



GEOENVIRONMENTAL DESK STUDY REPORT

Barnsley West

Reference

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JPG Leeds Limited. Site Zoning Plan. Barnsley West. Drawing No: 4848-JPG-ZZ-ZZ-DR-C-1000-S2-P02. Dated March 2023.

JPG Leeds Limited. Barnsley West. Conceptual Geological Ground Model - Coal Mining Risk (Based on Recorded Information Only). Drawing No: 4848-GC03-A. Dated December 2018.

JPG Leeds Limited. Barnsley West. Coal Mining Constraints Sections (A-C) (Based on Recorded Information Only). Drawing No: 4848-GC04-A. Dated December 2018.

JPG Leeds Limited. Barnsley West. Coal Mining Constraints Sections D (Based on Recorded Information Only). Drawing No: 4848-GC05-A. Dated January 2019.

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CONFIDENTIALITY STATEMENT

This report is addressed to and may be relied upon by the following:

Strata Sterling Barnsley West Limited
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This report has been prepared for the sole use and reliance of the above-named party. This report shall not be relied upon or transferred to any other parties without the express written authorisation of JPG (Leeds) Limited. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party.

DOCUMENT HISTORY

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P04	12.04.2023	Updated with zoning plan.	Final	DMH	JBW
P05	11.10.2023	Updated zoning plan	Final	JDM	JBW



EXECUTIVE SUMMARY

Site Address	Barnsley West
NGR	Approximate National Grid Reference 431600, 407200.
Current Site Use & Proposed Development	The site generally consists of sloping arable and grazing land, which is divided into fields by hedgerows, fences, and small watercourses. Hermit Lane, aligned roughly east to west, bisects the site. A steeply sided valley extends from the south-western boundary and trends to the north. A further steep valley with drainage ditch at its base, trending northerly, is also present centrally. It is proposed to develop the northern part of the site for residential end use and the southern part of the site for commercial end use.
Site History	Many parts of the site have undergone opencast coal extraction. The site was restored to agricultural use by the 1970s. The only built development on the site consists of Hermit House Farm and Cottage and Red Brook Farm; the farms dating from the nineteenth century. The surrounding land has also been used predominantly for agricultural use with also a long legacy of coal mining activity. Historical contaminative industries near the site include a bleach works, located approximately 150m to the north-east (downslope of the site).
Site Setting	<p>Geology – Large areas of the site are underlain by a significant thickness of non-engineered made ground, consisting of colliery spoil associated with backfilled opencast coal sites. The underlying bedrock geology comprises Pennine Middle Coal Measures strata of mudstone, siltstone, sandstone and coal seams.</p> <p>Mining – The site is underlain by several backfilled opencasts, namely the Craven I and Craven II, Hunters Cottage and Hunters Cottage Extensions, and Farm House Lane. There is also the potential for parts of the site to be at risk from unrecorded coal workings in the shallow seams, in particular below highwalls. There are 14 recorded mine entries on the site or within 20m of the site boundary. However, it is likely that the majority of these will have been removed as part of the opencast extraction. One of the recorded mine entries relates to a pumping shaft indicated within the Craven II opencast, which will likely require treatment.</p> <p>Hydrogeology – The bedrock geology is classified as a Secondary A Aquifer.</p> <p>Hydrology – There are several drainage channels, small streams and a pond located on the site.</p> <p>Flooding – The site does not lie within a Zone 2 or Zone 3 floodplain.</p> <p>Landfill – There are five records of Environment Agency historical landfill sites within 250m of the site and a further six within 500m.</p> <p>Radon Risks – No radon protective measures are required for new properties.</p>
Previous Investigation	Eastwood and Partners carried out a geoenvironmental appraisal of the site in 2013. As part of this appraisal, five cable percussive boreholes were carried out within the opencasts, none of which proved bedrock but refused on probable boulders.
Environmental Risk Assessment	<p>On the basis of the proposed end use and known history of the site, the following potential pollutant linkages may be present:</p> <ul style="list-style-type: none"> • Development and maintenance workers and site end users, e.g. residents and employees could come into contact with soils containing elevated concentrations of potential contaminants, asbestos fibres, elevated calorific value and hazardous gases/soil vapours. • The underlying Secondary A Aquifer and surface water features on and adjacent to the site could become contaminated due to the leaching and migration of potential contaminants from the made ground. • Buildings and services could be affected by potential contaminants in the made ground. • Plants in garden and landscape areas could be affected by phytotoxic elements within the made ground. • Development and maintenance workers, site end users, buildings and services could be affected by potentially combustible coal-rich made ground. <p>Based on the potential pollutant linkages present on the site, the site should be considered to be low to moderate risk with respect to contamination. This designation will be largely dependent on the nature of any made ground or hazardous gases present on or adjacent to the site.</p> <p>In order to fully assess and classify the risks to human health, groundwater, surface water and buildings/services, additional Phase 2 Intrusive Investigation, including chemical testing of soils and groundwater and ground gas monitoring will be required.</p>
Preliminary Engineering Assessment	<p>Mining - It will be necessary to carry out a mining investigation to confirm the nature and thickness of the made ground within the OCCSs, in order to assess the soil parameters and settlement characteristics. Also, intrusive investigation is required to confirm the locations of mineshafts on the site and also confirm that some of the mine entries do not extend below the bottom of the OCCS in which they were encountered. In addition, rotary boreholes are required to investigate the condition, depth and thickness of the shallow coal seams outwith the opencasts and also below the opencasts where the shallow seams may be within influencing distance of the surface.</p> <p>Foundations - The likely foundation solution for low-rise residential housing would be some form of earthworks and/or ground improvement, in order to accommodate a reinforced raft foundation. Depending on the loading associated with the proposed commercial units, a piled foundation</p>



	<p>solution may be required for the superstructure combined with some form of ground improvement in order to accommodate ground-bearing slabs. Alternatively, it may be possible, following earthworks/ground improvement, to use raft foundations.</p> <p>The long-term settlement characteristics, including self-weight settlement, of the backfilled opencast materials will require assessment.</p> <p>The requirements of any required gas protection measures will also need to be taken into consideration in relation to ground floor design and construction.</p> <p>Groundwater - It may be expected that shallow perched groundwater will be encountered within the made ground. It is likely that this groundwater will be confined to granular interbeds within the colliery spoil made ground. The presence of groundwater will need to be assessed as part of any ground investigation.</p> <p>Obstructions - The presence of obstructions including large boulders within the underlying opencast backfill should be anticipated. In addition, substructures and other manmade obstructions should be expected in the previously developed parts of the site, principally the farms.</p> <p>Earthworks - Some form of earthworks and ground improvement are likely to be required in order to achieve a consistent formation. Based on the current site levels, including steeply sloping ground surfaces, significant cut and fill earthworks will be required as part of the enabling works. Depending on the thickness and properties of the made ground within the opencasts, the following treatment methods may be appropriate.</p> <ul style="list-style-type: none"> • Removal of the full thickness of made ground and replacement with engineered fill. • Deep dynamic compaction of made ground. • Surcharging. <p>Any earthworks should be carried out in accordance with the Manual of Contract Documents for Highway Works, Volume 1 Specification for Highway Works, Series 600 Earthworks.</p> <p>An assessment of the suitability of the colliery spoil materials and also natural 'cut' soils for re-use in earthworks will be required.</p> <p>Roads, Pavements and Hardstanding Surfaces - It is likely that earthworks/ground improvement will be carried out as part of the redevelopment works. This may result in changes to the sub-grade materials. The works should be designed to achieve a suitable CBR value for the proposed development.</p> <p>Where roads/highways straddle highwalls associated with the former opencasts, special mitigation measures, e.g. geogrids, may be required.</p> <p>Chemical Attack on Buried Concrete - Samples of any made and natural ground should be obtained and submitted to the laboratory for testing in order to assess the sulphate content and acidity and hence the concrete class required for any buried concrete.</p>
<p>Further Work Required</p>	<p>It is recommended that a ground investigation is carried out in order to further assess the potential environmental and geotechnical constraints to development. It is recommended that the investigation is carried out in a phased approach.</p> <p>The scope of works below is designed to provide a preliminary overview of the site and target significant potential constraints to development.</p> <ul style="list-style-type: none"> • Trial pits across the site, primarily in areas of proposed cut, in order to obtain samples to submit for geotechnical testing in order to assess the suitability of the material for re-use in earthworks. • Rotary open hole boreholes within the backfilled opencast sites in order to confirm the depth to competent bedrock. • Extensometers are to be installed within each backfilled opencast. These will require monitoring on a long term basis, in order to assess the settlement of the backfilled opencast and allow predictions to be made of further settlements. It is anticipated that the extensometers will be monitored quarterly over a minimum two year period. • Rotary open hole boreholes outwith the boundaries of the opencasts in the southern part of the site in order to investigate underground coal workings at shallow depth. In addition, where shallow coal seams are present below the base of the opencast, further boreholes will be required. • Ground gas and groundwater monitoring wells are installed within selected boreholes in order to assess the levels of groundwater within and outside of the backfilled opencast, to provide an indication of whether groundwater rebound has been completed. Gas monitoring will also be carried out on six occasions in order to assess the potential presence of hazardous ground gases on the site. <p>Further works, i.e. additional soil characterisation, installation and monitoring of gas wells (possibly to include continuous ground gas monitoring), monitoring of extensometers and further rotary boreholes to investigate the depth of the opencast and potential for underground workings, may be required in order to supplement the information which will be obtained as part of the above works. These works would be required in order to satisfy the requirements of the regulators and inform any proposed earthworks contract.</p>
<p style="text-align: center;">This sheet is intended as a summary only of the assessment of the site in relation to ground condition. It does not provide a definitive engineering analysis.</p>	



1.0 INTRODUCTION

1.1 Instruction

JPG (Leeds) Limited (JPG) has been instructed by Strata Sterling Barnsley West Limited to carry out a geoenvironmental desk study for a proposed mixed use development at Barnsley West.

1.2 Objectives

The main objective of the geoenvironmental desk study is to identify potential geotechnical and environmental issues that may represent constraints to the proposed development of the site.

1.3 Scope of Works

The scope of works for the desk study included the following:

- Site inspection and description.
- Review of contemporary and historical Ordnance Survey publications.
- Obtain a Coal Authority Mining Report and Consultants Report and any abandonment plans.
- Consultations with regulatory authorities, where appropriate.
- Review of geological publications (including hydrology, hydrogeology and soil survey publications, where appropriate).
- Review of the radon status of the site.
- An environmental database search.
- Review of any previous reports provided.
- Outline environmental risk assessment.
- Preliminary recommendations with respect to mining, foundations, ground floor and pavement design.
- Recommendations for further work, where appropriate; and
- Presentation of the findings in a tabular non-technical summary.

1.4 Location

The site is located approximately 3km to the west of Barnsley town centre. The approximate centre of the site is located at NGR 431600, 407200.

The site is located to the east of the M1 motorway, to the south of the A635 Barugh Green Road and to the north of the A628 Dodworth Road. A site location plan is presented as Figure 1 in Appendix A.



1.5 Site Description and Topography

A site inspection was carried out by a JPG engineer on 6 December 2018.

The site is irregular in shape and occupies an area of approximately 120 hectares. Ground levels are approximately 150m AOD in the south generally falling to approximately 80m AOD in the north.

The site generally consists of sloping arable and grazing land, which is divided into fields by hedgerows, fences, and small watercourses. Hermit Lane, aligned roughly east to west, bisects the site. A steeply sided valley extends from the south-western boundary and trends to the north. A further steep valley with drainage ditch at its base, trending northerly, is also present centrally.

Hermit Lane falls steeply from the western boundary down into the valley bottom before rising steeply again in the east. A drainage ditch at the base of the valley is culverted below Hermit Lane, forming a stream with a pond to the north of Hermit Lane. The stream is culverted in parts. The valley is heavily wooded and overgrown to the north of Hermit Lane.

Hermit House Farm is located to the south of Hermit Lane in the centre of the site. The farm complex includes two residential dwellings and several agricultural buildings, typically constructed from concrete blocks, timber and roofing of possible asbestos cement sheeting.

Redbrook Farm is located on the north-eastern boundary. Agricultural buildings, including a large, dilapidated barn, several outbuildings and a large silo are located at the farm.

A raised plateau of grassland is present adjacent to the residential suburb of Pogmoor in the south-east of the site. To the west of this plateau, the landform falls away steeply forming the valley in the centre of the site.

The northern site boundary is formed by Barugh Green Road and, in part, adjacent undeveloped farmland, beyond which lies the Metro Trading Centre and Claycliffe Business Park. Redbrook Plantation and residential areas (Gawber and Pogmoor) are present beyond the eastern boundary. Hunters Farm and Cottages are about the southern tip of the site. The south-western boundary is formed by the M1 motorway, beyond which lies further farms and woodland. The residential areas of Higham and Barugh Green are located to the west and north-west, respectively.

At the time of the site walkover some standing water was noted at the lower points of Hermit Lane. Also, the fields were locally very muddy due to farm animals. Localised fly tipping (including tyres and household waste) was noticed immediately to the north of Hermit Lane.

An aerial photograph of the site is provided as Figure 2 in Appendix A and selected photographs of the site are provided in Appendix B.



1.6 Development Proposals

It is proposed to develop the northern part of the site for residential end use and the southern part of the site for commercial end use. A plan outlining the separate zones is referenced below and provided in Appendix A.

- JPG Leeds Limited. Site Zoning Plan. Barnsley West. Drawing Reference: 4848-JPG-ZZ-ZZ-DR-C-1000-S2-P02. Dated March 2023.

1.7 Limitations

The general limitations to the nature of the investigation are outlined in Appendix H.



2.0 SITE HISTORY

Historical maps for the site were obtained from GroundSure (GS). These have been reviewed in order to establish any former uses of the site and identify any potentially contaminative historical uses or potential geotechnical constraints to the proposed development.

A summary of the relevant map information is presented in Table 2.1 and copies of relevant plans are contained in Appendix C.

Table 2.1 – Summary of Relevant Historical Map Information

Date(s) & Scale	Feature
1850 1:10,560	<p>The site comprises open fields and parcels of woodland, namely Rhodes Wood (later annotated Velvet Wood) and Craven Wood in the central part of the site and Hermit Wood and Drury Spring in the southern part of the site.</p> <p>Hermit Lane is shown to cross the site in its current location, with Hermit House (a farm) and Hermit Cottage to the south of Hermit Lane.</p> <p>Red Brook Farm is indicated on/adjacent to the north-eastern site boundary.</p> <p>A pond is shown immediately to the north of Hermit Lane; a further pond is shown adjacent to the eastern boundary.</p> <p>Several wells are annotated within the site boundary including one associated with Hermit Cottage.</p> <p>Several footpaths are shown to cross the site.</p> <p>Small watercourses (streams and drainage ditches), generally flowing in a north-easterly direction, are indicated within the site boundaries.</p> <p>Possibly water-logged low-lying ground is indicated in the north-eastern part of the site.</p> <p>The surrounding land comprises open fields with some buildings including farms abutting the site. The villages of Gawber and Higham are located to the east and west of the site, respectively. Red Brook Bleach Works is shown approximately 150m to the north-east of the site.</p> <p>Sandstone quarries are indicated to the east of the site.</p> <p>Possible infilled ground is shown adjacent to the south-eastern boundary.</p> <p>A railway is shown approximately 200m to the south of the site.</p> <p>Silkstone New Colliery is indicated approximately 400m to the west of the site; old quarries, clay pits, tramway and infilled ground are indicated in this location.</p>
1890-1891 1:10,560	<p>No significant changes are shown on the site.</p> <p>Silkstone New Colliery is now named Higham Colliery.</p> <p>A further colliery (later annotated as Old Silkstone Collieries) is indicated approximately 600m to the south-west of the site.</p>
1904 1:10,560	<p>No significant changes are shown on the site.</p> <p>Red Brook Bleach Works to the north-east of the site is now annotated as Redbrook Linen Works. A gasometer is also indicated within the works, approximately 150m to the east of the site.</p> <p>Higham colliery is annotated as disused.</p>
1929 1:10,560	<p>Hermit Wood appears to be deforested with areas of infilled/uneven ground.</p> <p>The gasometer located approximately 150m to the east of the site is no longer shown. Farmhouse colliery is annotated approximately 100m to the south-east. Shafts and infilled ground are present to the south-east of the site.</p>
1938 1:10,560	<p>No significant changes are shown on or adjacent to the site.</p>
1948 1:10,560	<p>No significant changes are shown on or adjacent to the site.</p>
1956 1:10,560	<p>Woodland is no longer shown in the southern half of the site.</p> <p>The landform has also changed with the valley now extending from the south-west to the north-east.</p> <p>No significant changes are shown adjacent to the site.</p>
1959 1:2,500	<p>The pond located on the eastern boundary is no longer shown and is assumed to have been filled in.</p> <p>No significant changes are shown adjacent to the site.</p>
1966 1:10,560	<p>Opencast workings are indicated in the northern half of the site, to the north of Hermit Lane. Opencast workings are also indicated in the south-east (adjacent to Pogmoor).</p> <p>A large area of infilled ground is shown approximately 400m to the south-west.</p> <p>Infilled land is also indicated approximately 350m to the west.</p> <p>Works indicated 100m to north-west of the site.</p>
1969 1:2,500	<p>The pond to the north of Hermit Lane is no longer shown and is assumed to have been filled in.</p> <p>No significant changes are shown adjacent to the site.</p>
1973 1:10,000	<p>The sites of the opencast coal workings in the northern half and east of the site have been restored.</p> <p>The topography of the site is similar to the present day.</p>



		The M1 Motorway has been constructed to the west of the site, forming the site's south-western boundary. The infilled ground to the south-west has extended to approximately 175m to the south-west of the site.
1982, 1:10,000	1993	No significant changes are shown on the site. A works building is indicated approximately 100m to the north-east of the site.
2002, 2014 1:10,000	2010,	No significant changes are shown on or adjacent to the site.

In summary, many parts of the site have undergone opencast coal extraction. The site was restored to agricultural use by the 1970s. The only built development on the site consists of Hermit House Farm and Cottage and Red Brook Farm; the farms dating from the nineteenth century. The surrounding land has also been used predominantly for agricultural use with also a long legacy of coal mining activity. Historical contaminative industries near the site include a bleach works, located approximately 150m to the north-east (downslope of the site).



3.0 SITE SETTING

3.1 Geology

The GS Report and the following geological publications have been consulted:

- British Geological Survey (BGS), Sheet 87, Barnsley, 1:50,000 scale, Solid and Drift Edition, published 2008.
- BGS, Sheet SE30NW, Barnsley 1:10,000 scale, dated 2005.
- BGS, The Pennine Lower and Middle Coal Measures formations of the Barnsley district, Internal Report IR/06/135, dated 2006.

Large areas of infilled ground, associated with historical opencast coal sites (OCCSs), are indicated in the northern, central, southern and eastern parts of the site. The opencast areas are named Craven I and Craven II (in the north), Hunters Cottage & Extension (in the south) and Farm House Lane (in the east). The historical opencast coal workings are detailed in Section 3.2.

Landslip deposits are indicated in two localised areas in the centre of the site. It is likely that the landslips are the result of the very steep valley sides in this location.

No superficial deposits are recorded on the site.

The bedrock geology comprises Pennine Middle Coal Measures strata of mudstone, siltstone, sandstone, and coal seams. The overall dip of the solid geology is indicated to be 5 degrees to the north-east.

A fault, trending north-east to south-west with downthrown strata on the north-western side. Sandstone of the Haigh Moor Rock is shown to encroach onto the site on the downthrown side of this fault. A further four faults, generally trending north-west to south-east, are shown in the central and southern parts of the site.

The following coal seams outcrop on the site or anticipated to be present at shallow depth below the site (youngest to oldest):

- Barnsley (recorded thickness = 2.29m to 3.10m).
- Thin coal/unnamed.
- Dunsil Coal (recorded thickness = 0.46m to 0.81m).
- Thin coal/unnamed.
- Gawber Coal (recorded thickness = 0.72m to 0.76m).
- Thin coal (recorded thickness = 0.38m).
- Swallow Wood Coal (recorded thickness = 0.30m to 1.15m).
- Top Haigh Moor (recorded thickness = 0.69m to 1.19m).
- Low Haigh Moor (recorded thickness = 0.43m to 1.02m).



The shaft records for Redbrook Colliery and the Old Silkstone Colliery, located approximately 950m to the east of the site and 940m to the south-west, respectively; have been obtained from the BGS and are presented in Appendix D of this report.

The abandonment plans and shaft records also refer to the Swallow Wood Bottom coal seam. However, this is understood to be a variant name for the Top Haigh Moor coal seam.

3.2 Coal Mining

A Mining Report and Consultants Report have been obtained from the Coal Authority (CA). These are presented in Appendix E and pertinent information is detailed below.

“The property is in a surface area that could be affected by underground mining in seven seams of coal at shallow to 350m depth, and last worked in 1983.”

The recorded underground coal workings are summarised in Table 3.2.1 below.

Table 3.2.1 – Summary of Recorded Underground Coal Workings

Coal Seam	Shallowest Depth of Recorded Workings (m bgl)	Maximum Coal Seam Thickness (m)	JPG Comment
Barnsley	6	2.97	Underground workings later opencast in Farmhouse Lane OCCS / Pogmoor.
Flockton Thick	86	0.76	Not considered a risk to the surface stability of the site.
Top Fenton	128	0.91	Not considered a risk to the surface stability of the site.
Fenton	146	0.91	North of site. Not considered a risk to the surface stability of the site.
Parkgate	171	1.37	Not considered a risk to the surface stability of the site.
Silkstone	213	1.76	Not considered a risk to the surface stability of the site.
Whinmoor	287	1.15	Not considered a risk to the surface stability of the site.

With the exception of the Barnsley Coal, no other recorded underground coal workings are considered to pose a risk to the surface stability of the site, based on recorded depth and thickness of the coal seams. As the underground coal workings in the Barnsley Coal have been largely extracted during later opencast workings, only a residual risk below the highwall on the eastern flank of the Pogmoor site remains.

The Coal Authority Mining Report also states that there is also a risk to the surface stability of the site from possible unrecorded shallow workings. Areas where potential unrecorded coal workings may affect the site are indicated on JPG Drawing No. 4848-GC03. Rotary boreholes are required to investigate the condition, depth and thickness of the shallow coal seams that may affect the proposed development on the site.

There are 14 mine entries onsite or within 20m of the site boundary. The recorded mineshaft locations are shown on JPG Drawing No. 4848-GC03 and are summarised in Table 3.2.2 below.

**Table 3.2.2 – Summary of Recorded Mine Entries**

CA Mineshaft Reference	NGR Reference	CA Comment	JPG Comment
431406-002	431771, 406978	Has probably been removed to some extent by opencast mining.	Mineshaft located within Hunters Cottage Extension OCCS (Thin seam) in the centre of the site.
431406-003	431771, 406971	Has probably been removed to some extent by opencast mining.	
431406-004	431746, 406949	Has probably been removed to some extent by opencast mining.	
431406-005	431840, 406925	Has probably been removed to some extent by opencast mining.	Mineshaft located within Hunters Cottage Extension OCCS (Gawber seam) in the centre of the site.
431406-006	431838, 406909	Has probably been removed to some extent by opencast mining.	
432406-002	432364, 406628	No treatment details.	Mineshaft shown to the south of the Farm House Lane OCCS (outside the site boundary).
432406-011	432302, 406721	No treatment details.	Adit in the east, encountered within Farm House Lane OCCS.
432406-012	432423, 406995	No treatment details.	Mineshaft shown to be located to the north of the Farm House Lane OCCS (outside the site boundary).
432406-013	432452, 406972	No treatment details.	
432406-014	432413, 406745	Has probably been removed to some extent by opencast mining.	
432406-015	432298, 406795	No treatment details.	Adit in the east, encountered within Farm House Lane OCCS.
432406-016	432305, 406777	No treatment details.	
432406-017	432280, 406747	No treatment details.	
432406-018	432324, 406686	No treatment details.	
432406-019	432349, 406680	No treatment details.	
432406-020	432507, 406628	Was not encountered during drilling works undertaken by Abatech prior to development in 2007. CA have no record of what steps, if any, have been taken to treat this shaft.	
432406-021	432509, 406615	No treatment details.	Mineshaft located to the south-east of the Farm House Lane OCCS (outside the site boundary).
432406-031	432519, 406627	No treatment details.	
432407-008	432004, 407548	No treatment details.	Mineshaft located near north-eastern boundary. The mineshaft is a pumping shaft annotated on the abandonment plan in the east of the Craven II OCCS. The shaft has a recorded diameter of 0.91m, the centre of which is at NGR 432004.353, 407547.744. The shaft is reported to have been capped at a level of 87.88m AOD ('buried 5 feet below restored ground level').
432407-019	432435, 407008	No treatment details.	Mineshaft shown to be located to the north of the Farm House Lane OCCS (outside the site boundary).

It is likely that adits associated with the Barnsley Coal seam in the east were partly removed during opencast extraction of the Barnsley Coal at the Farm House Lane OCCS. The abandonment plan, Catalogue No. 9196, confirms that the adits were dayholes, encountered during opencast coal workings. The abandonment plans confirm that the workings in the Barnsley Coal seam extend beyond the highwall of the Farmhouse Lane OCCS in the east.



The mineshafts recorded within the Hunters Cottage Extension OCCS are shown on the abandonment plans for opencast coal workings. It is likely that the shafts do not extend deeper than the seams in which they were exposed. The Thin and Gawber coal seams. However, this will need to be confirmed by intrusive investigation.

The pumping shaft (CA mineshaft ref. 432407-008) is annotated on the Craven II abandonment plan. This mineshaft will need to be located and treated as part of the enabling works for the site.

There is also the potential for unrecorded mine entries including bell pits on the site.

"The property is within the boundary of an opencast site from which coal has been removed by opencast methods."

Coal mining abandonment plans showing the location of recorded opencast and underground workings on and beneath the site have been obtained from the Coal Authority.

A summary of the abandonment plans detailing the former opencast mining on the site is provided in Table 3.2.3.

Table 3.2.3 – Summary of Abandonment Plans Showing Opencast Workings on the Site.

Map Reference	Drawing Number	Seams Worked & Details
NE498 1 'Craven I & II'	OE/COMP/03/311	<p><u>Craven I</u> Coal seams extracted:</p> <ul style="list-style-type: none"> • Thin seam (localised). • Swallow Wood. <p>Coaling commenced: 10 July 1950. Coaling completed: 20 November 1951. Completion of re-soiling: July 1952.</p> <p>No old workings encountered in coal seams.</p> <p>Lowest point of excavation: 68.29m AOD; maximum thickness of made ground is approximately 13m.</p> <p><u>Craven II</u> Coal seams extracted:</p> <ul style="list-style-type: none"> • Gawber (localised). • Thin seam. • Swallow Wood. • Top Haigh Moor. • Low Haigh Moor. <p>Coaling commenced: 29 April 1957. Coaling completed: 7 February 1963.</p> <p>No old workings encountered in coal seams.</p> <p>Lowest point of excavation: 44.56m AOD; maximum thickness of made ground is approximately 43m.</p>
NE375 'Hunters Cottage & Extension'	OE/COMP/03/121	<p><u>Hunters Cottage</u> Coal seams extracted:</p> <ul style="list-style-type: none"> • Thin seam. • Swallow Wood Top. • Top Haigh Moor (Swallow Wood Bottom on plan). <p>Coaling commenced: 12 November 1945. Coaling completed: 10 August 1949. Completion of re-soiling: January 1950.</p>



Map Reference	Drawing Number	Seams Worked & Details
		<p>Old workings were identified in the Top Haigh Moor (Swallow Wood Bottom) in the south-east and appear to extend below the highwall in this location.</p> <p>Lowest point of excavation: 111.01m AOD; maximum thickness of made ground is approximately 16m.</p> <p><u>Hunters Cottage Extension</u> Coal seams extracted:</p> <ul style="list-style-type: none"> Thin seam (to west of the outcrop of the Gawber). Gawber (to east of the outcrop). <p>Coaling commenced: 1 October 1954. Coaling completed: 2 November 1954. Completion of re-soiling: 25 April 1956.</p> <p>Western Area: Lowest point of excavation: 104.03m AOD; maximum thickness of made ground is approximately 9m.</p> <p>Eastern Area: Lowest point of excavation: 110.22m AOD; maximum thickness of made ground is approximately 9m.</p> <p>Note: old workings were identified locally in the Thin seam and Gawber. These are likely to represent either bell pits or localised opencast and not deeper shafts.</p>
<p>Farm House Lane Colliery No 2 Mine, Barnsley Bed Pillars</p> <p>16 January 1928</p>	<p>9196, dated 20/10/2017</p>	<p><u>Farm House Lane</u> Coal seams extracted:</p> <ul style="list-style-type: none"> Barnsley. <p>The plan details the quarrying of the Barnsley Coal from its outcrop in the west and extending easterly.</p> <p>Five adits (dayholes), associated with previous underground workings in the Barnsley Coal seam, are shown to the west of the opencast, four of which are shown to extend to the east with one extending to the south-east. Extensive old workings are annotated on the plan.</p> <p>The line of dip is shown to be 1 in 12 to the north-east.</p>
<p>NE415 Farm House Lane – Private Opencast Site Worked by F.J.Swain Ltd., abandoned Nov. 1960</p>		<p><u>Farm House Lane</u> Coal seams extracted:</p> <ul style="list-style-type: none"> Barnsley. <p>The bottom of the Barnsley Coal is indicated between approximately 122m and 128m AOD. Approximately 80% had already been worked. The thickness of made ground below this part of the site is estimated to be between approximately 5m in the west and 15m in the east.</p> <p>Old (underground) workings were proven to extend beyond the highwall in the east.</p>

Copies of the opencast abandonment plans are presented in Appendix F.

A conceptual geological ground model and four cross sections summarising the coal mining risk onsite are presented in Appendix A.

3.3 Other Mining

The GS report refers to the underground abstraction of bedded iron ore on a small scale. The BGS indicate that 'the rock types present in these areas are such that small mineral veins may be present on which it is possible that small scale mining has been undertaken and/or it is possible that limited underground extraction of other materials may have occurred. All such occurrences are likely to be of minor localised extent and infrequent'.



Reference to *Sections of Strata of the Coal Measures of Yorkshire* (3rd edition, 1950) confirms the presence of iron rich strata below the Barnsley Coal seam, the Gawber and the Swallow Wood, and the possibility that ironstone was historically worked by underground means cannot be discounted at this stage.

The ground investigation will need to take into consideration the potential for underground ironstone workings.

3.4 Hydrogeology

The bedrock geology below the site is classified as a Secondary A Aquifer. These are 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 base flow to rivers. These are generally aquifers formerly classified as minor aquifer'.

There are no active recorded groundwater abstraction licences within 1km of the site.

The site does not lie within 500m of an Environment Agency Groundwater Source Protection Zone.

3.5 Hydrology

The site is located within the Don and Rother catchment area. There are several 'Inland Rivers' on the site, generally relating to field drainage and flowing from the south-west to the north-east. These include two streams located in the east.

There are three active licenced discharge consents to surface water relating to the site itself and a further one within 100m. These are summarised in Table 3.5.1 below.

Table 3.5.1 - Summary of Active Licenced Discharge Consents to Surface Water

Distance & Direction	Permit Number	Address	Effluent Type	Receiving water	Effective Date
On Site	WRA7686	Harden Close Pumping Station, Pogmoor	Sewage Discharges	Red Brook	06-MAR-2001
On Site	WRA8919	Hermit House Farm, Hermit Lane, Gawber	Sewage Discharges - Final/Treated Effluent	Groundwater via Soakaway	02-FEB-2006
On Site	NPSWQD 003261	2 Properties At 93 Church Street, Gawber	Sewage Discharges - Final/Treated Effluent	Tributary of River Dearne	21-JUL-2008
80m S	2118	Proposed Bungalow, Farmhouse Lane, Pogmoor	Sewage Discharges - Final/Treated Effluent	Tributary of Red Brook	27-JUL-1966

There are no recorded surface water abstraction licences within 2km of the site.

Information on the EA website and presented in the GS report indicates that the site does not lie within a Zone 2 or Zone 3 floodplain. The risk of the site flooding from Rivers and the Sea (RoFRaS) is indicated to be very low.



The GS report indicates that there is the potential for groundwater flooding at the surface due to the underlying geology. The BGS confidence level in their assessment is high, but the actual susceptibility and the risk of groundwater flooding occurring at the site should be assessed based on site specific information.

It is likely that a flood risk assessment will be required by the Local Authority as part of any planning application for the site.

3.6 Pollution Incidents

There are five recorded Environment Agency Recorded Pollution Incidents within 500m of the site. These are summarised in Table 3.6.1 below.

Table 3.6.1 – Summary of Environment Agency Recorded Pollution Incidents with Significant Impacts

Distance & Direction	Incident Date	Incident Identification	Pollutant	Impacts
On Site	14-JUL-2003	173561	Specific Waste Materials (commercial)	Land impact: Category 3 (minor)
163m N	21-MAY-2003	159730	Organic Chemicals/Products (Phenols and Creosote)	Land impact: Category 3 (minor)
216m NW	06-APR-2018	1603339	Contaminated Water (minewater)	Water impact: Category 2 (significant)
243m SW	20-FEB-2013	1088231	Contaminated Water (chemical)	Water impact: Category 2 (significant)
498m N	11-MAR-2002	63127	Specific Waste Materials	Land impact: Category 3 (minor) Air impact: Category 3 (minor)

The pollution incident that occurred on the site took place in the east of the site (adjacent to Pogmoor) some 15 years ago. It is likely to relate to fly tipping. There was no evidence of any fly tipping during the site walkover inspection. None of the other incidents is considered to have the potential to have impacted the site.

3.7 Landfills and Waste

The GS report includes information on active and former landfill sites supplied by the Environment Agency, Landmark, Local Authority and the BGS.

There are five records of Environment Agency historic landfill sites within 250m of the site and a further six within 500m. A summary of these is provided in Table 3.7.1.

**Table 3.7.1 - Summary of Historical Environment Agency Landfill Sites**

Distance & Direction	Site Address	Site Reference	Operator	Waste Type	Licence Issue
On Site	Football Pitch to rear of Mines PH, Higham Common Road, Higham	4400/(156)	Mr J Cooper	Commercial	-
74m NE	Cannon Way, Barugh Green Road, Barugh	4400/B45	F Booker	Inert	16-MAR-1995
167m N	Metro Trading Centre, Off Barugh Green Road, Barugh Green, Barnsley	WD20 B559, 4400/B559, 20B559(51)	R and J Masters	Inert, Commercial	23-JUL-1987
177m NE	South Yorkshire Industrial Estate, Redbrook, Barnsley	4400/B392, 20B392(87), WD20 B392	Northern Properties Limited	Inert, Commercial	02-SEP-1983
245m E	Wilthorpe Road, Redbrook, Barnsley	WD20 B390, 4400/B390, 20B390(86)	Tara Civil Engineering Limited	Inert	02-SEP-1983
319m E	Redbrook Road, Gawber, Barnsley	4400/(4)	Darton Urban District Council	Commercial, Household	-
375m NE	Land To East Of Whaley Road, Barugh Green, Barnsley	WD20 B1050	Mydrin Limited	Inert, Commercial	15-MAR-1994
379m SE	Recreation Ground, Pogmoor Road, Barnsley	4400/(134)	-	-	-
380m SE	Quarry at Higher Spring Head Farm, Oakworth, Keighley	671, 4400/(130)	-	Inert, Commercial	21-AUG-1988
390m NE	Whaley Road, Claycliffe Industrial Estate, Barugh Green road, Barugh	4400/B502, 20B502(81), WD20 B502	Amco Limited	Inert, Commercial	24-MAR-1986
427m NE	Tipping of Builders Waste opposite Whaley Road, Whaley Road, Barugh	WD24 B378, 4400/B375, 20B375(84), WD20 B375	Longden Homes	Inert, Commercial	14-APR-1983

There is also one record of a BGS/DoE within 500m of the site, located approximately 450m to the east. The landfill relates to the 'Gawber Refuse Tip on Withorpe Lane, Gawber'. This record relates to a point reference and appears to correspond with the Redbrook Road, Gawber landfill, which is approximately 320m to the east of the site.

There are two records of landfills from Local Authority and historical mapping records within 500m of the site. These are detailed in Table 3.7.2 below.

Table 3.7.2 - Summary of Local Authority and Historical Mapping

Distance & Direction	National Grid Reference	Site Reference	Source
330m E	432438, 407594	Refuse Tip	1975 mapping
434m NE	431847, 408308	Refuse Tip	1970 mapping

There are seven records of waste treatment, transfer or disposal sites taken from historical mapping within 500m of the site, although some of these records appear to be duplicate entries. A summary of the records is provided in Table 3.7.3 below.

Table 3.7.3 - Records of waste treatment, transfer or disposal sites within 500m

Distance & Direction	Type of Site	Grid Ref	Source
369m W	Ground Workings and Refuse Heap	430879, 406977	1893 Map
373m NE	Ground Workings and Refuse Heap	432107, 408320	1961 Map
374m W	Ground Workings and Refuse Heap	430830, 406978	1906 Map
428m SW	Ground Workings and Refuse Heap	431401, 405803	1961 Map
463m E	Refuse Destructor	433045, 406514	1948 Map
467m E	Refuse Destructor	433077, 406513	1929 Map
467m E	Refuse Destructor	433077, 406513	1929 Map



There are no EA licensed waste treatment, waste transfer or waste disposal sites within 500m of the site.

3.8 Environmental Permits, Incidents and Registers

There are 11 active Part A (2) or Part B permitted activities (potential to cause air pollution) within 500m of the site.

There are no records of any historic Integrated Pollution Control (IPC) authorisations within 500m of the site.

There are no recorded historical Part A(1) and Integrated Pollution Prevention Control (IPPC) authorised activities within 500m of the site.

There are no records of Water Industry Referrals (potentially harmful discharges to the public sewer) within 500m of the site.

There is no recorded Red List Discharge Consent (potentially harmful discharges to controlled waters) within 500m of the site.

There are no active List 1 Dangerous Substances Inventory Sites and one List 2 Dangerous Substances Inventory Site within 500m of the site. The List 2 authorised substances comprise copper, iron, nickel and zinc, and relates to Dodworth Colliery Tip.

There is one Category 3 or 4 Radioactive Substances Licences within 500m of the site, located approximately 347m to the north-east. The licence is operated by Static Solutions Limited and relates to the disposal of radioactive waste.

There are no recorded Control of Major Accidents Hazard (COMAH) or Notification of Installations Handling Hazardous Substances (NIHHS) or sites within 500m of the site.

There are no sites determined as Contaminated Land under Part IIA EPA 1990 within 500m of the site.

There are three records of petrol filling stations within 500m of the site, two of which are now obsolete. These are summarised in Table 3.8.1 below.

Table 3.8.1 - Summary of Petrol & Fuel Sites

Distance & Direction	National Grid Reference	Operator	Site Address	Status
182m N	431958, 407912	-	Claycliffe Road, A365, Redbrook	Obsolete
368m E	432852, 406659	Jet	Pogmoor Road, Barnsley	Operational
429m NE	432401, 407744	-	Wilthorpe Road, Barnsley	Obsolete

There are no electricity substations located on the site. The closest electricity substation is located approximately 11m to the north-west.

There are 44 records of historical garage and motor vehicle repair premises within 500m of the site, the closest of which is located approximately 33m to the north and relates to an electric motor works.



3.9 Current Land Use

There are 48 records of potentially contaminative sites within 250m of the site, none of which are located on the site itself. In addition, none of the sites within 100m are considered to have the potential to affect the contaminative status of the site.

3.10 Radon Risks

The site is located in a radon affected area as defined by the Health Protection Agency, as between 1% and 3% of properties are above the action level. However, in accordance with the Building Research Establishment publication BR211, no radon protective measures are required for new properties constructed on the site.

3.11 Previous Reports

As part of this desk study, the report referenced below has been reviewed:

- Eastwood & Partners. Barnsley West. Geotechnical and Geo-Environmental Site Appraisal Commentary. Job No: 36284, dated October 2013. For Strata.

The report summarises the environmental setting with particular regard to the coal mining legacy.

The Eastwoods' report included limited intrusive works consisting of six cable percussive boreholes drilled by Wellhead Drilling Company. The driller's borehole records, and the exploratory hole location plan are included in Appendix G of this report and are summarised in the Table 3.11.1 to 3.11.6.

Table 3.11.1 – Borehole Ref. BH1 (Located Within Craven II OCCS)

Strata (Based on Driller's Description)	Depth to Base (m bgl)	Comments
Topsoil	0.15	
MADE GROUND: Grey brown very stiff colliery spoil – mixed clays with gravels and cobbles of mudstone, siltstone, occasional coal and brick. Occasional soft-firm bands below 3.00m bgl.	21.80	Driller notes boulders. SPT N values range from 8 to refusal. Groundwater seepage at 16.00m bgl (no rise). Groundwater strike at 18.10m; rose to 12.80m bgl.
Moderately strong siltstone bedrock	>21.86	Bottom of OCCS anticipated to be at approximately 37m bgl in this location. Therefore, borehole terminated on a boulder and not bedrock.

**Table 3.11.2 – Borehole Ref. BH2 (Located Within Craven II OCCS)**

Strata (Based on Driller's Description)	Depth to Base (m bgl)	Comments
Topsoil	0.25	
MADE GROUND: Brown/Yellow brown firm – stiff sandy clay with grey mudstone pockets and gravels of coal, sandstone, mudstone and siltstone	1.80	Capping layer? No SPTs
COLLIERY SPOIL: Mixed mud/siltstones, grey and brown and clays. Occasional coal. Firm – stiff. Many siltstone boulders around 8.50m bgl.	9.90	SPT N values of 15 at 2.05m bgl and 27 at 6.05m bgl. Groundwater seepage at 16.00m bgl (no rise). Groundwater strike at 18.10m; rose to 12.80m bgl.
Moderately strong siltstone bedrock	>10.54	2no. SPT refusals Bottom of OCCS anticipated to be at approximately 35m bgl in this location. Therefore, borehole terminated on a boulder and not bedrock

Table 3.11.3 – Borehole Ref. BH3 (Located Within Craven I OCCS)

Strata (Based on Driller's Description)	Depth to Base (m bgl)	Comments
Topsoil	0.20	
MADE GROUND: Pale beige brown/brown stiff clay and mud/siltstone gravels and coal	1.00	Capping layer? No SPTs
COLLIERY SPOIL: Pale brown occasional grey firm mixed clays and mud/siltstone/sandstone and some bands of coal fines.	2.50	No SPTs
Coal band	2.60	Probably MG
Pale grey brown moderately weak weathered mudstone, becoming stronger below 3.40m bgl.	>3.70	2no. SPT refusals. Bottom of OCCS anticipated to be at approximately 8m bgl in this location. Therefore, borehole terminated on a boulder and not bedrock

Table 3.11.4 – Borehole Ref. BH4 (Located Within Hunters Cottage OCCS)

Strata (Based on Driller's Description)	Depth to Base (m bgl)	Comments
Topsoil	0.13	
COLLIERY SPOIL: Grey brown mud/siltstones with clay, little coal. Firm, becoming softer below 2.00m bgl.	5.10	SPT N value of 8 at 4.05m bgl. Water strike at 5.10m bgl, rose to 4.40m bgl after 20 minutes.
As above – becoming very gravelly with clayey bands	6.20	
Firm clayey COLLIERY SPOIL: mudstone, siltstone, coal	13.40	SPT N value of 18 at 6.05m bgl.
Very gravelly with clayey bands/pockets		SPT N values of 12 at 8.05m bgl and 15 at 10.05m bgl.
Much siltstone, mudstone cobbles below 12.00m bgl		SPT N value of 30 at 12.05m bgl.
Moderately strong siltstone bedrock	>13.48	2no. SPT refusals. Bottom of OCCS anticipated to be at approximately 13m bgl in this location. Therefore, borehole possibly proved bedrock

**Table 3.11.5 – Borehole Ref. BH5 (Located Within Farm House Lane OCCS)**

Strata (Based on Driller's Description)	Depth to Base (m bgl)	Comments
Topsoil	0.25	
MADE GROUND: Pale brown / brown grey mixed clays and mudstone, silt, brick, coal gravels.	0.90	Capping layer? No SPTs.
COLLIERY SPOIL: Brown/grey very stiff sandy clays and gravels of mud/siltstone, some coal and some red brown pockets below 2.00m bgl.	3.10	SPT N value of 10 at 2.05m bgl.
COLLIERY SPOIL: Red brown/grey/beige brown friable stiff sandy clay and much mud/siltstone gravels and cobbles. Rare coal. Much mudstone, little clay below 6.00m bgl. Very stiff.	8.30	SPT refusal at 6.05m bgl.
Red brown / dark grey moderately strong siltstone / sandstone	>8.61	2no. SPT refusals. Bottom of OCCS anticipated to be at approximately 15m bgl in this location. Therefore, borehole terminated on a boulder and not bedrock

Table 3.11.6 – Borehole Ref. BH6 (Located Within Craven II OCCS)

Strata (Based on Driller's Description)	Depth to Base (m bgl)	Comments
Topsoil	0.20	
MADE GROUND: Brown firm clay and mudstone, brick gravels	0.80	Capping layer?
COLLIERY SPOIL: Grey, occasionally brown clays and gravels of mud/siltstone, occasional coal and brick. Many siltstone boulders and cobbles between 5.30m and 6.00m bgl. Occasional cobble below 6.00m bgl.	8.70	SPT N values ranged between 17 and 38.
Moderately strong siltstone	>9.04	2no. SPT refusals. Bottom of OCCS anticipated to be at approximately 42m bgl in this location. Therefore, borehole terminated on a boulder and not bedrock

Based on the anticipated depths of backfilled opencast, it is apparent that none of the boreholes proved the full thickness of the made ground, with the exception of possibly BH4. The Standard Penetration Test (SPT) results carried out in the made ground generally indicate medium dense/medium strength conditions.

Based on the groundwater remarks, it is evident that water is present only locally and probably confined to granular interbeds within the colliery spoil.



4.0 ENVIRONMENTAL RISK ASSESSMENT

4.1 Introduction

The statutory definition of contaminated land is given in the Environmental Protection Act, Part 2A, Section 78, 1990, which was introduced by the Environment Act, Section 57, Department of Environment, 1995 and is defined as:

Land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land that:

- Significant harm is being caused or there is a significant possibility of such harm being caused (where harm is defined as harm to health of living organisms or other interference with the ecological systems of which they form a part and, in the case of man, includes harm to his property); and/or
- Significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused (by the land).

The presence of contaminated materials on a site is generally only of concern if an actual or potentially unacceptable risk exists. The potential for harm to occur requires three conditions to be satisfied:

- **Sources** – The presence of substances (potential contaminants/pollutants), in or under the ground, that may cause harm or pollution.
- **Receptors** - The presence of a receptor which may be harmed, e.g. the water environment or humans, buildings, fauna and flora; and
- **Pathway** - The existence of a linkage between the Source and the Receptor.

In summary, the presence of measurable concentrations of contaminants within the ground and subsurface environment does not automatically imply that a contamination problem exists, since contamination must be defined in terms of pollutant linkages and an unacceptable risk of harm to available receptors.

The nature and importance of both pathways and receptors, which are relevant to a particular site, will vary according to the sensitivity of the intended end use of the site and the site's characteristics and environmental setting.



Legislation and guidance on the assessment of contaminated sites acknowledges the need for a tiered risk-based approach. This is set out in the Environment Agency's manual Land contamination: risk management (LCRM), published in June 2019 and last updated on 19 April 2021. The LCRM outlines the following stages of risk assessment:

Tier 1: Preliminary risk assessment (PRA)	As part of this assessment, the overall site objectives are defined. Current and historical information about the site and the potential contaminants expected to be present are assessed and an outline conceptual model (CM) is developed. The risks are assessed qualitatively, and the findings reported in the PRA (or desk study). The report recommends what further works would be required in order to assess whether the site is suitable for its proposed use.
Tier 2: Generic quantitative risk assessment (GQRA)	The GQRA uses Generic Assessment Criteria and a standard set of generic assumptions based on specific end uses in order to assess the risks to receptors. It includes the collection of more detailed information including laboratory analysis of soil and water samples in order to inform and assess the risks.
Tier 3: Detailed quantitative risk assessment (DQRA)	If pollutant linkages are confirmed as part of the GQRA, these are known as relevant pollutant linkages (RPLs) and further detailed assessment is required. At this tier, detailed site-specific information is collected to estimate the risk or to develop site-specific assessment criteria (SSAC). This may include collecting information about the receptor.

This desk study report represents a Tier 1 Preliminary Risk Assessment.

4.2 Potential Sources

Based on the findings of the desk study, it is evident that the site has been subject to opencast coal mining and more recently for agricultural purposes.

Based on the above, the following potentially contaminative sources may be present on the site:

- Made ground associated with backfilled opencast mine workings.
- Made ground around the farm buildings.
- Made ground associated with infilled ponds (to the north of Hermit Lane and on eastern boundary)
- Potential leaks and/or spills of organic contamination associated with tanks, plant or machinery within farm complexes.
- Hazardous gases/soil vapours associated with the made ground and adjacent areas of infilled land.



Potential contaminants which could be present beneath the site, or which could have migrated onto the site from potential sources beyond the site are listed below:

- Metals, metalloids and their compounds.
- Inorganic compounds.
- Asbestos.
- Organic compounds including hydrocarbons (petrol/diesel/oils) and Polycyclic Aromatic Hydrocarbons (PAH).
- Calorific value associated with coal-rich made ground; and
- Hazardous Gases/Soil vapours.

4.3 Potential Pathways

Based on the available information and the proposed redevelopment of the site for a mixed end use comprising residential, commercial and industrial land uses, the following potential exposure pathways will require consideration, both during the redevelopment works and on completion of the construction:

- Ingestion and dermal contact with contaminated soil and groundwater.
- Inhalation of hazardous gases/soil vapours.
- Leaching/migration of contaminants from soil into surface water and groundwater via surface drainage/wash and groundwater flow.
- Permeation of water supply pipes and other services by organic and aggressive contaminants.
- Uptake of contaminants by planting in garden and landscape areas; and
- Combustion of soils with elevated calorific value.

4.4 Potential Receptors

The potential receptors considered are:

- Development workers and future maintenance workers involved in excavations, e.g. foundations or where services are being installed or repaired following development.
- Future end users of the site, i.e. employees and residents.
- The underlying bedrock strata, i.e. Secondary A Aquifer.
- Nearby surface water features, i.e. streams/drainage channels on and adjacent to the site.
- Buildings and services; and
- Planting in gardens and landscaped areas.



4.5 Pollutant Linkage Assessment

A potential pollutant linkage assessment has been completed and is summarised in the Conceptual Site Model, which is provided in Section 4.6. This is based on the proposed redevelopment of the site for commercial end use and residential end use.

On the basis of the proposed mixed end use and known history of the site, the following potential pollutant linkages may be present:

- Development and maintenance workers and site end users, e.g. employees and residents could come into contact with soils containing elevated concentrations of potential contaminants, elevated calorific value and hazardous gases/soil vapours.
- The underlying Secondary A Aquifer and surface water features on and adjacent to the site could become contaminated due to the leaching and migration of potential contaminants from the made ground.
- Buildings and services could be affected by potential contaminants in the made ground.
- Plants in garden and landscape areas could be affected by phytotoxic elements within the made ground.
- Development and maintenance workers, site end users, buildings and services could be affected by potentially combustible coal-rich made ground.

These are based on current site conditions and do not consider exposure pathways following any remediation of the site. If the site can be shown to pose no "significant harm" or pollution to controlled waters, then the site can be considered to be uncontaminated.



4.6 Conceptual Site Model & Risk Rating

The conceptual model is summarised in Table 4.6 below.

Table 4.6 Preliminary Conceptual Model

Source	Pathway	Receptor	Risk Rating	Comments
Contamination in Made Ground, Soil or Rock Made Ground associated with backfilled opencast mine workings, farm buildings and infilled ponds. Above Ground Fuel Storage Tanks. Underground Fuel Storage Tanks. Plant and machinery within the farm complexes. Fuel Spills.	Inhalation. Ingestion. Dermal contact.	Future Site Users Employees. Maintenance workers. Residents.	Low/ Moderate	Ground investigation and sampling to establish levels of contamination present.
		Users During Development Development workers.	Low/ Moderate	Ground investigation and sampling to establish levels of contamination present.
	Leaching of mobilised contaminants	Groundwater Secondary A Aquifer	Low/ Moderate	Recorded geology is classified as a Secondary A Aquifer. Site not located in a groundwater Source Protection Zone. No groundwater abstractions within 1km.
	Migration via surface water flow.	Surface Water Features Inland Rivers onsite.	Low/ Moderate	There are several 'Inland Rivers' on the site. No surface water abstractions licenses within 2km of the site.
Hazardous Ground Gases/Soil Vapours Made Ground associated with backfilled opencast mine workings, farm buildings and infilled ponds. Above Ground Fuel Storage Tanks. Underground Fuel Storage Tanks. Plant and machinery within the farm complexes. Fuel Spills.	Ground Gas Migration Migration through permeable soils/ fractured rock. Inhalation.	Future Site Users Employees. Maintenance workers.	Moderate	Gas monitoring to be undertaken as part of ground investigation. Appropriate health and safety procedures to be in place during the construction phase and maintenance of the development.
		Built Environment Buildings. Infrastructure.		
Areas of Phytotoxic Contamination	Root uptake.	Vegetation Landscaping.	Low/ Moderate	Ground investigation and sampling to establish levels of any phytotoxic contamination present.
Aggressive Contaminants in Soil/Water	Direct contact.	Construction Materials Concrete.	Low/ Moderate	Samples of made and natural ground should be obtained and submitted to the laboratory for testing in order to assess the sulphate content and acidity.
		Construction Materials Services.	Low/ Moderate	



4.7 Risk Classification

Based on the potential pollutant linkages present on the site, the site should be considered to be **low to moderate risk** with respect to contamination. This designation will be largely dependent on the nature of any made ground or hazardous gases present on or adjacent to the site.

In order to fully assess and classify the risks to human health, groundwater, surface water and buildings/services, additional Phase 2 Intrusive Investigation, including chemical testing of soils and groundwater and ground gas monitoring will be required.



5.0 PRELIMINARY ENGINEERING ASSESSMENT

5.1 Development Proposals

It is proposed to develop the northern part of the site for residential end use and the southern part of the site for commercial end use. A plan outlining the separate zones is referenced below and provided in Appendix A.

- JPG Leeds Limited. Site Zoning Plan. Barnsley West. Drawing Reference: 4848-JPG-ZZ-ZZ-DR-C-1000-S2-P02. Dated March 2023.

5.2 Mining

Based on the findings of the desk study, the site is underlain by several backfilled opencast coal sites (OCCSs), namely the Craven I and Craven II, Hunters Cottage and Hunters Cottage Extensions, and Farm House Lane. There is also the potential for parts of the site to be at risk from unrecorded coal workings in the shallow seams, in particular below highwalls.

There are 14 recorded mine entries on the site or within 20m of the site boundary. However, it is likely that the majority of these will have been removed as part of the opencast extraction. In addition, one of the recorded mine entries is a pumping shaft indicated on abandonment plans within the Craven II OCCS, which will likely require treatment.

It will be necessary to carry out a mining investigation to confirm the nature and thickness of the made ground within the OCCSs, in order to assess the soil parameters and settlement characteristics. Also, intrusive investigation is required to confirm the locations of mineshafts on the site and also confirm that some of the mine entries do not extend below the bottom of the OCCS in which they were encountered. In addition, rotary boreholes are required to investigate the condition, depth and thickness of the shallow coal seams outwith the opencasts and also below the opencasts where the shallow seams may be within influencing distance of the surface.

5.3 Foundations and Ground Floor Construction

Based on the findings of this desk study, it is evident that large areas of the site are underlain by a significant thickness of non-engineered made ground, consisting of colliery discard associated with backfilled opencast coal sites. The underlying bedrock geology comprises Pennine Middle Coal Measures strata of mudstone, siltstone, sandstone and coal seams.

The made ground in its current condition is unsuitable for the support of structural loads due to variations in material properties. If shallow spread foundations were to be used, these materials would become over-stressed, leading to significant settlements.



At this stage, the likely foundation solution for low-rise residential housing would be some form of earthworks and/or ground improvement, in order to accommodate a reinforced raft foundation.

Depending on the loading associated with the proposed commercial units, a piled foundation solution may be required for the superstructure combined with some form of ground improvement in order to accommodate ground-bearing slabs. Alternatively, it may be possible, following earthworks/ground improvement, to use raft foundations.

The long-term settlement characteristics, including self-weight settlement, of the backfilled opencast materials will require assessment.

The requirements of any required gas protection measures will also need to be taken into consideration in relation to ground floor design and construction.

5.4 Groundwater

It may be expected that shallow perched groundwater will be encountered within the made ground. It is likely that this groundwater will be confined to granular interbeds within the colliery spoil made ground. The presence of groundwater will need to be assessed as part of any ground investigation.

The potential for inundation settlement due to possible rising groundwater levels, following the cessation of deep coal mining, will also need to be taken into consideration.

5.5 Obstructions

The presence of obstructions including large boulders within the underlying opencast backfill should be anticipated.

In addition, substructures and other manmade obstructions should be expected in the previously developed parts of the site, principally the farms.

5.6 Earthworks

Some form of earthworks and ground improvement are likely to be required in order to achieve a consistent formation with regard to the future development on the site. Based on the current site levels, including steeply sloping ground surfaces, significant cut and fill groundworks will be required as part of the enabling works.

Depending on the thickness and properties of the made ground in the OCCs, the following treatment methods may be appropriate.

- Removal of the full or partial thickness of made ground and replacement with engineered fill.
- Deep dynamic compaction of made ground.
- Surcharging.



Any earthworks should be carried out in accordance with the Manual of Contract Documents for Highway Works, Volume 1 Specification for Highway Works, Series 600 Earthworks.

In addition, the advice of a specialist contractor will be required to confirm that ground conditions are suitable for earthworks/ground improvement and that adequate bearing values and tolerable settlements can be achieved.

An assessment of the suitability of the colliery spoil materials and also natural 'cut' soils for re-use in earthworks will be required.

5.7 Roads, Pavements and Hardstanding Surfaces

It is likely that earthworks/ground improvement will be carried out as part of the redevelopment works. This may result in changes to the sub-grade materials. The works should be designed to achieve a suitable CBR value for the proposed development.

Where roads/highways straddle highwalls associated with the former OCCSs, special mitigation measures, e.g. geogrids, may be required.

5.8 Chemical Attack on Buried Ground

Samples of any made and natural ground should be obtained and submitted to the laboratory for testing in order to assess the sulphate content and acidity and hence the concrete class required for buried concrete.

5.9 Recorded Landslips

The BGS mapping records two areas of landslips within the site area. If development is to take place in these areas, an investigation will be required.



6.0 FURTHER INVESTIGATIONS

It is recommended that a ground investigation is carried out in order to further assess the potential environmental and geotechnical constraints to development. It is recommended that the investigation is carried out in a phased approach.

The scope of works below is designed to provide a preliminary overview of the site and target significant potential constraints to development.

- Trial pits across the site, primarily in areas of proposed cut, in order to obtain samples to submit for geotechnical testing in order to assess the suitability of the material for re-use in earthworks.
- Rotary openhole boreholes within the backfilled opencast sites in order to confirm the depth to competent bedrock.
- Extensometers are to be installed within each backfilled opencast. These will require monitoring on a long term basis, in order to assess the settlement of the backfilled opencast and allow predictions to be made of further settlements. It is anticipated that the extensometers will be monitored quarterly over a minimum two year period.
- Rotary openhole boreholes outwith the boundaries of the opencasts in the southern part of the site in order to investigate underground coal workings at shallow depth. In addition, where shallow coal seams are present below the base of the opencast, further boreholes will be required.
- Ground gas and groundwater monitoring wells are installed within selected boreholes in order to assess the levels of groundwater within and outside of the backfilled opencast, to provide an indication of whether groundwater rebound has been completed. Gas monitoring will also be carried out on six occasions in order to assess the potential presence of hazardous ground gases on the site.

Further works, i.e. additional soil characterisation, installation and monitoring of gas wells (possibly to include continuous ground gas monitoring), monitoring of extensometers and further rotary boreholes to investigate the depth of the opencast and potential for underground workings, may be required in order to supplement the information which will be obtained as part of the above works. These works would be required in order to satisfy the requirements of the regulators and inform any proposed earthworks contract.



Appendix A Figures and Drawings

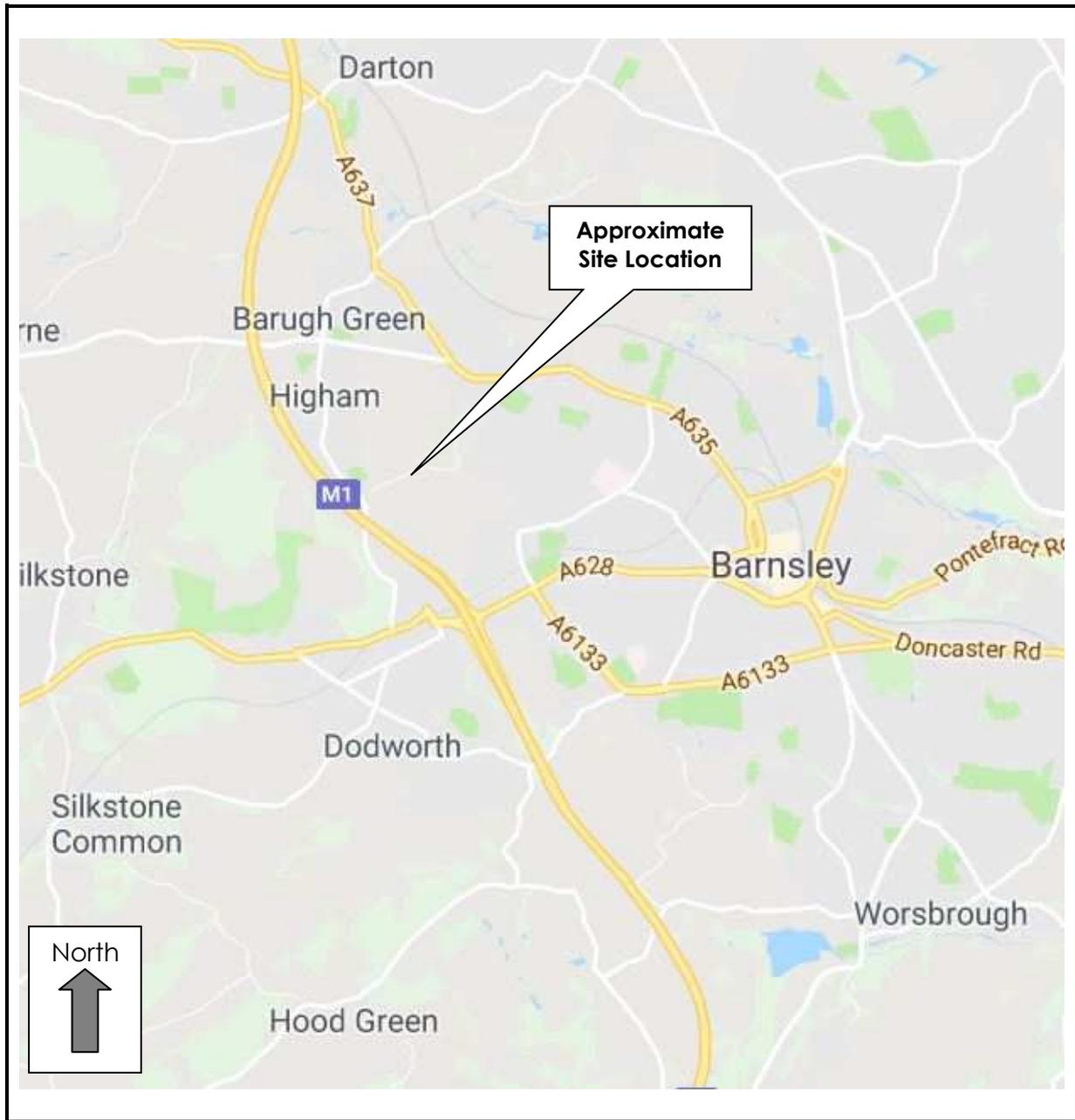


Figure 1 – Site Location Plan

Site	Barnsley West
Client	Strata Sterling Barnsley West Ltd
Job Number	4848
Scale	NTS



Figure 2 – Aerial Photograph

Site	Barnsley West
Client	Strata Sterling Barnsley West Ltd
Job Number	4848
Scale	NTS

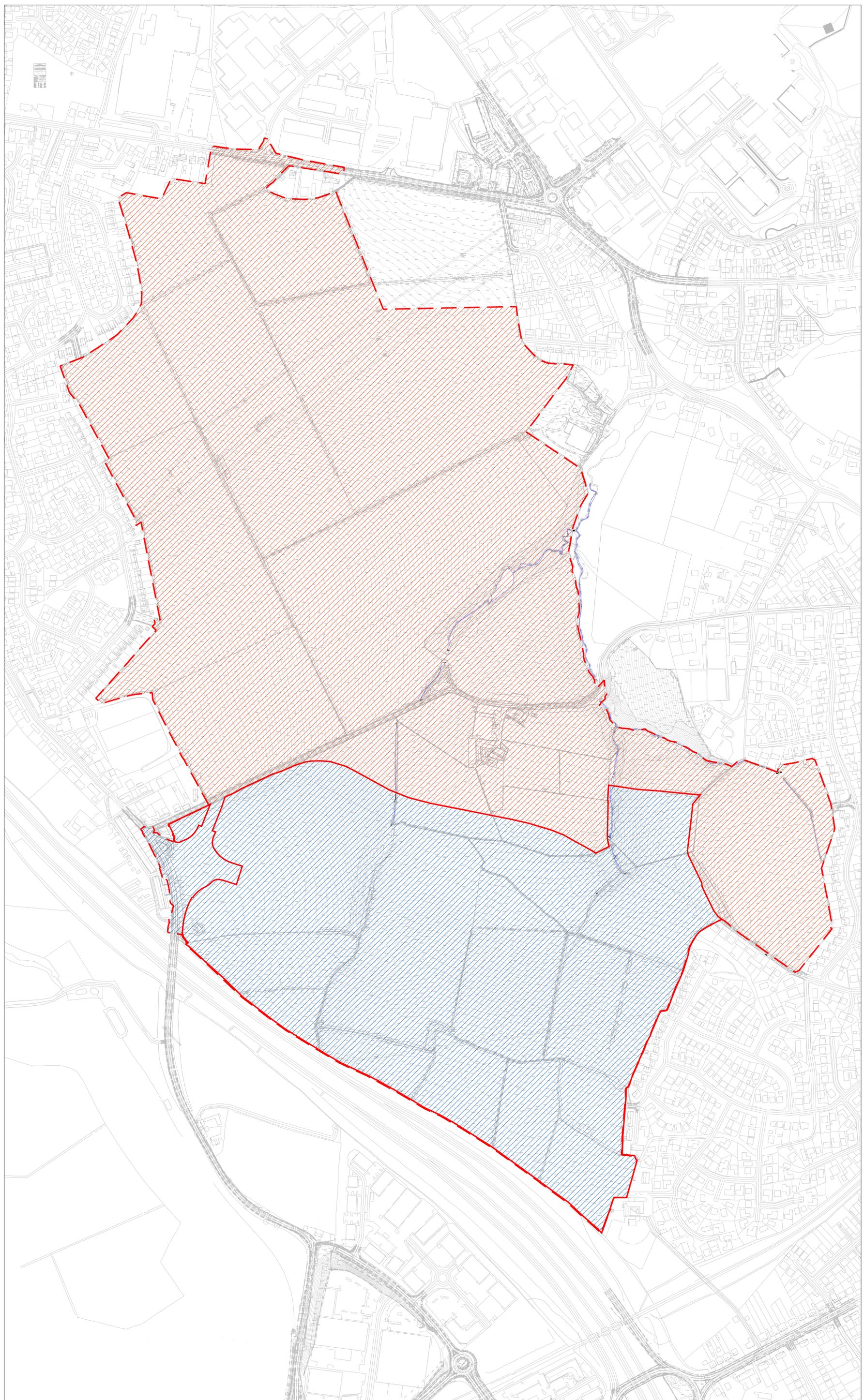
DO NOT SCALE (A0)

NOTES

- GENERAL NOTES**
1. ALL MATERIALS AND WORKMANSHIP IS TO COMPLY WITH JPC CONSULTANTS STANDARD SPECIFICATION & ALL RELEVANT BRITISH & EUROPEAN STANDARDS.
 2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECT, M&E CONSULTANTS AND JPC CONSULTANTS DRAWINGS.
 3. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ENGINEER IMMEDIATELY SO THAT CLARIFICATION CAN BE SOUGHT PRIOR TO COMMENCEMENT OF WORKS.

LEGEND

-  COMMERCIAL BOUNDARY
-  RESIDENTIAL BOUNDARY



REV	DESCRIPTION	DATE	CHK	BY
P02	REDLINE BOUNDARY UPDATED	10/10/23	JDM	LSG
P01	FIRST ISSUE	30/03/23	JDM	EBH

Project
BARNSELEY WEST

Drawing Title
SITE ZONING PLAN

INFORMATION



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