Grimethorpe, Barnsley

Geo-Environmental Desk Study Assessment

TETRA TECH

Version 2

October 2023

Tetra Tech
2nd Floor,
11 York Street,
Manchester
M2 2AW
0161 872 3223

tetratech.com

Geo-Environmental Desk Study Assessment

Report Reference: B034815.DS.2
Date: October 2023

PRESENTED TO

Oakland Golf and Leisure UK Ltd
37 Warren Street
London,
W1T 6AD

PRESENTED BY

Tetra Tech Ltd
2nd Floor,
11 York Street,
Manchester
M2 2AW

0161 872 3223
tetratecheurope.com

Prepared by:

Jordan Makepeace BSc (Hon) MSc FGS
Geo-Environmental Consultant

October 2023

Reviewed by:

Nicholas Brook BSc (Hon) FGS
Senior Geo-Environmental Consultant

October 2023

Authorised by:

Andy Moore BSc MSc FGS CGeol MICE CEng SiLC QP
Technical Director

October 2023

EXECUTIVE SUMMARY

Brief	Tetra Tech Ltd (Tetra Tech) was commissioned by Oakland Golf and Leisure UK Ltd (the Client) to undertake a Geo-Environmental Desk Study for land at Grimethorpe, Barnsley.
The Site	The site is an unused section of land located off Engine Lane, Grimethorpe, Barnsley S72 7BN approximately 10km northeast of Barnsley.
Proposed Development	The proposed development comprises the return of the site to productive use by improving the soil profile so that it is suitable for agriculture and outdoor recreational uses in a restored landscape to include new tree plantations and enhanced biodiversity.
Surrounding Site Information	The site is bound by farmland to the north and west, with industrial warehousing units adjacent to the eastern boundary. The southern boundary is unused grass and vegetation covered land
Site History	The site comprised agricultural fields from the earliest maps 1854 up until the mid-1900s when operations from the nearby Grimethorpe colliery began to expand into the present day site area. The area around the site comprised of agricultural fields from the earliest maps 1854 up until 1974 when the Dearne Valley Railway passes the eastern boundary of the site locally crossing the access road to the site in the northeast. Grimethorpe Colliery was present to the east of the site.
Geology	• Made Ground comprising Made Ground (Undivided) and Infilled Ground. • Superficial strata comprising Quaternary Alluvium in the far North-East mainly across the access road. • Bedrock Strata consisting of Pennine Middle Coal Measures. • Two Coal Seams are recorded as out cropping the superficial soils within the site boundary (Highgate Coal and Shafton Main Coal Seams). Two faults trending in a Northwest - Southeast direction, down throwing strata to north.
Hydrogeology & Hydrology	The Pennine Middle Coal Measures Formation is classified as a Secondary A aquifer. There is a small network of ditches and evidence of excavations which now contain standing water on the site.
Coal Authority Search Information	A Consultants Mining Report provided by the Coal Authority details: • Highgate Coal Seam and Shafton Coal are recorded as outcropping onsite. • Opencast workings are recorded on the site, potentially undertaken in Highgate Coal Seam and Shafton Coal seam. There is a risk of excessive total settlement and differential settlement associated with backfill area. • Underground mining of 8 no. coal seam took place beneath the site at a depth from 36m to 373m. The shallow mining undertaken in Shafton Coal Seam (36m to 64m) was undertaken at a depth which is considered to potentially present a risk to site. Although more than 17m of competent bedrock overlies the seam and it may be sufficient to mitigate any collapse there is a still a risk of instability due to shallow workings within 40m of ground surface. • There are 2. no identified mine shafts within the site. • Two recorded faults on site, which could act as a potential mine gas pathway. • No records of mine gas emissions within 500m however, combustible coal seams, Shafton Coal, Barnsley Coal, Parkgate Coal are present beneath site. There are 5 no. Coal Mining subsidence recorded within 50m of the site boundary.

Waste	There are no records of landfilling at the site.
Environmental database search	The site lies within a Green belt zone under the local authority of South and West Yorkshire. The site also lies within a Nitrate Vulnerable zone in relation to the River Dearne NVZ. The Environmental Database indicates that the soil/surface in the northwest has a leaching class of high and an infiltration value of >70% and a dilution value of <300mm/year. To the northeast the soil/surface has a leaching class of low, an infiltration value of <40% and a dilution value of <300mm/year. The Pennine Middle Coal Measures formation Secondary A Aquifer to the north onsite is considered to be of High Vulnerability with flow mechanisms of well-connected fractures.
Preliminary ground contamination assessment	• Construction / maintenance workers – a **Moderate** risk is identified from contamination sources and pathways but can be reduced to Low through the use of appropriate PPE. • Controlled waters – a **Low to Moderate/Low** risk is identified from contamination sources and pathways. • Future site users (Open Public Space) – a **Low** risk is identified from contamination sources and pathways. • Risk to site from adjacent properties and Aquifers (Bedrock) is **Low**. • The risk from ground contamination from the historical Tanks on adjacent land is **Low** to all receptors. • The risk from other off-site sources is **Low** to all receptors.
Preliminary Geotechnical Assessment	Potential geotechnical constraints have been identified associated with development of the site, relating to: • Unknown depth, strength characteristics and composition of each strata deposits across site. • Ground conditions across the site may differ to those anticipated. • Potential for differential settlement associated with the fill of the opencast.
Conclusions	There is the potential for deep Made Ground materials onsite associated with the former opencast within the proposed development area which may present a risk to construction workers, if exposed.

TABLE OF CONTENTS

DRAWINGS

B034815-TTE-00-XX-DR-U-0001-02 (Site Location Plan)

B034815-TTE-00-XX-DR-U-0002-02 (Redline Boundary Plan)

THIRD PARTY DRAWINGS

Drawing No. 901.02A/ Existing Site Levels dated 14th September 2023 by Weller Designs Ltd.

Drawing No. 901.03A/Grading Plan dated 14th September 2023 by Weller Designs Ltd.

Drawing No. 901.05A/Cross sections dated 14th September 2023 by Weller Designs Ltd.

Drawing No. 901.07 Rev B/Masterplan dated 14th September 2023 by Weller Designs Ltd.

APPENDICES

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
aOD	above Ordnance Datum
bgl	below ground level
BGS	British Geological Survey
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
C4SL	Category 4 Screening Levels
CIEH	Chartered Institute of Environmental Health
CLEA	Contaminated Land Exposure Assessment
CoC	Constituent of Concern
CSM	Conceptual Site Model
DEFRA	Department of Environment, Food and Rural Affairs
DQRA	Detailed Quantitative Risk Assessment
DTS	Desk Top Study
DRO	Diesel Range Organics
DWS	Drinking Water Standard
EA	Environment Agency (England)
EPH	Extractable Petroleum Hydrocarbons
EQS	Environmental Quality Standards
FOC	Fraction Organic Carbon
GPR	Ground Penetrating Radar
LOD	Limit Of Detection
LQM	Land Quality Management
NRW	Natural Resources Wales
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Poly Chlorinated Biphenyl
PPE	Personal Protective Equipment
ppm	parts per million
PRO	Petroleum Range Organics
SGV	Soil Guideline Values
SOM	Soil Organic Matter
SVOC	Semi-Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
TSV	Tier 1 Screening Values
VOC	Volatile Organic Compounds
VPH	Volatile Petroleum Hydrocarbons

1.0 INTRODUCTION

1.1 INSTRUCTION

Tetra Tech Ltd (Tetra Tech) was commissioned by Oakland Golf and Leisure UK Ltd (the Client) to undertake a Geo-Environmental Desk Study for the site at Grimethorpe, Barnsley (known hereafter as “the site”). The location of the site is shown on B034815-TTE-00-XX-DR-U-0001-02 (Site Location Plan).

1.2 BRIEF

The brief was to provide a Phase 1 Geo-environmental Desk Study report including a preliminary qualitative contamination risk assessment to assess the key geo-environmental constraints at the site in general accordance and with reference to the Environment Agency’s *Land Contamination Risk Management* (Environmental Agency, 2021).

A Coal Mining Risk Assessment has been produced under separate cover, by Tetra Tech and referenced B034815.CMRA.1 - South Barnsley.

1.3 PROPOSED DEVELOPMENT

The proposed development is to return the site to productive use by improving the soil profile so that it is suitable for agriculture and outdoor recreational uses in a restored landscape to include new tree plantations and enhanced biodiversity. The restoration of the site will be achieved through the importation of 430,300m^3 of soil and inert materials under an Environment Agency (EA) Permit as a waste recovery operation.

A Masterplan is presented for the proposed development in the Third Party Drawings.

1.4 REPORT SCOPE

This report includes the following key elements:

- Review of the site and local area history, primarily referring to past editions of Ordnance Survey Maps.
- Review of commercially available environmental database information, including information on waste facilities, water abstractions, environmental sensitive areas etc.
- Review of relevant web-based information including British Geological Society (BGS) and others.
- A baseline UXO risk assessment using on-line databases to classify the site with regards to UXO risk.
- A discussion of the anticipated ground and groundwater conditions based on geological and hydrogeological maps.
- A Qualitative Risk Assessment for ground contamination (compliant with CIRIA C552 (CIRIA, 2001) methodology).

1.5 LIMITATIONS

The recommendations and opinions expressed in this report are based on information obtained as part of the desk study or provided by others. Information provided from other sources is taken in good faith and Tetra Tech cannot guarantee its accuracy.

This report is subject to the report conditions presented in Appendix A.

The information contained in this report is intended for the use of Oakland Golf and Leisure UK Ltd (the Client) and Tetra Tech can take no responsibility for the use of this information by any third party or for uses other than that described in this report or detailed within the terms of our engagement.

2.0 SITE INFORMATION

2.1 LOCATION

The site is located to the west of Engine Lane, Upper Cudworth, Barnsley S72 7BN. (Grid reference: SE 39944 08562). The site area is approximately 12.54 ha and located approximately 10km northeast of Barnsley.A site location plan is presented as B034815-TTE-00-XX-DR-U-0001-02. Table 2-1 below describes the surrounding land uses.

Table 2-1 – Surrounding land uses

Direction	Description
North	Farmland and fields
East	Industrial Warehouse facilities
South	Wind Turbine and Farmland and fields
West	Farmland and fields

2.2 SITE DESCRIPTION

A review of the site has been undertaken using Google Earth with imagery, dated August 2022.

The site comprises an area of unused land to the west off Ferry Moor Lane and is predominantly grass covered with an abundance of trees and vegetation. There is a small network of ditches and evidence of excavations which now contain standing water on the site.

The site is currently not in use, however there is a network of hardstanding footpaths/tracks across the site.

2.2.1 Access and Boundaries

The whole of the site can be accessed by foot or by vehicle from Ferry Moor Lane to the Northeast of the site. The site is mainly bound by farmland and fields, however to the east, there are large industrial warehouse units present. The site boundary plan is detailed on B034815-TTE-00-XX-DR-U-0002-02.

2.2.2 Topography

Existing contours for the site are shown on the Existing Site Survey drawing included in the Third Party Drawings. The site access in the north-east is at approximately 37mAOD and accesses the site at c41.5mAOD in the northeast corner of the site. The northern area is a slope upward from approximately 40mAOD at the northern boundary to 48mAOD in the centre of the site.

To the south of the flat area, the main site area rises from 48mAOD to c56mAOD at the southern boundary. The southwest corner of the site falls steeply from site levels between c52.5mAOD and 55mAOD to 50mAOD to the west.

2.2.3 Ground Cover and Vegetation

The site comprises of mainly overgrown vegetation with many trees. There is a network of hardstanding tracks in all directions across the site. In the centre there are several pond features.

2.2.4 On-site Structures and Fuel Tanks

There are no no-site features visible from review of Google Earth Imagery. However, there are electricity pylons located near to the southwest boundary and overhead lines running up the western site boundary.

3.0 SITE HISTORY

3.1 INTRODUCTION

The historical development of the site and surrounding area has been assessed using information available from historical Ordnance Survey (OS) maps (GS-XGF-D5L-S8V-27F) shown in Appendix C within the Groundsure Report (GS-EQE-SP1-RZ9-BLY) for the site which is presented in Appendix B of this report.

In the context of the summary of historical development of the surrounding area, the descriptions are limited to within approximately 250m of the site boundary, unless specified in the following section.

3.2 SITE HISTORY

Table 3.1 below provides a summary of the review of available OS mapping coverage, Google Earth Imagery, and historical aerial imagery for the site dating back to 1886.

Table 3-1 – Summary of On-site Contaminative Historical Data

Feature	Map Years	Section	Notes
Farmland	1854 – 1981	Sitewide	Farmland and associated outbuildings were present on the site from earliest mapping, until prior to development in 1981.
Dearne Valley Railway	1904 - 1955	Access road, North-East	Railway became present and ran north-south across the access road to the site from 1904.
Overhead cables	1955	North-East corner	The 1955 map shows a pylon present north of the site with cables running south across the site. The 1967 map no longer records the presence of these overhead lines.
Slurry Ponds	1966-1982	South and East	The Nearby Coal mining operation begins and encroaches on to the site from 1966 mapping.
Possible Open cast Workings	1966-1982	North and West	The Nearby Coal mining operation begins and encroaches on to the site from 1966 mapping.
Tanks, Coal conveyor belts, and associated works.	1988-1992	East side of the site	Further expansion of colliery works onto the site.
Ponds	2010	Central	‘Man made’ ponds visible on mapping from c.2010.

There are several potentially contaminative land-uses near to the site; the main ones within 250 m of the site boundary are listed in Table 3.2 below.

Table 3-2 – Summary of Surrounding Contaminative Historical Data within 250 m

Feature	Map Years	Location	Notes
Dearne Valley Railway and associated sidings	1904-1955	Running North/South from south-east to north-west of the site.	Railway became present and ran north-south across the access road to the site from 1904.
Refuse Heap	1938-1967	6m South-East, 31m East, 19m North-East, 104m North-East 106m North-East	Refuse heap, assumed to be associated with the nearby colliery workings.
Unspecified Tanks	1938-1988	30m South-East, 84m South-East, 93m South-East, 113m South-East, 161m North-East, 237m North-East, 238m North-East, 242m North-East	Many unspecified tanks associated with the nearby colliery works and sewage works.
Tramway Sidings	1930—1948	90m North-East	Tramways associated with the industrial activities in the nearby area.
Pylons	1955	36m Northeast	From 1955 mapping, a pylon and overhead cables are located near the northeast boundary with cables running in a north/south direction.
Sewage Works	1981-1988	212m North-East	Sewage works present on the mapping from 1981.
Coal conveyor belts, and associated works.	1966-1992	10m-250m South-East/East	The Nearby Coal mining operation begins and becomes closer to the site from 1966 mapping.

4.0 GEOLOGY, HYDROGEOLOGY, HYDROLOGY AND RADON

4.1 GEOLOGY

Details of the geology underlying the site have been obtained from the following sources:

- BGS GeoIndex Onshore (British Geological Survey, 2022) accessed October 2023.
- BGS Interactive Geology Viewer of Britain (British Geological Survey, 2022) accessed October 2023.
- Coal Authority interactive viewer accessed October 2023.
- Environmental database (Groundsure, GS-EQE-SP1-RZ9-BLY) presented in Appendix B.
- Geological Survey of England and Wales 1:50,000 geological map series: Sheet 87 – Barnsley, Bedrock and Superficial, 2008
- UK Radon map dated December 2022.

4.1.1 Made Ground

The BGS mapping (Sheet 87, Barnsley, Bedrock and Superficial, 2008) and Groundsure data suggests that Made Ground is present on-site. Two variations of Made Ground are identified on this site, Made Ground (Undivided) and Infilled Ground. The Made Ground (undivided) has been identified to cover the majority of the site from the South and South-East and extending to the central and northern sections of the site. The Infilled ground mainly covers an area from the central to the north-east of the site.

4.1.2 Superficial Geology

The published geological map (Sheet 87, Barnsley, Bedrock and Superficial, 2008) and BGS GeoIndex mapping indicates that there is superficial on site, however the coverage is sparce. Quaternary Alluvium has been identified to be on site in the far North-East mainly over the access road section of the site and also outside the site to the North-West in a separate isolated section. Described as ‘a general term for clay, silt, sand and gravel. It is the unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream or on its floodplain or delta, or as a cone or fan at the base of a mountain slope’.

4.1.3 Solid Geology

The BGS mapping (Sheet 87, Barnsley, Bedrock and Superficial, 2008) and Groundsure data for the site indicates that the site is underlain by the Pennine Middle Coal Measures Formation. The site is underlain by two different strata associated with this formation, one being Sandstone and the other Mudstone, Siltstone and Sandstone. These are both of Duckmatian Sub-age and are described as ‘Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams, with a bed of mudstone containing marine fossils at the base, and several such marine fossil-bearing mudstones in the upper half of the unit.’ The sandstone bearing unit underlies the north-west and south-west sections of the site. Whereas the Mudstone, Siltstone and Sandstone unit underlies the central to east sections of the site.

The stratigraphic column (BGS Sheet No. 87 (Barnsley) Bedrock and Superficial 1:50,000) also describes the Highgate Coal Seam and Shafton Coal Seam outcrop on site.

4.1.4 Linear Features

The published geological map (Sheet 87, Barnsley, Bedrock and Superficial, 2008) and BGS GeoIndex mapping indicates two geological faults. The first fault runs west of the site, trending in a northwest to southeast direction,

down throwing strata to the north. The second northwest to southeast trending fault is located marginally towards the south-east of the site.

4.1.5 Coal Mining

A Coal Authority Consultant Mining Report has been obtained for the site (ref: GS-JYS-7U8-ANB-FJA) and is attached as Appendix D. The report indicates the presence of significant coal seams beneath the site. The recorded seams as anticipated are described by Table 4.1.

Table 4-1 – Summary of Coal Seams beneath the site.

Seam Name	Thickness (m)	Seam workable	Bearing of outcrop (°)	Dipped direction
Highgate	0 – 0.7	Yes	315 – 329	Unknown
Shafton	0.2 – 2.3	Yes	210	East
Winter/Abdy	0.0 – 1.9	Yes	-	East
Low Beamshaw	0.0 – 1.2	Yes	-	East
Meltonfield	0.0 – 1.4	Yes	-	East
Barnsley	0.0 – 3.9	Yes	-	East
Top Haigh Moor	0.0 – 4.3	Yes	-	East
Fenton	0.0 – 4.1	Yes	-	East
Parkgate	0.0 – 3.9	Yes	-	East and Northeast

The Coal Authority Consultant Mining report suggests that there are opencast workings at the site.

A Coal Mining Risk Assessment is available for the site (ref: B034815.CMRA.1 - South Barnsley).

4.1.6 Ground Workings and Natural Cavities

The absence or presence of BGS registered sites and cavities at or within 250 m of the site boundary have been summarised in Table 4-2 and

Table 4-3 below.

Table 4-2– Summary of BGS Features / Cavities

Feature	On-Site	Off-Site (within 250m)
Brit Pits	No	Yes
Surface Ground Workings	Yes	Yes
Recorded Underground Workings	No	Yes
Recorded Natural Cavities	No	No
BGS Mineral Sites	No	No
Mineral Planning Area	No	No
Non-Coal Mining	Yes	Yes

Table 4-3– On site Surface Ground Workings

Feature	Location	Mapping year	Description
Surface Ground Workings	On Site	1981	Unspecified Workings
Surface Ground Workings	On Site	1966, 1974	Opencast Workings
Surface Ground Workings	On Site	1981	Slurry Ponds
Surface Ground Workings	On Site	1982, 1988, 1992	Refuse Heap
Non-Coal Mining	On Site	n/a	Name: N/A Commodity: Iron Ore (Bedded) Class: B Localised small scale underground mining may have occurred
Non-Coal Mining	On Site	n/a	Name: N/A Commodity: Iron Ore Class: B Localised small scale underground mining may have occurred

Table 4-4– Surface Ground Workings within 250m of site

Feature	Location	Mapping year	Description
Non-Coal Mining	32m South-East	n/a	Name: N/A Commodity: Iron Ore Class: B Localised small scale underground mining may have occurred
Brit Pits	194m North-West	n/a	Name: Ferry Moor Revised OCCS Address: Barnsley, South Yorkshire Commodity: Coal, Surface Mined Status: Closed
Surface Ground Workings	6m South-East, 12m South-East, 19m North-East, 104m North-East, 106m North-East	1938, 1948, 1955, 1967, 1981	Refuse Heap
Surface Ground Workings	144m South-East	1904	Cuttings
Surface Ground Workings	212m North-East	1981,1988	Sewage Works
Surface Ground Workings	222m East	1988	Unspecified Workings
Underground Workings	222m East	1988	Unspecified Workings
Underground Workings	280m East	1967	Unspecified Mine

4.1.7 Historic Borehole Logs

There are twenty-one BGS borehole logs recorded onsite. Three of the boreholes are found across the length of the site, SE30NE220, SE30NE224 and SE40NW313 are described in the Table 4-5 below.

Table 4-5 – BGS Borehole Logs

BGS Reference Number, Depth and Date	Grid Reference, Distance and Direction	Details
SE30NE220, 9.45m, 24/3/1980	439970 408635, onsite, North East	0.00-2.50 – MADE GROUND: Generally black silty CLAY with frequent mudstone and shale gravel. 2.50-8.00m – Generally soft to firm light brown, greyish sandy silty CLAY with occasional mudstone, sandstone, and occasional coal gravel. 8.00-9.45m – Highly weathered dark grey laminated carbonaceous silty MUDSTONE.
SE30NE224, 7.50m, 26-27/08/1980	439947 408557, On Site, Central/South	0.00-0.60m – MADE GROUND: Firm, friable, grey and brown silty CLAY with mudstone fragments. 0.60-1.60m – MADE GROUND: Stiff brown, grey, silty, sandy, clay with sandstone gravel and occasional coal fragments. 1.60-1.80m – Stiff, brown, silty, coaly CLAY. 1.80-2.90m – MADE GROUND: Stiff, brown, silty CLAY with mudstone fragments 3.80-4.10m – MADE GROUND: Stiff brown silty sandy clay. 4.10-5.20m – MADE GROUND: Firm brown silty very sandy CLAY. 5.20-6.30m – Very stiff brown grey silty CLAY with small mudstone fragments. 6.30-7.50m – Very Weak highly weathered, light brown silty fine SANDSTONE
SE40NW313, 4.00m, 26/8/1980	440002 408439, On site, South East	0.00-1.70m – MADE GROUND: Stiff, brown, silty, sandy clay with gravel. Gravel is coal and mudstone. 1.70-2.50m – Stiff, orange brown mottled, silty, fine sandy clay with some fine to medium gravel. 2.50-2.80 – Very stiff, light grey brown, silty fine sandy CLAY. 2.80-3.70m – Very weak, highly weathered, grey and brown silty MUDSTONE 3.70-4.00m – Very weak, highly weathered, brown, clayey SILTSTONE.

4.1.8 BGS Soil Chemistry

The Groundsure Report also provides Estimated Background Soil Chemistry Averages for the site (British Geological Survey, 2022). The information is summarised in Table 4-6.

Table 4-6 – BGS Estimated Soil Background Chemistry

Determinand	Soil Concentration Range	
	Minimum (mg/kg)	Max (mg.kg)
Arsenic	15	25
Cadmium	1.8	1.8
Total Chromium	40	90
Lead	100	100
Nickel	15	30

4.2 HYDROGEOLOGY

Details of the hydrology of the area have been obtained from the following sources:

- Environmental database – GS-EQE-SP1-RZ9-BLY(Groundsure).
- MAGIC interactive mapping website (MAGIC, 2022).

4.2.1 Aquifer Classification

There are superficial deposits of Alluvium noted to be on the far North-East of the site and also on a small area to the North-West, both continue off site. Groundsure has identified these superficial deposits as a Secondary A aquifer, 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 aquifers.

The bedrock under the site is also classified as a Secondary A aquifer, 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 aquifers.

4.2.2 Groundwater Vulnerability

Guidance released by the EA (Envionment Agency , March 2017) states that activities that have the potential to affect the quality or quantity of groundwater must prevent groundwater pollution. All groundwater is vulnerable to pollution, and some geological formations are more vulnerable than others. The risks of groundwater pollution from any given activity depend in part on:

- The physical, chemical and biological properties of the underlying soil and rocks.
- Depth and quality of soil;
- The presence of glacial sediment and other materials – known as ‘Superficial’ deposits; and,
- Depth of the unsaturated zone.
- All the above affect how groundwater is more or less vulnerable to pollution, with type of vulnerability generally one of the following:
- Intrinsic vulnerability – this relates to the physical characteristics, it includes soil type, presence of superficial soils, or rock type; and,

- Specific vulnerability – this relates to the effect of the proposed activity including any contaminant and consequent risk to groundwater.

The Environmental Database indicates that the Superficial Secondary aquifer of Alluvium overlying bedrock to the North-West of the site has a soil/surface leaching class of High, an Infiltration value of >70% and a Dilution value of <300mm/year. Suggesting the strata is more likely to be granular.

The Alluvium overlying the North-East of the site, is also a Secondary aquifer with a High Vulnerability, though the soil/surface leaching class is Low, Infiltration value of <40% and a Dilution value of <300mm/year. Suggesting the strata is more likely to be cohesive.

The Environmental Database indicates that the bedrock Secondary A aquifer beneath the whole site is of High vulnerability, with flow mechanisms of well-connected fractures.

4.2.3 Groundwater Source Protection Zones

The site is not shown to be situated within an EA defined groundwater Source Protection Zone (SPZ).

4.2.4 Groundwater & Surface Water Abstractions

The absence or presence of groundwater abstraction wells and surface water abstractions at or within 500m of the site boundary have been summarised in Table 4-7.

Table 4-7 – Summary of Abstractions

Feature	On-Site	Off-Site – Within 500m
Groundwater Abstraction License	No	No
Surface Water Abstraction	No	No
Source Protection Zone	No	No

4.3 HYDROLOGY

Details of the hydrology of the area have been obtained from the following sources:

- Environmental database – GS-EQE-SP1-RZ9-BLY (Groundsure).
- MAGIC interactive mapping website.

4.3.1 Watercourses

The absence or presence of watercourses at or within 200m of the site boundary have been summarised in Table 4.8 below. Details are provided in Table 4.9.

Table 4-8 – Summary of Watercourses

Feature	On-Site	Off-Site
Watercourses	Yes	Yes

Table 4-9 – Description of Watercourses onsite

Feature	Location and Distance	Description
Inland river not influenced by normal tidal action	4no. Onsite	On the ground surface. Watercourse contains water year-round (in normal circumstances)
Inland river not influenced by normal tidal action	1no. Onsite	Underground watercourse. Watercourse contains water year-round (in normal circumstances)
Lake, Loch or reservoir	1no. Onsite	On the ground surface. Watercourse contains water year-round (in normal circumstances)
Inland river not influenced by normal tidal action	4m North-East	On the ground surface. Watercourse contains water year-round (in normal circumstances)
Inland river not influenced by normal tidal action	2no. 73m South West	
Inland river not influenced by normal tidal action	2no. 83m South West	
Inland river not influenced by normal tidal action	110m North-East	
Inland river not influenced by normal tidal action	2no. 133m North-East	
Inland river not influenced by normal tidal action	2no. 222m North-West	
Inland river not influenced by normal tidal action	156 m North-East	Underground watercourse. Watercourse contains water year-round (in normal circumstances)
Inland river not influenced by normal tidal action	162 m North-East	On the ground surface. Watercourse contains water year-round (in normal circumstances)
Inland river not influenced by normal tidal action	188m South-East	Underground watercourse. Watercourse contains water year-round (in normal circumstances)
Inland river not influenced by normal tidal action	195m South-East	On the ground surface. Watercourse contains water year-round (in normal circumstances)

4.3.2 Water Framework Directive Surface Water Body Catchments

The Water Framework Directive (European Parliment and Council, 2000) is an EU-led framework for the protection of inland surface waters, estuaries, coastal waters, and groundwater through river basin-level management planning. In terms of surface water, these basins are broken down into smaller units known as management, operational and water body catchments. The absence or presence of Water Framework Directive (WFD). Surface Water Body Catchments at or within 250m of the site boundary have been summarised in Table 4-10 and detailed in Table 4-11 below.

Table 4-10 – Summary of WFD Features

Feature	On-Site	Off-Site (250m)
WFD Catchments	Yes	No
WFD Groundwater Bodies	Yes	No
WFD Surface Water Bodies	Yes	No

Table 4-11 – Details of WFD Features

Feature	Location	Detail
WFD Surface water body catchments: Water Body: Dearne from Lundwood to River Dove Type: River	On-site	Operational Catchment: Dearne Management Catchment: Don and Rother Water body ID: GB104027063172 & GB104027063180
WFD Groundwater Bodies Name: Don & Rother Millstone grit & Coal Measures	On-site	Water body ID: GB40402G992300 Overall rating: Poor Chemical Rating: Poor Quantitative: Good Year: 2019
WFD Surface Water Bodies Name: Grimethorpe Dike from Source to River Dearne	On-Site	Water body ID: GB104027063180 Overall rating: Moderate Chemical Rating: Fail Quantitative: Moderate Year: 2019

4.3.3 Discharge to Controlled Waters including Pollution Incidents

The absence or presence of licenced discharge to controlled waters including pollution incidents at or within 250m of the site boundary have been summarised in Table 4-12 below. There are no current active licensed discharges or pollutant release to surface waters however revoked/historic details are given in Table 4-13.

Table 4-12 – Summary of Discharge to Controlled Waters and Pollution Incidents

Feature	On-Site	Off-Site (250 m)
Licensed Discharges to Controlled Waters	Yes	Yes
Pollutant release to surface waters (Red List)	No	Yes
Pollutant release to public sewer	No	No
List 1 Dangerous Substances	No	No
List 2 Dangerous Substances	No	No
Pollution Inventory Substances	No	No
Pollution Waste Transfers	No	No
Pollution Inventory Radioactive Waste	No	No
Pollution Incidents (EA/NRW)	No	No

Table 4-13 – Details of Discharge to Controlled Waters and Pollution Incidents

Feature	Location	Details
Licensed Discharges to Controlled Waters	On Site (North-East)	Grimethorpe Colliery (Closed), Off A1686 Effluent type: Trade Discharges - Unspecified Permit Number: 3385 Issue Date: 22/09/1983 Revocation Date: 09/08/1995
Licensed Discharges to Controlled Waters	51m North-East, 138m North-West	Ferry Moor Reclamation Scheme, Engine Lane, Grimethorpe Effluent type: Trade Discharges – Site Drainage (Contam surface water, Not waste) Permit Number: WRA7578 (1) Issue Date: 02/08/2001 Revocation Date: 01/02/2003
Licensed Discharges to Controlled Waters	51m North-East, 138m North-West	Ferry Moor Reclamation Scheme, Engine Lane, Grimethorpe Effluent type: Trade Discharges – Site Drainage (Contam surface water, Not waste) Permit Number: WRA7578 (2) Issue Date: 02/08/2001 Revocation Date: 01/11/2003
Licensed Discharges to Controlled Waters	51mNorth-East	Ferry Moor Reclamation Scheme, Engine Lane, Grimethorpe Effluent type: Trade Discharges – Site Drainage (Contam surface water, Not waste) Permit Number: WRA7578 (3) Issue Date: 02/08/2001 Revocation Date: 01/10/2004
Licensed Discharges to Controlled Waters	50m North	Grimethorpe Colliery (Closed), Off A1686 Effluent type: Trade Discharges - Process Effluent - Not Water Company Permit Number: 3748 (1) Issue Date: 22/11/1983 Revocation Date: 13/02/1986
Licensed Discharges to Controlled Waters	50m North	Grimethorpe Colliery (Closed), Off A1686 Effluent type: Trade Discharges - Process Effluent - Not Water Company Permit Number: 3748 (2)

		Issue Date: 14/02/1986 Revocation Date: 17/11/1988
Licensed Discharges to Controlled Waters	50m North	Grimethorpe Colliery (Closed), Off A1686 Effluent type: Trade Discharges - Process Effluent - Not Water Company Permit Number: 3748 (3) Issue Date: 18/11/1988 Revocation Date: 18/05/1993
Licensed Discharges to Controlled Waters	50m North	Grimethorpe Colliery (Closed), Off A1686 Effluent type: Trade Discharges - Process Effluent - Not Water Company Permit Number: 3748 (4) Issue Date: 19/05/1993 Revocation Date: 20/12/1994
Licensed Discharges to Controlled Waters	50m North	Grimethorpe Colliery (Closed), Off A1686 Effluent type: Trade Discharges - Process Effluent - Not Water Company Permit Number: 3748 (5) Issue Date: 21/12/1994 Revocation Date: 28/11/1995
Pollutant release to surface waters (Red List)	51m North-East	UK Coal Mining Limited, Ferry Moor Reclamation Scheme, Engine Lane Effluent Type: Trade Discharges – Site Drainage (Contam Surface Water, Not Waste) Permit Number: WRA7578 (3) Discharge Type: Coal Extraction, Surface Approval Date: 02/11/2003

4.4 RADON

Both the Groundsure environmental database and the Radon Interactive Viewer (UK Health Security Agency, 2022) indicate that approximately 50% of the site (East/North-East) is within a very low probability are where <1% of homes are estimated to be above the action level. Building control measures suggest that radon protection measures are not required for properties in England and Wales. However, the North / West and South of the site is between 3% - 5% of homes are estimated to be above action level. Therefore, building control measures are required to be 'Basic' for properties in England and Wales. No buildings are proposed as part of this development.

4.5 UNEXPLODED ORDNANCE (UXO)

The site falls within a low-risk area with regards to UXO as detailed by the risk map shown in Appendix E.

5.0 ENVIRONMENTAL DATABASE SEARCH

5.1 INTRODUCTION

Regulatory authority information relevant to the site and its surroundings has been obtained from the undertaking of an environmental database search (Groundsure). The information is summarised below, and the environmental database records are enclosed in Appendix B. Distances stated are approximate and are taken from the boundary of the site to the database recorded entries.

The following summary is generally limited to locations within 250m of the site boundaries unless it is considered that installations or activities beyond that range could potentially have an impact on the site or be affected by the development of the site.

5.2 WASTE

The absence or presence of waste facilities at or within 250m of the site boundary have been summarised in Table 5-1 below and detailed in Table 5-2.

Table 5-1 - Summary of Waste Facilities

Facility Type	On-Site	Off-Site (250m)
Active or Recent Landfill	No	No
Historical Landfill (BGS records)	No	No
Historical Landfill (LA/mapping records)	No	No
Historical Landfill (EA/NRW records)	No	No
Historical Waste Sites	No	No
Licensed Waste Sites	No	No
Waste Exemptions	Yes	No

Table 5-2 - Details of Waste Facilities – On-Site

Facility Type	Site Name & Location	Detail
Waste Exemption WEX246228	Northeast of Site	Category: Using Waste Exemption Sub-category: Not on a farm Description: Use of waste in construction

5.3 HAZARDOUS SUBSTANCES AND HEALTH & SAFETY

The absence or presence of sites subject to restrictions in relation to Health & Safety within 1 km of the site boundary has been summarised in Table 5-3 and 5-4 below.

Table 5-3 - Summary of Facilities Subject to Active Consents

Facility Type	On-Site	Off-Site
Regulated Explosive Sites	No	No
Hazardous Substance Storage/Usage	No	No
Historical Licenced Industrial Activities	Yes	Yes
Licensed Industrial Activities (Part A (1))	No	No
Licenced Pollutant Release (Part A(2)/B)	No	No
Registered Radioactive Substances Consents	No	No
Control of Major Accident Hazard sites	No	No

Table 5-4 - Detail of Facilities Subject to Active Consents

Facility Type	Site Name & Location	Description Details
Historical licensed industrial activities (IPC)	Ferry Moor Opencast Coal Site, Engine Lane, Grimethorpe, Barnsley, South Yorkshire, S72 7BH 90m North	Operator: Coalite Products Ltd T/a Coalite Chemicals Process: Carbonisation and Associated Process Status: Superseded by Variation Original Permit Number: IPCAIRAPP Date Approved: 06/07/1993. Status: Revoked
Historical licensed industrial activities (IPC)	Ferry Moor Opencast Coal Site, Engine Lane, Grimethorpe, Barnsley, South Yorkshire, S72 7BH 90m North	Operator: Coalite Products Ltd T/a Coalite Chemicals Process: Carbonisation and Associated Process Status: Superseded by Variation Original Permit Number: IPMINVAR Date Approved: 14/04/1994. Status: Revoked
Historical licensed industrial activities (IPC)	Main Building, Grimethorpe, Barnsley, South Yorkshire, S72 7AB 129m North-East	Operator: Grimethorpe Pfbc Establishment Process: Combustion Processes Original Permit Number: IPCAIRAPP Date Approved: 24/01/1992. Status: Surrendered

5.4 ENVIRONMENTAL AND CULTURAL DESIGNATIONS

The absence or presence of Environmental Designations at or within 250m of the site boundary have been summarised in Table 5-5 below. Further detail is provided in Table 5-6.

Table 5-5 - Summary of Environmental Designations

	On-Site	Off-Site
Environmental Designated Areas	Yes	No
Visual and Cultural Designations	No	No
Agricultural Designations	Yes	Yes
Habitat Designations	No	No

Table 5-6 - Detail of Environmental Designations

Designation	Location	Description	Details
Green Belt	On Site	South & West Yorkshire	Local Authority: Barnsley
Nitrate Vulnerable Zone	On site	River Dearne NVZ	Type: Surface Water NVZ ID: 278 Status: Existing

5.5 FLOODING

The absence or presence of flooding potential at the site is summarised in Table 5-7 below.

Table 5-7 - Summary of Flooding Potential

Designation	On Site	Off site	Detail
Risk of Flooding from Rivers and Sea	No	0-50m	On site Flood risk – High 0-50m off site Flood risk – High (Greater than or equal to 1 in 30 chance)
Historical Flood Events	Yes	91m North East	On Site - 2020 Storm Ciara (Main River Channel capacity exceeded – No raised Defences) Off Site – 2020 Storm Dennis (Drainage – Local drainage/surface water)
Flood Defences	No	No	-
Area Benefiting from Flood Defences	No	No	-
Flood Storage Areas	No	No	-
Flood Zone 2	On Site	-	Zone 2 – Fluvial / Tidal Models
Flood Zone 3	On Site	-	Zone 3 – Fluvial / Tidal Models
Groundwater Flooding	Yes	0-50m	Highest risk on site: Negligible Highest risk within 50 m: Negligible
Surface Water Flooding	Yes		Highest risk on site: 1 in 30 years, >1.0m Highest risk within 50 m: 1 in 30 years, >1.0m

5.6 HISTORICAL LAND USES

The absence or presence of Historical Land Uses at or within 250m of the wider site boundary has been summarised in Table 5-8 below. Further detail is given in Table 5-9.

Table 5-8 - Summary of Industrial Land Uses

Feature	On-Site	Off-Site (250 m)
Historical Industrial Land Uses	Yes	Yes
Historical Tanks	Yes	Yes
Historical Energy Features	No	No
Historical Petrol Stations	No	No
Historical Garages	No	No
Historical Military Land	No	No

Table 5-9 – Detail of Historical Land Uses

Type	Entry	Distance (Direction)	Mapping Date
Historical Industrial Land Uses	Unspecified Tank	On-site	1985, 1988
	Refuse Heap	On-site	1992
	Slurry Ponds	On-site	1981
	Unspecified Works	On Site	1988
	Unspecified Workings	On Site	1981
	Opencast Workings	On Site	1966-1974
	Refuse Heap	On Site	1981-1988
	Railway Sidings	4m Northeast, 18m North East, 48m East,	1955-1988
	Refuse Heap	6m Southeast, 12m South East, 19m North East, 105m North East	1938-1967
	Unspecified Tanks	30m Southeast, 84m South East, 93m South East, 113m South East, 161m North East, 237m North East, 238m North East, 242m North East	1938-1988
	Tramway Sidings	90m Northeast	1938
	Cuttings	144m Southeast	1904
	Sewage Works	212m Northeast	1981-1988
	Unspecified Commercial/Industrial	230m Northeast	1948
Historical Tanks	Unspecified Tank	On Site	1985
	Unspecified Tank	13m North	1985-1993
	Unspecified Tank	20m Southeast	1984

	Tanks	31m Southeast	1985
	Unspecified Tank	30m Southeast	1985
	Tanks	31m Southeast, 60m Southeast	1985
	Unspecified Tank	57m Southeast	1984
	Unspecified Tank	87m Southeast, 108m Southeast	1961-1985
	Unspecified Tank	129m Southeast	1984
	Tanks	148m Southeast	1985
	Unspecified Tank	146m Southeast,	1984
	Tanks	148m Southeast	1985
	Unspecified Tank	192m Southeast	1985
	Unspecified Tank	241m East	1961
	Unspecified Tank	239m Northeast	1931

5.7 CURRENT INDUSTRIAL LAND USES

The absence or presence of potentially contaminative Current Industrial Land Uses at or within 100 m of the wider site boundary have been summarised in Table 5-10 below. Further detail is given in Table 5-11.

Table 5-10 - Summary of Current Industrial Land Uses

Entry	On-Site	Off-Site (100 m)
Recent Industrial Land Uses	No	Yes
Current or Recent Petrol Stations	No	No
Electricity Cables	No	No
Gas Pipelines	No	No
Sites Determined as Contaminated Land	No	No

Table 5-11 - Detail of Current Industrial Land Uses

Type	Entry	Distance (Direction)	Details
Recent Industrial Land Uses	Pylon	14m West, 36m South West	South Yorkshire, S72 – Electrical Features
	Shafton Colliery Community Turbine	33m South	South Yorkshire, S72 Cudworth, Barnsley, South Yorkshire, S72 – Energy Production
	Pylon	146m North West, 210m South	South Yorkshire, S72 – Electrical Features
	Factory	88m North East	South Yorkshire, S72 – Unspecified works / Factories
	Electricity Sub Station	150m North East	South Yorkshire, S72 – Electrical Features

6.0 CONCEPTUAL SITE MODEL AND PRELIMINARY GROUND CONTAMINATION RISK ASSESSMENT

6.1 OVERVIEW

The information presented in the previous sections of this report has been collated and evaluated to establish an initial qualitative risk assessment for the site. A conceptual model of the site has been generated based on information derived from this Phase 1 Geo-environmental Assessment.

The site has been considered with regard to current UK legislation and guidance, namely Part 2A of the Environmental Protection Act 1990 and the Contaminated Land (England) Regulations 2006, as amended, and in accordance with current UK good practice guidelines (for example BS10175:2011).

In general, ground contamination can occur through several causes, particularly from historical operations and activities. Contamination can result from either on-site sources or from on-site migration from off-site sources, leading to long term liabilities under recent legislation for any site owner.

For a risk of pollution or environmental harm to occur because of ground contamination, all of the following elements must be present:

- Source, i.e., a substance that is capable of causing pollution or harm;
- Pathway, i.e., a route by which the contaminant can reach a target; and
- Receptor (target), i.e., something which could be adversely affected by the contaminant.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

6.2 CURRENT SITE USAGE AND PROPOSED DEVELOPMENT

The site is currently an unused area of land mainly covered by overgrown vegetation and ponds. The proposed redevelopment of the site comprises of a plan to repurpose the land including the import of 430,300m^3 of soils to create an open public space with grass, trees and other nature features.

A Masterplan has been provided and is included in the Third Party Drawings.

6.3 CONCEPTUAL SITE MODEL

The key source, pathways and receptor model is outlined below within the context of potential development of the site.

6.3.1 Potential Sources of Contamination

Potential sources within the proposed development area include the following:

On-site Sources

- Made Ground – potential contaminants associated with the presence of historic refuse heaps, colliery spoil and infilled opencast/slurry pits.
- Historic Features on site – Slurry Ponds, tanks, Colliery related industry

Off-site Sources

- Tanks – Unknown contaminants
- Refuse Heaps – potential contaminated land associated with historic refuse heaps.
- Historic Colliery – Works associated with coal mining and processing.

6.3.2 Potential Contaminant Pathways

The following contaminant pathways are considered to potentially be active based on the current site use and proposed development:

Human Exposure Pathways

- Direct dermal contact or ingestion of soils, or inhalation of dust and/or vapors (i.e., human interaction with surface and sub-surface materials).

Environmental Pathways

- Leaching and horizontal or vertical migration through the unsaturated ground, either through permeable sub-surface materials and/or preferential pathways.
- Lateral and vertical migration of groundwater through permeable sub-surface materials and/ or preferential pathways.
- Leaching to surface water run-off/drainage.
- The migration and accumulation of gases or vapors through permeable sub-surface materials and/ or preferential pathways.

6.3.3 Potential Receptors at Risk

The following potential receptors have been identified:

Human Health

- Future site users (commercial/leisure).
- Construction / Maintenance Workers (during and post construction).
- Adjacent site users (commercial)

Wider Environment

- Building Infrastructure and supply pipes.
- Adjacent Properties.
- Underlying Secondary A Aquifers.

6.4 GROUND CONDITIONS RISK ASSESSMENT

The source, pathway, receptor linkages identified in the previous section are outlined and a qualitative risk assessment shown in Table 6.1, and off-site sources in Table 6.2.

The risk assessment considers the site within an area context and assesses potential risks to identified receptors in relation to the existing site setting and the proposed development. CIRIA C552 has been used to define the risk rating presented in the Qualitative Risk Assessment matrix, the methodology for which is presented in Appendix F.

Table 6-1 - CIRIA C552 Qualitative Risk Assessment (On-Site Sources)

This matrix is based on CIRIA C552 risk evaluation methodology, definitions for risk ratings is presented in Appendix F						
Source	Pathway	Receptor	Consequence of risk being realised	Probability of risk being realised	Risk Classification	Justification & Potential Risk Management (if required)
Ground Conditions – Made Ground contaminants associated with unknown infill material.	Dermal contact, ingestion and/or inhalation of or dusts	Human Health – Future site users (Open Public Space/Leisure)	Medium	Unlikely	Low	Made Ground is anticipated onsite associated with the site by a) the Historic Opencast mining operations b) Slurry ponds and industrial activity associated with the Colliery c) Unknown infill of the site and presence of historic 'Refuse Heaps'. These areas should be identified during the groundwork's operation. Any imported material will be chemically tested and capped with topsoil therefore direct contact made with underlying material is unlikely therefore low risk
		Human Health (Construction Workers with PPE)		Likely	Moderate	Risk reduced to low through the use of appropriate site practices and PPE.
	Leaching to groundwater, drainage, and lateral / vertical migration.	Adjacent properties and land users	Mild	Low	Low	Made Ground is anticipated onsite associated with the site by a) the Historic Opencast mining operations b) Slurry ponds and industrial activity associated with the Colliery c) Unknown infill of the site and presence of historic 'Refuse Heaps'. These areas should be identified during the groundwork's operation. Based on current (and intended) usage of site, unlikely to impact off site receptors by leaching and moving off site. Historic borehole data described predominantly cohesive strata beneath the site, potentially reducing the risk. .
		Secondary A Aquifer	Medium	Low	Moderate/Low	
Made Ground - Ground Gas and vapors associated with Made Ground and infilled land	Generation and migration / accumulation of ground gases	Human Health – Future Site Users	Mild	Unlikely	Low	There is the potential for infilling and Made Ground to be present at the site. If no structures proposed, then a gas risk does not exist – everything is open space
		Buildings and Services				

Table 6-2 - CIRIA C552 Qualitative Risk Assessment (Off-Site Sources)

This matrix is based on CIRIA C552 risk evaluation methodology, definitions for risk ratings is presented in Appendix F						
Source	Pathway	Receptor	Consequence of risk being realised	Probability of risk being realised	Risk Classification	Justification & Potential Risk Management (if required)
Tanks	Leaching to groundwater, drainage and lateral / vertical migration.	Aquifers beneath site	Medium	Unlikely	Low	There is potential for mobile contaminants (hydrocarbons) to leach into the aquifers and migrate under the site. Historic borehole data described predominantly cohesive strata beneath the site, potentially reducing the risk so is unlikely to present a risk to site.
	Ground gases/vapours	Human Health – Future site users (commercial / leisure)	Medium	Unlikely	Low	There is some potential for generation of ground gases from the volatile hydrocarbons in tanks however given the proposed development is unlikely to present a risk to site.
Tram/Railway Sidings – potential contaminated land associated with historic railway and tramways	Leaching to groundwater, drainage and lateral / vertical migration.	Human Health – Future site users (Public Open Space)	Mild	Unlikely	Low	The aquifer beneath the site is a Secondary A (permeable) However, the historical boreholes for the site suggest the site is underlain by cohesive strata as such migration of contaminants onto site is unlikely and as such migration of contaminants is likely to be limited.
	Dermal contact, ingestion and/or inhalation of or dusts					
Made Ground – Associated with former Colliery and Refuse Heaps	Leaching to groundwater, drainage, and lateral / vertical migration.	Secondary A Aquifer	Medium	Low	Moderate/Low	Made Ground is anticipated to surround the site associated with a) the Historic Opencast mining operations b) Slurry ponds and industrial activity associated with the Colliery c) Unknown infill of the area and presence of historic 'Refuse Heaps'. The area around the has been shown in historic borehole data to be predominantly cohesive strata beneath the site, potentially reducing the risk .

7.0 PRELIMINARY GEOTECHNICAL ASSESSMENT

Based on the information identified in the preceding sections, the sections below summarise the anticipated ground conditions and associated geotechnical assessment for the site, including highlighting the potential constraints for future development. Actual ground conditions would need to be confirmed through ground investigation in due course.

7.1 ANTICIPATED GROUND CONDITIONS

The following ground conditions are anticipated to be underlying the site:

- Opencast backfill.
- Geological mapping suggests there is superficial strata on site, Quaternary Alluvium is recorded as being present to the North-East and to the North-West onsite and is absent from the remainder of the site.
- The Bedrock Strata mapped beneath the site indicates that it is underlain by the Pennine Middle Coal Measures Formation.

7.2 GROUND STABILITY

Table 7-1 indicates the potential ground stability hazards on-site, as obtained from the Groundsure report.

Table 7-1 – Ground Stability Hazards

Name	Details	Rating
Shrink Swell Clay	The potential hazard presented by soils that absorb water when wet (making them swell) and lose water as they dry (making them shrink).	The soils are considered to be variable with the majority of the site considered to be **Very Low**. **Negligible** soils are recorded to the south, west and northwest.
Running Sands	The potential hazard presented by types of ground that can contain loosely packed sandy layers that can become fluidised by water flowing through them. Such sands can 'run', removing support from overlying buildings and causing potential damage.	**Very Low -** Across the majority of the site except at the most north western boundary has been identified with a hazard rating of **Negligible** - Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions.
Compressible Deposits	The potential hazard presented by types of ground that may contain layers of very soft materials like clay or peat and may compress if loaded by overlying structures, or if the groundwater level changes, potentially resulting in depression of the ground and disturbance of foundations.	**Moderate –** The northeast area of the site has compressibility and uneven settlement hazards probably present. Land use should consider specifically the compressibility and variability of the site. The majority of the site has **Very Low** – Compressibility and **Negligible** at the northwestern tip where compressible strata are not thought to occur.
Collapsible deposits	The potential hazard presented by natural deposits that could collapse when a load (such as a	**Very Low -** Deposits with potential to collapse when loaded and saturated are unlikely to be present.

	building) is placed on them, or they become saturated with water.	
Landslides	The potential for land sliding (slope instability) to be a hazard assessed using 1:50,000 scale digital maps of superficial and bedrock deposits, combined with information from the BGS National Landslide Database and scientific and engineering reports.	**Very Low -** Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered. Two very small areas of the site have been identified to the northwest as **Low** - Slope instability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site.
Ground dissolution of soluble rocks	The potential hazard presented by ground dissolution, which occurs when water passing through soluble rocks produces underground cavities and cave systems.	**Negligible** - Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.

7.3 SLOPE STABILITY

The site has a variable and sloping topography, a spoil mound is described as being present to the centre south onsite. Given the proposed development, slope stability is not likely to be a constraint to developing the site.

7.4 DRAINAGE

The shallow soils underlying the site are anticipated to exhibit low/moderate permeability.

7.5 SUMMARY OF RELEVANT GEOTECHNICAL FACTORS

Within the context of this geotechnical assessment and based on the information above, the following potential constraints have been identified with respect to the proposed development:

- Unknown depth, strength characteristics and composition of each strata deposits across site.
- Ground conditions across the site may differ to those anticipated.
- Potential for differential settlement associated with the fill of the opencast.

It should, however, be noted that the actual ground conditions will need to be confirmed through intrusive investigation and laboratory testing in due course to assess the in-ground abnormals.

8.0 CONCLUSIONS

8.1 CONCLUSIONS

8.1.1 Geotechnical Assessment

Potential geotechnical constraints have been identified associated with development of the site, relating to:

- Unknown depth, strength characteristics and composition of each strata deposits across site.
- Ground conditions across the site may differ to those anticipated.
- Potential for differential settlement associated with the fill of the opencast.

8.1.2 Ground Contamination

The risk from ground contamination at the site is generally considered to be as follows:

- Future site users (Open Public Space) – the risk is **Low** from identified contamination sources and pathways.
- Construction / maintenance workers – the risk is **Moderate** from identified contamination sources and pathways but can be reduced to Low through the use of appropriate PPE.
- Controlled waters - the risk is **Low to Moderate/Low** from the identified contamination sources and pathways.
- Risk to site from adjacent properties and Aquifers (Bedrock) is **Low**.
- The risk from ground contamination from the adjacent Tanks is **Low** to all receptors.
- The risk from other off-site sources is **Low** to all receptors.

8.2 SUMMARY

Whilst there is Made Ground materials and infilled opencast onsite due to historic uses, the risk posed to the local environment and proposed development, import of natural and inert soils and upfilling of the site is low.

The proposed development does not include buildings, it is primarily the import and placement of soils. Should some areas of the site require reduction in levels or contouring, construction workers the risk of encountering contaminated soils is considered low although a watching brief should be maintained so that if unexpected ground is encountered, works stop and a geo-environmental consultant is consulted.

9.0 REFERENCES

British Geological Society. (2023). Geology of Britain Viewer. Retrieved from mapapps.bgs.ac.uk: https://mapapps.bgs.ac.uk/geologyofbritain/home.html

British Geological Survey. (2023). GeoIndex. Retrieved from http://www.bgs.ac.uk/GeoIndex/

CIRIA. (2001). Contaminated land risk assessment A guide to good practice.

Coal Authority. (2020). Coal Authority Interactive Map Viewer. Retrieved from mapapps2.bgs.ac.uk: https://mapapps2.bgs.ac.uk/coalauthority/home.html

Coal Authority (2022) CON29M Official Coal Mining Search.

DEFRA. (2021). MAGIC. Retrieved from Magic Map: http://magic.defra.gov.uk/MagicMap.aspx

Environment Agency. (April 2017). New Groundwater Vulnerability Mapping Methodology in England and Wales. Reference SC040016/R. Environment Agency.

Environmental Agency. (2021, April 19). Land contamination risk management (LCRM). Retrieved from Gov.uk: https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm

European Parliament and Council. (2000). The Water Framework Directive 2000/60/EC. The European Parliament.

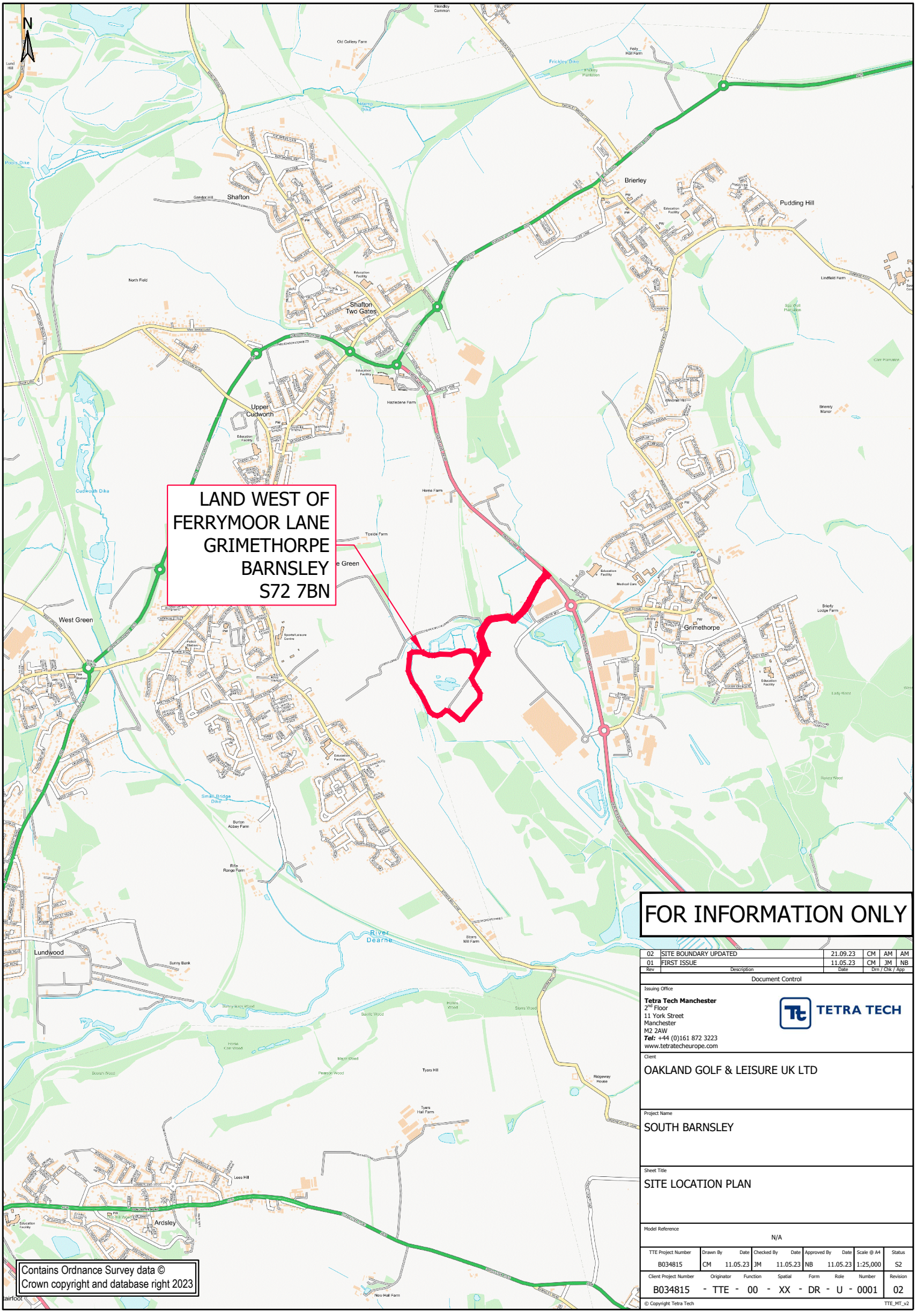
MAGIC. (2022). magic.defra.gov.uk. Retrieved from https://magic.defra.gov.uk/MagicMap.aspx

Scivyer, C. (2015). BRE 211. Radon: Guidance on protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishment projects). Fifth Edition.. BRE.

UK Health Security Agency. (2022). UK maps of radon. Retrieved from https://www.ukradon.org/information/ukmaps

Zetica UXO. (2022). Zetica UXO Risk Maps. Retrieved from https://zeticauxo.com/downloads-and-resources/risk-maps/

DRAWINGS



FOR INFORMATION ONLY

Rev	Description	Date	Drn	Chk	App
02	SITE BOUNDARY UPDATED	21.09.23	CM	AM	AM
01	FIRST ISSUE	11.05.23	CM	JM	NB

Document Control

Issuing Office

Tetra Tech Manchester
2nd Floor
11 York Street
Manchester
M2 2AW
Tel: +44 (0)161 872 3223
www.tetratecheurope.com

TETRA TECH

Client

OAKLAND GOLF & LEISURE UK LTD

Project Name

SOUTH BARNSLEY

Sheet Title

SITE LOCATION PLAN

Model Reference

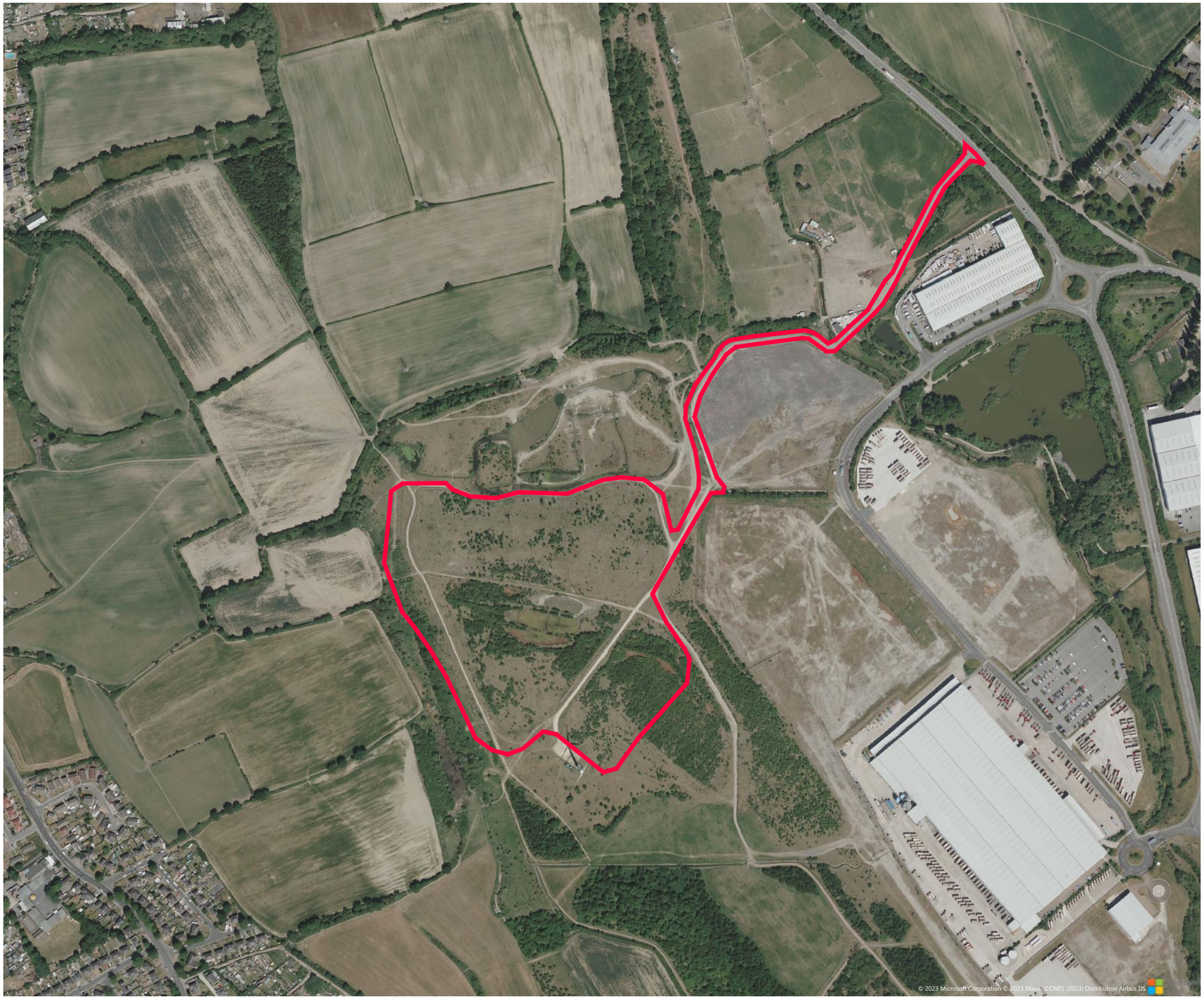
N/A

TTE Project Number	Drawn By	Date	Checked By	Date	Approved By	Date	Scale @ A4	Status
B034815	CM	11.05.23	JM	11.05.23	NB	11.05.23	1:25,000	S2

Client Project Number	Originator	Function	Spatial	Form	Role	Number	Revision
B034815	- TTE -	00 -	XX -	DR -	U -	0001	02

TTE_MT_v2

N



0 50 100 150 200 250 m

SCALE 1:5000

KEY

SITE BOUNDARY

FOR INFORMATION ONLY

Rev	Description	Date	Drn	Chk	App
02	SITE BOUNDARY UPDATED	21.09.23	CM	AM	AM
01	FIRST ISSUE	11.05.23	CM	JM	NB

Document Control

Issuing Office

Tetra Tech Manchester
2nd Floor
11 York Street
Manchester
M2 2AW
Tel: +44 (0)161 872 3223
www.tetratecheurope.com

TETRA TECH

Client

OAKLAND GOLF & LEISURE UK LTD

Project Name

SOUTH BARNSLEY

Sheet Title

REDLINE BOUNDARY PLAN

Model Reference

N/A

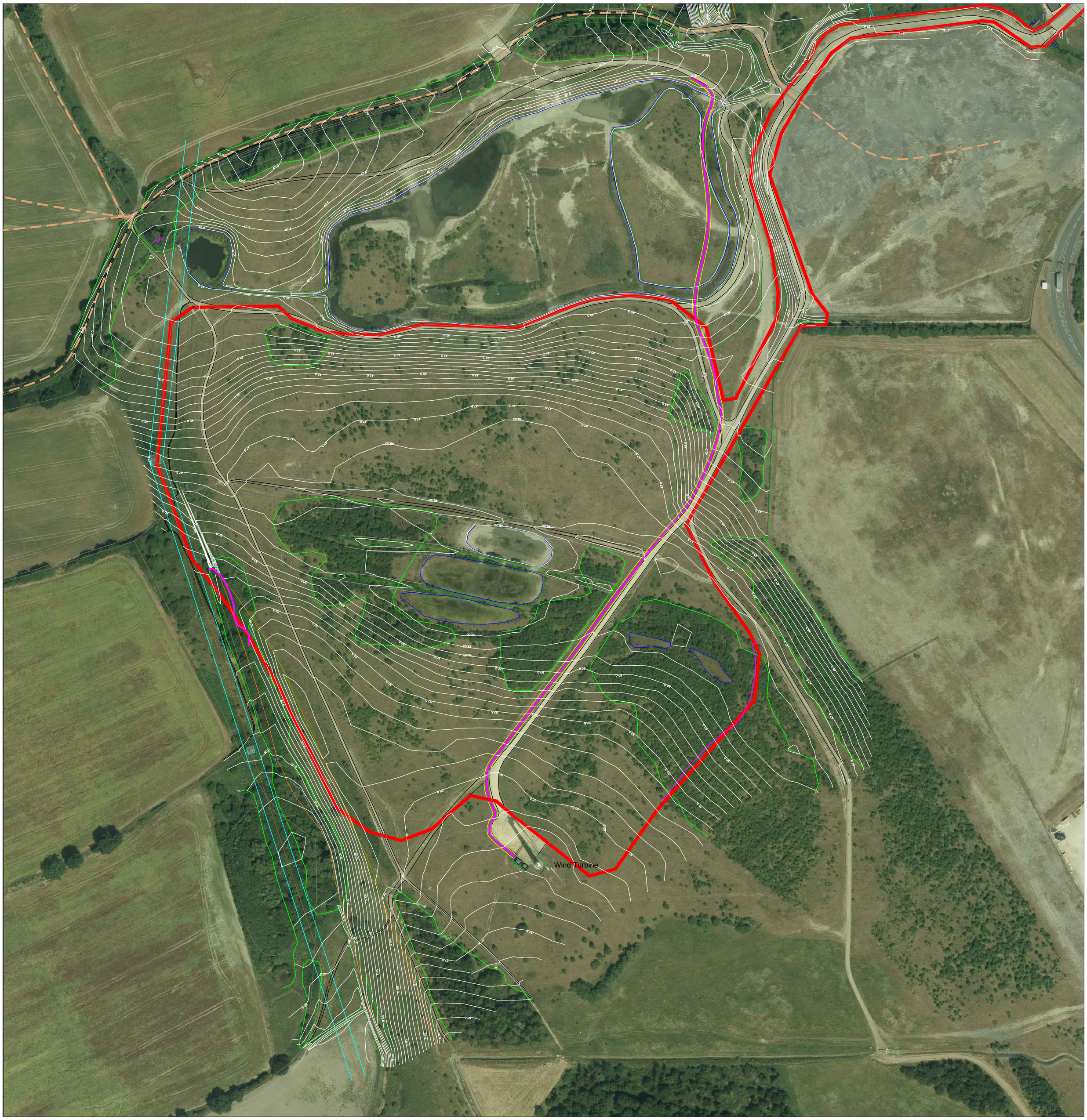
TTE Project Number	Drawn By	Date	Checked By	Date	Approved By	Date	Scale @ A3	Status
B034815	CM	11.05.23	JM	11.05.23	NB	11.05.23	1:5,000	S2

Client Project Number	Originator	Function	Spatial	Form	Role	Number	Revision
B034815	- TTE -	00 -	XX -	DR -	U -	0002	02

TTE_MT_v2

THIRD PARTY DRAWINGS

Agricultural Restoration & Landscape Enhancement Scheme



Key:

- Existing Contours (1m Metre Intervals)
- Existing Scrub Vegetation
- Overhead Powerlines
- Existing Tracks
- Existing Wet / Dry Areas
- Underground Powerline plus Wayleave
- Application Boundary (See Also Plan 901.05)
- Existing Public Rights Of Way

0 50 100 Meters

Scale 1:1250 @ A1

Drawn By: GW

Revision.: A - 14/09/23 - adjustment to red line

Scale: 1: 1250 @ A1

Drawing No: 901.02 Rev A

Project Name: Grimethorpe

Date: 14th September 2023

Drawing Name: Existing Site Survey

Checked By BW

OAKLAND GOLF AND LEISURE

Weller Designs Limited

Agricultural Restoration & Landscape Enhancement Scheme

Key:

- Existing Contours (1m Metre Intervals)
- Existing Scrub Vegetation
- Overhead Powerlines
- Existing Tracks
- Existing Wet / Dry Areas
- Existing Public Rights Of Way
- Underground Powerline plus Wayleave
- Application Boundary (See Also Plan 901.05)
- Proposed Contours (1m Intervals)
- Proposed Amenity Grass
- Proposed Permissive Public Access Paths

0 50 100 Mete

Scale 1:1250 @ A1

Drawn By: GW

Revision.: A - 14/09/23 - adjustment to red line

Scale: 1: 1250 @ A1

Drawing No: 901.03 Rev A

Project Name: Grimethorpe

Date: 14th September 2023

Drawing Name: Grading Plan

Checked By BW

OAKLAND GOLF AND LEISURE

Weller Designs Limited