Ground Appraisal Report

Sound Creation Design Centre, Windhill Lane, Barnsley

Client:	Pit Stop Productions
Document Type:	Report
Document No.:	1226-ACE-GEO-GA-001
Revision:	001
Date:	2024/04/30

Version History

This report has been prepared by Apex Consulting Engineers with reasonable skill, care and diligence, within the best practice and guidance current at the time of issue, within the scope of works which have been agreed with the client.

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The report is written in the context of the development proposals submitted to Apex by the Client as part of the appointment. Any changes to the development proposals may necessitate significant revisions to this report.

The report (including appendices) should be read in its entirety. Apex cannot be held responsible for any sections of this report being taken out of context. This includes information submitted separately via download link (i.e. full copies of environmental search data from Envirocheck) which are not included as part of the main PDF due to their file size.

Intrusive investigation only allows observation and assessment of ground across a small portion of the total site area. Therefore, it is possible that significant features may not have been encountered during the investigation, despite appropriate design and planning. Apex cannot accept for conditions not revealed by the exploratory holes. Any interpretation of strata between or below exploratory holes is for guidance only and Apex hold no responsibility as to its accuracy.

It should be noted that groundwater levels are susceptible to seasonal and other variations; this should be borne in mind when considering observations/measurements associated with groundwater contained in this Report.

Apex reserve the right to amend this Report in the light of further information that may become available.

Revision	Date	Notes	Prepared by	Checked by	Approved by
001	2024/04/30	First Issue	M Simmons	M Thompson	M Thompson

EXECUTIVE SUMMARY

Category	Comments
Site location	North Barnsley NGR: SE 323 111 Postcode: S75 5BH
Description	Roughly square parcel of rough grassland with the remains of a burned out stable and associated hard standing in the centre. The site slopes from north to south from a high point of c. 150mAOD to a low point of c. 142mAOD.
Proposed Development	Development of a low-rise commercial unit (sound studio) with associated single external “pods” in the west, areas for natural wildlife including woodlands and a pond in the centre & west, and a private access road with car parking in the south.
History	The site and surrounding area have been subject to coal mining activities, with a former shaft shown in the centre, and a spoil pile in the south-east. Other than the above and the current stables, no other significant development has taken place.
Environmental Setting	Mapped Geology comprises made ground (associated with mining), with Pennine Middle Coal Measures below (Secondary A Aquifer). No landfills are present within influencing distance. Nearest watercourse is 112m east. Not within a Source Protection Zone.
Ground conditions	The site is underlain in the north and west by granular and cohesive residual soils overlying the Pennine Middle Coal Measures. In the southeast significant heterogenous made ground deposits up to 3.10m thick are recorded which coincides with the spoil pile marked on historical plans. Rockhead is at c. 2m below the proposed studio (locally up to 2.7m depth), but deeper (up to c. 3.6m) in the south (area of former spoil pile).
Coal mining	The Meltonfield (outcrops on site) and Two Foot (present at shallow depth) coal seams are not considered to pose a significant risk to surface stability. The Winter/Abdy seam is worked beneath the site, but appears to have been “packed” with mining waste when abandoned. Given its depth, it poses a low risk to the site, and further mitigation (drilling & grouting) should not be required. A mine entry is recorded in the centre of the site. Trenching is required to locate the mine entry such that an appropriate treatment can be determined (likely grouting of the shaft or placement of a shaft cap at rockhead level).
Contamination	No significant contamination has been identified. Additional investigation within the vicinity of the stables buildings (once demolished) should be undertaken to confirm the absence of contamination in this area, especially given the presence of possible ACMs identified (corrugated sheeting) identified here during the site walkover.

Category	Comments
Hazardous gas	The site is considered to be at risk of hazardous gas due to the presence of mineworkings mapped beneath the site and in the vicinity, as well as made ground mapped within the site boundary and surrounding area associated with mining activities. Monitoring is currently being undertaken with an initial 6 visits proposed over a 2-month period. Basic radon protection measures are required.
Foundations & floor slabs	The natural strata should provide sufficient bearing capacity for the adoption of traditional pad foundations. Foundations will need to take account of potential tree influence, notably in the north-west. A settlement analysis should be undertaken to ascertain likely settlements between pads cast within Cohesive Residual Soils and those cast in Weathered Bedrock. Where excessive settlements are anticipated, foundations in areas of proposed fill (south) may need to extend to significant depths to reach Weathered Bedrock, which would necessitate use of underbuild techniques.
Drainage	In-situ testing has concluded that use of soakaways is not feasible. Apex have issued a Drainage Strategy Report for this site (ref. 1226-ACE-ZZ-XX-RP-C-1001, dated April 2024) which outlines recommendations in relation to drainage, and should be read in conjunction with this report.
Access road & car parking	Where the proposed access road crosses areas of made ground, this is the case, it is recommended that the made ground be excavated to its full thickness (or 2m, whichever is the shallower) and replaced with suitable engineered fill such that a CBR value of at least 3% is achieved at formation level. The natural strata should yield CBRs of 3% or greater, which should be verified by in-situ plate bearing tests/CBRs prior to construction. The suitability of imported materials used in the proposed access road and areas of car parking should be subjected to confirmatory lab and in-situ testing.
Further works	The following additional works are recommended in light of this investigation: • Additional investigation (trial pitting & chemical analysis) within the vicinity of the stables, once removed. • Trenching to locate & record the location and diameter of the mine entry • Provision of a specification for the treatment of the mine entry • Production of a tree influence plan to ascertain the impact of trees on the proposed foundation/floor slab. For this to be completed, a tree survey will be required. • Updating this report when the supplementary investigations are complete.

Contents

1. INTRODUCTION

1.1 Background & proposed development

This report has been prepared for Pit Stop Productions (PSP).

It is understood that the proposals include the development of a low-rise commercial unit (sound studio) with associated single external “pods” in the west, areas for natural wildlife including woodlands and a pond in the centre & west, and a private access road with car parking in the south.

1.2 Previous reports

Apex have been provided with copies of the following reports relating to this site:

1. CON29M: coal mining report (ref. 51002443000001) dated March 2021, issued to RB Geotechnical by The Coal Authority.

2. Land off Windhill Lane: Coal Mining Risk Assessment (ref. RBG229) dated March 2021, issued to Mr Sanderson by RB Geotechnical.

A review of the work previously carried out is included in Section 6.

The purpose of this report is to enable an assessment of potential shallow coal mining related geotechnical risks, as well as shallow ground-related contamination and geotechnical risks associated with PSP’s proposed development at Windhill Lane, Barnsley.

1.3 Scope of works

In summary, the agreed scope of works included:

- Desk Study (including a site walkover, review of environmental setting assessment of site history, review of third-party findings, a mining risk assessment).
- Coal Mining Investigation (12no. rotary probing bore holes to a maximum depth of c. 40m bgl to investigate the presence of shallow coal mine workings, c. 6no. ground gas and groundwater monitoring wells to monitor the risk of hazardous ground gas generation and migration associated with coal mining and shallow ground water levels across the site).
- Ground Investigation (c. 12no. mechanically excavated trial pits to c. 3m bgl to investigate shallow geotechnical and ground related contamination risks).
- Soakaway testing in 3 locations to enable assessment of the suitability of infiltration-based drainage systems.
- Laboratory analysis (geotechnical and chemical analysis of soils).
- Interpretation of findings and recommendations in relation to foundations, infrastructure, remediation requirements and hazardous gas risks.

1.4 Sources of information

This report includes findings from a number of external sources including Landmark Information Group, British Geological Survey, Coal Authority, Local Authority, 3rd party reports, as well as our own local knowledge and experience.

1.5 Report limitations

The Foreword to this report and the appended guidance notes on Apex's procedures and definitions (Appendix A) should be read in conjunction with the main text.

Existing 3rd party reports and information provided by others has been referred to in good faith as being accurate. Apex do not accept any liability for inaccuracies in third party information.

2. LOCATION AND DESCRIPTION

2.1 Site location

A location plan is included as Drawing 001 in Appendix B. The site is situated in a small field adjacent Windhill Lane in north Mapplewell, Barnsley.

2.2 Site description

The site comprises a roughly square parcel of rough grassland with the remains of a burned out stable and associated hard standing in the centre of the site.

A topographical survey has been provided to Apex. It shows the highest point in the north is at c. 153.00mAOD sloping south at a gradient of c.1.3°, the gradient reduces in the centre to c.0.6°. From 146.5mAOD the gradient increases to 1.5° down to 142.13m AOD in the south. The average gradient across the site is 1°.

A rough track leads directly from Windhill lane up to the remnants of the stable. The stables area has been used for fly tipping with litter common throughout. Burned materials, wood and suspected asbestos-containing materials (ACMs) in the form of corrugated sheeting are present. Concrete and macadam hardstanding are present surrounding the structure.

The Coal Authority records the presence of a historic mine shaft under the centre of the burned-out stable (further details are given in Section 5). No evidence is visible at surface level.

Site details are summarised in the table below:

CATEGORY	DETAILS
Location	Land off Windhill Lane, Barnsley.
NGR	SE 323 111
Nearest postcode	S75 5BH
Area and shape	Approximately square, c.1.0ha
Current use	No current land use.
Surrounding land	**North –** Generally agricultural fields delineated by hedgerows and fence lines. A small scale vehicle coatings industrial unit is located approximately 230m northeast. **East and South –** Residential housing estates forming part of the town Mapplewell. **West –** Warren Lane, residential road past which lies more agricultural fields.
Known constraints	A burned out stable is present in the centre of the site with areas of associated hard standing, asbestos containing materials are noted within the rubble. The BGS records a historic mine shaft beneath the burned out stable.

3. ENVIRONMENTAL CONTEXT

3.1 General

Information pertinent to the site's environmental setting has been reviewed from various sources (see Section 1.4), most notably with respect to: mining, radon gas, geology, groundwater & surface water quality, landfills and flooding.

A full copy of the 3rd party data obtained as part of this investigation is available electronically; key extracts are presented in the appendices. Key findings are summarised below:

CATEGORY	DETAILS
Geology	Information recorded on the BGS Geoindex and map sheet SE31SW show the following: **Made ground** – Disturbed ground, defined by the BGS as areas of ill-defined surface workings where unworked, worked and made ground are complexly associated. **Drift** – No drift is mapped in the site area. **Solid** – The Pennine Middle Coal Measures Formation is mapped underlying the site. The Meltonfield coal seam outcrops on site trending NW-SE. The Two-Foot and Adby seams which outcrop to the south are also indicated to underlie the site. **Faults** – Running close to the east boundary of the site area, a fault trends NE-SW. South of the site area various faults trending either NW-SE or NE-SW are common.
Mining	The site lies in a Coal Authority Development High Risk Area. Significant work has historically taken place across the site area from surface to deep levels relating to the extraction of coal. Further details and summary of the anticipated hazards can be found in Section 5.

CATEGORY	DETAILS
Radon	Within the 1km grid square where the site lies, 5 – 10% of homes are above the radon action level. Basic protection measures are required.
Groundwater	The bedrock geology (Pennine Middle Coal Measures) forms part of a Secondary A Aquifer. No source protection zones are recorded within 1000m of the site boundary. There are no recorded groundwater abstractions within 1000m of the site boundary. Within 1000m of the site boundary 2 no. groundwater discharge consents are recorded 396m northwest, operated by Windhill Gate Farm for discharge of treated effluent (not water company) into a Soakaway (revocation dates: 25/07/2012 and not supplied respectively).
Surface water	Nearest watercourse – 112m east, unnamed. There are no surface water abstractions within 1000m of the site boundary. Within 1km of the site boundary the recorded surface water discharge consents are: • 2 no. 105m east, operated by Yorkshire Water Services Ltd for discharge of sewage discharges into a tributary of Bushcliffe Beck (revocation dates: 05/02/2003 and not supplied). • 846m east, operated by Yorkshire Water Services Ltd for discharge of sewage discharges into a Applehaigh Clough (revocation 09/11/2002) • 936m east, operated by Yorkshire Water Services Ltd for discharge of sewage discharges into Applehaigh Clough (revocation date not supplied).
Landfill	No landfills are recorded on site or within 1km, however, the site itself is mapped as “made ground” and a spoil heap is mapped on historical plans in the south (see Section 4).
Flooding	The site lies in Flood Zone 1. The north of the site lies in an area where there is potential for groundwater flooding to occur at surface. The site is not at significant risk of surface water flooding.
Unexploded ordnance (UXO)	Based on a review of Zetica’s online Risk Maps utility, the site is considered to be at low risk from UXO. No further assessment is required.

4. SITE HISTORY

4.1 General

Historical OS maps (included within the Envirocheck report) provide a record of key changes at the site and surrounding areas over the past 170 years, dating back to 1854. It should be noted that not all changes will be shown on the plans, so some previous historical features may exist for which there is no record.

Key extracts from the historical plans are shown below, along with a description of features identified. A full set of the historical plans is available electronically upon request.

A summary of the key changes on/close to the site is given the table below:

DATE	ON-SITE FEATURES	OFF-SITE FEATURES
1854	No significant features.	Windhill Lane is in the same place as the current day. 380m & 770m south, and 770m southeast, "Sandstone Quarries" are labelled. 600m & 970m south, and 980m southeast, "Old Coal Pits" labelled.
1891 – 1893	"**Old Coal Shaft**" labelled in the centre of the site area.	350m south, "Longnight Works (Chaplet & Gas Hook)". 380m south, now "Old Sandstone Quarry". 520m northwest, "Wheatley Wood Colliery" and associated infrastructure including a northeast to southwest mineral railway. 780m southeast, now "Lane End Quarry". 790m west, "Old Dayhole", "Old Coal Pit", and "Reservoir" labelled.
1906	"**Spoil Pile**" indicated in the southeast of the site.	No significant changes.
1918	No significant changes.	385m south, "Darton Lane Head Service Reservoir" labelled. 420m west, "Sewage Works (Barnsley R.D.C)" labelled. 790m west, "Old Coal Shaft" and spoil piles shown adjacent to the mineral railway.
1930 – 1932	No significant changes.	No significant changes.
1938	No significant changes.	Significant residential development to the southeast from 250m away from the site.
1956	No significant changes.	520m northwest, "Wheatley Wood Colliery" and associated infrastructure including a northeast to southwest mineral railway now disused. 780m southeast, "Lane End Quarry" now disused.
1960 – 1962	"**Old Coal Shaft**" no longer labelled in the centre of the site area.	Further residential development in to the south and southeast. 520m northwest, "Wheatley Wood Colliery" now labelled "Mine".
1977 – 1978	**Spoil pile** no longer shown on site.	Greater residential development.

DATE	ON-SITE FEATURES	OFF-SITE FEATURES
1991 – 1993	No significant changes.	805m west, "Disused shaft" labelled.
2000	**Small structure** shown in the centre of the site.	No significant changes.
2006	No significant changes.	520m northwest, "Mine" now labelled "Workings (Disused)".
2023 – 2024	**Structure increased in size** shown in rough shape of the derelict structure on site.	Further residential development towards the south, southeast and east.

The site area has remained largely undeveloped since 1854, two small structures have been featured within the site boundary (stables buildings) and a spoil pile indicated in the southeast of the site.

An "Old Coal Shaft" is shown in the centre of the site from 1890 – 1960, this indicates that coal mining has occurred underneath the site.

5. COAL MINING RISK ASSESSMENT

5.1 Introduction

The site lies within a Coal Authority 'Development High Risk Area', defined as *"the known extent of coal mining activity and is used to determine whether a coal mining report is required for property transactions and the conveyance process".*

The Coal Authority will act as a statutory consultee to the Local Planning Authority and will require production of a coal mining risk assessment; which is provided below.

The following information sources and reference documents have been reviewed in compiling this mining risk assessment:

- Coal authority interactive map
- 1:10,000 BGS geological map (SE20NE)
- Consultant's Coal Mining Report
- Land off Windhill Lane: Coal Mining Risk Assessment (ref. RBG229) dated March 2021, issued to Mr Sanderson by RB Geotechnical.
- BGS Memoir - Geology of the country around Barnsley: Explanation of sheet 87

Key findings from the above sources are discussed below.

5.2 Land off Windhill Lane: Coal Mining Risk Assessment

This is a coal mining risk assessment report, which includes information from a non-residential coal mining report obtained at the time (2021), BGS geological maps, historic OS maps and other online sources.

Using the above, RB Geotechnical highlight the shallow underground coal mining and mine entries as posing potential risk to the client's proposed development.

The report summarises the information from the various sources and highlights the Meltonfield Coal, the Two-Foot Coal, and the Abdy Coal as underlying the site at potentially shallow depths.

The report concludes that an intrusive investigation including rotary boreholes to 30mbgl to investigate the presence of shallow mineworkings; and reduced level digs to assess for presence of the historical mine shaft.

5.3 Consultants Coal Mining Report

This report was obtained as part of Apex's ground investigation.

Key points include:

- There are recorded workings in 11 seams of coal beneath the site.
- Of the above, one (the Winter Seam, aka. the Abdy seam) lies within potentially influencing depth of the surface, at a depth of 12m. This seam is recorded as being 104cm thick, dipping 3.4° to the north-east, last worked in 1868.
- There are "probable unrecorded shallow workings". This is likely in reference to the Meltonfield and Two Foot coal seams.
- There are no recorded spine roadways at shallow depth.
- There is one mine shaft recorded on site; ref. 432411-003 at coordinates 432390, 411165.
- There is one outcrop on site (Meltonfield coal seam, bearing 252°) and one at 29m south (Two Foor coal seam, bearing 264°).
- There are no faults, fissures or breaklines recorded.
- The site is in within an area where notice to withdraw support was given in 1982.
- Areas of unlicensed opencast are present immediately to the south-west.
- No site investigations, remediations sites or coal mining subsidence recorded within 50m of the site boundary.
- No mine gas or mine water treatment schemes are recorded within 500m of the site boundary.

5.4 Abandonment plans

Abandonment plans for workings within the Winter/Abdy coal seam are available and have been obtained from the Coal Authority; a copy is included with the site boundary shown on Drawing 005 in Appendix B.

The abandonment plan shows the location of the mine entry on site, which looks to have targeted the Winter (aka. Abdy) coal seam. The plan also shows the site to lie within an area shaded blue, which indicates workings within this seam beneath the site.

A section showing the coal seam at Shaft “No. 1” (the shaft marked on site) is included and shown below, which indicates 2ft, 6.5inches of coal, 3 inches of dirt, then a further 7inches of coal, equating to a total thickness of 0.95m.

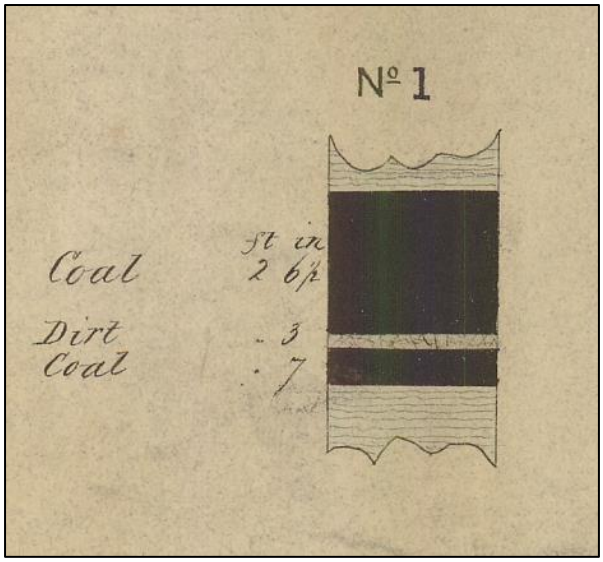


Figure 1 - extract from Winter Seam abandonment plan

Depths to the Abdy seam are not given on the abandonment plan. Faulting is suggested in the south-east and south-west, trending roughly south-west to north-east. The faults suggest throws both up and down to the south, with measurements of 4-5ft given.

Mining of this seam continues on the abandon plan over an extensive area to the north.

5.5 BGS 1:10,000 plan (SE31SW)

The BGS plan shows the site to be within an area of “Disturbed ground, defined by the BGS as areas of ill-defined surface workings where unworked, worked and made ground are complexly associated”, with Pennine Middle Coal measures bedrock below.

The Meltonfield coal seam outcrops on site, with the Two Foot Coal outcropping c.15m south of the site’s southern corner at its closest point.

The Meltonfield and Two Foot seams have maximum recorded thicknesses of 1.0m and 0.4m respectively.

The Abdy Coal outcrops within the same fault block as the site at 205m south-west at its closes point, with a maximum recorded thickness of 1.05m on the BGS stratigraphic column. The column also shows the Two Foot seam to lie c. 20m above the Abdy seam, but this will be a generalisation across the entire sheet area, not specific to the site.

Using the dip direction and angles given for each seam taken from the Coal Authority Consultant’s Mining Report and topographic data, along with information

on outcrop distance from the BGS plan, the following likely depths to each seam have been calculated beneath the south and north of the site in the proposed area of development (west).

NAME	SEAM THICKNESS	DEPTH		SEAM DIP	COMMENTS
		South	North		
Meltonfield	1.0m	Outcrops on site		Angle not show, but likely north-east direction	No workings recorded
Two-Foot	0.4m	c.6m	c.14m	4.2° north-east	No workings recorded, south to north depth estimated from seam dip and distance.
Winter/Abdy	0.95-1.05m	c.16m	c.24m	3.4° north-east	Workings recorded beneath property, south to north depth estimated from seam dip and distance.

The above depths are deeper than Coal Authority's predicted depth of 12m to the Abdy seam beneath the centre of the site. The 16m depth calculated above is beneath the southern-most point of the proposed building (i.e. the area which is topographically lowest, and closest to the outcrop).

Based on the above, there should be c. 10m of rock between the Two Foot and Winter/Adby seam.

5.6 BGS Memoir - Geology of the country around Barnsley: Explanation of sheet 87

The above memoir however describes the Abdy or Winter Coal as 2ft to 2ft 6inches in thickness, worked at places mainly from outcrop and shallow shafts.

The memoir suggests that within a few feet of the Abdy Coal there is usually a bed of sandstone [above] which varies in thickness across the district and is known as the Abdy Rock. This stratum is showing as outcropping to the south-west of the site, with the Abdy coal outcropping immediately south-west of the sandstone.

The distance between the Abdy Coal and the overlying Two Foot is quoted as being 30ft to 80ft (9m to 24m).

5.7 Discussion & risk assessment

"Construction over abandoned mine workings" (CIRIA, 1989) suggest that a void can migrate through a solid rock between 7h and 10h above the associated workings and void origin. This, where "h" is the height of the working, including extraction of any additional materials such as fireclay associated with coal seams.

The "Abandoned Mine Wokrings Manual" (CIRIA) notes that the 10h rule was adopted from examination of mine within Coal Measures bedrock which show that

the height of migration of voids in bedrock might extend up to 10x the height of the original extraction. Given the anticipated geology here (Lower Coal Measures Bedrock), use of the 10h rules is considered appropriate.

The risk assessment for this site uses the following assumptions:

- Worst case seam thicknesses:
  - Abdy/Winter: 1.05m
  - Two Foot: 0.4m
  - Meltonfield: 1.0m
- c. 3m of superficial and/or residual soil overlying bedrock
- Possible migration of up to 10x extraction thickness in solid rock

Based on the above, the any workings within the Meltonfield seam could pose a risk to surface stability north-east (down dip) of the outcrop in the centre of the site.

In the far south of the site, the Two Foot coal may pose a risk to surface stability where the coal is at its shallowest and the topography is lowest.

The Abdy/Winter Seam is likely to be at sufficient depth to not pose a risk to surface stability based on Apex's calculations, but could pose a risk based on the depth given by the Coal Authority. Intrusive investigation is required to confirm:

- The position of the Meltonfield outcrop
- The depth to rockhead across the site; especially given the indication on BGS plans that significant thicknesses of made ground may be present
- The thickness of the Meltonfield, Abdy and Two Foot coal seams
- Whether any evidence of workings is present in any of the seams

Below the Abdy seam, the next shallowest seam is the Stanley Main at >40m depth. At such depth, workings within this seam should not pose any significant risk to surface stability.

6. CONCEPTUAL SITE MODEL

6.1 Introduction & planning

With respect to ground conditions and pollution, National Planning Policy Framework (NPPF 2021) Section 183 states that planning policies should ensure that:

a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);

b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the environmental protection act 1990; and

c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.

6.2 Contamination risks

A conceptual site model has been prepared based on all the information reviewed. A visual version is included in Appendix B as Drawing 003. Key sources, pathways and receptors are summarised below:

SOURCE	PATHWAY	SEVERITY	PROBAB-ILITY	RISK RATING	REMARKS
RECEPTOR: Human health (End-users, site workers)					
Made ground beneath the site associated with spoil marked on historic OS maps (inorganics, organics, asbestos)	Dermal contact, ingestion, volatilization, inhalation, inhalation of dust.	Moderate	Low	Low to Moderate	Areas of potential spoil pile material are anticipated in the southeast of the site associated with historic mining activity within the site area. This is likely to be predominantly re-worked natural ground (spent material from coal mining).
	Generation and migration of ground gas.	Moderate	Low	Low to moderate	

SOURCE	PATHWAY	SEVERITY	PROBAB-ILITY	RISK RATING	REMARKS
Made ground associated with the remnants of the burned down stable present in the centre of the site (inorganics, organics, asbestos)		Moderate	Low	Low to Moderate	Burnt timber, asbestos sheeting and waste materials were noted within the footprint of the remnant stable building during the site walkover. However, no other significant development has taken place on site, so the made ground is likely to be localized to the stables area.
Abandoned shallow coal mineworkings.	Generation and migration of ground gas.	High	Moderate	Moderate	Recorded workings are present beneath the site, and further (unrecorded) workings may also be present.
RECEPTOR: Secondary Aquifer – A					
Made ground beneath the site associated with spoil marked on historic OS maps (inorganics, organics)	Leaching, vertical and horizontal migration of contaminants down natural fractures /joints within bedrock.	Low	Low	Low	The spoil pile is likely to be predominantly re-worked natural ground (spent material from coal mining).The bedrock Pennine Middle Coal Measures is a predominantly mudstone formation which weathers to clays at shallow depths and therefore may inhibit migration of contaminants somewhat.
Made ground associated with the remnants of the burned down stable present in the centre of the site (inorganics, organics)		Low	Low	Low	The made ground is likely to be localized to the stables area. The bedrock Pennine Middle Coal Measures is a predominantly mudstone formation which weathers to clays at shallow depths and therefore may inhibit migration of contaminants somewhat.

The proposed change in use and the potential for ground contamination warrants an intrusive ground contamination assessment, in accordance with the requirements of the NPPF.

6.3 Geotechnical risks

The conceptual site model has also been used to inform potential geotechnical risks, as outlined below:

ISSUE	REMARKS
Bedrock – Pennine Middle Coal Measures	Bedrock is anticipated across the site at a depth across the site at approximately 2-3mbgl.
Mining	Shallow coal mineworkings may be present in 2 coal seams at shallow depth and are recorded in the Abdy seam at c. 16-26m across the site area which may affect surface stability. An old coal mine shaft is recorded on historic OS maps and by the Coal Authority in the centre of the site. No record of the extent of treatment, if any, is available. It is likely to extend to at least the depth of the Abdy coal seam.
Former uses	A stables building is present in the centre of the site, buried obstructions and shallow foundations associated may be encountered, although these will be of limited depth and the proposed development in this area comprises woodland with no “hard” development.
Sulphate attack	To prevent the degradation of any below ground concrete, soluble sulphate should be assessed to determine a Design Sulphate class and Aggressive Chemical Environment of Concrete for strata encountered.
Tree Influence	Small trees and hedgerows are present in the northeast of the site area which may influence foundation depths of the proposed studio building. In addition, an area of woodland / natural land is planned as part of the site area thus, where shrinkable clays may be present (weathered bedrock) the zone of influence from planted trees should be assessed first.
Topography	Significant variation in the site topography from the northwest to southeast from 153mAOD to 142.13mAOD, with a level area in the centre of the of site at c. 147mAOD. This will necessitate some earthworks (cut & fill) to accommodate the proposed development.

6.4 Proposed ground investigation

A ground investigation is required in order to resolve uncertainties highlighted by the conceptual site model. Specifically, the investigation should enable:

- Assessment of the nature, thickness and lateral distribution of made ground.
- Contamination risk assessment via inspection and sampling of made ground (and natural soils where appropriate).
- Assessment of the risks of hazardous gas.
- Assessment of the geotechnical properties of the natural soils in order to inform foundation design.
- Assessment of ground instability hazards relating to the presence of mine workings at shallow depths.

- Assessment of geotechnical risks including the presence/absence of significant obstructions, stability of excavations and presence of any groundwater.

7. GROUND INVESTIGATION

Following completion of the desk study phase, a ground investigation was undertaken between 26/03/2024 and 02/04/2024. All works were supervised by a suitably experienced Geo-Environmental Engineer from Apex.

7.1 Fieldwork

Fieldwork undertaken is summarised in the table below:

Technique	Depths	Remarks/justification
TPs 1 to 13 Mechanically excavated trial pits (13 no.)	Between 1.85m and 3.50m	Hand vanes where possible in cohesive strata. TPs 9, 10, 12 & 13 positioned to target the spoil pile labelled on historic OS maps. Soakaway tests undertaken in TPs 8, 10 & 12.
BHs 1 to 12 Rotary open hole boreholes (12 no.)	Between 15m and 40.50m	Completed to target potential shallow coal mine workings across the site area.
Monitoring wells (5 no.)	Response zones installed between 2m and 4m	Monitoring wells installed above any potential coal mineworkings within the footprint of the proposed development to monitor hazardous ground gas generation and migration.

The majority of exploratory holes were targeted to the area of proposed development in the west and the associated proposed access road. Soakaway locations were selected in the east as this is the only viable area for use of infiltration based drainage bearing in mind the proposed layout and site topography.

The remnants of a burned down stable are present in the centre of the site area overlying the recorded historic mine shaft. During the site walkover charred timber, asbestos containing materials, metals and other general waste were noted. Following removal of the remaining structure and associated waste materials, further investigation of the potential mine shaft should be conducted, comprising shallow mechanical trenching.

8. GROUND CONDITIONS

For a full record of the ground conditions encountered in each exploratory hole, please refer to the ground investigation data in Appendix E.

The typical ground types encountered are described below:

8.1 Made ground

Made ground strata have been categorised (where possible) into three main ground 'types' based on their appearance, location on site, and likely origins, as identified during logging and through review of the desk study phase.

It should be noted however that made ground is often heterogeneous by nature and therefore made ground conditions may vary significantly between exploratory hole locations.

The following strata were encountered:

- **MADE GROUND TOPSOIL:** Found at surface level in BH's 9 & 11, and TP's 8 – 10, 12 & 13, to a maximum depth of between 0.10m and 0.50m. Typically comprises very soft brown silty slightly sandy CLAY with common rootlets and containing anthropogenic materials such as brick, concrete clinker and occasional metal fragments.
- **MADE GROUND SPOIL HEAP:** Historical maps indicate the presence of a spoil pile in the southeast of the site area associated with historical coal mining on site.

  Encountered in BH's 9 & 11, and TP's 8 – 10, 12 & 13, from below made ground topsoil to a maximum depth of between 0.40m to 3.10m. Heterogenous in composition with the ratio of primary, secondary and tertiary constituents varying throughout the stratum; it typically comprises reddish brown very sandy angular coal mudstone and burnt shale GRAVEL overlying grey gravelly CLAY of varying strength.

  NOTE: BH9 was drilled in the area of the spoil heap and was drilled by rotary open-hole technique. Distinction between the spoil heap stratum and underlying residual soils is not possible using this technique, therefore the maximum depth of the made ground encountered is based on the trial pit logs.

- **MADE GROUND REWORKED:** Encountered in TP's 8, 9 & 13, from below the made ground spoil heap to a maximum depth of between 1.10m and 2.95m. Typically encountered as a firm grey mottled green, black and red sandy gravelly CLAY/clayey GRAVEL where gravel is predominantly burnt shale.

Made ground was restricted to the east/southeast of the site area, this ties in with the historical OS maps which show a spoil pile in the vicinity (see Section 4).

8.2 Natural ground

The following strata were encountered:

- **TOPSOIL:** Encountered in all locations except from BH's 9 & 11, and TP's 8 – 10, 12 & 13, from surface level to a maximum depth of between 0.20m and 0.50m. Typically comprises dark brown sandy CLAY where sand is fine.
- **GRANULAR RESIDUAL SOILS:** Encountered in TP's 1, 3 to 7, & 11, from below topsoil to a maximum depth of between 0.4m and 2.0m. Typically comprises yellowish brown clayey slightly gravelly fine to coarse SAND where gravel is sandstone and mudstone.
- **COHESIVE RESIDUAL SOILS:** Encountered in TP's 1 to 4 & 7 – 13, from below either made ground – spoil heap, made ground – reworked, granular residual or the Meltonfield coal seam to a maximum depth of between 0.80m and 3.50m (base not proven). Typically comprises firm light yellowish brown sandy gravelly CLAY with common mudstone lithorelics. Sand is fine to medium, and gravels are angular fine to medium mudstone. Ratio of lithorelics to gravels increases with depth.
- **WEATHERED MUDSTONE:** Encountered in TP11 from below cohesive residual soils to a maximum depth of 2.70m. Comprising extremely weak light yellowish grey weathered mudstone recovered as silty very sandy angular tabular mudstone GRAVEL where sand is fine to coarse.

During rotary open hole drilling detailed strata descriptions are not possible therefore rates of drilling as well as changes in flush returns are used to identify strata boundaries. Within the shallow ground profile, distinguishment between granular residual soils, cohesive residual soils and weathered mudstone are grouped as **COHESIVE OVERBURDEN**. In instances where made ground overlies the residual soils the strata have been grouped as **UNDIFFERENTIATED MADE GROUND AND OVERBURDEN**.

Cohesive overburden was encountered in all BH's aside from BH's 9 & 11 where it is classed as undifferentiated made ground and overburden. Typically, overburden is encountered from below topsoil to a maximum depth of between 1.70 and 3.64m. Undifferentiated made ground and overburden was encountered from below made ground spoil heap or made ground reworked to a maximum depth between 10.70m and 12.30m.

- **UPPER MUDSTONE:** Encountered in BH's 1 to 8, & 12 and TP's 1 to 7, 10 & 11 from below either cohesive overburden, granular residual soils, cohesive residual soils or weathered mudstone to a maximum depth of between 1.85m to 8.60m. Typically comprising grey MUDSTONE.
- **CARBONACEOUS MUDSTONE:** Encountered in all BH's as overlying the Two Foot coal seam at depths of <10m, except BHs 9 and 11 where a thinner band was encountered at greater depths. In BH9, it is possible that this is indicative of packed mineworkings.
- **COAL MEASURES:** Encountered in all BH's from below the 2-Foot coal seam or undifferentiated made ground and overburden to a maximum depth of

40.50m (base not proven). Typically comprising mudstone and a deeper band of interbedded orangish brown sandstone and mudstone (possibly the Abdy Rock).

Rockhead Profile:

The depth to rockhead is variable across the site area, deepest in the south of the site where significant thicknesses of superficial deposits and made ground are recorded. Within the footprint of the proposed building in the west and north of the site rockhead is consistently shallow from 0.80m to 2.70m bgl. A summary is in the table below:

Location	Borehole / TP	Depth to Rockhead (m)
North	BH5	1.90
	BH6	1.80
	BH7	1.90
	BH8	1.90
	BH12	1.70
	TP4	0.80
	TP5	1.20
	TP6	0.60
East	TP7	1.80
	TP8	-
South	BH9	12.30
	BH10	3.64
	BH11	10.70
	TP9	-
	TP10	3.20
	TP12	-
	TP13	-
West	BH1	2.10
	BH2	2.10
	BH3	2.10
	BH4	2.00
	TP1	2.20
	TP2	1.84
	TP3	1.97
	TP11	2.70

There is a significant area of uncertainty in the south, within the area mapped as a former spoil pile; notably within the vicinity of BHs 09, 11 and TPs 09, 10, 12 & 13.

The aforementioned trial pits recorded either rockhead at shallow depth (3.20m to 3.64m) or natural ground within the uppermost 3.0m. However, BHs 09 and 11 recorded “undifferentiated made ground and overburden” to significant depths of 12.9m and 10.7m respectively, with rockhead below.

The trial pits provide a more certainty as to the shallow ground conditions as the geology can be better observed compared to rotary open-hole drilling (as noted in Section 8.2). TP13 was excavated to target the deep area of made ground/overburden initially found in BH09 and found natural ground at 2.95m.

Given the above, it is considered likely that the significant depths to rockhead encountered in BHs 09 and 11 are due to highly weathered natural strata (or possibly ground associated with movement due to faults/former mining) within the south; which, when disturbed by drilling and mixed with water drilling flush, was recovered as very gravelly CLAY.

The proposed studio structure is not within this area; however, the proposed access road will cross the south of the site. Further recommendations in relation to the access road are given in Section 18.2.

COAL SEAMS

Two seams of coal were intercepted during trial pitting and rotary probing:

Meltonfield Seam: The Meltonfield Seam was encountered in three trial pits in the north of the site as summarised in the table below:

Borehole	Depth to Top (m)	Thickness	State
TP5	0.67	0.18	Very weak black coal.
TP6	0.60	0.10	Black very sandy angular fine to coarse coal gravel.
TP7	0.67	0.18	Extremely weak black coal.

The Meltonfield Seam outcrop is further north than the conjectured outcrop shown on the BGS map. The BGS mapped outcrop and the line of the outcrop as encountered are shown on Drawing 004 in Appendix B.

Two-Foot Seam: The Two-Foot Seam was encountered in all boreholes aside from BH9 and BH11 as summarised in the table below:

Borehole	Depth to Top (m)	Thickness	State
BH1	5.10	0.30	COAL
BH2	7.90	0.30	COAL
BH3	6.70	0.30	COAL
BH4	4.80	0.30	COAL
BH5	8.30	0.30	COAL
BH6	9.10	0.30	COAL
BH7	10.60	0.30	COAL
BH8	11.60	0.20	COAL

Borehole	Depth to Top (m)	Thickness	State
BH10	4.60	0.30	COAL
BH12	8.30	0.30	COAL

No evidence of mineoworkings was encountered in the Meltonfield nor Two Foot coal seams.

The Abdy/Winter seam was not encountered during the investigation.

Within BH2 (drilled with air mist flush), a water strike was noted at 18.2m within mudstone bedrock, which coincided with a brief loss of flush. This could be indicative of localised softer material which is water-bearing, and could represent former workings within the Abdy seam which have been subsequently “packed”.

The majority of boreholes encountered a bed of interbedded mudstone and orange strong sandstone from depths of between 5.1m (BH4) and 12.0m (BH3); the top of which typically became deeper towards the north. This stratum could be indicative of the Abdy rock (sandstone) which is mapped as outcropping to the south of the site immediately above the Abdy coal seam and beneath the Two Foot seam.

Within BH9, a band of dark carbonaceous mudstone was encountered beneath this sandstone from 16.7m to 17.5m. This could be indicative of former workings within the Abdy seam, which have been subsequently “packed”.

An area of mine waste spoil has been identified in the southeast of the site, in line with historical OS maps.

8.3 Evidence of contamination

No olfactory or visual evidence of organic contamination was noted during the ground investigation.

Within in the stables area in the centre of the site, large quantities of burnt timber are present at surface level as well as suspected asbestos-containing materials (corrugated sheeting).

Significant amounts of burnt shale were noted in the area of the spoil pile, which can combustible.

8.4 Stability, groundwater and obstructions

Obstructions

No significant obstructions were encountered during the intrusive ground investigation; however, areas of surface hardstanding were noted by the site engineer surrounding the burned-out stables in the centre of the site.

Minor obstructions associated with the stables area are anticipated (former foundations and floor slabs).

Groundwater

Groundwater was encountered in BH2 at 18m, and as seepage within TP12 at 2.60m.

Groundwater levels will be monitored as part of the gas monitoring programme over the next 2 months.

Stability

Collapse of trial pit walls in the made ground associated with the spoil heap was encountered in TP's 9, 12 & 13.

During rotary open holing stability of the excavations is difficult to assess however, all boreholes remained open for the duration of drilling and installation where necessary.

8.5 Soakaway testing

Soakaway testing was completed in line with BRE 365 in TP's 8, 10 & 12 on the 28th March 2024. Copies of the test results are included in Appendix H.

TP's 8, 10 & 12 were positioned in the east of the site in an area of proposed soft landscaping, down gradient of the proposed structure.

Results of the testing are summarised below:

TP	TEST	DEPTH	STRATA	RESULT (m/s)	REMARKS
TP8	1	3.20m – 1.74m	Glacial Till – Type C	N/A	Calculation of infiltration rate not possible
TP10	1	3.40m – 2.50m	Glacial Till – Type B	N/A	
TP12	1	3.50m – 2.67m	Glacial Till – Type A	N/A	

Repeat tests were not completed due the very low rates of infiltration recorded across the site.

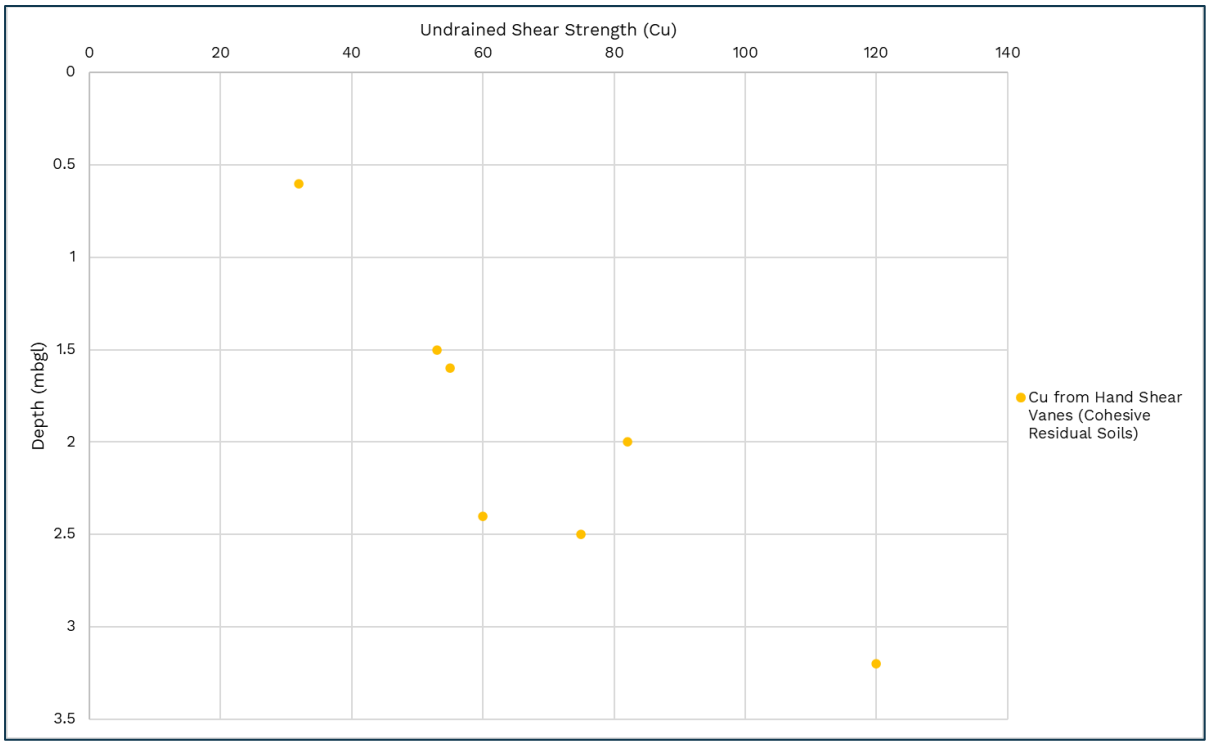
Based on the above results, soakaways will not provide a suitable means of surface water disposal at the site.

9. GEOTECHNICAL TESTING (FIELD TESTS)

9.1 Undrained shear strength (C_u)

Where possible, hand vane readings were taken by the Engineer in cohesive soils.

Results from hand vanes are plotted on the graph on the graph below:



The above shows that he Cohesive Residual Soils are typically medium to high strength, with one result (TP4 0.6m) recording a low strength reading of 32kPa.

10. GEOTEHNICAL TESTING (LABORATORY TESTS)

Samples taken during the investigation have been delivered to a UKAS accredited laboratory and scheduled for the following geotechnical tests:

Material	No. samples	Analysis scheduled
MG -Spoil Pile	2	pH & water soluble sulphate (2:1 extract)
Granular Residual Soils	3	pH & water soluble sulphate (2:1 extract) Atterberg Limits
Cohesive Residual Soil	3	pH & water soluble sulphate (2:1 extract) Atterberg Limits
Pennine Middle Coal Measures	3	pH & water soluble sulphate (2:1 extract) Atterberg Limits

A full copy of the results, as received from the laboratory, is included in Appendix G.

10.1 pH & soluble sulphate

In accordance with BRE SD1[1] and the site's conceptual model, samples were analysed for pH, water-soluble sulphate.

Results are summarised below:

Material	pH range (design value)	Water soluble sulphate range (mg/l)(design value)
MG -Spoil Pile	4.8 – 7.9 (6.75)	19.2 – 58.3 (49.78)
Granular Residual Soils	5.3	29.0
Cohesive Residual Soils	5.7 – 7.0 (5.7)	15.3 – 34.6 (34.60)
Pennine Middle Coal Measures	4.9 – 5.1 (5.1)	18.9 – 23.2 (23.29)

*Design values calculated in accordance with guidance contained within BRE SD1[1] relating to the number of samples tested per strata.

Ground beneath this site is not considered likely to be 'disturbed' such that significant oxidation of any sulphide would occur. Therefore, assessment of total potential sulphate has not been carried out.

Whilst the site has not seen any significant development, given its history of coal mining, it is considered prudent to regard the site as brownfield with a mobile water regime in relation to concrete mixes.

Based on the above, sub-surface concrete in contact with each stratum is summarised below:

Material	Design Sulphate (DS) class	Aggressive Chemical Environment of Concrete (ACEC) class
MG -Spoil Pile	DS-1	AC-1
Granular Residual Soils	DS-1	AC-3z
Cohesive Residual Soils	DS-1	AC-2z
Pennine Middle Coal Measures	DS-1	AC-3z

10.2 Atterberg limits

Results of Atterberg limit testing is summarised by stratum in the table below:

Material	Moisture content (ave)	Modified plasticity indices (ave)
Granular Residual Soils	22 – 33 (27.5)	Non-plastic – 9.57
Cohesive Residual Soils	36 – 40 (38.67)	14 – 20 (17)
Weathered Mudstone	35 – 64 (44.67)	15 – 20 (17)

[1] BRE Special Digest 1 Concrete in aggressive ground 2005

Plasticity indices have been modified in accordance with NHBC Chapter 4.2[2].

Based on the above, the Cohesive Residual Soils and Weathered Mudstone should be classed as low shrinkability (aka. volume change potential). Granular Residual Soils should be classed as non-shrinkable.

11. CHEMICAL TESTING (CONTAMINANTS)

11.1 Conceptual site model

As discussed in Section 3 and 4, former site features include:

- Former stable, now partially burned down.
- Spoil pile
- Mine entry

In addition, made ground was encountered across the site comprising made ground topsoil, made ground spoil pile, and made ground reworked.

Given the above, a total of 15 samples were scheduled for analysis, as summarised in the table below:

Material	No. samples	Analysis scheduled
Topsoil	6	pH & metals Asbestos ID TOC Banded TPH Speciated PAH
MG – Topsoil	4	
MG – Spoil pile	5	pH & metals Asbestos ID TOC Banded TPH Speciated PAH Calorific Value

Copies of the test results, as received from the laboratory, are included in Appendix F.

The first phase of contamination risk assessment comprises screening against threshold values. Apex utilise the LQM/CIEJH S4ULs (publication number S4UL3828) along with C4SLs where relevant (see Appendix A for more details on Apex's approach to contamination risk assessment).

The proposed development comprises a commercial unit in the west and small work units in the north. Therefore, the screening criteria utilised assume a commercial end-use.

For organic compounds, account has been taken of the TOC content of each strata; TOC values used have been determined from laboratory testing and are summarised below:

[2] NHBC Standards 2023

Stratum	Range of TOC (%)	Average TOC (%)	TOC (%) used	Remarks
Topsoil	1.40 – 4.10	3.03	1.5	Conservative approach adopted.
MG - Topsoil	1.20 – 6.20	4.06	1.5	Conservative approach adopted.
MG – Spoil pile	0.30 – 1.40	1.88	1.5	Conservative approach adopted.

11.2 Summary of contamination

None of the samples tested yielded results above the screening criteria for the tested suites of potential contaminants both organic and inorganic.

Whilst the proposed development is commercial, the screening values adopted assume that employees in a commercial setting are essentially based indoors. The proposed development includes significant areas of proposed landscaping and gardens, where it is anticipated that employees/site visitors will spend some time.

Therefore, it was considered prudent to also screen the chemical testing results against "POS_{park}" values, which are typically used for a public park setting with recreational use (picnics, playgrounds, sports, dog walking).

None of the results yielded concentrations above screening values for a POS_{park} setting.

11.3 Asbestos

No asbestos was identified in any of the samples screened. However, possible asbestos-containing materials (ACMs) were noted within the stables area in the form of corrugated sheeting.

11.4 Calorific value

Given the presence of burnt shale within the spoil pile, 5 samples were scheduled for calorific value (CV) analysis.

Materials with a CV of >10MJ/kg are considered combustible, whereas those with a CV of <2MJ/kg are considered unlikely to burn.

All results were below the laboratory's limit of detection (0.12MJ/kg). Therefore, the material within the spoil pile is not considered to pose a risk of spontaneous combustion.

12. HAZARDOUS GAS

12.1 General

Given the present of recorded coal workings beneath the site and in the vicinity, the site is considered to be potentially at risk from mines gas.

In addition, a spoil pile is mapped in the south and the ground investigation has found this to extend to c. 3m depth, albeit mainly consisting of re-worked natural materials, likely spent material from the nearby mine entry. The site and surrounding area is also mapped by BGS as lying in a potential area of made ground associated with former coal mining.

The mine entry itself poses a potential pathway for mines gas, and will require remediation (further information is given in Section 15.5).

In accordance with BS8576 and CIRIA C665, risks associated with hazardous gas are considered to be low to moderate.

12.2 Investigation

As part of the ground investigation, monitoring wells were installed within 5no. rotary open holes. An initial programme of 6 visits of 2 months is planned using a GFM430 infrared gas analyser.

Gas monitoring wells have been concentrated in the west of the site, within the footprint of the proposed studio.

Installations are summarised below:

BH	Response zone	Strata
BH1	2.0m to 4.0m	Pennine Middle Coal Measures
BH4	2.0m to 4.0m	Pennine Middle Coal Measures
BH5	2.0m to 4.0m	Pennine Middle Coal Measures
BH7	2.0m to 4.0m	Pennine Middle Coal Measures
BH12	2.0m to 4.0m	Pennine Middle Coal Measures

Additional comments regarding gas protection measures required will be made in the final Gas Risk Assessment, due to be issued in July 2024.

12.3 Radon

According to the UK radon maps online[3], the site lies within a 1km grid square where 5-10% of homes are above the action level for radon and therefore basic radon protection measures are required.

[3] https://www.ukradon.org/information/ukmaps

It is recommended that a site-specific radon report is obtained to confirm radon risks for the proposed building itself.

BRE guidance[4] states that basic radon protection measures comprise the following:

- Membrane within floor construction (minimum 1,200 gauge)
- Link of membrane into the DPC in the building walls
- Cavity trays to be used within walls to link the DPC to the radon membrane
- Joints within the membrane and service penetrations are to be sealed

BRE guidance also recommends inspection of the membrane during installation to ensure the above requirements are met.

13. REVISED CONCEPTUAL SITE MODEL

13.1 General

The ground investigation and laboratory analysis has enabled revision of the conceptual site model; a revised version is presented as Drawing 006 in Appendix B.

13.2 Geotechnical

The exploratory hole logs show the site to be underlain in the north and west by granular and medium to high strength cohesive residual soils overlying the Pennine Middle Coal Measures. In the southeast significant heterogenous made ground deposits up to 3.10m thick are recorded which coincides with the spoil pile marked on historical plans.

An area of suspected highly weathered coal measures bedrock was encountered in the south (BHs 9 and 11).

Groundwater was encountered in BH2 and TP12, occurring as deep groundwater and seepage respectively.

During trial pitting, the Cohesive and Granular Residual Soils were noted to remain stable. Within three locations where “Made Ground – Spoil Pile” was encountered collapse of the pit walls was recorded.

No obstructions were encountered during the trial pitting and rotary open holing; however, intrusive investigation was completed in the footprint of the remaining structure on site. Aside from the surface hardstanding surrounding the structure shallow foundation maybe anticipated with the former stables.

Historically the site was used for shallow and deep coal mining with a Mine Entry Shaft shown on historical OS maps and abandonment plans from the Coal Authority (see section 5).

[4] BR211 Radon – Guidance on protective measures for new buildings (2015)

No evidence of shallow coal mineworkings were encountered during the ground investigation. Both the Meltonfield and Two-Foot seams were encountered without evidence of workings. The Meltonfield seam was encountered in 3no. trial pits from between 0.60m and 0.67m with a maximum thickness of 0.18m. The Two-Foot seam was encountered in 10no. locations during rotary probing from between 4.60m and 11.60m with a maximum thickness of 0.30m.

13.3 Contamination

When screened for organic and inorganic contaminants no exceedances of screening values were found when assuming both commercial and POS_{park} settings.

Further investigation (trial pitting with chemical analysis) is recommended within the vicinity of the stables area once the buildings have been removed.

Potential ACMs were noted within this area and should be removed from site by a qualified contractor.

Any ACMs encountered during earthworks should be hand-picked by trained staff with appropriate PPE, placed in double-sealed bags and put into designated sealed skip awaiting off-site disposal. Any such material will be classified as hazardous waste.

During earthworks, should significant quantities of ACMs be encountered (eg burial pits, shuttering beneath floor slabs etc), work should cease immediately and further advice be sought from the Engineer.

It should also be noted that during ground investigations only a relatively small proportion of the ground is uncovered. Therefore, potential for as of yet unidentified contamination may still be present within the site area, should any areas be identified during subsequent phases of development the material should be kept separate and Apex are to be contacted for consultation.

Assessment of hazardous gas risk is ongoing via a monitoring programme, due for completion in July 2024.

14. WASTE AND MATERIALS MANAGEMENT

14.1 Materials Management

This report has identified sub-populations of made ground which may be classed as differing waste types.

Consequently, it is essential that groundworkers involved in the excavation and handling of materials beneath the site are adequately briefed on the importance good materials management (i.e. not mixing soils from different waste types).

In particular, the made ground, material from the tables area, and any suspected ACMs should be kept in separate, designated stockpiles.

Any natural soils excavated as part of site preparatory works (i.e. below the basement, for drainage etc) should also be kept separate from all other made ground strata.

14.2 Waste classification

Assessment of any material proposed for off-site disposal should be undertaken in accordance with WM3[5]. At the heart of this guidance is the need to accurately characterise sub-populations of waste via appropriate sampling (ideally when stockpiled). Waste classification should never be determined on the basis of individual sample test results.

Waste Acceptance Criteria (WAC) testing should only be required where material is likely to be disposed of as 'hazardous' based on the WM3 assessment.

Asbestos

In accordance with WM3, soils which contain >0.1% asbestos will be regarded as hazardous waste. No such material has been identified to date within soils.

Any soils which contain visible fragments of potentially asbestos-containing materials will be regarded as hazardous waste (if the fragments contain >0.1% asbestos), unless all such fragments can be removed by hand-picking prior to disposal.

Conclusion

Contractors involved in the removal of waste from site should assess the data within this report in order to make their own assessment with respect to appropriate waste codes and disposal routes.

15. REVISED COAL MINING RISK ASSESSMENT

15.1 Introduction

Results of the coal mining investigation (rotary probing) are discussed in Section 8. This section outlines the risks associated with coal mining beneath the site, and refinement of the conceptual model in relation to mining.

15.2 Meltonfield and Two Foot coal seams

In summary, evidence of the Meltonfield and Two-Foot coal seams have been encountered and no evidence of mineworkings was noted in either seam. Indeed, the Meltonfield seam lies beyond the north of the proposed studio (based on trial pit findings) but may be encountered at shallow depth during works to construct the proposed sound booths.

Any such coal encountered will need to removed under an "incidental coal" license from the Coal Authority.

[5] Technical Guidance WM3 – Guidance on the classification and assessment of waste – Environment Agency (2015)

These seams are not considered to pose a significant risk of subsidence at the site.

15.3 Winter/Abdy coal seam

This seam is mapped as being worked beneath the site on Coal Authority abandonment plans. The Coal Authority have confirmed in recent correspondence (see Appendix E) that the depth of 12m stated in their Consultants Mining Report is an approximate depth at the centre of the site and is based on a "rationalised plan for opencast workings to the south-west of the site".

There is some discrepancy between the Coal Authority's predicted depth and Apex's calculated depths based on nearby outcrops on the BGS plan (see Section 5), with Apex's calculations suggesting a depth of c. 16m in the south of the site and c. 24m in the north of the site.

This seam was not encountered in any of Apex's boreholes across the site, although a brief loss of flush along with a water strike was noted in BH2 at 18.0m, and a dark carbonaceous material was noted in BH9 from 16.7m to 17.5m in BH9. This material is a similar thickness to the Abdy Seam and occurred directly beneath a bed of interbedded mudstone & sandstone (possibly the Abdy Rock).

There are a number of possible explanations for the lack of coal/workings encountered:

Explanation	Remarks
The seam dips much more significantly than the CA/BGS assume, meaning it is deeper than the boreholes drilled.	Whilst possible, this seems **unlikely** given the close proximity of the opencast workings on which the CA base their dip assumptions, and based on the BGS plan.
The coal is not present (washed out).	The abandonment plan proves the presence of workings beneath the site. The only possibility of the Winter seam not being present would be if the abandonment plan has been mis-labeled as the Winter seam, but actually refers to a deeper seam. Whilst not unheard of, this seems **unlikely**. The memoir indicates that this seam is locally washed out in the Barnsley area, but not within the area of the site.

Explanation	Remarks
Workings have been “packed” (aka. “goaf packing”) following completion of working.	This practice was common, where mines were essentially backfilled with spent materials from mining to negate the need to dispose of them at surface. Where packed tightly, combined with subsequent pressure from the overlying ground, such workings can be hard to detect in rotary open-hole investigations. The only possible indications of this having occurred was in BH2 where a brief loss of flush and water strike were noted at 18.0m, which is broadly at the expected depth of the Abdy seam. In addition, a dark carbonaceous material was noted in BH9 from 16.7m to 17.5m in BH9 beneath interbedded sandstone and mudstone (possibly the Abdy Rock), again, broadly at the expected depth of the Abdy seam.

Based on the above, the most likely explanation for the lack of evidence of the Winter/Abdy seam or workings is that they have packed following mining and compressed over time, making the seam/workings difficult to detect.

15.4 Risk assessment

Based on the depths anticipated by Apex (see Section 5), even if present and worked, the Winter/Abdy seam should not pose a significant risk of subsidence at surface as there is at least 10x competent rock cover above the anticipated depth of the seam.

The intrusive investigation has shown potential evidence of packed workings in BHs 2 and 9, which are at the anticipated depth of the Winter/Abdy seam. Additional evidence of the dark carbonaceous material in BH9 being possible packed workings comes from the fact that it occurs immediately beneath a bed of mudstone & sandstone, which is possibly the Abdy Rock (mapped as lying directly above the coal seam).

At the depths encountered, any residual workings/voids should not pose a significant risk to surface stability beneath the proposed structure.

Further lines of evidence as to the depth of the suspected packed workings come from using the Two Foot coal as a marker for the likely depth of the Winter/Abdy seam. Based on the calculations in Section 5, the Winter/Abdy should be c. 10m deeper than the Two Foot seam. The BGS technical memoir also records the Abdy lying at between 30ft (9m) and 80ft (24m) beneath the Two Foot coal.

The Two Foot coal seam is present beneath the site and has been encountered at depths of between 4.6m and 11.6m, marginally shallower than the depths predicted in Section 5. Based on the calculations in Section 5 and the BGS technical memoir, the Winter/Abdy should be c. 9m-10m deeper than the Two Foot seam. Therefore, using the Two Foot as a “marker” for the Winter/Abdy seam, it should lie at between c. 13.6m and 21.6m beneath the site.

The maximum depth to rockhead beneath the proposed building is 2.7m (TP11), although is typically around 2.0m.

Assuming a maximum seam thickness of 1.04m (recorded by the Coal Authority), and a shallowest possible depth of 13.6m, there should be sufficient rock cover (using the 10h rule) above the Winter/Abdy coal seam.

Indeed, if the workings have been “packed” this would also help mitigate the risks of significant movement, but localised voids such as former roadways could remain.

Based on the above, risks associated with the Winter/Abdy seam appear low and further mitigation of risks is not required.

15.5 Mine entry

A mine entry is present on site; its recorded location from both historical OS plans and the Coal Authority coordinates is shown on Drawing 004 in Appendix B.

It is noted that the proposed layout includes a 20m exclusion zone around the mine entry and that no “hard” development will be placed in this area.

To date, no trenching has been undertaken in an attempt to find the mine entry as it is positioned beneath the stables buildings.

Once the buildings are demolished, attempts should be made to locate the shaft. Once located, the shaft will require treatment to an appropriate specification, to be agreed with Coal Authority and the Local Authority.

Given its presence within a proposed landscaped area, it is considered that treatment could comprise either grouting of the mine entry, **or** placement of a shaft cap (inclusive of gas venting measures) at rockhead level. Where a shaft cap is utilised, it should be 2x the shaft diameter, and founded on competent bedrock, which is anticipated at c. 2-3m depth.

16. FOUNDATIONS

16.1 General

The proposed layout shows a finished floor level of 148.450mAOD.

Based on current ground levels, this will mean filling of the ground towards the southern end of the building will be required (c. 2.0m of fill) and cutting of ground towards the northern end of the building will be required (c. 1.0m of fill).

Foundations will need to extend through any made ground and into natural soils below of adequate bearing capacity.

16.1 Shallow spread foundations

At this stage, proposed loadings are unknown.

Made ground and topsoil are not a suitable founding stratum and foundations should be extended through these deposits into competent natural ground below.

Given the proposed fill required in the south of the site, there may be a requirement for some underbuild, along with use of retaining walls.

Preliminary bearing capacities are given in the table below and have been calculated in general accordance with EC7[6] requirements. For this preliminary assessment, vertical actions are considered, and the following limit states have been accounted for:

- Bearing failure
- Excessive settlements

Foundation	Stratum	Minimum depth	Allowable bearing capacity	Maximum allowable load
1m x 1m square pad	Cohesive Residual Soils	0.75m	120kN/m^2	120kN
	Granular Residual Soils	0.75m	120kN/m^2	120kN
	Mudstone Bedrock	0.45m	200kN/m^2	200kN

Notes
1) The capacities given above have been calculated using Design Approach 1 in EC7
2) The capacities and loadings given above assume minimum foundation depths of 0.75m in Cohesive/Granular Residual Soils and 0.6m in mudstone bedrock.
3) Settlements of greater than 25mm should not occur providing the above loadings are not exceeded.
4) All foundations should be at >0.45m depth due to potential frost susceptibility.
5) Foundations should be taken to a depth below a 45° line drawn up from the base of any nearby excavations (eg, for drainage etc).
6) Foundations should be deepened where impacted by tree influence in accordance with NHBC Standards Chapter 4.2.
7) Deepened foundations should be stepped in accordance with NHBC Standards Chapter 4.3.
8) Heave precautions are required for foundations within the influence of trees and have a required foundation depth of >1.5m in accordance with NHBC Standards Chapter 4.2.

[6] Eurocode 7 : Geotechnical design BS EN 1997-1:2004+A1:2013 (February 2009)

It is recommended that foundations are cast as soon as possible following excavation in order to minimise the risk of disturbance (softening/loosening) at formation level. Alternatively, base of footings could be blinded with a layer of lean-mix concrete.

Given the need for cut & fill on the site, foundations in the north (proposed cut) will encounter weathered bedrock (non-shrinkable) at shallow depth (<1m); whereas, in the south (proposed fill), weathered bedrock will lie at c. 4.5m below proposed finished floor levels, with Cohesive Residual Soils (shrinkable) above.

The above means that there is potential for foundations to be cast in differing strata across the footprint of the proposed studio. They may give rise to differential settlements between pad foundations.

Therefore, it recommended that once loadings are known, a settlement analysis should be carried out for each pad based on proposed loads and the founding stratum at each pad location. Should this analysis suggest that intolerable differential settlement will occur, it will be necessary to extend foundations in the south (proposed fill) to the level of weathered bedrock. This would likely necessitate use of underbuild techniques to cast foundations prior to filling the ground to avoid excessive foundation excavation depths.

16.2 Tree influence

Trees/hedgerows are present along site boundaries, field boundaries. Their influence may have an effect on a number of pads, particularly along the north-west wall of the studio.

The site is underlain by shrinkable soils of Low Volume Change Potential, and therefore a minimum foundation depth of 0.75m is required. This should be taken from original or finished ground level, whichever is the lower.

Where proposed buildings are within the influence of trees and are underlain by shrinkable soils, deepening of foundations will be required in accordance with NHBC Standards Chapter 4.2.

On this site, the shrinkable soils are often underlain by non-shrinkable strata (weathered bedrock). Therefore, where weathered bedrock is encountered at depths shallower than the depth specified due to tree influence, foundations can be cast within the non-shrinkable stratum, which need only be penetrated by the foundation thickness.

16.3 Sub-surface concrete

Concrete classifications for the various strata on site are given in Section 10.2.

Designated mixes should be specified by the structural engineer taking into account soil chemistry long with other structural considerations.

17. FLOOR SLABS

The proposed studio underlain by low-shrinkability soils with no significant made ground.

However, significant fill is required in the south. Therefore, the proposed floor slab should comprise either:

- A suspended floor slab; or,
- A ground bearing slab cast on granular fill treated to a suitable engineering specification*

* NOTE where areas of floor slab lie within the zone of influence of trees, removal of shrinkable soils within these areas will be required, following by replacement of fill to the same engineering specification.

Floor slab design will also need to take account of the required radon protection measures and the results of the gas monitoring (currently being undertaken).

18. PREPARATORY WORKS & CONSTRUCTION ISSUES

18.1 Excavations

Excavations across the majority of the site are expected to remain stable throughout construction, but may require shoring where left open for significant periods of time. Excavations in the south-east of the site (former spoil pile) may experience some instability, necessitating support.

Significant inflows of groundwater are not anticipated, but some seepage of water may be encountered in excavations of greater than c. 2.5m.

18.2 Proposed access road & car parking

The proposed access road is likely to cross areas of made ground in the south-east (former spoil pile). Where this is the case, it is recommended that the made ground be excavated to its full thickness (or 2m, whichever is the shallower) and replaced with suitable engineered fill such that a CBR value of at least 3% is achieved at formation level.

Elsewhere, where the access road is underlain by natural strata and in areas of proposed car parking (south-west), the natural strata should yield CBRs of 3% or greater, which should be verified by in-situ plate bearing tests/CBRs prior to construction.

The suitability of imported materials used in the proposed access road and areas of car parking should be subjected to confirmatory lab testing (compaction and particle size distribution tests) prior to use, along with in-situ testing (plate load tests) following construction.

18.3 Drainage and new water supplies

Based on the in-situ testing, soakaways will not provide a suitable means of water disposal at this site.

Apex have issued a Drainage Strategy Report for this site (ref. 1226-ACE-ZZ-XX-RP-C-1001, dated April 2024) which outlines the following recommendations in relation to drainage:

Surface water from the site will discharge to the surface water sewer within adjacent Windhill Lane at a maximum discharge rate of 1.7 l/s (QBAR).

Hydraulic calculations have been undertaken for all storms up to and including the 1 in 100 year return with an allowance of 40% climate change. Storage volumes can be readily accommodated within the site boundary.

The surface water drainage system will use SuDS attenuation techniques where possible such as permeable paving and swales.

Foul drainage will discharge unrestricted to the foul sewer within the residential area located to the south of Windhill Lane, crossing Keswick Road.

A sewer survey is required to determine the depth of the proposed connection points and location of existing drainage within the site boundary.

Overland flooding for storm events exceeding the worst case 1 in 100 year event + 40% climate change will be retained on site where possible.

Where new water mains are to be laid, UKWIR testing will be required in order to confirm pipe construction materials, as detailed in UKWIR report 10/WM/03/21[7]. This should ideally be carried post-earthworks and after any remediation.

18.4 Existing services

Overhead electricity services run across the site.

Consultation is required with service providers in order to ascertain any restrictions or easements required, along with feasibility of diversion (where required).

[7] Guidance for the selection of water supply pipes to be used in brownfield sites – UK Water Industry Research (2011)

19. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

19.1 Background & proposed development

The site is situated in a small field adjacent Windhill Lane in north Mapplewell, Barnsley and comprises a roughly square parcel of rough grassland with the remains of a burned out stable and associated hard standing in the centre of the site.

The site slopes from north to south from a high point of c. 150mAOD to a low point of c. 142mAOD.

It is understood that the proposals include the development of a low-rise commercial unit (sound studio) with associated single external “pods” in the west, areas for natural wildlife including woodlands and a pond in the centre & west, and a private access road with car parking in the south.

19.2 Ground conditions

The site is underlain in the north and west by granular and cohesive residual soils overlying the Pennine Middle Coal Measures. In the southeast significant heterogenous made ground deposits up to 3.10m thick are recorded which coincides with the spoil pile marked on historical plans.

Rockhead is at c. 2m below the proposed studio (locally up to 2.7m depth), but deeper (up to c. 3.6m) in the south (area of former spoil pile).

19.3 Coal mining

The Meltonfield coal seam outcrops in the north, and the Two Foot coal underlies the site at depths of between 4.6m and 11.6m. No workings were identified in these seams and they are not considered to pose a significant risk to the site.

The Meltonfield coal seam may be encountered in excavations in the north of the site; where encountered, the coal will need to be excavated under an “incidental coal” license from the Coal Authority.

The Winter/Abdy seam is shown as being worked beneath the site. Whilst the Coal Authority state a depth of c.12m to this seam, Apex’s investigation and review of available data suggests the seam is deeper, at c. 13.6m to 21.6m beneath the proposed studio building.

This seam was not encountered during the investigation, but possible evidence of “packed workings” was encountered in two locations, which coincided with the estimated depths of the seam based on desk study information.

Given its depth and thickness, the Winter/Abdy seam risks associated with this seam are considered low.

A mine entry is recorded in the centre of the site beneath the stables buildings.

This mine entry should be located via trenching once access is available, and be treated to make it safe. Measures to remediate this mine entry will require approval from the Coal Authority, but at this stage are likely to comprise either grouting of its full thickness, or placement of a shaft cap at rockhead.

19.4 Contamination and remediation

No significant contamination has been identified.

Additional investigation within the vicinity of the stables buildings (once demolished) should be undertaken to confirm the absence of contamination in this area, especially given the presence of possible ACMs identified (corrugated sheeting) identified here during the site walkover.

19.5 Hazardous gas

The site is considered to be at risk of hazardous gas due to the presence of:

- Mineworkings mapped beneath the site and in the vicinity
- Made ground mapped within the site boundary and surrounding area associated with mining activities

Monitoring is currently being undertaken with an initial 6 visits proposed over a 2-month period.

On completion, as gas risk assessment will be issued which will detail any necessary gas protection measures.

Mapping indicates that basic radon protection measures are required; a site-specific radon report should be obtained to confirm this.

19.6 Foundations & floor slabs

At this stage, proposed loadings for the structure are not known. However, the Cohesive and Granular Residual Soils should provide sufficient bearing capacity for the adoption of traditional pad foundations.

A settlement analysis should be undertaken to ascertain likely settlements between pads cast within Cohesive Residual Soils and those cast in Weathered Bedrock.

If this assessment highlights the potential for significant differential settlement between strata, then underbuild may be required for foundations in areas of fill (south) in order to reach Weathered Bedrock.

Foundations will need to take account of potential tree influence, notably in the north-west.

A suspended slab will be required, or ground-bearing slab on engineered fill placed to a suitable specification. Where a ground-bearing slab is used, any shrinkable soils within the zone of influence of trees will also require removal and replacement with suitable engineered fill.

19.7 Drainage

In-situ testing has concluded that use of soakaways is not feasible.

Apex have issued a Drainage Strategy Report for this site (ref. 1226-ACE-ZZ-XX-RP-C-1001, dated April 2024) which outlines recommendations in relation to drainage, and should be read in conjunction with this report.

19.8 Access road & car parking

The proposed access road is likely to cross areas of made ground in the south-east (former spoil pile). Where this is the case, it is recommended that the made ground be excavated to its full thickness (or 2m, whichever is the shallower) and replaced with suitable engineered fill such that a CBR value of at least 3% is achieved at formation level.

Elsewhere, the natural strata should yield CBRs of 3% or greater, which should be verified by in-situ plate bearing tests/CBRs prior to construction.

The suitability of imported materials used in the proposed access road and areas of car parking should be subjected to confirmatory lab and in-situ testing.

19.9 Flooding

The site lies in Flood Zone 1.

The north of the site lies in an area where there is potential for groundwater flooding to occur at surface.

19.10 Further works

The following additional works are recommended in light of this investigation:

- Additional investigation (trial pitting & chemical analysis) within the vicinity of the stables, once removed.
- Trenching to locate & record the location and diameter of the mine entry
- Provision of a specification for the treatment of the mine entry
- Production of a tree influence plan to ascertain the impact of trees on the proposed foundation/floor slab. For this to be completed, a tree survey will be required.
- Updating this report when the supplementary investigations are complete.

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Appendix A – Guidance Notes

Guidance Note A – Preliminary Ground Appraisal (Desk Study)

1. INTRODUCTION

Information sources typically utilised as part of Apex's Preliminary Ground Appraisal (Desk Study) are presented below, along with details on the various issues assessed as part of this phase of investigation.

2. SOURCES OF INFORMATION

The following resources are used to form a conceptual site model and thereby enable identification of risks (both geotechnical and contamination) which may require further assessment as part of an intrusive phase of investigation. Where additional resources have been used, these are referred to in the report's main text.

British Geological Survey

Resources used include:

- BGS' online 'Geology of Britain' viewer
- Online borehole scans
- Mapping sheets (1:50,000 and 1:10,000 scale)
- Geological memoirs to accompany mapping sheets

The above are used to inform the conceptual site model with regards to anticipated ground conditions (including the presence of made ground, drift deposits and bedrock). In addition, BGS resources help inform of likely risks of ground movement associated with mining (e.g., coal, ironstone, sandstone, quarrying etc), and subsidence (e.g., soluble rocks such as limestone and gypsum).

Coal Authority

Resources include:

- Interactive map viewer – this provides an initial 'screen' as to likely mining risks as it determines whether or not the site lies in a Development High Risk Area, a Development Low Risk Area, or lies beyond the CA's defined coalfields.
- Consultant's Mining Report – this includes information on any likely shallow coal mining; recorded mining beneath the site; presence of mine entries, coal outcrops, opencasts which could affect surface stability, and future planned mining. Where issues are highlighted, these are discussed in further detail in the main report's text.
- Additional resources such as abandonment plans, mine entry datasheets and subsidence reports etc might be reviewed on a site-by-site basis.

The above, combined with other resources outlined in this guide, is used to inform risks associated with mining including the likelihood of shallow mine workings

which could cause subsidence, presence of deep made ground (e.g. opencasts) and risks associated with hazardous gas generation.

Landmark Information Group – "Envirocheck" report

This includes information from a wide range of sources, but most notably the Environment Agency, Local Authorities and BGS. Key information reviewed by Apex as part of the Desk Study phase includes:

- Historical OS plans. These typically date back to the mid-19th Century and are reviewed in order to assess past land use which in turn informs the conceptual site model in terms of geotechnical risk and contamination risk. These may also be used to inform risks of unexploded ordnance (UXO) for example, if the site is within an urban setting and/or has past military use.
- Location of landfills, most notably those within 250m of the site to inform risks of gas migration and possible leaching of contaminants.
- Aquifer designations of the underlying geological strata (split between superficial (drift) deposits and bedrock) and categorised as one of the following:
    - Principal Aquifers – typically with high water storage capacity (karstic or intergranular). Major water supply and/or river base flow support.
    - Secondary Aquifers:
        - Secondary A – support water supply at a regional scale
        - Secondary B – limited storage of water supply
        - Secondary Undifferentiated – variable nature of rock type means it cannot be identified solely as A or B.
    - Unproductive strata: little/no permeability; insignificant in terms of water supply/supporting base flow to rivers.
- Presence of Groundwater Source Protection Zones: maps within the Envirocheck report show areas designated as SPZ 1, 2 or 3 based on proximity to groundwater source (e.g. abstraction boreholes, wells, springs etc). Where no shading is shown on the Envirocheck maps, no SPZ is present. Where present, SPZs are discussed in the main text in more detail.
- Nearby surface waters (hydrology) including:
    - Distance and direction to the nearest surface waters
    - Quality of the surface water
- Flood risks including:
    - Flood Zones 1, 2 and 3 associated with flooding from Rivers and Sea, including any areas benefitting from flood defences (see definitions below).
        - Flood Zone 1 – land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding
        - Flood Zone 2 – land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.
        - Flood Zone 3 – land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or

greater annual probability of flooding from the sea (>0.5%) in any year.
    - Potential for Groundwater Flooding, split into areas where there is:
        - No shading (no/minimal risk)
        - Limited potential for groundwater flooding to occur
        - Potential for groundwater flooding of property situated below ground level
        - Potential for groundwater flooding to occur at surface
- For groundwater and surface water:
    - Licensed abstractions which could affect/be affected by the site
    - Records of pollution incidents
    - Licensed discharge consents

In addition to the above, the Envirocheck report is screened to look for any additional information pertinent to ground contamination. The 'checklist' of key information used in our assessment is given here: https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm/lcrm-stage-1-risk-assessment1

Zetica's online Risk Maps

This online resource, combined with review of historical plans, is used to help determine whether or not is likely to be at risk from UXO. Where risks are identified, Apex recommend further assessment by a UXO specialist.

Site walkover

As part of a desk study, Apex typically carry out a site walkover. Features which are looked out for include:

- Evidence of contamination/sources of contamination (eg, fuel tanks, machinery storage, staining, spillage etc)
- Mining risks highlighted in the desk study (eg,location of shafts, quarry highwalls)
- Nature of buildings on site (including: evidence of damage, presence of potential ACM, current use)
- Topography (eg, presence of retaining walls, steep slopes, evidence of movement)
- Surface waters (eg, field drains, ditches, springs, evidence of contamination within them)
- Current land use

In addition to the above, on operational sites, Apex will conduct interviews with site users/staff where possible to gain more insight into the former and current processes taking place (including details of waste generated, location of key features such as fuel tanks, materials storage etc).

[1] Land Contamination Risk Management (8th October 2020)

3. CONCEPTUAL SITE MODEL

The above information sources enable formulation of the Conceptual Site Model (CSM). This forms the basis of the contamination risk assessment by using the Source-Pathway-Receptor principal: identification of contamination sources, identification of receptors (most notably human health, waters and vegetation) and pathways between the two. This model is used in the context of each site's proposed development in to assess whether a significant risk exists, and therefore if further assessment (intrusive investigation) is warranted.

As well as contamination risks, the CSM is also used to identify any geotechnical risks which might affect the proposed development (for example, presence of obstructions, deep made ground, mining issues).

Where further assessment is required, the CSM is used as a basis to design the ground investigation.

Guidance Note B – Fieldwork

1. UK GUIDANCE

Ground investigation fieldwork undertaken by Apex Consult (SY) Ltd is done so in general accordance with UK guidance. Most notably, in planning and carrying out ground investigation fieldwork, the following documents are referred to: BS5930:2015[1]; BS10175[2]; LCRM[3], BS8004[4], BS1377-9[5].

2. GROUND INVESTIGATION DESIGN

Locations

Locations of exploratory holes are selected after formulation of the site's conceptual site model, which looks at geotechnical and contamination risks. Positions of exploratory holes are selected in order to resolve uncertainties highlighted by the conceptual model (for example, checking for obstructions associated with a former builder or to enable sampling close to a former fuel tank, etc). In addition, hole locations are selected to gain a general view of the strata across the site to enable refinement of the conceptual site model.

On site, positions may be altered due to access constraints or risks posed by service runs. Further exploratory holes might be advanced to enable delineation of features such as grossly contaminated soils, poor ground, etc.

Techniques

The following techniques are typically utilised depending on ground conditions and site constraints:

- Trial pitting – used wherever possible as this allows better quality representative sampling and a more thorough inspection of the ground (stability, ease of excavations, etc) than techniques such as windowless sampling. Limited to around 3-4m depth or presence of bedrock. Hand shear vane tests are carried out in cohesive soils throughout trial pitting to enable assessment of undrained shear strength.
- Windowless sampling – typically used where access constraints prevent trial pitting and/or to enable installation of monitoring wells to up to c. 5m depth. Limited to around 3-4m depth or presence of bedrock. Where appropriate, standard penetration tests (SPTs) might be carried out in granular soils. Whilst hand-vane tests can be carried out, they are considered less reliable than those within trial pits due to the disturbance caused during drilling.
- Cable percussion boreholes – Used where geotechnical parameters and detailed inspection of ground conditions are required from depths greater than can be reached with trial pitting/window sampling techniques. SPTs

[1] Code of practice for ground investigations (2015+A1:2020)
[2] Investigation of potentially contaminated sites – code of practice (2011 + A2:2017)
[3] Land Contamination Risk Management (8th October 2020)
[4] Code of practice for foundations (2015+A1:2020)
[5] Methods of test for soils for civil engineering purposes. In-situ tests (1990)

are typically undertaken at c. 1m intervals to allow assessment of the density of granular soils and/or estimation of undrained shear strength of cohesive soils. Within cohesive soils, SPTs are usually alternated with collection of UT100 samples (undisturbed samples). Depending on ground conditions, use of dynamic sampling or rotary drilling with a casing system (for example, Odex/Duplex drilling) gives similar results, but might be considered more appropriate. This is discussed with the drilling contractor prior to fieldwork.

- Rotary open-hole drilling – typically used in coal mining investigations to look at the depth and thickness of underlying coal seams (and/or evidence of mineworking's). Generally, at least 3 holes are taken to c. 30m depth below rockhead in all coal mining investigations, with additional boreholes drilled to the depths of the targeted coal seams.
- Rotary core drilling – this is utilised where detailed information (fracture spacing, RQD TCR values) is needed from bedrock, usually for pile design. Rotary coring also enables recovery of rock samples for strength tests such as point load index and unconfined compressive strength (UCS).

During drilling, installations to monitor for hazardous gas and/or groundwater might be installed as per the Engineer's instructions.

Other ground investigation techniques (such as hand-excavated inspection pits, CPTs, etc) might be utilised on certain sites depending on ground conditions and redevelopment proposals.

3. SAMPLING

Usually, at least one sample is taken from each stratum encountered in each exploratory hole, with particular attention paid to made ground deposits within the uppermost 1m. Unless stated otherwise, samples taken are representative of the stratum encountered at a given depth. In trial pitting, this involves taking samples from around the side walls of the entire trial pit (where possible) and not from a specific point. Where a 'spot' sample is required (for example, a sample of lens of ash & clinker or oily fill), this is clearly denoted on the sample by an "*****" and in the Engineer's notebook.

Samples are collected in containers appropriate for their proposed analysis, as dictated by laboratory requirements. Typically, this means that the following containers are needed for soils:

- For chemical analysis: 50ml glass jar, 500ml glass jar, and 500ml plastic tub
- For geotechnical analysis on disturbed samples: 500ml plastic tub, and bulk bags

Once collected, all samples scheduled for chemical analysis are stored in cool boxes at c. 4°C. Samples scheduled for asbestos ID are 'double bagged' (i.e., plastic tubs stored within a plastic bulk bag).

If groundwater sampling is required, typically 2 x 1 litre glass bottled, and 2 x 50ml glass vials will be collected from each sample point. However, specific instructions regarding containers will be discussed with the laboratory.

4. ENGINEERING SUPERVISION & LOGGING

During fieldwork, full time engineering supervision is required. The Engineer logs the ground conditions in general accordance with BS 5930 including observations on groundwater, stability, ease of excavation, and any visual/olfactory evidence of organic contamination.

Guidance Note C – Contamination Testing & Assessment

1. CONCEPTUAL SITE MODEL

The conceptual site model, combined with fieldwork findings, is used to determine the locations and depths of samples scheduled for chemical analysis. Samples taken from points of interest (i.e., potential sources of contamination, as determined during the desk study phase and/or by visual and olfactory evidence on site) are scheduled for analysis as well as samples from across the site to enable characterisation of ground types encountered.

The analysis suite is determined by a review of the history of both the site and surrounding area as well as current features. Reference is also made to relevant DETR Industry Profiles.

Typically, all soil samples are scheduled for the following analysis as a broad screen, with additional site-specific contaminants tested for as and when required based on the conceptual model:

- pH & metals
- Asbestos ID (with quantification if evidence of asbestos is detected)
- Water soluble sulphate
- Total organic carbon
- Speciated polycyclic aromatic hydrocarbons
- Petroleum hydrocarbons (brownfield only, unless a clear source is shown on greenfield sites) with speciation where appropriate

Where significant risks to controlled waters are identified, leachability analysis may also be scheduled as well as analysis of water samples (ground/surface). Additional assessment may be required.

Details of laboratory analysis techniques and limits of detection are included within the laboratory results.

2. ASSESSMENT CRITERIA

To assess whether a plausible pollutant linkage exists between a contaminant source and a site receptor, Apex initially screen results against generic assessment criteria as part of a generic quantitative risk assessment. The criteria used are the LQM/CIEH "Suitable 4 Use Levels" (S4UL)[1], publication number S4UL3828 and Category 4 Screening Values (C4SLs). This approach is in line with LCRM[2]. Screening values used for a variety of end-uses are shown at the end of this guidance note.

Where criteria other than S4ULs or C4SLs have been used, this is stated in the report's main text.

[1] The LQM/CIEH S4Uls for Human Health Risk Assessment (2015)

[2] Land Contamination Risk Management (8th October 2020)

2.1 LQM/CIEH Suitable 4 Use Levels (S4UL)

The S4ULs are *"intended for use in assessing the potential risks posed to human health by contaminants in soil and as transparently-derived and cautious 'trigger values' above which further assessment of the risks or remedial actions may be needed."*

The S4ULs are based on a principal of minimal or tolerable risk in line with SR2[3] and are therefore considered suitable as assessment criteria under the planning regime.

The S4ULs are derived using CLEA software; the S4UL for each contaminant is the concentration of the contaminant in soil at which the predicted average daily exposure equals the Health Criteria Value[1].

The S4ULs assume a sandy loam as per Environment Agency guidance[3]. For organic contaminants, soil organic matter (derived from TOC testing) is also considered in order to apply the correct screening value for each contaminant.

In assessing contamination risks by comparing site-derived values with the S4ULs, it should be noted that:

- Non-exceedance of a relevant S4UL indicates that soil contaminant levels are such as not to compromise human health[1]
- Exceedance of a S4UL does not necessarily mean there is a significant possibility of significant harm, nor that remediation is needed under the planning regime[1]
- Exceedance should however warrant further discussion, assessment, and possibly additional investigation, following this, the need for remediation should then be considered

2.2 Category 4 Screening Values (C4SL)

Category 4 Screening Values were published by Defra in 2014 as part of SP1010[4]. C4SLs are available for six contaminants (arsenic, benzene, benzo[a]pyrene, cadmium, chromium VI, and lead). These values were based on a 'low level of toxicological concern' (LLTC) rather than minimal or tolerable level of risk as advocated by the Environment Agency in SR2[3].

In the absence of S4ULs, namely for lead, C4SLs have been adopted by Apex as initial screening criteria. This approach is generally accepted by regulators.

2.3 TPH assessment

When assessing TPH results, a 3-step approach is adopted by Apex, in accordance with Environment Agency guidance[5]. This involves:

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[3] Human health toxicological assessment of contaminants in soil (1st January 2009)
[4] Development of Category 4 Screening Values (C4SLs) for Assessment of Land Affected by Contamination
[5] Environment Agency document P5-080/TR3 - The UK approach for evaluating human health risks from petroleum hydrocarbons in soils (June 2003)

Step 1 – assessment of indicator compounds. Results of laboratory testing for the indicator compounds given in Table 4.1 of P5-080/TR3[5] are compared to the appropriate screening values (see above).

Step 2 – assessment of individual fractions. Where indicator compounds are present, results for the individual TPH fractions are assessed against their respective screening values.

Step 3 – assessment of cumulative effects

This is done using the following equation:

$$HI = \sum_{F_i=1}^{16} HQ\ F_i = \frac{Measured\ concentration\ F_i\ (mg\ kg^{-1})}{SGV\ F_i\ (mg\ kg^{-1})}$$

where HI = Hazard Index
HQ = Hazard Quotient
F_i = Fraction $_i$
SGV = Soil Guideline Value

In the event of exceedances of screening value at Stages 1 or 2, no further assessment is needed.

In stead of speciated TPH, banded TPH may be scheduled as an initial 'screen' for potential TPH contamination. This splits the results into 3 bandings: gasoline-range, diesel range, and lubricating range organics (GRO, DRO and LRO). When assessing results of banded TPH analysis, the most stringent S4UL screening value for individual TPH bandings is used from within the GRO, DRO and LRO ranges. This is considered to be a conservative approach, and where exceedances are recorded, additional analysis (speciated TPH) may be scheduled to enable further risk assessment.

2.4 Asbestos

There is no published screening value below which asbestos within soil is deemed as 'safe'. This is because, even at trace amounts (<0.001%) potentially respirable fibres may be present within soils which could cause harm to human health. However, CL:AIRE guidance[6] suggests that release of asbestos fibres from the ground is unlikely to result in airborne concentrations equivalent to those which could be released when working with asbestos-containing building materials (insulation, AIB, coatings etc). This assumes that the asbestos-containing soils are not being subjected to highly energetic processes (e.g. crushing & screening).

When assessing site investigation data, any sample where asbestos fibres are detected requires further assessment to fully understand risks.

Quantification is scheduled on samples where asbestos is identified. This looks at the amount of asbestos with a sample as a percentage of the soil mass, also gives details on the type of asbestos and its nature within the sample (e.g. a fragment of ACM, loose fibres, debris etc).

After quantification, a risk assessment is carried out based on the number of samples yielding a positive ID, the strata where asbestos was identified, the

[6] Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials – Control of Asbestos Regulations, CL:AIRE (2012).

nature of the asbestos, any proposed earthworks and the final development layout.

3. ADDITIONAL ASSESSMENT

In the event of exceedances during the initial screen, a number of options might be used to further assess the hazard posed by contaminants in soils:

3.1 Statistical assessment

Additional assessment using various statistical techniques where appropriate. It should be borne in mind that statistical methods should only be used where a sufficient number of samples are available from each ground type (typically six as a minimum). In addition, statistics should only be used in conjunction with appropriate averaging areas. These may be certain material types, site sub-areas based on past use, spillage of contaminants etc. Where averaging areas and statistics are used, further detail is given in the report text.

3.2 Detailed quantitative risk assessment (dQRA)

Additional assessment might be undertaken to determine whether a risk actually exists. For example, this may involve re-visiting input parameters in the CLEA model and deriving site-specific screening values or use of bio-accessibility testing.

3.3 Additional investigation

Where areas of contamination are encountered, particularly those thought to be attributed to a ‘hotspot’ (i.e., a spillage or leakage of contamination) additional sampling and analysis might be recommended to delineate areas of soil affected.

3.4 Remediation

Where the above procedures highlight an unacceptable risk, remediation options will be advocated. This might involve removal of the source, or breakage of the pathway(s).

Guidance Note D – Geotechnical Testing & Assessment

The following geotechnical analysis is commonly undertaken by Apex. All testing is done in accordance with the specified methods outlined in 1377:1990.

Any additional testing not listed below and/or deviations from set procedures will be stated in the report's main text.

1. UNDRAINED, UNCONSOLIDATED TRIXIAL TESTING

The above is frequently scheduled on undisturbed samples (ideally UT100s) as a method of assessing undrained shear strength of cohesive soils in the worst-case scenario (i.e. during loading, where excess pore pressure has not dissipated, meaning effective strength is at its lowest).

Where possible, tests are scheduled on a single 100mm diameter specimen as opposed to 3no. 38mm diameter sub-specimens to minimise the risk of sample disturbance.

Samples are typically scheduled for analysis at a confining pressure roughly equal to overburden pressure.

2. OEDOMETER (CONSOLIDATION) TESTS

This testing is undertaken to enable assessment of consolidation settlement in clays for a given load. This is usually done for cohesive soils other than those which are over-consolidated and/or where significant ground surcharge is anticipated.

Samples are scheduled to include 4 loading pressures and one unloading pressure. In accordance with BS1377, the initial pressure is determined by the soil's origin and strength and where possible, the scale of pressures should include at least one which is equal to (or greater than) the likely maximum pressure to be imposed on the soil.

The results are used to give typical coefficient of volume compressibility (m_v) values for ground types across a range of depths. This is used in settlement calculations and might be used by others in pile design for example.

3. ATTERBERG LIMITS

Atterberg Limits testing is carried out on samples of cohesive soils to help determine minimum foundation depths including the impact of any tree influence, requirements for heave precaution etc.

The test involves determination of the Liquid and Plastic Limits of cohesive soils using the rolling thread test cone penetrometer method.

Results received are modified by Apex in line with BRE Special Digest 240[1] and NHBC Chapter 4.2[2] in order to determine a soil's volume change potential (aka. shrinkability). Data is typically grouped into ground types and average shrinkability values are used for each type. However, where a significant number of samples of yield results in a higher shrinkability category to that of the average, the ground type is conservatively assigned the higher shrinkability category.

This may also be used in conjunction with Particle Size Distribution tests (PSDs) to determine whether a particular soil/sample should be classed as potentially shrinkable or not. This is done by looking at the 'fines' content (%< 63µm) form the PSD test along with the modified plasticity indices. Where the soil contains <35% fines and/or has a modified PI value of <10%, it can be regarded as non-shrinkable (in accordance with NHBC Chapter 4.2).

4. Sulphate and pH

Samples are scheduled for pH and water-soluble sulphate analysis in order to determine the Aggressive Chemical Environment for Concrete (ACEC) classification along with the Design Sulphate (DS) class in accordance with the requirements of BRE SD1[3].

Where groundwater samples are available, sulphate results from groundwater may be used in addition to soil results.

On all sites, pH and water-soluble sulphate analysis in scheduled on each ground type. On brownfield sites, testing for nitrate and chloride is also undertaken. These are converted to equivalent sulphate values (NO_3 x 0.77 and Cl x 1.35) and are added to the water-soluble sulphate results for each sample.

Where sulphate readings are >3,000mg/l, magnesium concentrations are also considered.

Where there is a risk of pyrite (iron sulphide) within the ground (as identified by the desk study), total sulphur and total sulphate may also be scheduled in order to determine the "total potential sulphate (TPS)". However, the risks to concrete associated with pyrite need only be considered where ground is 'disturbed'. Examples include colliery spoil or cut slopes. For a typical shallow foundation within in-situ natural soils, pyrite should not present a significant risk.

Results are used to determine the highest water-soluble sulphate (or TPS where risks of pyrite need to be considered) and lowest pH for each soil type. Where >10 samples for each soil type are available, the mean of the highest/lowest 20% of values for water-soluble sulphate/pH are used respectively.

The results from the above are used to determine the ACEC and DS classes for static and mobile groundwater using Tables C1 (for greenfield sites) and C2 (for brownfield sites) of BRE SD1. Where flowing groundwater is identified (eg springs), additional consideration of carbon dioxide may be required.

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[1] Low-rise buildings on shrinkable soils (1993)
[2] Building Near trees - NHBC Standards (2021)
[3] Concrete in aggressive ground - third edition (2005)

Guidance Note E – Hazardous Gas

1. RADON

Radon is a naturally occurring radioactive gas formed by underlying uranium and radium containing bedrock. Where radon is able to migrate into buildings, it can pose a risk to human health.

An Action Level for radon has been determined by Public Health England (PHE) as an annual average concentration in the home of 200 Bqm^{-3}. A Target Level of 100 Bqm^{-3} was also determined for preventative action in new homes and as a remedial target in existing homes.

To assess radon risk, Apex refer to the PHE website which splits the UK into 1km grid squares. Each square is given a "maximum radon potential", which corresponds to the percentage of homes in that grid square estimated to be above the radon Action Level. The categories are: <1%, 1-3%, 3-5%, 5-10%, 10-30% and >30%.

Radon protection measures are detailed in BRE Report BR211[1] which refers to 'Basic' and 'Full' measures. Building Regulations requires measures in radon affected areas as follows:

- **Basic** – in areas with a maximum radon potential of >3%, but less than 10%
- **Full –** in areas with a maximum radon potential of >10%

It should be noted however that PHE's advice is to include basic measures in all homes where the maximum radon potential is >1%.

The Action and Target levels should also be applied to schools and non-residential structures where occupancy is greater than 2,000 hours per year.

Where this is a significant radon risk, Apex may also use higher-resolution radon risk maps from BGS to determine areas of higher/lower risks within a given 1km grid square.

2. OTHER GASSES

Hazardous gasses pose a potential risk of explosion, asphyxiation or poisoning in new structures.

Conceptual site model

Gas risks are considered by Apex as part of the conceptual site model (see Note A – Preliminary Ground Appraisal). Potential sources may include landfills (most notably those within 250m); backfilled historical features (e.g. ponds, quarries, clay pits, railway cuttings); spillages of volatile contaminants; naturally occurring geological deposits (e.g. coal, peat, limestone); mineworkings; significant depths of made ground.

[1] Radon: guidance on protection measures for new buildings – BRE Report 211 (2015)

The main hazardous gasses generated by degradation of materials (such as in the case of landfills, backfilled features, organic-deposits and made ground) are carbon dioxide and methane, along with depleted oxygen. These pose a risk of asphyxiation and potential explosion where they accumulate within buildings. Mineworkings also pose a significant risk of methane and carbon monoxide generation.

As part of the conceptual site model, migration pathways for hazardous gasses are assessed. These may include natural fissures, cavities, fractures, fault lines and movement along any permeable strata. Man-made features such as service runs, shafts and tunnels may also create preferential migration pathways. Low permeability layers (e.g. clay) and groundwater levels may also influence gas flow.

Investigation

Depending on the level of risk, as determined by the conceptual site model (see above), an intrusive gas investigation may be required.

Where this is the case, gas monitoring wells are placed across the investigation area. Wells are located to target the potential gas source, and their response zones are carefully installed within specific strata to enable robust assessment of gas risk. UK Guidance including BS8576[2] and CIRIA C665[3] is referred to help determine the number of wells and monitoring frequency.

Monitoring typically involves measurement of:

- Peak and steady gas flow
- Peak and steady carbon dioxide and methane concentrations
- Minimum oxygen concentration
- Groundwater level and base of well

Where groundwater levels are above the well response zone, wells are bailed and re-monitored within the same visit. Concentrations of hydrogen sulphide, carbon monoxide and volatiles (using a photo-ionisation detector) may also be monitored on some sites.

At least one monitoring visit (ideally more) should be undertaken during, or immediately after, periods of falling atmospheric pressure, as well as during periods of low pressure (<1000mb).

Interpretation

Results are used to calculate a gas screening value (GSV):

GSV = gas concentration (%) / 100 x flow rate (ltr/hr)

Typically, GSVs are determined using the maximum recorded steady concentration of a given gas in any borehole and the maximum recorded flow rate in any borehole. However, on some sites it may be deemed appropriate to zone the site based on gas risk, and/or to use peak readings. This is discussed on site-specific basis within the final Gas Risk Assessment.

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[2] Guidance on investigations for ground gas - British Standards (2013)

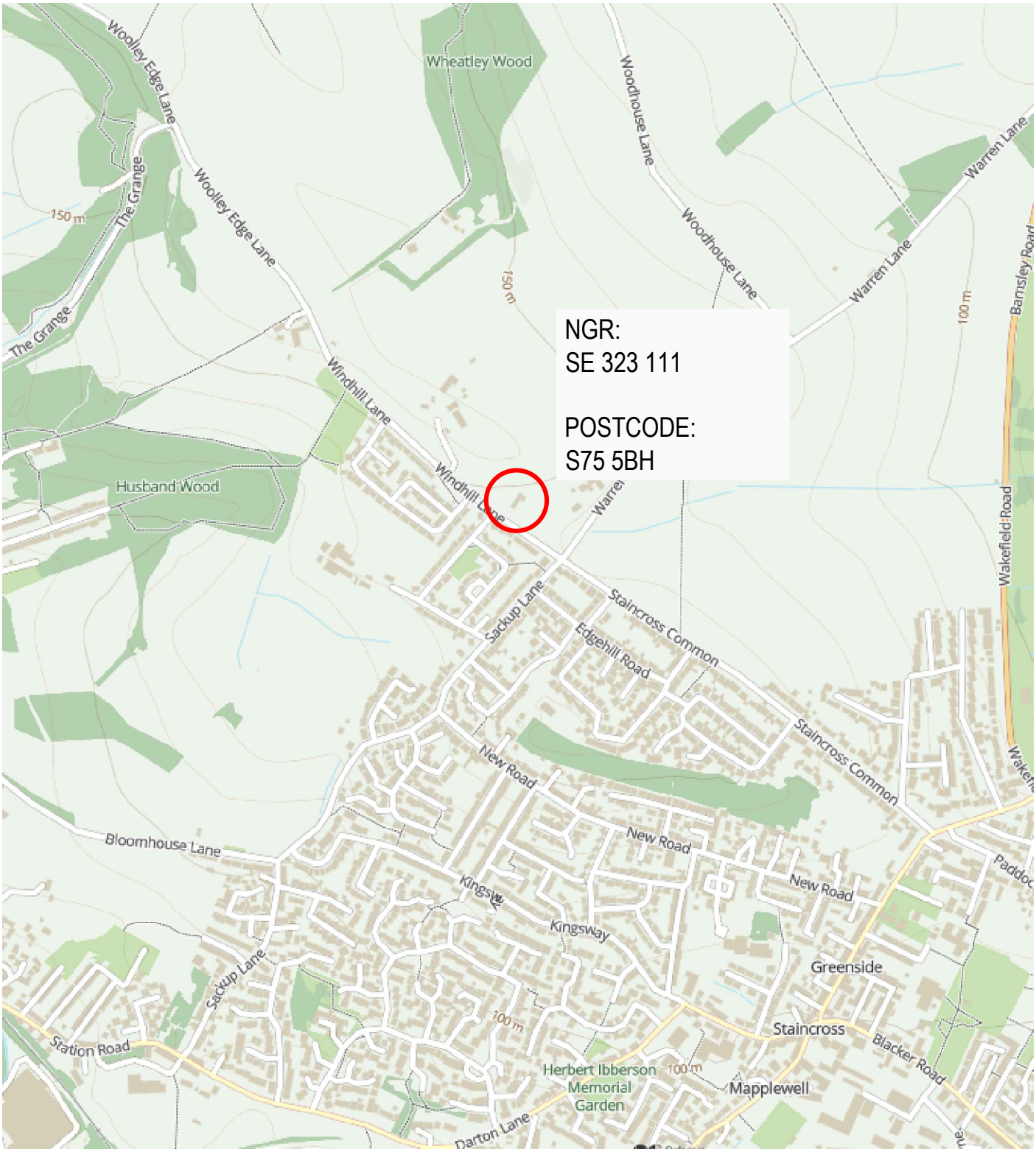
[3] Assessing the risks posed by hazardous ground gases to buildings - CIRIA (2007)

Guidance on the level of protection required based on GSVs and typical maximum readings throughout monitoring are given in Wilson & Card[4]; CIRIA C665 and BS8576.

Monitoring results, combined with the guidance above are used to determine appropriate gas protection measures for the proposed structures. As part of this assessment, other factors such as the required foundations and floor slabs (as determined by the geotechnical site constraints) are considered to ensure a feasible solution is recommended.

[4] Reliability and Risk in Gas Protection Design – Wilson SA and Card GB (1999)

Appendix B – Drawings



Project

WINDHILL LANE, BARNSLEY

Title

001 - SITE LOCATION PLAN

Job No.

1226

A4

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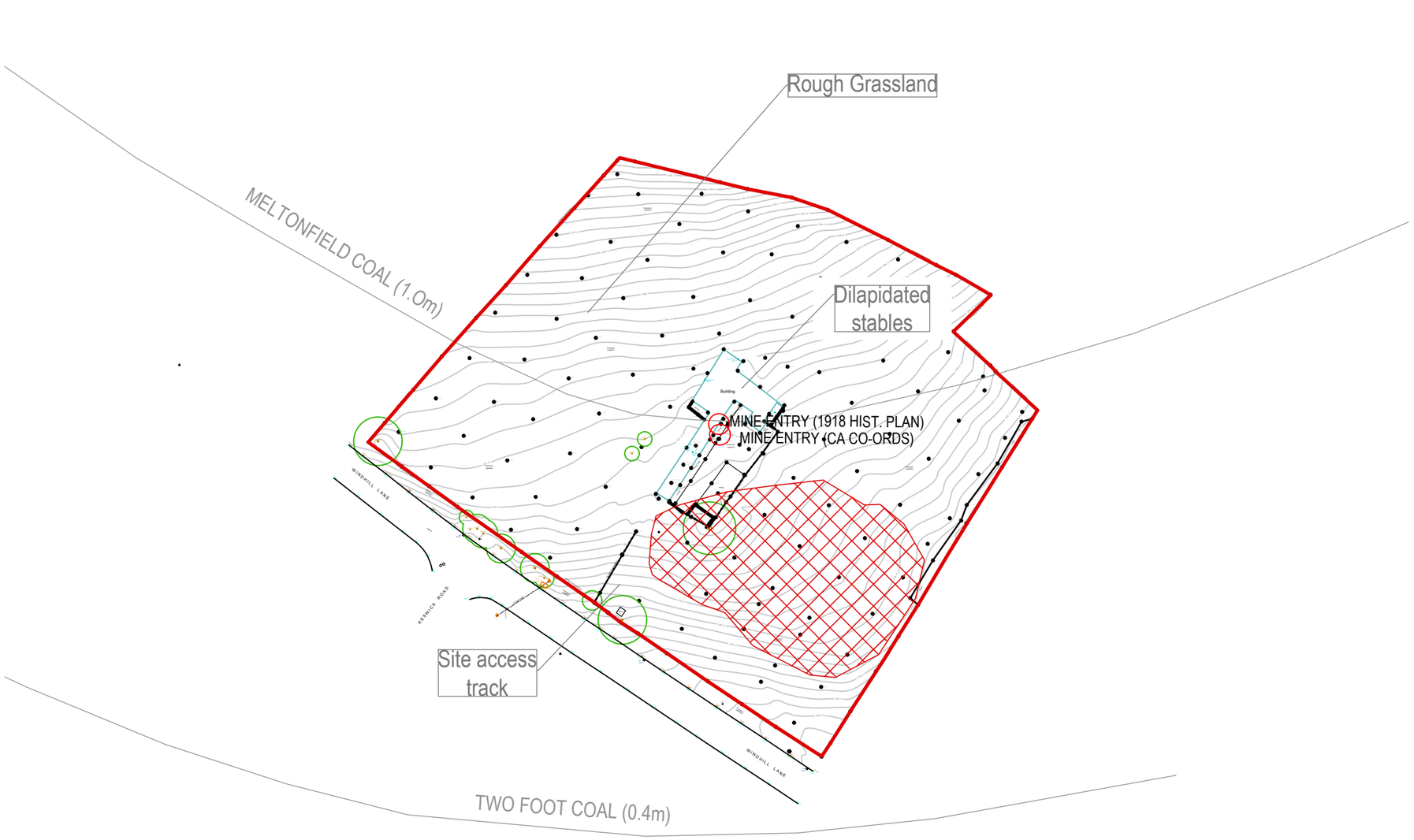

SPOIL HEAP ON HISTORICAL PLANS

COAL SEAM OUTCROP
(BGS PLAN OVERLAY)

APPROXIMATE SITE BOUNDARY

Client	Project	Scale
PIT STOP PRODUCTIONS	WINDHILL LANE, BARNSLEY	1:1,000 AT A3
		Date: APRIL 2024
	Title: 002 - SITE FEATURES & MINING FEATURES	
A3		

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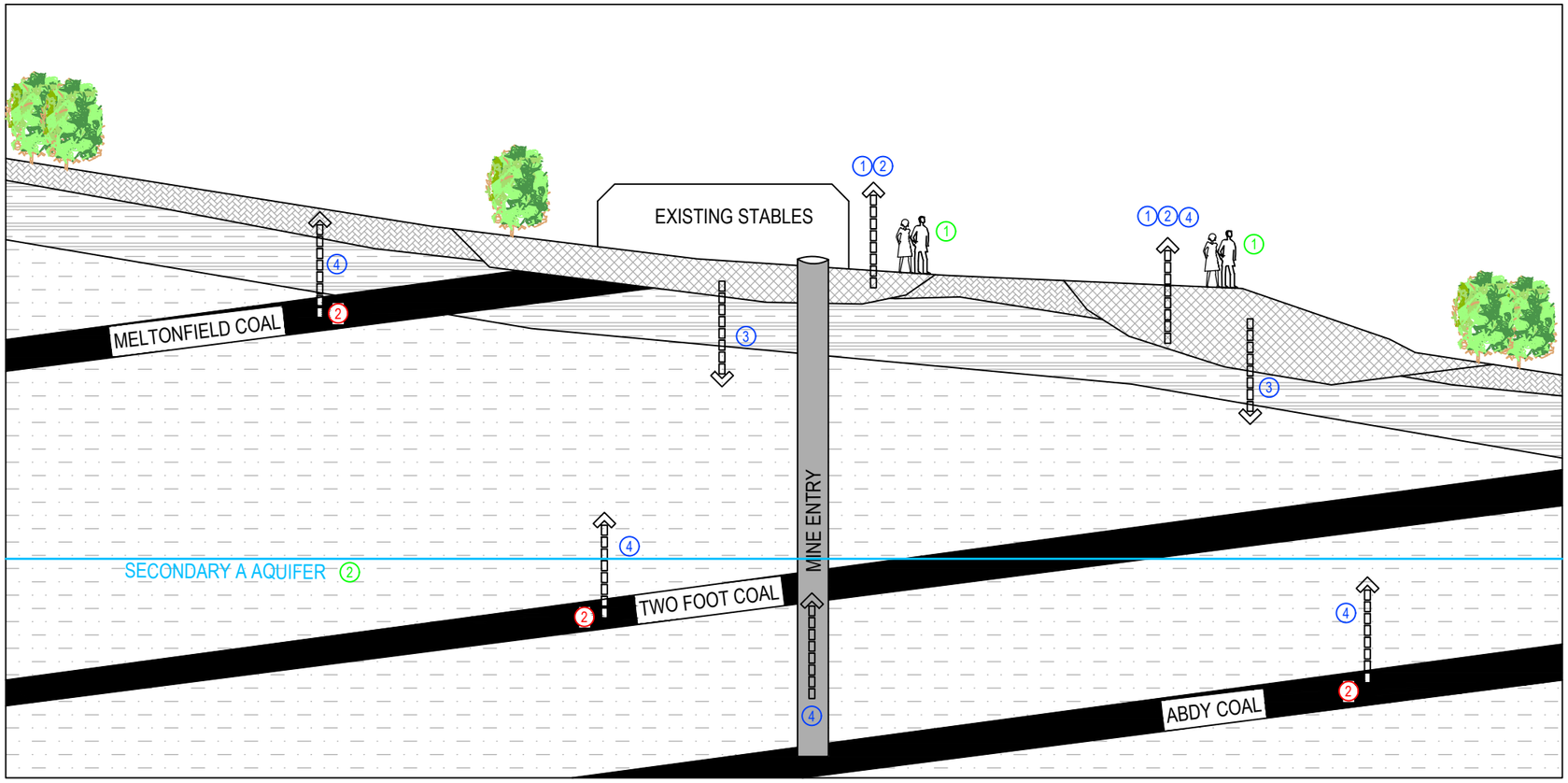

GROUND TYPES	SOURCES	PATHWAYS	RECEPTORS
TOPSOIL	(1) MADE GROUND	(1) DERMAL CONTACT, INGESTION, INHALATION OF DUST	(1) HUMAN HEALTH
MADE GROUND	(2) COAL SEAMS	(2) VOLATILISATION	(2) GROUNDWATER
WEATHERED COAL MEASURES		(3) LEACHING	
COAL MEASURES		(4) GAS MIGRATION	

Client
PIT STOP PRODUCTIONS

Project
WINDHILL LANE, BARNSLEY

Scale
NTS

Date
APRIL 2024

Title
003 - PRELIMINARY CONCEPTUAL SITE MODEL

A3

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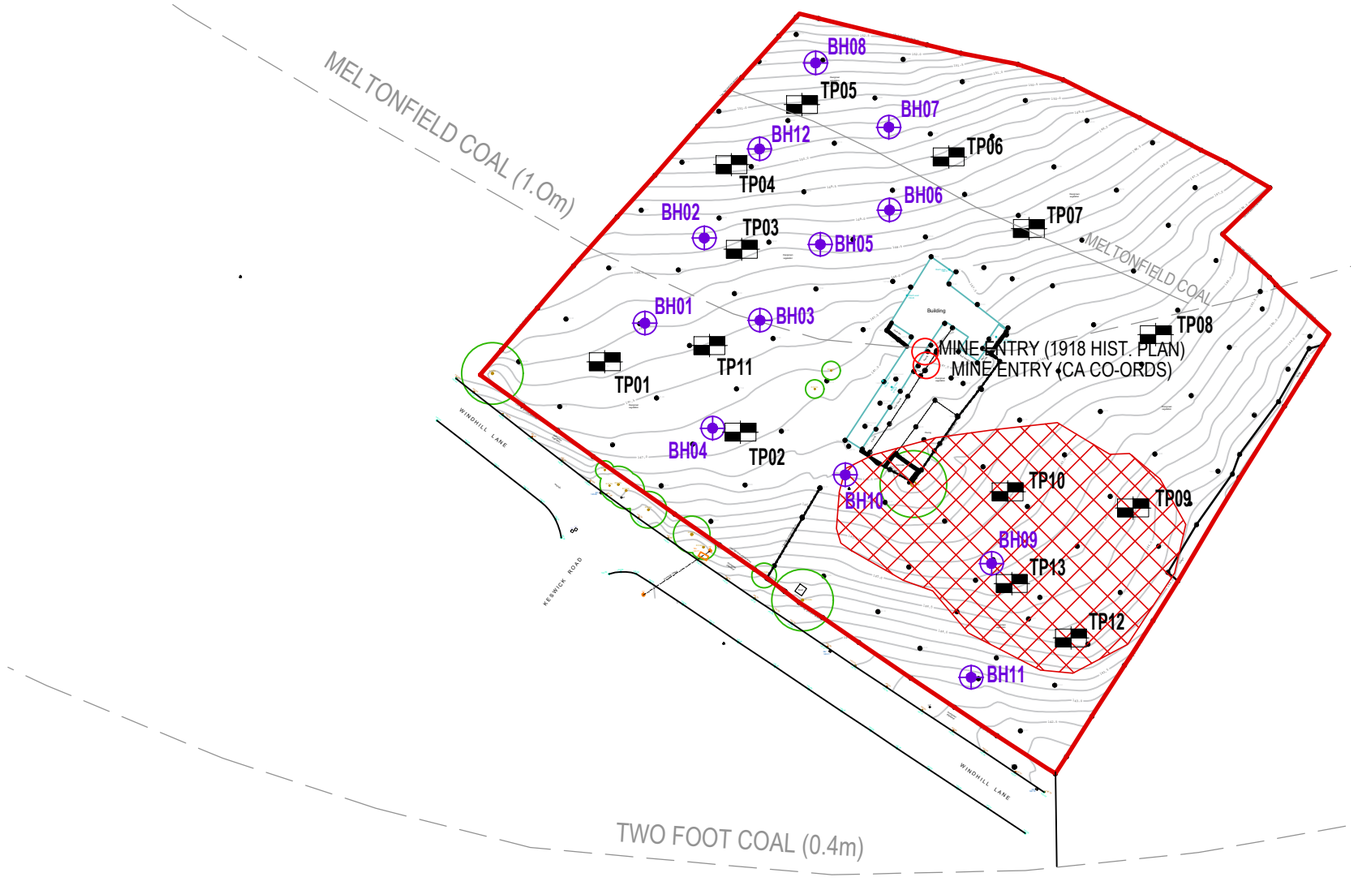

TRIAL PIT LOCATION

PROBEHOLE LOCATION

SPOIL HEAP ON HISTORICAL PLANS

COAL SEAM OUTCROP (BGS PLAN OVERLAY)

COAL SEAM OUTCROP (ENCOUNTERED)

APPROXIMATE SITE BOUNDARY

Client	Project	Scale
PIT STOP PRODUCTIONS	WINDHILL LANE, BARNSLEY	1:1,000 AT A3
		Date: APRIL 2024
A3	Title: 004 - EXPLORATORY HOLES LOCATIONS & MINING FEATURES	

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