

River Dearne, Smithies - Habitat Creation Feasibility Study

Final Report

June 2015

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This report describes work commissioned by Amanda Best, on behalf of the Environment Agency, by a letter dated 15th January 2015. Laura Thomas, Alex Jones, Natasha Todd-Burley, Alice Davis, Seb Bentley, Brendon McFadden, Helen Archer and Mike McDonald of JBA Consulting carried out this work.

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Purpose

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Acknowledgements

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Non-Technical Summary

The Environment Agency is currently exploring the feasibility of creating wetland habitat on three sites across the Don catchment, including on the River Dearne at Smithies site. The site is located to the north of the River Dearne, and consists of two parts, a 6 ha low lying area within the floodplain and a 7 ha area which slopes up the valley side to the disused railway line (SE 34484 08168). The biodiversity aims for this project are:

1. To create UK BAP Priority wetland habitats that would function as part of an ecological network at the landscape scale, and/ or:
2. To create UK BAP Priority non-wetland habitats that would function as part of an ecological network at the landscape scale, and/ or:
3. To improve river habitats (both bank-side and in-river) on the River Dearne

A number of site surveys, desk-based assessments and data collation exercises have been completed in order to inform the habitat feasibility study, including:

- A hydromorphological audit
- A hydrology, hydrogeology and geology assessment
- A contaminated land assessment and Preliminary Environmental Appraisal
- Soil contamination testing
- Collation and review of ecological data
- A rapid archaeological appraisal
- A review of potential constraints (i.e. services/ utilities, public access, anti-social behaviour)

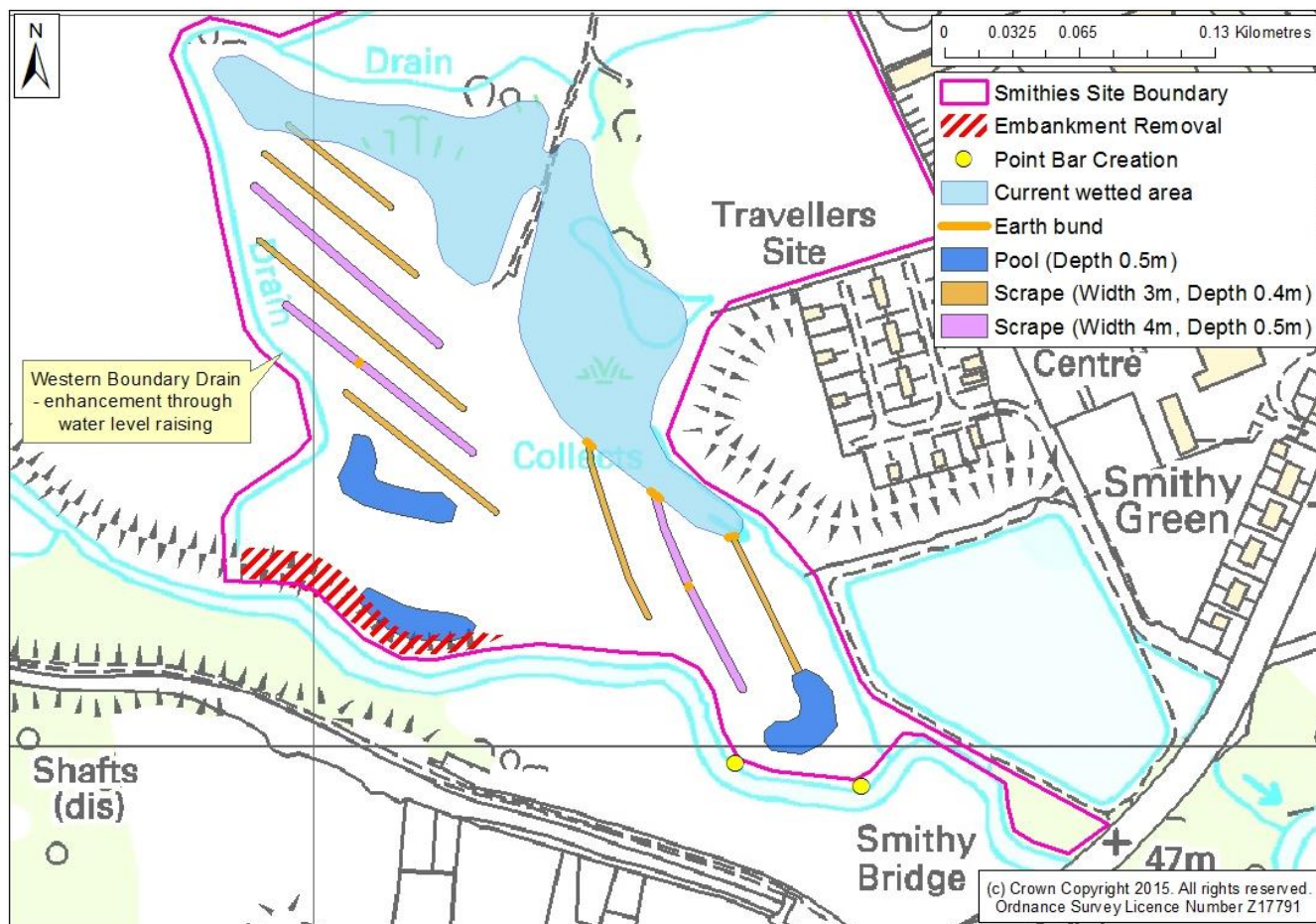
The studies identified that key constraints to the project include:

- Non-native invasive plant species (i.e. Japanese Knotweed, Himalayan Balsam, Signal Crayfish) which will require appropriate mitigation and biosecurity to be implemented during any site works.
- The presence of a Scheduled Monument close to the northern site boundary and for which the site provides part of the historic context. English Heritage should be consulted and any works that would directly affect the structure will require Scheduled Monument Consent. Liaison with South Yorkshire Archaeology Services should also be undertaken.
- Overhead cables across the will require appropriate health and safety measures to be put in place.
- Whilst there are no public rights of way across the site, informal public access is however extensive and measures need to be put in place to ensure public safety during the works and upon completion.
- Levels of anti-social behaviour in the area are relatively high and should be considered when planning works implementation.

Taking into account the above site constraints and conditions identified, a number of habitat creation options were developed for the site. During an options development workshop with the Environment Agency, and other key stakeholders (i.e. Rotherham Metropolitan Borough Council and Sheffield and Rotherham Wildlife Trust), a preferred option was agreed, which will consist of:

- Option 1 - Raising of water levels within the River Dearne through the inclusion of gravel features (not woody debris)
- Option 2 - Creation of point bar features on the River Dearne
- Option 3 - Removal of the small flood embankment at the south-west of the site
- Option 4 - Scrape creation
- Option 5 - Enhancement works on the western boundary drain
- Option 7 - Minimal enhancement works to the existing wetland habitats on the site
- Small-scale habitat opportunities.

Proposed Habitat Creation Scheme – River Dearne at Smithies



Contents

Non-Technical Summary.....	iii
1 Introduction.....	1
1.1 Project Background	1
1.2 Site Location	1
1.3 Purpose.....	2
2 Hydromorphology.....	3
2.1 Introduction	3
2.2 Hydromorphic audit.....	3
2.3 Conclusions and Recommendations	10
3 Hydrology, Hydrogeology and Geology.....	11
3.1 Introduction	11
3.2 Methodology	11
3.3 Topography, Climate and Land Use	11
3.4 Geology and Soils.....	14
3.5 Surface Water Hydrology.....	16
3.6 Catchment Descriptors	17
3.7 Hydrogeology.....	17
3.8 Hydrogeological Conceptual Model.....	18
4 Contaminated Land Assessment and Preliminary Environmental Appraisal	20
4.1 Introduction	20
4.2 Site Regulatory and Environmental Data	20
4.3 Historical Land Use.....	22
4.4 Summary of Site Sensitivity	23
4.5 Preliminary Environmental Assessment	24
5 Soil Contamination Testing	28
5.1 Introduction	28
5.2 Method for Contamination Testing	28
5.3 Results	29
5.4 Conclusions and Recommendations	30
6 Summary of Site Constraints	31
6.1 Introduction	31
6.2 Ecology	31
6.3 Archaeology.....	32
6.4 Contaminated Land	32
6.5 Coal Mining.....	32
6.6 Services/ Utilities	33
6.7 Public Access	34
6.8 Anti-social Behaviour	35
7 Options Appraisal.....	37
7.1 Introduction	37
7.2 Option 1 - Raising of Water Levels in the Dearne (Woody Debris, Gravels)	37
7.3 Option 2 - Creation of Point Bars.....	38
7.4 Option 3 - Removal of Floodplain Embankment.....	39
7.5 Option 4 - Scrape Creation	39
7.6 Option 5 - Control Structure on Drain	43
7.7 Option 6 - Enhancement on Western Boundary Drain	44
7.8 Option 7 - Enhancement Works to Existing Wetland Habitats on Site	44
7.9 Other small-scale habitat creation/ enhancement opportunities	45
8 Preferred Option	46

Contents

8.1	Preferred Option	46
8.2	Flood Risk Assessment	46
8.3	Estimated Costs.....	47
8.4	Public Safety Risk Assessment Designers Summary	48
8.5	Likely Further Work.....	48
Appendices.....		I
A	Envirocheck Report.....	I
B	Methodology for Preliminary Environmental Assessment	II
C	Soil Contamination Testing Results	VI
D	Baseline Ecological Assessment.....	X
E	Rapid Archaeological Appraisal	XV
F	Public Safety Risk Assessment	XIX
G	Environmental Action Plan	XXI
H	Site Investigation Logs	XXII
References.....		XXVII
I		

List of Figures

Figure 1-1: Smithies - Site Location	1
Figure 2-1: River Dearne at Barnsley Weir.....	4
Figure 2-2: Historic change in the River Dearne valley from 1885 to 2015.....	5
Figure 2-3: The River Dearne in the vicinity of the proposed site boundary	6
Figure 2-4: Downstream section of the River Dearne, to the west of the Smithies Lane road bridge	7
Figure 2-5: Left bank flood embankment to the southwest of the site.....	7
Figure 2-6: Wet woodland section	8
Figure 2-7: Glide biotope upstream of the Smithies site	9
Figure 2-8: Possible locations for creation of a point bar at the downstream end of the site.....	10
Figure 3-1 Site location.....	12
Figure 3-2 Graph of surface elevation from north to south.....	12
Figure 3-3 Bedrock geology map	15
Figure 3-4: Superficial geology map	16
Figure 3-5: Hydrogeological Conceptual Model of Smithies	19
Figure 5-1: Soil Sampling Locations at the River Dearne at Smithies Site	29
Figure 6-1: Services and Utilities at the River Dearne at Smithies Site	34
Figure 6-2: Public Rights of Way in and around the River Dearne at Smithies Site (Public Rights of Way shown by Green dashed line).....	35
Figure 7-1: Concept riffle design	38
Figure 7-2: Concept point bar creation	39
Figure 7-3: Typical Wet Grassland Mechanisms.....	40
Figure 7-4: Smithies scrape design	42
Figure 7-5: Example of drain control structures.....	43
Figure 7-6: Water retention due to control structure set at 45.3 mAOD	44
Figure 7-7: Typical design for an amphibian refugia (from: Natural England (formerly English Nature), 2001)	45
Figure 8-1: River Dearne at Smithies Preferred Option	46
Figure D-1-1: Designated Nature Conservation Sites within 2 km of the Site.....	XI
Figure D-1-2: Japanese Knotweed Stand on eastern site boundary.....	XIII
Figure D-1-3: Evidence of Himalayan Balsam infestation in south-west of site, evident from numerous dead canes on the ground	XIV
Figure E-1: Designated Heritage Sites	XVI
Figure E-2: Ordnance Survey Map extract from 1892-93	XVII

List of Tables

Table 3-1 Rainfall and Potential Transpiration Data for the local agro-climatic area (MAFF, 1971)	13
Table 3-2: Summary of site geology	14

2015s2245 Smithies, Barnsley FINAL

Table 3-3: Surface water abstractions located within 2 km of the site	17
Table 4-1: Regulatory data	20
Table 4-2: Potential contaminative land uses identified from the historical map review ...	23
Table 4-3: Sensitivity of Environmental receptors in the vicinity of the site	23
Table 4-4: Preliminary Qualitative Risk Assessment.....	25
Table 6-1: Identified Potential Ecological Constraints and Recommended Mitigation/ Action	31
Table 6-2: Crime Statistics for December 2014 for the area within 1 mile of the River Dearne site at Smithies, in comparison to other sites within this project (from: UKCrimeStats, 2015)	35
Table 7-1: Scrape area and volume for proposed design	42
Table B-1: Classification of Associated Hazard [Potential Severity] (modified from CIRIA C552)	III
Table B-2: Classification of Probability	IV
Table B-3: Contamination Risk Matrix	IV
Table B-4: Description of the risk classifications and likely action required	V
Table C-1: Soils testing results (green = test result below recommended S4UL or EQS, red = test result higher than recommended S4UL or EQS, amber = test result below or close to detection limit)	VII
Table C-2: Soils testing leachate results (green = test result below recommended S4UL or EQS, red = test result higher than recommended S4UL or EQS, amber = test result below or close to detection limit)	IX
Table D-1: Non-statutory Designated Sites situated within 2 km of the Site	X
Table D-2: Protected Species Records for within 2 km of the Site.....	XII

Abbreviations

AOD	Above Ordnance Datum
BAP	Biodiversity Action Plan
bgl	Below Ground Level
BGS	British Geological Survey
CEH	Centre for Ecology and Hydrology
COMAH.....	Control of Major Accident Hazard Sites
DTM	Digital Terrain Mapping
EQS	Environmental Quality Standard
FEH.....	Flood Estimation Handbook
GEP	Good Ecological Potential
HER	Historic Environment Record
IPC	Integrated Pollution Control
IPPC.....	Integrated Pollution Prevention & Control
JBA	Jeremy Benn Associates
LAPPC	Local Authority Pollution Prevention & Controls
LNR.....	Local Nature Reserve

LPG	Liquid Petroleum Gas
LWS	Local Wildlife Site
MAGIC	Multi Agency Geographic Information for the Countryside
MORECS	Meteorological Office Rainfall and Evapotranspiration Calculation System
NIHHS	Notification of Installations Handling Hazardous Substances
OS	Ordnance Survey
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PMCM	Pennine Middle Coal Measures
RBMP	River Basin Management Plan
S4UL	Suitable for Use Levels
SAAR	Standard Annual Average Rainfall
SPR	Standard Percentage Runoff
SPZ	Source Protection Zone
UKAS	United Kingdom Accreditation Service
WFD	Water Framework Directive

1 Introduction

1.1 Project Background

The Environment Agency is currently exploring the feasibility of creating wetland habitat on three sites across the Don catchment, on the Rivers Dearne, Rother and Doe Lea. This report provides baseline environmental data and preliminary options for wetland habitat creation beside the River Dearne, near Smithies on the northern edge of Barnsley, South Yorkshire.

1.1.1 Aims and Objectives

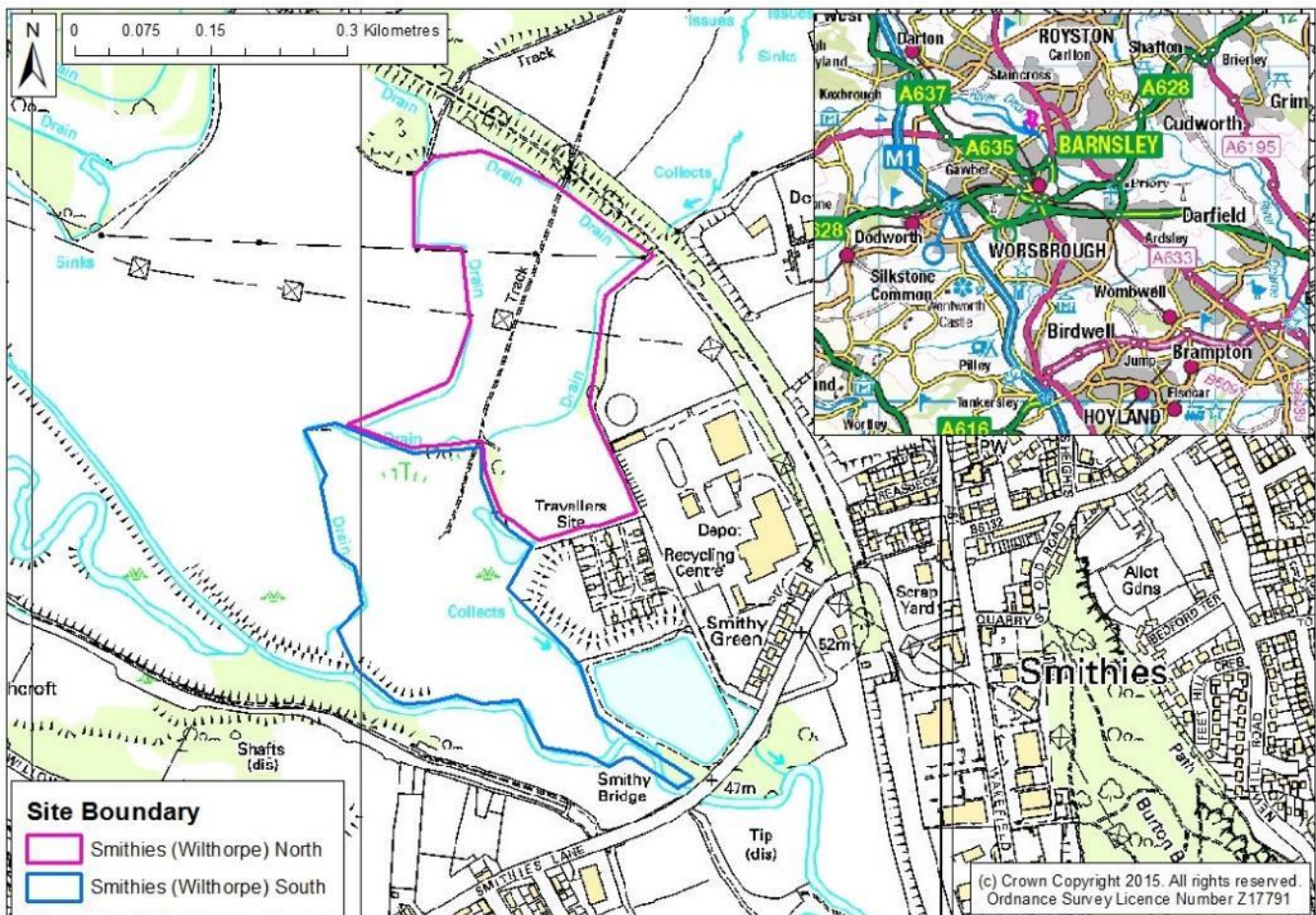
The biodiversity aims of this project are:

4. **To create UK BAP Priority wetland habitats** that would function as part of an ecological network at the landscape scale, and/ or:
5. **To create UK BAP Priority non-wetland habitats** that would function as part of an ecological network at the landscape scale, and/ or:
6. **To improve river habitats** (both bank-side and in-river) on the River Dearne.

1.2 Site Location

This site is located to the north of the River Dearne (SE 34484 08168) (see Figure 1-1). It consists of two parts; to the south there is a 6 ha area of low-lying land within the floodplain of the River Dearne; to the north there is a 7 ha area which slopes up the valley side to the disused railway line. The southern section of the site will be the primary focus of this study.

The site comprises a mosaic of grazed pasture, ponds, Reedmace *Typha latifolia* dominated swamp, rough grassland, scrub and woodland.



1.3 Purpose

The purpose of this report is to undertake a series of baseline surveys and assessments to develop outline plans for habitat creation, and also identify potential constraints to works at the site. This report therefore contains the following:

- **Chapter 2** - Details the results of a hydromorphological audit conducted at the site and identifies hydromorphological baseline conditions, potential impacts of work and considerations to be taken forward into any habitat creation options.
- **Chapter 3** - Provides comprehensive details on the hydrological, geological and hydrogeological baseline of the site, including consideration of site topography, surface water sources and groundwater in order to establish the conditions in which habitat creation scheme could be implemented, through development of a hydrogeological conceptual model for the site.
- **Chapter 4** - Considers land use, both current and historical in relation to potential sources of contamination, and also includes a preliminary environmental assessment which qualitatively assesses the likely risks associated with potential sources of contamination in and around the site in relation to habitat creation works.
- **Chapter 5** - Provides the results and assessment of the soil contamination testing conducted on site to determine if this is likely to place a constraint on habitat creation.
- **Chapter 6** - Collates relevant information from previous chapters, and also Appendices A, C, D and E to summarise the main constraints to undertaking habitat creation works at the site. This includes consideration of ecology, archaeology/ heritage, contaminated land, services/ utilities, public access and the risk of anti-social behaviour.
- **Chapter 7** - Summarises a number of habitat design options that could be implemented to achieve the aims and objectives of the project (see section 1.1.1).
- **Chapter 8** - Provides further details of the preferred option selected during a stakeholder workshop.

2 Hydromorphology

2.1 Introduction

A hydromorphic audit has been undertaken to assess the hydromorphological baseline conditions, impacts and design considerations in relation to the proposed wetland habitat creation on the River Dearne and Smithies site, near Barnsley, South Yorkshire.

This section details the current hydromorphic state of the River Dearne and audits the character of the channel, allowing prediction to be made concerning channel response and hydromorphic change following creation of the proposed habitats. It also seeks to inform the concept design options for the proposed restoration site to ensure developed options are effective and sustainable from a geomorphological perspective (with a focus on working with natural processes wherever possible).

2.2 Hydromorphic audit

2.2.1 Study Approach

A desk and field based hydromorphic (fluvial) audit of the River Dearne was conducted in January 2015 to investigate potential opportunities for, and impacts of, proposed habitat creation and restoration works on the hydromorphology of the River Dearne. The audit places the character and dynamics of the river in the historic context of channel engineering and management. It considers the response to, and consequences of, the proposed habitat creation and uses this information to inform the design of restoration measures.

2.2.2 Wider Catchment Character

The River Dearne rises to the west of Birdsedge in West Yorkshire and flows in a generally eastwards direction through several urban areas, including Barnsley, to its confluence with the River Don at Conisborough.

The upper River Dearne catchment (upstream of Smithies) is predominantly rural, with land cover consisting mainly of woodland, grassland and arable/ horticultural land use. The lower River Dearne catchment contains significant urban development in the valley.

The River Dearne (in the vicinity of Smithies) is a Heavily-Modified water body in accordance with the Water Framework Directive (WFD) classification system. At present the WFD defines the overall ecological potential as Moderate, with a target of reaching Good Ecological Potential (GEP) by 2027.

2.2.3 Flow Regime and Geomorphological Characteristics

The River Dearne has a moderately flashy flow regime (Figure 2-1), where the rise to peak is often rapid. The River Dearne is a heavily modified, low gradient, predominantly single thread channel, and the channel has been modified significantly over time by channel straightening, widening and deepening. The flashy flow regime and historical modification has resulted in an oversized channel, in which flood flows are retained in-bank for longer and for flows that would naturally flow into the floodplain, preventing the accumulation of significant gravel features due to elevated energy levels within the channel. The oversized nature of the channel means that it is prone to fine sediment deposition during low flows (due to the low energy flow conditions created by the oversized channel).

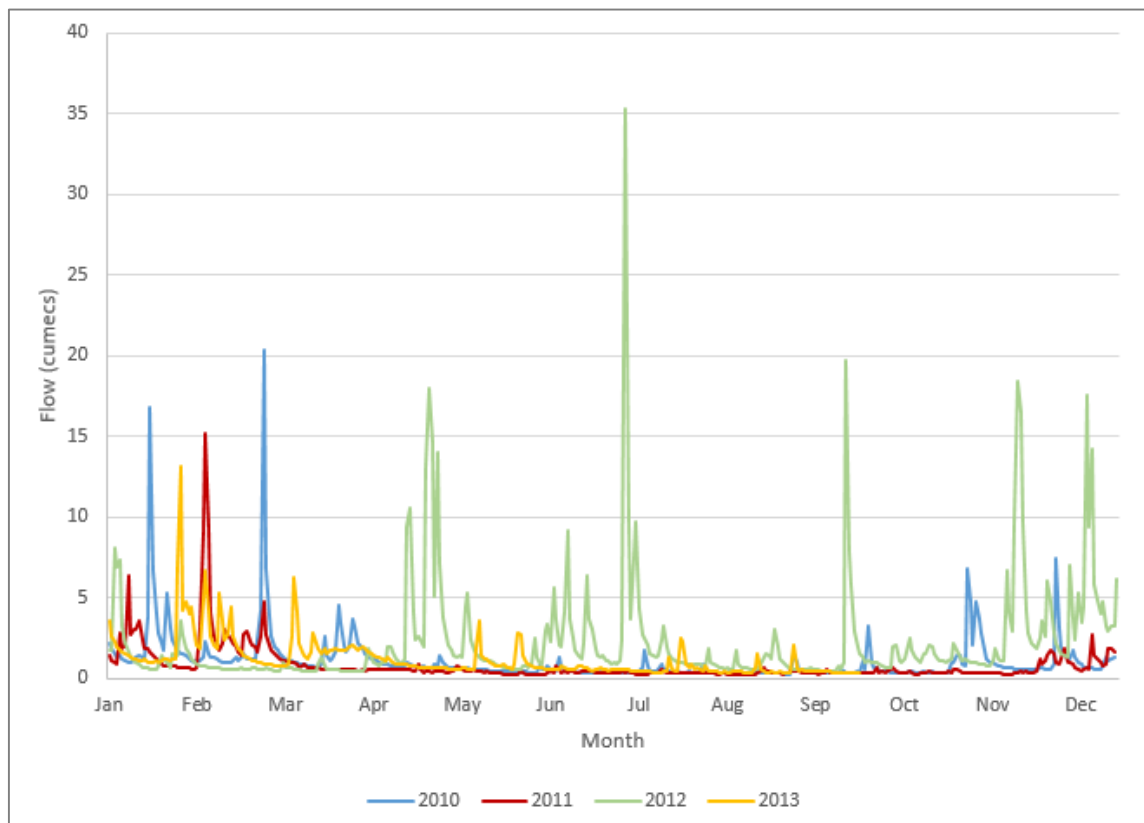


Figure 2-1: River Dearne at Barnsley Weir

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2.2.4 Historic Trend Analysis

Comparison of the current channel planform to historic maps (1885-1900 and 1937-1961) indicate that there has been significant historical anthropogenic modification to the system (Figure 2-2). To the north-west of the site a large section of river was bypassed with a shorter, straight section post-1961. Mapping supplied by Envirocheck (see Appendix A) indicates that this occurred relatively late, between 1984 and 1993. Between 1900 and 1937 another large section of channel to the south of Smithies was bypassed with a shorter, straighter section. Channel straightening increases channel slope and decreases channel length, elevating erosive forces within the channel and triggering incision as a result. The overdeepened channel evident in the upstream section of the hydromorphic survey extent is likely to have developed in response to the channel straightening in this area.

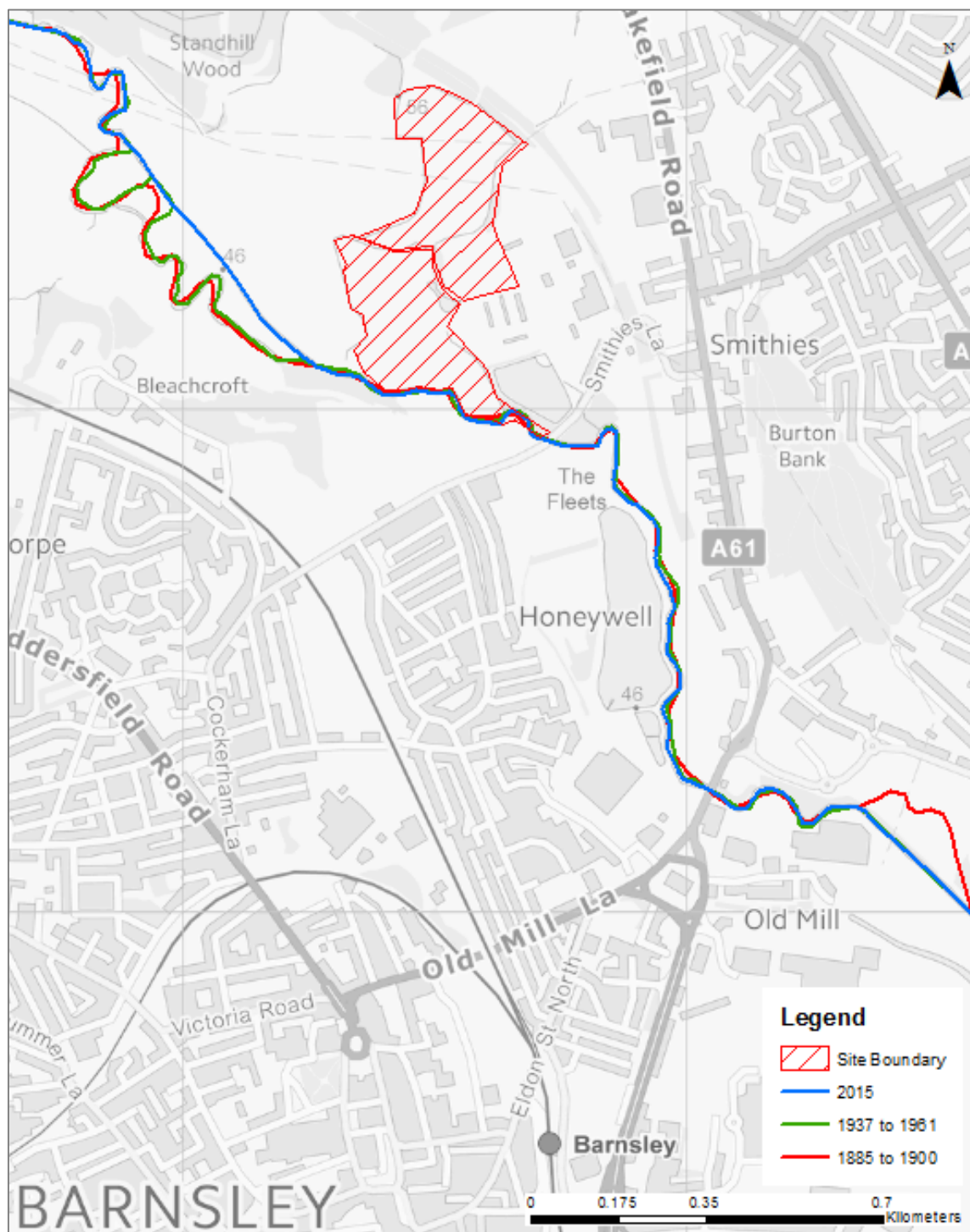


Figure 2-2: Historic change in the River Dearne valley from 1885 to 2015

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2.2.5 Current Hydromorphic Condition and Processes

The approximate length of the hydromorphic field audit study reach is shown in Figure 2-3 below. Wider catchment processes have been assessed as part of this desktop study. The River Dearne is a low-gradient channel throughout the majority of the hydromorphic audit study extent.



Figure 2-3: The River Dearne in the vicinity of the proposed site boundary

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In the downstream section, to the south of the fishing pond, and east of the Smithies Lane road bridge, the channel is oversized and floodplain connection is generally poor (Figure 2-4). Although channel features and the bed composition were not visible during the hydromorphic audit due to the water level, it is assumed that:

- a. the bed is primarily composed of gravel, partially infilled with fine sediment in places due to the oversized nature of the channel in this section, and;
- b. under normal flow conditions this section will contain some embryonic/ limited riffled sections and deeper pool areas, with glide biotopes also common in areas where there is a monotonous flow depth.



Figure 2-4: Downstream section of the River Dearne, to the west of the Smithies Lane road bridge

To the south-west corner of the site boundary, a flood embankment on the left bank is reducing floodplain connectivity (Figure 2-5); this is currently protecting agricultural land.



Figure 2-5: Left bank flood embankment to the southwest of the site

Further upstream, there is better flow and bed diversity in the wet woodland section that is well connected to the main channel (Figure 2-6). Here the channel takes on a semi-anastomosed nature, where the river is composed of multiple channels that divide and reconnect, separated by semi-permanent, cohesive banks. At higher flows, the various sub-channels of the anastomosed system are activated, spreading flow across a wider surface area, creating stable flow and channel conditions. This river type is assisted by the frequent presence of woody debris in the channel, that creates locally elevated water levels behind the features, improving the frequency of connection of the anastomosed channels. The main channel is narrower compared to the downstream section and there is better connectivity to the right bank floodplain. Woody debris is frequent, causing local narrowing of the channel, increasing flow velocity and allowing the exposure of some gravel beds, as a result of locally heightened energy levels that promote transport of fine sediment rather than deposition.



Figure 2-6: Wet woodland section

Further upstream of the wet woodland section, the straightened section is a monotonous glide with bank slumping due to incision and/ or overdeepening (Figure 2-7).



Figure 2-7: Glide biotope upstream of the Smithies site

2.2.6 Possible Hydromorphological Improvements

At the downstream end of the site, water level raising and/ or bank level lowering may be required to reconnect the floodplain and create a wetter habitat. There is potential to create a point bar on the left bank and to grade this into the proposed wetland area. Two possible locations for point bar creation are indicated by the yellow markers in Figure 2-8 below. Any design options will need to take into consideration that the pond is connected to the river and that the channel is stone lined in the far south-east extent of the site.

The wet woodland, semi anastomosed section provides a useful analogue that could be used as part of the restoration design in the downstream section to improve morphological and flow diversity alongside other wetland habitat creation works. The woody debris through this section narrows the channel and exposes local areas of gravels and could be used further downstream to improve flow diversity.

The proposed removal of a small section of the left bank flood embankment would benefit the system, encouraging floodplain reconnection and possibly some deposition of gravel. This also works alongside the anastomosed type principle.

Fine sediment management measures, such as riparian corridor improvements on the left bank, will help to reduce the amount of sediment entering the channel from surrounding fields.

Further detail on these potential hydromorphological improvements, developed into habitat creation options, are provided in Chapter 7.



Figure 2-8: Possible locations for creation of a point bar at the downstream end of the site

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2.3 Conclusions and Recommendations

Opportunities exist for geomorphological improvement at the site. Water level raising and/ or bank lowering to reconnect the floodplain in the downstream section can be achieved.

The floodplain can be reconnected in the downstream section of the site using water level raising and/ or bank lowering. The wet woodland further upstream can be used as an analogue for the restoration design. Floodplain connection in the upstream section of the site can be improved by removing the section of embankment in this area.

Furthermore, in relation to the WFD, the Humber River Basin Management Plan (RBMP) gives the current Ecological Status of the water body as Moderate, and the objective is to achieve Good Ecological Potential by 2027. The proposed geomorphological improvements will contribute to the delivery of the WFD objectives, by improving floodplain connection and in-channel/ floodplain features and habitats.

3 Hydrology, Hydrogeology and Geology

3.1 Introduction

This chapter describes the geology, hydrology and hydrogeology of the River Dearne site at Smithies and the surrounding area.

3.2 Methodology

To inform this section, the feasibility study has involved:

- Desk-based study
- Site walkover survey undertaken by JBA hydrogeologists on 5th February 2015

3.2.1 Data Sources

The data used for this chapter were obtained from the following sources:

- Topography and general mapping:
 - Ordnance Survey (OS) Open Data, Terrain 50 Digital Terrain Mapping (DTM)
 - Aerial photography (Google Earth and Bing Maps)
- Climate:
 - Flood Estimation Handbook (FEH) and CD-ROM (Centre for Ecology and Hydrology (CEH), 2009)
 - Meteorological Office Rainfall and Evapotranspiration Calculation System (MORECS) data
- Geology and Soils:
 - British Geological Survey (BGS) 1:50,000 Geology Map, Solid and Drift Edition, Sheet 100, Sheffield (1974)
 - BGS digital geology mapping
 - BGS online borehole database (BGS website)
 - BGS online Lexicon (BGS website)
 - 1:250,000 soils mapping (Soil Survey of England and Wales, 1983)
- Hydrogeology:
 - Aquifer classification (Environment Agency website)
 - Groundwater vulnerability (Environment Agency website)
 - Source Protection Zones (Environment Agency website)
 - Licensed abstractions (Environment Agency website)
 - Groundwater quality (Environment Agency website; ESI, 2006)
 - Major (Principal) Aquifer properties manual (Allen *et al.*, 1997)
 - Minor Aquifer properties manual (Jones *et al.*, 2000)

3.3 Topography, Climate and Land Use

3.3.1 Topography

The site as a whole slopes down towards the south, to where it meets the River Dearne. It has an elevation of between 44 mAOD (at the Dearne) and 58 mAOD to the north. The site can be split in half to show two distinct topographical regions; north and south (Figure 3-1 and Figure 3-2). Figure 3-2 illustrates the topography of the site along the cross section indicated in Figure 3-1. The southern half has a much flatter topography, with minor changes in elevations between 45 to 46 m. The northern half is characterised by steeper gradients in the north-south profile, with elevations from 46 m in the south to 57 m in the north.

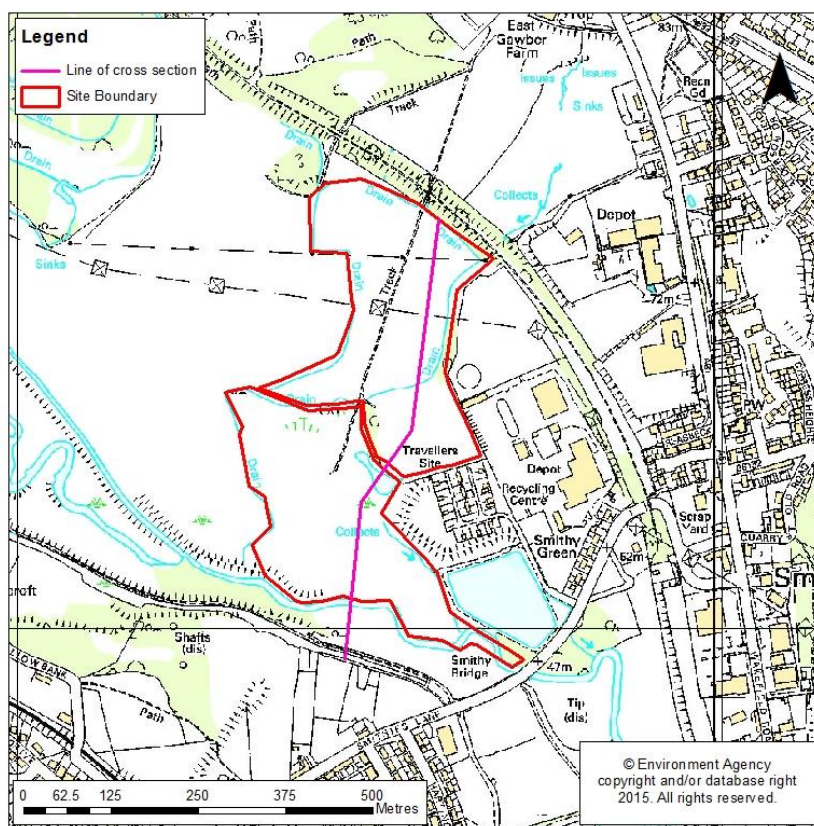


Figure 3-1 Site location

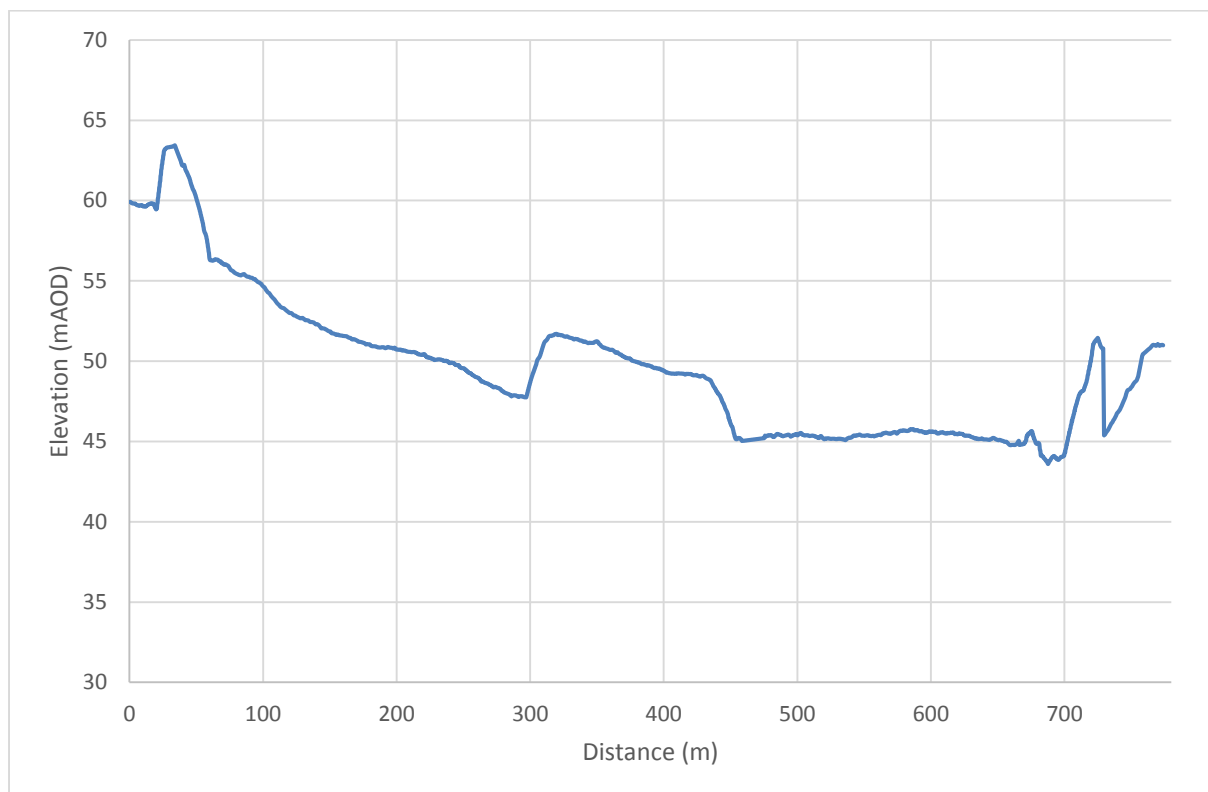


Figure 3-2 Graph of surface elevation from north to south

3.3.2 Climate

The FEH CD-ROM includes long-term average rainfall data for catchments in the UK. Catchment descriptors were obtained for the entire River Dearne catchment upstream of the site in question and a smaller proxy catchment adjacent to the area containing the site to the east. For the smallest and largest FEH catchment covering the site the Standard Annual Average Rainfall (SAAR) is 653 to 771 mm for the period 1961 - 1990, and 668 to 768 mm for the period 1941 - 1970 (CEH, 2009), respectively.

3.3.3 Water Balance

A simple water balance has been produced for the site showing the difference between monthly average figures for rainfall and potential transpiration for the region containing the site obtained from the Agricultural Climate of England and Wales (MAFF, 1971). The water balance uses rainfall input to the system and evaporative losses to determine the monthly and annual deficit of water. This is a simple water balance and the following factors have not been taken into account:

- Lateral groundwater and surface water movement - surface run-off and shallow groundwater input from the north.
- Vertical groundwater movement - the southern site is located in the base of a valley so vertical groundwater losses are likely to be relatively small (although potentially significant during drier periods). The northern section of the site is situated on a steep gradient, with bedrock cropping close to the surface and therefore there is potential for some water loss through vertical groundwater movement.
- Flood events from the river - input from flood events have not been accounted for in the water balance. Limited information regarding the history of flooding on-site is available, though evidence suggests the site was flooded in June 2007 (<http://www.wearebarnsley.com/photos/gallery/37/capture-barnsley-2006-2008>).
- The water balance does not represent losses from different land use types, but represents average losses for the agro-climatic region within which the site is located.

Table 3-1 Rainfall and Potential Transpiration Data for the local agro-climatic area (MAFF, 1971)

	J	F	M	A	M	J	J	A	S	O	N	D	Annual Average
Rainfall (mm)	54	42	43	42	52	49	56	65	52	51	62	54	622
Potential Transpiration (mm)	1	10	32	57	84	93	93	71	44	20	4	1	510
Excess/Deficit (mm)	53	32	11	-15	-32	-44	-37	-6	8	31	58	53	112

The water balance shows that generally rainfall received exceeds evaporative losses, with the exceptions being in April, May, June, July and August when there is a deficit of water. If attempts are made to prolong the length of time water remains on site, in an attempt to encourage wetland development, the water balance suggests this would be effective from September to March. Any water held on site would likely dry out to some degree during the summer months without an external input of water to the system or additional rainfall. The amount of water lost from the system would vary from year to year.

3.3.4 Land Use

The site is primarily grassland with pathways and tracks around the outer boundaries and through the centre of the site. There is an area of sparse woodland within the site, and scattered trees situated along all boundaries, including along the River Dearne bank.

Existing land uses immediately adjacent to the site comprise:

- North:
 - Adjacent to the northern border of the site is a woodland corridor situated along the alignment of a disused railway line, and further grassland, with a residential zone beyond.
- East:
 - The eastern boundary of the site is adjacent to a grassland area and a designated traveller settlement, with a small permanent residential area. Adjacent to that are industrial units and a waste management site.
- South:
 - To the south of the site is the River Dearne, with a linked reservoir adjacent to the south-east corner of the site. Beyond the riparian buffer of the river is further grassland and agricultural land.
- West:
 - Adjacent to the western boundary of the site is a large arable field, with areas of grassland and woodland beyond.

3.4 Geology and Soils

Information on the soils and geology of the site and surrounding area has been derived from the Soil Survey of England and Wales (1983), 1:50,000 BGS geology mapping, and the BGS online borehole archive. The geology beneath the site is summarised in Table 3-2.

Table 3-2: Summary of site geology

Age	Group	Formation / Member	Description	Thickness
Quaternary		Alluvium	Clay and silt	Unknown
Carboniferous	Pennine Coal Measures Group	Pennine Middle Coal Measures Formation	Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams.	~ 650 m ***
Sources: *Nearby borehole records ** BGS 1:50,000 Geology Map, Solid and Drift Edition, Sheet 100, Sheffield (1974) *** BGS online Lexicon of Named Rock Units				

3.4.1 Bedrock Geology

The southern half of the site overlies the Pennine Middle Coal Measures (PMCM) Formation, consisting of mudstone, siltstone and sandstone. The northern is underlain by the Kent's Rock sandstone, as well as the PMCM Formation mudstone, siltstone and sandstone (Figure 3-3).

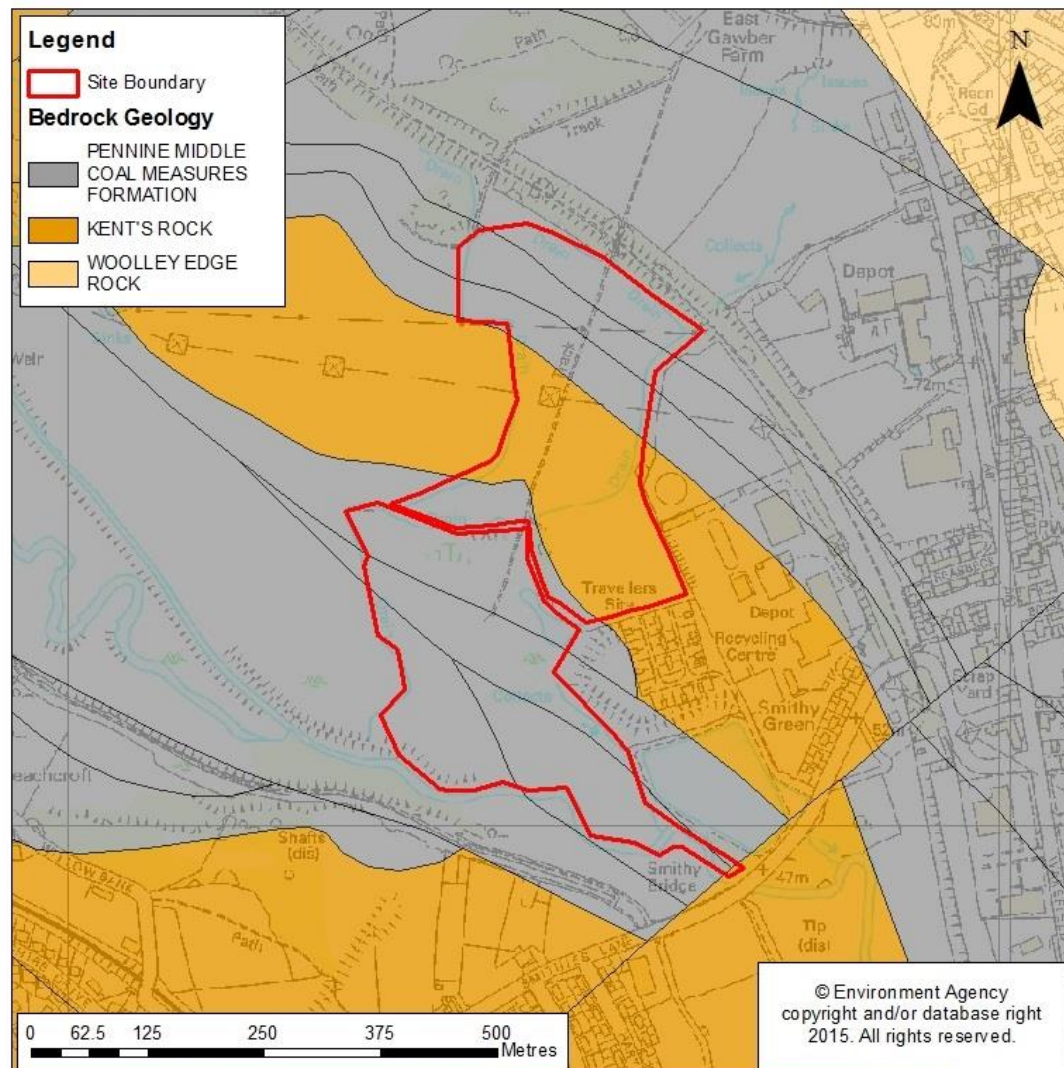


Figure 3-3 Bedrock geology map

3.4.2 Superficial (Drift) Geology

The southern half of the site is recorded by BGS (Figure 3-4) as being covered by alluvium comprising clay and silt. There are no recorded superficial deposits in the northern site, and no available borehole records. Made ground is present in the south-eastern corner of the northern site, this is land adjacent to Smithies tip which is now the location of a Travellers site. The surface of the made ground sits approximately 3 m above the ground surface of the surrounding land on-site. There is also extensive made ground to the east of the northern site. The nature of the made ground both on-site and in the surrounding area is unknown.

A site investigation was undertaken on 11th February 2015 by JBA hydrogeologists using a hand auger, with the borehole logs shown in Appendix I (locations shown on Figure 5-1). They show that the alluvium on the site is composed of primarily clay below the top soil layer, with select areas being largely made ground near the surface. Made ground was found along a track created through the centre of the site from north to south, and a mound in the centre of the site previously used as a tip. The made ground is largely comprised of ash material.

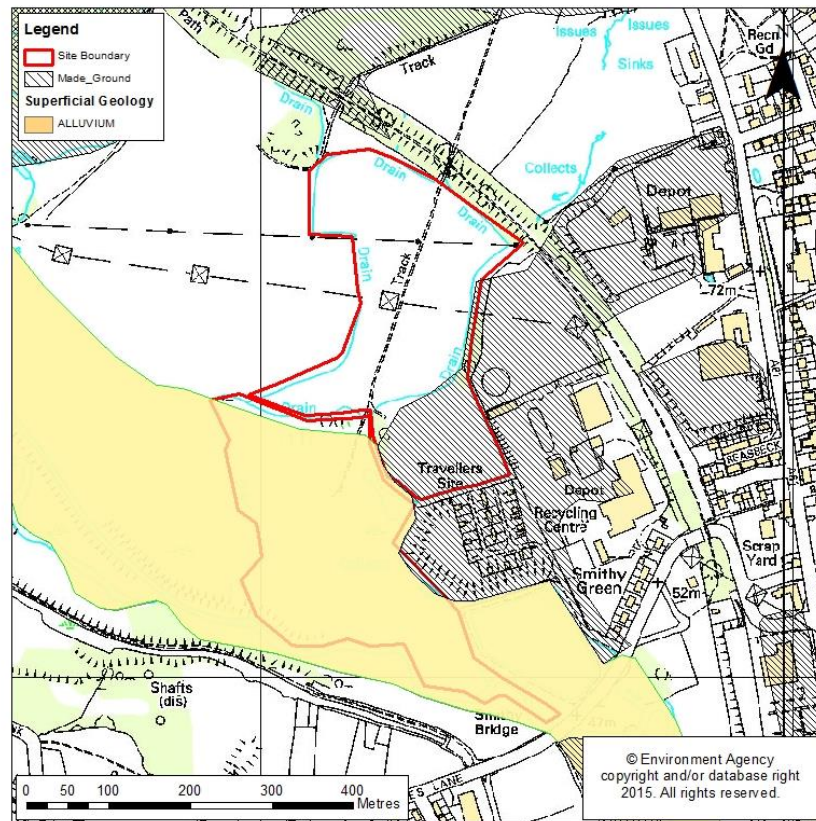


Figure 3-4: Superficial geology map

3.5 Surface Water Hydrology

The River Dearne, which originates to the north-west, forms the southern boundary of the site. The river has a large catchment upstream of the site that extends to the west of Smithies, up to the west of Birdsedge in West Yorkshire. The Dearne joins the River Don at Conisborough, near Doncaster.

3.5.1 On-site Hydrology

There are several drains around the boundaries of the site. The drains form the north, east and western boundaries of the site, with a drain running through the centre east to west. The middle drain is the remnants of an old mill race that flowed eastwards across the site. The old mill was originally embanked, and following the removal of the embankment the function of the drain has altered from operating as a high level carrier to a catchwater drain which now transports water westwards then south along the western boundary of the site.

The eastern drains run along the base of the raised made ground before entering the river adjacent to the reservoir, which drains water from the northern site and east of the southern site. Historical maps suggest that the drain running down the eastern boundary of the site was once used to feed the reservoir to the east and therefore didn't run the full length of the site. The drain in its present form is believed to have been formed following the cessation of this topping up of the reservoir.

3.5.2 Surface Water Abstractions

There is one surface water abstraction located within 1 km of the site. There are five surface water abstractions currently licensed within 2 km of the site, details of these are given in Table 3-3.

Table 3-3: Surface water abstractions located within 2 km of the site

Operator	Source	Location	Distance from site (m)	Daily rate (m ³)	Yearly rate (m ³)
Yorkshire Water Plc	The Fleets	South-east	453	18	2273
Barnsley Metropolitan Borough Council	River Dearne	South-east	1472	87	7800

3.6 Catchment Descriptors

The FEH CD-ROM holds catchment descriptors for more than four million sites across the UK. Catchment descriptors were obtained for the entire River Dearne catchment upstream of the site in question and a smaller proxy catchment adjacent to the area containing the site to the east. This comparison is done to assess the likely variance of the parameters of the site, as the smaller proxy catchment is geographically more representative than the entire Dearne catchment. It should be noted that the smaller proxy catchment contains a large proportion of urban coverage (~50%) within Smithies, which the site does not.

The FEH gives the Standard Percentage Runoff (SPR) for the site as 24.6% for the entire upper catchment and 36.3% for the smaller adjacent catchment. It is likely that the true value at the site would be approximately that of the entire upper catchment, as the urban nature of the smaller proxy is likely to greatly increase runoff potential. The SPR is the percentage of rainfall responsible for the short term increase in river flow during and/or following a rainfall event (Boorman *et al.*, 1995).

The Baseflow Index (BFI) for the site is approximately 0.39 to 0.55, with the highest value for the entire upper catchment (CEH, 2009). This is the proportion of total streamflow made up of baseflow (mostly groundwater input).

3.7 Hydrogeology

The alluvium on site is regarded as a Secondary A aquifer by the Environment Agency. A Secondary A aquifer is described as "*permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of baseflow to rivers*". The bedrock beneath the site (PMCM) is also regarded as a Secondary A aquifer.

3.7.1 Groundwater Abstractions

There are no operational licences for groundwater abstraction located within 2 km of the site.

3.7.2 Groundwater Source Protection Zones

There are no groundwater Source Protection Zones (SPZs) located within 2 km of the site.

3.7.3 Aquifer Vulnerability and Water Quality

The groundwater beneath the site is described by the Environment Agency as belonging to a minor aquifer of high vulnerability in the southern half, and low vulnerability in the northern half. The high vulnerability is attributed to the fact that the soils overlying the site are of high leaching potential, and can readily transmit liquid discharges because they are either shallow, or susceptible to rapid by-pass flow directly to rock, gravel or groundwater.

The groundwater body beneath the site is named the Don and Rother Millstone Grit and Coal Measures, it is currently regarded as having poor chemical quality and good quantitative quality by the Environment Agency. Quantitative status is an expression of the degree to which the groundwater body is affected by direct and indirect abstractions.

3.7.4 Aquifer Properties

The alluvial deposits will contain some groundwater, with groundwater storage and transport likely to be contained within more permeable horizons where sands and gravels dominate.

The Coal Measures Group form a complex multi-layered minor aquifer. Argillaceous strata predominate, acting as aquitards or aquicludes, isolating the sandstone horizons which

effectively act as separate aquifers (Jones *et al.*, 2000). Coal Measures sandstones generally possess very little primary porosity or intergranular permeability as they are generally very fine grained, well cemented, and hard and dense. Groundwater storage and movement within the Coal Measures occurs predominantly within and through fractures in the sandstones.

3.7.5 Groundwater Flow

Local groundwater flow is likely to be towards the River Dearne, with flow primarily within more permeable alluvial layers and within fractures of the Coal Measures Sandstones.

3.7.6 Springs and Issues

The nature of groundwater flow within the PMCM, primarily through fractures, can lead to the discharging of groundwater to the surface at discrete locations forming springs.

3.7.7 Implications for habitat creation

The alluvium is dominated by clay which is likely to act as low permeability aquitard which will limit the rate of infiltration to the ground and yield limited groundwater. This was reinforced during site visits where standing water was observed in various sections of the southern extent, which is dominated by the alluvium. This suggests that the southern extent is ideal for habitat creation through excavation work such as scrapes, as these benefit from low permeability strata which allow perched water bodies.

The northern site is unlikely to be suitable for habitat creation works as the topography has a steep gradient, with little superficial deposit coverage. This makes it difficult to create features that will naturally retain water.

3.8 Hydrogeological Conceptual Model

The Environment Agency defines a conceptual model as "*a description of how a hydrogeological system is believed to behave*" and its development as "*an iterative or cyclical process of development and testing in which new observations are used to evaluate and improve the model*" (Environment Agency, 2002, p.4.1-2).

A conceptual model summarises our understanding of the functioning of a groundwater system and is typically presented as a schematic summary diagram with accompanying maps and explanatory text as required.

3.8.1 Conceptual Model of the Site

Figure 3-5 summarises the hydrogeological conceptual model proposed for the River Dearne site at Smithies.

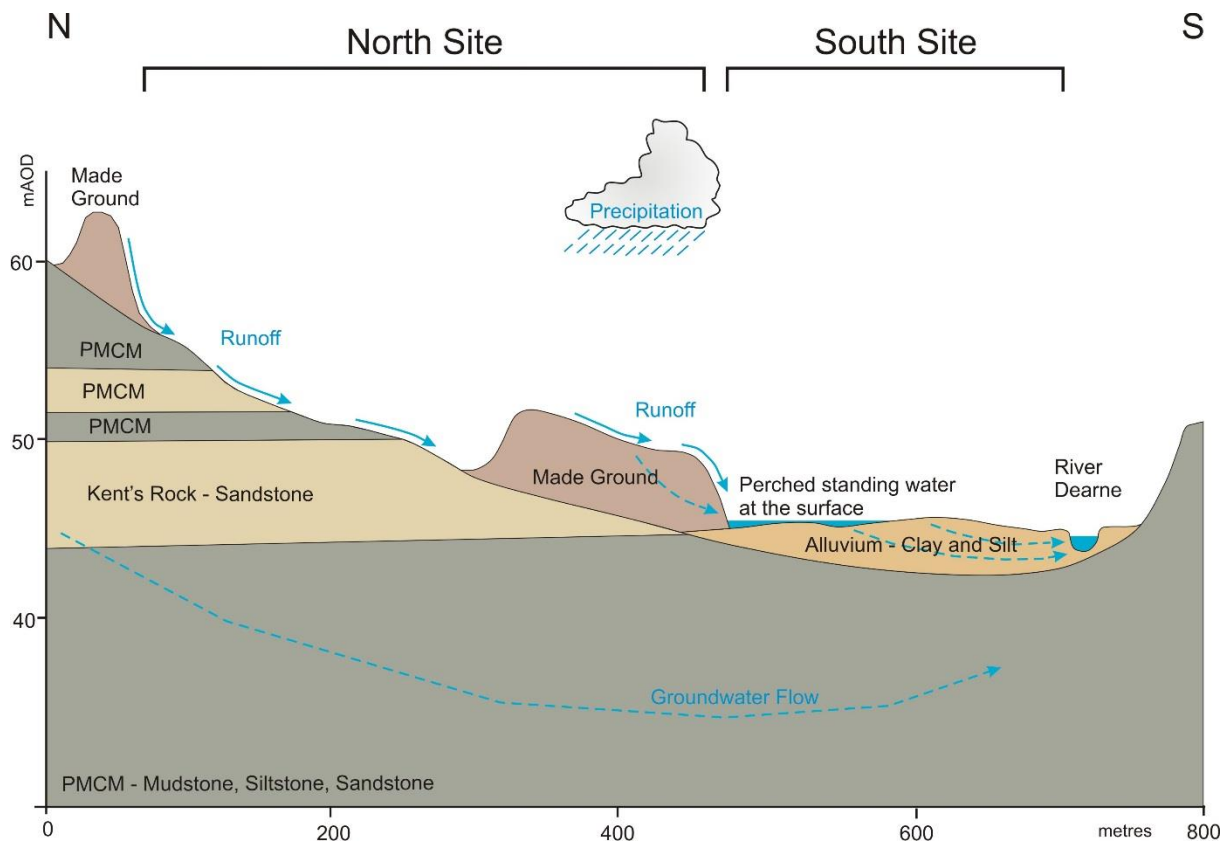


Figure 3-5: Hydrogeological Conceptual Model of Smithies

The main features of the conceptual model are as follows:

- The bedrock underlying the site belongs to the PMCM Formation which predominantly comprises interbedded mudstone, siltstone, sandstone and commonly coal seams. At this site various bands of the PMCM outcrop in the northern half of the site.
- The southern part of the site is underlain by alluvial deposits, consisting largely of clay and silt. Whereas the northern part of the site does not have superficial deposits recorded by the BGS, and is underlain predominantly by the PMCM bedrock and made ground.
- The southern part of the site is bordered by the River Dearne in the south and the made ground/ drain system further north-east/ north. The northern part of the site is bordered by made ground in both the south and north, with the northern made ground comprising of the railway line.
- Both the alluvial deposits and PMCM bedrock are regarded as Secondary A aquifers by the Environment Agency.
- In the southern part of the site there is an area of inundation adjacent to the boundary with made ground.

4 Contaminated Land Assessment and Preliminary Environmental Appraisal

4.1 Introduction

This contaminated land assessment and preliminary environmental appraisal chapter summarises the findings of an assessment of current and historical land uses in and around the River Dearne at Smithies to identify any potentially contaminative activities, along with the results of the qualitative risk assessment conducted in relation potential sources of contamination. The methodology for the preliminary environmental assessment is given in Appendix B.

4.2 Site Regulatory and Environmental Data

Information regarding potential hazards associated with environmental regulatory controls is summarised in Table 4-1. This information was obtained from the Landmark Envirocheck Report, which is provided in Appendix A.

Table 4-1: Regulatory data

Data Source	Details	Potential for impact on site?
Explosive Sites	None within 1 km.	No
Contaminated land register entries	None within 1 km.	No
Landfill sites	There are several historical landfill sites located within close proximity to the site. One adjacent to the site to the east used to deposit waste of an unknown nature. One 19 m to the south-east used to deposit waste including industrial waste. One 106 m to the north-east used to deposit waste of an unknown nature. One 122 m to the south-east used to deposit waste including inert waste and liquid sludge. One 180 m to the east used to deposit waste including industrial and commercial waste. One 191 m to the north-east used to deposit waste of an unknown nature. One 364 m to the south-east used to deposit waste including inert and commercial waste. One 464 m to the west used to deposit waste including inert and commercial waste. One 535 m to the south used to deposit waste including inert waste. One 724 m to the south used to deposit waste including inert waste. One 777 m to the south-east used to deposit waste including inert waste. One 830 m to the east used to deposit waste including inert and commercial waste. One 839 m to the south used to deposit waste including inert and commercial waste.	Yes, landfill site adjacent to study site.
Waste management sites	One 178 m to the east used for household waste and operated by F C C Recycling (UK) Limited. One 631 m to the east used for household,	Yes, located adjacent and 71m from site in

Data Source	Details	Potential for impact on site?
	commercial and industrial transfer and operated by Yorkshire Water Services Ltd. One 800 m to the south-east and used for household, commercial and industrial transfer and operated by British Gas Transco Plc.	uphill location, potential leachate through groundwater.
Integrated Pollution Control (IPC) authorisations and Integrated Pollution Prevention and Control (IPPC) permits	None within 1 km.	No
Hazardous substances	There is a Control of Major Accident Hazards (COMAH) consent and Notification of Installations Handling Hazardous Substances (NIHHS) with Tansco/National Grid Gas Plc 866 m to the south-east. A Planning Hazardous Substance Consent with British Gas Plc 864 m to the south-east for the use of liquefied extremely flammable gas (including LPG) and natural gas.	No
Fuel Station Entries	Wakefield Road Service Station 391 m to the east, but now obsolete. Asda Barnsley 792 m to the south-east currently open.	No
Contemporary trade directory entries	Two within 250 m, 38 between 250 and 500 m, and 51 between 500 and 1,000 m of the site.	No
Local Authority Pollution Prevention and Controls (LAPPC)	One 344 m to the east for air pollution control at a petrol filling station. One 719 m to the south for air pollution control at a petrol filling station. One 743 m to the north for a dry cleaners.	No
Discharge consents	There are 10 consents within 0 to 250 m, 7 within 251 to 500 m and 12 within 501 to 1000 m.	Yes
Recorded pollution incidents to controlled waters	One incident on site in 1990, a minor incident concerning oils - diesel. Six incidents 0 to 250 m from site between 1990 and 1998. Nine incidents 501 to 1000 m from site between 1990 and 1998.	No - most recent incident occurred in 1998 (over 16 years ago)
Contraventions	None within 1 km.	No
Radon	Part of the site lies within both a lower probability radon area where less than 1% of homes are above the active level and part of the site lies within an intermediate probability radon area, as between 1 and 3% of homes are above the action level. No radon protective measures are necessary in the construction of new dwellings on site.	No

4.3 Historical Land Use

In order to determine land use changes, and if any contaminative land uses have ever been present on site, a review of OS historical maps has been undertaken.

4.3.1 On-site History

In 1855, the site is split into two halves via a mill race running west to east. It consists of fields in the southern half, with the majority of the northern half comprised of woodland, which is part of Smithy Woods.

In 1894, it appears that the woodland has been cleared from the site, with Smithy Wood no longer labelled. There is also a track running through the centre of the site, from across the River Dearne in the south-west to over the railway in the north-east. An area of open standing water has been mapped on the east side of the site, as well as a small marsh area just south.

In 1907, the track is now missing in the south-west, and it no longer extends to the River Dearne. The marsh area in the southern half has extended further westwards.

In 1932, the standing water to the east is now labelled as a band of marsh. There is also a square building of some kind within the site in the south-east corner of the site.

In 1966, the lower marsh area is now categorised as open standing water. The mill race that ran through the middle of the site is now converted to a drain that feeds the standing water and marsh on the eastern side. Other drains are also marked around the site, including another into and out of the marsh. The square building in the south east corner is no longer mapped.

In 1993, the track through the centre of the site appears extended further south, with an area at the end of it labelled as a disused tip to the west of the marsh area.

4.3.2 Off-site History

In 1855, the site is surrounded by fields, with Smithy Wood extending outwards to the north-east. The reservoir is present in this earliest record adjacent to the south-east corner as part of water works. The mill race that runs through the middle of the site extends to the east side of the reservoir and feeds Smithy Mill. There is also a canal system that runs approximately parallel with River Dearne to the south of it.

In 1894, a new railway appears on the map that runs from south-east of the site northwards, and bends north-west to run adjacent to the north side of the site, now forming the upper boundary. Adjacent to this railway are three new collieries to the east, north and north-east of the site.

In 1907, the building east of the reservoir is now labelled as 'Paper Works' which is potentially using a mill fed by the mill race. To the south-west of the site, just south of the canal is an area labelled as having 'old shafts'.

In 1955, the reservoir is now categorised as disused (previously operated by Barnsley Water Works).

In 1966, there is a significant increase in residential buildings within Smithies, to the east and north-east.

In 1973, the area adjacent to the east is labelled as a disused tip, indicating previous waste disposal use. There is also now a depot to the east.

In 1993, the River Dearne has an approximately 600 m straightened section, bypassing the original meandering river section. The disused tip adjacent to the east of the site is now being used as a traveller residential zone.

4.3.3 Mining and Mineral Extraction

The site lies within a Coal Mining Reporting Area. The Coal Authority's interactive map does not indicate the presence of any mine entries within the site itself, although some are indicated in the surrounding area. The closest entry is to the north-west of the site, close to the boundary, and the rest are predominantly to the east of the site within Smithies urban centre.

There are no mine gas sites (areas where the Coal Authority has undertaken remedial works following the report of a mine gas related surface hazard(post 1994)) on site, but there are two to the east in Smithies.

No past or current surface mining is indicated on site, although there are areas in the surrounding locality, to the east and north-west, with a zone to the east marked as being a past surface hazard. There are some surrounding areas of past shallow coal mine workings to the east, and larger areas indicated as being probable shallow coal mine workings from the north-west to south-east, including a strip that runs through the centre of the site.

There are various bands of coal outcrops in very close proximity to the site to the north, south and west, as well as a band through the centre corresponding to the previously mentioned probable shallow coal mine workings.

Table 4-2: Potential contaminative land uses identified from the historical map review

Industry / Source	Location	Date	Potential for Impact on site?
Farming	Predominantly to the west of the site	1855 - present	Yes - potential for migration of any contaminants (such as fertilisers used on arable land) in groundwater.
Mine shafts	Collieries to the north-east, and some shafts to the south-west	1894 - 1955	Yes - mining in the area could have led to the mobilisation of metalloids etc. in groundwater.
Railway line	Along northern boundary and east	1894 - present	Yes - Contaminants could wash down embankment from railway to the site.
Landfill and waste management	Adjacent to east boundary of site	Pre 1973 - present	Yes - potential for migration of any waste leachate in groundwater and pluvial runoff.

4.4 Summary of Site Sensitivity

The sensitivity of each of the identified hydrological and hydrogeological receptors in the vicinity of the site to contamination is summarised in Table 4-3. This includes an assessment for the Dearne Valley Park Local Nature Reserve (LNR) which is located downstream of the site (see Appendix D).

Table 4-3: Sensitivity of Environmental receptors in the vicinity of the site

Receptor Type	Receptor	Sensitivity	Reasoning
Groundwater	Secondary Aquifer (Alluvium)	Moderate	The alluvium, as a Secondary A aquifer may store and transmit reasonable volumes of groundwater. The aquifer is reasonably vulnerable to contamination as the deposits are located near to the surface, however, the overlying soils are of low leaching potential which will reduce vulnerability.
Groundwater	Secondary A Aquifer (PMCM)	Moderate	The PMCM, as a Secondary A aquifer will store and transmit reasonable volumes of groundwater primarily within sandstone layers and within fractures. Though the aquifer is somewhat protected by the overlying alluvium and soils of low leaching potential, any contaminants penetrating the aquifer could be rapidly transmitted via fracture flow within the unit.

Receptor Type	Receptor	Sensitivity	Reasoning
Surface Water	River Dearne	Moderate	The River Dearne currently has moderate ecological quality and good chemical quality though it is a tributary of the River Don which a more sensitive receptor.
Surface Water	River Don	Moderate	The River Don at its confluence with the River Dearne currently has moderate ecological quality.
Ecological	Dearne Valley Park LNR	Moderate	Dearne Valley Park is of importance to local wildlife.

Although the Dearne Valley Park LNR is located downstream of the site, it is located significantly far enough away (directly 830m, further for the river course) that there would be little or no impact from habitat creation work carried out on site. As a result, Dearne Valley Park LNR is not considered as a receptor in the preliminary risk assessment

4.5 Preliminary Environmental Assessment

4.5.1 Identified Sources of Contamination

The following sources of contamination have been identified from historic and current uses of the site and the surrounding area:

- On site:
 - Mound/ embankment of unknown material deposited in the centre of the southern site
 - Landfill and waste management sites located near the east boundary
- Off site:
 - Landfill and waste management sites located near the east boundary
 - The disused railway adjacent to the north boundary of the site
 - Discharge consents
 - Farming (arable) land adjacent to western boundary

4.5.2 Pathways and Receptors

Potential receptors, and possible pathways for contaminants to reach these receptors, are summarised below:

- Current and future site users [direct contact, inhalation, accidental ingestion]
- Groundwater (Secondary A aquifers) [migration via permeable strata]
- Surface water (River Dearne, on-site standing water) [overland flow, migration via drainage, baseflow]

4.5.3 Qualitative Risk Assessment

A qualitative risk assessment has been undertaken for these potential source-pathway-receptor linkages based on DEFRA (DEFRA, 2011) and CIRIA guidance (CIRIA, 2001). This is based on consideration of both:

- The **likelihood of an event** (probability - takes into account both the presence of the hazard and the receptor, as well as the integrity of the pathway);
- The **severity of the potential consequence** (takes into account both the potential severity of the hazard and the sensitivity of the receptor).

Further information of the risk assessment methodology is given in Appendix B. The preliminary qualitative risk assessment is given in Table 4-4.

Table 4-4: Preliminary Qualitative Risk Assessment

Source	Pollutant	Receptor	Pathway to receptor	Associated Hazard [Potential Severity]	Likelihood of Occurrence	Risk
Mound/ embankment of unknown material deposited in the centre of the southern site	Unknown	Site users (current and future use)	Direct contact, inhalation, accidental ingestion	Health risk [Medium]	Low There is unlikely to be a risk to site users unless the mound is excavated. Even if the mound were excavated it is unlikely to contain contaminants in a concentration that would be detrimental to human health.	Moderate/ Low Risk
		Groundwater	Migration via permeable strata	Pollution of groundwater [Mild]	Likely As the mound is located on site, any mobilisation of contaminants within the mound will infiltrate to the groundwater body beneath the site. However, it is unknown whether the mound is composed of contaminant material.	Moderate/ Low Risk
		Surface water	Overland flow, migration via drainage, baseflow	Pollution of surface waters [Mild]	Likely As the mound is located on site and adjacent to a water course it is almost certain that runoff generated from the mound will reach the standing water. However, it is unknown whether the mound is composed of contaminant material.	Moderate/ Low Risk
Landfill and waste management sites surrounding the site	Landfill gas Organic compounds Ammonia Iron and other metals Inorganic compounds Asbestos Polychlorinated biphenyls (PCBs) Polycyclic aromatic hydrocarbons (PAHs)	Site users (current and future use)	Direct contact, inhalation, accidental ingestion	Health risk [Medium]	Unlikely Any contaminants are likely to undergo attenuation and/ or dilution during transport to the site and are therefore unlikely to be present in concentrations that could be detrimental to human health.	Low Risk
		Groundwater	Migration via permeable strata	Pollution of groundwater [Mild]	Likely More soluble organic and inorganic compounds may be leached out by infiltrating water. Contamination reaching site is likely to be greatest from the landfill site to the north which is adjacent to the site and not separated from the site by a watercourse. Any contaminants will likely undergo some attenuation and/ or dilution during transport.	Moderate/ Low Risk

Source	Pollutant	Receptor	Pathway to receptor	Associated Hazard [Potential Severity]	Likelihood of Occurrence	Risk
		Surface water	Overland flow, migration via drainage, baseflow	Pollution of surface waters [Mild]	Likely It is likely that any contaminants leached out of the landfill and waste management sites will ultimately be discharged to the River Dearne, however, they are likely to undergo attenuation and/ or dilution during the transportation process.	Moderate/ Low Risk
Disused railway line	PCBs PAHs Ethylene glycol Creosote Herbicides Ferrous residuals Metal fines Ash Sulphate	Site users (current and future use)	Direct contact, inhalation, accidental ingestion	Health risk [Medium]	Low Although a pollution linkage does exist, there is unlikely to be significant contamination (if any) arising from the disused railway line as it is simply a stretch of track and not an area of high contaminant risk. Any contaminants are unlikely to present in volumes that would be detrimental for human health.	Moderate/ Low Risk
		Groundwater	Migration via permeable strata	Pollution of groundwater [Mild]	Low Although a pollution linkage does exist, there is unlikely to be significant contamination (if any) arising from the railway line as it is simply a stretch of track and not an area of high contaminant risk. The greatest risk arises from the embankment itself of which the composition is uncertain. Any contaminants will likely undergo significant dilution and/ or attenuation.	Low Risk
		Surface water	Overland flow, migration via drainage, baseflow	Pollution of surface waters [Mild]	Low Although a pollution linkage does exist, there is unlikely to be significant contamination (if any) arising from the railway line as it is simply a stretch of track and not an area of high contaminant risk. The greatest risk arises from the embankment itself of which the composition is uncertain. Any contaminants will likely undergo significant dilution and/ or attenuation.	Low Risk

Source	Pollutant	Receptor	Pathway to receptor	Associated Hazard [Potential Severity]	Likelihood of Occurrence	Risk
Discharge consents	Fuels/hydrocarbons Metals PAHs Organic compounds	Site users (current and future use)	Direct contact, inhalation, accidental ingestion	Health risk [Medium]	Unlikely Contaminants are unlikely to be mobilised to site in concentrations that would be detrimental to human health.	Low Risk
		Groundwater	Migration via permeable strata	Pollution of groundwater [Mild]	Unlikely Contaminants will likely be attenuated within the surface water courses they are discharged to, with limited migration to groundwater.	Very Low Risk
		Surface water	Drainage, baseflow	Pollution of surface waters [Mild]	Likely Discharge consents are to the River Dearne and tributaries, with some located in close proximity to the site. Treated effluent discharges are regarded as environmentally safe and any contaminants mobilised in storm discharges should be largely diluted given the flow of the river, particularly during storm events.	Moderate /Low Risk
Farming (arable) land adjacent to west boundary	Inorganic compounds (sulphates, phosphates, nitrate, chloride) Pesticides	Site users (current and future use)	Direct contact, inhalation, accidental ingestion	Health risk [Mild]	Unlikely Any contaminants are likely to undergo attenuation and/ or dilution during transport to the site and are therefore unlikely to be present in concentrations that could be detrimental to human health.	Very Low Risk
		Groundwater	Migration via permeable strata	Pollution of groundwater [Mild]	Low Contaminants originating from farming practices could migrate into groundwater, though the concentration of contaminants is likely to be low as they would be subject to attenuation within the aquifers.	Low Risk
		Surface water	Overland flow, migration via drainage, baseflow	Pollution of surface water [Mild]	Low Contaminants originating from farming practices could reach surface water bodies via overland flow or groundwater discharge. The concentrations of these contaminants is likely to be low as they would be subject to attenuation and dilution.	Low Risk

5 Soil Contamination Testing

5.1 Introduction

In order to provide an initial assessment of soil contamination issues a targeted intrusive site investigation has been undertaken involving recovery and analysis of a limited number selected shallow soil samples followed by analysis at a UK UKAS accredited laboratory for a broad range of potential metallic, inorganic and organic contaminants.

Selected soils chemical analysis samples have been screened against recently (2015) published Suitable for Use Levels (S4ULs) where values for particular contaminants have been developed¹.

In addition, selected analytical data for potential key indicators of contamination from the leachability tests have been assessed by direct comparison against Environmental Quality Standards (EQS) for a number of priority pollutants on the basis that these standards are appropriate (conservative) screening values for protection of the water environment.

It should be noted that the purpose of the assessment is to provide an initial screening assessment of soil quality issues in relation to the proposals for future habitat creation and not to provide a detailed assessment of the sites within the context of Part IIA of the 1990 Environmental Protection Act.

Where possible, soil sampling has focussed on potential soil contamination source areas as identified through a review of desk based information

5.2 Method for Contamination Testing

Soil sampling was undertaken across the site using a hand auger to obtain soil samples from varying depths and locations across the site. Samples were taken to determine the presence of:

- Contaminants in the soils, including metals, phenols, and PAHs (polycyclic aromatic hydrocarbons)
- Leachable contaminants within the soils, including metals, phenols and PAHs.

Figure 5-1 shows the soil sampling locations across the site. Samples were obtained from depths of between 0.1 and 0.6 m below ground level (bgl) and were distributed to obtain a general coverage across the site as well as targeting suspected areas of contamination. When sampling, the mound and trackway of suspected made ground on site were targeted (S7 and S8), as well as soils near a drainage network running adjacent to an area of historic landfilling (S9). The southern half of the site was the focus of the contamination testing as this is the area which will be the focus of wetland creation as it forms the natural floodplain of the River Dearne. Only one sample was obtained from the far north of the site (S10) where no works are currently planned. Logs of the auger holes excavated at each soil sampling location are provided in Appendix I.

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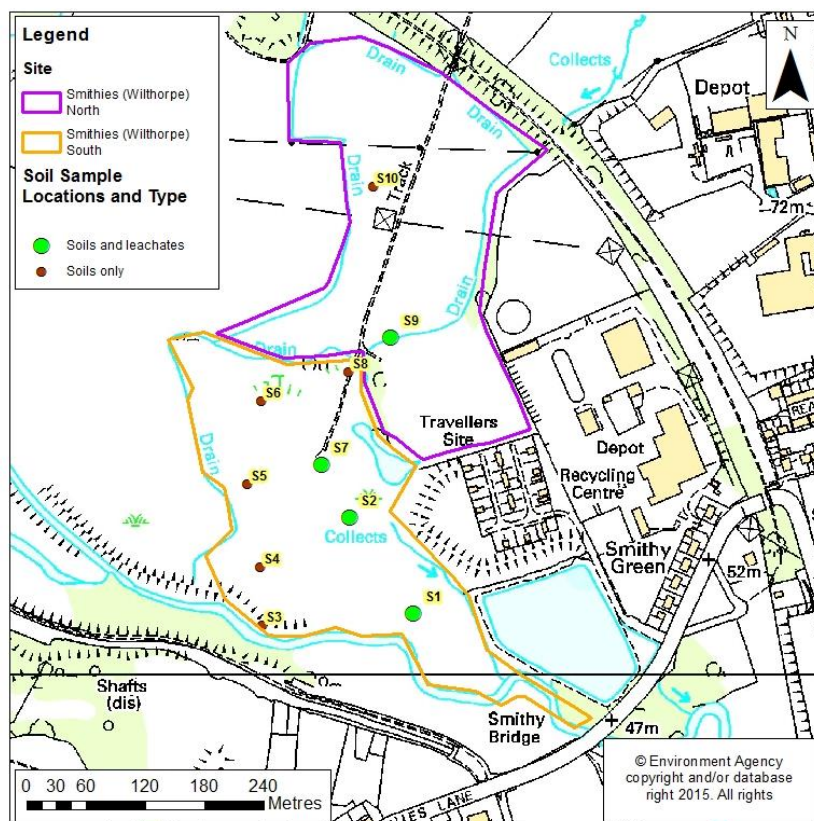


Figure 5-1: Soil Sampling Locations at the River Dearne at Smithies Site

5.3 Results

The tables in Appendix C show the results of the chemical testing performed on the soil samples.

5.3.1 Soils

The following bullet points summarise the results of the soils testing:

- None of the results exceed defined S4ULs for Public Open Space (park). Where S4ULs are available the test results are in all instances significantly lower than the defined levels.
- Many of the contaminants for which S4ULs are not available have been detected in the samples at very low concentrations, either below or very close to the limits of detection.
- All of the samples tested were found to contain less than 150 mg/kg of lead. In our opinion the levels observed are not indicative of contamination and are below the 95th percentile value of normal background concentration for lead in urban soils in England of 820mg/kg². Furthermore, while there is no current published S4UL for lead, the provisional UK Category 4 Screening Level (C3SL)³ for lead for a public open space land use is 580 - 1,400 mg/kg and none of the samples returned values above this threshold.

5.3.2 Leachates

Soils across the Smithies site were found to represent the natural soil profile which was generally dominated by clay with the exception of locations S7 and S8 where made ground largely comprising ash was encountered. Four samples were tested for leachability to give an indication of potential contaminant mobility. The results of the leachate testing are provided in Appendix C alongside screening levels. The following bullet points summarise the results of the leachate testing:

² Ander, EL, Johnson CC, Cave, MR, Palumbo-Roe, B, Nathanail, P and Lark, RM. 2013. Methodology for the determination of normal background concentrations of contaminants in English soil. Science of The Total Environment, Volumes 454–455, 1 June 2013, Pages 604-618

³ SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, CL:AIRE 2014.

- Where EQS guideline values were available, all of the test results fell below the respective screening value.
- All of the additional leachates for which EQS are not available are present in the samples below the limits of detection, this means they are either absent from the samples or present in very low concentrations.
- In summary, the test data indicate overall low contaminant leachability.

5.4 Conclusions and Recommendations

The testing results show the site to have low levels of soil contamination with regard to metallic compounds, phenols and PAHs. Levels recorded were below S4UL screening criteria and also there was very limited evidence of contaminant mobility as shown by leachability testing of selected soil samples suggesting limited potential impact upon the water environment and any new habitats created.

In summary, the desk based research and contamination testing carried out show limited evidence of a potential soil contamination source on the site. However, it should be noted that this is based on analysis of a relatively limited soils testing dataset and additional investigation and analysis should be carried in advance of habitat creation works. Additional sampling and analysis should be targeted in areas where excavation of soils is proposed. For this particular development this would include areas of proposed scrapes and the soils within the existing flood embankment. Once such testing is undertaken then options for re-use of these soils on site can be further assessed.

Alternatively, as the initial screening suggested low levels of contamination across the site, habitat creation works could proceed without further investigations being undertaken, provided an experienced contamination professional be on hand for the duration of the works. Should any potential contamination be encountered during the works, this could be dealt with on a "live" basis during the work, for example by segregation/ quarantining of material suspected to be contaminated in a dedicated area of the site and promptly arranging suitable laboratory testing to determine the fate, or re-use (e.g. for placement on other areas of the site) of any such material. It should be noted that adopting this approach could potentially impact upon construction programmes and cost in the event that contamination was encountered and designs for the site altered.

5.4.1 Waste Disposal and Environmental Permitting Considerations for Future Site Development

In relation to future earthworks activities that may be undertaken at the site as part of habitat creation works we would note the following:

- Should it be necessary to remove made ground or natural soils from site, these should be disposed of at an appropriately licenced landfill facility. There is also a legal requirement to pre-treat contaminated soils (including non-hazardous materials) prior to disposal.
- If it is proposed to re-use site derived excavated soils or import soils from another site, such activities may fall under the Environmental Permitting Regulations (2010) depending on levels of contamination present. It may however be possible to deal with such soils under the CL:AIRE (Contaminated Land: Applications in Real Environments) Code of Practice.

6 Summary of Site Constraints

6.1 Introduction

In order to identify any potential constraints to undertaking habitat creation works at the River Dearne at Smithies site a series of desk-based assessments were undertaken/ commissioned to collate available data and identify any significant risks to delivery of a project. Areas of consideration included:

- Ecological constraints
- Archaeological/ heritage constraints
- Contaminated land
- Services/ Utilities
- Public access
- Risk of anti-social behaviour

This section provides a brief summary of the key site constraints that have been identified, with further details provided in the Appendices, where relevant

6.2 Ecology

Details of the ecological baseline assessment are provide at Appendix D. Table 6-1 below provides details on the potential ecological constraints at the River Dearne site, and summarises likely recommended mitigation and other actions needed to facilitate a habitat creation project.

Table 6-1: Identified Potential Ecological Constraints and Recommended Mitigation/ Action

Potential Ecological Constraint		Recommended Mitigation/ Action
Otter	The data search identified historical records of Otter on the River Dearne, immediately downstream of the site and this species may be disturbed by implementation of the project.	Implement appropriate mitigation measures (e.g. no night-time working, leaving any excavations with a means of escape).
Bats	The data search identified that the area is important for a number of bat species, with a Daubenton's Bat roost immediately downstream of the site.	Implement appropriate mitigation measures (e.g. no night-time working; no lighting installed). Should any mature trees require removal, these should first be subject to a bat roost potential assessment and, if required, a bat activity survey.
Nesting Birds	Any vegetation clearance undertaken as part of the implementation of a project could result in the damage/ destruction of birds' nests if conducted between March - September.	Schedule any vegetation clearance required to implement the project outside of the March to September nesting period.
Crayfish	The data search returned records of both native White-clawed Crayfish and non-native Signal Crayfish for the River Dearne around the Smithies site.	Any in-channel works must be designed and undertaken with regards to the potential presence of White-clawed Crayfish. Furthermore, appropriate biosecurity protocols must be implemented. Any contractors working on site must be given a toolbox talk regarding crayfish and the measures required.
Japanese Knotweed	The data search and site visit identified that Japanese Knotweed is present in localised patches within and around the site.	It is advised that no earthworks are conducted within 7m of the above-ground growth of Japanese Knotweed, and no plant, machinery or the

Potential Ecological Constraint		Recommended Mitigation/ Action
		workforce should enter this exclusion zone. If this is not possible, an appropriate mitigation strategy will be required. Implement appropriate biosecurity protocols
Himalayan Balsam	The data search and site visit identified a number of stands of the species, particularly in the south-west of the site.	An appropriate mitigation strategy will be required to undertake works in areas infested within this species. Implement appropriate biosecurity protocols.

Any habitat creation scheme has the potential to bring about significant ecological benefits to the site. Potential ecological opportunities that will/ could be pursued as part of this project include:

- Enhancement of the wetland habitats within Barnsley Canal at Wilthorpe Local Wildlife Site (LWS) (Site Reference Number 25).
- Enhancement of habitat for a range of protected and notable species (e.g. artificial Otter holt creation, bird and bat box installation, amphibian and reptile refugia/ habitat piles).

6.3 Archaeology

A Rapid Archaeological Appraisal is provided at Appendix E. One Scheduled Monument lies close to the northern boundary of the site, and retains below ground evidence for colliery structures. This is currently densely vegetated, but the proposed site would have formed part of its historic context. English Heritage should be consulted as part of the process, and any works that would directly affect the structure will require Scheduled Monument Consent.

Further earthwork and structural remains may survive across the site, associated with mills and the colliery. It is recommended that:

- South Yorkshire Archaeology Services should be contacted at an early date to agree a suitable scope of works.
- A full desk-based archaeological assessment (including detailed map regression) be carried out to more fully establish the archaeological potential and significance of the site, and to inform a programme of mitigation if required.

6.4 Contaminated Land

A Preliminary Qualitative Risk Assessment highlighted a number of potential contamination sources within and surrounding the site. A limited intrusive assessment was then undertaken to determine actual levels of contamination in potential source areas. The testing showed the site to have low levels of soil contamination with regard to metallic compounds, phenols and PAHs, and little evidence of contaminant mobility as shown through leachability testing. For those contaminants where screening levels are available (S4ULs and EQS) all of the test results fall well below the respective value.

Contamination does not appear to be a particular constraint for the works proposed on site. A mound of made ground dominated by ash was encountered at the sampling location S7, with a trackway comprising made ground leading from here north to the railway line. Any disturbance of this material during the works should be carefully considered, although should not form a significant constraint to habitat creation.

6.5 Coal Mining

Records held by the Coal Authority suggest that areas of the site may have been affected by shallow coal mine workings and a number of mine entries are mapped to the north-west and east of the site. There are three areas of probable shallow mine workings on site, two in the northern site area, both run broadly north-west to south-east, and one in the south. The third area is in the south-west of the southern site running broadly west to east alongside the River Dearne. The areas of probable shallow coal working in the northern site are unlikely to pose a constraint to the works as it is not proposed to undertake any habitat creation within this site. The probable

workings in the south are also unlikely to pose a constraint to the works as the works involve very shallow earthworks (<1m excavations). Site investigations undertaken by JBA proved a thickness of clay to at least 1m bgl across the floodplain. Proposed excavations are not anticipated to extend below this layer.

If habitat creation works involve the construction of structures or significant earthworks (>1m excavations e.g. creation of deeper voids to retain water) then a site specific investigation should be carried out to evaluate any potential risks posed by former mine workings should they exist.

6.6 Services/ Utilities

An interrogation of services and utilities was conducted for the site by the Environment Agency, with plans collected for any that may be present on or close to the site. The utilities and services contacted included electricity, water, Virgin Media, BT and gas.

Figure 6-1 displays the utilities and services present within the site boundaries at Smithies, and shows that only overhead cables were found to be located within the site. It should be noted that cables are drawn to approximate locations and Northern Powergrid's original Safe Digging Map should be consulted for more accurate network locations before conducting any earth works on site.

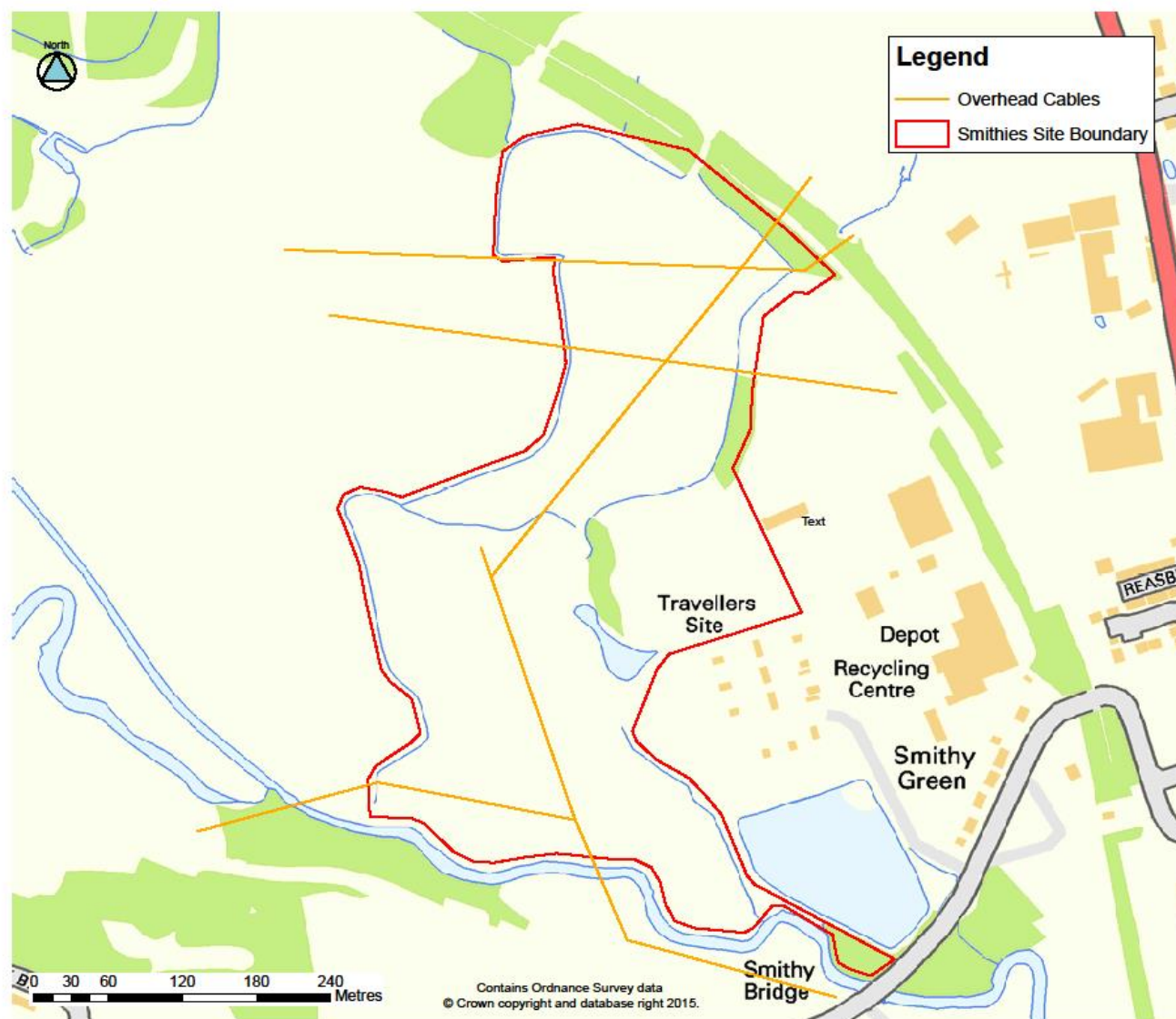


Figure 6-1: Services and Utilities at the River Dearne at Smithies Site

6.7 Public Access

There are a number of Public Rights of Way around the site, as shown in Figure 6-2, along with a number of more informal paths and access points. To the north, a public right of way follows the route of the disused railway, and an informal access track then runs southwards from this across the northern part of the site and part way into the southern section.

There is a footpath from the car park associated with the fishing lake, which follows the western boundary of the lake, before an informal crossing point allows access into the site. No formal access point exists at this location, but a fencing panel has been used to create a bridge across the drain. Despite the lack of formal public access points and paths, the site does appear to be regularly used by the local population. The site is also used for horse grazing without the landowners' permission.

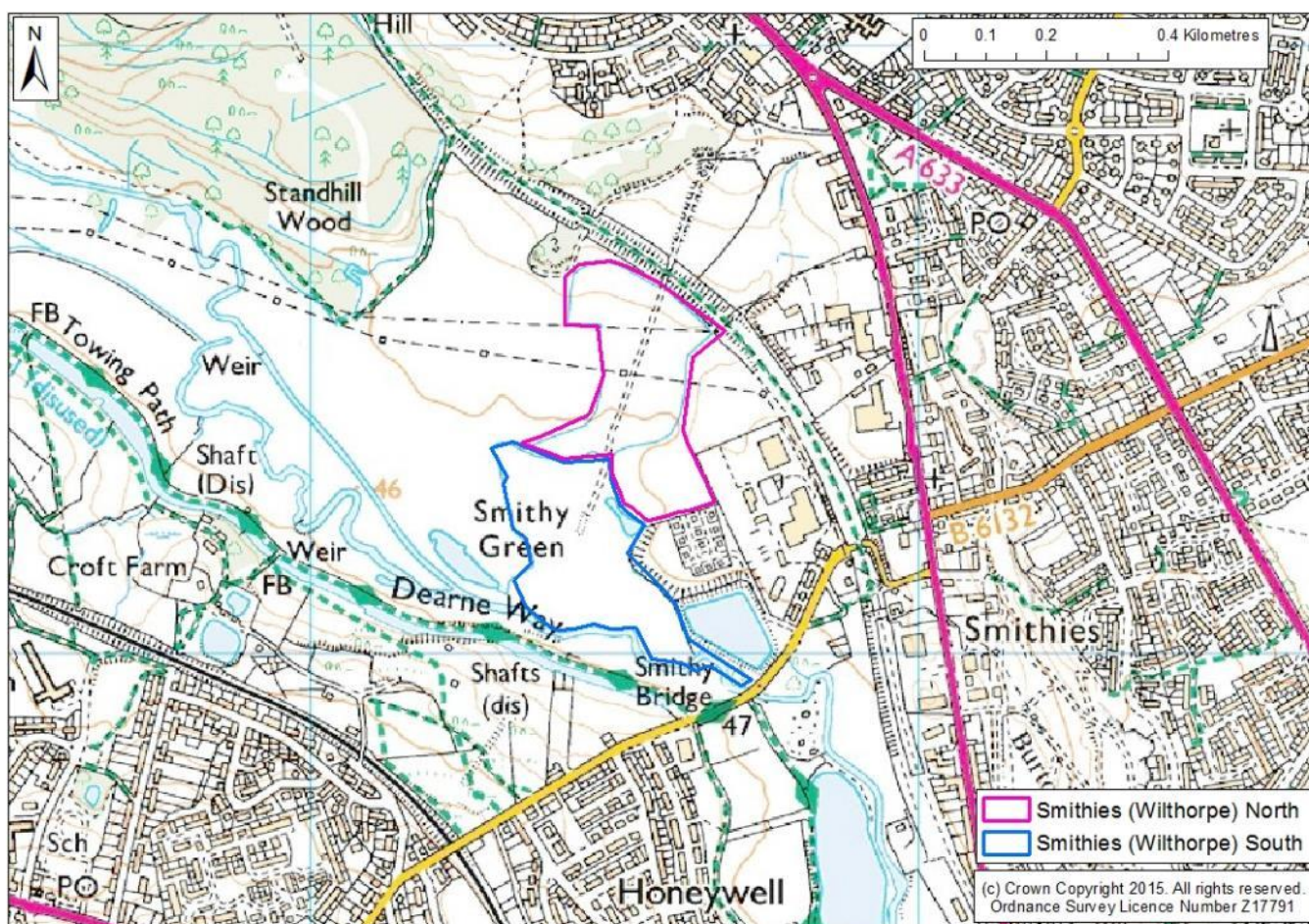


Figure 6-2: Public Rights of Way in and around the River Dearne at Smithies Site (Public Rights of Way shown by Green dashed line)

JBA is also aware of the considerable public interest in this site, and surrounding area, having recently worked with the Willow Bank Community Partnership on a biodiversity, heritage and recreation strategy for areas to the south of the Dearne. In the future, considerable potential for partnership working with this community group may exist, with the Smithies site potentially an important site for the local community.

6.8 Anti-social Behaviour

A review of crime statistics for the local area (UKCrimeStats, 2015) identified the number of reported crimes, by type over a one month period, within one mile of the postcode for the site (S71 3HX). This data was collected for the most recent month available and the data is presented in Table 6-2 below. The data for the site at Smithies is presented in comparison to data for within one mile of the other two sites within this project, for comparative purposes. The monthly crime total for South Yorkshire is also presented. This shows that, in comparison to the Derbyshire site, levels of anti-social behaviour relatively high, although not quite as high as for the Rotherham site. However, during the construction works, consideration may be required to on-site security to avoid theft or vandalism of machinery or tools.

Table 6-2: Crime Statistics for December 2014 for the area within 1 mile of the River Dearne site at Smithies, in comparison to other sites within this project (from: UKCrimeStats, 2015)

Crime	Smithies (Wilthorpe) - within 1 mile of S71 3HX	River Doe Lea at Norbriggs Flash - within 1 mile of S43 3AQ	River Rother Parkway - S60 5LD	Total for South Yorkshire
Anti-social Behaviour	58	14	61	5984
Burglary	6	4	3	1113

Crime	Smithies (Wilthorpe) - within 1 mile of S71 3HX	River Doe Lea at Norbriggs Flash - within 1 mile of S43 3AQ	River Rother Parkway - S60 5LD	Total for South Yorkshire
Robbery	0	0	0	79
Vehicle	10	3	8	907
Violent (and sexual offences)	17	7	10	1434
Drugs	3	2	2	316
Criminal Damage and Arson	7	1	11	1226
Shoplifting	3	0	14	753
Bike Theft	0	0	1	60
Theft from the person	0	0	2	188
Other theft	11	0	5	1020
Weapons	0	0	1	49
Public Order	1	1	2	182
Other	0	0	1	90
TOTAL	116	32	121	13401

Furthermore, during the site walkover survey conducted as part of the hydrological and hydrogeological assessment, an area of fly tipping which had been set alight was noted; this was reported to the local police.

7 Options Appraisal

7.1 Introduction

This chapter outlines a number of possible habitat creation opportunities for the River Dearne at Smithies site. The preferred option will likely consist of a combination of a number of these individual measures. Given the results of the baseline studies and the conditions/ constraints identified on site, it has been identified that the target UK BAP priority habitats to be created/ enhanced on the site are:

- Coastal and floodplain grazing marsh
- Wet woodland
- Reedbed

In addition, options are proposed to improve the riverine habitats of the River Dearne.

7.2 Option 1 - Raising of Water Levels in the Dearne (Woody Debris, Gravels)

During the site visit, an analogue section of watercourse was identified consisting of a semi anastomosed (multi-thread channel at higher flows) wooded system which has been used to inform the restoration of this site in this option.

This option would involve improving connectivity to the left bank floodplain so that it frequently wets to encourage development of the anastomosed system and creation of wet woodland, as present immediately upstream. This water level raising could be achieved through a combination of woody debris features (which were identified on site) and use of gravel features such as riffles in the main channel (see Figure 7-1 which provides a conceptual illustration of this may be achieved). These features would work with the existing natural processes in the main channel where woody debris naturally forms and where gravel features form in unmanaged zones. The riffles would be created by importing gravel, minor local channel widening (subject to detailed design) and raising the river bed locally to create an elevated water surface upstream. This concept is shown in Figure 7-1.

Gravel features composition would be sized to remain dynamically stable, where a large fraction of gravel/ smaller cobbles would ensure they remain permanent features, but also smaller fractions to ensure some transport and replenishment from upstream. Woody debris features may require to be pinned to satisfy flood risk concerns. Water level raising could be achieved through use of gravel features alone and therefore woody debris is not a critical design feature, as debris would return to the reach naturally over time. During the options development workshop it was therefore agreed that raising water levels through the installation of gravel was the preferred option, allowing woody debris to generate naturally.

Similar principles could be adopted for the small ditch running to the western boundary of the site but water level raising here to improve floodplain connectivity is likely to be achieved through use of fine sediment features in the channel to raise water levels, to ensure introduced features are working with natural processes characteristic of the ditch (see section 7.7 for further details).

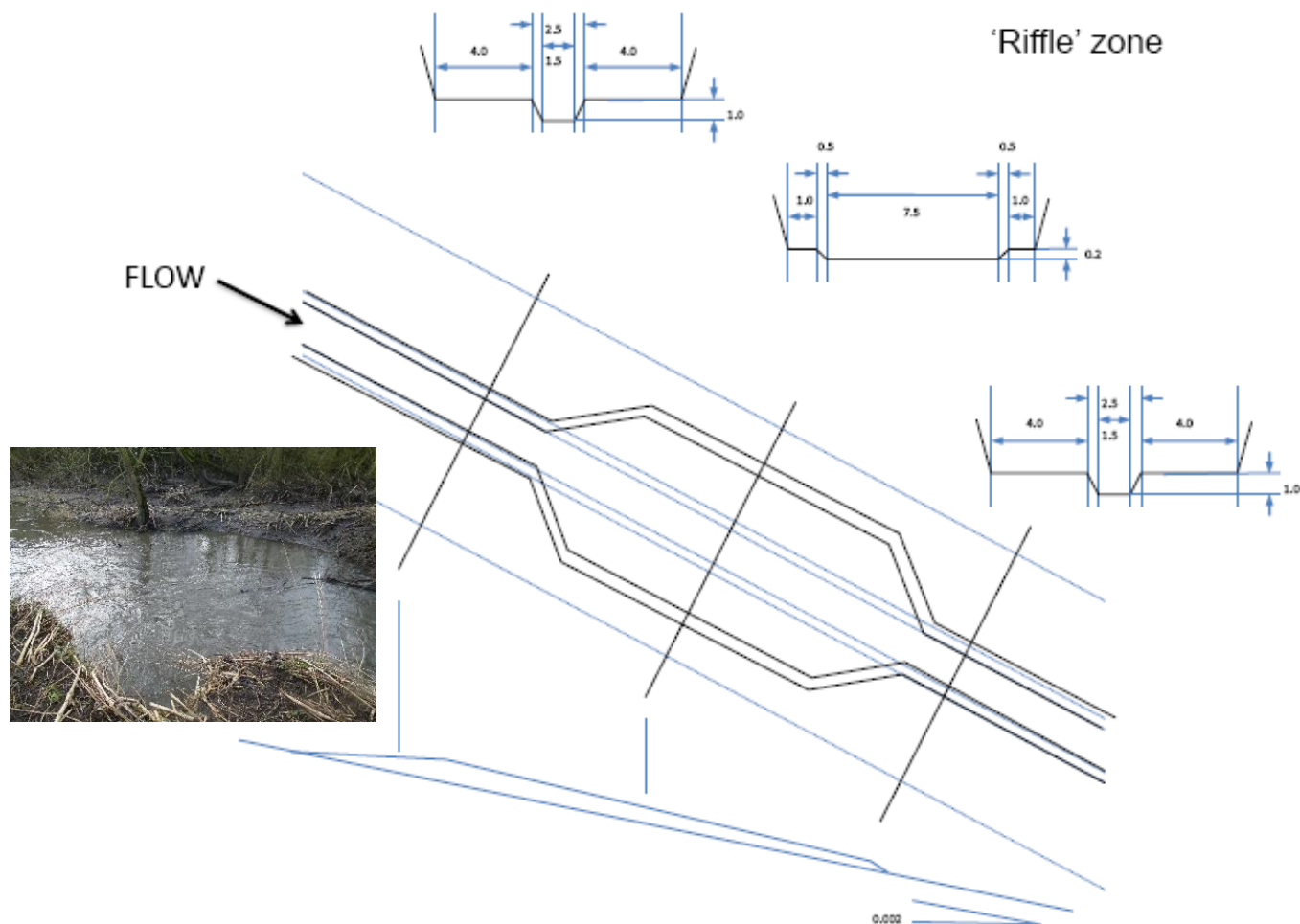


Figure 7-1: Concept riffle design

7.3 Option 2 - Creation of Point Bars

This option could be implemented alongside Option 1 and would involve shallowing of the inner bend zones to create gravel features that wet frequently and provide improved connectivity to the local floodplain (see Figure 7-2 which provides a conceptual illustration of this may be achieved). The proposed gravel point bar feature is shown in light blue in Figure 7-2. This works with the principles of creating wet woodland as this habitat could be allowed to develop on these point bar features. Gravel features would be sized to ensure dynamic stability and would be composed of gravel sizes similar to nearby gravel bed and morphological features.

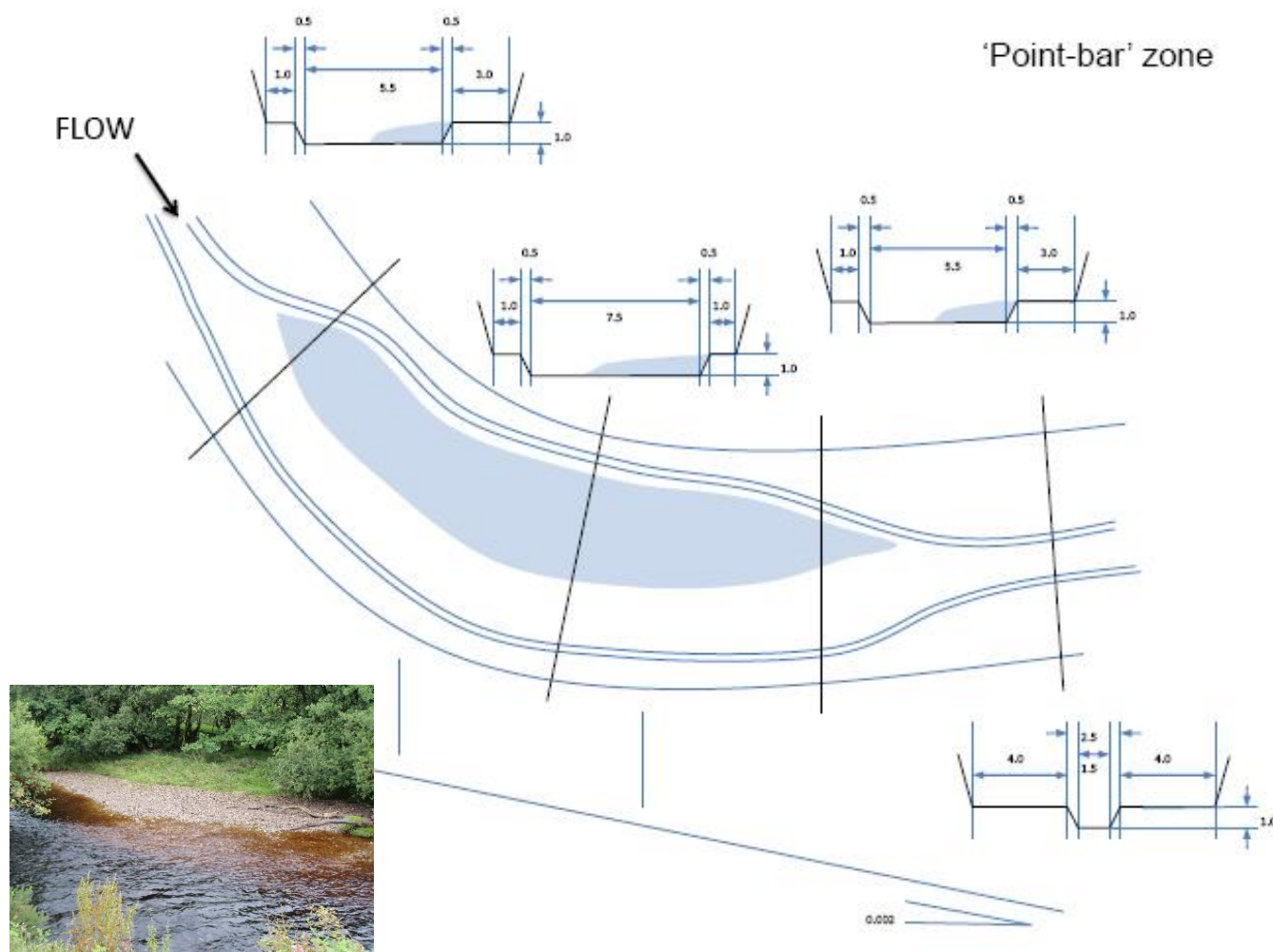


Figure 7-2: Concept point bar creation

7.4 Option 3 - Removal of Floodplain Embankment

There is a small length of flood embankment towards the western boundary (see Figure 2-5) of the site that could be removed to work with the principles of improving floodplain connectivity, creating wet woodland (which would be allowed to develop naturally) and creating greater habitat heterogeneity. Due to the short length of flood embankment, it would be preferable to remove this completely with the excavated material retained on site.

7.5 Option 4 - Scrape Creation

This section describes the general principles of scrape design proposed for the River Dearne at Smithies site. Scrapes are shallow pools which will gradually dry out towards the end of summer if they are not replenished by additional rainfall inputs.

7.5.1 Hydrogeological controls

There are two main hydrological types of wet grassland: those developed on high permeability soils which are dependent on maintaining high groundwater levels, and those on low permeability soils which are dependent on retaining surface water in topographical hollows. Figure 7-3 gives an overview of how these types work. The wet grassland on high permeability ground model is dependent on high water levels in the surrounding drains or rivers to cause high groundwater levels to occur across the site, whereas the groundwater levels in the low permeability model are not dependent. This is because of the slow drainage through the soil. Instead the low permeability model is dependent on surface inundation; either through flooding or through retaining rainfall.

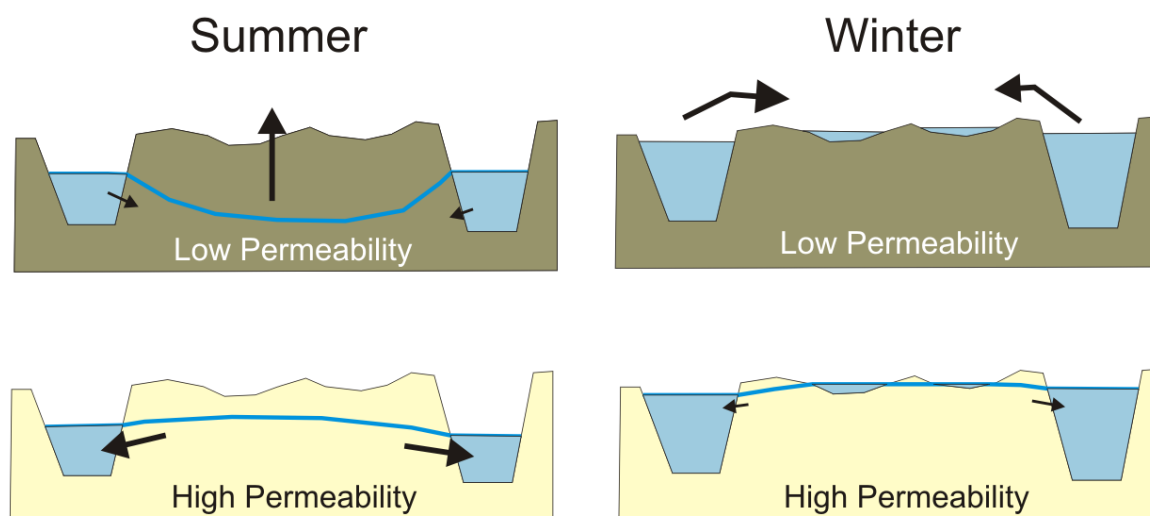


Figure 7-3: Typical Wet Grassland Mechanisms

7.5.2 Water Level Targets

Wet grasslands provide a valuable habitat for a range of species, particularly wading birds such as Snipe *Gallinago gallinago*, Lapwing *Vanellus vanellus* and Redshank *Tringa totanus*, and also potentially other species such as Curlew *Numenius arquata*. However, each of the above species have slightly different habitat preferences, particularly when it comes to breeding, as discussed below. They also provide valuable wintering and migratory feeding sites for wildfowl.

Snipe has a relatively restricted diet, feeding mainly on earthworms (and other invertebrates) in soft, damp soil (Ausden, 2001) with its long bill. Flooding of the land severely reduces the numbers of earthworms and other invertebrates in the soil while letting the water table fall too dramatically leads to a loss of these species at the surface and, therefore, a decline in their availability for this species.

Lapwing feed on soils and sward invertebrates and earthworms (especially adults) which are especially abundant in unflooded grassland. However, unlike Snipe, Lapwing prefer a close-cropped sward and this is usually achieved with either winter flooding (which restricts sward growth) or grazing with livestock (Ausden, 2001; Benstead *et.al.* 1997, p 72.). Redshank prefer very similar conditions.

The scrapes discussed in Section 7.5.4 do not offer any formal control on surface water level conditions and the low permeability nature of the soils means that groundwater levels also cannot be controlled. Therefore, in terms of scrape design the following should be achieved:

- Scrapes should not create large scale winter flooding;
- They should be sufficiently deep to allow the scrapes to be maintained with water until mid-June in most years;
- The scrapes should not be so deep that water levels are maintained in all but a few scrapes after June;
- The scrapes should form large water edges with soft soil to allow birds to feed in invertebrates.

7.5.3 Scrape Design on Low Permeability Soils

On clay soils, wetland birds will use the wetted margins provided by the scrapes to feed in (rather than feeding across the surfaces of the field) and therefore it is important for scrapes to create and maintain long margins (Acreman *et al.*, 2010). Scrapes are not intended to be permanent bodies of water like ponds and therefore will not provide habitat for fish and other aquatic species which require a significant water depth throughout the year.

Successful scrapes should retain the water they collect and be effective at concentrating surface water towards them. It is ideal to have a relatively large catchment to scrape size, and to have the shortest distance possible between the edge of the catchment from the scrape (without limiting the catchment area too much), and the steepest slope possible. This will allow the greatest possible

amount of run-off to reach the scrape and limit the amount of infiltration of rainfall into the ground. Scrapes should have wide shallow sides, so whatever the water levels within them, there are still shallow muddy margins and extensive drawdown zones for the creation of suitable feeding habitat for wader birds.

A good scrape design for focusing run-off will have the following features:

1. A relatively large catchment to scrape size.
2. The shortest distance possible between the edge of the catchment and the scrape (without limiting the catchment area too much) and the steepest slope possible. Together this will limit the infiltration of rainfall into the ground before it enters the scrape.
3. Once run-off is within the scrape, it should be allowed to flow to one low point so that when water levels are low, the catchment of the scrape does not splinter, feeding many smaller depressions.
4. The scrapes should have shallow sides so whatever the water levels is within them, there are still shallow margins for feeding.
5. Will not have spoil laid down immediately next door to the scrapes in a way that reduces their receiving catchment area.

The scrapes should hold water until at least mid-summer to allow for successful wader breeding and they should be located some distance from any areas of trees and scrub to reduce the risk of predation from potential predator perches and areas of cover.

7.5.4 Proposed Scrapes

Figure 7-4 shows the proposed scrape design for the River Dearne at Smithies site. The design focuses entirely on the southern half of the available site, due to the high topography gradient of the northern half being impractical for scrape habitat creation.

There are overhead electricity cables on site which could be potentially hazardous during excavation works. To mitigate this hazard a 15m exclusion zone has been drawn from the overhead cables to ensure scrapes are excavated at a safe distance.

To establish the area to be excavated with scrapes, a guide value of 12 to 14% of wetted area was used, which is known to be a good estimate for promotion of wet grassland habitats (JBA, 2013). The area of the southern site available for scrape creation that is not already inundated approximates to 39,000 m², with 12 to 14% resulting in 4700 to 5500 m² of scrapes (the current design gives a potential wetted area of approximately 14%, as shown in Table 7-1). To allow variation of habitat type, three scrape types have been incorporated, including small (width: 3 m, depth: 0.4 m) and large (width: 4 m, depth: 0.5 m) long linear scrapes, and pool type scrape features which will provide a larger proportion of deep water, which will have greater potential to retain some water during the summer months.

Scrapes are orientated approximately at right angles to slope directions where possible to reduce outflow and ensure an even depth of water within the scrapes. Where there is a natural step down in the topography along a long, linear scrape an earth bund has been suggested. This will allow greater retention in the higher portion of the scrape, and prevent any flow or settling preference towards the lower section of the scrape. The three scrapes proposed in the south-east of the site are designed to be in connection with the currently inundated area near the old mill race drain. As the currently inundated area is at a lower elevation than the connected scrapes it is recommended to include earth bunds where they join to aid in water retention within the scrapes, while still allowing overflow to fill the scrapes during wetter periods.

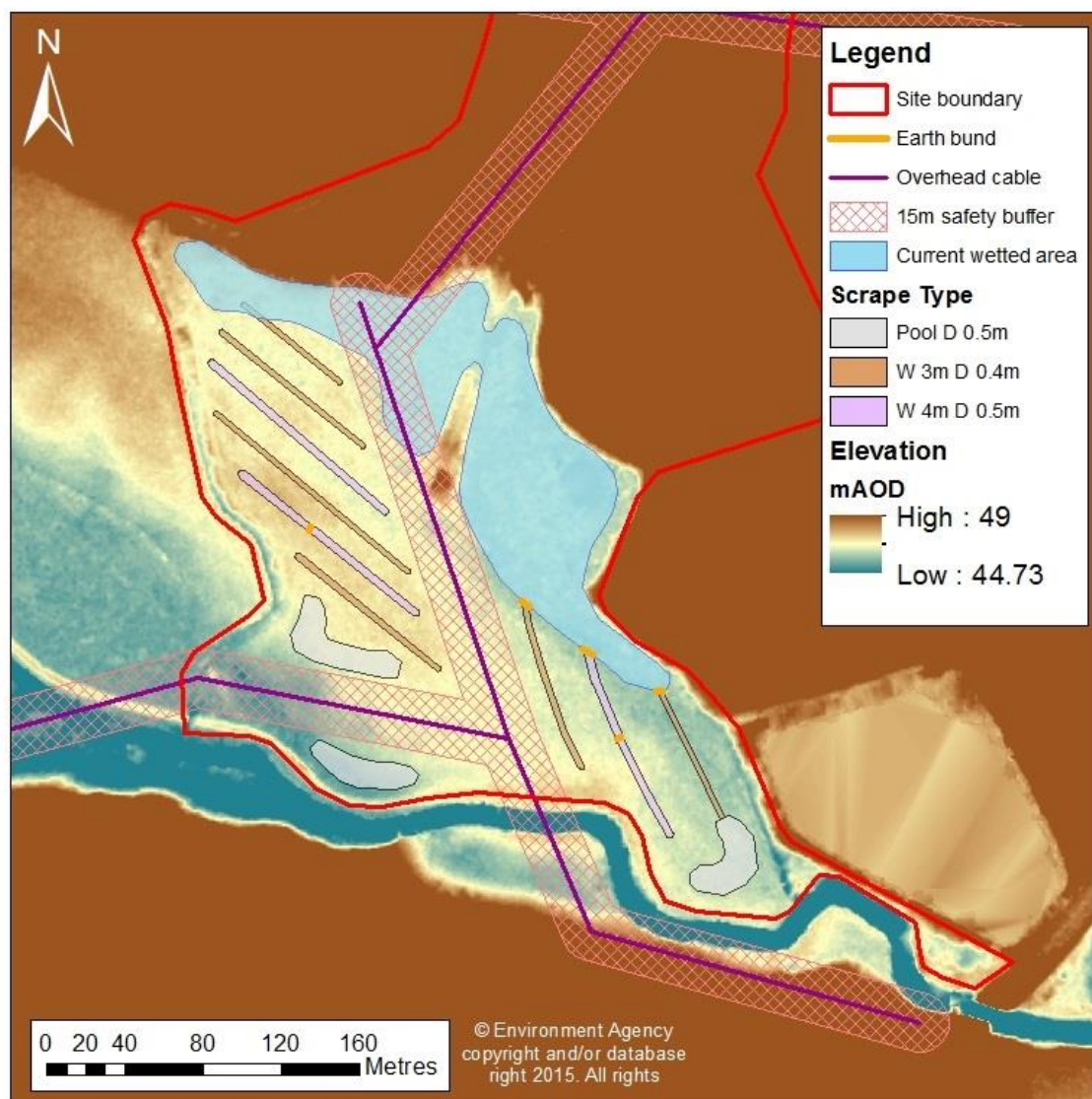


Figure 7-4: Smithies scrape design

7.5.5 Excavation estimation

An approximation of excavation volume has been calculated for the proposed scrape design and the results are summarised in Table 7-1. The area of each scrape type has been calculated by summing the area of each polygon within the ArcGIS design for each given type. These total areas were then converted to approximate volumes based on the assumption that the average depth of the scrapes will be half the desired deepest depth of a scrape, giving the equation:

$$\text{Volume (m}^3\text{)} = \text{Area (m}^2\text{)} \times \text{Depth (m)} \times 0.5$$

Therefore the approximate area to be excavated is 5,470 m² with a volume of 1,285 m³.

Table 7-1: Scrape area and volume for proposed design

Scrapes	Area (m ²)	Volume (m ³)
3m wide / 0.4m deep	1641	328
4m wide / 0.5m deep	1354	338
Pools 0.5m deep	2476	619
Total	5470	1285

7.6 Option 5 - Control Structure on Drain

In order to more carefully regulate water levels on the site, a control structure could be installed at the mouth of the drain which follows the eastern boundary (i.e. the drain that was originally a mill race). This would allow increased water retention along the drain and extend the area of land inundated by water adjacent to the drain. Figure 7-6 shows the inundation extent based on current topography due to a structure with a crest height of 45.3 mAOD.

Potential control structures that could be used are shown in Figure 7-5. These allow precise water level control on the drain, and could also potentially provide a formal access point to the site if desired. Currently, it is believed that this drain only holds water back on the site due to a lack of maintenance.

A review of crime statistics for the local area (see section 6.8) identified relatively high levels of crime in the local area, and although there are no formal access points to the site, nor pathways crossing the site, it does appear to be regularly used by the local population. Additionally, JBA employees also observed an area of fly tipping which had been set alight during a site visit. The evidence suggests that any structure installed on the drain could potentially fall victim to vandalism or indeed simply have its crest height altered by a curious passer-by. Any damage to the structure or alteration to its set level would nullify its effectiveness, and as a result this option is not recommended for this site. Furthermore, it is understood the local council have no plans to maintain the drain which is currently infilled with waste and debris, which is likely to already block the drain and contribute to the current inundation, limiting the advantage of a control structure.

Tilting Weir



Stop Log



Figure 7-5: Example of drain control structures

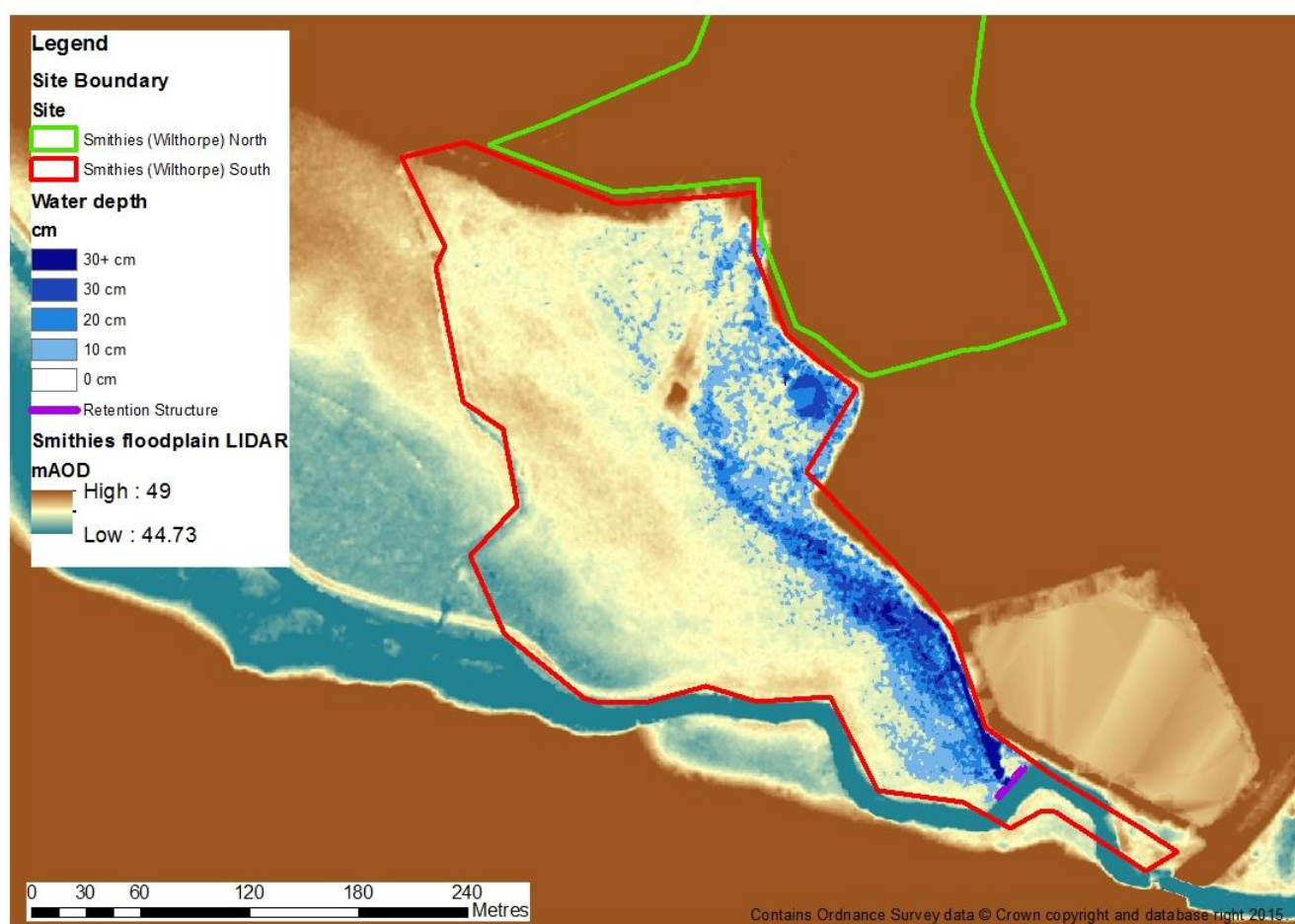


Figure 7-6: Water retention due to control structure set at 45.3 mAOD

7.7 Option 6 - Enhancement on Western Boundary Drain

Similar principles to Option 1 (see section 7.2) could be adopted for the small ditch running along the western boundary of the site. However, water level raising here to improve floodplain connectivity is likely to be achieved through use of fine sediment features in the channel to raise water levels, to ensure introduced features are working with natural processes characteristic of the ditch. This will improve connectivity to the floodplain, with it wetting more frequently in combination with increased wetting from the main watercourse to help achieve the habitat objectives of floodplain grazing marsh/ wet grassland creation. The fine sediment features would be composed of cohesive sediment to ensure stability across the low energy flow regime and planted with suitable vegetation to provide further stability. This would allow local water level raising, impacts upstream would need to be considered as part of a future modelling assessment.

7.8 Option 7 - Enhancement Works to Existing Wetland Habitats on Site

Within the central area of the site, there is an area of swamp habitat, consisting of a range of wetland species, including dominant Common Reedmace *Typha latifolia*, Reed Canary-grass *Phalaris arundinacea*, Reed Sweet-grass *Glyceria maxima*, Sedges *Carex sp.* and a range of other wetland species. This wetland habitat extends along the alignment of the drainage channels on the site and also around the pool adjacent to the traveller's site, and is very dense.

Whilst machinery is on site to implement other options, the opportunity could be taken to undertake some enhancement works within this swamp area. Whilst the floristic diversity is already good and the habitat of good quality, the swamp vegetation will begin to encroach on the pool and reduce the open water area. Consequently, removal of some small areas of the dominant tall emergent wetland vegetation would create additional open waters, and may help to increase floristic diversity. However, this should be done very carefully, with only small areas removed, with scalloped not straight margins and machine movements within the wetland area should be minimised to prevent ground compaction and damage to soil structure.

7.9 Other small-scale habitat creation/ enhancement opportunities

Within the site, there are a number of other small-scale habitat enhancement opportunities that could be pursued, including:

- Installation of bat roosting boxes
- Installation of bird nesting boxes
- Creation of amphibian and reptile refugia/ habitat piles (see Figure 7-7 below for a recommended design).

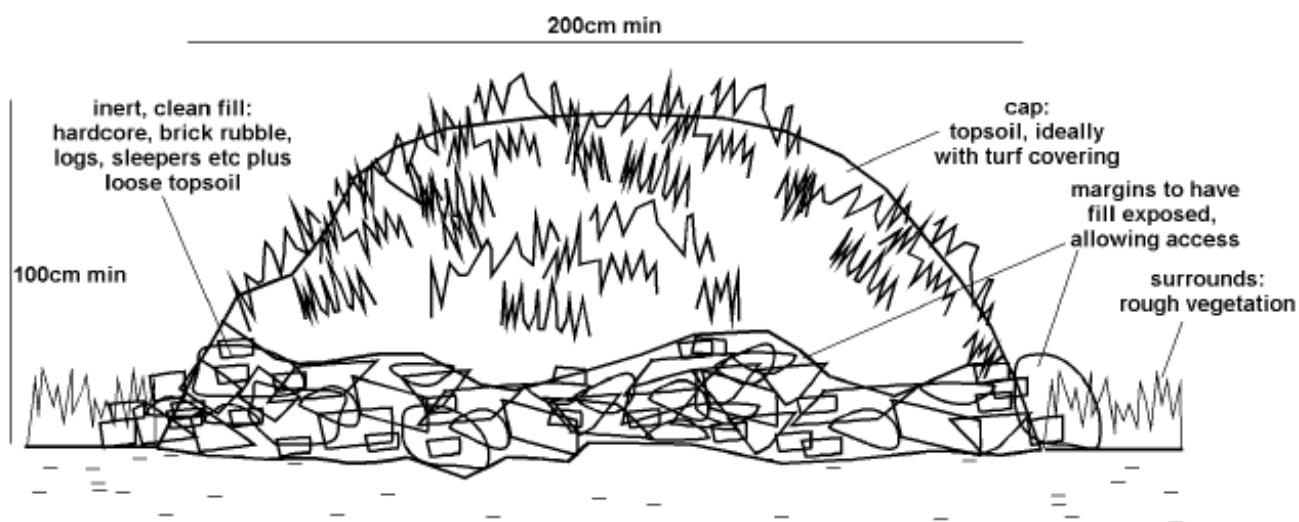


Figure 7-7: Typical design for an amphibian refugia (from: Natural England (formerly English Nature), 2001)

8 Preferred Option

8.1 Preferred Option

Following discussion with the Environment Agency and Barnsley Metropolitan Borough Council, the RSPB and the Garganey Trust as key stakeholders, the following were selected as the preferred options for the River Dearne at Smithies site:

- Option 1 - Raising of water levels within the River Dearne through the inclusion of gravel features (not woody debris)
- Option 2 - Creation of point bar features on the River Dearne
- Option 3 - Removal of the small flood embankment at the south-west of the site
- Option 4 - Scrape creation
- Option 5 - Enhancement works on the western boundary drain
- Option 7 - Minimal enhancement works to the existing wetland habitats on the site
- Small-scale habitat opportunities.

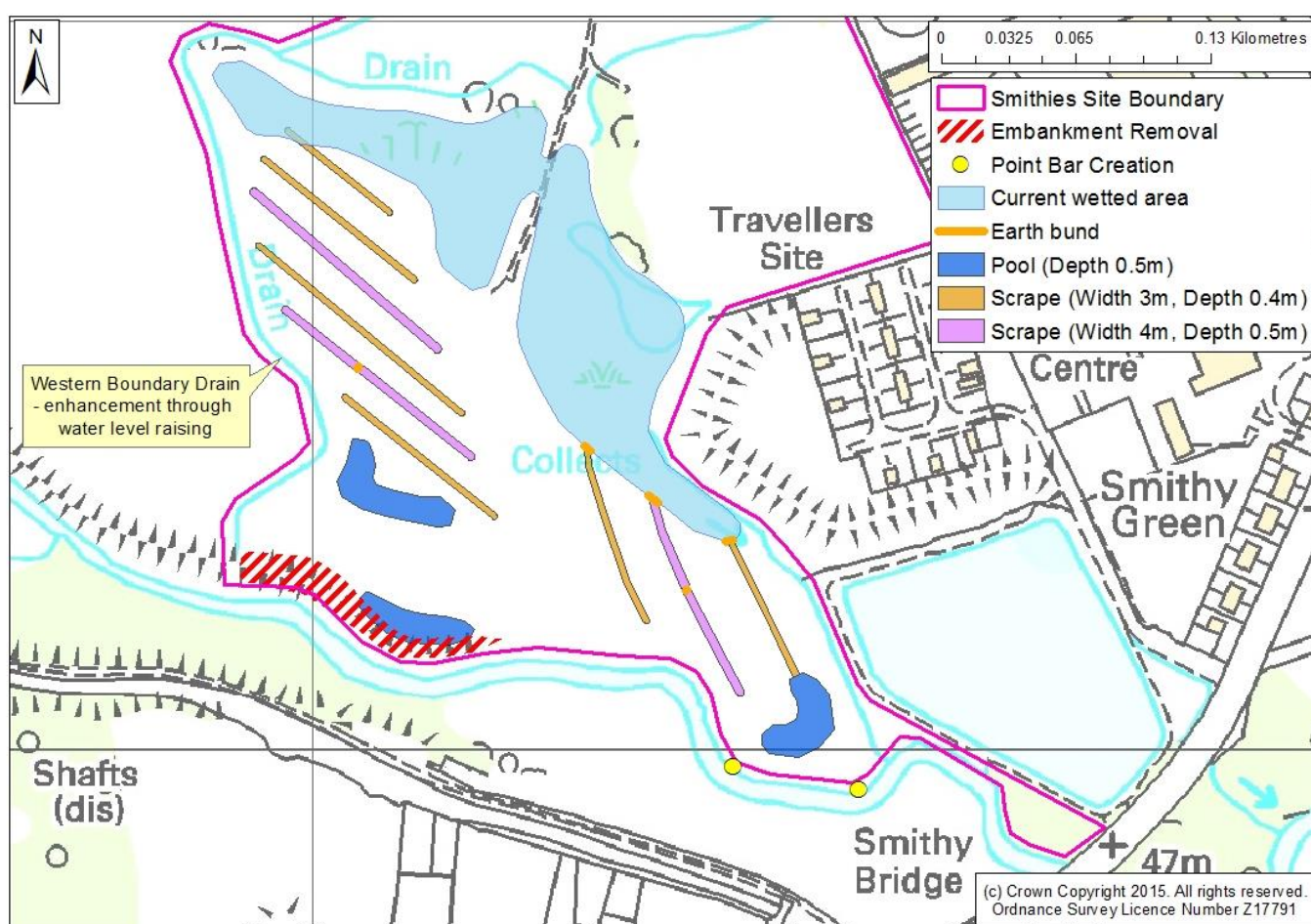


Figure 8-1: River Dearne at Smithies Preferred Option

8.2 Flood Risk Assessment

A Flood Risk Assessment for the preferred scheme can be found at Appendix F. This assessment concludes that, in relation to the scrape creation elements of the scheme, if the spoil is deposited outside of Flood Zone 3, in the northern part of the site, the requirements of the National Planning Policy Framework for a water-compatible use should be met.

The river restoration works may locally change the flood regime of the river and flooding may increase on site and in a small low lying area upstream which was previously a pond, however, no assessment has currently been made on the significance of this change in terms of its impact on

floodplain loss, impeding water flow and increasing flood risk elsewhere. It may be possible that the changes will be deemed negligible or beneficial; either on the basis of currently available information or as a result of further assessment.

8.3 Estimated Costs

Indicative costs for implementation of the preferred habitat creation scheme options have been determined with reference to the Civil Engineering Standard Method of Measurement Guide (CESMM4) (Institute of Civil Engineers, 2012). Indicative costs are provided in Table 8-1 below.

Table 8-1: Estimate Costs for Implementation

Option	Item		Area (m²)	Length (m)	Volume (m³)	CESMM4 code	CESMM4 Cost	Other Cost	Unit	Sub-total
Option 1 - Raising of water levels in the Dearne	Installation of gravel material	Include for 3 No. 10m long x channel width (18m) x 0.5m in depth features. Consisting of a mixed calibre of gravels and some cobbles	n/a	n/a	270	E424	3.34	n/a	217	£724.78
						E532	6.77	n/a	217	£1,469.09
						E542	4.9	n/a	217	£1,063.30
								n/a		
Option 2 - Creation of point bars	Localised re-grading of bank x2	Localised excavation of 2 No. small areas of left bank (approx. 40m2). Change in depth from river to bank is 1m	80	n/a	40	E637	29.3		217	£6,358.10
						E522	2.51	n/a	80	£200.80
						E627	26.45	n/a	16	£423.20
								n/a		
	Installation of gravel material	Seeding of point bars with gravel to 0.2m depth	80	n/a	16	E532	6.77		16	£108.32
						E424	3.34	n/a	40	£133.60
						E532	6.77	n/a	40	£270.80
						E542	4.9	n/a	40	£196.00
Option 3 - removal of floodplain embankment			2.7	135	365	E424	3.34	n/a	365	£1,219.10
						E532	6.77	n/a	365	£2,471.05
						E542	4.9	n/a	365	£1,788.50
						E722	2.41	n/a	2.7	£6.51
Option 4 - scrape creation	Scrape	3m wide / 0.4m deep	1641	n/a	328	E412	2.3	n/a	328	£754.40
						E532	3.38	n/a	328	£1,108.64
						E542	8.51	n/a	328	£2,791.28
	Scrape	4m wide / 0.5m deep	1354	n/a	338	E412	2.3	n/a	328	£754.40
						E532	3.38	n/a	328	£1,108.64
						E542	8.51	n/a	328	£2,791.28
	Pools	0.5m deep	2476	n/a	619	E412	2.3	n/a	619	£1,423.70
						E532	3.38	n/a	619	£2,092.22
E432						8.51	n/a	619	£5,267.69	
Option 6 - enhance western boundary drain	Installation of fine sediment features to raise water levels in the drain	Include for 6 No. clay features installed in drain. 10m long x channel width (3m) x 0.5m in depth	n/a	n/a	90	E635	25.53		90	£2,297.70
						E542	8.51		90	£765.90
Option 7 - enhance existing habitats	Vegetation clearance in pond/ swamp	Allow 1 day for 1 excavator	n/a	n/a	n/a			1000	1	£1,000.00
Small-scale habitat creation options	Bat boxes	x5	n/a	n/a	n/a	n/a	n/a	100	1	£100.00
	Bird boxes	x5	n/a	n/a	n/a	n/a	n/a	100	1	£100.00
	Creation of artificial Otter holt		n/a	n/a	n/a	n/a	n/a	100	1	£100.00
Sub-total									£38,889.00	
Class A (10%)									£42,777.90	
CESMM4 under estimate									£47,055.69	

Option	Item	Area (m ²)	Length (m)	Volume (m ³)	CESMM4 code	CESMM4 Cost	Other Cost	Unit	Sub-total
Contingency (10%) Total									£51,761.26
Assumptions: All excavated material can be disposed of on site, within 1.5km of excavation location. Approx. excavation volume from: area x scrape/point bar depth x 0.5 Class A relates to provisional items that would be required (e.g. mobilisation to site, compliance with CDM Regulations, setting up welfare facilities, H&S requirements) The CESMM4 Under Estimate accounts for potential uncertainty in the volume/ material estimates at this stage given that it is not a detailed design. This is in addition to the 10% contingency cost.									

8.4 Public Safety Risk Assessment Designers Summary

A Public Safety Risk Assessment Designers Summary for the preferred scheme is contained at Appendix H which details the likely risks to visitors to the site and how this has influenced the scheme design, along with any mitigation that may be required.

8.5 Likely Further Work

In order to progress the proposed habitat creation options, the following additional elements of work are likely to be required:

- Liaison with County Archaeologist regarding any additional works that may be required on site.
- Liaison with Environment Agency Flood and Coastal Erosion Risk Management (FCERM) staff to determine what additional information would be required to satisfy them that the project will not increase flood risk. Some additional modelling work may be required to undertake this work (**indicative cost for undertaking this modelling would be £3000, assuming an existing 1D-2D model is available; this cost will increase if a 2D model needs to be built. This price would also not include for additional survey work that may be required**).
- Further investigation into possible public access to the site. Barnsley Metropolitan Borough Council to investigate whether there is any desire within the council to allow more formal public access to the site.
- If undertaken, additional sampling and analysis, targeted in areas where excavation of soils is proposed (**indicative cost for undertaking this sampling would be £1,500 to £2000**).

An Environmental Action Plan, detailing the likely actions required pre-, during and post-implementation of habitat creation options is provided at Appendix I.

Appendices

A Envirocheck Report

B Methodology for Preliminary Environmental Assessment

B.1 Site History

Ordnance Survey (OS) maps of Britain are available from the late 1880s to the present time. These maps provide an excellent record of historical uses of a site. This can be very important in assessing the potential for environmental liabilities associated with a site, since the site owner may be held responsible for historic pollution which could be released, even if it is not caused by current activities operating on the site. Historical maps can show if the facility was, for example, the location for a former industrial site, mineral working or landfill.

Historic map extracts supplied by Landmark Information Group were reviewed (see Appendix A).

B.2 Site Sensitivity

The vulnerability of the site with respect to the potential for contamination of the surface and subsurface aqueous environments was assessed using British Geological Survey (BGS) data and Environment Agency data on groundwater and surface water sensitivity. With respect to groundwater, and wherever possible surface water, likely receptors in the form of abstractions have been obtained from the Landmark Information Group (Envirocheck report contained in Appendix A). Information, pertaining to the classification of the aquifer, nature and direction of groundwater flow, distance to licensed abstractions, nature of overlying strata and whether the site was located within a groundwater protection zone was sought from Environment Agency and available map information from the BGS, in order to determine the hydrogeological sensitivity. The 1:25,000 OS sheet for the area was used to determine the location of surface watercourses, the quality of which were then determined through consultation with Environment Agency data. The combination of distance to the watercourse and its quality were used to assess its sensitivity to pollution. Based on all the available information a summary assessment of vulnerability to contamination of surface and sub-surface waters was made.

B.3 Public Registers

In relation to this site, and due to the time constraints of this exercise, the information from the public register was accessed from a commercially available database operated by the Landmark Information Group (Appendix A). The data supplied covers a 1 km buffer area around the site boundary. This is the only method by which the required information can be gathered in the time available. This database contains the information supplied to it by Environment Agency, and the other statutory authorities; however, for the purposes of this report JBA does not accept any liability for the accuracy or otherwise of the information obtained from the Landmark Information Group.

B.4 Qualitative Risk Assessment Methodology

Risk assessment is the process of collating known information on a hazard or set of hazards in order to estimate actual or potential risks to receptors. The receptor may be human health, a water resource, a sensitive local ecosystem or even future construction materials. Receptors can be connected with the hazard under consideration via one or several exposure pathways (e.g. the pathway of direct contact). Risks are generally managed by isolating or removing the hazard, isolating the receptor, or by intercepting the exposure pathway. Without the three essential components of a source (hazard), pathway and receptor, there can be no risk. Thus, the mere presence of a hazard at a site does not mean that there will necessarily be attendant risks. The following risk assessment thus focuses on those parts of the site where hazards or potential hazards have been identified and is not general to the whole site.

B.5 Hazards

Potential sources of contamination are identified for the site, based on a review of the current and previous site uses. Not only the nature but also the likely extent of any contamination is considered, e.g. whether such contamination is likely to be localised or widespread.

B.6 Receptors

The varying effects of a hazard on individual receptors depends largely on the sensitivity of the target. Receptors include any people, animal or plant population, or natural or economic resources within the range of the source which are connected to the source by the transport pathway. Receptors can, in addition, extend to remediation processes and future construction materials that may be adversely affected by on-site contamination. In general, however, receptors can be divided into a number of groups dependant on the final use of the site.

B.7 Pathways

The mere presence of contamination does not infer a risk. The exposure pathway determines the dose delivered to the receptor and the effective dose determines the extent of the adverse effect on the receptor. The pathway which transports the contaminants to the receptor or target generally involves conveyance via soil, water or air.

B.8 Exposure Assessment

By considering the source, pathway and receptor, an assessment is made for each contaminant on a receptor by receptor basis with reference to the significance and degree of the risk. In assessing this information, a measure is made of whether the source contamination can reach a receptor, determining whether it is of a major or minor significance. The exposure risks are assessed against the present site conditions. The assessment of risk presented here has been based upon the procedure outlined in DEFRA Circular 01/2006. In addition DEFRA, with the Collaborative Centre of Excellence in Understanding and Managing Natural and Environmental Risks, Cranfield University, has published guidance on risk assessment (Guidelines for Environmental Risk Assessment and Management). A guide to good practice for contaminated land risk assessment has also been produced by CIRIA (CIRIA C552 2001). This guidance from DEFRA and CIRIA states that the designation of risk is based upon a consideration of both:

- The likelihood of an event (probability); [takes into account both the presence of the hazard and receptor and the integrity of the pathway].
- The severity of the potential consequence [takes into account both the potential severity of the hazard and the sensitivity of the receptor].

Table B-1 provides a classification of the potential severity of contamination risks occurring at the site.

Table B-1: Classification of Associated Hazard [Potential Severity] (modified from CIRIA C552)

Classification	Associated Hazard [Potential Severity]
Severe	Short-term (acute) risks to human health likely to result in significant harm. Short-term risk of pollution to a sensitive water resource or ecosystem. Catastrophic damage to crops/buildings/property/infrastructure, including off-site soils. Short-term risk to a particular ecosystem or organism forming part of such an ecosystem.
Medium	Chronic damage to human health. Risk of pollution of sensitive water resource or ecosystem. Significant change in a particular ecosystem. Significant damage to crops/buildings/property/infrastructure (on or off-site). Contamination of off-site soils.
Mild	Pollution of non-sensitive water resources. Significant damage to crops/buildings/property/infrastructure (on or off-site).
Minor	Harm, although not necessarily significant harm which may result in a financial loss. Easily preventable, non-permanent health effects on humans, or no

Classification	Associated Hazard [Potential Severity]
	effects.
	Easily repairable damage to crops/buildings/property/infrastructure.

Table B-2 outlines the probability of contamination risks classifications used within this assessment. Where no pollution linkage occurs there is no likelihood of contamination risk.

Table B-2: Classification of Probability

Classification	Definition of Probability
High	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such an event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

Once the classification of consequence and probability has been assigned to a pollution linkage, the risk associated with it can be evaluated. Table B-3 shows how a risk category is assigned based on the consequence and probability. Definitions of each risk category and the investigation actions that are likely to be necessary in each case are given in Table B-4. These definitions and the risk matrix are based upon CIRIA C552.

Table B-3: Contamination Risk Matrix

		Consequence			
		Severe	Medium	Mild	Minor
Probability	Highly Likely	Very High Risk	High Risk	Moderate Risk	Moderate/ Low Risk
	Likely	High Risk	Moderate Risk	Moderate/ Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/ Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/ Low Risk	Low Risk	Very Low Risk	Very Low Risk

Table B-4: Description of the risk classifications and likely action required

Risk Category	Definition and likely actions required
Very high	There is a high probability of severe harm to a defined receptor, or there is evidence that severe harm is currently taking place. The risk is likely to result in a substantial liability. Urgent investigation (if not already undertaken) and remediation is likely to be required.
High	Harm to a designated receptor is likely. The risk, if realised, is likely to present a substantial liability. Urgent investigation (if not already undertaken) is likely to be required.
Moderate	Harm to a designated receptor is possible. However, it is either relatively unlikely that the harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation is likely to be required to clarify the level of potential liability and risk.
Low	Harm to a designated receptor is possible, but is likely to be mild at worst. Further investigation is not required at this stage.
Very low	There is a low possibility of harm to a designated receptor occurring, and if it were to be realised it would be likely to be mild at worst. Further investigation is not required at this stage.

C Soil Contamination Testing Results

C.1 Introduction

The following tables show the results of the chemical testing performed on the soil samples. The results for soils and leachates are displayed separately alongside the relevant S4UL or EQS. The results have been colour coded using the following method:

- Green - The test result is below the relevant recommended S4UL or EQS.
- Red - The test result is higher than the recommended S4UL or EQS.
- Amber - The test result is below or close to the detection limit of the equipment for the specified contaminant.

S4ULs and EQS criteria do not exist for all contaminants for which test results have been obtained, and as a result it has not been possible to classify all of the results according to the colour coding system discussed above.

C.1.1 Soils

The results of the soils testing are provided in Table C-1 alongside the recommended S4UL for each contaminant (where a value has been published). The S4ULs provided relate to the Public Open Space (park) land use scenario which describes "An area of open space, usually owned and maintained by the Local Authority, provided for recreational uses including family visits and picnics, children's play area, informal sporting activities such as football (but not a dedicated sports pitch), and dog walking". This description is nearer the current and proposed land use at the site for all of the define end use scenarios incorporating the S4ULs.

C.1.2 Leachates

The results of the leachate testing are provided in Table C-2 alongside screening levels

Table C-8: Soils testing results (green = test result below recommended S4UL or EQS, red = test result higher than recommended S4UL or EQS, amber = test result below or close to detection limit)

	Sample location		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	
	Depth of sample (m)		0.15	0.1	0.2	0.1	0.15	0.1	0.6	0.2	0.1	0.2	
	Date of sampling		11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	
Determinand	Units	Limit of Detection											S4UL mg kg-1 DW
Moisture	%	0.02	27	57	27	40	34	45	15	19	42	24	
Stones	%	0.02	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	
pH			6	7	6.5	7.1	6.5	6.9	3.6	5	6.5	5.5	
Boron (Hot Water Soluble)	mg/kg	0.4	1.2	2.6	0.67	1.8	< 0.40	1.6	0.89	< 0.40	2	0.44	46000
Sulphate (2:1 Water Soluble) as SO ₄	g/l	0.01	0.017	0.16	0.017	0.08	0.011	0.056	0.047	0.011	0.6	0.023	
Cyanide (Total)	mg/kg	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	
Cyanide (Free)	mg/kg	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	
Thiocyanate	mg/kg	5	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	
Sulphide (Easily Liberatable)	mg/kg	0.5	11	36	1.7	6.9	1.6	2.1	1.6	2.1	1.7	1.3	
Sulphate (Total)	%	0.01	0.11	0.38	0.083	0.16	0.13	0.13	0.45	0.28	0.24	0.059	
Arsenic	mg/kg	1	20	13	12	14	14	13	34	24	21	16	170
Cadmium	mg/kg	0.1	0.34	0.3	0.36	0.53	0.47	0.36	< 0.10	0.24	1.5	0.27	532
Chromium	mg/kg	1	40	39	32	41	38	28	9	16	29	20	220
Copper	mg/kg	0.5	37	39	33	35	33	29	33	57	80	23	44000
Mercury	mg/kg	0.1	0.16	0.18	< 0.10	0.3	0.2	0.14	0.15	0.14	0.4	0.11	30
Nickel	mg/kg	0.5	34	30	47	37	35	34	12	23	43	19	3400
Lead	mg/kg	0.5	69	56	41	52	56	52	31	52	130	51	
Selenium	mg/kg	0.2	0.65	1	0.66	0.76	0.56	0.82	1	0.62	1.1	0.83	1800
Zinc	mg/kg	0.5	130	130	160	130	110	92	25	70	350	81	170000
Chromium (Hexavalent)	mg/kg	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	
Organic Matter	%	0.4	15	10	4.8	21	12	11	62	48	16	5.5	

	Sample location		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	
	Depth of sample (m)		0.15	0.1	0.2	0.1	0.15	0.1	0.6	0.2	0.1	0.2	
	Date of sampling		11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	
Naphthalene	mg/kg	0.1	0.71	1.2	0.13	0.74	0.35	< 0.10	< 0.10	< 0.10	0.43	< 0.10	3000
Acenaphthylene	mg/kg	0.1	0.55	0.35	0.11	0.62	0.3	< 0.10	< 0.10	< 0.10	0.45	< 0.10	30000
Acenaphthene	mg/kg	0.1	0.17	0.46	< 0.10	0.26	< 0.10	< 0.10	< 0.10	< 0.10	0.12	< 0.10	30000
Fluorene	mg/kg	0.1	0.33	0.68	< 0.10	0.39	0.19	< 0.10	< 0.10	< 0.10	0.28	< 0.10	20000
Phenanthrene	mg/kg	0.1	1.1	2.1	0.22	1.7	0.52	< 0.10	< 0.10	< 0.10	1.2	< 0.10	6300
Anthracene	mg/kg	0.1	0.11	0.63	< 0.10	0.23	0.13	< 0.10	< 0.10	< 0.10	0.12	< 0.10	150000
Fluoranthene	mg/kg	0.1	1.9	2.3	0.4	3	0.89	0.39	0.41	0.53	2	0.21	6400
Pyrene	mg/kg	0.1	1.9	2.5	0.43	3.1	0.93	0.53	0.66	0.72	2	0.18	15000
Benzo[a]anthracene	mg/kg	0.1	0.72	0.8	< 0.10	1.4	0.25	< 0.10	< 0.10	< 0.10	0.63	< 0.10	62
Chrysene	mg/kg	0.1	0.9	3.7	< 0.10	3.1	0.15	< 0.10	< 0.10	< 0.10	0.57	< 0.10	120
Benzo[b]fluoranthene	mg/kg	0.1	0.52	1.4	< 0.10	1.8	0.48	< 0.10	< 0.10	< 0.10	1.7	< 0.10	16
Benzo[k]fluoranthene	mg/kg	0.1	0.1	0.54	< 0.10	0.33	< 0.10	< 0.10	< 0.10	< 0.10	0.4	< 0.10	440
Benzo[a]pyrene	mg/kg	0.1	0.9	0.93	< 0.10	1.6	0.2	< 0.10	< 0.10	< 0.10	1.3	< 0.10	13
Indeno(1,2,3-c,d)Pyrene	mg/kg	0.1	0.56	0.5	< 0.10	0.99	0.25	< 0.10	< 0.10	< 0.10	1.3	< 0.10	180
Dibenz(a,h)Anthracene	mg/kg	0.1	< 0.10	< 0.10	< 0.10	0.34	< 0.10	< 0.10	< 0.10	< 0.10	0.2	< 0.10	1.4
Benzo[g,h,i]perylene	mg/kg	0.1	0.58	4.3	< 0.10	1.3	0.36	< 0.10	< 0.10	< 0.10	1.6	< 0.10	1600
Total Of 16 PAH's	mg/kg	2	11	22	< 2.0	21	5	< 2.0	< 2.0	< 2.0	14	< 2.0	
Total Phenols	mg/kg	0.3	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	3200

Table C-2: Soils testing leachate results (green = test result below recommended S4UL or EQS, red = test result higher than recommended S4UL or EQS, amber = test result below or close to detection limit)

	Sample location		S1	S2	S7	S9	Freshwater leachate screening level µg/l
	Depth of sample (m)		0.15	0.1	0.6	0.1	
	Date of sampling		11-Feb-15	11-Feb-15	11-Feb-15	11-Feb-15	
Determinand	Units	Limit of Detection					
pH			8.6	8.2	8.1	8.1	
Sulphate	mg/l	1	< 1.0	< 1.0	6.4	10	
Cyanide (Total)	mg/l	0.05	< 0.050	< 0.050	< 0.050	< 0.050	
Thiocyanate	mg/l	0.5	< 0.50	< 0.50	< 0.50	< 0.50	
Sulphide	mg/l	0.05	< 0.050	< 0.050	< 0.050	< 0.050	
Arsenic (Dissolved)	µg/l	1	< 1.0	9.5	1.6	< 1.0	50
Boron (Dissolved)	µg/l	20	< 20	< 20	< 20	< 20	2000
Cadmium (Dissolved)	µg/l	0.08	< 0.080	< 0.080	< 0.080	< 0.080	0.08
Chromium (Dissolved)	µg/l	1	< 1.0	< 1.0	< 1.0	< 1.0	3.4
Copper (Dissolved)	µg/l	1	6	7.5	< 1.0	1.2	1 - 28
Mercury (Dissolved)	µg/l	0.5	< 0.50	< 0.50	< 0.50	< 0.50	0.07
Nickel (Dissolved)	µg/l	1	4.5	< 1.0	< 1.0	< 1.0	20
Lead (Dissolved)	µg/l	1	6.5	6.4	1.8	3	7.2
Selenium (Dissolved)	µg/l	1	< 1.0	< 1.0	< 1.0	< 1.0	
Zinc (Dissolved)	µg/l	1	5.4	< 1.0	1.3	< 1.0	8 - 125
Chromium (Hexavalent)	µg/l	20	< 20	< 20	< 20	< 20	
Naphthalene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	2.4
Acenaphthylene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Acenaphthene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Fluorene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Phenanthrene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Anthracene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Fluoranthene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	1
Pyrene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo[a]anthracene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Chrysene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo[b]fluoranthene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo[k]fluoranthene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo[a]pyrene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	0.01
Indeno(1,2,3-c,d)Pyrene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Dibenz(a,h)Anthracene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo[g,h,i]perylene	µg/l	0.1	< 0.10	< 0.10	< 0.10	< 0.10	
Total Of 16 PAH's	µg/l	2	< 2.0	< 2.0	< 2.0	< 2.0	
Total Phenols	mg/l	0.03	< 0.030	< 0.030	< 0.030	< 0.030	30000

D Baseline Ecological Assessment

This section provides details of the desk-based assessment undertaken to assess the baseline ecology of the River Dearne at Smithies site. It collates and reviews historical ecological data provided by the Environment Agency and identifies where this may constrain habitat creation opportunities on the site.

Sources of information include:

- Environment Agency, including Easimap records and a site visit note produced from a visit on 09 September 2014
- Barnsley Biological Records Centre
- Sheffield City Ecology Unit
- South Yorkshire Badger Group
- South Yorkshire Bat Group
- The Multi Agency Geographic Information for the Countryside (MAGIC) website (<http://magic.defra.gov.uk/>)

No ecological site surveys have been conducted as part of this project, however, an ecologist did attend the project start-up meeting, with any additional incidental observations on ecological receptors/ constraints noted in this section

D.1 Statutory Designated Sites

There are no statutory designated nature conservation sites located within 2 km of the site.

D.2 Non-Statutory Designated Sites

There are a small number of non-statutory designated sites situated within a 2 km radius of the site. These include one Local Nature Reserve (LNR) and three Local Wildlife Sites (LWSs). These are detailed in Table D-1, below. The location and distribution of these are given in Figure D-1-1.

Table D-1: Non-statutory Designated Sites situated within 2 km of the Site

Site	Designation	Proximity to Site	Comments
Barnsley Canal at Wilthorpe (Site Reference Number 25)	LWS	Falls partially within the southern part of the River Dearne at Smithies site	This site includes a stretch of the disused Barnsley Canal and adjacent pasture. The site has a broad diversity of habitats, and rich species diversity, including well established wetland/ swamp with a good mix of aquatic and marginal species (TEP, 2011a). Part of the study site for this project falls within this LWS.
Cliff Wood (Site Reference Number 26)	LWS	>0.3 km south-east	Cliff Wood is located within Dearne Valley Park, to the north of the River Dearne. It contains broadleaved woodland dominated by oak and birch, with some Ash, Hawthorn, Holly, Hazel and Field Maple. There are also areas of open neutral grassland, scrub, standing water and swamp (TEP, 2011b).
Old Mill Lane Culvert Bat Roost (Site Reference Number 54)	LWS	>0.1 km south-east	This LWS is located on the River Dearne, downstream of the Smithies Site. The river contains a series of culverts associated with the road, river and former mill races, including a 90m long culvert beneath Old Mill Road that since 1990 has been known to support an important maternity roost of Daubenton's Bat <i>Myotis daubentonii</i> , which feed along the river course. The site also includes the tree-lined Dearne, other areas of woodland and scrub, recreation grounds, neutral

Site	Designation	Proximity to Site	Comments
			grassland, standing water and plantation woodland (TEP, 2011c).
Dearne Valley Park LNR (1008867)	LNR	>0.7 km south-east	This site is a mixed use reserve developed from relict habitats and reclaimed colliery/ associated uses around a river valley. There are two large ponds, one run by a local angling club, along with amenity grassland and pockets of woodland. A network of public footpaths and a concessionary cycleway run the length of the park (Natural England, 2015).

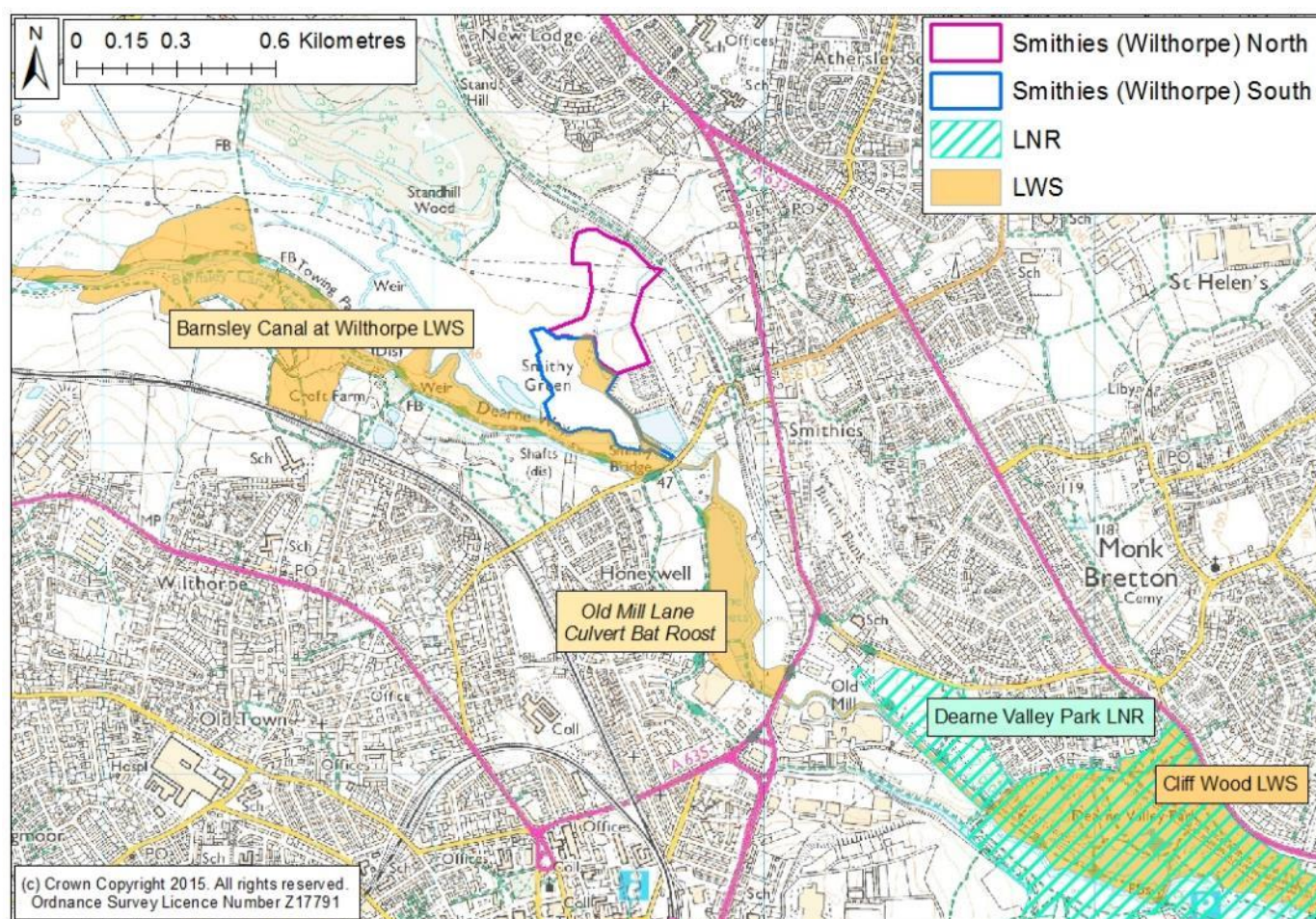


Figure D-1-1: Designated Nature Conservation Sites within 2 km of the Site

D.3 Priority Biodiversity Action Plan (BAP) Habitats

Priority BAP Habitat records, as provided from the MAGIC website and the Easimap data, indicate the following habitats within 2 km of the site:

- Deciduous woodland (classified under the National Inventory of Woodland and Trees (Natural England) Level of protection: NERC Section 41) is established within 2 km of the works site at the following locations:
 - 0.6 km north of the site - Adjacent to the north of the site along disused railway and surrounding woodland areas.
 - 1.7 km south-east of the site - Part of Dearne Valley Park
 - 2 km south-east of the site - Contributes part of Cliffe Wood LWS and Dearne Valley Park LNR

Much of the southern part of the site is also identified as areas where no main BAP habitat is present, but additional BAP habitat exists; this indicates the importance of the site in providing a mosaic of habitat areas.

D.4 Protected Species

The data provided by the Environment Agency, Barnsley Biological Records Centre, Sheffield City Ecology Unit, South Yorkshire Badger Group and South Yorkshire Bat Group has returned a number of protected and notable species records within 2 km of the site. Details on the location and dates of these records are given in Table D-2 below. However, it should be noted that, the absence of records does not necessarily mean the absence of species.

Table D-2: Protected Species Records for within 2 km of the Site

Scientific Name	Common Name	Location/ Proximity to Site	Grid Reference	Date
Amphibians and Reptiles				
<i>Bufo bufo</i>	Common Toad	Several records for around Barnsley Canal and the River Dearne.	Several	2003-2012
<i>Triturus cristatus</i>	Great Crested Newt	Barnsley Canal at Wilthorpe LWS 0.8 km to west	SE350085	2011-2012
Mammals				
<i>Arvicola amphibius</i>	Water Vole	1 km to north-west (River Dearne) 1.6 km to north (several records) 0.7 km to west (River Dearne)	SE335086 SE350101 SE336085	1999 2011-2012 2004
<i>Erinaceus europaeus</i>	Hedgehog	A small number of records for within 2 km of site	SE3507/ SE3208	188-2012
<i>Lutra lutra</i>	Otter	0.8 km to south-east at Old Mill Lane Smithy Bridge, The Fleets immediately downstream of the site	SE350072 SE34730792	2012 2007
<i>Meles meles</i>	Badger	1.6 km south-east	-	2010
<i>Myotis daubentonii</i>	Daubenton's Bat	Numerous recent records for within 1 km of the site, including animals foraging and commuting along the River Dearne and around Old Mill Lane	Several	1992-2013
<i>Nyctalus leisleri</i>	Leisler's Bat	Roost located 0.9 km to the south-west 1 km to south-west	SE339073 SE336074	2005 2005
<i>Nyctalus noctula</i>	Noctule Bat	Several records for within 1 km of the site, including foraging activity on the River Dearne	Several	1988-2011
<i>Pipistrellus pipistrellus</i>	Common Pipistrelle Bat	Several recent records for within 1 km of the site, including foraging along the River Dearne and at Wilthorpe Marsh	Several	2011-2012
<i>Pipistrellus pygmaeus</i>	Soprano Pipistrelle	0.6 km to south	SE349074	2011
<i>Pipistrellus sp.</i>	Pipistrelle Bat Species	Numerous records for within 1 km of the site	Several	1988-2011
Invertebrates				
<i>Erynnis tages</i>	Dingy Skipper	Mapplewell Tip 1.7km to north-west	SE329095	2013
Schedule 1 Birds				
<i>Alcedo atthis</i>	Kingfisher	Numerous records from within 2 km of the site	Several	1980-2013
<i>Charadrius dubius</i>	Little Ringed Plover	Wilthorpe Marsh area	SE3308/ SE3208	1987-2010
<i>Falco peregrinus</i>	Peregrine Falcon	Wilthorpe Marsh	SE3309	2010
<i>Falco subbuteo</i>	Hobby	Wilthorpe Marsh	SE3308	2008
<i>Fringilla montifringilla</i>	Brambling	1.3 km to west	SE330079	2009
<i>Phoenicurus ochruros</i>	Black Redstart	Barnsley Town Centre	SE30I	1994
<i>Tringa glareola</i>	Wood Sandpiper	Wilthorpe Marsh west	SE3208	2008
<i>Tringa ochropus</i>	Green sandpiper	Wilthorpe Marsh west	SE3208	2008-2009

Scientific Name	Common Name	Location/ Proximity to Site	Grid Reference	Date
<i>Turdus iliacus</i>	Redwing	Several records from the Wilthorpe Marsh and Barnsley Canal area	Several	1990-2013
Lower Plant				
<i>Cratoneuron filicinum</i>	Threatened Bryophyte	0.5 km to 1.5 km to south-west	SE3507	2006

The data search also returned records of a number of BAP priority bird species for the wider area, including Skylark *Alauda arvensis*, Tree Pipit *Anthus trivialis*, Nightjar *Caprimulgus europaeus*, Lesser Redpoll *Carduelis cabaret*, Linnet *Carduelis cannabina*, Twite *Carduelis flavirostris*, Cuckoo *Cuculus canorus*, Corn Bunting *Emberiza calandra*, Yellowhammer *E. citrinella*, Reed Bunting *E. schoeniclus*, Grasshopper Warbler *Locustella naevia*, Yellow Wagtail *Motacilla flava*, Spotted Flycatcher *Muscicapa striata*, House Sparrow *Passer domesticus*, Tree Sparrow *P. montanus*, Grey Partridge *Perdix perdix*, Wood Warbler *Phylloscopus sibilatrix*, Marsh Tit *Poecile palustris*, Bullfinch *Pyrrhula pyrrhula*, Starling *Sturnus vulgaris*, Song Thrush *Turdus philomelos* and Lapwing *Vanellus vanellus*.

D.5 Non-native Invasive Species

The presence of the non-native invasive species Himalayan Balsam *Impatiens glanulifera* and Japanese Knotweed *Fallopia japonica* on the site was identified from the data provided and also the site visit. Japanese Knotweed is present on the left drain bank, running along the eastern boundary, between the site and the traveller site. Himalayan Balsam is frequent, in particular in the south-west of the site, in the wet woodland area.



Figure D-1-2: Japanese Knotweed Stand on eastern site boundary



Figure D-1-3: Evidence of Himalayan Balsam infestation in south-west of site, evident from numerous dead canes on the ground

TEP (2011c) also report that Giant Hogweed *Heracleum mantegazzianum* is present within the LWS downstream of the site.

The Environment Agency also has records of the following non-native invasive fauna species within the area:

- Signal crayfish *Pacifastacus leniusculus* - located 1km upstream of the site on the River Dearne
- American Mink *Neovison vison* - record from 1.7 km to south-east
- Northern River Crangonyctid *Crangonyx pseudogracilis* (a shrimp) - Adjacent to site at Smithies Lane Bridge.

E Rapid Archaeological Appraisal

The Appendix provides details of the rapid archaeological appraisal conducted by Dr Nicola Toop of FAS Heritage Ltd.

E.1 Aims and Objectives

The aim of the rapid appraisal is to identify known heritage assets that would potentially be affected by habitat creation at the site, and the constraints that this might represent.

This does not represent a full archaeological assessment of the site; recommendations for further work are made where appropriate.

E.2 Methodology

E.2.1 Sources

In order to assess the potential heritage impact of habitat creation at the site, the following sources were consulted:

- South Yorkshire Sites and Monuments Record (via Heritage Gateway)
- National Heritage List for England
- Historic Ordnance Survey editions (first edition onwards)
- Site visit

E.2.2 Study area

In order to facilitate searches and broadly characterise archaeological potential, a 1km radius study area was established around the site.

E.3 Baseline Conditions

E.3.3 Designated Heritage Assets

There are no designated heritage assets within the proposed site boundary. One Scheduled Monument (NHLE 1017748) lies immediately to the north-east of the northern boundary of the site. This is the East Gawber Hall colliery fanhouse (or exhauster house) that formed part of a much larger colliery complex that opened in 1856 and closed in 1922 (see Figure E-1). The proposed site would have formed part of the wider industrial landscape associated with the colliery, and as such forms part of its historic setting.

Two Listed buildings lie within 1km of the site boundary; Barnsley 6th Form College is Grade II Listed (NHLE 1191653) and New Lodge is Grade II Listed (NHLE 1286779); both lie within the built fabric of surrounding towns and their setting would not be affected.

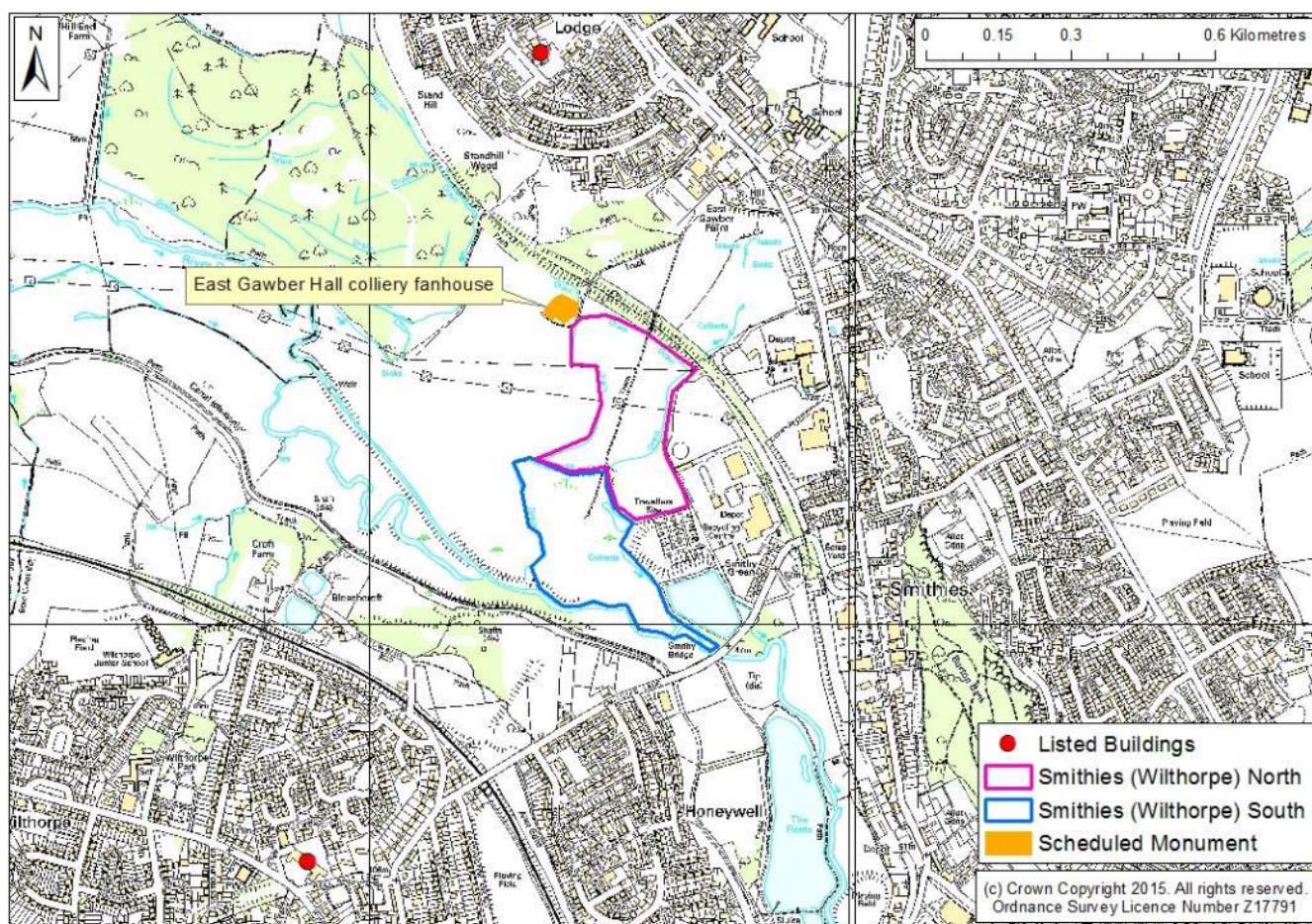


Figure E-1: Designated Heritage Sites

E.3.4 Non-designated Heritage Assets and Archaeological Potential

A search of the South Yorkshire Sites and Monuments Record (via Heritage Gateway) demonstrates that this an area rich in industrial archaeology; a large number of fulling, paper, flax and linen mills and bleachworks are recorded on the River Dearne from the post-medieval onwards (SYSMR 2720, 4106, 4107, 4109).

Industrial activity is known from the site itself, and the extent of activity in the immediate area is demonstrated by the 1892-3 Ordnance Survey edition (1:2500) (see Figure E-2). Within the south-eastern tip of the southern (blue boundary) site was Burton Smithies Paper Mill and Corn Mill (SYSMR 4108). The mill race to the Valley Paper Works crossed the central part of the site. To the north was the East Gawber Hall Colliery; the fanhouse (Scheduled Monument, see above) lay to the north of the site boundary, a NNE-SSW aligned track is shown under the railway and extending across the site, possibly a former railed route. The alignment of the latter is still visible today, with a well-used path leading between the stone revetment walls of the rail bridge.

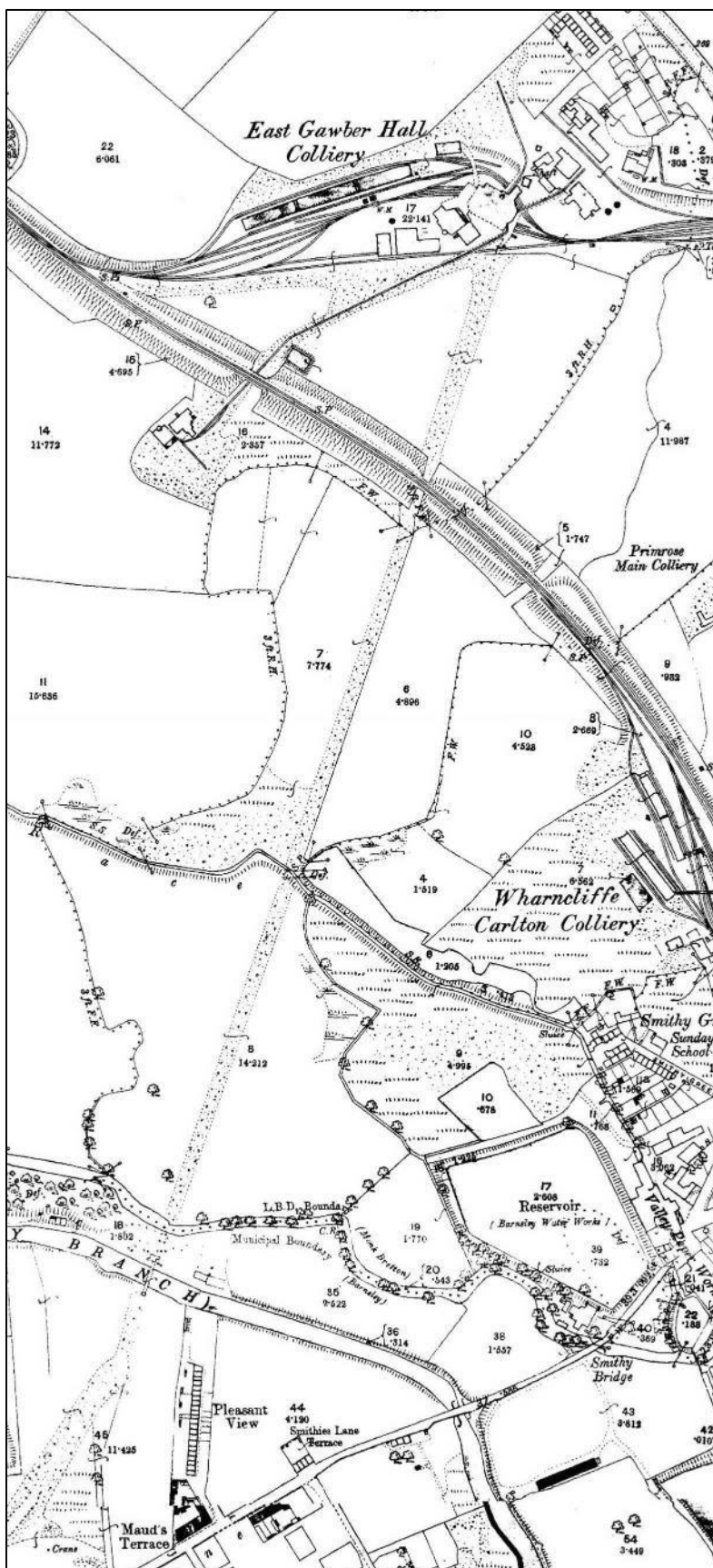


Figure E-2: Ordnance Survey Map extract from 1892-93

E.4 Appraisal and Recommendations

One Scheduled Monument lies close to the northern boundary of the site, and retains below ground evidence for colliery structures. This is currently densely vegetated, but the proposed site would have formed part of its historic context. English Heritage should be consulted as part of the process, and any works that would directly affect the structure will require Scheduled Monument Consent.

Further earthwork and structural remains may survive across the site, associated with mills and the colliery. It is recommended that a full desk-based archaeological assessment (including detailed map regression) be carried out to more fully establish the archaeological potential and significance of the site, and to inform a programme of mitigation if required. South Yorkshire Archaeology Services should be contacted at an early date to agree a suitable scope of works.

F Flood Risk Assessment



Smithies Wetland Creation Scheme Flood Risk Assessment

Draft Report
June 2015

**Environment Agency
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Contract

This report describes work commissioned by the Environment Agency. Alex Jones of JBA Consulting carried out this work.

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Contents

1	Introduction	1
1.1	Description of the Proposed Development	1
1.2	NPPF and Flood Map	2
1.3	Description of Site.....	4
1.4	Flood history	6
1.5	Information used	7
2	Flood risk assessment	8
2.1	Fluvial flood risk	8
2.2	Surface water flood risk	8
2.3	Other sources of flood risk.....	8
2.4	Changes in Control Washland Storage	8
3	Flood risk management measures	1
	1	
4	Conclusions and recommendations	1
	1	

1 Introduction

A Flood Risk Assessment (FRA) for the proposed wetland habitat creation scheme has been completed. The assessment has been undertaken in accordance with the National Planning Policy Framework¹ (NPPF). The assessment has undertaken with no modelling at this stage as agreed within the scope of the project. Available techniques have been used to provide a qualitative assessment which could be supplement by further modelling work, if deemed necessary.

1.1 Description of the Proposed Development

The proposed wetland involves the following:

- The creation of a series of shallow scrapes in Flood Zone 3 to produce UK Biodiversity Action Plan (BAP) floodplain grazing marsh wet grassland habitat
- River restoration works consisting of:
 - Installation of gravel features to raise water levels in the channel
 - Point bar features
 - Removal of the on-site flood embankment

The location of these features is shown in

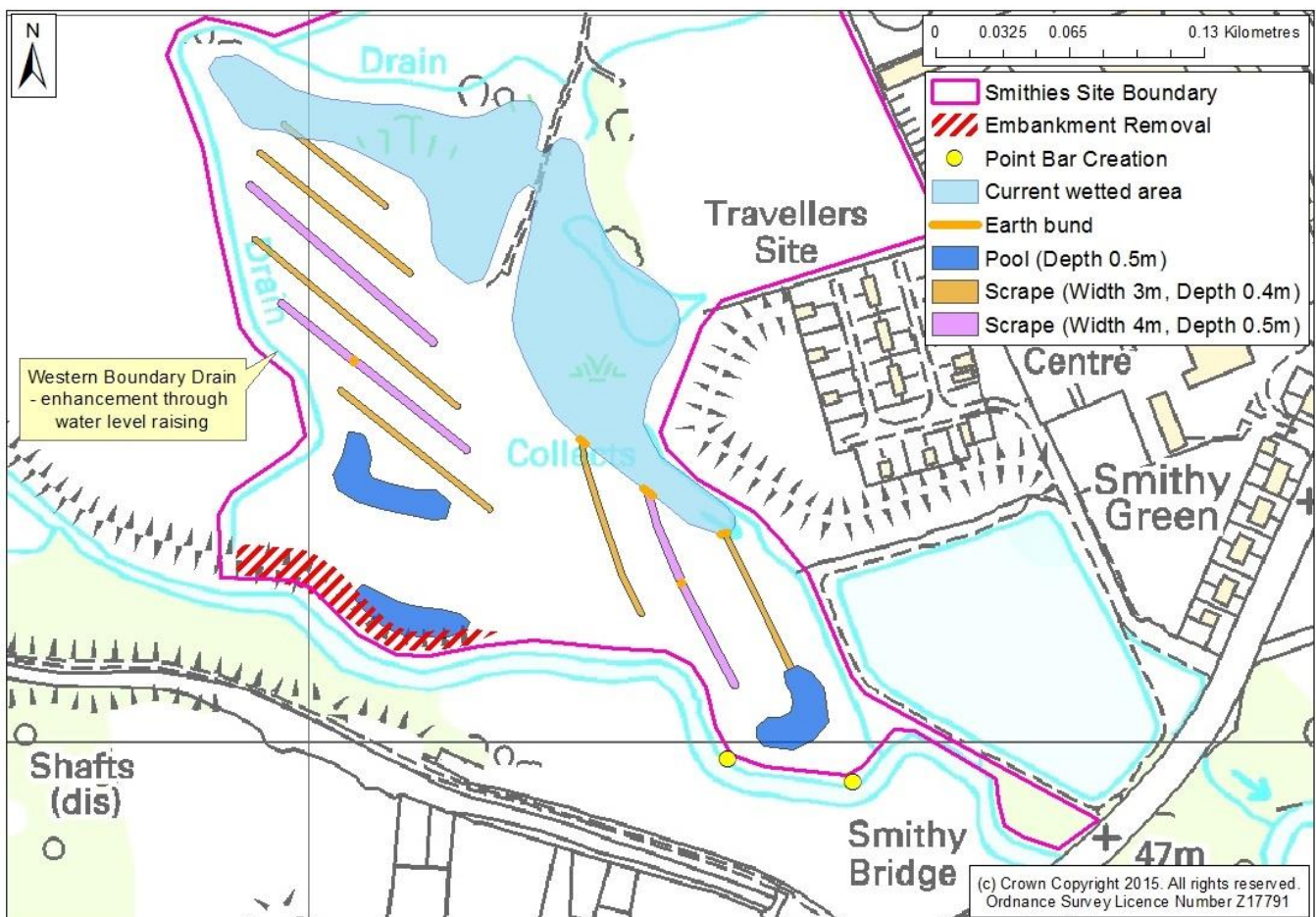


Figure 1-1.

Further details are available in JBA (2015).

¹ National Planning Policy Framework 2012. Department for Communities and Local Government.
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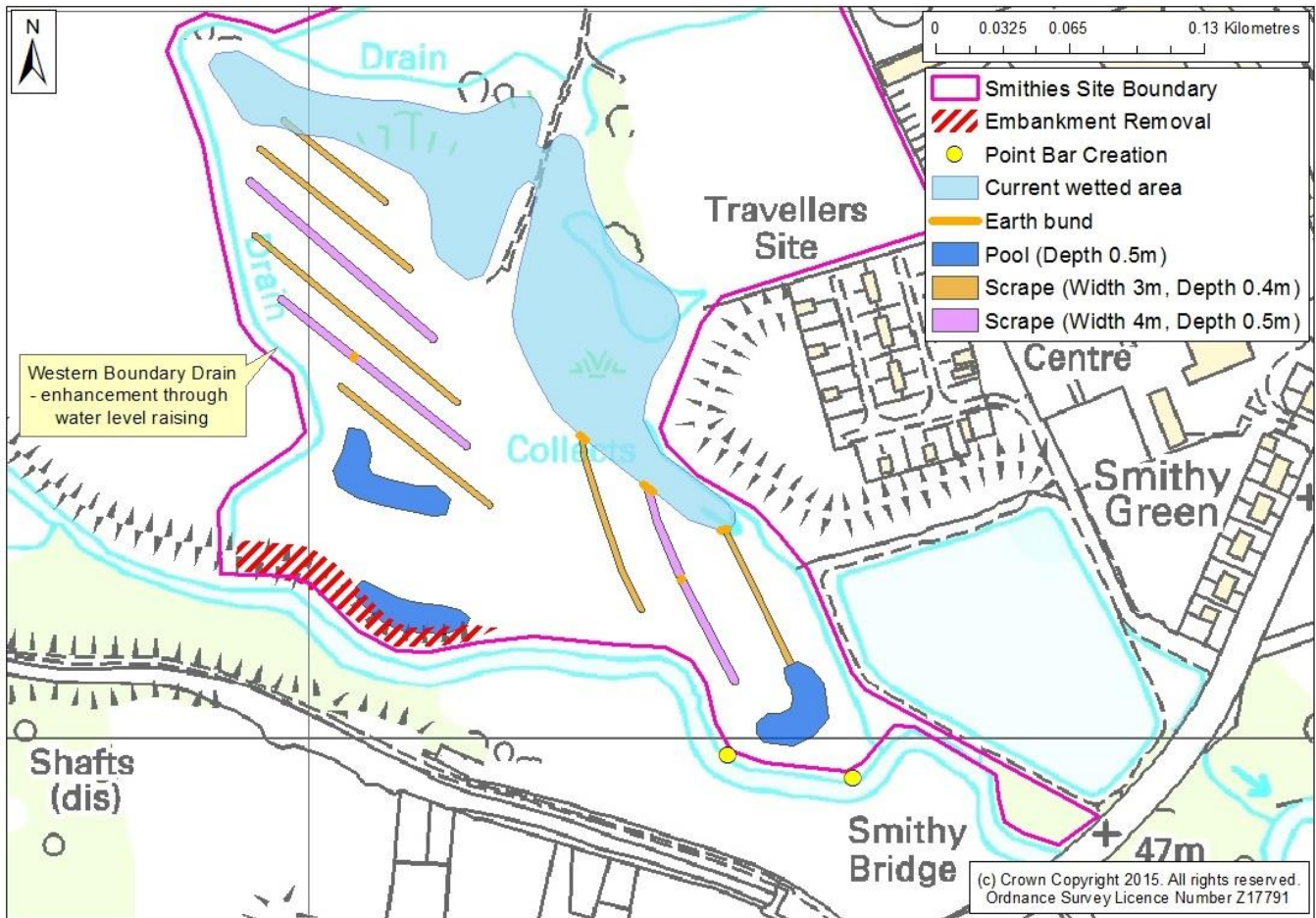


Figure 1-1: Proposed Scheme

Contains Ordnance Survey data © Crown copyright and database right 2015.

1.2 NPPF and Flood Map

All forms of flooding and their impact on the natural and built environment are material planning considerations. The NPPF and subsequent Planning Practice Guidance (published in March 2014) stress the importance of assessing, appraising and managing flood risk at all stages of the planning process. The NPPF aims to avoid inappropriate development in areas at risk from flooding but where development is necessary, making it safe without increasing flood risk elsewhere.

The River Dearne at Smithies site is split into two parts. The southern half is low lying, within the functional floodplain and Flood Zone 3. The northern half occupies the valley side, the lower section of which lies in Flood Zone 2. All the habitat creation works are proposed to occur in Flood Zone 3. As the site is would be used for nature conservation and biodiversity, then the proposed restoration works can be deemed to be a 'Water-Compatible Development' under the NPPF Planning Practice Guidance 6th March 2013². Under this guidance, water-compatible uses can be permitted in this zone as long as they³:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- do not impede water flows; and
- do not increase flood risk elsewhere.

² see <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-2-flood-risk-vulnerability-classification/>

³ see <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-3-flood-risk-vulnerability-and-flood-zone-compatibility/>

X: 434,574;Y: 408,056 at scale 1:10,000

Other maps Data search Text only version

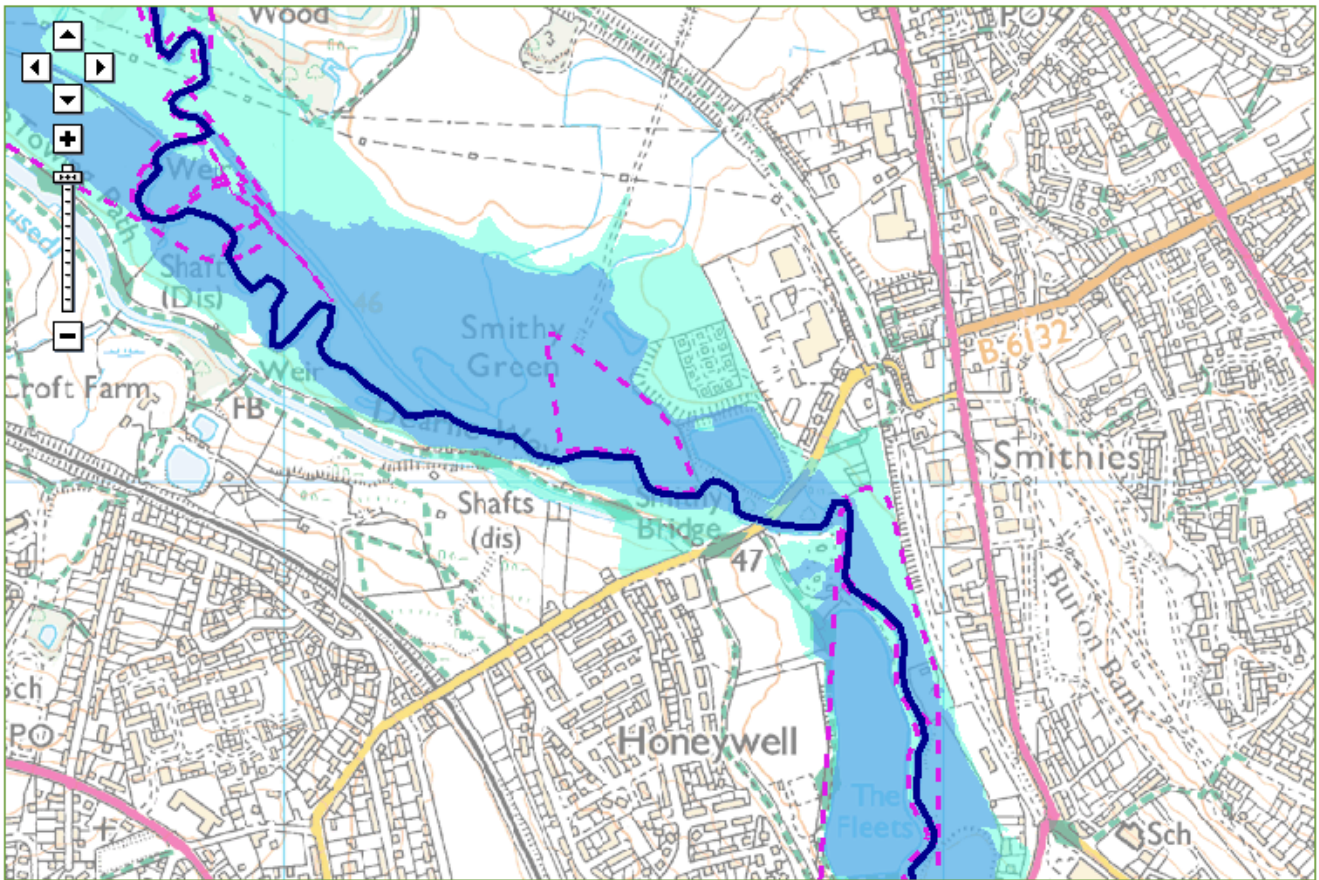


Figure 1-2: Flood Zones in and around the Site (as mapped by the Environment Agency)

Note: Blue - Flood Zone 3,

Light blue - Flood Zone 2 (extent of 1 in 1,000 year return period flood).

Purple Line - Flood Defences (part of the controlled washlands system)

Figure 1-2 also shows an area of flood defences on-site. The site walkover identified sections of flood defences on-site (see Figure 1-3), but these did not relate spatially to those shown on Figure 1-2.



Figure 1-3: Flood Defence on Site

1.3 Description of Site

The following is a summary of the site description found in JBA (2015).

1.3.1 Topography

The site as a whole slopes down towards the south, to where it meets the River Dearne. It has an elevation of between 44 mAOD (at the Dearne) and 58 mAOD to the north. The site can be split in half to show two distinct topographical regions; north and south. The southern half has a much flatter topography, with minor changes in elevations between 45 to 46 m. The northern half is characterised by steeper gradients in the north-south profile, with elevations from 46 m in the south to 57 m in the north.

1.3.2 Geology

The geology beneath the site is summarised in Table 1-1.

Table 1-1: Summary of site geology

Age	Group	Formation / Member	Description	Thickness
Quaternary		Alluvium	Clay and silt	Unknown
Carboniferous	Pennine Coal Measures Group	Pennine Middle Coal Measures Formation	Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams.	~ 650 m ***

Sources:

*Nearby borehole records

** BGS 1:50,000 Geology Map, Solid and Drift Edition, Sheet 100, Sheffield (1974)

*** BGS online Lexicon of Named Rock Units

1.3.3 Hydrology

1.3.3.1 River Dearne

The River Dearne rises to the west of Birdsedge in West Yorkshire and flows in a generally eastwards direction through several urban areas, including Barnsley, to its confluence with the River Don at Conisborough.

The upper River Dearne catchment (upstream of Smithies) is predominantly rural, with land cover consisting mainly of woodland, grassland and arable/ horticultural land use. The lower River Dearne catchment contains significant urban development in the valley.

The River Dearne (in the vicinity of Smithies) is a Heavily-Modified water body in accordance with the Water Framework Directive (WFD) classification system. At present the WFD defines the overall river potential as Moderate, with a target of reaching Good Ecological Potential (GEP) by 2027.

The River Dearne has a moderately flashy flow regime (Figure 1-4), where the rise to peak is often rapid. The River Dearne is a heavily modified, low gradient, predominantly single thread channel, and the channel has been modified significantly over time by channel straightening, widening and deepening.

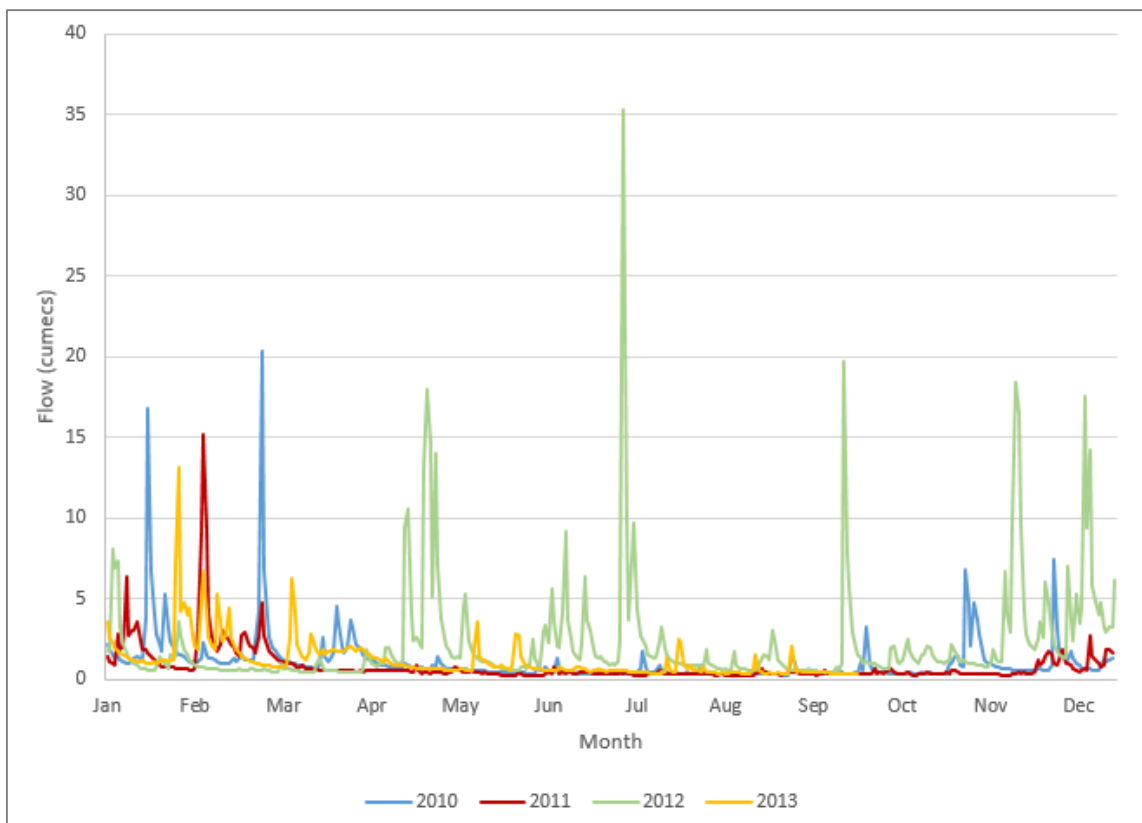


Figure 1-4: River Dearne at Barnsley Weir

© 2015 NERC. UK National River Flow Archive

Figure 1-5: Upstream section of the site (looking upstream from the footbridge)



1.3.3.2 Site Hydrology

There are several drains around the boundaries of the site. The drains form the north, east and western boundaries of the site, with a drain running through the centre east to west. The middle drain is the remnants of an old mill race that flowed eastwards across the site. The old mill was originally embanked, and following the removal of the embankment the function of the drain has altered from operating as a high level carrier to a catchwater drain which now transports water westwards then south along the western boundary of the site.

The eastern drains run along the base of the raised made ground before entering the river adjacent to the reservoir, which drains water from the northern site and east of the southern site. Historical maps suggest that the drain running down the eastern boundary of the site was once used to feed the reservoir to the east and therefore didn't run the full length of the site. The drain in its present form is believed to have been formed following the cessation of this topping up of the reservoir.

1.4 Flood history

An internet search has identified a flood event that flooded Smithies Lane next to the site in June 2007⁴. This related to the highest water levels recorded at Barnsley Weir on the River Dearne through all record between 1960 and 2013 (see Figure 1-6).

⁴ see <http://www.wearebarnsley.com/photos/gallery/37/capture-barnsley-2006-2008>
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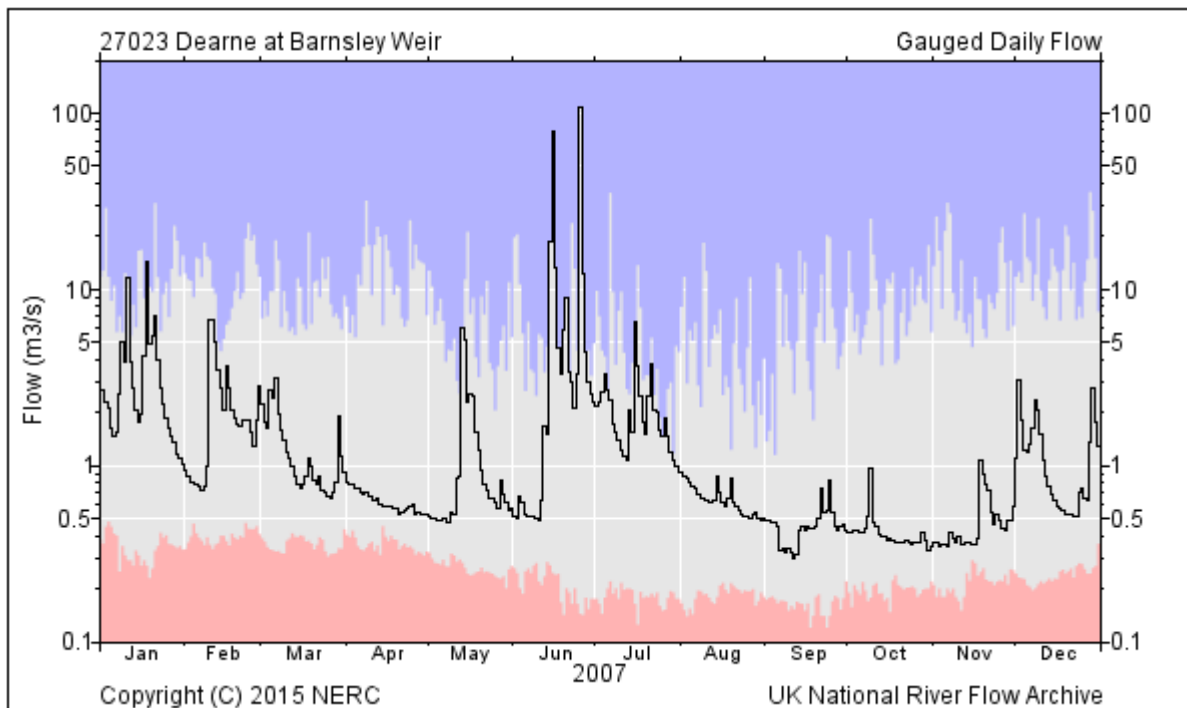


Figure 1-6: River Dearne at Barnsley Weir in 2007

© 2015 NERC. UK National River Flow Archive -data from <http://www.ceh.ac.uk/data/nrfa/data/meanflow.html?27023>.

1.5 Information used

This FRA is based on the following key items of information:

- JBA (2015), River Dearne, Smithies - Habitat Creation Feasibility Study (Draft).

2 Flood risk assessment

2.1 Fluvial flood risk

In a normal situation flooding from the rivers may occur when the flow exceeds the hydraulic capacity of the rivers as represented in the Environment Agency flood map. This will result in floodwaters spilling over the bank tops and onto adjacent land. The southern part of the site is in the floodplain and is classified as Flood Zone 3. Part of the valley side lies within in Flood Zone 2 but the highest part of the site is within Flood Zone 1.

2.2 Surface water flood risk

The Environment Agency's website shows that surface water flooding is limited to floodplain area and a flow path along the eastern edge of the site where it bounds an area of raised made ground. Areas with a medium to high risk of surface water flooding is limited to the lowest lies area of the floodplain which are currently mainly dominated by reedbed/ swamp habitat.

2.3 Other sources of flood risk

The Environment Agency flood map showed that the site is not at risk of coastal flooding.

The low permeability clayey alluvium on site also means that the groundwater flood risk is likely to be low.

The site is also at risk of flooding from a reservoir located 7kms upstream of the site at NGR 429022, 412455. This is owned by Wakefield Metropolitan Borough Council.

2.4 Changes in Flood Risk as a Result of Scrape Creation

The following section aims to review the planned scrape creation design against the tests outlined in the NPPF for water-compatible uses in Flood Zone 3 (see section 1.2):

- Remain operational and safe for users in times of flood;
 - The scrapes will not be required to be visited during times of flood. Therefore this test should be passed. The Public Safety Risk Assessment (PSRA) assesses the potential risk of this to site visitors further (JBA, 2015).
- Result in no net loss of floodplain storage;
 - The spoil material if deposited within Flood Zone 3 could result in a loss of floodplain storage (this is discussed further below).
 - The water levels within the scrapes will be at or below the current ground level.
- Do not impede water flows; and
 - The scrapes will be set below the current ground surface so it is not envisaged that they will impede water flow. Therefore this test should be passed.
- Do not increase flood risk elsewhere.
 - The potential storage within the scrapes has the potential to reduce flood risk in certain circumstance or have a neutral impact when full. Therefore, this test should be passed.

Three of the tests are passed without the need for mitigation measures. The only test that requires mitigation is the net loss of floodplain storage. If spoil from the scrapes is deposited in Flood Zone 1, floodplain storage would increase. Within the site boundary (see Figure 1-2) there are large areas of the site within Flood Zone 1. Material from the scrapes could be deposited within this area so that there would not be a loss of floodplain storage.

2.5 River Restoration Works Assessment

The section below aims to identify potential changes to flood risk as a result of the proposed river restoration works. In assessing the impacts, identifying potential receptors on a different scale is required. The area within the site boundary is not identified as a receptor for these purposes. The potential receptors can be classified as following:

- The low lying land on the left bank immediately to the west of the site.
 - The lowest part is a Rush *Juncus* spp. dominated wet area shown on the current 1:50k OS map as a pond (see Figure 1-2). The site walkover and current 1:10k map indicate that this pond has been drained. The upper part is used for arable production and lies at least 2m above the former pond level (see Figure 2-1)
- The floodplain upstream of the site.
 - The floodplain upstream of the site is dominated by pasture. The nearest infrastructure within it is a sewerage works 2km upstream.
- The floodplain downstream of the site.
 - The site lies immediately upstream of Barnsley. The Smithies Lane Bridge lies 90m downstream of the proposed works and the Old Mill area of Barnsley, which includes a number of warehouses within the floodplain, lies 900m downstream.

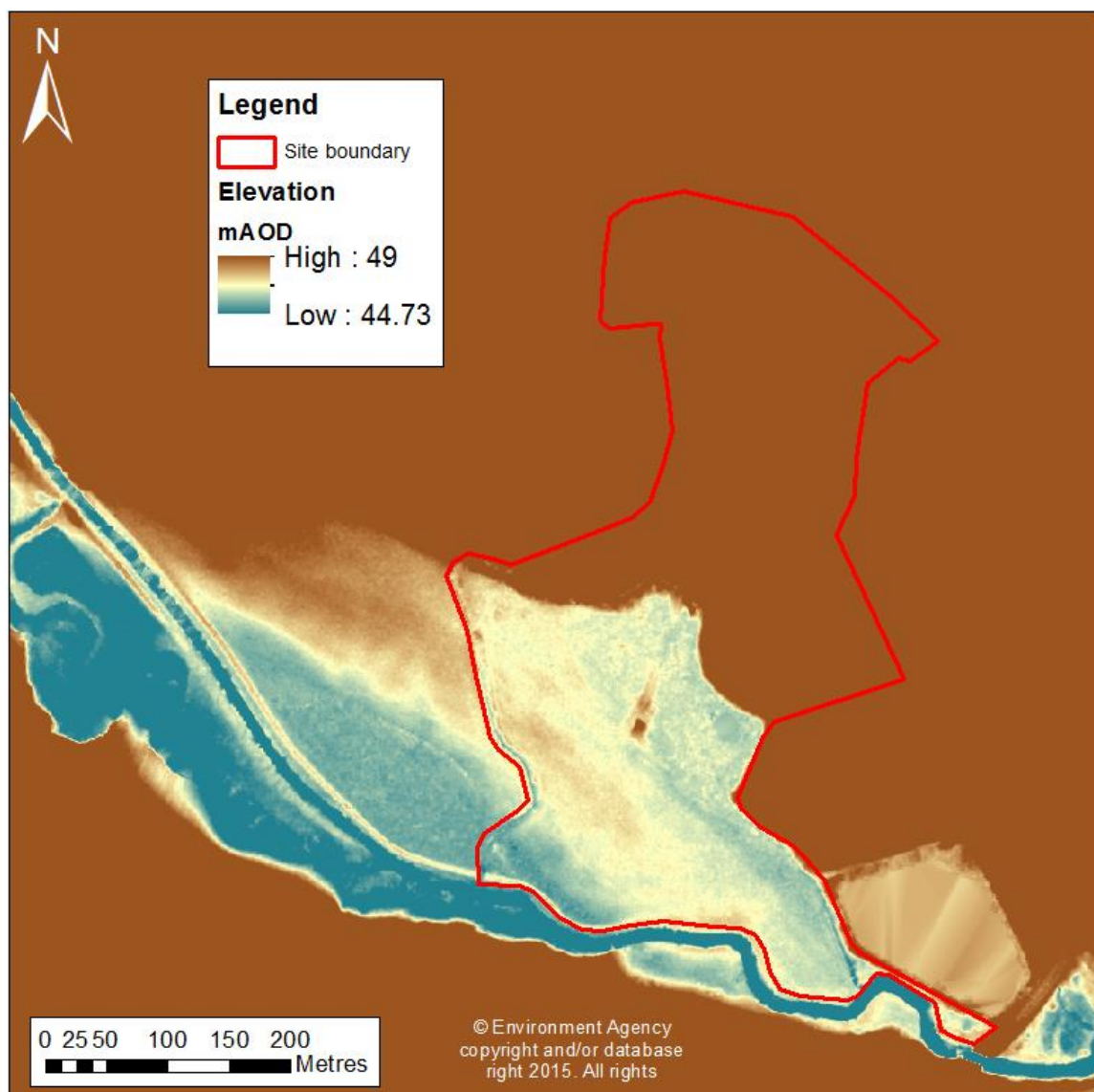


Figure 2-1: Floodplain topography on Site and on the land immediately upstream

2.5.1 Changes in Flood Risk as a Result of Flood Embankment Removal

Three of the NPPF test require discussion with regards to the proposed flood embankment removal:

- Result in no net loss of floodplain storage;
 - If the spoil from the removed embankment is deposited in Flood Zone 1 (like the scrape spoil discussed above) it should result in an increase in flood plain storage.
 - Floodplain storage will also increase for low return period events as a new area of floodplain will be accessible.
- Do not impede water flows; and
 - Removal of the embankment should not impede the flow of water.
- Do not increase flood risk elsewhere.
 - Removal of the embankment is designed to improved floodplain connectivity during flood events and therefore, there will be increased floodplain wetting frequency and extent within the site boundary. This is likely to result in lowered water levels downstream during flood events. The spread of flood water within the floodplain locally may need to be considered to ensure it does not flow further downstream along the floodplain (the risk of this is deemed to be low through interrogation of LiDAR).
 - There is no hydraulic barrier between the site and the low lying former pond area immediately upstream of the site (see Figure 1-2). This area may, like the site itself, be more prone to flooding as a result of the scheme.
 - The wider floodplain upstream should not be affected.

The "do not increase flood risk elsewhere" test is not formally passed. However, the Environment Agency with current information (or on the basis of additional information) may assess that given the nature of the floodplain which would be effected, the net impact on the "do not increase flood risk elsewhere" test may be deemed not to increase flood risk elsewhere.

2.5.2 Changes in Flood Risk as a Result of in Channel Works

Three of the NPPF tests require discussion with regards to the in-channel river restoration works (proposed installation of gravel features and point bar features):

- Result in no net loss of floodplain storage;
 - The combination of gravel features and point bars will act to raise local water levels and encourage water to spill into the floodplain more frequently than under current conditions. Therefore, there will be local water level raising and increases in flood extent within the site boundary. This is likely to result in reduced water levels downstream.
- Do not impede water flows; and
 - The use of woody debris and point bars will raise water levels locally and create local flow diversity. These will act to slow down the flood wave as it travels downstream and encourage some water into the floodplain as a result of improved connectivity. The gravel features have been designed to remain dynamically stable to prevent significant washing downstream.
- Do not increase flood risk elsewhere.
 - The installation of gravel features and point bars is designed to improve floodplain connectivity during flood events and therefore, there will be increased floodplain wetting frequency and extent within the site boundary. This is likely to result in lowered water levels downstream during flood events. The spread of flood water within the floodplain locally may need to be considered.
 - LIDAR analysis suggests that risk to the downstream floodplain is unlikely however, like the flood embankment to be removed, the low lying area immediately upstream on the left bank may be affected.
 - As the works are likely to only locally raise water levels, the wider floodplain upstream, which has little infrastructure, is unlikely to be significantly affected.

The works are likely to result locally in a loss of floodplain storage and increase flood risk to the site. The overall flood alleviation benefit of the works though may be deemed to have a net benefit.

This judgement however should be confirmed by the Environment Agency for the tests to be passed.

3 Flood risk management measures

This is not a residential development and the development need only be accessed for construction and maintenance. We advise that all activities should not occur if a flood alert, warning or severe flood warning is in place. If a flood alert, warning or severe flood warning is put in place whilst operatives are on Site they should vacate the Site immediately.

A flood warden should be assigned prior to the commencement of construction work on Site and made responsible for monitoring the weather forecast and disseminating flood warnings to Site staff as appropriate (up to and including evacuation of the Site). The flood warden should also be familiar with a safe escape route from the Site to higher ground in Flood Zone 1. The Environment Agency provides a flood warning service throughout England and Wales in areas at risk of flooding from rivers or the sea. The Site is located within an Environment Agency Flood Warning Area. It is recommended that this free Floodline Warning Direct service is signed up to as part of this scheme's implementation and that the flood warden is responsible for receiving and disseminating these warnings to all Site staff.

Once the scheme is operational, the Environment Agency should identify a flood warden responsible to train personnel charged with the maintenance works required. This training would involve:

- Monitoring weather forecasts and flood warning before site visits;
- Providing information on safe escape routes to higher ground;
- Identifying safe methods and mitigation measures when adjusting control structures including identifying when it is suitable to access the site.

The Public Safety Risk Assessment (PSRA) designer's summary (JBA, 2015) developed for this scheme further examines the flood risk and mitigation recommended in relation to site visitors.

4 Conclusions and recommendations

The site is within Flood Zone 3 but the wetland creation scheme is defined as a water-compatible use under the NPPF. In relation to the scrape creation, the needs of the NPPF, with regards to flood risk, will be met if spoil from the scrapes is disposed of outside Flood Zone 3.

The river restoration works may locally change the flood regime of the river and flooding may increase on site and in a small low lying area upstream which was previously a pond. The report makes no conclusive assessment as to the significance of this change in terms of its impact on floodplain loss, impeding water flow and increasing flood risk elsewhere. JBA consulting have assessed that the scheme has the potential to bring overall flood risk benefits, however such conclusions will need to be confirmed by the Environment Agency; either on the basis of currently available information or as a result of further assessment. Further assessment may take the form of pre- and post-change hydraulic modelling using the existing Environment Agency flood risk model. If it is deemed negligible the requirements of the NPPF for the scheme, with respect to flood risk, are met.

Management measures are suggested during the construction and operational phase of the scheme to ensure that site personnel remain safe.

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t: +44(0)1756 799919

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Registered in England 3246693

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G Public Safety Risk Assessment

Form PSRA 2:
New & Improvement Works – Designer’s Summary

To be completed by Designer			
Site Name	River Dearne, Smithies	Location	River Dearne, Smithies, Barnsley, South Yorkshire
River	River Dearne	Type of Structure	Scrape creation, gravel/point bar in-channel features, embankment removal
Grid Ref	SE 34484 08168	Structure Function	Wetland habitat creation, river enhancement
Designer / Employer	Laura Thomas / JBA Consulting	Date of Design Risk Assessment	14 th April 2015
To be completed by Asset Manger			
FDMS No		Asset Manager	
PSRA to be reviewed on		Overall risk rating as reviewed by Asset Manager following hand-over	

Brief description of the structure and its purpose	At the River Dearne, Smithies site, the project aim is to create UK BAP Priority wetland and non-wetland habitats and to improve river habitats. The preferred option to achieve this aim is to: • Raise water levels in the River Dearne through the inclusion of gravel features • Create point bar features on the River Dearne • Remove a small flood embankment in the south-west of the site • Create a series of scrapes • Enhance the western boundary drain • Undertake minimal enhancement works to existing wetland habitats on the site • Small-scale habitat opportunities. To deliver the above habitat creation scheme a series of earthworks and in-channel works will be undertaken allowing water to stand on the site for longer creating additional wetland habitats and to increase habitat and morphological diversity within the River Dearne.
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The assessment should be carried out within the context of the local environment, i.e. are the hazards created by the structure significantly different to those created by the surrounding topography? If so, what additional risks does the structure introduce?

1. SITE HAZARDS	Y/N	Identify hazards and control measures included in the design to mitigate the risk	Risk Level See matrix page 3
1.1 Vertical drops (>2m) and slopes <i>Eg. Slipping, walking off into eg. Excavations, concrete slopes, grass banks.</i>	N	n/a	N/A

1. SITE HAZARDS	Y/N	Identify hazards and control measures included in the design to mitigate the risk	Risk Level See matrix page 3
1.2 Uneven ground/floor <i>Eg. Danger of tripping eg. loose/uneven flooring, protruding obstacles.</i>	Y	Once completed the habitats created will include a mosaic of wet grassland, scrapes, floodplain grassland and swamp which will be uneven with numerous trips/ obstacles (e.g. boggy ground, rush and other vegetation tussocks, protruding roots, tangled vegetation). Habitats already present on the site are of this nature and consequently the habitat creation scheme will not increase this risk further. Control measures: this site currently has no formal public access and there are no plans to allow public access to the site. However, the general public do appear to regularly informally access the site, with illegal grazing of ponies extensive. Within the north of the site, and part way into the south of the site, there is an existing elevated trackway which provides a preferential pedestrian route which will direct any members of the public who do access the site away from most of the areas where wetland habitat will be created. Appropriate signage highlighting that the land is private with no access should be erected to deter public access.	3 Likelihood = 3 Severity = 1
1.3 Traps and confined spaces <i>Eg. What kind? eg. Deep mud, bogs, chambers, manhole, self locking doors</i>	Y	The creation of scrapes will create areas of boggy ground, however, these are not likely to be areas of deep mud given the ground conditions and they will only hold water at certain times of year. Control measures: this site currently has no formal public access and there are no plans to allow public access to the site. However, the general public do appear to regularly informally access the site, with illegal grazing of ponies extensive. Within the north of the site, and part way into the south of the site, there is an existing elevated trackway which provides a preferential pedestrian route which will direct any members of the public who do access the site away from the scrapes and wetland areas. Appropriate signage highlighting that the land is private with no access should be erected to deter public access.	3 Likelihood = 3 Severity = 1
1.4 Falls from structures <i>Eg. Falling into or onto what?</i>	N	n/a	N/A
1.5 Trees <i>Danger of being hit by fallen tree/branch, or vehicle hitting a fallen tree/branch</i>	Y	The site contains some woody vegetation cover. However, the woody vegetation on site is scrubby in nature so that it is generally impenetrable to the public, and low growing so the risk of any falling branches is minimal. Control measures: this site currently has no formal public access and there are no plans to allow public access to the site. However, the general public do appear to regularly informally access the site, with illegal grazing of ponies extensive. Within the north of the site, and part way into the south of the site, there is an existing elevated trackway which provides a preferential pedestrian route which will direct any members of the public who do access the site away from the existing scrub areas and wooded areas in the north of the site. Appropriate signage highlighting that the land is private with no access should be erected to deter public access.	2 Likelihood = 2 Severity = 1
1.6 Moving parts <i>Eg. Adequately guarded eg. mechanical, electrical, gravity, flywheels, automatically operated</i>	N	n/a	N/A
1.7 Electricity <i>Eg. Danger of electrocution eg. exposed wires, damaged casings, overhead power lines</i>	N	n/a	N/A
1.8 Deep/fast flowing water around/through structure <i>Eg. Danger of drowning eg. weir, flooded area, wide well, water filled pit</i>	Y	The creation of scrapes will create areas of standing water at certain times of the year. These areas of standing water may provide a risk to the public. Flooding of the site also has the slight potential to result in the stranding of any visitors. Control measures: this site currently has no formal public access and there are no plans to allow public access to the site. However, the general public do appear to regularly informally access the site, with illegal grazing of ponies extensive. Within the north of the site, and part way into the south of the site, there is an existing elevated trackway which provides a preferential pedestrian route which will direct any members of the public who do access the site away from the scrapes and wetland habitats, and this track is some way from the River Dearne. Appropriate signage highlighting that the land is private with no access should be erected to deter public access. Furthermore, scrapes are very shallow in their nature and will be less than 0.5m deep for the most part, although generally much shallower. Flooding resulting in the stranding of visitors is not considered to be a major risk as floodwaters are unlikely to inundate the site at a rate fast enough to result in stranding given the nature of the site. In the unlikely event that a flood event does potentially strand visitors, the elevated trackway in the centre of the site will only be 300m away at maximum (and usually less).	3 Likelihood = 1 Severity = 3
1.9 Combustible materials <i>Eg. Fire risk eg. petrol, chemicals, build up of waste material</i>	N	n/a	N/A

1. SITE HAZARDS	Y/N	Identify hazards and control measures included in the design to mitigate the risk	Risk Level See matrix page 3
1.10 Storage <i>Eg. Collapse eg. uneven, too high, space constraints</i>	N	n/a	N/A
1.11 Other <i>continue on a separate sheet if required</i>	N	n/a	N/A

2. RISK FACTORS	Y/N	Identify hazards and control measures included in the design	
2.1 Location <i>Eg proximity of schools, parks, footpaths, highways</i>	Y	The site is located on the periphery of an urban area, to the north of Barnsley and west of Monk Bretton. There is a traveller site located immediately adjacent to the eastern site margin, with a recycling centre immediately beyond that.	
2.2 Means of access <i>Do the public have access onto or through the site? Eg footpaths, other owners</i>	Y	There are a number of Public Rights of Way around the site, along with a number of more informal paths and access points. To the north, a public right of way follows the route of the disused railway, and an informal access track then runs southwards from this across the northern part of the site and part way into the southern section. There is a footpath from the car park associated with the fishing lake, which follows the western boundary of the lake, before an informal crossing point allows access into the site. No formal access point exists at this location, but a fencing panel has been used to create a bridge across the drain. Despite the lack of formal public access points and paths, the site does appear to relatively regularly used by the local population. The site is also used for horse grazing without the landowners' permission	
2.3 Usage or local knowledge <i>Eg Formal or custom and practice activities eg Camping, canoeing, swimming, picnic, vandalism, trespassing children, structure used for amenity, leisure or recreational activities.</i>	Y	The site is evidently regularly visited by the local community, with informal access points created and extensive illegal grazing. It is also adjacent to a fishing lake which provides an amenity resource. During the site walkover surveys conducted as part of the hydrological and hydrogeological assessment, an area of fly tipping which had been set alight was noted indicating potentially high levels of vandalism and anti-social behaviour in this area.	

Risk Matrix

(Risk level – post construction)

		LIKELIHOOD				
		1	2	3	4	5
SEVERITY	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

Definitions

No.	Likelihood	Severity
1	Very unlikely	Minor injury
2	Unlikely	1 st aid required
3	Likely	Serious (3 day)
4	Very Likely	Major, req' hospital
5	Almost Certain	Fatal

Overall Risk: 1-5 **Low** 6-10 **Medium** 12-25 **High**

3. MEASURES INCORPORATED IN THE DESIGN (include description of location of signs/barriers etc) Use additional sheets if required.

The design includes scrapes, rather than permanent ponds, to create open water habitat features. Scrapes, in their nature, are shallow water features of 0.5m maximum depth (but much shallower over the majority of the area) and only holding water of this depth in the central areas during the winter period. They also have very shallowly sloping sides by their design, rather than steeper sides that a permanent pond would have.

This site currently has no formal public access and there are no plans to allow public access to the site. However, the general public do appear to regularly informally access the site, with illegal grazing of ponies extensive. Within the north of the site, and part way

into the south of the site, there is an existing elevated trackway which provides a preferential pedestrian route which will direct any members of the public who do access the site away from the main scrapes and wetland habitats created. Appropriate signage highlighting that the land is private with no access should be erected to deter public access.

The construction of a control structure on one of the site drains was considered in order to more formally control water levels on the site. However, this was discounted during the design process as, given the likely high levels of informal public use and potential for vandalism/ anti-social behaviour in the area, the risk of this being tampered with leading to additional H&S risks was considered too high.

H Environmental Action Plan

National Environmental Assessment Service

Environmental Action Plan

Project name	River Dearne, Smithies – Habitat Creation Feasibility Study
Project 1B1S reference	IMNE790499
Region and Area	
Date	16 th April 2015
Version number	1
Author	Laura Thomas

Revision history

Revision date	Summary of changes	Author	Version number
16/04/2015	First issue	Laura Thomas	1

EAP Approvals

Name	Signature	Title	Date	Version

Distribution

Name	Title	Date	Version

Purpose

This Environmental Action Plan (EAP) summarises the actions required to implement the environmental mitigation and outcomes for the ***River Dearne, Smithies – Habitat Creation Feasibility Study***. It also details roles and responsibilities of those involved in the proposal and relates to all **temporary** and **permanent** works.

These actions form part of the contract documentation and must be adhered to.

Roles

Each action in the table below has **one** named person who is responsible for ensuring that the action is implemented. It is ultimately the contractor's responsibility for ensuring the EAP commitments, which may include planning conditions, are delivered.

The Environmental Clerk of Works (ECW) is responsible for agreeing any changes to the EAP and for signing off, or agreeing to the signing off of, the actions.

The contractor and Project Manager are responsible for advising the ECW on any changes to method statements or the planned construction work as these may result in changes to the EAP or additional consultation with statutory consultees. The ECW will assess the significance of these changes and determine the appropriate course of action.

The contractor is also responsible for implementing good environmental practice on site, in line with their own EMS. The ECW will monitor adherence to the EMS. Typical issues include:

- Any working hour restrictions
- Dust suppression measures
- Traffic management
- Site waste management
- Materials management
- Maintenance of the carbon calculator
- Vehicle maintenance and management
- Pollution prevention and control (including storage, refuelling and incident response)
- Response procedures eg services strike, contaminated land
- Hazardous materials handling and storage
- Noise management
- Securing and delineation of working areas including signage

Environmental Audits

The appended template should be used when undertaking any site audits during construction. These audits will be undertaken by the ECW. Technical assistance can be obtained from functional staff as appropriate. Site audits can potentially highlight good practice and can be separate to the review of EAP actions as undertaken in progress meetings. They do not replace the regular checks undertaken by the ECW during the works; no set template has been provided for this.

Audits are required for medium and high environmental risk sites (risk level assigned by NEAS).

Environmental Incident Reporting system

All environmental incidents must be reported to the Environment Agency Incident Hotline 0800 80 70 60 as per the [Environmental Incident Reporting Poster](#) at the earliest opportunity and then to the ECC Project Manager, Site Supervisor, Environment Agency Project Manager and Environment Agency NEAS Environmental Project Manager. In addition, near misses must be reported via the hotline where there was/is the potential for a significant impact and where lessons can be learned.

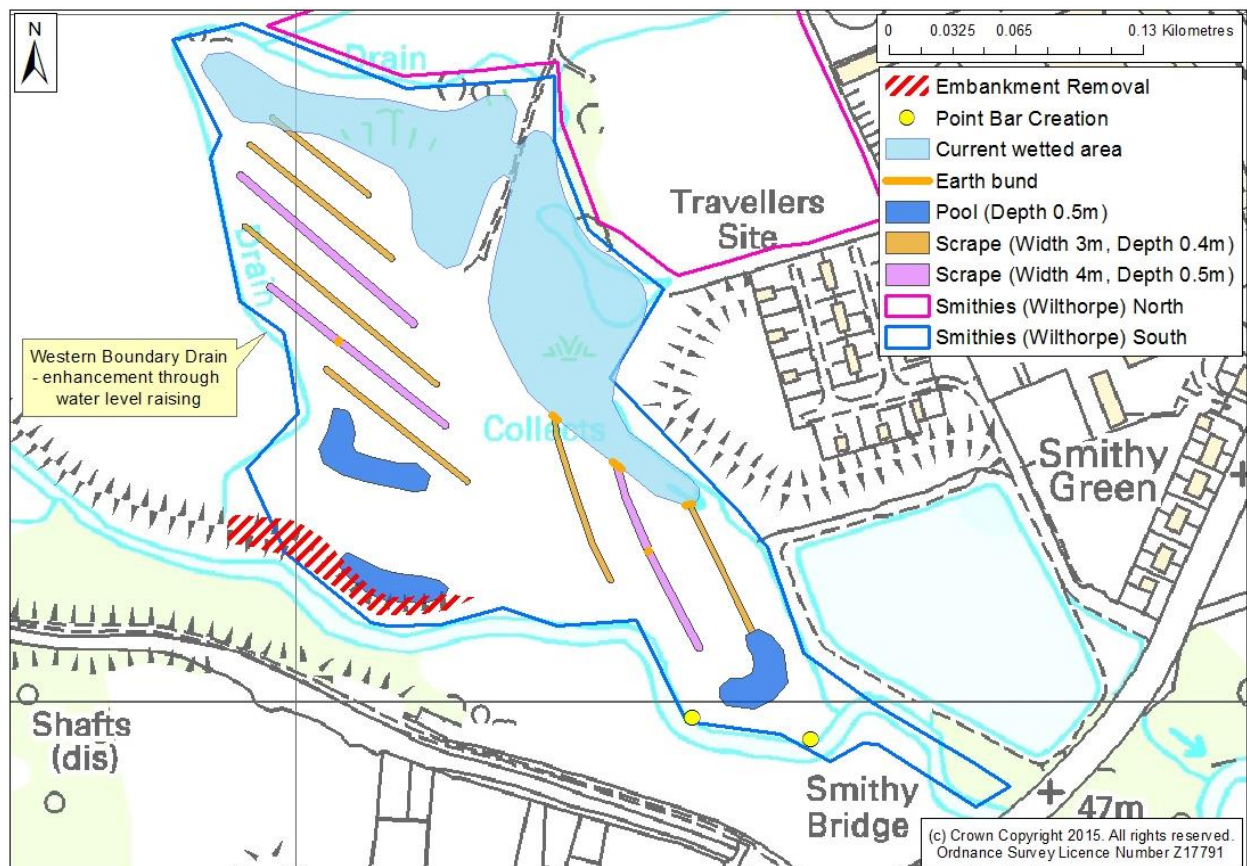
Initial reports for such incidents and near misses must be followed by a written report using the contractor's in-house forms. This must include the following information (project/location, date, contractor, NIRS reference number, details of what happened, cause of incident, lessons learned). This final and comprehensive investigation report is to be provided by the Contractor to the ECC Project Manager, Environment Agency Project Manager and Safety, Health and Environment Manager within 14 days.

Summary of scope of works

The Environment Agency is currently exploring the feasibility of creating wetland habitat on three sites across the Don catchment, including on the River Dearne at Smithies. The aims of this project are to create UK BAP Priority wetland and non-wetland habitats that would function as part of an ecological network at the landscape scale, and improve river habitats (both bank-side and in-river) on the River Dearne.

A number of baseline studies have been undertaken to help with the development of the preferred scheme, including a hydromorphological audit, hydrological/ hydrogeological assessment, preliminary environmental assessment and soil contamination testing, a rapid archaeological desk-based assessment, ecological desk-based data collation and collection of other relevant data. In agreement with project stakeholders, the preferred scheme is:

- Option 1 - Raising of water levels within the River Dearne through the inclusion of gravel features (not woody debris)
- Option 2 - Creation of point bar features on the River Dearne
- Option 3 - Removal of the small flood embankment at the south-west of the site
- Option 4 - Scrape creation
- Option 5 - Enhancement works on the western boundary drain
- Option 7 - Minimal enhancement works to the existing wetland habitats on the site
- Small-scale habitat opportunities.



This EAP is a preliminary document that will remain live throughout the project's development and implementation and will require regular updating as new information/ constraints/ opportunities are identified.

Relevant contact details

EA Budget Holder	Martin Slater, Environment Programme Manager
Project Manager	Amanda Best (0113 8196332)
NEAS	Tbc
ECW	Tbc
Contractor	Tbc
Site Supervisor	Tbc
Design Contractor Project Manager	Laura Thomas (01302 720313)

Environmental Action Plan

Ref. No.	Objective	Action	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
Pre-construction						

River Dearne, Smithies – Habitat Creation Feasibility Study

Ref. No.	Objective	Action	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
PR1	Ensure the proposed habitat creation scheme does not increase flood risk in the local area.	Liaise with Environment Agency Flood and Coastal Erosion Risk Management (FCERM) staff to determine what additional information would be required to satisfy them that the project will not increase flood risk.	EA Project Manager		Undertake additional modelling of scheme to determine impacts if FCERM require it.	
PR2	Limit disruption to local landowners and any nearby residents.	Establish working hours and access routes prior to work commencing.	Contractor			
PR3	Compliance with the Conservation of Habitats and Species Regulations 2010 and Wildlife and Countryside Act 1981 – no adverse impact on bat roosts.	Should any mature trees require removal, these should first be subject to a bat roost potential assessment and, if required, a bat activity survey.	EA Project Manager		If a roost is confirmed, the tree should be retained, or appropriate mitigation, under Natural England Licence, implemented.	
PR4	Compliance with Wildlife and Countryside Act 1981 – no adverse impact on nesting birds	Any vegetation clearance required to facilitate the works to be undertaken outside of the bird breeding season (March to September inclusive).	EA Project Manager / Contractor			
PR5	Compliance with Wildlife and Countryside Act 1981 – no spread of invasive non-native species	Ensure appropriate mitigation and biosecurity strategies are in place to deal with Japanese Knotweed, Himalayan Balsam and Signal Crayfish	EA Project Manager		Implement mitigation and biosecurity strategy if required.	

River Dearne, Smithies – Habitat Creation Feasibility Study

Ref. No.	Objective	Action	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
PR6	No adverse impact on local archaeology	Liaise with • South Yorkshire Archaeology Services to discuss the project and agree a suitable scope of mitigation works.	EA Project Manager		Implement archaeological mitigation strategy as agreed with South Yorkshire Archaeology Services. A full desk-based archaeological assessment may need to be carried out to more fully establish palaeoenvironmental and archaeological potential and significance, should significant earthworks be required	
PR7	Ensure safe working environment for site staff and any public on the site.	When working on site review original site services/ utilities plans for more accurate network locations before conducting any earth works on site.	Contractor			
During construction – Will need to be developed further as final design and project develops						

River Dearne, Smithies – Habitat Creation Feasibility Study

Ref. No.	Objective	Action	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
<i>DU1</i>	Limit disruption to local landowners and any nearby residents.	Follow considerate working hours (8:00 – 18:00). Ensure measures are put in place to limit noise and dust levels.	Contractor			
<i>DU2</i>	Limit disruption to local traffic and other users of highways (cyclists, horses, pedestrians).	Ensure all site vehicles use designated routes to and from site (i.e. compound).	Contractor			
<i>DU3</i>	Compliance with the Conservation of Habitats and Species Regulations 2010 and Wildlife and Countryside Act 1981 – No adverse impact on local Otter and bat population.	Implement appropriate mitigation strategies (e.g. no night-time working, no lighting installed, leaving any excavations with a means of escape) throughout works to avoid adverse impact.	Contractor			
<i>DU4</i>	Ensure protection of the public	Whilst there are no public footpaths on site, ensure that all site personnel are aware of the areas where the general public may be encountered and implement appropriate measures to ensure the safety of the general public during works.	EA Project Manager/ Contractor			
<i>DU5</i>	Protect water quality	Pollution Prevention Guidance to be followed	Contractor			

River Dearne, Smithies – Habitat Creation Feasibility Study

Ref. No.	Objective	Action	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
DU7	Compliance with Wildlife and Countryside Act 1981 – no spread of invasive non-native species	Biosecurity protocol should be followed (i.e. Check-Clean-Dry).	Contractor			
DU8	Limit disruption due to adverse weather, potential flooding event	Weather forecasts to be checked daily. Put in place appropriate procedures for flood event.				
DU9	Compliance with relevant waste/ Environmental Permitting Regulations	As it is proposed to re-use site derived excavated soils, such activities may fall under the Environmental Permitting Regulations (2010), depending on levels of contamination present. It may however be possible to deal with such soils under the CL:AIRE (Contaminated Land: Applications in Real Environments) Code of Practice.				
Post construction – Will need to be developed further as final design and project develops						

River Dearne, Smithies – Habitat Creation Feasibility Study

Ref. No.	Objective	Action	Responsibility	Reference to further information	Progress and Further Action	Sign off and date
PO1	Compliance with Wildlife and Countryside Act 1981 – no spread of invasive non-native species	Biosecurity protocol should be followed (i.e. Check-Clean-Dry) ensuring thorough clean down of equipment and machinery and adequate time allowed for drying (at least 72 hours) before use on other sites.	Contractor			

Environmental audit record

Project	River Dearne, Smithies – Habitat Creation Feasibility Study	Project ref.:	IMNE790499
Project Manager:	Amanda Best	NEAS EPM:	
Location	Smithies, Barnsley, South Yorkshire	Grid reference:	SE 34484 08168

Site Visit Audit Details

Visit During/Post Construction:		Date of Visit:		Time of Visit:	
Audit Officer:		Photos taken (y/n):		Referenced to Pre-Photos(y/n):	

Does the Site Supervisor have an up to date copy of the EAP? Yes / No

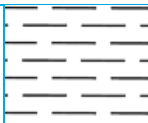
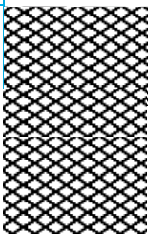
General comments

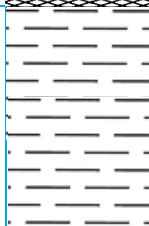
I Site Investigation Logs

Equipment & Methods: Hand Auger	Hole Name: S1		Ground Level (mAOD):	Date: 11/02/2015	
Logged by: Alice Davis and Brendon McFadden	Project: 2015s2245 EA Habitat Creation Site: Smithies Log Grid Reference: 434547 408063				
Description	Level BGL	Reduced level	Lithology	Samples	Notes
Dark brown SOIL	0.05 m				
Grey brown CLAY	1 m				Clay becomes lighter in colour at 0.3 m Becomes saturated from 0.7m
END at 1 mbgl					

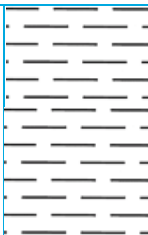
Equipment & Methods: Hand Auger	Hole Name: S2		Ground Level (mAOD):	Date: 11/02/2015	
Logged by: Alice Davis and Brendon McFadden	Project: 2015s2245 EA Habitat Creation Site: Smithies Log Grid Reference: 434482 408160				
Description	Level BGL	Reduced level	Lithology	Samples	Notes
Dark grey saturated CLAY	0.2 m				
END at 0.2 mbgl					
Notes	Standing water creating issues with gaining a deeper log				

Equipment & Methods: Hand Auger	Hole Name: S3		Ground Level (mAOD):	Date: 11/02/2015	
Logged by: Alice Davis and Brendon McFadden	Project: 2015s2245 EA Habitat Creation Site: Smithies				
	Log Grid Reference: 434394 408051				
Description	Level BGL	Reduced level	Lithology	Samples	Notes
Mid brown clayey SOIL	0.1 m				

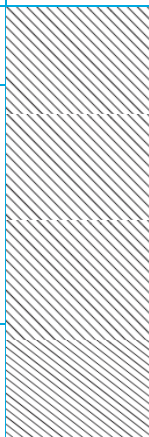
Orange brown mottled firm CLAY	0.4 m				
Grey brown clayey SOIL	1 m				
END at 1 mbgl					

Equipment & Methods: Hand Auger	Hole Name: S4		Ground Level (mAOD):	Date: 11/02/2015	
Logged by: Alice Davis and Brendon McFadden	Project: 2015s2245 EA Habitat Creation Site: Smithies Log Grid Reference: 434392 408110				
Description	Level BGL	Reduced level	Lithology	Samples	Notes
Dark brown clayey SOIL	0.1 m				
Dark greyish brown mottled CLAY	1 m				Water strike at 0.9 m
END at 1 mbgl					

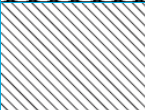
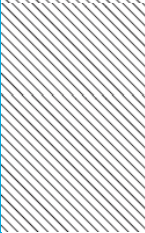
Equipment & Methods: Hand Auger	Hole Name: S5		Ground Level (mAOD):	Date: 11/02/2015	
Logged by: Alice Davis and Brendon McFadden	Project: 2015s2245 EA Habitat Creation Site: Smithies Log Grid Reference: 434379 408194				
Description	Level BGL	Reduced level	Lithology	Samples	Notes
Brown very clayey SOIL	0.05 m				
Brown stiff CLAY with black organic fragments	0.3 m				

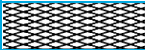
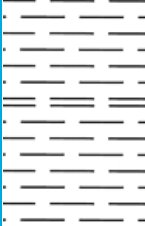
Orangey brown mottled stiff CLAY with black organic fragments					
	1 m				
END at 1 mbgl					

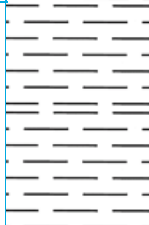
Equipment & Methods: Hand Auger	Hole Name: S6		Ground Level (mAOD):	Date: 11/02/2015	
Logged by: Alice Davis and Brendon McFadden	Project: 2015s2245 EA Habitat Creation Site: Smithies Log Grid Reference: 434393 408277				
Description	Level BGL	Reduced level	Lithology	Samples	Notes
Greyish brown CLAY with some burnt orange mottling, becoming more orange and cohesive with depth	0.4 m				
Grey and orange mottled CLAY	0.75 m				Water strike at 0.65 m
END at 0.75 mbgl					

Equipment & Methods: Hand Auger	Hole Name: S7		Ground Level (mAOD):	Date: 11/02/2015	
Logged by: Alice Davis and Brendon McFadden	Project: 2015s2245 EA Habitat Creation Site: Smithies Log Grid Reference: 434454 408213				
Description	Level BGL	Reduced level	Lithology	Samples	Notes
Dark grey clayey MADE GROUND largely ash based with rootlets	0.05 m				
Dark grey ashy stiff clayey MADE GROUND with some sandstone gravel and brick fragments	0.5 m				
Black with grey mottled ashy clayey MADE GROUND	0.7 m				

Grey ashy clayey MADE GROUND with sandstone gravel up to 30 mm	0.85 m				
END at 0.85 mbgl					

Equipment & Methods: Hand Auger	Hole Name: S8		Ground Level (mAOD):	Date: 11/02/2015	
Logged by: Alice Davis and Brendon McFadden	Project: 2015s2245 EA Habitat Creation Site: Smithies Log Grid Reference: 434481 408307				
Description	Level BGL	Reduced level	Lithology	Samples	Notes
Dark brown clayey SOIL with numerous rootlets	0.05 m				
Ashy clayey MADE GROUND with some small brick fragments and sandstone gravel	0.2 m				
Very ashy MADE GROUND	0.3 m				
END at 0.3 mbgl					

Equipment & Methods: Hand Auger	Hole Name: S9		Ground Level (mAOD):	Date: 11/02/2015	
Logged by: Alice Davis and Brendon McFadden	Project: 2015s2245 EA Habitat Creation Site: Smithies Log Grid Reference: 434524 408342				
Description	Level BGL	Reduced level	Lithology	Samples	Notes
Dark brownish black clayey SOIL	0.05 m				
Dark brownish black CLAY with some subangular sandstone gravel up to ~30 mm	0.15 m				
Orangey brown mottled CLAY with some sandstone sand and gravel up to ~15 mm	0.3 m				
END at 0.3 mbgl					
Notes	No returns at 0.3 m with water at base				

Equipment & Methods: Hand Auger	Hole Name: S10		Ground Level (mAOD):	Date: 11/02/2015	
Logged by: Alice Davis and Brendon McFadden	Project: 2015s2245 EA Habitat Creation Site: Smithies Log Grid Reference: 434506 408495				
Description	Level BGL	Reduced level	Lithology	Samples	Notes
Greyish brown clayey SOIL	0.05 m				
Mid brown CLAY	0.25 m				
Orange and brown mottled slightly silty CLAY with some subrounded sandstone and siltstone gravel (4-20 mm) with some sand grains	0.5 m				
END at 0.5 mbgl					

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