

Selby Level 2 SFRA Cross Hills Lane (Site A) Addendum

Addendum report
November 2010

Prepared for



Revision Schedule

Cross Hills Lane (Site A) Addendum November 2010

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Table of Contents

1 Introduction 1

1.1 Study Background 1

1.2 Project Scope & Methodology..... 1

2 Site A: Cross Hills Lane 3

2.1 Site Introduction..... 3

2.2 Potential Development Proposals 4

2.3 Sequential Test Addendum..... 4

2.4 Flood Risk Sources..... 4

2.5 Existing Flood Mitigation Measures 6

2.6 Flood Depth Hazard Mapping 7

2.7 Policies and Recommendations..... 13

3 Summary and Conclusions 16

References..... 17

Appendix A 18

1 Introduction

1.1 Study Background

- 1.1.1 In February 2010, Scott Wilson completed the Level 2 Strategic Flood Risk Assessment (SFRA) for Selby District Council (SDC). The Level 2 SFRA included an appraisal of flood risk issues at Site A - Cross Hills Lane to the west of Selby town centre. Site A was identified as a potential Strategic Growth site to accommodate residential development and ancillary uses.
- 1.1.2 The best available data at the time was used to undertake the assessment. The SFRA concluded that the Selby Dam watercourse posed a medium to high flood risk (Flood Zone 2 and 3) to the southern area of the site. The north of the site was considered to have a low risk of flooding from fluvial and tidal sources (Flood Zone 1).
- 1.1.3 Following the issue of the Level 2 SFRA, the Environment Agency (EA) released an update to the Flood Map for Selby. The Flood Map update was based on the final version of a hydraulic model for the River Ouse and was created to demonstrate Areas Benefiting from Defences (ABD) in Selby to the right bank (west) of the river. The revised flood map was created assuming that no flood defences exist on the right bank of the River Ouse through Selby. It is therefore important to note that the revised ABD flood map does not represent *actual* flood risk to Selby but does, nonetheless, demonstrate a *residual* risk. The area of the Cross Hills Lane site identified as Flood Zone 1 in the Level 2 SFRA is now shown to be Flood Zone 2 and 3 on the revised EA Flood Map.
- 1.1.4 Following the release of the revised Flood Map, Scott Wilson undertook a scoping review of the new data that the map is based on to determine the depths of flooding at the site from the River Ouse. The scoping review confirmed that the Cross Hills Lane site is located within Flood Zone 3 of the River Ouse and Selby Dam. However, as stated above, it is important to note that the new flood zone 3 represents a residual risk of flooding as the site benefits from the presence of flood defences along the River Ouse. As a result of the Flood Map revision, the guidance and policy that was outlined in the Level 2 SFRA for the Cross Hills Lane site also needs revision. The findings of the scoping review were discussed with the EA and SDC and a recommended way forward was agreed.
- 1.1.5 This addendum report builds on the scoping report and provides information on fluvial and tidal flood risk at the Cross Hills Lane site and must be read in conjunction with the Selby Level 2 SFRA (Scott Wilson, February 2010). This addendum report supersedes the Level 2 assessment included in Section 5 of the Selby Level 2 SFRA. The assessments and advice included in all other sections of the Selby Level 2 SFRA still remain relevant. The approach adopted in this addendum reflects the 'living document' status of the Selby Level 2 SFRA.

1.2 Project Scope & Methodology

- 1.2.1 The aim of this Level 2 SFRA addendum is to provide updated information on fluvial and tidal flood risk for the Cross Hills Lane site.
- 1.2.2 The scope of this addendum report is outlined below:
- Undertake detailed interrogation of the River Ouse model in the area of interest to identify the flooding mechanism from the River Ouse for the Cross Hills Lane site. It is

important to note that this will be limited to flood depths, flood levels and the general direction of inundation. This is because the River Ouse model is one dimensional (1D) only. This means that more detailed aspects of flooding detailed in PPS25, such as velocity, flow and time of inundation cannot be included in this assessment.

- Undertake a detailed review of the extensive reports that accompany the Environment Agency's River Ouse model, to allow an overview of the modelling approach and inform recommendations for the site.
- Provide updated guidance and policy that is appropriate to the risk of fluvial / tidal flooding at the Cross Hills Lane site from both the River Ouse and Selby Dam. This will include recommendations for site-specific Flood Risk Assessments (FRAs), site layout and access and egress.
- Produce a short addendum report that describes the fluvial / tidal flood risk issues at the Cross Hills Lane site and provides appropriate and meaningful guidance and recommendations.

1.2.3 The methodology for this Level 2 addendum takes full account of the requirements and guidance outlined in Planning Policy Statement 25: Development and Flood Risk (PPS25) (CLG, 2010) and its accompanying Practice Guide (CLG, 2009).

2 Site A: Cross Hills Lane

2.1 Site Introduction

2.1.1 Site A 'Cross Hills Lane' covers approximately 42 ha and is located on the western edge of the Selby urban area. The Selby Dam watercourse constitutes the southern site boundary and flows in an easterly direction. The Selby Dam and River Ouse confluence is located 1.1 km to the east of the site. Cross Hills Lane crosses through the site in an east-west direction and provides access to Selby town centre.

2.1.2 Existing land uses at the site include residential and outbuildings associated with Cross Hills Farm, located at the western end of Cross Hills Lane, and East Farm located in the north eastern corner of the site, which is accessed from the east by Flaxley Road. The remaining area of the site comprises cultivated fields bordered by mature hedgerows and intermittent trees. The majority of the site is therefore greenfield.

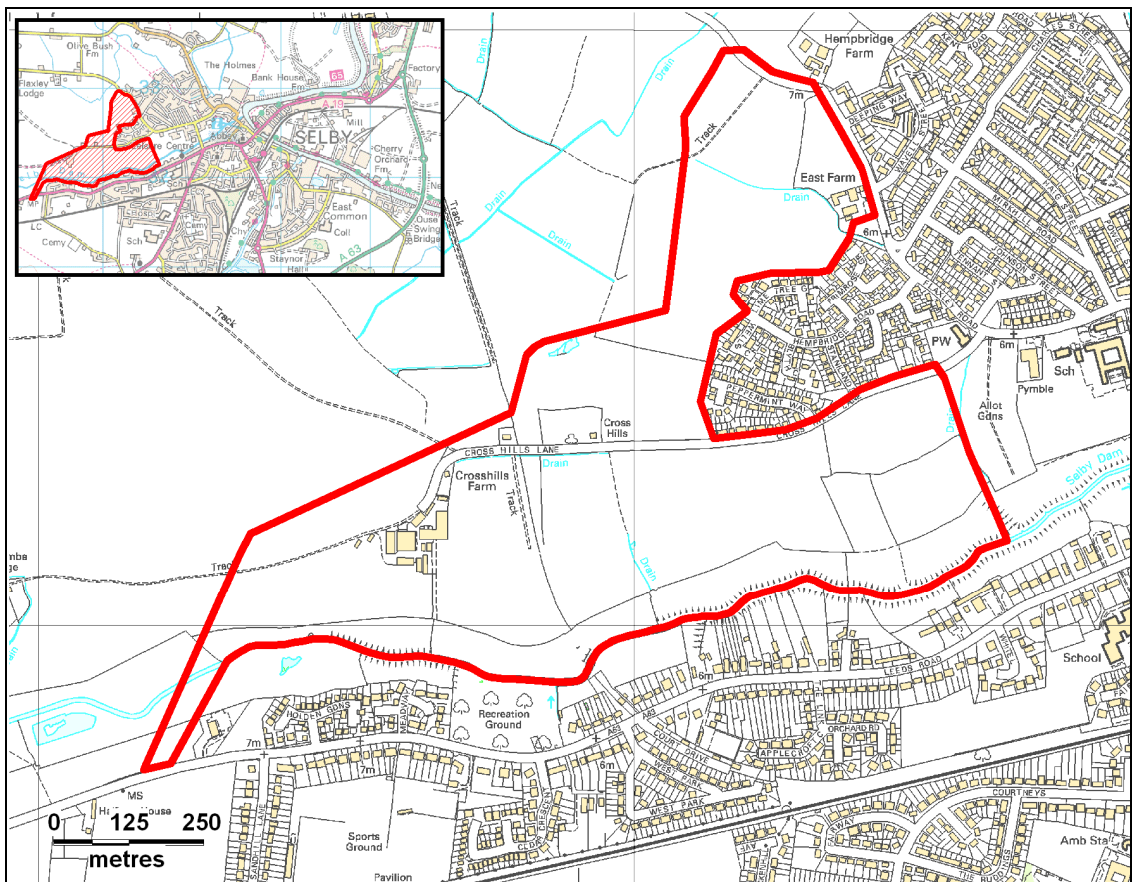


Figure 2-1: Site A – Cross Hills Lane location plan (insert) and site boundary

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2.2 Potential Development Proposals

- 2.2.1 Part of Site A (21.9 ha) has an existing allocation (SEL/1) in the Selby Local Plan for residential development, which was proposed to provide approximately 450 new houses, served from Meadway. SDC suggest that the increased site boundary of Site A, served from Leeds Road via a potential access bridge crossing Selby Dam at the western extent of the site, could accommodate up to 1000 dwellings. However, the actual residential yield that the site is capable of delivering will be determined by the findings of a detailed site specific flood risk assessment to be carried out by the developer. Residential development is considered by PPS25 to be 'more vulnerable'.

2.3 Sequential Test Addendum

- 2.3.1 Following the release of the revised EA Flood Maps (showing ABD and residual risk) and changes to the Core Strategy housing requirements, SDC have produced an addendum to the Sequential Test originally undertaken in February 2010. The original Sequential Test was undertaken to inform the spatial distribution of development in Selby and identify the strategic growth sites that required a Level 2 SFRA. The Sequential Test Addendum assesses whether changes since February 2010 materially affect the conclusions made in the Sequential Test regarding the distribution of the development and the selection of preferred strategic growth sites.
- 2.3.2 The Sequential Test Addendum acknowledges that the revised EA Flood Maps indicate that a number of settlements, including Selby, are now affected by a higher probability of flooding (assuming the absence of flood defences). The proportion of Flood Zone 2 and 3 land within the Strategic Growth Sites has also increased. However, the relative difference between the strategic housing site options in flood risk terms is unchanged and the reasons for Site A (Cross Hills Lane) and D (Olympia Park) being sequentially preferable to Sites B, C, E and F regarding highways, flood risk and policy issues, remain the same.
- 2.3.3 The flood risk posed at Site D (Olympia Park) has not changed as a result of the revised EA flood maps so it is not necessary to revise the recommendations made in the original Level 2 SFRA (February 2010) in this regard. This addendum updates the recommendations for Site A (Cross Hills Lane) to address the increased flood risk indicated on the revised EA Flood Maps.
- 2.3.4 The full Sequential Test Addendum (October 2010) will be published on SDC's website and should be read in the context of this Level 2 SFRA Addendum.

2.4 Flood Risk Sources

Fluvial and tidal flood sources

- 2.4.1 The Selby Level 2 SFRA (Scott Wilson, February 2010) identified that fluvial and tidal sources present the greatest flood risk to the Cross Hills Lane site. The latest EA Flood Map, reproduced in Figure A-1, Appendix A and Figure 2-2 below, shows that the site is located within Flood Zones 2 and 3. Parts of the north and the south of the site benefit from the presence of flood defences on the River Ouse. The different sources of fluvial and tidal flood risk are explored in greater detail below.

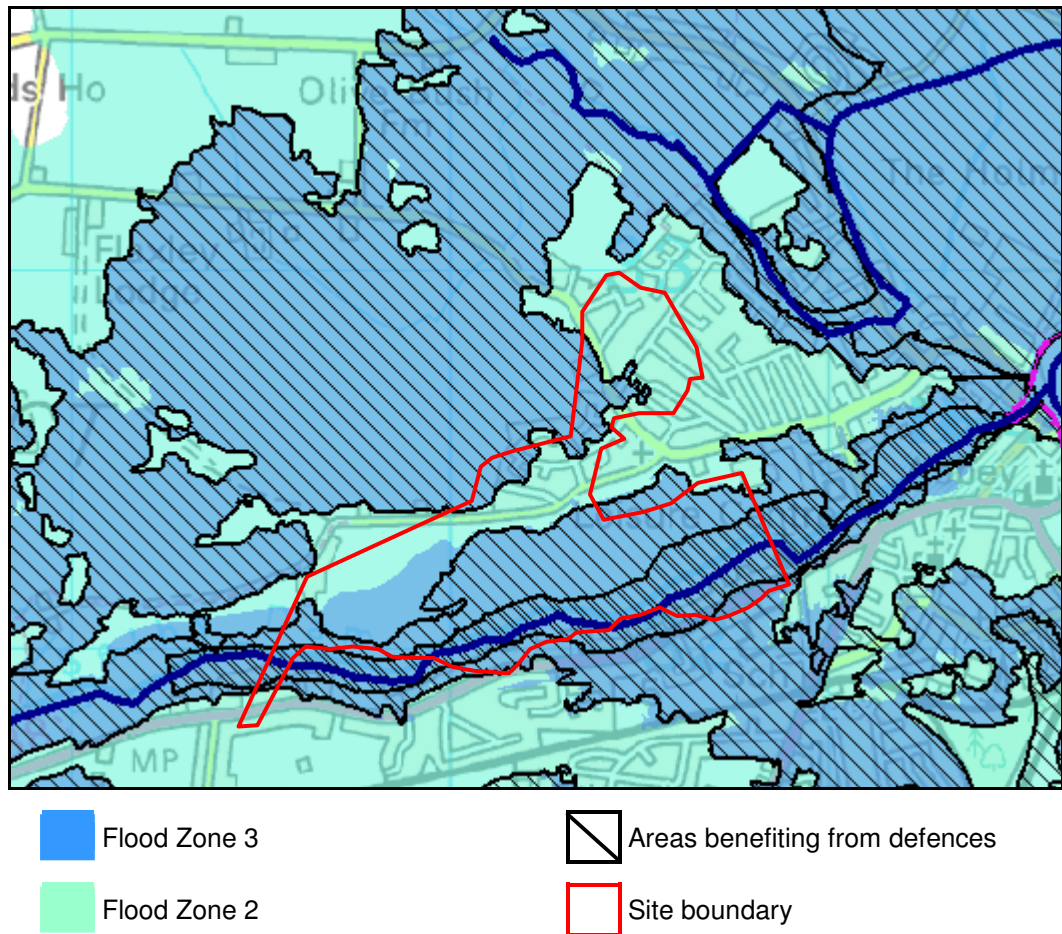


Figure 2-2: Environment Agency Flood Map for Site A: Cross Hills Lane

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River Ouse

- 2.4.2 The River Ouse is one of the largest watercourses in England draining an area of approximately 5,000 km². The principal tributaries include the River Ure, River Swale and River Nidd.
- 2.4.3 The River Ouse generally flows in a south easterly direction for approximately 100 km, through the City of York and the market towns of Selby and Goole, before joining the River Trent at Trent Falls near the village of Faxfleet, forming the Humber Estuary.
- 2.4.4 Upstream of Selby, the catchment is varied, from the Pennines to low lying land in the Vale of York. The River Ouse approaches Selby from the north east. At Barlby, the watercourse begins to meander as a tight bend around the north eastern edge of the town before continuing in a south easterly direction away from Selby towards Hemingbrough.
- 2.4.5 Heavy rainfall in the Ouse catchment can cause severe flooding and, in recent years, Selby and surrounding villages have been very badly affected. The principal flood risk to Selby is through storm surges that flow upstream from the tidal reach of the Ouse. There is a well-documented history of flooding from the River Ouse, with records dating back as far as 1263.

More recently, the Ouse hit local and national media as a result of widespread flooding in Autumn 2000, with Selby town and Barlby amongst the worst affected areas.

Selby Dam

- 2.4.6 The main channel of Selby Dam is a designated Main River. The river originates to the east of the settlement of Sherburn-in-Elmet, approximately 5.5 km to the west of Selby. The main settlements located within the Selby Dam catchment include Sherburn-in-Elmet, South Milford, Thorpe Willoughby and the smaller settlements of Monk Fryston (north side), Church Fenton, Little Fenton, Biggin and Hambleton. The catchment comprises a drainage network that has been heavily modified from the natural drainage pattern of the area, assisted by a pumping station at Selby and various other structures. Tributaries discharging into Selby Dam are the responsibility of the Selby Internal Drainage Board (IDB).
- 2.4.7 Selby Dam flows in an easterly direction along the southern boundary of the Cross Hills Lane site. From OS 1:10,000 scale mapping, three minor tributaries of Selby Dam are identifiable within the site boundary; one flowing southwards along the eastern boundary, a second flowing southwards in the central southern area of the site, and a third running west to east along the southern side of Cross Hills Lane..

Fluvial – Agricultural drain tributaries of Cockret Dike

- 2.4.8 A small number of agricultural land drains facilitate drainage of the northern area of the site. These drains are the responsibility of the Selby IDB and comprise tributaries of Cockret Dike to the north, which forms a part of the wider Holmes Dike catchment area.

2.5 Existing Flood Mitigation Measures

- 2.5.1 Formal flood defences are typically engineered structures designed to reduce the risk of flooding, but do not eliminate flood risk completely. They can take several forms including bunds/embankments, canalised channels, culverts and flood storage areas among others.
- 2.5.2 Flood defences are generally designed and constructed to protect people and property from a given magnitude of flood. This is referred to as the Standard of Protection (SoP) or Design Standard and may vary depending on the type, age and condition of the structure, and the probability and consequence of its failure. The reduction in flood risk that the defence provides depends on the SoP and the performance and reliability of the defences. For new flood defence schemes, such issues and others are balanced through a cost benefit analysis to determine whether investment in a defence scheme can be justified.
- 2.5.3 In accordance with PPS25, a Level 2 SFRA should consider the location, condition, operating standard and level of protection offered by flood defences and flood risk management infrastructure. The residual risk of flooding to the site should also be considered as part of a Level 2 assessment. . Residual risk is defined as that which remains following consideration of flood risk mitigation measures.

River Ouse

- 2.5.4 Immediately following the November 2000 flood event, the EA constructed emergency works at Selby to provide increased temporary protection to the town. A £13.7 million permanent flood defence scheme was completed soon after and provides protection to approximately 2,500 homes. These defences are the responsibility of the EA.

- 2.5.5 At Cross Hills Lane a breach in flood defences on the River Ouse during extreme flood events presents a residual risk.
- 2.5.6 Information on defence structures within the study area has been provided by the EA from their National Flood and Coastal Defence Database (NFCDD). The NFCDD is used as a repository for information relating to flood defences including their location, type, condition and design standard. The NFCDD is still being populated and constantly updated. In the vicinity of the Cross Hills Lane site, the River Ouse is defended by raised floodwalls along its right bank. The River Ouse model update (Halcrow, 2009) identifies that the flood defences on the right bank of the River Ouse that protect the site offer a SoP in excess of the 0.5% AEP (200 year) flood event.
- 2.5.7 The embanked defences are relatively new in the vicinity of the site and are constructed to rigorous modern standards. They are subject to the EA's periodic asset management, inspection and maintenance regime. Given the young age and good condition of the defences, the likelihood of a defence breach adjacent to the site is considered to be low. The condition and standard of defences on the River Ouse will deteriorate through the expected lifetime of any development (100 years for residential development), which could increase the risk of failure through time. However, it should be noted that the Ouse Catchment Flood Management Plan (CFMP) recommends that the Environment Agency will maintain defences in Selby to their current standard into the future.

Selby Dam

- 2.5.8 The EA have confirmed that there are no raised flood defences along the left bank of Selby Dam in the vicinity of Site A. However, flood risk management infrastructure in the vicinity of the site includes the Selby Dam Pumping Station, located to the west of Water Hill Lane, which pumps water from Selby Dam into the River Ouse. The EA recently took responsibility for the pumping station and its equipment under new flood management regulations. The Selby Dam pumping station failed to operate during the 2000 flood event, demonstrating the realistic and probable nature of the residual risk posed by this flood risk management infrastructure.
- 2.5.9 The EA are currently looking at options for refurbishing and upgrading the pumps and their capacity at Selby Dam. This work is ongoing and no conclusions have been reached so far. However, the EA has implemented measures to act as a failsafe in the event of pump failure. Pipework and a hardstanding area have been installed to accommodate a 24-inch mobile pump in case of such an emergency. The weedscreen is also due to be upgraded and will use automatic means to keep it clean.

2.6 Flood Depth Hazard Mapping

Methodology

- 2.6.1 Full hazard mapping undertaken in line with Defra guidance (FD2320/TR2) determines the flood hazard based on flood depth and velocity. The best available data is 1D hydraulic modelling of both the River Ouse and Selby Dam. 1D hydraulic models do not represent flood flow routes or velocities in the floodplain and two-dimensional (2D) modelling would be required to obtain such information.
- 2.6.2 Consequently, using the best available information, it is not possible to undertake full hazard mapping. In agreement with the EA, depth hazard mapping has been used as a substitute to determine the areas of greatest flood hazard from fluvial / tidal sources. The depth hazard

categories have been mapped using guidance set out in Defra guidance¹, which suggests categorising depth hazard as shown in Table 2-1.

Table 2-1: Key to Depth Hazard

Depth of Flooding	At Risk
0.30m - 0.50m	Danger for Some
0.50m - 1.50m	Danger for Most
>1.50m	Danger for All

2.6.3 The purpose of the depth maps is to identify areas at greatest flood hazard and provide a basis for informing spatial flood-related planning policies at Cross Hills Lane.

River Ouse

2.6.4 The reach of the River Ouse in the vicinity of Selby is influenced by both fluvial flows and tidal water levels.

2.6.5 The EA hold a 1D ISIS model of the River Ouse which has been used to generate the EA's Flood Map for Selby. The outlines shown on the majority of the Flood Map for the River Ouse catchment represent the highest flood level from the fluvial and tidal simulations (Halcrow, 2009) with the absence of flood defences.

2.6.6 The River Ouse model and accompanying reports (Halcrow, 2009) were reviewed to determine the modelling approach and methodology. The EA has modelled a range of scenarios for the River Ouse at Selby, which are summarised in Table 2-2.

Table 2-2: River Ouse model scenarios (relevant to Selby)

Model Run Scenario	Details of Scenario	Comment
Defended Scenario	All flood defences within the Ouse catchment are included in the model.	Generally not used in creating Flood Maps. However, PPS25 states that a Level 2 SFRA must take account flood risk management assets so this scenario is relevant to this addendum.
Undefended Scenario	The model is run with all flood defences "removed". The aim is to simulate the 'natural' floodplain without the influence of flood defences. The objective to produce a set of	This is the usual approach to defining ABD on the EA flood map. However, with such a large river catchment that is so heavily defended, the effect of removing all defences shows that flooding in Selby is relatively minor.

¹ Flood Risk Assessment Guidance for New Development, Defra/EA Flood and Coastal Defence R&D Programme Technical Report FD2320/TR2, October 2005

Model Run Scenario	Details of Scenario	Comment
	flood outlines that represent the area of land that benefits from flood defences – ABD.	Consequently, this scenario does not provide a realistic indication of the ABD for Selby.
Selby Scenario	<p>The model is run with all defences present except for a 2km reach on the right bank of the Ouse through Selby (see Figure 2-4).</p> <p>The aim is to simulate what area of Selby benefits directly from the Selby Flood Defence Scheme.</p> <p>The objective to produce a set of flood outlines that represent the area of land that benefits from the Selby flood defences – ABD.</p>	<p>This is an appropriate approach for assessing the benefits of the right bank Selby Flood Defences.</p> <p>However, in terms of defining a new flood map, it must be noted that the resulting outlines do not represent actual risk.</p> <p>It should also be noted that the new flood outlines do not represent a residual risk that is appropriate for use in an SFRA or FRA.</p> <p>A more accurate reflection of residual risk could be derived through single or multiple breach modelling rather than the removal of such a long reach of defences.</p>

2.6.7 As shown in Table 2-2, the modelling study examined three scenarios to demonstrate the benefits provided by the flood alleviation schemes in Selby and Cawood. The defended scenario represents the current situation in Selby with the substantial flood defence scheme incorporated into the model. According to the PPS25 Practice Guide, a Level 2 SFRA must take into account the presence of flood defences. However, before a Level 2 SFRA can assess flood defences, it is necessary to assess the area that the defences protect.

2.6.8 Normally, the Flood Zones shown on the EA's Flood Map represent the 'undefended' scenario. Therefore, the second scenario modelled was the fully 'undefended' scenario. In the fully 'undefended' scenario, all defences within the catchment are removed from the model. The aim is to simulate the natural storage of floodwater in the floodplain throughout the whole catchment. This scenario results in a much reduced flood outline through Selby and is unlikely to represent a realistic indication of the areas benefiting from defences in Selby.

2.6.9 To assess the effects of defences more locally in Selby a third scenario was run through the model. The 'Selby Scenario' simulates the removal of the right bank flood defences from the warehouses at The Holmes (SE 616 328) to the treatment plant in East Common (SE 631 317), a stretch of almost 2 km. All other flood defences are left within the model, including those on the left bank adjacent to Olympia Park. The aim of the Selby Scenario was to determine the ABD for the right bank of the River Ouse through Selby (See Figure A-1 in Appendix A).

2.6.10 However, in addition to defining ABDs for Selby, the 'Selby Scenario' model run has also been used to define Flood Zones and update the EA's flood map (see Figure 2-3 and Figure A-1 in

Appendix A) and the Environment Agency advises on using the 'Selby Scenario' as a starting point to assess the residual risk of flooding in Selby.

2.6.11 Although appropriate for assessing the benefits that the flood defences provide, the 'Selby Scenario' represents an extremely low probability, worst-case scenario for the town. Consequently, the flood levels and extents are significantly greater than the previous flood map used in the Level 2 SFRA (February, 2010). Furthermore, it should be stressed that the Ouse defences are approximately 1km to the east of the site and the speed and onset of flooding has not been taken into account with the latest EA Flood Map.

2.6.12 It is important to note that the 'Selby Scenario' is not representative of a breach in defences. Usually, for flood wall defences, a breach width of 20 m would be a simulated for a total of 36 hours to assess residual risks, whereas the Selby Scenario shows the removal of 2km of defences – see Figure 2-4. In recognition of this, the EA have agreed that for the purposes of assessment of residual risks in flood risk assessments, the 'Selby Scenario' is a less appropriate dataset to use and that more detailed breach analysis should be undertaken.

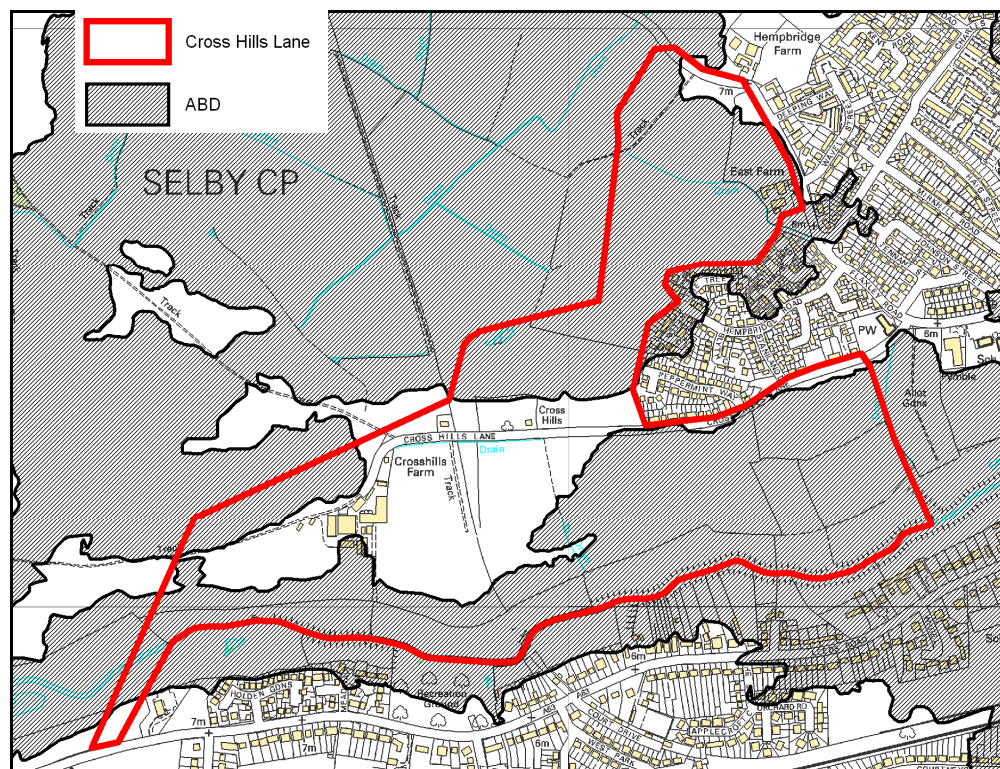


Figure 2-3: Areas Benefiting from Defences (ABD) on the River Ouse in the vicinity of Cross Hills Lane

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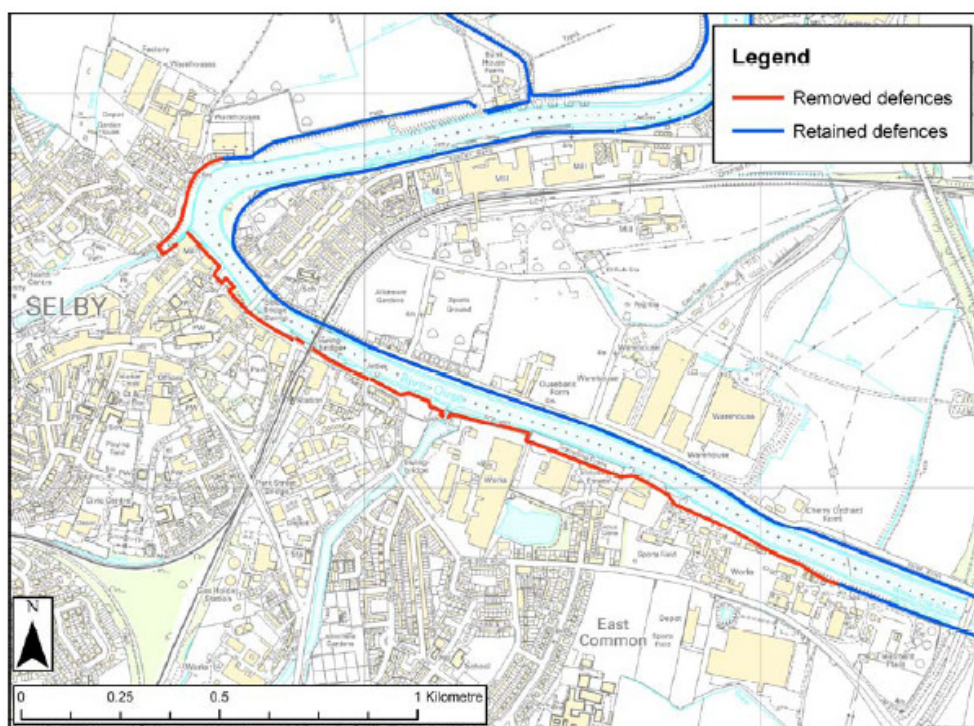


Figure 2-4: 'Selby Scenario' flood defence arrangement

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Selby Dam

2.6.13 The Environment Agency holds a 1D HEC-RAS model of Selby Dam in the vicinity of the site. The Selby Dam and Tributaries modelling study (JBA, 2008) and the final modelled flood outlines for Selby Dam and its associated tributaries were provided by the EA for inclusion in the Selby Level 1 SFRA (November 2008). The model data was also used as part of the Selby Level 2 SFRA (February 2010) for Cross Hills Lane. The data represents the best available delineation of the Flood Zones associated with Selby Dam and its tributaries and therefore provides the best available representation of flood risk.

2.6.14 The Selby Dam hydraulic model considers the 1 in 100 year (1% AEP) event and the 1 in 1000 year (0.1% AEP) event excluding allowances for climate change. The modelling study simulated a number of different scenarios on Selby Dam and its tributaries. Two main hydrological scenarios were considered in the original study:

- 1) Fluvial flooding from Selby Dam (fluvial); and
- 2) Flooding where the River Ouse is a dominant factor (tidal).

2.6.15 For each of the above scenarios, the modelling study considered four scenarios:

- a) Defended - All pumping stations operating at full capacity;
- b) Option 1 - Pumping stations not operating;
- c) Option 2 - Pumping stations operating at 50% capacity; and

- d) Option 3 - Pumping stations not operating and all embankments (upstream of the site) removed.

2.6.16 The 'Ouse Dominated' scenario gives higher flood levels than 'fluvial only' scenario. 'Option 3' also gives the highest or worst-case flood levels, as it assumes failure of all pumping stations along the watercourse, including the station that pumps the Selby Dam into the River Ouse. In order to assess flood hazard at Cross Hills Lane from Selby Dam, flood levels were extracted for the worst-case Ouse Dominated scenario, assuming all pumping stations are not operating and all embankments are removed (Option 3).

Comments on flood scenarios

2.6.17 As described above, the 'Selby scenario' has been used to update the EAs Flood Map and ABD for Selby. Although appropriate for defining the ABD and confirming the standard of protection for the Selby Flood Defences, the EA have agreed that the flood outlines presented by the Selby Dam modelling present a more appropriate representation of residual risks to the Cross Hills Lane Site.

2.6.18 Selby Dam is considered to present the most realistic and probable residual flood risk to the Cross Hills Lane site. Therefore, for the purposes of the Selby SFRA, the outputs from the Selby Dam modelling, which represents the failure of the Selby Dam pumping station, will be used to assess residual risks to Cross Hills Lane. This will include the depth hazards associated with those residual risks.

2.6.19 However, until proven otherwise through detailed modelling, the updated EA flood map that delineates much of the Cross Hills Lane site as Flood Zone 3 must be used to shape and inform local flood risk policy (Figures A-1 and A-2 in Appendix A).

Depth hazard maps

2.6.20 Simple depth hazard maps have been created using flood levels extracted from the hydraulic models queried against topographic (LiDAR) data for the site. A suite of maps has been produced to represent the flood hazard from Selby Dam during the 1% AEP (100 year) event², considering that the River Ouse is a dominant factor, pumping stations are not functioning and all upstream embankments are removed (Option 3).

Flood depth mapping results for Selby Dam

2.6.21 The depth hazard map for Selby Dam is included Figure A-3, Appendix A. Unlike the River Ouse, Selby Dam does not benefit from flood defences. There is also a residual risk of failure of the pumping station.

2.6.22 The depth map shows that intermittent areas across the southern area of the site adjacent to the watercourse suffer the deepest flooding and are classed as 'Danger to All'. Extending further northwards along this corridor, particularly in the eastern half of the site to the south of Cross Hills Lane, depths become shallower and are classified as 'Danger for Most'. A narrow band alongside this, again to the south of Cross Hills Lane and more pronounced in the eastern area of the site, is classified as 'Danger to Some'. The shallow flood depths within the remaining flood envelope and the remainder of the Cross Hills Lane site pose a minimal hazard.

² The Selby Dam modelling study did not consider the 1% AEP event including an allowance for climate change, or the 0.5% AEP event.

2.7 Policies and Recommendations

General policies for Cross Hills Lane Site

2.7.1 Policies relating to development falling within the Cross Hills Lane site must make due consideration of the fact that much of the site now falls within Flood Zone 2 and Flood Zone 3 according to the EA's updated Flood Map for Selby. In addition, policies must also take into account the residual flood hazards presented by Selby Dam.

- Since the site falls within Flood Zone 3 of the defended floodplain, any proposed development should adhere to the sequential approach advocated by PPS25 and take consideration of the residual flood risk and development vulnerability.
- In accordance with PPS25, a site-specific FRA must be undertaken for all development proposals in the Cross Hills Lane Site. In addition to the requirements of PPS25, FRAs should take account of the following:
 - The FRA should incorporate two-dimensional breach modelling of the right bank River Ouse defences. The approach to breach modelling and locations of breaches should be agreed with the Environment Agency and carried out and in accordance with Defra guidance³. The locations of the breach should be selected to represent the greatest risk to the site. The breach modelling should quantify the residual flood risk from the River Ouse at the Cross Hills Lane site with full hazard mapping.
 - The existing hydraulic model for Selby Dam does not take into account a potential increase of 20% in peak river flows due to climate change over the expected lifespan for residential development which PPS25 recommends. Site-specific FRAs and future updates to the Level 2 SFRA should therefore take account of the 1% AEP (1 in 100 year) including an allowance for climate change, and the 5% (1 in 20 year) event to determine the extent of the Functional Floodplain (Flood Zone 3b) as defined by PPS25.
 - The results from the site-specific FRA should be used to inform potential mitigation measures against residual risks, such as floor levels, access and egress routes and development layout.
 - Any proposed raising of ground levels as part of mitigation must provide compensatory floodplain storage on a 'level-for-level' basis to ensure that flood risk to surrounding areas is not exacerbated. Adequate compensatory storage must be demonstrated as part of the FRA.
 - As part of the site specific FRA modelling, Flood Zone 3b (functional floodplain) should be defined. Once defined, only 'water compatible' development will be appropriate within the functional floodplain (Table D.3 of PPS25). Flood mitigation measures should consider the 1% AEP (100 year) event including an allowance for climate change.

³ The following document provides guidance on the assessment of sites located behind flood defences: Defra (2005), 'Flood Risk Assessment guidance for new development: Phase 2. R&D Technical Report FD2320/TR2', available at: <http://www.hydres.co.uk/>

- Master plans for development should give due consideration to existing flood flow routes. The FRA must demonstrate that the development layout does not interrupt existing flood flow routes and that flood risk is not exacerbated.
- For all development proposals, finished floor levels must be determined as part of a site-specific FRA and agreed with the EA. Finished floor levels must be set with a minimum freeboard level⁴ above the 0.5% AEP (200 year) breach flood level from the River Ouse or the 1% AEP (100 year) plus climate change flood level from Selby Dam, whichever is greatest.
- The FRA must demonstrate, in consultation with emergency planners, that suitable access and egress routes and evacuation plans are in place for any development falling within Area B and that the development is safe for occupants with regards flood risk.
- A Flood Plan should be developed for the site by the developer. The Flood Plan should be informed by breach modelling that should be undertaken as part of the FRA. The Plan should provide information on flood warning and evacuation procedures and give consideration to the speed of onset during a breach event, as determined by hydraulic modelling.

Policies relating to flood hazards

2.7.2 Pending further two-dimensional modelling for the whole Cross Hills Lane site, proposed development should be directed away from Selby Dam and towards this lowest depth hazard category.

- **No Danger** (i.e., white area): 'Less vulnerable' development is appropriate for this hazard category. If, following application of the Exception Test, 'more vulnerable' development can also be justified in this area, any residential development should be limited to apartments / townhouses with no sleeping accommodation on ground floor level. Suitable flood resilience measures should be incorporated into the development, in line with best practice and guidance⁵.
- **Danger for Some:** 'Less vulnerable' development is likely to be appropriate for this hazard category. If, following application of the Exception Test, 'more vulnerable' development can also be justified in this area, the ground floor level of any residential development should be occupied by 'less vulnerable' uses, such as non-sleeping residential rooms, garages or commercial use (i.e., applying the sequential approach within a building). Suitable flood resilience measures should be incorporated into the development, in line with best practice and guidance⁵.
- **Danger for Most:** Guidance suggests that development within this danger category should be avoided and rolled back from the watercourse and that the area should be allocated for 'water compatible' uses only, such as public amenity open space, sports grounds or nature reserves. However, in recognition of the fact that the hazard

⁴ Environment Agency (2000), Fluvial Freeboard Guidance Note, A M Kirby and J R V Ash.

⁵ Recommendations for flood resilient construction can be found in Sections 9.1.1 and 9.2.3 of the Selby Level 2 SFRA. Current guidance can also be found in the following document:

Communities and Local Government (2007), 'Improving the flood performance of new buildings: flood resilient construction', DCLG: London.

Available at: <http://www.communities.gov.uk/publications/planningandbuilding/improvingflood>

mapping for Selby Dam (and potential future hazard mapping for the updated Flood Zone 3 maps in Selby) is for residual risks rather than actual risks, this approach could be perceived as being overly precautionary. As such, development in this hazard zone must be carefully assessed and undergo the Exception Test in close consultation with the EA and SDC. Mitigation measures should include:

- Minimum floor levels above the 1% AEP (100 year) flood event including an allowance for climate change – to be confirmed following site specific FRA
- For residential developments, sleeping accommodation should be on the first floor or above. For non-residential developments, a flood refuge should be incorporated (above the 1% (100 year) flood level including an allowance for climate change) to ensure that users of the building are safe in a flood event
- Flood resilience measures should be incorporated into the developments
- Safe access and egress must be incorporated into developments
- **Danger for All:** Development should be avoided in this area and rolled back from the watercourse to provide a 'blue' corridor. The area should be allocated for 'water compatible' uses, such as public amenity open space, sports fields or nature conservation areas.

3 Summary and Conclusions

- 3.1.1 This Selby Level 2 SFRA Addendum report relates to fluvial flood risk for Site A: Cross Hills Lane, and should be read in conjunction with the Selby Level 2 SFRA (Scott Wilson, February 2010).
- 3.1.2 The Environment Agency's Flood Map for Selby was updated following the completion of the Selby Level 2 SFRA. The Flood Map update shows a much larger extent of Flood Zone 2 and Flood Zone 3 and consequently, the Cross Hills Lane site is at a greater risk of fluvial and tidal flooding compared to earlier versions. The Flood Map update is based on the River Ouse Model update (Halcrow, 2009).
- 3.1.3 There are two fluvial / tidal flood sources at the Cross Hills Lane site:
1. Residual flood risk from the River Ouse,
 2. Residual risk from Selby Dam (pump failure).
- 3.1.4 Although appropriate for assessing the benefits that the flood defences provide, the updated EA flood map for Selby represents an extremely low probability, worst-case scenario for the town. Consequently, the flood levels and extents are significantly greater than the previous flood map used in the Level 2 SFRA (February, 2010). It is important to note that the 'Selby Scenario' is not representative of a breach in defences. In recognition of this, the EA have agreed that for the purposes of assessment of residual risks in flood risk assessments, the updated Flood Map is a less appropriate dataset to use and that more detailed breach analysis should be undertaken.
- 3.1.5 Selby Dam is considered to present the most realistic and probable residual flood risk to the Cross Hills Lane site. Therefore, for the purposes of the Selby SFRA, the outputs from the Selby Dam modelling, which represents the failure of the Selby Dam pumping station, will be used to assess residual risks to Cross Hills Lane. This will include the depth hazards associated with those residual risks.
- 3.1.6 The Sequential Test Addendum produced by SDC concludes that although the revised EA Flood Maps indicate that flood risk has increased on Site A (Cross Hills Lane), the site remains (along with Site D – Olympia Park) sequentially preferable to the other Strategic Growth Sites considered for delivering Selby's future housing numbers.
- 3.1.7 A series of policies and recommendations have been derived for the future development of the site. The policies and recommendations are based on the source of flood risk (River Ouse or Selby Dam) and the flood hazard. Future development should take account of the policies and recommendations to ensure that future development of the site is safe with regards to flood risk.

References

Communities and Local Government (2009), 'Planning Policy Statement 25: Development and Flood Risk Practice Guide', TSO, London

Communities and Local Government (2010), 'Planning Policy Statement 25: Development and Flood Risk', TSO, London

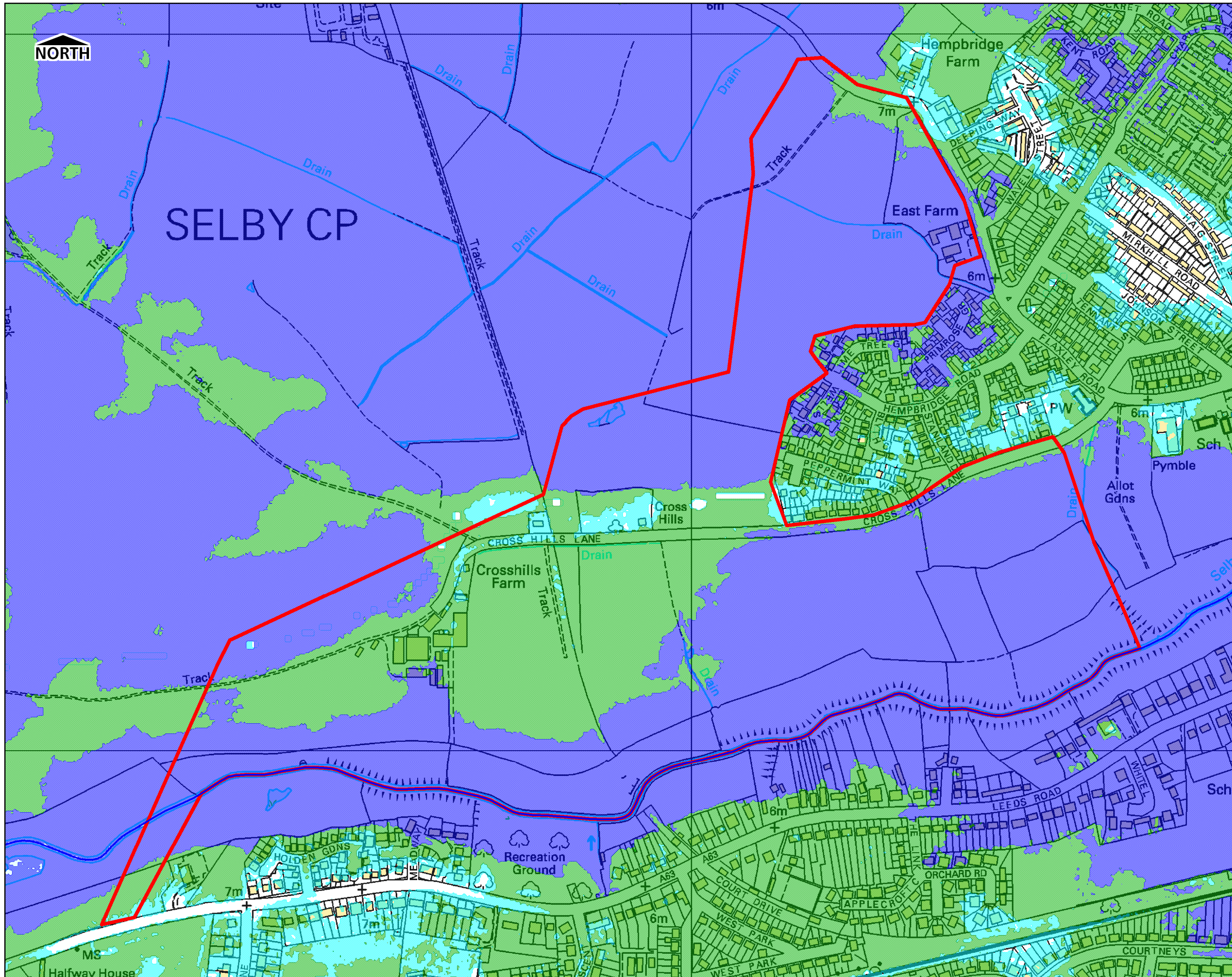
Halcrow (2009), 'River Ouse model update: Summary report (final)', Halcrow: Leeds.

Scott Wilson (2010), 'Selby Level 2 Strategic Flood Risk Assessment', available at: http://www.selby.gov.uk/service_main.asp?menuid=&pageid=&id=1622, accessed 13 September 2010

Scott Wilson (2008), Selby Level 1 Strategic Flood Risk Assessment, available at: http://www.selby.gov.uk/service_main.asp?menuid=&pageid=&id=1622, accessed 13 September 2010

Appendix A

- Figure A-1: River Ouse 'Selby Scenario' flood outlines
- Figure A-2: LiDAR topographic map for Cross Hills Lane site.
- Figure A-3: Flood risk from the Selby Dam, 1 in 100 year flood event.



Notes
THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED AND ONLY WRITTEN DIMENSIONS SHALL BE USED

Legend

- Main River Centreline
- Site Boundary
- Selby Scenario 100 year extent
- Selby Scenario 100 year + CC extent
- Selby Scenario 1000 year extent

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Revision Details	By	Date	Suffix
	Check		

Drawing Status
FINAL

Job Title
SELBY DISTRICT COUNCIL LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT UPDATE

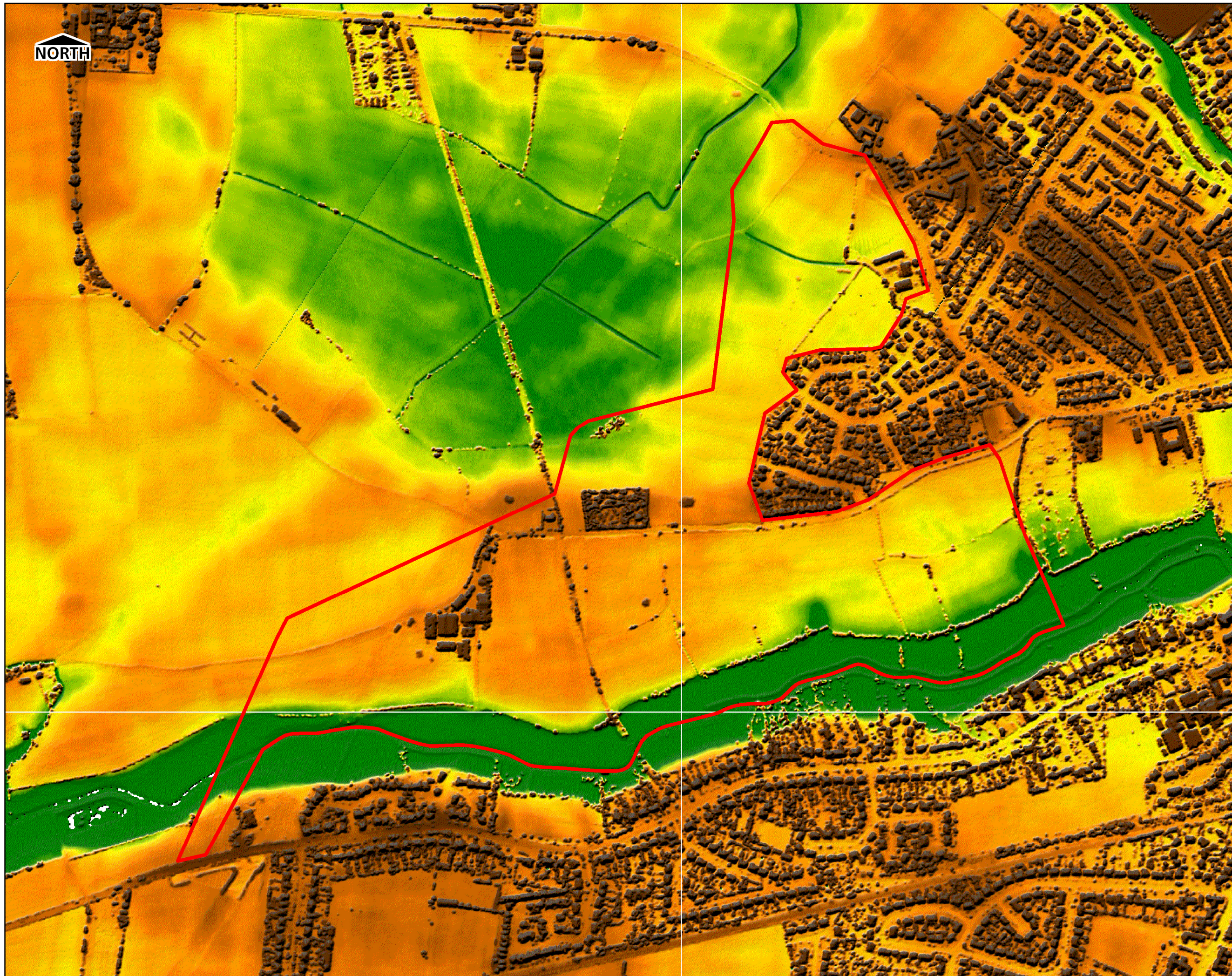
Drawing Title
Flood risk from the River Ouse (Selby Scenario)

Scale at A3 **AS SHOWN**

Drawn	FT	Approved	MT
Stage 1 Check	Stage 2 Check	Originated	Date
			11-2010

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Drawing Number
FIGURE A-1



Notes
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Legend

Elevation

- 7m AOD
- 6m AOD
- 5m AOD
- 4m AOD

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Job Title
SELBY DISTRICT
COUNCIL LEVEL 2
STRATEGIC FLOOD RISK
ASSESSMENT ADDENDUM

Drawing Title
Crosshills Lane (Site A)
Topography
(LiDAR data)

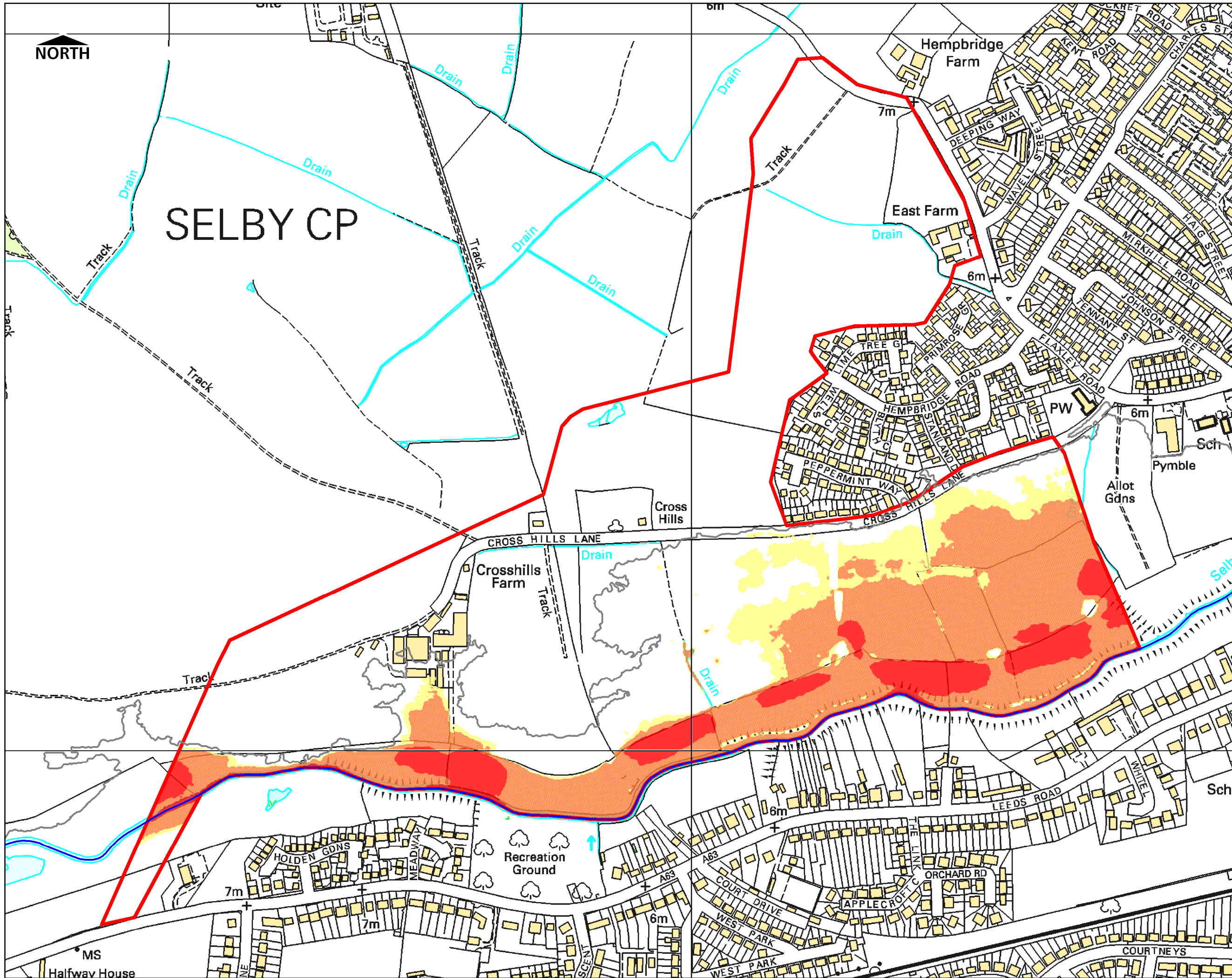
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FIGURE A-2



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Legend

- Site Boundary
- Undefended Flood Extent
- Main River Centrelines

Degree of Depth Hazard (Defra FD2320/TR2)

- 0.3 - <0.5m - Danger for Some
- 0.5 - 1.5m - Danger for Most
- >1.5 - Danger for All

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Drawing Status: **FINAL**

Job Title: **SELBY DISTRICT COUNCIL LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT UPDATE**

Drawing Title: **Flood risk from the Selby Dam 1 in 100 year (1% AEP) event**

Scale at A3: **AS SHOWN**

Drawn	FT	Approved	MT
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			11-2010

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SELBY DISTRICT COUNCIL
 Moving forward with purpose

Drawing Number: **FIGURE A-3**