



FLOOD RISK ASSESSMENT

FOR
**LAND OFF FORGE LANE,
DEWSBURY**

ON BEHALF OF
HEBBLE HOMES LTD

ARP ASSOCIATES

CHARTERED CONSULTING ENGINEERS

Northwest House 5/6 Northwest Business Park Servia Hill Leeds LS6 2QH

c 0113 245 8498 **m** leeds@arpassociates.co.uk **w** www.arpconsultingengineers.co.uk

Flood Risk Assessment for land off Forge Lane, Dewsbury

2465/01r1

	Initial Issue 25th November 2024	Revision A	Revision B
Prepared By:	I Casling MEng (Hons)		
Signature	M Darby MEng (Hons) GradCIWEM GMICE		
Authorised By:	M Ingram MCIHT		

CONTENTS

		Page
1.0	Introduction	4
2.0	Site Description	5 – 9
3.0	Consultation and Data Review	10 – 13
4.0	Material Considerations in Respect of NPPF and PPG	14 – 24
5.0	Summary	25 – 26

APPENDICES

Appendix A	Site Location Plan
Appendix B	Topographical Survey
Appendix C	Digital Terrain Model
Appendix D	Proposed Site Plan
Appendix E	Water Authority Sewer Map
Appendix F	Environment Agency Flood Map
Appendix G	EA Historic Flood Map
Appendix H	EA Flood Data
Appendix I	Stage-discharge calculation
Appendix J	EA Flood Map Surface Water
Appendix K	Risk of Flooding From Surface Water Map Data drawing
Appendix L	Surface water flood compensation drawing
Appendix M	EA Reservoir Flood Map

1.0 INTRODUCTION

- 1.1 Hebble Homes Ltd are proposing the development of 2 commercial units at land to the east of Forge Lane, Dewsbury, which is referred henceforth as “the site”. As the site is greater than one hectare, a Flood Risk Assessment is required to support the planning application.
- 1.2 ARP Associates have been appointed to prepare a Flood Risk Assessment for the development, undertaking appropriate assessments, and preparing a report to satisfy the requirements of the Planning Authority.
- 1.3 The site appraisal for this assessment was carried out between September and November 2024. A review of these assessments has been undertaken in November 2024.
- 1.4 The report has been initially prepared for the use and reliance of the Client only. The report shall not be relied upon or transferred to any other parties without the written agreement of ARP Associates. For the avoidance of any doubt, where ARP Associates enters into a letter of reliance for the benefit of a third party, that third party will be permitted to rely on the report. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party without ARP Associates consent.
- 1.5 Attention is drawn to the requirements of the Construction Design and Management Regulations 2015, and in particular, the duties and obligations of the Client.

2.0 SITE DESCRIPTION

General

- 2.1 The site, which is centred on Ordnance Survey Grid Reference 423724, 419734 and is located to the south of Dewsbury, off Forge Lane nearest postcode WF12 9HF. The site is to be accessed off Forge Lane and is to the north of the junction with Lees Road.
- 2.2 The site is a rectangular shaped piece of land extending to an area of approximately 4.43 hectares (ha), with overall dimensions of approximately 140m (north - south) by 350m (east - west).
- 2.3 A site location plan is presented in **Appendix A**, which shows the application site to which this report refers and the surrounding development for reference.

Current Use

- 2.4 The existing site comprises of heavily vegetated scrubland. The site contains an extensive area of existing hardstanding which has remained following the previous steelworks superstructure being demolished. The site is covered by a number of mature bushes, shrubs and trees across the site.

Topography

- 2.5 A topographical survey of the site was undertaken by Aecom in November 2009. A copy of the survey plan is included in **Appendix B** for reference. The site generally falls steeply from the western and southern boundaries where levels are of the order of 43.50 metres Above Ordnance Datum (m AOD) towards the canal along the northern boundary of the site. The levels are generally around 38.50mAOD along the northern boundary. There are various embankments and low spots across the site formed from the previous development and demolition. Levels along Forge Lane immediately adjacent to site entrance range from 43.57 – 43.65mAOD. A digital terrain model was produced and shown in **Appendix C**.

Development Proposals

- 2.6 The development proposals are for the construction of two commercial units within the western and central area of the site. Vehicular access will be provided from a new access point off Forge Lane. The proposed development proposals are shown in the Site Layout plan within **Appendix D.**

Boundaries

- 2.7 The western and northern boundaries of the site are formed by Forge Lane and the Calder and Hebble Navigation Canal respectively. The eastern and southern boundaries are defined by residential development, with allotments just off the south-west corner of the site and a public open space/play area against the eastern boundary which was part of more recent housing development.

Hydrology

- 2.8 The nearest major watercourse to the site is the River Calder, which is approximately 400 metres to the north of the site. The River Calder is classified as an Environment Agency (EA) Main River. This main river flows in a meandering easterly direction past the north of the site. Land between the River Calder and the railway line to the north of the site is designated as flood storage area, which extends up to approximately 250m north of the site. The EA are responsible for any maintenance and construction work on main rivers and flood storage areas.
- 2.9 The nearest watercourse to the site is an unnamed ordinary watercourse/ditch which flows through the eastern extent of the site before turning in a westerly direction along the northern boundary. It is culverted but for two open sections on the development site. The watercourse is believed to serve a culvert draining land to the south and a number of roads and properties along Sovereign Way, Mortons Grove and Fiddler Hill. From existing surveys this culverted watercourse enters the site directly north of the road Fiddlers Hill and enters a small pond with an outlet to an open channel just before the site boundary, in the rear landscaped area to the property on the corner of Fiddlers Hill and Kimberley Street. The channel travels towards the

northern boundary and then along it west. Existing survey information has proved inconclusive as it only defines approximately 60m of open channel in the site from the southern boundary, but it is believed to travel north another 55m in a culvert, then west approximately 90m as open channel and then enters a 1200mm diameter culvert that travels another 130m to a manhole where it runs north-east under the canal as a siphon drain.

- 2.10 There is a low point that exists along the site boundary in a similar position to where the last section of open watercourse on site enters the 1200mm diameter pipe, which would allow overtopping into the canal. There is also another culverted watercourse/drain that connects on to this culverted section of watercourse approximately 36m downstream of the beginning of the 1200mm diameter pipe. The connection is a drain that terminates around the marshy area, likely serving the old steelworks and pond.
- 2.11 The low-lying marshy area recorded within the topographic surveys historically appears to have originally been a gravel pit and later a pond potentially serving the former iron and steel forge and glassworks. According to survey information there was an assumed culverted watercourse draining land above coming from the south across Lees Hall Road under the footprint of plot 324a discharging to a headwall at the site boundary. However, no outfall has been found and assumed this has been blocked up. The water levels in this area are assumed to drain via a surface water drain/culvert (as described above) which discharges to the downstream culverted watercourse which outfalls from the site to the siphon drain under the canal towards the north-west corner of the site.

Ground Conditions

- 2.12 In previous correspondence with the LLFA, it has been acknowledged the site is unsuitable for soakaways due to the ground conditions being poor for infiltration (British Geological Survey rates the potential at level 4 – which is severe constraints).
- 2.13 According to the BGS Geology Viewer online, the bedrock geology is Pennine Lower Coal Measures Formation – Mudstone, siltstone and sandstone. The superficial deposits are Alluvium – Clay, silt, sand and gravel. Further information was obtained from the LandIS

Soilscapes Viewer online and describes the soils as loamy and clayey floodplain soils for a majority of the site, and slowly permeable seasonally wet acid loamy and clayey soils surrounding the site to the south, which are known to impede infiltration. The site is not situated within a Source Protection Zone (SPZ).

- 2.14 The Environment Agency check long term flood risk service website states that groundwater is unlikely in this area. Therefore, the risk of groundwater flooding is considered to be low.

Existing Drainage

- 2.15 A topographical survey was produced by Bullen Consultants dated 7.10.1997 and shows the position of manholes as indicated on the site survey ref 97291/01 dated 07.10.1997. The onsite drainage routes were interpolated from Yorkshire Water records (a more current record is within **Appendix E**). The survey indicates a 500mm water main down the western side of the site, a 375mm foul water sewer crossing part of the site from the south-west corner and running along the southern boundary.
- 2.16 A 375mm diameter surface water sewer comes into the site from the south-west corner east along the southern boundary, then centrally turns directly north to where it increases in diameter to 450mm then connects into an assumed 1200mm diameter culverted watercourse which heads back west along the northern site boundary.
- 2.17 A culverted watercourse/sewer line appears from the central marshy area passing to the north which appeared to pick up a land drainage connection from the south and then runs along the western extent north towards the canal as described in the hydrology section of this report.
- 2.18 A headwall outfall is shown to the culverted watercourse that passes under 324a Lees Hall Road and discharges at the southern site boundary. A 450mm culvert marked as private passes through a manhole then discharges to a headwall/piped outlet to a pond with outlet to the open ditch/ordinary watercourse to the rear of the property on the junction with Fiddler Hill and Kimberley Street.

- 2.19 Aecom carried out a CCTV drainage plan on behalf of Kirklees Council dated 17.02.2022 and it shows a similar record of drainage as described above, but for the sewer crossing the north-west corner as a 600mm diameter pipe and as abandoned, connecting to the manhole downstream where it meets the culverted watercourse (assumed 1200mm diameter) with an outfall to the siphon drain crossing under the canal.
- 2.20 The surface water generated on site appears to flow from the western and southern boundaries to the north. With flows coming on to site via the headwall as described above into the open ditch passing along the eastern extent of the site, with some flows passing into the marsh area before either discharging to the surface water sewer/culvert running centrally through the site or being carried overland towards the open ditch and then the downstream culverted watercourse. It is believed that in times of exceedance the last section of open watercourse on site can pond at the downstream end and then overtop into the canal, as there is a low spot of approximately 38.259m AOD approximately 90m from the eastern edge along the northern site boundary nearby.
- 2.21 No further land drainage has been picked up in the surveys available.

3.0 CONSULTATION AND DATA REVIEW

Environment Agency

- 3.1 Consultation with the Environment Agency was undertaken in September 2024 in order to obtain the latest flood risk information due to the site being greater than one hectare in area. The Environment Agency has provided its response to this enquiry in October 2024.
- 3.2 The Environment Agency Flood Map for Planning shows areas of land that may flood from rivers or the sea. These areas do not take into account defences, as water can overtop them or the defences can fail in extreme conditions. The Flood Zone classifications are:-
- Flood Zone 1 - "Low Probability" is assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (less than 0.1%).
 - Flood Zone 2 - "Medium Probability" is assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding in any year (1% - 0.1%) and between a 1 in 200 and 1 in 1,000 annual probability of flooding from the sea (0.5% - 0.1%).
 - Flood Zone 3 - "High Probability" is assessed as having a 1 in 100 or greater annual probability of river flooding in any year (greater than 1%) and a 1 in 200 chance or greater annual probability of flooding from the sea (less than 0.5%).
- 3.3 The Flood Map for Planning shown within **Appendix F**, confirms that the site is predominantly located within Flood Zone 2, and therefore at a medium probability of fluvial flooding.
- 3.4 Environment Agency data including the historic flood records indicate that the site has previously flooded and the extent of this is shown within **Appendix G**. The flooded extent correlates with Environment Agency Flood Zone 2 extents depicted within the site. A review of Environment Agency recorded flood outlines the site flooded during the boxing day floods in December 2015 which caused by channel exceedance of the River Calder.

3.5 The Environment Agency provide a map on their website showing the likelihood of flooding from surface water which shows areas at risk of flooding from surface water flow paths or surface water ponding. The classifications of risk for surface water flooding are as follows:-

Very low - This area has a chance of flooding of less than 1 in 1000 (0.1%) in any given year.

Low - This area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) in any given year.

Medium - This area has a chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%) in any given year.

High - This area has a chance of flooding greater than 1 in 30 in any given year (annual probability of flooding 3.3%).

3.6 The EA Risk of Flooding from Surface Water map, confirms that the proposed site is at a 'low' risk of flooding from surface water in the western and central areas. There is a localised 'medium to 'high risk of surface water flooding within the central area where the gravel pit/old pond/marsh area was situated due to the natural low lying depression. The eastern half of the site is at 'high' risk of surface water flooding along the alignment of the where the culverted watercourse issues into the site from Fiddlers Hill.

3.7 The Environment Agency's online Flood Risk from Reservoirs map has also been reviewed as part of this study. This mapping shows the expected inundation area should a reservoir fail and release its capacity. There are two flooding scenarios shown on these maps:-

'Dry Day' - The 'dry-day' scenario predicts the flooding that would occur if the dam or reservoir failed when rivers are at normal levels.

'Wet Day' - The 'wet day' scenario predicts how much worse the flooding might be if a river is already experiencing an extreme natural flood.

3.8 The Flood Risk from Reservoirs map confirms that the site is located in an area considered to be at risk in the event of a reservoir breach.

Lead Local Flood Authority

- 3.9 A pre-application response was made by Kirklees Council, letter reference 2023/21634, which confirms an online meeting was held on 08.02.2024 with Paul Farndale (LLFA) and David Wordsworth (Development Management Group Leader) of Kirklees Council. It also outlined further correspondence between Paul Farndale and the applicant in regard to flood risk/drainage.
- 3.10 In summary of the correspondence and pre-application response, it confirmed the site is located in Flood Zone 2 (EA and SFRA) and that the officers agree that a full and detailed sequential test has been carried out (by ID planning dated October 2023). It also highlights that should a planning application be submitted, an up-to-date sequential test is submitted. Also, the are number of points were raised about the existing and proposed drainage, surface water drainage and flood risk and routing through the site which will be further addressed by subsequent sections of this report.

Climate Change

- 3.11 NPPF requires that the projected impacts of climate change are taken into account over the lifetime of a development. Studies have projected that the Global Sea level will continue to rise and there will be an increase in river flows and rainfall intensity across the country, with the degree of change depending on greenhouse gas emissions and the sensitivity of the climate system.
- 3.12 Recommended allowances for assessment are set out in Environment Agency publication 'Flood risk assessments: climate change allowances' (published February 2016; last updated May 2022). Within this guidance, a regionalised approach is adopted to climate change impacts based upon the river Management Catchment within which the proposed development site falls, and the intended design life of the development.
- 3.13 The site is situated within the 'Aire and Calder' Management Catchment. For commercial development, climate change impacts over a design life of at least 50 years should be considered.

- 3.14 Impact on River Flooding - With respect to river flows, the applicable allowances are also influenced by the flood risk vulnerability of the proposed development and the present-day Flood Zone classification of the site. As the proposed development comes under general industry, storage and distribution this would be less vulnerable according to the NPPF Annex 3: Flood risk vulnerability classification. An applicable allowance for sites in Flood Zone 2 is specifically given by the current guidance, that the impacts of the central climate change allowance should be considered. Within this Management Catchment, the central climate change scenario is predicted to lead to an increase in peak river flows of up to 23% for the 2080's epoch (2070-2125).
- 3.15 Impact on Rainfall Intensity - In accordance with the current guidance, for a design life of at least 50 years the impacts of the 'central' climate change allowance with a lifetime of between 2061 and 2100 should use the 2070's epoch (2061 to 2125). Within this Management Catchment, this is predicted to lead to an increase in rainfall intensity of up to 25% in the 1 in 30 year (3.33% annual exceedance probability) rainfall event, and up to 30% in the 1 in 100 year (1% annual exceedance probability) rainfall event.

4.0 MATERIAL CONSIDERATIONS IN RESPECT OF NPPF AND PPG

Flood Sources

- 4.1 Flooding from the Sea – With reference to the Environment Agency Rivers and the Seas map, the site is at predominantly ‘moderate’ risk from rivers and sea sources with some areas along the canal are at ‘medium’ and ‘high risk’. According to the Aire Catchment Flood Management Plan the site is not within the tidally influenced region of the River Calder and therefore is considered to be at low risk from tidal sources.
- 4.2 Flooding from Rivers - With reference to the Environment Agency Flood Map for Planning, the site is predominantly located within Flood Zone 2 and some areas of Flood Zone 1, suggesting the site is predominantly at ‘medium’ probability of flooding from rivers.
- 4.3 Environment Agency climate change information (**Appendix H**) shows the site is not at risk of fluvial flooding up to and including the 1 in 100 year plus 20% climate change event during the defended and undefended scenarios.

Table 1: Environment Agency Modelled Flood Levels

Node	Location	Defended Scenario		Undefended Scenario	
		1 in 100 year	1 in 100 year +20% CC	1 in 100 year	1 in 100 year +20% CC
7	X: 423676 Y: 419926	38.0	38.73	38.0	38.72*
8	X: 423800 Y: 419796	38.0	38.73	38.0	38.66*

* EA Data taken from 2011 River Calder model, all other data from 2015 Calder and Canals model.

- 4.4 Based on the latest climate change allowances published by the Environment Agency in May 2022, the central allowance indicates a 23% increase in river flows should be considered for the lifetime of commercial development in this location. A 20% climate change scenario has been modelled and included within the EA data. The data gives a good indication of the impact of

climate change compared to the 100 year event. Based upon a proportional percentage uplift in stage and flow. It is assessed that the 23% climate change increase to peak river flows would give an indicative flow flood levels of 38.40m and 38.47m AOD and flows of 5.114m³/s and 5.971m³/s at nodes 7 and 8 respectively (Refer to **Appendix I**). This flood level is expected to remain consistent across the site due to the nature of the canals flood mechanism and topography. Based on this flood water would just enter the lowest point on the southern boundary of 38.259m AOD the site during this event. On the above basis, the risk of flooding from this source is considered to be moderate/high as flood water will enter a small area of the northern boundary in this flood event.

- 4.5 The flood risk due to the proximity of the canal has been considered. Previous flood risk assessments, namely the JBA Consulting FRA dated July 2005 states that for flood waters from the River Calder to reach the site it must escape over the southern bank and enter the canal. Studies were conducted and shown that the locks upstream and downstream are not overtopped but spill from the river downstream of the railway viaduct at Ravens Wharfe and large volumes are stored in low-lying areas between the river and the railway embankments. Flood waters eventually pass through the bridge openings, some into the canal. A considerable amount of storage is in the canal and can be contained when there are normal canal water levels, however an increase of 0.5m in the canal could result in flooding to the site. A maximum flood level of 38.5m AOD was arrived at in the report. As described below this is in between the current Flood Zone 1 and 2 extents, based on defended flood data modelling.
- 4.6 There is flood risk due to the open watercourse on the eastern side of the site. Modelling of the watercourse was carried out previously by Aecom in 2009 but based on historical data and assumptions. Further to this, current modelled EA data including flood defences has been obtained, which shows the 1% AEP level (Flood Zone 2) extents at 38.0m at nodes 7 and 8 closest to the site with the 0.1% AEP level (Flood Zone 1) extents at 39.84m at the same nodes.

Therefore, the site is not functional floodplain with the lowest on-site level along the northern boundary at 38.259m AOD (within Flood Zone 2).

- 4.7 The watercourse on the eastern boundary begins just north of the southern boundary and is shown on previous surveys to have a 450mm diameter pipe discharge into the top of it. The 450mm pipe has been surveyed up Fiddler Hill Road, Morton Grove up past Morton House Allotments where the survey ends. A connection is shown to the drainage ditch/ordinary watercourse spanning from near the end of Ingham Road west to a point just above the allotment gardens and the intersection with the path where a trash screen allows the ditch to drain to the culverted stream.
- 4.8 The catchment is estimated at approximately 75 ha which would give a flow roughly twice the capacity of the 450mm diameter pipe if it were laid relatively flat at 1 in 300 gradient. Under these surcharged conditions the culverted watercourse would not necessarily flood.
- 4.9 In the absence of any directly modelled watercourse data, the current Environment Agency surface water flood maps do reflect the extent of surface water flooding based on the topography of the area and the depressions of the watercourse. It also reflects the level of surface water flooding without the culverted watercourse and siphon drain modelled so would provide a good reflection of how flooding would affect the site due to a blockage of the siphon and the watercourse.
- 4.10 Due to the topography of the site, it acts like a bowl, with the western, southern and eastern boundaries higher than the northern boundary but with an area (approximately 4600m²) of slight depressions below the top of the ditch/ordinary watercourse embankment in the eastern extent just off the development footprint. The watercourse passes through this lower area and potentially could flood water into the lower areas, along with surface water being trapped in the depressions, the lowest levels of which are approximately 37.269m AOD and the top of the watercourse at approximately 37.650m AOD leaving a shallow area of surface water ponding. The mitigation of the loss of surface water flood plain is considered below.

- 4.11 Flooding from Surface Water - The Environment Agency Risk of Flooding from Surface Water map (refer to **Appendix J**) suggests that the site is ranges from 'low' to 'high risk of flooding from surface water due to varying topography of the site. The 'high' risk areas are centred around the old gravel pit pond and the existing ditch/ordinary watercourse which are both low lying areas of land situated within the bowl-shaped topography of the site.
- 4.12 The 'high' risk of surface water at the site is due to several factors. Firstly, the topography which shows land to the south of the site naturally falls down towards the canal and flattens off to create a bowl within the site whereby increasing the flood risk on site. Secondly the Environment Agency surface water flood map is prepared has some limitations which is that is doesn't model the conveyance impact of culverts etc. Water levels are currently controlled by a series of surface water drainage systems and land drains connecting into the open and culverted sections of watercourse that leads toward a siphon drain in the north-west corner of the site and drains under the Calder and Hebble Navigation Canal towards the River Calder.
- 4.13 Given the nature of the site's topography and that surface water on the site is controlled by a siphon, the surface water flood map provides an indicative flood depth and extent of the potential surface water flooding anticipated on the site during a blockage scenario of the siphon. In this scenario flood depth across the site would be expected to build until the minimum embankment depth is exceeded. Based on existing topographic survey information the low spot in the canal embankment is adjacent the open ditch and is approximately 38.259m AOD on the northern boundary, 90m from the eastern edge of the site.
- 4.14 Redevelopment of the site, including provision of a robust surface water drainage and level design, would be expected to mitigate the site from the risk of flooding in this location. However, during a blockage scenario event of the siphon, surface water is considered a risk to the proposed development. As such, some site regrading is proposed to manage surface water flood extents. On the above basis, the risk of flooding from this source is considered to be high but will be reduced subject to the proposed mitigation measures.

- 4.15 The Risk of Flooding from Surface Water (RoFSW) mapping data set published by the Environment Agency was downloaded and the surface water flood depth data for the 1 in 100 year scenario (1%) was extracted for the site. This data was plotted in CAD to provide flood outlines of the 1 in 100 year surface water flooding on site (Refer to **Appendix K**).
- 4.16 The areas of surface water flooding under the development footprint were identified and the volume contained underneath each of these areas from the lowest point on site 38.259 (breach level) to the ground level was calculated in earthworks software. The three areas were labelled A, B and C which totalled 2,241m³ (Refer to **Appendix L**).
- 4.17 To provide surface water flood compensation, the area to the east of the existing watercourse was regraded, with 1 in 3 batters just off the boundaries/existing levels and the gain in volume was calculated at 2,435m³ from current existing ground levels to the new compensation levels, which exceeds that lost by the development footprint.
- 4.18 The flood compensation calculations and regrading works and sections are shown within **Appendix L**.
- 4.19 Flooding from Groundwater - Flooding from groundwater can happen when groundwater levels are high. This may be due to rainfall in the groundwater source area but can also happen on floodplains if river levels are held above the level of the flood plain by embankments.
- 4.20 On balance, there is the potential for relatively high groundwater levels during prolonged wet periods of the year. However, based on the finding described in **Section 2**, the risk of groundwater flooding to the site is considered to be low.
- 4.21 Flooding from Reservoirs, Canals or Artificial Sources - The Environment Agency produce maps which show the expected inundation area should a reservoir fail and release its capacity. The site is shown to be in an area at risk of flooding from this source during when river levels are normal (refer to **Appendix M**).

- 4.22 The risk of flooding from reservoirs, canals and artificial sources is deemed to be moderate.
- 4.23 Flooding from Drains and Sewers – As set out in **Section 2**, there are a number of public sewers within and in the immediate vicinity of the site. There is a 375mm / 450mm diameter public surface water sewer from the south-west corner running along the southern boundary then north through the site connecting to the culverted watercourse. The culverted watercourse then runs west along the northern boundary to a manhole that discharges through a syphon drain under the canal. An incoming 600mm diameter surface water comes in off Forge Lane in a north-easterly direction to the same manhole. A 450mm surface water culvert/drain in the east enters the open ditch in the east from the southern boundary. Another drain further to the west on site boundary is recorded as discharging towards the marsh/pond area but is believed blocked and unused. Near to the old building footprint in the central area, a surface water drain runs north to the culverted watercourse along the northern boundary.
- 4.24 The topography of the site and surrounding area is such that, in the event flooding did occur from any drain or sewer, it is likely to flow along towards the northern boundaries of the site or pond around the central marsh area or the area to the east of the existing watercourse/ditch.
- 4.25 The local water authority are responsible for maintenance of the public drainage infrastructure; they would be expected to undertake proactive and reactive maintenance as necessary to minimise the risk of flooding from their assets. Further to this, the architect layout has situated the proposed units off the respective easements for the adopted sewers crossing the site and is also not in the vicinity of the water main.
- 4.26 The existing culverted and open watercourse spanning round the eastern and northern extents of the site and the culverted watercourse/sewer from the previous building footprint/marsh area is not affected by the development footprint. The latter may be capped off/grubbed up subject to relevant approvals although the proposed units do not affect it.
- 4.27 In the event of the routes of the sewers are found to be in different locations, S185 diversionary works, reduced or offset easements or build-over agreements may be necessary.

- 4.28 A new surface water drainage system will be provided to manage surface water runoff from the development site itself, without causing an unacceptable risk of flooding on site, and without increasing flood risk elsewhere. The principles of the proposed sustainable surface water drainage strategy are set out with the Drainage Strategy report (ref: 2465-01r2). There is a residual risk that any blockage of the new on-site drainage system will result in flooding from manholes or gullies. However, this can be adequately mitigated by measures as set out.
- 4.29 On the above basis, the risk of flooding from existing drains and sewers is considered to be moderate and will likely be reduced in risk upon successful completion of the on-site drainage and surface water flood risk mitigation measures.

Climate Change

- 4.30 Given that the site is located in close proximity to the Calder and Hebble Navigation canal and River Calder, consideration of on the impacts of climate change need to be made. As described in **Section 4.7**, the impact of climate change allowance for river flows shows the site is at risk of minor flooding for its design life for a small and shallow area of the site on its northern boundary. The site is located mostly in Flood Zone 2 and a 13% increase in river flows during the lifetime of the development is not likely to have any significant impact upon the development site due to the site due to the predicted extents of flooding.
- 4.31 As per the requirements of the current national guidance, the allowance for increased rainfall intensity will be considered in the design of the surface water drainage systems for the new development. On this basis the capacity of the surface water drainage system would be expected to remain robust over the lifetime of the development and will not lead to an increase in flood risk in the future.

Surface Water Drainage

- 4.32 It is a requirement of the NPPF to ensure that surface water run-off from any proposed development has negligible consequence on downstream areas, either in terms of impact upon downstream sewer capacity or flood risk impacts due to discharge to a watercourse.
- 4.33 Existing Surface Water Runoff – As set out in **Section 2**, it is assumed that surface water runoff generated within the site partially infiltrates or flows overland towards the lowest areas of topography.
- 4.34 Proposed Surface Water Runoff – The proposed surface water drainage strategy for the scheme is covered within ARP's Drainage Strategy Report (ref: 2465-01r2 Drainage Strategy).

Flood Mitigation

- 4.35 The proposed residential development site is to be situated within Flood Zone 1 and 2 extents. The risk of flooding from the majority of sources has been assessed as being moderate risk coming from fluvial/pluvial sources.
- 4.36 There is also a need to consider the residual risks to the site. The residual risks include blockage of the drain siphon carrying flows under the canal to the north, surface water flooding from outside of the site during an extreme rainfall event and the residual risk of surface water flooding on site due to blockage or exceedance of drainage system capacity. The existing and proposed topography of the site should also be considered in terms of managing the residual risks, along with the following precautionary mitigation measures are, therefore, recommended:
- 4.36.1 Finished Floor Levels should be set a minimum of 600mm above the estimated flood level in accordance with current guidance. Therefore, the minimum finished floor level for the development site should be at least 38.47m AOD + 0.3m = 38.77m AOD (based on interpolated 23% climate change allowance river flooding level for highest node 8 data).

- 4.36.2 A surface water flood compensation area is to be formed on the eastern extent to allow surface water that was previously allowed to pond in the development footprint can do so post-development in the eastern area (as set out above, refer to **Appendix L**).
- 4.36.3 External levels should be designed with falls to direct overland flows away from the building entrances where possible, so that any flooding remains in less vulnerable areas such as landscaped areas, car parks, or roads, where the consequences of surface water flooding would be less significant. Where falls towards buildings are unavoidable, additional cut-off drainage and gullies/channel drains should be provided to prevent water entering buildings during extreme events.
- 4.36.4 The proposed ground floors shall comprise solid concrete slabs or beam and block floors with screed construction.
- 4.36.5 Incoming electricity supplies shall be raised above lower ground floor level (after the meter) and lower ground floor electric sockets shall be served by loops from upper levels.
- 4.36.6 A sustainable surface water drainage system shall be provided to manage surface water run-off from the site itself up to the 1 in 100 year plus climate change event (see ARP's Drainage Strategy Report (ref: 2465-01r2 Drainage Strategy) for further details).
- 4.37 Any mitigation measures, including drainage systems, would require suitable maintenance systems to be implemented, so that the design standard is maintained over the lifetime of the development.

Sequential Test

- 4.38 As set out in the NPPF, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding from all sources. The specific requirements for application of the test are to be determined by the Local Planning Authority.
- 4.39 The Environment Agency Flood Map for Planning has identified that the proposed commercial development is within land assessed as having between a 1% and 0.1% annual probability of river flooding. In accordance with Table 1 of the Flood risk and coastal change guidance, the proposed commercial units are situated predominantly within Flood Zone 2, "medium probability".
- 4.40 The Environment Agency Risk of Flooding from Surface Water map has identified that the sites western half has a majority of land in low (0.1% to 1.0%) chance to medium (1.0% to 3.3%) chance of surface water flooding. In the eastern half the site is predominantly at a high (more than 3.3%) chance of surface water flooding.
- 4.41 On the above basis a sequential test is required and is satisfied by the sequential test submitted in the report 'Flood Risk Sequential Assessment – Proposed development of industrial / warehousing use on land off Forge Lane, Dewsbury' by I D Planning dated October 2023. In the report it finds there are no sequentially preferable sites that are reasonably available, appropriate for the development and at a lower risk of flooding than this proposed site at Forge Lane, Dewsbury so passes the sequential test.

Flood Risk Vulnerability and Exception Test

- 4.42 Annex 3: Flood Risk Vulnerability Classification of the NPPF, shows that the proposed end use is considered to be "less vulnerable" development under the general designation "General industry, storage and distribution".

4.43 When the proposed development vulnerability classification is evaluated in accordance with Table 2 of the PPG, is determined that there is no requirement to apply the Exception Test to “Less Vulnerable” development in Flood Zone 1 and 2.

5.0 SUMMARY

- 5.1 This report details the flood risk assessment for the development of two commercial units at land to the east of Forge Lane, Dewsbury. The proposed residential development is predominantly located within Flood Zone 2 of the site, indicating a 'moderate' risk of flooding from rivers and the sea. On this basis, application of the NPPF Exception Test is not required.
- 5.2 The risk of flooding from the majority of sources has been assessed as being moderate from fluvial/pluvial flood sources and drainage/watercourse flooding. There is also a need to consider the residual risks to the site. The residual risks include blockage of the surface water network and watercourse passing through the eastern and northern extent of site. This could cause increased risk for surface water flooding from outside of the site during an extreme rainfall event, and the residual risk of surface water flooding on site due to blockage or exceedance of drainage system capacity. The existing and proposed topography of the site should also be considered in terms of managing the residual risks, along with the following precautionary mitigation measures are, therefore, recommended:
- 5.2.1 Finished Floor Levels should be set a minimum of 600mm above the estimated flood level in accordance with current guidance. Therefore, the minimum finished floor level for the development site should be at least $38.47\text{m AOD} + 0.3\text{m} = 38.77\text{m AOD}$.
- 5.2.2 A surface water flood compensation area is to be formed on the eastern extent to allow surface water that was previously allowed to pond in the development footprint can do so post-development in the eastern area (as set out above, refer to **Appendix L**).
- 5.2.3 External levels should be designed with falls to direct overland flows away from the building entrances where possible, so that any flooding remains in less vulnerable areas such as landscaped areas, car parks, or roads, where the consequences of surface water flooding would be less significant. Where falls towards buildings are unavoidable, additional cut-off drainage and gullies/channel drains should be provided to prevent water entering buildings during extreme events.

- 5.2.4 The proposed ground floors shall comprise solid concrete slabs or beam and block floors with screed construction.
- 5.2.5 Incoming electricity supplies shall be raised above lower ground floor level (after the meter) and lower ground floor electric sockets shall be served by loops from upper levels.
- 5.2.6 A sustainable surface water drainage system shall be provided to manage surface water run-off from the site itself up to the 1 in 100 year plus climate change event (see ARP's Drainage Strategy Report (ref: 2465-01r2 Drainage Strategy) for further details).
- 5.2.7 A management company along with an associated surface water management plan to maintain the on-site surface water network and also the eastern watercourse passing through the site.
- 5.3 The findings of this report are subject to the approval of the Regulatory Authorities subject to compliance with the above, and subject to the further approvals of Regulatory Authorities. It is anticipated that the proposed development can satisfy the requirements of the National Planning Policy Framework and the Planning Practice Guidance in relation to flood risk.

APPENDIX A

SITE LOCATION PLAN

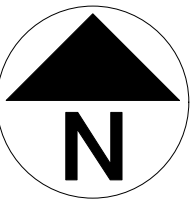
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 M

Forge Lane Bridge

41.9m

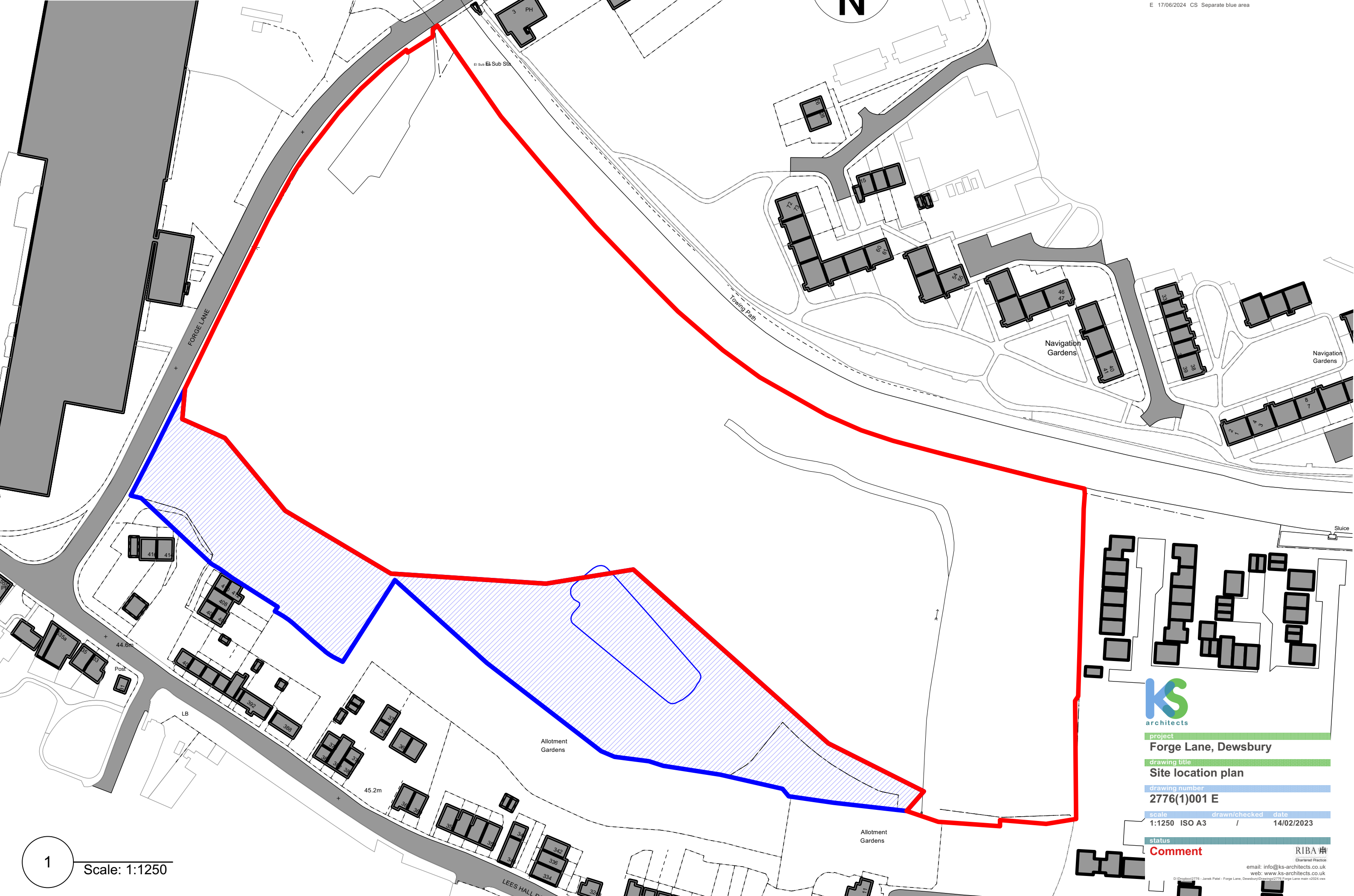
PH

El Sub El Sub Stn



Do not scale from this drawing. If in doubt please contact the architect.

- Revisions**
- C 03/05/2023 CS Boundary adjusted
 - D 29/11/2023 CS Scale bar added
 - E 17/06/2024 CS Separate blue area



1

Scale: 1:1250



project
Forge Lane, Dewsbury

drawing title
Site location plan

drawing number
2776(1)001 E

scale	drawn/checked	date
1:1250 ISO A3	/	14/02/2023

status
Comment

RIBA #

email: info@ks-architects.co.uk
web: www.ks-architects.co.uk

D:\Dropbox\2776 - Janek Patel - Forge Lane, Dewsbury\Drawings\2776 Forge Lane main v2024.vsw

APPENDIX B

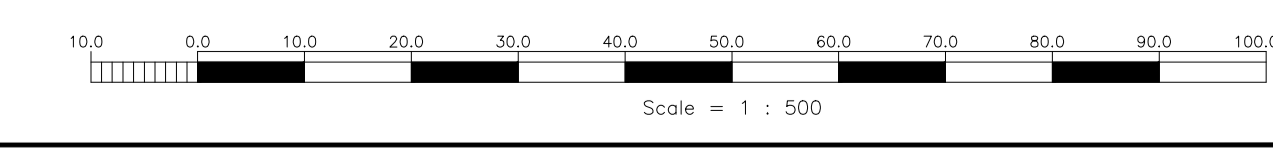
TOPOGRAPHICAL SURVEY



STATION	EASTING	NORTHING	HEIGHT
STNB	423695.418	419949.970	42.052
STNA	423672.919	419935.889	43.020
STNC	423681.239	419931.801	43.000
STNK	423632.092	419908.475	43.610
STNH	423659.572	419899.919	41.155
STND	423563.799	419788.977	43.630
STNP	423536.900	419718.318	43.928
STNF	423686.639	419783.245	38.305
STNE	423689.873	419827.153	38.578
STND	423707.853	419840.384	38.564
STNJ	423651.061	419875.776	39.930
STAF	423755.219	419808.431	38.580
STAH	423741.390	419773.475	38.399
STAG	423776.065	419734.957	38.152
STAJ	423825.148	419701.107	39.044
STAK	423843.455	419669.963	39.069
STAL	423836.610	419653.424	37.714
STNF	423686.680	419793.228	38.278
STNN	423548.910	419738.826	43.618
STNQ	423604.329	419868.282	44.298
STNL	423588.622	419839.488	43.832
STNS	423682.683	419897.733	39.154
STNR	423708.239	419869.353	38.658
STNX	423602.897	419760.817	38.752
STAO	423770.985	419700.300	40.631
STAN	423755.571	419899.076	38.184
STAM	423795.298	419664.271	37.899
STNG	423639.561	419757.063	38.188
STNV	423597.332	419730.274	39.452
STNY	423584.906	419748.900	41.031
STAA	423605.844	419833.892	39.747
STAC	423625.045	419860.029	39.769
STAB	423640.188	419836.455	38.541
STAU	423635.191	419791.856	38.303
STAV	423601.860	419789.735	40.281
STAZ	423588.584	419790.849	40.271
STAT	423662.538	419734.305	38.148
STAE	423728.426	419666.026	39.823
STAD	423694.407	419691.469	38.747

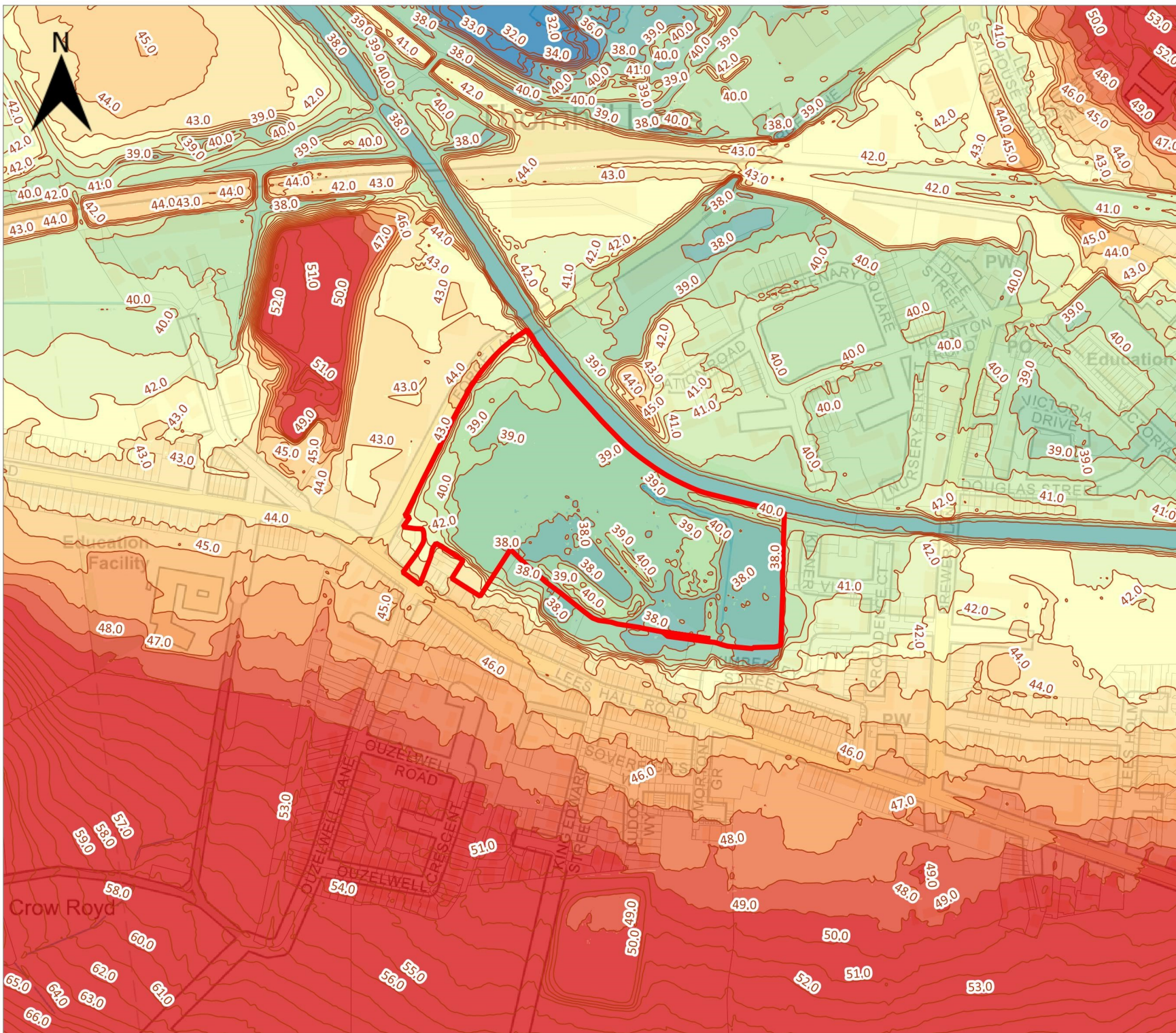
- NOTES**
- ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM NEWLYN BY MEANS OF ORDNANCE SURVEY LEICA SMARTNET.
 - DO NOT SCALE FROM THIS DRAWING.
- KEY**
- ±0.000 GROUND LEVEL (m.A.O.D)
 - 0.000 LEVEL TOP OF WALL (m.A.O.D)
 - BO BOLLARD
 - GU GULLY
 - GV GAS VALVE
 - LP LAMP POST
 - MH MANHOLE
 - WH WATER HYDRANT
- LINE KEY**
- BUILDING
 - HEDGE LINE
 - FENCE
 - ROAD CHANNEL WITH KERB
 - ROAD CHANNEL WITH DROP KERB
 - TOP OF BANK
 - BOTTOM OF BANK
 - WALL
 - DENSE CLUSTER OF TREES & BRAMBLES

SECTION A-A ADDED		K	K
Rev	Date	Drawn	Checked
DRAFT COPY			
Client:			
Project:			
FORGE LANE DEWSBURY			
Title:			
TOPOGRAPHICAL SURVEY PLAN			
Eng: IK	CAD: IK		
Chkd:	App'd:		
Date: 25/11/2009	Scale: AS SHOWN @ A0		
AECOM			
5th Floor 2 City Walk LEEDS, LS11 5AB		Tel: +44 (0) 113 391 8900 Fax: +44 (0) 113 391 8999 www.aecom.co.uk	
No. 60140787_LS01 3D			



APPENDIX C

DIGITAL TERRAIN MODEL



NOTES:

1) This drawing to be read in conjunction with all relevant ARP drawings and reports.

KEY:

- Site Outline
- Contour 1.0m

LIDAR Levels (m AOD)

- <= 36.0
- 36.0 - 37.0
- 37.0 - 38.0
- 38.0 - 39.0
- 39.0 - 40.0
- 40.0 - 41.0
- 41.0 - 42.0
- 42.0 - 43.0
- 43.0 - 44.0
- 44.0 - 45.0
- 45.0 - 46.0
- 46.0 - 47.0
- 47.0 - 48.0
- 48.0 - 49.0
- > 49.0



Northwest House • 5 & 6 Northwest Business Park • Servia Hill, Leeds • LS6 2QH
 ☎ 0113 245 9498 ☎ 0113 244 3864 ✉ leeds@arpassociates.co.uk 🌐 www.arpassociates.co.uk
 ARP Associates is a trading division of ARP Geotechnical Ltd, a company registered in England and Wales with company number 3171811, whose registered office is at 5/6 Northwest Business Park, Servia Hill, Leeds LS6 2QH

TITLE:
DTM CONTOUR PLAN

PROJECT:
FORGE LANE - DEWSBURY

CLIENT:
HEBBLE HOMES LTD

DRAWING STATUS:
PRELIMINARY

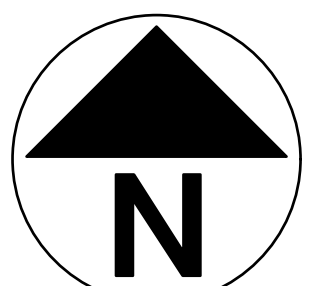
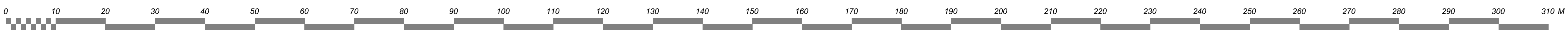
SCALE: 1:5,000 @ A4	DATE: OCT 24	DRAWN: MD
		CHECK: MD

DRG NO: 2465-01-A-DTM CONTOUR MAP	REV A
---	-----------------

APPENDIX D

PROPOSED SITE PLAN

Do not scale from this drawing. If in doubt please contact the architect.
 Revisions
 D 08/05/2024 CS Access position adjusted.
 E 13/08/2024 CS Boundary revised to accommodate road
 F 16/09/2024 CS Boundary adjacent to canal relocated
 from canal



KS architects
 project
Forge Lane, Dewsbury
 drawing title
Site layout industrial
 drawing number
2776(1)003 F
 scale drawn/checked date
 1:500 ISO A0 / 14/02/2023
 status
Comment RIBA #
 email: info@ks-architects.co.uk
 web: www.ks-architects.co.uk
 © Copyright 2023 - JKAA Pte Ltd - Forge Lane, Dewsbury Drawing 2776(1)003 F

APPENDIX E

YORKSHIRE WATER SEWER RECORDS

APPENDIX F

ENVIRONMENT AGENCY FLOOD MAP

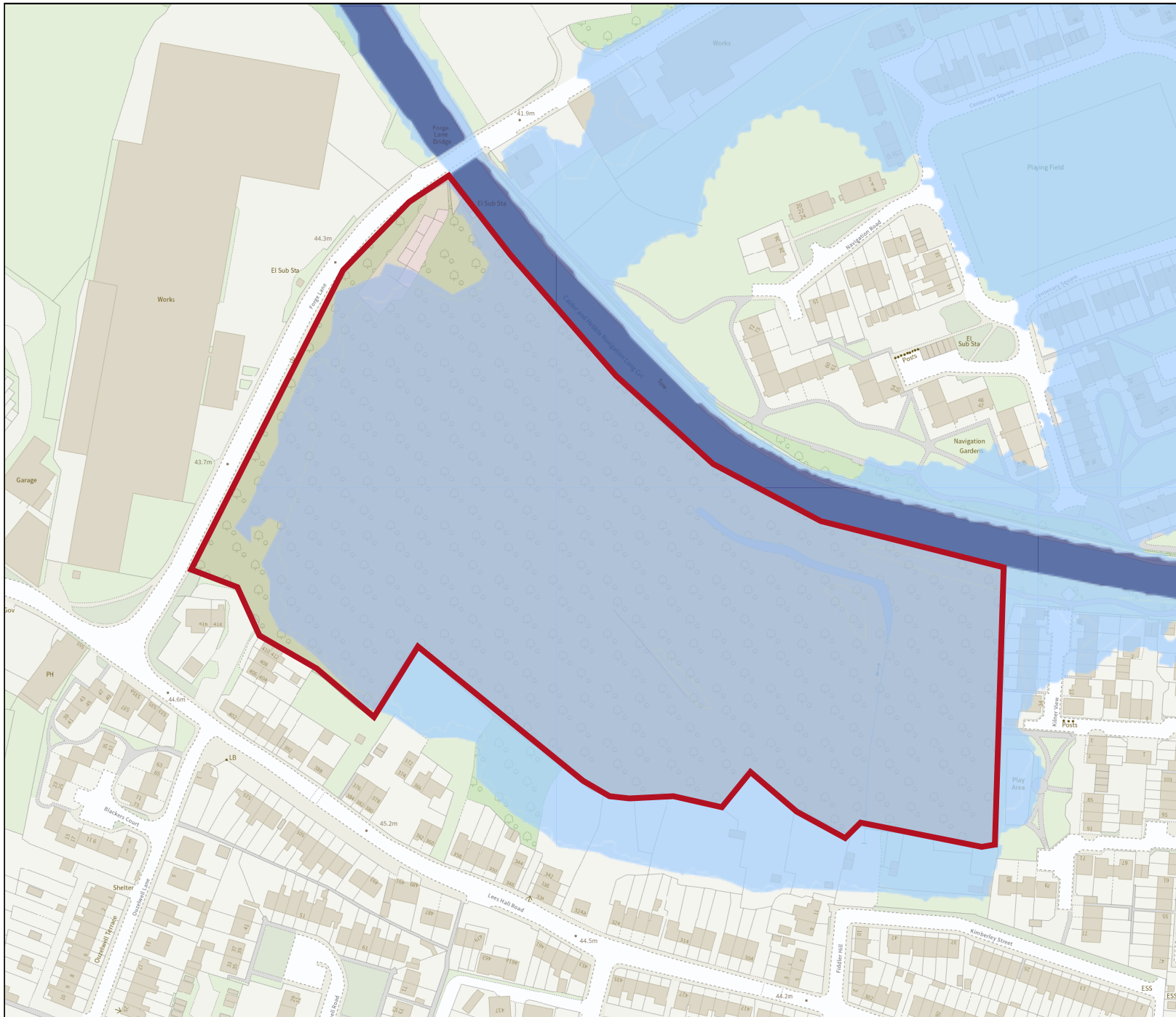
Flood map for planning







Your reference
2465-01

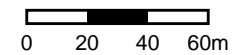
Location (easting/northing)
423737/419770

Scale
1:2500

Created
19 Sep 2024 11:54



-  Selected area
-  Flood zone 3
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Water storage area



APPENDIX G

ENVIRONMENT AGENCY HISTORIC FLOOD MAP







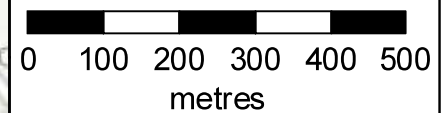
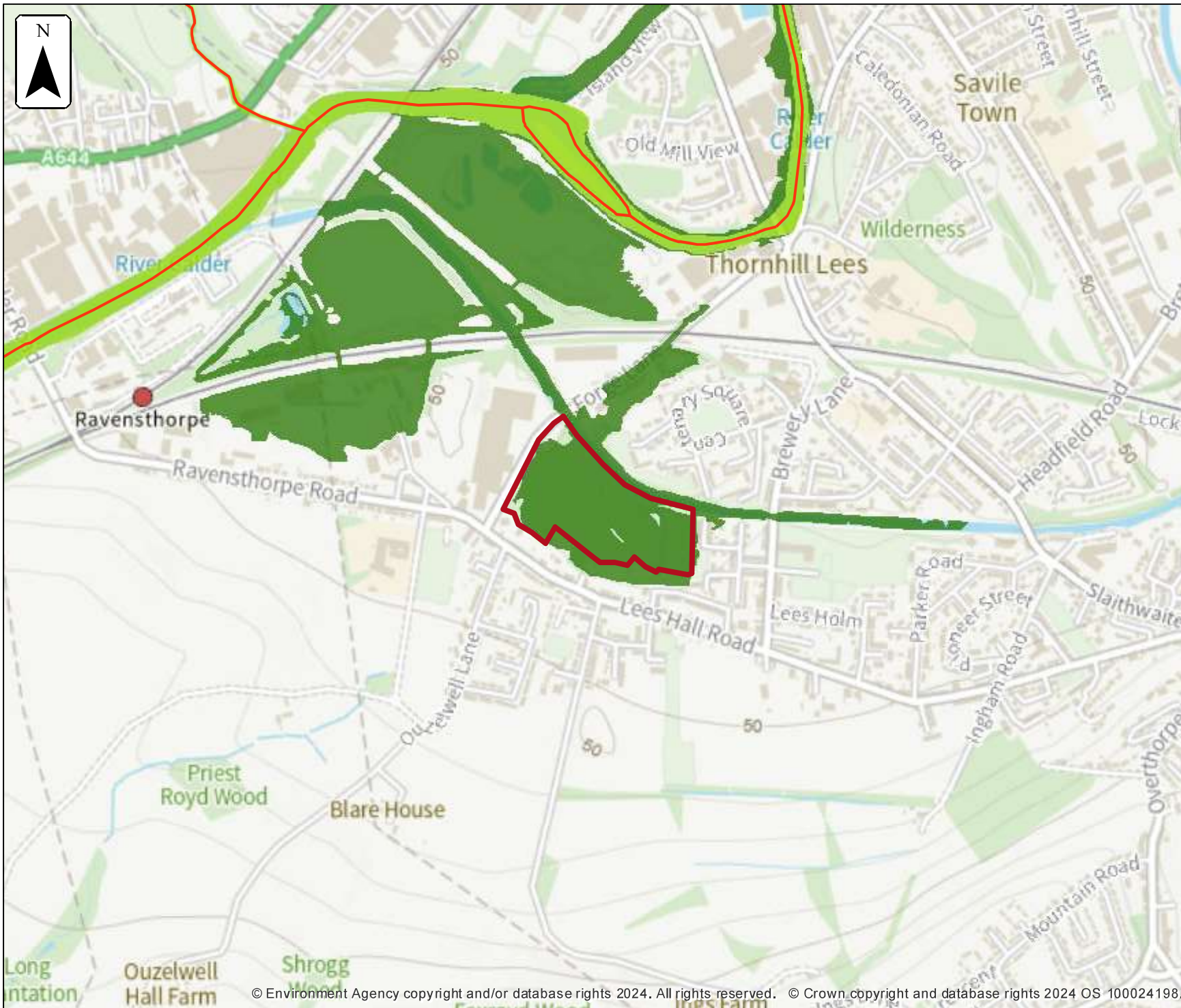
Historic flood map

Location (easting/northing)
423736/419748

Scale
1:10,000

Created
19 Sep 2024

-  Selected area
-  Main river
-  February, 2020
-  December, 2015



APPENDIX H

ENVIRONMENT AGENCY FLOOD DATA









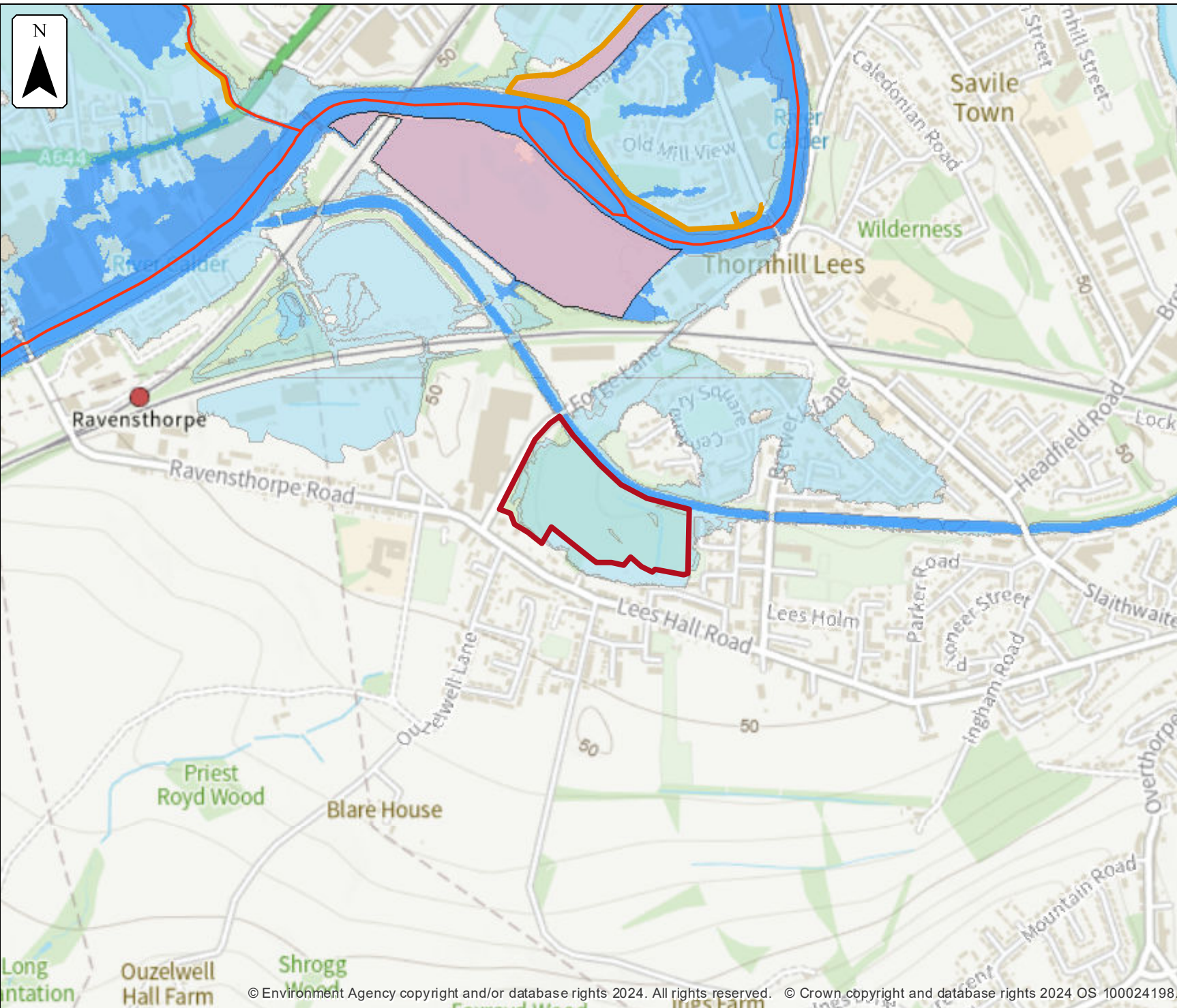
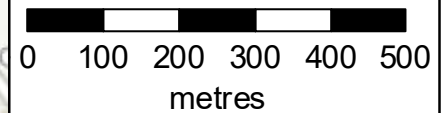
Flood map for planning

Location (easting/northing)
423736/419748

Scale
1:10,000

Created
19 Sep 2024

-  Selected area
-  Main river
-  Flood defence
-  Water storage area
-  Flood zone 3
-  Flood zone 2








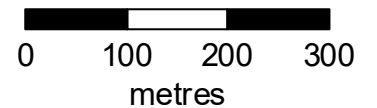
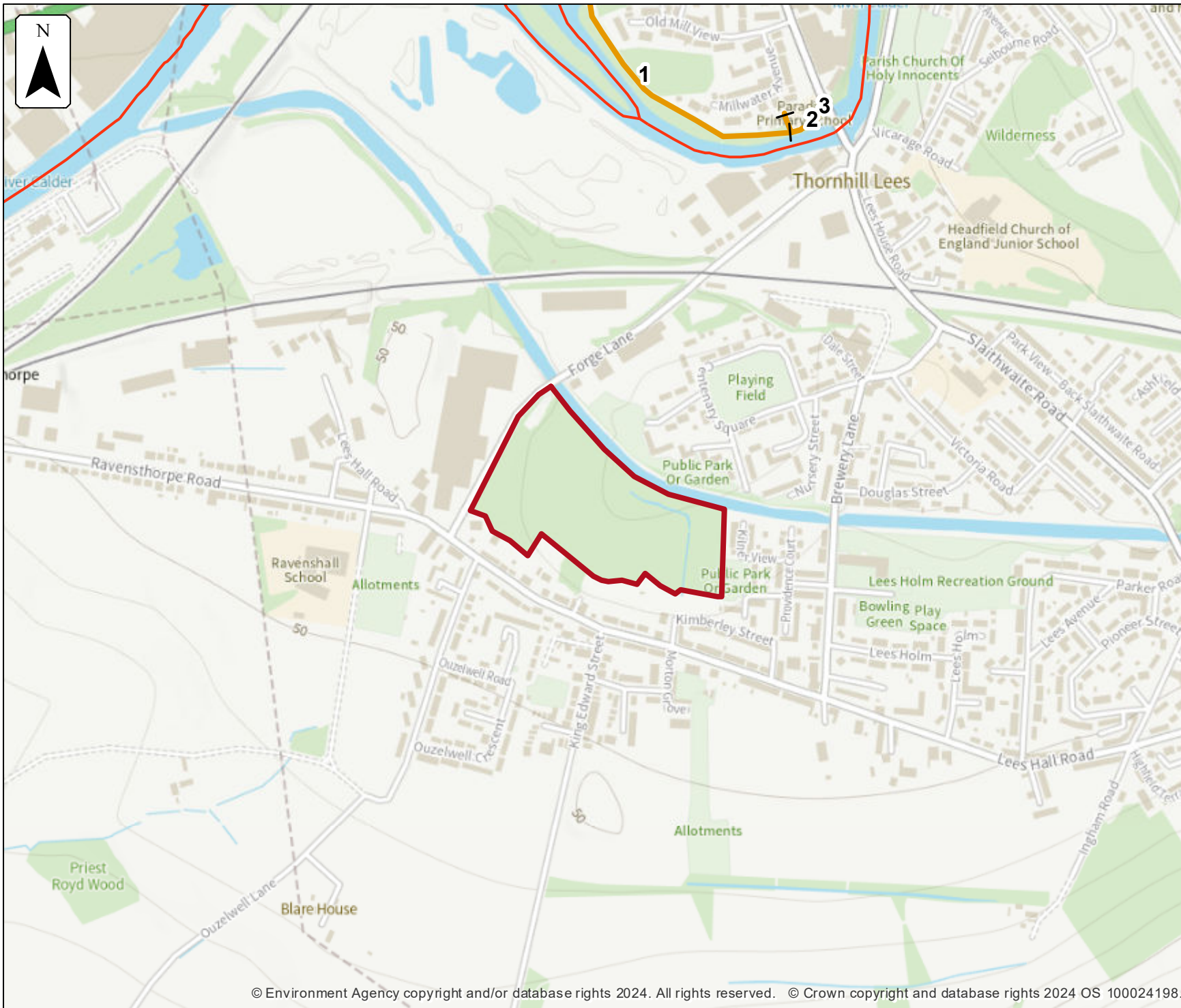
Flood defences

Location (easting/northing)
423736/419748

Scale
1:7,500

Created
19 Sep 2024

-  Selected area
-  Main river
-  Flood defence



Flood defences data

Label	Asset ID	Asset Type	Standard of protection (years)	Current condition	Downstream actual crest level (mAOD)	Upstream actual crest level (mAOD)	Effective crest level (mAOD)
1	51909	Embankment	50		39.80	40.30	
2	150301	Wall	50		39.72	39.88	
3	330913	Wall			39.75	39.75	

Any blank cells show where a particular value has not been recorded for an asset.










Defended modelled fluvial extent

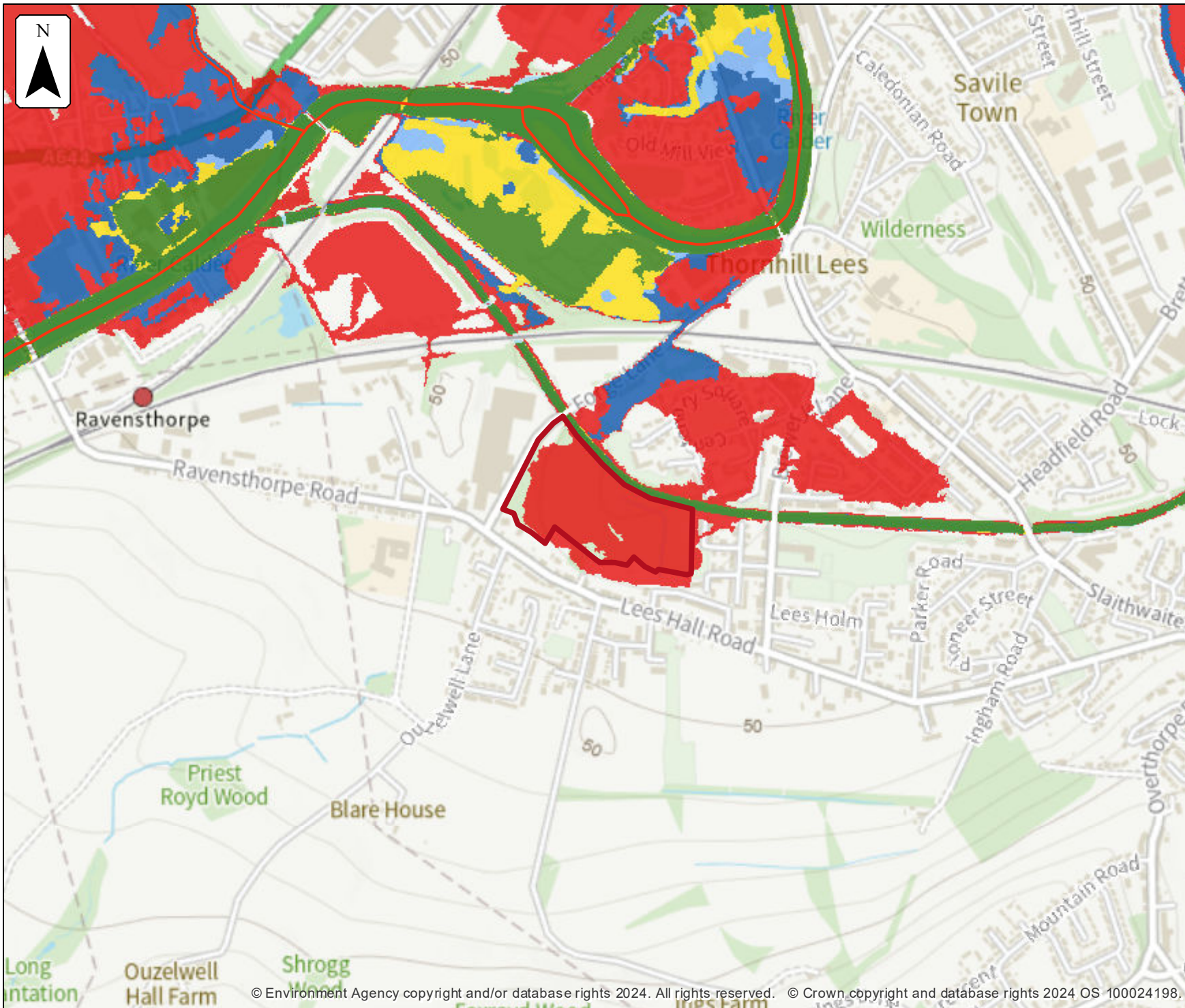
Location (easting/northing)
423736/419748

Scale Created
1:10,000 19 Sep 2024

Model name
2015 Calder and Canals - downstream

-  Selected area
-  Main river
- Modelled flood extent**
-  2% AEP
-  1.33% AEP
-  1% AEP
-  0.5% AEP
-  0.1% AEP

Flood extents may not be visible where they overlap other return periods









Defences removed modelled fluvial extent

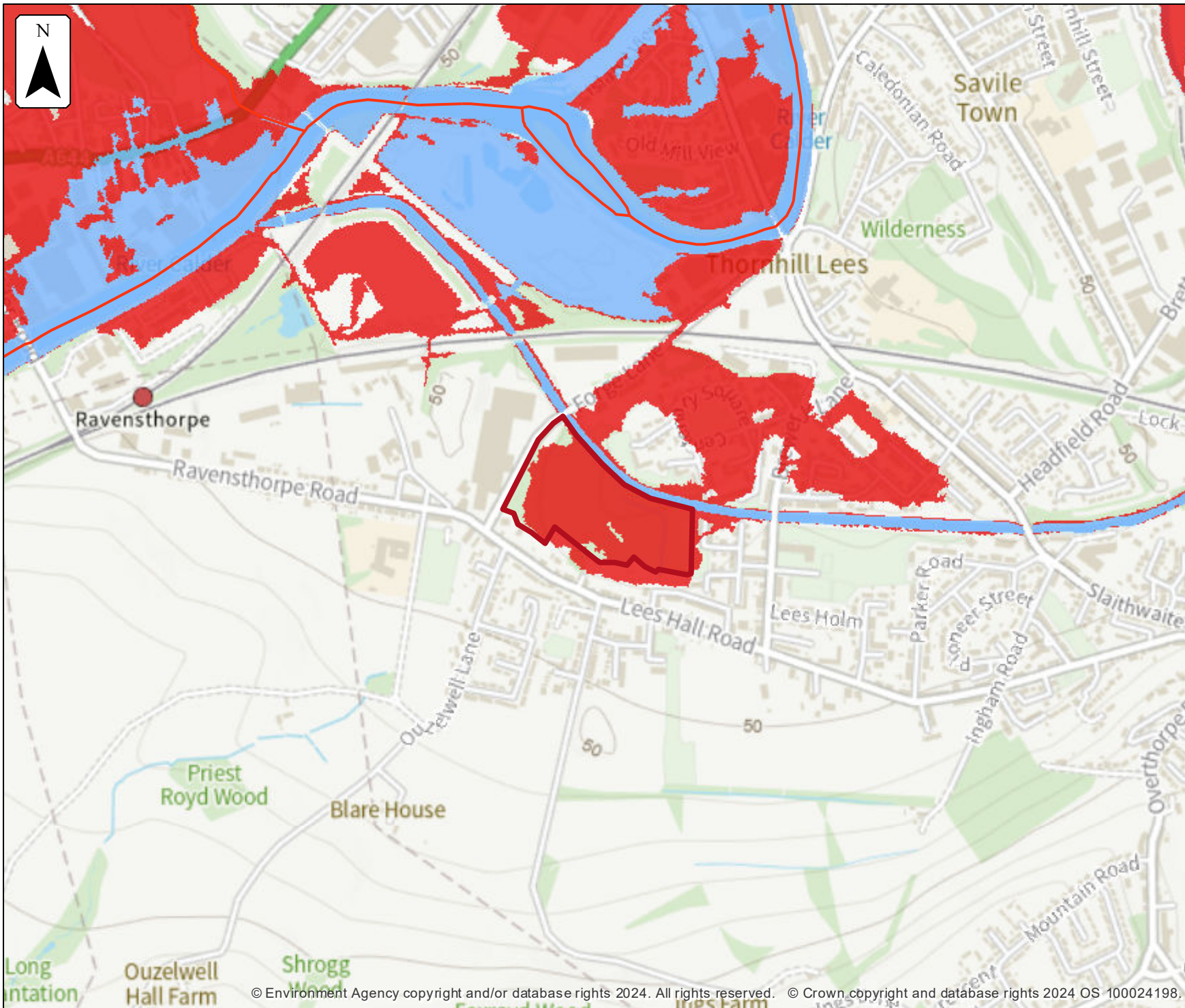
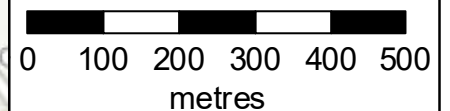
Location (easting/northing)
423736/419748

Scale Created
1:10,000 19 Sep 2024

Model name
2015 Calder and Canals - downstream

-  Selected area
-  Main river
- Modelled flood extent**
-  1% AEP
-  0.1% AEP

Flood extents may not be visible where they overlap other return periods








Defended climate change modelled fluvial extent

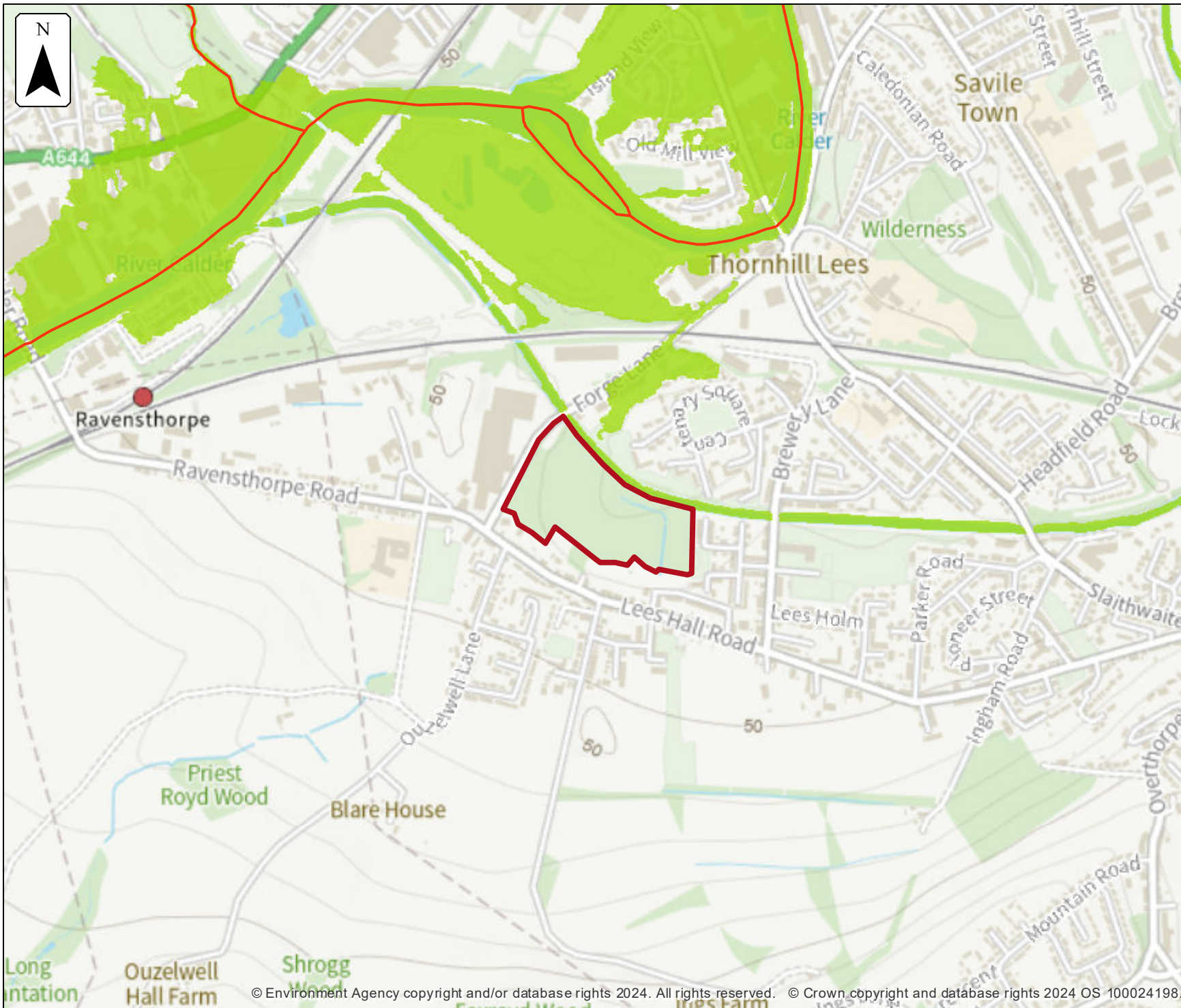
Location (easting/northing)
423736/419748

Scale Created
1:10,000 19 Sep 2024

Model name
**2015 Calder and
Canals - downstream**

-  Selected area
-  Main river
- Modelled flood extent
 -  1.0% AEP (+20%)

Flood extents may not be visible where they overlap other return periods







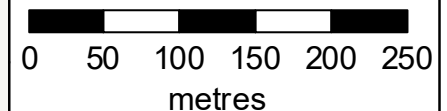
Defended modelled fluvial node locations

Location (easting/northing)
423736/419748

Scale Created
1:5,000 19 Sep 2024

Model name
2015 Calder and Canals - downstream

-  Selected area
-  Modelled location



Modelled node locations data

Defended

Label	Modelled location ID	Easting	Northing	4% AEP	2% AEP	1.33% AEP	1% AEP	0.5% AEP	0.1% AEP
				Level	Level	Level	Level	Level	Level
1	1130097	423464	420228	38.0	38.0	38.01	38.0	38.14	39.89
2	1130126	423520	420152	38.0	38.0	38.01	38.0	38.14	39.88
3	1130105	423530	420140	38.0	38.0	38.01	38.0	38.14	39.86
4	1129894	423575	420086	38.0	38.0	38.01	38.0	38.14	39.85
5	1129696	423586	420067	38.0	38.0	38.01	38.0	38.14	39.85
6	1129656	423670	419936	38.0	38.0	38.01	38.0	38.14	39.85
7	1129821	423676	419926	38.0	38.0	38.01	38.0	38.14	39.84
8	1130164	423800	419796	38.0	38.0	38.0	38.0	38.14	39.84
9	1129679	424074	419730	38.0	38.0	38.0	38.0	38.14	39.83
10	1129684	424086	419730	38.0	38.0	38.0	38.0	38.14	39.82

Data in this table comes from the 2015 Calder and Canals - downstream of Sowerby Bridge model.

Level values are shown in mAOD, and flow values are shown in cubic metres per second.

Any blank cells show where a particular scenario has not been modelled for this location.

If no level or flow data is available for a scenario, no table will be shown.

Defended

Label	Modelled location ID	Easting	Northing	4% AEP	2% AEP	1.33% AEP	1% AEP	0.5% AEP	0.1% AEP
				Flow	Flow	Flow	Flow	Flow	Flow
1	1130097	423464	420228	1.96	2.02	2.04	2.06	2.10	14.57
2	1130126	423520	420152	1.95	2.0	2.03	2.05	2.38	18.41
3	1130105	423530	420140	1.95	2.0	2.03	2.05	2.38	18.41
4	1129894	423575	420086	1.94	1.99	2.02	2.04	2.36	21.13
5	1129696	423586	420067	1.94	1.99	2.02	2.04	2.36	21.13
6	1129656	423670	419936	1.92	1.97	1.99	2.02	2.29	20.94
7	1129821	423676	419926	1.92	1.97	1.99	2.02	2.29	20.94
8	1130164	423800	419796	1.89	1.93	1.95	1.98	2.20	21.56
9	1129679	424074	419730	1.86	1.89	1.91	1.94	2.12	21.59
10	1129684	424086	419730	1.86	1.89	1.91	1.94	2.12	21.59

Data in this table comes from the 2015 Calder and Canals - downstream of Sowerby Bridge model.

Level values are shown in mAOD, and flow values are shown in cubic metres per second.

Any blank cells show where a particular scenario has not been modelled for this location.

If no level or flow data is available for a scenario, no table will be shown.





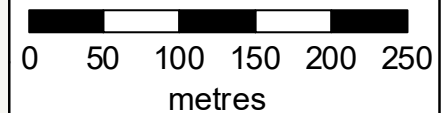
Defences removed modelled fluvial node locations

Location (easting/northing)
423736/419748

Scale Created
1:5,000 19 Sep 2024

Model name
**2015 Calder and
Canals - downstream**

-  Selected area
-  Modelled location



Modelled node locations data

Defences removed

Label	Modelled location ID	Easting	Northing	4% AEP	2% AEP	1.33% AEP	1% AEP	0.5% AEP	0.1% AEP
				Level	Level	Level	Level	Level	Level
1	1130097	423464	420228	38.0	38.0	38.0	38.0	38.04	39.91
2	1130126	423520	420152	38.0	38.0	38.0	38.0	38.04	39.90
3	1130105	423530	420140	38.0	38.0	38.0	38.0	38.04	39.88
4	1129894	423575	420086	38.0	38.0	38.0	38.0	38.04	39.88
5	1129696	423586	420067	38.0	38.0	38.0	38.0	38.03	39.87
6	1129656	423670	419936	38.0	38.0	38.0	38.0	38.03	39.87
7	1129821	423676	419926	38.0	38.0	38.0	38.0	38.03	39.87
8	1130164	423800	419796	38.0	38.0	38.0	38.0	38.03	39.86
9	1129679	424074	419730	38.0	38.0	38.0	38.0	38.03	39.85
10	1129684	424086	419730	38.0	38.0	38.0	38.0	38.03	39.85

Data in this table comes from the 2015 Calder and Canals - downstream of Sowerby Bridge model.

Level values are shown in mAOD, and flow values are shown in cubic metres per second.

Any blank cells show where a particular scenario has not been modelled for this location.

If no level or flow data is available for a scenario, no table will be shown.

Defences removed

Label	Modelled location ID	Easting	Northing	4% AEP	2% AEP	1.33% AEP	1% AEP	0.5% AEP	0.1% AEP
				Flow	Flow	Flow	Flow	Flow	Flow
1	1130097	423464	420228	1.90	1.97	2.0	2.06	2.07	14.95
2	1130126	423520	420152	1.89	1.95	1.99	2.05	2.06	18.84
3	1130105	423530	420140	1.89	1.95	1.99	2.05	2.06	18.84
4	1129894	423575	420086	1.88	1.95	1.98	2.04	2.05	21.56
5	1129696	423586	420067	1.88	1.95	1.98	2.04	2.05	21.56
6	1129656	423670	419936	1.86	1.93	1.96	2.01	2.02	21.39
7	1129821	423676	419926	1.86	1.93	1.96	2.01	2.02	21.39
8	1130164	423800	419796	1.84	1.90	1.93	1.98	1.97	21.82
9	1129679	424074	419730	1.81	1.86	1.88	1.94	1.92	22.05
10	1129684	424086	419730	1.81	1.86	1.88	1.94	1.92	22.05

Data in this table comes from the 2015 Calder and Canals - downstream of Sowerby Bridge model.

Level values are shown in mAOD, and flow values are shown in cubic metres per second.

Any blank cells show where a particular scenario has not been modelled for this location.

If no level or flow data is available for a scenario, no table will be shown.

Modelled node locations data

Defended climate change

Label	Modelled location ID	Easting	Northing	1.0% AEP (+20%)	
				Level	Flow
1	1130097	423464	420228	38.74	2.17
2	1130126	423520	420152	38.73	3.84
3	1130105	423530	420140	38.73	3.84
4	1129894	423575	420086	38.73	4.79
5	1129696	423586	420067	38.73	4.79
6	1129656	423670	419936	38.73	4.71
7	1129821	423676	419926	38.73	4.71
8	1130164	423800	419796	38.73	5.45
9	1129679	424074	419730	38.73	4.60
10	1129684	424086	419730	38.73	4.60

Data in this table comes from the 2015 Calder and Canals - downstream of Sowerby Bridge model. Level values are shown in mAOD, and flow values are shown in cubic metres per second. Any blank cells show where a particular scenario has not been modelled for this location. If no level or flow data is available for a scenario, no table will be shown.

Modelled node locations data

Defences removed climate change

Label	Modelled location ID	Easting	Northing	1.0% AEP (+20%)	1.0% AEP (+20%)
				Level	Flow
1	228782	422991	420271	40.90	530.56
2	30304	423188	420494	40.56	529.91
3	8148	423356	420534	40.01	539.07
4	3069	423622	420544	39.11	119.84
5	61827	423633	420500	39.11	419.11
6	300146	423748	420613	39.01	119.69
7	101235	423784	420341	38.72	418.0
8	71600	424079	420289	38.66	415.23
9	56457	424103	420703	38.33	414.42
10	169494	424133	420462	38.45	414.77

Data in this table comes from the 2011 River Calder - Calder model.

Level values are shown in mAOD, and flow values are shown in cubic metres per second.

Any blank cells show where a particular scenario has not been modelled for this location.

If no level or flow data is available for a scenario, no table will be shown.

APPENDIX I

STAGE DISCHARGE CALCULATION



HEBBLE HOMES LTD

FORGE LANE, DEWSBURY

STAGE-DISCHARGE ASSESSMENT OF FLOOD LEVELS FOR RIVER CALDER
 INCREMENTAL APPROACH TO FLOW INCREASE

November 2024

Prepared by: I Casling

Checked by: M Wilson

Data taken from Environment Agency data supplied in September 2024 (2015 Calder and Canals - downstream of Sowerby Bridge model)

1a) Modelled flood level (mAOD)

Node	Return period (1:x years)					
	50	75	100	200	100+20%	1000
Node 7 - ID:1129821	38.000	38.010	38.000	38.140	38.730	39.840
Node 8 - ID:1130164	38.000	38.010	38.000	38.140	38.730	39.840

3) Projected peak flood level (mAOD)

Line of best-fit equation (from graphs)	Projected 100yr+23% level (Central)	Projected 100yr+31% level (Higher)	Projected 100yr+51% level (Upper)
$y = 0.0941x + 37.921$	38.40	38.50	38.76
$y = 37.921e^{0.0002x}$	38.47	38.60	38.92
$R^2 = 0.9515$			

1b) Modelled flow (m3/s)

Node	Return period (1:x years)					
	50	75	100	200	100+20%	1000
Node 7 - ID:1129821	1.970	1.990	2.020	2.290	4.710	20.940
Node 8 - ID:1130164	1.930	1.950	1.980	2.200	5.450	21.560

2) Estimated flow (m3/s)

Incremental increase for 20% flow	Incremental increase for 1% flow	Projected 100yr+23% flow	Projected 100yr+31% flow	Projected 100yr+51% flow
2.69	0.13	5.114	6.190	8.880
3.47	0.17	5.971	7.359	10.829

Using peak river flow allowances for flood risk assessments

Use the [flood risk vulnerability classification](#) to classify the vulnerability of your development.

Assess both the central and higher central allowances for strategic flood risk assessments.

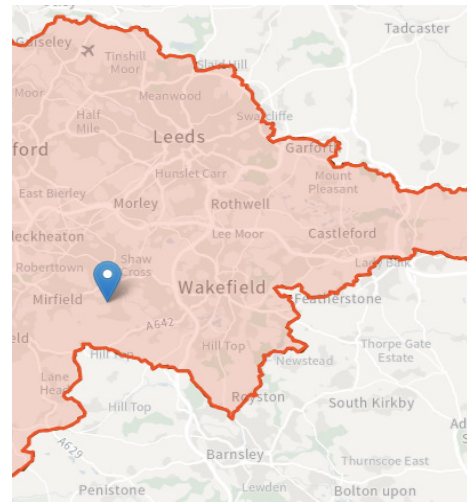
In flood zones 2 or 3a for:

- essential infrastructure – use the higher central allowance
- highly vulnerable – use central allowance (development should not be permitted in flood zone 3a)
- more vulnerable – use the central allowance
- less vulnerable – use the central allowance**
- water compatible – use the central allowance

In flood zone 3b for:

- essential infrastructure – use the higher central allowance
- highly vulnerable – development should not be permitted
- more vulnerable – development should not be permitted
- less vulnerable – development should not be permitted
- water compatible – use the central allowance

Apply the peak river flow allowances to developments and allocations where the strategic flood risk assessment shows an increased risk of flooding in the future. This includes locations that are currently in flood zone 1, but might be in flood zone 2 or 3 in the future.

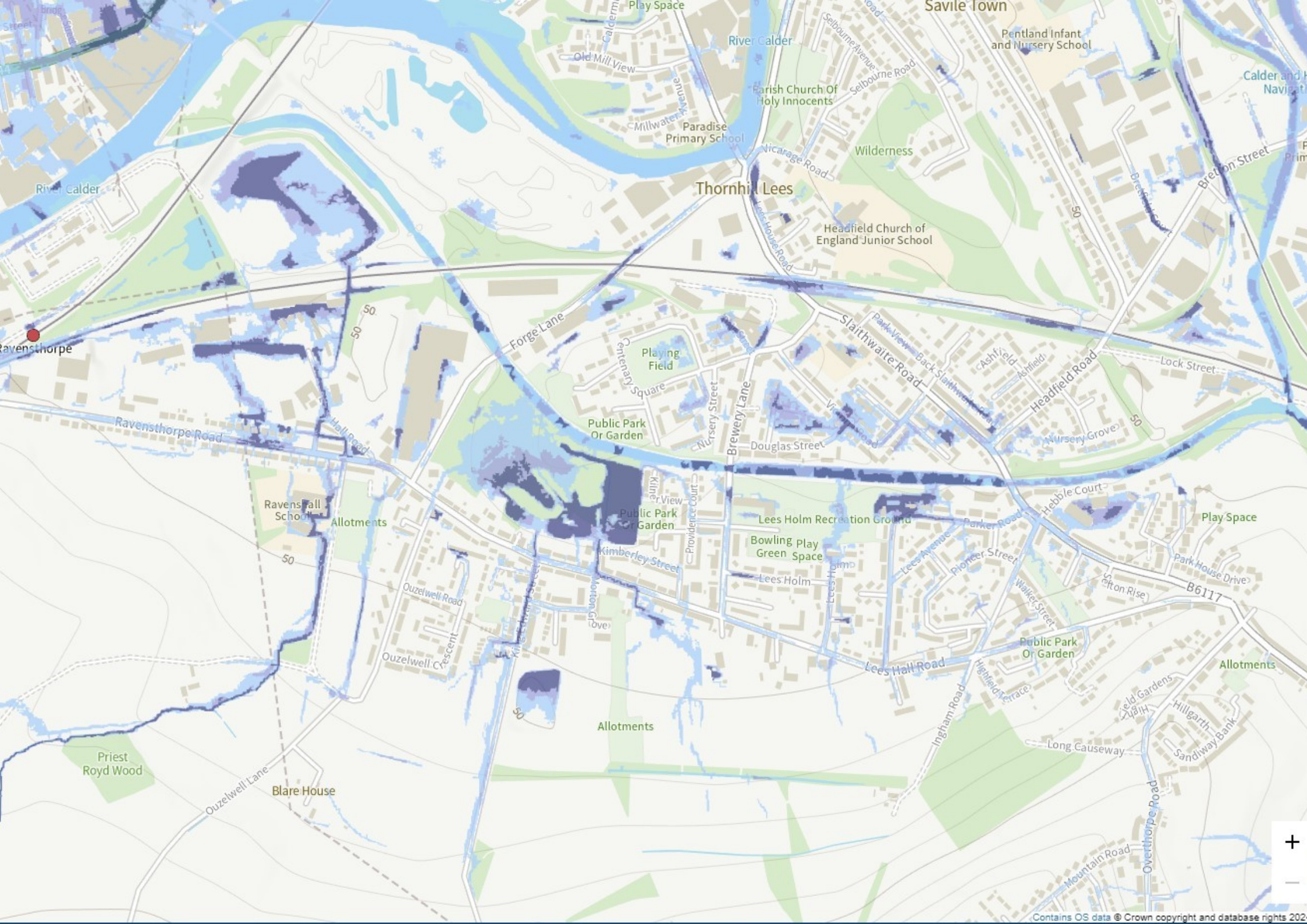


	Central	Higher	Upper
2020s	11%	15%	24%
2050s	13%	18%	31%
2080s	23%	31%	51%

This map contains information generated by [UK Centre for Ecology and Hydrology](#) using UK Climate projections.

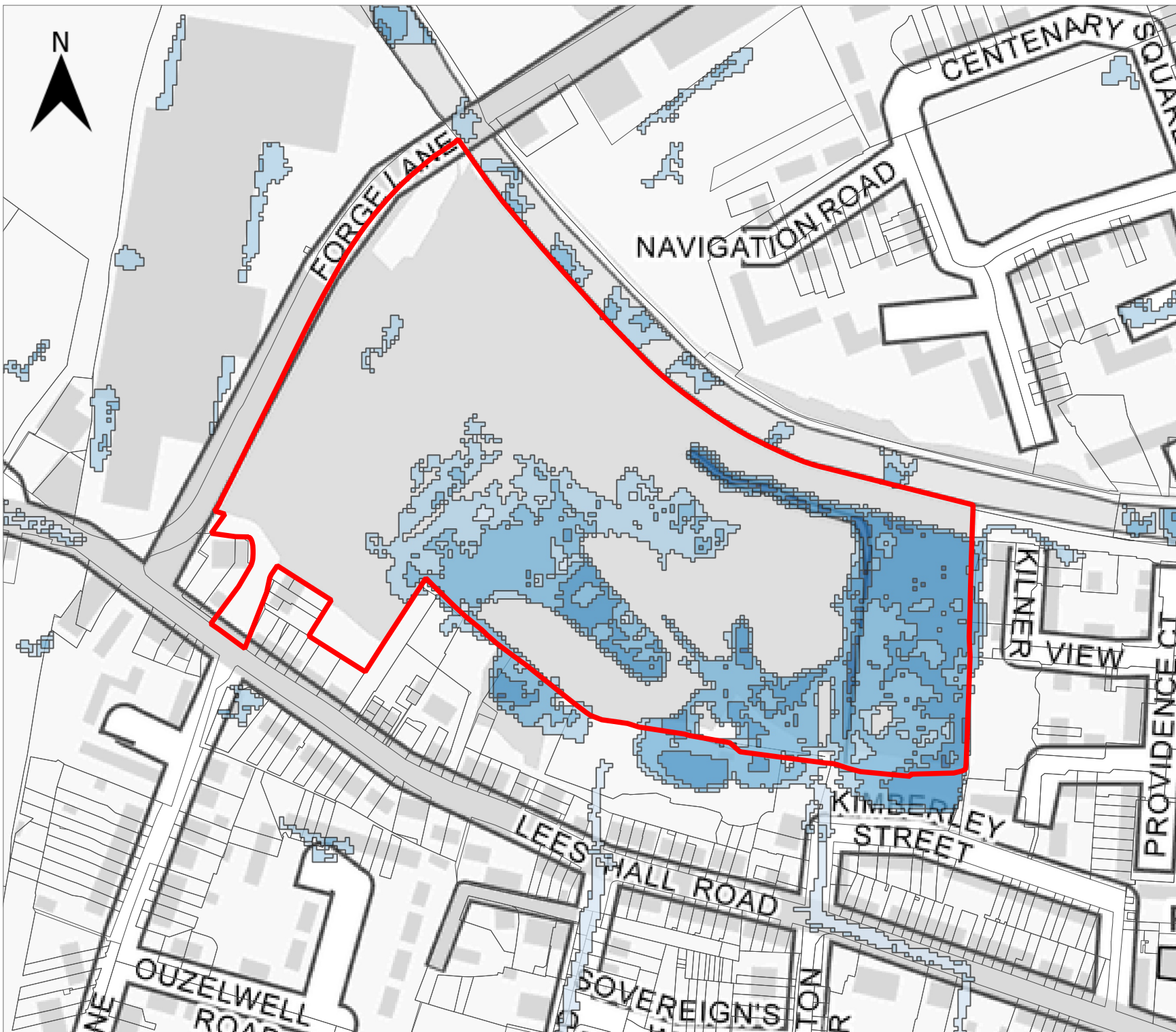
APPENDIX J

ENVIRONMENT AGENCY SURFACE WATER FLOOD MAP



APPENDIX K

RISK OF FLOODING FROM SURFACE WATER MAP DATA DRAWING



NOTES:
 1) This drawing to be read in conjunction with all relevant ARP drawings and reports.
 2) Contains Ordnance Survey data © Crown copyright and database right 2020
 3) © Environment Agency copyright and/or database right 2015. All rights reserved.

KEY:

Site Outline

RoFSW Depth (m)

- 0.00 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- > 1.20

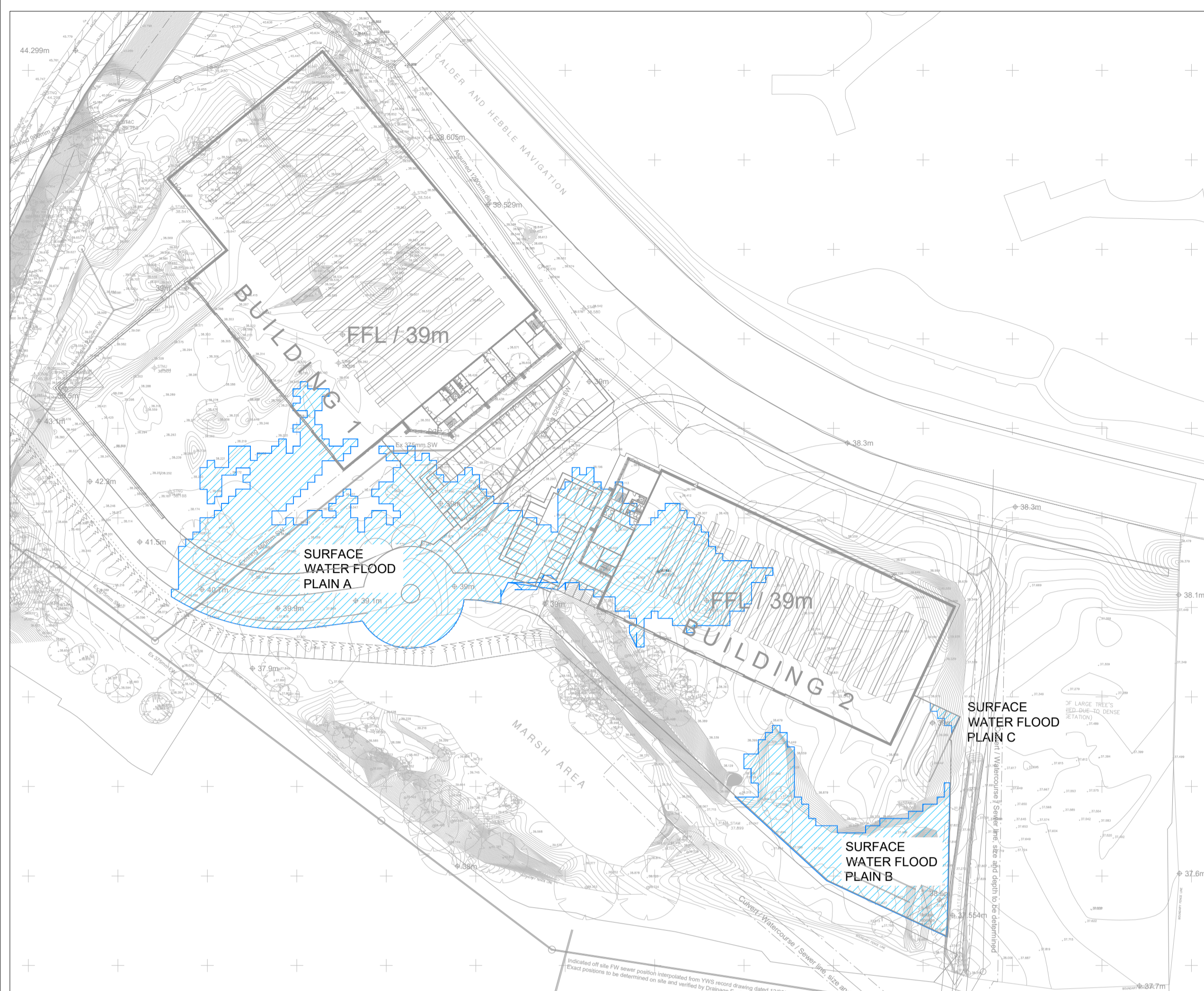
ARP
 ARP ASSOCIATES
 Chartered Consulting Engineers

Northwest House ● 5 & 6 Northwest Business Park ● Servia Hill, Leeds ● LS6 2QH
 ☎ 0113 245 8498 ☎ 0113 244 3864 ✉ leeds@arpassociates.co.uk ● www.arpassociates.co.uk
 ARP Associates is a trading division of ARP Geotechnical Ltd, a company registered in England and Wales with company number 3771811, whose registered office is at 5/6 Northwest Business Park, Servia Hill, Leeds LS6 2QH

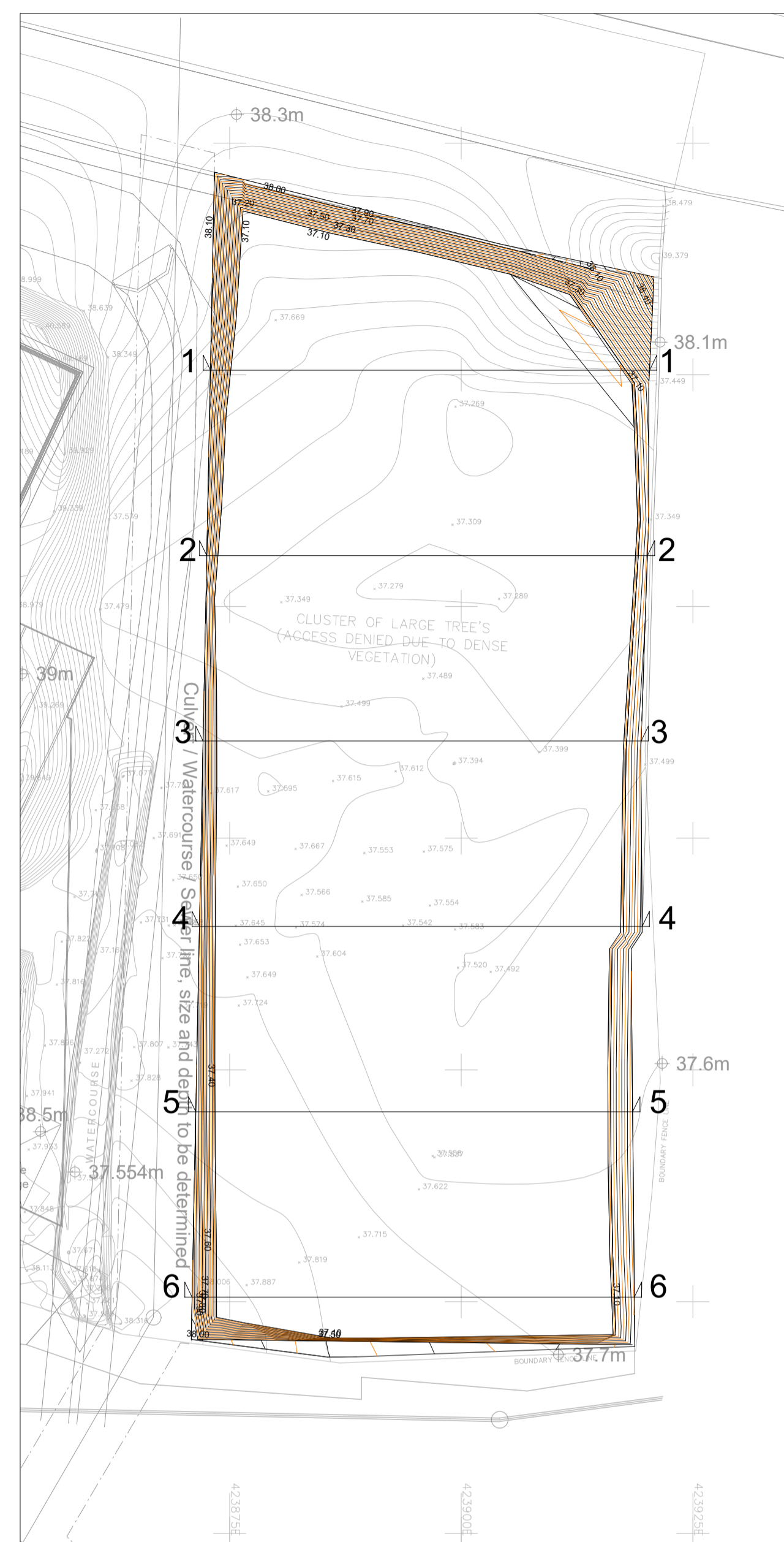
TITLE: SURFACE WATER FLOOD DEPTH MAP 1 IN 100 YEAR SCENARIO (1%)		
PROJECT: FORGE LANE - DEWSBURY		
CLIENT: HEBBLE HOMES LTD		
DRAWING STATUS: PRELIMINARY		
SCALE: 1:5,000 @ A4	DATE: NOV 24	DRAWN: MD CHECK: MD
DRG NO: 2465-01-A-RoFSW FLOOD MAP 1%	REV A	

APPENDIX L

SURFACE WATER FLOOD COMPENSATION DRAWING

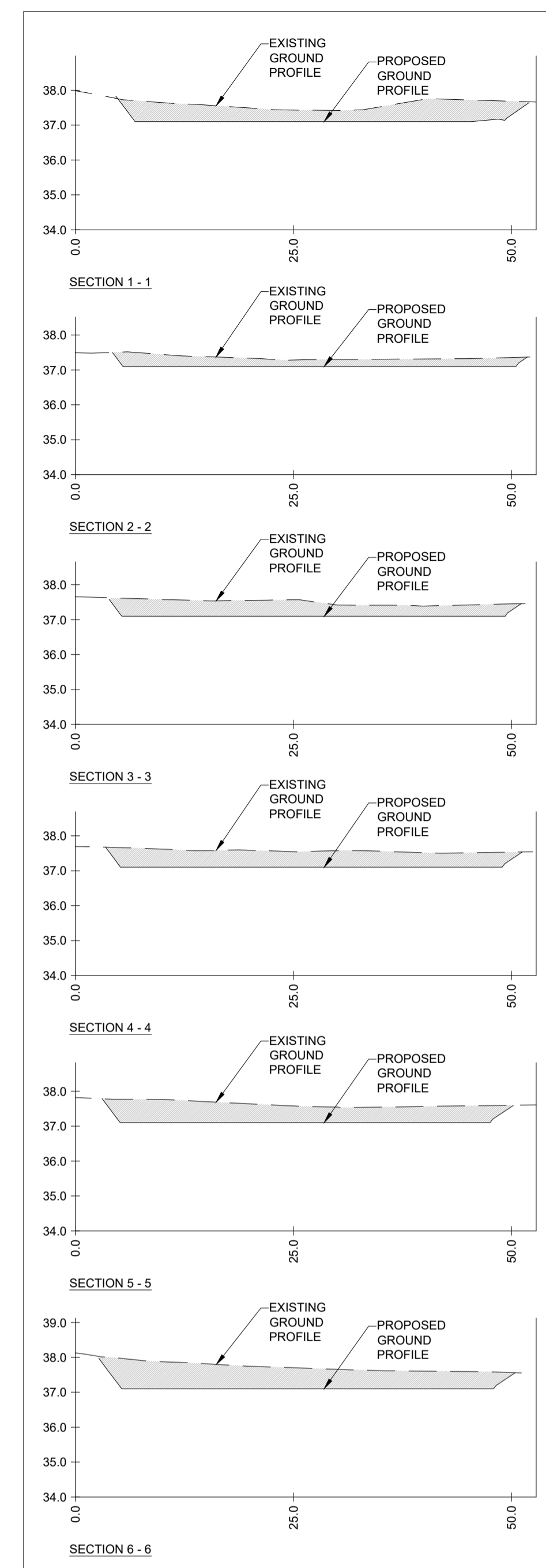


EXISTING SURFACE WATER FLOODING TO THE 1 IN 100 YEAR (1%) EVENT
SCALE 1:1000



PROPOSED SURFACE WATER FLOOD VOLUME
COMPENSATION CONTOURS
SCALE 1:500

PROPOSED SURFACE WATER FLOOD PLAIN VOLUME COMENSATION		
TOTAL GROSS:	CUT	FILL
NET:	2435.8	0.2
	2435.6	



PROPOSED SURFACE WATER FLOOD VOLUME
COMPENSATION SECTIONS
SCALE H1:500 V1:125

EXISTING SURFACE WATER FLOOD PLAIN
VOLUMES AFFECTED BY DEVELOPMENT

AREA A	CUT	FILL
TOTAL GROSS:	25.4	1646.9
NET:		1621.5

AREA B	CUT	FILL
TOTAL GROSS:	50.3	675.3
NET:		625.0

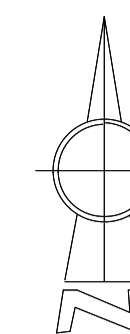
AREA C	CUT	FILL
TOTAL GROSS:	7.0	1.2
NET:		5.8

TOTAL VOLUME OF SURFACE WATER CONTAINED IN
AREAS A, B AND C: **2,241m³**

N O T E S

KEY

- Primary Contour (0.1m Intervals)
- Secondary Contour (0.05m Intervals)



Notes

- All compensation shown indicatively and subject to detailed design and all relevant approvals.

Rev	By	Date	Revision	Apvd.
/	IC	20.11.24	Issued for approval	MI

ARP ARP ASSOCIATES
Chartered Consulting Engineers

Northwest House • 5 & 6 Northwest Business Park • Servia Hill, Leeds • LS6 2QH
0113 245 6498 (or 0113 244 3864) • leeds@arpassociates.co.uk • www.arpassociates.co.uk

ARP Associates is a trading division of ARP Geotechnical Ltd, a company registered in England and Wales with company number 3773833, whose registered office is at 5/6 Northwest Business Park, Servia Hill, Leeds LS6 2QH

TITLE
SURFACE WATER VOLUME
COMPENSATION

PROJECT
FORGE LANE, DEWSBURY

CLIENT
HEBBLE HOMES

DRAWING STATUS
PRELIMINARY

Scale	Date	Drawn	IC
AS SHOWN @ A1	NOV 24	Chk.	MI

Org. No.	Rev
2465/01/SK02	/

APPENDIX M

EA RESERVOIR FLOOD MAP

EA Reservoir Flood Map

