

2018s1534

Wombwell Ings

Geotechnical and Geoenvironmental Desktop Study

Draft Report

November 2018

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giving
nature
a home

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Revision history

Revision Ref/Date	Amendments	Issued to
06/12/2018 / v1.0		Jayne Wood

Contract

This report describes work commissioned by Jayne Wood, on behalf of RSPB, by an email dated 02/08/2018. Stephen Dixon of JBA Consulting carried out this work.

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Purpose

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Carbon footprint

JBA is aiming to reduce its per capita carbon emissions.

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1 Introduction

1.1 Brief

RSPB are proposing to undertake habitat development of the Wombwell Ings site 7km south-east of Barnsley in Yorkshire at National Grid Reference E441727, N463663.

The site plan is shown in Figure 1-1, and the site location is shown in Figure 2-1.

The scheme involves the following elements (RSPB, 2018):

1. Installation of a water control structure on the River Dove in the north-west of the site.
2. Creation of a site perimeter ditch with associated predator fence
3. Creating island habitats utilising some of the arisings from the perimeter ditch. The remaining excavated material to be moved to the RSPB Dearne Valley Old Moor site, around 1km south-east of Wombwell Ings.

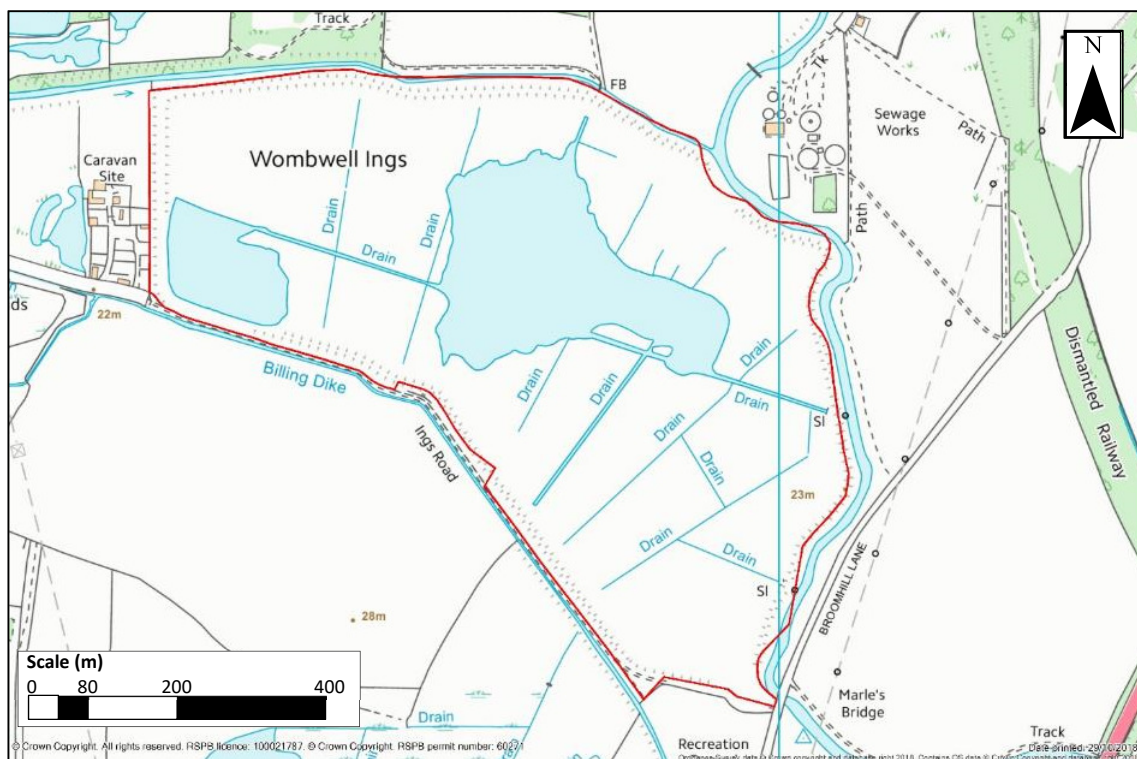


Figure 1-1: Site location plan (OS OpenData 2018)

1.2 Scope

The RSPB have commissioned JBA Consulting (JBA) to produce a geoenvironmental and geotechnical desk study for the proposed works at Wombwell Ings.

The scope of this report is to summarise ground conditions at the site using existing data and identify significant geoenvironmental and geotechnical hazards which may affect the construction or operation of the proposed works.

2 Site Information

2.1 Site Description

The site is on a floodplain to the south of the south-east flowing River Dearne. Ground levels vary from around 18mAOD to 22mAOD, with the higher topography recorded in on the northern perimeter of the site (Figure 2-2).

The majority of land onsite is recorded as rough grassland with two large standing bodies of water (one oval and approximately 120m in diameter in the south-western corner of the site, the other irregularly shaped in the centre of the site).

The site boundaries and the land surrounding the site comprise:

- The River Dearne lies immediately to the north of the site, forming its northern boundary, with residential land associated with Darfield beyond
- Bulling Dike forms the southern site perimeter with agricultural land and the village of Broomhill beyond. An electricity sub-station and allotments are recorded immediately south east of the site.
- To the east of the site is the Old Moor wetland and agricultural land.
- West of the site is recorded as a derelict land and a small residential area, with a sewage works and Low Valley residential land beyond.

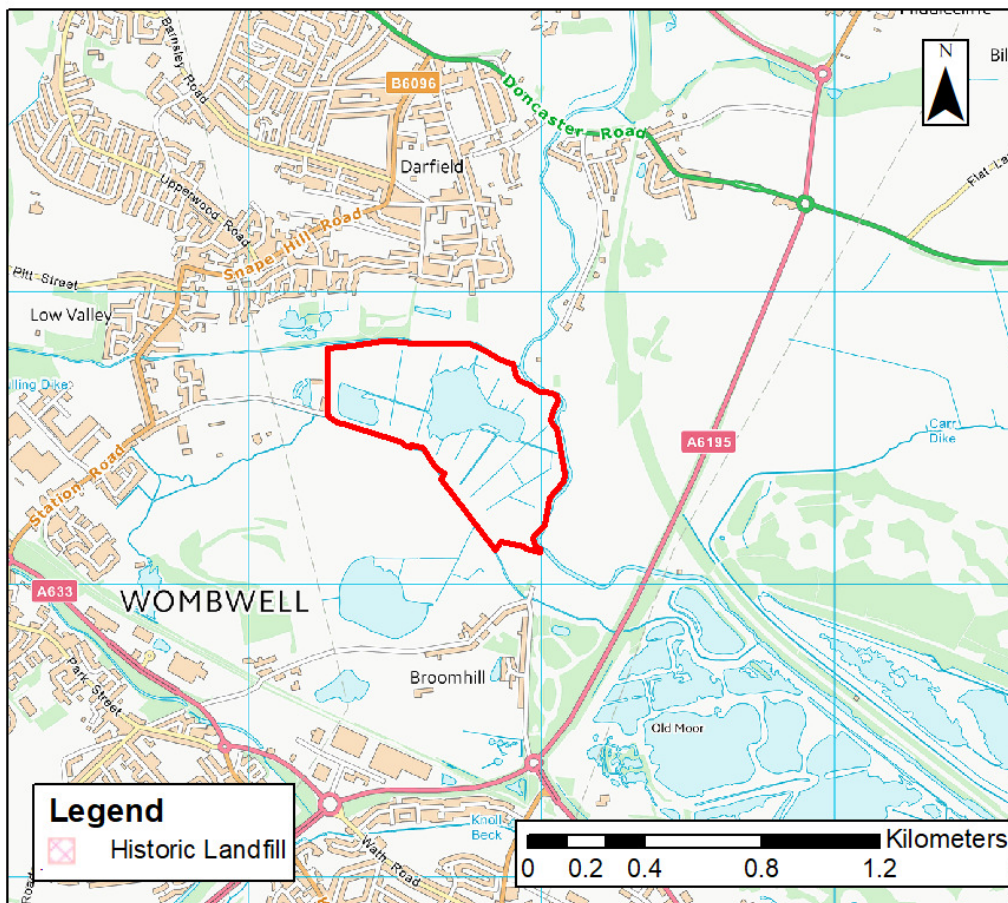


Figure 2-1: Historic landfills near Wombwell Ings (OS 2018)

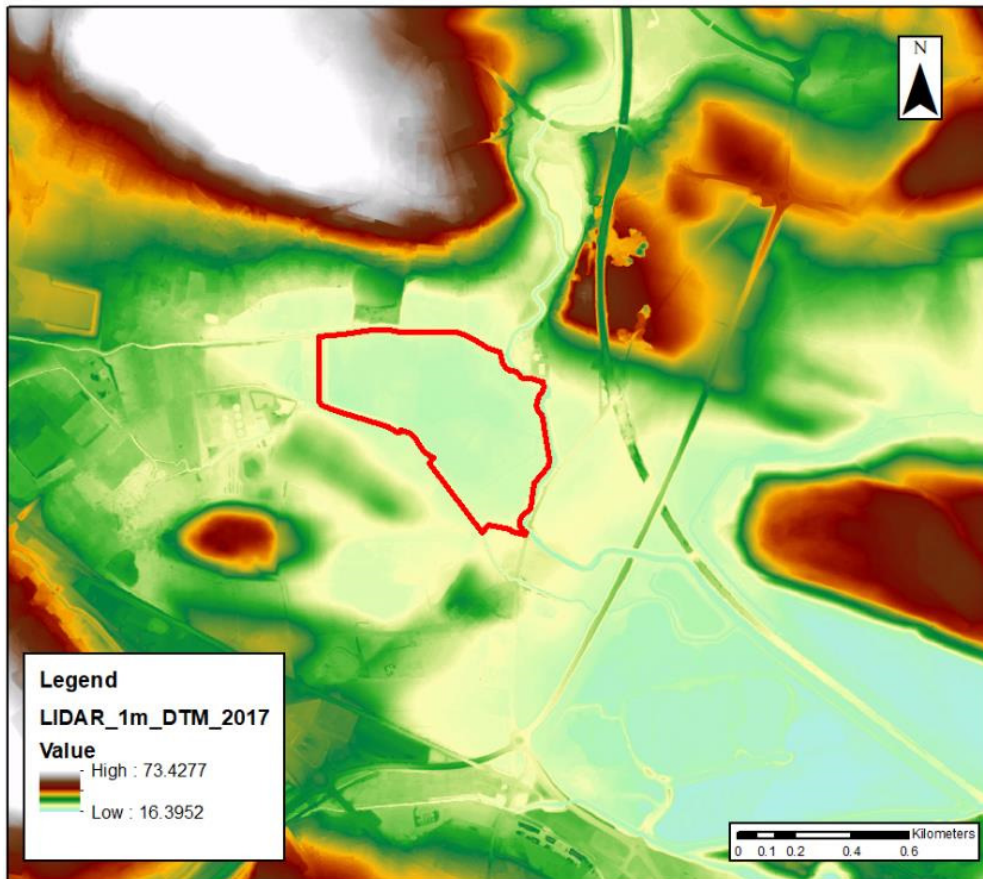


Figure 2-2: Lidar map of Wombwell Ings

2.2 Site History

The following summary is based on the historical maps (Appendix A) obtained for the site and the surrounding area (dated 1854 to 2018; Google Earth, 2018; Envirocheck; 2018).:

- The site was recorded as agricultural land named Wombwell Ings from 1854. Bulling Dike was recorded to the south of the site, and the River Dove to the north.
- Across the site eight (8No.) north-south aligned drains crossed the site; this was reduced to seven (7No.) before 1980. One long drain, perpendicular to the original drains was recorded after 1980.
- The site was recorded as subject to floods in 1854, and liable to floods until 1948.
- Sewage works were recorded from 1905 to present located 150m north-east of the site and 200m south-west of the site.
- A railway line was recorded 300m east of the site from 1854 until 1989.
- Park Hill Brickworks was recorded 600m south-west of the site from 1905. It was subsequently recorded as a disused tip from 1989 to 2015.
- The caravan site is recorded adjacent to the south-western border of the site from 2006.
- A nature reserve is recorded 250m south of the site from 1989.

2.3 Environmental Designations

The MAGIC Map online application has been used to identify environmental designations on and surrounding the site, the details of which are described below:

- The entire site is recorded to be Dearne Valley RSPB reserve (Non-Statutory)
- The entire site is recorded to be a Coastal and Floodplain Grazing Marsh on the Priority Habitat Inventory with an area of 26Ha.
- The site is not recorded to have any statutory land designations.

2.4 Hydrology

- The site is within a Nitrate Vulnerable Zone (NVZ) for surface water, area S278 River Dearne.
- Bulling Dyke (ID: GB104027057510) is designated as heavily modified watercourse with moderate overall (chemical and ecological) quality.
- The River Dove up to confluence with the River Dearne (ID: GB104027063173) is designated as a heavily modified watercourse with moderate overall (chemical and ecological) quality.
- River Dearne (ID: GB104027063173) is designated as a heavily modified watercourse with moderate overall (chemical and ecological) quality.

2.5 Groundwater

The following information on groundwater at the site has been derived from the BGS GeoIndex Onshore (2018) and the MAGIC Map (2018) online viewers:

- The onsite bedrock and the superficial material onsite are designated as a Secondary A Aquifers.
- Groundwater Vulnerability is designated as minor.
- The site is not recorded to be within a Groundwater Source Protection Zone.

2.6 Unexploded Ordnance

The site is in an area considered to have a low risk of UXO (Zetica, 2018).

2.7 Mineral Resources

The mineral resources map for South Yorkshire (BGS, 2002) record the following (as indicated in Figure 2-3):

- A sub-alluvial mineral resource beneath the site.
- Brick clay recorded beneath the alluvial deposits onsite.
- Glaciofluvial deposits 100m south of the site.
- Park Hill (previously Wombwell) Brickworks is recorded as inactive and restored 400m south-west of the site.

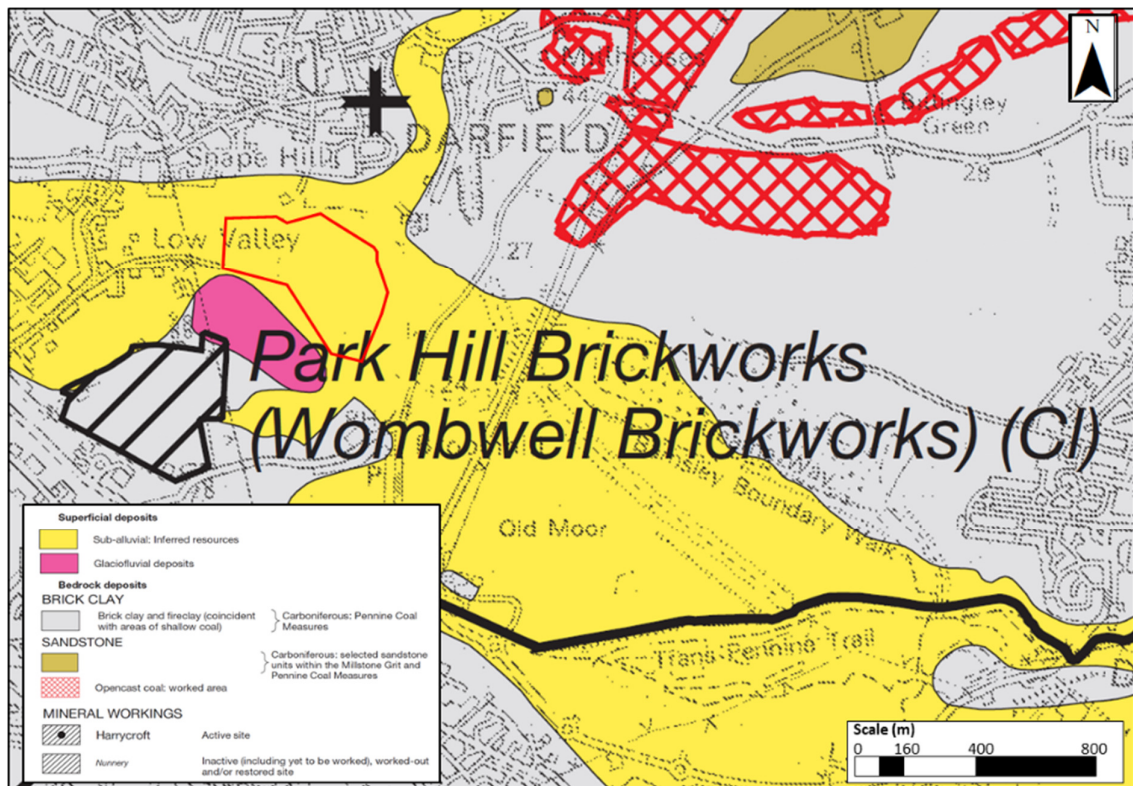


Figure 2-3: Mineral resources map of Wombwell Ings (BGS, 2002)

2.8 Coal Mining Legacy

The online viewer of the Coal Authority (2018) records the following coal mine legacy relevant to the site (as indicated in Figure 2-4):

- The site is not in or within 300m of a Development High Risk Area.
- No mine entries are recorded within 100m of the site. The nearest historic mine entry is an untreated adit bearing 354°, 200m north-west of the site. This is also the nearest Development High Risk Area, which is restricted to the surface influence zone of the adit.
- No coal is recorded to sub-crop beneath the site or within 500m of the site.
- Underground workings are recorded in coal about 550m beneath the site dipping around 3° towards the north-north-east.
- The shallowest coal seam recorded beneath the site is at -143m AOD.

2.1 Radon

Some parts of the 1km grid square encompassing the site are recorded to have bands of elevated radon potential to a maximum of between 3-5% (Public Health England, 2018).

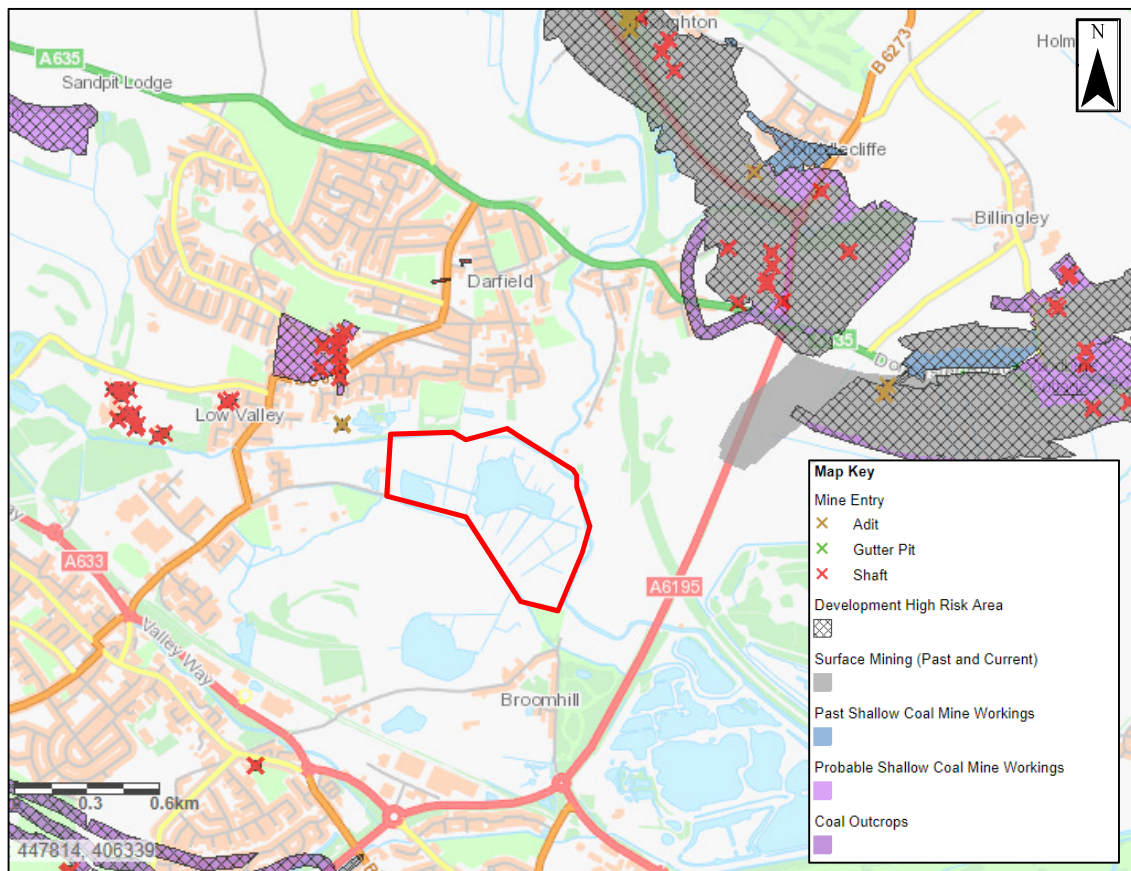


Figure 2-4: Online Map view of Wombwell Ings (The Coal Authority, 2018)

3 Ground Conditions

The Soils UK viewer (2018), the British Geological Survey (BGS), GeoIndex online viewer, the BGS 1:50,000 geological map Sheet 87 'Barnsley' and the BGS online borehole archive have been reviewed to determine the ground conditions anticipated beneath the site.

A summary of the anticipated geology beneath the site is presented in Table 3-1.

Table 3-1: Summary of geology beneath the site.

Age	Group	Formation / Member	Description	Thickness (m)
Quaternary		Alluvium	Soft to firm consolidated, compressible silty clay. Can contain layers of silt, sand, peat and basal gravel.	unknown
		Glaciofluvial Deposits	Sand and Gravel	0 to 5
Carboniferous	Pennine Middle Coal Measures Group	Pennine Middle Coal Measures Formation	Interbedded grey mudstone, siltstone, pale grey sandstone and common coal seams	circa 650
		Mexborough Rock	Sandstone	Up to 10
		Oaks Rock	Sandstone	0 to 56

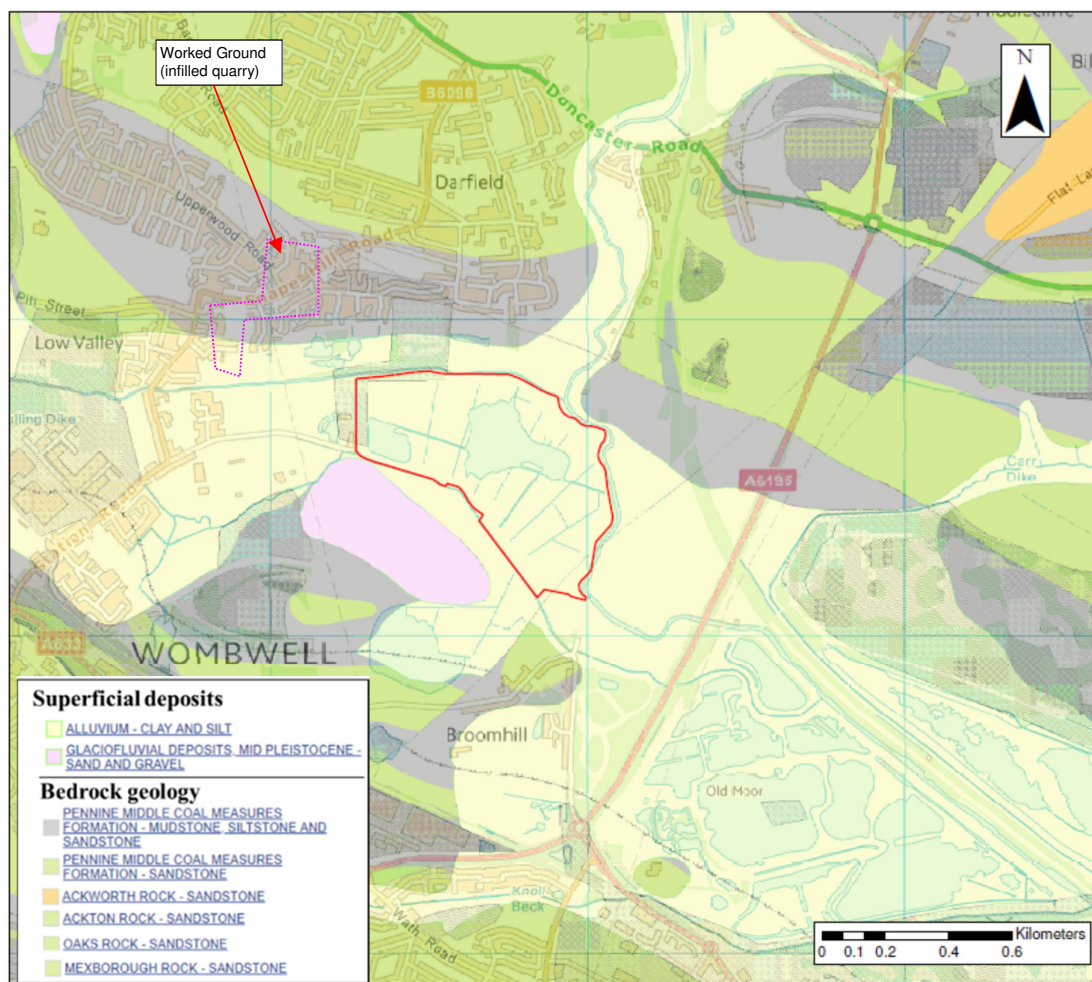


Figure 3-1: BGS (2018) map of bedrock & superficial deposits (OS, 2018)

3.1.1 Superficial Deposits

Topsoil of Loamy and clayey floodplain soils with naturally high groundwater are recorded onsite (Soilscapes, 2018).

The British Geological Survey (BGS) records indicate most of the site to be underlain by alluvium superficial deposits comprising clay, silt and potentially interbedded coarser granular materials. Worked ground (infilled quarry) is recorded on the north-west and western site perimeter (highlighted in Figure 3-1).

Glaciofluvial strata comprising sand and gravels are recorded to the south west of the site. These strata are inferred to be historic river terraces.

3.1.2 Bedrock Geology

The site is underlain by the Carboniferous Pennine Middle Coal Measures Formation (Figure 3-2) which consists of interbedded mudstone, siltstone, sandstone and coal. The bedrock recorded beneath the site comprises predominantly mudstone with sandstone recorded in the very south-east of the site.

The Oaks Rock sandstone member sub-crops approximately 1km south of the site, and the Mexborough Rock sandstone member is recorded around 200m north of the site.

The Pennine Middle Coal Measures are recorded to be faulted with two main trends (north-west to south-east and north-east to south-west). The Broomhill fault is recorded in the south-east of the site and accommodates a downthrow towards the south-east.

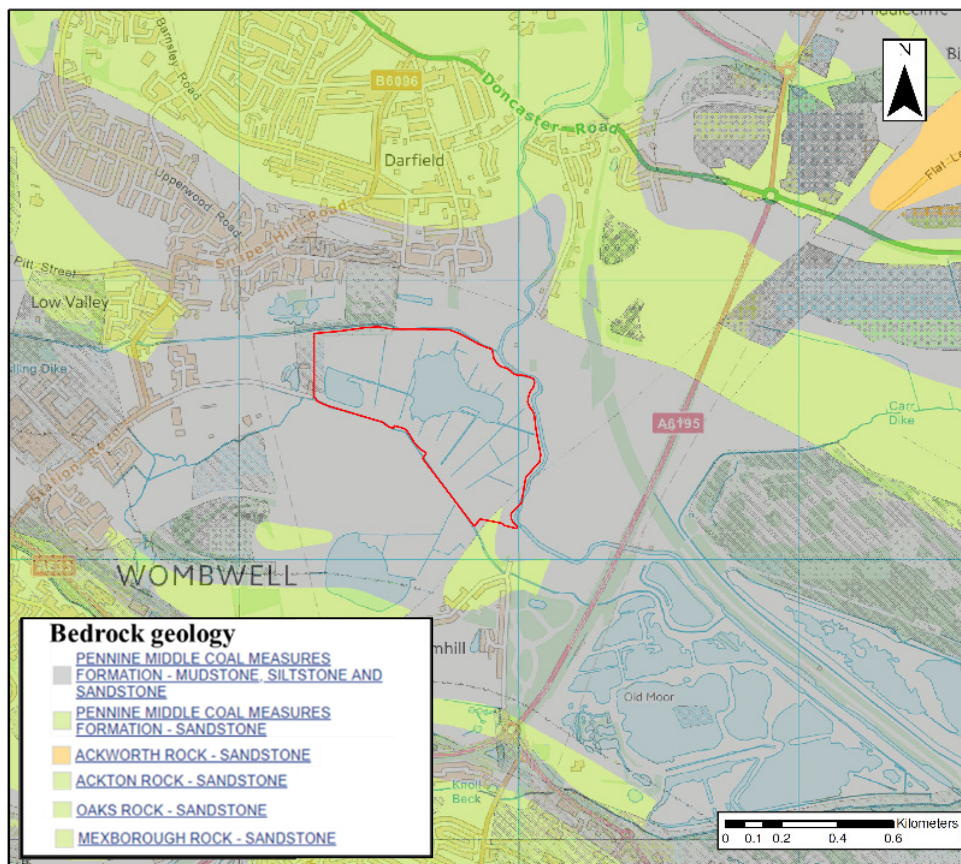


Figure 3-2: BGS (2018) map of bedrock deposits (OS, 2018)

3.2 Previous Ground Investigations

Two (2No.) borehole records within 300m of the site are available on the BGS GeoIndex Onshore viewer (accessed December 2018). A summary is presented in Table 3-2 and the locations are indicated on Figure 3-3. The BGS borehole records used in this review are presented in Appendix B.

- SE40SW44 is associated with Wath Colliery and was undertaken in 1974.
- SE40SW232 was formed as part of the Dearne Valley and South Yorkshire Highway between 1970 and 1971.

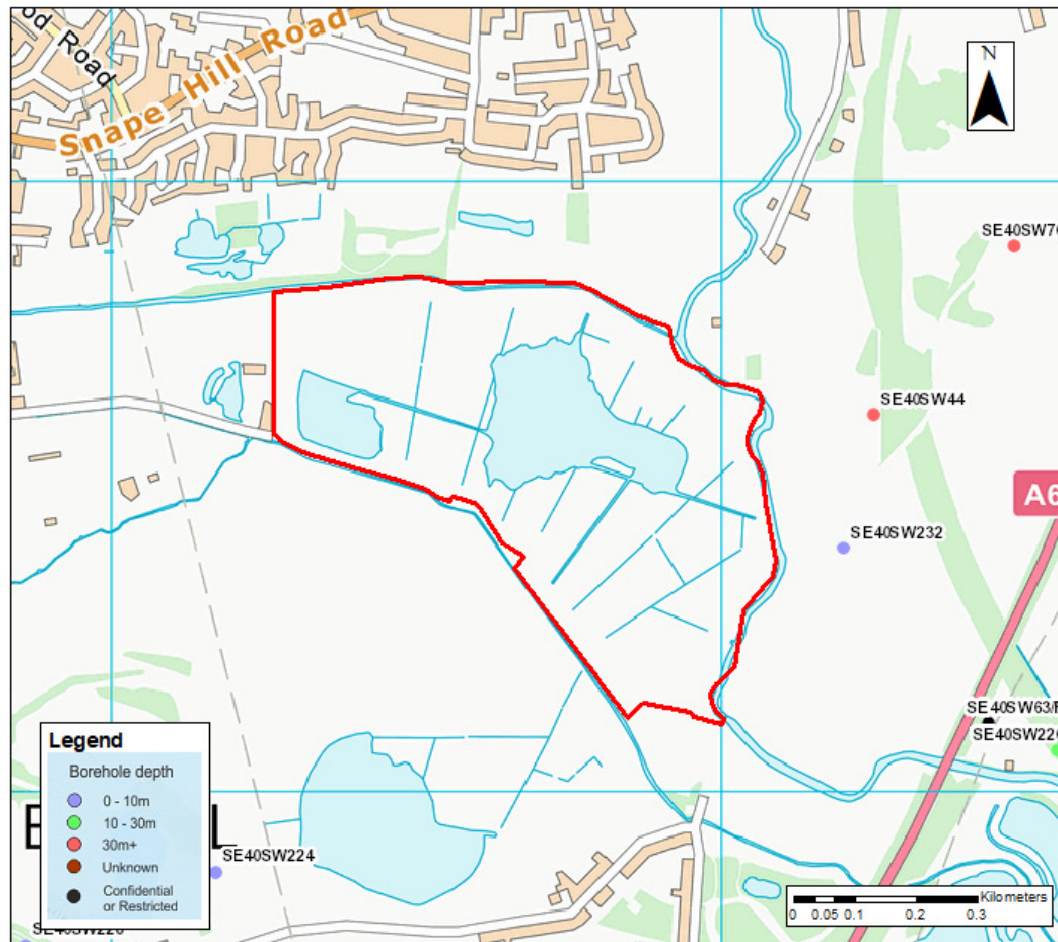


Figure 3-3: Historic borehole records at Wombell Ings (BGS, 2018)

3.3 Ground Summary

A general ground profile of made ground topsoil underlain by alluvium comprising clays, silts and sands is anticipated across the site. The bedrock is anticipated to be the interbedded siltstone, sandstone, mudstone and coal of the Pennine Middle Coal Measures Formation. Groundwater is likely to be shallow across the site.

Table 3-2: Summary of borehole records

Borehole No	Strata	Top Depth (mbgl)	Thickness (m)	Ground Water Levels (mbgl)	SPT N Value / Remarks
SE40SW44 Wath Colliery borehole No. 14	Yellow to orange brown Sand	0.00	6.10	No ground-water recorded	None recorded
	Grey silty Clay	6.10	4.57		
	Grey Siltstone	10.67	1.52		
	Interbedded grey siltstone, pale grey sandstone and coal.	13.72	3.05		
	Coal	16.76	1.52		
SE40SW232 Derne Valley and South Yorkshire Highway Borehole No. 10	Asphalt, tarmacadam	0.00	0.20	No ground-water recorded	None recorded
	Light brown clayey Sand	0.20	0.18		None recorded
	Light brown boulders of sandstone (possible fill)	0.38	0.46		None recorded
	Light brown sandy Clay	0.84	0.40		MC – 15% LL – 37% PL – 23%
	Light brown with traces of grey mudstone with iron and carbon staining.	1.24	0.53		MC – 16% LL – 36% PL – 20%
	Light brown fine grained shaly Sandstone	1.77	0.31		MC – 14% LL – 29% PL – 19% N > 200
	Interbedded shaly sandstone and mudstone with iron staining	2.08	+4.19		MC – 9% LL – 28% PL – 20% N > 200

4 Preliminary Environmental Assessment

The potential sources pathways and receptors onsite are listed in Table 4-1.

Table 4-1: Summary of potential contamination sources, receptors and pathways

Source	Position	Receptor	Potential Pathway
Farmland	Onsite	Ecology	Overland flow, transportation via surface watercourses, migration via drainage, baseflow
		Current and Future Site Users	Direct contact, inhalation, accidental ingestion
		Construction Workers	Direct contact, inhalation, accidental ingestion
Historic landfill to the southwest, previously Park Hill (Brick Works)	Offsite	Ecology	Overland flow, transportation via surface watercourses, migration via drainage
Sewage works north-east of the site		Surface Waters (Bulling Dike, River Dearne, River Dove)	Overland flow, migration via drainage
Sewage works to the west of the site		Groundwater (Secondary A Aquifers)	Migration via permeable strata
Farmland surrounding the site			
Caravan site to the west			
Disused railway to the east of the site		General Public	Direct contact, inhalation, accidental ingestion

4.1 Preliminary Environmental Assessment Recommendations

A preliminary environmental qualitative assessment for the potential source-pathway-receptor (SPR) linkages is based on Defra (Defra, 2011) and CIRIA guidance (CIRIA, 2001). The involves the production of a conceptual site model to determine the hazard of a complete SPR linkage, each being a product of the following:

- 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).

During the ground investigation, the following environmental samples should be collected (with method statements and risk assessments ensuring samples are collected safely):

- Soil samples of the made ground and natural ground immediately beneath.
- Surface water samples from any standing water onsite, and water samples from the upstream, downstream and midstream of the three (3No.) watercourses surrounding the site (River Dove, River Dearne, Bulling Dike).
- Groundwater samples if there is any significant inflow into exploratory positions.

5 Preliminary Engineering Assessment

The current scope of works is to create a habitat by undertaking the following elements: installation of a water control feature in the north-west of the site, a perimeter ditch with fencing around the site and islands within the existing water bodies.

A preliminary engineering assessment for the proposed works, with regards to the geotechnical risks and hazards, has been made based on information contained within this report. A geotechnical risk register is presented in Appendix C.

5.1 Embankment Culvert

The geotechnical hazards associated with the construction of a culvert beneath the existing flood embankment to connect the River Dove to the proposed habitat onsite are outlined in Appendix A. An options appraisal is recommended to determine the most appropriate method of construction. This should consider the relative risks associated with each method including induced settlement, stability of the embankment of the embankment.

5.2 Earthworks

5.2.1 Excavation of the Perimeter Ditch

The construction of an open ditch around most of the perimeter of the site will produce a volume of material comprising up to four (4No.) strata groups (made ground, interbedded alluvium, glaciofluvial sand and gravels, Pennine Middle Coal Measures bedrock of mudstone and sandstone). The quantity of each type of material excavated will depend on the base level of the excavation and the ground conditions encountered. Bulking of the excavated material will occur, and should be accounted for in the earthworks operations, especially when determining the amount of material that is to be transported from the site.

The stability of the excavation will be a function of the ground conditions along the proposed ditch. Soft and loose, water bearing strata are anticipated to be beneath the site. This implies excavation is unlikely to be stable without shoring of the excavation walls, or temporary reduction of local groundwater levels. Long term stability may require permanent control of seepage flows into the ditch.

5.2.2 Island Construction

The movement of the material excavated in the formation of the open ditch around the site, will require a Material Management Plan (MMP). This will inform how some of the spoil will be used to construct two shallow islands that are to be constructed in the larger body standing water in the centre of the site. The soft, wet ground area will be difficult for large plant to access.

During construction of the islands, the placed material will surcharge the ground and is likely to induce time dependent settlement. The construction of the islands should therefore be undertaken in stages, with an allowance of sufficient material to ensure the proposed target levels are maintained.

5.2.3 Exportation of Material Offsite

The balance of spoil excavated will be exported offsite to the Old Moor Reserve, south-east of the site. This will require approval from the Local Authority that will be included as part of the MMP.

6 Recommendations

The open perimeter ditch is around 2.2km in length, requiring, in accordance with Eurocode 7, a minimum spacing of 200m is advised between exploratory positions.

The risks outlined in the geotechnical risk register (GRR) include the potential to induce failure of the existing flood embankment, settlement of islands in the centre of the site, contamination from offsite sources, contamination during the proposed works, unrecorded underground services.

In order to undertake a geotechnical assessment that would enable the assessment and mitigation (where feasible) of the risks outlined in the GRR, an intrusive ground investigation and site walkover are recommended.

The intrusive ground investigation is to be confirmed following a site walkover, but preliminary recommendations include:

- 4No. dynamic (windowless) sampling boreholes in the location of the proposed embankment culvert
 - 2No. on the crest of the flood embankment
 - 2No. at the toe of the flood embankment
- 24 No. excavated trial pits within 10m of the proposed open ditch alignment
- In-situ tests on soil samples to include standard penetration tests and hand shear vanes
- Geotechnical and geoenvironmental testing on samples acquired during the intrusive ground investigation.

Additionally, sufficient notice should be allowed for to attain access to the land from the current owner, to gain permission from the Local Authority to import the spoil onto the site from Old Moor, and from the EA to undertake the works adjacent to the flood embankment in the north of the site.