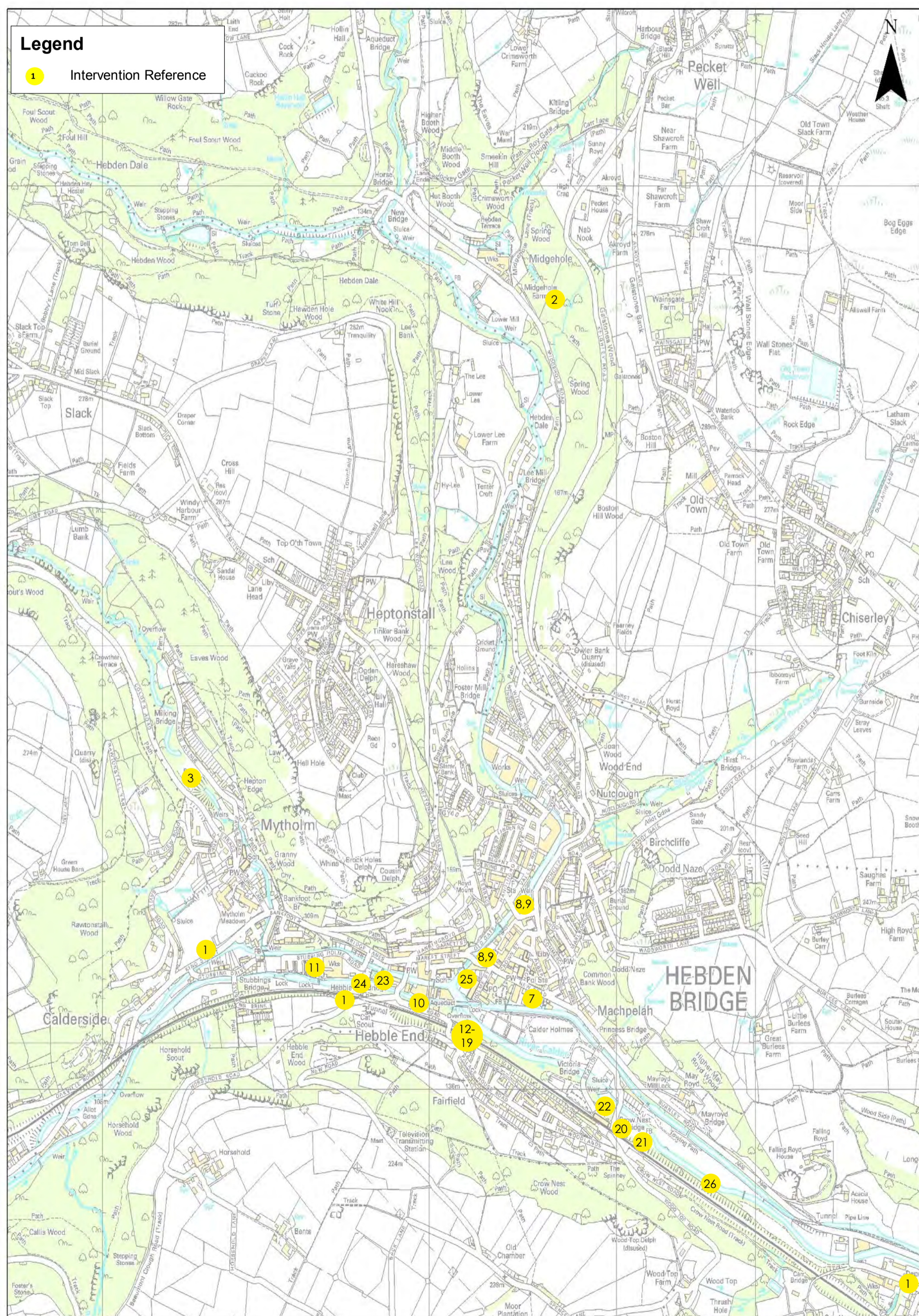


River Flooding Optioneering: Investigations

The map below shows the locations of interventions which we thought could reduce flood risk in Hebden Bridge. The table shows what the intervention would be, and provides a summary of the likely benefits and constraints associated with the intervention.

Performance Summary Key

- Modelling shows little or no benefit
- Modelling shows significant benefit, other constraints mean these options are less preferable
- Modelling shows significant benefit, other constraints acceptable



No.	Option type	Location	Watercourse	Description	Commentary
1	Storage	Mytholm Meadows, Salt Store on right bank of Calder and Stubbing Holme Rd car park	Calder	Flood storage reservoir located at Mytholm Meadows and other potential small storage locations through reach	Storage areas too small to provide a significant reduction in fluvial flood flows on River Calder. Mytholm Meadows constrained by location of the main road between the site and the River Calder.
2	Storage	Midgeholme	Hebden Water	Create a flood storage reservoir approximately 8,000m ³ in capacity	Storage area too small to provide a significant reduction in fluvial flood flows on Hebden Water.
3	Storage	Colden above recreation ground	Calder	Create a flood storage reservoir to store flows on Colden Clough, a tributary of the River Calder upstream of Hebden Bridge	Storage area too small to provide a significant reduction in fluvial flood flows on River Calder.
4	Storage	Yorkshire Water Hebden Water Group of reservoirs	Hebden Water	Utilise existing YW water supply reservoirs for flood alleviation	Full commentary provided on standalone posters. Reservoir groups not shown on this map.
5	NFM	Calder catchment	Calder	Natural flood management measures within the Calder catchment to river flooding	Further information available on Natural Flood Management poster.
6	NFM	Hebden Water catchment	Hebden Water	Natural flood management measures within the Hebden Water catchment	Further information available on Natural Flood Management poster.
7	Residual Risk Management	New Road to Calder Holmes Park	Hebden Water	Insert pipes, pumps or similar to convey flood water from Hebden Water collecting at the low point on New Road into Calder Holmes Park	This option has been assessed primarily with the aim of addressing residual risk of fluvial flooding should proposed defences be overlapped on Hebden Water. Modelling shows little benefit from this option unless significant pump infrastructure applied, due to high Calder levels in Calder Holmes Park limiting ability to drain by gravity.
8	Containment	Confluence to Innovation Weir existing line	Hebden Water	Works to include wall heightening and re-profiling of banks to tie into existing bank lines as far as possible and to contain flow within the channel for target return periods	This option is taken forward as a key component of our preferred option. With wall heights set to a maximum value of 1.2m at the top of the wavy steps, a present day SoP of 1 in 50yrs can be achieved. Impact downstream will be taken into account and mitigated, where necessary.
9	Containment	Confluence to Innovation Weir set back	Hebden Water	Works to include wall heightening and re-profiling of banks to tie into set back bank lines and to contain flow within the channel for target return periods	This option showed very similar performance to the above containment configuration, with limited improvement in performance. Consequently, the above defence alignment is considered preferable as it causes less disruption to existing development in Hebden Centre.
10	Containment	Calder - confluence to Stubbing Holme Road Bridge	Calder	Improve wall condition and plug gaps / ensure continuity for it to be utilised for flood containment	Modelling has shown that target flood return periods of 1 in 50 to 1 in 100 years can be contained in this reach with improvements to existing walls. This is taken forward within our preferred option.
11	Containment	Stubbing Holme Rd	Calder	Replacement wall - increased in height and replacement of existing porous wall with water tight flood defence	This is taken forward as a key component of our preferred option. A SoP of between 1 in 50yrs and 1 in 100yrs can be achieved with wall heights in the region of 1.5m directly upstream of Stubbing Holme Rd Bridge.
12	Conveyance	Confluence	Calder	Re-align piers to reduce current constriction	CFD modelling suggests limited upstream water level decreases as a result of this option.
13	Conveyance	Aqueduct	Calder	Replace aqueduct with improved capacity structure, no channel modification up or downstream	This results in modelled benefit of ~200-300mm reduction in peak water levels directly upstream of the aqueduct. However, impact does not travel far enough upstream on River Calder or Hebden Water to result in a significant reduction in required wall levels.
14	Conveyance	Aqueduct	Calder	We simulated removing the aqueduct to enable us to understand the maximum possible benefit upstream on both watercourses.	This results in modelled benefit of ~200-300mm reduction in peak water levels directly upstream of the aqueduct. However, impact does not travel far enough upstream on River Calder or Hebden Water to result in a significant reduction in required wall levels.
15	Conveyance	Confluence	Calder	River training minor (benching)	Modelling shows only localised benefit and on a small scale, consequently this is unlikely to be taken forward.
16	Conveyance	Confluence	Calder/Hebden Water	River realignment through riverside school playground	In isolation this only shows limited benefit upstream on Hebden Water and the River Calder. When combined with improving capacity of New Road Bridge, decreases in water level upstream of New Rd Bridge are increased in magnitude. However, it is considered that the disruption and loss of school land caused by this option is too great for the return provided at this stage.
17	Conveyance	Confluence	Calder	Dredge u/s through and d/s aqueduct	Modelling shows only localised benefit and on a small scale - benefit does not extend upstream of aqueduct.
18	Conveyance	Confluence	Calder	Widening channel through aqueduct reach and minor increase to aqueduct capacity	Modelling of this option showed that to gain significant benefit from work at the aqueduct any amendment to the structure needs to incorporate a substantial increase in structure capacity (as below) along with increasing channel capacity up and downstream of the aqueduct reach.
19	Conveyance	Confluence	Calder	Widening channel through aqueduct reach and significant increase to aqueduct capacity	With an additional opening of significant capacity (near to doubling cross sectional area of existing openings) and channel widening up and downstream of the aqueduct, substantial reductions in flood levels upstream of the aqueduct can be achieved (~600mm peak water level reduction at the Wavy Steps in the 1 in 50yr event). However, the constraints on this option in terms of buildability, cost, disruption, heritage issues at the aqueduct and loss of school land means that this option is unlikely to be progressed further at this time.
20	Conveyance	Downstream of Victoria Bridge	Hebden Water	Replacement current bridge arrangement to a less restrictive option	Modelling shows only localised benefit and on a small scale - benefit does not extend upstream of aqueduct.
21	Conveyance	Crows Nest Bridge	Calder	Remove channel obstruction near Crow's Nest Bridge	Modelling shows only localised benefit and on a small scale - benefit does not extend upstream of aqueduct.
22	Conveyance	Crows Nest Bridge	Calder	Remove weir at Crow's Nest Bridge to reduce channel restrictions and progress flood flow further downstream	Modelling shows only localised benefit and on a small scale - benefit does not extend upstream of aqueduct.
23	Conveyance and Containment	Adult Learning Centre Bridge	Calder	Remove bridge causing restriction at Adult Learning Centre and fill in openings for bridge crossing (these works have already been completed)	Modelling shows a significant benefit shown in dropping in channel flood levels upstream of the bridge structure and by reducing frequency of flooding via openings in walls adjacent to the bridge
24	Conveyance	Stubbing Holme Rd	Calder	Replacing the existing bridge structure with a clear spanning structure, providing less of an obstruction in the channel	Removing the bridge at Stubbing Holme Rd drops upstream peak water levels by >1m in a 1 in 100 year flood event. However, there may be knock on impacts of removing this structure or replacing with a clear spanning structure, as this would potentially allow more flow downstream. There are also heritage and cost considerations for the removal or amendment of this structure, which may not currently outweigh the cost benefits resulting from the decrease in upstream water levels.
25	Conveyance	New Bridge Road	Hebden Water	Improving the capacity of New Road bridge.	Improving the capacity of New Road bridge may have a significant impact in reducing flood levels upstream of this structure, particularly when combined with further improvements to channel capacity downstream to and through the confluence and aqueduct reach. Works at New Road bridge alone may provide ~300mm drop in peak water levels at the top of the wavy steps in the 1 in 50 yr event. However, this option is not included within the preferred scheme configuration due to the relatively low benefit when compared to the potential cost and traffic disruption through the anticipated construction period.
26	Conveyance	Crows Nest Bridge reach	Calder	Alter current floodplain arrangement to convey flow out of the area more effectively, aiming to decrease levels upstream in Hebden Bridge.	Modelling shows only localised benefit and on a small scale - benefit does not extend upstream of aqueduct.