

East Lancashire Paper Mill

784-B038963

Flood Risk Assessment & Drainage Strategy Addendum

For Discharge of Conditions

Version 7

Morris Homes

[24/11/2023]

**Document prepared on behalf of Tetra Tech Limited. Registered in England number:
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DOCUMENT CONTROL

Document:	Flood Risk Assessment & Drainage Strategy
Project:	East Lancashire Paper Mill
Client:	Morris Homes
Project Number:	784-B038963
File Origin:	\\lds-dc-vm-101\Data\Projects\784-B038963_ELPM_Modelling\60 Project Output\61 Work in Progress\FRA & DS

Revision:	Version 1	Prepared by:	O Chard/F Aguilar/T Beavis
Date:	12/06/2018	Checked by:	M Elliott/T Beavis
Status:	First Issue	Approved By:	M Elliot
Description of Revision:	First Issue		

Revision:	Version 2	Prepared by:	L Stewart
Date:	05/10/22	Checked by:	M Bell
Status:	First Issue	Approved By:	R Carr
Description of Revision:	Updated for new development layout and using the latest guidance on climate change.		

Revision:	Version 3	Prepared by:	L Stewart
Date:	12/10/22	Checked by:	M Bell
Status:	Second Issue	Approved By:	M Bell
Description of Revision:	Report updated to reflect client comments		

Revision:	Version 4	Prepared by:	L Stewart
Date:	06/12/22	Checked by:	M Bell
Status:	For Planning	Approved By:	M Bell
Description of Revision:	Report updated to reflect most recent layout		

Revision:	Version 5	Prepared by:	L Stewart
Date:	27/10/23	Checked by:	D Percival
Status:	For Planning	Approved By:	D Percival
Description of Revision:	Report updated to reflect revised layout and detailed drainage design drawings produced by Banners Gate		

Revision:	Version 6.1	Prepared by:	R Bramwell-Carr
Date:	23/11/2023	Checked by:	F Hurt / M Bell
Status:	For Internal Review	Approved By:	R Bramwell-Carr
Description of Revision:	Revisions following internal review		

Revision:	Version 7	Prepared by:	F Hurt
Date:	24/11/2023	Checked by:	M Bell
Status:	For Planning	Approved By:	M Bell
Description of Revision:	Revisions following internal review		

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
NPPF	National Planning Policy Framework
PPG	Planning Practice Guidance
FRA	Flood Risk Assessment
BC	Bury Council
LLFA	Lead Local Flood Authority
EA	Environment Agency
SuDS	Sustainable Drainage Systems
UU	United Utilities
BGS	British Geological Society
SFRA	Strategic Flood Risk Assessment
PFRA	Preliminary Flood Risk Assessment
SWMP	Surface Water Management Plan
AEP	Annual Exceedance Probability
ELPM	East Lancashire Paper Mill
FFL	Finished Floor Level

NOTE ON FLOOD FREQUENCIES

AEP (%)	50	20	10	5	3.33	2	1.33	1	0.5	0.1
AEP	0.5	0.2	0.1	0.05	0.033	0.02	0.0133	0.01	0.005	0.001
Return Period (Years)	2	5	10	20	30	50	75	100	200	1000

1.0 INTRODUCTION

1.1 PURPOSE OF THIS REPORT

- 1.1.1 Tetra Tech Ltd has been commissioned by Morris Homes to undertake a Flood Risk and Drainage Strategy Addendum with regards to the development of up to 400 dwellings, public open space, sports facilities, and associated landscaping and infrastructure on the former site of the East Lancashire Paper Mills in Radcliffe, Bury.
- 1.1.2 This report has been prepared in support of a Reserved Matters application for the proposed development as outlined in Section 1.2.

1.2 PROPOSED DEVELOPMENT

- 1.2.1 A Reserved Matters application is being submitted for the development of up to 400 dwellings, public open space, sports facilities, and associated landscaping and infrastructure.
- 1.2.2 The proposed layout is included in Appendix A.

1.3 REQUIREMENT FOR THIS REPORT

- 1.3.1 The application site is located in Flood Zone 1, (land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1% Annual Exceedance Probability (AEP)) in any one year); Flood Zone 2 (0.1% < AEP < 1% AEP in any one year); and Flood Zone 3 (AEP > 1% in any one year).
- 1.3.2 The application has an area of 20.92 Ha.
- 1.3.3 Given that the site is within Flood Zone 3 and greater than 1 Ha, in accordance with the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (Flood Risk & Coastal Change) (PPG), a Flood Risk Assessment (FRA) and Drainage Strategy is required to support the planning application.
- 1.3.4 An outline planning application was approved on 19/12/2018. This was subsequently updated from a Section 73 application dated 25/10/21 and reference no. 67597. This application included a number of planning conditions relating to flood risk and drainage.
- 1.3.5 Following the requirements of Bury Council (BC) as the Lead Local Flood Authority (LLFA), a drainage strategy incorporating a surface water assessment is required to support the discharge of conditions 10, 11, 29 and 31.

1.4 SCOPE OF THIS REPORT

- 1.4.1 The FRA will be undertaken in accordance with the guidelines of the Environment Agency (EA) Flood Risk Assessment Guidance.

- 1.4.2 In line with the PPG requirements, the FRA will consider all potential sources of flood risk, such as fluvial and pluvial flooding, sewers, overland flow routes, groundwater flooding, reservoir flooding, and ordinary watercourses.
- 1.4.3 The FRA will also establish a management regime for surface water runoff from the site such that flood risk to adjoining areas is not exacerbated and where possible improved. If not managed properly, surface water runoff from the site could potentially lead to increases in flood risk to other areas or the development itself.
- 1.4.4 The FRA includes detailed hydraulic modelling to demonstrate that the flood risk and compensation proposals do not pass flooding on to others.
- 1.4.5 An indicative surface water drainage strategy will be included in which potential measures for draining surface water will be discussed. This will have a specific focus on implementing SuDS strategies, where viable.
- 1.4.6 The Foul Drainage Assessment will review the existing foul water drainage systems within and adjacent to the development site and identify the peak flows from the proposed development.

1.5 LIMITATIONS OF THE REPORT

- 1.5.1 This report has been prepared by Tetra Tech on behalf of Morris Homes in connection with the scope of the report as described in Section 1.4 above and takes into account the particular instructions and requirements set out in our fee proposal and the acceptance. It is not intended for and should not be relied on by any third party and no responsibility is undertaken to any third party.
- 1.5.2 Tetra Tech accepts no duty or responsibility (including in negligence) to any party other than Morris Homes and disclaims all liability of any nature whatsoever to any such party in respect of this report.
- 1.5.3 This report cannot be reproduced without Tetra Tech's written consent.

2.0 SITE DESCRIPTION

2.1 EXISTING SITE

- 2.1.1 The application site covers an area of 20.92 ha and is located to the south of Cross Lane, Radcliffe at grid reference SD 79279 07408. The nearest postcode is M26 2RF. A location and site plan are shown in Figure 2-1 and Figure 2-2 below.

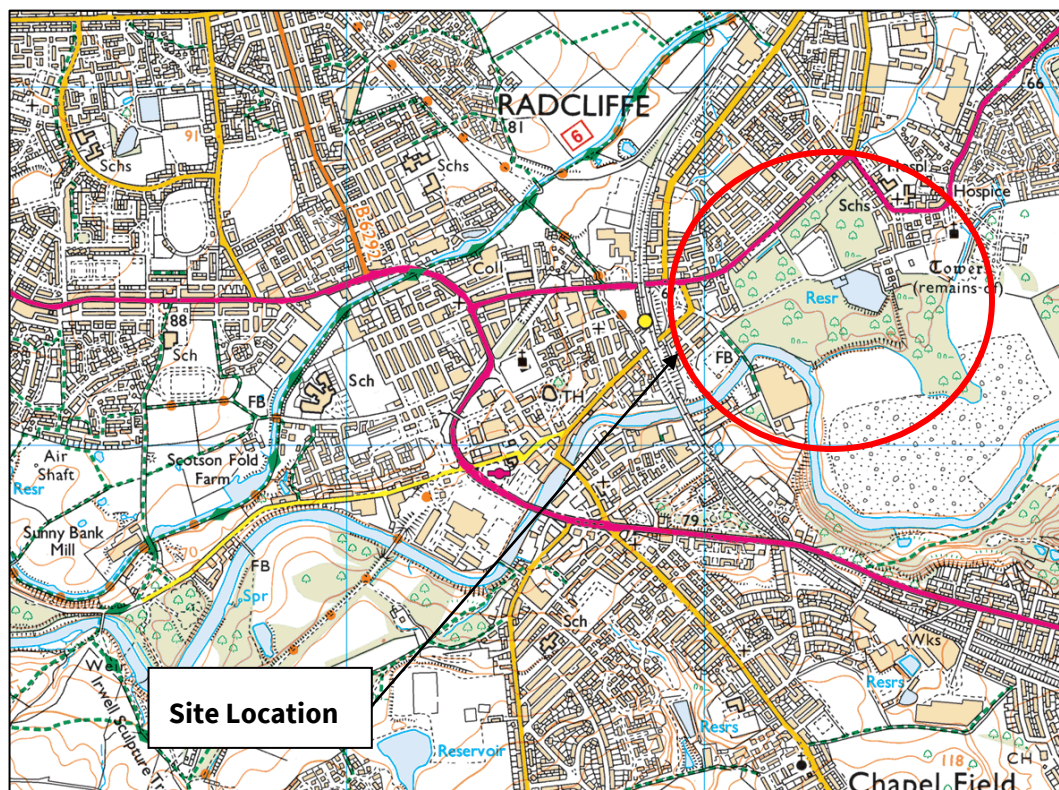


Figure 2-1: Site Location Plan

- 2.1.2 The application site is bounded to the north by Cross Lane and residential developments, to the east by Bury Street and undeveloped land, to the south by a largely abandoned watercourse known as Bealey's Goit, and by the River Irwell.

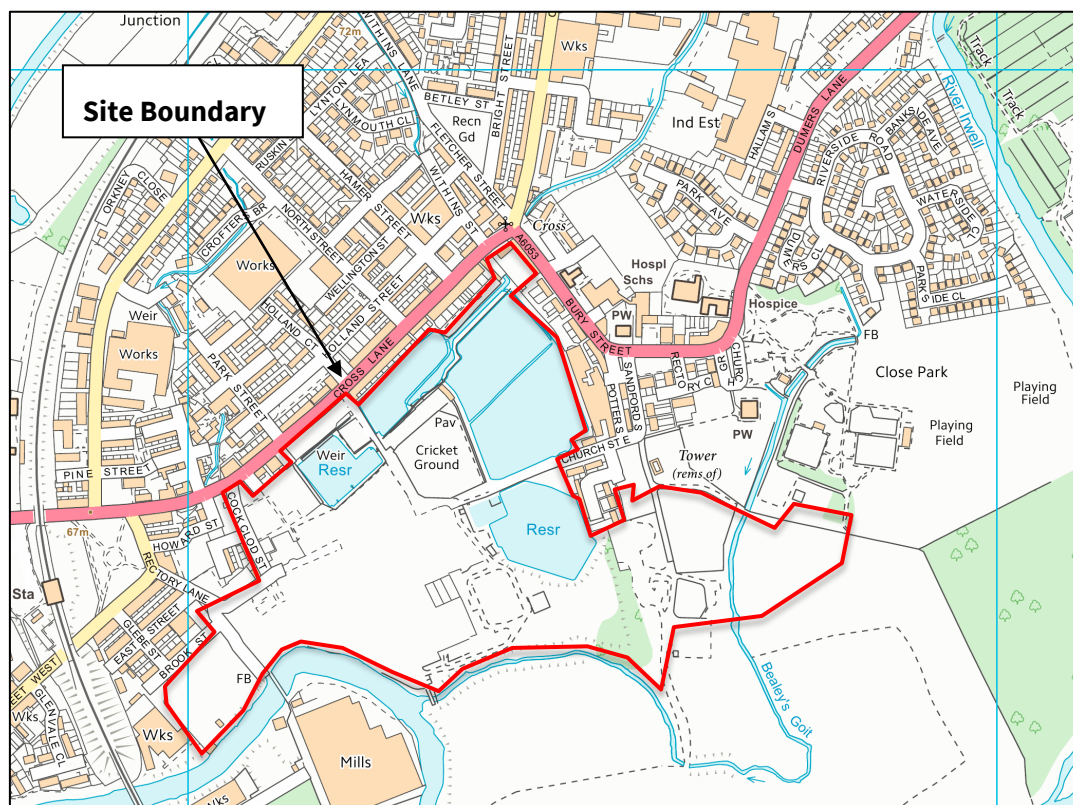


Figure 2-2: Site Boundary

- 2.1.3 Due to the former nature of the site, it is considered brownfield in planning terms. However, most of the land is undeveloped, and therefore in terms of surface hydrology it is considered as a greenfield site.
- 2.1.4 The site was previously used as an industrial (Paper Mills) site. As the paper industry requires significant amounts of water, reservoirs were constructed within the site to feed the industries. Hutchinson's Goit was constructed in order to abstract water from the River Irwell and feed the reservoirs within the site. It appears that Crow Trees Farm Brook was also culverted and diverted towards the site for water abstraction purposes. Bealey's Goit is an old outfall from former upstream industries.
- 2.1.5 A complex network of culverts was put in place to divert water resources to industries and the main watercourses are discussed in more detail below.
- 2.1.6 The earliest available historic map was published in 1850 and shows print works and bleach works within the site. The map published in 1895 shows the addition of the paper mill in the south western part of the site. The historic maps available in Google Earth show the presence of industrial units within the site until April 2003, the following map dated 2005 shows the land being clear. Evidence of a landfill can also be seen on the historic maps.

2.2 SITE TOPOGRAPHY

- 2.2.1 The topography of the proposed site will differ from the original site as recontouring is proposed for the developable area. This is discussed further in section 4.4.
- 2.2.2 A copy of the topographical survey for the existing site is included as Appendix B.

2.3 EXISTING DRAINAGE

2.3.1 Main Rivers

- 2.3.2 The nearest Main River to the application site is the River Irwell, which forms the western boundary of the site.
- 2.3.3 Crow Trees Farm Brook is classified as main river and it flows culverted from north to south through the western part of the application site, discharging to the River Irwell. As indicated above, Crow Trees Farm Brook was culverted in the 1800s. It appears that a branch from Crow Trees Farm Brook also diverted water towards the site alongside Withins Lane and Withins Street. This connection was abandoned recently as it caused localised flooding within the area.

2.3.4 Ordinary Watercourses

- 2.3.5 Hutchinson's Goit is a manmade ordinary watercourse which was created to supply the paper mills with water from the Irwell. It flows in an open channel from the abstraction point 1.5 km to the northeast of the site. It is culverted under Cross Lane/Bury Street and drains to the reservoir within the site. The exact route by which Hutchinson's Goit flows back to the Irwell is unknown.
- 2.3.6 Bealey's Goit forms the southern boundary of the site. Bealey's Goit fed former industries and allowed the resultant water to be treated prior to its return to the Irwell. Remnants of the open Goit can be seen to the east of the site. It no longer follows the route shown on the OS mapping; it is diverted back to the Irwell to the east of the site.

2.4 SEWERS

2.4.1 Public Sewers

- 2.4.2 Records obtained from United Utilities (UU) indicate that there are a number of public sewers within the site.

2.4.3 Surface Water Sewers:

- A 600mm diameter sewer in Church St East, which bends 90 degrees and discharges to the river Irwell.
- A 500mm diameter sewer south of Cock Clod Street, that discharges to the river as well. There is also an adjacent 500/300mm surface water sewer to the west of the aforementioned 500 mm sewer.
- A further 450mm diameter surface water sewer is located within Rectory land flowing towards the Irwell, adjacent to the sludge main, discussed in 2.5.4 below.

2.4.4 Combined Sewers:

- A 450mm diameter sewer flows across the site (in Church St East) from east to west.
- A 300mm sewer joins the 450mm sewer at the north-western part of the site.
- A 225mm diameter sewer in Cock Clod St joins the 354mm sewer near the north-western boundary of the site.
- A 150mm sewer joins the 225mm sewer to the west in Cock Clod Street.
- A 600x900 mm sewer in Cross Lane.
- Another 225mm sewer flows from the northern part of the site and joins the 600x900mm sewer.

2.4.5 In addition to the surface water and combined sewers mentioned above, there is a 200mm sludge main flowing alongside the 450mm combined sewer in Church Street.

2.4.6 The UU public sewer records indicate a circular tank with associated pipework between Rectory Lane and Cock Clod Street. This is a storage facility to limit the discharges of the combined sewer overflow into the Crow Trees Farm Brook culvert.

2.4.7 A copy of the sewer records received from UU are included in Appendix C.

2.4.8 Private Sewers

2.4.9 There are no known private sewers within the site.

2.5 GROUND CONDITIONS

2.5.1 Geology

2.5.2 A review of British Geological Survey (BGS) online geological mapping indicates that the bedrock geology of the site overlies a bedrock layer of Pennine Middle Coal Measures which comprises Mudstone, Siltstone, and Sandstone.

2.5.3 BGS online geological mapping indicates that the superficial geology of the site is Glaciofluvial Sheet Deposits comprising sand and gravel.

2.5.4 Previous boreholes from within the site boundary indicate that the water table is approximately 3.6m below ground level and the bedrock is overlain with layers of clay and then layers of sand and gravel.

2.5.5 Hydrogeology

2.5.6 A review of Defra's online 'Magic' mapping indicates that the bedrock aquifers are Secondary A aquifers which comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers.

2.5.7 The superficial aquifers are also classified as Secondary A.

2.5.8 The site area was also designated as a high-risk area with pollution being able to easily be transmitted to groundwater, thus presenting a risk of contamination.

2.5.9 Groundwater Protections Zones

2.5.10 The site does not fall within in Groundwater Source Protection Zones.

2.5.11 Ground Contamination

2.5.12 A large area of the site's south-eastern area was previously used as a landfill site known as Boiler House Landfill and is known to contain contaminants.

2.5.13 A geo-environmental survey from June 2017 identified significant areas of contamination throughout the southern half of the site. Of concern across the entire area was in-ground asbestos, ground gas and elevated levels of lead. Groundwater tests also indicated elevated metal levels and potential hydrocarbon contamination. Hotspots of Semi-Volatile Organic Compounds, Naphthalene, lead, and beryllium were also found.

3.0 FLOOD RISK

3.1 FLUVIAL FLOOD RISK

3.1.1 A floodplain is the area that would naturally be affected by flooding if a river rises above its banks or is inundated by the sea (coastal or tidal flooding). In England, floodplains are divided into flood zones for planning purposes. They are divided as follows, as defined by the EA:

- Flood Zone 1 is land assessed as having a less than 0.1% AEP of river flooding. The risk of flooding is low.
- Flood Zone 2 is land assessed as having between a 0.1% and 1% AEP of river flooding. The risk of flooding is medium.
- Flood Zone 3 is land assessed as having a greater than 1% AEP of river flooding. The risk of flooding is high.

3.1.2 The EA's Flood Map for Planning (Figure 3-1) indicates that the site is located within Flood Zone 1, 2 and 3. The EA Flood Map for Planning has been updated since the 2018 planning application suggesting that EA modelling has been updated since the previous iteration of the report and the flood zone extents now differ. This report provides an updates based on proposed development platforms and climate change estimates as discussed throughout.

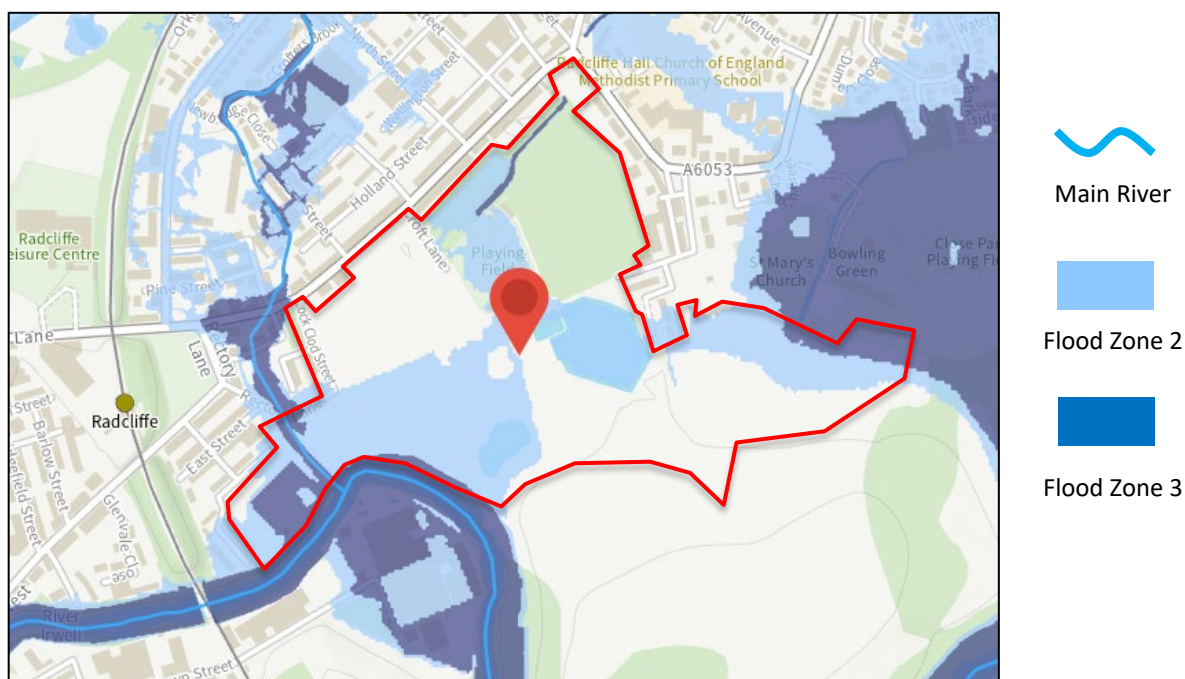


Figure 3-1: Extract of the EA's Flood Map for Planning (Sep 2022)

3.1.3 EA Flood Risk Management Schemes

3.1.4 The Radcliffe and Redvales FRMS consists of two phases on the River Irwell that have been granted planning permission with requirements for a third phase being investigated.

- 3.1.5 Phase 1¹ consists of works at Close Park, Morris Street and Drummer Lane and began construction in June 2019. Phase 2² followed in July 2020 including works from Bury Grammar School to Hardy's Gate Bridge. Phase 1 and 2 consists of the provision of linear defences designed with a 100-year design life to provide protection against a 1% AEP flood with allowance for climate change.
- 3.1.6 The FRA for Phase 2 states that the flood storage area proposed as part of Phase 2 of the Rochdale and Littleborough FRMS is estimated to result in a net decrease in peak flows in the River Roch that will be of sufficient magnitude to offset the increase in peak flows in the River Irwell as a result of the Radcliffe and Redvales FRMS. It also states that if Phase 2 of the Rochdale and Littleborough FRMS was not progressed then a third phase of the Radcliffe and Redvales FRMS would be implemented to provide additional storage.
- 3.1.7 The Rochdale and Littleborough FRMS consists of two phases on the River Roch. Phase 1 has been split into two parts (1A and 1B). Phase 1A was granted planning permission May 2020 and Phase 1B was submitted for planning in April 2022.
- 3.1.8 Phase 1A³ consists of removal of bridges, modifications and repairs to existing floodwalls and linear defences in Littleborough. Phase 1B⁴ consists of linear defences within Littleborough and provision of a flood storage reservoir. Phase 2 includes the provision of three additional flood storage areas in Rochdale.
- 3.1.9 Hydraulic Modelling**
- 3.1.10 The EA provided the 2016 Radcliffe and Redvales hydraulic model on the 14th June 2022. The model was updated by JBA Consulting as part of the Bury South 2016 Modelling study which included incorporating new survey and calibrating the model to the event that occurred in December 2015.
- 3.1.11 The model is linked 1D-2D where Flood Modeller is used to represent the channels in 1D and TUFLOW to represent the floodplain in 2D. Additional 1D elements that integrate with the 2D aspects have been modelled using the TUFLOW 1D solver ESTRY.
- 3.1.12 The model covers the River Irwell extending from its upstream extent in Bury (SD 79572 10304) through Radcliffe and Redvales to its downstream boundary on the Irwell at Sion Weir (SD 77448 06335). The model also includes a section of the River Roch from Blackford Bridge (SD 80724 07792) to its confluence with the River Irwell (SD 80190 07307). The Hutchinson Goit is also included in the model.
- 3.1.13 The model did not include any information on the EA Radcliffe and Redvales Flood Risk Management Scheme (FRMS), nor does it consider the impacts of the Rochdale and Littleborough FRMS.
- 3.1.14 Between June and October 2022, additional hydraulic modelling was completed to represent the updated site layout for detailed design of the drainage and site infrastructure. This included amendments to the compensatory storage area and flow management within the Hutchinson

¹ Radcliffe and Redvales flood defence scheme Phase 1 planning permission reference 63559, Bury Council.

² Radcliffe and Redvales flood defence scheme Phase 2 planning permission reference 64789, Bury Council.

³ Rochdale and Littleborough Flood Risk Management Scheme Phase 1A planning permission reference 20/00082/FUL, Rochdale Borough Council.

⁴ Rochdale and Littleborough Flood Risk Management Scheme Phase 1B planning permission reference 22/00485/FUL, Rochdale Borough Council.

- Goit. The additional modelling followed the principles set for the development within the outline planning application approval.
- 3.1.15 Following completion of the modelling October 2022, the site design was developed by Banners Gate on behalf of Morris Homes.
- 3.1.16 The EA provided an updated version of the Radcliffe and Redvales hydraulic model on the 10th November 2023 which included the Radcliffe and Redvales now included within it.
- 3.1.17 The EA requested that Morris Homes use this updated model to inform the Reserved Matters application, rather than the model issued in 2022.
- 3.1.18 The new model provided included schematisation for the defences from the Radcliffe and Redvales FRMS within it. Following a review of this model and it's flood risk assessment for planning, it was understood that this scheme when viewed in standalone will pass on flood risk downstream in the 1% AEP event +35% Central allowance for climate change.
- 3.1.19 This created a change to the agreed baseline within the outline planning permission and detailed design work over the last 18 months using the older model.
- 3.1.20 However it is understood that once Rochdale and Littleborough FRMS is implemented, the scheme will provide a reduction in >8m³/s on the Roch which will offset the pass forward flow created by the Radcliffe and Redvales scheme. This is outlined within the approved Full planning application reference 22/00485/FUL and cited in report ENV0000389C-MMD-XX-00-RP-MO-1201002-S2-P09-Modelling Report section 9.2.3.
- 3.1.21 It is therefore deduced that the increase in the risk of flooding to the site will be temporary until all phases of the Rochdale and Littleborough scheme have been completed. As a full application has been granted, it has been assumed works will be completed in the short term.
- 3.1.22 To establish a new baseline for the site following the previously approved outline planning application, and interim baseline which was established in 2022, the following scenario has been considered.
- 3.1.23 **Scenario** - the 1% AEP event +35% Central allowance for climate change representing the 2080s baseline with the Radcliffe and Redvales FRMS in place and an 8m³/s flow reduction applied to flows from the River Roch which represent the full completion of the Rochdale and Littleborough FRMS.
- 3.1.24 Both baselines will be used to demonstrate the site can still meet the requirements within its agreed outline planning permission and the NPPF to not pass on flood risk to others.
- 3.1.25 The model has been run using Flood Modeller v6.1 and TUFLOW 2023-03-AB.
- 3.1.26 The baseline model was reviewed, and changes were made to the 1D model in the vicinity of the development site. The deactivation markers for the right bank or the River Irwell between IRWE04_0312 and IRWE03_6041d were changed to match the width of the nulled 2D domain. Conveyance was checked in these sections and panel markers added to refine conveyance curves. An additional interpolate unit was added between IRWE04_0232 and IRWE04_0146.
- 3.1.27 The footbridge represented in the model at IR04_BR0000u that connects Pioneer Mills and Rectory Lane was destroyed during Storm Eva on Boxing Day 2015. Following site visits it was established

that this structure has not been reinstated to date. The structure was removed from the hydraulic model as it is assumed any new structure will be designed to be raised above the flood levels and will have no impact on the modelled flood risk.

- 3.1.28 Within the EA model, the Hutchinson's Goit flow restriction of $1.1\text{m}^3/\text{s}$ has been applied which was a core component of the FRMS. In 2021, it was further agreed with the EA and BC that a smaller orifice plate could be applied to reduce flows to a maximum of $0.5\text{m}^3/\text{s}$. The model has been updated to include this restriction. This evidence trail is included in the East Lancashire Papermills Additional Hydraulic Modelling Report June 2021, section 3.3.1 and Appendix C of that report. A copy of this report is included in Appendix I of this report.
- 3.1.29 The baseline scenario hydraulic modelled result for the 1% AEP event with the 2080s central allowance for climate change is shown in Figure 3-2.

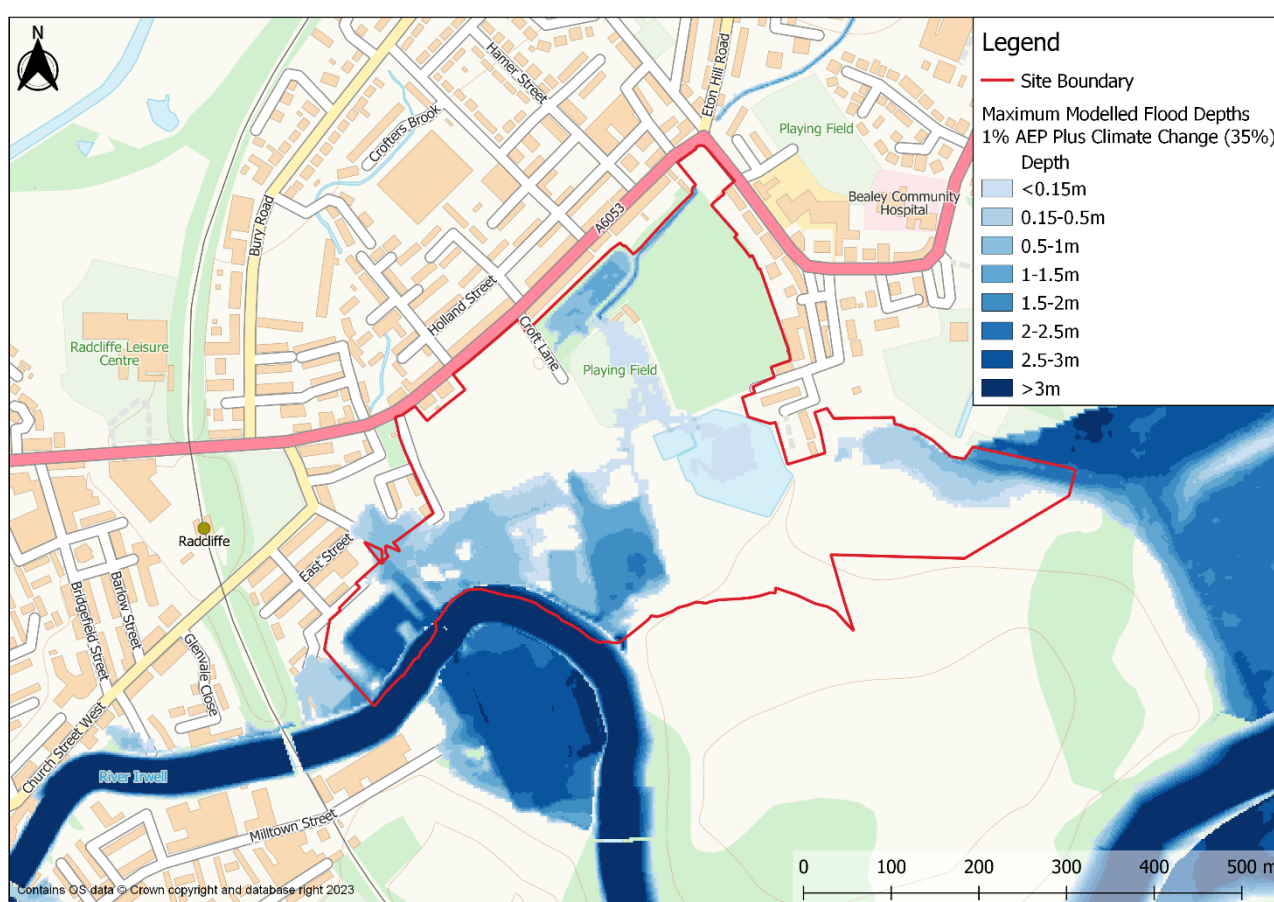


Figure 3-2: Maximum Modelled Flood Depths for the 1% AEP event plus climate change (35%)

- 3.1.30 The model result shows flooding from the River Irwell from both banks in the meander at Pioneer Mills.
- 3.1.31 On the left bank of the River Irwell Pioneer Mills is shown the be at significant risk of flooding in this event with widespread flooding over the entire site with depths modelled approaching 3m covering large parts of the site.
- 3.1.32 On the right bank of the River Irwell part of the former ELPM site are indicated to be at risk of flooding. The modelled flood extents extend north on Rectory Lane as far as Church Street East.

The Hutchinson Goit remains in channel until it goes into culvert upstream of the ELPM Cricket Club. The model also indicates that parts of Bridgewater View are vulnerable to flooding.

3.1.33 Greater Manchester 2015 Boxing Day Flood Investigation Report

- 3.1.34 Radcliffe suffered extensive fluvial flooding during the 2015 Boxing Day floods, with 690 properties flooded and over 3,000 losing power. Additionally, a pedestrian bridge and a gas main that connected the application site with the Pioneer Mills site were washed away.
- 3.1.35 Most of the properties were affected by fluvial flooding, although a small proportion of them suffered from surface water flooding. It was concluded that the flooding was caused by an accumulated rainfall of 128mm over a 36h period on the saturated soils of the Irwell Catchment. Despite the relatively low return period (10 to 15 years) of the rainfall event, the registered river levels were the highest recorded on 37 of the 44 gauging stations within the catchment. It is estimated that the return period of the flows in the Irwell at Pioneer Mills gauging station was between 120 and 180 years.

3.2 CROW TREES FARM BROOK

- 3.2.1 In their letter to BC, the EA indicated that the FRA did not consider appropriately the risk of flooding from Crow Trees Farm Brook.
- 3.2.2 'Cost-recoverable' advice was sought from the EA in order to obtain further clarification on the risk of flooding from the Brook and any detailed modelling requirements. It was indicated in the meeting that although the EA product 4 data imply that a considerable number of existing properties may be subject to flooding in a 5% AEP event, since telemetry and screening at the upstream culvert entry were introduced, there have not been reports of flooding (due to Crow Trees Farm Brook).
- 3.2.3 It was agreed with the EA that further detailed modelling of the culvert is not required if no modifications to the existing culvert are proposed and finished floor levels (and resilience measures if appropriate) are provided for any properties within the zone of influence of flooding from Crow Trees Farm Brook based on the relevant existing EA model data.

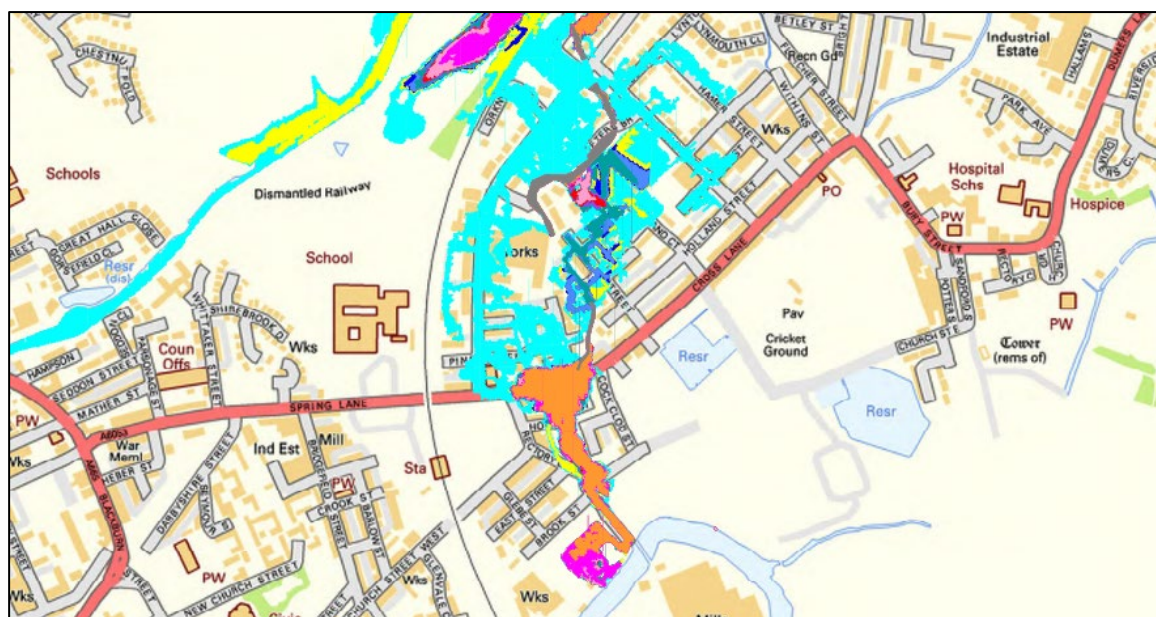


Figure 3-3: Baseline Flood Extents (Nov 2016 EA Modelling Report)

- 3.2.4 Figure 3-3 Shows that the flows are retained within rectory lane. The ground levels at the site boundary on Rectory Lane is 64.11 m AOD and descends to 59.85 m AOD which acts as a flow route for flood flows.
- 3.2.5 For the 35% central allowance the climate change impacts are an increase of 4cm to flood levels at this location which means the flows will still be retained within this existing flow route and is far below the development platform levels proposed in Section 5.
- 3.2.6 The proposed scheme will not change any levels around the Crow Tree Farm Brook, its 8m easement or floodplain and therefore will not be impacted by any flood event which occurs within the 1% AEP + climate change 2080s event.
- 3.2.7 Some flooding does occur along Church Street East but this is limited to the road, the levels of which are constrained by the existing sludge main. These flood extents do not encroach on any of the proposed residential units.

3.3 SURFACE WATER AND OVERLAND FLOWS

- 3.3.1 Surface water flooding can occur during high intensity rainfall events as sheet runoff from fields or hard paved areas. It is particularly prevalent in areas with significant hardstanding or poorly permeable soils (i.e. clay). This is because the grounds capacity for infiltration is reduced. In addition, the inability to enter local drainage systems also contributes to risk from this source. The risk of surface water flooding is divided as follows, as defined by the EA:
- Very low risk means that the annual probability of flooding is less than 1 in 1000 (<0.1%).
 - Low risk means that the annual probability of flooding is between 1 in 1000 (0.1%) and 1 in 100 (1%).
 - Medium risk means that the annual probability of flooding is between 1 in 100 (1%) and 1 in 30 (3.3%).

- High risk means that the annual probability of flooding of greater than 1 in 30 (3.3%).

3.3.2 The EA's Surface Water Flood Map (Figure 3-4 below) indicates that most of the site is in an area of very low risk with a few localised areas of low, medium or risk.

3.3.3 Therefore, the overall risk to the site from surface water flooding is low.

3.3.4 Additionally, there is an overland flow associated to the culverted Crow Trees Farm Brook. This is the only identified overland flow route into the site from external areas.

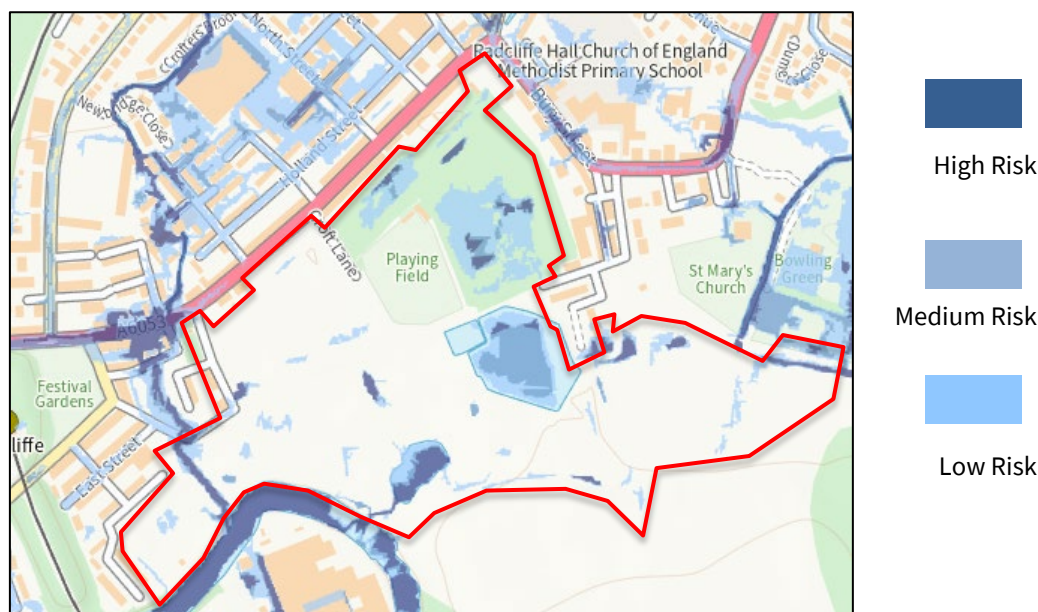


Figure 3-4: Extract from the EA's Risk of Surface Water Flooding Map (Sep 2022)

3.4 GROUNDWATER FLOODING

3.4.1 Groundwater flooding occurs when groundwater emerges at the surface under conditions where the 'normal' range of groundwater levels and groundwater flows is exceeded.

3.4.2 A review of the BC Strategic Flood Risk Assessment (SFRA) indicates that alluvial groundwater flooding could occur alongside some reaches of the River Irwell.

3.4.3 A review of the Preliminary Flood Risk Assessment (PFRA) indicates that the susceptibility of the site to flooding from groundwater is 75% or greater but it is difficult to translate this into risk.

3.4.4 Based on the above, it is concluded that the site is at low risk of flooding from groundwater.

3.5 SEWER FLOODING

3.5.1 Sewer flooding occurs when intense rainfall overloads the sewer system capacity and/or when sewers cannot discharge properly to watercourses due to high water levels. Sewer flooding can also be caused when problems such as blockages, collapses or equipment failure occur in the sewerage system.

3.5.2 A review of the PFRA highlighted that sewer flooding has been recorded in Radcliffe, however no records are shown in the site. Additionally, sewer flooding incidents identified from the DG5 record

and noted in the Surface Water Management Plan (SWMP) were located to Radcliffe; although these are not associated with any specific site.

3.5.3 Therefore, it is considered that the site is at low risk of flooding from sewers.

3.6 RESERVOIR FLOODING

3.6.1 The probability of a catastrophic dam failure is considered to be extremely low. All large reservoirs must be regularly inspected and supervised by reservoir panel engineers under the EA's enforcement of the Reservoirs Act 1975 in England.

3.6.2 A review of the EA's online Extent of Flooding from Reservoirs indicates that the site is located within the reservoir flood extents when river levels are normal and when there is also flooding from rivers as shown in Figure 3-5 below.

3.6.3 Despite this, the overall risk of reservoir failure is low.

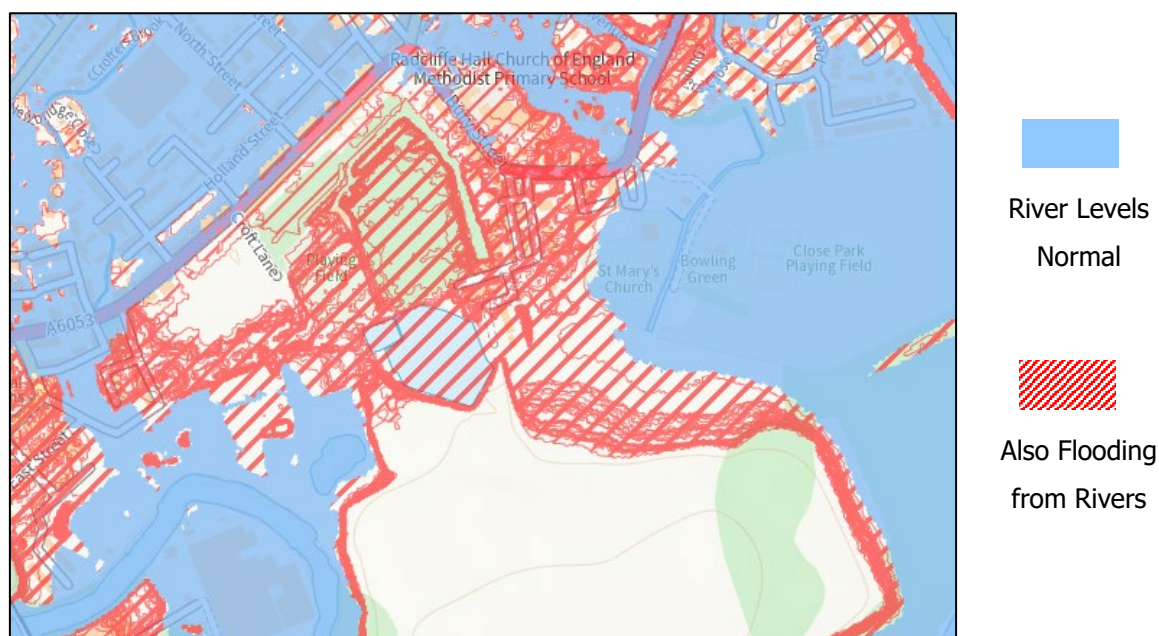


Figure 3-5: Extract from the EA's Risk of Flooding from Reservoirs (Sep 2022)

3.7 CANAL FLOODING

3.7.1 There are no canals on or in proximity to the site and so the risk of flooding from this source is negligible.

3.8 SUMMARY OF FLOOD RISK

3.8.1 A review of flood risk to the site highlighted the following:

- The site is considered to fall within Flood Zone 1, 2 and 3.
- The surface water risk to the site is generally low.
- The risk of groundwater flooding is low.

- The risk of sewer flooding is low.
- The risk of reservoir flooding is low.
- The risk of flooding from canals is negligible.

3.8.2 Based on the above, it can be seen the majority of the site is at low risk of flooding from the River Irwell, surface water, overland flows and sewers. However, the south western quarter of the site, which bounds the River Irwell, and the areas on the route of Hutchinson's Goit are at medium risk of fluvial flooding.

4.0 FLOOD RISK MANAGEMENT AND MITIGATION

4.1 SEQUENTIAL AND EXCEPTION TESTS

- 4.1.1 One of the aims of NPPF is to steer development away from zones of high flood risk towards Flood Zone 1.
- 4.1.2 The proposed development components are classified as either 'More Vulnerable' (dwellings and school), 'Less Vulnerable' (commercial and retail uses) or 'Water Compatible' (ecology, open space and sport areas).
- 4.1.3 Since part of the development is in Flood Zones 2 and 3, then in accordance with Table 3 of the PPG (Flood Risk & Coastal Change), any of the 'More Vulnerable' components of the site located in Flood Zone 2 should pass the Sequential Test; and any in Flood Zone 3 should pass the exception test.
- 4.1.4 The site has the benefit of an Outline Planning approval with an approved Flood Risk Assessment therefore the principle of a 400 units housing development is already established and therefore a further sequential test is not required.

4.2 BURY LOCAL PLAN

- 4.2.1 The Bury Local Plan - Flood Risk dated October 2018 highlights the provision of flood water storage area SuDS as flood risk management measures for new development.

4.3 BURY LOCAL FLOOD RISK MANAGEMENT STRATEGY

- 4.3.1 The LFRMS dated April 2018 includes objective 4 'To ensure that new development in Bury reduces rather than increases flood risk'. The council, as Lead Local Flood Authority, is a statutory consultee on major planning applications.

4.4 SITE RECONTOURING

4.4.1 Original Scheme submitted for planning in 2018

- 4.4.2 It was proposed to recontour the site in order to provide higher ground levels in the areas of proposed residential development, whilst providing a larger area of the site dedicated to functional floodplain and making sure that flood risk elsewhere does not increase as a result of the proposed development.
- 4.4.3 The proposed site recontouring strategy was as follows:
- Increased functional floodplain associated with the River Irwell along the riverside; this will require the removal of existing river walls and replacement with soft engineered solutions;
 - Open up watercourses within the site to create blue corridors and utilise 'soft engineered' solutions to define channels.

- Take due account of the restrictions arising from the landfill above where sports facilities will be located. The former landfill prevents these areas from being lowered as part of the proposals;

4.4.4 Revised Contours (20/21)

4.4.5 The revised hydraulic modelling undertaken as part of the 2018 FRA Addendum in 2018 incorporated the following changes:

- Limitation in inflows from Hutchinson's Goit;
- Amendments to the reservoir operation;
- Removal of floodable gardens; and
- Lowering of public open space along the Irwell.

4.4.6 The contours were revised to maintain a 7m easement from the sludge main and to avoid the loss of floodplain storage.

4.4.7 The areas of open space within the Irwell's floodplain were slightly lowered further to compensate for the reduction in excavations in the area around the sludge main to ensure no difference in volume.

4.4.8 The cut and fill assessment was updated to suit the proposed contours. The assessment indicates that there was a shortfall of material of 3,175 m³.

4.4.9 Revised Contours (2022)

4.4.10 Further revisions were made to the contour plan and are described as follows:

- Small refinements have been made to the island site area to the south of the site moving the same platform area southwards.
- Minor amendments to maximise storage volume for the River Irwell have been made for the Hutchinson Goit channel exiting the Lodge within the compensation area.

4.4.11 Contour level changes from the Outline Application

4.4.12 Within the original application which was approved on 19/12/2018, the 1% AEP plus 2080s climate change allowance was set to +70% rather than in this FRA Addendum of +35%. This change is as a result of the changes in EA climate change guidance.

4.4.13 The +70% uplift for climate change accounted for the Higher Central allowance which was required based on EA guidance for climate change at the time of the outline application.

4.4.14 The EA updated their climate change guidance in July 2021. Their updated guidance reflected greater confidence in the future understanding of climate change to a regional level within catchments. This meant that the Central allowance for climate change could be considered instead and reduced uplift allowance requirement to +35% instead of +70%. In addition with have run sensitivity tests for the Central 2020s +12% and Higher Central 2080s +46% uplift.

4.4.15 Contour levels were updated following hydraulic modelling in 2022 based on the above guidance which was used to inform the detailed design.

- 4.4.16 These have been further updated and refined using the new hydraulic model that was issued by the Environment Agency in November 2023. This model has resulted in some changes to the contours to ensure this scheme is compliant with the NPPF.

4.5 SURFACE WATER MANAGEMENT

4.5.1 Drainage Hierarchy

- 4.5.2 The management of runoff should be considered via a sequential approach, in line with Building Regulations (Part H). The following options for the disposal of runoff should be considered, in order of preference:

- Discharge to an adequate soakaway or some other adequate infiltration system (i.e. to ground);
- Discharge to a watercourse; and
- Discharge to a sewer (surface water before combined).

4.5.3 Discharge to Ground

- 4.5.4 As discussed in Section 2.3, the site's previous industrial and landfill uses have left contaminated ground through the site. Therefore, it is not feasible to use infiltration methods within this site.

4.5.5 Discharge to Watercourse

- 4.5.6 As it is proposed to open up Hutchinson's Goit within the site, this watercourse will provide suitable outfalls for attenuated flows alongside the Crow Trees Farm Brook and the River Irwell.

4.5.7 Discharge to Sewer

- 4.5.8 Discharging surface water runoff into a sewer is the least preferred option and therefore it is not proposed to discharge into the existing UU sewer network.

4.6 PROPOSED SURFACE WATER DRAINAGE STRATEGY

- 4.6.1 The drainage strategy presented by Tetra Tech in version 4 of this report proposed a discharge to watercourse by dividing the site in 5 smaller catchments with Catchment 1 and 2 draining into the Hutchinson's Goit downstream of the reservoir, Catchment 3 draining into the open section of Hutchinson's Goit upstream of the reservoir, Catchment 4 draining into Crow Trees Farm Brook and Catchment 5 draining into the River Irwell due to constraints from the existing sludge main. The drainage network incorporated SuDS elements in the form of attenuation ponds but due to the nature of the development and the constraints on site it was not considered possible to include attenuation ponds in each of the catchments. Additionally, it was not considered possible to manage all the surface water runoff above ground and so underground attenuation was provided.
- 4.6.2 The strategy provided by Tetra Tech has been further developed by Banners Gate with the latest version of the drainage strategy and supporting calculations included as Appendix D.
- 4.6.3 The latest strategy has divided the site into four catchments (as shown in the catchment drawing included as Appendix E) and incorporates the storage potential of the reservoir to minimise the need for underground attenuation tanks. There is now no underground storage proposed in Catchments 1, 2 and 3 but a tank is required in Catchment 4.

- 4.6.4 The location and layout of the attenuation basins have been adapted to account for the reservoir storage and basins are proposed in Catchments 2 and 3 with Catchment 1 draining entirely to the reservoir.

4.7 EXISTING AND PROPOSED DEVELOPMENT AREAS

- 4.7.1 The application site covers an area of 20.92 Ha and is currently greenfield in terms of surface hydrology.
- 4.7.2 It is proposed to provide a significant area of the site, approximately 9.33 Ha of land alongside the River Irwell, Bealey's Goit and the former landfill dedicated to public open space (POS); part of this area will become functional floodplain. Therefore, only the remaining 11.59 Ha will be dedicated to residential development.
- 4.7.3 Table 4-1 below includes an indication of the estimated developable area within each catchment.

Table 4-1: Developable Areas

Catchment	Total Developable Area (Ha)
1	5.15
2	3.49
3	2.70
4	0.25
Total	11.59

- 4.7.4 The developable areas have been assumed to be 60% impermeable.

4.8 DISCHARGE RATES & ATTENUATION REQUIREMENTS

- 4.8.1 The greenfield runoff rates for the site have been obtained using the online UK SUDS Tool using the IH124 method. This method has been used because it is referenced in the SuDS manual and has been previously been accepted as the approach for this site. The results per catchment are shown in Table 4-3 below.
- 4.8.2 As agreed at planning stage, in order to prevent an increase to the off-site flood risk discharge rates from impermeable areas will be restricted to their greenfield Q_{BAR} rates.
- 4.8.3 The Q_{BAR} discharge rate calculated by Tetra Tech is 7.55 l/s/ha and the greenfield runoff calculations are included as Appendix F.
- 4.8.4 It is required to ensure that that there is no flooding within the site during any rainfall event up to and including the 3.33% AEP event; and that any flooding up to and including the 1% AEP plus 45% climate change event can be retained within external areas.
- 4.8.5 Due to the topography of the site, it is not possible to retain exceedance flows within the site and so attenuation will need to be provided for the 1% AEP + 45% climate change event.
- 4.8.6 The attenuation calculations previously conducted by Tetra Tech show that across the entire site 5111m³ is required to provide storage for the 1% AEP + 45% climate chan event.

- 4.8.7 This discharge rates used across the new catchments and the attenuation provided within the latest drainage strategy provided by Banner Gate are shown in Table 4-2. This strategy provides 5230m³ of attenuation and therefore exceeds the previously calculated attenuation requirements.

Table 4-2: Proposed Discharge Rates

Catchment	Total Developable Area (Ha)	QBar (l/s)	Attenuation Provided (m ³)
1	5.15	38.9	2700
2	3.49	26.3	1380
3	2.70	20.4	1050
4	0.25	1.9	100

- 4.8.8 The drainage plan with the discharge rates and attenuation volumes and supporting calculations are included in Appendix D.
- 4.8.9 This is subject to detailed design and consideration of the full levels strategy and detailed drainage design to the outfall location.

4.9 CONSTRUCTION AND FUTURE MAINTENANCE

- 4.9.1 Details of how surface water runoff and potential pollution can be managed for any potential development will be detailed and managed by the appointed Contractor for any works in a Construction Environmental Management Plan (CEMP) or similar.
- 4.9.2 Any future drainage system should be maintained by the client or an appointed management company as part of the overall maintenance of the site. Details of the maintenance requirements of different SuDS elements are included in Section 5 below.

4.10 EXCEEDANCE FLOW ROUTES

- 4.10.1 In setting the final external levels for the development it is important to ensure that if flows in exceedance of the 1% AEP plus 45% allowance for Climate Change storm event occur or a failure of the site surface water drainage system occurs, suitable overland flood routes are provided within the development to ensure no localised flooding of the buildings occurs within the development.
- 4.10.2 It is therefore proposed to direct overland surface water flows towards the watercourses. The site levels and layout will be set in order to retain the 1% AEP plus 45% CC flow within the site.

4.11 RESIDUAL FLOOD RISK

- 4.11.1 If the above mitigation measures are provided as part of the development, it is considered that the primary residual failure would be as a result of some type of failure of the site drainage system during the life of the development. Regular, ongoing maintenance will therefore be required to ensure that the capacity of the system is maintained as it has been designed.

- 4.11.2 In addition, as discussed above there remains a residual risk of a storm event that exceeds the capacity of the drainage system, as events beyond the 1% AEP storm event plus 45% allowance for Climate Change will not be catered for explicitly.

5.0 HYDRAULIC MODELLING

5.1 PROPOSED ELPM DEVELOPMENT HYDRAULIC MODELLING

- 5.1.1 Hydraulic modelling was undertaken at the outline planning stage with additional work undertaken in June 2021⁵. This report can be found in Appendix I.
- 5.1.2 The earlier scheme proposed has been adapted to incorporate design changes to improve the efficiency of the proposed scheme.
- 5.1.3 The EA hydraulic model has been adapted to represent and simulate flooding post development. This was completed in 2022 and issued to Banners Gate to complete detailed design. The design followed the principles set within the outline planning application to provide a freeboard allowance on finished floor levels of 600mm.
- 5.1.4 Following the release of the updated hydraulic model in November 2023, this design has been reviewed in light of the changes in flow condition which the site will now need to accommodate.
- 5.1.5 The development has been represented in the hydraulic model with a scenario that includes the proposed development represented with a new 2D model surface replacing the LiDAR data that representing the existing ground levels.
- 5.1.6 Upstream of the Lodge Reservoir a new section of channel that ties into the existing open section of the Hutchinson Goit has been represented using a trapezoidal channel 6m wide with a base width of 3.2m and 1 in 2 side slopes with bank elevations 0.7m above the bed.
- 5.1.7 This new open channel section is connected to the Lodge via a 600 x 1800mm box culvert. The upstream invert level is set to 66mAOD with the downstream invert at 65.5mAOD. The top water level (TWL) in the Lodge has been reduced to 65.5mAOD. The bathymetry within the Lodge has been represented using the APEM survey data from April 2022⁶.
- 5.1.8 To the south of the Lodge a new culvert with an invert level at 65.5mAOD and control chamber has been represented and is connects to a new section of open channel with a bed level of 62mAOD and the same channel cross section as upstream of the Lodge. This new channel flows to the south west, outfalling to the River Irwell in the same location as the disused Bealey's Goit outfall.
- 5.1.9 The land in the floodplain of the River Irwell has been reprofiled with compensation storage areas lowered from 58mAOD on the right bank of the River Irwell sloping to the development platform.
- 5.1.10 To link the compensatory storage area with the River Irwell, the River Irwell wall which delineates the eastern half of the site will be lowered to bed level and channel sides battered back to a 1 in 3 slope to the level of the compensatory storage area level. This follows the agreed principle within the outline planning application.

⁵ Proposed Residential Development, Former East Lancashire Paper Mills, Radcliffe, Additional Flood Modelling Report, Tetra Tech. June 2021.

⁶ APEM (2022). East Lancashire Paper Mill Lake Surveys. APEM Survey Report P00007490. Homes England and Bury Council, April 2022, v2.0 Final, 51 pp.

- 5.1.11 Investigation was completed if lower parts of the wall could be retained however due to lack of foundations and poor condition, risk of collapse into the river was high leading the decision to fully remove the wall to bed level.
- 5.1.12 A similar exercise to demolish and remove the wall in the northern extent of site was completed by Homes England in 2021 as the wall was collapsing into the river. The proposed design mimics that removal and channel side design.
- 5.1.13 Towards Rectory Lane gabion baskets at an elevation of 61.6mAOD have been represented. The design arrangement drawing of the gabion baskets is provide in Appendix J.
- 5.1.14 To the east of the site there are three constraints where existing ground levels cannot be altered. These are the UU Sludge Main, the Crow Trees Farm Brook culvert and the land where the replacement Milltown Street Footbridge will be constructed. In these areas contours from LiDAR Composite DTM 2020 were extracted at 0.5m intervals and incorporated into the proposed surface.
- 5.1.15 Downstream of this the main flood compensation level is set at 61mAOD stepped down in 1m increments to 59mAOD.
- 5.1.16 Figure 5-1 shows the modelled development surface.

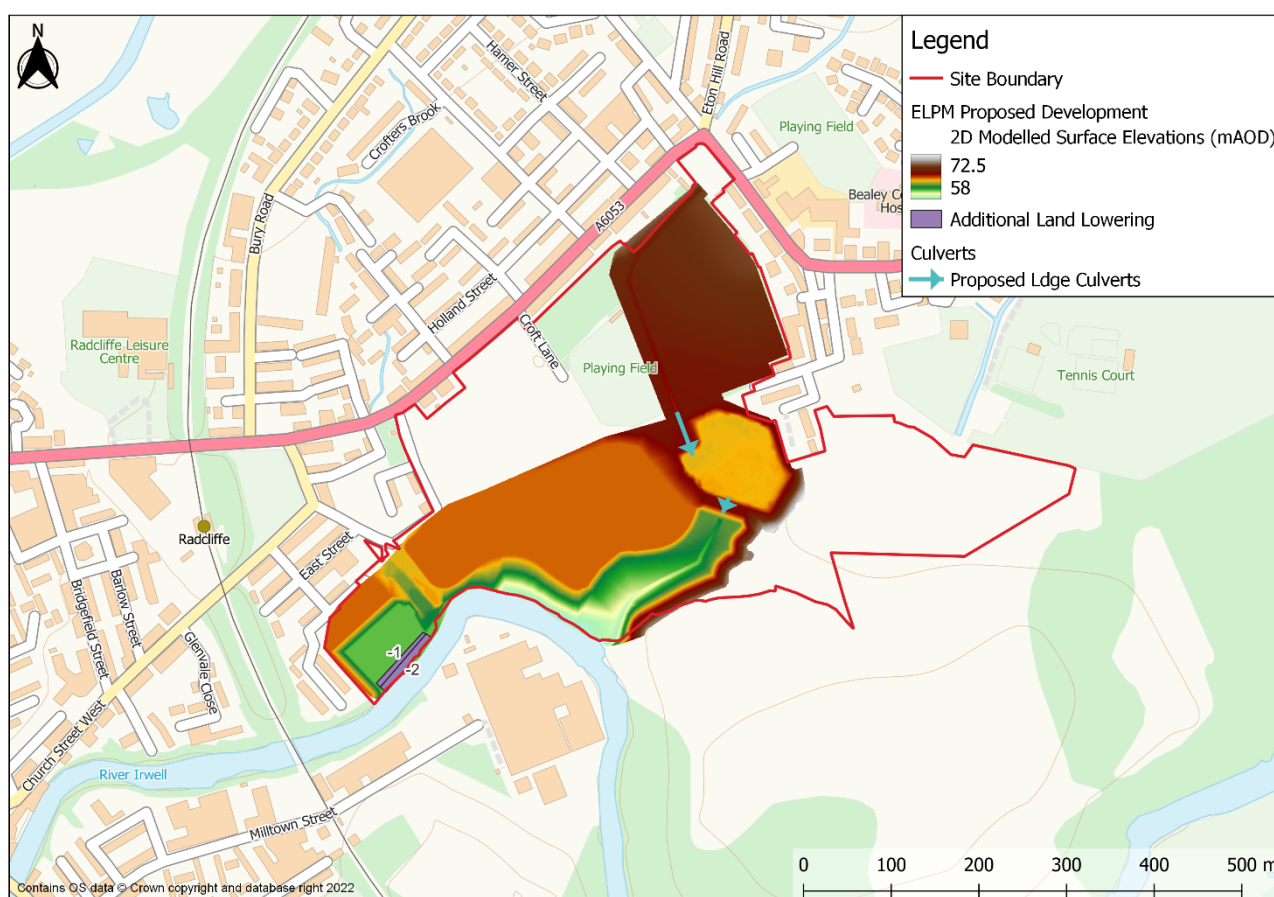


Figure 5-1: ELPM proposed development model surface.

- 5.1.17 Figure 5-2 shows the results from the development scenario and Figure 5-3 shows the difference in modelled depths and extents between both scenarios.

- 5.1.18 The results show where the modelled flood extent has changed. This is confined to the right bank of the River Irwell and is related to the reprofiling of the site and the diversion of the Hutchinson Goit.
- 5.1.19 As indicated in Figure 5-3 the area outside of the site the proposed development has a negligible impact on the modelled flooding.
- 5.1.20 Within the ELPM site the modelled flood depths are shown to increase in the areas where the floodplain has been lowered to offer compensatory storage. Flood extents have changed where land has been raised or lowered as part of the development proposals.
- 5.1.21 On the Hutchinson Goit change is limited to the reach where diversion of the watercourse has been simulated.
- 5.1.22 Figure 5-4 shows a long section of the River Irwell from confluence with the River Roch to Railway viaduct downstream of the site. This result shows the difference in maximum modelled results with the baseline result is indicated in blue and the development in red. The plot indicates a negligible difference in maximum modelled water levels in this reach of the River Irwell. Towards the railway viaduct there is a marginal reduction in maximum water levels in the development scenario.
- 5.1.23 The results carried forward from the 2022 model indicate a maximum modelled water level of 64.7mAOD on the River Irwell for the 1% AEP plus 2080s central climate change allowance (35%) event. Therefore, FFLs for design were set at a minimum of 65.3mAOD which includes a 600mm freeboard. This is in accordance with the Environment Agency's 'Using peak river flow allowances for flood risk assessments' guidance which proposes use of the Central allowance for more vulnerable developments.
- 5.1.24 Following the revised model issued by the Environment Agency in November 2023 the assessment flood levels are now slightly higher than previously reported, standing just below at 64.8mAOD at their peak.
- 5.1.25 FFLs for the detailed design have now been raised to 65.4mAOD, at their lowest, to maintain the 600mm freeboard previously agreed.
- 5.1.26 It should also be noted that the flow reduction applied by the Rochdale and Littleborough scheme is stated as minimum 8m³/s, and therefore could be greater. It has not been confirmed what the final flow reduction will be above this so has been modelled at 8m³/s to avoid over predicting the impact. Any increase in this figure would reduce the flood levels at the site.
- 5.1.27 On the Hutchinson Goit modelled water levels for the 1% AEP plus 2080s central climate change allowance (35%) event have been modelled by Banners Gate as 66.76mAOD. FFLs for this part of the site should be a minimum of 67.36mAOD.
- 5.1.28 Sensitivity testing was undertaken to test for further increase in climate change by assessing the Higher Central 2080s Uplift of +46%. Figure 5-5 indicates flooding does now occur on the development platform but depths are shallow, less than 150mm.
- 5.1.29 Additional sensitivity testing was undertaken to test the impact of not reducing the flow into the River Roch as part of the Rochdale and Littleborough Flood Risk Management Scheme. Sensitivity

testing assessed the 1% AEP +35% and 1% AEP +12% climate change events. Figure 5-6 and Figure 5-7 show that even if the scheme were not implemented the platform would not flood.

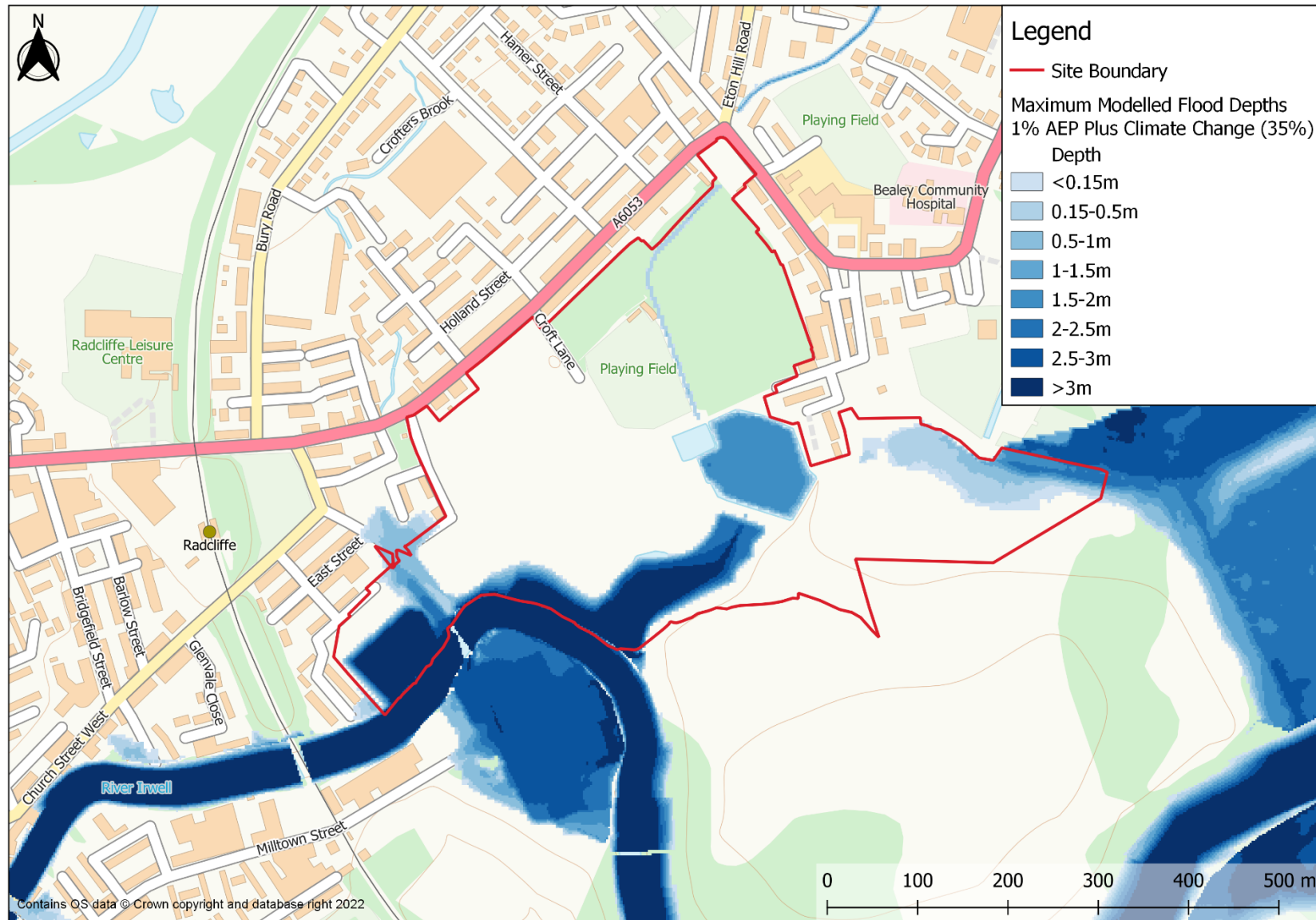


Figure 5-2: Maximum Modelled Flood Depths for the 1% AEP event plus climate change (35%).

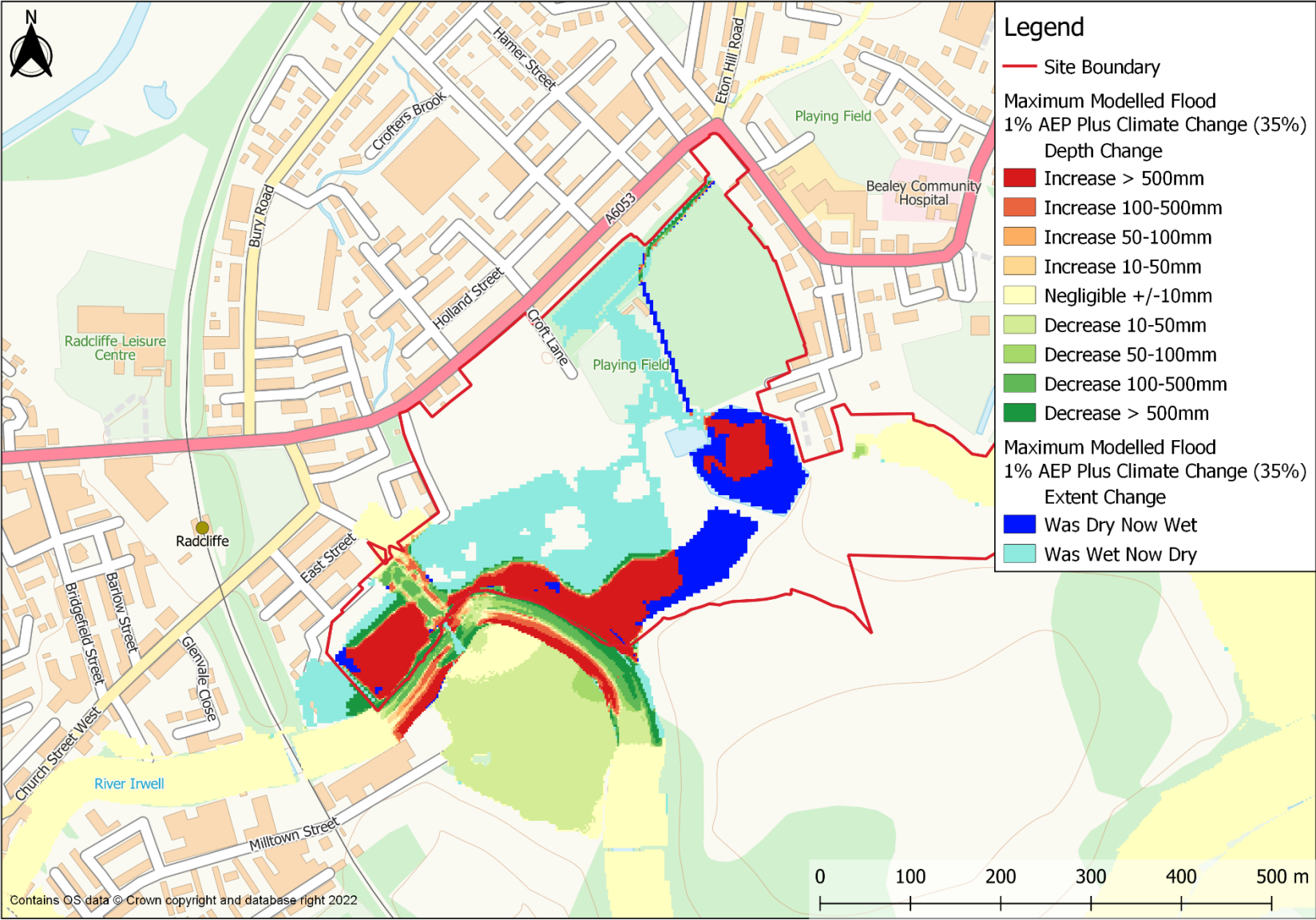


Figure 5-3: Modelled Flood Difference for the 1% AEP event plus climate change (35%).

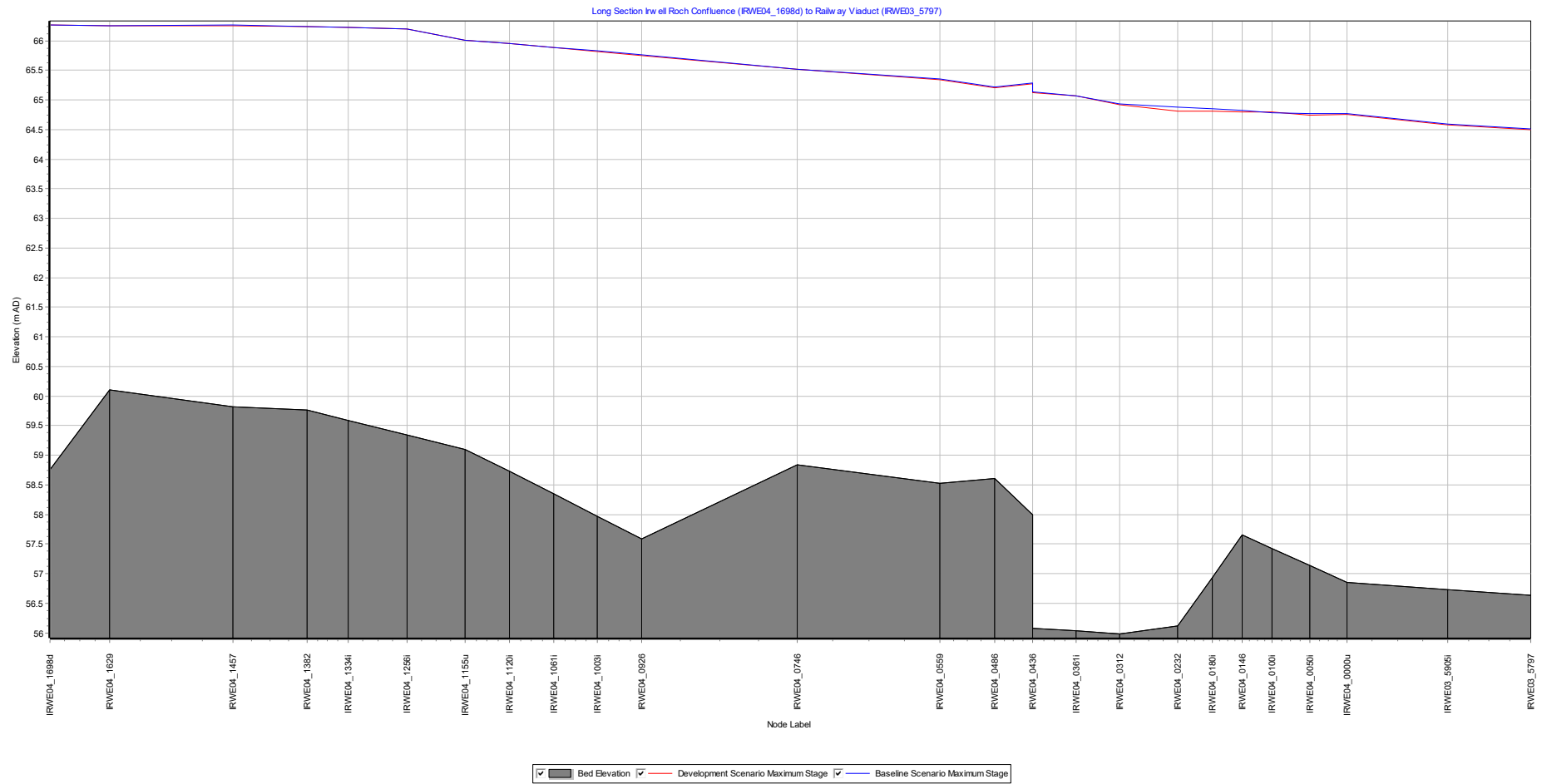


Figure 5-4: Long section of maximum modelled water levels in the River Irwell for the 1% AEP plus climate change (35%) event.

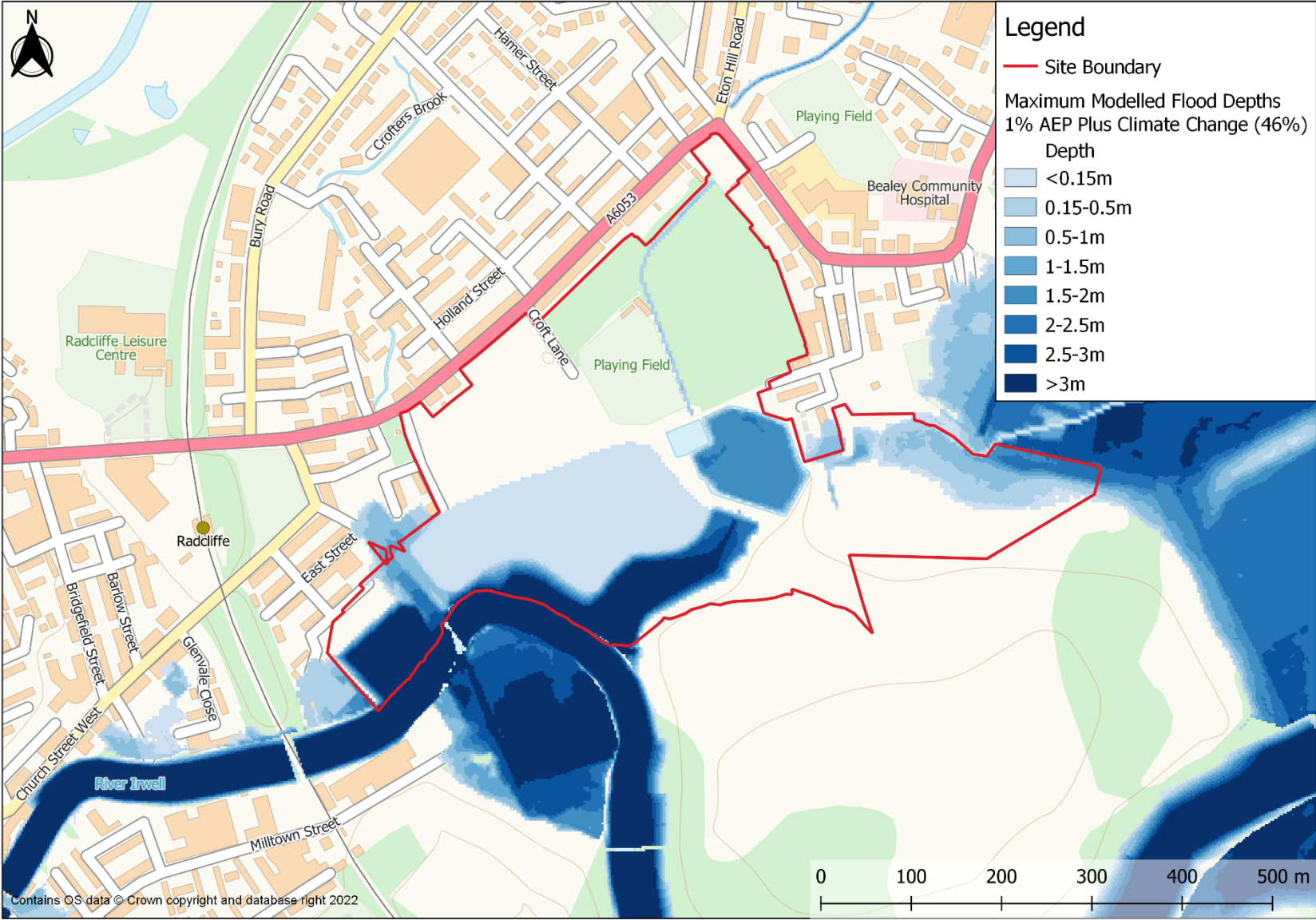


Figure 5-5: Maximum Modelled Flood Depths for the 1% AEP event plus climate change (46%).

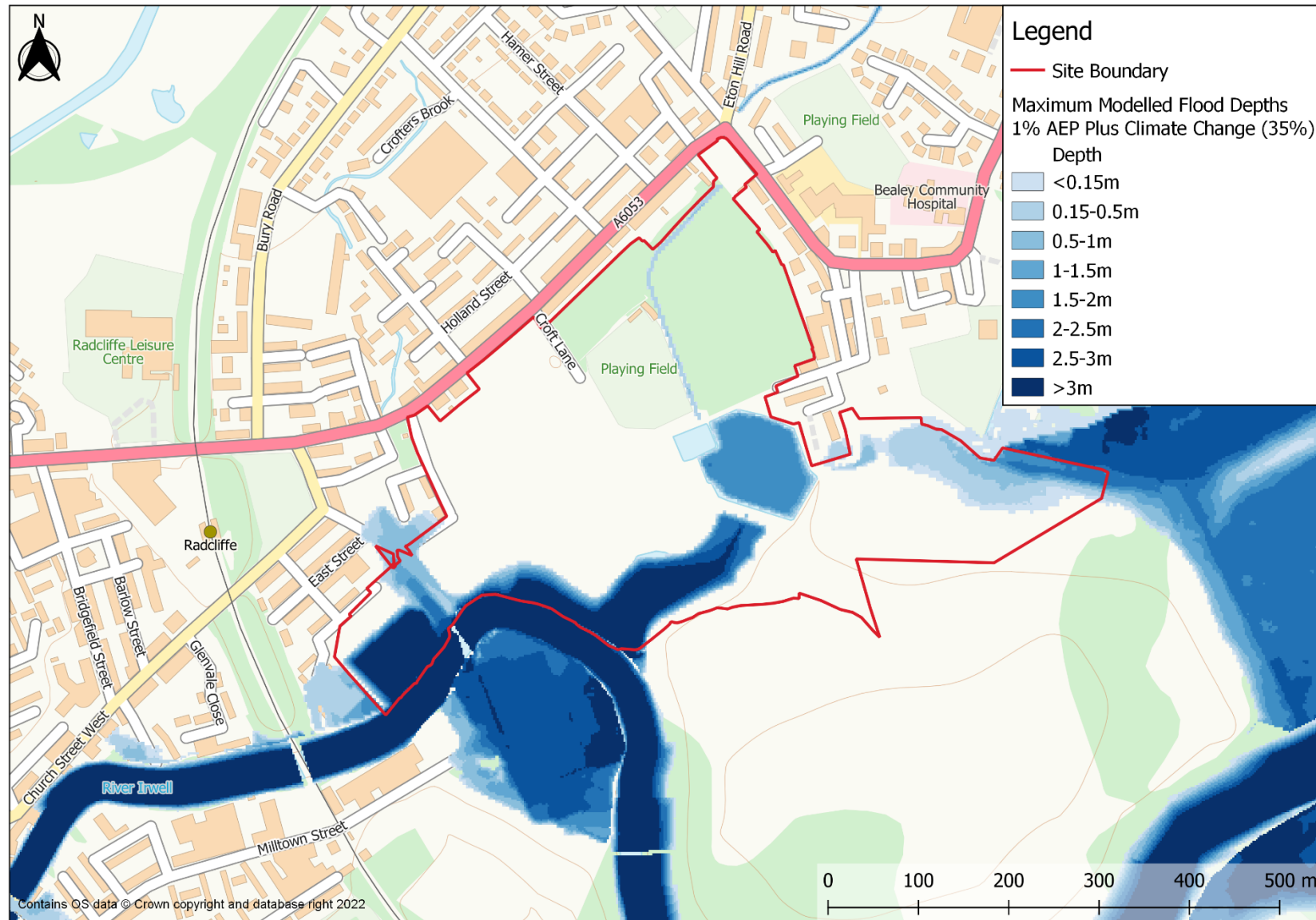


Figure 5-6: Maximum Modelled Flood Depths for the 1% AEP event plus climate change (35%) without River Roch Reduced Flow

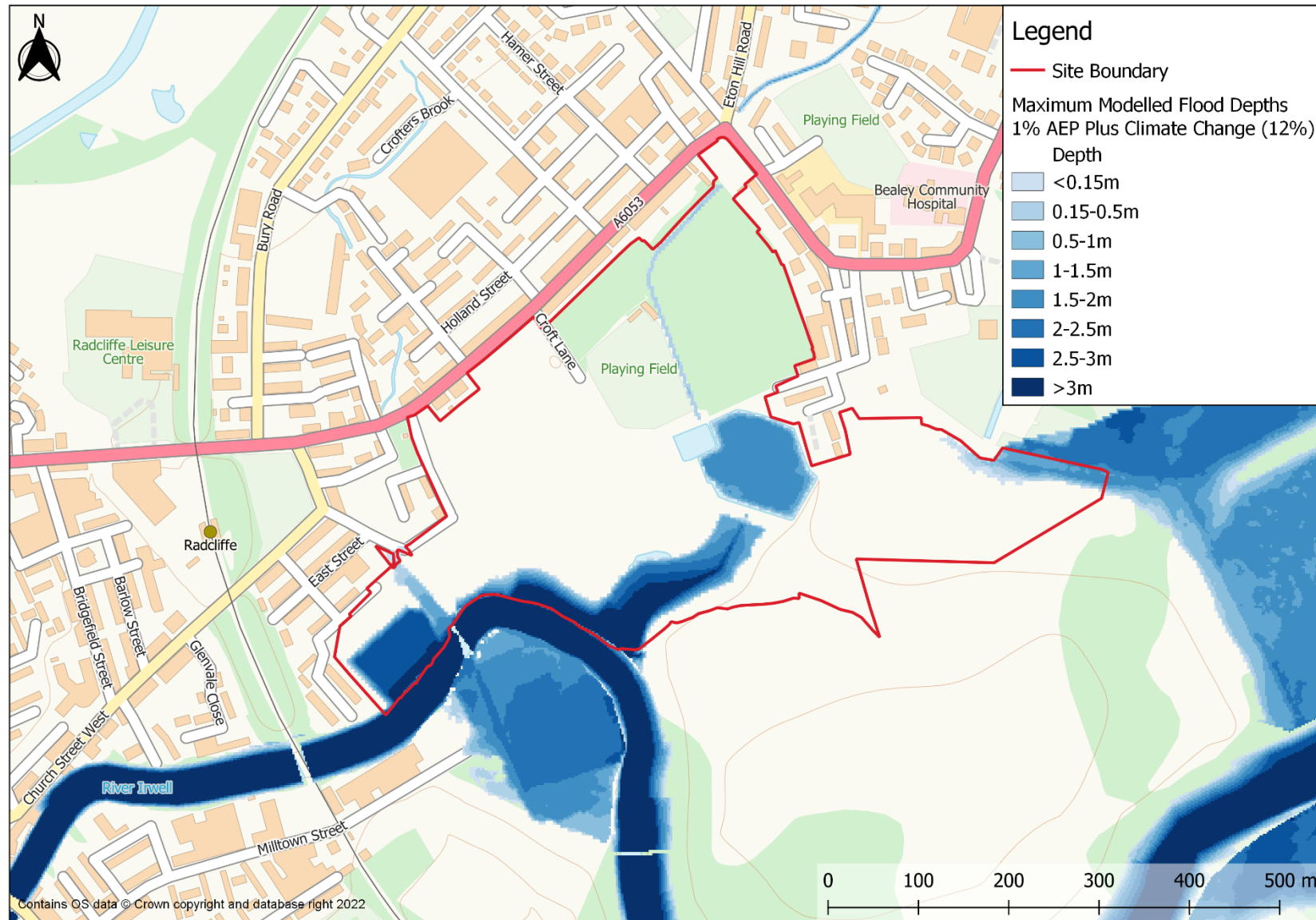


Figure 5-7: Maximum Modelled Flood Depths for the 1% AEP event plus climate change (12%) without River Roch Reduced Flow

6.0 SUSTAINABLE DRAINAGE

6.1 REVIEW OF SUDS OPTIONS

- 6.1.1 In order to comply with the national guidelines and policies set by the EA and the Non-Statutory Technical Standards for Sustainable Drainage, the design of the surface water drainage system should seek to maximise the use of SuDS techniques.
- 6.1.2 This section reviews the suitability of the different SuDS elements available for the application site.
- 6.1.3 As stated previously, where it is possible and viable, it is proposed to incorporate a fully compliant SuDS drainage system to deal with the discharge of surface water from the proposed development.

6.2 THE SUDS MANAGEMENT TRAIN

- 6.2.1 The main purpose of SuDS is to manage the surface water runoff generated by a development within the development site, attenuating additional flows generated by the introduction of impermeable areas whilst providing water quality treatment to the runoff and amenity and landscape benefits to the community. SuDS features can be categorised as follows:

6.2.2 Source Control - Manage Runoff at its Source:

- Water butts, green/brown roofs, permeable pavements, rainwater harvesting systems, bio-retention systems.

6.2.3 Site Control - Manage Runoff Generated by a Wider Area

- Swales, ponds, infiltration devices, filter strip, French drains.

6.2.4 Regional Control - Manage Runoff Generated by Several Sites

- Basins, ponds and wetlands.

- 6.2.5 The following (Figure 6-1) is an illustration of the SUDS principles and how they may be applied to a development via a SuDS Management Train.

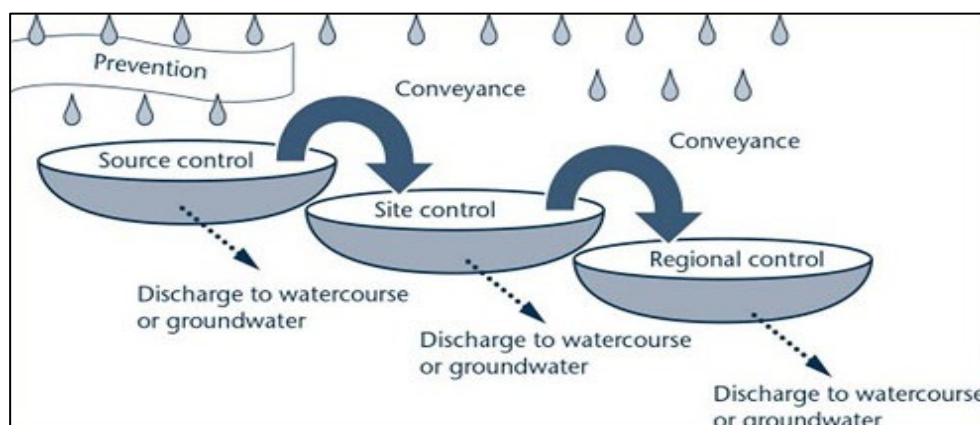


Figure 6-1: SuDS Management Train.

6.2.6 Table 6-1 below summarises the suitability of the different SuDS elements for the proposed development.

Table 6-1: Suitability of SuDS to the Development

Type of SuDS	Description	Applicability to the Site
Source Control		
Water Butts	Small storage tanks on each individual housing plot.	This may be appropriate for the site.
Rainwater Harvesting	Recycling of water from roofs and impermeable areas.	This is not appropriate for the site.
Green Roofs	Vegetated roofs that reduce runoff and remove pollutants.	This is not appropriate for the site.
Permeable Surfaces	Access roads and site compound formed by compacted crushed aggregate.	This may be appropriate for the site.
Rain Gardens & Bio-retention Systems	Shallow depressions with free draining soil and planted with vegetation that withstands occasional flooding.	This may be appropriate for the site.
Site and Regional Control		
Filter drains	Linear drains or trenches filled with granular material that allow infiltration to the surrounding ground.	This is not appropriate for the site.
Swales	Vegetated channels to convey, store and treat runoff.	This is not appropriate for the site.
Detention Basins & Ponds	Shallow areas of open space that temporarily hold water and collect silt.	This is appropriate for the site.
Infiltration Basins	Shallow depression that stores runoff before it infiltrates into the subsoil.	This is not appropriate for the site.
Infiltration Devices	Generally granular trenches or soakaways that store water and allow infiltration to the surrounding ground.	This is not appropriate for the site.

6.2.7 Based on Table 6-1 above, Detention Basins and Ponds are the most appropriate SuDS feature for the site.

6.3 PROPOSED SUDS PRINCIPLES

6.3.1 As explained above, the strategy will be based on providing a series of Detention Ponds and Underground Attenuation and swales (watercourse improvements) throughout the site and improvements to the watercourse network. The following section sets out in more detail the most appropriate SuDS elements for the development:

6.3.2 Water Butts & Rainwater Harvesting

6.3.3 The use of water butts and rainwater recycling in individual dwellings should be promoted in the design of the individual housing units where possible to further reduce run-off and minimise water consumption but will be explicitly catered for in this strategy.

6.3.4 Attenuation Basins

- 6.3.5 Detention basins will be provided within Catchments 2 and 3 to help provide the required attenuation volume. The detention basins will discharge to the watercourses at controlled rates. The basins will provide an element of pollution treatment to the discharge.

6.3.6 Watercourse Improvements

- 6.3.7 In addition to the 'traditional' SuDS elements mentioned above, it is proposed that the main watercourses within the site will be improved. Sections of Hutchinson's Goit will be opened up and set in 'blue' corridors with 'soft engineering' techniques employed to define channel boundaries. This can be considered as a SuDS element, given that the upgrades will provide greater drainage capacity, enhanced landscape features and water quality and biodiversity benefits.
- 6.3.8 In order to comply with the national guidelines and policies set by the EA and the Non-Statutory Technical Standards for Sustainable Drainage, the design of the surface water drainage system should seek to maximise the use of SuDS techniques.

6.4 WATER QUALITY

- 6.4.1 The SuDS design should seek to provide an appropriate management train of SuDS components to effectively mitigate the pollution risks associated with the site users.
- 6.4.2 Within this development, there are two key drivers in respect of pollutant risks to the receiving downstream sewer systems, these being pollution from vehicle parking areas and pollution from highways.
- 6.4.3 In accordance with Table 26.2 of The SuDS Manual CIRIA C753, the pollution hazard level of the entire site is 'Low' for the proposed land use. Therefore, the requirements for discharge to surface waters state that the 'Simple index approach' should be used. Step 1 of the simple index approach is to identify the pollution hazard indices for the proposed land use as set out in Table 6-2 below.

Table 6-2: Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbon
Low Traffic Roads	Low	0.5	0.4	0.4

- 6.4.4 Step 2 of the simple index approach is to select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index. Provided that the mitigation indices of the treatment techniques are greater than or equal to the hazard indices for the proposed development then there should be no reduction in the overall water quality within the receiving system.
- 6.4.5 Treatment will be provided through the provision of attenuation basins in Catchments 2 and 3, In Catchments 1 and 4, treatment will be provided through an interceptor tank. Table 26.3 of The SuDS Manual states the various mitigation indices for discharges to surface waters. The mitigation indices for detention ponds are shown below in Table 6-3.

Table 6-3: SuDS Mitigation Indices

SuDS Component	Total Suspended Solids (TSS)	Metals	Hydrocarbon
Detention Basin	0.5	0.5	0.6

- 6.4.6 Based on Table 6-3 above, it is shown that runoff from the roads, which will go through the detention ponds will receive sufficient treatment.
- 6.4.7 Catchments 1 and 4 will receive the required treatment through the use of an interceptor tanks. The specifications of the required product will be determined by the pollution hazard indices in Table 6-2.
- 6.4.8 Although possible options have been stated, alternative SuDS options may also be considered during the detailed design stage which achieves or exceeds the water quality objective.

6.5 DRAINAGE AND SUDS MAINTENANCE

- 6.5.1 As stated previously, where it is possible and viable, it is proposed to incorporate a fully compliant SuDS drainage system to deal with the discharge of surface water from the proposed development.
- 6.5.2 If Bury Council or United Utilities do not adopt any site wide SuDS, maintenance of the drainage system will be the responsibility of individual homeowners or a management company if appointed. Where a site wide management company is appointed this will be funded by the residents or site owners and the requirement to fund the management company shall be written into the deeds of each property.
- 6.5.3 A summary of the general maintenance requirements for the proposed SuDS elements is shown in Table 6-4 below.

Table 6-4: SuDS Maintenance Requirements

Type of SUDS	Maintenance Task	Frequency
Ponds and Basins	Remove litter and debris	Monthly
	Cut grass & vegetation management	Monthly in Spring and Summer or as required
	Inspect inlets, outlets and structures	Every 12 months
	Remove sediments from inlet and outlet	
	Prune and trim trees	
	Remove sediments from main basin	Every 5 years
	Repair erosion and other damages	As required
	Relevel surfaces	

- 6.5.4 As part of any future reserved matters applications then a full and specific inspection and maintenance schedule shall be provided identifying who will be responsible for each SuDS element and the proposed inspection and maintenance schedules.

7.0 FOUL DRAINAGE ASSESSMENT

7.1.1 Existing Foul Sewers

7.1.2 As discussed in Section 2 above, there are a number of combined sewers within and near the site.

7.1.3 A copy of the sewer records received from UU are included in Appendix C.

7.1.4 Proposed Foul Drainage

7.1.5 Based on a peak foul flow of 0.0462 l/s per dwelling as specified in Sewers for Adoption, the proposed development of 400 dwellings has been estimated to discharge foul water at a maximum of 18.5 l/s.

7.1.6 In a predevelopment response dated 12th December 2016, United Utilities confirmed that a foul water connection would be permitted to their existing system at any convenient point and at an unlimited flow rate. This was for a maximum of 450 dwellings at 21 l/s and therefore it is assumed that the lower rate of 18.5 l/s would also be acceptable.

7.1.7 Foul flows from the majority of the proposed dwellings will be discharged to the 450mm diameter combined sewer going through the site or to the sewers in Cross Lane.

7.1.8 This will be through a foul sewer system separate from the surface water drainage network.

7.1.9 The response provided by UU is included in Appendix G.

8.0 CONSENTS REQUIRED

8.1.1 Land Drainage Act 1991

8.1.2 Any modifications to the ordinary watercourses within the site that may affect the flows or the channel and any new outfalls into a watercourse will need to obtain Land Drainage Consent as per Section 23 of the Land Drainage Act 1991.

8.1.3 The proposed works to Hutchinson's Goit will require to be consented under the LDA 1991.

8.1.4 Environmental Permit

8.1.5 Any activity within 8m from a Main River needs to be consented by the EA. The following activities will require environmental permits:

- Amendments to the banks of the River Irwell;
- Extension and improvement of the functional floodplain of the River Irwell; and

8.1.6 Section 106 Water Industry Act 1991

8.1.7 Any new connection to the United Utilities public sewer system will require a Section 106 application under the Water Industry Act 1991.

8.1.8 Section 104 Water Industry Act 1991

8.1.9 It is anticipated that the on and off site sewers will be put forward for adoption under Section 104 of the Water Industry Act 1991 and technical approval will be required for these sewers.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 CONCLUSIONS

- 9.1.1 This report has identified the following conclusions:
- 9.1.2 The development site is shown on the EA Statutory Flood Maps for Planning as being partly in Flood Zones 1, 2 and 3.
- 9.1.3 The outline planning application consisting of up to 400 dwellings, sports pitches, landscaping and infrastructure has already been granted with a requirement to discharge conditions.
- 9.1.4 The application site is mostly considered greenfield in terms of surface hydrology, although the site has been used for different industrial purposes since the 1800s and is therefore brownfield from a planning perspective.
- 9.1.5 The proposed development components are classified as either 'More Vulnerable' (dwellings) or 'Water Compatible' (sports pitches and open space areas) in accordance with Table 2 of the PPG (Flood Risk & Coastal Change).
- 9.1.6 It is proposed to locate residential development within areas shown as being in Flood Zones 2 and Flood Zone 3 on the EA Flood Map for Planning. However, as the site has been allocated into the Bury Council Local Plan, it is not required to provide a site specific Sequential Test according to Table 3 of the PPG (Flood Risk & Coastal Change).
- 9.1.7 Detailed hydraulic modelling has been undertaken and ensures that development platforms have been set above the 1% AEP plus 35% climate change flood level.
- 9.1.8 The nearest main river to the application site (as listed on the EA Flood Map for Planning) is the River Irwell, which forms the south-western boundary of the site. Crow Trees Farm Brook is also classified as a main river and flows culverted under Radcliffe and through the western part of the site.
- 9.1.9 Hutchinson's Goit flows through the north-eastern part of the site discharging into a water body within the site. Bealey's Goit within the site and along the southern site boundary is now abandoned. Both are manmade watercourses that were originally created to abstract and return water from the River Irwell as part of former industrial activities.
- 9.1.10 The site is shown as being at low risk of flooding from groundwater; and at very low risk of flooding surface water, sewers and reservoir failure.
- 9.1.11 It is proposed to recontour the land within the site in order to provide additional area of functional floodplain while raising ground levels within the areas of proposed residential dwellings.
- 9.1.12 It is proposed to open up the section of Hutchinson's Goit that is culverted through the site and create a 'blue' corridor.
- 9.1.13 There is contaminated land within the site as a result of the previous industrial and landfill uses and therefore the ground is not suitable for infiltration.

- 9.1.14 A combination of attenuation ponds, underground storage and existing available storage in the reservoir will provide the required attenuation volume to make sure that no flooding takes place during any rainfall event up to and including the 1% AEP plus 45% event.
- 9.1.15 It is proposed to dispose of foul flows to the UU public sewers in within the site. United Utilities have confirmed that there is adequate capacity to accept the foul flows into the local sewer network.

9.2 RECOMMENDATIONS

- 9.2.1 Based on the above, the following recommendations are made:

9.2.2 Condition 10

- 9.2.3 Foul and surface water shall be drained on separate systems. Reason. To secure property drainage and to manage the risk of flooding and pollution pursuant to Policies EN7/5 - Waste Water Management and EN5/1 - New Development and Flood Risk of the Bury Unitary Development Plan.
- The updated proposals comply with the requirements of this condition to maintain separate systems for surface water and foul.

9.2.4 Condition 11

- 9.2.5 No development shall commence (excluding works of site clearance and preparation) unless and until surface water drainage proposals have been submitted to and approved in writing by the Local Planning Authority. The scheme should be in accordance with the submitted Surface Water Sustainable Drainage Assessment and must be based on the hierarchy of drainage options in the National Planning Practice Guidance and be designed in accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015). This must include assessment of potential SUDS options for surface water drainage with appropriate calculations and test results to support the chosen solution. Details of proposed maintenance arrangements should also be provided. The approved scheme only shall be implemented prior to first occupation and thereafter maintained.
- The updated proposals have been completed in line with local and national guidance and updated to reflect the latest policy on climate change set by the Environment Agency. They follow the drainage hierarchy set out within the SUDs manual with supporting calculations to size features. Maintain schedules for all proposed features have been provided.

9.2.6 Condition 22

- 9.2.7 A drainage strategy that demonstrates that there will be no negative impacts on the ecological status/potential of the River Irwell resulting from the disposal of foul water and surface water disposal post-development shall be submitted to and approved in writing by the Local Planning Authority. The details, as approved, shall be implemented in full in accordance with a timetable which has first been agreed in writing by the Local Planning Authority.
- The proposed drainage scheme will provide enhancement to the site in the form of an open channel along with open surface water features within the development providing ecological enhancement to the site.

9.2.8 Condition 29

9.2.9 At the first reserved matters stage, a scheme detailing the following to support the FRA addendum by WYG (ref: A090070-193 dated 1/11/2018) shall be submitted to and approved in writing by the Local Planning Authority: Existing and proposed ground levels with supporting hydraulic modelling of the River Irwell. The detailed modifications and controls associated with Hutchinson's Goit referred to in the FRA addendum section 4.2. Confirmation that overland flow routes associated with Crow Trees Brook culvert would be retained as part of any ground level changes.

- Detailed hydraulic modelling has been undertaken using the latest available hydraulic model and updating this with further site intelligence to accurately represent flooding across the site. The modelling confirms the site does not pass flood risk on to others and outlines the control requirements for modifications for the Hutchinson's Goit.
- Confirmation of overland flows from the Crows Trees Brook has been identified and levels within the site confirmed not to impact the proposed development.

9.2.10 Condition 31

9.2.11 The finished floor levels for the proposed dwellings shall be submitted to and approved in writing by the Local Planning Authority as part of each reserved matters application for layout.

- Detailed hydraulic modelling has confirmed the minimum level for FFLs based on the Environment Agency guidance for climate change. The minimum level proposed is 65.4mAOD.

APPENDIX A – PROPOSED DEVELOPMENT

APPENDIX B – TOPOGRAPHIC SURVEY

APPENDIX C – SEWER RECORDS

APPENDIX D – DRAINAGE STRATEGY

APPENDIX E – CATCHMENT PLAN

APPENDIX F – DISCHARGE CALCULATIONS

APPENDIX G – UU RESPONSE

APPENDIX H – CROW TREES FARM BROOK TECHNICAL NOTE

APPENDIX I – ADDITIONAL FLOOD MODELLING REPORT JUNE 2021

APPENDIX J – GABION BASKET DESIGN