Bradford Level 2 Strategic Flood Risk Assessment - Site H35

Final Draft

May 2025

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

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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 H35. 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.

It is understood that site H58 and site H35 are being pursued by the Council as one allocation within the Local Plan, site H1565. However, for the purposes of the SFRA, the sites have been assessed separately, as they were originally identified as individual sites.

1.1 Site H35

- Location: Green Lane
- Existing site use: Greenfield, wooded
- Existing site use vulnerability: Water compatible
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 0.22 hectares
- Proposed development impermeable area: 0.22 hectares
- Watercourse: River Aire (main river)
- Environment Agency (EA) river model: Leeds FAS Kildwick to Esholt 2022
- 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

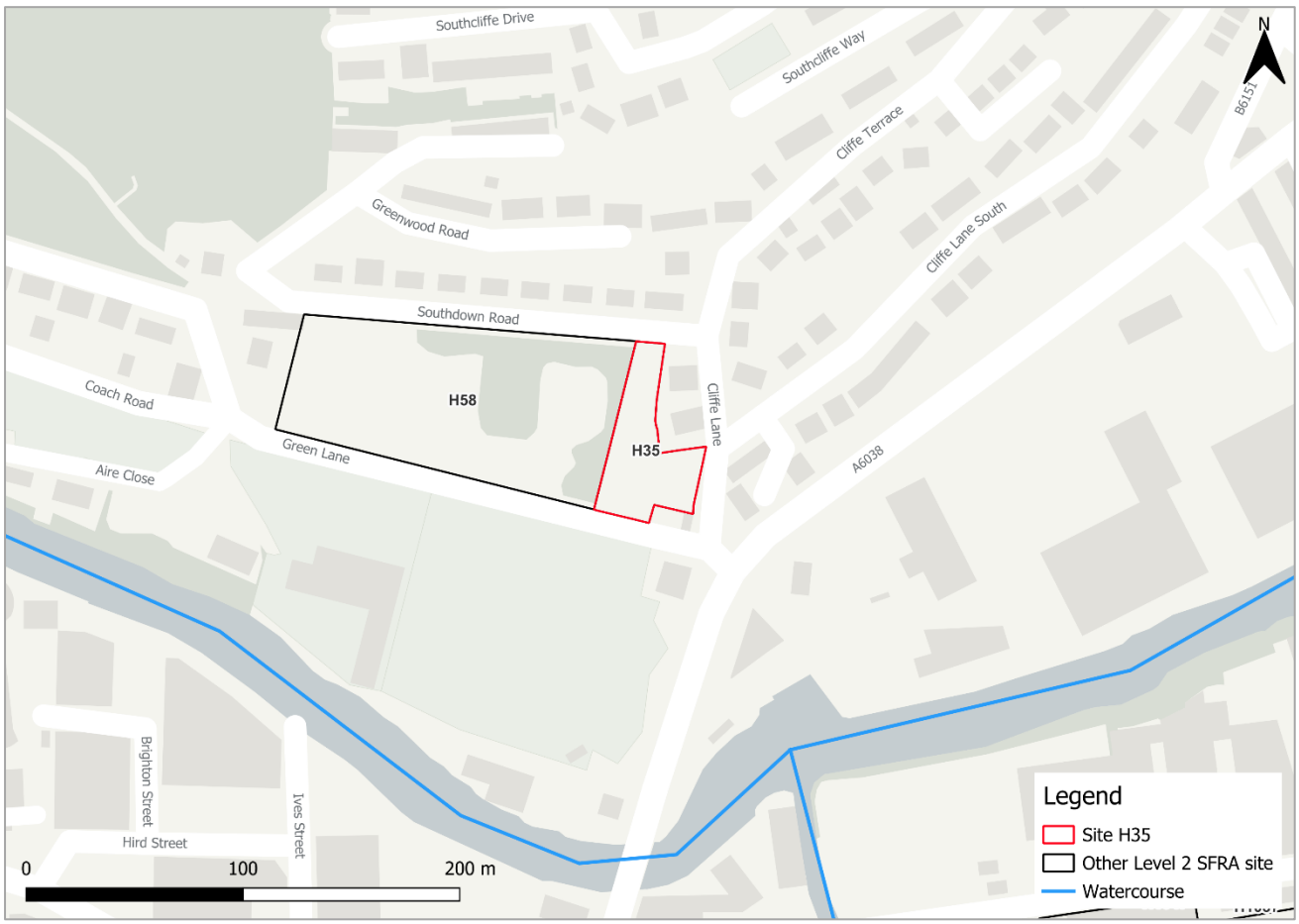


Figure 1-1: Existing site location boundary

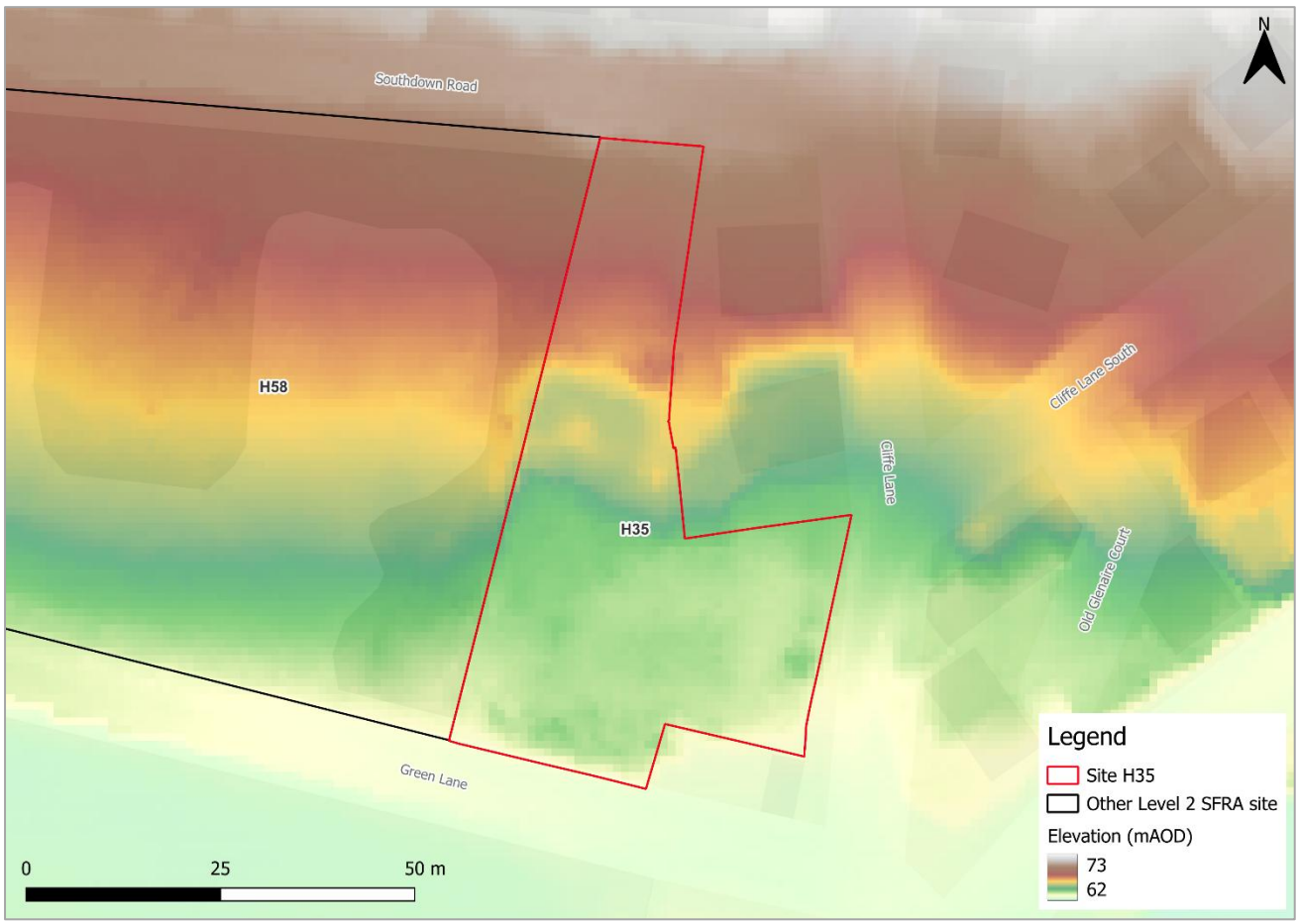


Figure 1-2: Topography



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 Aire to the south of the site. The River Aire is designated main river. Functional floodplain is present in a very small area along the southern site boundary. The area of functional floodplain onsite should be left free of development. The functional floodplain in this location is based on the 3.33% AEP defended event from the Leeds FAS Kildwick to Esholt 2022 model. The southern boundary of the site is situated within Flood Zone 3a and therefore at high risk. A small area within the east of the site is within Flood Zone 2 and therefore at medium risk. Flood Zone 2 in this location is not based on modelled data. It is based on the EA's Historic Flood Map (HFM). See Section 2.4.

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)
82	8	9	1

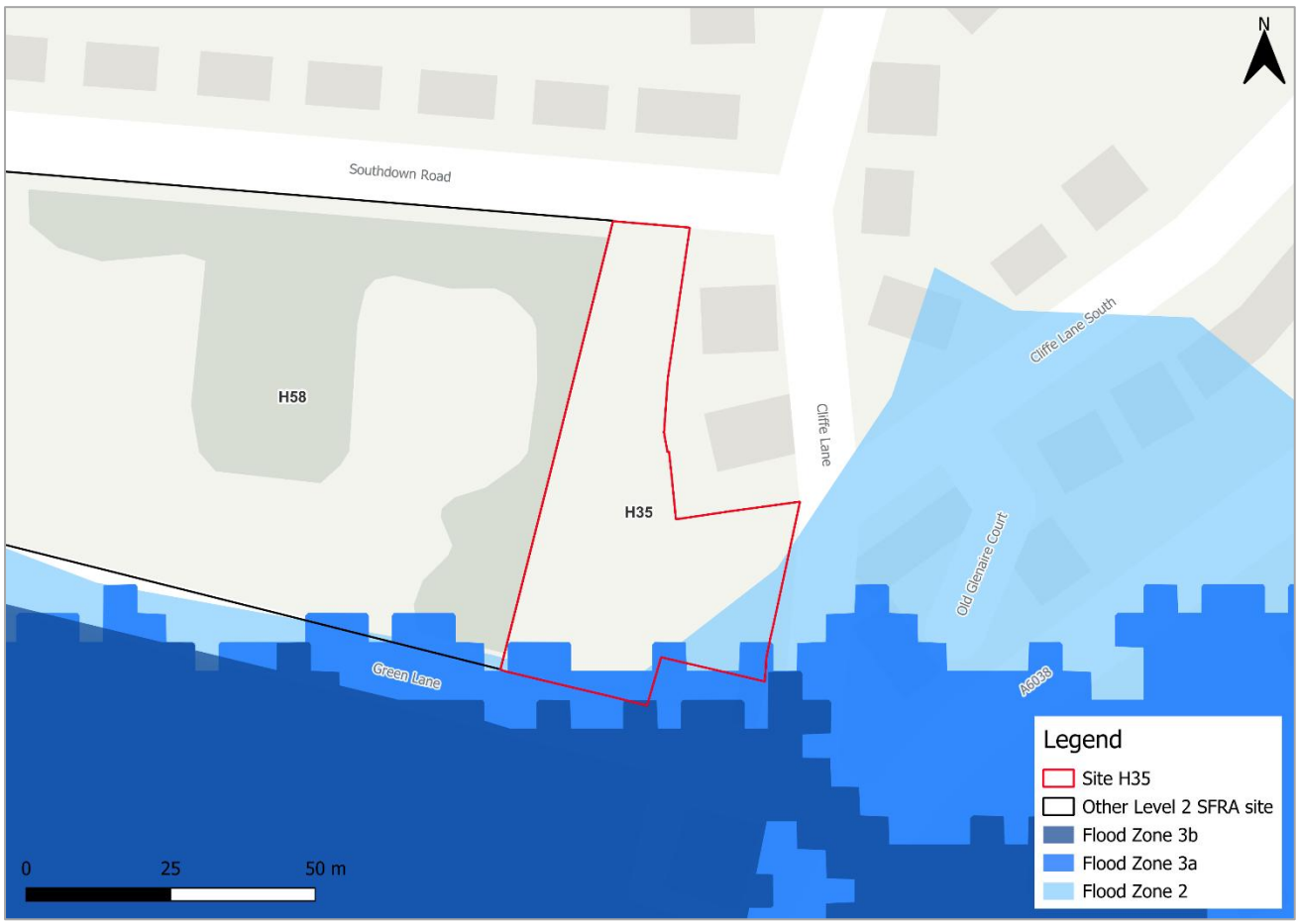


Figure 2-1: Existing risk from rivers to the site

2.1.2 Leeds FAS Kildwick to Esholt 2022 model outputs

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 southern boundary of the site. Maximum flood depths within the site are modelled to be shallow, between 0.15 and 0.3 m. Maximum modelled flood velocities are between 0.5 and 1 m^3/s (Figure 2-3). The modelled flood hazard within the site is either classified as 'very low hazard' or 'danger for some' across the area at risk (Figure 2-4). Safe access and escape routes would likely be achievable via Southdown Road to the north of the site during a flood event. Section 2.3.1 discusses the defended model outputs.

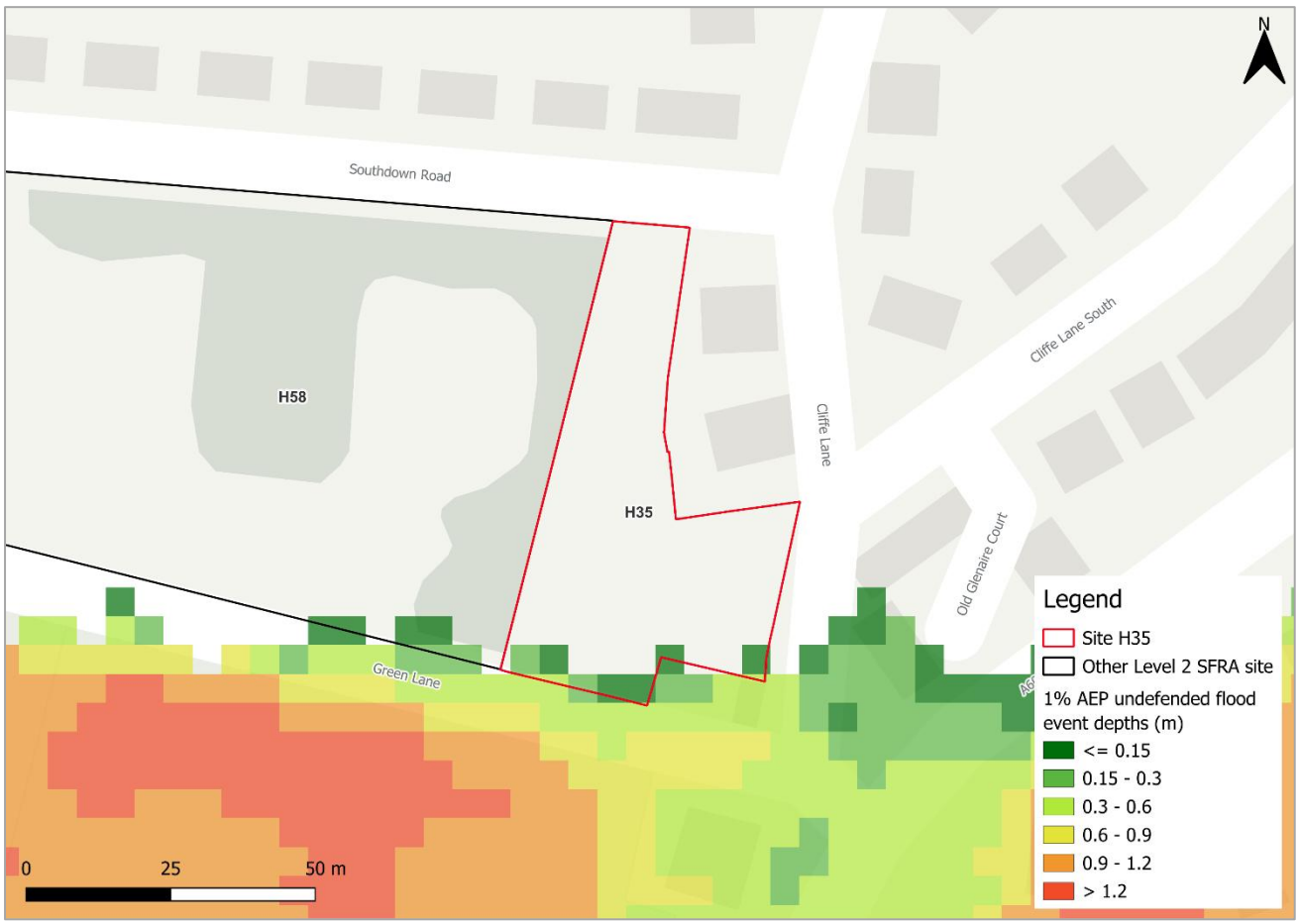


Figure 2-2: Flood depths for 1% AEP undefended flood event

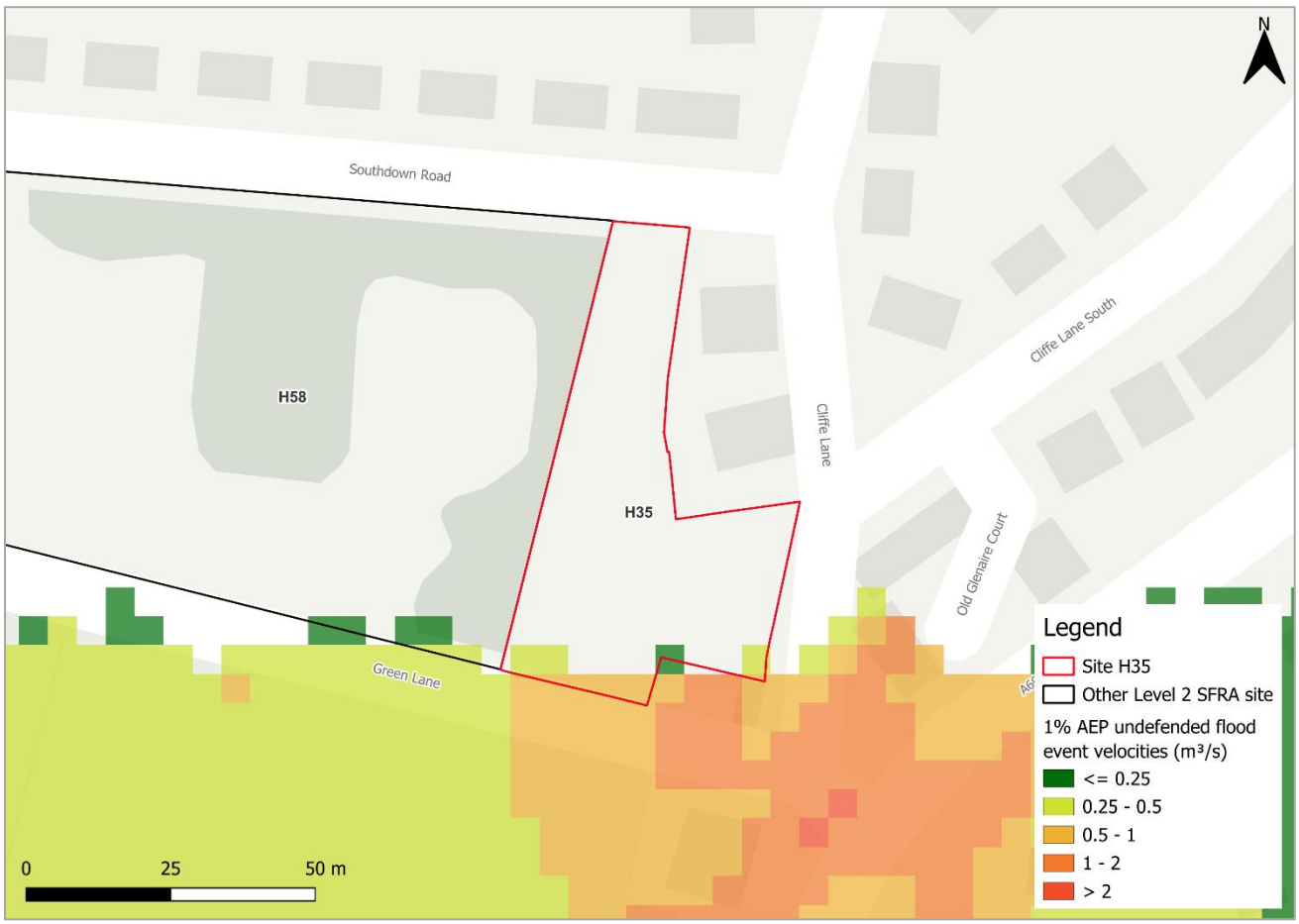


Figure 2-3: Flood velocities for 1% AEP undefended flood event

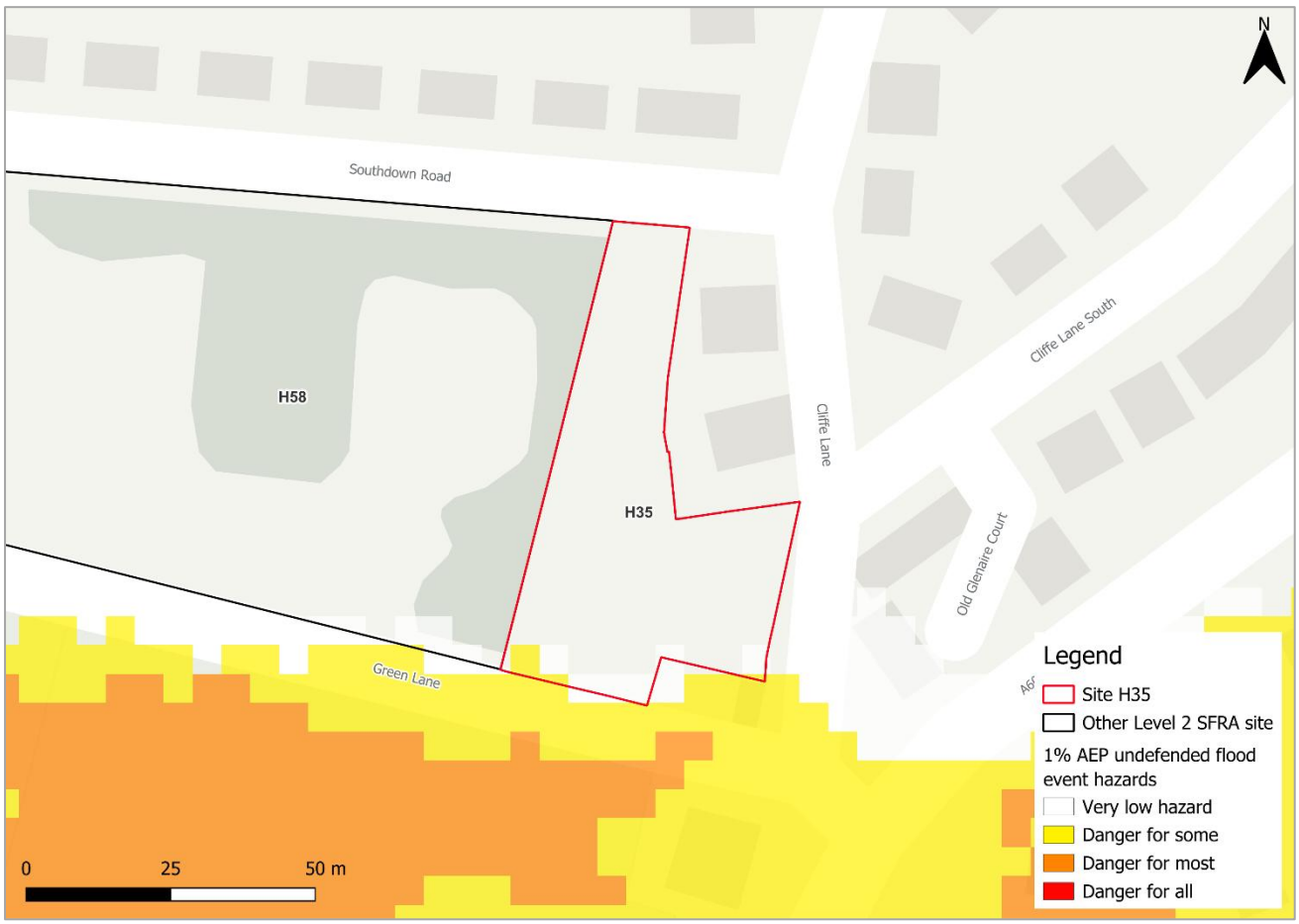


Figure 2-4: Flood hazard[1] for 1% AEP undefended flood event

2.2 Impacts from climate change

The impacts of climate change on flood risk from the River Aire 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

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

Table 2-2.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 onsite is likely to increase to a similar extent as the present day Flood Zone 3a in the future.

Figure 2-5 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 modelled to be between 0.3 and 0.6 m. Flood velocities are modelled to increase, with maximum velocities between 1 and 2 m^3/s (Figure 2-6). This indicates the floodwater within the site is likely to be fast moving, posing a greater risk to site users. The modelled flood hazard within the area at risk is largely categorised as 'danger for some' (Figure 2-7). Safe access and escape routes would likely remain achievable via Southdown Road during the climate change event.

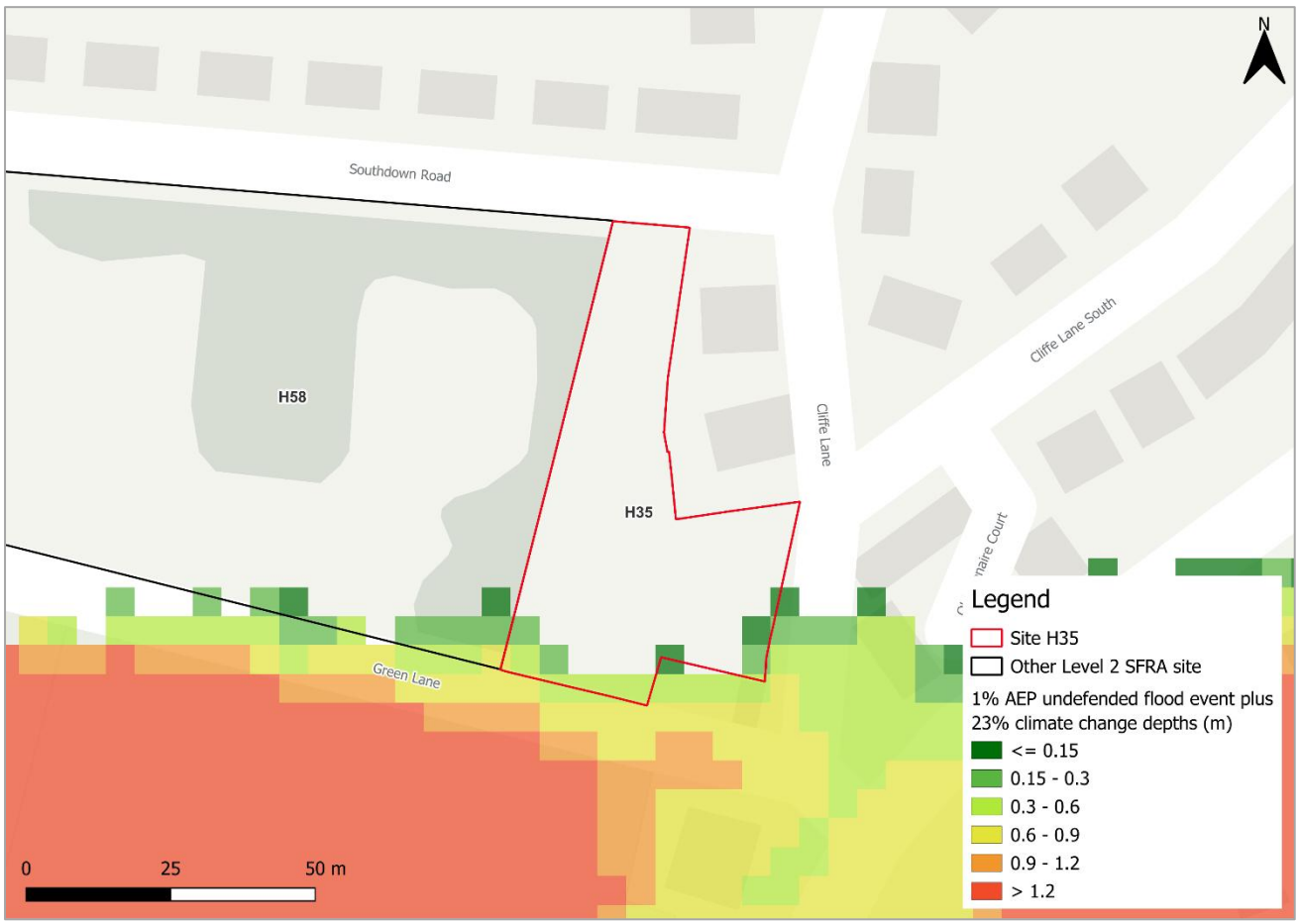


Figure 2-5: Flood depths for 1% AEP undefended flood event +23% (central climate change allowance)



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



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

2.3 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 2-8). This is consistent with the modelled climate change events.

There are areas of natural high ground along the banks of the River Aire adjacent to the site.

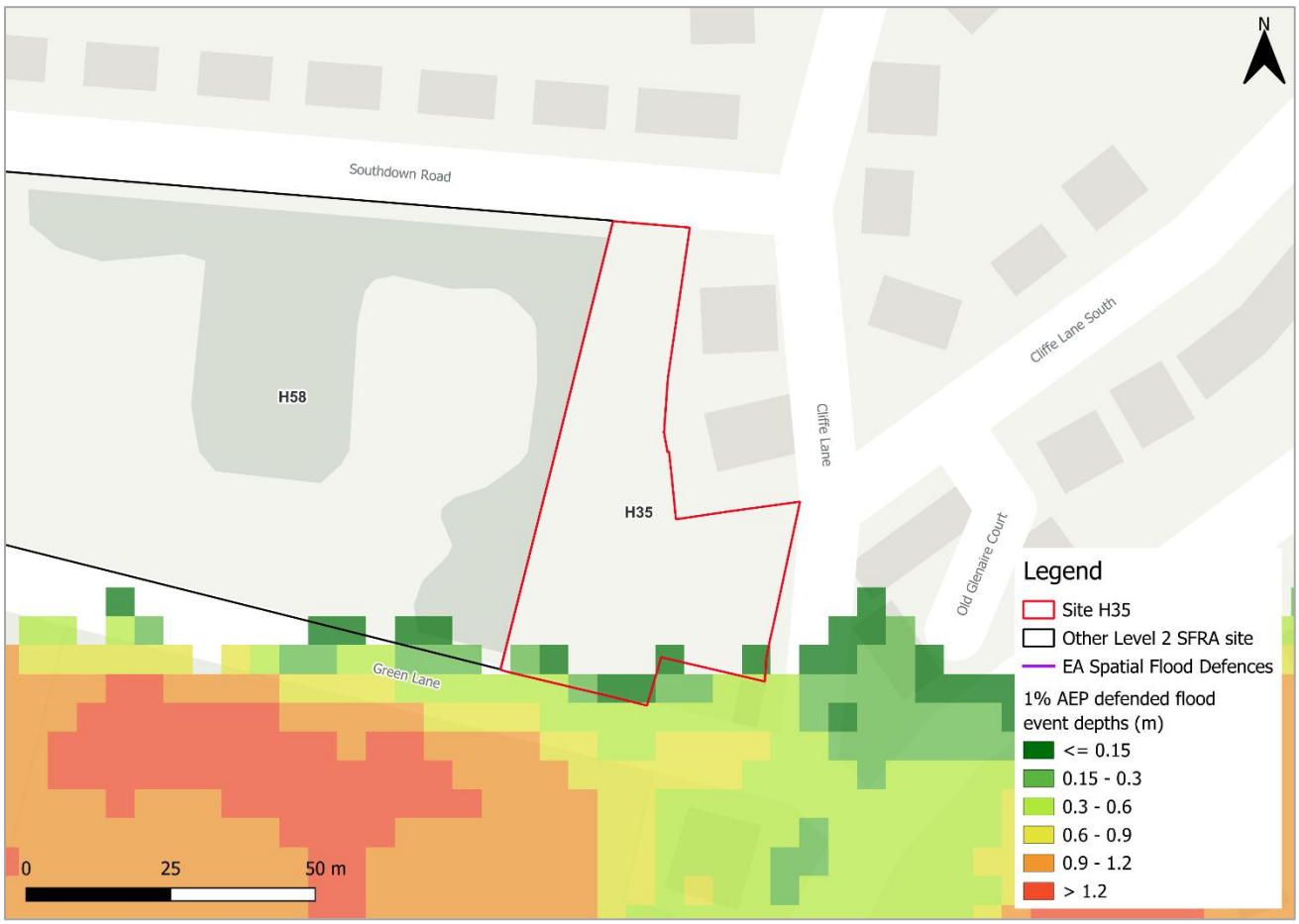


Figure 2-8: Flood depths for 1% AEP defended flood event

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. Upstream of the site, there is potential for floodplain reconnection to establish reconnection between the River Aire and its natural floodplain. These areas are shown in Figure 2-9. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

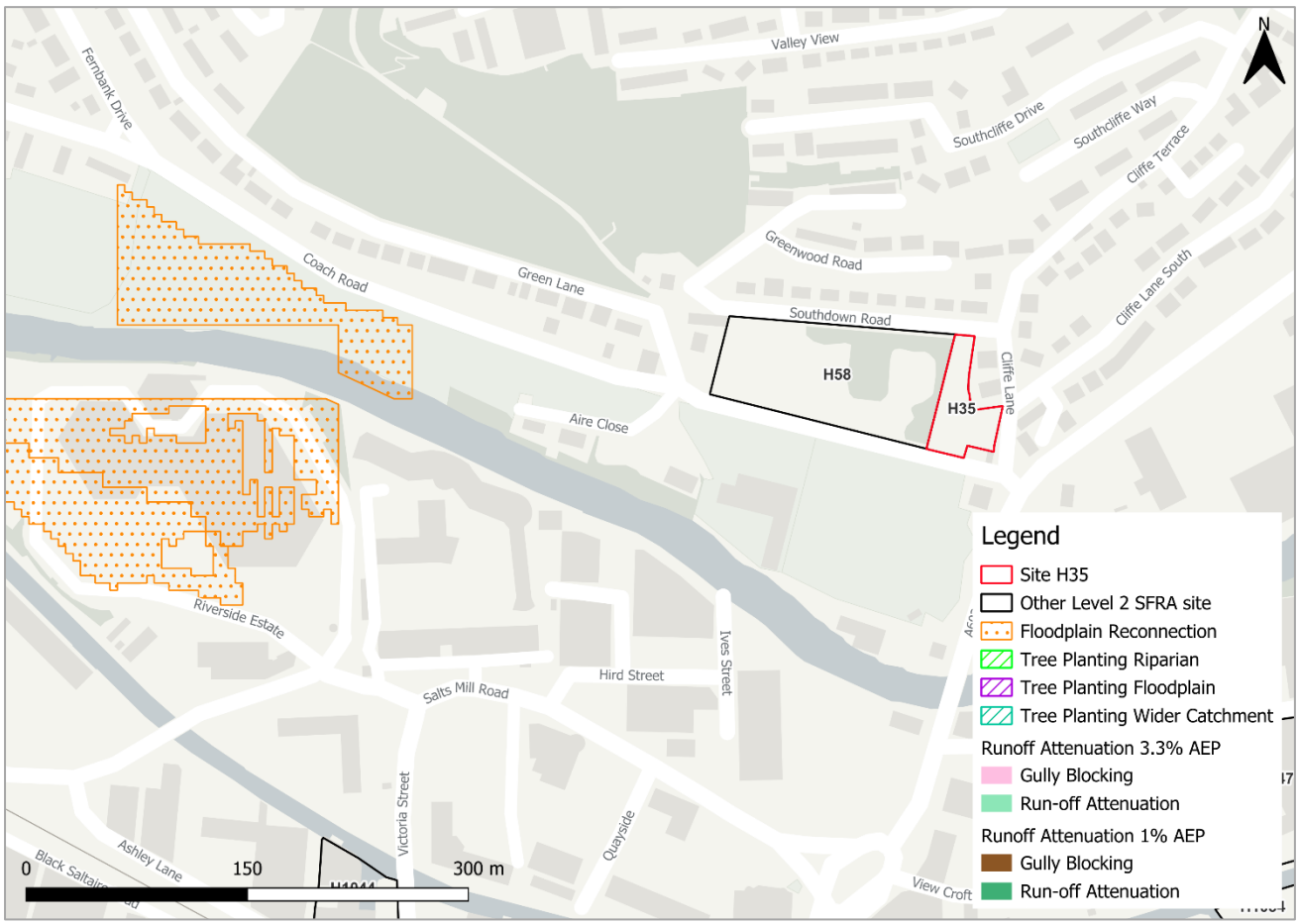


Figure 2-9: Natural Flood Management (NFM) potential mapping

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) has been considered and mapped in Figure 2-10 which shows the south 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 Aire being exceeded in October 2000, February 2020 and most recently in December 2015.

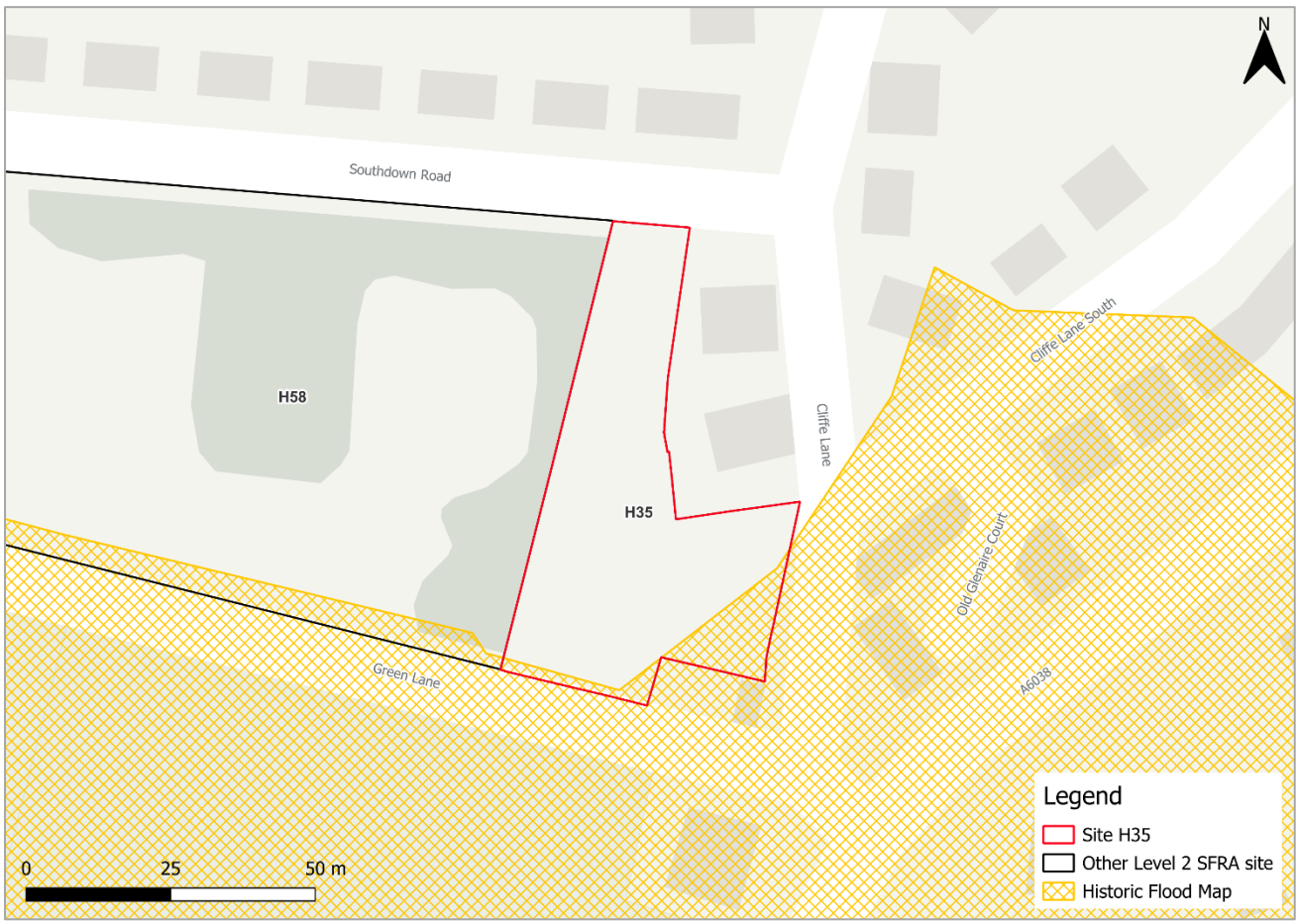


Figure 2-10: Recorded historic flood events onsite and around the site

2.5 LLFA flood incidents

The LLFA have records of nine flood incidents taking place to the east and south of the site, which all 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 site is partially located within a FWA, namely 123FWF119 - River Aire at Shipley.

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 also partially located within a FAA, namely 123WAF961 - Middle River Aire catchment.

Based on available information, safe access and escape routes would likely be achievable via Southdown Road to the north of the site during a flood event.

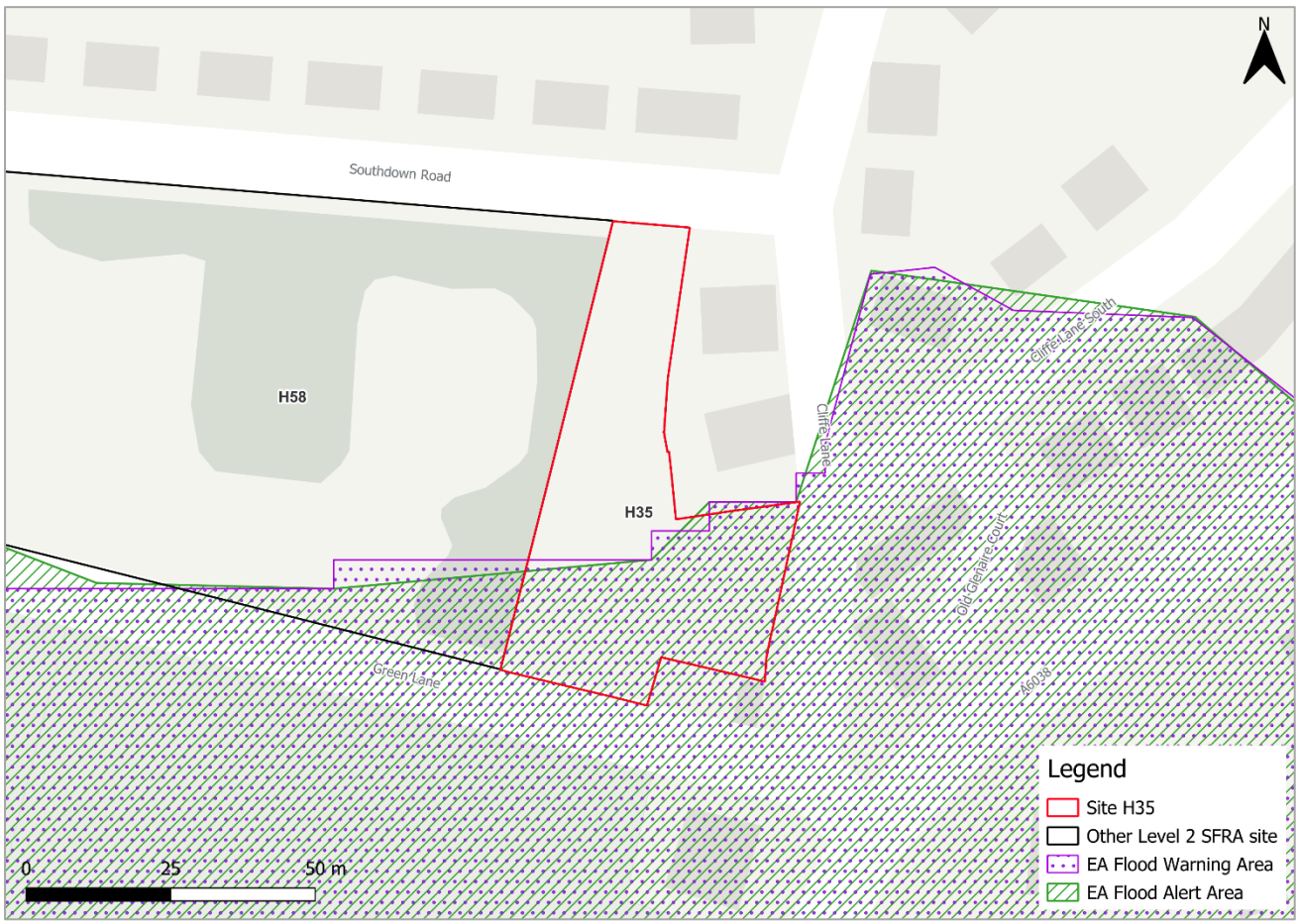


Figure 2-11: EA Flood Warning Areas and Flood Alert Areas

2.7 Observations, mitigation options and site suitability - fluvial

- The proposed development of the site would see a change in the risk classification from water compatible 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 modelled to be within nominal area of functional floodplain along the southern boundary of the site, which increases to a similar extent as the present day Flood Zone 3a with climate change. Development is not permitted within the functional floodplain. This area should remain as open greenspace.
- The southern boundary of the site is modelled to be at risk from fluvial sources (according to the Leeds FAS Kildwick to Esholt 2022 model) in the 1% AEP undefended scenario, to the same extent as Flood Zone 3a. There is a small area in the east of the site within Flood Zone 2.
- 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.
- EA flood warnings and 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 3% of the site is at low surface water risk, as shown in Table 3-1.

In the low risk event, surface water risk is confined to the southern and eastern boundaries of the site. The risk area is largely within the fluvial Flood Zone 3a area. There is a shallow flow path present on Cliffe Lane, however, this should not detrimentally affect access to the site from Cliffe Lane. Flood depths and hazards are significant on the cricket field across Green Lane to the south. Greatest flood depths within the site in the low risk event are between 0.15 and 0.3 m (Figure 3-1) with hazard largely categorised as moderate (Figure 3-2). Safe access and escape routes should be achievable via Southdown Road.

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

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
97	3	0	0

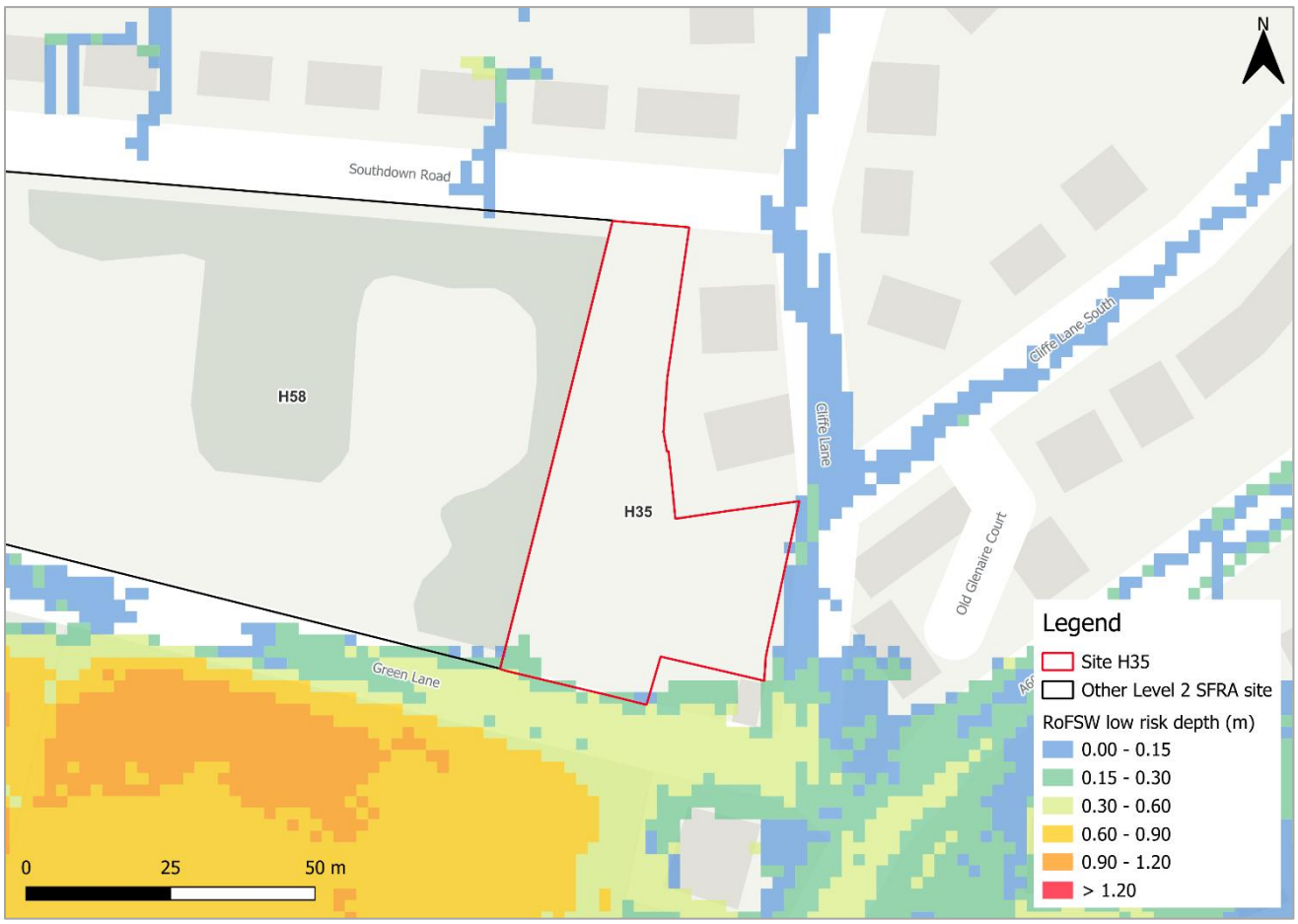


Figure 3-1: Low risk event surface water flood depths (Risk of Flooding from Surface Water map)

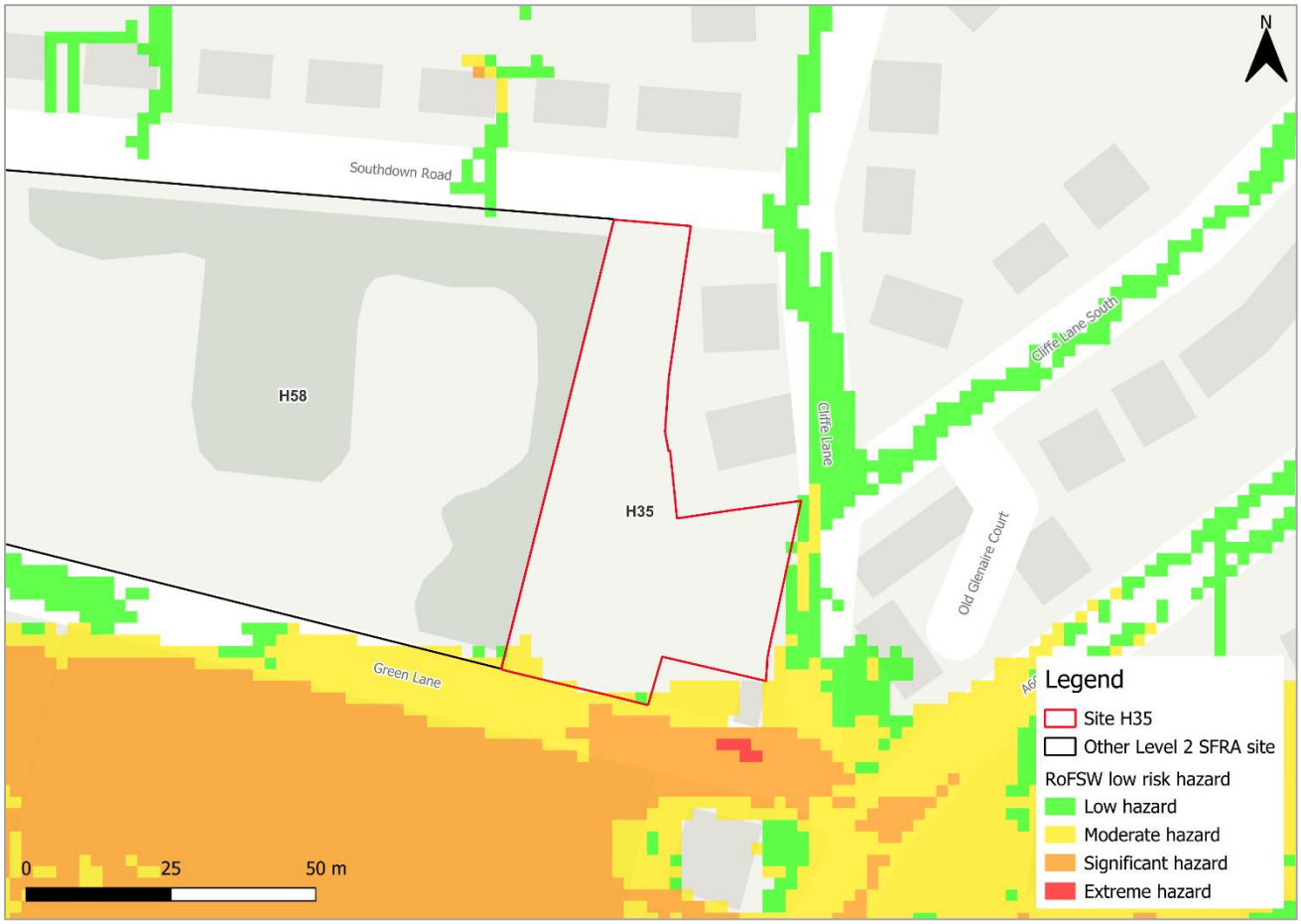


Figure 3-2: Low risk event surface water flood hazard[2] (Risk of Flooding from Surface Water map)

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 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%

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

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

the medium risk climate change event showing a similar level of risk to the present day low risk event. Maximum depths are modelled to be between 0.3 and 0.6 m, with some areas of hazard categorised as significant (Figure 3-4). Safe access and escape routes would likely remain achievable during the climate change event.

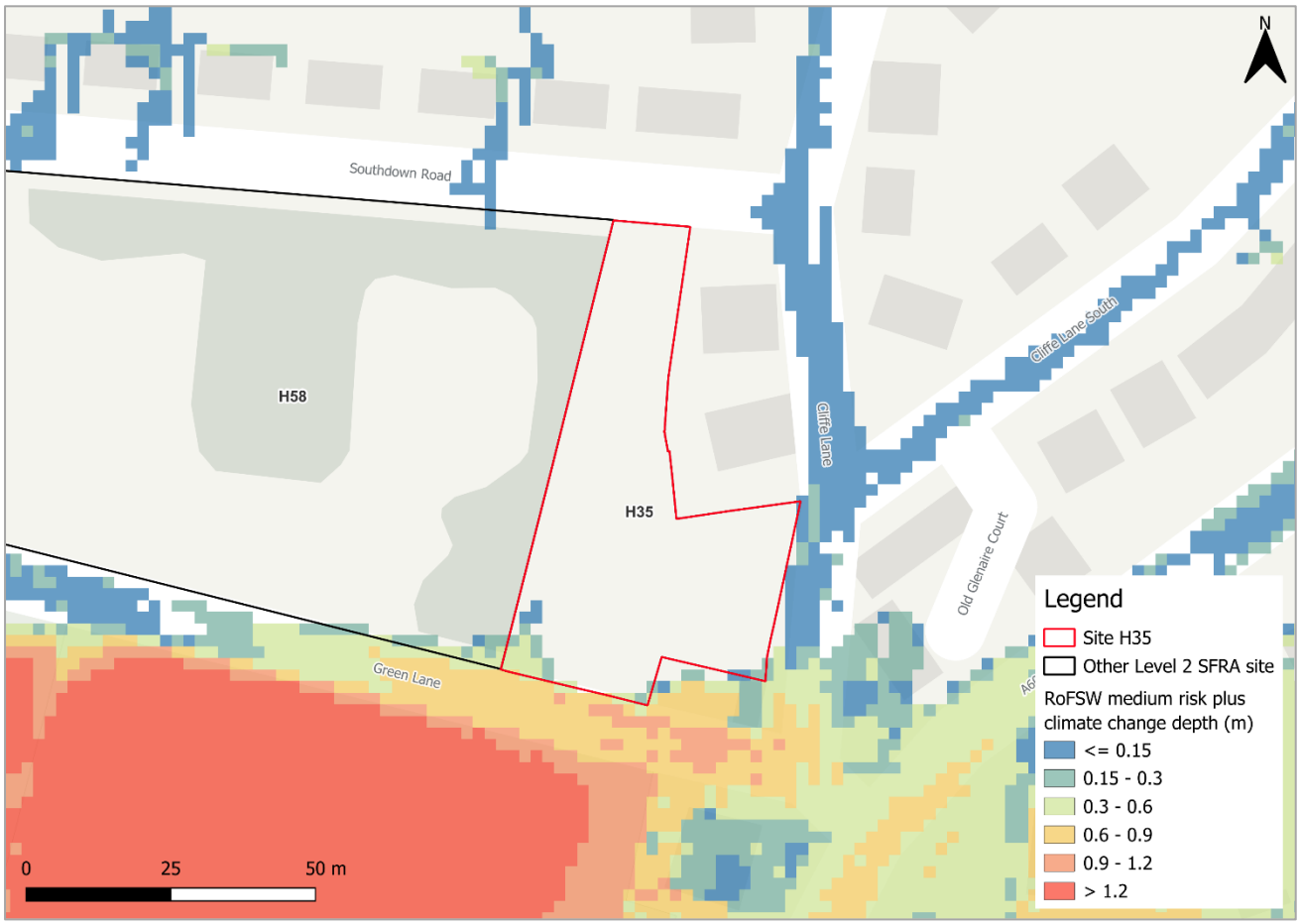


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

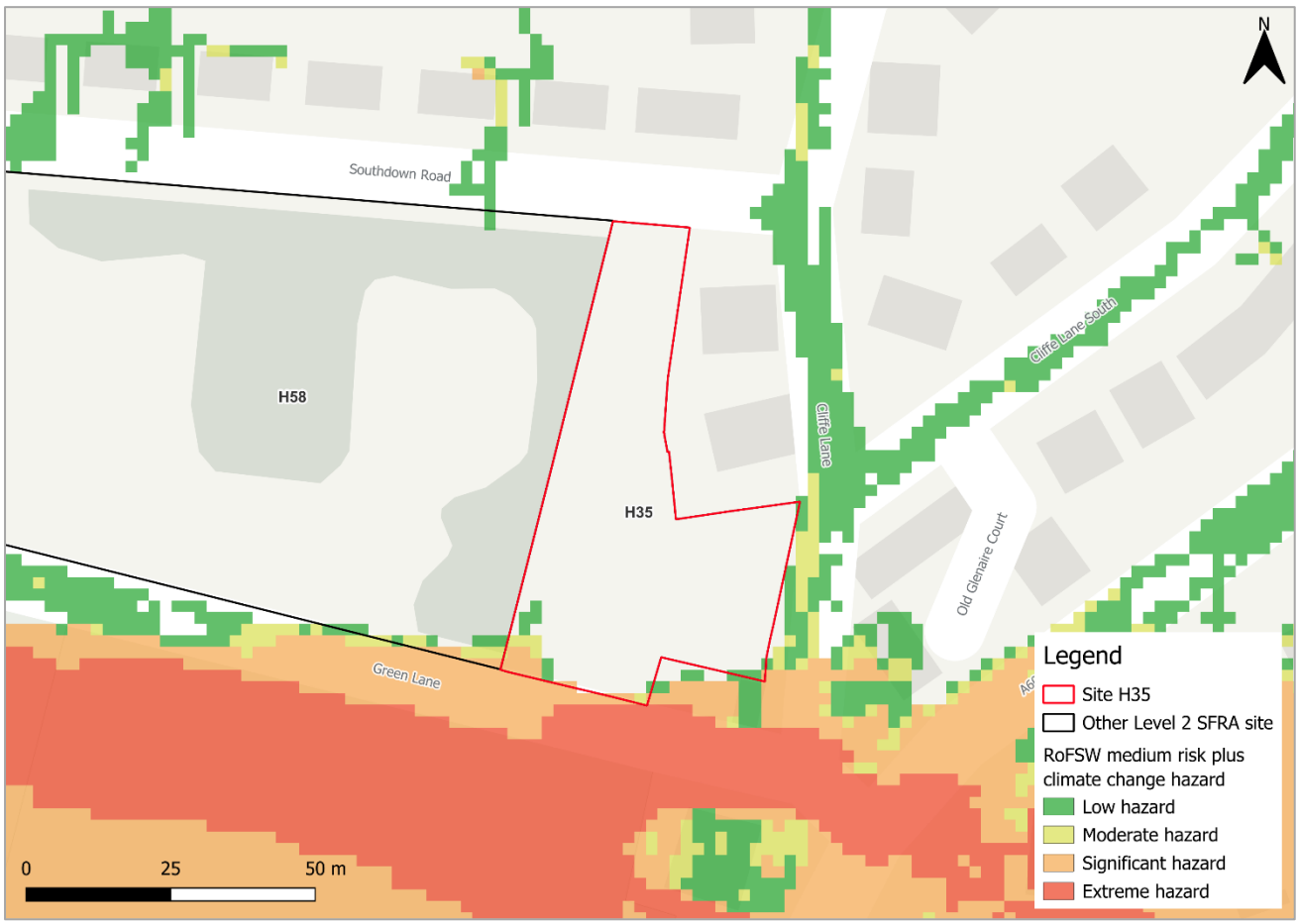


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Surface water flood risk to the site is nominal and is confined to the southern and eastern boundaries of the site. The areas at surface water flood risk are within the fluvial risk areas and should therefore be included within any mitigation solutions for fluvial risk.
- A 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 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 Guide[3]. Figure 4-1 shows the map covering this site and the surrounding areas and. Table 4-1 explains the risk classifications.

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



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

5.1 Flood risk from reservoirs

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

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

5.2 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

- There is no known residual risk to the site.

6 Overall site assessment

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

This site is required to pass part b) of the exception test[4], given it is proposed for more vulnerable uses and is located within Flood Zone 3a. It must be proven that the development can be safe for its lifetime, which is 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 south of the site modelled to be at fluvial and surface water flood risk.
- 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

7 Licencing

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Bradford Level 2 Strategic Flood Risk Assessment - Site H58

Final Draft

May 2025

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

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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 H58. 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.

It is understood that site H58 and site H35 are being pursued by the Council as one allocation within the Local Plan, site H1565. However, for the purposes of the SFRA, the sites have been assessed separately, as they were originally identified as individual sites.

1.1 Site H58

- Location: Green Lane, Baildon
- Existing site use: Amenity open space
- Existing site use vulnerability: Water-compatible
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 1.02 hectares
- Proposed development impermeable area: 0.92 hectares
- Watercourse: River Aire (main river)
- Environment Agency (EA) river model: Leeds FAS Kildwick to Esholt 2022
- 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

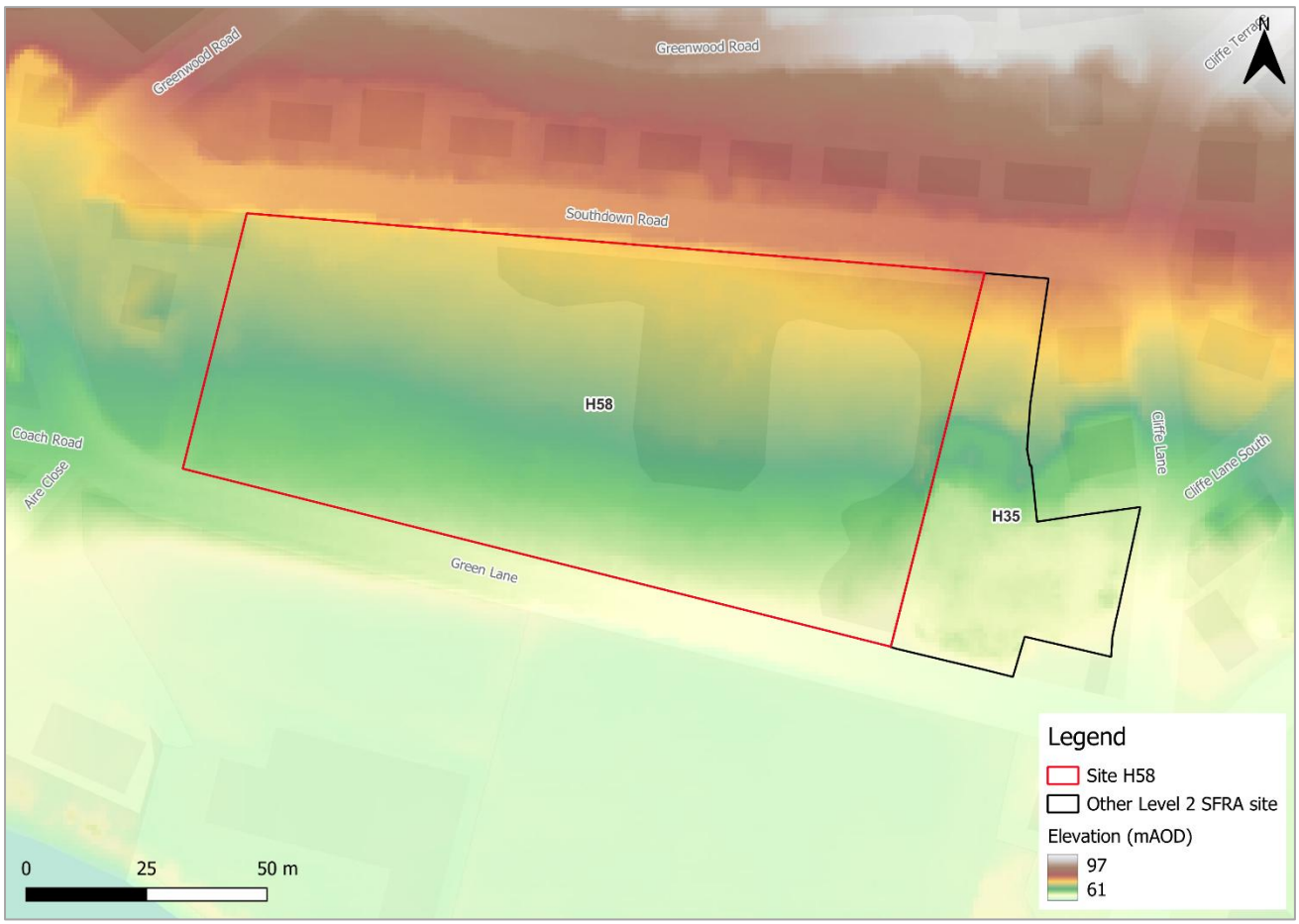


Figure 1-2: Topography



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 Aire which runs eastwards across the southern boundary of the site. The River Aire is a designated main river. Functional floodplain is not modelled to be present within the site, however it is located outside of the site to the south within the floodplain of the Aire. The functional floodplain in this location is based on the 3.33% AEP defended event from the Leeds FAS Kildwick to Esholt 2022 model. An area within the southeast corner of the site is situated within Flood Zone 3a and therefore at high risk. A small area of the southwest corner of the site is located within Flood Zone 2 and therefore at medium risk. Flood Zone 2 is however not based on modelling. It is based on the EA's Historic Flood Map (HFM).

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)
95	3	2	0

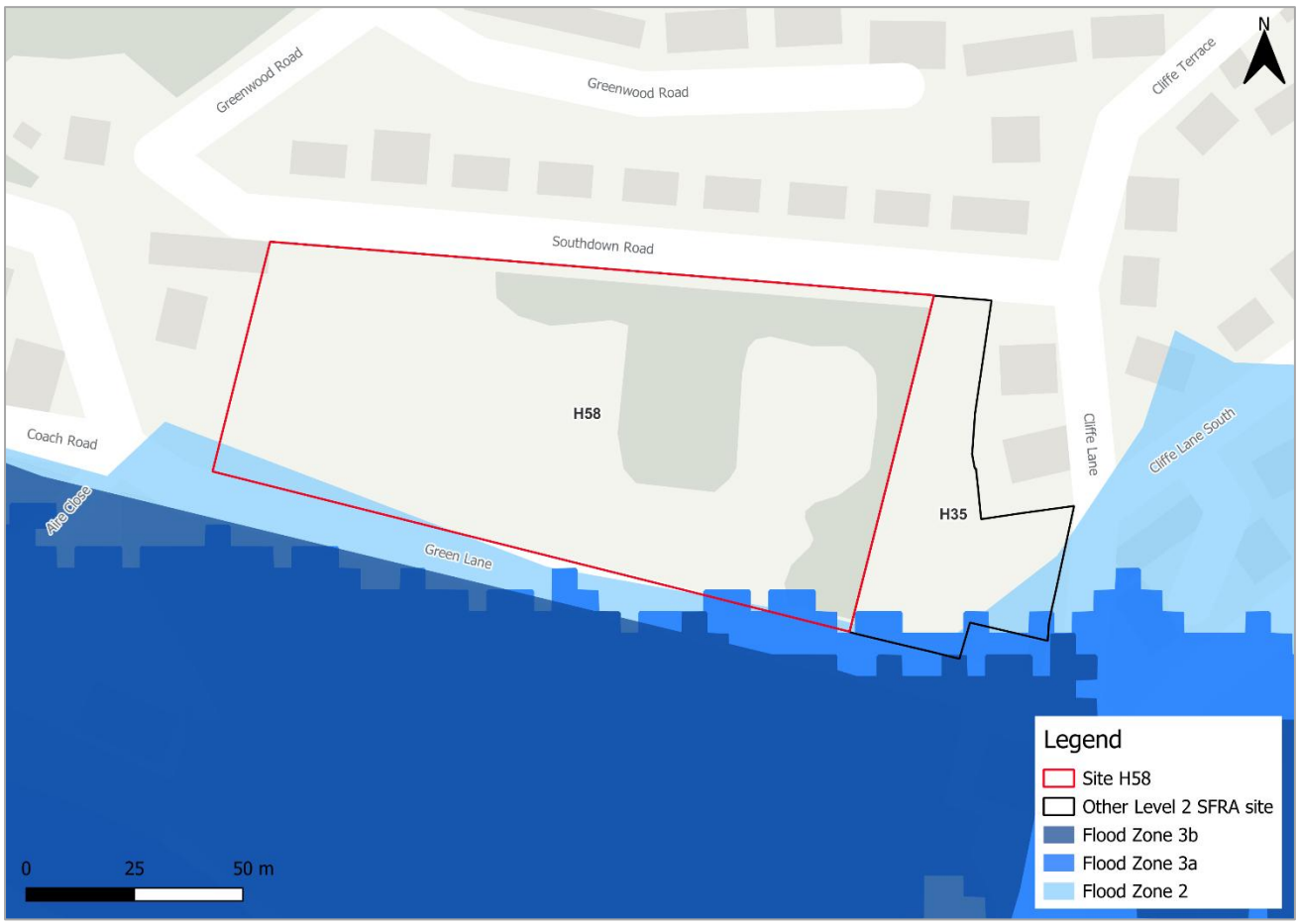


Figure 2-1: Existing risk from rivers to the site

2.1.2 Leeds FAS Kildwick to Esholt 2022 model outputs

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. Maximum flood depths within the site are modelled to be shallow, between 0.15 and 0.30 m within a small area of the site. Modelled flood velocities are moderate across the area at risk (Figure 2-3), with one instance of velocities in the range of 0.5 - 1.0 m^3/s located on the southern boundary. The modelled flood hazard is designated as 'very low hazard' across the area at risk within the site (Figure 2-4). Safe access and escape routes should be achievable via Southdown Road, travelling north, during this event. Section 2.3.1 discusses the defended model outputs.

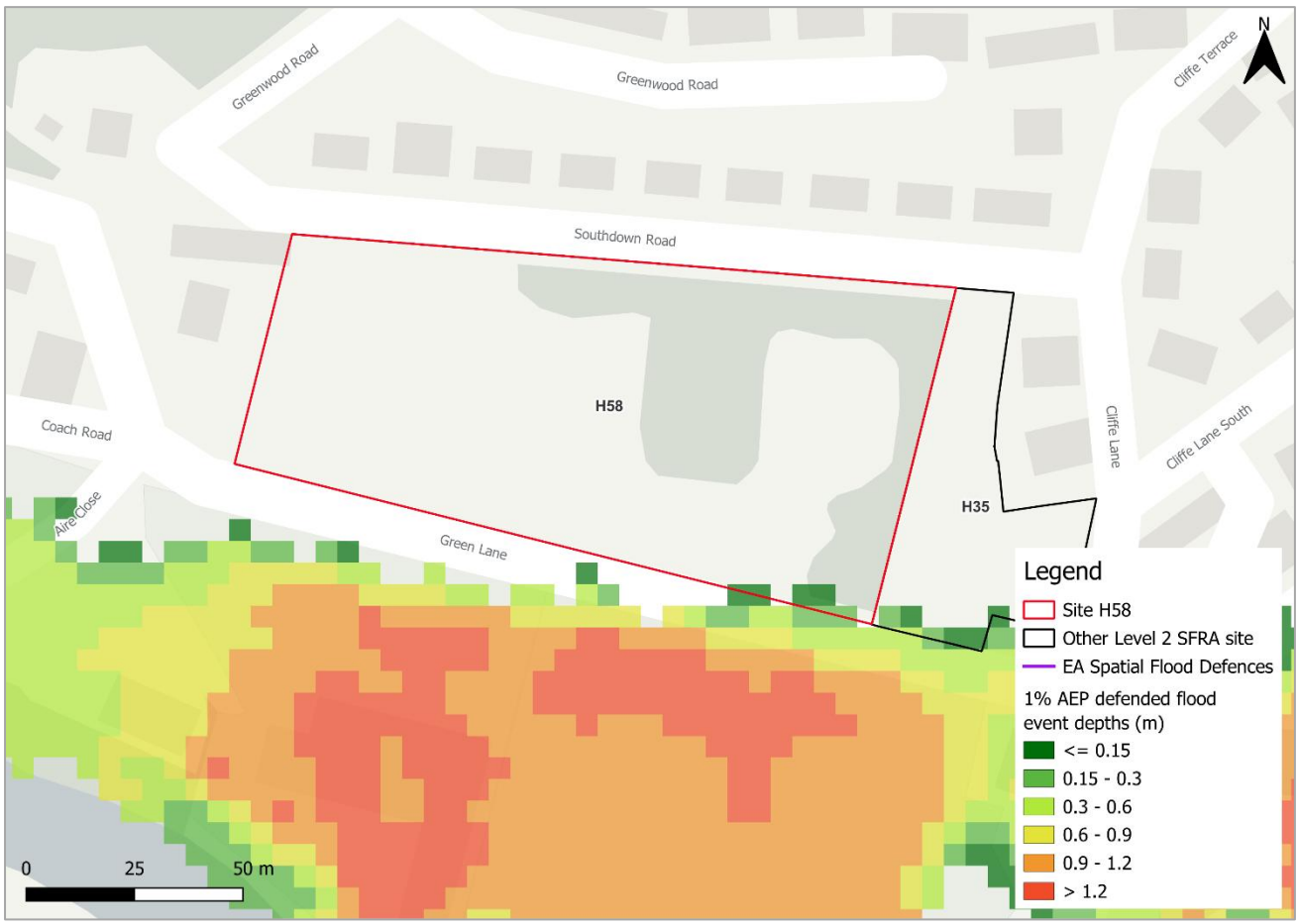


Figure 2-2: Flood depths for 1% AEP undefended flood event

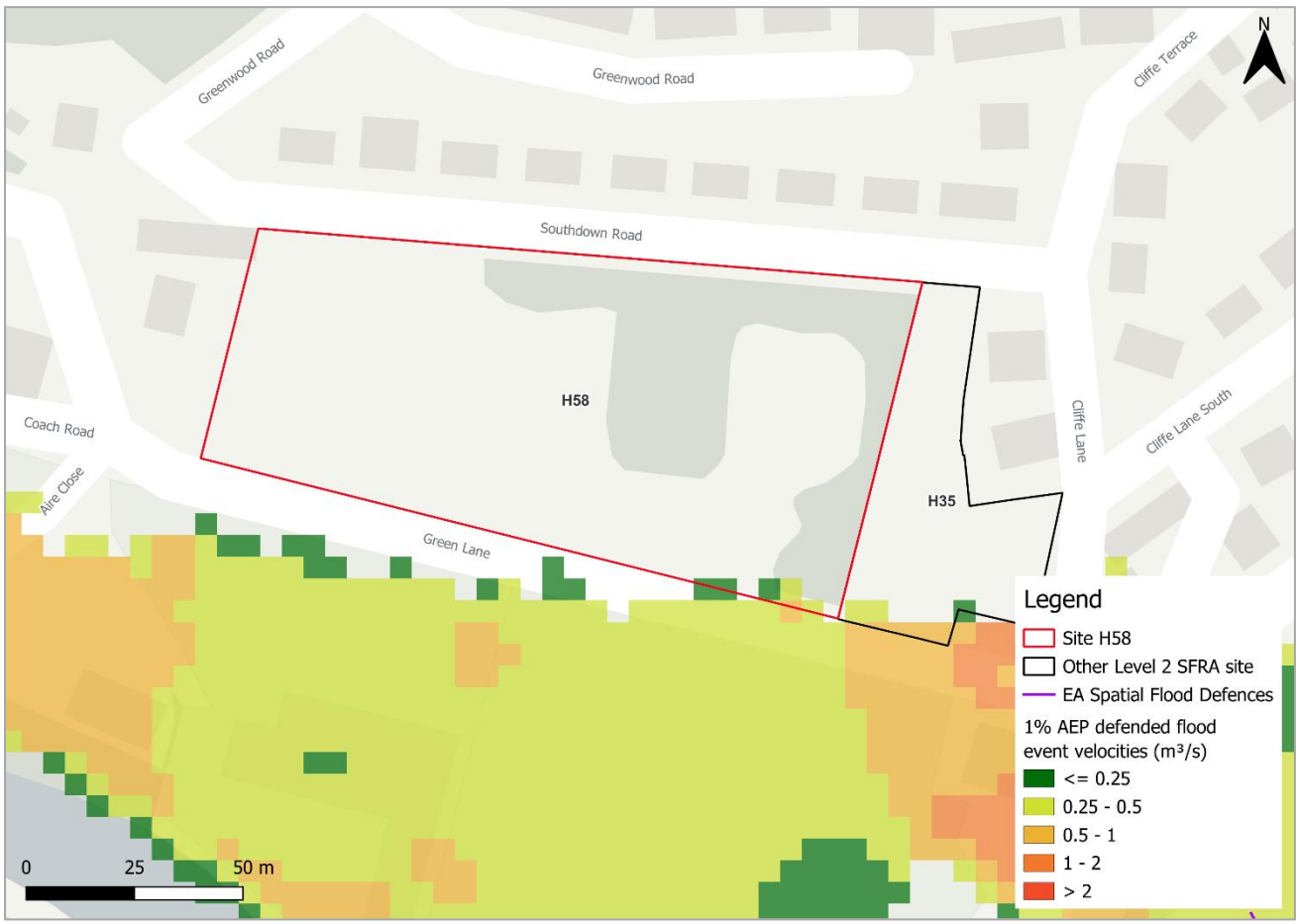


Figure 2-3: Flood velocities for 1% AEP undefended flood event

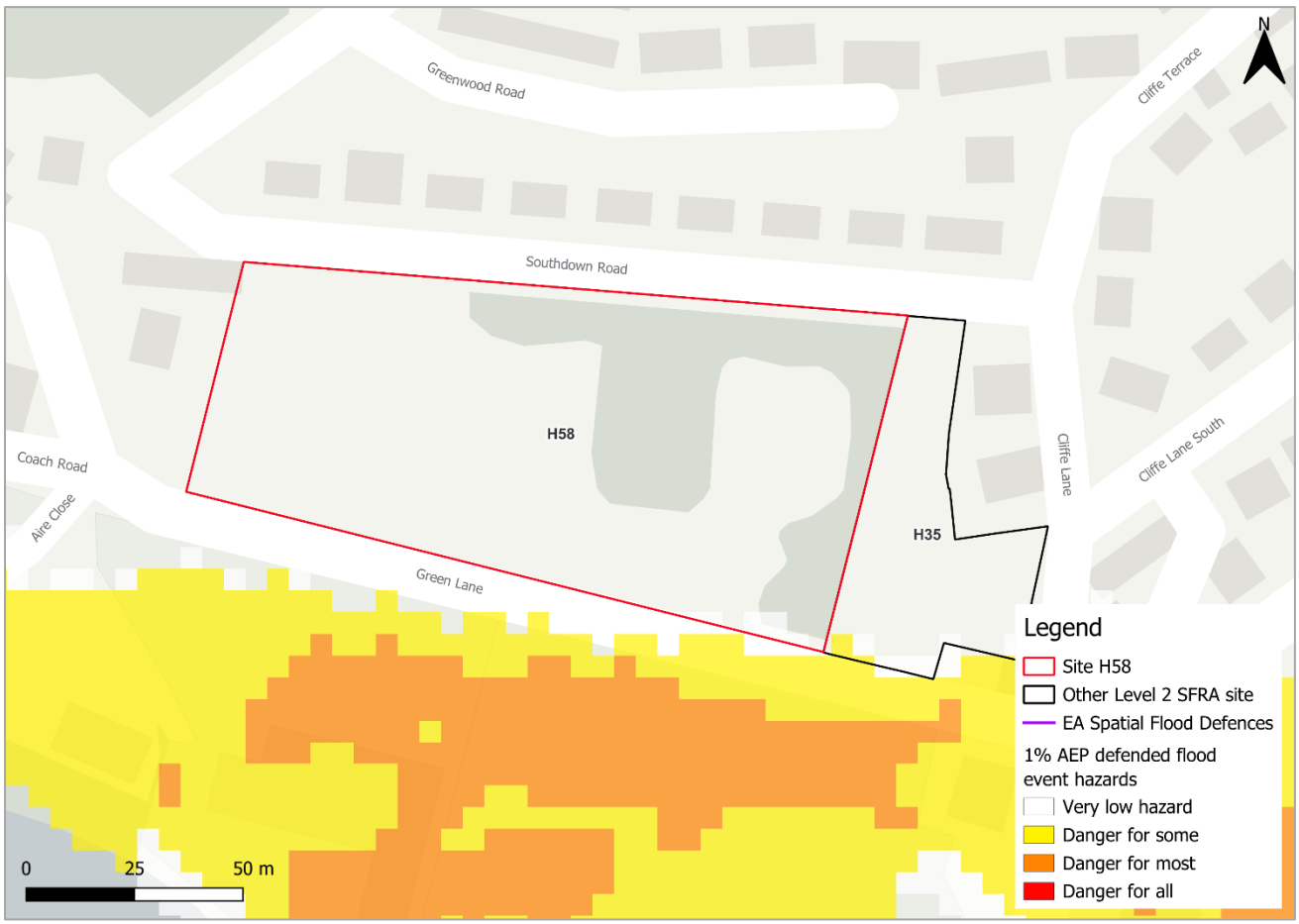


Figure 2-4: Flood hazard[1] for 1% AEP undefended flood event

2.2 Impacts from climate change

The impacts of climate change on flood risk from the River Aire 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

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

Table 2-2. 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%

Figure 2-5 shows the onsite modelled flood depths for the 1% AEP undefended event +23% for climate change. Risk is modelled to be nominally greater in both extent and depth in comparison to present day conditions. Maximum depths within the area at risk are observed between 0.30 and 0.60 m. Flood velocities are modelled to remain broadly similar to the present-day event (Figure 2-6). The modelled flood hazard within the area at risk in the southeast of the site is largely categorised as 'danger for some' (Figure 2-7). Safe access and escape routes are anticipated to remain viable during the climate change event via Southdown Road.



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



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



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

2.3 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 2-8), although modelled flood depths are marginally lower. This is consistent with the modelled climate change events.

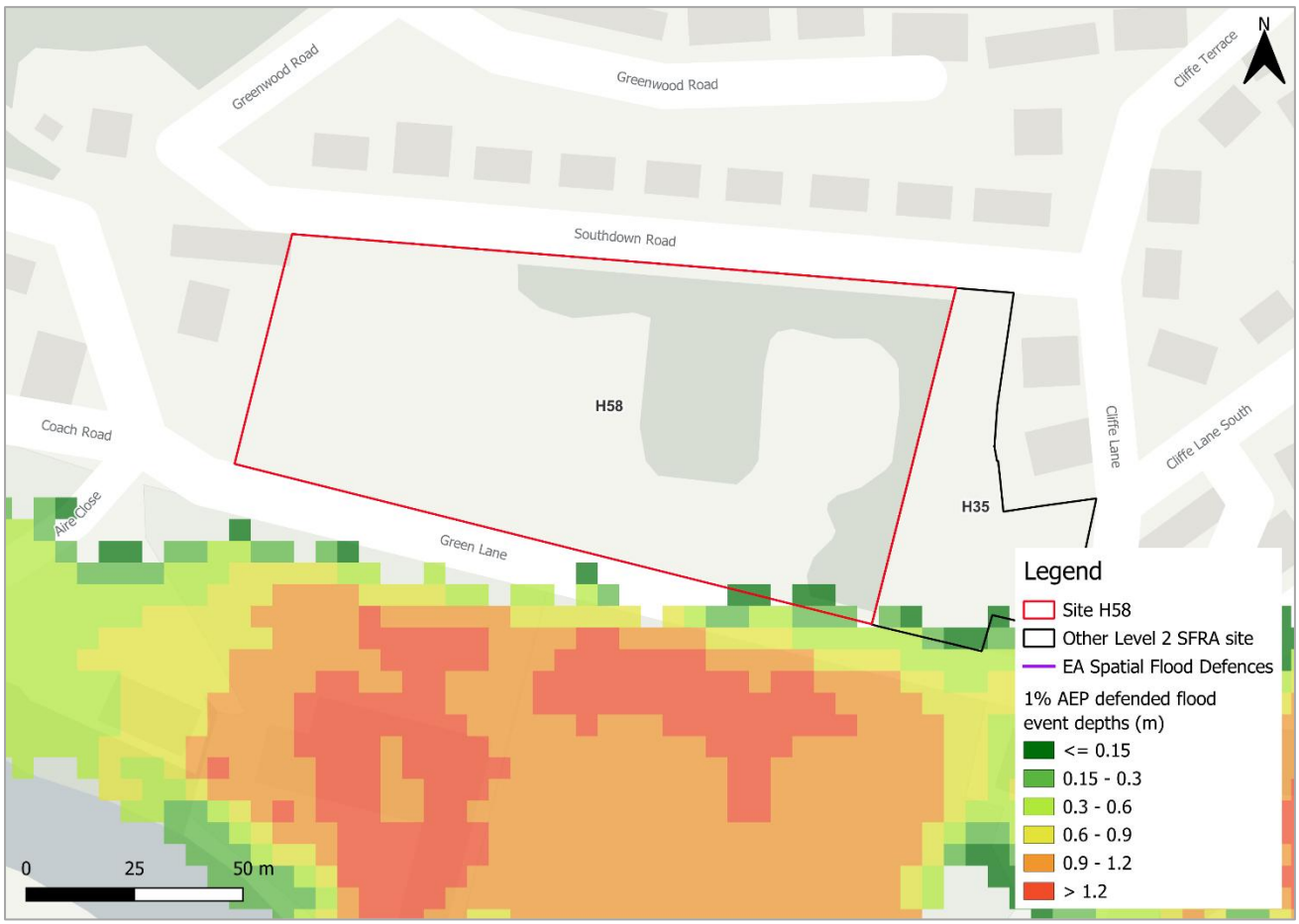


Figure 2-8: Flood depths for 1% AEP defended flood event

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. Upstream of the site, to the north and west, there is potential for tree planting indicating locations where woodland and riparian planting may be possible and effective to attenuate flooding. There is also potential for runoff attenuation during the 3.3% and 1% AEP events including via gully blocking to the west of the site. Floodplain reconnection is also indicated to be possible along the banks of the River Aire upstream of the site. These areas are shown in Figure 2-9. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

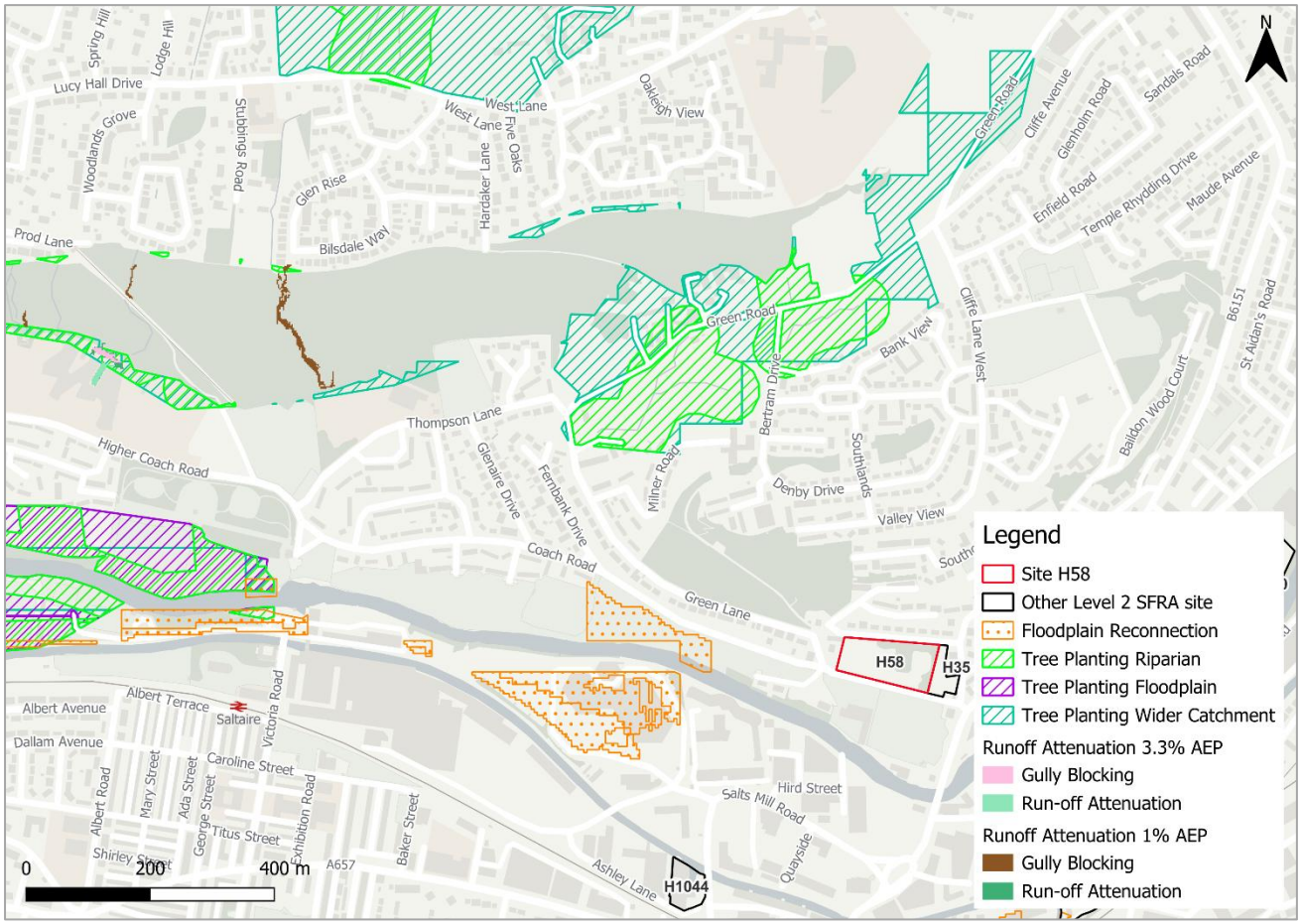


Figure 2-9: Natural Flood Management (NFM) potential mapping

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) has been considered and mapped in Figure 2-10 which shows the south of the site has been subject to flooding in the past. The RFO dataset indicates that these historic events have occurred from an unspecified cause in the autumn of 2000 and most recently due to the River Aire exceeding its banks in December 2015. Whilst the RFO dataset holds no specific cause for the flooding of autumn 2000, it is noted that the event's flood extents are similar in nature to those caused by the River Aire exceeding bank volume. The HFM outline in this location is used to represent Flood Zone 2.



Figure 2-10: 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 south of the site is located within a FWA, namely 123FWF119 - River Aire at Shipley.

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 an FWA. The area adjacent to the southern border of the site is also located within a FAA, namely 123WAF961 - Middle River Aire catchment.

Based on available information, Safe access and escape routes are anticipated to remain achievable via Southdown Road to the north of the site.

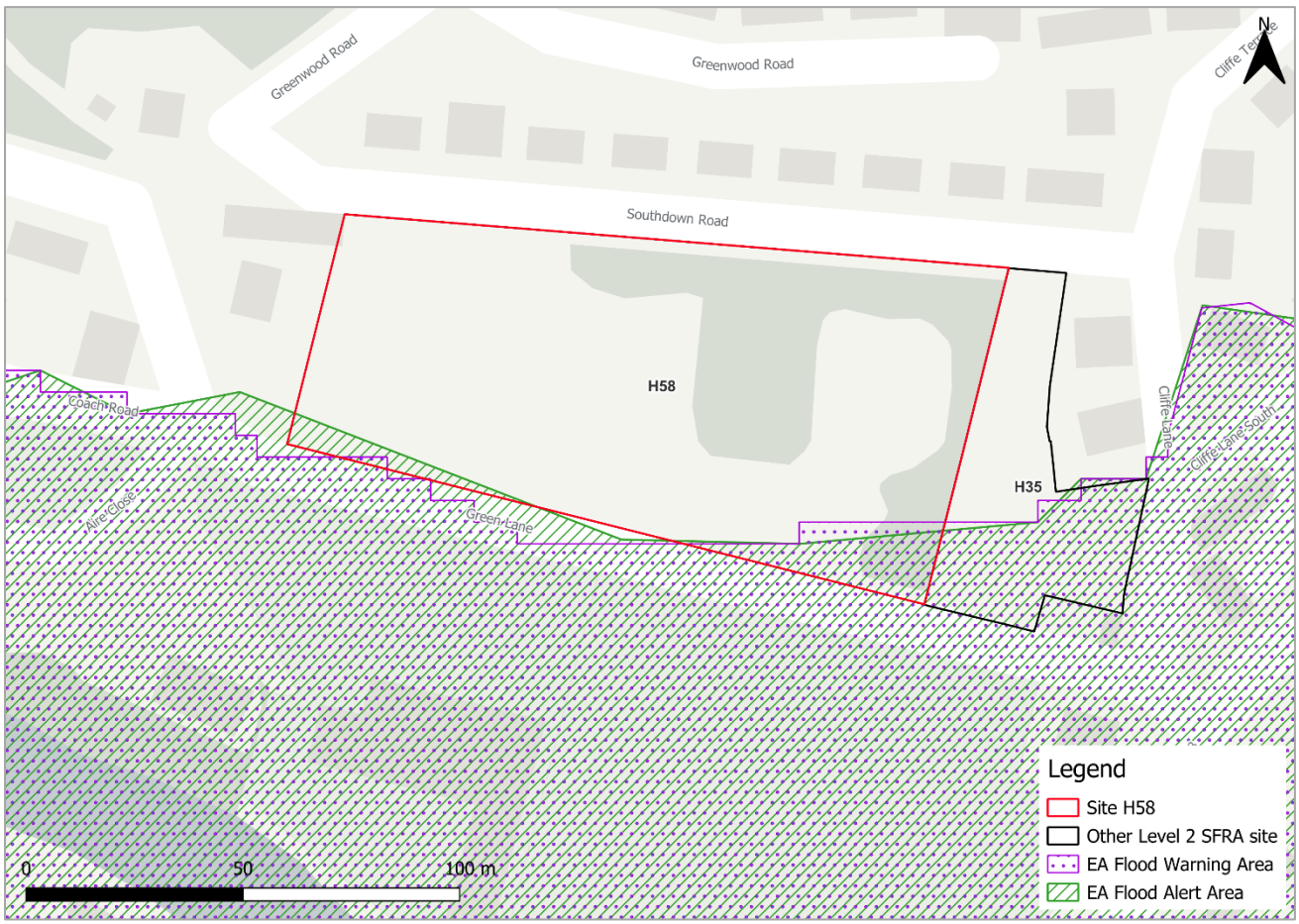


Figure 2-11: EA Flood Warning Areas and Flood Alert Areas

2.6 Observations, mitigation options and site suitability - fluvial

- The proposed development of the site would see a change in the risk classification from water-compatible 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 Flood Map for Planning indicates that the southeastern corner of the site is within Flood Zone 3a, and southwestern corner of the site is within Flood Zone 2. The remainder of the site is in Flood Zone 1. The southeastern corner of the site modelled to be at risk from fluvial sources (according to the Leeds FAS Kildwick to Esholt 2022 model) in the 1% AEP undefended scenario, to the same extent as 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 95% of the site is within Flood Zone 1.
- EA flood warnings and 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 4% of the site is at low risk, as shown in Table 3-1.

In the low-risk event, surface water risk is confined to an area of ponding within a topographic low spot within the west of the site, as well as a small area in the southeast of the site.

Greatest flood depths within the site in the low risk event are shallow of between 0.15 - 0.30m (Figure 3-1) with hazard largely categorised as moderate, and a small area modelled to be significant (Figure 3-2). Safe access and escape routes are anticipated to remain achievable via Southdown Road in the low-risk event.

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

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
96	4	0	0

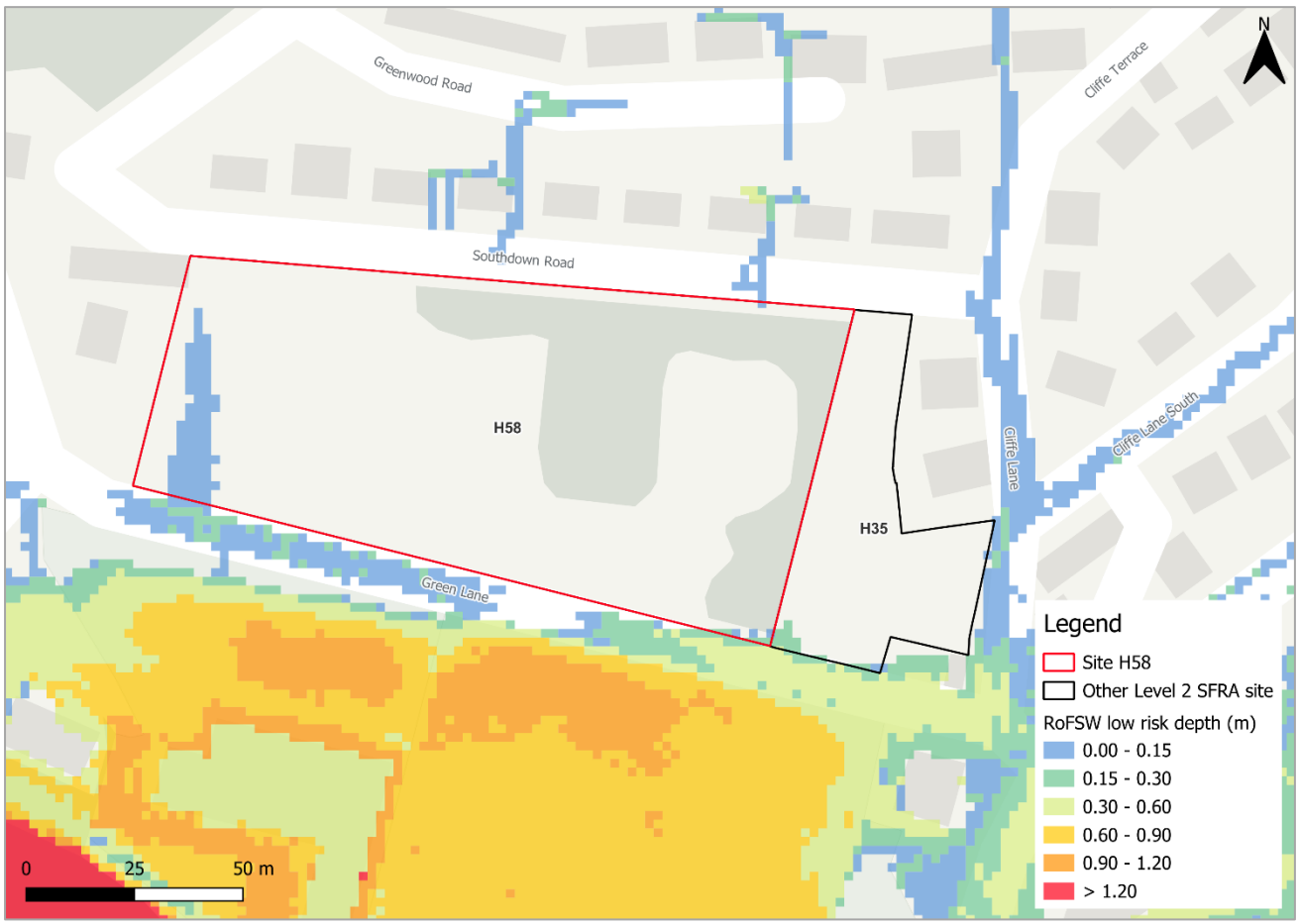


Figure 3-1: Low risk event surface water flood depths (Risk of Flooding from Surface Water map)

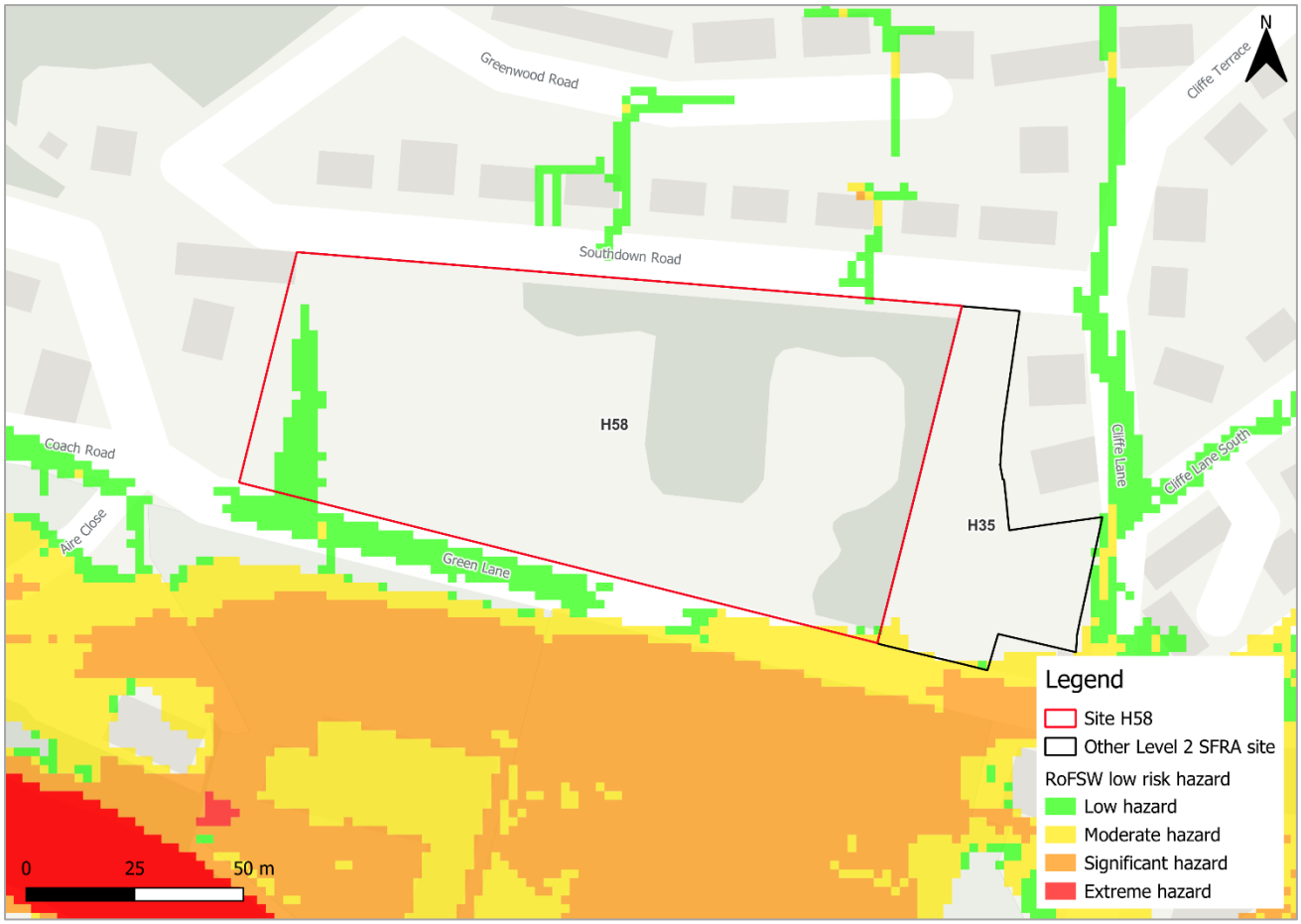


Figure 3-2: Low risk event surface water flood hazard[2] (Risk of Flooding from Surface Water map)

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 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%

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 though

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

not significantly, with the medium risk climate change event showing an increased level of risk compared to the present-day low risk event. Maximum depths are modelled to be between 0.3 and 0.6 m, with areas of hazard categorised as significant in the southeast corner of the site (Figure 3-4). Safe access and escape routes are anticipated to remain achievable via Southdown Road to the north of the site.

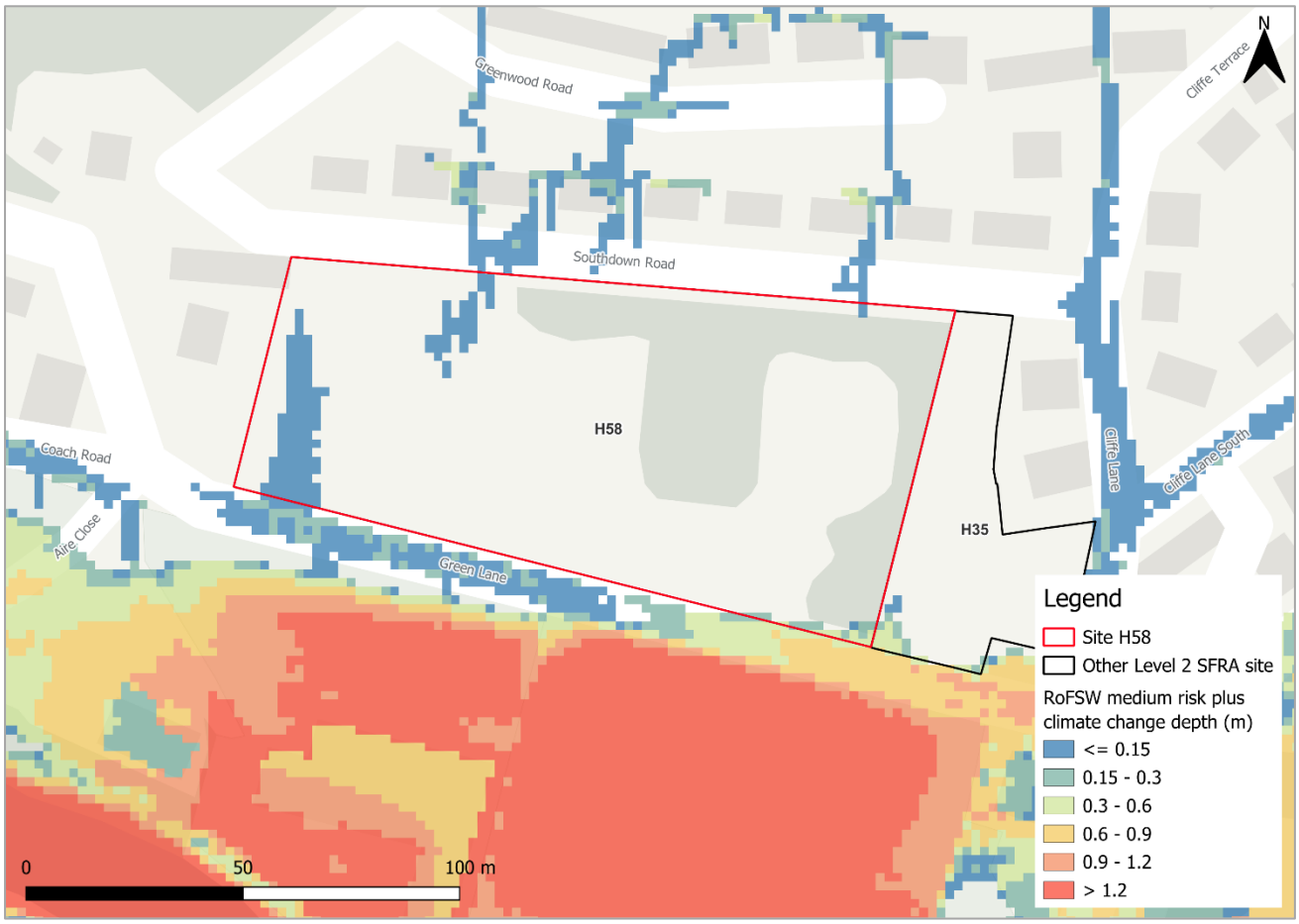


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)



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 to the site is predominantly very low with 96% of the site being at very low surface water flood risk. Surface water in the low-risk event is confined to a topographic depression in the west of the site, as well as a small area within the southeast corner of the site.
- Surface water flood risk is shown to be greater in the medium risk climate change event; with additional flow paths observed in the north of the site. Surface water should be retained onsite and runoff volumes must not exceed existing greenfield rates and, if possible, betterment should be achieved. Figure 4-1 shows that the use of infiltration SuDS onsite should be possible to retain water. However, further ground investigation would be required at the FRA stage.
- A 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 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 Guide[3]. Figure 4-1 shows the map covering this site and the surrounding areas and. Table 4-1 explains the risk classifications.

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



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

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 18 reservoirs. Of these 18 reservoirs, 15 are located within Bradford, two located within North Yorkshire and one located within Lancashire. These are operated by either Yorkshire Water Services Ltd, the National Trust or the City of Bradford Metropolitan District Council.

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

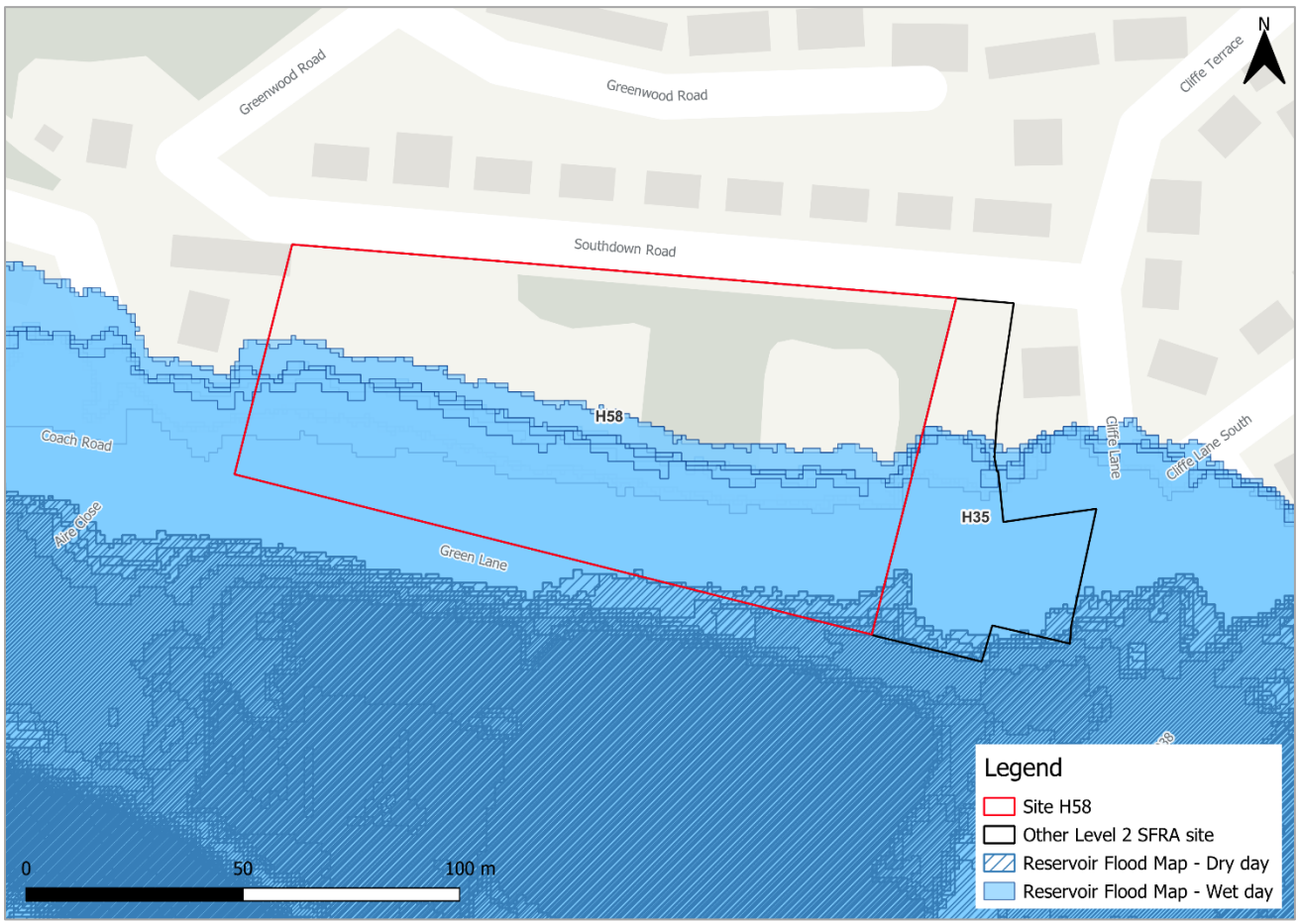


Figure 5-1: Flood risk from reservoirs

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 18 reservoirs. However, only five reservoirs impact the site in the 'dry day' flood extent, namely Graincliffe, Lower Laithe, Stubden, Water Sheddles and Thornton Moor reservoirs, all located within Bradford with the exception of Water Sheddles, which is located within Lancashire. This indicates that the remaining 15 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 consider[4]:
  - Consulting with the local resilience forum for advice on emergency planning,
  - Consulting with relevant reservoir owners to understand the impact development may have on their reservoirs, and
  - Using this Level 2 SFRA to understand whether any proposed development will be safe throughout its lifetime.

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

6 Overall site assessment

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

This site is required to pass part b) of the exception test[5], given it is proposed for more vulnerable uses and is 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. 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 assuming development avoids the southern areas of the site modelled to be at fluvial flood risk.
- Consultation should be had with the reservoir owners that may be affected by the development of this site.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

5 Para 178 National Planning Policy Framework 2024

7 Licencing

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Bradford Level 2 Strategic Flood Risk Assessment - Site H420

Final

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. Freya Nation of JBA Consulting carried out this work.

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

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H420. 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 H420

- Location: Bradford Road, Riddlesden, Keighley
- Existing site use: Greenfield, open space
- Existing site use vulnerability: Water compatible
- Proposed site use: Residential
- Proposed site use vulnerability: More vulnerable
- Site area: 2.8 hectares
- Proposed development impermeable area: 2.1 hectares
- Watercourse: River Aire (main river)
- Environment Agency (EA) river model: Leeds FAS Kildwick to Esholt 2022
- 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

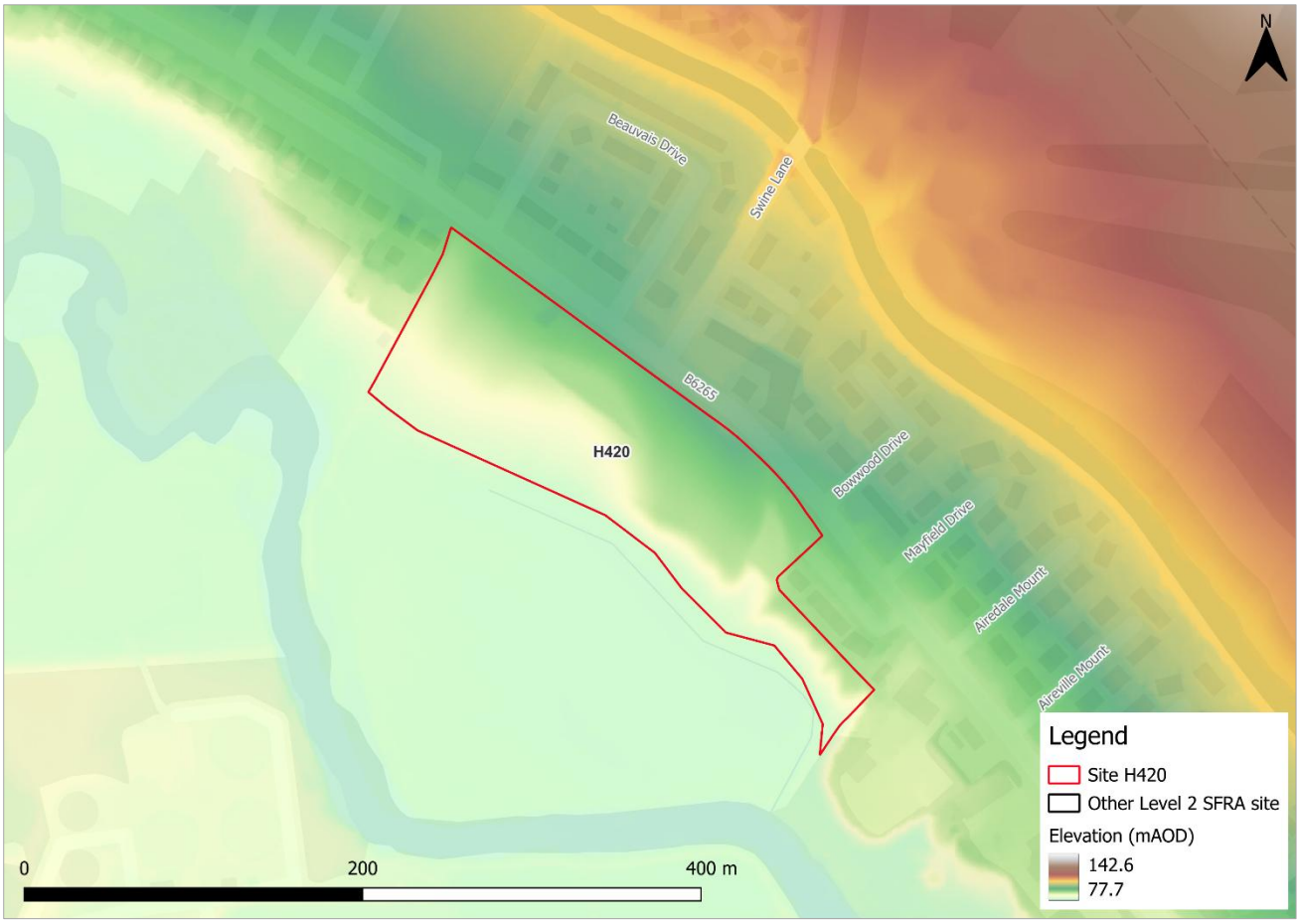


Figure 1-2: Topography



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 Aire approximately 50m from the southwestern site boundary. The River Aire is designated main river. Functional floodplain is present along the southwestern boundary of the site. The area of functional floodplain should be left free of development. The functional floodplain in this location is based on the 3.33% AEP defended event from the Leeds FAS Kildwick to Esholt 2022 model as well as the 3.33% AEP defended event from the River Worth 2022 model. The Flood Map for Planning appears to be based on the outputs from the Leeds FAS Kildwick to Esholt 2022 model rather than the River Worth 2022 model. However, this Level 2 SFRA reviews the modelled risk from both models.

The southwestern site boundary is also situated within Flood Zone 3a and therefore at high risk. More of the western side of the site is situated within Flood Zone 2 and is therefore at medium risk of flooding. Flood Zone 2 in this area is not based on modelled data. It is based on the EA's Historic Flood Map (HFM). See Section 2.4. The remaining area of the site is within Flood Zone 1 and therefore at low risk.

A small ditch exists adjacent to the southwestern boundary of the site and enters the River Aire near the far southeastern corner of the site. This ditch is unmodelled therefore does not contribute to the observed fluvial 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)
53	41	1	5

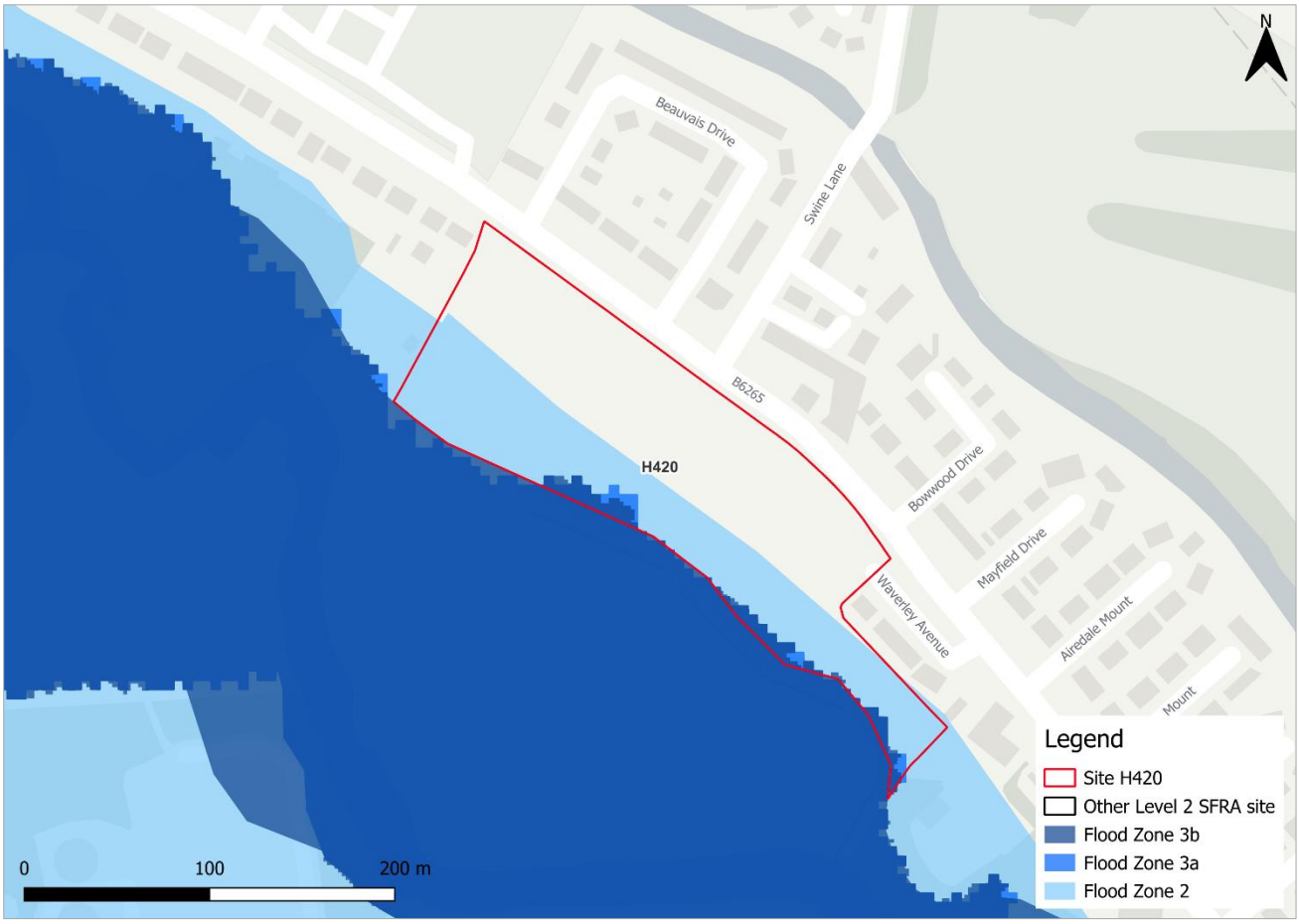


Figure 2-1: Existing risk from rivers to the site

2.1.2 Leeds FAS Kildwick to Esholt 2022 model outputs

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 southwestern boundary of the site. Maximum flood depths within the site are modelled to be significant, >1.2m, however this is only within a small area of the site. Modelled flood velocities are varied across the area at risk (Figure 2-3), with velocities between <= 0.25 and 0.5 m^3/s. This is reflected in the modelled flood hazard being either 'very low hazard' or 'danger for some' across the area at risk (Figure 2-4). Safe access and escape routes should be achievable via the B6265 (Bradford Road) during this event. Section 2.3.1 discusses the defended model outputs.

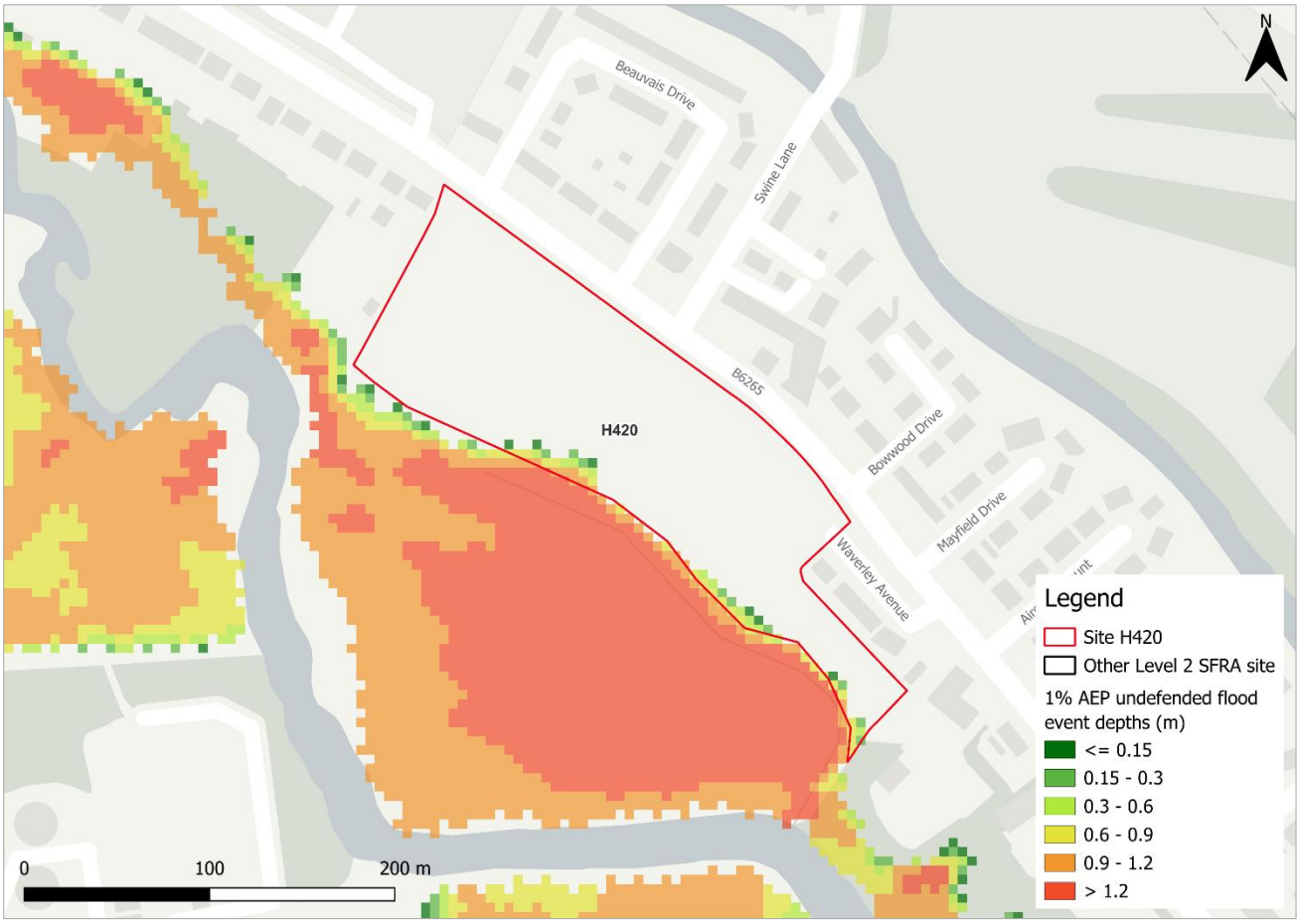


Figure 2-2: Flood depths for the Kildwick to Esholt model 1% AEP undefended flood event

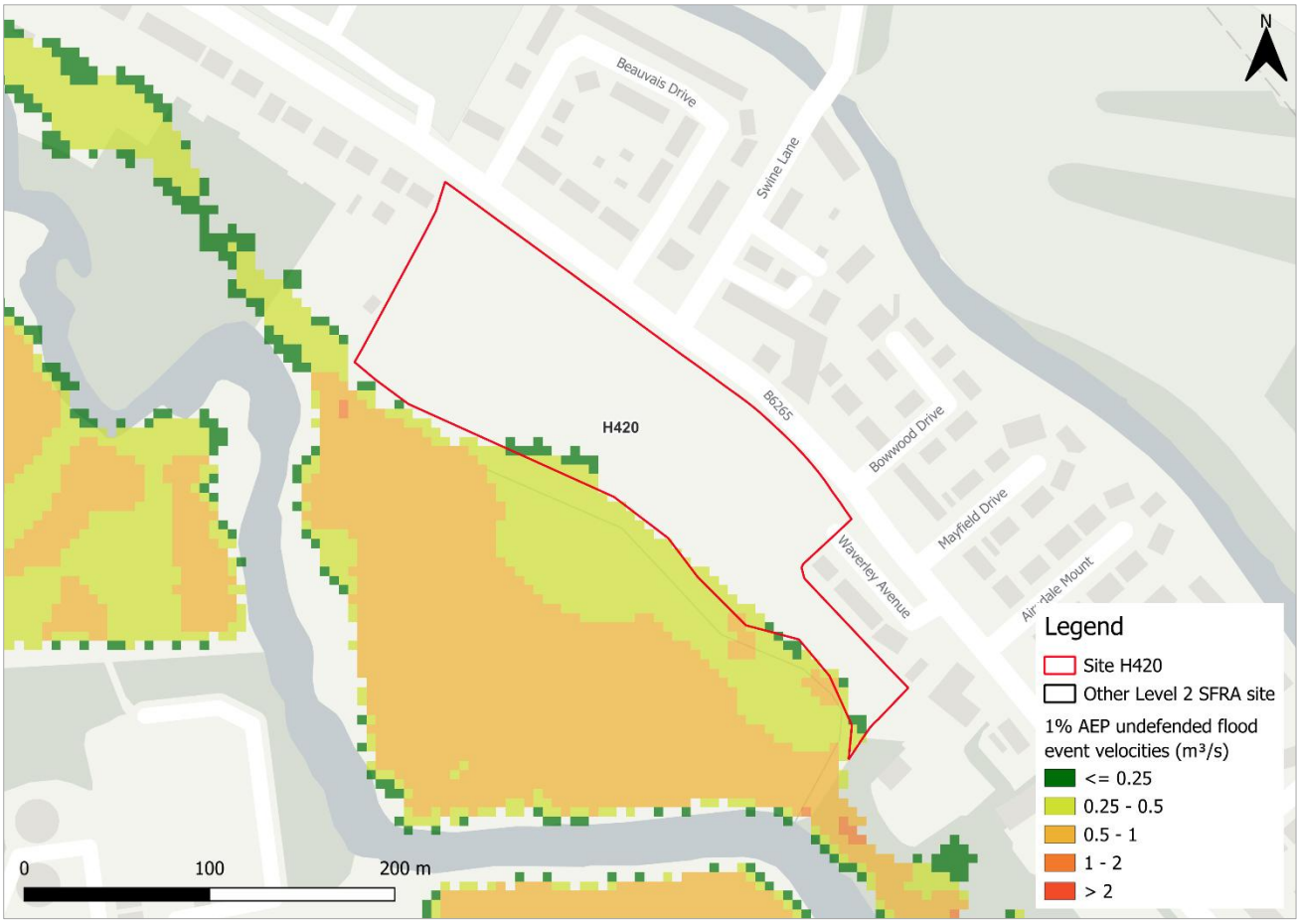


Figure 2-3: Flood velocities for the Kildwick to Esholt model 1% AEP undefended flood event

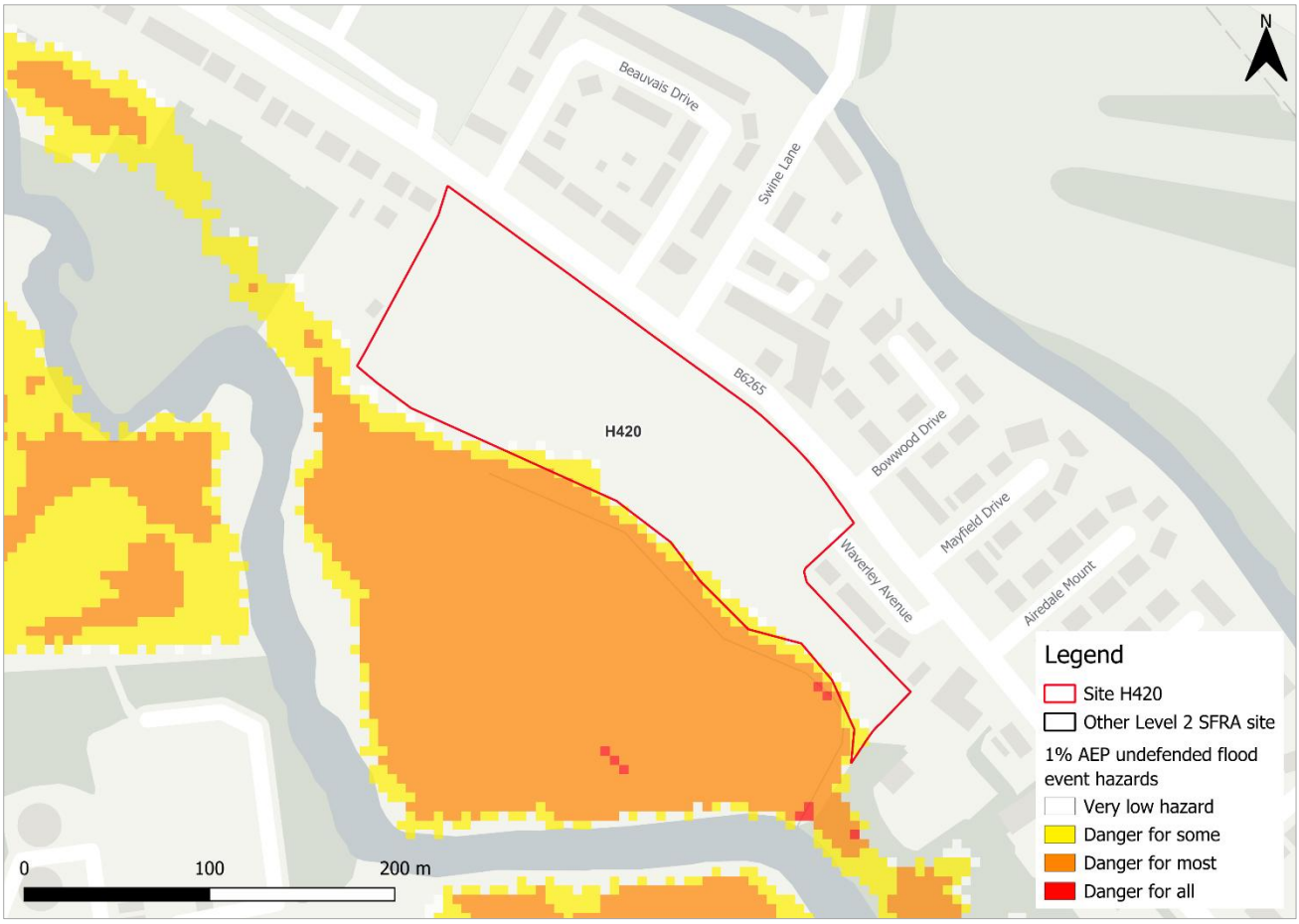


Figure 2-4: Flood hazard[1] for the Kildwick to Esholt model 1% AEP undefended flood event

2.1.3 River Worth 2022 model outputs

Flooding from the River Aire has also been modelled in the 2022 River Worth model. Figure 2-5 shows the modelled flood depths for the 1% AEP undefended event which impacts the southwestern boundary of the site to a similar extent to that shown by the Leeds FAS Kildwick to Esholt 2022 model.

Maximum flood depths within the site are modelled to be between 0.9 and 1.2 m, however this is only within a small area of the site. Modelled flood velocities are varied across the area at risk (Figure 2-6), with velocities between <= 0.25 and 0.5 m^3/s. This is reflected in the modelled flood hazard being either 'very low hazard' or 'danger for some' across the area at risk (Figure 2-4). Safe access and escape routes should be achievable via the B6265 (Bradford Road) during this event. Section 2.3.1 discusses the defended model outputs.

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

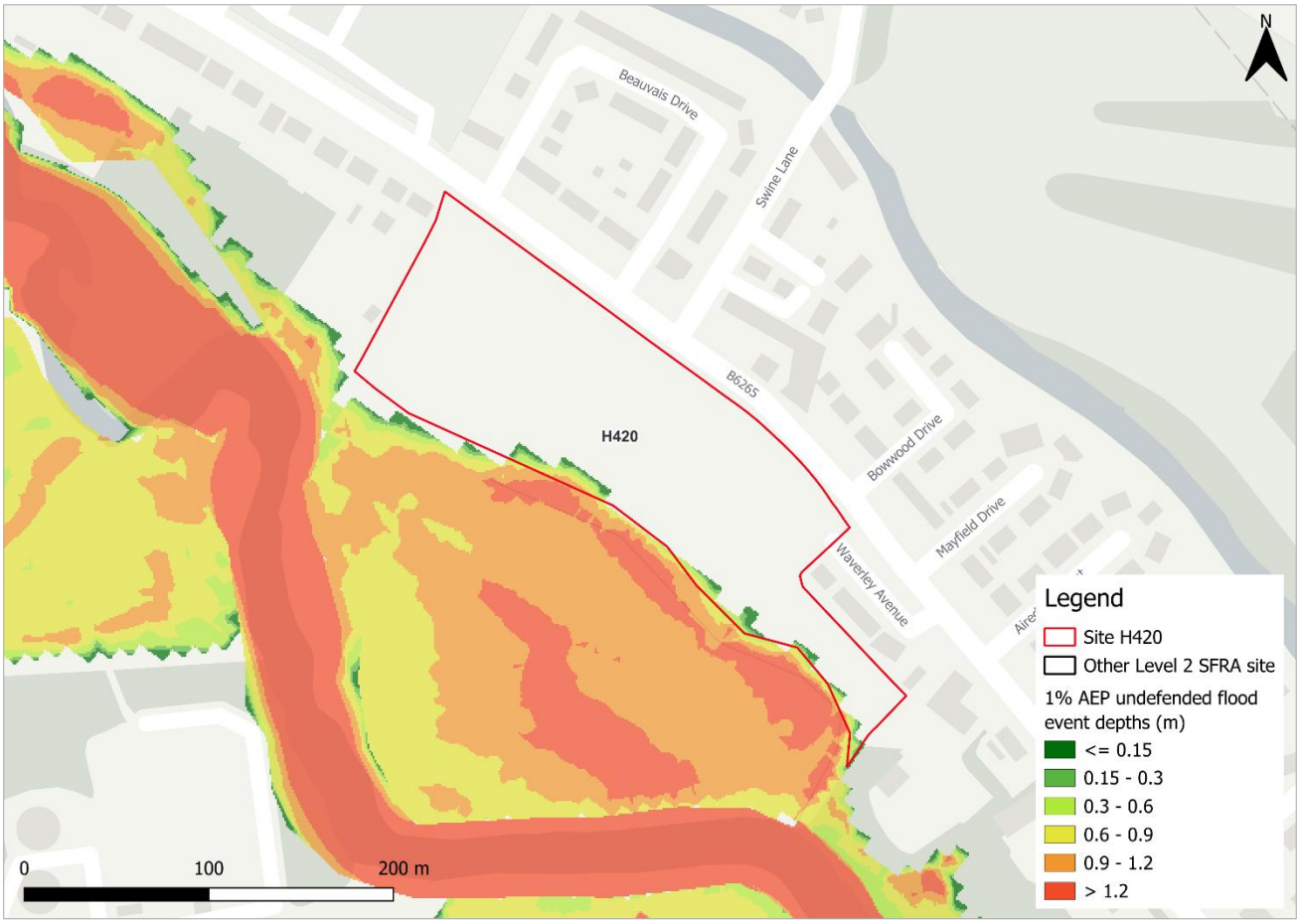


Figure 2-5: Flood depths for the Worth model 1% AEP undefended flood event

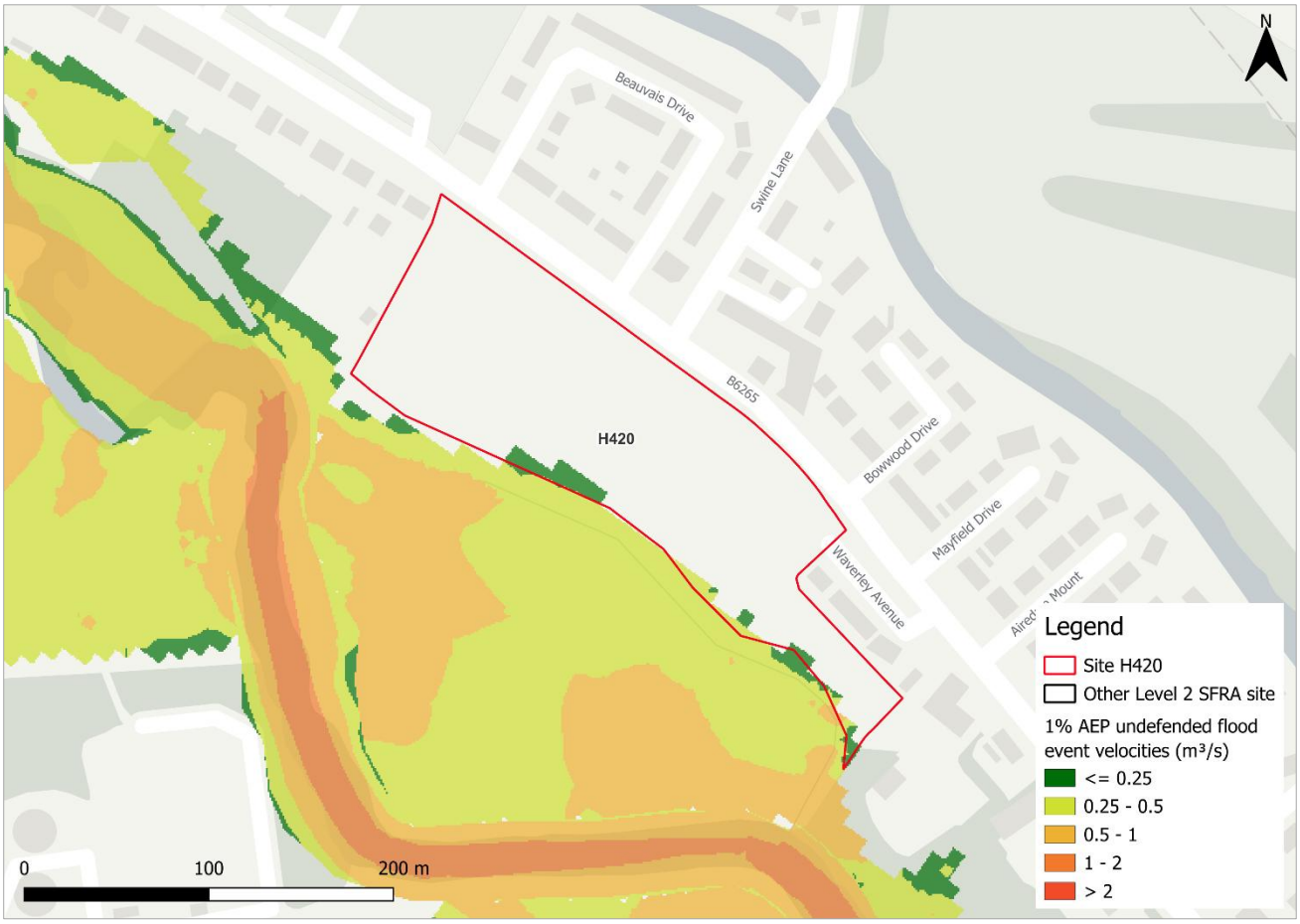


Figure 2-6: Flood velocities for the Worth model 1% AEP undefended flood event

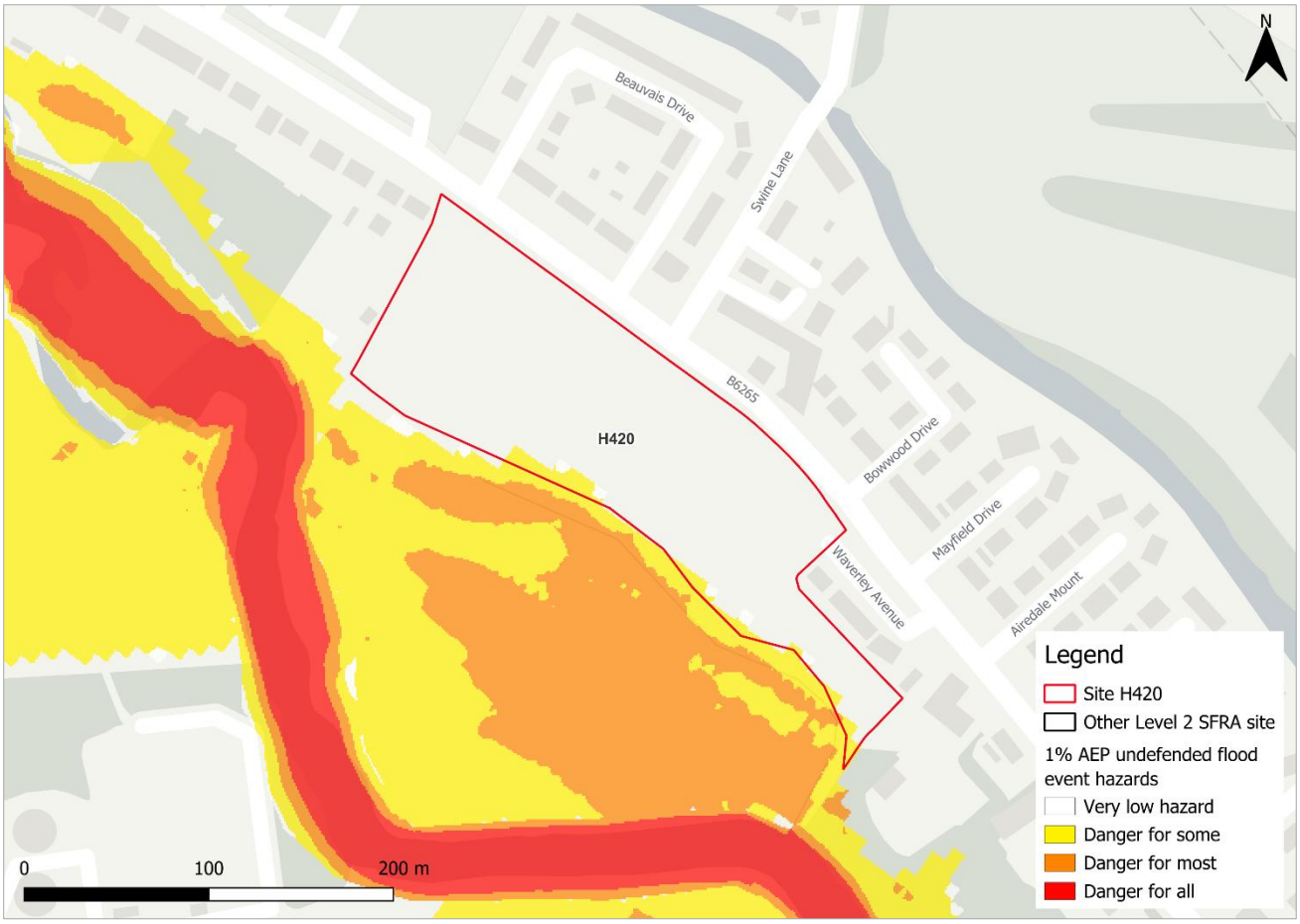


Figure 2-7: Flood hazard[2] for the Worth model 1% AEP undefended flood event

2.2 Impacts from climate change

The impacts of climate change on flood risk from the River Aire have been modelled without flood defence infrastructure in place using both models. 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 should be assessed for essential infrastructure.

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

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

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

2.2.1 Leeds FAS Kildwick to Esholt 2022 climate change model outputs

The functional floodplain plus climate change dataset indicates that the area of functional floodplain onsite is likely to marginally increase in the future.

Figure 2-8 shows the onsite modelled flood depths for the 1% AEP undefended event +23% for climate change. Risk is modelled to be slightly greater in extent in comparison to present day conditions. Maximum depths within the area at risk are significant, up to >1.2 m. Flood velocities are modelled to remain largely the same as the present day event, with maximum velocities between 0.25 and 0.5 m^3/s (Figure 2-9). The modelled flood hazard within the area at risk is largely categorised as 'danger for some' with some a small area categorised as 'danger for most' at the southwestern site boundary (Figure 2-10). Safe access and escape routes should remain achievable via the B6265 (Bradford Road) during the climate change event.

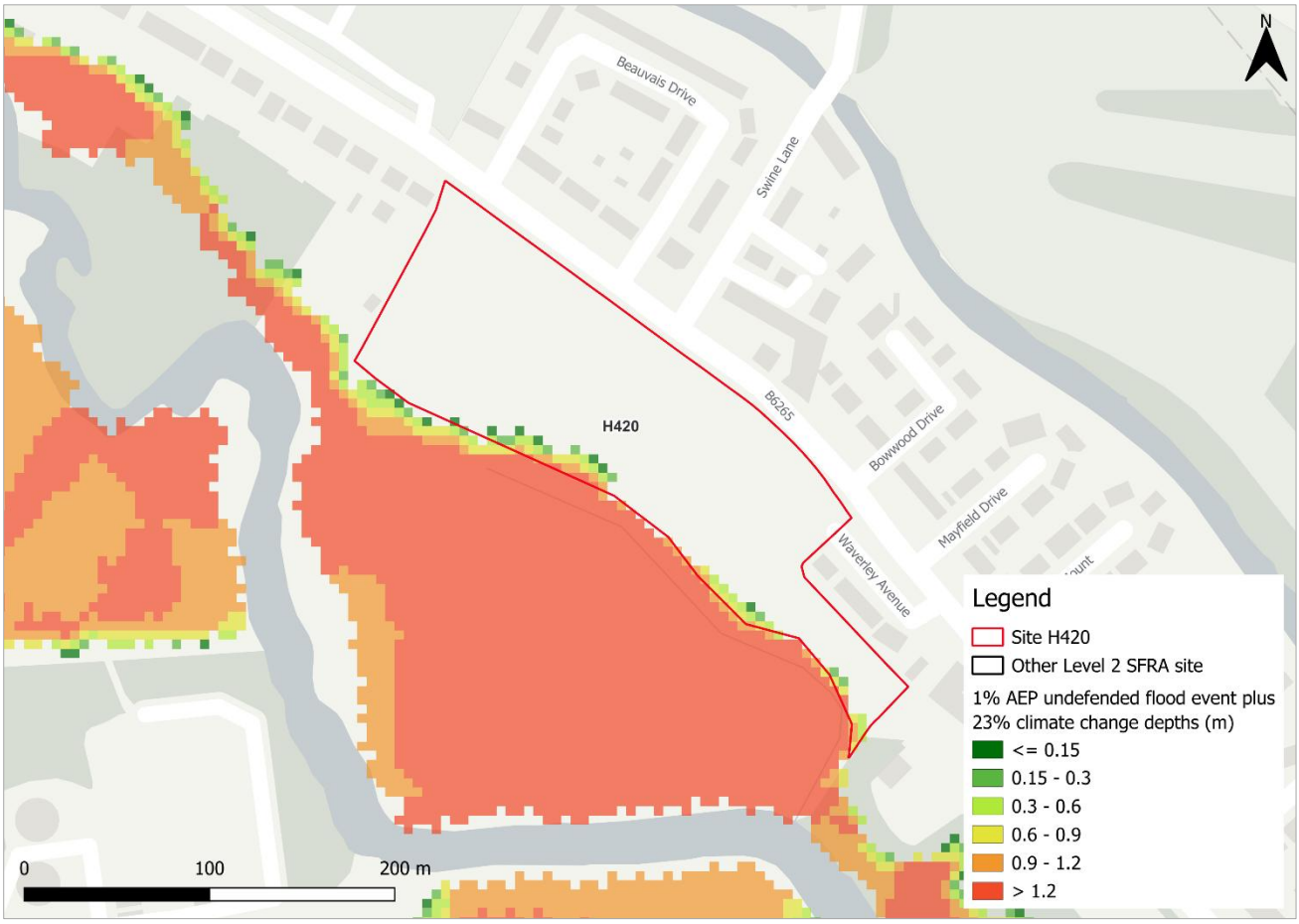


Figure 2-8: Flood depths for the Kildwick to Esholt model 1% AEP undefended flood event +23% (central climate change allowance)

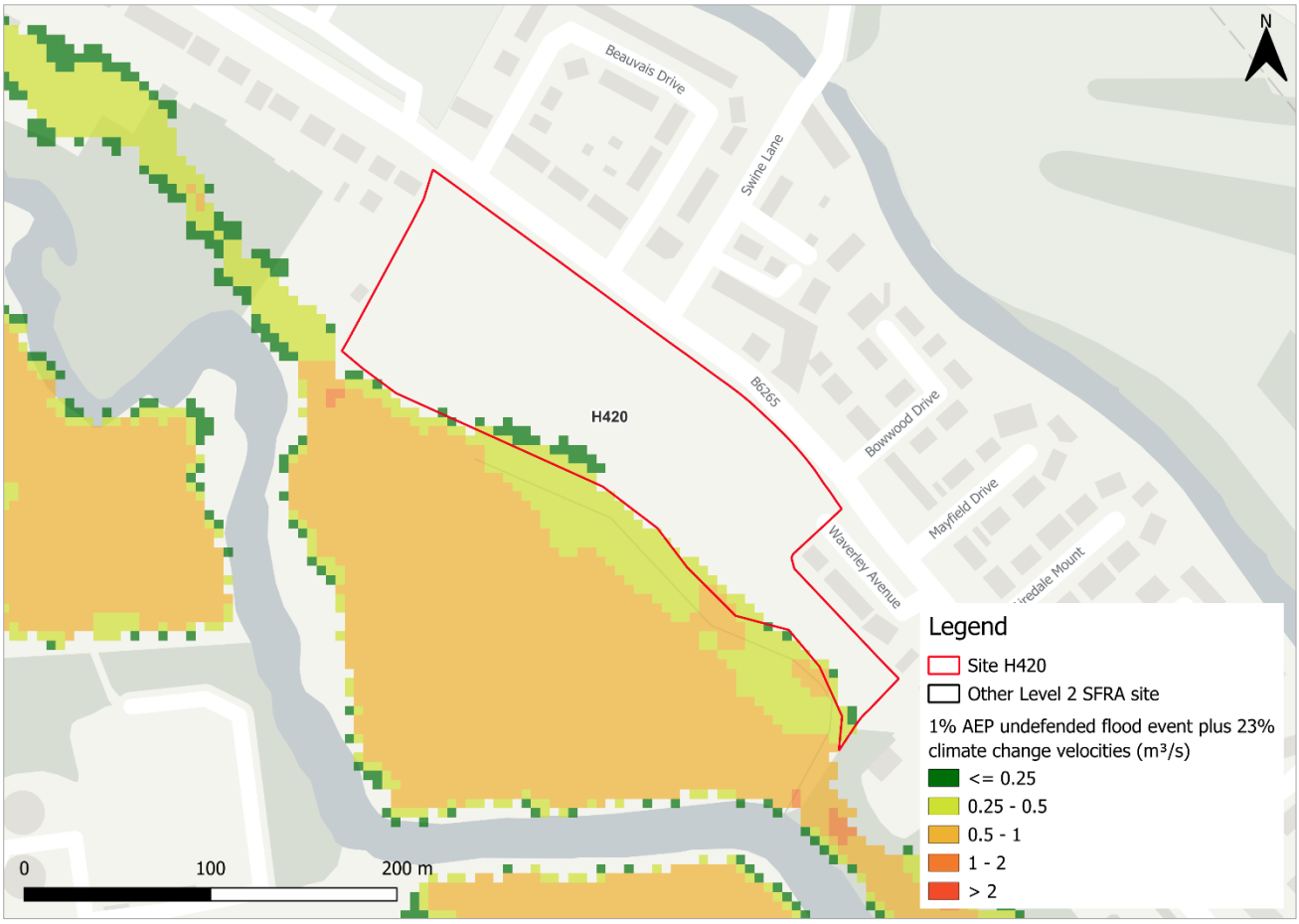


Figure 2-9: Flood velocities for the Kildwick to Esholt model 1% AEP undefended flood event +23% (central climate change allowance)

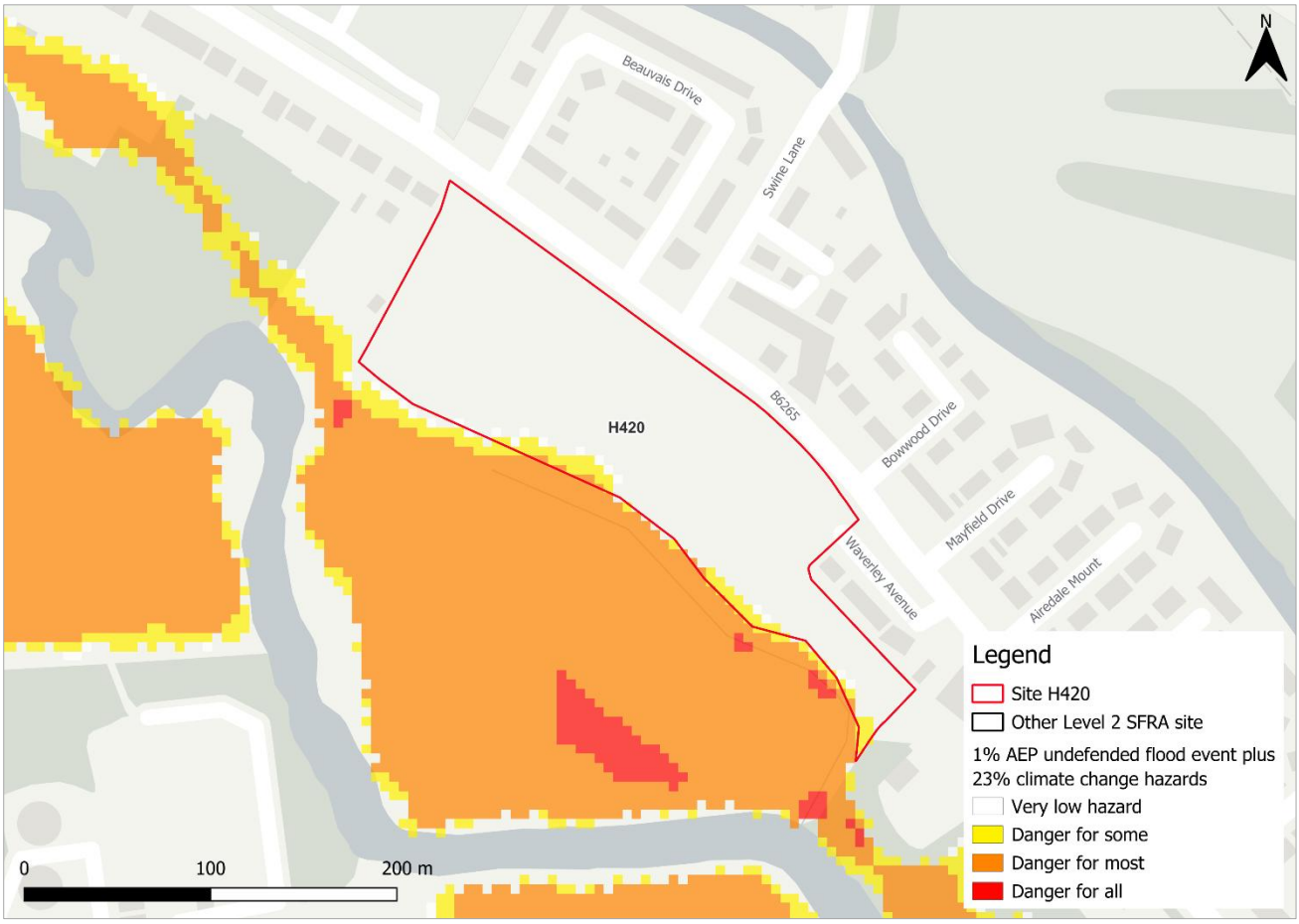


Figure 2-10: Flood hazard for the Kildwick to Esholt model 1% AEP undefended flood event +23% (central climate change allowance)

2.2.2 River Worth 2022 model climate change outputs

The functional floodplain plus climate change dataset indicates that the area of functional floodplain onsite is likely to marginally increase in the future.

Figure 2-11 shows the onsite modelled flood depths for the 1% AEP undefended event +23% for climate change. Risk is modelled to be slightly greater in extent in comparison to present day conditions. Maximum depths within the area at risk are significant, up to >1.2 m. Flood velocities are modelled to remain largely the same as the present day event, with maximum velocities between 0.25 and 0.5 m^3/s (Figure 2-12). The modelled flood hazard within the area at risk is largely categorised as 'danger for some' with a small area categorised as 'danger for most' at the southwestern site boundary (Figure 2-13). Safe access and escape routes should remain achievable via the B6265 (Bradford Road) during the climate change event.

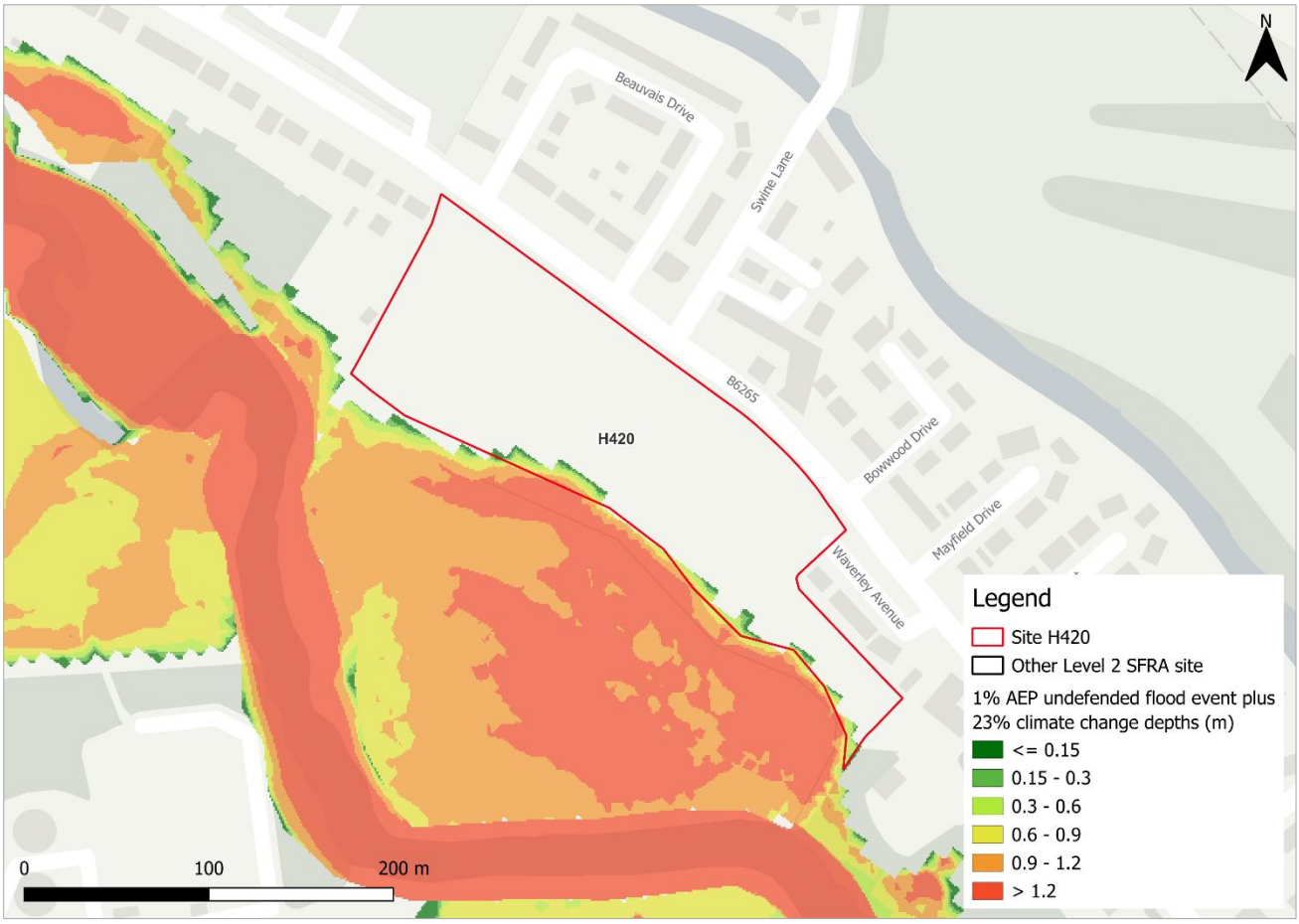


Figure 2-11: Flood depths for the Worth model 1% AEP undefended flood event +23% (central climate change allowance)

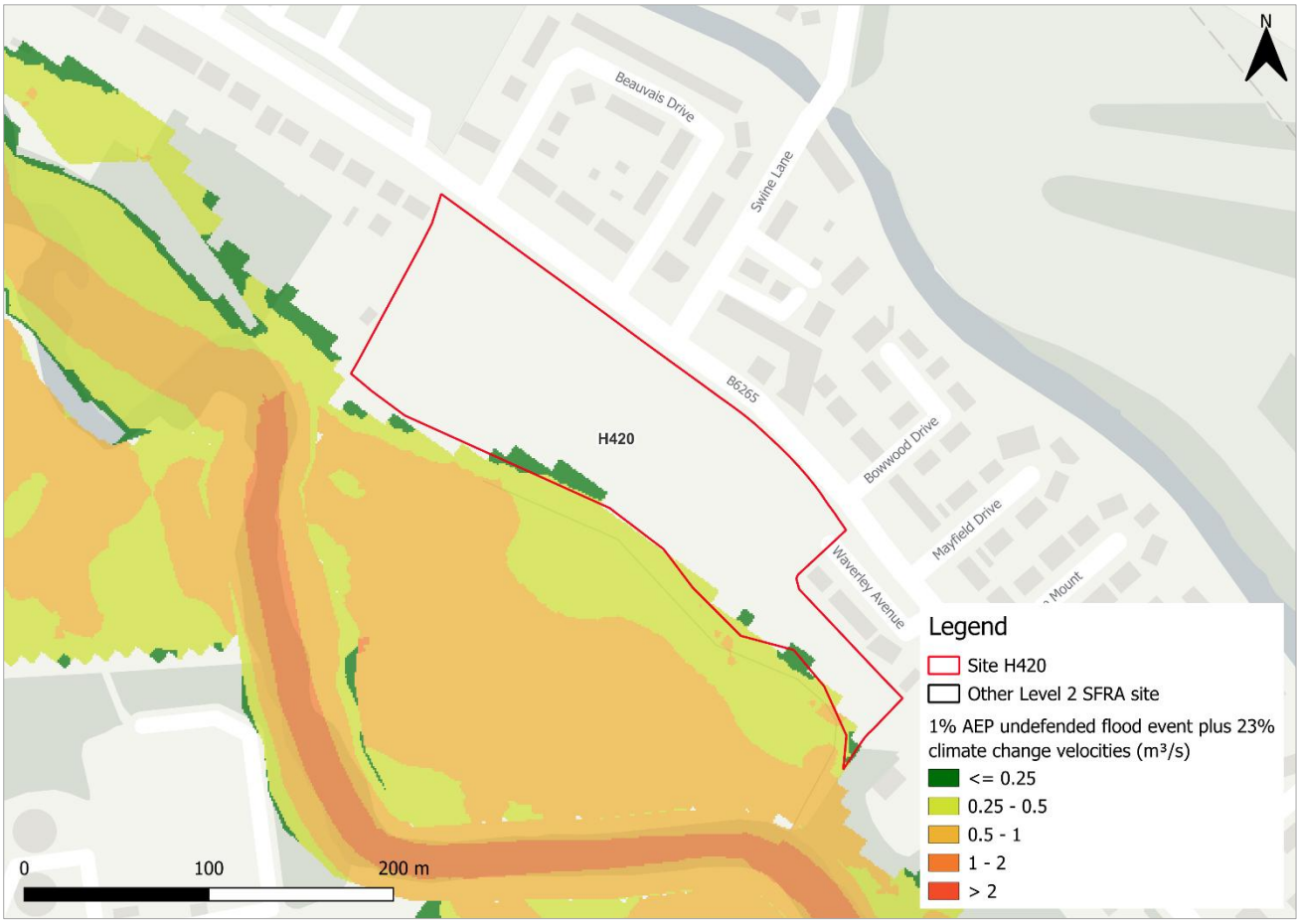


Figure 2-12: Flood velocities for the Worth model 1% AEP undefended flood event +23% (central climate change allowance)

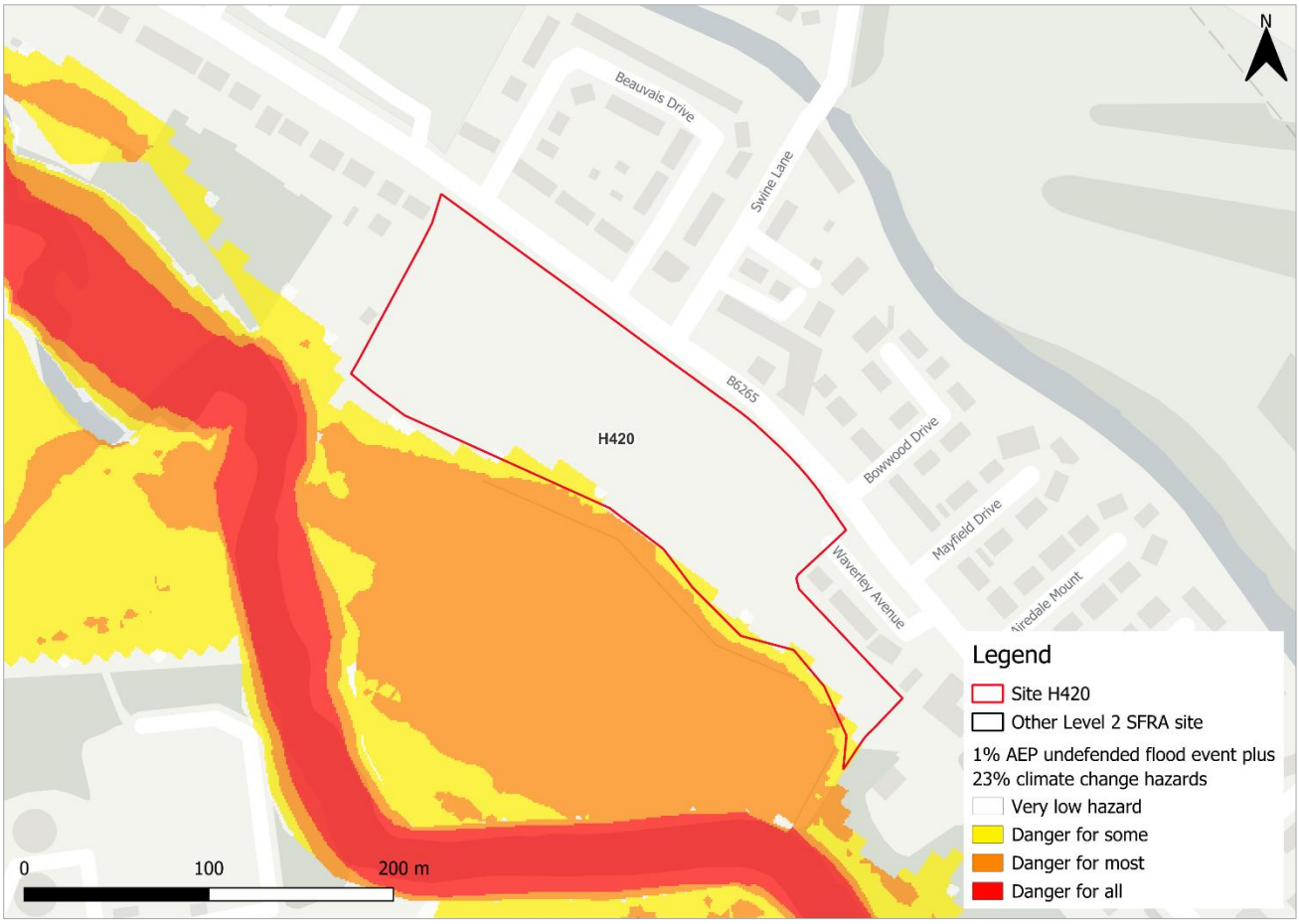


Figure 2-13: Flood hazard for the Worth model 1% AEP undefended flood event +23% (central climate change allowance)

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 extents and depths being very similar to the undefended event within the site for both models (Figure 2-14 and Figure 2-15). This is consistent with the modelled climate change events for both models.

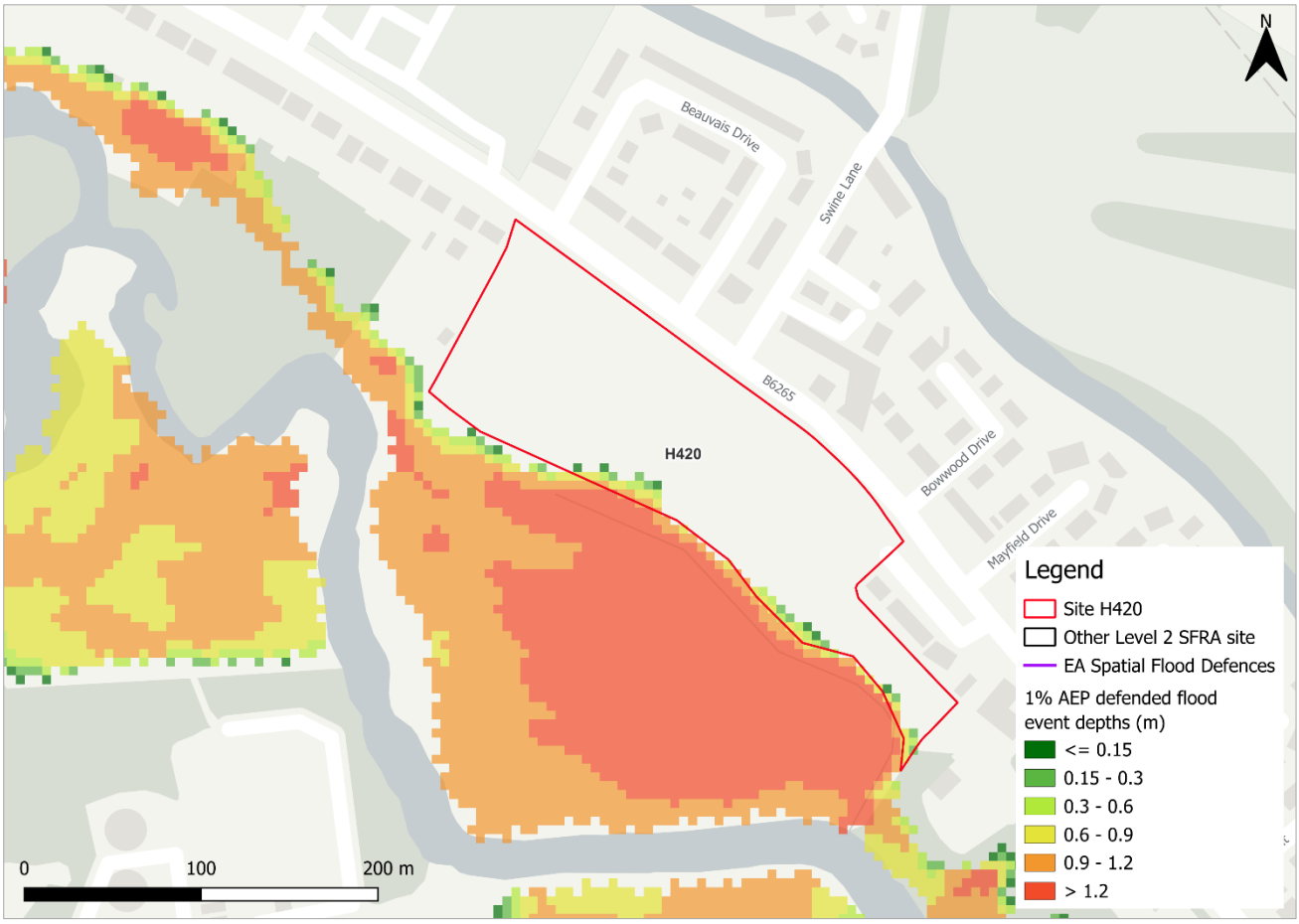


Figure 2-14: Flood depths for the Kildwick to Esholt model 1% AEP defended flood event

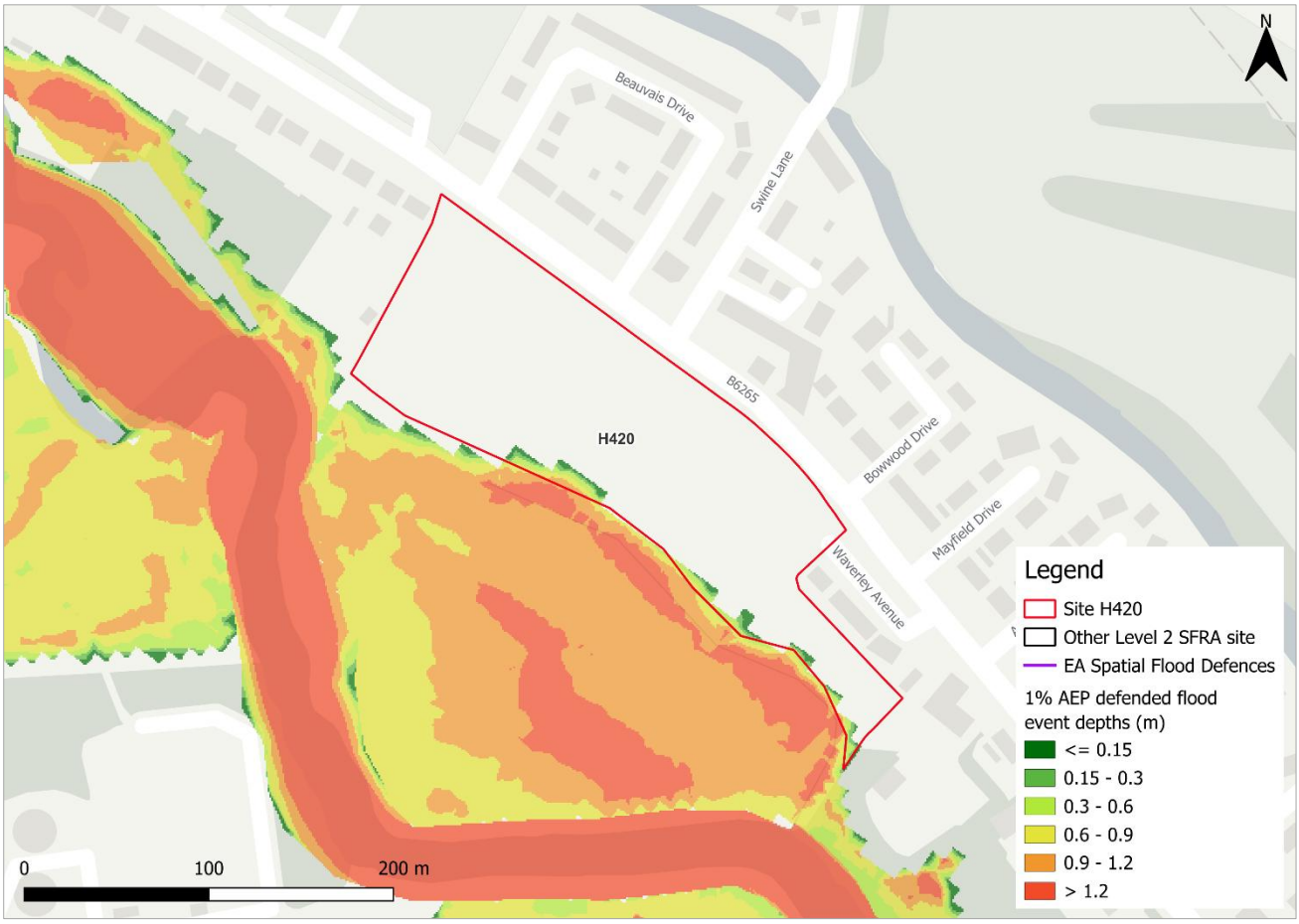


Figure 2-15: Flood depths for the Worth model 1% AEP defended flood event

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. Across the site, there is potential for tree planting indicating locations where woodland and floodplain planting may be possible and effective to attenuate flooding. There is also potential for runoff attenuation during the 1% AEP event at the northwestern site boundary. These areas are shown in Figure 2-16. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

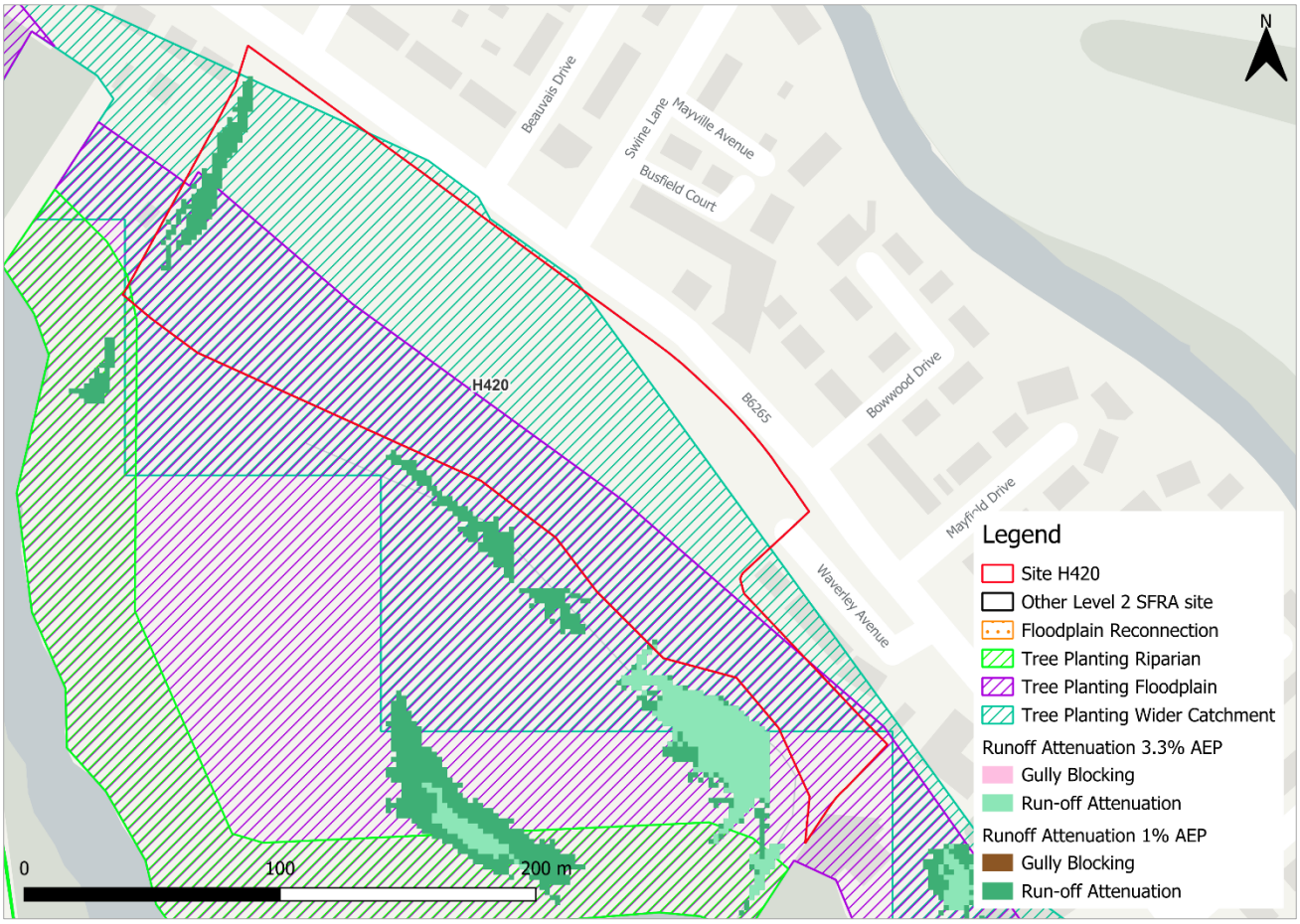


Figure 2-16: Natural Flood Management (NFM) potential mapping

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) has been considered and mapped in Figure 2-17 which shows the western side 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 Aire being exceeded in December 1978, October 2000, February 2002 and most recently in December 2015.

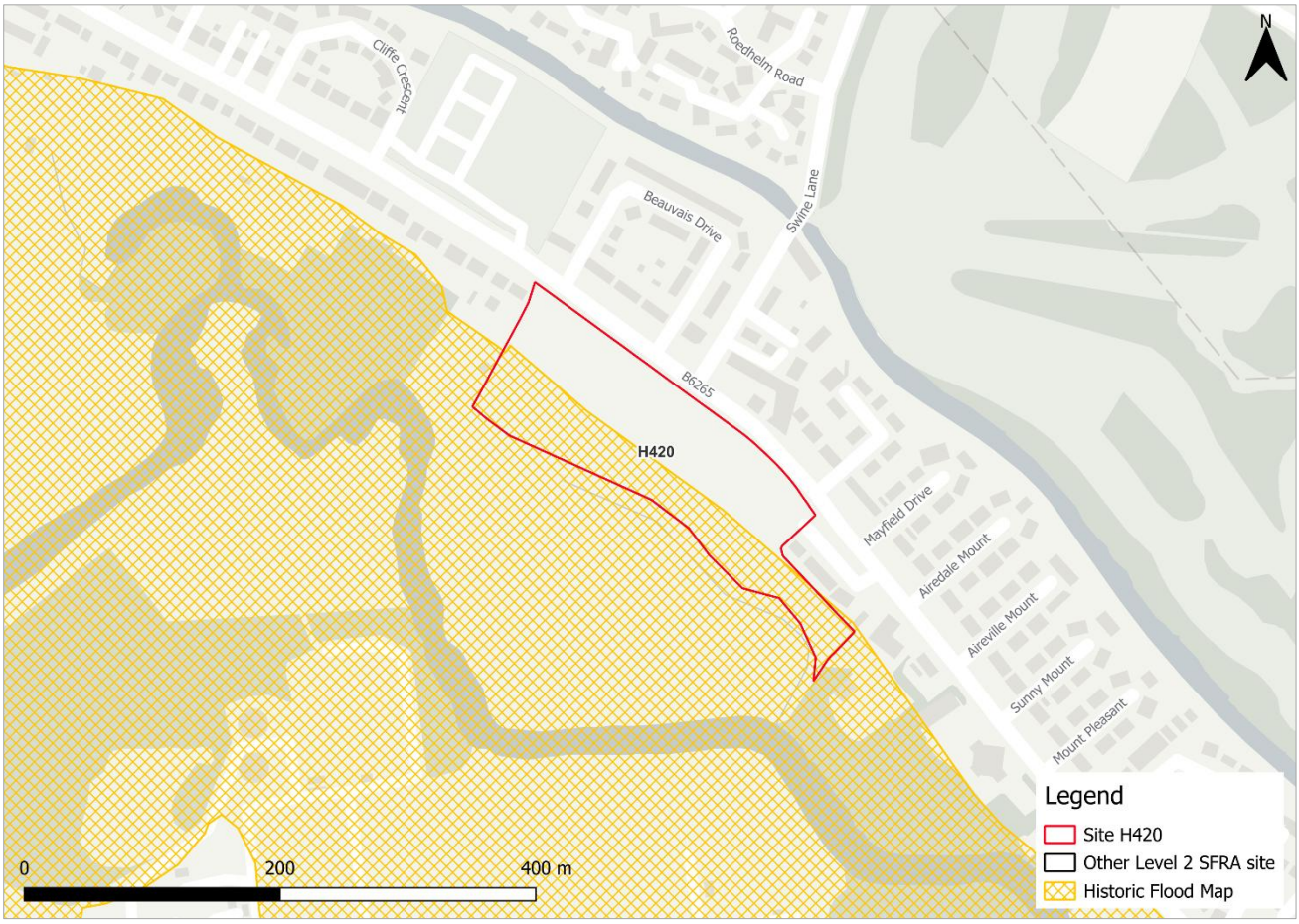


Figure 2-17: Recorded historic flood events onsite and around the site

2.5 LLFA flood incidents

The LLFA have records of five flood incidents taking place to the east of the site, which occurred in 2000, 2001, 2003, 2004 and 2007. 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 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 western side of the site is located within a FAA, namely 123WAF960 - Upper River Aire catchment, as shown in Figure 2-18.

Based on available information, safe access and escape routes would likely be achievable via the B6265 during a flood event.



Figure 2-18: 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 water compatible open greenspace to more vulnerable residential development, 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 modelled to be partially within the functional floodplain along the southwestern boundary of the site, adjacent to the River Aire. Development is not permitted within the functional floodplain. This area should remain as open greenspace.
- The southwestern site boundary is modelled to be at risk from fluvial sources (according to the Leeds FAS Kildwick to Esholt 2022 model and the Worth 2022 model) in the 3.3% AEP undefended scenario as well as in the 1% AEP undefended scenario. Flood Zone 2 is based on the HFM. Approximately half of the site is within Flood Zone 1.
- Flood Zone 3 of the Flood Map for Planning is based on the 1% AEP undefended output from the Leeds FAS Kildwick to Esholt 2022 model. However, modelled risk is very similar between both models.

- 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 and Flood Zone 2, including for climate change, and therefore satisfy the requirements of the exception test. However, any development in Flood Zone 2 must be accompanied by suitable emergency plans and evacuation procedures and escape routes. Property Flood Resilience (PFR) techniques should be also considered for any development in Flood Zone 2.
- 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 southwestern site boundary is shown to be at risk in the 1% AEP undefended +23% climate change event.
- 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.
- Access and escape routes should be made available along the B6265 (Bradford Road).
- 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 3% of the site is at medium risk and a further 10% is at low surface water risk, as shown in Table 3-1.

In the high risk event, surface water risk is confined to small amount of ponding at the southern corner of the site, adjacent to the small ditch located south of the site boundary. In the medium risk event, a new area of ponding forms at the northern corner of the site, adjacent to the northwestern site boundary. This ponding expands and forms part of a large flow path through the north of the site during the low risk event. A second flow path forms flowing through the eastern side of the site during the low risk event.

Greatest flood depths within the site in the medium risk event are largely shallow up to 0.15 m, though there is small area at the southern corner of the site with a depth of between 0.3 and 0.6 m (Figure 3-1). Hazard is largely categorised as low, with the small area of greater flood depth modelled to have a significant hazard rating (Figure 3-2). During the medium risk event, safe access and escape routes via the B6265 (Bradford Road) may be achievable travelling south rather than north, given the modelled surface water flood depths along the north of the road. During the low risk event, safe access and escape may be challenging to achieve due to the greater flood depth and hazard on the B6265 (Bradford Road).

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

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
86	10	3	1

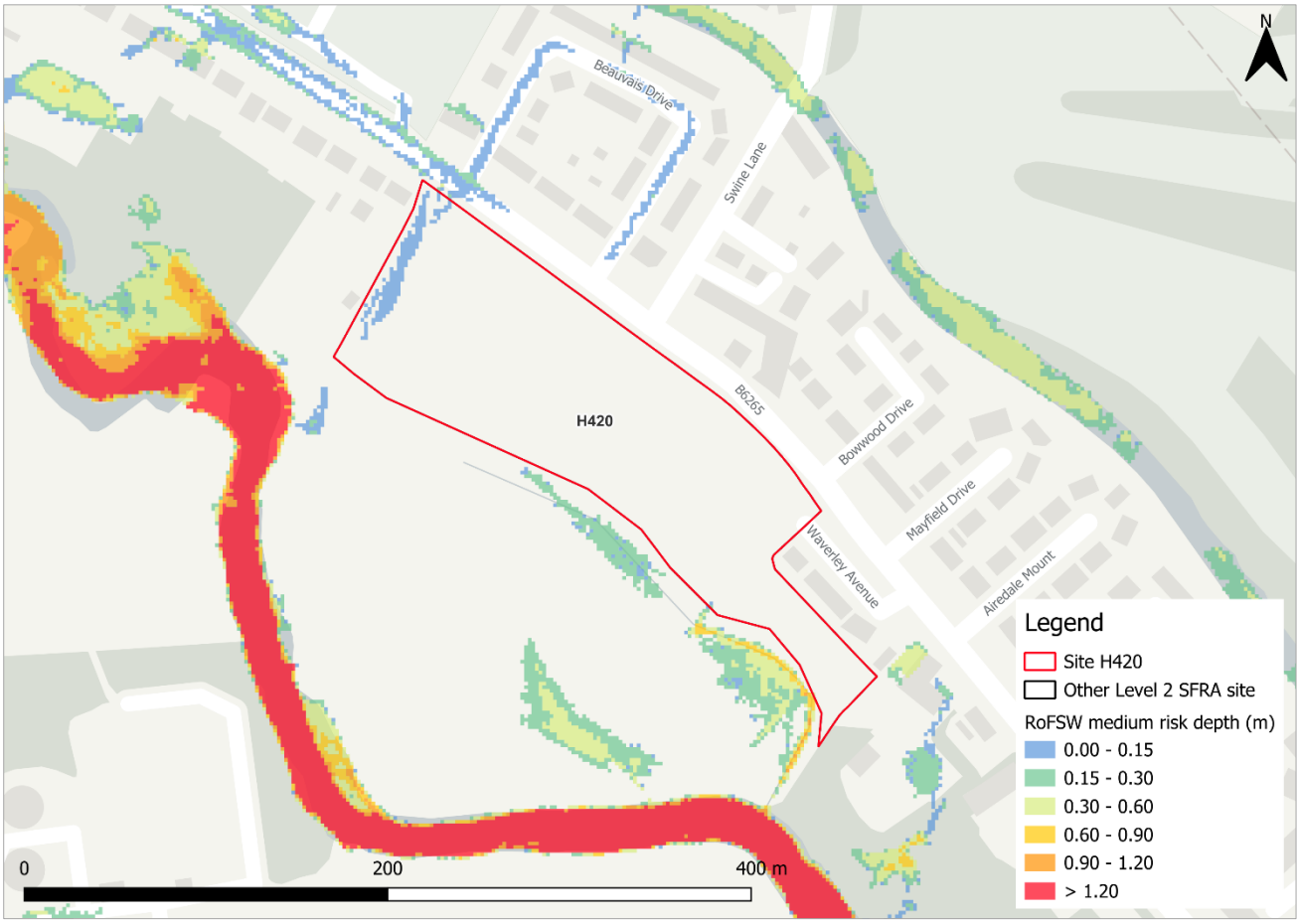


Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

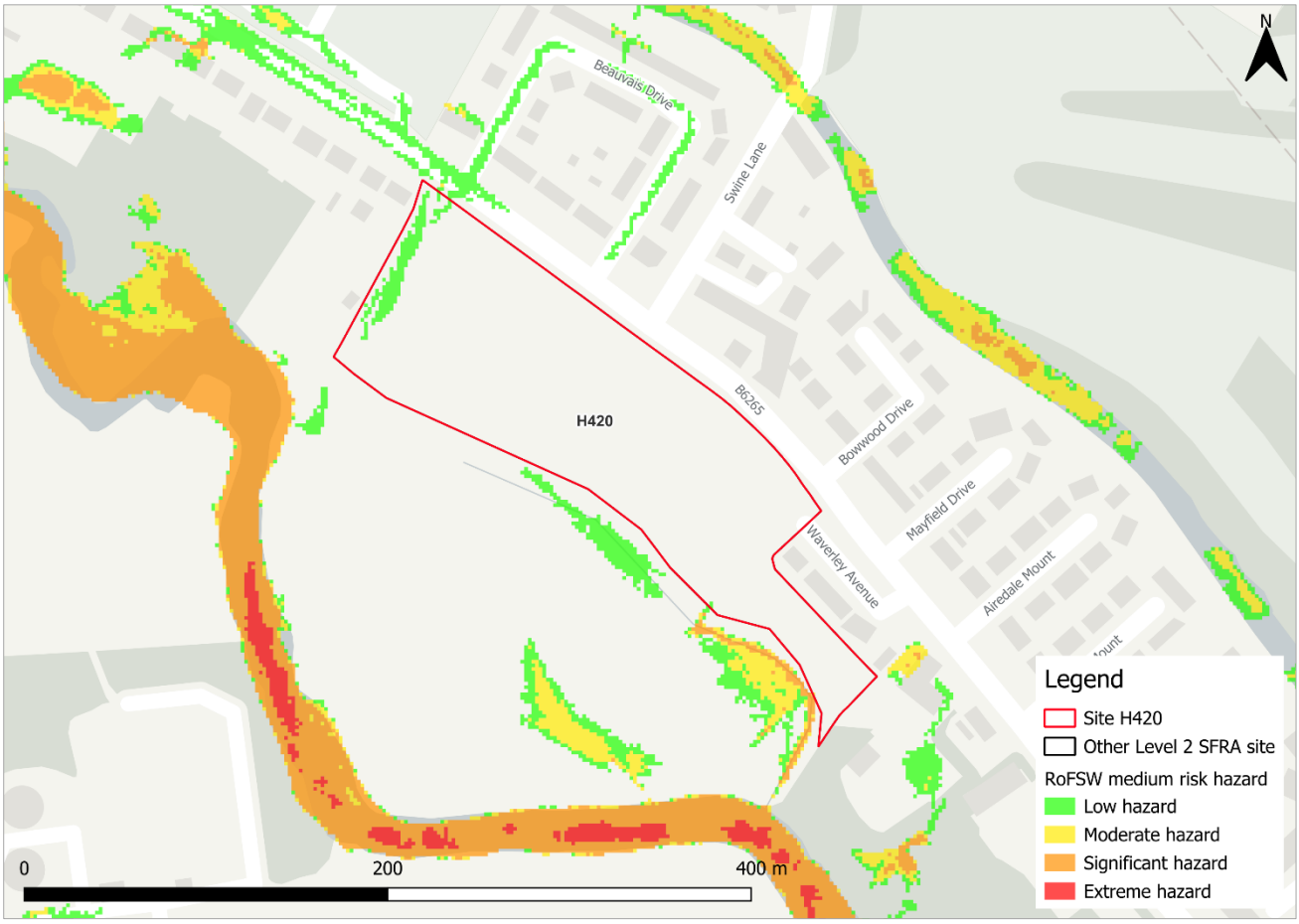


Figure 3-2: Medium risk event surface water flood hazard[3] (Risk of Flooding from Surface Water map)

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 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%

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

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

the medium risk climate change event showing a similar level of risk to the present day low risk event. There are two flow paths originating from the adjacent residential area to the north. These flow paths flow through the site downhill to the floodplain of the River Aire. Maximum depths are modelled to be between 0.6 and 0.9 m, with some areas of hazard categorised as significant (Figure 3-4). Safe access and escape routes may be challenging to achieve during the climate change event due to the greater flood depth and hazard on the B6265 (Bradford Road).

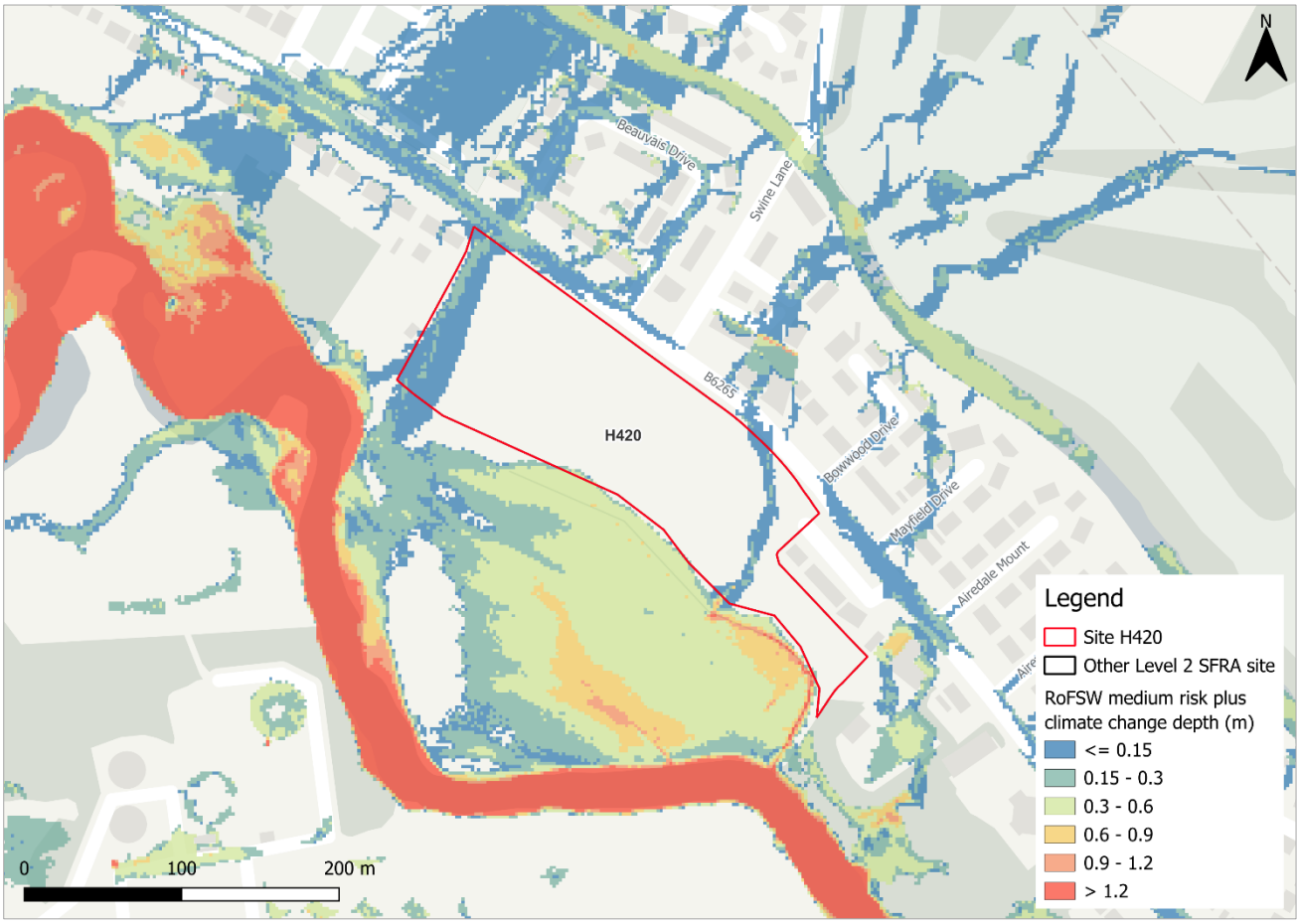


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

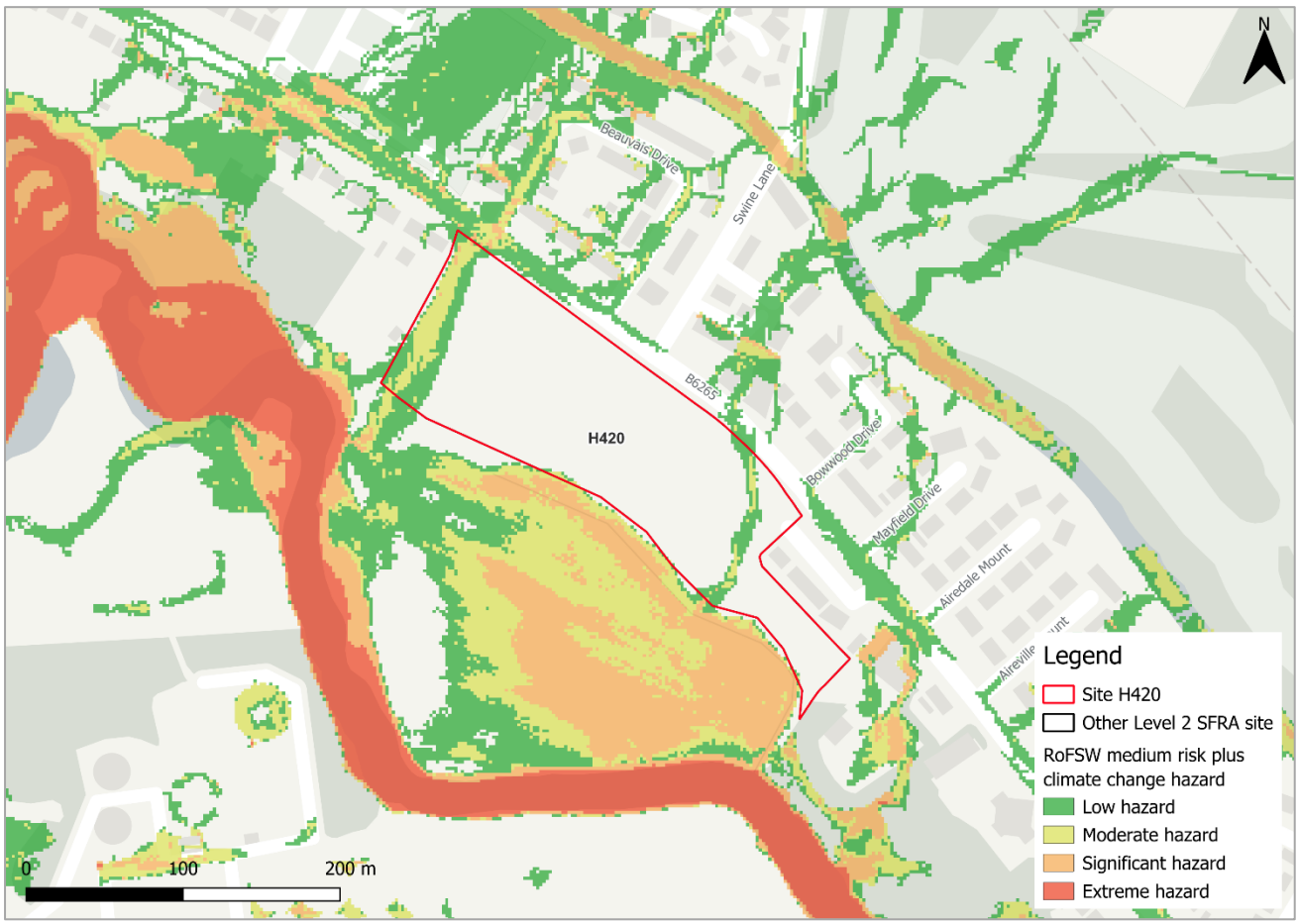


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk is limited to the north of the site in the medium risk event. In the low risk event, large flow paths form, flowing through the north and south of the site. These 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 volumes to ensure risk is contained safely onsite for the lifetime of development.
- Safe access and escape routes should be achievable based on the modelled surface water flood depths along the B6265 (Bradford Road) during the low risk event and the future medium risk event.
- 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 Guide[4]. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

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

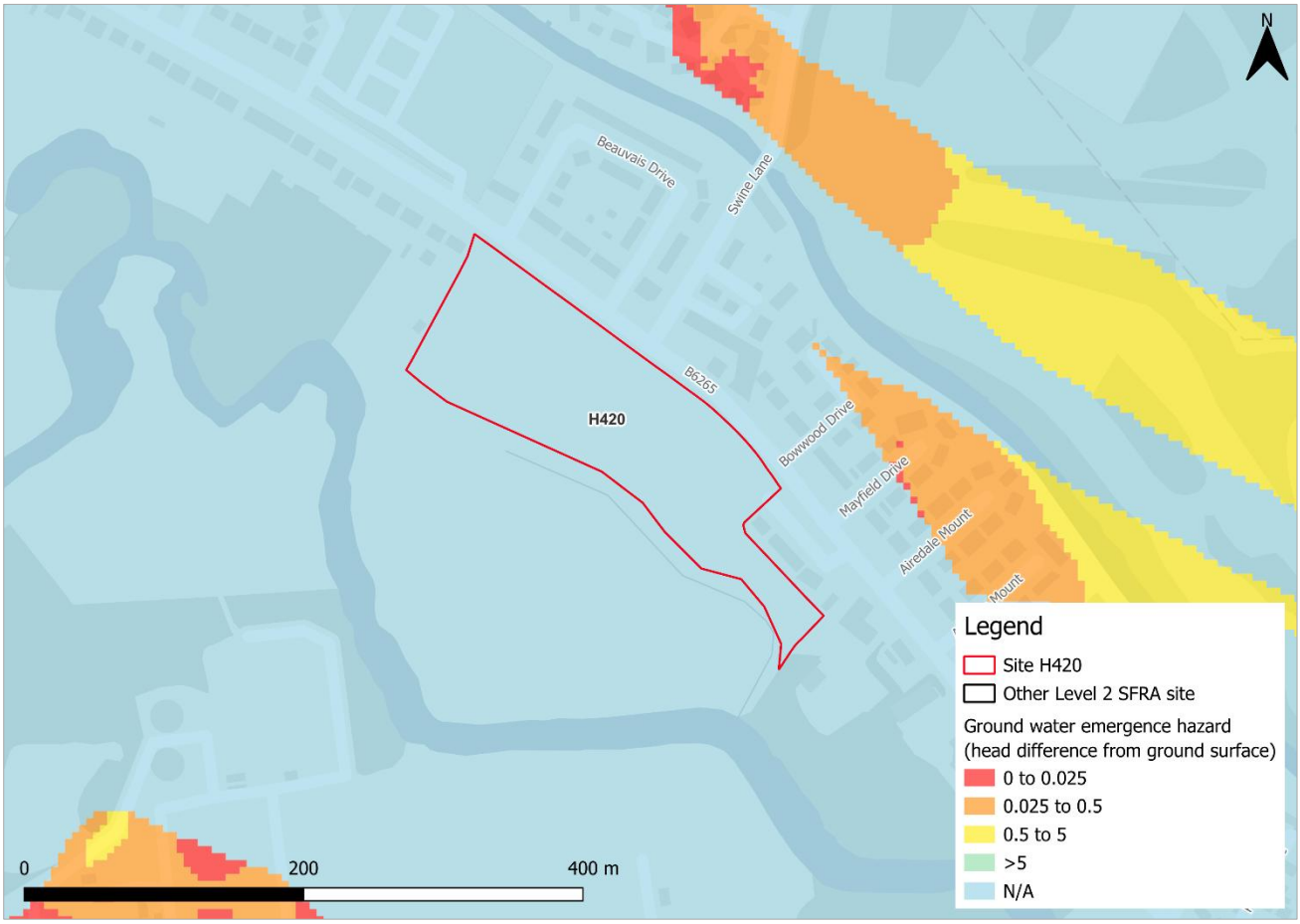


Figure 4-1: JBA 5m Groundwater Emergence Map

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

Table 4-1: Groundwater Hazard Classification

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

5 Residual risk

5.1 Flood risk from canals

The Leeds and Liverpool Canal is located to the north of the site at a higher elevation. An existing housing estate is located between the site and the canal. Therefore, it is expected that the canal is subject to regular maintenance and inspection to reduce any potential residual risk of failure or overtopping. However, it may be prudent to consult the Canal & River Trust at the planning application stage.

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 12 reservoirs. Of these 12 reservoirs, eight are located within Bradford, three located within North Yorkshire and one located within Lancashire. These are operated by either Yorkshire Water Services Ltd, the National Trust or the Canal & River Trust.

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, it's 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 12 reservoirs. However, only six reservoirs impact the site in the 'dry day' flood extent, namely Keighley Moor, Leeming, Leeshaw, Lower Laithe and Ponden reservoirs, located within Bradford; and Water Sheddles reservoir, located in Lancashire. This indicates that the remaining six 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 proximity of the site to the Leeds and Liverpool Canal, it may be prudent to consult the Canal & River Trust at the planning application stage.

- Given the potential reservoir risk to the site, developers should consider[5]:
  - Consulting with the local resilience forum for advice on emergency planning,
  - Consulting with relevant reservoir owners to understand the impact development may have on their reservoirs, and
  - Using this Level 2 SFRA to understand whether any proposed development will be safe throughout its lifetime.

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

6 Overall site assessment

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

This site is required to pass part b) of the exception test[6], given it is proposed for more vulnerable uses and is 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. Based on the available information documented within this Level 2 SFRA, this site could pass the exception test if residential development is located outside of the areas at risk during the 1% AEP modelled present day and future fluvial risk events.

6.2 Recommendations, FRA requirements, and further work

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

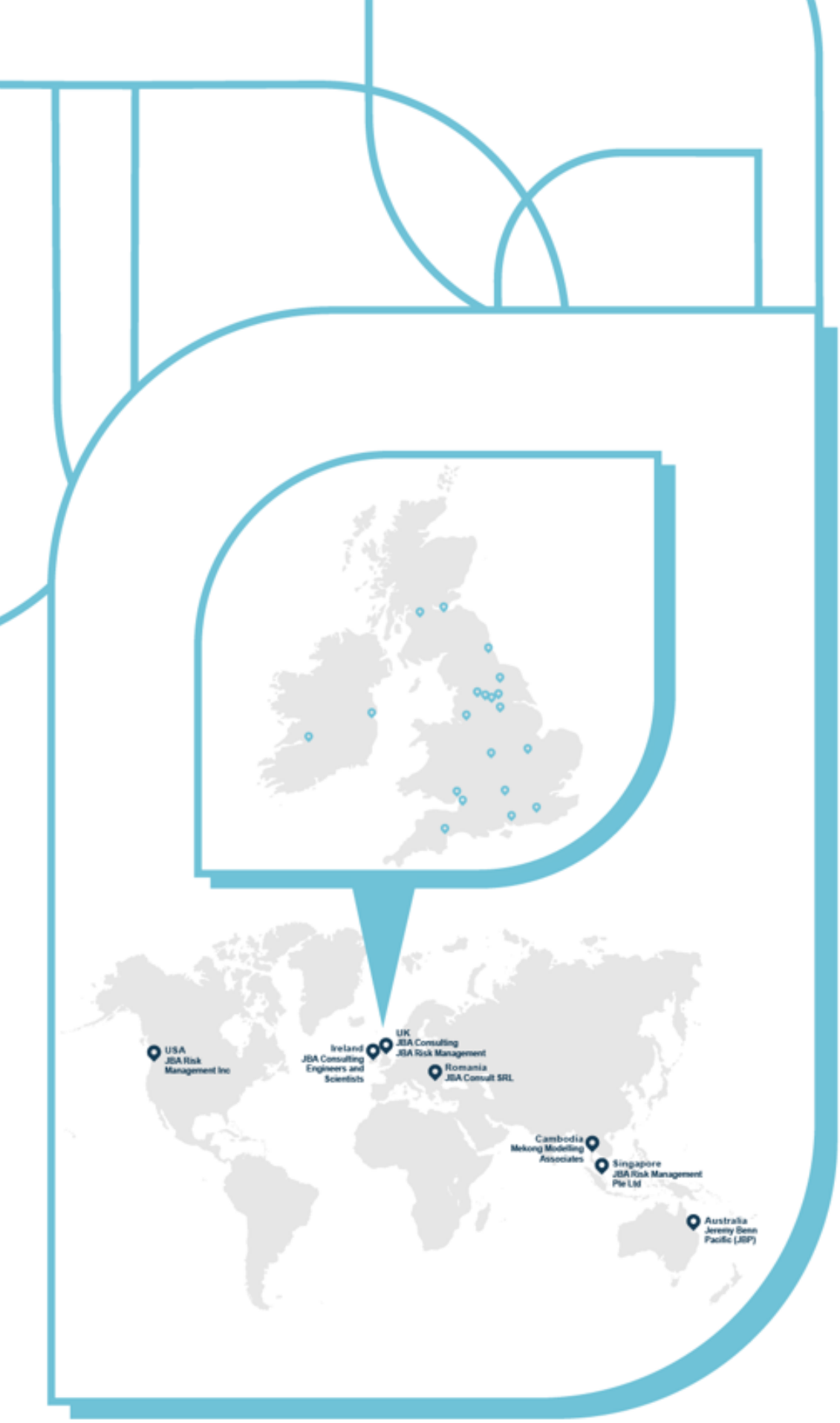
- There should be no development within the existing area of functional floodplain present on site. However, given the nominal risk from Flood Zone 3, this site should be permitted for residential development on flood risk grounds.
- It is recommended that the area of the site within the functional floodplain is left as open greenspace. Any development in Flood Zone 2 should be accompanied by emergency plans, Property Flood Resilience measures and flood alerts should remain in place.
- Any FRA must further consider the safe access and escape routes to the site.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

6 Para 178 National Planning Policy Framework 2024

7 Licencing

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Bradford Level 2 Strategic Flood Risk Assessment - Site H533

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. Freya Nation 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 H533. 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 H533

- Location: Holmewood Residential, Fell Lane, Keighley
- Existing site use: Former care home
- Existing site use vulnerability: More vulnerable
- Proposed site use: Residential
- Proposed site use vulnerability: More vulnerable
- Site area:0.53 hectares
- Proposed development impermeable area: hectares: 0.47
- Environment Agency (EA) river model: N/A
- Watercourse: 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 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

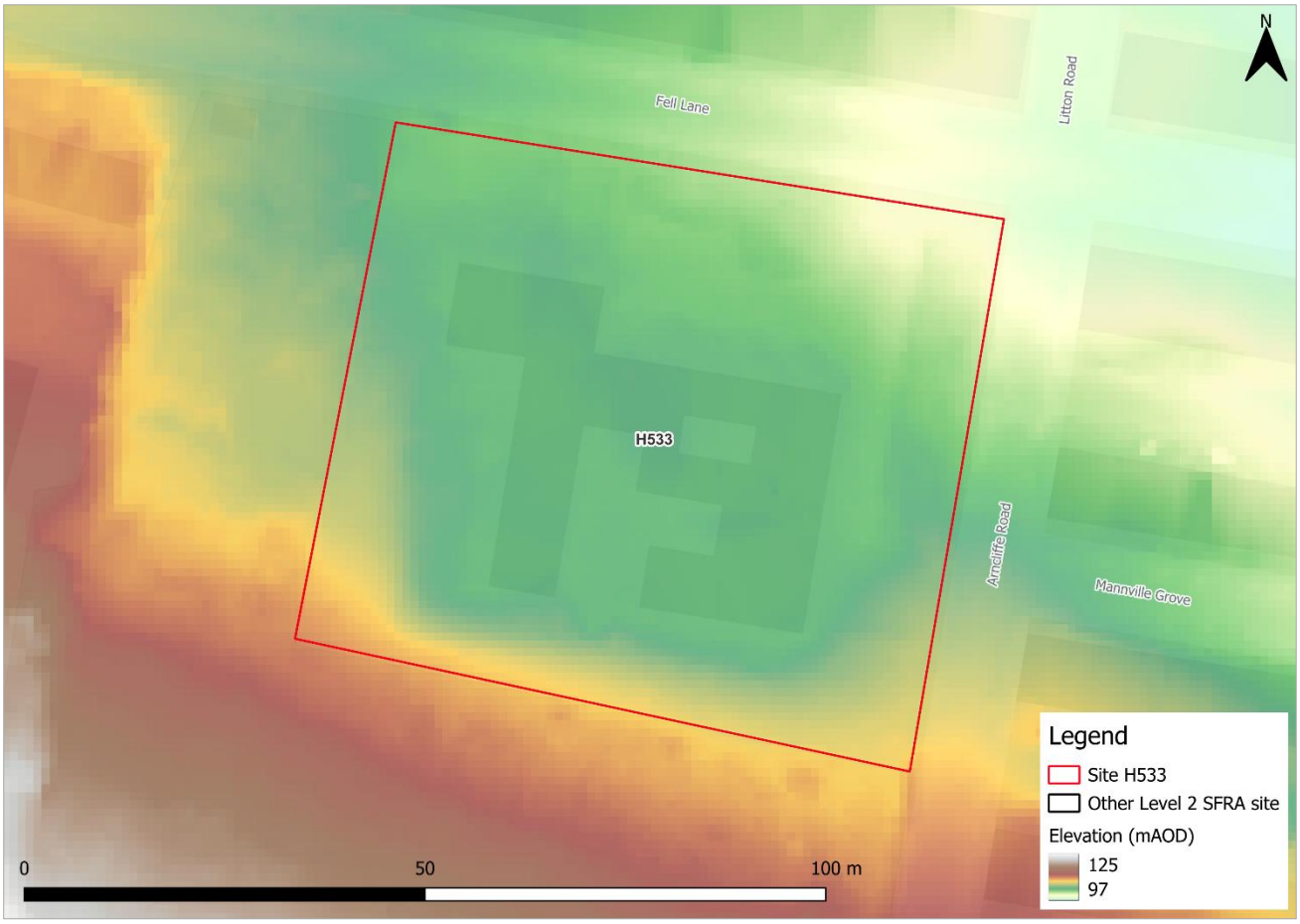


Figure 1-2: Topography



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 2.2) or the impacts of climate change.

The site is modelled to be wholly within Flood Zone 1, indicating it is at low risk of flooding from rivers.

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 Flood risk management

2.2.1 Flood defences

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

There is an area of natural high ground northeast of the site, along the bank of North Beck.

2.2.2 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. There are no applicable areas that could benefit the site.

2.3 Historic flood incidents

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

2.4 LLFA flood incidents

The LLFA have record of one flood incident east of the site, which occurred in 2014. Developers should contact the LLFA for further information at the FRA stage, to assess potential flood risk to the site associated with this incident.

2.5 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 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. This site is not located within a FAA.

2.6 Observations, mitigation options and site suitability - fluvial

- The site is wholly located within Flood Zone 1 and is therefore at low risk of flooding from rivers. .

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 risk to the site is predominantly low. Approximately 5% of the site is within the high risk surface water zone. 5% is within the medium risk zone and a further 12% is at low surface water risk, as shown in Table 3-1.

In the high risk event surface water within the site is largely constrained by the existing building. Water ponds within the centre of the site. There is also a small flow path along Fell Lane, north of the site. In the medium event, flooding within the site and along Fell Lane expands. In the low risk event, ponding within the site expands further, linking to the flow path along Fell Lane.

Greatest flood depths within the site during the medium risk event are between 0.3 and 0.6m (Figure 3-1) with some areas of moderate hazard (Figure 3-2). There is a flow path evident along Fell Lane during all events. In the extreme event, flood hazard on the road is significant in places. Safe access and escape routes should be via Arncliffe Road where, though impacted by flooding, depths remain low during the extreme event.

The surface water modelling for the site shown in Figure 3-1 and Figure 3-2 was conducted based on LiDAR data that existed from when a previous development was present at the site, but which has since been knocked down. This LiDAR data was flown prior to that shown in Figure 1-2. As such, existing flood risk from surface water to the site is unknown, and therefore detailed modelling based on a new topographic survey will be required to inform development plans within a planning application for this 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)
78	12	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 hazard[1] (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 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%

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

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

medium risk climate change event showing a marginally greater level of risk than the low risk present day event. Ponding within the site increases slightly as well as the flow path along Fell Lane. Maximum depths remain between 0.3 and 0.6 m with some areas of significant hazard.



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 to the south of the site and is currently constrained by the existing building in the high and medium risk events. Any change in site layout where current buildings are to be demolished and changes to road layouts will require detailed surface water modelling.
- However, this modelling of surface water flood risk to the site is based on LiDAR data flown at a time when a previous development existed on site which has since been demolished. Therefore, existing surface water flood risk to the site is currently unknown. Detailed pluvial modelling based on a new topographic survey will therefore be required to inform of flood risk to the site development layout plan considerations. Post development modelling must demonstrate that development will not result in offsite detriment.
- 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. This will require surface water modelling based on layout plans and detailed design and full consultation with the LLFA.

- The Groundwater Emergence Map (Figure 4-1) indicates that ground conditions may not be suitable for infiltration SuDS across the site. This should be further explored through appropriate ground survey as part of the FRA and drainage strategy.
- Assessment of the current drainage system in place should be carried out to ascertain any current capacity issues and whether the current system could accommodate the proposed residential development or whether further capacity will be required.
- Note that the RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

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

Within most of the site there is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely. In the north of the site, there is no risk of groundwater emergence.

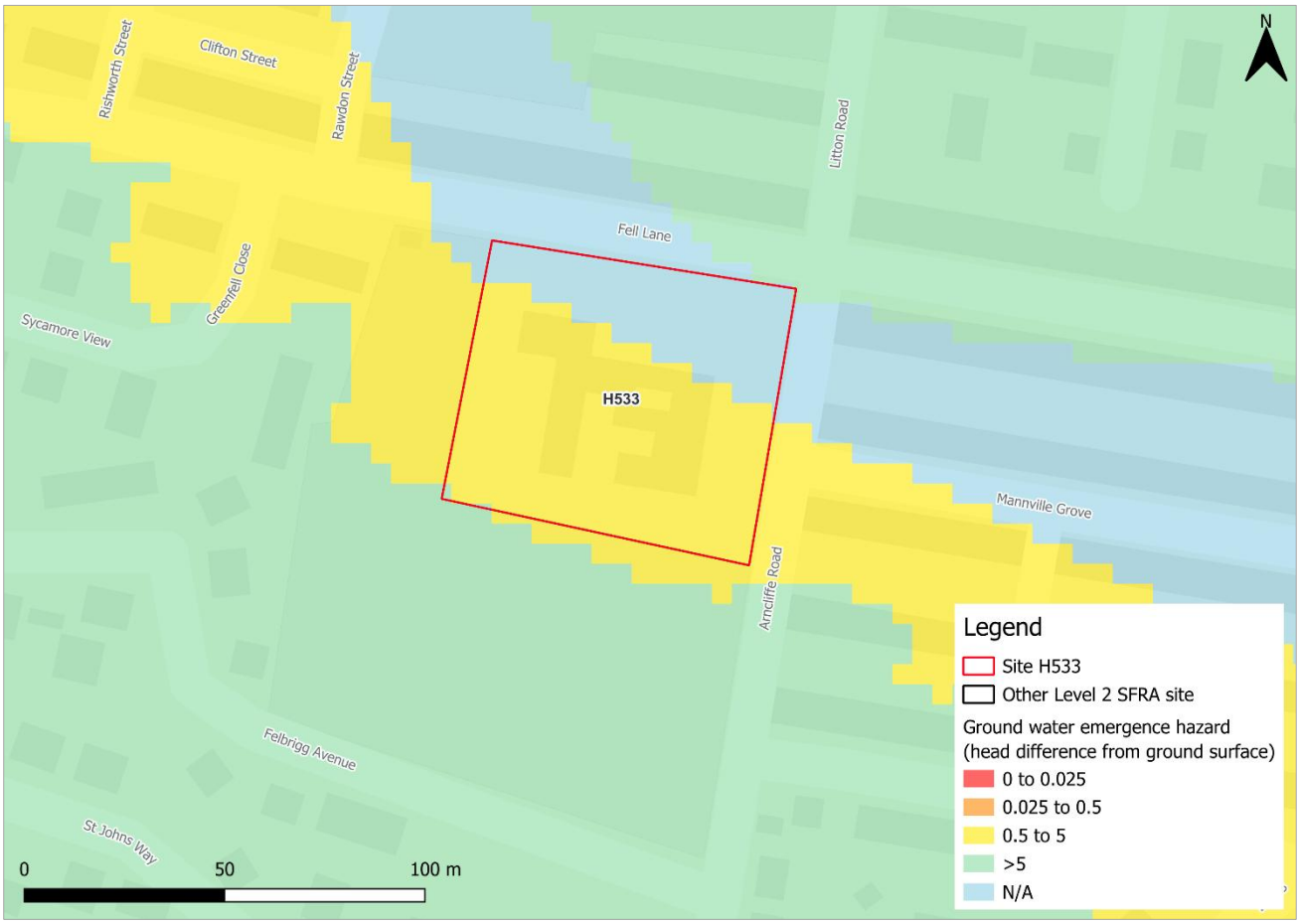


Figure 4-1: JBA 5m Groundwater Emergence Map

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 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. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is not modelled to be at risk from 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, blocked or it cannot discharge due to a high water level 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

- There is no modelled residual risk to the site.

6 Overall site assessment

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

This site is not required to pass part b) of the exception test[3] as it is located within Flood Zone1, 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:

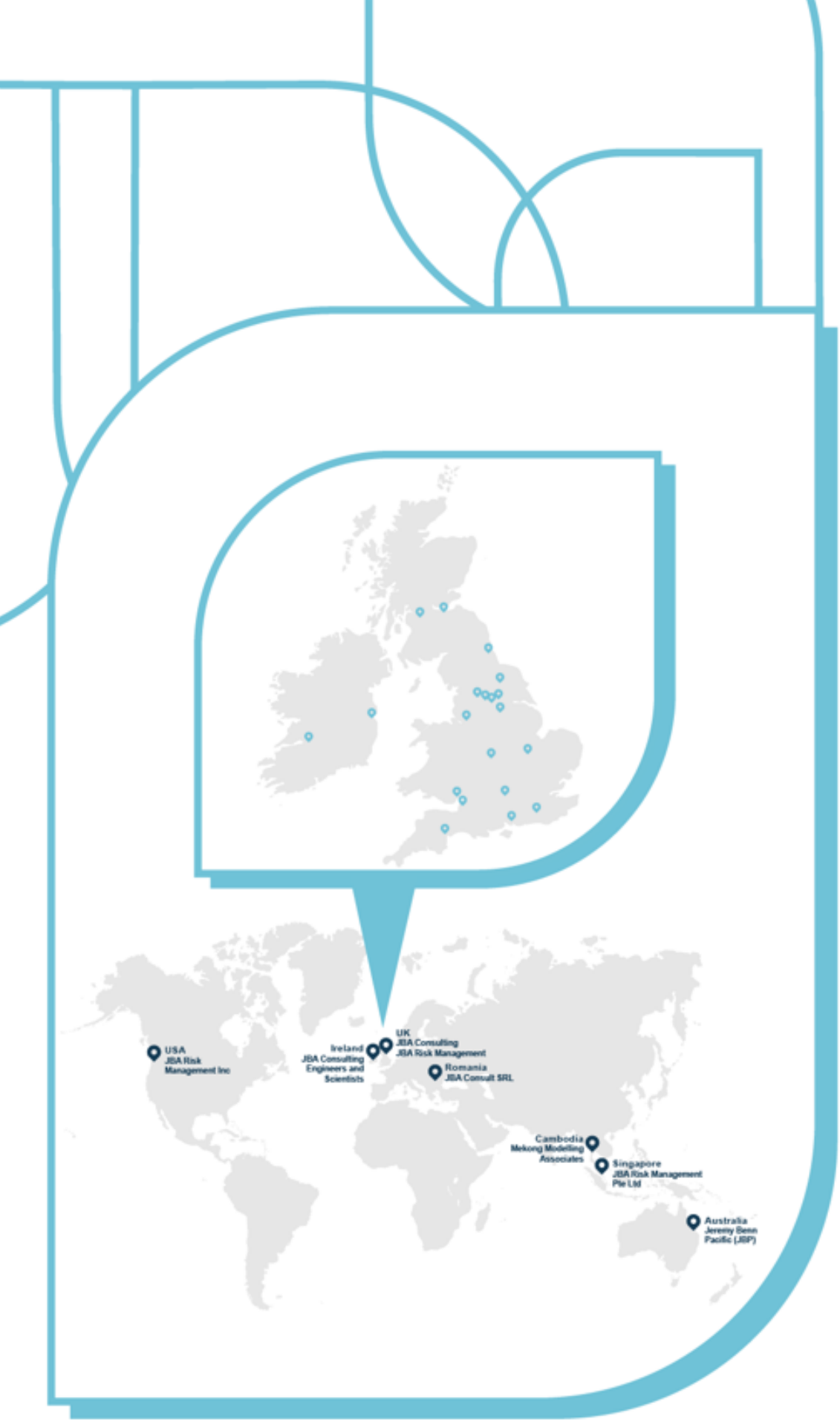
- It should be appropriate to develop this site for more vulnerable purposes given its location in Flood Zone 1.
- The existing surface water modelling for the site is based on outdated LiDAR data from when a previous development was present on site. This previous development has since been demolished and as such, existing flood risk from surface water to the site is unknown. Therefore, new detailed modelling based on an updated topographic survey will be required to inform of flood risk to the site development layout plan considerations. Post development modelling must demonstrate that development at the site will not result in offsite detriment.
- Surface water should be retained onsite which may reduce units. This will require detailed surface water modelling based on layout plans and detailed design and full consultation with the LLFA on required runoff rates, likely to be brownfield or betterment. The use of infiltration SuDS should be investigated for suitably across the majority of the site.
- Groundwater conditions must be investigated further through the site-specific FRA to ascertain groundwater levels and conditions.
- 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.

3 Para 178 National Planning Policy Framework 2024

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Bradford Level 2 Strategic Flood Risk Assessment - Site H544

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

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H544. 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 H544

- Location: Moss Carr Road, Long Lee, Keighley
- Existing site use: Agricultural
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Residential
- Proposed site use vulnerability: More vulnerable
- Site area: 1.3 hectares
- Proposed development impermeable area: 1.1 hectares
- Environment Agency (EA) river model: N/A
- Watercourse: 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 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

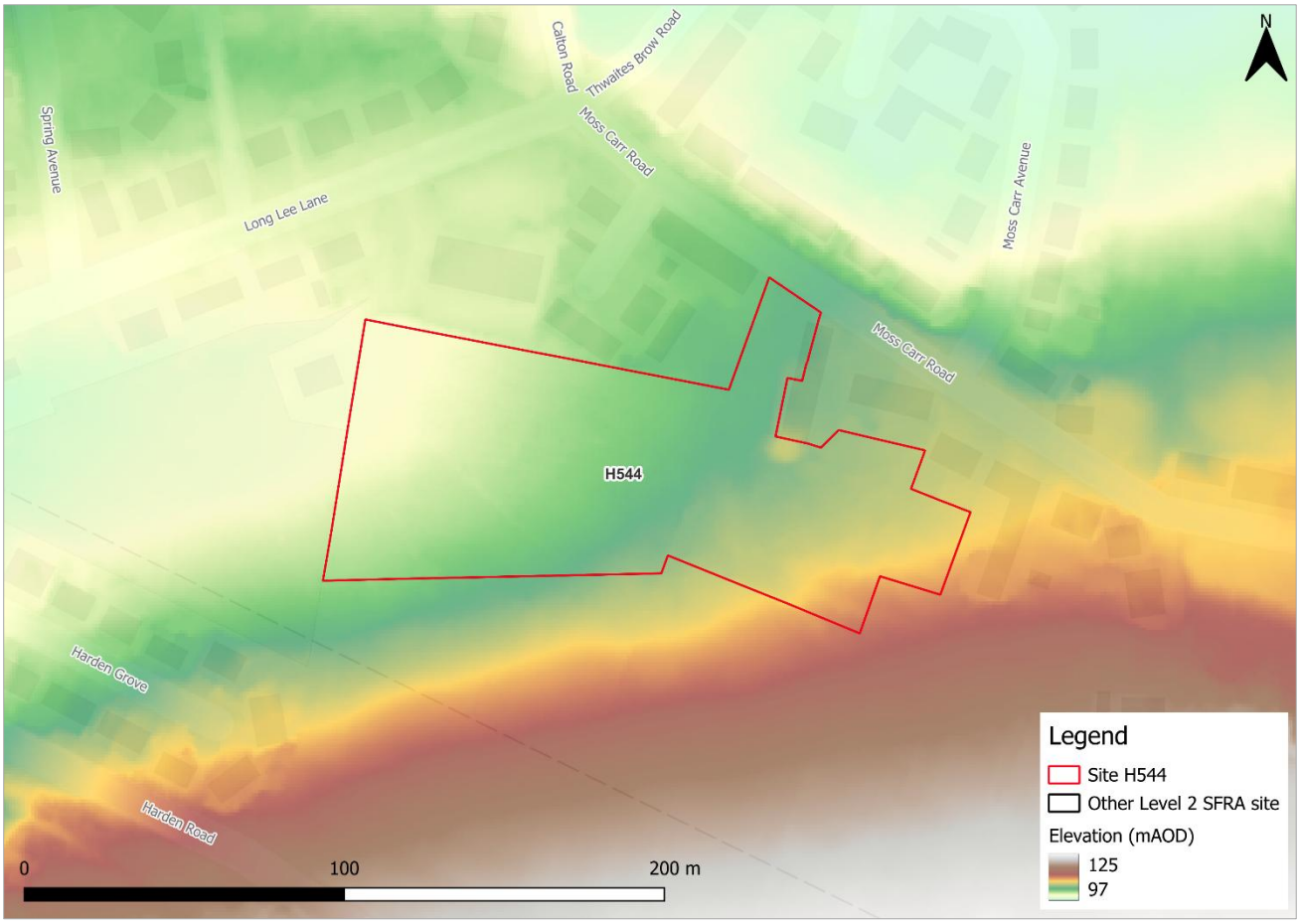


Figure 1-2: Topography



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.

The site is modelled to be wholly within Flood Zone 1, indicating it is at low risk of flooding from rivers.

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

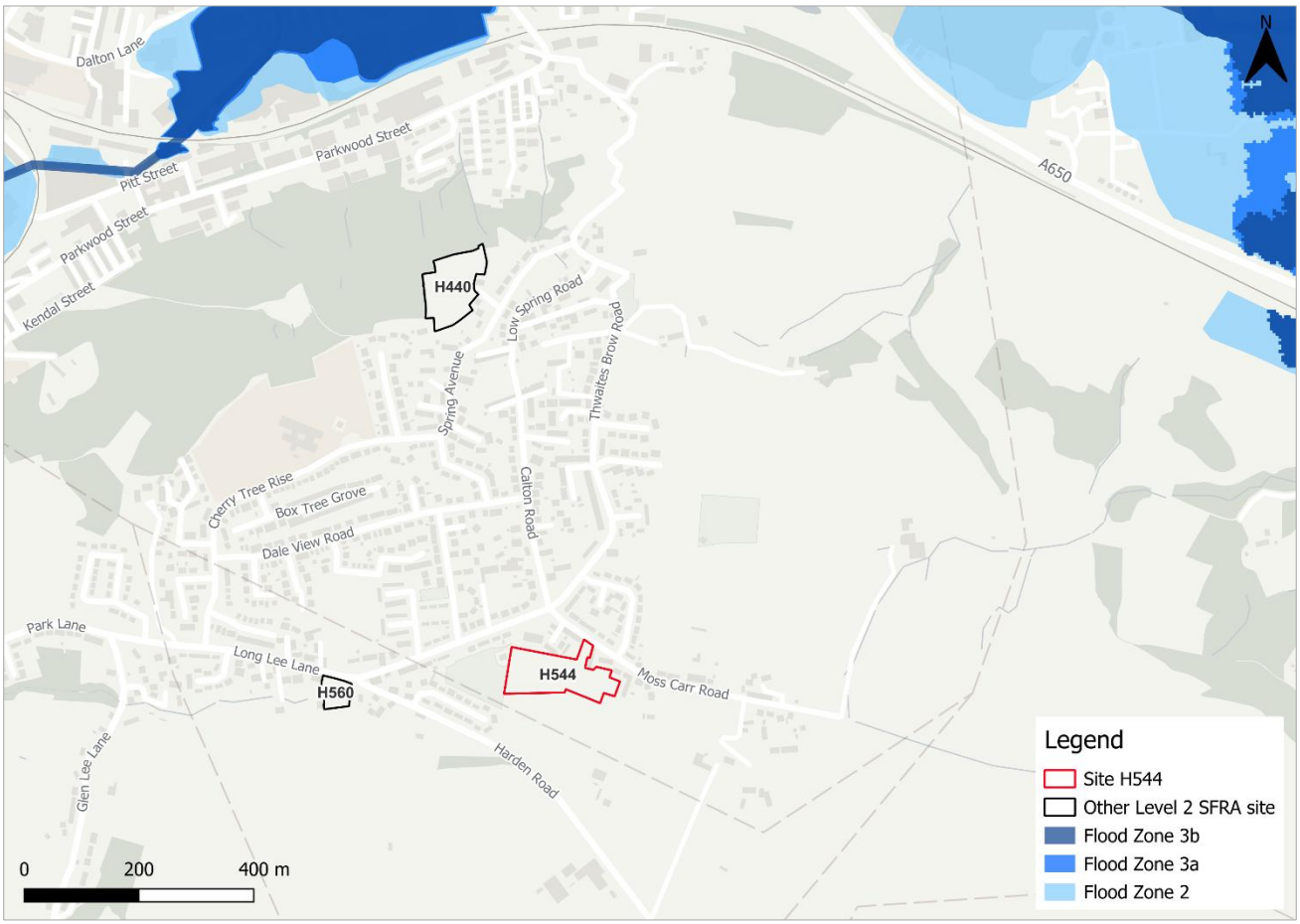


Figure 2-1: Existing risk from rivers to the site

2.2 Historic land-use mapping

Historic land-use mapping held by the LLFA indicates a watercourse within the western half of the site. This should be confirmed, and the exact location ascertained, through site investigation. Potential flood risk from this watercourse may have 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.

2.3 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. There are no applicable areas that could benefit the site.

2.4 Historic flood incidents

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

2.5 LLFA flood incidents

The LLFA have records of a history of runoff from this site to the rear of the Long Lee Village Hall and Moss Carr Road. There is also record that the culvert from the site has been found to be blocked in past. 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 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. This site is not located within a FAA.

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 site is wholly located within Flood Zone 1 indicating it is at low risk of flooding from rivers.
- Potential flood risk from the watercourse shown in historic land-use mapping to enter the site may have 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.
- If a watercourse is identified, it may need to be modelled to quantify the risk from any culverts.
- 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.
- The history of runoff from this site to adjacent land should be considered through a drainage strategy and an FRA.

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 risk to the site is predominantly very low. Approximately 1% of the site is within the medium risk surface water flood zone and 3% is within the low risk zone, as shown in Table 3-1.

In the medium risk event, surface water flooding is confined to a small area of ponding at the western site boundary. In the low risk event, this ponding expands, joining other smaller areas of ponding and forming a flow path parallel to Long Lee Lane. This flow path encroaches into the northwestern corner of the site. There is also a flow path along part of Long Lee Lane during the low risk event.

Greatest flood depths in the medium risk event are between 0.15 and 0.3 m (Figure 3-1) with a low flood hazard rating (Figure 3-2). Long Lee Lane and Moss Carr Road flood during the low risk event, however, safe access and escape should be achievable due to the low depths of flooding on these roads.

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)
96	3	1	0

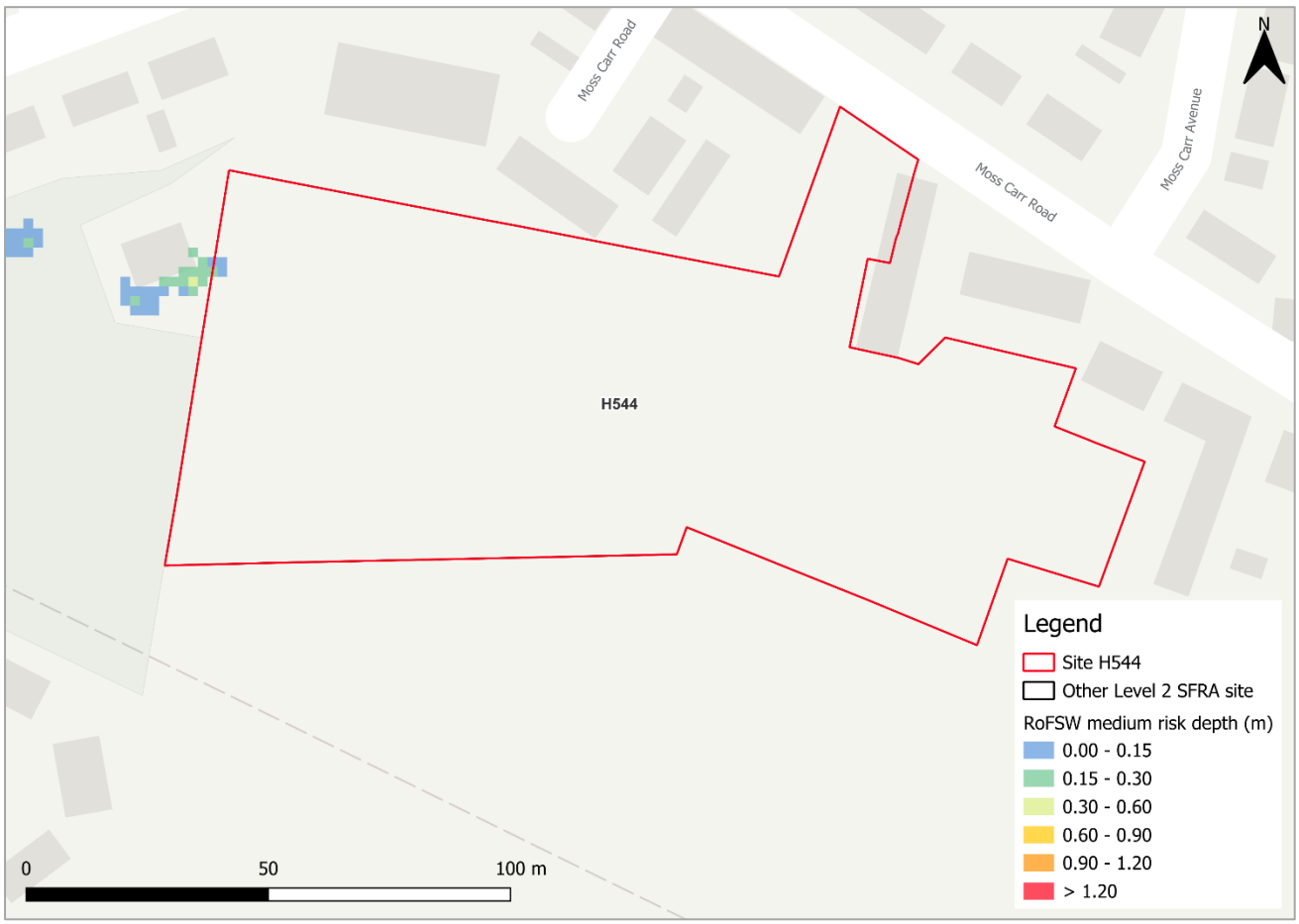


Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

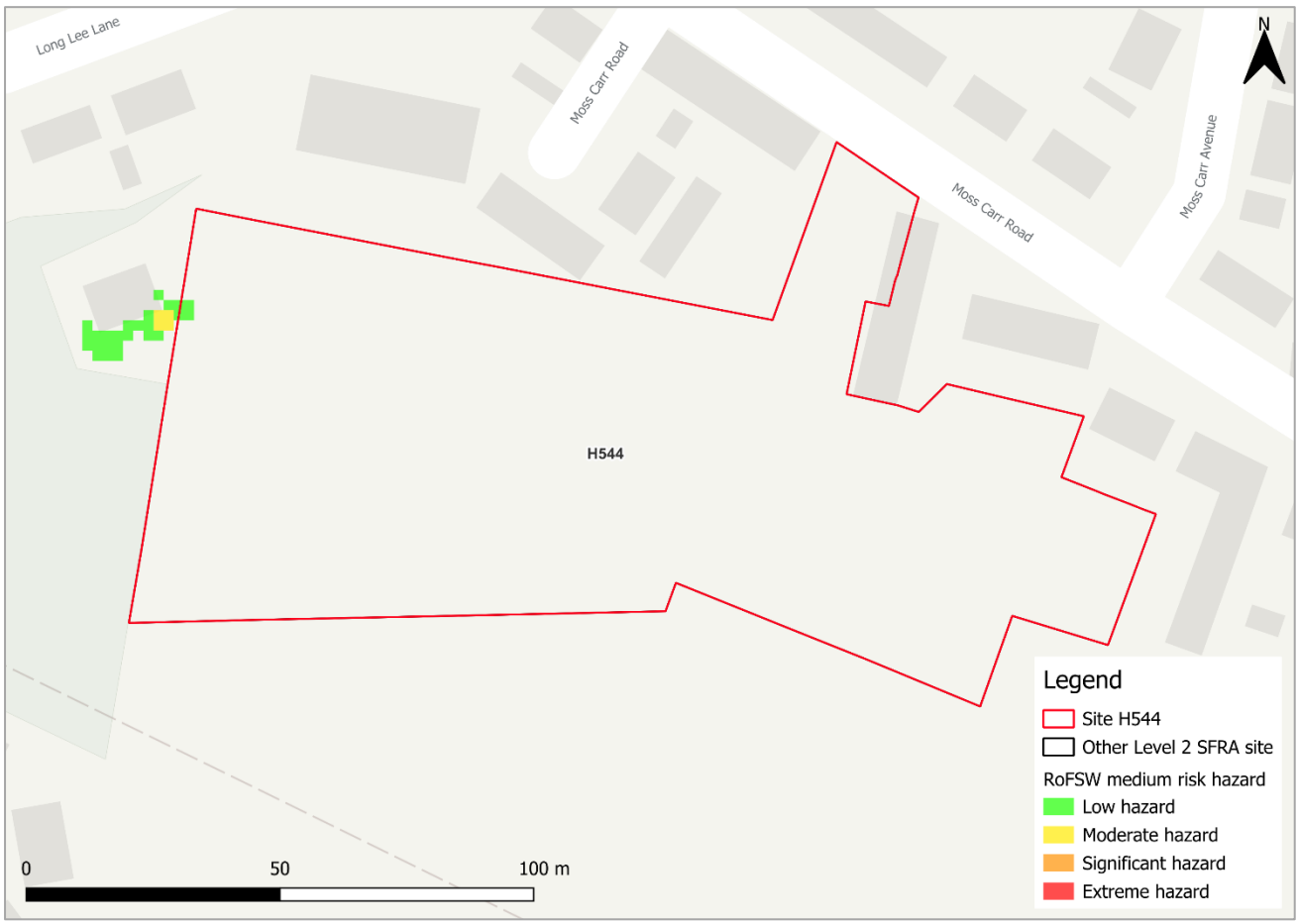


Figure 3-2: Medium risk event surface water flood hazard[1] (Risk of Flooding from Surface Water map)

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 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%

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

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

medium risk climate change event showing a greater level of risk than the low risk present day event. The flow path encroaches further across the northern site boundary. Maximum depths increase to between 0.3 and 0.6 m (Figure 3-3) with a small area of significant hazard along the western site boundary (Figure 3-4).

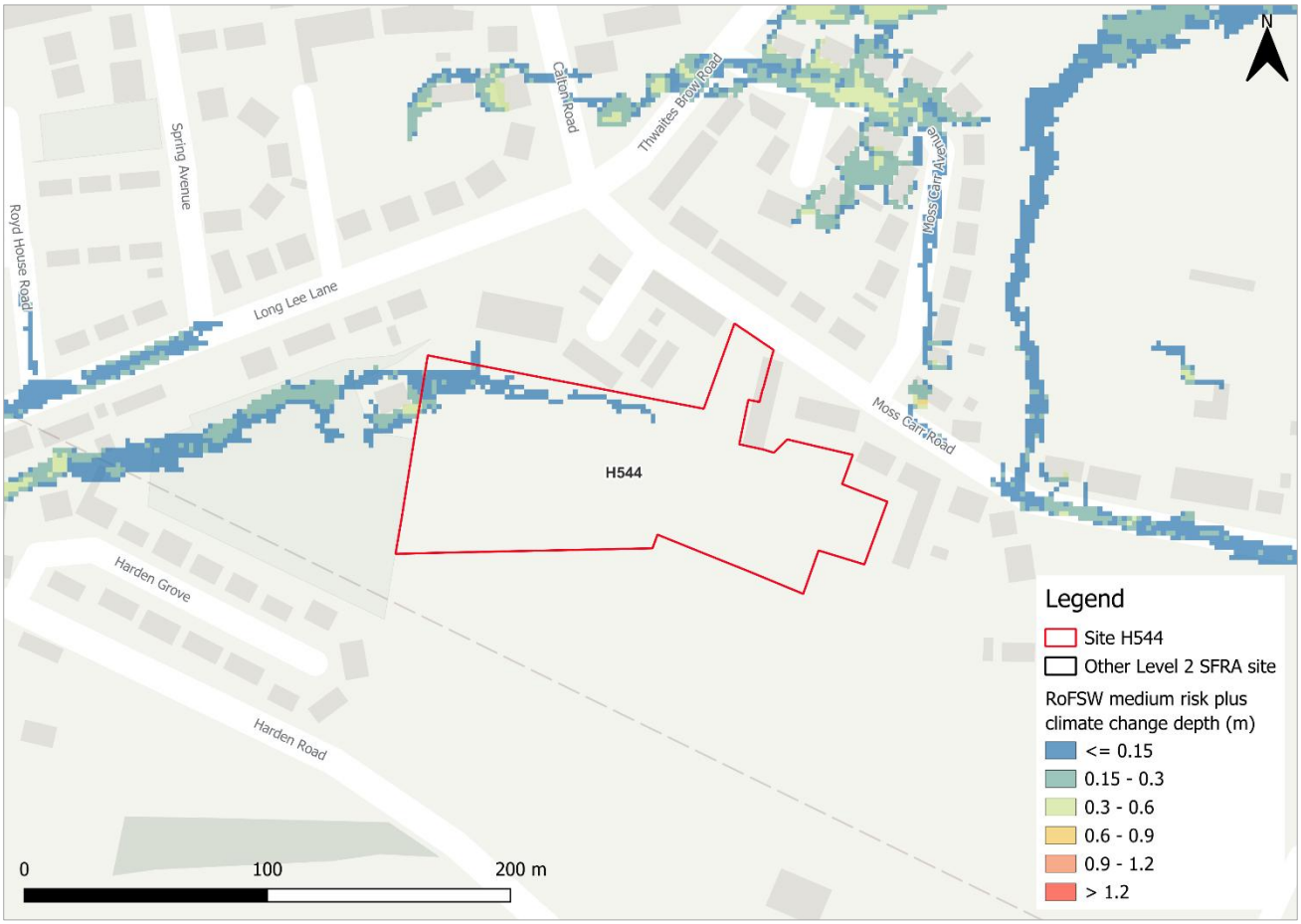


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

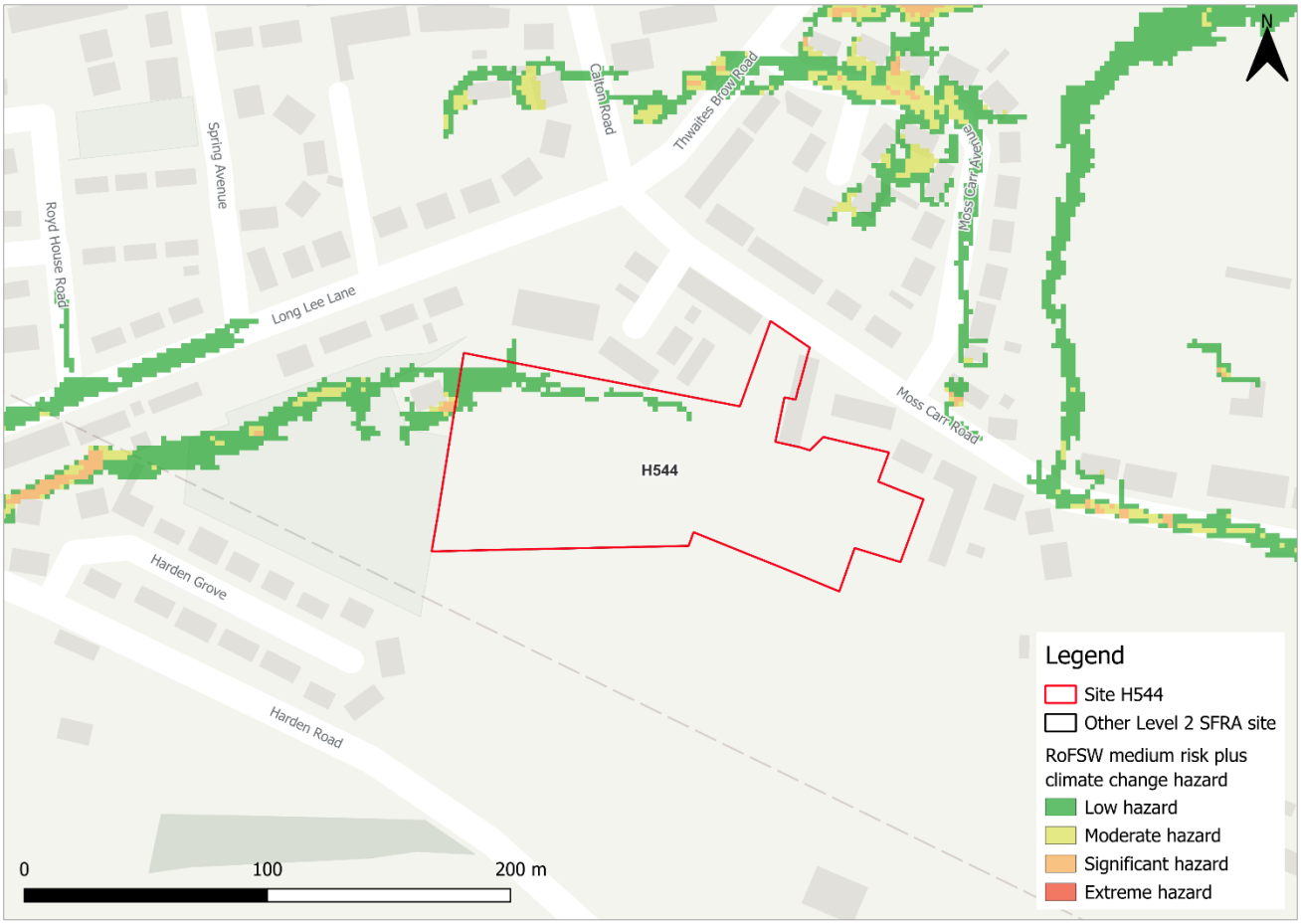


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk is predominantly very low, with a small amount of surface water flooding to the western site boundary during the medium risk event. In the low risk event, a flow path extends across the northwest of the site.
- Topographic flow routes and depressions should be considered and included in site design and ideally left in place to flood naturally when required. 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 with runoff rates restricted to greenfield or betterment if possible. This will require surface water modelling based on layout plans and detailed design and full consultation with the LLFA.
- The Groundwater Emergence Map (Figure 4-1) indicates that ground conditions may be suitable for infiltration SuDS across the site. This should be further explored through appropriate ground survey as part of the FRA and drainage strategy.
- Note that the RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or

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

4 Risk from groundwater

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

In the northern two thirds of the site there is no risk of groundwater emergence. In the southern third of the site, flooding from groundwater is unlikely.



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 beneath the site. If a watercourse is present, there will be a residual risk of flooding to the site were there to be a culvert failure or blockage. A model for this watercourse is not available. Therefore, residual risk could not be modelled for this Level 2 SFRA.

5.2 Flood risk from canals

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

5.3 Flood risk from reservoirs

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

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

5.4 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, blocked or it cannot discharge due to a high water level 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.

5.5 Observations, mitigation options and site suitability - residual risk

- There is no modelled residual risk to the site.
- Historic mapping indicates there may be a watercourse culverted beneath the site. If present, the culvert 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.

6 Overall site assessment

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

This site is not required to pass part b) of the exception test[3] as it is located within Flood Zone1, 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:

- It should be appropriate to develop this site for more vulnerable purposes given its location in Flood Zone 1.
- Historic mapping indicates there may be a watercourse culverted beneath the site. If present, the culvert 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.
- No development should take place over the top of a culvert 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.
- The history of runoff from this site to adjacent land should be considered through a detailed drainage strategy and an FRA. Developers should contact the LLFA for further information to assess potential flood risk to the site and surrounding areas associated with historic flood incidents.
- There is some risk from surface water in the medium and low risk events, currently affecting the northwestern corner of the site. A drainage strategy will be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This will require detailed surface water modelling based on layout plans and detailed design and full consultation with the LLFA on required runoff rates, likely to be greenfield or betterment.
- The surface water flow path should be retained onsite which may reduce units.
- The use of infiltration SuDS should be investigated for suitability across the majority of the site.
- 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.

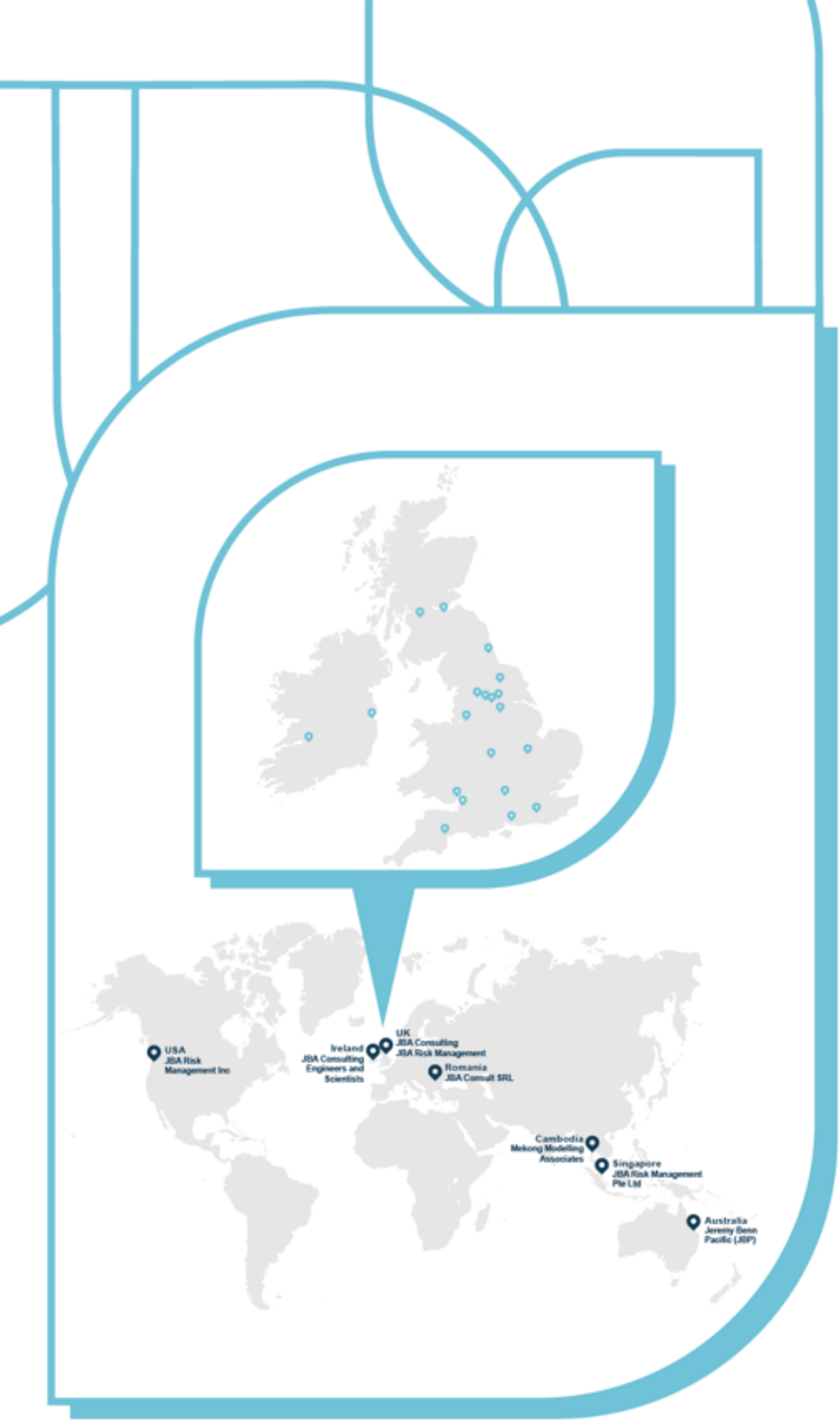
3 Para 178 National Planning Policy Framework 2024

- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

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Bradford Level 2 Strategic Flood Risk Assessment - Site H554

Final Draft

July 2026

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City of BRADFORD METROPOLITAN DISTRICT COUNCIL

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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-Jones 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 H554. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the 'CBMDC Level 1 SFRA' (2023) and read the 'CBMDC Level 2 SFRA Main Report' (2026) and is therefore familiar with the terminology used in this report.

1.1 Site H554

- Location: Woodhouse Road, Keighley
- Existing site use: Greenfield
- Existing site use vulnerability: Water compatible
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 0.79 hectares
- Proposed development impermeable area: 0.71 hectares
- Watercourse: N/A
- Environment Agency (EA) river model: N/A
- Summary of requirements from scoping stage:
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk

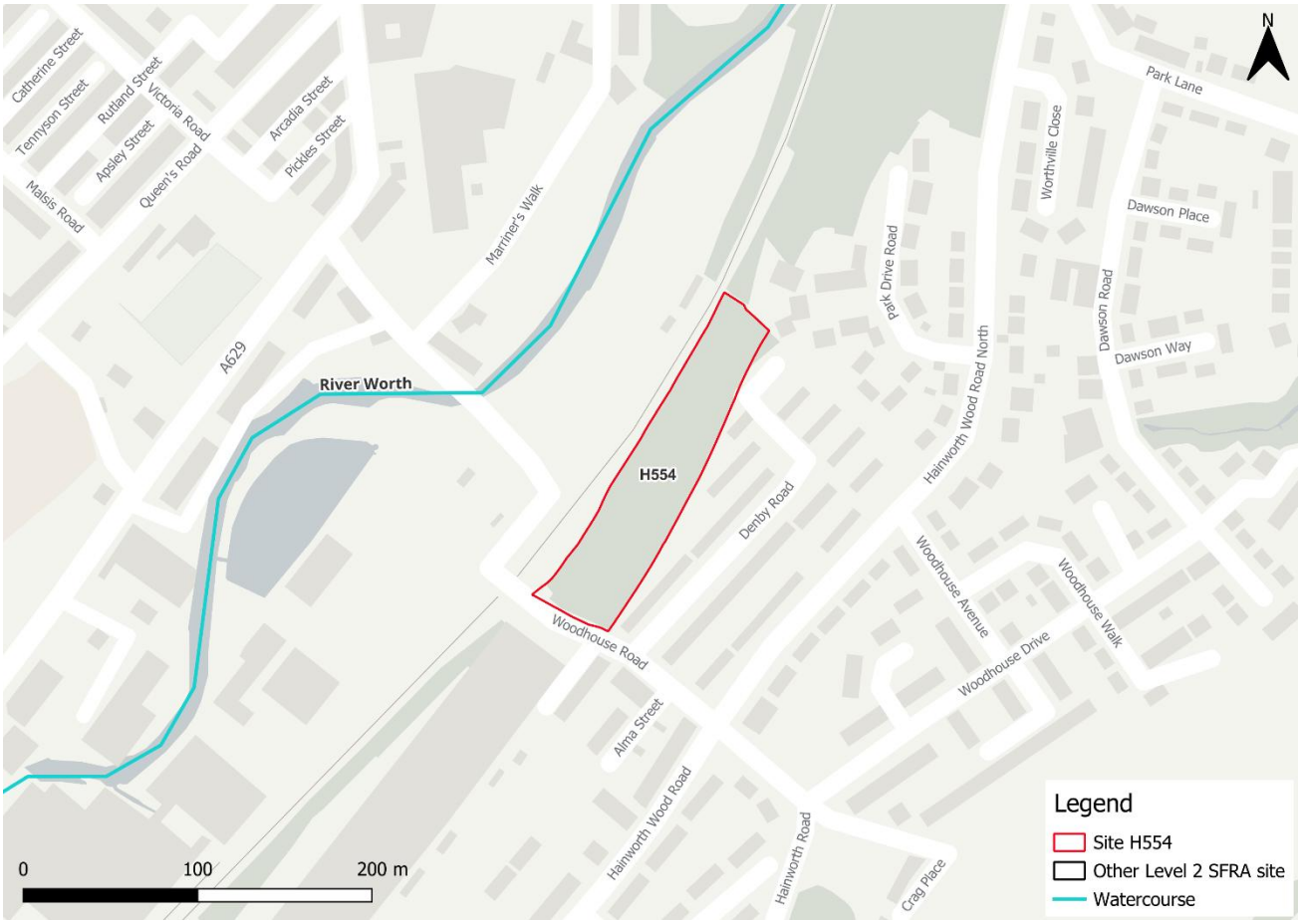


Figure 1-1: Existing site location boundary

The topography of the site is varied, with higher elevation in the south of the site, which slopes down towards the north and towards River Worth to the west (Figure 1-2).

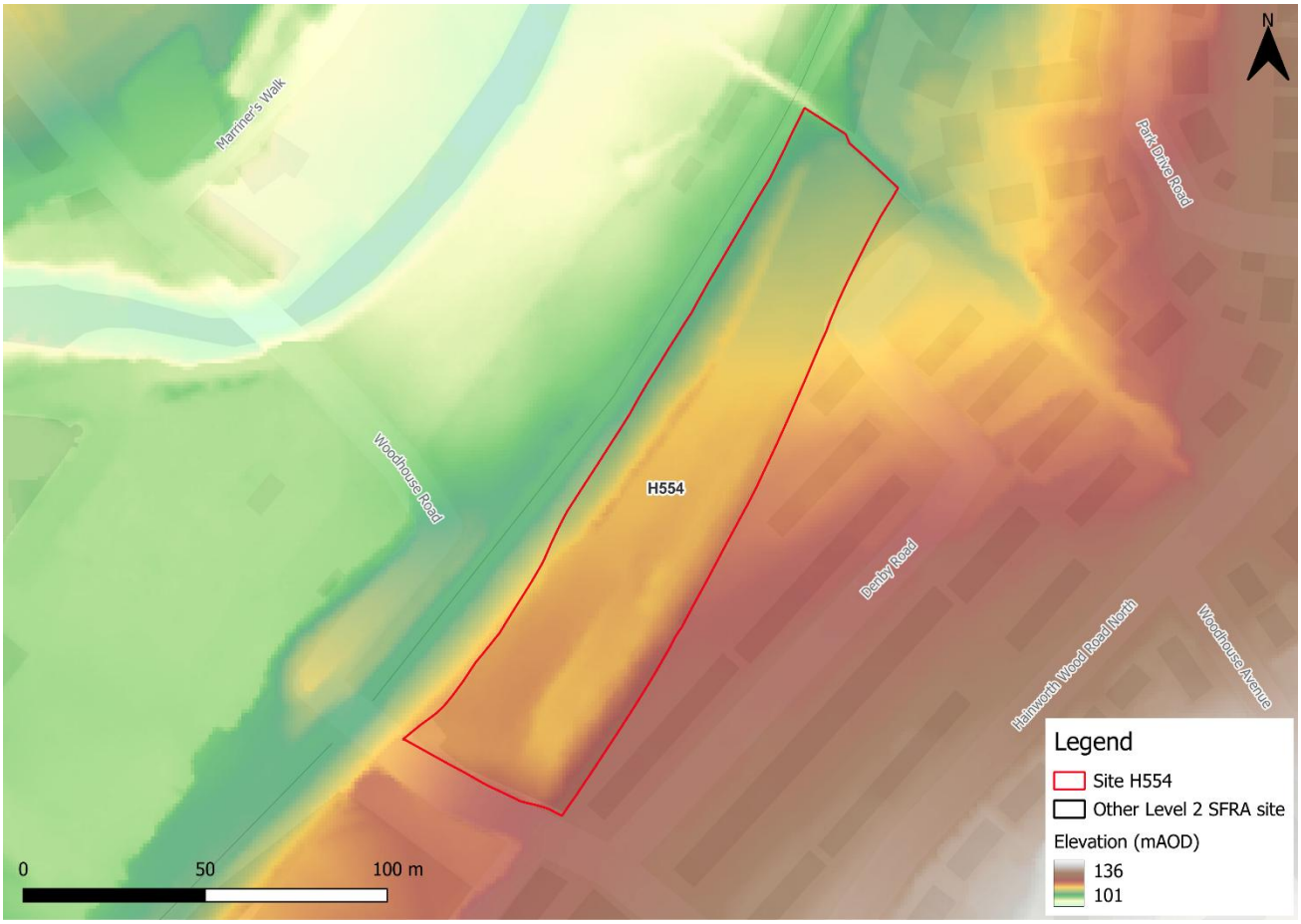


Figure 1-2: Topography

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



Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

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

The site is located wholly within Flood Zone 1 and is therefore at low risk of fluvial flooding. There is a break in both Flood Zones 2 and 3a along the reach of the River Worth to the west of the site. The EA should be contacted to confirm the reason for this, however it is unlikely that this will impact onsite fluvial flood 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)
100	0	0	0

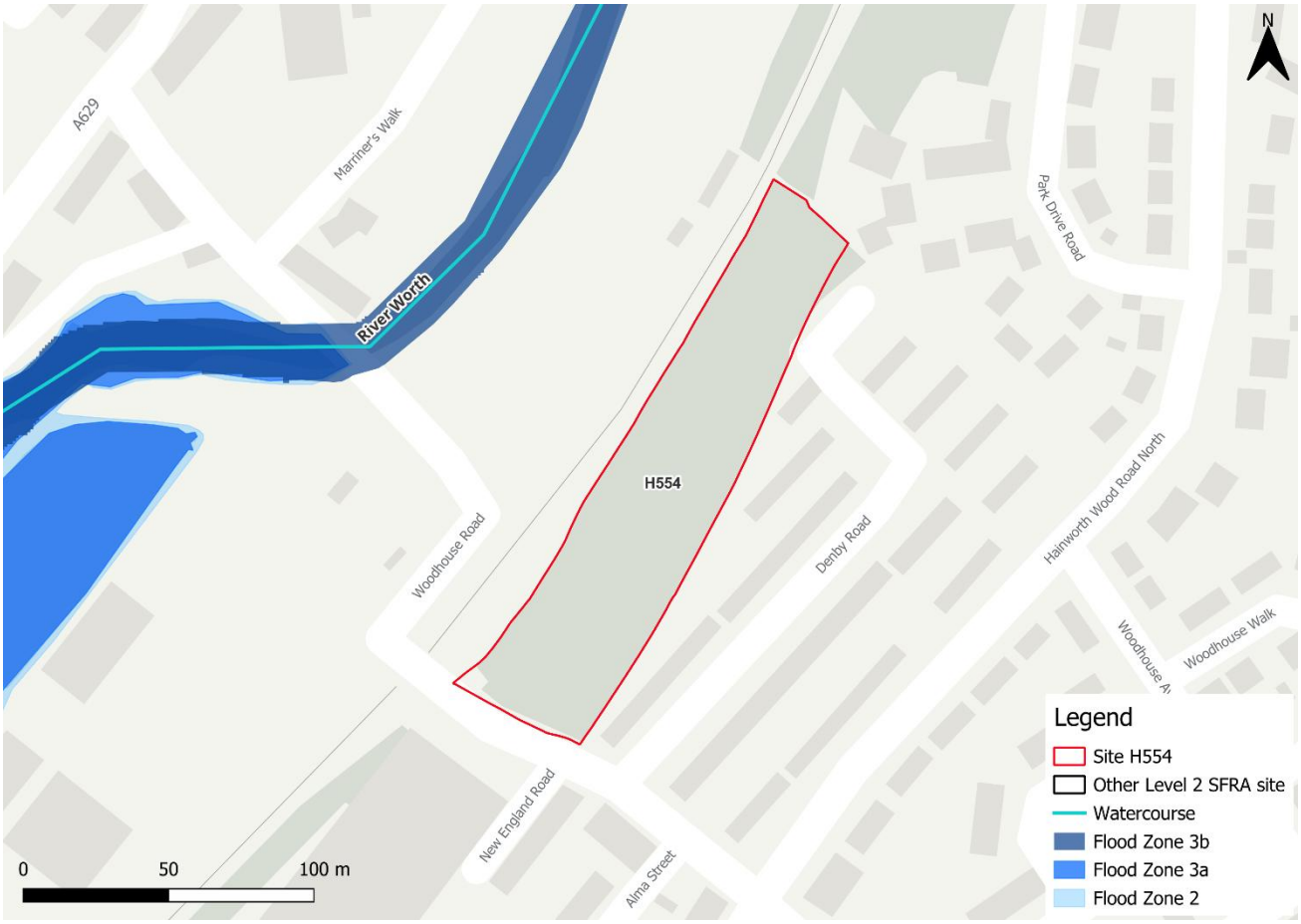


Figure 2-1: Existing risk from rivers to the site

2.1.2 River Worth 2024 model outputs - present day

Based on the River Worth 2024 model, there is no modelled fluvial risk to the site in the 1% AEP undefended event (Figure 2-2).



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

2.2 Impacts from climate change

The EA's SFRA guidance states that SFRAs should assess the central allowance for less vulnerable, more vulnerable, highly vulnerable and water compatible development (Table 2-2). The impacts of climate change on flood risk from the River Worth 2024 model have been modelled without flood defence infrastructure in place. As documented in Section 2.3.1, there are no formal engineered flood defences that would benefit the site.

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

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

2.2.1 River Worth 2024 model outputs - climate change

Based on the River Worth 2024 model, there is no modelled fluvial risk to the site in the 1% AEP plus central climate change undefended event (Figure 2-3).

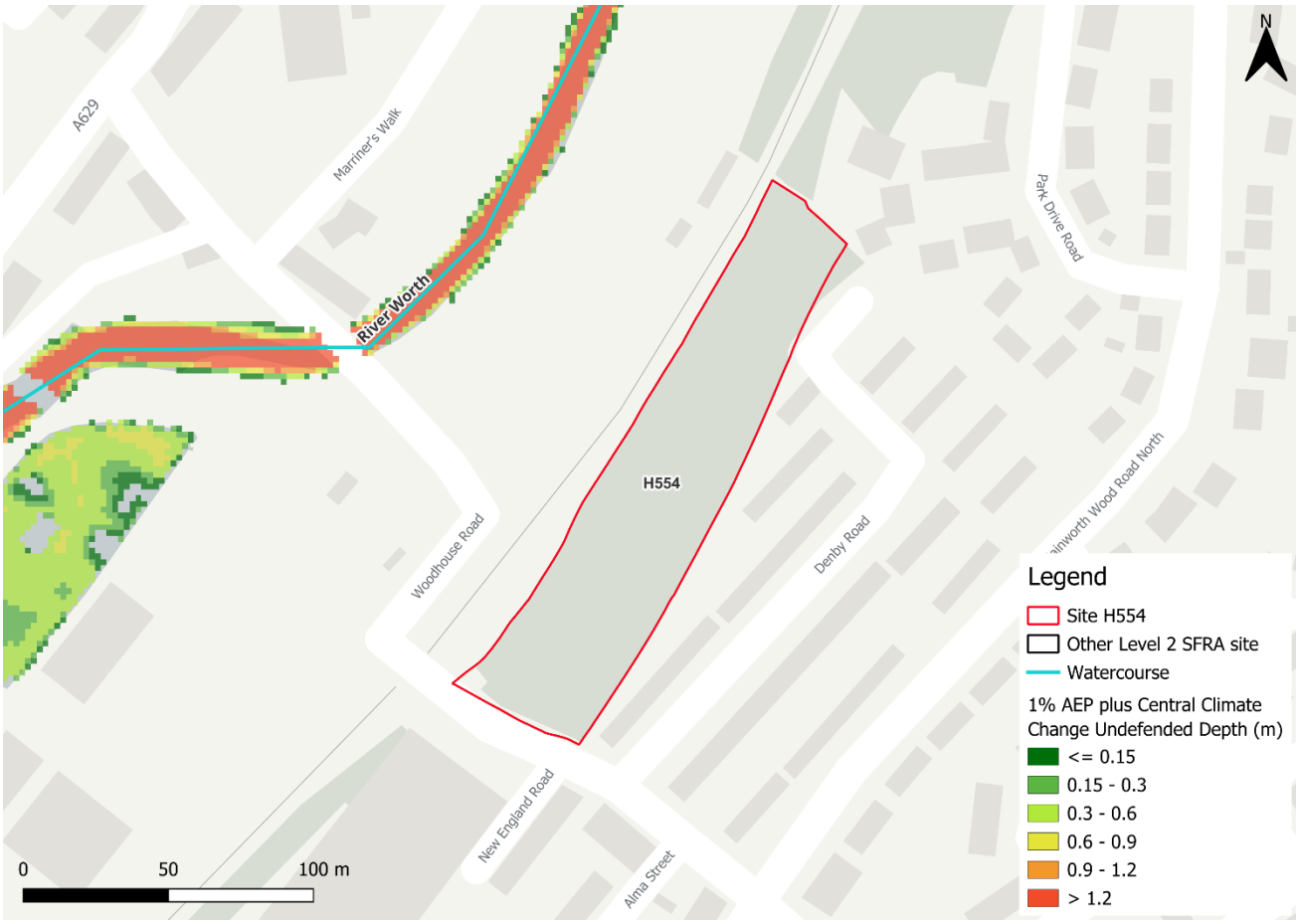


Figure 2-3: Flood depths for 1% AEP undefended flood event +23% (central climate change allowance)

2.2.2 Flood Map for Planning - Climate Change

Climate change data in this area is unavailable from the EA's Flood Map for Planning plus Climate Change (2070-2125) dataset, as shown in Figure 2-4.

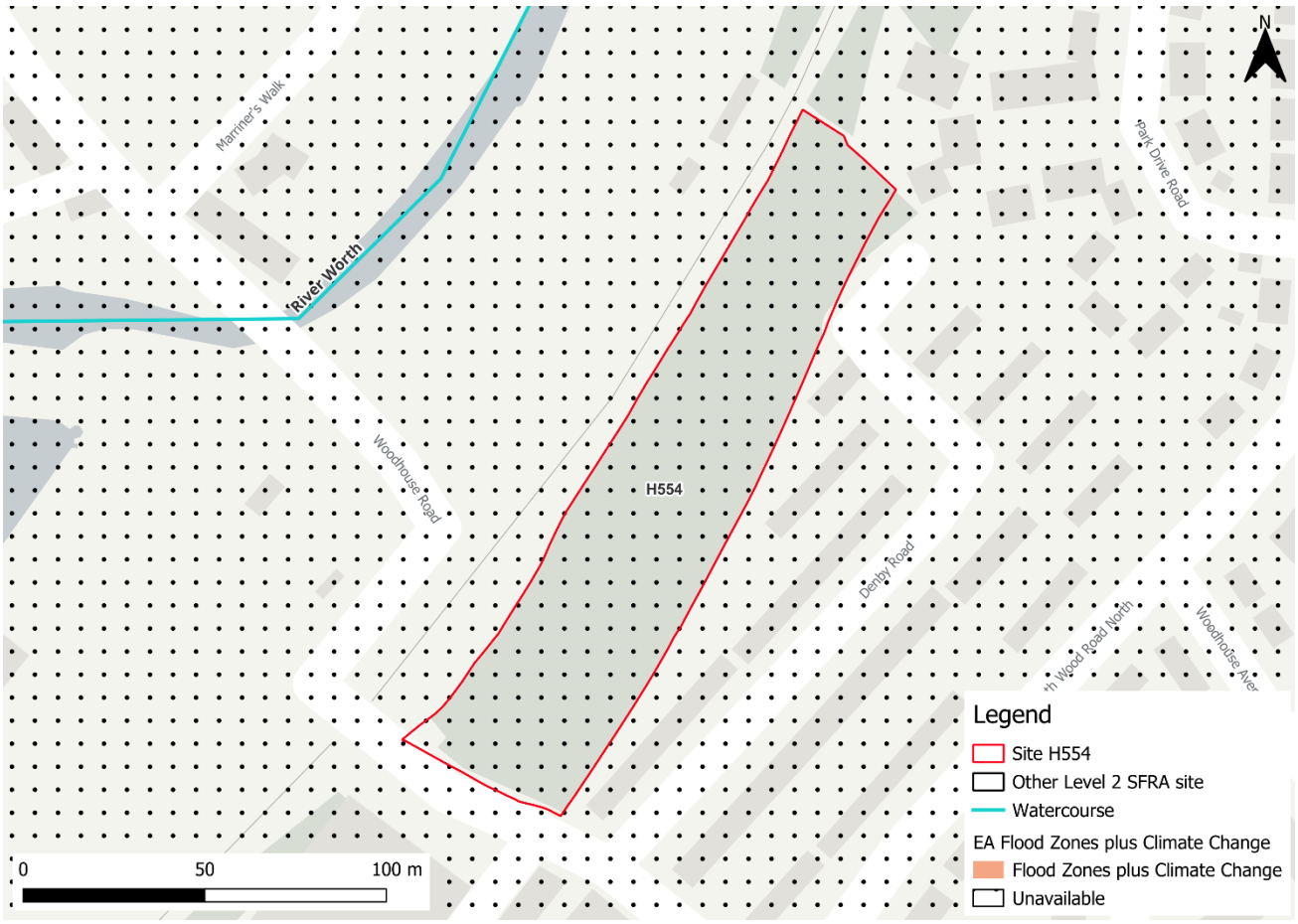


Figure 2-4: EA Flood Zones plus Climate Change

2.3 Flood risk management

2.3.1 Flood defences

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

2.3.2 Working with Natural Processes

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

2.4 Historic flood incidents

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

2.5 Emergency planning

2.5.1 Flood warnings

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The 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 also not located within a FAA.

2.5.2 Access and escape routes

Based on available information, safe access and escape routes would likely be achievable via Woodhouse Road to the south of the site during a fluvial flood event (Figure 2-5).

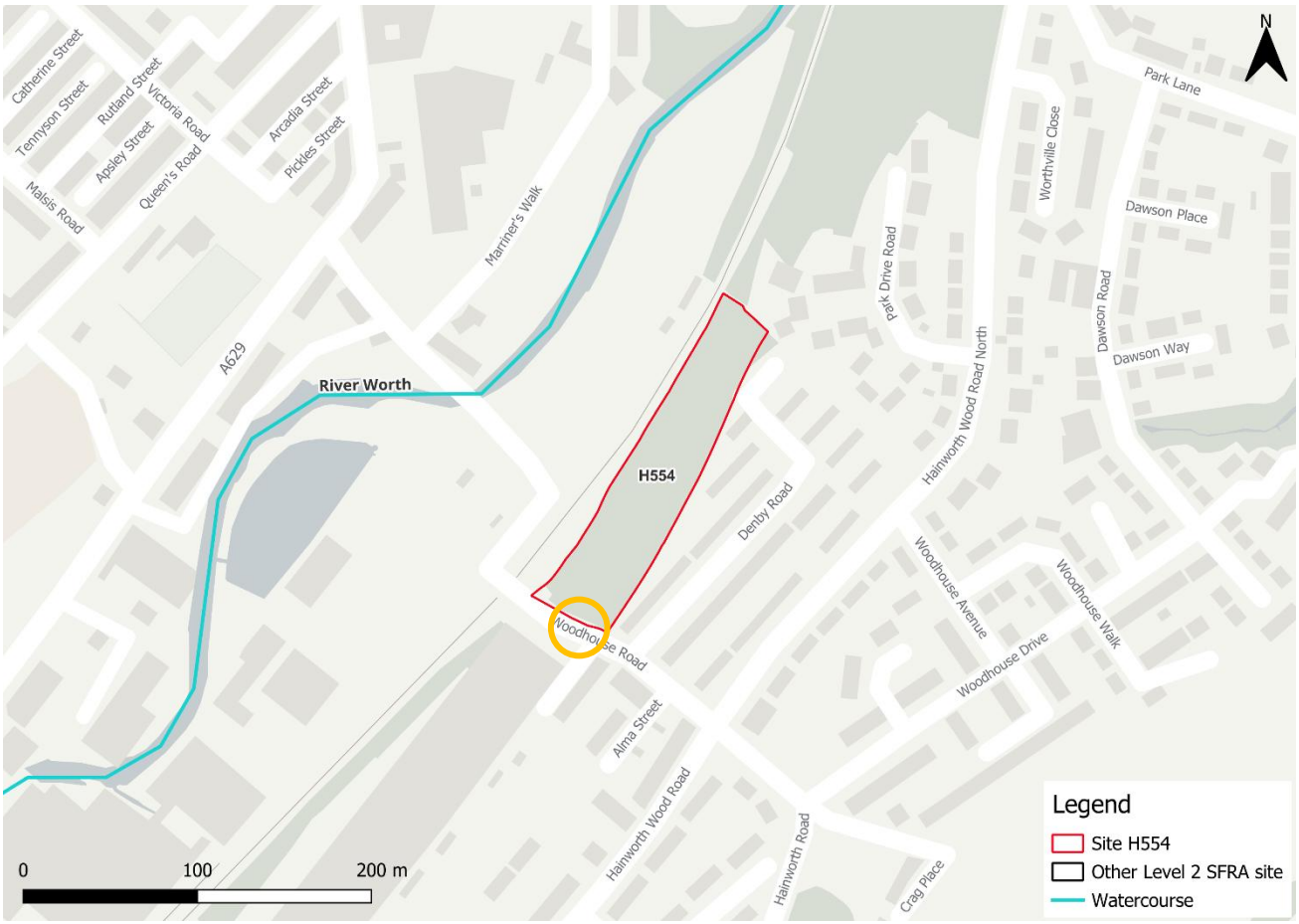


Figure 2-5: Potential access and escape routes

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

- Observations:
  - The proposed development of the site would see a change in the risk classification from water compatible to more vulnerable, according to the NPPF.
  - Given the change in use and therefore vulnerability of the site, the LPA must consider whether the change of use is acceptable and whether the development can be designed to be safe, including for adequate emergency planning provision, accounting for the information provided in this Level 2 SFRA (para 014 FRCC-PPG).
  - The site is wholly located within Flood Zone 1. There is a break in both Flood Zones 2 and 3a along the reach of the River Worth to the west of the site. The EA should be contacted to confirm the reason for this, however it is unlikely that this will impact onsite fluvial flood risk.
- Access and escape:
  - Based on available information, safe access and escape would likely be achievable via Woodhouse Road to the south of the site.

3 Flood risk from surface water

3.1 Existing risk

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

3.1.1 Risk of Flooding from Surface Water - NaFRA2 extents

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

Surface water risk is confined to an area of ponding within a topographic low spot within the south of the site (Figure 3-1). Safe access and escape routes would likely be achievable via Woodhouse Road to the south 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)
85	4	2	9

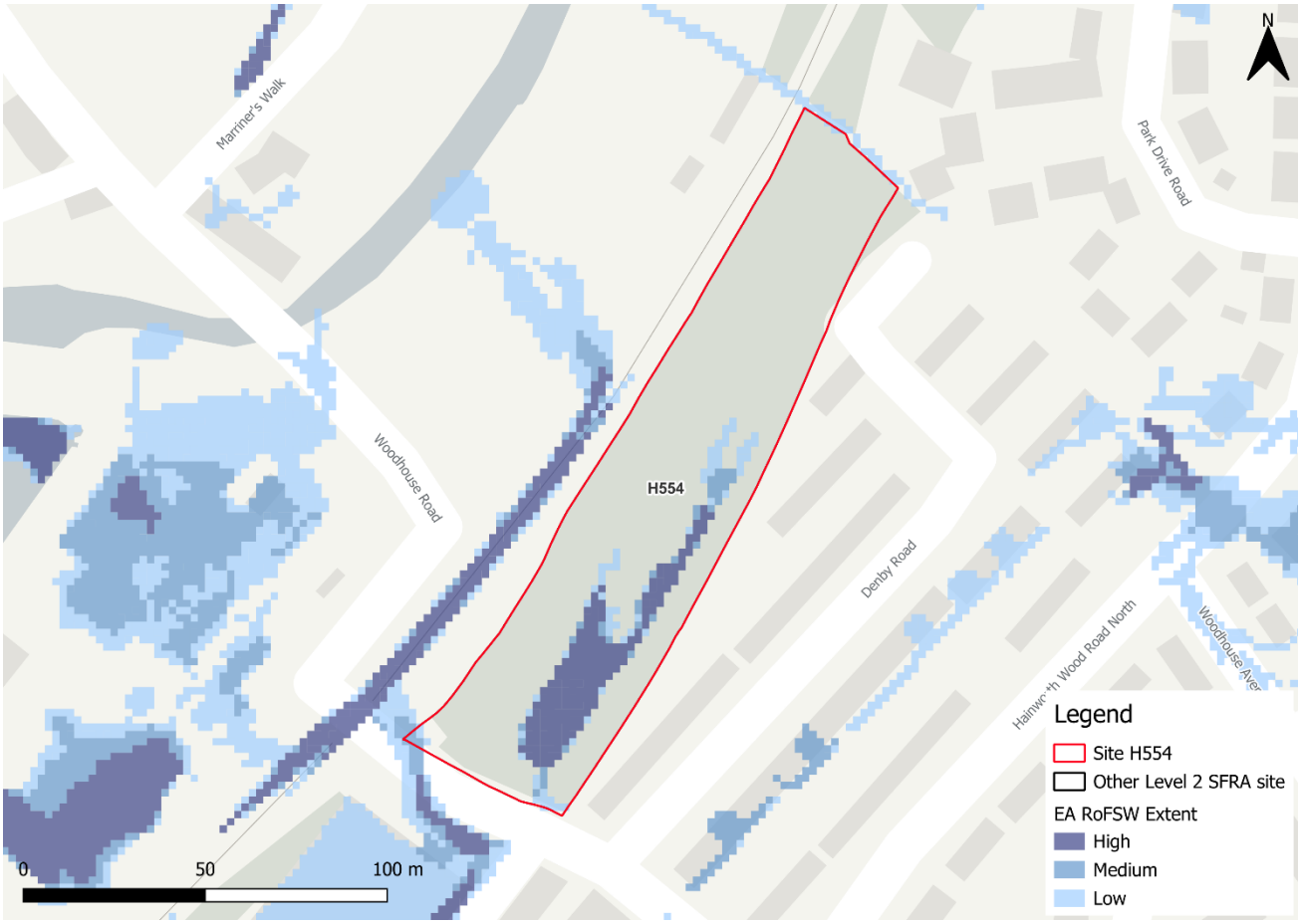


Figure 3-1: Surface water flood extents (NaFRA2 - Risk of Flooding from Surface Water map)

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

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

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

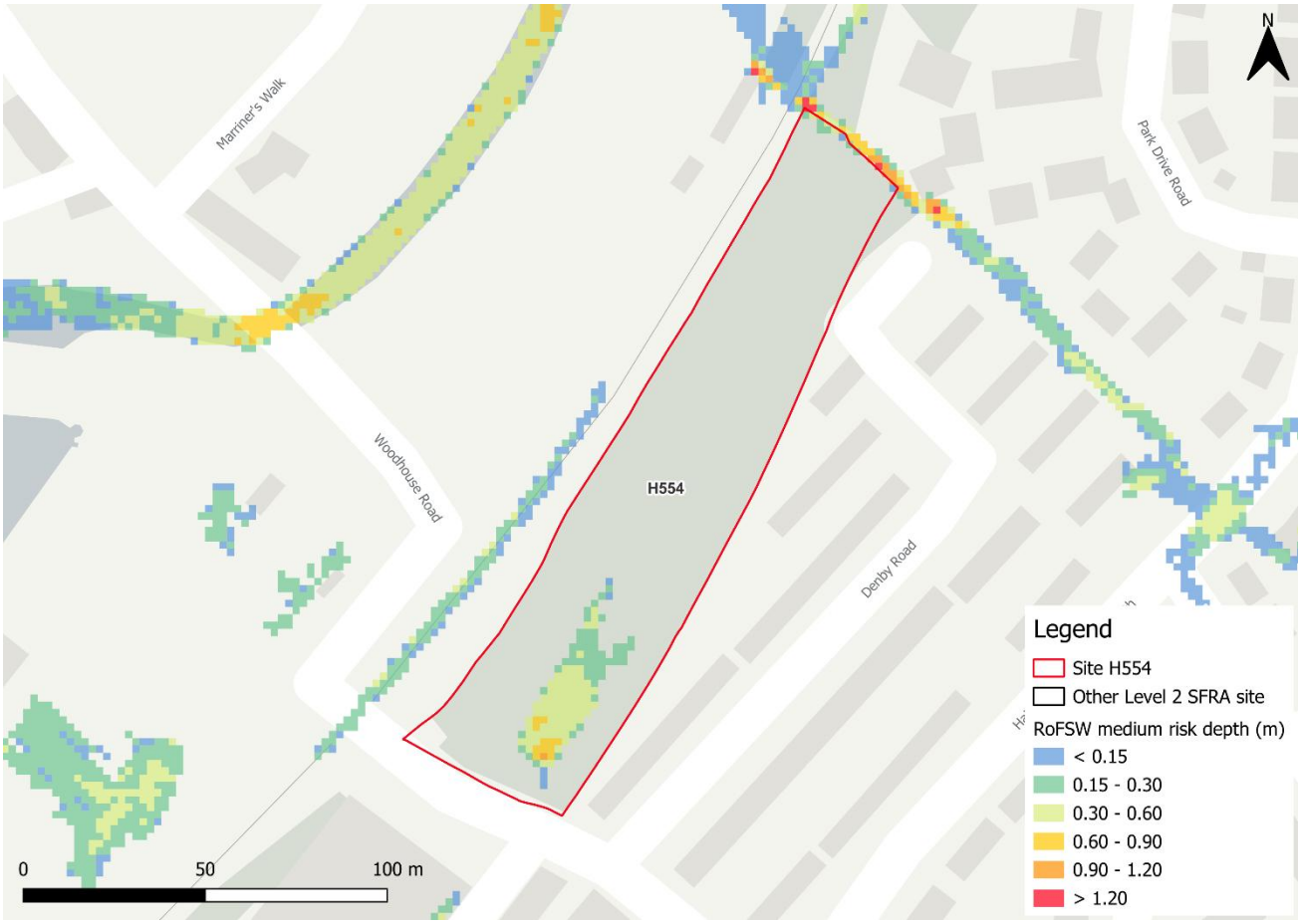


Figure 3-2: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)



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

3.2 Impacts from climate change

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

Using the low risk event as a proxy, the medium risk surface water event is likely to increase slightly in extent within the site when accounting for climate change (Figure 3-4). The third generation map indicates maximum flood depths are likely to increase to between 0.9 and 1.2 m (Figure 3-5), with hazard remaining as 'significant' (Figure 3-6).

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

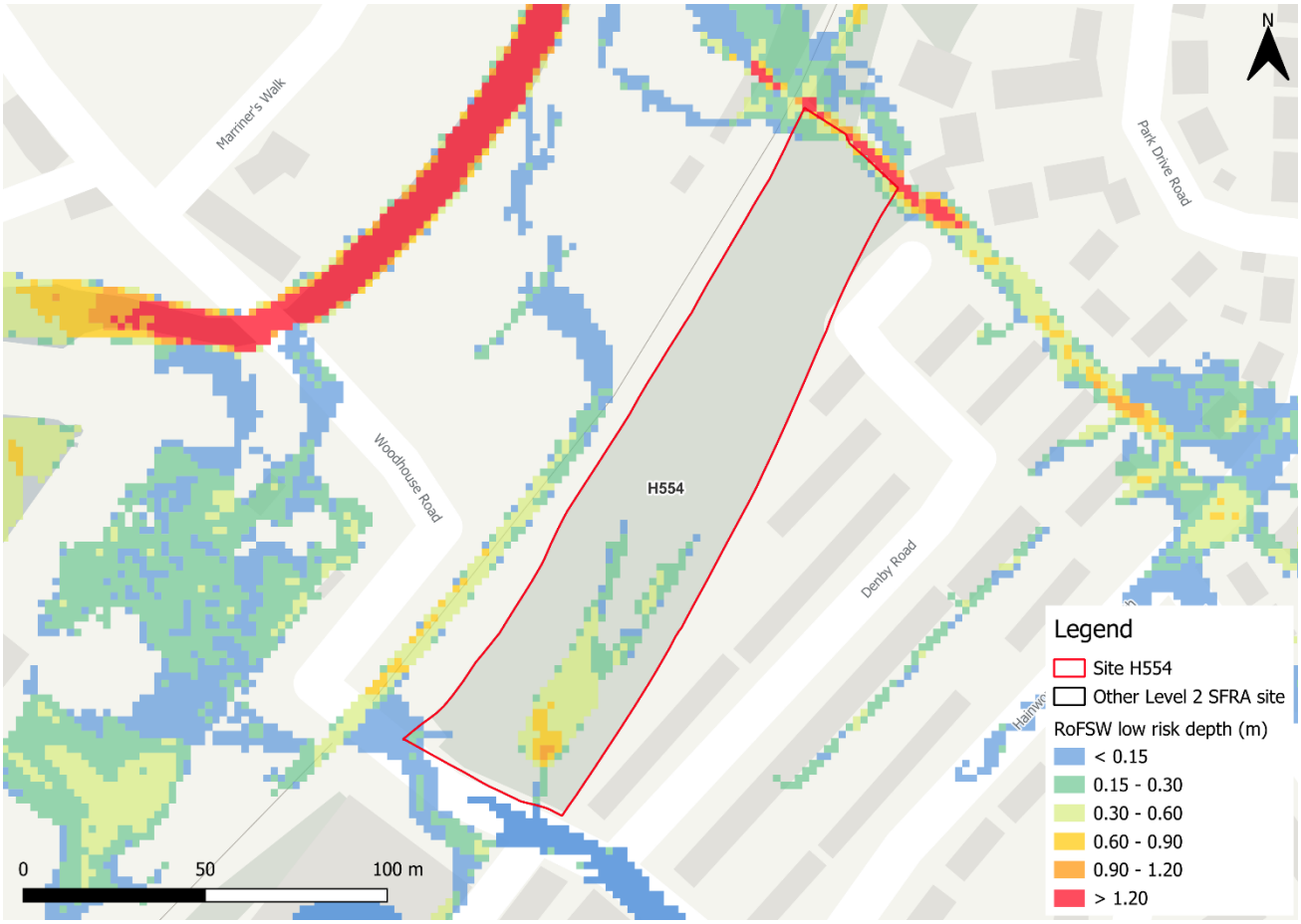


Figure 3-5: Low risk event surface water flood depths, as a proxy for the medium risk event plus climate change (Third generation - Risk of Flooding from Surface Water map)



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

3.3 Observations, mitigation options and site suitability - surface water

- Current risk to the site is predominantly very low with 85% of the site being at very low surface water flood risk. Surface water risk is confined to an area of ponding within the south of the site.
- The effects of climate change on surface water have not been modelled for this SFRA, however the low risk surface water event has been used as a proxy for the medium risk event plus climate change. Surface water risk is unlikely to increase significantly when accounting for climate change, based on the proxy approach.
- Topographic low spots should be considered and included in site design and ideally left in place to flood naturally when required.
- Safe access and escape routes would likely be achievable via Woodhouse Road to the south of the site in all events.
- The drainage strategy must ensure there is no increase in surface water flood risk elsewhere as a result of new development. Existing greenfield rates will likely apply, though the developer should consult local LLFA guidance and the National SuDS guidance.

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

4 Risk from groundwater

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

The majority of the site is located within an area where there is no risk of groundwater emergence. This is reflected in the geology of the area being a combination of mudstone, siltstone and sandstone (Figure 1-3), contributing to potentially reduced rates of infiltration and low water tables. Infiltration SuDS may therefore be an appropriate option within these areas as there is a lower risk of groundwater emergence. However, the underlying bedrock geology being less permeable means that the type of infiltration SuDS needs to be considered further through the drainage strategy.

The south of the site is in an area where there is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.

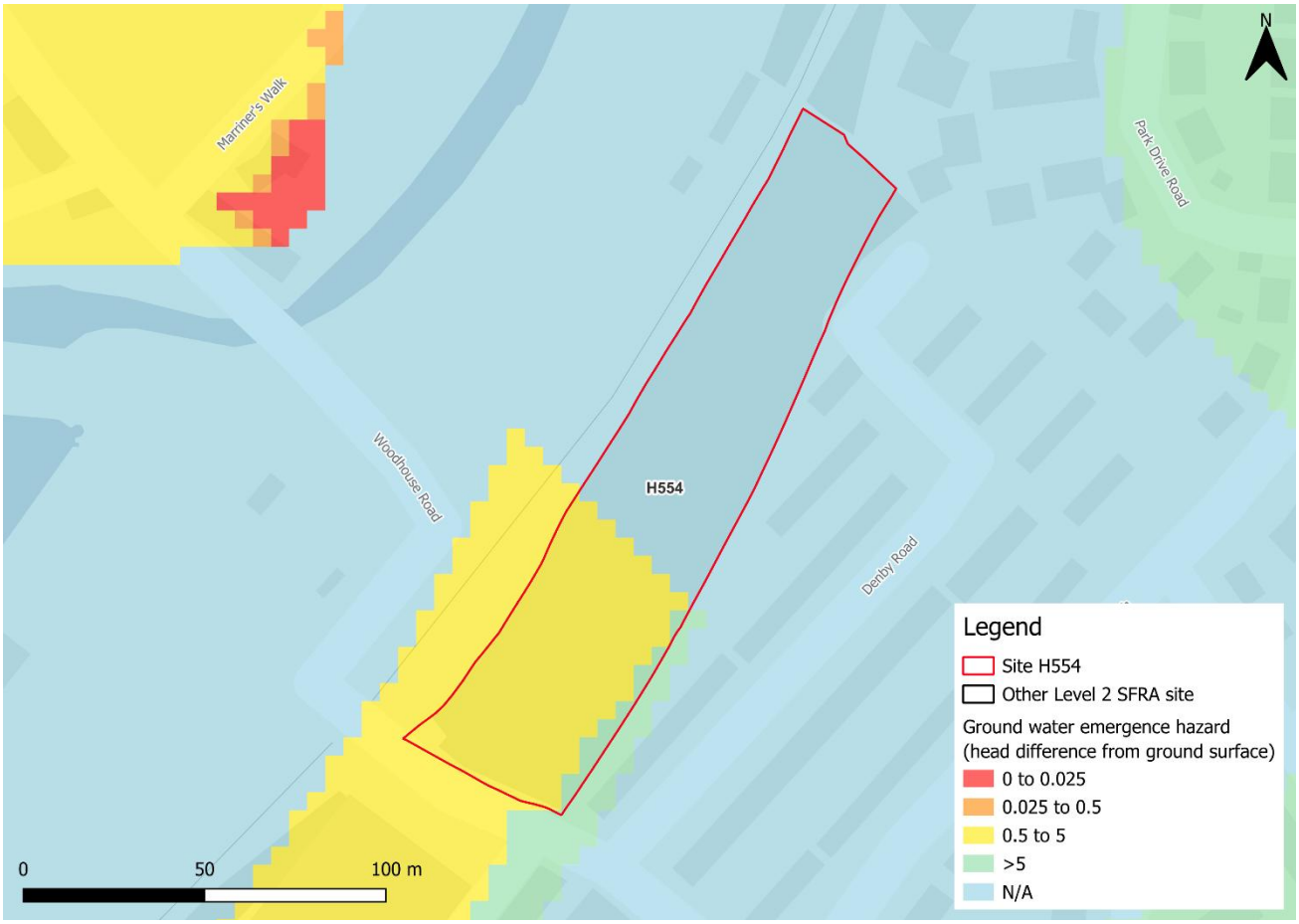


Figure 4-1: JBA 5m Groundwater Emergence Map

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

Table 4-1: Groundwater Hazard Classification

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

5 Residual risk

Although a site may be afforded some protection from defences and / or drainage infrastructure, there is always a residual risk of flooding from asset failure i.e. defence breaches, or blockages of culverts or drainage assets.

5.1 Flood risk from reservoirs

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

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

5.2 Observations, mitigation options and site suitability - residual risk

- There is no anticipated residual risk to this site.

6 Overall site assessment

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

This site is not required to pass part b) of the exception test[3] 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 generally considered to be 100 years for residential development.

6.2 Recommendations summary

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

- It should be appropriate to develop this site for more vulnerable purposes given its location in Flood Zone 1.
- Surface water should be retained onsite which may reduce units. This will require detailed surface water modelling based on layout plans and detailed design and full consultation with the LLFA on required runoff rates, likely to be greenfield or betterment. The use of infiltration SuDS should be investigated across the majority of the site.

6.3 Site-specific FRA requirements and further work

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

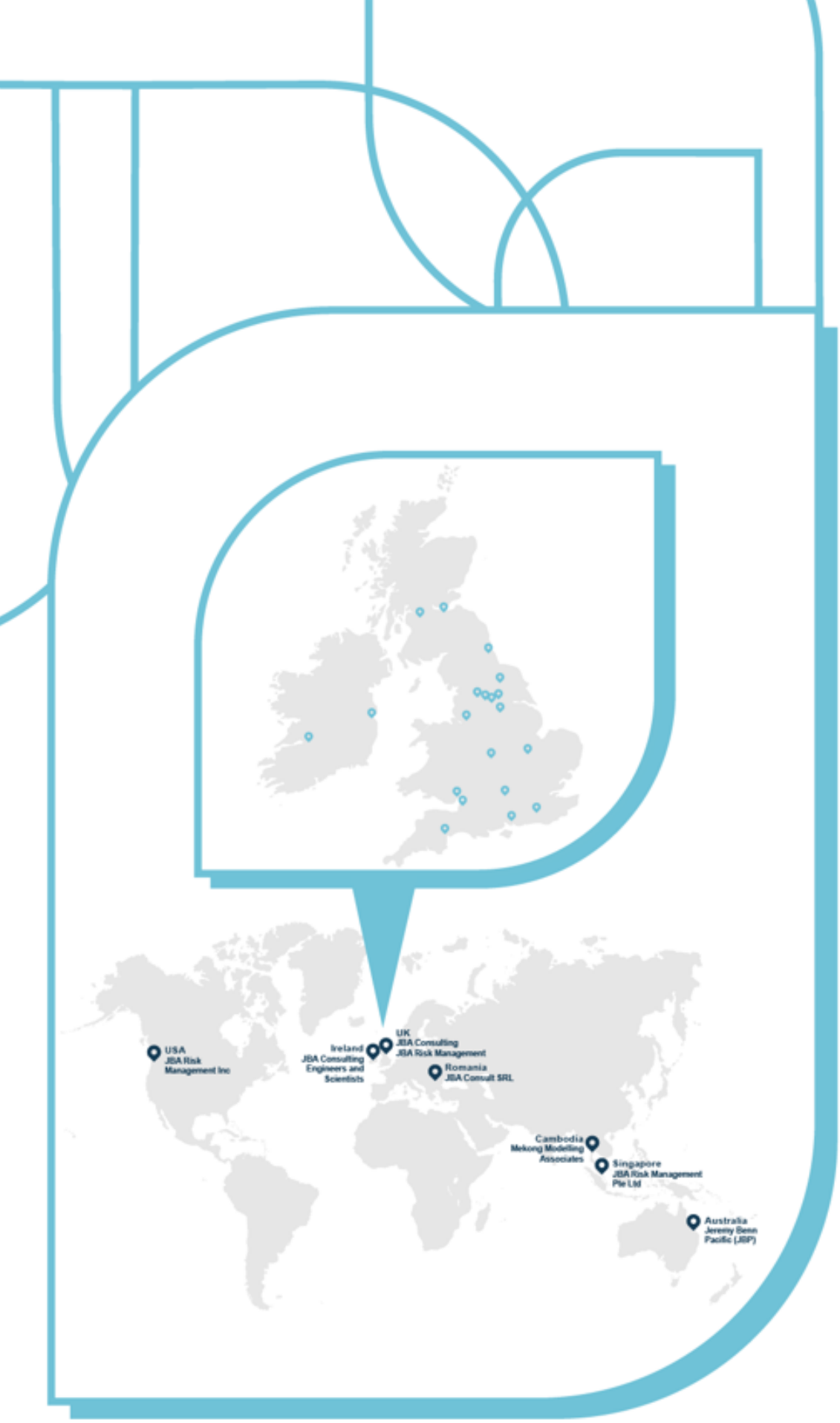
- Further modelling to understand the impacts of climate change on surface water flood risk to the site.
- FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, 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.

3 Para 178 National Planning Policy Framework 2024

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