OUGHTIBRIDGE MILL

Breathing New Life into this Former Industrial Site

Flood Risk Assessment

March 2016

Weetwood

Development • Planning • Environment

OUGHTIBRIDGE MILL, OUGHTIBRIDGE, SHEFFIELD

FLOOD RISK ASSESSMENT

Final Report v1.0

March 2016

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Client:	CEG
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1 INTRODUCTION

1.1 PURPOSE OF REPORT

Weetwood Services Ltd ('Weetwood') has been instructed by CEG to undertake a flood risk assessment (FRA) for the proposed redevelopment of the former Oughtibridge Mill site, Oughtibridge, Sheffield.

The FRA has been undertaken in accordance with the requirements of the National Planning Policy Framework (NPPF) and supporting Planning Practice Guidance.

The FRA should be read in conjunction with the drainage scheme set out in the Drainage Assessment report prepared by Weetwood (ref: Oughtibridge Mill, Oughtibridge, Sheffield - Drainage Assessment, Final Report v1.0, March 2016). The drainage assessment presents a strategy for managing surface and foul water for the proposed development.

1.2 STRUCTURE OF THE REPORT

The report is structured as follows:

Section 1 Introduction and report structure

Section 2 Presents national and local flood risk and drainage planning policy

Section 3 Provides background information relating to the development site, the development proposals, ground conditions and existing site access arrangements

Section 4 Assesses the potential sources of flooding to the development site

Section 5 Presents flood risk mitigation measures based on the findings of the assessment

Section 6 Presents a summary of key findings

Section 7 Presents the recommendations

2 PLANNING POLICY AND GUIDANCE

2.1 NATIONAL PLANNING POLICY

The aim of the NPPF is to ensure that flood risk is taken into account at all stages in the planning process and is appropriately addressed.

2.1.1 Sequential Test

Paragraph 100 of the NPPF states that *'inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk but where development is necessary, making it safe without increasing flood risk elsewhere*'.

This policy is implemented through the application of the flood risk Sequential Test which aims to steer new development to areas with the lowest probability of flooding.

2.1.2 Exception Test

If, following application of the Sequential Test, it is not possible for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied, if appropriate.

As detailed in paragraph 102 of the NPPF, for the Exception Test to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment (SFRA) where one has been prepared; and
- A site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

2.2 LOCAL PLANNING POLICY AND GUIDANCE

The FRA has been informed by the following policy:

Sheffield City Council's (SCC) Core Strategy was adopted on 4 March 2009. Policy CS 67 'Flood Risk Management' states, in part, that the extent and impact of flooding will be reduced by:

a. Not culverting and not building over watercourses wherever practicable;
b. Not increasing and, where possible, reducing the building footprint in areas of developed functional floodplain;
c. Developing only water-compatible uses in the functional floodplain;
d. Not locating or subdividing properties that would be used for more vulnerable uses in areas of developed functional floodplain;
e. Designating areas of the city with high probability of flooding for open space uses where there is no overriding case for development;
f. Developing areas with high probability of flooding only for water-compatible uses unless an overriding case can be made and adequate mitigation measures are proposed;
g. Ensuring safe access to and from an area with a low probability of flooding.

Where an overriding case remains for developing in a zone with high probability of flooding, development will be permitted only if:

h. More vulnerable uses, including housing, would be above ground floor level; and
i. The lower floor levels of any other development with vulnerable equipment would remain dry in the event of flooding; and
j. The building would be resilient to flood damage; and
k. Adequate on and off-site flood protection measures would be provided.

Housing in areas with a high probability of flooding will not be permitted before 2016/17.

SCC's Unitary Development Plan (UDP) was adopted as the statutory development plan for Sheffield in March 1998. Policy G17 (Green Environment), in part, states that all new development will be set back from a main river or stream by 8m to allow for landscaping and access.

Barnsley Metropolitan Borough Council (BMBC) Core Strategy was adopted on 8 September 2011. 'CSP 4 Flood Risk' states, in part, that the extent and impact of flooding will be reduced by:

- Not permitting new development where it would be at an unacceptable risk of flooding or would give rise to flooding elsewhere;
- Requiring developers with proposals in Flood Zones 2 and 3 to provide evidence of the sequential test and exception test where appropriate;
- Requiring site-specific FRA for proposals over 1 hectare (ha) in Flood Zone 1 and all proposals in Flood Zones 2 and 3;
- Expecting proposals over 1000 m^2 floor space or 0.4 hectares in Flood Zone 1 to demonstrate how the proposal will make a positive contribution to reducing or managing flood risk; and
- Using flood resilient design in areas of high flood risk.

2.3 FLOOD DEFENCE CONSENT

Flood defence consent is required before the commencement of any works in, over, or under a main river to ensure that any works do not increase flood risk, damage flood defences, or harm the environment, fisheries, or wildlife (Water Resources Act 1991). For main rivers in England, responsibility for consenting rests with the Environment Agency (EA).

Undertaking activities controlled by local Byelaws (made under the Water Resources Act 1991) also requires the relevant consent. Byelaws typically include erecting an obstruction with 8 metres of a main river or erecting structures within the floodplain.

2.4 RELEVANT DOCUMENTS

The FRA has been informed by the following documents:

- SFRA Level 1, SCC, July 2008
- SFRA Level 1, BMBC, September 2010
- Preliminary Flood Risk Assessment, BMBC, July 2011
- South Yorkshire Interim Local Guidance for SuDS, June 2015
- DEFRA's Non-Statutory Technical Standards for Sustainable Drainage Systems, March 2015

3 SITE DETAILS AND PROPOSED DEVELOPMENT

3.1 SITE LOCATION

The 13.79 hectare (ha) site is located at the former Oughtibridge Mill site, Oughtibridge at Ordnance Survey (OS) National Grid Reference SK 302 940, as illustrated in **Figure 1**.

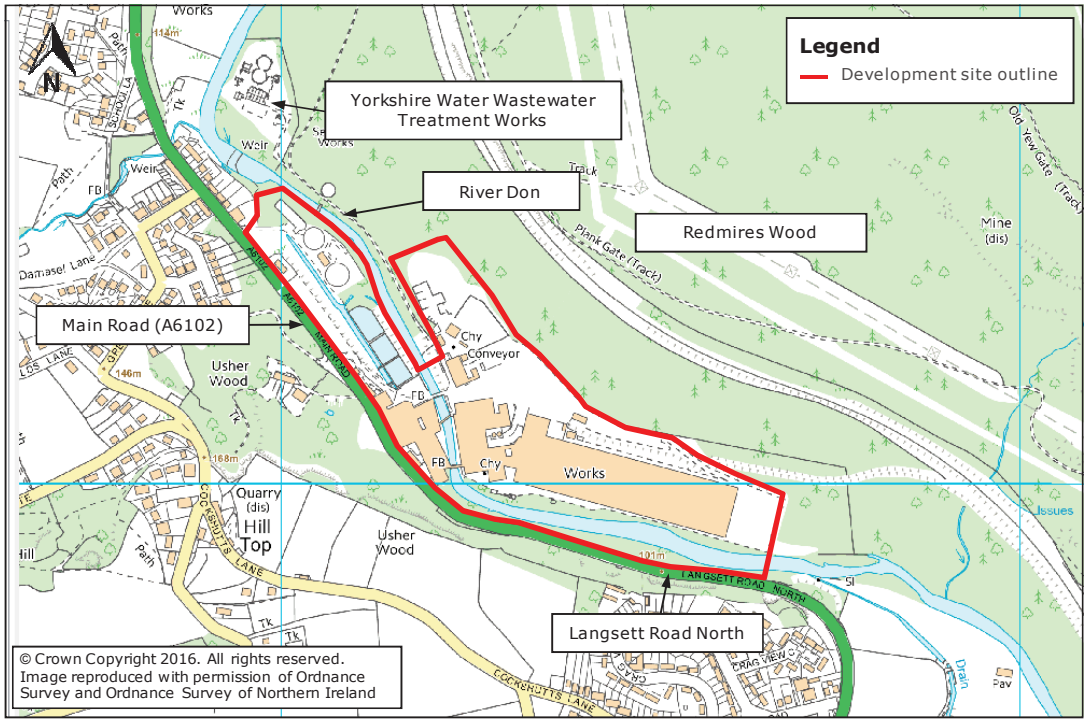


Figure 1: Site Location

3.2 EXISTING AND PROPOSED DEVELOPMENT

The existing site comprises of industrial units and large areas of hardstanding associated with the former paper manufacturing facility located at the site. It is understood that the buildings adjacent to Main Road/Langsett Road North, two bridges, and the mill race/ponds have been demolished within the past 18 months.

The development proposals entail the demolition of existing buildings and structures and erection of residential development (Use Class C3) with means of site access including a new vehicular bridge and a pedestrian/cycle bridge across the River Don, and associated landscaping and infrastructure works. Access to the site will remain via Main Road/Langsett Road North. A parameters plan is shown in **Appendix A**.

The NPPF Planning Practice Guidance (Reference ID: 7-066-20140306) classifies residential development as 'more vulnerable' land use.

3.3 WATERBODIES IN THE VICINITY OF THE SITE

The River Don, a designated main, flows in a south-easterly direction through the centre of the site.

3.4 GROUND CONDITIONS

An intrusive site investigation (SI) has been undertaken by Sirius Geotechnical and Environmental Limited in December 2015/January 2016.

The SI indicates that the site is underlain by variable depths of made ground. Variable granular and cohesive made ground soils were recorded within the north and north western site areas, to maximum depths of approximately 6.0 m bgl. It is understood that made ground was tipped within the northern portion of the site between approximately 1960 and 1990, whilst infilling of typically cohesive made ground has only recently been completed within the north western site area. Made ground depths within the south western and mill areas range between 0.35 m and >6.0 m, with granular ash rich / demolition rubble materials generally predominating within these areas.

The made ground is predominantly underlain by partly organic, compressible cohesive superficial alluvial soils,. Residual Millstone Grit soils were recorded between approximately 0.4 m and 10.0 m bgl, in turn underlain by competent mudstone or sandstone bedrock.

3.5 SITE LEVELS

A topographic survey of the site was undertaken by Met Geo-Environmental in November 2015 and is provided in **Appendix B**. This information has been utilised to develop a digital elevation model as illustrated in **Figure 2**.

Site levels generally range from 107 to 94 metres Above Ordnance Datum (m AOD), with levels generally sloping down towards the River Don.

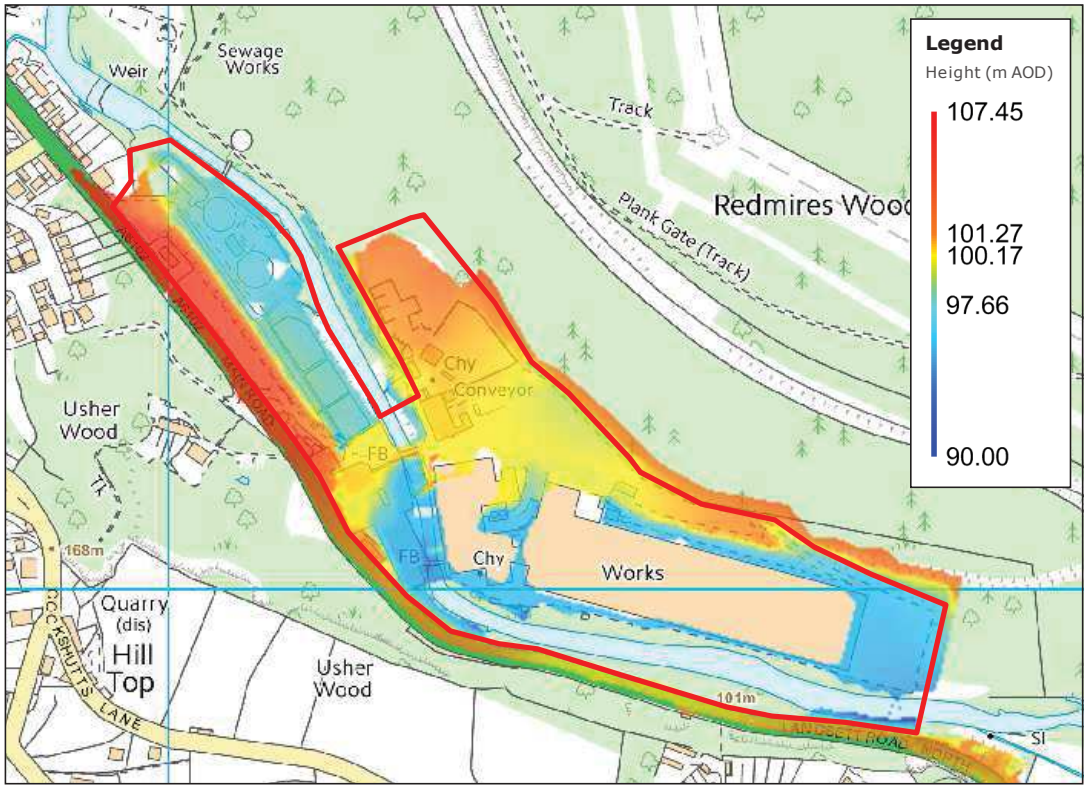


Figure 2: Digital Elevation Model

4 REVIEW OF FLOOD RISK

4.1 FLOOD ZONE DESIGNATION

Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. The NPPF Planning Practice Guidance defines Flood Zones as follows:

- **Flood Zone 1: Low Probability**. Land having a less than 1 in 1,000 annual probability of river or sea flooding.
- **Flood Zone 2: Medium Probability**. Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
- **Flood Zone 3a: High Probability**. Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.
- **Flood Zone 3b: The Functional Floodplain**. This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

The Flood Zones are shown on the EA Flood Map for Planning (Rivers and Sea). The Planning Practice Guidance states that the Zones shown on the EA Flood Map do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding.

According to the EA Flood Map for Planning (Rivers and Sea) (**Figure 3**) the site is predominantly located in Flood Zone 2 and Flood Zone 1, with areas adjacent to the River Don located in Flood Zone 3.

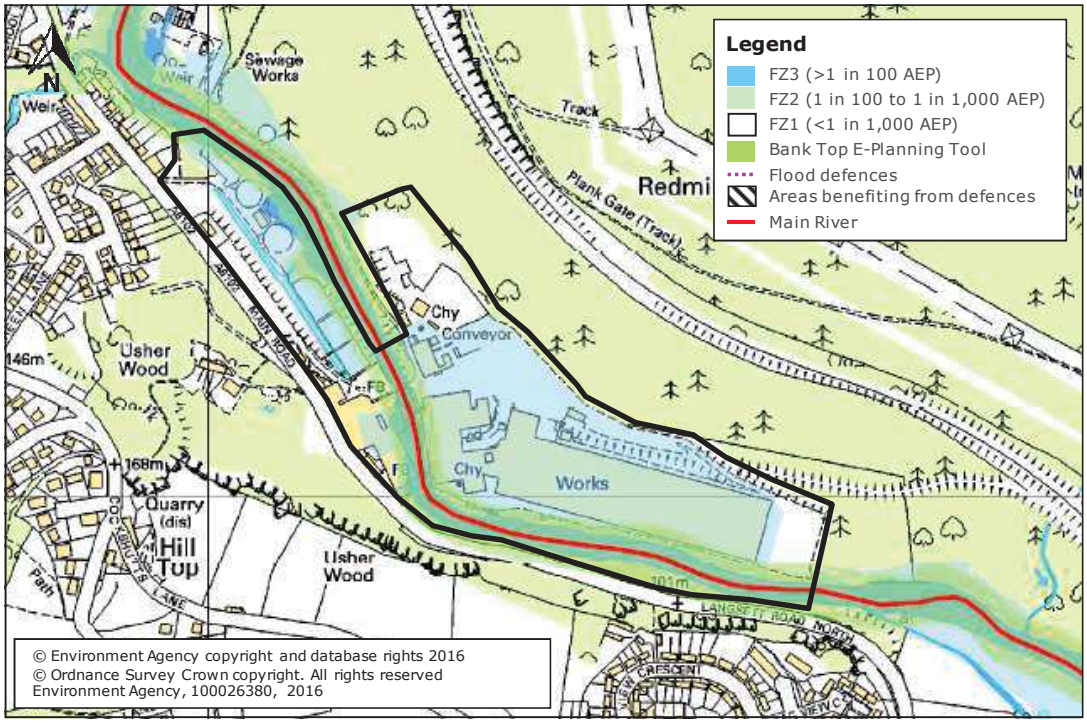


Figure 3: Environment Agency Flood Map for Planning (Rivers & Sea)

4.2 SEQUENTIAL TEST AND EXCEPTION TEST

The Sequential Test and first part of the Exception Test has been addressed by NLP Planning and is reported separately. This report addresses the second part of the Exception Test.

4.3 FLUVIAL FLOOD RISK – THE RIVER DON

4.3.1 Historical Flooding

The EA historic flood map indicates that widespread flooding occurred at the site in June 2007. The 2007 flood outline has been applied to define the Flood Zone 2 outline on the EA Flood Map for Planning (Rivers and Sea).

The EA has confirmed[1] that it does not have any information regarding the site flooding aside from the flood extent. However, anecdotal evidence from workers present on site at the time of the flooding confirms that the flooding was caused by blockage of a bridge immediately downstream of the main vehicular bridge. This bridge and another one further downstream, have now been removed.

Figure C of the SFRA reaffirms that flooded occurred within the immediate vicinity of the site during 2007 due to fluvial flooding.

4.3.2 Flood Defences

EA data indicates that the River Don is defended throughout the reach of the site. However, the recorded assets are informal, comprising of privately maintained channels and factory walls.

4.3.3 Modelled Flood Levels

The EA has provided the model geometry files for its 1d-2d (ISIS-TuFLOW) hydraulic model of the Upper Don catchment (ref: Sheffield Comprehensive Flood Review (SCFR), 2012). The model has been reviewed and revised to be more representative of the existing site, including the removal of two bridges which have recently been demolished.

The revised flood levels for the 1 in 100, 1 in 100 plus climate change, and 1 in 1,000 annual probability events for the model nodes illustrated on **Figure 4** are summarised in **Table 1**. The peak flows through the site are also provided in **Table 1**.

Based on the latest EA guidance[2], climate change allowances of 20% and 30% have been applied for the site based upon the proposed land use (i.e. more vulnerable) and the site being predominately located within Flood Zones 2 and 1 (**Figure 3**).

An assessment of the modelled flood levels and the topographic survey indicates that the site would not be expected to flood during the 1 in 100 annual probability flood event. Parts of the northern section of the site and central areas along the right-bank of the River Don would be expected to inundate during the 1 in 100 plus climate change (20% and 30%) and 1 in 1,000 annual probability flood events. Central and southern areas would be expected to flood on both sides of the River Don during the 1 in 1,000 annual probability event.

[1] Gary Cliff (Environment Agency) confirmed to Weetwood that it does not have any additional data other than the flood outline during a pre-application meeting on 17 February 2016

[2] Flood Risk Assessments: Climate Change Allowances, Environment Agency, 19 February 2016

The flood risk to the site will be mitigated through the implementation of the measures proposed in **Section 5** of this report.

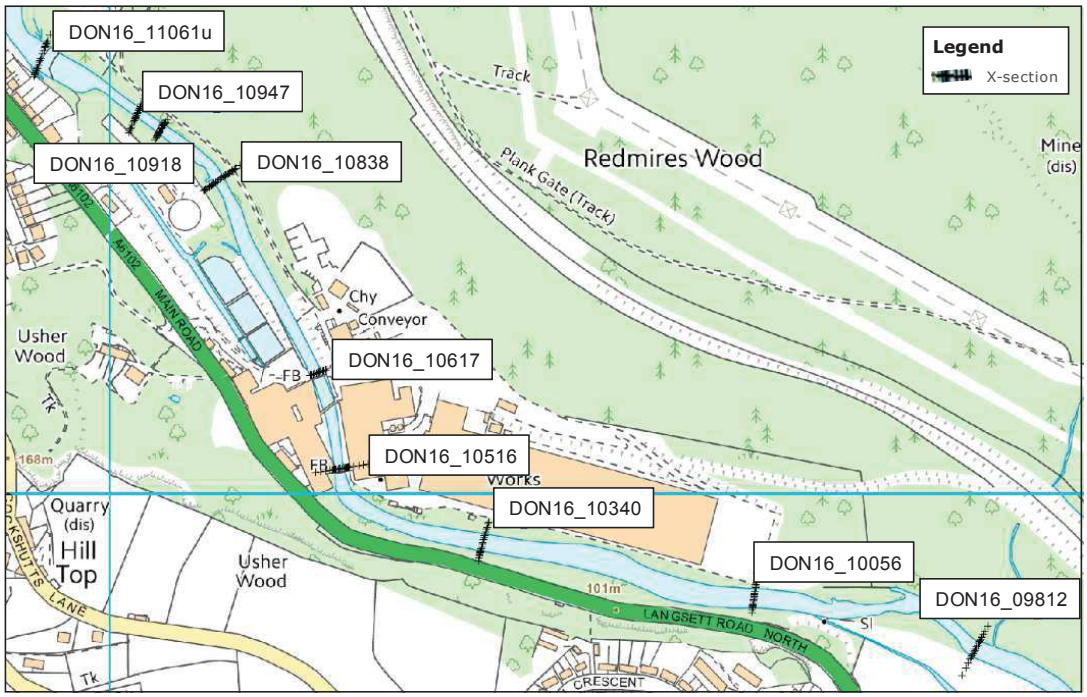


Figure 4: River Don Modelled Node Locations
(Source: EA 2012 SCFR Model)

Table 1: River Don Modelled Flood Levels

Model Node	Annual Probability Flood Level (m AOD)			
	1 in 100	1 in 100 + CC (20%)	1 in 100 + CC (30%)	1 in 1,000
DON16_11061u	99.12	99.28	99.34	99.58
DON16_11061d	97.52	97.91	98.06	98.58
DON16_10947	97.16	97.61	97.81	98.40
DON16_10918	96.76	97.10	97.27	98.25
DON16_10838	96.57	97.03	97.23	98.11
DON16_10617	95.45	95.83	95.99	96.66
DON16_10516	94.83	95.16	95.30	95.92
DON16_10340	94.09	94.42	94.57	95.20
DON16_10056	92.10	92.40	92.52	93.07
DON16_09975	91.42	91.74	91.87	92.40
DON16_09894	90.87	91.20	91.34	91.81
DON16_09812	90.50	90.83	90.98	91.43
Peak Flow (m^3s^{-1})	115	141	153	209

4.4 FLOOD RISK FROM RESERVOIRS, CANALS AND OTHER ARTIFICIAL SOURCES

There are no canals within the vicinity of the site.

The EA Risk of Flooding from Reservoirs map (**Figure 5**) indicates that the site is at potential risk of flooding from a number of reservoirs located approximately 2 to 17 km from the site.

However, as the enforcement authority for the Reservoirs Act 1975 in England, the EA ensures that all reservoirs are inspected regularly by reservoir panel engineers and essential safety work is carried out as required. As such, and as stated on the EA website, reservoir flooding is extremely unlikely to occur.

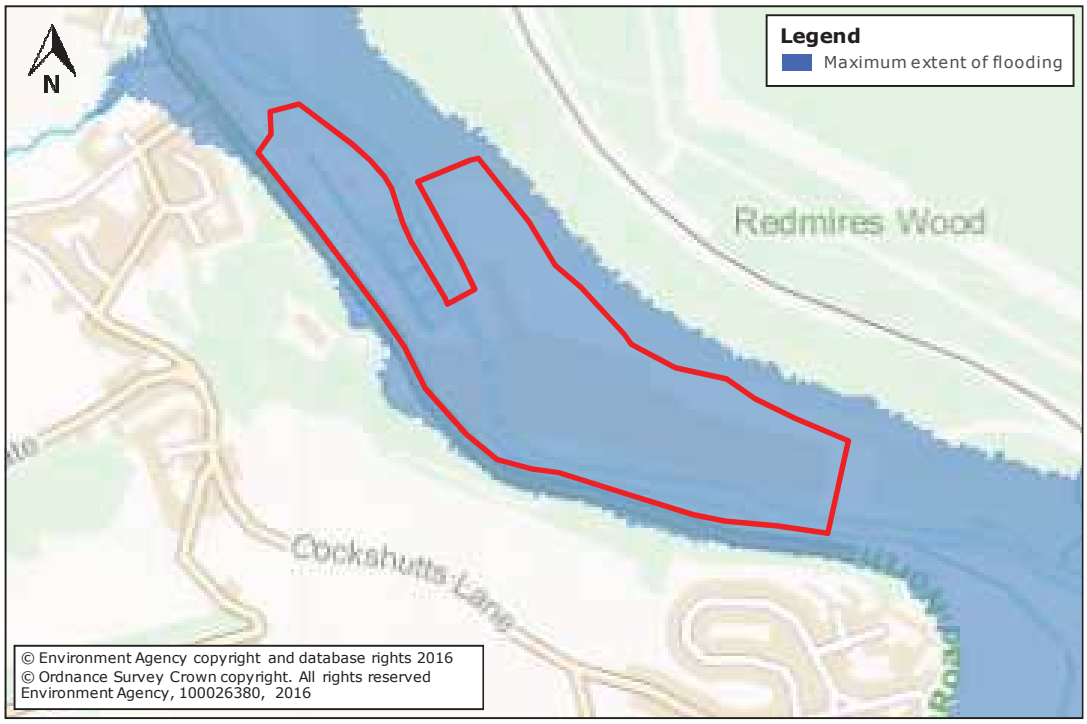


Figure 5: Environment Agency Risk of Flooding from Reservoirs Map
(Source: EA website)

4.5 FLOOD RISK FROM GROUNDWATER

According to the British Geological Survey (BGS) Groundwater Flooding Hazard map (**Figure 6**) the susceptibility to groundwater flooding is primarily negligible, albeit with central areas of the site at moderate to significant risk.

The risk of flooding from this source will be mitigated through the implementation of the measures proposed in **Section** 5 of this report.

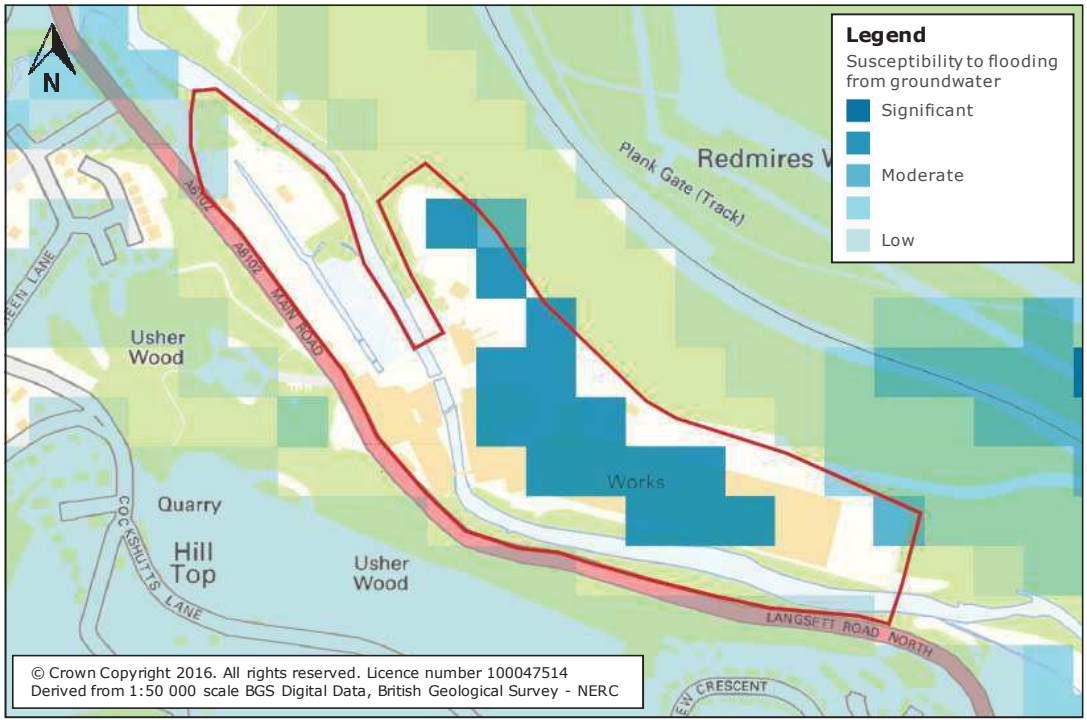


Figure 6: Groundwater Flooding Hazard Map
(Source: Findmaps)

4.6 FLOOD RISK FROM SURFACE WATER

The EA Risk of Flooding from Surface Water map (**Figure 7**) indicates that the majority of the site is at very low risk of flooding from surface water.

As discussed in **Section 3.2**, the mill race and ponds have recently been removed, with **Figure 2** indicating the existing site to slope down towards the River Don. As such, surface water runoff would be expected to flow overland in the direction of the River Don and/or slowly infiltrate where conditions allow within these areas.

Areas indicated to be at low to high risk of flooding from this source within the eastern portion of the site coincide with areas of land adjacent to buildings at the lower end of sloping roads/hardstanding surfaces, as identified in **Figure 2**.

The EA Surface Water Depth Low, Medium and High Chance of Occurring maps (see **Figure 8**) indicates that maximum flood depths range between 0-900 mm. However, the site is served by a surface water drainage system which would prevent surface water accumulation to this depth. In addition, following redevelopment the profile of the site will alter and continue to be served by a formal drainage system, all of which may prevent significant surface water ponding.

Surface water runoff from Redmires Wood is intercepted by a French drain located along the northern boundary of the site, and is understood to outfall into the River Don.

The flood risk to the site will be mitigated through the implementation of the measures proposed in **Section** 5 of this report and the surface water drainage strategy proposed in the Drainage Assessment report (ref: Oughtibridge Mill, Oughtibridge - Drainage Assessment, Final Report v1.0, March 2016).

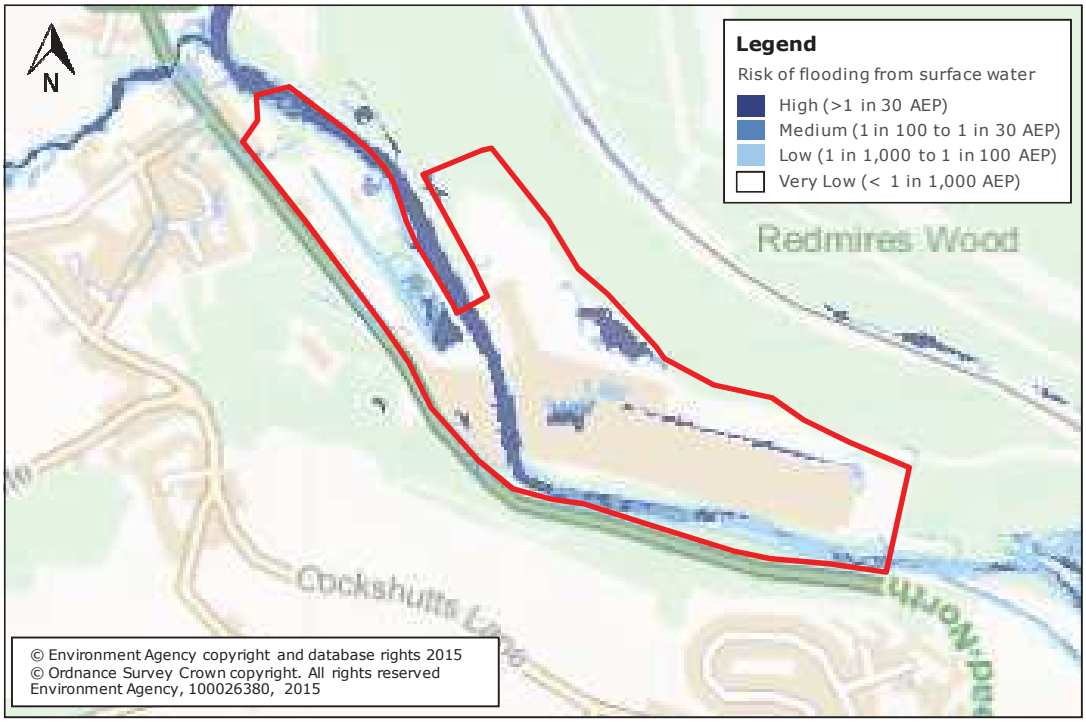


Figure 7: Environment Agency Risk of Flooding from Surface Water
(Source: EA website)

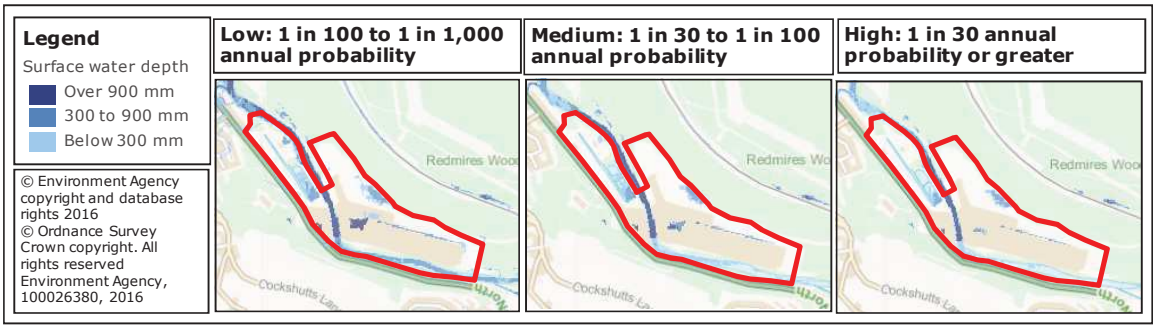


Figure 8: Environment Agency Surface Water Depth Maps
(Source: EA website)

5 FLOOD RISK MITIGATION MEASURES

The risk/residual risk of flooding to the site from all sources will be mitigated though the implementation of the measures proposed within the following section of this report.

5.1 GROUND RE-PROFILING AND COMPENSATORY STORAGE

Part of the proposed development platform is, according to the EA Flood Map for Planning, indicated to be located in Flood Zone 2 and 3.

It is proposed to raise existing ground levels so that the development platform is above the modelled level of the modelled 1 in 1,000 annual probability event. This will ensure that the development is safe from flood risk and that flood risk will not be increased for the lifetime of the development.

The buildings on the right-bank of the River Don immediately downstream of the main access bridge extended to the river edge. Although recently demolished, the EA has confirmed[2] that they can be considered as being *in situ* for the purpose of determining the requirement (and quantum) of compensatory storage.

A comparison of the existing building footprint and the proposed development platform footprint located in Flood Zone 3 indicates that the build footprint within Flood Zone 3 will be reduced following redevelopment of the site.

Based on the above, there will be no requirement to provide compensatory flood storage and no increase in flood risk elsewhere during the lifetime of the development.

The EA has confirmed[3] that the above assessment is acceptable in principle.

5.2 FINISHED FLOOR LEVELS

Finished floor levels should be set at a minimum of 0.15 m above adjacent ground levels following reprofiling of the site. This will enable any potential overland flows to be conveyed safely across the site and reduce the risk of property being affected in accordance with the approach promoted by government policy[4].

5.3 BRIDGE DESIGN PRINCIPLES

The soffit level of the lowest point on the proposed vehicle bridge and pedestrian bridge will be set at a minimum of the 1 in 100 annual probability flood level including an allowance for climate change plus a minimum freeboard of 600 mm.

5.4 FLOOD MANAGEMENT PLAN

According to the EA Flood Warning Areas map (**Figure 9**) the site is partly located within the 'River Don at Wharncliffe Side' flood warning area and the 'River Don Upper Catchment' flood alert area.

[3] Confirmation from Gary Cliff (Environment Agency) to Weetwood by way of email dated 18 February 2016 following a pre-application meeting on 17 February 2016

[4] Making Space for Water, Taking forward a new Government strategy for flood and coastal erosion risk management in England, March 2005, Dept for Environment, Food and Rural Affairs

It is recommended that a Flood Management Plan is prepared in consultation with Sheffield City Council Emergency Planners prior to occupation of any dwellings. This should detail the existing flood risk to the site, the actions that should be taken to prepare for flooding and those necessary in the event of flooding.

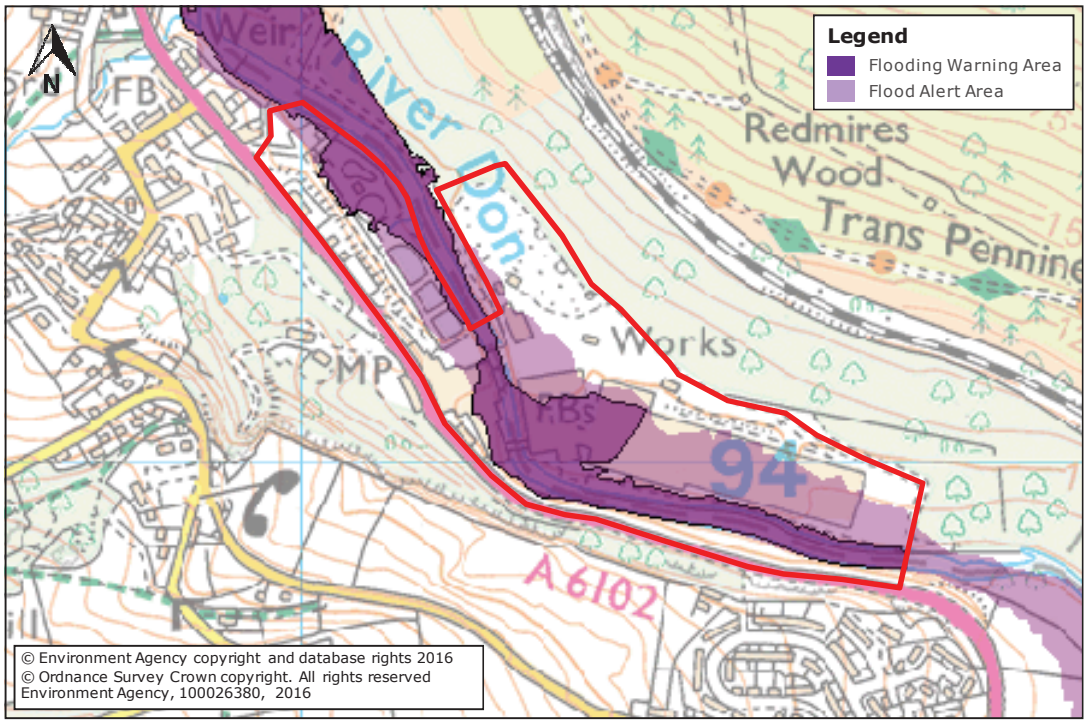


Figure 9: Flood Warning Areas
(Source: EA website)

5.5 FLOOD DEFENCE CONSENT

A minimum 8.0 m undeveloped buffer strip should be provided from the top of the River Don's bank, for maintenance purposes and to offer ecological benefit. Where the top of the bank is undefined, it is recommended that it is delineated by the level of the 1 in 100 annual probability flood event.

It should be noted that the development proposals indicate that the development platform within Plot B may encroach the 8.0m buffer; however, previous buildings abutted the river in this location, and thus the development proposals provide betterment compared to the previous development.

5.6 ACCESS AND EGRESS

Access to the site will be via Main Road/Langsett Road North, which is located within Flood Zone 1. In addition, the proposed bridge soffit levels will be set at a minimum of the 1 in 1,000 annual probability design event. Based on the above, safe and dry access/egress will be provided.

6 SUMMARY

This FRA has been prepared on behalf of Commercial Estates Group Ltd in relation to the proposed redevelopment of the former Oughtibridge Mill site, Oughtibridge, Sheffield.

According to the EA Flood Map for Planning (Rivers and Sea) the proposed development is predominantly located in Flood Zone 2 and Flood Zone 1, with areas adjacent to the River Don located in Flood Zone 3.

The Sequential Test and first part of the Exception Test has been addressed by NLP Planning and is reported separately. This FRA addresses the second part of the Exception Test.

The EA has provided the model geometry files for its 1d-2d (ISIS-TuFLOW) hydraulic model of the Upper Don catchment. The model has been reviewed and revised to be more representative of the existing site, including the removal of two bridges.

An assessment of the modelled flood levels and the topographic survey indicates that the site would not be expected to flood during the 1 in 100 annual probability flood event. Parts of the northern section of the site and central areas along the right-bank of the River Don would be expected to inundate during the 1 in 100 plus climate change (20% and 30%) and 1 in 1,000 annual probability flood events. Central and southern areas would be expected to flood on both sides of the River Don during the 1 in 1,000 annual probability event.

A package of mitigation measures has been proposed to mitigate the risk of flooding from all identified sources.

Access to the site will be via Main Road/Langsett Road North, which is located within Flood Zone 1. Bridge soffit levels will be set at a minimum of the 1 in 100 annual probability flood level including an allowance for climate change plus a minimum freeboard of 600 mm. As such, safe and dry access/egress will be ensured in times of flooding.

The FRA should be read in conjunction with the drainage scheme set out in the Drainage Assessment report prepared by Weetwood (ref: Oughtibridge Mill, Oughtibridge, Sheffield - Drainage Assessment, Final Report v1.0, March 2016) which presents a strategy for managing surface and foul water for the proposed development.

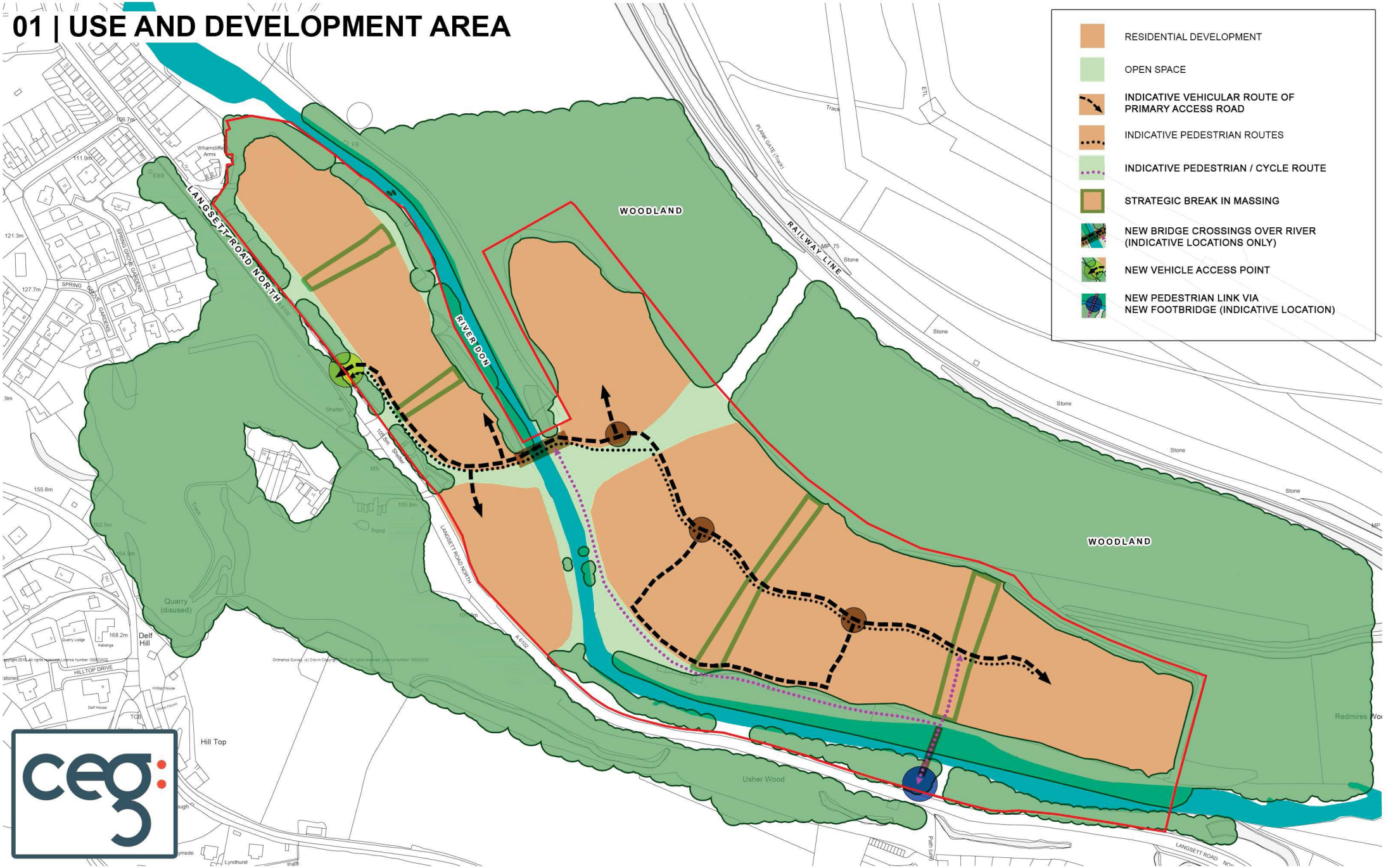
7 RECOMMENDATIONS

This FRA has demonstrated that the proposed development may be completed without conflicting with the requirements of the NPPF subject to the following:

- Raise existing ground levels so that the development platform is above the modelled level of the modelled 1 in 1,000 annual probability event.
- Finished floor levels to be set 150 mm above adjacent ground levels.
- Bridge soffit levels to be at a minimum of the 1 in 100 annual probability flood level including an allowance for climate change plus a 600 mm freeboard.
- Flood Management Plan to be developed in consultation with Sheffield City Council.
- An 8.0 m undeveloped buffer strip to be provided from the top of the River Don's bank, except in areas where betterment will be provided.

APPENDIX A:	Development Proposals Parameters Plan

01 | USE AND DEVELOPMENT AREA



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APPENDIX B:	Topographic Survey