey, including percolation testing may be required to fully ascertain groundwater conditions at the site.

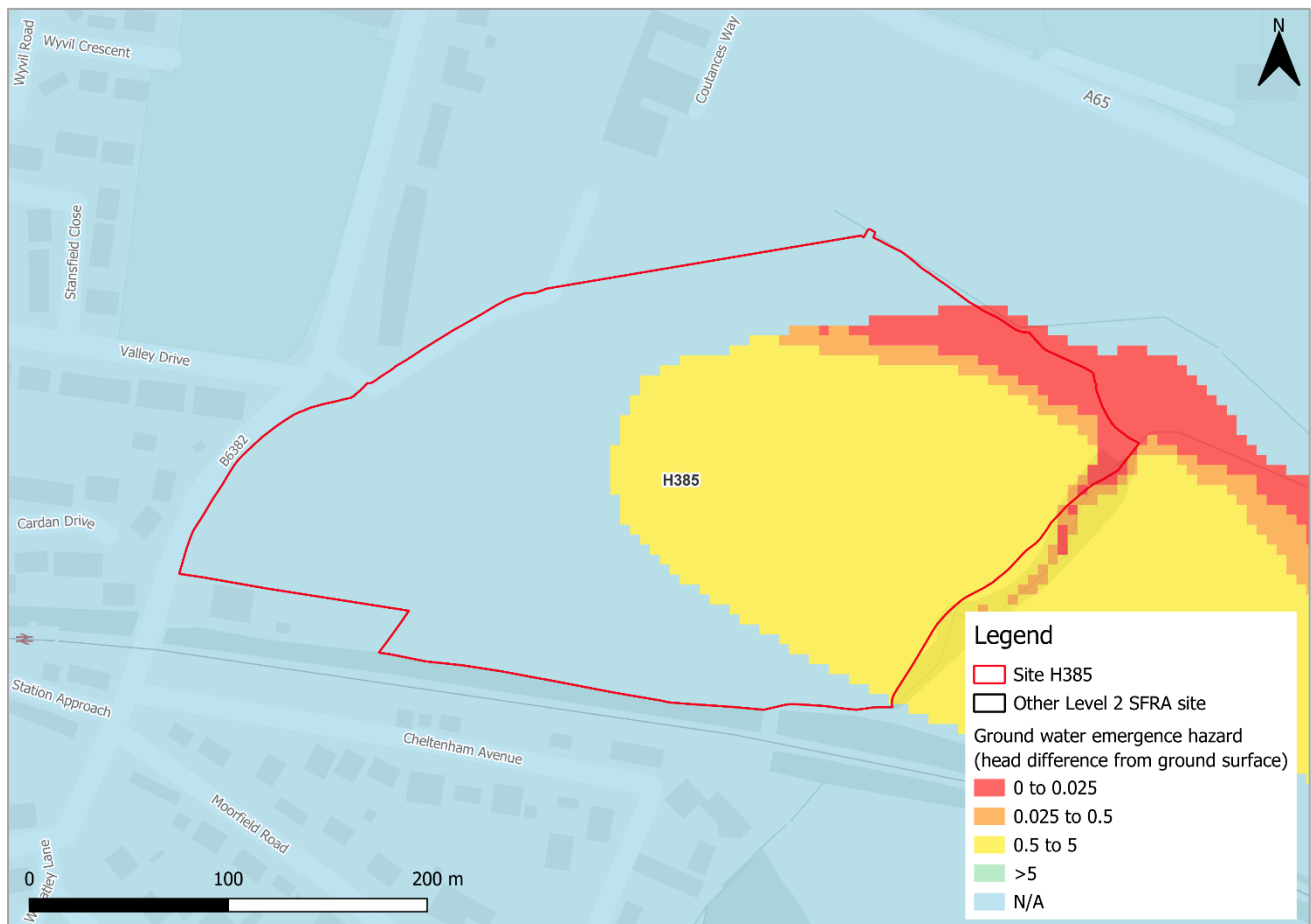


Figure 4-1: JBA 5m Groundwater Emergence Map

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

5.1 Potential culvert

Historic land-use mapping held by the LLFA, indicates that there may be a watercourse culverted along the northwestern boundary of the site, as well as two other watercourses perpendicular to the northern and southern site boundaries. If watercourses are present, there will be a residual risk of flooding to the site were there to be a culvert failure or blockage. Models for these watercourses are not available. Therefore, residual risk could not be modelled for this Level 2 SFRA.

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 5-1 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 six reservoirs, namely; Barden Lower, Barden Upper, Chelker, Grimwith, March Ghyll and Panorama reservoirs. Of these, one is located within Bradford and five are located within North Yorkshire. These are all operated by Yorkshire Water Services Ltd.

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 Yorkshire Water Services Ltd 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.

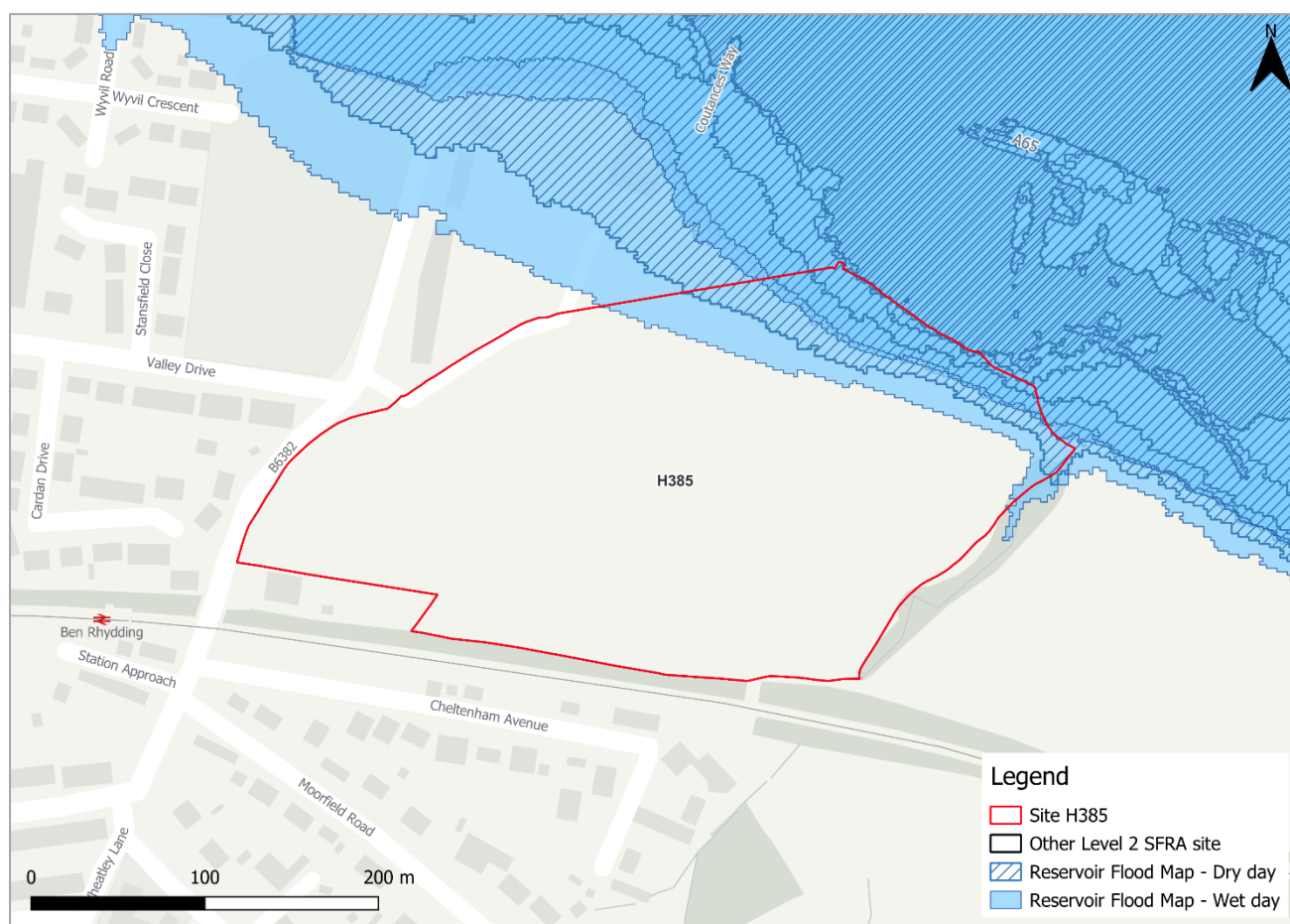


Figure 5-1: Flood risk from reservoirs

5.3 Flood risk from sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes overloaded or blocked, or it cannot discharge due to high water levels in the receiving watercourse.

According to Yorkshire Water's records, there have been no incidents of sewer flooding in the area over the last two years.

5.4 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a breach of six reservoirs. However, only four reservoirs impact the site in the 'dry day' flood extent. This indicates that the remaining two reservoirs are only 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 any actual flood would be this large.
- Given the potential reservoir risk to the site, developers should consider³:
 - Consulting with the local resilience forum for advice on emergency planning,

³ [Reservoir flood maps: when and how to use them | Environment Agency | 2021](#)

- 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.
- Historic mapping indicates there may be a watercourse culverted along the northwestern site boundary, as well as two other watercourses perpendicular to the northern and southern site boundaries. If present, culverts represent potential residual risk of flooding to the site through culvert failure or blockage. This may need to be further investigated and modelled at the FRA stage.

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 test⁴, 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 100 years for residential development. Based on the available information documented within this Level 2 SFRA, this site should be able to pass the exception test provided development is directed to the areas of the site within Flood Zone 1, including for the impacts of climate change.

6.2 Recommendations, FRA requirements, and further work

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

- It should be possible to develop this site for more vulnerable uses.
- There should be no development within the existing area of functional floodplain present on site.
- Development should be directed away from the northeast of the site modelled to be at fluvial flood risk.
- Historic mapping indicates there may be a watercourse culverted along the northwestern site boundary, as well as two other watercourses perpendicular to the northern and southern site boundaries. If present, culverts represent potential residual risk of flooding to the site through culvert failure or blockage. This may need to be further investigated and modelled at the FRA stage. Modelling should include for residual risk and options for culvert removal.
- No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.
- Assuming culverts are located beneath the site, opportunities for opening up the culverts should be explored for inclusion in site design as a blue green corridor. This would remove any residual risk of flooding to the site as a result of culvert failure or blockage.
- Safe access and escape routes during the medium risk plus climate change event must be considered further as part of a site-specific FRA.
- Any FRA should consider undertaking detailed 2D flood modelling of the River Wharfe in this location to understand the onsite hazards and velocities associated with a flood event. The unnamed watercourse may also require modelling.
- 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

⁴ 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 H386

Final Draft

May 2025

Prepared for:



City of
BRADFORD
METROPOLITAN DISTRICT COUNCIL

www.jbaconsulting.com

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Contract

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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. Dominic Richardson 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 H386. 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' (2025) and is therefore familiar with the terminology used in this report.

1.1 Site H386

- Location: Stockeld Road
- Existing site use: Open greenspace and car park
- Existing site use vulnerability: Less Vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 0.23 hectares
- Proposed development impermeable area: 0.23 hectares
- Watercourse: River Wharfe (main river)
- Environment Agency (EA) river model: Mid River Wharfe 2021
- 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 latest EA climate change allowances for peak river flows and peak rainfall intensities



Figure 1-1: Existing site location boundary

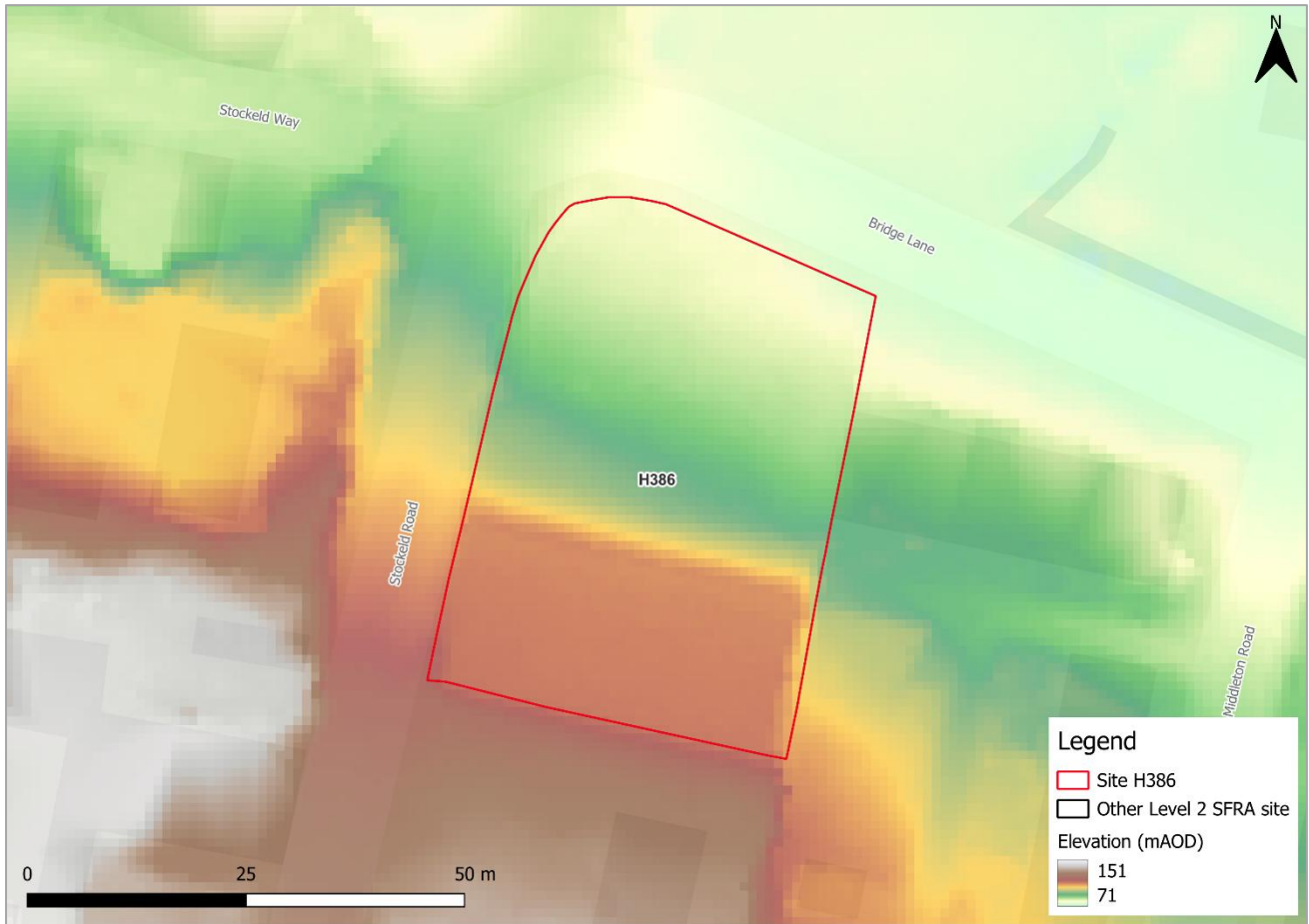


Figure 1-2: Topography



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 (September 2024) 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) or the impacts of climate change (Section 2.2).

Fluvial flood risk to the site comes from the River Wharfe adjacent to the northern site boundary. The River Wharfe is a designated main river. A nominal area of functional floodplain is present within the northeast corner of the site. The functional floodplain in this location is based on the 3.33% AEP defended event from the Mid River Wharfe 2021 model. The fluvial risk area is currently greenfield land.

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	6	1	1



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

2.1.2 Mid River Wharfe 2021 model outputs

The modelled flood depth information for the Mid River Wharfe model was derived through a 1D mapping process, which involves projecting 1D flood depths within the channel across a 2D LIDAR surface. This method assumes uniformity across each cross-section and does not account for the detailed variations in topography and flow behaviour that occur laterally. This process may lead to some differences between the resulting depth grid and the mapped flood extent provided by the Environment Agency, due to a different Digital Terrain Model (DTM) used to define the 2D floodplain.

Figure 2-2 shows the 1D mapped flood depths for the 1% AEP undefended event, which is the event Flood Zone 3 of the Flood Map for Planning should be based on. However, modelled risk to the site is marginally less than that shown by Flood Zone 3a, although also impacts upon the northeastern boundary of the site. Maximum flood depths within the site are modelled to be moderate, between 0.6 and 0.9 m. Modelled flood velocities and hazards were not able to be derived through the 1D mapping process.

1D mapped flood depths for the 0.1% AEP undefended event, which is the event Flood Zone 2 of the Flood Map for Planning should be based on could not be generated due to issues with the 1D results files for these events. Figure 2-3 shows the 1D mapped onsite modelled flood depths for the 1% AEP undefended event +51% for climate change, which

is the closest proxy for the 0.1% AEP event. Maximum flood depths within the site are modelled to be moderate, between 0.9 and 1.2 m. Modelled flood velocities and hazards were not able to be derived through the 1D mapping process.

Section 2.3.1 discusses the defended model outputs.

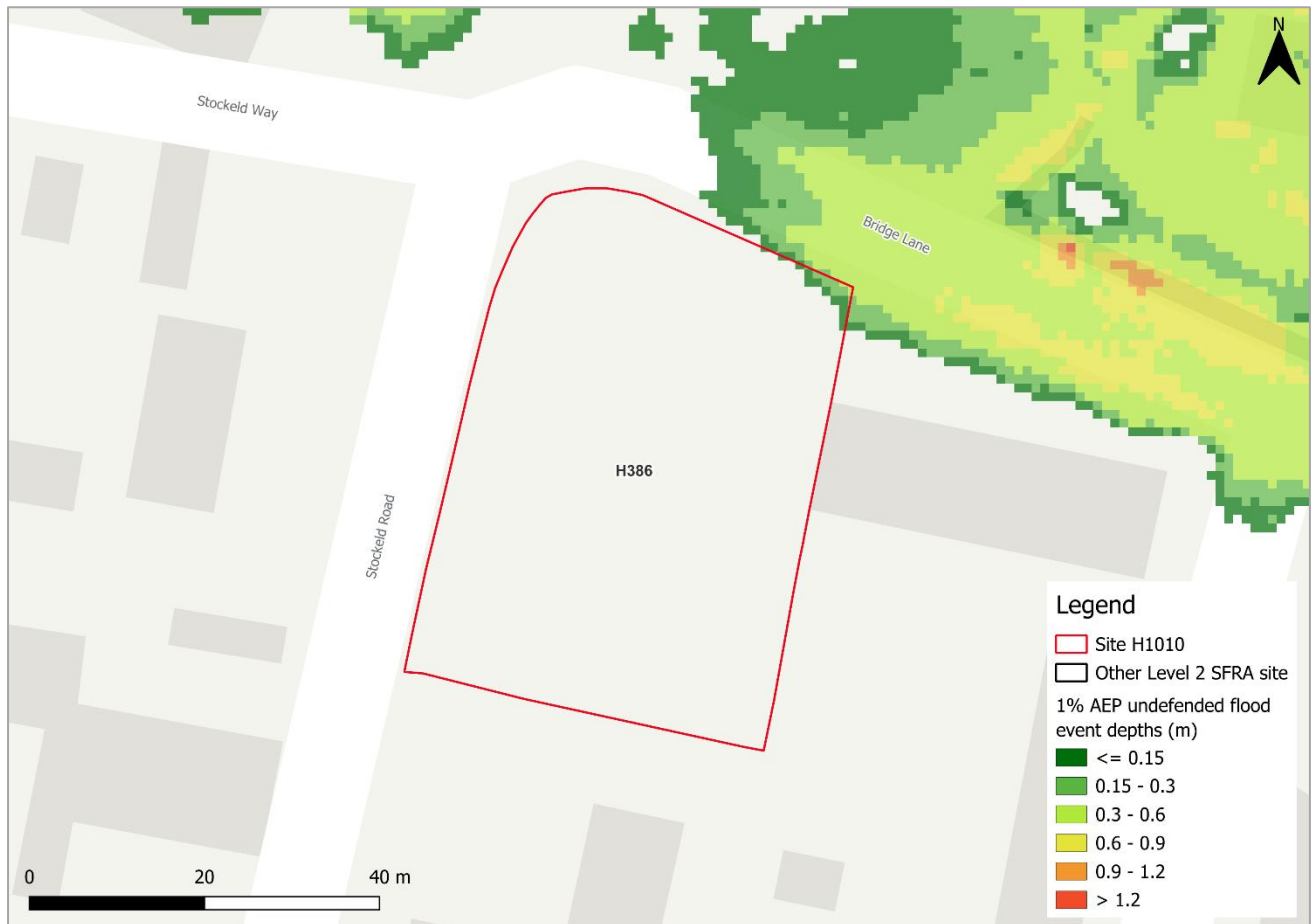


Figure 2-2: Flood depths for 1% AEP undefended flood event

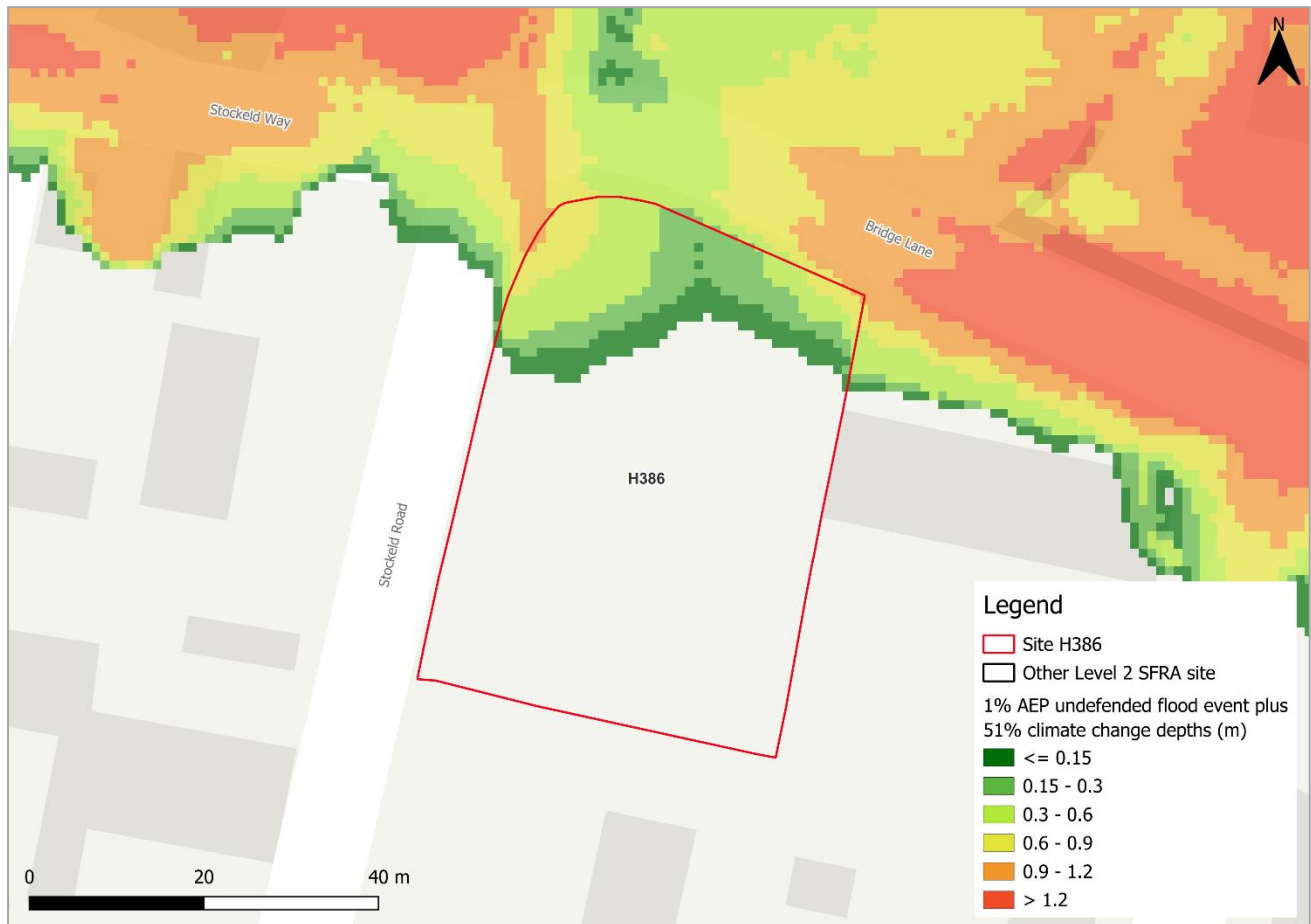


Figure 2-3: Flood depths for 1% AEP undefended flood event +51% (upper end climate change allowance)

2.2 Impacts from climate change

The impacts of climate change on flood risk from the River Wharfe have been modelled without flood defence infrastructure in place. This allows for direct comparison with the existing risk of the Flood Map for Planning. Section 2.3.1 discusses the defended model outputs.

With consideration of the EA's SFRA guidance, the latest climate change central and higher central allowances have been modelled as shown in

Table 2-2. The EA's SFRA guidance states that SFRAs should assess the central allowance for less, more, and highly vulnerable development, and also water compatible development. The higher central allowance should be assessed for essential infrastructure.

Table 2-2: Modelled climate change allowances for peak river flows for the Wharfe and Lower Ouse 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%	48%
1%	23%	31%	48%

The functional floodplain plus climate change dataset indicates that the area of functional floodplain onsite is likely to increase to a greater extent than the present-day Flood Zone 3a in the future.

Figure 2-4 shows the onsite modelled flood depths for the 1% AEP undefended event +23% for climate change. Risk is modelled to be greater in extent when compared to present day conditions. Maximum depths within the area at risk are moderate, of between 0.6 m to 0.9 m in parts of the northern areas of the site. Safe access and escape routes are anticipated to remain viable via Stockeld Road to the southwest of the site.

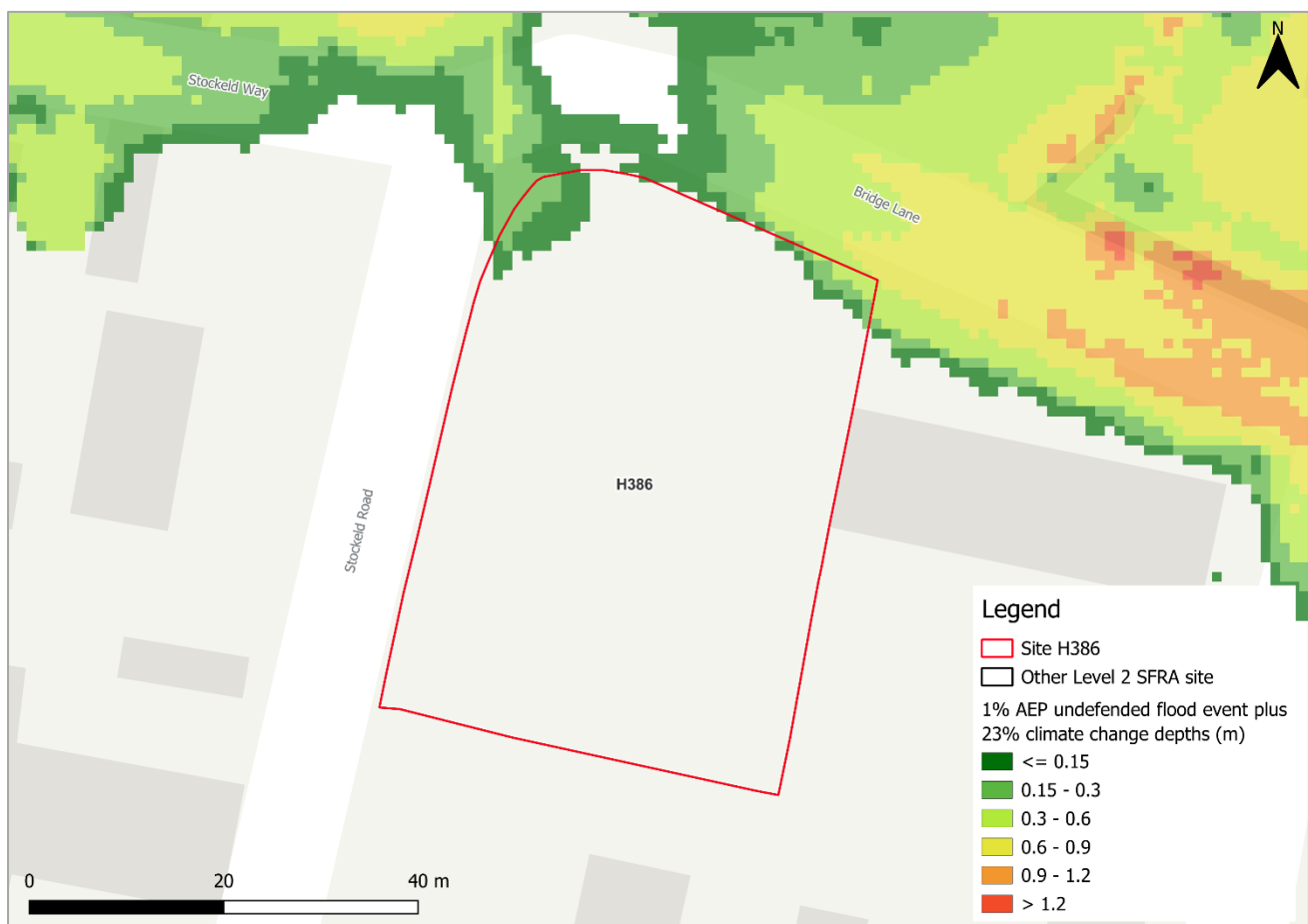


Figure 2-4: Flood depths for 1% AEP undefended flood event +23% (central climate change allowance)

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. This is reflected in the defended modelled flood extent and depths being very similar to the undefended event within the site (Figure 2-5). This is consistent with the modelled climate change events.

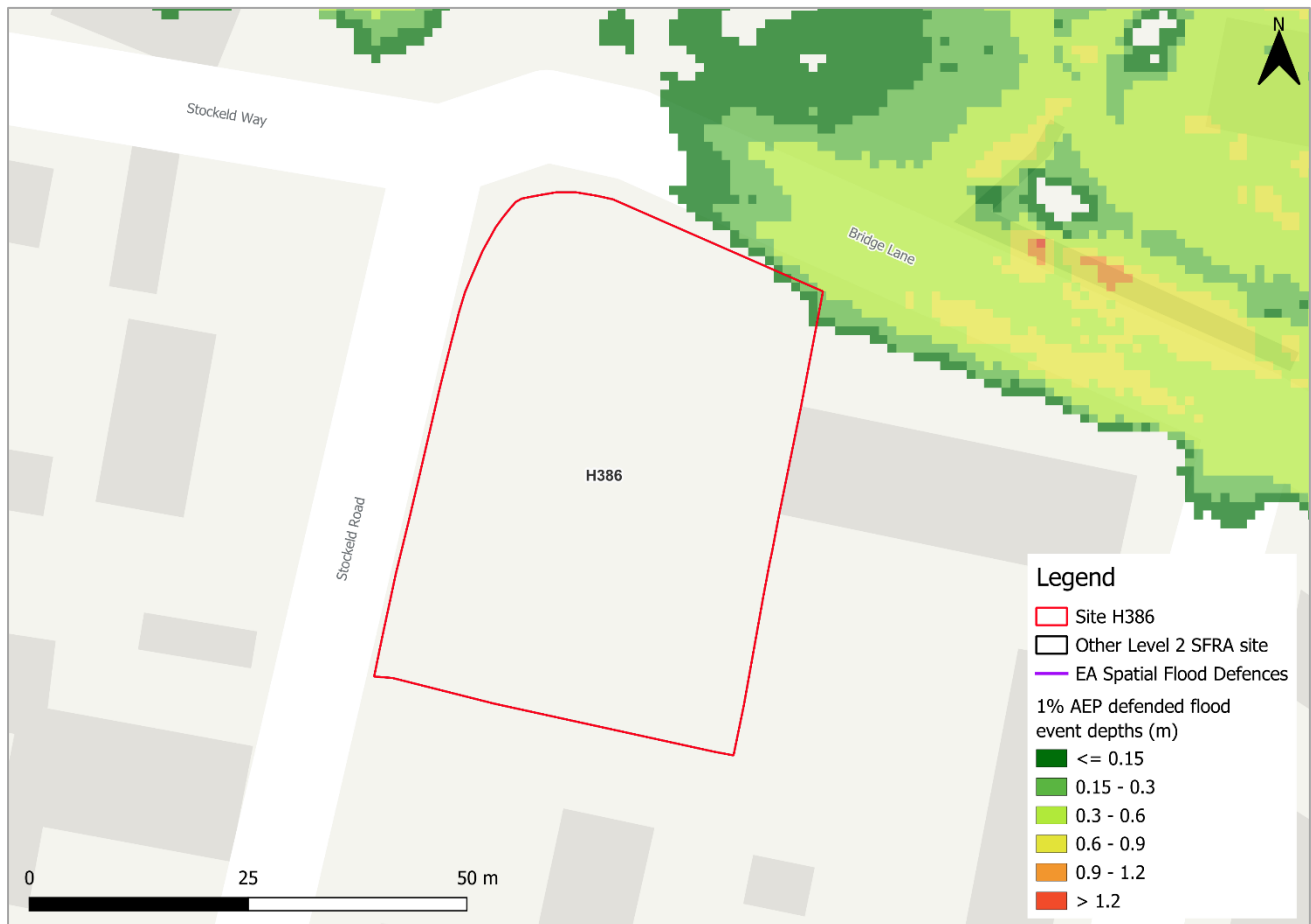


Figure 2-5: Flood depths for 1% AEP defended flood event

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. To the west of the site, upstream, there are opportunities for riparian and floodplain tree planting, effective to increase infiltration and attenuate flooding. There are additionally opportunities for floodplain reconnection upstream of the site to the west and northwest of the site. These areas are shown in Figure 2-6.

The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

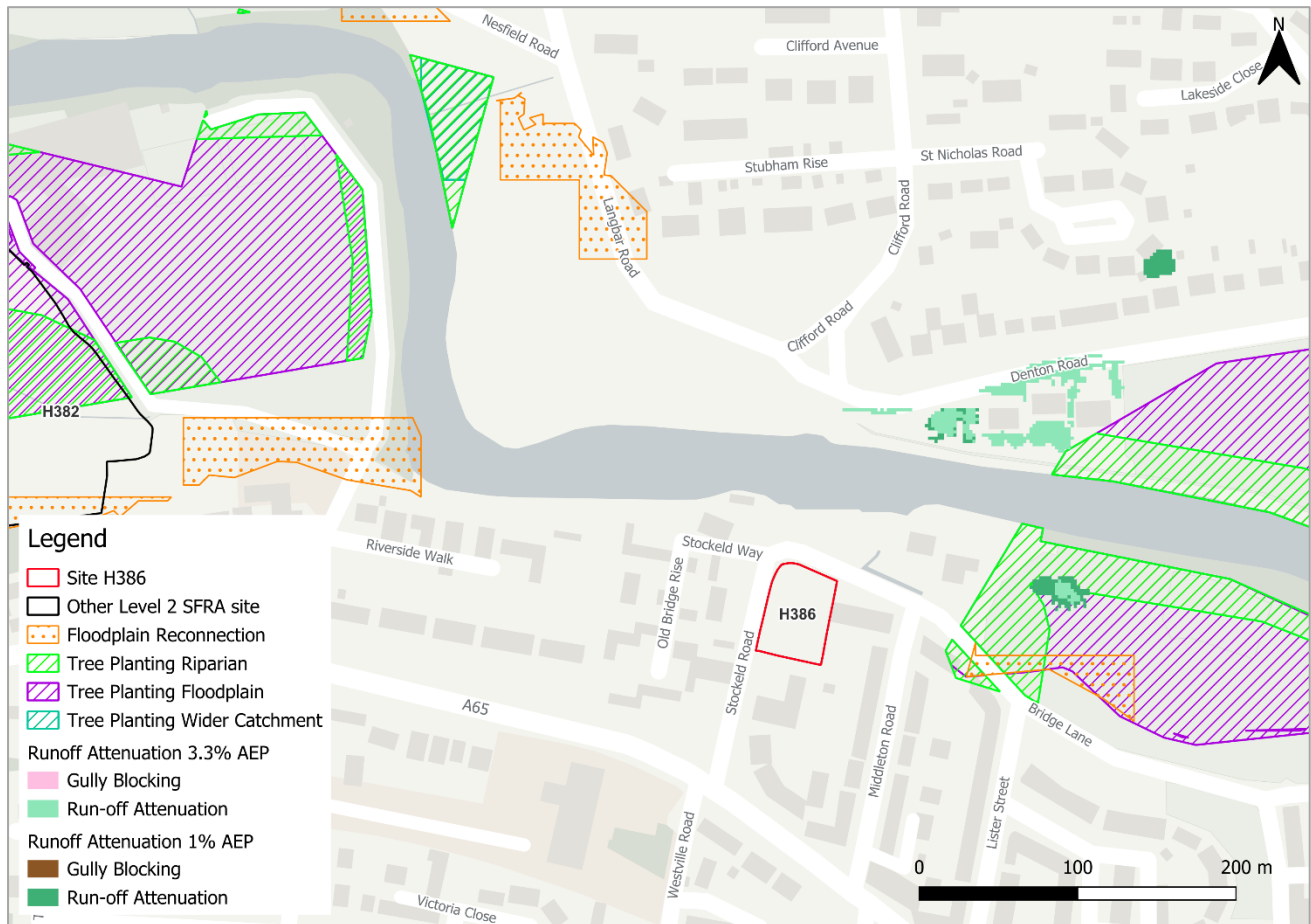


Figure 2-6 Natural Flood Management (NFM) potential mapping

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) has been considered and mapped in Figure 2-7 which shows the north of the site has been subject to flooding in the past. The RFO dataset indicates that these historic events have occurred as a result of the channel capacity of the River Wharfe being exceeded in December 2015, and an unspecified ordinary watercourse exceeding bank levels in October/November 2020 as the remnants of Hurricane Epsilon impacted the UK.

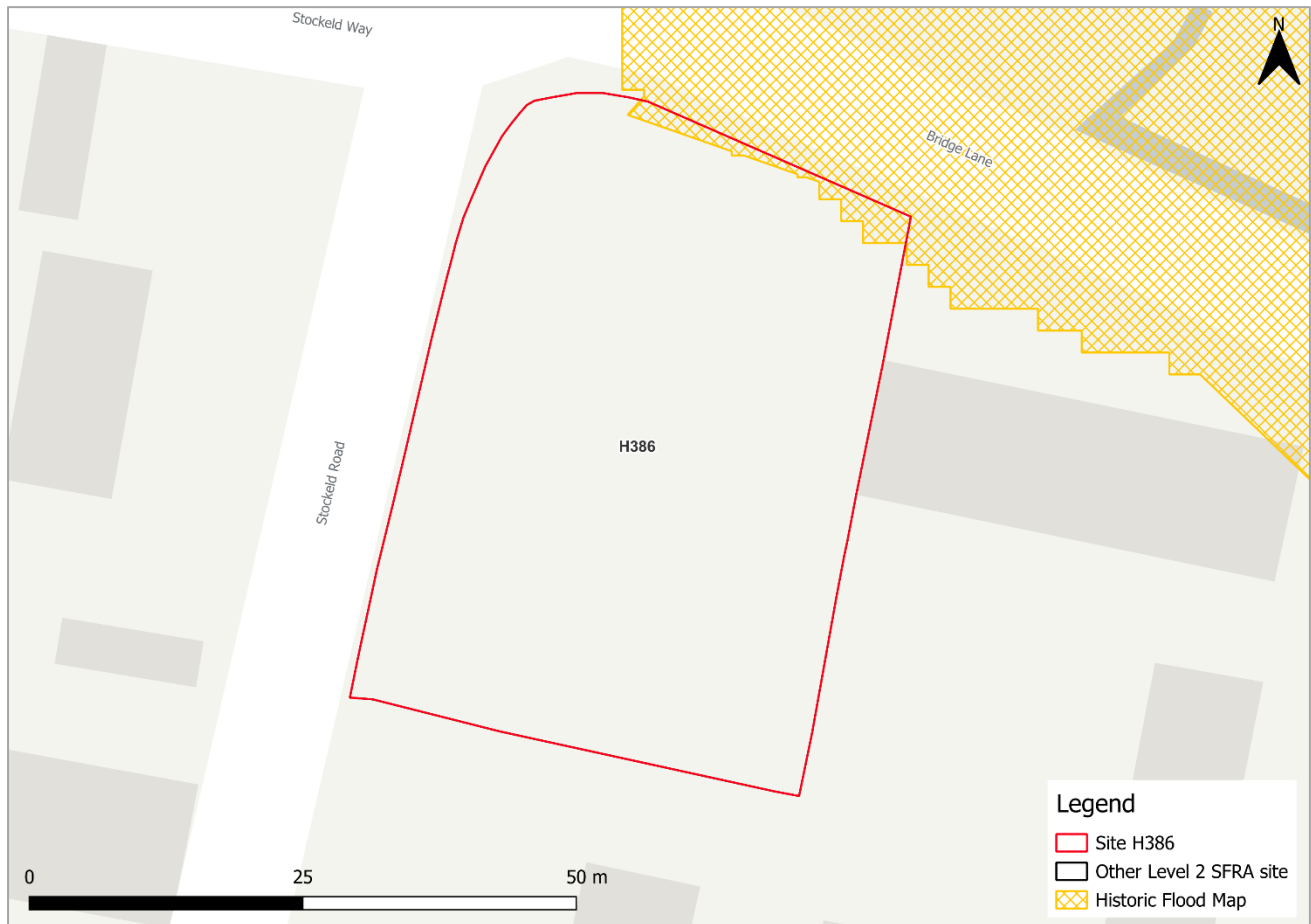


Figure 2-7: Recorded historic flood events onsite and around the site

2.5 Flood warning and access and escape routes

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 area adjacent to the northern boundary of the site is located within a FWA, namely 122FWF532 - River Wharfe at Ilkley.

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 area adjacent to the northern boundary of the site is also located within a FAA, namely 122WAF942 - Upper River Wharfe.

Based on available information, safe access and escape routes are anticipated to be achievable via Stockeld Road.

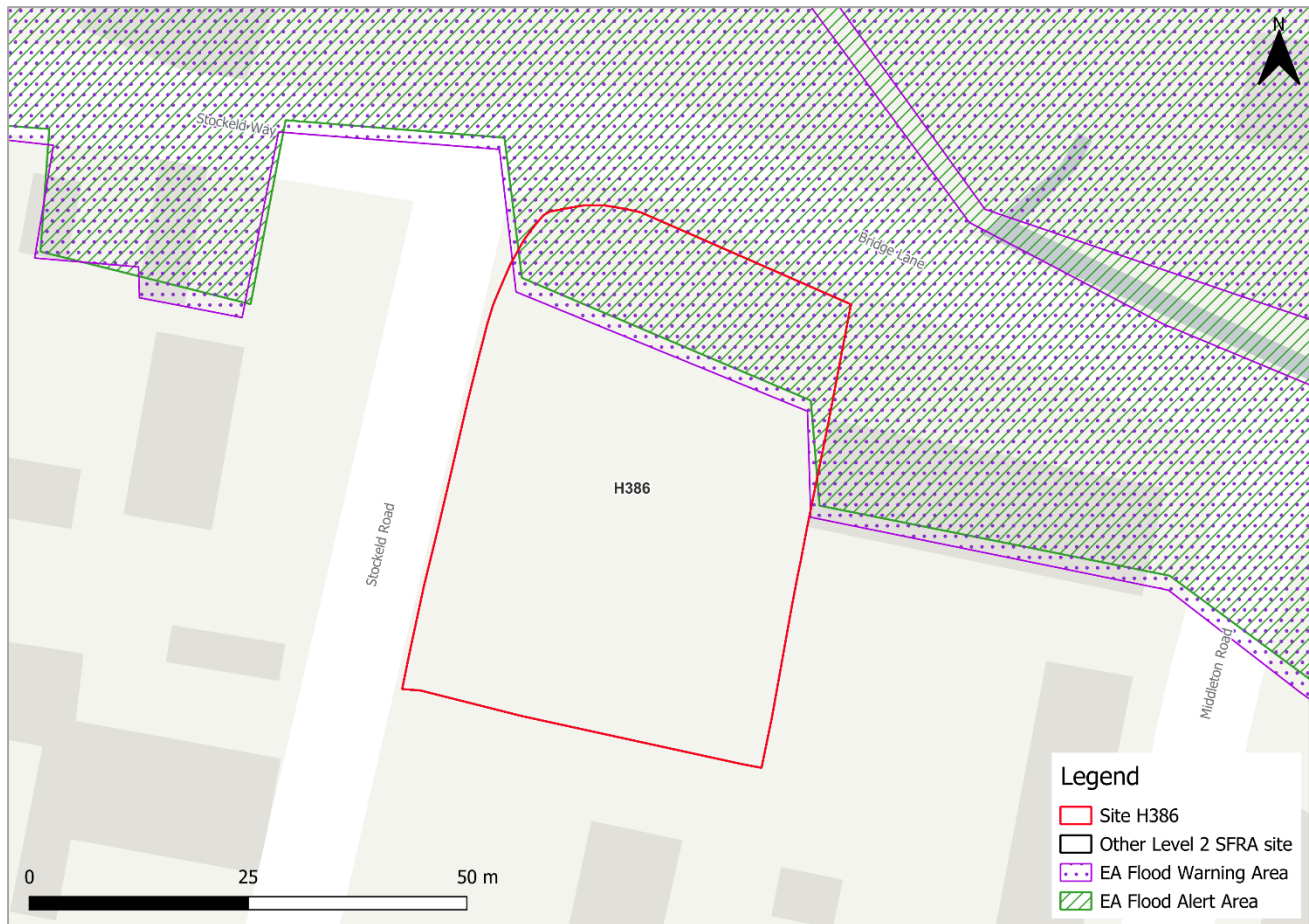


Figure 2-8: EA Flood Warning Areas and Flood Alert Areas

2.6 Observations, mitigation options and site suitability - fluvial

- 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 FRA must show that the development can be designed to be safe and that there is adequate emergency planning provision (para 014 FRCC-PPG).
- Given the site is more vulnerable and partially within Flood Zone 3a, and also partially within the 1% AEP undefended event modelled flood outline, the site must be subject to and must pass the exception test.
- Given the site is more vulnerable, partially within Flood Zone 3a and at future risk from the modelled 1% AEP undefended event plus climate change, 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. Ideally, this area would be left free of more vulnerable development, which should be achievable.
- Any development considered in Flood Zone 2 must be accompanied by suitable emergency plans, property flood resilience, and continued flood warnings and alerts. 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.

3 Flood risk from surface water

3.1 Existing risk

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map (November 2024), surface water risk to the site is predominantly very low. Approximately 1% of the site is at medium risk and a further 7% is at low surface water risk, as shown in Table 3-1.

The surface water flow route along Stockeld Road may be a concern though depths are very low (Figure 3-1) with hazard categorised as low, whilst a small area modelled to be significant (Figure 3-2). Safe access and escape routes via Stockeld Road may remain viable given the modelled surface floodwater along this route is of low to moderate hazard level, however this would need to be investigated.

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)
92	7	1	0

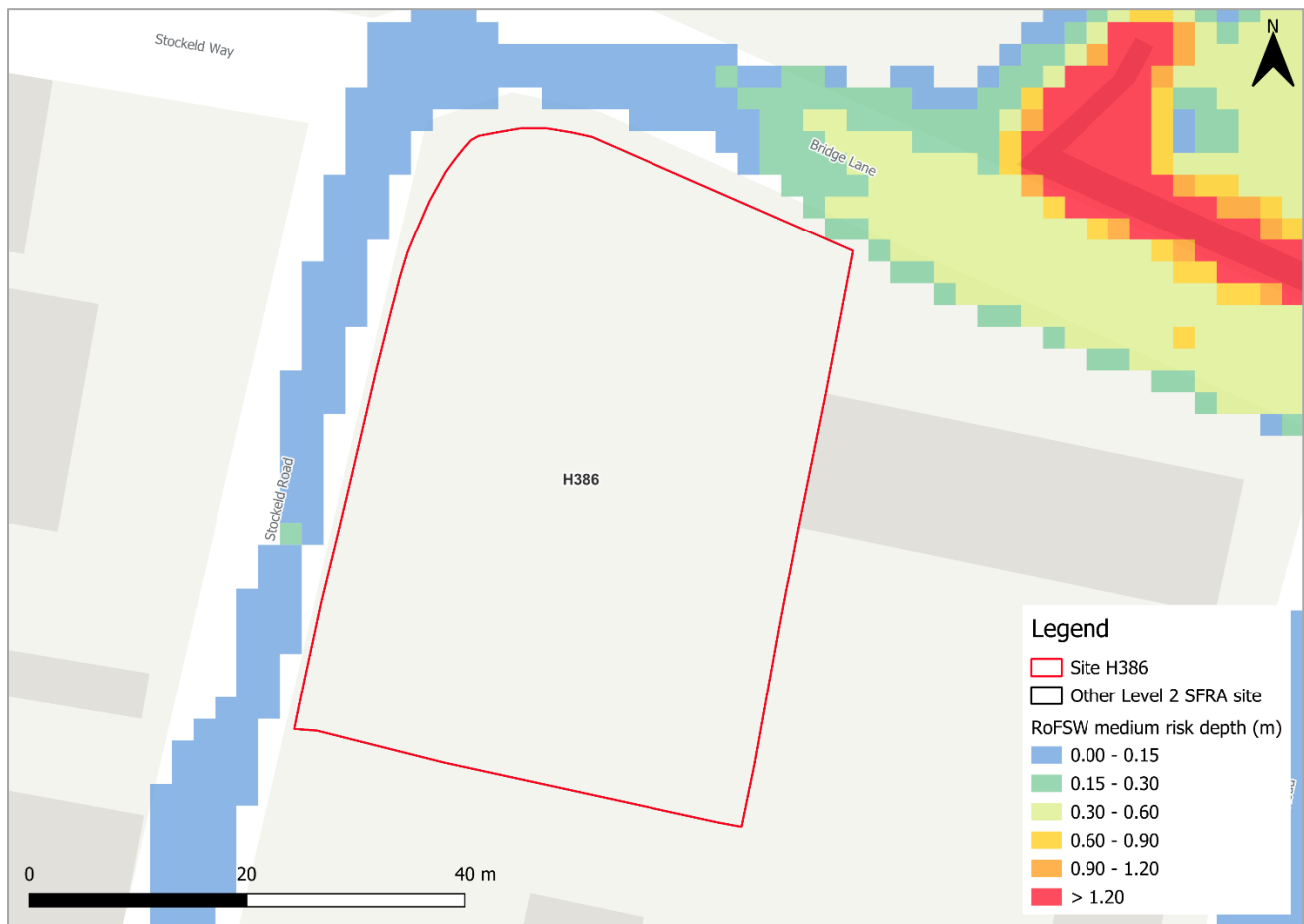


Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

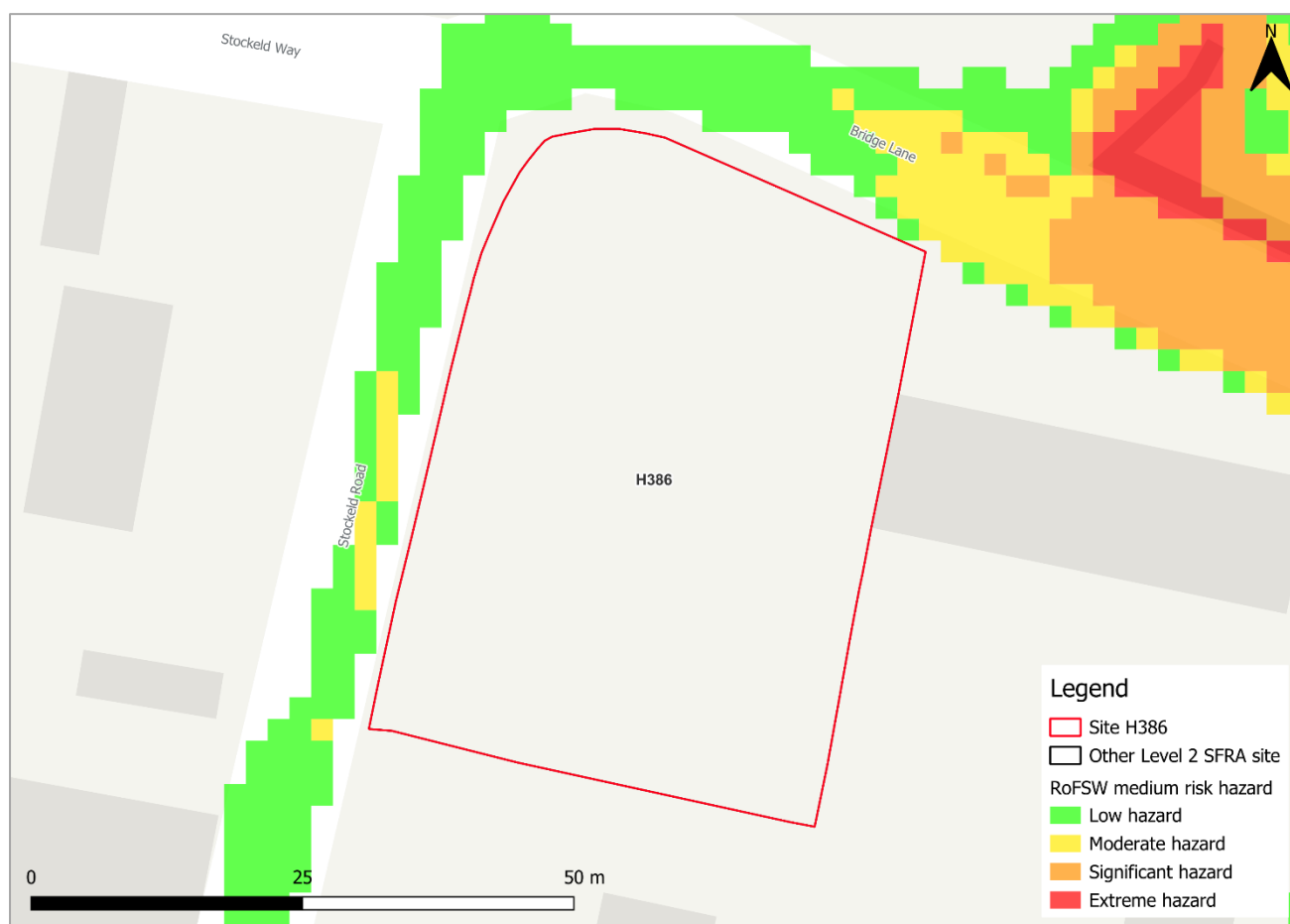


Figure 3-2: Medium risk event surface water flood hazard¹ (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

The impact of climate change on surface water flood risk has been modelled. This allows for direct comparison with the RoFSW map. With consideration of the EA's SFRA guidance, the latest climate change allowances have been modelled as shown in Table 3-2.

Table 3-2: Modelled climate change allowances for rainfall for the Wharfe and Lower Ouse management catchment

Return period	Central allowance 2070s (% increase)	Upper end allowance 2070s (% increase)
3.3% (high risk)	25%	40%
1% (medium risk)	30%	40%

Figure 3-3 shows the modelled surface water flood depths for the medium risk event plus 45% climate change. Surface water risk is confined to the flow routes along Stockeld Road

¹ 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

and Bridge Lane. The flow route along Stockeld Road is observed to enter to site where elevations are lower. Safe access and escape routes should remain achievable during the climate change event via Stockeld Road.

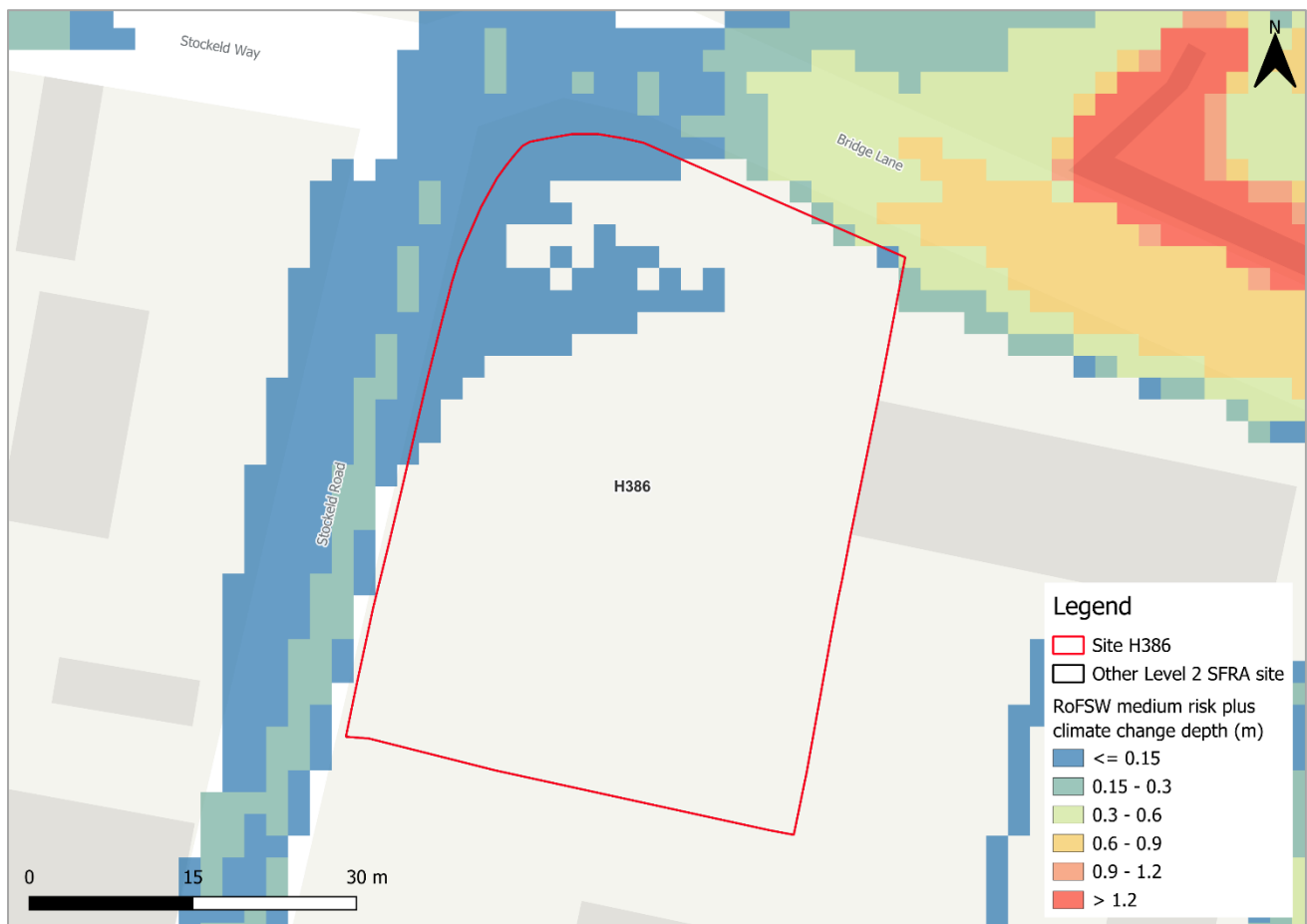


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

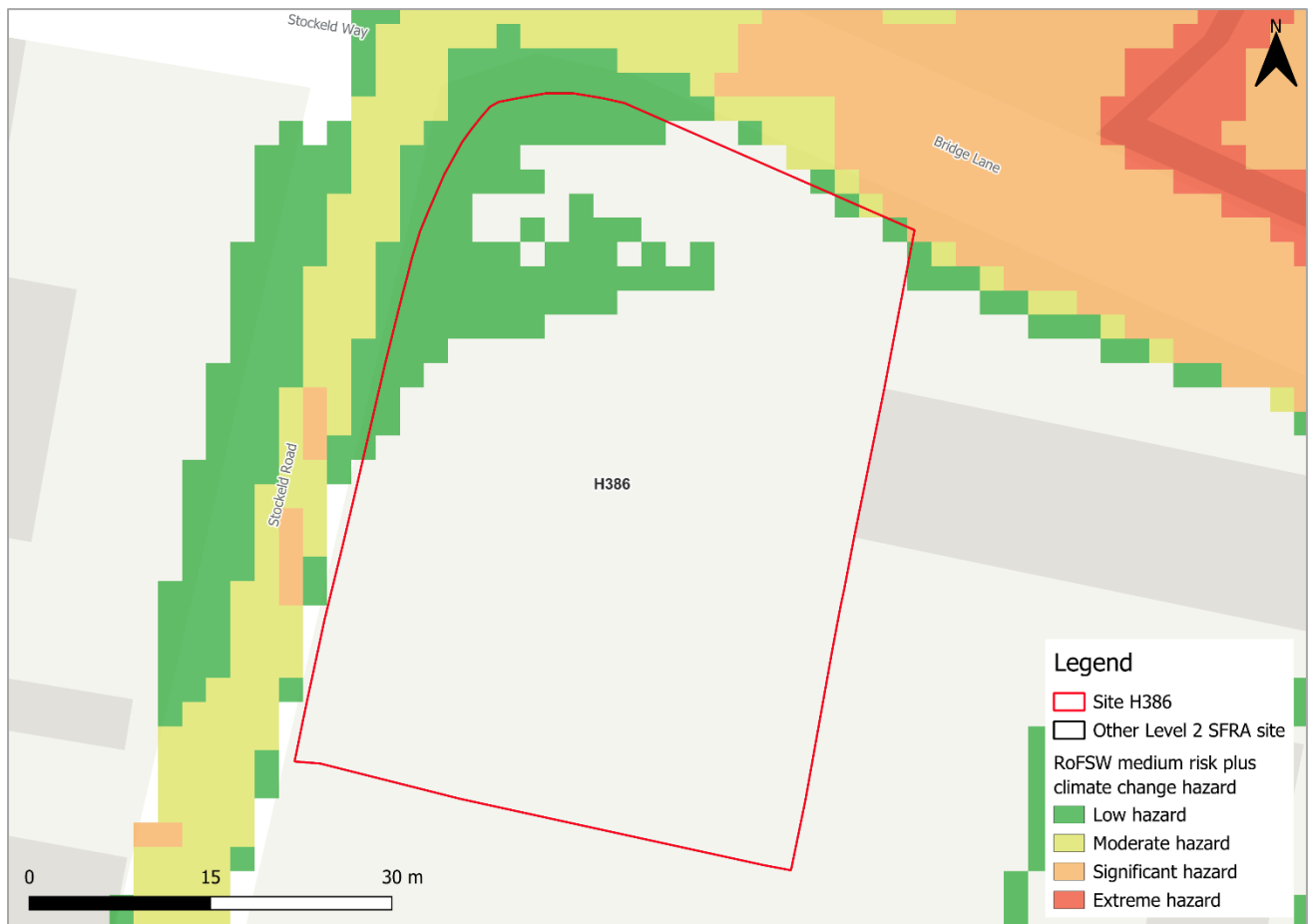


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk is nominal and confined to surrounding roads. Climate change may lead to shallow isolated risk onsite.
- Safe access and escape routes should be achievable via Stockeld Road.
- 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 Guide². Figure 4-1 shows the map covering this site and the surrounding areas whilst Table 4-1 explains the risk classifications.

The site is located in an area where there is a risk of groundwater flooding to surface and subsurface assets. Ground survey, including percolation testing will be required to fully ascertain groundwater conditions at the site.

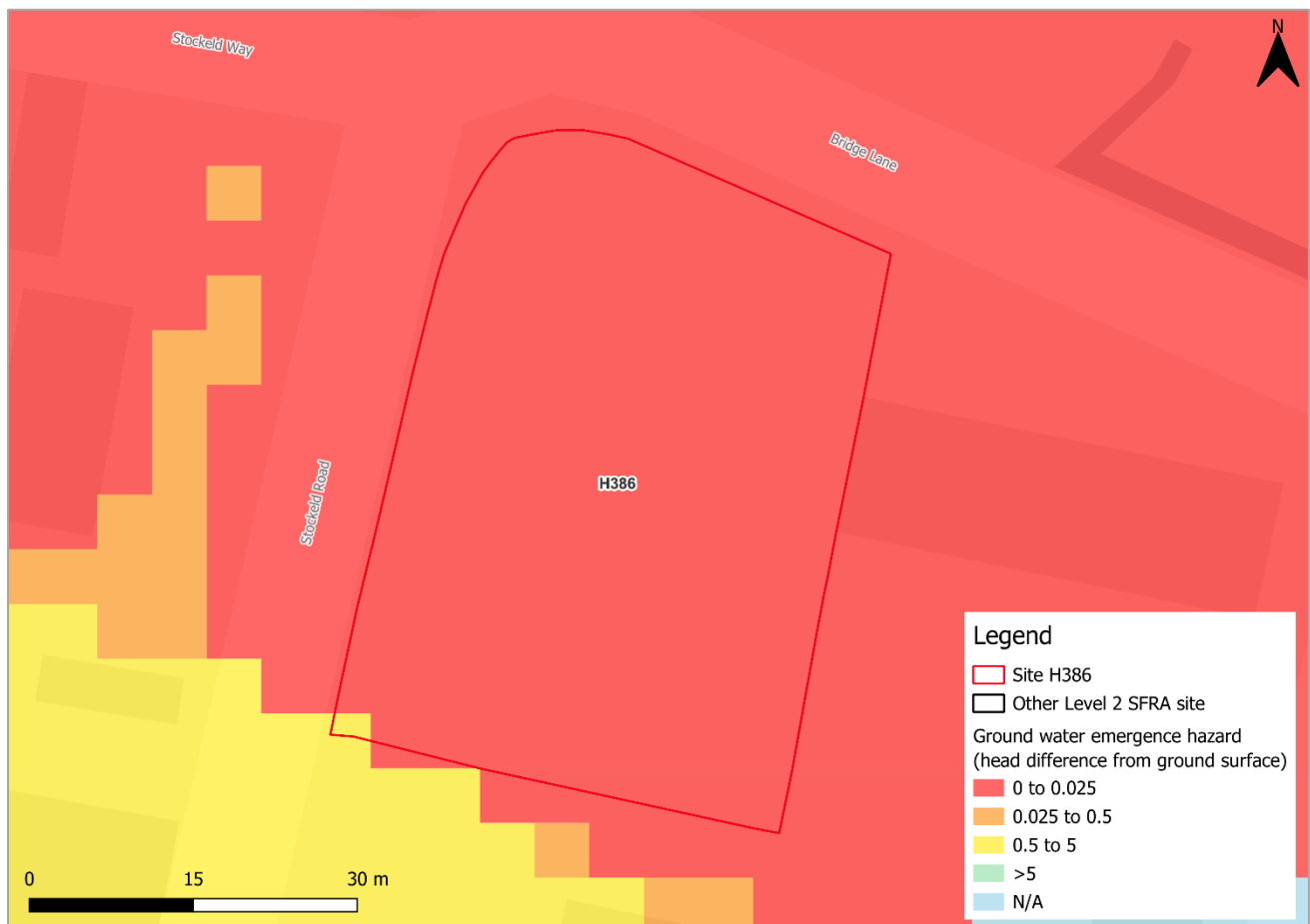


Figure 4-1: JBA 5m Groundwater Emergence Map

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

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 5-1 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 five reservoirs. Of these five reservoirs, four are located within North Yorkshire, and one located within Bradford. These are operated by Yorkshire Water Services Ltd.

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.

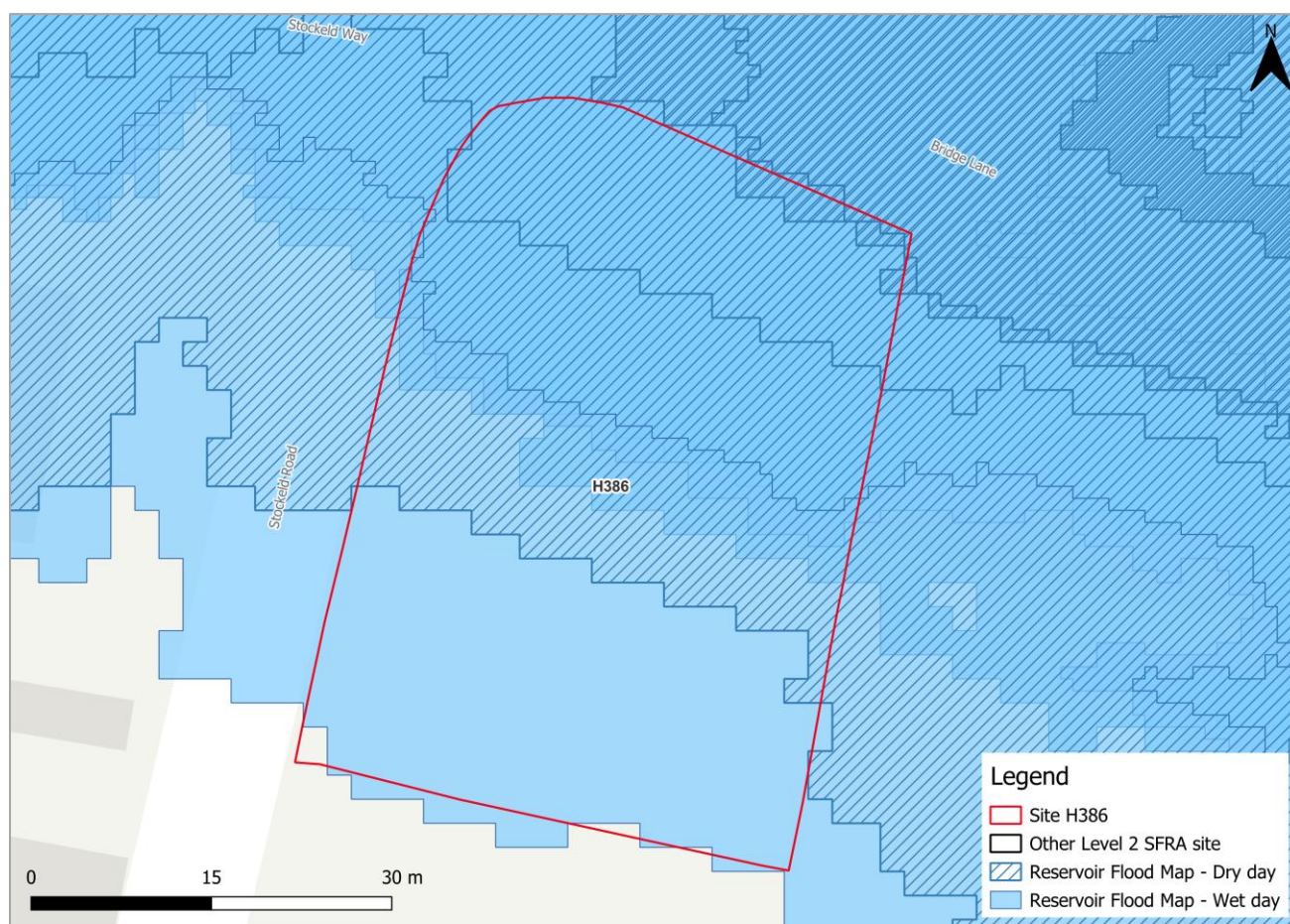


Figure 5-1: Flood risk from reservoirs

5.2 Flood risk from sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes overloaded or blocked, or it cannot discharge due to high water levels in the receiving watercourse.

According to Yorkshire Water's records, there have been no incidents of sewer flooding in the area over the last two years.

5.3 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a breach of five reservoirs. Out of these, four reservoirs impact the site in the 'dry day' flood extent, namely Barden Lower, Barden Upper, Grimwith, and Panorama reservoirs. Of these, the first four are located in North Yorkshire whilst the latter is located within Bradford.
- Given the potential reservoir risk to the site, developers should consider³:
 - Consulting with the local resilience forum for advice on emergency planning,

³ [Reservoir flood maps: when and how to use them | Environment Agency | 2021](#)

- 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.

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 test⁴, given it is proposed for more vulnerable uses and is partially located within Flood Zone 3a. It must be proven that the development can be safe for its lifetime, which is 100 years for residential development. Assuming all built development can be directed to areas of low (Flood Zone 1) and medium (Flood Zone 2) flood risk, and areas at high flood risk (Flood Zone 3) accounting for climate change left as open greenspace, the exception test can be passed.

6.2 Recommendations, FRA requirements, and further work

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

- It should be possible to develop this site for more vulnerable uses.
- It is recommended that the risk area in the north of the site is left as open greenspace.
- Any FRA must further consider the safe access and escape routes via Stockeld Road.
- 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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